PHILIPS

Data handbook

PHILIPS

Electronic components and materials

Electron tubes

Part 5b December 1978

Camera tubes and accessories

Image intensifiers

ELECTRON TUBES

Part 5b **December 1978**

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, sub-assemblies and materials; it is made up of three series of handbooks each comprising several parts.

ELECTRON TUBES	BLUE
SEMICONDUCTORS AND INTEGRATED CIRCUITS	RED
COMPONENTS AND MATERIALS	GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need **confirmation** that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

October 1977

ELECTRON TUBES (BLUE SERIES)

Part 1a	December 1975	ET1a 12-75	**Transmitting tubes for communication, tubes for r.f. heating** Types PE05/25 to TBW15/25
Part 1b	August 1977	ET1b 08-77	**Transmitting tubes for communication, tubes for r.f. heating, amplifier circuit assemblies**
Part 2a	November 1977	ET2a 11-77	**Microwave tubes** Communication magnetrons, magnetrons for microwave heating, klystrons, travelling-wave tubes, diodes, triodes T-R switches
Part 2b	May 1978	ET2b 05-78	**Microwave semiconductors and components** Gunn, Impatt and noise diodes, mixer and detector diodes, backward diodes, varactor diodes, Gunn oscillators, sub-assemblies, circulators and isolators
Part 3	January 1975	ET3 01-75	**Special Quality tubes, miscellaneous devices**
Part 4	March 1975	ET4 03-75	**Receiving tubes**
Part 5a	March 1978	ET5a 03-78	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
Part 5b	December 1978	ET5b 12-78	**Camera tubes and accessories,image intensifiers**
Part 6	January 1977	ET6 01-77	**Products for nuclear technology** Channel electron multipliers, neutron tubes, Geiger-Müller tubes
Part 7a	March 1977	ET7a 03-77	**Gas-filled tubes** Thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes
Part 7b	March 1977	ET7b 03-77	**Gas-filled tubes** Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units
Part 8	May 1977	ET8 05-77	**TV picture tubes**
Part 9	March 1978	ET9 03-78	**Photomultiplier tubes; phototubes**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

Part 1a	August 1978	SC1a 08-78	**Rectifier diodes, thyristors, triacs** Rectifier diodes, voltage regulator diodes (> 1,5 W), transient suppressor diodes, rectifier stacks, thyristors, triacs
Part 1b	May 1977	SC1b 05-77	**Diodes** Small signal germanium diodes, small signal silicon diodes, special diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes
Part 2	November 1977	SC2 11-77	**Low-frequency and dual transistors**
Part 3	January 1978	SC3 01-78	**High-frequency, switching and field-effect transistors**
Part 4a	June 1976	SC4a 06-76	**Special semiconductors*** Transmitting transistors, field-effect transistors, dual transistors, microminiature devices for thick and thin-film circuits
Part 4b	September 1978	SC4b 09-78	**Devices for optoelectronics** Photosensitive diodes and transistors, light emitting diodes, photocouplers, infrared sensitive devices, photoconductive devices
Part 4c	July 1978	SC4c 07-78	**Discrete semiconductors for hybrid thick and thin-film circuits**
Part 5a	November 1976	SC5a 11-76	**Professional analogue integrated circuits**
Part 5b	March 1977	SC5b 03-77	**Consumer integrated circuits** Radio-audio, television
Part 6	October 1977	SC6 10-77	**Digital integrated circuits** LOCMOS HE4000B family
Signetics integrated circuits 1978			Bipolar and MOS memories Bipolar and MOS microprocessors Analogue circuits

* The most recent information on field-effect transistors can be found in SC3 01-78, on dual transistors in SC2 11-77, and on microminiature devices in SC4c 07-78.

COMPONENTS AND MATERIALS (GREEN SERIES)

Part 1	June 1977	CM1 06-77	**Assemblies for industrial use** High noise immunity logic FZ/30-series, counter modules 50-series, NORbits 60-series, 61-series, circuit blocks 90-series, circuit block CSA70(L), PLC modules, input/output devices, hybrid circuits, peripheral devices, ferrite core memory products
Part 2a	October 1977	CM2a 10-77	**Resistors** Fixed resistors, variable resistors, voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC), test switches
Part 2b	February 1978	CM2b 02-78	**Capacitors** Electrolytic and solid capacitors, film capacitors, ceramic capacitors, variable capacitors
Part 3	January 1977	CM3 01-77	**Radio, audio, television** Components for black and white television, components for colour television
Part 3a	September 1978	CM3a 09-78	**FM tuners, television tuners, surface acoustic wave filters**
Part 3b	October 1978	CM3b 10-78	**Loudspeakers**
Part 4a	November 1978	CM4a 11-78	**Soft ferrites** Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores
Part 4b	December 1976	CM4b 12-76	**Piezoelectric ceramics, permanent magnet materials**
Part 6	April 1977	CM6 04-77	**Electric motors and accessories** Small synchronous motors, stepper motors, miniature direct current motors
Part 7	September 1971	CM7 09-71	**Circuit blocks** Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive
Part 8	February 1977	CM8 02-77	**Variable mains transformers**
Part 9	March 1976	CM9 03-76	**Piezoelectric quartz devices**
Part 10	April 1978	CM10 04-78	**Connectors**

General

A

PRINCIPLES OF OPERATION

1 PHOTOCONDUCTIVE CAMERA TUBES

1.1 General description

The optical image to be televised is focused on the faceplate of the camera tube by means of a lens system. In the photoconductive layer on the faceplate, the optical image is converted into an electric charge image. This is scanned line by line by a narrow electron beam and transformed into an electric signal.

Figure 1 illustrates the arrangement of the electrodes and coils for a vidicon or Plumbicon tube with magnetic focusing and deflection. Three parts may be distinguished: the electron gun producing the scanning beam, the focusing and deflection coils assembly and the target section containing the photoconductive layer.

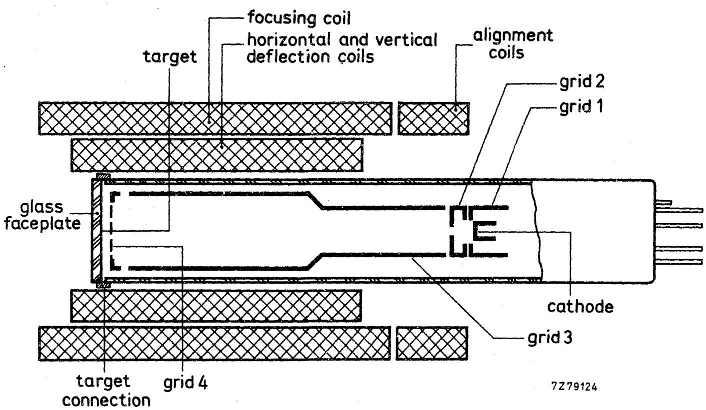


Fig. 1 Schematic electrode and coil arrangement in a vidicon or Plumbicon tube.

The electron gun consists of an indirectly heated cathode, a grid g_1 controlling the electron beam current, a first anode g_2 which accelerates the electrons and limits the beam in its cross-section, a cylindrical electrode g_3 and a fine mesh electrode g_4 which terminates the cylindrical electrode and produces a uniform decelerating field in front of the target.

The deflection coils supply the magnetic field required to scan the electron beam line by line across the photoconductive target. The focusing coil produces an axial magnetic field which, with the correct voltage on g_3, focuses the electrons in one loop onto the target. Focusing may be adjusted either by varying the g_3 voltage or by varying the focusing coil current.

The scanning beam should land perpendicularly on the target. To achieve this in the centre of the scanned area, the beam is aligned parallel to the tube axis by two sets of alignment coils which produce an adjustable transverse magnetic field. Instead of alignment coils, small adjustable permanent magnets, e.g. in the shape of rings, may be used.

The target section is illustrated in Fig. 2. It consists of:
- an optically flat faceplate;
- a transparent conductive film on the inner surface of the faceplate, connected electrically to the external signal electrode contact;
- a thin layer of photoconductive material deposited on the conductive film. In darkness this material has a high specific resistance which decreases with increasing illumination.

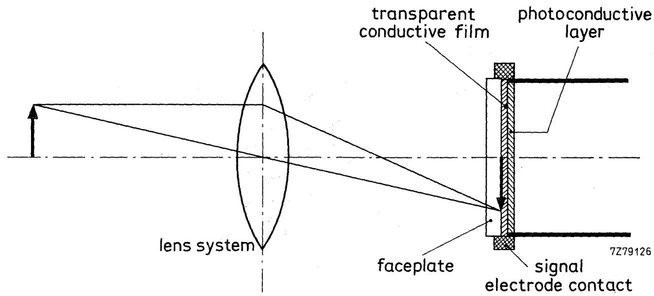


Fig. 2 Target section.

1.2 Operation

The external signal electrode contact is connected via a load resistor to a positive voltage of e.g. 45 V, see Fig. 3. The target may be assumed to consist of a large number of target elements corresponding to the number of picture elements. Each target element may be represented by a small capacitor C_e, connected on one side to the signal electrode via the transparent conductive film and shunted by a light dependent resistor R_e.

When the target is scanned, beam electrons – approaching the target at a low velocity – will continue to land until the scanned surface is approximately at cathode potential. This is called cathode potential stabilization. In this way a voltage difference is established across the layer, with each element capacitor charged to nearly the same potential as that applied to the signal electrode.

In the dark, the photoconductive material is a fairly good insulator, so that only a minute fraction of the charge of the element capacitors will leak away between successive scans. This fraction will be restored by the beam and the resulting current to the signal electrode is called 'dark current'.

When an optical image is focused on the target, those target elements which are illuminated will become conductive and will be partly discharged. As a consequence of this a pattern of positive charges corresponding to the optical image will be produced on the side of the target facing the electron gun.

While scanning this charge pattern, the electron beam will deposit electrons on the positive elements until the latter are restored to their original cathode potential, causing a capacitive current to the signal electrode – and hence a voltage across the load resistor R_l. This voltage is the video signal and is fed to the preamplifier.

A camera tube is called 'stabilized' when the magnitude of the beam current is sufficient to restore the scanned surface to the cathode potential. All element capacitors, including those at the highlights of the image, are then completely recharged by the passing electron beam.

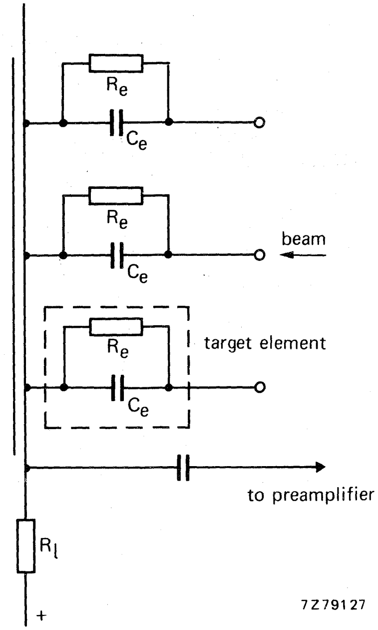


Fig. 3.

1.3 Separate mesh construction

The focusing coils commonly used do not produce an ideal focus field distribution in the vicinity of the photoconductive target. The resulting 'landing errors' of the scanning beam (non-perpendicular landing outside the central area) may cause picture defects such as geometrical distortion and 'stern waves' behind moving objects. These landing errors can be corrected by electron-optical means. A lens is formed for this purpose between the cylindrical electrode g_3 and the mesh electrode g_4. The mesh electrode should be made positive with respect to the cylindrical electrode; the lens action depends on the ratio of the two potentials V_{g4} and V_{g3}. The optimum potential ratio depends on the construction of the electron gun and on the particular type of coil assembly used.

All currently available types of Plumbicon tubes have this separate mesh construction. Some vidicon types, however, have the 'integral mesh' construction (cylindrical electrode and mesh internally connected). Separate mesh tubes have better resolution than integral mesh tubes as, in the field free region near the mesh, space charge can build up in an integral mesh tube; this has an adverse effect on resolution and may also cause geometrical distortion. As this space charge increases with increasing beam current, separate mesh tubes can operate with higher beam currents than integral mesh tubes.

1.4 Electrostatic focus

Both focusing and deflection may be obtained by electrostatic means. Figure 4 shows a possible arrangement of electrodes and coils for a camera tube with electrostratic focusing and magnetic deflection.

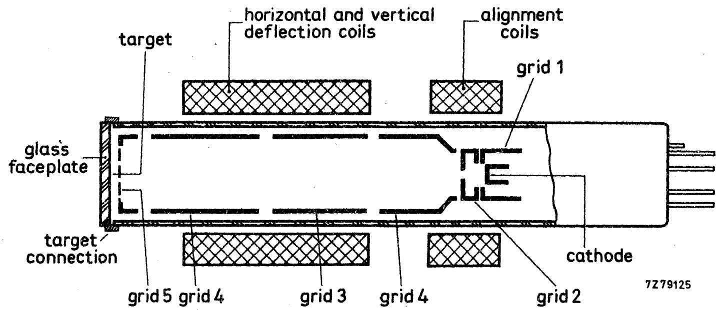


Fig. 4 Schematic electrode and coil arrangement with electrostatic focusing.

As before, the electron gun has an indirectly heated cathode, a control grid g_1, a first anode g_2, a cylindrical electrode g_4 and a mesh electrode g_5. The electrode g_4 has been split into two parts and a lens has been formed by inserting a low voltage focusing electrode g_3 between these parts. As no focusing coil is used, power dissipation is appreciably lower in the case of electrostatic focusing.

1.5 Anti-comet tail gun

To cope with extreme highlights, where stabilization cannot be obtained with normal beam currents, a special electron gun has been developed known as the 'anti-comet tail' (ACT) gun. A short description of this is found in the General operational notes on Plumbicon tubes.

2 MAIN PROPERTIES

2.1 Sensitivity

In the case of a black/white camera, the illuminance of the photoconductive layer, B_{ph}, is related to scene illuminance, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{RT}{4F^2\ (m+1)^2}$$

in which

R = the average scene reflectivity or the object reflectivity whichever is relevant;
T = lens transmission factor;
F = lens aperture;
m = linear magnification from scene to target.

In the case of a colour camera, a similar formula may be derived for the illuminance level on the photoconductive layers of the R, G and B tubes in which the effects of the various components of the entire optical system have been taken into account.

The sensitivity S_L of a camera tube may be expressed in μA/lumen. The number of lumens falling on the scanned area is AB_{ph}, in which B_{ph} is measured in lx and A is the scanned area in m^2. The signal current I_s, obtained from a camera tube where the photoconductive layer is uniformly illuminated by B_{ph} lx, is given by $I_s = \alpha S_L B_{ph} A$.

($\alpha = \frac{100}{100-\beta}$, β being the total blanking time in %: for the CCIR system α = 1,3.)

2.2 Spectral response

As an example the spectral responses of some camera tubes are given in Fig. 5. The sensitivity is given in mA/W. The relation between the sensitivity S_r in mA/W (the *radiant* sensitivity) and the sensitivity S_L in μA/lumen (the *luminous* sensitivity) at a given wavelength is $S_r(\lambda) = 0{,}680\ V(\lambda)$ in which $V(\lambda)$ is the relative spectral sensitivity distribution of the average human eye (peak value 1 at 555 nm).

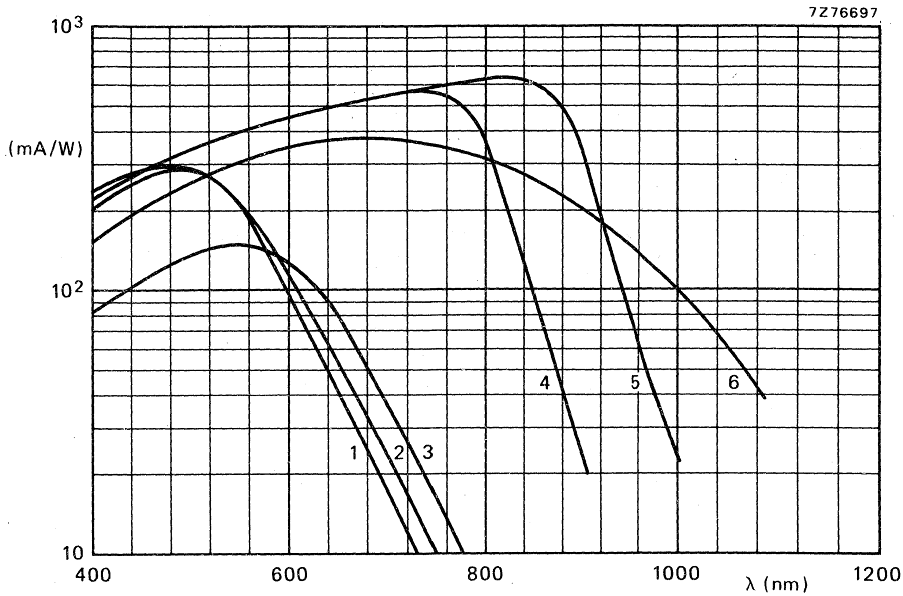


Fig. 5 Spectral response of various camera tubes. Curve 1: Plumbicon XQ1073; curve 2: Sb_2S_3 – vidicon, B – response XQ1280; curve 3: Sb_2S_3 – vidicon, A-response XQ1240; curve 4: Newvicon tube, C_1 – response XQ1274; curve 5: Newvicon tube, C_2 – response XQ1276; curve 6: silicon-vidicon XQ1400.

2.3 Resolution

The resolution of a camera tube may be given by its square-wave modulation transfer characteristic: the response of the tube to vertical patterns of black and white bars of equal width. Such a bar pattern can be specified by the corresponding video frequency or by the corresponding number of TV lines (the number of bar widths on the picture height). For the CCIR system a frequency of 5 MHz is very close to 400 TV lines.

A bar pattern can also be specified by the number of line pairs per mm (lp/mm), i.e. the number of sets of black and white bars per mm. For a 30 mm diameter tube (scanned area 12,84 mm x 17,12 mm), a 1 inch diameter tube (scanned area 9,6 mm x 12,8 mm) and a 2/3 inch diameter tube (scanned area 6,6 mm x 8,8 mm), 400 TV lines corresponds to a 15,6, 20,8 and 30,3 lp/mm respectively.

The modulation depth at 400 TV lines is expressed as a percentage of the modulation depth at 40 TV lines. The modulation depth values given in this handbook include the slight degradation due to a lens with an aperture f: 5,6. The measuring channel must be flat to well over 5 MHz.

2.4 Lag

There are two important components of lag in a camera tube: photoconductive lag and discharge lag (also called capacitive lag).

Two forms of lag are usually measured: decay lag and build-up lag. Decay lag is measured after a minimum of 5 s illumination on the target. Typical residual values are given in % of the original signal. These are typically measured 60 and 200 ms after the illumination has been removed (for 50 Hz frame frequency).

Build-up lag is measured after 10 s of darkness and is expressed as a percentage of the ultimate steady-state current. It is usually measured 60 and 200 ms after the illumination has been applied.

3 TYPES OF TARGET

3.1 Plumbicon tube: lead oxide

The photoconductive layer forms a continuous array of reverse-biased PIN-diodes, with an extremely low dark current. Its linear transfer characteristic, high sensitivity, very low photoconductive lag, good resolution and low burn-in make it pre-eminently suitable for colour TV camera tubes. The absorption of lead oxide cuts off at about 650 mm. By incorporating a small amount of sulphur into the layer, the response can be extended to the deep reds ('extended red' Plumbicon tube).

3.2 Vidicon tube: antimony trisulphide (Sb_2S_3)

The sensitivity of an Sb_2S_3 layer is dependent on the voltage across the layer (the 'target voltage'). Thus it is possible to control the sensitivity by varying the target voltage. The dark current is strongly dependent on target voltage and temperature.

The Sb_2S_3 layer has photoconductive lag and is somewhat prone to burn-in. Its transfer characteristic is not linear. As the layer is thin, its resolution is high.

As standard vidicons are less expensive to manufacture they are extensively used in less critical applications. A specially developed variant is used in medical X-ray equipment where it is coupled to an X-ray image intensifier.

3.3 Newvicon tube: heterojunction layer

This contains a sublayer of zinc selenide (ZnSe) and a sublayer of a mixture of zinc telluride (ZnTe) and cadmium telluride (CdTe).

The heterojunction layer is reverse-biased; its non-negligible dark current is temperature dependent. The sensitivity of the Newvicon layer is very high and extends into the near infrared. Regulation of the sensitivity with the target voltage is not possible.

The transfer characteristic is linear, burn-in is low. A Newvicon tube has more lag than a corresponding Plumbicon tube due to the high capacitance of its thin photoconductive layer. The resolution of the layer is high.

3.4 Silicon vidicon: mosaic array of silicon planar diodes

The diodes are reverse-biased, their dark current is temperature dependent. Sensitivity is very high and extends into the infrared. Regulation of the sensitivity with the target voltage is not possible. The transfer characteristic is linear and burn-in is very low. Lag and resolution are dependent on the manufacturing method.

3.5 Pyroelectric vidicon (PEV)

This tube works on an entirely different principle. The pyroelectric properties of the target and the operation of a PEV tube are described in the General operational notes pyroelectric vidicons.

4 EQUIPMENT DESIGN AND OPERATING CONDITIONS

4.1 Signal electrode connection

The signal electrode connection should be made by a spring contact which bears against the metal ring at the face end of the tube. The spring contact may be provided as part of the coil assembly.

4.2 Deflection circuitry

The deflection circuitry must provide constant scanning speeds in order to obtain a uniform signal from areas with uniform illumination. As the signal obtained is proportional to the velocity of scanning, any change in this velocity will produce a variation in signal output.

4.3 Electrostatic shielding

Electrostatic shielding of the signal electrode is required to avoid interference effects in the picture. Effective shielding may be provided by one grounded shield inside the focusing coil at the faceplate end, and one inside the deflection yoke.

4.4 Polarity of focusing coil

The polarity of a focusing coil should be such that a north-seeking pole is attracted (for 30 mm Plumbicon tubes, repelled) at the image end of the focusing coil, with this pole located outside the focusing coil.

4.5 Full size scanning

Full size scanning of the specified area of the photoconductive layer should always be observed. Under-scanning of the photoconductive layer or failure of scanning for even a short duration during operation must be avoided, as this may cause permanent damage.

During vertical and horizontal flyback the electron beam must not land on the photoconductive layer as this would remove some of the picture information from the target. This can be prevented by applying negative blanking pulses to the control grid or positive blanking pulses to the cathode.

Tubes with a separate mesh construction have the advantage that corner resolution can be improved by applying appropriately shaped pulses of line and frame frequency to the cylindrical electrode g_3 ('dynamic focusing' or 'focus modulation').

The resolution of most types of photoconductive camera tubes increases with increasing V_{g3} and V_{g4}. Operation in a high voltage mode requires increased power for the deflection and focusing coils.

RATING SYSTEM

ABSOLUTE MAXIMUM RATING SYSTEM

(As defined in IEC publication 134.)

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, and variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

Plumbicon tubes

B

SURVEY OF PLUMBICON ® TUBES

Abbreviations used in the tables:

- **Photoconductive layer**

S	= standard	cut-off ≈ 650 nm
SHR	= special high resolution	cut-off ≈ 650 nm
ER	= with extended red response	cut-off ≈ 900 nm
ER(F)	= with extended red response and IR reflecting filter on anti-halation glass disc	cut-off ≈ 750 nm

- **Quality grade**

Br = broadcast
Ind = industrial
Med = medical

- **Applications**

B/W = for black and white cameras
L = for luminance channel
R = for red chrominance channel
G = for green chrominance channel
B = for blue chrominance channel
Med = medical; coupled to X-ray image intensifier
Sc = scientific, surveillance; coupled e.g. to image intensifier

Notes
1. Without anti-halation glass disc.
2. With infrared reflecting filter on anti-halation glass disc.
3. Without anti-halation glass disc: add suffix /01 to type number.
4. Add suffix /02 for rear loading type, with provisions for adjustable light bias.
5. Add suffix /03 for front loading type, with provisions for adjustable light bias.

® Registered Trade Mark for television camera tube.

PLUMBICON TUBES - 1¼ inch (30 mm)

type		photo-conductive layer	quality grade Br	Ind	Med	applications B/W	L	R	G	B	Med		notes
Current types	300 mA; 6,3 V	○ magnetic focusing and deflection ○ separate mesh construction											
XQ1020		S	•			•	•	•	•	•			
XQ1021		S		•		•		•	•	•			
XQ1022		S			•						•		1
XQ1023		ER	•			•	•	•					
XQ1024		ER		•		•		•					
XQ1025		ER(F)	•			•	•	•					2
XQ1026		ER(F)		•		•		•					2
Design types	300 mA; 6,3 V	○ provision for both fixed and adjustable light bias ○ high resolution											
XQ1410		SHR	•			•	•	•	•	•			
XQ1411		SHR		•		•		•	•	•			
XQ1413		ER	•			•	•	•					
XQ1414		ER		•		•		•					
XQ1415		ER(F)	•			•	•	•					2
XQ1416		ER(F)		•		•		•					2
New design types (63XQ; 63XQ-ER)	190 mA; 6,3 V	○ anti-comet-tail electron gun (ACT) ○ provision for both fixed and adjustable light bias ○ high resolution											
XQ1520		SHR	•			•	•	•	•	•			
XQ1521		SHR		•		•		•	•	•			
XQ1523		ER	•			•	•	•					
XQ1524		ER		•		•		•					
XQ1525		ER(F)	•			•	•	•					2
XQ1526		ER(F)		•		•		•					2
Maintenance types	95 mA; 6,3 V	○ magnetic focusing and deflection ○ integral mesh construction											
55875		S	•			•	•	•	•	•			
55875IG		S		•		•		•	•	•			
55876		S			•						•		1
	300 mA; 6,3 V	○ magnetic focusing and deflection ○ separate mesh construction ○ fibre-optic face plate ○ anti-comet tail electron gun ○ provisions for adjustable light bias										SC	
XQ1230		S			•						•	•	
XQ1233		S		•								•	

PLUMBICON TUBES - 1 inch (25 mm)

Current types — 95 mA; 6,3 V
- magnetic focusing and deflection
- separate mesh construction
- front and rear loading types, with or without provision for adjustable light bias

front loading type	for rear loading light bias versions see notes	photo-conductive layer	quality grade Br	Ind	Med	applications B/W	L	R	G	B	Med	notes
XQ1070		SHR	●			●	●	●	●	●		3 or 4 or 5
XQ1071		SHR		●		●		●	●	●		3 or 4 or 5
XQ1072		SHR			●						●	1
XQ1073		ER	●			●		●				3 or 4 or 5
XQ1074		ER		●		●		●				3 or 4 or 5
XQ1075		ER(F)	●			●		●				2 or 4 or 5
XQ1076		ER(F)		●		●		●				2 or 4 or 5

Current types — 95 mA; 6,3 V
- anti-comet-tail electron gun
- provision for adjustable light bias

rear loading type	front loading type	photo-conductive layer	quality grade Br	Ind	Med	applications B/W	L	R	G	B	notes
XQ1080	XQ1090	SHR	●			●	●	●	●	●	
XQ1081	XQ1091	SHR		●		●		●	●	●	
XQ1083	XQ1093	ER	●			●		●			
XQ1084	XQ1094	ER		●		●		●			
XQ1085	XQ1095	ER(F)	●			●		●			2
XQ1086	XQ1096	ER(F)		●		●		●			2

New design types (64XQ; 64XQ-ER) — 190 mA; 6,3 V
- high resolution anti-comet-tail electron gun
- provision for adjustable light bias

rear loading type	front loading type	photo-conductive layer	quality grade Br	Ind	Med	applications B/W	L	R	G	B	notes
XQ1500	XQ1510	SHR	●			●	●	●	●	●	
XQ1501	XQ1511	SHR		●		●		●	●	●	
XQ1503	XQ1513	ER	●			●		●			
XQ1504	XQ1514	ER		●		●		●			
XQ1505	XQ1515	ER(F)	●			●		●			2
XQ1506	XQ1516	ER(F)		●		●		●			2

PLUMBICON TUBES - 2/3 inch (17,7 mm)

New design types — 95 mA; 6,3 V
- ○ magnetic focusing and deflection
- ○ separate mesh construction

type	photo-conductive layer	quality grade Br	Ind	Med	applications B/W	L	R	G	B
XQ1427	ER	●			●		●	●	
	SHR	●			●			●	●
XQ1428	ER		●		●		●	●	
	SHR		●		●			●	●

PLUMBICON TUBES - 5/8 inch (16 mm)

Maintenance types — 300 mA; 6,3 V
- ○ electrostatic focusing and magnetic deflection
- ○ separate mesh construction

type	photo-conductive layer	quality grade Br	Ind	Med	applications B/W	L	R	G	B
XQ1213	ER	●			●		●	●	●
XQ1214	ER		●		●		●	●	●

Accessories for Plumbicon tubes

	1¼" dia. all magnetic			1" dia. all magnetic					2/3" dia. all magnetic	5/8" dia. electrostatic focusing and magnetic deflection
	standard	light bias	ACT and light bias	standard	/03 versions light bias	/02 versions light bias	ACT and light bias	ACT and light bias		
	rear loading	rear loading	rear loading	front loading	front loading	rear loading	rear loading	front loading	front loading	rear loading
example	XQ1020	XQ1410	XQ1520	XQ1070	XQ1070/03	XQ1070/02	XQ1080	XQ1090	XQ1427	XQ1213
coil unit B/W	AT1132/01			AT1102/01 AT1103 AT1116		AT1119/01		AT1116	KV12S	AT1117
coil unit colour	AT1113/03 *					AT1115/01 *		AT1116/06	AT1106*	AT1117
socket	56021 56025		56025	56098			56026		56049	
light bias lamp		56106			56106		56027			
adapters ** B/W R G B		56122 56123 56124 56125 56126***								
mask	56029			56028					56033	

* Computer selected triplet.
** Adapters for fixed light bias for XQ1410 to XQ1416 and XQ1520 to XQ1526.
*** Adapter for adjustable light bias for XQ1410 to XQ1416 for use in Marconi Mark VIII camera (variant).

GENERAL OPERATIONAL NOTES

1 PROPERTIES OF THE PLUMBICON PHOTOCONDUCTIVE LAYER

The Plumbicon photoconductive layer consists of lead oxide. In tubes with an extended red response a small amount of sulphur has been added.

1.1 Sensitivity

As the light transfer characteristic is linear, the sensitivity of a Plumbicon tube can be specified by the number of μA per lumen. A typical value for a standard layer (without extended red response) for tungsten light with a colour temperature of 2856 K is 400 μA/lumen.

At low target voltages the sensitivity decreases. At the advised voltage (45 V) the sensitivity is nearly saturated; it increases only slightly with further increase of target voltage.

It is clear that, for the same target illumination, the signal current depends on the size of the scanned area. It can be shown that with a linear transfer characteristic, different sized tubes have the same sensitivity, provided the same depth of focus and angle of view is used.

1.2 Spectral response

Figure 1 shows the typical spectral response curves of some 30 mm Plumbicon tubes. Curve 1 applies to the high-resolution layer which is used, for example, in the XQ1410. Curve 2 applies to the extended-red layer as used in the XQ1413.

For proper colour rendition the sensitivity of the XQ1413 is too high in the deep red region; it extends into the near infrared. It is possible to correct the colour response with an infrared reflecting filter. In the Plumbicon tube type XQ1415 the anti-halation glass disc, cemented on the face-plate, is provided with such a filter. The typical spectral response of the XQ1415 is shown in curve 3.

Curve 1: XQ1020, XQ1410, XQ1520
Curve 2: XQ1023, XQ1413, XQ1523
Curve 3: XQ1025, XQ1415, XQ1525

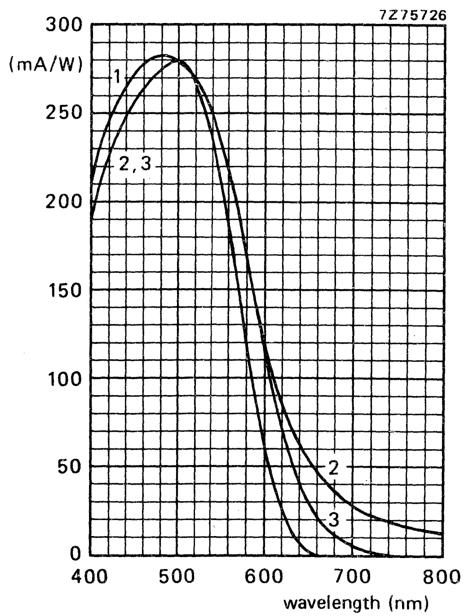


Fig. 1 Typical spectral response curves of 30 mm Plumbicon tubes.

1-inch Plumbicon tubes with extended red sensitivity, such as the XQ1073 and the XQ1083, have somewhat lower red and deep red sensitivities due to a smaller amount of sulphur in the photoconductive layer. For correction of the colour response therefore less filtering is needed. The Plumbicon tube types XQ1075 and XQ1085 are provided with the appropriate infrared reflecting filter.

1.3 Resolution

The resolution of the extended-red layer is higher than that of the standard layer, which is used, for example, in the XQ1020. A high resolution layer without extended-red response has been developed, which closely approaches the resolution of the extended-red layer.

Figure 2 shows typical modulation transfer characteristics of some Plumbicon tubes, measured in green light, as a function of the number of line pairs per mm.

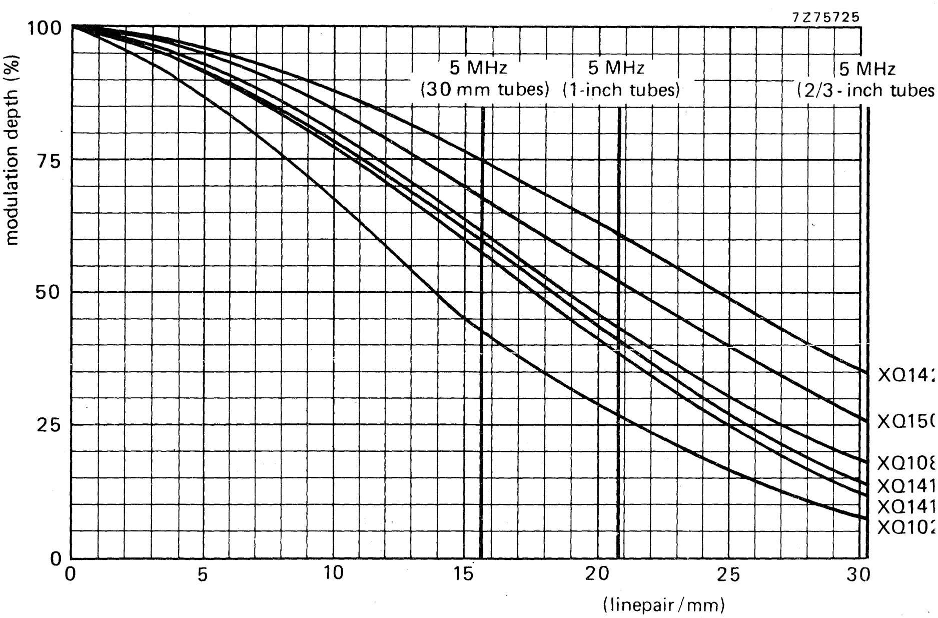


Fig. 2 Typical square-wave modulation transfer curves of some Plumbicon tubes.

The vertical lines in the figure correspond to 400 TV lines for 30 mm (15,6 lp/mm), 1-inch (20,8 lp/mm) and 2/3-inch (30,3 lp/mm) tubes. It can be seen that at 400 TV lines (5 MHz) resolution increases with increasing tube size (increased scanning area). For a given number of line pairs per mm the smallest tube has the highest resolution.

The XQ1020 has a standard layer, the XQ1415 and the XQ1427 have extended-red layers the XQ1410, XQ1080 and XQ1500 have high resolution layers. Due to a special gun construction the XQ1500 has an appreciably higher resolution that the XQ1080.

1.4 Lag

The photoconductive lag of the lead oxide layer is practically negligible. Due to the fact that the photoconductive layer in the tubes is relatively thick (10 to 18 μm, depending on tube type), Plumbicon tubes show very little discharge lag at normal signal currents.

Discharge lag becomes evident under low key conditions, when signal currents are small. This type of lag depends on layer capacitance and beam resistance. The effective beam resistance is decreased by applying light bias and thereby the discharge lag is reduced. Figure 3 shows an example of the effect of light bias on discharge lag (30 mm Plumbicon tube type XQ1410, signal current of 40 nA, green light, beam setting 600 nA).

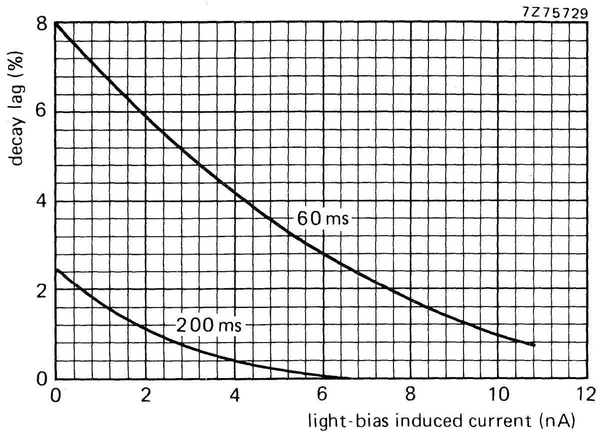


Fig. 3 Typical influence of light bias on decay lag in XQ1410.

In some types of Plumbicon tubes means are available for applying light bias on the gun side of the photoconductive layer (internal light bias). Figure 4 shows how this is achieved in the 30 mm Plumbicon tube XQ1410.

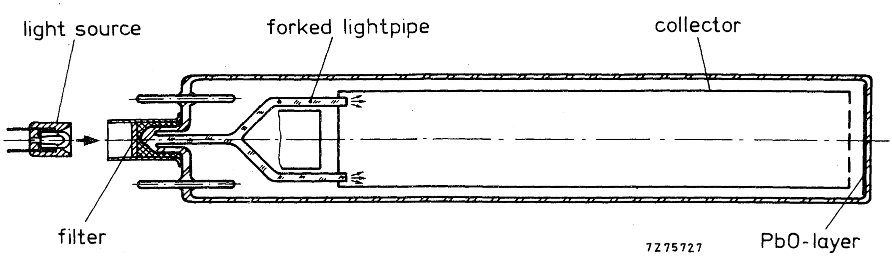


Fig. 4 Light bias in the XQ1410.

Light from a small lamp falls on the pumping stem of the tube and is conveyed by a forked glass light pipe into the collector space. It then falls directly or via reflection against the collector wall on the target. The light source (fixed or adjustable) fits in a metal sleeve fixed on the pumping stem.

1. 5 Stray light

The reflectance of the target is not negligible. It is at its highest in the red part of the spectral range. Diffusely reflected light can be caught in the faceplate of the tube and cause stray light, 'halation'. To reduce this, an anti-halation glass disc is cemented on the faceplate, see Fig. 5.

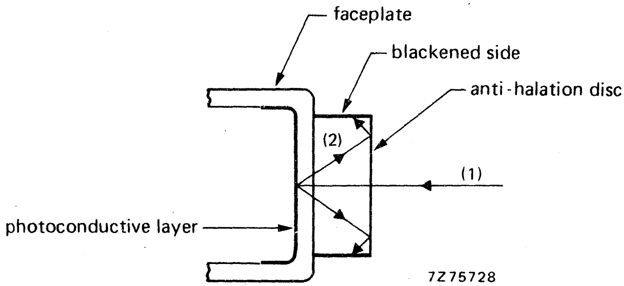


Fig. 5 Anti-halation disc on faceplate.

Further reduction of stray light can be obtained by fitting a mask on the anti-halation disc with an aperture slightly larger than the used scanning area.

1. 6 Highlight behaviour

The transfer characteristic of a Plumbicon tube is linear up to a point determined by the available beam current. This restricts its dynamic range. Local highlight levels on the target may cause blooming due to beam-bending and, in extreme cases, loss of stabilization. As it takes a number of scannings to re-establish stabilization when an extreme highlight has moved away, 'comet tails' can occur behind a moving object.

The anti-comet-tail (ACT) gun was developed to reduce these effects. In a tube with such a gun the beam current is strongly increased during line flyback, and most of the re-charging of the target element capacitors in the areas of extreme highlight occurs in the flyback period. Figure 6 shows the principle of an ACT gun.

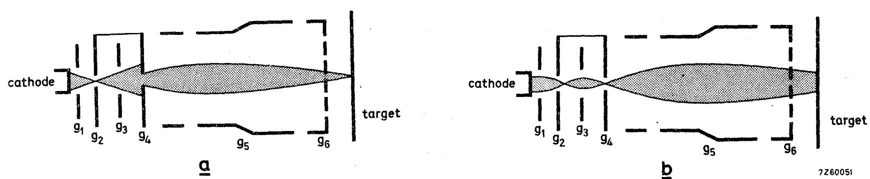


Fig. 6 Anti-comet-tail (ACT) gun; a = read-out mode; b = flyback mode.

The first anode - see Fig. 6 - has been split into two parts, the anode g_2 and the limiter g_4, which are electrically connected. An additional electrode g_3 has been placed between these parts. During the normal read-out scan this extra grid is maintained at a potential close to that of g_2 and g_4. The scanning beam will then be in focus at the target, as shown in Fig. 6a.

During line flyback a negative-going pulse is applied to g_3 to focus the scanning beam on the aperture in the limiter g_4, as shown in Fig. 6b. At the same time the beam current is strongly increased by a positive-going pulse on g_1. Thirdly, a positive-going pulse is applied to the cathode so that it is at a positive potential (e.g. + 8 V) during flyback.

In this way a defocused beam carrying a large current (e.g. $\approx$ 100 μA) is scanning the surface of the photoconductive layer during line flyback. This beam contains sufficient current to recharge the areas of extreme highlights; it brings the surface here to cathode potential during flyback. Potential levels below this contain picture information and are not influenced. Consequently, during normal read-out, the scanning beam does not meet target potentials which are higher than the cathode potential during flyback. Therefore stabilization is possible everywhere and blooming and comet-tails are strongly reduced.

1. 7 Burn-in or picture sticking

The target of a Plumbicon tube has a high resistance to picture sticking but some sticking may occur at target voltages lower than specified.

1. 8 Temperature effects

Plumbicon tubes tolerate short excursions of temperature up to 70 °C. Prolonged use at temperatures above 50 °C will, however, adversely influence tube life. It is therefore advisable to ensure that the faceplate temperature of a Plumbicon tube in a television camera does not exceed 50 °C under normal ambient temperature conditions.

2 RECOMMENDATIONS

2. 1 During transport, handling and storage the axis of the Plumbicon tube must be either vertical, with faceplate up, or horizontal. The faceplate should be covered with the hood provided.

2. 2 To avoid damage to the base pins, the Plumbicon tube should be inserted into its socket with care. Shocks, undue force and bending loads on the pins are to be avoided.

2. 3 During prolonged idle periods - days or weeks - gas pressure may slowly build up in the tube due to residual gas molecules emerging from the electrodes and the glass wall. There is then a slight risk that the pressure is sufficiently high to cause cathode damage by ion bombardment if cathode current is drawn immediately after switching on the camera.

A cathode heating time of at least a minute before drawing cathode current is therefore recommended. After very long idle periods - e.g. months - it is advisable to extend this pre-heating time to 30 minutes.

2. 4 In isolated cases the properties of a Plumbicon tube may deteriorate slightly when it is kept idle for long periods such as may occur:

- between the factory's pre-shipment test and the actual delivery to the customer;
- between receipt of the tube and its installation;
- when the camera is not used for a long time.

Although the chances of such a deterioration are remote it is advisable to operate the tube for some hours at intervals not more than 4 weeks apart.

The following procedure and conditions are recommended then:

- Set grid g_1, bias control, to maximum negative bias (beam cut-off).
- Allow a heating-up time of the cathode of at least 1 minute before turning up the grid g_1 control to produce a beam.
- Set scanning amplitudes to overscan condition.
- Apply an even illumination to the target to obtain a signal of approximately 0,15 μA and adjust the beam current for correct stabilization.

2. 5 During long-term storage the ambient temperature should not exceed 30 $^{\circ}$C.

2. 6 The light transfer characteristic of the Plumbicon tube has a gamma near unity. It may be desirable to incorporate a gamma correcting circuit in the video amplifier system with an adjustable gamma of 0,5 to 1.

2. 7 Plumbicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters).

2. 8 The beam current of a Plumbicon tube without an ACT gun is usually set at twice the value required for stabilization of normal peak white. Highlight handling is improved by using higher beam currents. Very high beam currents, however, cause increased lag, some loss of resolution, geometry shifts and reduction of tube life.

2. 9 Alignment currents are used to correct for slight mechanical and electrical misalignments encountered in tubes and coil assemblies.

Alteration of alignment settings influences corner focus, geometry, beam size and registration. Poor alignment can moreover cause lag problems or a degradation of picture quality with regard to spots and blemishes.

Spurious signal specification for Plumbicon* tubes

(with plain glass faceplate)

SECTION A

Test conditions

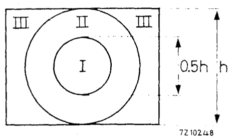
Spurious signal tests on Plumbicon tubes are carried out in the manufacturer's test channel under the following conditions:

1. Light source: 2856 K colour temperature (broadcast and industrial tubes);
   P20 light distribution (tubes for medical X-ray equipment).

2. Filter: inserted in the light path for chrominance tubes (see published data for required filter characteristics).

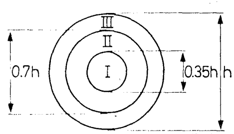
3. Test transparency, back-illuminated, projected onto the target by means of a high quality lens, producing an even illumination on the specified scanned area.
   The test transparency has an aspect ratio of 3 : 4 for the evaluation of broadcast and industrial quality tubes. The area of the chart is divided into three quality zones by two concentric circles as shown in Fig. 1.

Fig. 1



   The test transparency is of a circular shape for the evaluation of tubes for medical X-ray equipment. The area of the chart is divided into three quality zones by two concentric circles as shown in Fig. 2.

Fig. 2



4. The video amplifier frequency response is essentially flat to 5 MHz, with a sharp fall-off to 6 MHz.

5. No gamma correction or aperture correction are applied in the video amplifier.

6. The light level on the Plumbicon tube target is adjusted to produce a peak signal current I_s in accordance with Table I.

7. The electrical settings of the tube are in accordance with its published data and the "Instructions for use".

8. The beam current of the Plumbicon tube is adjusted to just stabilize a peak signal current of magnitude I_b in accordance with Table I.

9. Monitor. The obtained picture is observed on a monitor producing a non-blooming white.

*) Registered Trade Mark for TV camera tube.

Table I
I_s and I_b settings

		Tube diameter	Tube diameter 30 mm ($1\frac{1}{4}$ in)		Tube diameter 25 mm (1 in)		16 mm (5/8 in)	17,7mm (2/3 in)
		Scanned area	Scanned area 12,8 x 17,1 mm^2		Scanned area 9,6 x 12, 8 mm^2		6 x 8 mm	6,6 x 8,8 mm
			I_s µA	I_b µA	I_s µA	I_b µA	I_s µA	I_b µA
Broadcast quality tubes	Luminance		0, 30	0, 60	0, 2	0, 4	0, 15	0, 30
	Black and white		0, 30	0, 60	0, 2	0, 4	0, 15	0, 30
	Chrominance tubes	Red R	0, 15	0, 30	0, 1	0, 2	0, 075	0, 15
		Green G	0, 30	0, 60	0, 2	0, 4	0, 15	0, 30
		Blue B	0, 15	0, 30	0, 1	0, 2	0, 075	0, 15
Industrial quality tubes	Black and white		0, 30	0, 60	0, 2	0, 4	0, 15	0, 15
	Chrominance tubes	Red R	0, 15	0, 30	0, 1	0, 2	0, 075	0, 15
		Green G	0, 30	0, 60	0, 2	0, 4	0, 15	0, 30
		Blue B	0, 15	0, 30	0, 1	0, 2	0, 075	0, 15

P20 light source	Scanned area [1]) 18 mm circular		Scanned area [1]) 16,2 mm circular	
X-ray medical tubes (for use in combination with an X-ray image intensifier)	0, 15	0, 30	0, 1	0, 2

1) Scanning amplitude controls adjusted such that the circular quality area of the target is displayed on a standard monitor as a circular area with a diameter equal to the raster height.

SECTION B

Definition

Blemishes. Both spots (sharply defined) and smudges (with vague contours) are termed blemishes.
Blemishes are small areas producing uneven modulation of any signal current between black level (black current) and white level (peak signal current).

SECTION C

Broadcast quality tubes

The degrading effect caused by a blemish on the quality of the picture as observed on the monitor is expressed in its Spot Nuisance Value (S.N.V.).

The S.N.V. of a blemish is basically defined as the product of its size (measured in % of the picture height, with a special test transparency) and its contrast (or modulation depth) in % of the peak signal current produced by the circular area of the target, having a diameter of 5% of the picture height, which encircles this blemish.
The contrast is measured on a waveform oscilloscope provided with a line selector.

Tables II show which blemishes are to be neglected, because of their small size or contrast, and how the actual S.N.V. is determined per type of tube for dark and white blemishes (see also the addendum to this section).

Tables III define the maximum number of blemishes and the maximum sum of S.N.V.'s per tube type, per zone, and the total which are allowed.

Tubes with 30 mm or 25 mm diameter

Table II

		Black and white Luminance L Green G	Red R	Blue B
To be neglected	size	≤ 0,2% [2])	≤ 0,2% [2])	≤ 0,2% [2])
	contrast	≤ 5%	≤ 8%	≤ 8%
S.N.V. of	white blemish	2 x M.V. [3])	1 x M.V. [3])	
	dark blemish	1 x M.V. [3])		
Max. S.N.V.	per blemish	20	20	20

Table III

	bl/wh, L, G, R [4])				B [4])			
Zone	I	II	III	tot.	I	II	III	tot.
Max. number	0	2	3	4	1	3	4	6
Max. sum of S.N.V. [5])	0	30	50	60	20	45	80	90

Tubes with 16 mm diameter (5/8 inch) and 17,7 mm diameter (2/3 inch)

Table II [1])

		Black and white Green G	Red R	Blue B
To be neglected	size	≤ 0,2% [2])	≤ 0,2% [2])	≤ 0,2% [2])
	contrast	≤ 6%	≤ 8%	≤ 10%
S.N.V. of	white blemish	2 x M.V. [3])	1 x M.V. [3])	
	dark blemish	1 x M.V. [3])		
Max. S.N.V.	per blemish	20	20	20

Table III	Black and white [4] Green G				Red R [4]				Blue B [4]			
Zone	I	II	III	tot.	I	II	III	tot.	I	II	III	tot.
Max. number	1	2	3	4	1	3	4	6	2	4	6	8
Max. sum of S.N.V. [5]	10	30	50	60	15	45	80	100	20	50	90	110

Notes

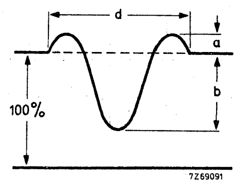
1. No blemishes > 0,2% shall be visible when the lens is capped.
2. Blemishes of this size are not counted unless their concentration causes a smudged appearance. Such concentrations are evaluated as blemishes and as contrast, the average contrast of the concentration is taken.
3. M.V. = measured value (size x contrast).
4. The minimum distance as measured in any direction between any two blemishes with S.N.V. $\geq$ 10 shall be 5% of picture height.
5. Arithmetic sum of individual S.N.V.'s.

ADDENDUM

Black blemishes with a white surrounding and white blemishes with a black core.

On the osciiloscope the general shape of such a blemish will be as shown in Fig. 3.

Fig. 3



→ A blemish shall be considered to be a white blemish if a $\geqslant$ b (S.N.V. = a x d or 2 x a x d in accordance with Table II) or a black blemish if b > a (S.N.V. = b x d).

SECTION D

Industrial quality tubes

Number, size, and location of blemishes allowed. [1])

Dimensions of blemishes in % of picture height	Permitted number of blemishes			
	Zone I	Zone II	Zone III	Total
≤ 2% but > 1% [2])	0	1	2	2
≤ 1% but > 0, 7%				
≤ 0, 7% but > 0, 45%	1	2	4	4
≤ 0, 45% but > 0, 2%	2	4	6	6
≤ 0, 2%	[3])	[3])	[3])	[3])
Total permitted number of blemishes	2	4	6	6 [4])

Notes

1. Blemishes with contrast ≤ 10% shall not be counted.
2. Blemishes of these dimensions are not allowed when their contrast exceeds 20%.
3. Blemishes of this size are not counted unless their concentration causes a smudged appearance. Such concentrations are evaluated as blemishes and as contrast, the average contrast of the concentration is taken.
4. The distance between any two blemishes with dimensions > 0, 45% shall be greater than 5% of picture height as measured in any direction.

SECTION E

Tubes for medical X-ray equipment

Number, size, and location of blemishes allowed [1]

Dimensions of blemishes in % of picture height	Permitted number of blemishes		
	Zone I	Zone II	Zone III
> 0,7%	0	0	0
≤ 0,7% but > 0,45%	0	1	3
≤ 0,45% but > 0,2%	2	3	6
≤ 0,2%	[2]	[2]	[2]
Total permitted number of blemishes	2	6	

Notes

1. Blemishes with contrast ≤ 6% (if black) and ≤ 3% (if white) are neglected.
2. Blemishes of this size are not counted unless their concentration causes a smudged appearance. Such concentrations are evaluated as blemishes and as contrast, the average contrast of the concentration is taken.

CAMERA TUBE

Plumbicon *, sensitive high-definition pick-up tube with photoconductive target and low velocity stabilization.
The XQ1020 is intended for use in black and white, the L, R, G, and B versions for use in four and three tube colour studio cameras.

QUICK REFERENCE DATA			
Focusing	magnetic		
Deflection	magnetic		
Diameter	approx.	30	mm
Heater	6,3 V ,	300	mA

OPTICAL

Dimensions of quality rectangle on photoconductive layer (aspect ratio 3:4)	12,8 mm x 17,1 mm			1)
Orientation of image on photoconductive layer	by means of mark on tube base			2)
Sensitivity at colour temperature of illumination = 2856 K	min.	typ.		
type: XQ1020, XQ1020L	375	400	µA/lm	3)
XQ1020R	70	85	µA/lm	3)
XQ1020G	130	165	µA/lm	3)
XQ1020B	35	38	µA/lm	3)
Gamma of transfer characteristic	0,95 ± 0,05			4)
Spectral response; max. response at	≈	500	nm	
cut-off at	≈	650	nm	
response curve	see page B26			

HEATING

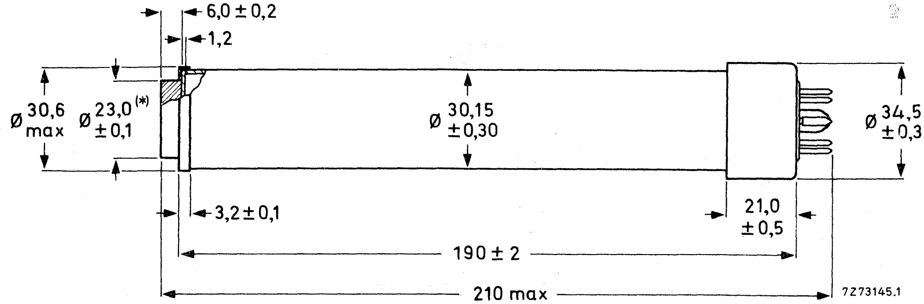
Indirect by a.c. or d.c.; parallel supply			
Heater voltage	V_f	6,3	V
Heater current	I_f	300	mA

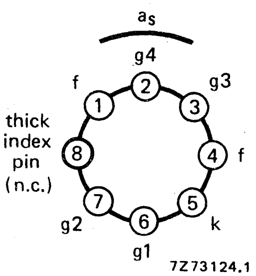
* Registered Trade Mark for T.V camera tube

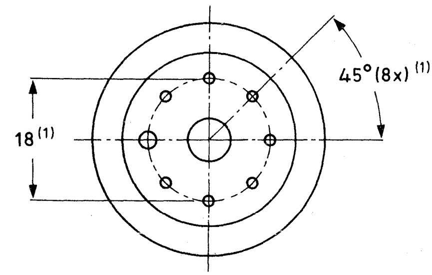
Notes: see page B24.

→ MECHANICAL DATA

Dimensions in mm

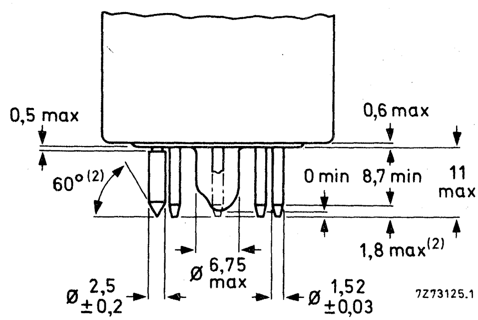






Mounting position: any

Net mass: ≈ 100 g



(*) Distance between axis of anti-halation glass disc and geometrical centre of signal electrode ring, measured in plane of faceplate: max. 0,2 mm. Total glass thickness: 7,2 ± 0,2 mm; n = 1,5.

(1) The base passes a flat gauge with a centre hole with a diameter of 8,230 ± 0,005 mm and holes for passing the pins with the following diameters: 7 holes of 1,690 ± 0,005 mm and one hole of 2,950 ± 0,005 mm. The holes may deviate max. 0,01 mm from their true geometrical position. Thickness of gauge: 7 mm.

(2) The ends of the pins are tapered and/or rounded but not brought to a sharp point.

ACCESSORIES

Socket	type 56021 or 56025
Focusing and deflection coil assembly,	
for XQ1020	type AT1132/01
for XQ1020L, R, G, B	type AT1113/01

For optimal screening of the target from the live end of the line deflection coils the use of AT1132/01 or AT1113/01 is recommended.

CAPACITANCE

Signal electrode to all	C_{as}		3 to 6	pF	5)

FOCUSING magnetic 6)

DEFLECTION magnetic 6)

CHARACTERISTICS

Grid no. 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100	V	7) 8)
Blanking voltage, peak to peak, on grid no. 1	V_{g1p-p}		50 ± 10	V	
on cathode	V_{kp-p}		25	V	
Grid no. 2 current at normally required beam currents	I_{g2}	≤	1	mA	
Dark current at V_{as} = 45 V	I_{as}	≤	0,003	μA	

LIMITING VALUES (Absolute max. rating system)

Signal electrode voltage	V_{as}	max.	50	V	8)
Grid no. 4 voltage	V_{g4}	max.	1100	V	8)
Grid no. 3 voltage	V_{g3}	max.	800	V	8)
Voltage between grid no. 4 and grid no. 3	$V_{g4/g3}$	max.	350	V	8)
Grid no. 2 voltage	V_{g2}	max.	350	V	8)
Grid no. 2 dissipation	W_{g2}	max.	1	W	
Grid no. 1 voltage, positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Cathode heating time before drawing cathode current	T_h	min.	1	min.	
Cathode to heater voltage, positive peak	V_{kfp}	max.	50	V	
negative peak	$-V_{kfp}$	max.	50	V	
Ambient temperature, storage and operation	t_{amb}	max.	50	°C	
		min.	−30	°C	
Faceplate temperature, storage and operation	t	max.	50	°C	
		min.	−30	°C	
Faceplate illumination		max.	500	lx	9)

Notes: see page B24.

OPERATING CONDITIONS AND PERFORMANCE

Conditions

Cathode voltage	V_k	0	V
Grid no. 2 voltage	V_{g2}	300	V
Signal electrode voltage	V_{a_s}	45	V [10]
Beam current	I_b	See note 11	
Focusing coil current at given values of grid no. 4 and grid no. 3 voltages		See note 12	
Line coil current and frame coil current		See note 12	
Faceplate illumination		See notes 13 and 14	
Faceplate temperature	t	20 to 45	°C

Performance

Resolution

Modulation depth i.e. uncompensated horizontal amplitude response at 400 TV lines, at centre of picture.

The figures shown represent the typical horizontal amplitude response of the tube as obtained with a lens aperture of f:5,6 [15]

		XQ1020 XQ1020L	XQ1020R	XQ1020G	XQ1020B
Highlight signal current	I_s	0,3 μA	0,15 μA	0,3 μA	0,15 μA
Beam current	I_b	0,6 μA	0,3 μA	0,6 μA	0,3 μA
Modulation depth at 400 TV lines	typ. min.	40 % 35 %	35 % 30 %	40 % 35 %	50 % 40 %

Limiting resolution ≥ 600 TV lines

Lag (typical values)

Light source with a colour temperature of 2856 K.
Appropriate filter inserted in the light path for the chrominance tubes R, G, and B.

Notes : see page B24.

Low-key conditions

	build-up lag 16)				decay-lag 17)			
	Is/Ib = 20/300 nA		Is/Ib = 40/600 nA		Is/Ib = 20/300 nA		Is/Ib = 40/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1020 XQ1020L XQ1020G			95	≈ 100			9	3
XQ1020R	85	≈100			12	3,5		
XQ1020B	70	≈100			14,5	5		

High-key conditions

	build-up lag 16)				decay-lag 17)			
	Is/Ib = 150/300 nA		Is/Ib = 300/600 nA		Is/Ib = 150/300 nA		Is/Ib = 300/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1020 XQ1020L XQ1020G			99	100			1,2	0,4
XQ1020R	98	100			2	0,5		
XQ1020B	97	100			3,5	2		

Notes: see page B24.

NOTES

1) Underscanning of the specified useful target area of 12,8 mm x 17,1 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.

2) **For proper orientation of the image on the photoconductive layer the vertical scan direction should be parallel to the plane passing through the tube axis and the mark on the tube base.**

3) Measuring conditions:

Illumination 4,54 lx at black body colour temperature of 2856 K; the appropriate filter inserted in the light path. The signal current obtained in nA is a measure of the colour sensitivity expressed in μA per lumen of white light before the filter. Filters used:

XQ1020R	Schott	OG570	thickness	3 mm
XQ1020G	Schott	VG9	thickness	1 mm
XQ1020B	Schott	BG12	thickness	3 mm

See page B26 for transmission curves.

4) The use of gamma-stretching circuitry is recommended.

5) The capacitance C_{as} to all, which effectively is the output impedance, increases when the tube is inserted into the deflecting/focusing coil assembly.

6) For focusing/deflection coil assembly, see under "Accessories".

7) Without blanking voltage on grid no. 1.

8) At $V_k = 0$ V.

9) For short intervals. During storage the tube shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.

10) The signal electrode voltage shall be adjusted to 45 V. To enable the tube to handle excessive highlights in the scene to be televised the signal electrode voltage may be reduced to a minimum of 25 V, this will, however, result in some reduction in performance.

11) The beam current I_b, as obtained by adjusting the control grid (grid no. 1) voltage is set to 300 nA for R and B tubes, 600 nA for black and white, L and G tubes.

I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.

In the performance figures, e.g. for resolution and lag, the signal current and beam current conditions are given, e.g. as I_s/I_b = 20/300 nA. This hence means: with a signal current of 20 nA and a beam setting which just allows a signal current of 300 nA.

N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area. The peak signal currents as measured on a wave-form oscilloscope will be a factor α larger.
($\alpha = \frac{100}{100 - \beta}$, β being the total blanking time in %, for the CCIR system α amounts to 1,3.)

12)

	Focus current * mA	Line current$_{pp}$ mA	Frame current$_{pp}$ mA
Black and white coil assembly AT1132/01	25	235	35
Colour coil assemblies AT1113/01	100	235	35

(approx. values)

* Adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is repelled at the image end of the focusing coil.

13) Typical faceplate illumination level for the XQ1020 and XQ1020L to produce 0,3 μA signal current will be approx. 4 lx. The signal currents stated for the colour tubes XQ1020R, G, B respectively will be obtained with an incident white level (2856 K) on the filter of approx. 10 lx. These figures are based on the filters described in note 3, for filter BG12 however a thickness of 1 mm is chosen.

14) In the case of a black/white camera the illumination on the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

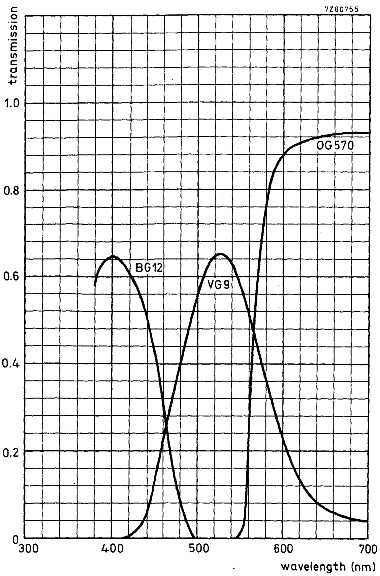
$$B_{ph} = B_{sc} \frac{R.T.}{4F^2 (m+1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor. F the lens aperture, and m the linear magnification from scene to target.
A similar formula may be derived for the illumination level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the complete optical system have been taken into account.

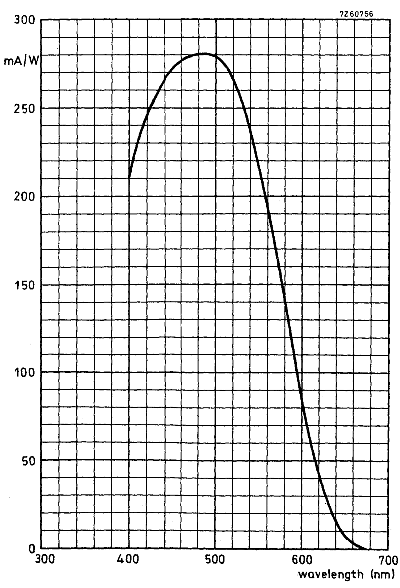
15) The horizontal amplitude response can be raised by the application of suitable correction circuits, which affects neither the vertical resolution, nor the limiting resolution.

16) After 10 s of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms respectively 200 ms after the illumination has been applied.

17) After a minimum of 5 s of illumination on the target. The figures given represent typical residual signal in percents of the original signal current 60 ms respectively 200 ms after the illumination has been removed.



Transmission of filters
BG12, VG9 and OG570
See note 3.



Typical spectral response curve.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1020 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1021	for use in black and white cameras
XQ1021R XQ1021G XQ1021B	for use in the chrominance channels of colour cameras

For all further information see data of the XQ1020 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon *, sensitive high definition pick-up tube with lead-oxide photoconductive target and low velocity stabilisation.
Provided with separate mesh construction.
The XQ1022 is exclusively intended for use with X-ray image intensifiers in medical equipment.

QUICK REFERENCE DATA			
Focusing	magnetic		
Deflection	magnetic		
Diameter	approx.	30	mm
Heater	6, 3 V,	300	mA
Without anti-halation glass disc			

OPTICAL

Dimensions of quality area on photoconductive layer	circle of 18 mm diameter 1) 2)		
Orientation of image on photoconductive layer	by means of mark on tube base 2)		
Sensitivity, measured with a fluorescent light source having P_{20} distribution	min.	typ.	
	200	275	μA/lumen
Gamma of transfer characteristic	0, 95 ± 0, 05 3)		
Spectral response; max. response at	≈	500	nm
cut-off at	≈	650	nm
response curve	see Fig. 1		

HEATING

Indirect by a.c. or d.c.; parallel supply

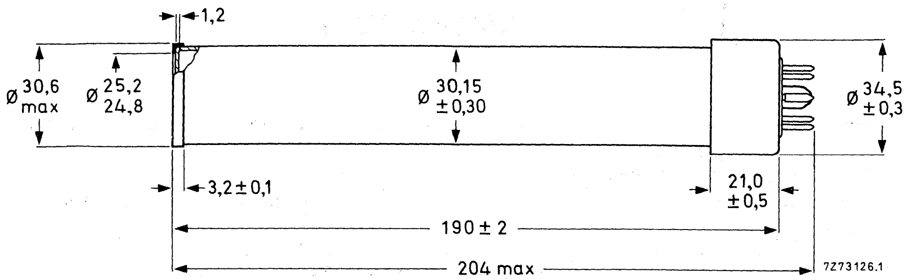
Heater voltage	V_f	6, 3	V ± 5 %
Heater current	I_f	300	mA

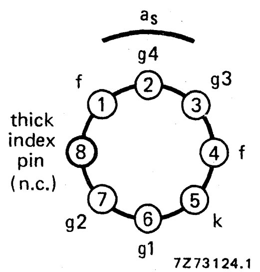
* Registered Trade Mark for TV Camera tube

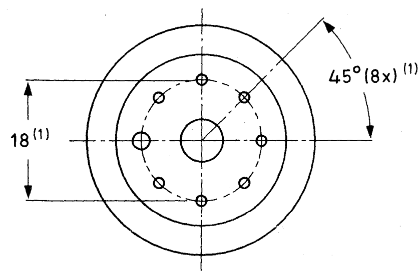
Notes see page B33.

MECHANICAL DATA

Dimensions in mm

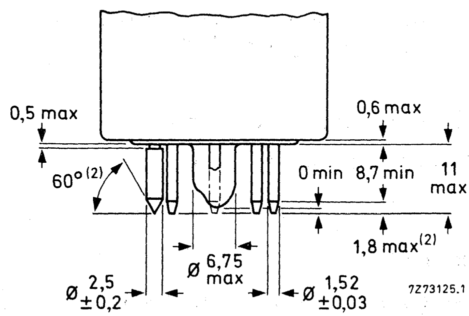






Mounting position: any

Net mass: ≈ 100 g



(1) The base passes a flat gauge with a centre hole with a diameter of 8, 230 ± 0, 005 mm and holes for passing the pins with the following diameters: 7 holes of 1, 690 ± 0, 005 m and one hole of 2, 950 ± 0, 005 mm. The holes may deviate max. 0, 01 mm from their true geometrical position. Thickness of gauge: 7 mm.

(2) The ends of the pins are tapered and/or rounded but not brought to a sharp point.

ACCESSORIES					
Socket	type 56021 or 56025				
Focusing and deflection coil assembly	AT1132/01				4)
CAPACITANCE					
Signal electrode to all	C_{as}		3 to 6	pF	5)
FOCUSING magnetic 6)					
DEFLECTION magnetic 6)					
CHARACTERISTICS					
Grid no. 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100	V	7)8)
Blanking voltage, peak to peak, on grid no. 1	V_{g1p-p}		50 ± 10	V	
on cathode	V_{kp-p}		25	V	
Grid no. 2 current at normally required beam currents	I_{g2}		1	mA	
Dark current	I_{as}		3	nA	*)
LIMITING VALUES (Absolute max. rating system)					
Signal electrode voltage	V_{as}	max.	50	V	8)
Grid no. 4 voltage	V_{g4}	max.	1100	V	8)
Grid no. 3 voltage	V_{g3}	max.	800	V	8)
Voltage between grid no. 4 and grid no. 3	$V_{g4/g3}$	max.	350	V	8)
Grid no. 2 voltage	V_{g2}	max.	350	V	8)
Grid no. 2 dissipation	W_{g2}	max.	1	W	
Grid no. 1 voltage, positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Cathode heating time before drawing cathode current	T_h	min.	1	min.	
Cathode to heater voltage, positive peak	V_{kfp}	max.	50	V	
negative peak	$-V_{kfp}$	max.	50	V	
Ambient temperature, storage and operation	t_{amb}	max.	50	°C	
		min.	−30	°C	
Faceplate temperature, storage and operation	t	max.	50	°C	
		min.	−30	°C	
Faceplate illumination		max.	500	lx	9)

*) Target voltage adjusted to the value indicated by the tube manufacturer in the test sheet as delivered with each individual tube.

Notes: see page B33.

OPERATING CONDITIONS AND PERFORMANCE

Conditions

Cathode voltage	V_k	0	V
Grid no. 2 voltage	V_{g2}	300	V
Grid no. 3 voltage	V_{g3}	600	V
Grid no. 4 voltage	V_{g4}	675	V
Signal electrode voltage	V_a	15-45	V [11]
Beam current	I_b	See note 12	
Focusing coil current Line coil current and frame coil current		See note 13	
Highlight signal electrode current	I_{a_s}	0,1 to 0,5	μA
Average signal output		≈ 0,06	μA [14]
Faceplate temperature	t	25 to 45	°C
Faceplate illumination		≈ 2	lx [15]

Performance

Resolution

Modulation depth, i.e. uncompensated horizontal amplitude response at 5 MHz (10,5 lp/mm) (625 lines, 50 field system) in picture centre — 55 % [16] [17]

Decay (or lag)

Measured with 100% video signal current of 0,1 μA which has been flowing through the layer for a minimum of 5 s. Beam adjusted for correct stabilisation. Fluorescent light source having P_{20} distribution.

Residual signal after dark pulse of 60 ms	< 10 %	typ. 5 %
Residual signal after dark pulse of 200 ms	< 4 %	typ. 2 %

Notes: see pages B33 and B34.

NOTES

1) All underscanning of the specified useful target area of 18 mm diameter or failure of scanning should be avoided since this may cause permanent damage to the photoconductive layer.
The area beyond the 18 mm optical image preferably to be covered by a mask.

2) For correct orientation of the image on the photoconductive layer the vertical scan should be essentially parallel to the plane passing through the tube axis and the mark on the tube base.

3) The near unity gamma of the XQ1022 ensures good contrast when televising low contrast X-ray image-intensifier pictures as encountered in radiology. Further contrast improvement may be obtained when an adjustable gamma expansion circuitry is incorporated in the video amplifier system.

4) For optimal screening of the target from the live end of the deflection coils the use of AT1132/01 is recommended.

5) C_{as} which effectively is the output impedance, increases when the tube is inserted into the deflection/focusing coil assembly.

6) See "Accessories".

7) With no blanking voltage on g_1.

8) At V_k = 0V

9) For short intervals. During storage the tube face shall be covered with the plastic hood provided.

10) The optimum voltage ratio V_{g4}/V_{g3} depends on the type of focusing/deflection coil used: for type AT1132/01 a ratio of 1,1 : 1 to 1,15 : 1 is recommended.

11) The target voltage should be adjusted to the value indicated by the tube manufacturer on the test sheet accompagnying each tube.

12) Operation of the tube with beam currents I_b not sufficient to stabilize the brightest picture elements must be carefully avoided to prevent loss of highlight detail and/or "sticking" effects. The incorporation of a separate mesh construction allows excess beam currents I_b up to 0,6 μA to be applied without appreciable loss in resolution.

13) For AT1132/01, at V_{g3} = 600 V, V_{g4} = 675 V

* Focus current	25 mA	
Line deflection current, p-p	330 mA	for 24 x 18 mm scanning as required for circular picture, on monitor
Frame deflection current, p-p	50 mA	

* Adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is repelled at the image end of the focusing coil.

14) Substraction of the dark current is unnecessary because of the extremely low value.

15) In the case of a black/white camera the illumination of the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{R.T.}{4F^2 (m+1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target.

16) With a signal current of 0,1 μA and a beam current of 0,5 μA.

17) Horizontal amplitude response can be raised by the application of aperture correction. Such compensation, however, does not affect the vertical resolution, nor does it influence the limiting resolution.

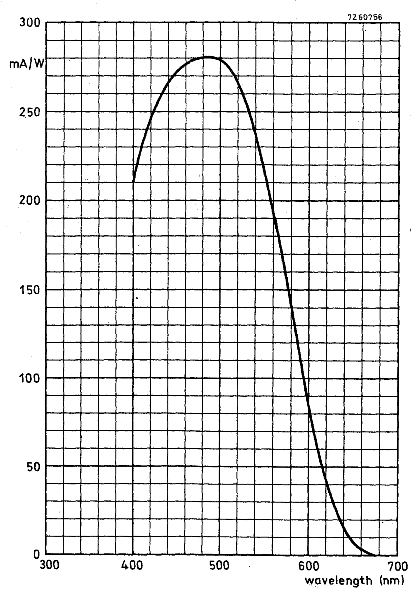


Fig. 1 Spectral response curve

CAMERA TUBE

Plumbicon *, sensitive pick up tube, with lead-oxide photoconductive target with extended red response and high resolution.
Low velocity target stabilization. Provided with separate mesh construction for good uniformity of signal and resolution and good highlight handling.
The XQ1023 is intended for use in black and white cameras, the XQ1023L for use in the luminance channel of four tube colour cameras, the XQ1023R for use in the red channel of both three and four tube colour cameras.

QUICK REFERENCE DATA			
Focusing	magnetic		
Deflection	magnetic		
Diameter	≈	30	mm
Heater	6, 3 V,	300	mA
Spectral response, cut-off	>	850	nm
Provided with anti-halation glass disc			

OPTICAL

Dimensions of quality rectangle on target (aspect ratio 3: 4) — 12, 8 x 17, 1 mm [1])

Orientation of image on target — by means of mark on tube base. [2])

Sensitivity (colour temperature of light source 2856 K)		min.	typ.	
	XQ1023	390	450 μA/lmF	[3])[4])
	XQ1023L	390	450 μA/lmF	[3])[4])
	XQ1023R	120	150 μA/lmF	[5])

Gamma of transfer characteristic — 0, 95 ± 0, 05 [6])

Spectral response — See page 8
max. response at — ≈ 500 nm

HEATING

Indirect by a.c. or d.c.; parallel supply

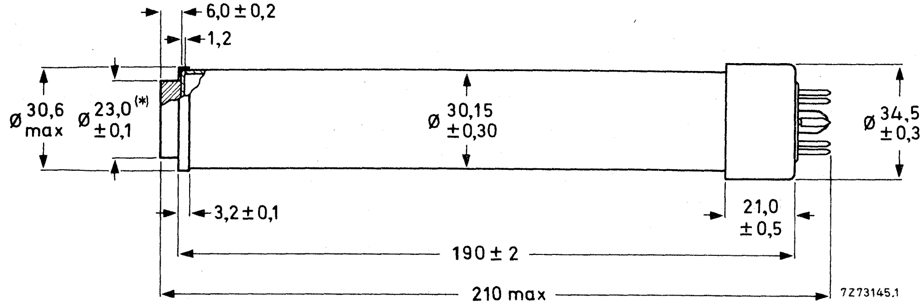
Heater voltage	V_f	6, 3	V ± 5%
Heater current	I_f	300	mA

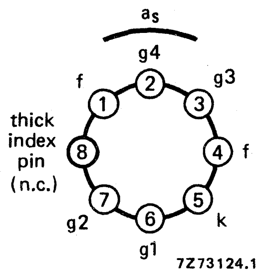
* Registered Trade Mark for TV camera tube.

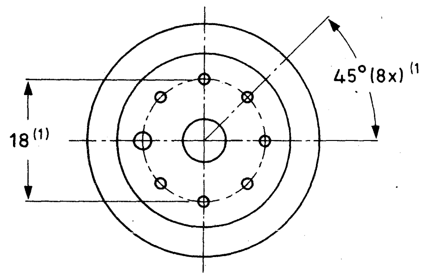
Notes: see page B40.

→ MECHANICAL DATA

Dimensions in mm

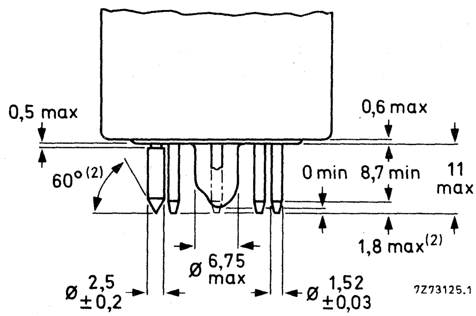






Mounting position: any

Net mass: ≈ 100 g



(*) Distance between axis of **anti-halation glass disc and** geometrical centre of signal electrode ring, measured in plane of faceplate: max. 0, 2 mm. Total glass thickness: 7, 2 ± 0, 2 n = 1, 5.

(1) The base passes a flat gauge with a centre hole with a diameter of 8, 230 ± 0, 005 mm and holes for passing the pins with the following diameters: 7 holes of 1, 690 ± 0, 005 mm and one hole of 2, 950 ± 0, 005 mm. The holes may deviate max. 0, 01 mm from their true geometrical position. Thickness of gauge: 7 mm.

(2) The ends of the pins are tapered and/or rounded but not brought to a sharp point.

ACCESSORIES

Socket		type 56021 or 56025
Focusing and deflection coil assembly for XQ1023		AT1132/01 [7]
for XQ1023L, XQ1023R		AT1113/01 [7]

CAPACITANCES

Signal electrode to all	C_a		3 to 6	pF	[8]

FOCUSING magnetic [9]

DEFLECTION magnetic [9]

CHARACTERISTICS

Grid no. 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100	V	[10]
Blanking voltage peak to peak on grid no. 1	V_{g1pp}		50 ± 10	V	
on cathode	V_{kpp}		25	V	
Grid no. 2 current at normally required beam currents	I_{g2}	max.	1	mA	
Dark current at V_{a_s} = 45 V	I_{a_s}	max.	0,003	μA	

LIMITING VALUES (Absolute max. rating system)

Signal electrode voltage	V_{a_s}	max.	50	V	[11]
Grid no. 4 voltage	V_{g4}	max.	1100	V	[11]
Grid no. 3 voltage	V_{g3}	max.	800	V	[11]
Potential difference between grid no. 4 and no. 3	$V_{g4/g3}$	max.	350	V	
Grid no. 2 voltage	V_{g2}	max.	350	V	[11]
Grid no. 2 dissipation	W_{g2}	max.	1	W	
Grid no. 1 voltage positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Cathode to heater voltage, positive peak	V_{kf_p}	max.	50	V	
negative peak	$-V_{kf_p}$	max.	50	V	
Cathode heating time before drawing cathode current	T_h	min.	1	min	[12]

Ambient temperature, storage and operation	t_{amb}	max.	50	°C
		min.	−30	°C
Faceplate temperature, storage and operation	t	max.	50	°C
		min.	−30	°C
Faceplate illumination		max.	100	lx [13]

OPERATING CONDITIONS AND PERFORMANCE

Conditions

Cathode voltage	V_k	0	V
Grid no. 2 voltage	V_{g2}	300	V
Signal electrode voltage	V_{a_s}	45	V [14]
Grid no. 3 voltage	V_{g3}	600	V
Grid no. 4 voltage	V_{g4}	675	V
Beam current	I_b	see note [16]	
Focusing coil current		see note [15]	
Line and frame deflection coil current		see note [15]	
Faceplate illumination		see note [17] and [18]	
Faceplate temperature		20 to 45	°C

Performance

Resolution

Modulation depth, i.e. uncompensated horizontal amplitude response at 400 TV lines (note 19). The figures shown represent the horizontal amplitude response as obtained with a lens aperture of f : 5,6 [16]

		XQ1023, XQ1023L	XQ1023R
Highlight signal current	I_s	0, 3 μA	0, 15 μA
Beam current	I_b	0, 6 μA	0, 3 μA

Picture centre — min. 45, typ. 55 % [19]

Limiting resolution — ≥ 700 TV lines

Lag (typical values)

Light source with a c.t. of 2856K, filter B_1/K_1 inserted in the light path for the black and white and L versions, filter OG570 additionally inserted for R version.

Notes: see pages B40, B41 and B42.

Low key conditions

	build-up lag [20]				decay-lag [21]			
	I_s/I_b = 40/600 nA		I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA		I_s/I_b = 20/300 nA	
	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)
XQ1023, XQ1023L	85	100			14	3, 5		
XQ1023R			75	98			16	4, 5

High key conditions

	build-up lag [20]				decay lag [21]			
	I_s/I_b = 300/600 nA		I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA		I_s/I_b = 150/300 nA	
	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)
XQ1023, XQ1023L	98	100			3	1, 5		
XQ1023R			96	100			5	2

Notes: see page B42.

NOTES

1) Underscanning of the specified target area of 12, 8 x 17, 1 mm^2 or failure of scanning, should be avoided since this may cause damage to the photoconductive target.

2) For proper orientation of the image on the photoconductive layer the vertical scan direction should be parallel to the plane passing through the tube axis and the mark on the tube base.

3) All measurements are made with an infrared reflecting filter, Balzers, Calflex B1/K1 interposed between light source and target. For typical transmission curve of this filter see page B42.

4) Measured with 4, 54 lux on the specified target area, when the infrared absorbing filter is removed. The signal current obtained in nA equals the sensitivity in µA per filtered lumen (µA/lmF).

5) Measured as indicated in notes 3 and 4 but with additional filter interposed between light source and target. Filter used is : Schott, OG570(3 mm). For transmission curve see page B43.

6) The use of gamma-stretching circuitry is recommended.

7) For optimal screening of target from live end of line deflection coils type AT1113/01 and type AT1132/01 are recommended.

8) Capacitance C_{as} to all, which effectively is the output impedance, increases when the tube is inserted into the deflecting/focusing assembly.

9) For focusing/deflecting coil assembly, see under "Accessories".

10) With no blanking voltage on g_1.

11) At $V_K = 0$ V.

12) A minimum of 1 minute heating-up time for the heater is to be observed before drawing cathode current.

13) For short intervals. During storage and idle periods of the camera the tube-face shall be covered with the plastic hood provided, respectively the lens be capped.

14) The signal electrode voltage shall be adjusted to 45 V. To compete with excessive highlights in the scene to be televised the signal electrode voltage may be reduced to a minimum of 25 V, this will however result in some reduction in performance.

		* focus current mA	line deflection current mA_{pp}	frame deflection current mA_{pp}
15) Black and white coil assemblies AT1132/01 V_{g3} = 600 V V_{g4} = 675 V	approx.	25	235	35
Colour assemblies AT1113/01 V_{g3} = 600 V V_{g4} = 675 V	approx.	100	235	35

* Adjusted for correct electrical focus.
The direction of the current through the focusing coil should be chosen such that a north seeking pole will be repelled at the faceplate end of the coil.
The optimum voltage difference between grid no. 4 and grid no. 3 is depending on the type of focusing/deflection assembly used.

16) The beam current I_b, as obtained by adjusting the control grid (grid no. 1) voltage is set to 300 nA for R-tubes, to 600 nA for black and white and L tubes.
I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.

In the performance figures, e.g. for resolution and lag, the signal current and beam current conditions are given, e.g. as I_s/I_b = 20/300 nA. This hence means: with a signal current of 20 nA and a beam setting which just allows a signal current of 300 nA. N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area. The peak signal currents as measured on a wave-form oscilloscope will be a factor α larger.

($\alpha = \frac{100}{100-\beta}$, β being the total blanking time in %, for the CCIR system β amounts to 1, 3).

17) Faceplate illumination level for the XQ1023 and XQ1023L typically needed to produce 0, 3 μA signal current will be approx. 3 lux. The signal stated for the XQ1023R will be obtained with an incident light-level (2856 K) on the filter of approx. 10 lux.
The figures stated for modulation depth are based on the use of the filter described in note 5.

18) Illumination on the photo-conductive layer, B_{ph}, in the case of a black and white camera is related to scene illumination, B_{sc}, by the formula:

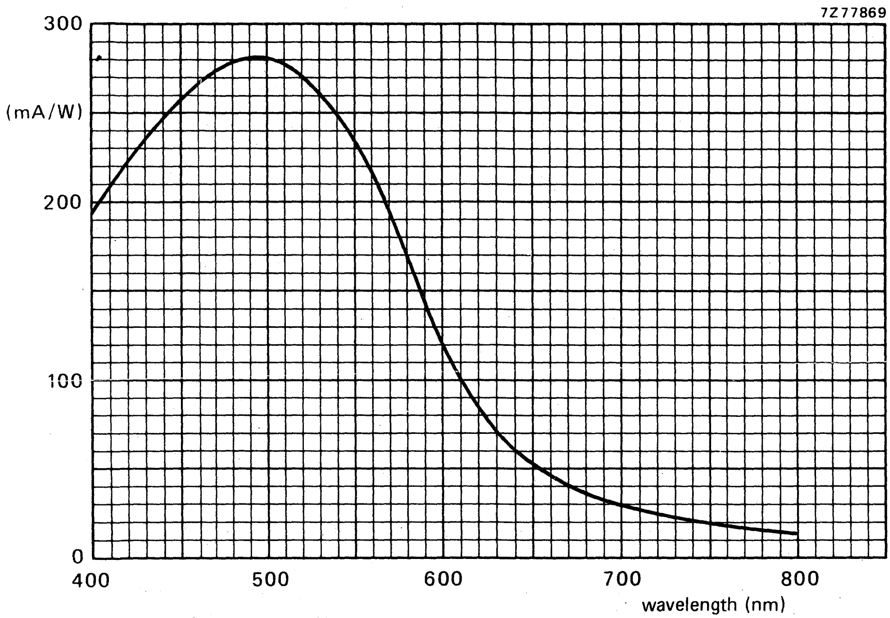
$$B_{ph} = B_{sc} \frac{R.T.}{4F^2 (m+1)^2}$$

in which R represents the scene-reflexivity (average or the object under consideration, whichever is relevant), T the lens transmission factor, F the lens aperture and m the linear magnification from scene to target.
A similar formula may be derived for the illumination level on the photo-conductive layer of the XQ1023L, XQ1023R tubes in which the effects of the various components of the complete optical system have been taken into account.

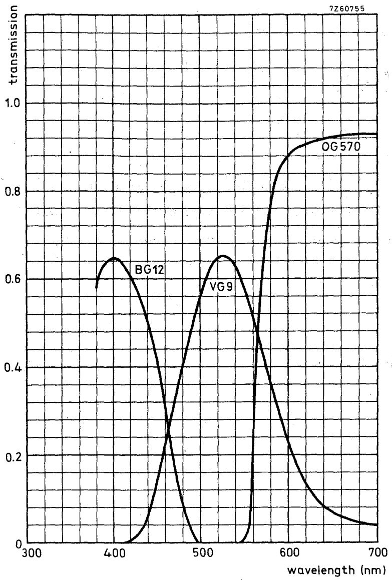
19) Horizontal amplitude response can be raised by the application of suitable correction circuits. Such compensation, however, does not affect vertical resolution, nor does it it influence the limiting resolution.

20) After 10 s of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms respectively 200 ms after the illumination has been applied.

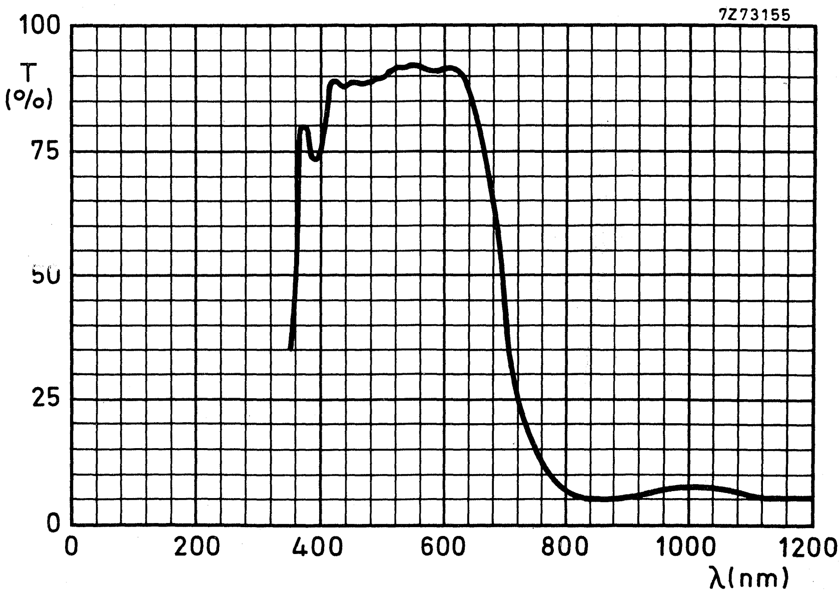
21) After a minimum of 5 s of illumination on the target. The figures represent typical residual signals in percents of the original signal current 60 ms respectively 200 ms after the illumination has been removed.



Spectral sensitivity characteristic measured at a constant signal output of 50 nA from 12, 8 mm x 17 mm. (except at low sensitivity values).



Transmission curve of filters



Typical transmission curve of heat reflecting interference filter type CALFLEX – B1/K1.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1023 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1024 for use in black and white cameras

XQ1024R for use in the red chrominance channel of colour cameras.

For all further information see data of the XQ1023 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon*, sensitive pick-up tube with lead-oxide photoconductive target with extended red response and high resolution.

Low velocity target stabilization. Provided with separate mesh for good uniformity of signal and resolution and good highlight handling.

The tubes of the XQ1025 series are identical to the tubes of the XQ1023 series but incorporate an infra-red reflecting filter on the anti-halation glass disc.

QUICK REFERENCE DATA			
Focusing :	magnetic	Heater :	6,3 V, 300 mA
Deflection :	magnetic	Cut-off of	
Diameter :	approx. 30 mm	spectral response :	750 nm [1])
Provided with anti-halation glass disc with infra-red reflecting filter.			

The infra-red reflecting filter eliminates the need for additional filters in the colour splitting systems when the XQ1025L and XQ1025R are applied in colour cameras originally designed for tubes of the XQ1020 series.

The manufacturer selects the filters per individual tube such, that the spreads in spectral responses in the long wavelength region as published for the XQ1023 tubes (See data XQ1023) are greatly reduced, warranting minimum differences in colour rendition between colour cameras of identical manufacture.

The XQ1025 will provide black and white pictures with true tonal rendition of colours, the spectral response approaching very nearly the relative spectral sensitivity of the human eye.

The XQ1025L is intended for use in the luminance channel of four tube colour cameras, the XQ1025R for use in the red channel of both three and four tube colour cameras.

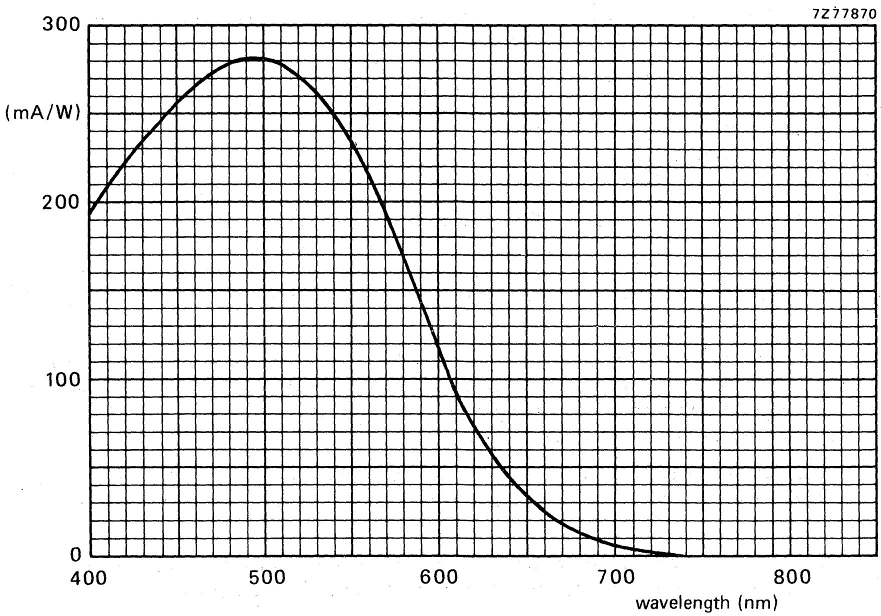
*) Registered Trade Mark for T.V. camera tube.

OPTICAL

Spectral reponse at	see below
Max. response at	approx. 500 nm
Cut-off	~ 750 nm [1])

Filter: Hard coating on anti-halation glass disc. Care in handling to avoid scratches is strongly recommended.

For all further data revert to the Published Data of the tubes of the XQ1023 series. Note 3 of these data, referring to the Balzers B1/K1 filter, does not apply.



Typical spectral response.

[1]) Defined as the wavelength at which the spectral response has dropped to $\leq 1\%$ of the peak response (~ 500nm).

[2]) An infra-red absorbing filter for wavelengths in excess of 900 nm is assumed to be incorporated in the optical system of the camera.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1025 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1026 for use in black and white cameras

XQ1026R for use in the red chrominance channel of colour cameras.

For all further information see data of the XQ1025 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon *) television camera tube with high resolution lead-oxide photoconductive target, low heater power, separate mesh construction, magnetic focusing, magnetic deflection and 25,4 mm (1 in) diameter.
The tubes of the XQ1070 series produce the same resolving power as the 30 mm diameter tubes like the XQ1020. They are mechanically interchangeable with 1 inch diameter vidicons with separate mesh, and have the same pin connections. The XQ1070 tubes are intended for use in black-and-white cameras, the XQ1070L, R, G, B in colour cameras in broadcast, educational and high quality industrial applications.

QUICK REFERENCE DATA	
Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length, excluding 5 mm anti-halation disc	158 mm (6,25 in)
Provided with anti-halation glass disc	
Heater	6,3 V, 95 mA
Resolution	≥ 750 T.V. lines

OPTICAL

Quality rectangle on photoconductive target (aspect ratio 3 : 4)	9,6 mm x 12,8 mm [1])

Orientation of image on photoconductive target
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane through the tube axis and the marker line on the metal sleeve on the base end of the tube.

Faceplate	
Refractive index	n 1,49
Refractive index of anti-halation glass disc	n 1,52

Notes: see page B55.

*) Registered Trade Mark for television camera tube.

ELECTRICAL

Heating: Indirect by A.C. or D.C.; parallel or series supply

Heater voltage	V_f		6,3	V ± 5%
Heater current	I_f		95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed 9,5 V_{rms} when the supply is switched on.
To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

Electron gun characteristics

Cut-off

Grid no. 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−35 to −100	V
Blanking voltage, peak to peak				
on grid no. 1	V_{g1p-p}		50 ± 10	V
on cathode	V_{kp-p}		25	V
Grid no. 2 current at normally required beam currents	I_{g2}	max.	0,5	mA

Focusing — magnetic 2)

Deflection — magnetic 2)

Capacitance

Signal electrode to all	C_{as}		3 to 5	pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

LIMITING VALUES (Absolute max. rating system)

All voltages are referred to the cathode, unless otherwise stated

Signal electrode voltage	V_{as}	max.	50	V [3]
Grid no. 4 voltage	V_{g4}	max.	1100	V
Voltage between grid no. 4 and grid no. 3	$V_{g4/g3}$	max.	450	V
Grid no. 3 voltage	V_{g3}	max.	800	V
Grid no. 2 voltage	V_{g2}	max.	350	V
Grid no. 1 voltage, positive	V_{g1}	max.	0	V
negative	$-V_{g1}$	max.	125	V
Cathode to heater voltage, positive peak	V_{kf_p}	max.	125	V
negative peak	$-V_{kf_p}$	max.	50	V
Impedance between cathode and heater at $-V_{kf_p} > 10$ V	Z_{kf}	min.	2	kΩ
Ambient temperature, storage and operation	t_{amb}	max.	50	°C
		min.	−30	°C
Faceplate temperature, storage and operation	t	max.	50	°C
		min.	−30	°C
Cathode heating time before drawing cathode current	T_h	min.	1	min
Faceplate illumination	E	max.	500	lx [4]

ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit for bl/wh cameras	AT1102/01, AT1103 or equivalent
for colour cameras	AT1116 or equivalent

Notes: see page B55.

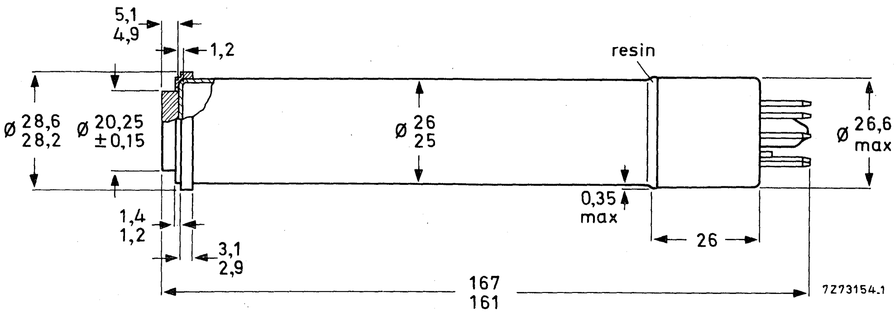
MECHANICAL DATA

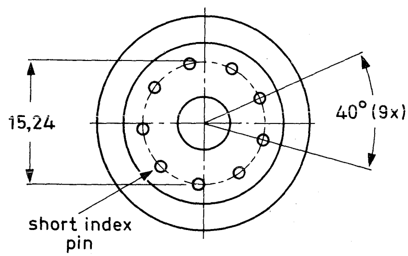
Dimensions in mm

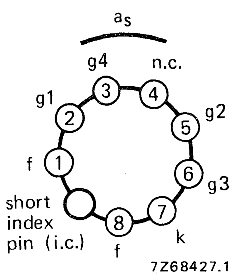
Mounting position : any

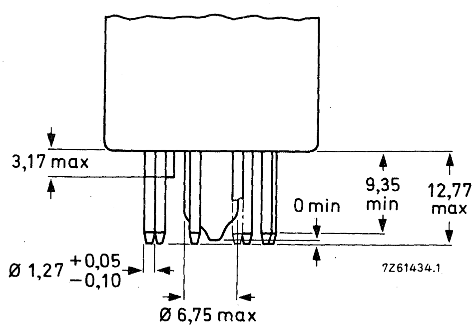
Mass : approx. 60 g

Base : JEDEC E8-11, IEC 67-I- 33a









OPERATING CONDITIONS AND PERFORMANCE

Conditions (scanned area 9,6 x 12,8 mm^2)

Cathode voltage	V_k	0	V	
Grid no. 2 voltage	V_{g2}	300	V	
Signal electrode voltage	V_{as}	45	V	5)
Beam current	I_b	see note		6)
Focusing coil current at given values of grid no. 4 and grid no. 3 voltages		see note		7)
Deflection and alignment currents		see note		7)
Faceplate illumination		see note		8)
Face plate temperature	t	20 to 45	°C	

	low voltage mode	high voltage mode		
Grid no. 4 voltage	600	960	V	9)
Grid no. 3 voltage	370	600	V	9)
Grid no. 1 voltage	see note 6			
Blanking voltage on grid no. 1, peak to peak		V_{g1pp} 50	V	

Performance

Dark current ≤ 3 nA

Sensitivity at colour temperature of illumination = 2856 K

	min.	typ.	10)
XQ1070	375	400	µA/lm
XQ1070L	375	400	µA/lm
XQ1070R	70	80	µA/lm F
XQ1070G	130	165	µA/lm F
XQ1070B	35	38	µA/lm F

Gamma of transfer characteristic 0,95 ± 0,05 11)

Spectral response: max. response at	approx. 500	nm
cut-off at	approx. 650	nm
response curve	see page B58	

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 T.V. lines at the centre of the picture. The figures quoted refer to the conditions in the high voltage mode.
The figures typically obtained in the low voltage mode will be 2 to 3 absolute percents lower.

The figures shown represent the horizontal amplitude response of the tube as obtained with a lens aperture of f : 5,6 [6]) [12]) [13]).

	XQ1070 XQ1070L	XQ1070R	XQ1070G	XQ1070B
Highlight signal current I_s	0,2 μA	0,1 μA	0,2 μA	0,1 μA
Beam current, I_b	0,4 μA	0,2 μA	0,4 μA	0,2 μA
Modulation depth at 400 T.V. lines in % typical	40	35	40	50
minimum	35	30	35	40

Limiting resolution ≥ 750 T.V. lines

Modulation transfer characteristics see page B58

Lag (typical values)

Light source with a colour temperature of 2856 K
Appropriate filter inserted in the light path for the chrominance tubes R,G and B.

Low key conditions

	build-up lag 14)				decay lag 15)			
	I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1070R XQ1070B	90	98			11	4		
XQ1070 XQ1070L XQ1070G			95	99			7	2,5

High key conditions

	build-up lag 14)				decay lag 15)			
	I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1070R XQ1070B	97	≈ 100			2,5 3,5	1 2		
XQ1070 XQ1070L XQ1070G			98	≈ 100			1,5	0,6

NOTES

1) Underscanning of the specified useful area of 12,8 mm x 9,6 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.

2) For focusing/deflection coil unit see under "Accessories".

3) Plumbicon tubes do not permit automatic sensitivity control be means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters).
If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated in note 5).

4) For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.

5) The signal electrode voltage shall be adjusted to 45 V. To enable the tube to handle excessive highlights in the scene to be televised the signal electrode voltage may be reduced to a minimum of 25 V, this will, however, result in some reduction in performance.

6) The beam current I_b, as obtained by adjusting the control grid (grid no. 1) voltage is set to 200 nA for R and B tubes, 400 nA for bl/wh, L and G tubes.

I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.

In the performance figures, e.g. for resolution and lag, the signal current and beam current conditions are given, e.g. as I_s/I_b = 20/200 nA. This hence means: with a signal current of 20 nA and a beam setting which just allows a signal current of 200 nA.

N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area.
The peak signal currents as measured on a wave-form oscilloscope will be a factor α larger.
($\alpha = \frac{100}{100-\beta}$, β being the total blanking time in %, for the CCIR system α amounts to 1,3.)

7)

Coil units	V_{g4}/V_{g3}	Focusing current * mA		Line current mA_{pp}		Frame current mA_{pp}	
		600/375	960/600	600/375	960/600	600/375	960/600
AT1102/01		18	23	200	250	27	34
AT1103		20	26	200	250	29	38
AT1116		83	105	260	330	38	48
		Approx. values for scanned area of 9,6 mm x 12,8 mm					

*Adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil. Line and frame alignment coil currents max. 21 mA (AT1103) resp. 15 mA (AT1116) corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

8) In the case of a black/white camera the illumination on the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{R.T.}{4F^2 (m+1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target.
A similar formula may be derived for the illumination level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the complete optical system have been taken into account.

9) The optimum voltage ratio V_{g4}/V_{g3} to obtain minimum beam landing errors (preferably ≤ 1 V) depends on the type of coil unit used. For types AT1102/01, AT1103 and AT1116 a ratio of 1,5 : 1 to 1,6 : 1 is recommended.

10) Measuring conditions:
Illumination 4 lx (luminous flux = 0,5 mlm) from a tungsten light source with a c.t. of 2856 K, the appropriate filter inserted in the light path.

Filters used:

XQ1070R	Schott	OG570	thickness	3 mm
XQ1070G	Schott	VG9	thickness	1 mm
XQ1070B	Schott	BG12	thickness	3 mm

For transmission curves see page B58.

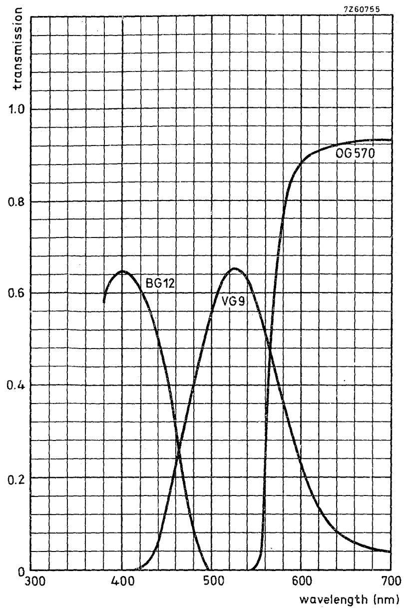
11) Gamma-stretching circuitry is recommended.

12) Typical faceplate illumination level for the XQ1070 to produce 0,2 μA signal current will be approx. 4 lx. The signal currents stated for the colour tubes R, G, B will be obtained with an incident white light level (c.t. = 2856 K) on the filter of approx. 10 lx. These figures are based on the filters described in note 10). For filter BG12, however, a thickness of 1 mm is chosen.

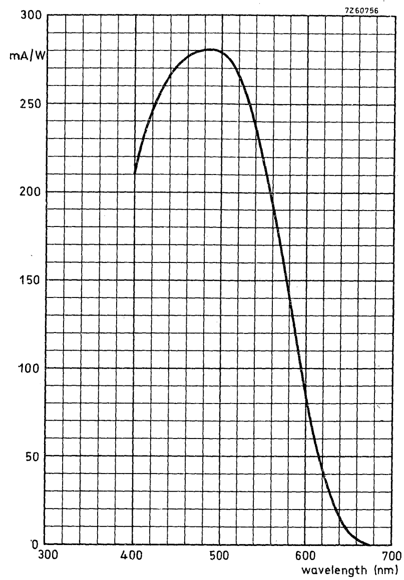
13) The horizontal amplitude response can be raised by the application of suitable correction circuits, which affect neither the vertical resolution nor the limiting resolution.

14) After 10 s of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms respectively 200 ms after the illumination has been applied.

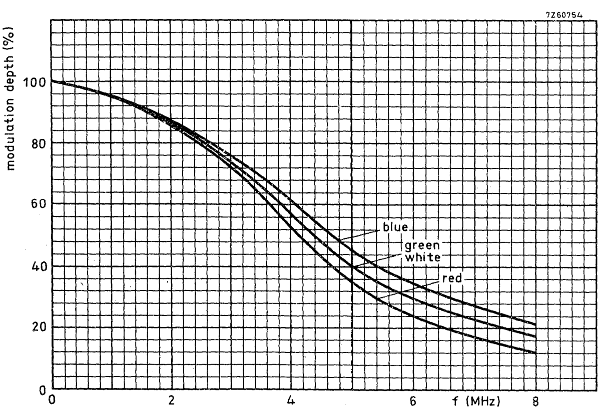
15) After a minimum of 5 s of illumination on the target. The figures given represent typical residual signals in percents of the original signal current 60 ms respectively 200 ms after the illumination has been removed.



Transmission of filters BG12, VG9 and OG570.



Typical spectral response curve.



Typical square-wave modulation transfer characteristics.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1070 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1071 for use in black and white cameras

XQ1071R
XQ1071G
XQ1071B
} for use in the chrominance channels of colour cameras.

For all further information see data of the XQ1070 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon* television camera tube with high resolution lead-oxide photoconductive target, low power heater, separate mesh construction, magnetic focusing, magnetic deflection, and 25.4 mm (1 in) diameter.

The XQ1072 produces the same resolving power as the 30 mm diameter tube type XQ1022 and is exclusively intended for use with an X-ray intensifier in medical equipment.

The XQ1072 is mechanically interchangeable with 1 in diameter vidicons with separate mesh construction and has the same pin connections.

QUICK REFERENCE DATA	
Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25.4 mm (1 in)
Length	158 mm (6.25 in)
Without anti-halation glass disc	
Heater	6.3 V, 95 mA
Resolution	$\geq$ 35 lp/mm

OPTICAL

Dimensions of quality area on photoconductive target — circle of 15 mm diameter [1])

Orientation of image on photoconductive target

For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane through the tube axis and the marker line on the metal sleeve on the base end of the tube.

Faceplate

Thickness		1.2	mm
Refractive index	n	1.49	

* Registered Trade Mark for television camera tube

ELECTRICAL

Heating: Indirect by A.C. or D.C.; parallel or series supply

Heater voltage	V_f	6.3	V±5%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed 9.5 V_{rms} when the supply is switched on.

Electron gun characteristics

Cut-off

Grid no. 1 voltage for cut-off at V_{g_2} = 300 V	V_{g_1}	−35 to −100	V
Blanking voltage, peak to peak			
on grid no. 1	$V_{g_{1p-p}}$	50± 10	V
on cathode	$V_{k_{p-p}}$	25	V
Grid no. 2 current at normally required beam currents	I_{g_2}	max. 0.5	mA
Focusing		magnetic	2)
Deflection		magnetic	2)

Capacitance

Signal electrode to all	C_{a_s}	3 to 5	pF

This capacitance which is effectively the output impedance, increases when the tube is inserted in the coil unit.

LIMITING VALUES (Absolute max. rating system)

All voltages, are referred to the cathode, unless otherwise stated.

Signal electrode voltage	V_{as}	max.	50	V	3)
Grid no. 4 voltage	V_{g4}	max.	1100	V	
Grid no. 3 voltage	V_{g3}	max.	800	V	
Voltage between grid no. 4 and grid no. 3	$V_{g4/g3}$	max.	450	V	
Grid no. 2 voltage	V_{g2}	max.	350	V	
Grid no. 1 voltage, positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Cathode to heater voltage, positive peak	V_{kf_p}	max.	125	V	
negative peak	$-V_{kf_p}$	max.	50	V	
Impedance between cathode and heater at $-V_{kf_p} > 10$ V	Z_{kf}	min.	2	kΩ	
Ambient temperature, storage and operation	t_{amb}	max.	50	°C	
		min.	-30	°C	
Faceplate illumination	E	max.	500	lx	4)
Cathode heating time before drawing cathode current	T_h	min.	1	min	

ACCESSORIES

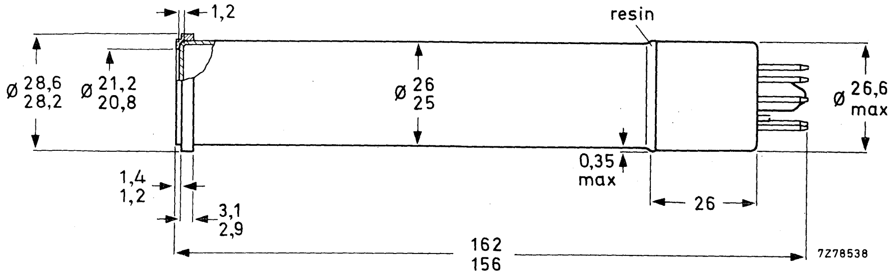
Socket	type 56098 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1103, AT1116 or equivalent

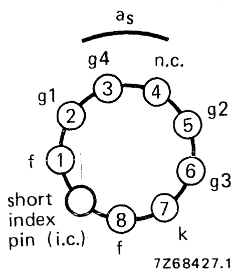
MECHANICAL DATA Dimensions in mm

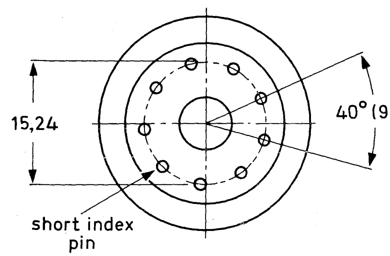
Mounting position: any

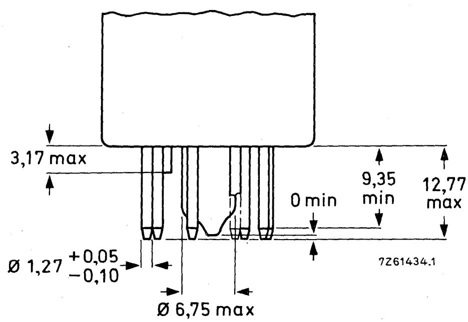
Net mass: approx. 60 g

Base: IEC 67-I-33a (JEDEC E8-11) except for stem









OPERATING CONDITIONS AND PERFORMANCE

Conditions 5)

Cathode voltage	V_k	0	V
Grid no. 2 voltage	V_{g2}	300	V
Signal electrode voltage	V_{a_s}	20 to 45	V 3) 8)
Beam current	I_b	see note 6a)	
Focusing coil current at given values of grid no. 4 and grid no. 3 voltages		see note 9)	
Deflection and alignment currents		see note 9)	
Faceplate illumination (P20 light source)	E	2	lx
Faceplate temperature	t	20 to 45	^{o}C

		low voltage mode	high voltage mode 7)	
Grid no. 4 voltage	V_{g4}	600	960	V
Grid no. 3 voltage	V_{g3}	375	600	V
Grid no. 1 voltage		see note 6a)		

Blanking voltage on grid no. 1, peak to peak	$V_{g1_{p-p}}$	50	V

Performance

Dark current		≤	3	nA
Signal current, peak	I_{sp}	min.	175	nA 6a) 6b)
		typ.	225	nA 6a) 6b)
Gamma of transfer characteristic			0.95 ± 0.05	10)
Spectral response: max. response at		approx.	500	nm
cut-off at		approx.	650	nm

Resolution

Modulation depth i.c. uncompensated amplitude response at 13 lp/mm (5.0 MHz) at the centre of the picture

low voltage mode	high voltage mode 11a)
65%	70%

Modulation transfer characteristic — see page B68 11b)

Decay
Measured with a peak signal current of 0.2 μA

Residual signal after dark pulse of 60 ms	max. 6 %, typ. 4 % 12)
Residual signal after dark pulse of 200 ms	max. 2.5%, typ. 1.5 % 12)

NOTES

1) Underscanning of the specified useful target area of 15.0 mm ϕ or failure of scanning should be avoided since this may cause damage to the photoconductive layer. The area beyond the 15.0 mm ϕ area preferably to be covered by a mask.

2) For focusing/deflection coil unit see under "Accessories".

3) Plumbicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage.
If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated in note 8.

4) For short intervals. During storage the tube face shall be covered with the plastic hood provided.

5) Scanning amplitude controls adjusted such that the 15 mm ϕ quality area of the target is displayed on a standard monitor as a circular area with a diameter equal to the raster height.

6a) Grid no. 1 (control grid) voltage adjusted to produce a beam current, I_{bp}, which will allow a maximum peak signal current I_{sp} of 500 nA.
N.B. The peak signal currents are measured on a waveform oscilloscope and with a uniform illumination on the 15 mm ϕ target area. When measured with an integrating instrument connected in the signal-electrode lead the average signal currents will be smaller
a) by a factor α ($\alpha = \frac{100 - \beta}{100}$), β being the total blanking time in %; for the CCIR system α amounts to 0.75.

b) by a factor δ, δ being the ratio of the active target area (circle with 15 mm ϕ) to the area which would correspond with the adjusted scanning amplitudes (15 x 20 mm^2), see note 5, this ratio amounts to $\delta = 0.59$.
The total ratio of integrated signal current, I_s, to the peak signal current, I_{sp}, amounts to $\alpha \times \delta = 0.44$.

6b) The peak signal currents stated relate to a target sensitivity to light with P20 distribution of min. 200 μA/lm, typical 275 μA/lm.

7) The optimum voltage ratio V_{g4}/V_{g3} to obtain minimum beam landing errors (preferably $\leq$ 1 V) depends on the type of coil unit used. For types AT1102/01, AT1103, AT1116 a ratio of 1.5:1 to 1.6:1 is recommended.

8) Target voltage, V_{as}, adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each tube.

9)

	Focusing current* (mA)		Line current (mA_{pp})		Frame current (mA_{pp})	
V_{g4}/V_{g3}	600/375	960/600	600/375	960/600	600/375	960/600
AT1102/01	18	23	310	390	42	53
AT1103	20	26	310	390	46	59
AT1116	83	105	400	510	59	75
	Approx. values for scanning amplitudes corresponding to **15 mm x 20 mm scanned area**					

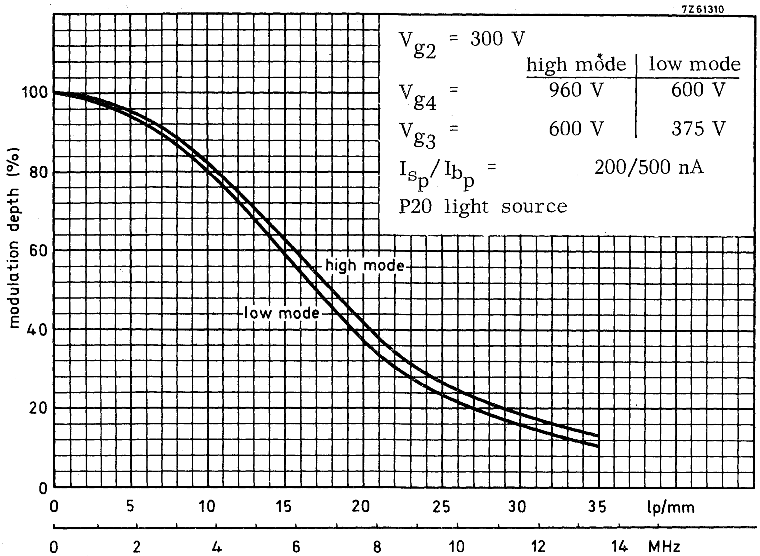
*Adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil.
Line and frame alignment coil currents max. 21 mA (AT1103) resp. 15 mA (AT1116) corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

10) The near unity gamma of the XQ1072 ensures good contrast when televising low contrast X-ray image-intensifier pictures as encountered in radiology. Further contrast improvement may be obtained when an adjustable gamma expansion circuitry is incorporated in the video amplifier system.

11a) Measured with a transparency with a square wave test pattern with vertical bars. The figures given relate to a low frequency reference obtained from a square wave pattern of 1.0 lp/mm (385 kHz).
The aperture of the lens system adjusted for **f : 5,6**

11b) As in 11a). Bandwidth of the video amplifier system and the waveform oscilloscope 15 MHz (−3 dB point).

12) After a minimum of 5 s of illumination on the target. The figures given represent the residual signals in % of the original signal current 60 ms respectively 200 ms after the illumination has been removed.



Modulation transfer characteristic

CAMERA TUBE

Plumbicon * television camera tube with high resolution lead-oxide photoconductive target with extended red response, low heater power, separate mesh construction, magnetic deflection and 25,4 mm (1 in) diameter.

The tubes of the XQ1073 series are mechanically interchangeable with 1 in diameter vidicons with separate mesh and have the same pin connections. The XQ1073 is intended for use in black and white cameras, the XQ1073R for use in the red chrominance channel of colour cameras in broadcast, educational and high-quality industrial applications.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length, excluding 5 mm anti-halation glass disc	158 mm (6,25 in)
Provided with anti-halation glass disc	
Cut-off of spectral response	850 to 950 nm
Heater	6,3 V, 95 mA
Resolution	⩾ 750 TV lines

OPTICAL DATA

Quality rectangle on photoconductive target
(aspect ratio 3: 4) — 9,6 mm x 12,8 mm (note 1)

Orientation of image on photoconductive target
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the metal sleeve on the base end of the tube.

Faceplate

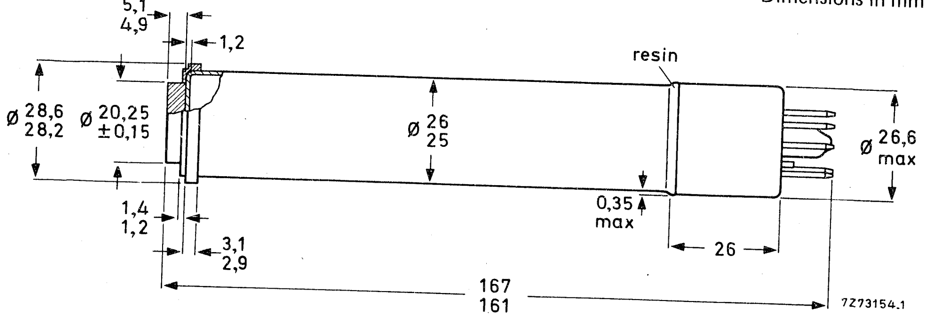
Refractive index	n 1,49
Refractive index of anti-halation glass disc	n 1,52

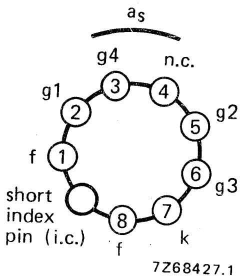
* Registered Trade Mark for television camera tube.

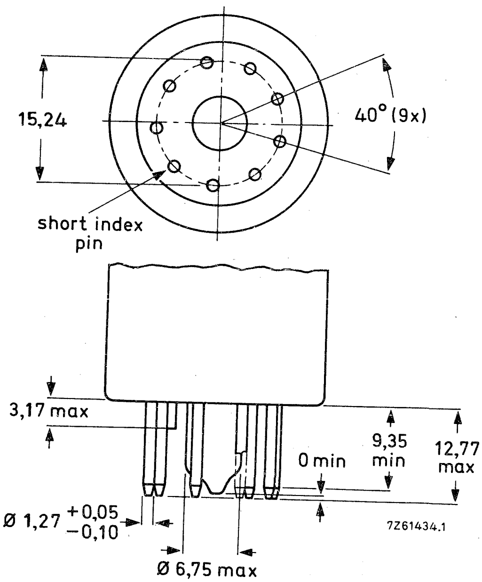
Notes: see page B74.

MECHANICAL DATA

Dimensions in mm







Mounting position: any

Mass: approx. 60 g

Base: JEDEC E8-11, IEC67-I-33a,
except length of stem

ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit	
for black and white cameras	AT1102/01, AT1103, or equivalent
for colour cameras	AT1116 or equivalent
Mask on anti-halation disc (for flare reduction)	type 56028

ELECTRICAL DATA

Heating: indirect by a.c. or d.c.; parallel or series supply

Heater voltage	V_f	6,3	V ± 5%
Heater current, at V_f = 6,3 V	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

Electron gun characteristics

				note
Cut-off Grid 1 voltage for cut-off at $V_{g2} = 300$ V	V_{g1}		−35 to −100 V	
Blanking voltage, peak to peak on grid 1	$V_{g1\,pp}$		50 ± 10 V	
on cathode	$V_{k\,pp}$		25 V	
Grid 2 current at normally required beam currents	I_{g2}	max.	0,5 mA	

Focusing magnetic 2

Deflection magnetic 2

Capacitance

Signal electrode to all C_{as} 3 to 5 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

LIMITING VALUES (Absolute maximum rating system)

All voltages are referred to the cathode, unless otherwise stated.

				note
Signal electrode voltage	V_{as}	max.	50 V	3
Grid 4 voltage	V_{g4}	max.	1100 V	
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	450 V	
Grid 3 voltage	V_{g3}	max.	800 V	
Grid 2 voltage	V_{g2}	max.	350 V	
Grid 1 voltage, positive	V_{g1}	max.	0 V	
Grid 1 voltage, negative	$-V_{g1}$	max.	125 V	
Cathode to heater voltage, positive peak	$V_{kf\,p}$	max.	125 V	
Cathode to heater voltage, negative peak	$-V_{kf\,p}$	max.	50 V	
Impedance between cathode and heater at $-V_{kf\,p} > 10$ V	Z_{kf}	min.	2 kΩ	
Ambient temperature storage and operation	t_{amb}	max.	50 °C	
		min.	−30 °C	
Faceplate temperature storage and operation	t	max.	50 °C	
		min.	−30 °C	
Faceplate illumination	E	max.	100 lx	4
Cathode heating time before drawing cathode current	T_h	min.	1 min	

Notes: see page B74.

OPERATING CONDITIONS AND PERFORMANCE

Conditions (scanned area 9,6 mm x 12,8 mm)

				note
Cathode voltage	V_k		0 V	
Grid 2 voltage	V_{g2}		300 V	
Signal electrode voltage	V_{as}		45 V	5
Beam current	I_b			6
Focusing coil current at given values of grid 4 and grid 3 voltages				7
Deflection and alignment currents				7
Faceplate illumination				8
Faceplate temperature	t		20 to 45 °C	

		low voltage mode	high voltage mode	note
Grid 4 voltage	V_{g4}	600	960 V	9
Grid 3 voltage	V_{g3}	375	600 V	9
Grid 1 voltage				6
Blanking voltage on grid 1, peak to peak	$V_{g1\,pp}$		50 V	

Performance

				note
Dark current		≤	3 nA	
Sensitivity at colour temperature of illumination = 2856 K		min.	typ.	10
XQ1073		350	400 μA/lmF	
XQ1073R		75	115 μA/lmF	11
Gamma of transfer characteristic			0,95 ± 0,05	12
Spectral response				
max. response at		approx.	500 nm	
cut-off at			850 to 950 nm	13
response curve			see page B77	

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures quoted refer to the conditions in the high voltage mode. The figures typically obtained in the low voltage mode will be 2 to 3 absolute per cent lower.

The figures shown represent the horizontal amplitude response of the tube as obtained with a lens aperture of f : 5,6 (see notes 6 and 14).

	XQ1073	XQ1073R
Highlight signal current I_s	0,2 μA	0,1 μA
Beam current, I_b	0,4 μA	0,2 μA
Modulation depth at 400 TV lines in %		
typical	50	45
minimum	40	35

Limiting resolution ⩾ 750 TV lines

Modulation transfer characteristics see page B77

Lag (typical values)

Light source with a colour temperature of 2856 K. Appropriate filter inserted in the light path for the chrominance tubes XQ1073R.

Low key conditions

	build-up lag (note 15)				decay lag (note 16)			
	I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1073	–	–	95	≈ 100	–	–	7,5	3
XQ1073R	85	98	–	–	11	4	–	–

High key conditions

	build-up lag (note 15)				decay lag (note 16)			
	I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1073	–	–	98	≈ 100	–	–	2	1
XQ1073R	98	≈ 100	–	–	3	1,5	–	–

Notes: see pages B74 and B75.

NOTES

1. Underscanning of the specified useful area of 12,8 mm x 9,6 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.
2. For focusing/deflection coil unit see under "Accessories".
3. Plumbicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters).
   If the tube is used in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated in note 5.
4. For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.
5. The signal electrode voltage shall be adjusted to 45 V. To enable the tube to handle excessive highlights in the scene to be televised the signal electrode voltage may be reduced to a minimum of 25 V, this will, however, result in some reduction in performance.
6. The beam current I_b, as obtained by adjusting the control grid (grid 1) voltage, is set to 200 nA for XQ1073 and to 400 nA for XQ1073. I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.

   In the performance figures, e.g. for resolution and lag, the signal current and beam current conditions are given as, e.g. I_s/I_b = 20/200 nA. This means: with a signal current of 20 nA and a beam setting which just allows a signal current of 200 nA.
   Note that the signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area. The peak signal currents as measured on a waveform oscilloscope will be a factor α larger.

   ($\alpha = \frac{100}{100-\beta}$, β being the total blanking time in %. For the CCIR system α amounts to 1,3.)
7.

		focusing current * mA		line current mA (p-p)		frame current mA (p-p)	
Coil units	V_{g4}/V_{g3}	600/375	960/600	600/375	960/600	600/375	960/600
AT1102/01		18	23	200	250	27	34
AT1103		20	26	200	250	29	38
AT1116		83	105	260	330	38	48
		approx. values for scanned area of 9,6 mm x 12,8 mm					

* Adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil.

Line and frame alignment coil currents max. 21 mA (AT1103) and 15 mA (AT1116) corresponding to a flux density of approx. 4 x 10^{-4}T (4 Gs).

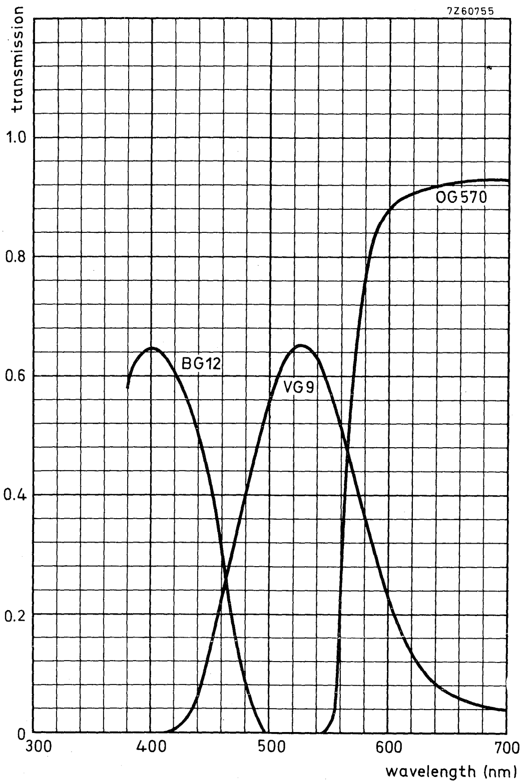
8. In the case of a black/white camera the illumination of the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{RT}{4F^2 (m+1)^2}$$

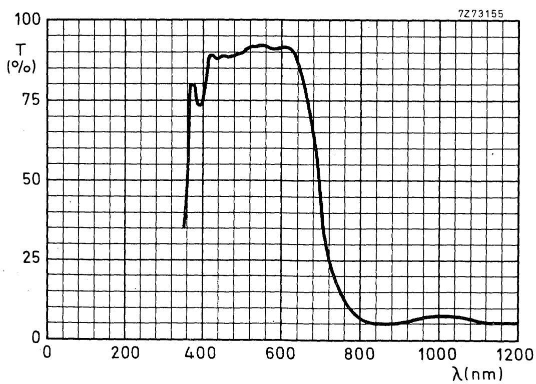
in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target.

A similar formula may be derived for the illumination level on the photoconductive layer of the R tubes, in which the effects of the various components of the complete optical system have been taken into account.

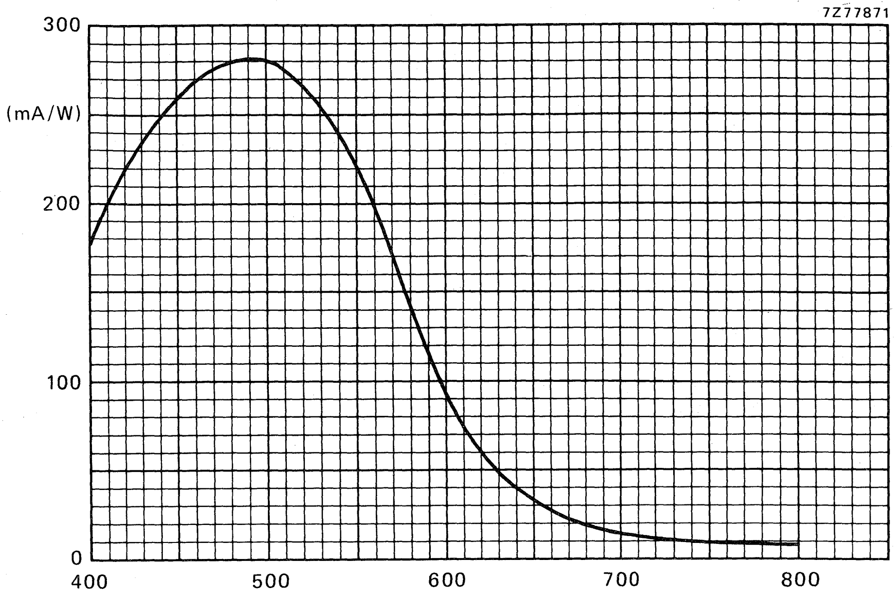
9. The optimum voltage ratio V_{g4}/V_{g3} to obtain minimum beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. For types AT1102/01, AT1103 and AT1116 a ratio of 1,5: 1 to 1,6: 1 is recommended.
10. All measurements are made with an infrared reflecting filter interposed between light-source and target. Balzers Calflex B1/K1 filter is chosen for this purpose since, for accurate colour reproduction in a colour camera, a similar IR reflecting filter will be required. For typical transmission curve of this filter see page B78.
11. With an additional filter (see note 10) interposed between light-source and target. Filter used is: Schott OG570 (3 mm). For transmission curve see page B76.
12. Gamma stretching circuitry is recommended.
13. Defined as the wavelength at which the spectral response has dropped to 1% of the peak response ($\approx$ 500 nm).
14. The horizontal amplitude response can be raised by the application of suitable correction circuits.
15. After 10 s of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms and 200 ms after the illumination has been applied.
16. After a minimum of 5 s of illumination on the target. The figures given represent typical residual signals as percentages of the original signal current 60 ms and 200 ms after the illumination has been removed.



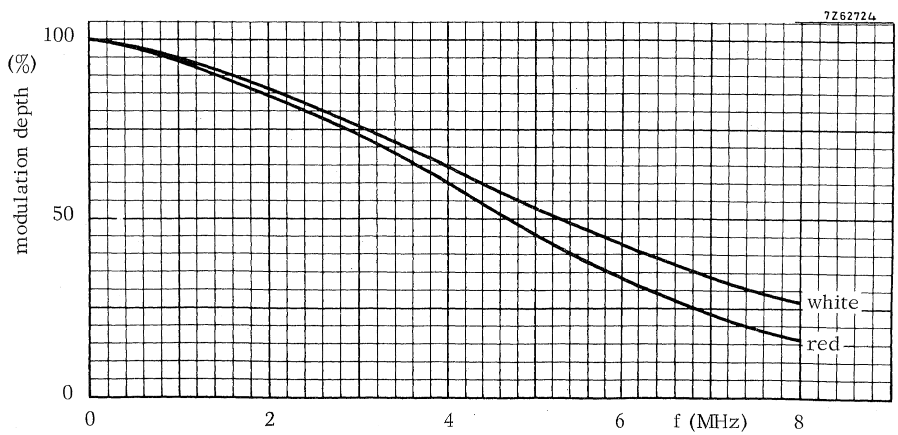
Transmission of filters BG12. VG9 and OG570. See note 11.



Typical transmission curve of heat-reflecting interference filter, type CALFLEX B1/K1.



Spectral sensitivity characteristic.



Typical square-wave modulation transfer characteristic.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1073 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1074 for use in black and white cameras

XQ1074R for use in the red chrominance channel of colour cameras.

For all further information see data of the XQ1073 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon*, sensitive pick-up tube with lead-oxide photoconductive target with extended red response, high resolution, low heater power separate mesh construction, magnetic focusing, magnetic deflection and 25,4 mm (1 in) diameter.

The tubes of the XQ1075 series are identical to the tubes of the XQ1073 series but incorporate an infra-red reflecting filter on the anti-halation glass disc.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length, excluding 5 mm of anti-halation glass disc	158 mm (6,25 in)
Cut-off of spectral response	750 nm
Heater	6,3 V, 95 mA
Provided with anti-halation glass disc with infra-red reflecting filter.	

The infra-red reflecting filter eliminates the need for additional filters in the optical systems when the XQ1075 and XQ1075R are applied in black and white and colour cameras originally designed for tubes of the XQ1070 series.

The spread in spectral responses in the long wavelength region as published for the XQ1073 and XQ1073R tubes is greatly reduced, warranting minimum differences in colour rendition between cameras of identical manufacture.

The XQ1075 will provide black and white pictures with true tonal rendition of colours, the spectral response approaching very nearly the relative spectral sensitivity of the human eye.

The XQ1075R is intended for use in the red chrominance channel of colour cameras in broadcast, educational and high-quality industrial applications.

* Registered Trade Mark for television camera tube.

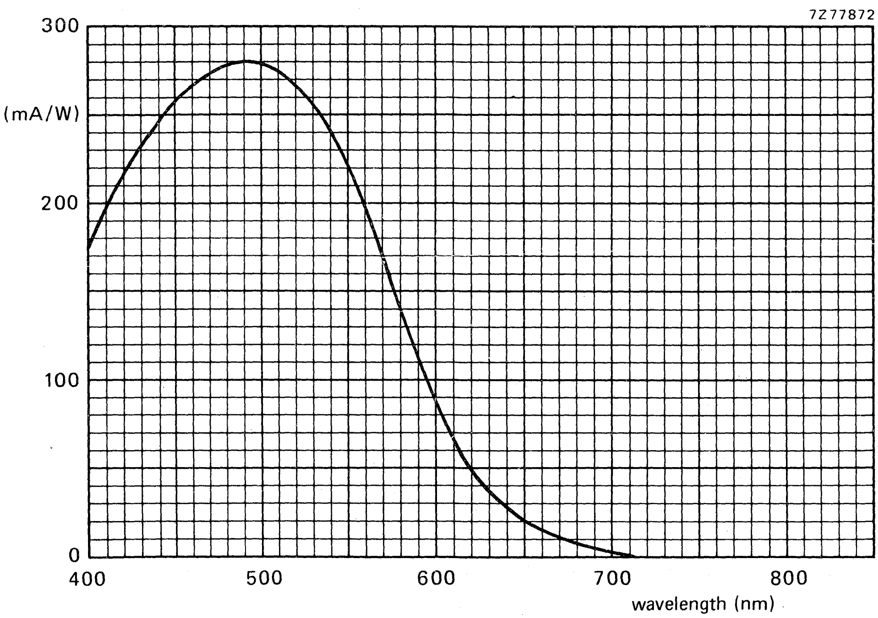
OPTICAL DATA

Spectral response	see curve below	
Maximum response at	500	nm
Cut-off	750	nm [1]

Filter Hard coating on anti-halation glass disc. Care in handling to avoid scratches is strongly recommended.

For further information refer to data of the XQ1073 series.

Note [10] of these data referring to Balzers B1/K1 filter does not apply.



Typical spectral sensitivity characteristic

[1] Defined as the wavelength at which the spectral response has dropped to 1 % of the peak response (≈ 500 nm).

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1075 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1076 for use in black and white cameras

XQ1076R for use in the red chrominance channel of colour cameras.

For all further information see data of the XQ1075 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Mechanical variants of the tubes of the XQ1070 to XQ1076 series are available. The kind of variant is indicated by a suffix to the main type number as follows:

/01	without anti-halation glass disc
/02	rear loading (like XQ1080) and with provisions for adjustable light bias
/03	front loading (like XQ1070) and with provisions for adjustable light bias

The XQ1070 to XQ1076 series is complemented as shown in the following survey.

B/W type	lum.	red	green	blue	mechanical dimensions
XQ1070/01	L	R	G	B	Figs 1, 4 and 6.
XQ1071/01		R	G	B	
XQ1073/01		R			
XQ1074/01		R			
XQ1070/02	L	R	G	B	Figs 2, 5, 6 and 7.
XQ1071/02		R	G	B	
XQ1073/02		R			
XQ1074/02		R			
XQ1075/02		R			
XQ1076/02		R			
XQ1070/03	L	R	G	B	Figs 3, 5 and 6.
XQ1071/03		R	G	B	
XQ1073/03		R			
XQ1074/03		R			
XQ1075/03		R			
XQ1076/03		R			

PERFORMANCE

The performance of the variants is basically identical to that of the tubes of the basic types. The small differences are as follows:

- /01 : The absence of anti-halation glass disc: more flare and sensitivity; slightly reduced resolution.
- /02 : Reduced output capacitance; less lag when light bias applied.
- /03 : Less lag when light bias applied.

ACCESSORIES

version	socket	defl. and focusing unit B/W	colour	mask	light bias
/01	56098	AT1103 AT1116	AT1116/06 (triplet)	–	–
/02	56098	AT1119	AT1115 (triplet)	56028	56106*
/03	56098	AT1103 AT1116	AT1116/06 (triplet)	56028	56106*

* Fits into metal cylinder cemented on to pumping stem.

MECHANICAL DATA

Dimensions in mm

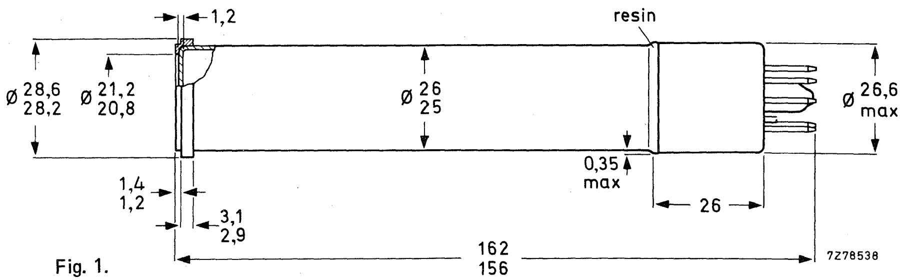


Fig. 1.

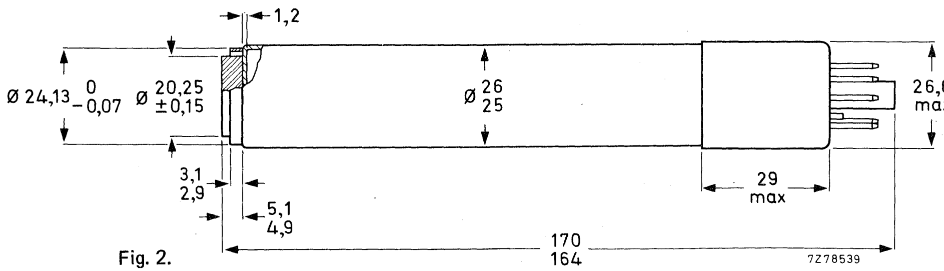


Fig. 2.

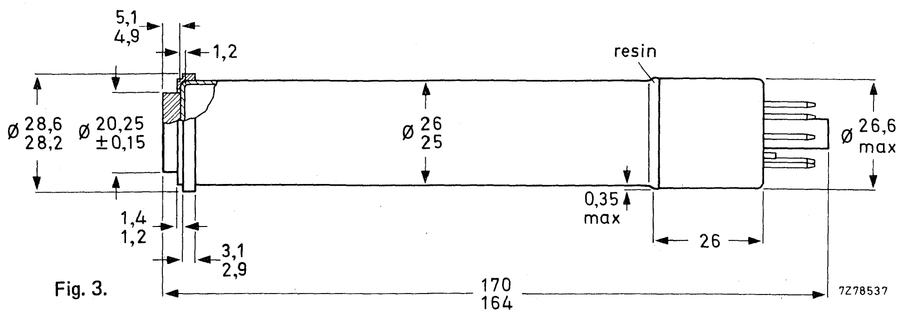


Fig. 3.

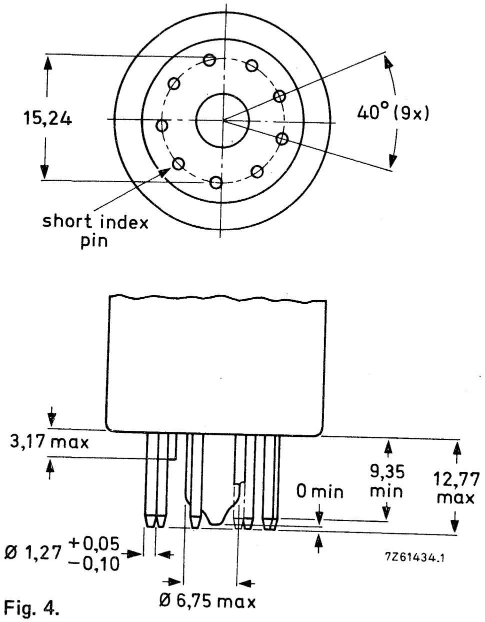


Fig. 4.

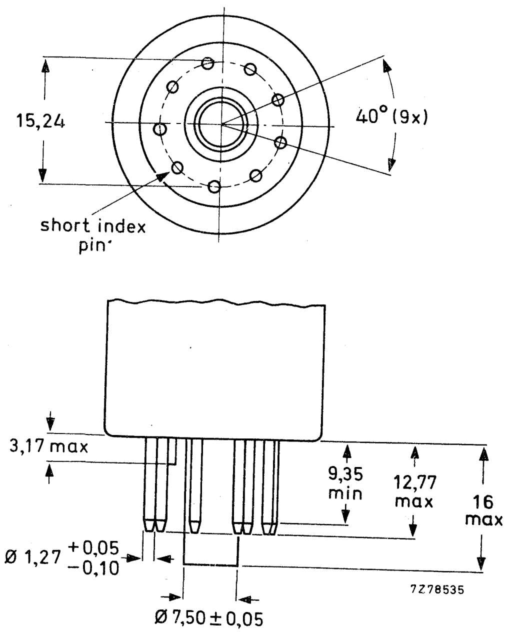


Fig. 5.

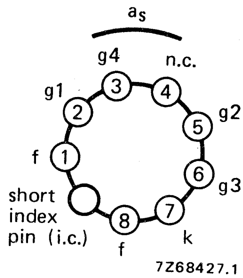
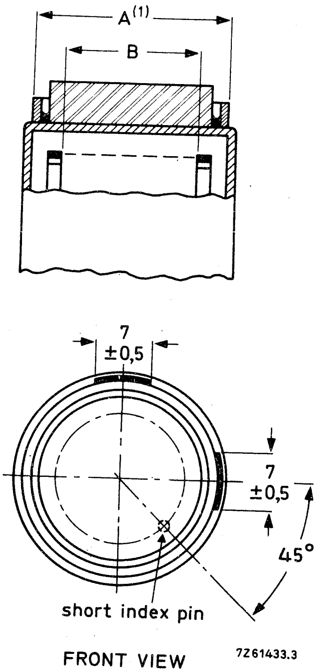


Fig. 6.



(1) The distance between the geometrical centres of diameter A of the reference ring and diameter B of the mesh electrode ring is < 100 μm.

Fig. 7.

CAMERA TUBES

Plumbicon, * 25,4 mm (1 in) diameter television camera tube with high resolution lead-oxide photoconductive target, magnetic deflection, magnetic focus. The tubes of the XQ1080 series are provided with a separate mesh and a 0,6 W heater and feature:

- Anti-Comet-Tail electron gun for highlight handling.
- Extremely low lag.
- Provisions for adjustable light bias to minimize lag under low-key conditions.
- Same resolving power as the 30 mm tubes such as the XQ1020.
- Ceramic centring ring for precise optical alignment.
- Electrode system with precision construction.
- Low output capacitance for optimum S/N ratio.

The tubes of the XQ1080 series are rear-loading tubes, i.e. to be inserted at the rear end of a special coil unit, and they have slightly different dimensions and pin connections to other 1 in diameter Plumbicon tubes like e.g. XQ1070.

The XQ1080 is intended for use in black and white cameras, XQ1080L, R, G and B are intended for use in colour cameras in broadcast, educational and high quality industrial applications in which high contrast ratios may occur.

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length, excluding anti-halation glass disc	158 mm (6¼ in)
Special features:	Anti-Comet-Tail gun Light bias Anti-halation glass disc Ceramic centring ring Rear loading construction
Heater	6,3 V, 95 mA
Resolution	⩾ 750 TV lines
Cut-off of spectral response	approx. 650 nm

* Registered Trade Mark for television camera tube.

OPTICAL

			notes
Quality rectangle on photoconductive target (aspect ratio 3: 4)		9,6 mm x 12,8 mm	1

Orientation of image on photoconductive target:
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the protecting sleeve at the base. 2a

Optical alignment 2b

Faceplate

Thickness		1,2	mm
Refractive index	n	1,49	
Refractive index of anti-halation disc	n	1,52	

HEATING

Indirect by a.c. or d.c.; parallel or series supply.

Heater voltage	V_f	6,3	V ± 5%
Heater current, at V_f = 6,3 V	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on. To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE

Signal electrode to all	C_{as}	2,5 to 3,5 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

DEFLECTION
magnetic

FOCUSING
magnetic

ACCESSORIES

Socket		type 56026
Light bias lamp in holder		type 56027
Deflection, focusing and alignment coil unit	black/white	type AT1119/01
	colour	type AT1115/01 *
Mask		type 56028

* AT1115/01 is a computer selected triplet of AT1119/01 units.

ELECTRON-GUN CHARACTERISTICS

			notes
Cut-off			
Grid 1 voltage for cut-off at $V_{g2,4}$ = 300 V, without blanking or ACT pulses	V_{g1}	−40 to −110 V	
Blanking voltage, peak to peak at $V_{g2,4}$ = 300 V, on grid 1	$V_{g1p\text{-}p}$	50 ± 10 V	3
Grids 2 and 4 current (d.c. values)	$I_{g2,4}$	< 0,2 mA	4
Grids 3, 5 and 6 currents			4
Pulse timing and amplitude requirements (ACT)			10

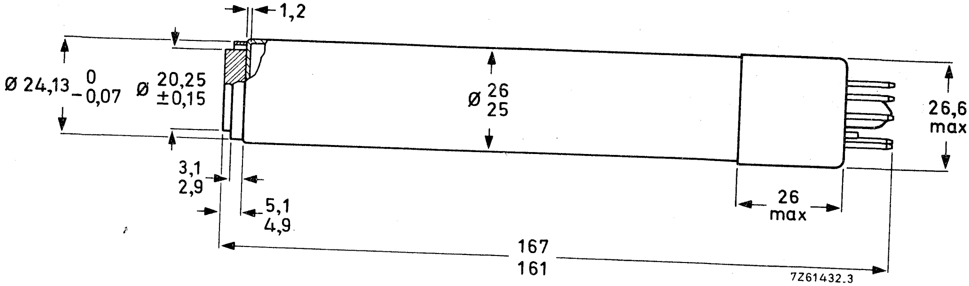
LIMITING VALUES (Absolute maximum rating system)

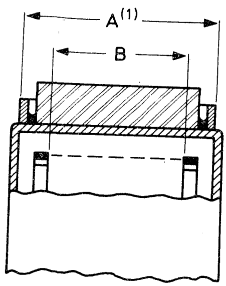
All voltages are referred to the cathode, unless otherwise stated.

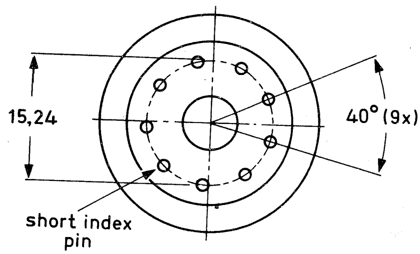
				notes
Signal electrode voltage	V_{as}	max.	50 V	5
Grid 6 (mesh) voltage	V_{g6}	max.	1100 V	
Grid 5 (collector) voltage	V_{g5}	max.	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max.	350 V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max.	350 V	
Grid 3 (auxiliary grid) voltage	V_{g3}	max.	350 V	
Grid 1 (control grid) voltage,				
positive	V_{g1}	max.	0 V	
negative	$-V_{g1}$	max.	200 V	
Cathode heating time before drawing cathode current	T_h	min.	60 s	
Cathode to heater voltage,				
positive peak	V_{kfp}	max.	125 V	
negative peak	$-V_{kfp}$	max.	50 V	
Impedance between cathode and heater at $-V_{kfp} > 10$ V	Z_{kf}	min.	2 kΩ	
Ambient temperature, storage and operation	t_{amb}	max.	50 °C	
		min.	−30 °C	
Faceplate temperature, storage and operation	t	max.	50 °C	
		min.	−30 °C	
Faceplate illumination	E	max.	500 lx	6

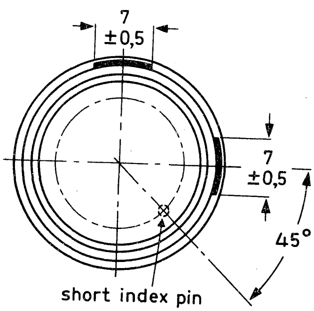
MECHANICAL DATA

Dimensions in mm

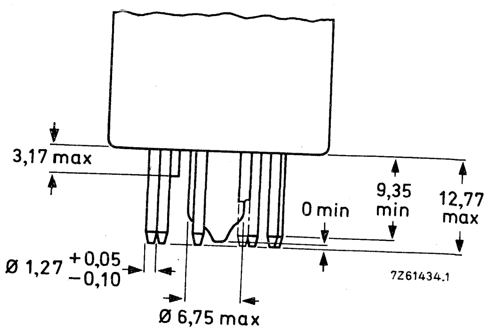








FRONT VIEW 7Z61433.3

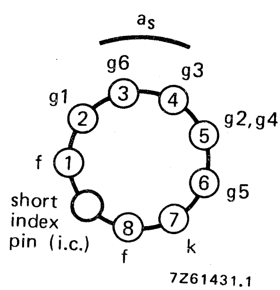


Mounting position: any

Mass: ≈ 70 g

Base: IEC 67-I-33a (JEDEC E8-11)

Fig. 1.



The distance between the geometrical centres of the diameter A of the reference ring and the diameter B of the mesh-electrode ring is < 100 μm.

OPERATING CONDITIONS AND PERFORMANCE

			notes
Conditions (with ACT action)			7
For a scanned area of 9,6 mm x 12,8 mm. All voltages are specified with respect to the cathode potential during the read-out mode, unless otherwise indicated.			8,9,10
Cathode voltage,			
during read-out mode	V_k	0 V	
during ACT mode	V_k	0 to 15 V	
Signal electrode voltage	V_{as}	45 V	5
Grid 6 (mesh) voltage	V_{g6}	750 V	11,12
Grid 5 (collector) voltage	V_{g5}	475 V	11,12
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300 V	
Grid 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}		10
during ACT mode	V_{g3}		
Grid 1 (control grid) voltage,			
during read-out mode	V_{g1}		13
during ACT mode	V_{g1}		10
blanking on grid 1, peak	V_{g1p}	50 V	
Typical beam current, signal current and pulse settings			10

		XQ1080 XQ1080L	XQ1080R	XQ1080G	XQ1080B
	I_{sp}	200 nA	100 nA	200 nA	100 nA
	I_{bp}	400 nA	200 nA	400 nA	200 nA
ACT level (peak)		280 nA	140 nA	280 nA	140 nA
Cathode pulse	V_{kp}	8 V	4 V	8 V	4 V
Grid 1 pulse	V_{g1p}	28 V	24 V	28 V	24 V
Grid 3 pulse	V_{g3p}		see note 10		

		notes
Faceplate illumination		14
Light bias		15
Temperature of faceplate	20 to 45 °C	
Deflection, focusing and alignment coil unit	AT1119/01	16
Deflection, focusing and alignment currents		

V_{g6}/V_{g5} V	focus current mA	line current (p-p) mA	frame current (p-p) mA
750/475	32	290	35

Line and frame alignment currents max. 15 mA, corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

Performance

		notes
Dark current	$\leqslant$ 3 nA	
Sensitivity at colour temperature of illumination = 2856 K	min. / typ.	17
XQ1080	375 / 400 μA/lm	
XQ1080L	375 / 400 μA/lm	
XQ1080R	70 / 85 μA/lmF	
XQ1080G	130 / 165 μA/lmF	
XQ1080B	35 / 38 μA/lmF	
Gamma of transfer characteristic	0,95 $\pm$ 0,05	18
Light transfer characteristics with ACT	see Fig. 5	
Highlight handling	$\geqslant$ 5 lens stops	19
Spectral response		
maximum response at	$\approx$ 500 nm	
cut-off at	$\approx$ 650 nm	
curve	see Fig. 3	

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures represent the horizontal amplitude response as measured with a lens aperture of f: 5,6. 13,20,21

		XQ1080 XQ1080L	XQ1080R	XQ1080G	XQ1080B
Highlight signal current	I_{sp}	0,2 μA	0,1 μA	0,2 μA	0,1 μA
Beam current	I_{bp}	0,4 μA	0,2 μA	0,4 μA	0,2 μA
Modulation depth at 400 TV lines in %	typ.	40	35	40	50
	min.	35	30	35	40

Modulation transfer characteristics	see Fig. 6
Limiting resolution	$\geqslant$ 750 TV lines

Lag (typical values)

Light source with a colour temperature of 2856 K.
Appropriate filter inserted in the light path for the chrominance tubes R, G and B.

Low key conditions (without light bias)

	build-up lag see note 22				decay lag see note 23			
	I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1080, L, G			98%	≈ 100%			5%	2%
XQ1080R, B	>95%	≈ 100%			8%	3%		

Low key conditions (with light bias) see note 24

See Figs 7 to 12.

High key conditions

	build-up lag see note 22				decay lag see note 23			
	I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1080, L, G			98%	≈ 100%			1,5%	0,6%
XQ1080R	>97%	≈ 100%			2,5%	1%		
XQ1080B					3,5%	2%		

Shading of light bias induced dark current: 12,5%, see note 25.

NOTES

1. Underscanning of the specified useful area of 9,6 mm x 12,8 mm, or failure of scanning, should be avoided so as not to damage the photoconductive layer.

2. a. The position of this marker line corresponds to the position of one of the small area contacts on the ceramic centring ring. The spring contact in the coil units AT1115 (or AT1119) is located accordingly in the plane of the vertical scan, preferred for the construction of colour cameras with a horizontal spider design. A second small area contact at 90° with the first is provided on the ceramic centring ring for operation of the tube with a contact spring in the plane of the horizontal scan, as preferred for the construction of colour cameras with a vertical spider design.
Total possible rotation of the tube while maintaining contact is approx. 35°.

   b. The outer periphery of the ceramic centring ring is concentric with the inner periphery of the mesh ring (grid 6).
In the AT1115 (AT1119) coil units the tube is centred with this ring as a reference; this ensures proper optical alignment of the tube in the optical system of the camera.

3. Blanking can also be applied to the cathode:
   - without ACT action: required cathode pulse approx. 25 V.
   - with ACT action: timing, polarity and amplitudes of the ACT pulses will have to be adapted.

4. The d.c. voltage supply and/or pulse supply to these electrodes should have a sufficiently low impedance to prevent distortion caused by the peak currents drawn during the ACT mode.
These peak currents may amount to:

cathode	2 mA
grid 1	0 mA
grids 2 and 4	1 mA
grid 3	150 μA
grid 5	300 μA
grid 6	300 μA

The cathode impedance should preferably be chosen ⩽ 300 Ω.

5. Plumbicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters).
If the tube is used in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set at 45 V.

6. For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.

7. When the tube is to be used without Anti-Comet-Tail action, grid 3 (auxiliary grid) should be connected to grids 2 and 4 and no ACT pulses should be applied to the cathode and grid 1 (control grid). The performance of the tube will then be as described herein with the exception of the highlight handling.

8. a. For proper ACT action the d.c. voltage supply and/or pulse supply to the various electrodes should have sufficiently low impedance. See note 4.

   b. Video preamplifier. In the presence of highlights, peak signal currents of the order of 15 to 45 μA may be offered to the preamplifier during flyback. Special measures have to be taken in the preamplifier to prevent temporary overloading.

9. a. Read-out mode: defined as the operating conditions during the active line scan (full line period-line blanking interval). For the CCIR system this will amount to 64 μs – 12 μs = 52 μs.

   b. ACT mode: defined as the operating conditions during that part of the line blanking interval during which the ACT electrode gun is fully operative. The ACT interval is equal to or slightly within the line flyback time.

10. Pulse timing (CCIR) and amplitudes for ACT action (blanking applied to grid 1) see note 3.
   a. For proper operation and setting up of the ACT electron gun three electrodes have to be pulsed:
      - Cathode. A positive-going pulse, V_{kp}, with an adjustable amplitude of 0 to 20 V. This pulse can be chosen to coincide with the camera blanking period ($\approx$ 11 μs). The amplitude of this pulse determines the ACT cutting level and may in general be preset to 8, 4, 8, 4 V respectively, for black/white, R, G, B application. An amplitude of 20 V should be available to preset the I_s/I_b (see note 13).
      - Grid 1. A positive-going pulse, V_{g1p}, with such an amplitude that during the ACT mode the grid 1 bias is effectively reduced by 20 V, (V_{g1p} = 20 V + V_{kp}), to produce an extra amount of cathode current. The duration of this pulse should be so chosen that it is just within the flyback period ($\approx$ 5 μs).
      - Grid 3. A negative-going pulse, V_{g3p}, timing and duration coinciding with V_{g1p}, with either an *adjustable amplitude* and superimposed on a *fixed grid 3 voltage* of 250 to 300 V, or with *fixed amplitude* and superimposed on an *adjustable grid 3 voltage* of 250 to 300 V. In either case adjusted to result in a grid 3 voltage of 8,5 ± 0,5 V with respect to the cathode voltage during the ACT mode.

      This pulse ensures that an adequate amount of beam current is drawn from the cathode current.
   b. A suggested pulse timing and amplitude diagram is shown overleaf.
11. The optimum voltage ratio V_{g6}/V_{g5} to minimize beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. For type AT1115 a ratio of 1,5: 1 to 1,6: 1 is recommended.
12. Operation with ACT at $V_{g6} >$ 750 V is not recommended since this may introduce dark current.
13. Adjusted with the ACT made inoperative, e.g. by setting the cathode pulse to 20 V. The control grid voltage is adjusted to produce a beam current just sufficient to allow a peak signal current of twice the typical value, I_{sp}, as observed and measured on a waveform oscilloscope. This amount of beam current is termed I_{bp}.

    N.B. The signal current, I_s, and beam current, I_b, conditions quoted with the performance figures e.g. for lag, relate to measurements with an integrating instrument connected in the signal-electrode lead and a uniform illumination on the scanned area. The corresponding peak currents, I_{sp} and I_{bp}, as measured on a waveform oscilloscope will be a factor α larger (α = 100/100-β, β being the total blanking time in %): for CCIR system α amounts to 1,3.
14. In the case of a black/white camera the illumination on the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{RT}{4F^2\ (m+1)^2}$$

    in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target.

    A similar formula may be derived for the illumination level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the complete optical system have been taken into account.
15. The light bias lamp in its holder fits into the socket type 56026 and requires maximum 5 V, 110 mA. Its light is projected onto the pumping stem via a blue-green transmitting filter and is conducted to cause a bias illumination on the target. The required amount of light bias can be obtained by adjusting the filament current of the lamp.
16. Focus current adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.

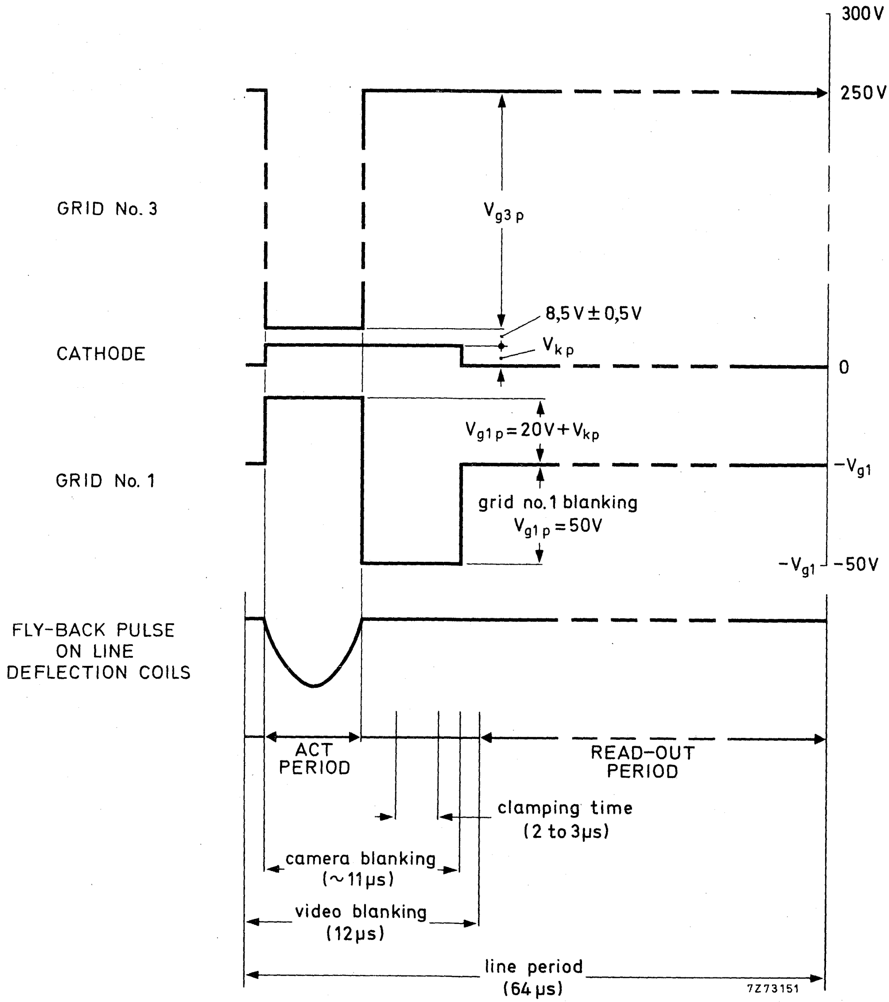


Fig. 2 Pulse timing and amplitude diagram.

17. Measuring conditions: Illumination ≈ 4 lx (luminous flux = 0,5 mlm) at a colour temperature of 2856 K, the appropriate filter inserted in the light path.

    Filter used:

XQ1080R	Schott	OG570	thickness	3 mm
XQ1080G	Schott	VG9	thickness	1 mm
XQ1080B	Schott	BG12	thickness	3 mm

    For transmission curves see Fig. 4.

18. Below the "knee" caused by ACT operation. Gamma stretching circuitry is recommended.
19. With pulses applied as indicated in note 10, the tube will properly handle a highlight with a diameter of 10% of picture height and with a brightness corresponding to 32 times peak signal white, I_{sp}.
20. Typical faceplate illumination level for the XQ1080 to produce 0,2 μA signal current will be approx. 4 lx. The signal current stated for the colour tubes R, G, B will be obtained with an incident white light level (c.t. = 2856 K) on the filter of approx. 10 lx. These figures are based on the filters described in note 17. For filter BG12, however, a thickness of 1 mm is chosen.
21. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affects neither the vertical resolution not the limiting resolution.
22. After 10 s of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms and 200 ms respectively after the illumination has been applied.
23. After a minimum of 5 s of illumination on the target. The figures given represent typical residual signals in % of the original signal current 60 ms and 200 ms respectively after the illumination has been removed.
24. For black/white operation a light bias corresponding to 2 to 3 nA extra dark current is usually adequate for excellent speed of response. In a colour camera the speeds of response of the tubes can be balanced by adjusting the amount of light bias per tube. A typical setting in a 3-tube colour camera could be R, G, B: 3, 5, 8 nA.
25. Deviation of the level of any of the four corners, i.e. 10% inwards in L. and V. direction, from the level in picture centre. The observed shading is composed of slight parabolic and sawtooth components in both line and frame direction which can be sufficiently compensated by suitable black shading compensation circuitry.

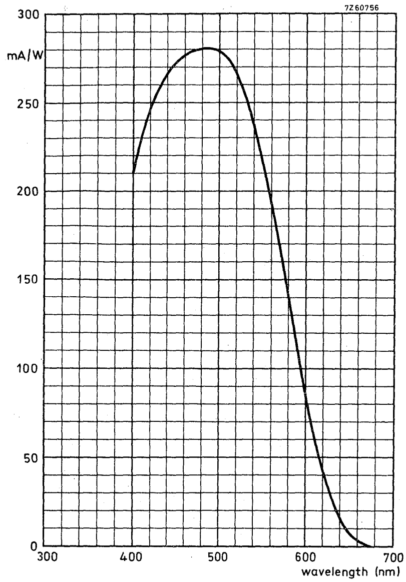


Fig. 3 Typical spectral response curve.

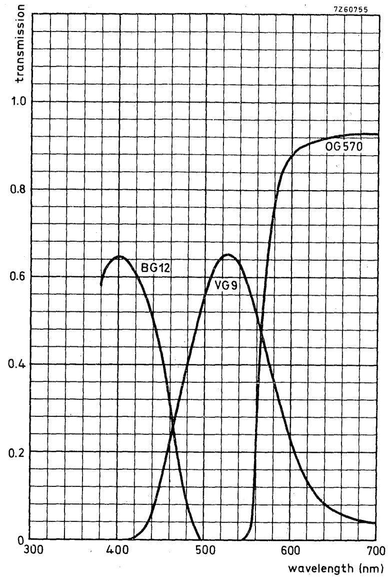


Fig. 4 Transmission of filters OG570, VG9 and BG12. See note 17.

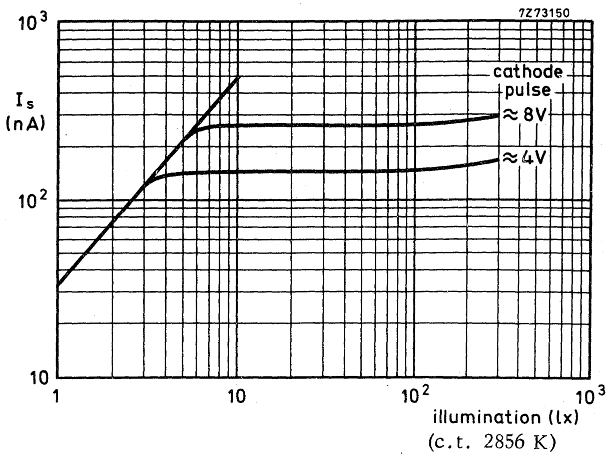


Fig. 5 Typical light transfer characteristics with ACT applied.

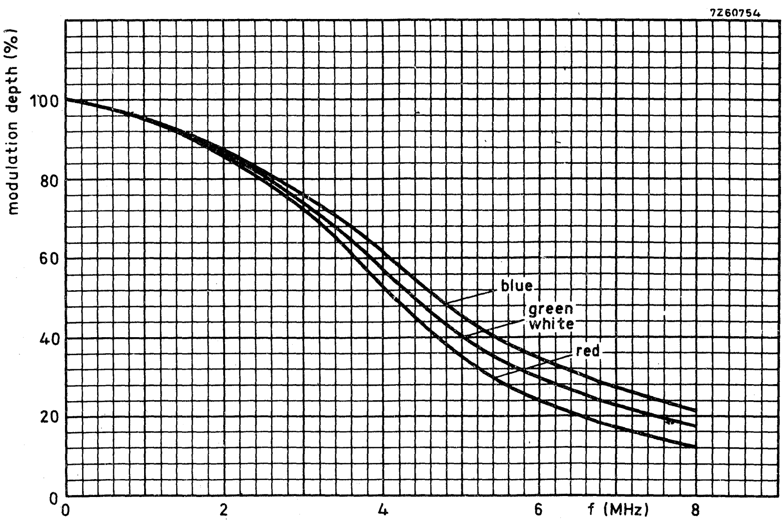


Fig. 6 Square-wave modulation transfer characteristics. $V_{g2,\,g4}$ = 300 V, V_{g5} = 475 V, V_{g6} = 750 V.

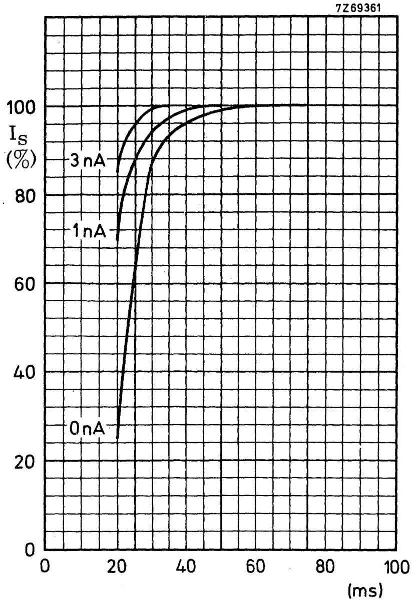


Fig. 7.

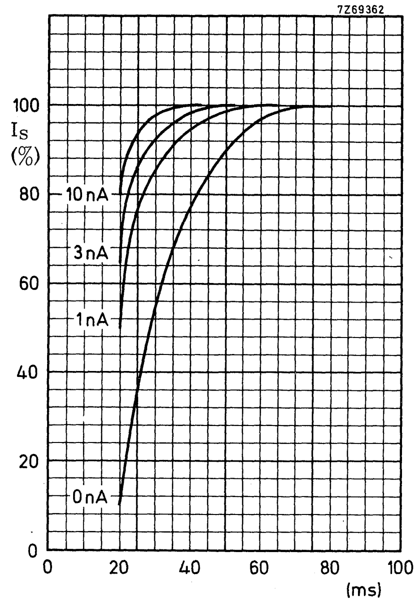


Fig. 8.

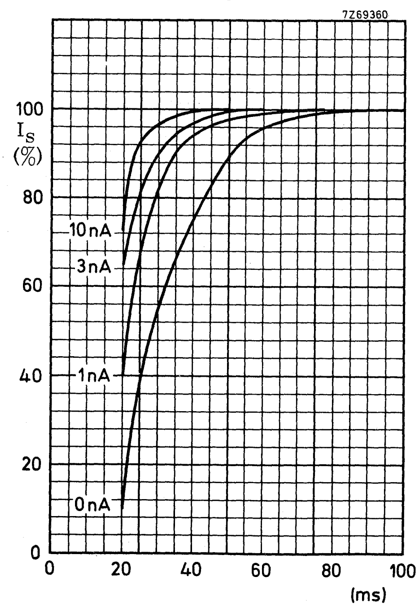


Fig. 9.

Build-up lag (see note 22)

Light bias induced dark current as parameter.

Fig. 7 XQ1080, XQ1080L, XQ1080G. I_s/I_b = 40/400 nA.

Fig. 8 XQ1080R. I_s/I_b = 20/200 nA.

Fig. 9 XQ1080B. I_s/I_b = 20/200 nA.

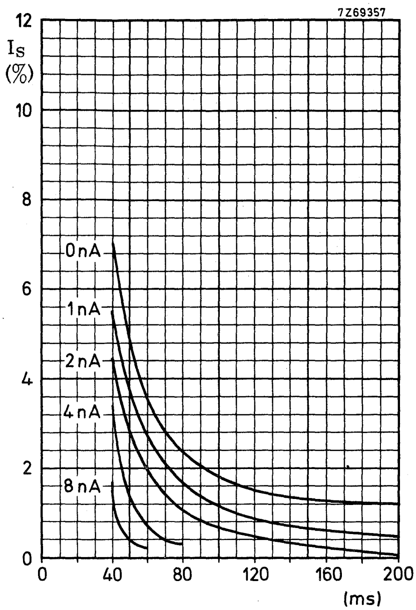


Fig. 10.

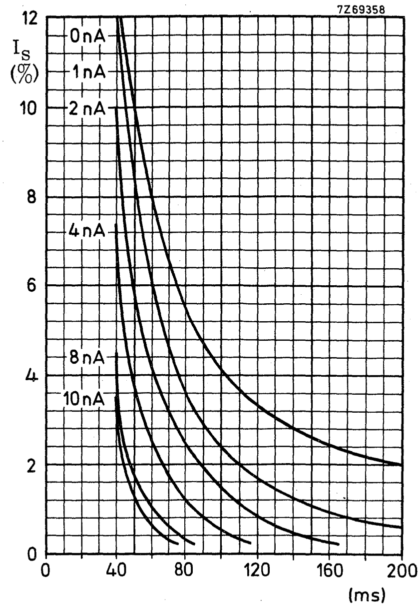


Fig. 11.

Decay lag (see note 23)

Light bias induced dark current as parameter.

Fig. 10. XQ1080, XQ1080L, XQ1080G. I_s/I_b = 40/400 nA.

Fig. 11. XQ1080R. I_s/I_b = 20/200 nA.

Fig. 12. XQ1080B. I_s/I_b = 20/200 nA.

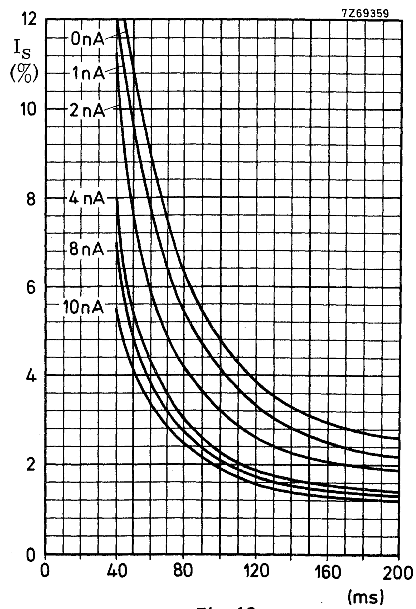


Fig. 12.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1080 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1081 for use in black and white cameras

XQ1081R, XQ1081G, XQ1081B for use in the chrominance channels of colour cameras.

For all further information see data of the XQ1080 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon, * television camera tubes identical to the tubes of the XQ1080 series, hence provided with an ACT electron gun, provisions for light bias, and a ceramic centring ring, but with a high resolution lead-oxide photoconductive target with extended red response as used in the XQ1073 series.

The XQ1083 series comprise two versions: the XQ1083 intended for use in black and white cameras, and the XQ1083R for use in the red chrominance channel of colour cameras in broadcast, educational and high quality industrial applications in which high contrast ratios may occur.

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length, excluding anti-halation glass disc	158 mm (6¼ in)
Special features	Anti-Comet Tail gun Light bias Anti-halation glass disc Ceramic centring ring Rear loading construction
Heater	6,3 V, 95 mA
Resolution	⩾ 750 TV lines
Cut-off of spectral response	850 to 950 nm

* Registered Trade Mark for television camera tube.

OPTICAL

			notes
Quality rectangle on photoconductive target (aspect ratio 3 : 4)		9,6 mm x 12,8 mm	1

Orientation of image on photoconductive target:
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the protecting sleeve at the base. 2a

Optical alignment 2b

Faceplate

Thickness		1,2 mm
Refractive index	n	1,49
Refractive index of anti-halation disc	n	1,52

HEATING

Indirect by a.c. or d.c.; parallel or series supply.

Heater voltage	V_f	6,3 V
Heater current, at $V_f = 6{,}3$ V	I_f	95 mA

When the tube is used in a series heater chain the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on. To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE

Signal electrode to all	C_{as}	2,5 to 3,5 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

DEFLECTION magnetic

FOCUSING magnetic

ACCESSORIES

Socket		type 56026
Light bias lamp in holder		type 56027
Deflection, focusing and alignment coil unit	black/white	type AT1119/01
	colour	type AT1115/01 *
Mask		type 56028

* AT1115/01 is a computer selected triplet of AT1119/01 coil units.

ELECTRON GUN CHARACTERISTICS

				notes
Cut-off				
Grid 1 voltage for cut-off at $V_{g2,4}$ = 300 V, without blanking or ACT pulses	V_{g1}		−40 to −110 V	
Blanking voltage, peak to peak at $V_{g2,4}$ = 300 V, on grid 1	V_{g1p-p}		50 ± 10 V	3
Grids 2 and 4 current (d.c. values)	$I_{g2,4}$	max.	0,2 mA	4
Grids 3, 5 and 6 currents				4
Pulse timing and amplitude requirements (ACT)				10

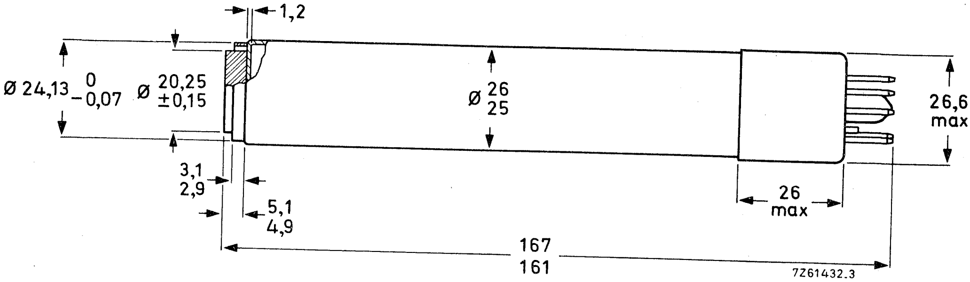
LIMITING VALUES (Absolute maximum rating system)

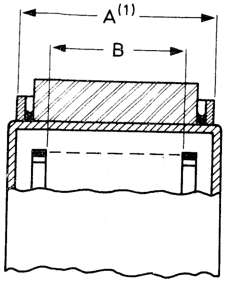
All voltages are referred to the cathode, unless otherwise stated.

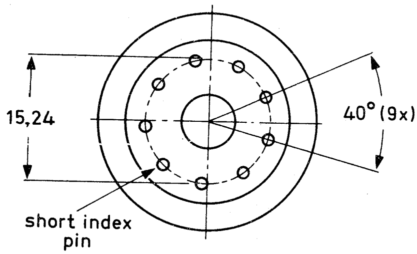
Signal electrode voltage	V_{as}	max.	50 V	5
Grid 6 (mesh) voltage	V_{g6}	max.	1100 V	
Grid 5 (collector) voltage	V_{g5}	max.	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max.	350 V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max.	350 V	
Grid 3 (auxiliary grid) voltage	V_{g3}	max.	350 V	
Grid 1 (control grid) voltage, positive	V_{g1}	max.	0 V	
negative	$-V_{g1}$	max.	200 V	
Cathode heating time before drawing cathode current	T_h	min.	60 s	
Cathode to heater voltage, positive peak	V_{kfp}	max.	125 V	
negative peak	$-V_{kfp}$	max.	50 V	
Impedance between cathode and heater at $-V_{kfp} > 10$ V	Z_{kf}	min.	2 kΩ	
Ambient temperature, storage and operation	t_{amb}	max.	50 °C	
		min.	−30 °C	
Faceplate temperature, storage and operation	t	max.	50 °C	
		min.	−30 °C	
Faceplate illumination	E	max.	100 lx	6

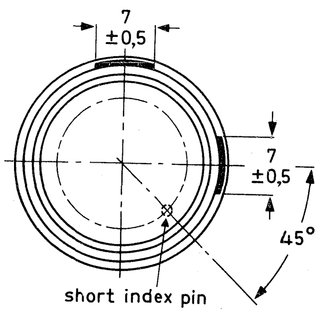
MECHANICAL DATA

Dimensions in mm

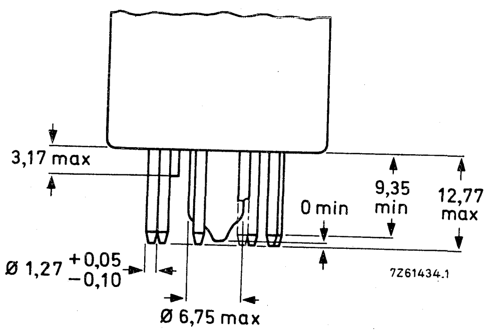








FRONT VIEW 7Z61433.3



Mounting position: any

Mass: ≈ 70 g

Base: IEC 67-I-33a (JEDEC E8-11)

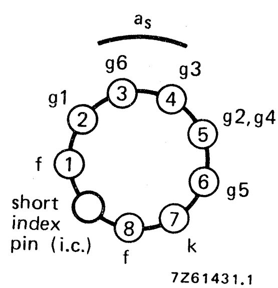


Fig. 1.

The distance between the geometrical centres of the diameter A of the reference ring and the diameter B of the mesh-electrode ring is < 100 μm.

OPERATING CONDITIONS AND PERFORMANCE

			notes
Conditions (with ACT action)			7
For a scanned area of 9,6 mm x 12,8 mm. All voltages are specified with respect to the cathode potential during the read-out mode, unless otherwise indicated.			8,9,10
Cathode voltage,			
during read-out mode	V_k	0 V	
during ACT mode	V_k	0 to 15 V	
Signal electrode voltage	V_{as}	45 V	5
Grid 6 (mesh) voltage	V_{g6}	750 V	11,12
Grid 5 (collector) voltage	V_{g5}	475 V	11,12
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300 V	
Grid 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}		10
during ACT mode	V_{g3}		
Grid 1 (control grid voltage,			
during read-out mode	V_{g1}		13
during ACT mode	V_{g1}		10
blanking on grid 1, peak	V_{g1p}	50 V	
Typical beam current, signal current and pulse settings			10

		XQ1083	XQ1083R
	I_{sp}	200 nA	100 nA
	I_{bp}	400 nA	200 nA
ACT level (peak)		280 nA	140 nA
Cathode pulse	V_{kp}	6 V	3V
Grid 1 pulse	V_{g1p}	26 V	23 V
Grid 3 pulse	V_{g3p}	see note 10	

			notes
Faceplate illumination			14
Light bias			15
Temperature of faceplate		20 to 45 °C	
Deflection, focusing and alignment coil unit	AT1119/01		16

Deflection, focusing and alignment currents

V_{g6}/V_{g5} V	focus current mA	line current (p-p) mA	frame current (p-p) mA
750/475	32	290	35

Line and frame alignment currents max. 15 mA, corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

Performance

				notes
Dark current (without light bias)	$\leqslant$	3 nA		
Sensitivity at colour temperature of illumination = 2856 K	min.	typ.		
XQ1083	350	400	μA/lmF	17a
XQ1083R	75	115	μA/lmF	17b
Gamma of transfer characteristic	0,95 ± 0,05			18
Light transfercharacteristic with ACT	see Fig. 11			
Highlight handling	$\geqslant$ 5 lens stops			19
Spectral response				
maximum response at	$\approx$	500	nm	
cut-off (= 1% of peak response)	$\approx$	850 to 950	nm	20
curve	see Fig. 3			

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures represent the typical horizontal amplitude response as measured with a lens aperture of f : 5,6. 13,21,22

		XQ1083	XQ1083R
Highlight signal current	I_{sp}	0,2 μA	0,1 μA
Beam current	I_{bp}	0,4 μA	0,2 μA
Modulation depth at 400 TV lines in %	typ.	50	45
	min.	40	35

Modulation transfer characteristics — see Fig. 6

Limiting resolution — $\geqslant$ 750 TV lines

Lag (typical values), without light bias

Light source with a colour temperature of 2856 K
Appropriate filter inserted in the light path for the chrominance tube.

Low key conditions, (without light bias)

	build-up lag see note 23				decay lag see note 24			
	I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1083			98	100			7	2,5
XQ1083R	95	100			8	2,5		

Low key conditions, (with light bias) see note 25
See curves in Figs 7 to 10.

High key conditions

	build-up lag see note 23				decay lag see note 24			
	I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1083			98	100			2	1
XQ1083R	98	100			3	1,5		

Shading of light bias induced dark current: 12,5%, see note 26.

NOTES

1. Underscanning of the specified useful area of 9,6 mm x 12,8 mm, or failure of scanning, should be avoided so as not to damage the photoconductive layer.

2. a. The position of this marker line corresponds to the position of one of the small area contacts on the ceramic centring ring. The spring contact in the coil units AT1115 (or AT1119) is located accordingly in the plane of the vertical scan, preferred for the construction of colour cameras with a horizontal spider design. A second small area contact at 90° with the first is provided on the ceramic centring ring for operation of the tube with a contact spring in the plane of the horizontal scan, as preferred for the construction of colour cameras with a vertical spider design.
Total possible rotation of the tube while maintaining contact is approx. 35°.

   b. The outer periphery of the ceramic centring ring is concentric with the inner periphery of the mesh ring (grid 6).
In the AT1115 (AT1119) coil units the tube is centred with this ring as a reference; this ensures proper optical alignment of the tube in the optical system of the camera.

3. Blanking can also be applied to the cathode:
   - without ACT action: required cathode pulse approx. 25 V.
   - with ACT action: timing, polarity and amplitudes of the ACT pulses will have to be adapted.

4. The d.c. voltage supply and/or pulse supply to these electrodes should have a sufficiently low impedance to prevent distortion caused by the peak currents drawn during the ACT mode.
These peak currents may amount to:

cathode	2 mA
grid 1	0 mA
grids 2 and 4	1 mA
grid 3	150 μA
grid 5	300 μA
grid 6	300 μA

The cathode impedance should preferably be chosen ⩽ 300 Ω.

5. Plumbicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters).
If the tube is used in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set at 45 V.

6. For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.

7. When the tube is to be used without Anti-Comet-Tail action, grid 3 (auxiliary grid) should be connected to grids 2 and 4 and no ACT pulses should be applied to the cathode and grid 1 (control grid). The performance of the tube will then be as described herein with the exception of the highlight handling.

8. a. For proper ACT action the d.c. voltage supply and/or pulse supply to the various electrodes should have sufficiently low impedance. See note 4.

   b. Video preamplifier. In the presence of highlights, peak signal currents of the order of 15 to 45 μA may be offered to the preamplifier during flyback. Special measures have to be taken in the preamplifier to prevent temporary overloading.

9. a. Read-out mode: defined as the operating conditions during the active line scan (full line period-line blanking interval). For the CCIR system this will amount to 64 μs − 12 μs = 52 μs.

   b. ACT mode: defined as the operating conditions during that part of the line blanking interval during which the ACT electron gun is fully operative. The ACT interval is equal to or slightly within the line flyback time.

10. Pulse timing (CCIR) and amplitudes for ACT action (blanking applied to grid 1), see note 3.

a. For proper operation and setting up of the ACT electron gun three electrodes have to be pulsed:

- Cathode. A positive-going pulse, V_{kp}, with an adjustable amplitude of 0 to 20 V. This pulse can be chosen to coincide with the camera blanking period (≈ 11 μs). The amplitude of this pulse determines the ACT cutting level and may in general be preset to 8, 4, 8, 4 V, respectively, for black/white, R, G, B application. An amplitude of 20 V should be available to preset the I_s/I_b (see note 13).
- Grid 1. A positive going pulse, V_{g1p}, with such an amplitude that during the ACT mode the grid 1 bias is effectively reduced by 20 V, ($V_{g1p} = 20\text{ V} + V_{kp}$), to produce an extra amount of cathode current. The duration of this pulse should be so chosen that it is just within the flyback period (≈ 5 μs).
- Grid 3. A negative-going pulse, V_{g3}, timing and duration coinciding with V_{g1p}, with either an *adjustable amplitude* and superimposed on a *fixed grid 3 voltage* of 250 to 300 V, or with *fixed amplitude* and superimposed on an *adjustable grid 3 voltage* of 250 to 300 V. In either case adjusted to result in a grid 3 voltage of 8,5 ± 0,5 V with respect to the cathode voltage during the ACT mode.

  This pulse ensures that an adequate amount of beam current is drawn from the cathode current.

b. A suggested pulse timing and amplitude diagram is shown on page overleaf.

11. The optimum voltage ratio V_{g6}/V_{g5} to minimize beam landing errors (preferably ⩽ 1 V) depends on the type of coil unit used). For type AT1115 a ratio of 1,5 : 1 to 1,6 : 1 is recommended.

12. Operation with ACT at $V_{g6} > 750$ V is not recommended since this may introduce dark current.

13. Adjusted with the ACT made inoperative, e.g. by setting the cathode pulse to 20 V. The control grid voltage is adjusted to produce a beam current just sufficient to allow a peak signal current of twice the typical value, I_{sp}, as observed and measured on a waveform oscilloscope. This amount of beam current is termed I_{bp}.

N.B. The signal current, I_s, and beam current, I_b, conditions quoted with the performance figures e.g. for lag, relate to measurements with an integrating instrument connected in the signal-electrode lead and a uniform illumination on the scanned area. The corresponding peak currents, I_{sp} and I_{bp}, as measured on a waveform oscilloscope will be a factor α larger ($\alpha = 100/100\text{-}\beta$, β being the total blanking time in %): for CCIR system α amounts to 1,3.

14. In the case of a black/white camera the illumination on the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc}\ \frac{RT}{4F^2\ (m+1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target.

A similar formula may be derived for the illumination level on the photoconductive layer of the R chrominance tube in which the effects of the various components of the complete optical system have been taken into account.

15. The light bias lamp in its holder fits into the socket type 56026 and requires maximum 5 V, 110 mA. Its light is projected on to the pumping stem via a blue-green transmitting filter and is conducted to cause a bias illumination on the target. The required amount of light bias can be obtained by adjusting the filament current of the lamp.

16. Focus current adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.

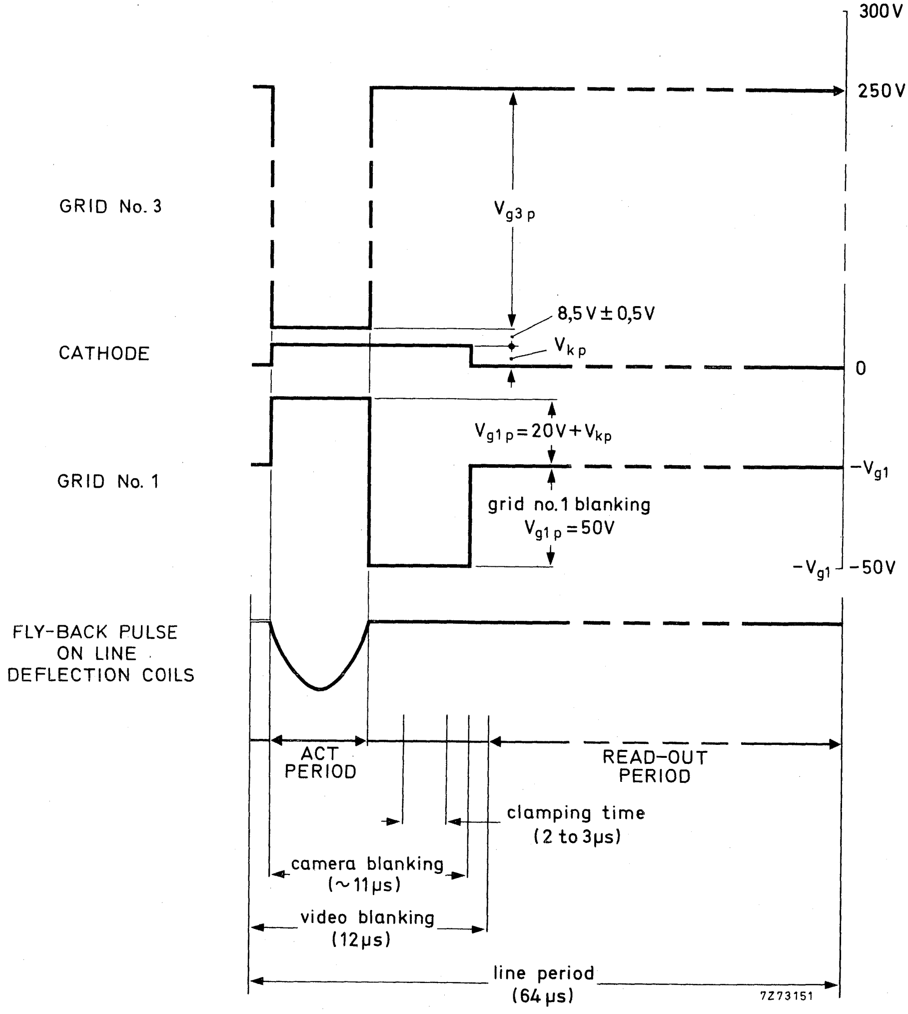


Fig. 2 Pulse timing and amplitude diagram.

17\. a. All measurements are made with an infrared reflecting filter interposed between light-source and target. Balzers Calflex B1/K1 filter is chosen for this purpose since, for accurate colour reproduction in a colour camera, a similar infrared reflecting filter will be required. For typical transmission curve of this filter see Fig. 5.

b. With an additional filter (see note 17a) interposed between light source and target. Filter used is Schott OG570 (3 mm). For transmission curve see Fig. 4.

18\. Below the "knee" caused by ACT operation. Gamma stretching is circuitry is recommended.

19\. With pulses applied as indicated in note 10 the tube will properly handle a high-light with a diameter of 10% of picture height and with a brightness corresponding to 32 times peak signal white, I_{sp}.

20\. Without infrared reflecting filter B1/K1.

21\. Typical faceplate illumination level for the XQ1083 to produce 0,2 μA signal current will be approx. 4 lx. The signal current stated for the chrominance tube XQ1083R will be otained with an incident white level (c.t. = 2856 K) on the filter - Schott OC570 - of approx. 8 lx.

22\. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affects neither the vertical resolution nor the limiting resolution.

23\. After 10 s of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms respectively 200 ms after the illumination has been applied.

24\. After a minimum of 5 s of illumination on target. The figures given represent typical residual signals in % of the original signal current 60 ms respectively 200 ms after the illumination has been removed.

25\. For black/white operation a light bias corresponding to 2 to 3 nA extra dark current is usually adequate for excellent speed of response. In a colour camera the speeds of response of the tubes can be balanced by adjusting the amount of light bias per tube. A typical setting in a 3-tube colour camera could be for XQ1083R, XQ1080G, XQ1080B respectively, 4, 3, 8 nA.

26\. Deviation of the level of any of the four corners, i.e. 10% inwards in L and V direction, from the level in picture centre. The observed shading is composed of slight parabolic and sawtooth components in both line and frame directions which can be sufficiently compensated by suitable black shading compensation circuitry.

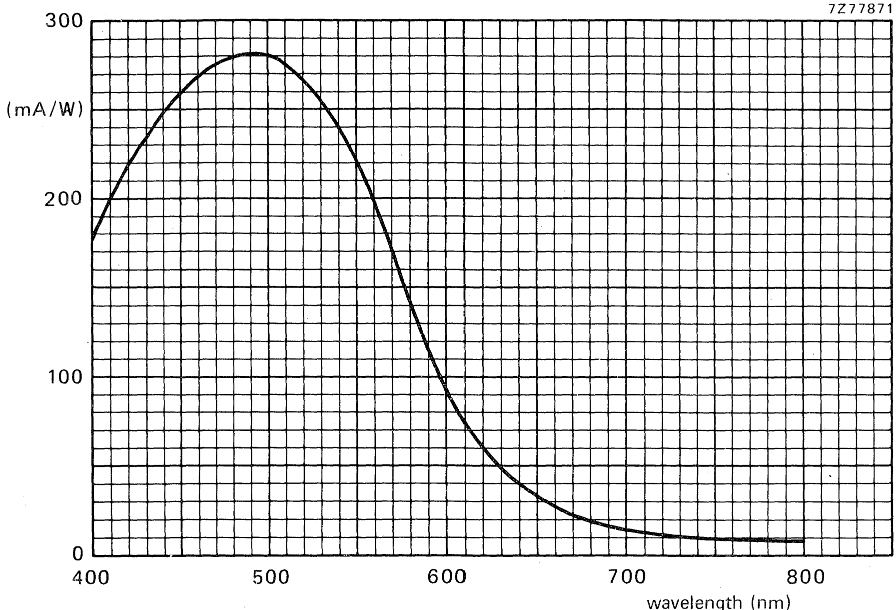


Fig. 3 Typical spectral sensitivity characteristic.

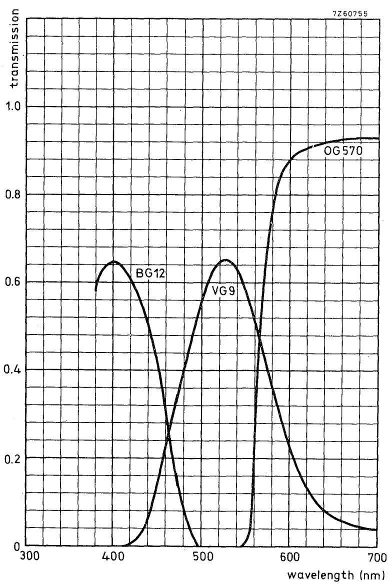


Fig. 4 Transmission curve of filter OC570. See note 17b.

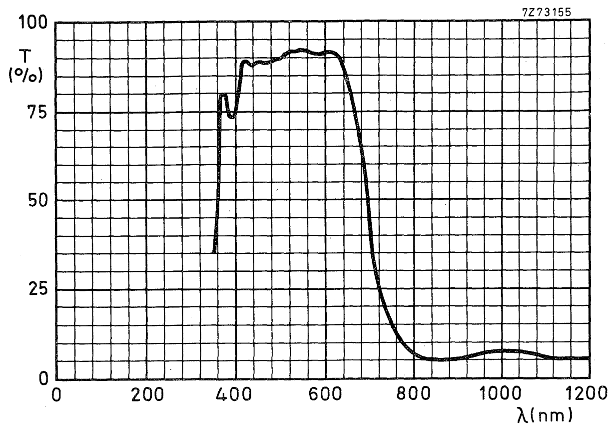


Fig. 5 Typical transmission curve of heat reflecting interference filter CALFLEX B1/K1. See note 17a.

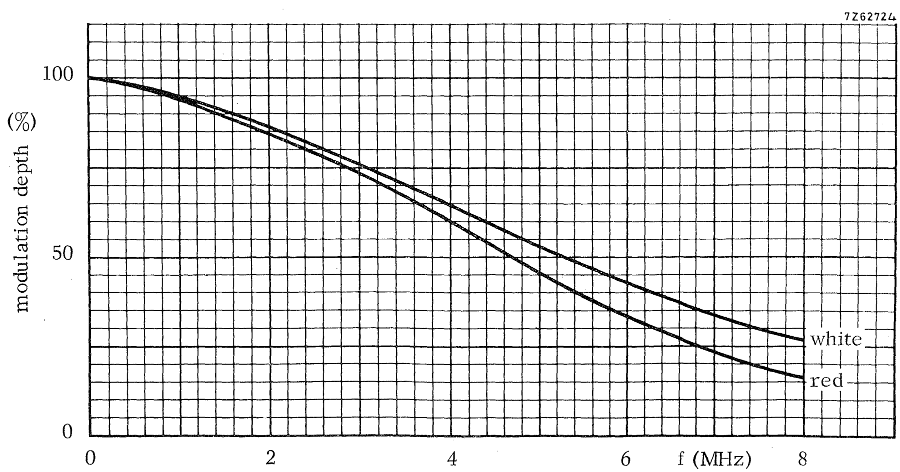


Fig. 6 Square-wave modulation transfer characteristic.

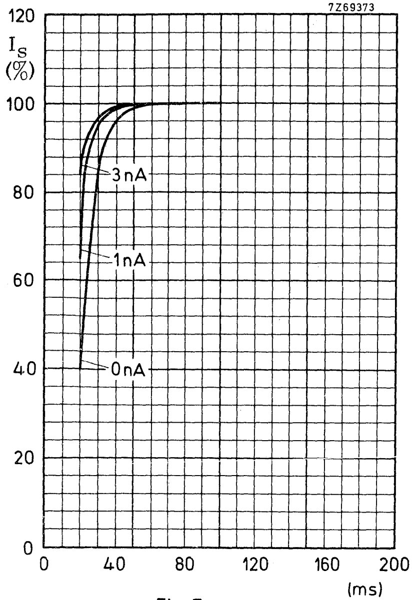


Fig. 7.

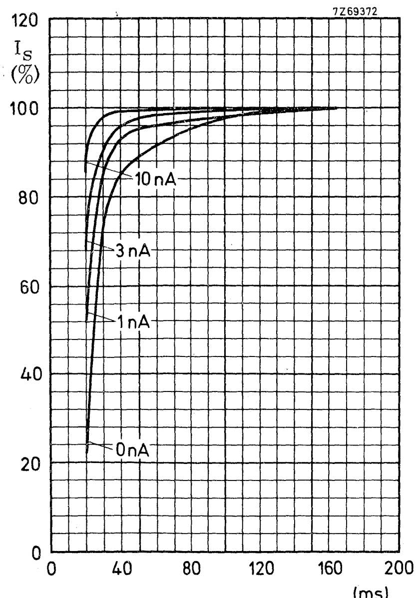


Fig. 8.

Build-up lag (See note 23)

Light bias induced dark current as parameter

Fig. 7 XQ1083: I_s/I_b = 40/400 nA.

Fig. 8 XQ1083R: I_s/I_b = 20/200 nA.

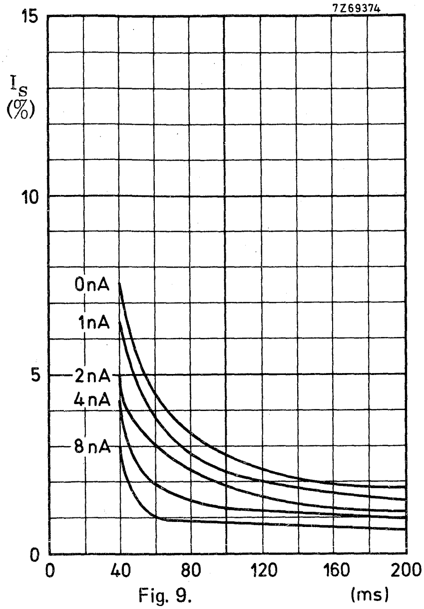


Fig. 9.

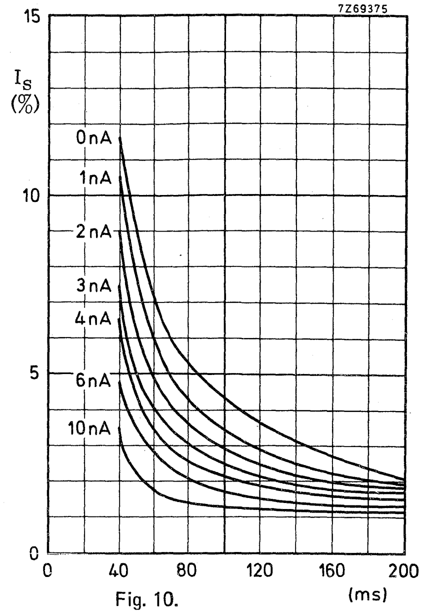


Fig. 10.

Decay lag (See note 24)

Fig. 9 XQ1083: I_s/I_b = 40/400 nA.

Fig. 10 XQ1083R: I_s/I_b = 20/200 nA.

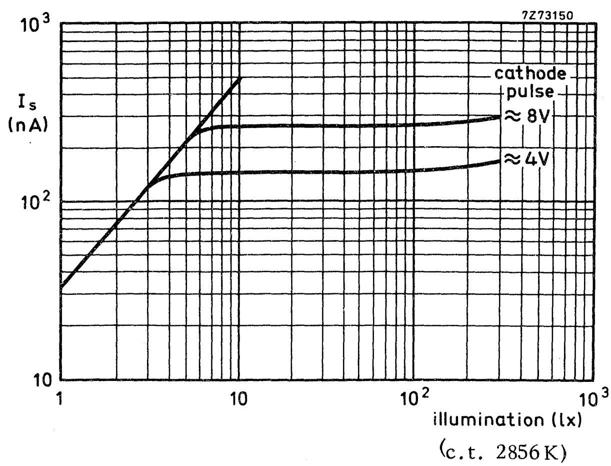


Fig. 11 Typical light transfer characteristics with ACT applied.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1083 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1084	for use in black and white cameras
XQ1084R	for use in the red chrominance channel of colour cameras

For all further information see data of the XQ1083 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon * television camera tubes identical to the tubes of the XQ1083 series, hence provided with an ACT electron gun, provisions for lightbias, ceramic centring ring and a lead-oxide photoconductive target with extended red response. However, these tube types incorporate an infra-red reflecting filter on the anti-halation glass disc.

QUICK REFERENCE DATA	
Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length	158 mm ($6\frac{1}{4}$ in)
Special features	Anti-Comet-Tail gun Provisions for light bias Anti-halation glass disc Ceramic centring ring Rear loading construction
Heater	6,3 V, 95 mA
Resolution	≥ 750 TV lines
Spectral response, cut-off	750 nm
Provided with anti-halation glass disc with infra-red reflecting filter.	

The infra-red reflecting filter eliminates the need for additional filters in the optical systems when the XQ1085 and XQ1085R are applied in black and white and colour cameras originally designed for tubes of the XQ1070 series.

The spread in spectral responses in the long wavelength region as published for the XQ1083 and XQ1083R tubes is greatly reduced, warranting minimum differences in colour rendition between cameras of identical manufacture.

The XQ1085 will provide black and white pictures with true tonal rendition of colours, the spectral response approaching very nearly the relative spectral sensitivity of the human eye.

The XQ1085R is intended for use in the red chrominance channel of colour cameras in broadcast, educational and high-quality industrial applications.

* Registered Trade Mark for television camera tube.

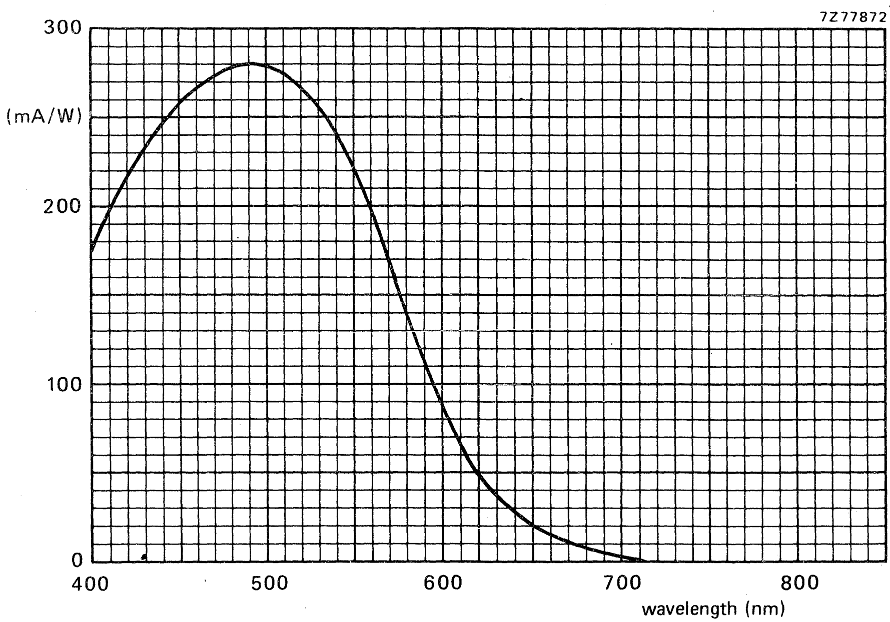
OPTICAL DATA

Spectral response	see curve below	
Maximum response at	500	nm
Cut-off	750	nm [1])

Filter Hard coating on anti-halation glass disc. Care in handling to avoid scratches is strongly recommended.

For further information refer to data of the XQ1083 series.

Note [10]) of these data referring to Balzers B1/K1 filter does not apply.



Typical spectral sensitivity characteristic

[1]) Defined as the wavelength at which the spectral response has dropped to 1% of the peak response (≈500 nm).

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1085 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1086	for use in black and white cameras
XQ1086R	for use in the red chrominance channel of colour cameras

For all further information see data of the XQ1085 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon®, television camera tube with high resolution lead-oxide photoconductive target, low heater power, separate mesh construction, magnetic focusing, magnetic deflection and 25,4 mm (1 in) diameter.

The tubes of the XQ1090, XQ1091 series are provided with an A.C.T. electron gun and provisions for light bias like the tubes of the XQ1080, XQ1081 series but are front loading types and hence without ceramic centring ring.

The series comprise the following versions.

For use in bl/wh and colour cameras in broadcast applications	XQ1090 L R G B
For use in bl/wh and colour cameras in industrial applications	XQ1091 R G B

The electrical and mechanical data of the tubes are identical to those of the XQ1080 or XQ1081 respectively, with the following exceptions.

ELECTRICAL DATA

Capacitance

Signal electrode to all C_{as} 3 to 5 pF

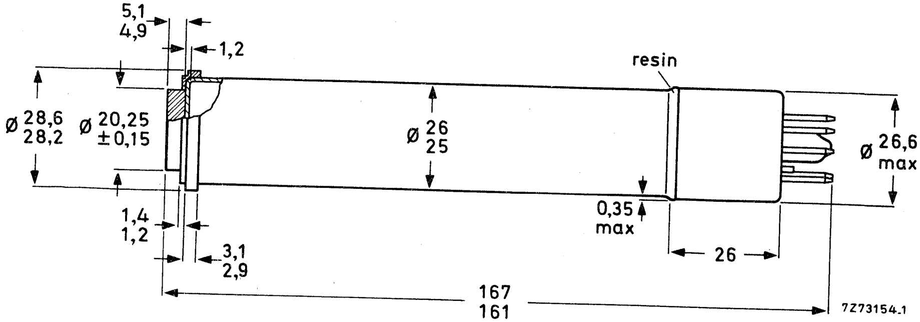
ACCESSORIES

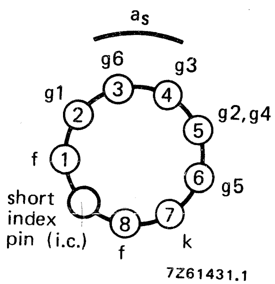
Deflection and focusing coil unit for colour and bl/wh cameras AT1103, AT1116 or equivalent

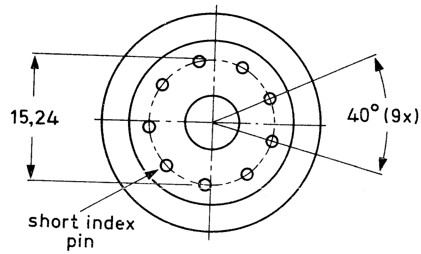
® Registered Trade Mark for camera tube.

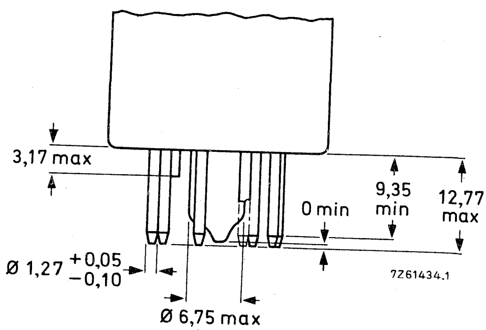
MECHANICAL DATA

Dimensions in mm









CAMERA TUBES

Plumbicon® television camera tube with high resolution lead-oxide photoconductive target, low heater power, separate mesh construction, magnetic focusing, magnetic deflection and 25,4 mm (1 in) diameter.

The tubes of these series are provided with an ACT electron gun and provisions for light bias like the tubes of the XQ1083 and XQ1084 series but are front-loading types without ceramic centring ring.

The series comprise the following versions.

		with anti-halation glass disc and IR filter
For use in black/white and colour cameras in broadcast applications	XQ1093 XQ1093R	XQ1095 XQ1095R
For use in black/white and colour cameras in industrial applications	XQ1094 XQ1094R	XQ1096 XQ1096R

The electrical and mechanical data of the tubes are identical to those of the XQ1083 or XQ1085 series with the following exceptions.

ELECTRICAL DATA

Capacitance

Signal electrode to all — C_{as} — 3 to 5 pF

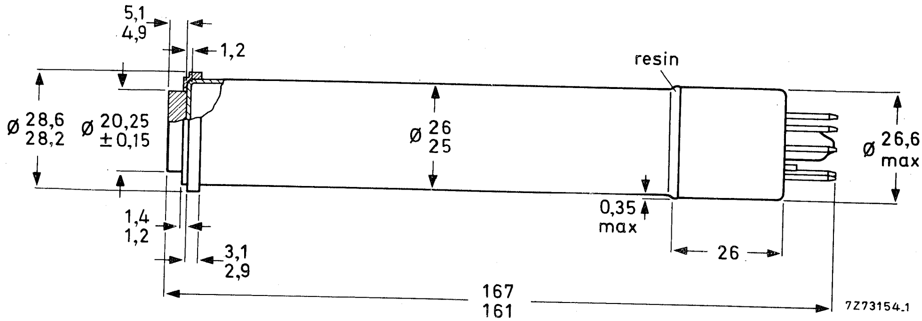
ACCESSORIES

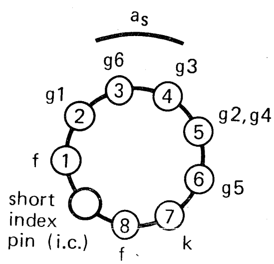
Deflection and focusing coil unit	for colour and black/white cameras: AT1103, AT1116 or equivalent
Socket	type 56026
Bias light lamp in holder	type 56027

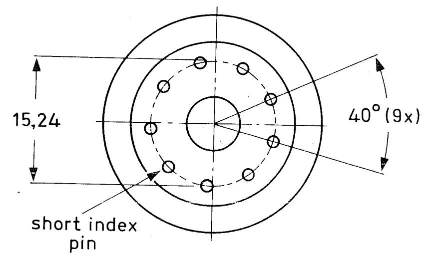
® Registered Trade Mark for television camera tube.

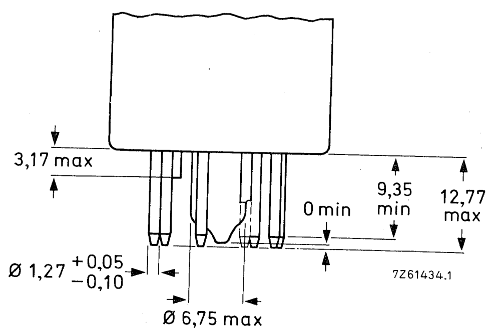
MECHANICAL DATA

Dimensions in mm









CAMERA TUBE

Small-size Plumbicon* television camera tube with lead-oxide photoconductive target with extended red response and high resolution.
Hybrid gun construction, i.e. electrostatic focusing and magnetic deflection.
The XQ1213 is intended for use in compact broadcast black and white cameras, the R, G and B versions are intended for use in the red, green, and blue chrominance channels in compact three-tube broadcast colour cameras.

QUICK REFERENCE DATA	
Focusing	electrostatic
Deflection	magnetic
Diameter	15,9 mm (5/8 in)
Length	approx. 135 mm (5 5/16 in)
Provided with anti-halation glass disc	
Cut-off of spectral response	approx. 850 nm
Heater	6,3 V, 300 mA
Resolution	≥ 600 TV lines

OPTICAL

Quality rectangle on photoconductive target
(aspect ratio 3:4) 6 x 8 mm^2 [1])

Orientation of image on photoconductive target
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the white marker line on the base.

Faceplate
Refractive index n 1,49
Refractive index of anti-halation glass disc n 1,52

* Registered Trade Mark for television camera tubes.

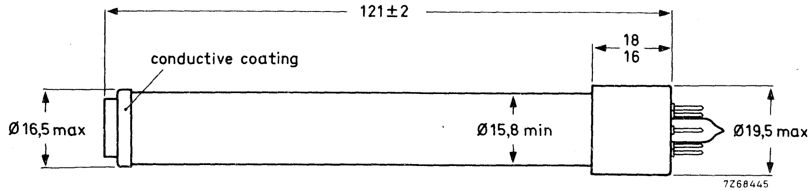
MECHANICAL DATA

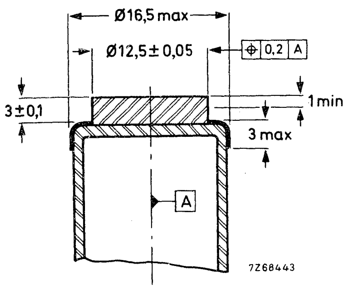
Dimensions in mm

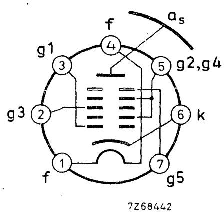
Mounting position: any

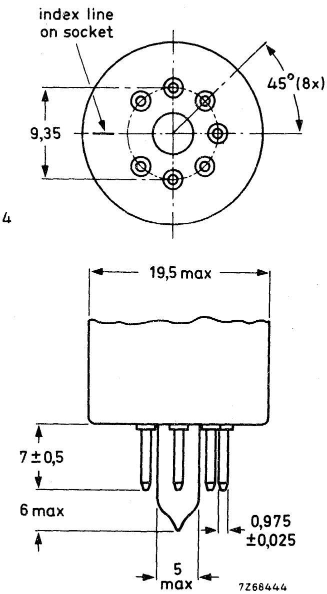
Weight : approx. 30 g

Base : 7-pin miniature with pumping stem and modified pin length.









ACCESSORIES

Socket:	type 56049 or equivalent
Deflection unit	AT1117

ELECTRICAL DATA

Heating: indirect by a.c. or d.c.; parallel supply

Heater voltage	V_f	6,3	V ± 5%
Heater current	I_f	300	mA

To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

Electron gun characteristics

Cut-off				
Grid no. 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100	V 2)
Blanking voltage, peak to peak				
on grid no. 1	$V_{g1_{pp}}$		50	V
on cathode	$V_{k_{pp}}$		25	V
Grid no. 2 current at normally required beam currents	I_{g2}	max.	0,5	mA

Focusing electrostatic

Deflection magnetic 3)

Capacitance

Signal electrode to all	C_{as}	1,5 to 3,0	pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the deflection coil unit.

LIMITING VALUES (Absolute max. rating system)

All voltages are referred to the cathode, unless otherwise stated.

Signal electrode voltage	V_{as}	max.	50	V	
Grid no. 5 voltage	V_{g5}	max.	750	V	
Grid no. 4 and grid no. 2 voltage	V_{g4+2}	max.	350	V	
Grid no. 1 voltage, positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Voltage between grid no. 4 and grid no. 3	$V_{g4/g3}$	max.	350	V	
Voltage between grid no. 5 and grid no. 4	$V_{g5/g4}$	max.	400	V	
Cathode to heater voltage, positive peak	V_{kf_p}	max.	50	V	
negative peak	$-V_{kf_p}$	max.	50	V	
Cathode heating time before drawing cathode current	T_h	min.	1	min.	4)
Ambient temperature, storage and operation	t_{amb}	max.	50	°C	
		min.	−30	°C	
Faceplate temperature, storage and operation	t	max.	50	°C	
		min.	−30	°C	
Faceplate illumination	E	max.	100	lx	5)

OPERATING CONDITIONS AND PERFORMANCE

Conditions (scanned area 6 mm x 8 mm)

Cathode voltage	V_k	0	V	
Grid no. 4 and grid no. 2 voltage	V_{g4+2}	300	V	
Grid no. 3 (beam focus) voltage	V_{g3}	60 to 80	V	6)
Grid no. 5 voltage	V_{g5}	575	V	
Signal electrode voltage	V_{as}	45	V	7)
Beam current	I_b	see note		8)
Grid no. 1 voltage	V_{g1}	see note		8)
Line coil current and frame coil current		see note		9)
Faceplate illumination		see note		10)
Faceplate temperature	t	20 to 45	°C	
Blanking voltage on grid no. 1, peak to peak	V_{g1pp}	50	V	

Performance

Dark current $\leq$ 3 nA

Sensitivity at colour temperature of illumination = 2856 K 11)

	min.	typ.	
XQ1213	310	360	μA/lmF
XQ1213R	75	95	μA/lmF
XQ1213G	120	140	μA/lmF
XQ1213B	26	30	μA/lmF

Gamma of transfer characteristic 0,95 ± 0,05 12)

Spectral response: max. response at approx. 500 nm
cut-off at approx. 850 nm
response curve see graph on page B133

Resolution

Modulation depth, i.e. uncompensated amplitude response at 320 TV lines, at the centre of the picture. The figures shown represent the typical amplitude response of the tube as obtained with a lens aperture of f:5,6 8) 13).

	XQ1213	XQ1213R	XQ1213G	XQ1213B	
Highlight signal current I_s	0,15	0,075	0,15	0,075	μA
Beam current I_b	0,3	0,15	0,3	0,15	μA
Modulation depth at 320 TV lines, typ.	35	30	35	50	%
min.	30	25	30	35	%

Limiting resolution	≥	600	TV lines
Modulation transfer characteristics		see page 10	

Lag (typical values)

Light source with a colour temperature of 2856K.
Appropriate filter inserted in the light path for the chrominance tubes R, G, and B.

Low-key conditions

	build-up lag 8) 14)				decay lag 8) 15)			
	I_s/I_b = 20/300 nA		I_s/I_b = 20/150 nA		I_s/I_b = 20/300 nA		I_s/I_b = 20/150 nA	
	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)
XQ1213,G	95	≈ 100			9	3		
XQ1213R,G			> 95	≈ 100			9	3

High-key conditions

	build-up lag 8) 14)				decay lag 8) 15)			
	I_s/I_b = 150/300 nA		I_s/I_b = 75/150 nA		I_s/I_b = 150/300 nA		I_s/I_b = 75/150 nA	
	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)
XQ1213,G	98	100			3, 5	1		
XQ1213R,G			98	100			3, 5	1

NOTES

1. Underscanning of the specified useful target area of 6 x 8 mm^2 or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.
2. Without blanking on grid no. 1.
3. For deflection coil unit see under "Accessories".
4. Ensure that before the camera is switched on the grid no. 1 controls are set at maximum bias.
5. For short intervals. During storage the tube shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.
6. Adjusted for optimal electrical focus.
7. The signal electrode voltage shall be adjusted at 45 V. To enable the tube to handle excessive highlights in the scene to be televised the signal electrode voltage may be reduced to a minimum of 25 V. This will, however, result in some reduction of performance, especially in terms of sensitivity.
8. The beam current I_b, as obtained by adjusting the control grid (grid no. 1) voltage is set at 150 nA for R and B tubes, 300 nA for bl/wh, and G tubes.
   I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.
   In the performance figures, e.g. for resolution and lag, the signal current and beam current conditions are given, e.g. as I_s/I_b = 20/300 nA. This means: with a signal current of 20 nA and a beam setting which just allows a signal current of 300 nA.
   N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area. The peak signal currents as measured on a waveform oscilloscope will be a factor α larger.

   ($\alpha = \frac{100}{100-\beta}$, β being the total blanking time in %, for the CCIR system

   α amounts to 1, 3).
9. Deflection unit: AT1117

Line deflection current, peak to peak	125	mA
Frame deflection current, peak to peak	20	mA

10. In case of a black/white camera the illumination on the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{R.T.}{4F^2 (m+1)^2}$$

in which
R = the average scene reflectivity or the object reflectivity whichever is relevant
T = lens transmission factor
F = lens aperture
m = linear magnification from scene to target.
A similar formula may be derived for the illumination level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the complete optical system have been taken into account.

11. All measurements are made with an infrared **reflecting** filter, Balzers, Calflex B1/K1 interposed between light source and the target. Illumination level approx. 10, 5 lx (luminous flux: 0, 5 mlm) when this filter is removed. In the case of chrominance tubes the appropriate filters are inserted.
Filters used

R	Schott	OG570	thickness	3 mm
G	Schott	VG9	thickness	3 mm
B	Schott	BG12	thickness	1 mm

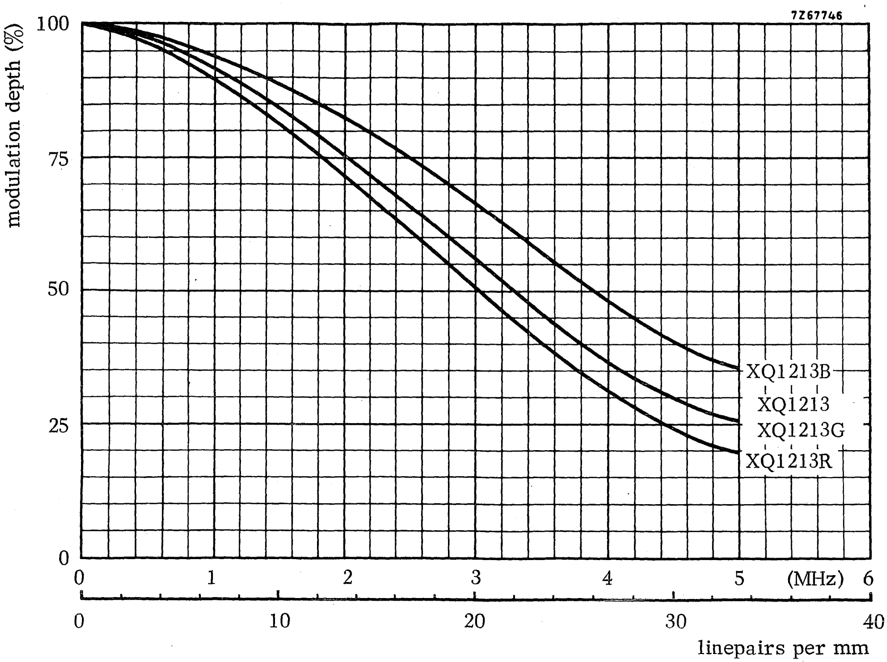
For transmission curves see page B133.

12. Gamma-stretching circuitry is recommended.

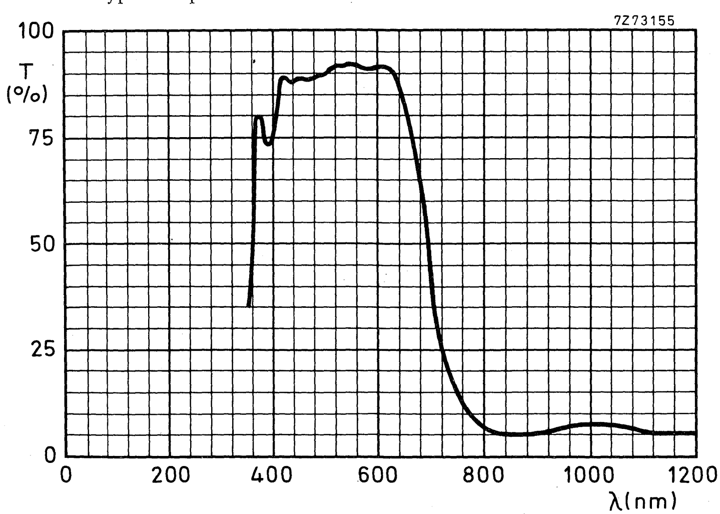
13. The horizontal amplitude response can be raised by means of suitable correction circuits, which affects neither the vertical resolution nor the limiting resolution.

14. After 10 s of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms or 200 ms respectively after introduction of the illumination.

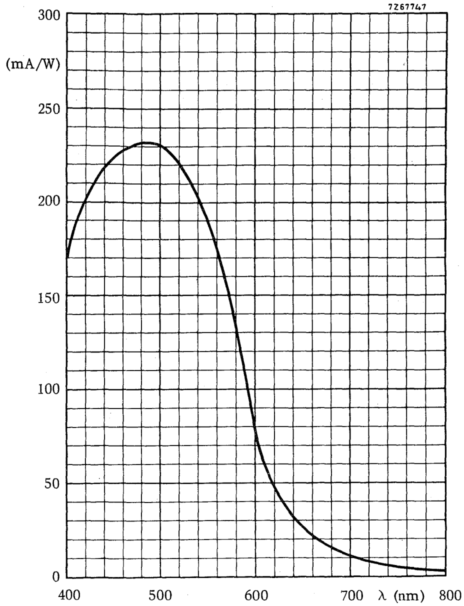
15. After a minimum of 5 s of illumination on the target.
The figures represent typical residual signals in percentage of the original signal current 60 ms or 200 ms respectively after removal of the illumination.



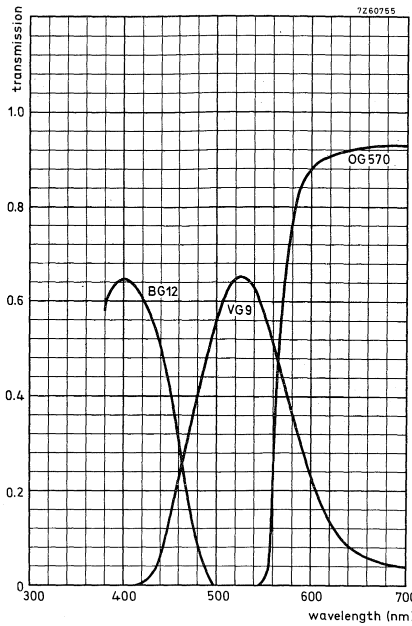
Typical square-wave modulation transfer characteristics



Typical transmission curve of heat-reflecting interference filter, type CALFLEX B1/K1



Typical spectral response curve.



Transmission of filters BG12, VG9 and OG570. See note 11.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ1213 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial, educational or ENG cameras.

The series comprises the following versions:

XQ1214	for use in black and white cameras
XQ1214R XQ1214G XQ1214B	for use in the chrominance channels of colour cameras

For all further information see data of the XQ1213 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon®, sensitive high-definition pick-up tube with lead-oxide photoconductive target. Provided with: separate mesh construction for good resolution; Anti-Comet Tail electron gun for improved highlight handling; provision for light bias for reduced lag under low-key conditions; fibre-optic faceplate.
The tubes can be used in medical, scientific and low level TV systems in which they can be coupled direct to, e.g. X-ray image intensifiers and light intensifiers with fibre optic output windows.

QUICK REFERENCE DATA

Fibre optic faceplate		
ACT electron gun		
Light bias		
Focusing		magnetic
Deflection		magnetic
Diameter	approx.	30 mm
Length	approx.	210 mm

Available types:

Quality area	12,8 mm x 17,1 mm	
Grade	A	B
	XQ1230	XQ1233

Resolution	≥	25 lp/mm
Heater		6,3 V, 300 mA
Cut-off spectral response	≈	650 nm

® Registered Trade Mark for television camera tube.

OPTICAL

Quality rectangle on photoconductive target (aspect ratio 3 : 4)		12,8 mm x 17,1	mm	1)

Orientation of image on photoconductive target
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the mark on the tube base.

Faceplate				
Diameter of fibres		approx. 7	μm	
Flat within		1	μm	

ELECTRICAL

Heating: Indirect by a.c. or d.c.; parallel supply

Heater voltage	V_f	6,3	V ± 5%	
Heater current	I_f	300	mA	

Electron gun characteristics

Cut-off				
Grid no. 1 voltage for cut-off at $V_{g2,4}$ = 300 V, without blanking nor ACT pulses		−45 to −110	V	
Blanking, peak to peak				
Applied to grid no. 1, at $V_{g2,4}$ = 300 V		50 ± 10	V	6) 9)
Grid no. 2 and no. 4 current		max. 0,2	mA	7)

Focusing (see under Accessories)

Deflection (see under Accessories)

Capacitance

Signal-electrode to all	C_{as}	3 to 6	pF	

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

LIMITING VALUES (Absolute max. rating system)

All voltages are referred to the cathode, unless otherwise stated.

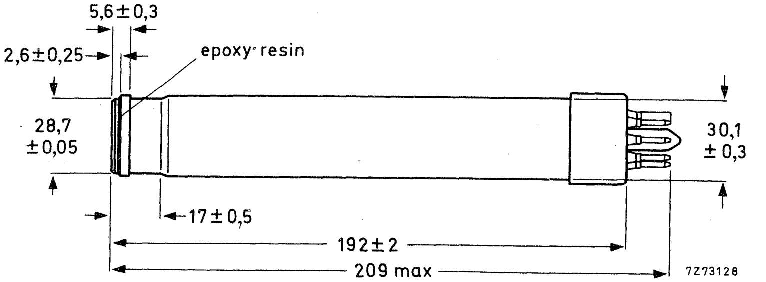
Signal electrode voltage	V_{as}	max.	50	V	
Grid no. 6 (mesh) voltage	V_{g6}	max.	1100	V	
Grid no. 5 (collector) voltage	V_{g5}	max.	800	V	
Voltage between grid no. 6 and grid no. 5	$V_{g6/g5}$	max.	350	V	
Grid no. 4 (limiter) and grid no. 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max.	350	V	
Grids no. 4 and no. 2 dissipation	$W_{g2,4}$	max.	1	W	
Grid no. 3 (auxiliary grid) voltage	V_{g3}	max.	350	V	
Grid no. 1 (control grid) voltage, positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Grid no. 1 ACT pulse, peak		max.	40	V	6)
Cathode heating time before drawing cathode current	T_h	min.	1	min	
Cathode to heater voltage, positive peak	V_{kfp}	max.	50	V	
negative peak	$-V_{kfp}$	max.	50	V	
Faceplate temperature, storage and operation	t	max.	50	°C	
		min.	−30	°C	
Faceplate illumination	E	max.	500	lx	2)

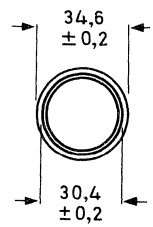
ACCESSORIES

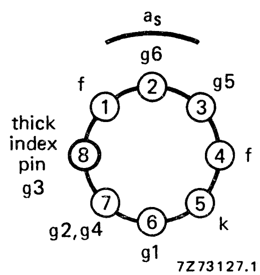
Coil unit	AT1132/01	3)
Socket	type 56025	
Biaslight lamp in holder	type 56027	

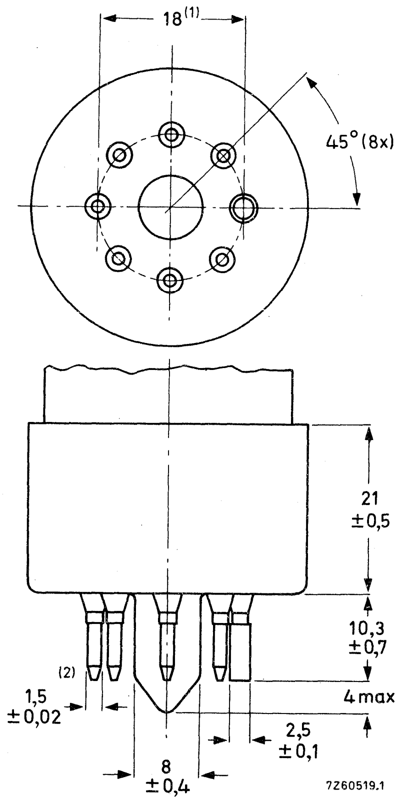
MECHANICAL DATA

Dimensions in mm









Mounting position: any

Mass: ≈ 110 g

(1) The base passes a flat gauge with a centre hole of ϕ 9,00 ± 0,01 mm and holes for passing the pins with the following diameters: 7 holes of ϕ 1,750 ± 0,005 mm and one hole of ϕ 3,000 ± 0,005 mm. The holes may deviate max. 0,01 mm from their true geometrical position. Thickness of gauge 7 mm.

(2) The ends of the pins are tapered and/or rounded but not brought to a sharp point.

OPERATING CONDITIONS AND PERFORMANCE

Conditions (with Anti-Comet Tail action) 4)
All voltages are specifeid with respect to cathode

Cathode voltage,			
during read-out mode	V_k	0	V 5) 6) 7)
during ACT mode	V_k	0 to 10	V
Signal electrode voltage	V_{as}	45	V
Grid no. 6 (mesh) voltage	V_{g6}	675	V 7)
Grid no. 5 (collector) voltage	V_{g5}	600	V 7)
Grid no. 4 (limiter) and grid no. 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300	V 7)
Grid no. 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}	240 to 260	V 7)
during ACT mode	V_{g3}	0 to 10	V
Grid no. 1 (control grid) voltage	V_{g1}	see note 8)	
Blanking voltage to grid no. 1	V_{g1_p}	50	V 6) 9)
Scanned area on target		12,8 x 17,1	mm^2
Temperature of faceplate		20 to 45	^oC
Coil unit		AT1132/01	

Deflection, focusing and alignment currents

Focus current (adjusted for correct electrical focus) (mA)	Line deflection $current_{pp}$ (mA)	Frame deflection $current_{pp}$ (mA)
25	235	35

Line and frame alignment coil currents max. 5 mA,
corresponding to a flux density of approx. 4×10^{-4} T (4 Gs)

Performance

Dark current (without light bias)	<	3	nA
Sensitivity			
to white light of c.t. 2856 K		250	μA/lm
to light with P11 distribution		10×10^{-3}	μA/μW 10)
to light with P20 distribution		$7,5 \times 10^{-3}$	μA/μW 10)

Transfer characteristic	see page B143
Gamma of transfer characteristic below knee	0,95 ± 0,05
Spectral response	
Max. response at	approx. 550 nm
Cut-off at	approx. 650 nm
Response curve	see page B144

Resolution (I_s/I_b = 150/300 nA) 8) 11)
at 15 lp/mm (385 TV lines)

P11	P20	
45	40	%

Modulation transfer characteristic see page B144

Lag (typical values), white light (2856 K), P11, and P20

	build-up lag 12)				decay lag 13)			
	I_s/I_b = 20/300 nA		150/300 nA		20/300 nA		150/300 nA 8)	
	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)
without light bias	70	100	98	100	16	5	3,5	1,2
with 2,5 nA light bias 14)	98	100	99	100	11	2,5	2,8	0,9
with 5 nA light bias 14)	99	100	100	100	8	2	2,4	0,7

NOTES

1) All figures quoted in these data sheets refer to a scanned area of 12,8 mm x 17,1 mm. Underscanning of the once chosen area or failure of scanning should be avoided since this may cause damage to the photoconductive target.

2) For short intervals. During storage and idle periods the tube face must be covered with the plastic hood provided for the purpose, or the lens be capped.

3) For optimal screening of the signal-electrode from the live end of the line deflection coils the AT1132/01 is recommended.

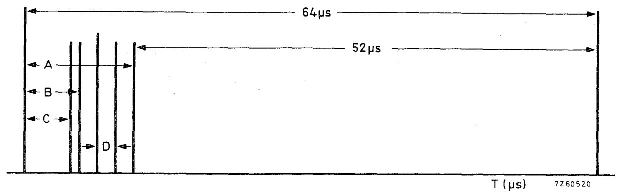
4) When the tube is to be used without Anti-Comet Tail action, grid no. 3 (auxiliary grid) should be connected to grids no. 2 and no. 4 and no ACT pulses should be applied to the cathode and grid no. 1 (control grid). The performance of the tube will then be as described herein with the exception of the highlight handling.

5) a. Read-out mode: defined as the operating conditions during the active line scan (full line period - line blanking interval).
For the CCIR system this will amount to 64 μs - 12 μs = 52 μs.

b. ACT mode: defined as the operating conditions during that part of the line blanking interval during which the ACT electrode gun is fully operative.
The ACT interval is equal to or is slightly within the line flyback time.

6) Pulse timing and amplitudes for ACT action (CCIR system) (blanking on grid no. 1)
For proper operation of the ACT electrode gun three pulses are required, being:
a. - a positive-going pulse on the cathode with an adjustable amplitude of 0 to 10 V.
b. - a positive-going pulse on grid no. 1 (control grid) of fixed amplitude of 30 to 35 V. The duration of this pulse should be chosen such that it just includes the flyback period (≈ 5 μs) of the line deflection.
c. - a negative-going pulse on grid no. 3 (auxiliary grid) with an amplitude of approx. 240 V, adjusted for a V_{g3} voltage during the ACT interval of 0 to 10 V. Duration and timing of this pulse should be equal to those of the grid no. 1 pulse.

The timing diagram is as follows:



A = Line blanking period: ≈ 12 μs, V_k pulse
B = ACT period: ≈ 6 μs, grids no. 1 and no. 3 pulses
C = Line flyback period: ≈ 5 μs
D = Clamping time: 2 to 3 μs

7) The d.c. voltage supply and /or pulse supply to these electrodes should have a sufficiently low impedance to prevent distortion caused by the peak currents drawn during the ACT mode.
These peak currents may amount to:

grid no. 1	0 mA
grids no. 2 and no. 4	1 mA
grid no. 3	150 μA
grid no. 5	300 μA
grid no. 6	300 μA

8) Adjusted, with the ACT switched off, to produce a beam current I_b = 300 nA. I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.

In the performance figures e.g. for resolution and lag the signal current and beam current conditions are given as I_s/I_b = 20/300 nA.
This hence means: with a signal current of 20 nA and a beam setting which just allows a signal current of 300 nA.

N.B. The signal currents are measured with an integrated instrument connected in the signal-electrode lead, and an uniform illumination on the scanned area. The peak signal currents as measured on a waveform oscilloscope will be a factor α larger ($\alpha = \frac{100}{100-\beta}$), β being the total blanking time in %; for CCIR system α amounts to 1,3).

9) Blanking can also be applied to the cathode:
a. - without ACT action (see note 4): required cathode pulse approx. 25 V
b. - with ACT action: timing, polarity and amplitudes of the ACT pulses will have to be adapted.

10) The figures shown represent the signal output current in μA obtained per μW of electrical input power into a P11 or P20 phosphor on a fibre optic output window of e.g. an image intensifier or a converter tube.

The figures were obtained as the product S x T_1^2 x η (see table below)

		symbol	P11	P20	unit
Plumbicon tube target	Sensitivity of photoconductive target		1800	290	μA/lm
	Conversion factor Watt to lumen		140	480	lm/W
	Sensitivity of photoconductive target	S	0,25	0,14	μA/μW
Fibre optics	Transmission of a fibre plate	T_1*	60	60	%
Phosphor	Luminous efficiency of phosphor	η**	10	14	%

* For the sake of simplicity it is assumed that the fibre optics in the output window and in the Plumbicon tube faceplate are identical.

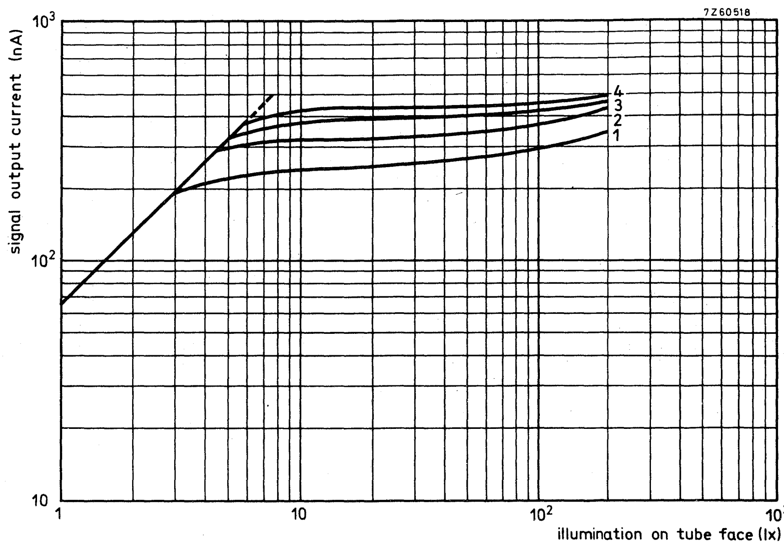
** The phosphors being usually metal-backed, the figures for the luminous efficiencies have been corrected for the effects of the backing.

11) Measured with a test transparency with the emulsion side in direct contact with the faceplate and which is illuminated with diffused light (lambertian illumination).
The test transparency has square wave patterns in a white background.
The figures given relate to a low frequency reference obtained from a square wave pattern of 1,0 lp/mm (330 kHz).

12) After 10 seconds of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms respectively 200 ms after the illumination has been applied.

13) After a minimum of 5 s of illumination on the target. The figures given represent typical residual signals in % of the original signal current 60 ms respectively 200 ms after the illumination has been removed.

→ 14) The bias light lamp 56027 fits in the socket 56025 and projects its light on the pumping stem via a blue-green transmitting filter. The light is conducted to cause a bias illumination on the target.
The desired amount of light bias can be obtained by adjusting the current through the filament of the small bulb.



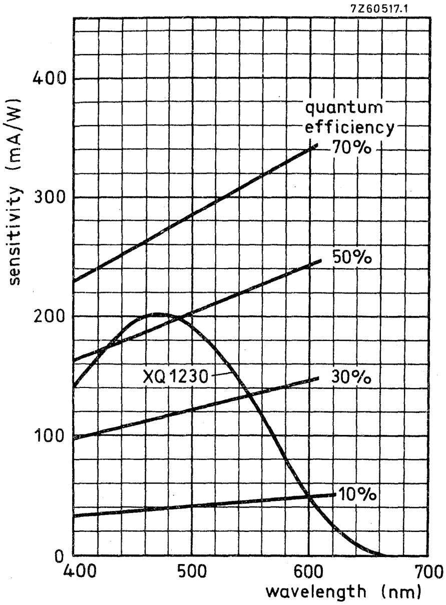
(2856 K)

Typical signal output characteristics in ACT operation

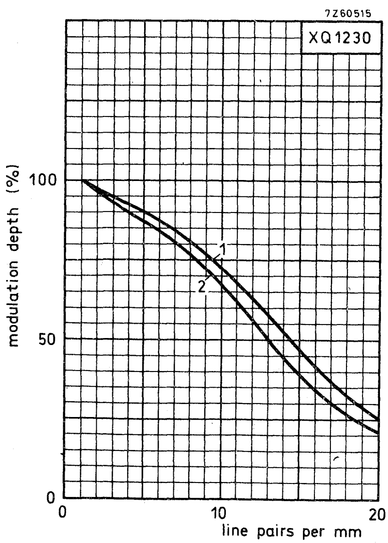
Scanning area : 12, 8 mm x 17, 1 mm

Beam current : just sufficient to stabilize 500 nA signal current

Cathode voltage during flyback:
curve 1 : 4, 5 V
curve 2 : 6 V
curve 3 : 7, 5 V
curve 4 : 9 V



Typical spectral response characteristic



Typical square wave modulation transfer characteristic in tube centre
(1) for blue light (P11)
(2) for green light (P20)
Measuring conditions : see note 11

CAMERA TUBES

Plumbicon, * 30 mm (1,2 in) diameter television camera tube with high resolution lead-oxide photoconductive target, separate mesh, magnetic deflection and magnetic focusing. The tubes of the XQ1410 series are interchangeable with those of the XQ1020 series and feature an increased resolution,provisions **for both fixed and adjustable** light bias for reduction of lag under low-key conditions. The XQ1410 is intended for use in black and white cameras, the XQ1410-L, R, G, and B in colour cameras in broadcast, educational and high quality industrial applications.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	approx. 30 mm (1,2 in)
Length	approx. 215 mm (8,5 in)
Special features	Anti-halation glass disc Adjustable light bias
Heater	6,3 V, 300 mA
Resolution	⩾ 750 TV lines
Cut-off of spectral response	approx. 650 nm

OPTICAL DATA

				notes
Quality rectangle on photoconductive target (aspect ratio 3: 4)		12,8 mm x 17,1	mm	1

Orientation of image on photoconductive target:

For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the base of the tube.

Faceplate

Thickness		1,2	mm
Refractive index	n	1,49	
Refractive index of the anti-halation glass disc	n	1,52	

* Registered Trade Mark for television camera tube.

			notes
HEATING			
Indirect by a.c. or d.c.; parallel supply			
Heater voltage	V_f	6,3 V ± 5%	
Heater current at V_f = 6,3 V	I_f nom.	300 mA	

To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE			
Signal electrode to all	C_{as}	3 to 6 pF	

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

DEFLECTION		magnetic	2
FOCUSING		magnetic	2
ACCESSORIES			
Socket		type 56021 or 56025	
Light bias lamp in holder		type 56106	3a
Adapters for fixed light bias			
B/W tubes		type 56122	3b
R tubes		type 56123	
G,L tubes		type 56124	
B tubes		type 56125	
Deflection and focusing coil unit	black/white	type AT1132/01	
	colour	type AT1113/01 or equivalent	

ELECTRON GUN CHARACTERISTICS

Cut-off			
Grid 1 voltage for cut-off at V_{g2} = 300 V without blanking applied	V_{g1}	−30 to −100 V	
Blanking voltage, peak-to-peak,			
on grid 1	$V_{g1p\text{-}p}$	50 ± 10 V	
on cathode	$V_{kp\text{-}p}$	25 V	
Grid 2 current at normally required beam currents	I_{g2}	< 1 mA	

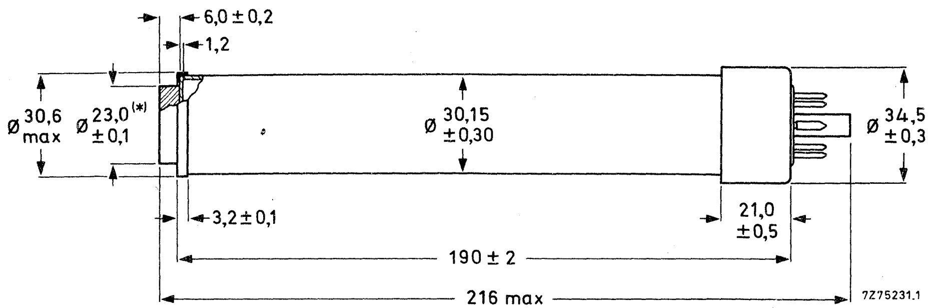
LIMITING VALUES (Absolute maximum rating system)

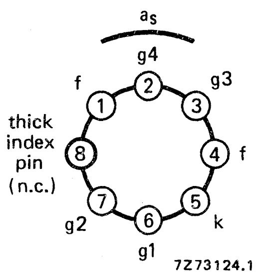
Unless otherwise stated, all voltages are referred to the cathode.

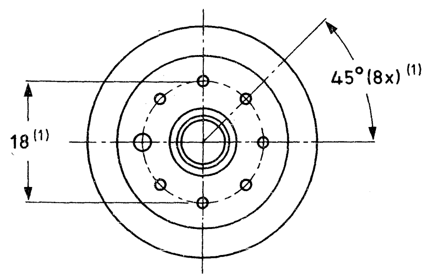
				notes
Signal electrode voltage	V_{as}	max.	50 V	
Grid 4 voltage	V_{g4}	max.	1100 V	
Grid 3 voltage	V_{g3}	max.	800 V	
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	350 V	
Grid 2 voltage	V_{g2}	max.	350 V	
Grid 2 dissipation	W_{g2}	max.	1 W	
Grid 1 voltage				
positive	V_{g1}	max.	0 V	
negative	$-V_{g1}$	max.	125 V	
Cathode to heater voltage,				
positive peak	V_{kfp}	max.	50 V	
negative peak	$-V_{kfp}$	max.	50 V	
Cathode heating time before drawing cathode current	T_h	min.	60 s	
Ambient temperature, storage and operation	t_{amb}	max.	50 °C	
		min.	−30 °C	
Faceplate temperature, storage and operation	t	max.	50 °C	
		min.	−30 °C	
Faceplate illumination	E	max.	500 lx	4

MECHANICAL DATA

Dimensions in mm

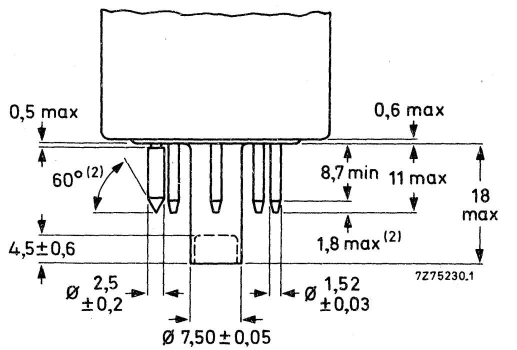






Mounting position: any

Mass: ≈ 100 g



(*) Distance between axis of anti-halation glass disc and geometrical centre of signal electrode ring, measured in plane of faceplate: max. 0,2 mm. Total glass thickness: 7,2 ± 0,2 mm.

(1) The base passes a flat gauge with a centre hole 8,230 ± 0,005 mm diameter and holes for passing the pins with the following diameters: 7 holes of 1,690 ± 0,005 mm and one hole of 2,950 ± 0,005 mm. The holes may deviate max. 0,01 mm from their true geometrical position. Thickness of gauge 7 mm.

(2) The ends of the pins are tapered and/or rounded but not brought to a sharp point.

OPERATING CONDITIONS AND PERFORMANCE

Conditions

			notes
For a scanned area of 12,8 mm x 17,1 mm			
Cathode voltage	V_k	0 V	
Grid 2 voltage	V_{g2}	300 V	
Signal electrode voltage	V_{as}	45 V	5
Grid 3 voltage	V_{g3}	600 V	
Grid 4 voltage	V_{g4}	675 V	
Beam current	I_b		6
Focusing and deflection coil current			7
Faceplate illumination			8,9
Faceplate temperature	t	20 to 45 °C	
Blanking voltage on grid 1, peak-to-peak	$V_{g1p\text{-}p}$	50 V	

Performance

	min.	typ.	notes
Dark current (without light bias)		≤ 2 nA	
Sensitivity at colour temperature of illumination = 2856 K			10
XQ1410	375	400 μA/lm	
XQ1410L	375	400 μA/lm	
XQ1410R	70	85 μA/lmF	
XQ1410G	135	165 μA/lmF	
XQ1410B	35	38 μA/lmF	
Gamma of transfer characteristic		0,95 ± 0,05	11
Spectral response			
maximum response at		≈ 500 nm	
cut-off at		≈ 650 nm	
response curve		see Fig. 1.	

Resolution

Modulation depth, i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures shown represent the horizontal amplitude response of the tube as measured with a lens aperture of f: 5,6. See note 12.

		XQ1410; L	XQ1410R	XQ1410G	XQ1410B
Highlight signal current	I_s	0,3 μA	0,15 μA	0,3 μA	0,15 μA
Beam current	I_b	0,6 μA	0,3 μA	0,6 μA	0,3 μA
Modulation depth at 400 TV lines in %	typ.	55	50	55	60
	min.	50	40	50	50

Limiting resolution ⩾ 750 TV lines

Lag (typical values)

Light source with a colour temperature of 2856 K.
Appropriate filter inserted in the light path for the chrominance tubes R, G, and B, see note 12.

Low key conditions (without light bias)

	build-up lag, see note 13				decay lag, see note 14			
	I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA		I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1410 XQ1410L XQ1410G			95	≈ 100			9	3
XQ1410R	85	≈ 100			13	3,5		
XQ1410B	70	≈ 100			15	5,5		

Low key conditions (with light bias)

Typical effect of light bias on both build-up and decay lag under low key signal current and beam current settings (I_s/I_b see note 6) are shown in Figs 3 to 8. See notes 13, 14, 15.

High key conditions (with and without light bias)

	build-up lag, see note 13				decay lag, see note 14			
	I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA		I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1410 XQ1410L XQ1410G			99	100			1,2	0,4
XQ1410R	98	100			2	0,5		
XQ1410B	97	100			3,5	2		

Shading of light bias induced dark current: 12,5%, see note 16.

NOTES

1. Underscanning of the specified target area of 12,8 mm x 17,1 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive target.
2. For focusing/deflection coil unit see under "Accessories".
3. a. Adjustable light bias. The light bias lamp assembly as supplied with each tube, type 56106, fits in the metal tube cemented to the pumping stem of the tube. The tube and the light bias lamp assembly will fit properly in the 56021 and 56025 socket. The wires should be connected to a source, capable of supplying max. 110 mA at 5 V. Considerations and recommendations for the choice of such a source, depending on the application, are supplied with each tube. The light bias lamp projects its light via a blue-green transmitting filter on the pumping stem where it is conducted to the target to cause a bias illumination. The desired amount of light bias can be obtained by adjusting the current through the filament of the lamp. See also note 15.

   b. Fixed light bias. An adapter is supplied with each tube, connecting a small lamp via a calibrated series resistor to the heater pins. The heater supply should be stabilized at 6,3 ± 0,1 V and be capable of supplying an additional current of 95 mA. The adapter is colour coded according to the application of the tube.
4. For short intervals. During storage the tube shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.
5. The signal electrode voltage shall be adjusted to 45 V. To enable the tube to handle excessive highlights in the scene to be televised the signal electrode voltage may be reduced to a minimum of 25 V, this will, however, result in some reduction in performance.
6. The beam current I_b, as obtained by adjusting the control grid (grid 1) voltage is set to 300 nA for R and B tubes, 600 nA for black and white, L and G tubes. I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.

   In the performance figures, e.g. for resolution and lag, the signal current and beam current conditions are given, e.g. as I_s/I_b = 20/300 nA. Hence this means: with a signal current of 20 nA and a beam setting which just allows a signal current of 300 nA.

   N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area. The peak signal currents as measured on a waveform oscilloscope will be a factor α larger.
   (α = 100/100-β, β being the total blanking time in %): for the CCIR system α amounts to 1,3.

7.

	Focus current * mA	Line current (p-p) mA	Frame current (p-p) mA
Black and white coil assemblies AT1132/01 $V_{g3} = 600$ V, $V_{g4} = 650$ to 700 V	25	235	35
Colour coil assemblies AT1113/01 $V_{g3} = 600$ V, $V_{g4} = 650$ to 700 V	100	235	35
		(approx. values)	

* Adjusted for correct electrical focus.

The direction of the current through the focusing coil should be chosen such that a north-seeking pole will be repelled at the faceplate end of the coil. The optimum voltage difference between grid 4 and grid 3 depends on the type of focusing/deflection assembly used. For above types a voltage difference of 50 V to 100 V is recommended.

8. Typical faceplate illumination level for the XQ1410 and XQ1410L to produce 0,3 μA signal current will be approx. 4 lx. The signal currents stated for the colour tubes XQ1410R, G, and B will be obtained with an incident white light level (2856 K) on the filter of approx. 10 lx. These figures are based on the filters described in note 10. For filter BG12, however, a thickness of 1 mm is chosen.

9. In the case of a black/white camera the illumination on the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{RT}{4F^2 (m + 1)^2}$$

in which R represents the average scene reflectivity, or the object reflectivity, whichever is relevant; T is the lens transmission factor. F is the lens aperture, and m the linear magnification from scene to target.

A similar formula may be derived for the illumination level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the complete optical system have been taken into account.

10. Measuring conditions: Illumination 4,54 lx at black body colour temperature of 2856 K, the appropriate filter inserted in the light path. The signal current obtained in nA is a measure of the colour sensitivity expressed in μA per lumen of white light before the filter.

Filters used:

XQ1410R	Schott	OG570	thickness	3 mm
XQ1410G	Schott	VG9	thickness	1 mm
XQ1410B	Schott	BG12	thickness	3 mm

See Fig. 2.

11. Gamma-stretching circuitry is recommended.

12. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affect neither the vertical resolution nor the limiting resolution.

13. Build-up lag. After 10 s of darkness. The values and curves shown represent the typical percentages of the ultimate signal obtained as a function of the time (in units of 20 ms = field period for CCIR system) after the illumination has been applied.

14. Decay lag. After a minimum of 5 s of illumination on the target. The values and curves shown represent the residual signal currents in percentages of the original signal current as a function of time (in units of 20 ms = field period for CCIR system) after the illumination has been removed.

15. a. For monochrome operation a light bias, corresponding to 5 nA extra dark current is usually adequate for excellent speed of response.

b. In a colour camera the speeds of response of the tubes can be balanced by adjusting the amount of light bias per tube. In a 3-tube R, G, B camera, for instance, it is recommended first to adjust the tubes to their normal highlight signal current and beam current settings and then point the camera at a dark scene comprising a metronome. The moving hand of the metronome carries a small white square. The illumination should be chosen such that the square produces a peak signal of approx. 50 nA in the green chrominance channel. A max. of 3 nA artificial dark current shall then be induced in the green chrominance tube. Subsequently light bias shall be applied to the tubes in the red and blue channels, until the lag of the three tubes is neutralized. A typical setting for correct speeds of response in a 3-tube R, G, B camera with a colour splitter as in the Philips LDK3 camera would be 2 to 3 nA (R), 1 to 3 nA (G) and 6 to 8 nA (B).

16. Deviation of the level of any of the four corners, i.e. 10% inwards in H and V direction from the level in picture centre. With the settings suggested in note 15 black shading compensation in the camera video processing amplifier will not normally be required. Further improvement in lag can be obtained by applying still higher light bias levels. It may then be necessary to use black shading compensation in the video processing amplifier.

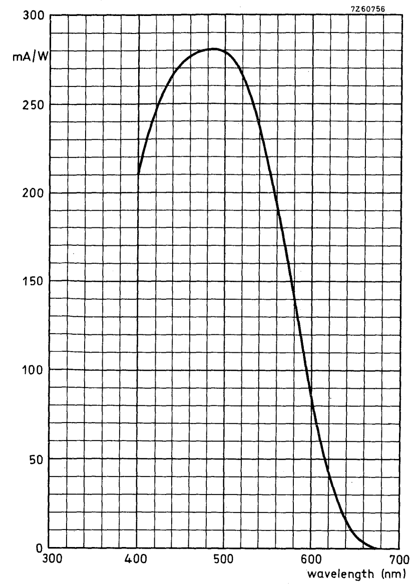


Fig. 1 Spectral response curve.

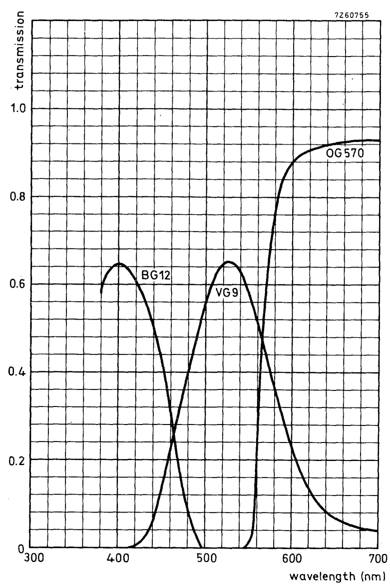


Fig. 2 Transmission of filters BG12, VG9, and OG570.

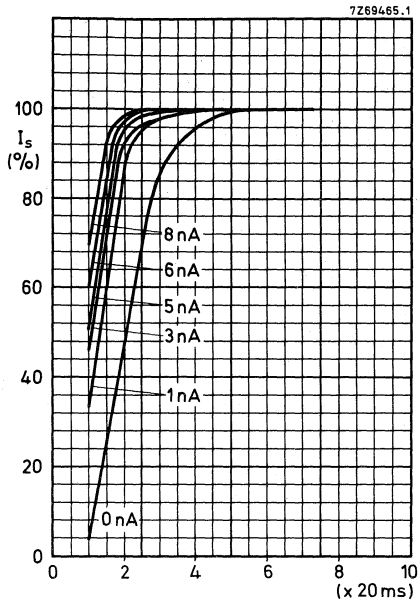


Fig. 3.

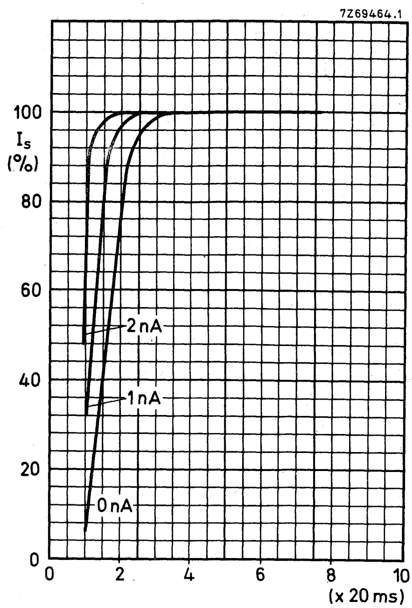


Fig. 4.

Build-up lag (see note 13)

Light bias induced dark current as parameter.

Fig. 3 XQ1410R: I_s/I_b = 20/300 nA.

Fig. 4 XQ1410, XQ1410L, XQ1410G: I_s/I_b = 40/600 nA.

Fig. 5 XQ1410B: I_s/I_b = 20/300 nA.

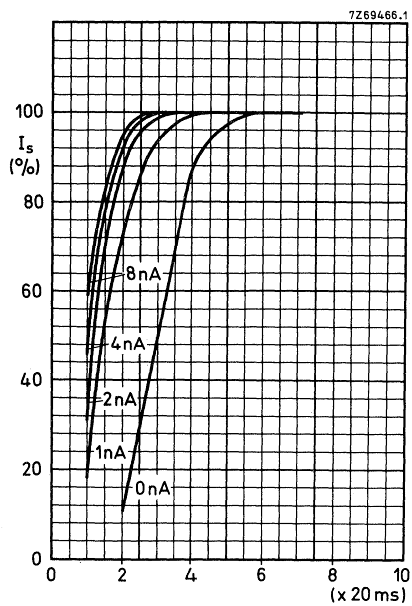


Fig. 5.

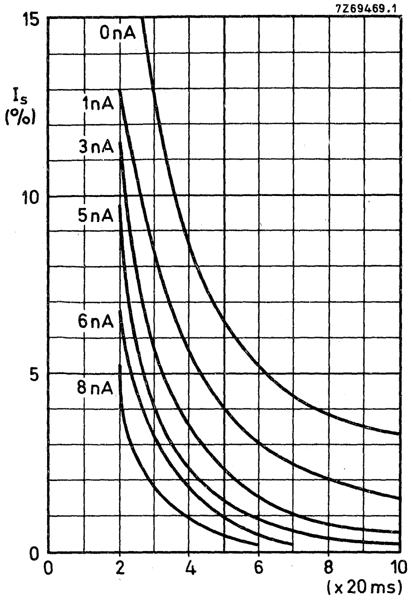


Fig. 6.

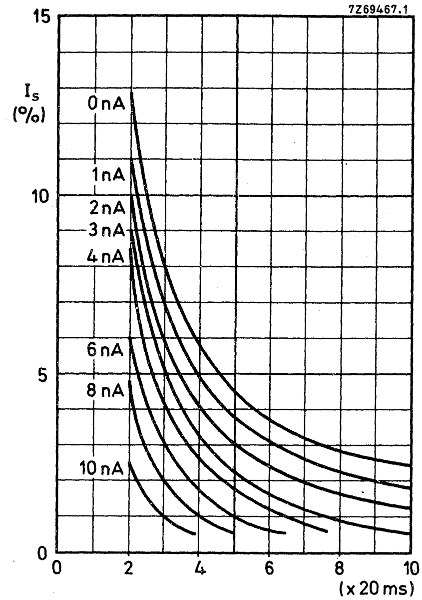


Fig. 7.

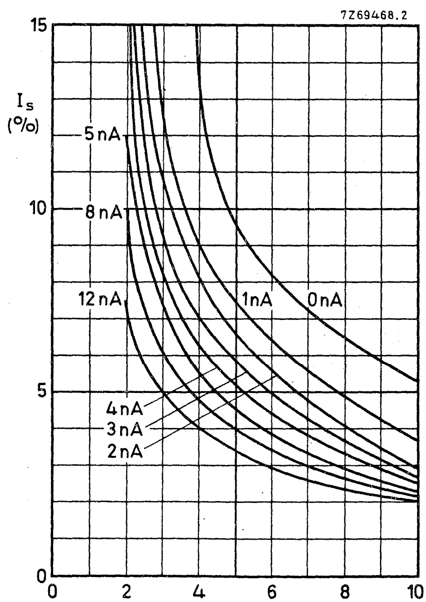


Fig. 8.

Decay lag (see note 14)

Light bias induced dark current as parameter.

Fig. 6 XQ1410R: I_s/I_b = 20/300 nA.

Fig. 7 XQ1410, XQ1410L, XQ1410G: I_s/I_b = 40/600 nA.

Fig. 8 XQ1410B: I_s/I_b = 20/300 nA.

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1410 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1411	for use in black and white cameras
XQ1411R XQ1411G XQ1411B	for use in the chrominance channels of colour cameras

For all further information see data of the XQ1410 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon*, 30 mm (1,2 in) diameter television camera tube with high resolution lead-oxide photoconductive target with extended red response, separate mesh, magnetic deflection, and magnetic focusing. The tubes of the XQ1413 series are interchangeable with those of the XQ1023 series and feature provision for **both fixed and adjustable** light bias for reduction of lag under low-key conditions.

The XQ1413 is intended for use in black and white cameras, the XQ1413L, and R in colour cameras in broadcast, educational and high-quality industrial applications.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	approx. 30 mm (1,2 in)
Length	approx. 215 mm (8,5 in)
Special features	anti-halation glass disc fixed or adjustable light bias
Heater	6,3 V, 300 mA
Resolution	⩾ 750 TV lines
Cut-off of spectral response	850 to 950 nm

OPTICAL DATA

				notes
Quality rectangle on photoconductive target (aspect ratio 3 : 4)		12,8 mm x 17,1	mm	1

Orientation of image on photoconductive target

For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the base of the tube.

Faceplate			
Thickness		1,2	mm
Refractive index	n	1,49	
Refractive index of the anti-halation glass disc	n	1,52	

* Registered Trade Mark for television camera tube.

HEATING

			notes
Indirect by a.c. or d.c.; parallel supply			
Heater voltage	V_f	6,3 V ± 5%	
Heater current at V_f = 6,3 V	I_f	nom. 300 mA	

To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE

Signal electrode to all	C_{as}	3 to 6 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

DEFLECTION	magnetic	2
FOCUSING	magnetic	2

ACCESSORIES

Socket		type 56021 or 56025	
Light bias lamp in holder (for adjustable light bias)		type 56106	3a
Adapters (for fixed light bias)			3b
B/W tubes		type 56122	
R tubes		type 56123	
Deflection and focusing coil unit	black/white	type AT1132/01	
	colour	type AT1113/01 or equivalent	

ELECTRON GUN CHARACTERISTICS

Cut-off		
Grid 1 voltage for cut-off at V_{g2} = 300 V without blanking applied	V_{g1}	−30 to −100 V
Blanking voltage, peak-to-peak		
on grid 1	$V_{g1p\text{-}p}$	50 ± 10 V
on cathode	$V_{kp\text{-}p}$	25 V
Grid 2 current at normally required beam currents	I_{g2}	< 1 mA

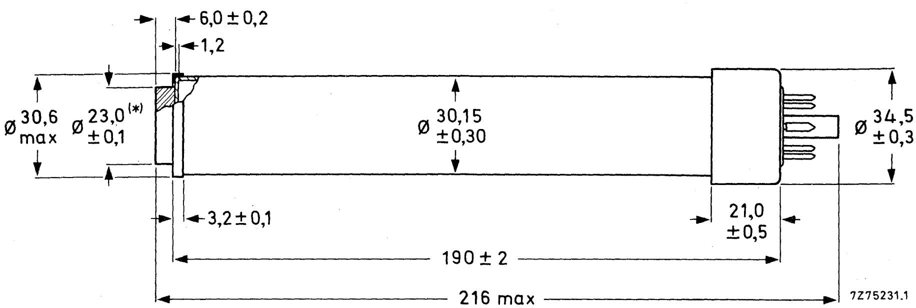
LIMITING VALUES (Absolute maximum rating system)

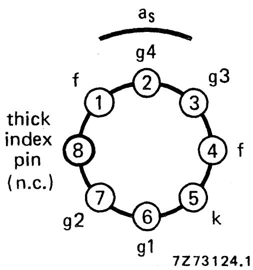
Unless otherwise stated, all voltages are referred to the cathode

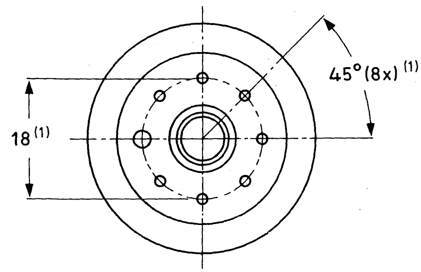
Signal electrode voltage	V_{as}	max.	50 V
Grid 4 voltage	V_{g4}	max.	1100 V
Grid 3 voltage	V_{g3}	max.	800 V
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	350 V
Grid 2 voltage	V_{g2}	max.	350 V
Grid 2 dissipation	W_{g2}	max.	1 W
Grid 1 voltage			
positive	V_{g1}	max.	0 V
negative	$-V_{g1}$	max.	125 V
Cathode-to-heater voltage,			
positive peak	V_{kfp}	max.	50 V
negative peak	$-V_{kfp}$	max.	50 V
Cathode heating time before drawing cathode current	T_h	min.	1 min.
Ambient temperature, storage and operation	t_{amb}	max.	50 °C
		min.	−30 °C
Faceplate temperature, storage and operation	t	max.	50 °C
		min.	−30 °C
Faceplate illumination	E	max.	100 lx
			see note 4

MECHANICAL DATA

Dimensions in mm

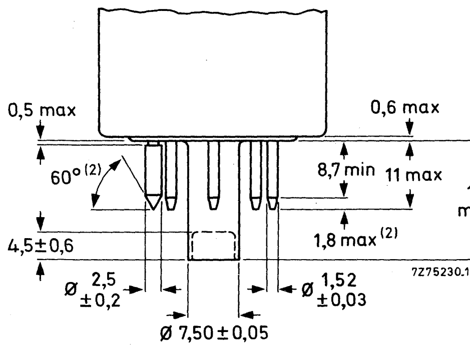






Mounting position: any

Mass: ≈ 100 g



(*) Distance between axis of anti-halation glass disc and geometrical centre of signal electrode ring, measured in plane of faceplate: max. 0,2 mm. Total glass thickness: 7,2 ± 0,2 mm.

(1) The base passes a flat gauge with a centre hole 8,230 ± 0,005 mm diameter and holes for passing the pins with the following diameters: 7 holes of 1,690 ± 0,005 mm and one hole of 2,950 ± 0,005 mm. The holes may deviate max. 0,01 mm from their true geometrical position. Thickness of gauge 7 mm.

(2) The ends of the pins are tapered and/or rounded but not brought to a sharp point.

OPERATING CONDITIONS AND PERFORMANCE

Conditions

			notes
For a scanned area of 12,8 mm x 17,1 mm			
Cathode voltage	V_k	0 V	
Grid 2 voltage	V_{g2}	300 V	
Signal electrode voltage	V_{as}	45 V	5
Grid 3 voltage	V_{g3}	600 V	
Grid 4 voltage	V_{g4}	675 V	
Beam current	I_b		6
Focusing and deflection coil current			7
Faceplate illumination			8, 9
Faceplate temperature	t	20 to 45 ^oC	
Blanking voltage on grid 1, peak-to-peak	V_{g1p-p}	50 V	

Performance

Dark current (without light bias)		$\leqslant$2 nA		
Sensitivity at colour temperature of illumination = 2856 K	min.	typ.		10a, 10b
XQ1413, XQ1413L	390	450	μA/lmF	
XQ1413R	120	150	μA/lmF	
Gamma of transfer characteristic	0,95 ± 0,05			11
Spectral response				
maximum response at	$\approx$	500	nm	
cut-off at	850 to	950	nm	12
response curve	see Fig. 1.			

Resolution

Modulation depth, i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures shown represent the horizontal amplitude response of the tube as measured with a lens aperture of F: 5,6. See note 13.

		XQ1413, L	XQ1413R
Highlight signal current	I_s	0,3 μA	0,15 μA
Beam current	I_b	0,6 μA	0,3 μA
Modulation depth at 400 TV lines in %	typ.	60	55
	min.	50	45

Limiting resolution ⩾ 750 TV lines

For modulation transfer characteristics see Fig. 3.

Lag

Light source with a colour temperature of 2856K, appropriate filter inserted in the light path for the chrominance tube XQ1413R: see notes 10a, 10b.

Low-key conditions (with light bias). See notes 14, 15, 16, 17. Typical effect of light bias on both build-up and decay lag under low-key signal current and beam current settings (I_s/I_b see note 6) are shown in Figs 4 to 7.

High-key conditions (with and without light bias)

	build-up lag, see note 14				decay lag, see note 15			
	I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA		I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1413 XQ1413L			98	100			3	1,5
XQ1413R	96	100			5	2		

Shading of light bias induced dark current: 12,5%, see note 18.

NOTES

1. Underscanning of the specified target area of 12,8 mm x 17,1 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive target.
2. For focusing/deflection coil unit see under "Accessories".

3a. Adjustable light bias. The light bias lamp assembly as supplied with each tube, type 56106, fits in the metal tube cemented to the pumping stem of the tube. The tube and the light bias lamp assembly will fit properly in the 56021 and 56025 socket. The wires should be connected to a source, capable of supplying max. 110 mA at 5 V. Considerations and recommendations for the choice of such a source, depending on the application, are supplied with each tube. The light bias lamp projects its light via a blue-green transmitting filter on the pumping stem where it is conducted to the target to cause a bias illumination. The desired amount of light bias can be obtained by adjusting the current through the filament of the lamp.

3b. Fixed light bias. An adapter is supplied with each tube, connecting a small lamp via a calibrated series resistor to the heater pins. The heater supply should be stabilized at 6,3 ± 0,1 V and be capable of supplying an additional current of 95 mA. The adapter is colour coded according to the application of the tube.

4. For short intervals. during storage the tube shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.
5. The signal electrode voltage shall be adjusted to 45 V. To enable the tube to handle excessive highlights in the scene to be televised the signal electrode voltage may be reduced to a minimum of 25 V, this will, however, result in some reduction in performance.
6. The beam current I_b, as obtained by adjusting the control grid (grid 1) voltage is set to 300 nA for R tubes, 600 nA for black and white and L tubes. I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.

   In the performance figures, e.g. for resolution and lag, the signal current and beam current conditions are given, e.g. as I_s/I_b = 20/300 nA. This means; with a signal current of 20 nA and a beam setting which just allows a signal current of 300 nA.

   N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area. The peak signal currents as measured on a waveform oscilloscope will be factor α larger.
   (α = 100/100 − β, β being the total blanking time in %): for the CCIR system α amounts to 1,3.

7.

	focus current * mA	line current (p-p) mA	frame current (p-p) mA
Black and white coil assemblies AT1132/01 V_{g3} = 600 V, V_{g4} = 650 to 700 V	25	235	35
Colour coil assemblies AT1113/01 V_{g3} = 600 V, V_{g4} = 650 to 700 V	100	235	35

(approx. values)

* Adjusted for correct electrical focus.

The direction of the current through the focusing coil should be chosen such that a north-seeking pole will be repelled at the faceplate end of the coil. The optimum voltage difference between grid 4 and grid 3 depends on the type of focusing/deflection assembly used. For above types a voltage difference of 50 V to 100 V is recommended.

8. Typical faceplate illumination level for the XQ1413 and XQ1413L to produce 0,3 μA signal current will be approx. 4 lx. The signal currents stated for the colour tube XQ1413R will be obtained with an incident white light level (2856 K) on the filter of approx. 10 lx. These figures are based on the filters described in note 10.

9. In the case of a black/white camera the illumination on the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{RT}{4F^2 (m + 1)^2}$$

in which R represents the average scene reflectivity, or the object reflectivity, whichever is relevant; T is the lens transmission factor. F is the lens aperture, and m the linear magnification from scene to target.

A similar formula may be derived for the illumination level on the photoconductive layers of the R tube in which the effects of the various components of the complete optical system have been taken into account.

10a. All measurements are made with an infrared reflecting filter interposed between light source and target. Balzers Calflex B1/K1 filter is chosen for this purpose since, for accurate colour reproduction in a colour camera, a similar infrared reflecting filter will be required. For typical transmission curve of this filter see Fig. 8.

10b. With an additional filter (see note 10a) interposed between light source and target. Filter used is: Schott OG570 (3 mm). For transmission curve see Fig. 2.

11. Gamma-stretching circuitry is recommended.

12. Defined as the wavelength at which the spectral response has dropped to 1% of the peak response.

13. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affect neither the vertical resolution not the limiting resolution.

14. Build-up lag. After 10 s of darkness. The values and curves shown represent the typical percentages of the ultimate signal obtained as a function of the time (in units of 20 ms = field period for CCIR system) after the illumination has been applied.

15. Decay lag. After a minimum of 5 s of illumination on the target. The values and curves shown represent the residual signal currents in percentages of the original signal current as a function of time (in units of 20 ms = field period for CCIR system) after the illumination has been removed.

16. The tubes are designed for operation with light bias, either applied to the front via the colour splitter of the camera, or applied to the pumping stem from where it is conducted to the target by means of light pipes. For the latter mode of operation special precautions have been taken, such as partical blackening of the envelope to prevent transmission of the bias light directly to the target via the envelope. This would cause peaked shading of the light bias induced dark current in the picture corners. This partial blackening, however, also absorbs the light emitted by the heater of the cathode, causing the tube to exhibit statistically slightly more beam discharge lag than the non-light-bias type XQ1023 when no light bias is applied.

17. Adjustable light bias.
   a. For monochrome operation a light bias, corresponding to 5 nA extra dark current is usually adequate for excellent speed of response.
   b. In a colour camera the speeds of response of the tubes can be balanced by adjusting the amount of light bias per tube. In a 3-tube R, G, B camera e.g., it is recommended that the tubes first be adjusted to their normal highlight signal current and beam current settings and then point the camera at a dark scene comprising a metronome. The moving hand of the metronome carries a small white square. The illumination should be chosen such that the square produces a peak signal of approx. 50 nA in the green chrominance channel. An artificial dark current of ≈ 1,5 nA shall then be induced in the green chrominance tube XQ1410G. Subsequently light bias shall

be applied to the tubes in the red channel, XQ1413R, and blue channel, XQ1410B, until the lag of the three tubes is neutralized. A typical setting for correct speeds of response in a 3-tube R, G, B camera with a colour splitter as in the Philips LDK3 camera would be ≈ 3 nA (R), ≈ 1,5 nA (G), and ≈ 5 nA (B).

Fixed light bias.

c. An attractive reduction in both build-up lag and decay lag is obtained, when the fixed light bias adapter, see note 3b, is applied.

18. Deviation of the level of any of the four corners, i.e. 10% inwards in H and V direction from the level in picture centre. With the settings suggested in note 17 black shading compensation in the camera video processing amplifier will not normally be required. Further improvement in lag can be obtained by applying still higher light bias levels. It may then be neccessary to use black shading compensation in the video processing amplifier.

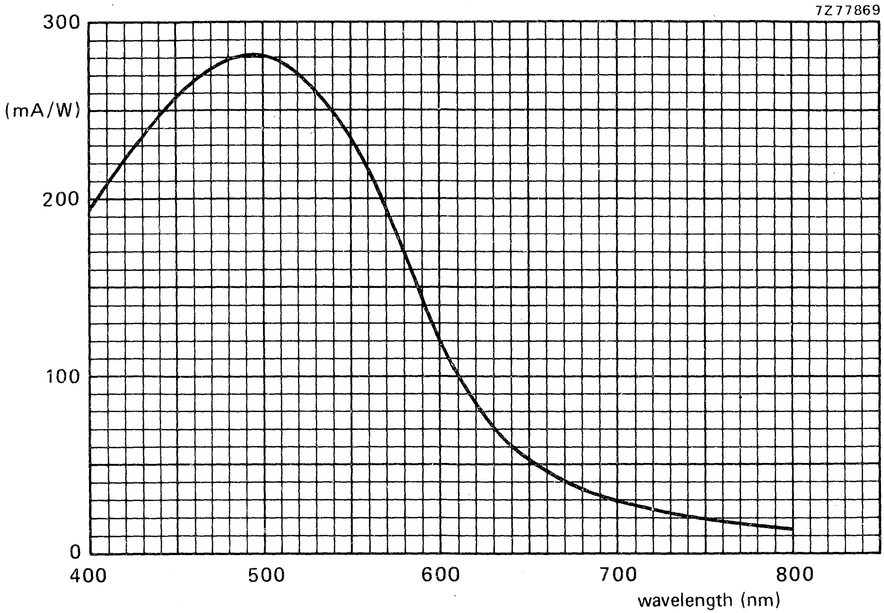


Fig. 1 Spectral sensitivity characteristic.

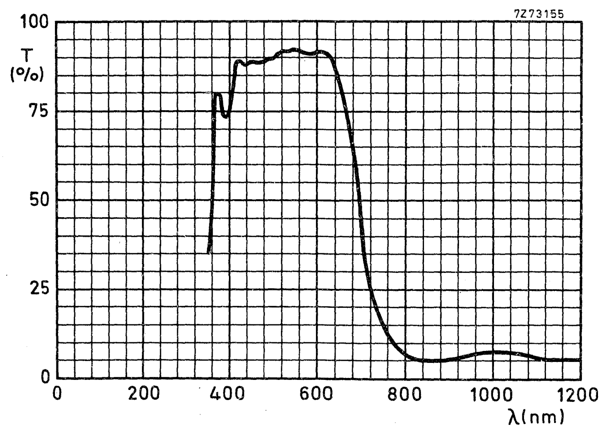


Fig. 2 Typical transmission curve of heat reflecting filter type CALFLEX B1/K1.

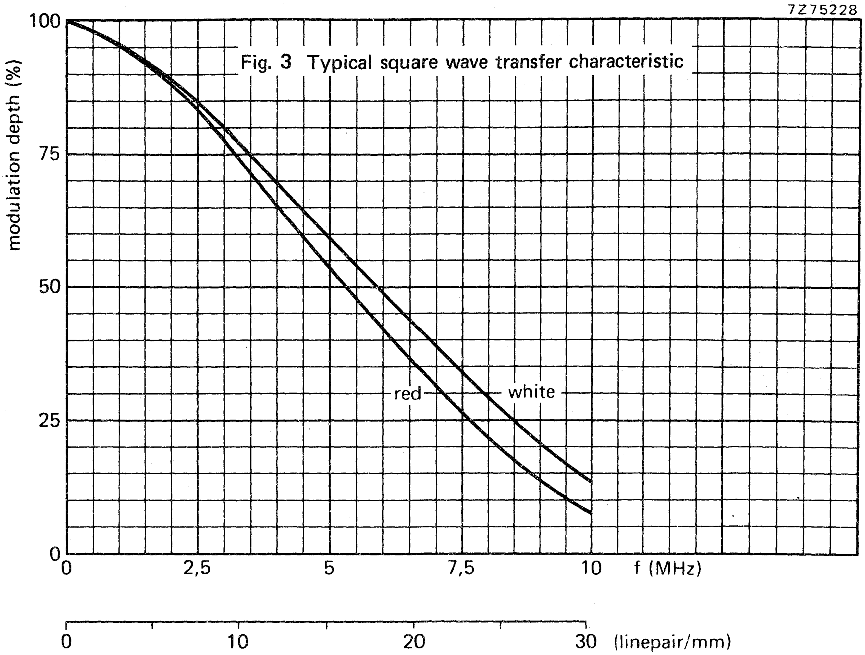


Fig. 3 Typical square wave transfer characteristic

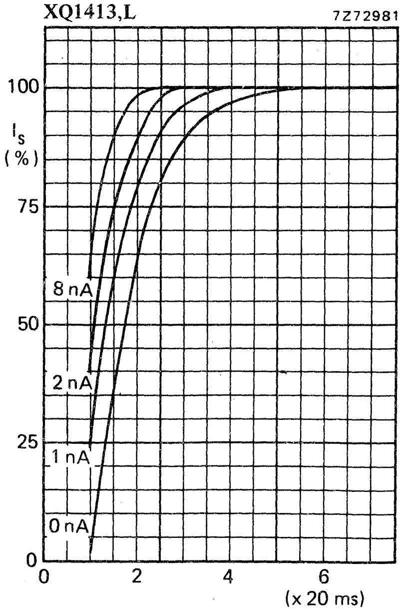


Fig. 4 Build-up lag: I_s/I_b = 40/600 nA.

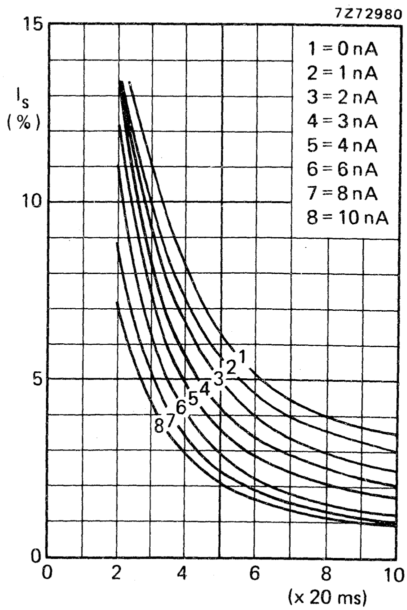


Fig. 5 Decay lag.

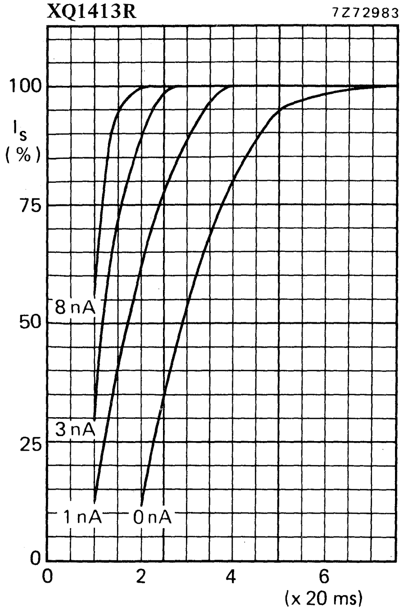


Fig. 6 Build-up lag: I_s/I_b = 20/300 nA.

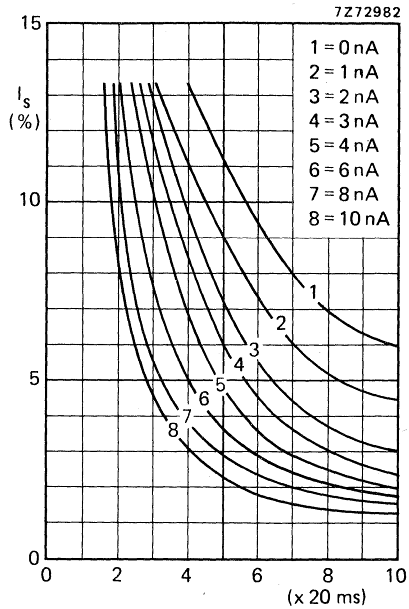


Fig. 7 Decay lag.

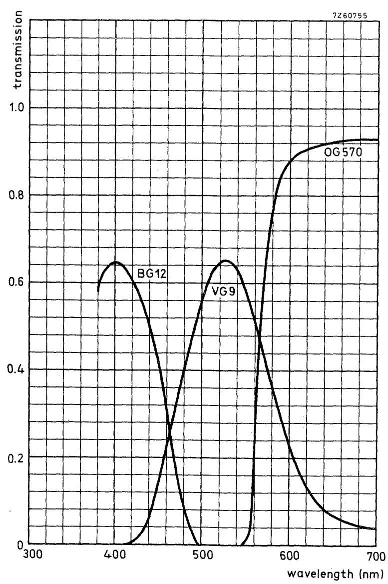


Fig. 8 Transmission of filters BG12, VG9 and OG570.

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1413 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1414	for use in black and white cameras
XQ1414R	for use in the red chrominance channel of colour cameras

For all further information see data of the XQ1413 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon*, 30 mm (1,2 in) diameter television camera tube with high resolution lead-oxide photoconductive target with extended red response, separate mesh, magnetic deflection, magnetic focusing and provisions for **both fixed and adjustable** light bias for reduction of lag under low-key conditions. The tubes of the XQ1415 series are identical to the tubes of the XQ1413 series but have an infrared reflecting filter on the anti-halation glass disc.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	≈ 30 mm (1, 2 in)
Length	215 mm (8, 5 in)
Special features	anti-halation glass disc with infrared reflecting filter fixed or adjustable light bias
Heater	6, 3 V, 300 mA
Resolution	≥ 750 TV lines
Cut-off of spectral response	≈ 750 nm

The infrared reflecting filter eliminates the need for additional filters in the optical systems when the XQ1415L and XQ1415R are applied in colour cameras originally designed for tubes of the XQ1020 series.

The spread in spectral responses in the long wavelength region as published for the XQ1413 and XQ1413R tubes is greatly reduced, warranting minimum differences in colour rendition between cameras of identical manufacture.

The XQ1415 will provide black and white pictures with true tonal rendition of colours, the spectral response approaching very nearly the relative spectral sensitivity of the human eye.

The XQ1415L is intended for use in the luminance channel of four-tube colour cameras, the XQ1415R for use in the red channel of both three and four tube colour cameras in broadcast, educational and high-quality industrial applications.

*) Registered Trade Mark for television camera tube.

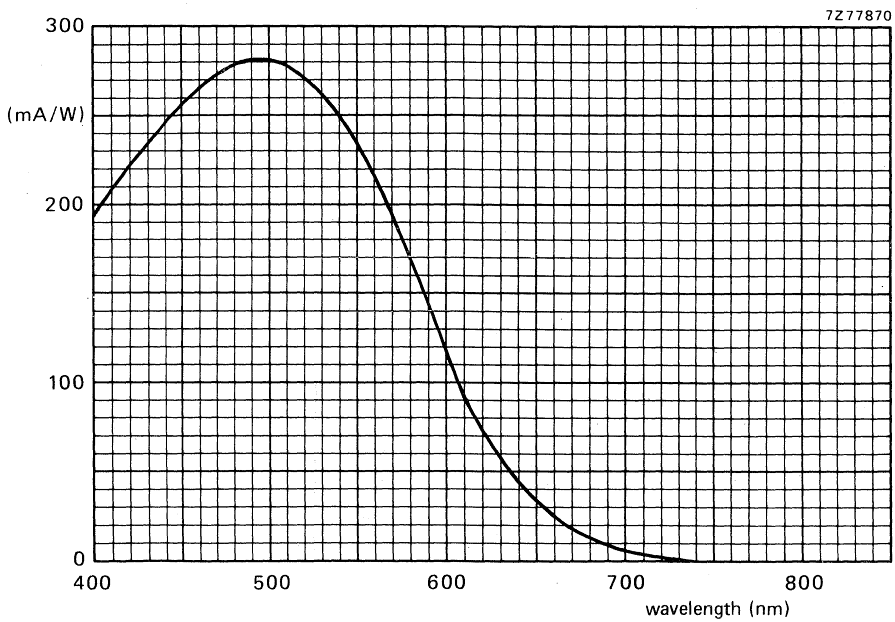
OPTICAL DATA

Spectral response	see curve below	
Maximum response at	500	nm
Cut-off	750	nm *

Filter Hard coating on anti-halation glass disc. Care in handling to avoid scratches is strongly recommended.

For further information refer to data of the XQ1413 series.

Note 10 of these data referring to Balzers B1/K1 filter does not apply.



Spectral sensitivity characteristic

* Defined as the wavelength at which the spectral response has dropped to < 1% of the peak response (≈ 500 nm).

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1415 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1416	for use in black and white cameras
XQ1416R	for use in the red chrominance channel of colour cameras

For all further information see data of the XQ1415 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Small size Plumbicon ® television camera tube with high resolution lead-oxide photoconductive target, low heater power, separate mesh, magnetic focusing and deflection and 17,7 mm (≈ 2/3 in) diameter.

The tubes of the XQ1427 series are mechanically interchangeable with 2/3 in diameter vidicons with separate mesh like the XQ1271 and have the same pin connections.

The tubes are specially selected to meet the high picture quality standard as required for black/white and colour cameras in broadcast (electronic journalism), educational, and high-quality industrial applications.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	17,7 mm (2/3 in)
Length	approx. 108 mm (4¼ in)
Provided with anti-halation glass disc	
Cut-off of spectral response	
XQ1427R	≈ 850 nm
XQ1427, G	≈ 650 to 850 nm
XQ1427B	≈ 650 nm
Heater	6,3 V, 95 mA
Resolution	⩾ 600 TV lines

OPTICAL

Quality rectangle on photoconductive target
(aspect ratio 3 : 4) (note 1) 6,6 mm x 8,8 mm

Orientation of image on target
For correct orientation of the image on the target the horizontal scan should be essentially parallel to the plane passing through the tube axis and the gap between pins 1 and 7.

Faceplate

Refractive index	n	1,49
Refractive index of the anti-halation glass disc	n	1,52

® Registered Trade Mark for television camera tube.

HEATING

Indirect by a.c. or d.c.; parallel or series supply

Heater voltage	V_f		6,3 V ±5%
Heater current, at V_f = 6,3 V	I_f	nom.	95 mA

When the tube is used in a series heater chain the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE

Signal electrode to all	C_{as}	1,5 to 3 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

DEFLECTION

magnetic (note 2)

FOCUSING

magnetic (note 2)

ACCESSORIES

Socket	type 56049
Deflection and focusing coil unit,	
black/white	type KV12S or equivalent
colour	type AT1106 or equivalent
Mask for reduction of flare	type 56033

ELECTRON GUN CHARACTERISTICS

Cut-off			
Grid 1 voltage for cut-off at V_{g2} = 300 V without blanking	V_{g1}		−30 to −80 V
Blanking voltage, peak to peak			
on grid 1	$V_{g1\ p\text{-}p}$		50±10 V
on cathode	$V_{k\ p\text{-}p}$		25 V
Grid 2 current at normally required beam currents	I_{g2}	<	0,5 mA

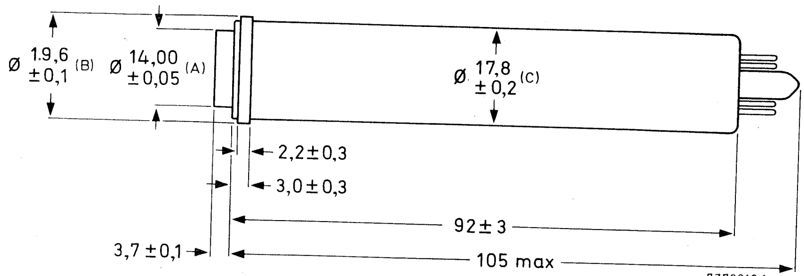
LIMITING VALUES (Absolute maximum rating system)

All voltages are referred to the cathode, unless otherwise stated.

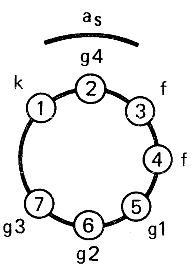
					note
Signal electrode voltage	V_{as}	max	50	V	3
Grid 4 voltage	V_{g4}	max	1000	V	
Grid 3 voltage	V_{g3}	max	750	V	
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max	400	V	
Grid 2 voltage	V_{g2}	max	350	V	
Grid 1 voltage, positive	V_{g1}	max	0	V	
Grid 1 voltage, negative	$-V_{g1}$	max	200	V	
Cathode to heater voltage, positive peak	$V_{kf\,p}$	max	125	V	
Cathode to heater voltage, negative peak	$-V_{kf\,p}$	max	50	V	
Cathode heating time before drawing cathode current	T_h	min	1	min	
Impedance between cathode and heater at $V_{kf\,p} > 10$ V	Z_{kf}	min	2	kΩ	
Ambient temperature, storage and operation	t_{amb}	max	50	°C	
		min	−30	°C	
Faceplate temperature, storage and operation	t	max	50	°C	
		min	−30	°C	
Faceplate illuminance	E	max	500	lx	4

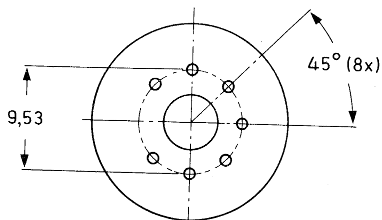
MECHANICAL DATA

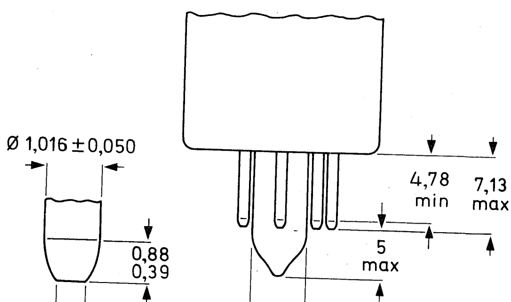
Dimensions in mm



The distance between the geometrical centres of diameters A (anti-halation disc), B (signal-electrode ring), and the geometrical centre of diameter C (tube envelope) is ≤ 200 μm.







Mounting position: any

Mass: ≈ 23 g

Base: IEC 67-I-10a (JEDEC E7-1) with pumping stem

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 mm x 8,8 mm — note 7a

Conditions

						note
Cathode voltage	V_k		0		V	
Grid 2 voltage	V_{g2}		300		V	
Signal electrode voltage	V_{as}		45		V	3, 5
Beam current	I_b		see note 6			
		low voltage mode		high voltage mode		
Grid 4 voltage	V_{g4}	500		750	V	7b, 7c
Grid 3 voltage	V_{g3}	300		475	V	7b, 7c
Grid 1 voltage	V_{g1}		see note 6			
Blanking voltage on grid 1, peak to peak	$V_{g1\ p\text{-}p}$		50		V	
Focusing coil current			see note 8			
Deflection current, alignment			see note 8			
Faceplate illuminance	E		see note 9			
Faceplate temperature	t		20 to 45		^{o}C	

Performance

Dark current			$\leqslant$ 1,5		nA	
Sensitivity at colour temperature of illuminance = 2856 K						10
XQ1427	min.	325	typ.	375	μA/lmF	
XQ1427R	min.	75	typ.	125	μA/lmF	
XQ1427G	min.	110	typ.	140	μA/lmF	
XQ1427B	min.	35	typ.	38	μA/lmF	
Gamma of transfer characteristic			0,95 + 0,05			11
Spectral response:						
max response at						
cut-off XQ1427R			≈	850	nm	12
cut-off XQ1427, G			≈ 650 to 850		nm	
cut-off XQ1427 B			≈	650	nm	
response curves			see Figs 1, 2 and 3			

Resolution

Modulation depth, i.e. uncompensated amplitude response at 320 TV lines at the centre of the picture picture. The figures shown represent the typical amplitude response of the tube as obtained with a lens aperture of f : 5,6 (notes 6, 13).

		XQ1427	XQ1427R	XQ1427G	XQ1427B
Highlight signal current	I_s	150 nA	75 nA	150 nA	75 nA
Beam current	I_b	300 nA	150 nA	300 nA	150 nA
Modulation depth at 320 TV lines (4 MHz) in %					
low voltage mode	typ.	55	50	55	60
high voltage mode	typ.	60	55	60	65

Modulation transfer characteristics — see Figs 6 and 7

Limiting resolution — ⩾ 600 TV lines

Lag (typical values)

Light source with a colour temperature of 2856 K

Appropriate filter inserted in light path for the chrominance tubes R, G, and B.

Low key conditions

	build-up lag (notes 6, 14)				decay lag (notes 6, 15)			
	I_s/I_b = 20/300 nA		I_s/I_b = 20/150 nA		I_s/I_b = 20/300 nA		I_s/I_b = 20/150 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1427, G	90	≈ 100			9	3,5		
XQ1427, R, B			95	≈ 100			8	3

High key conditions

	build-up lag (notes 6, 14)				decay lag (notes 6, 15)			
	I_s/I_b = 150/300 nA		I_s/I_b = 75/150 nA		I_s/I_b = 150/300 nA		I_s/I_b = 75/150 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1427, G	98	100			3,5	1		
XQ1427, R, B			98	100			3,5	1

NOTES

1. Underscanning of the specified useful target area of 6,6 mm x 8,8 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.
2. For focusing/deflection coil unit see under Accessories.
3. Plumbicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters).
   N.B. When the tube is to be applied in a camera originally designed for vidicons, the automatic sensitivity control circuitry should, to prevent permanent damage or destruction of the target, be made inoperative and the signal electrode voltage be set to the voltage indicated in note 5.
4. For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.
5. The signal electrode voltage shall be adjusted at 45 V. To enable the tube to handle excessive highlights in the televised scene the signal electrode voltage may be reduced to a minimum of 25 V. This will, however, cause some reduction of performance.
6. The beam current I_b, as obtained by adjusting the control grid voltage (grid 1) is set at 150 nA for R and B tubes, 300 nA for black/white, and G tubes. I_b is not the total current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.
   In the performance figures, e.g. for resolution and lag, the signal current and beam current conditions are given, e.g. as I_s/I_b = 20/300 nA. This means: with a signal current of 20 nA and a beam setting which just allows a signal current of 300 nA.
   N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination of the scanned area.
   The peak signal currents as measured on a waveform oscilloscope will be a factor α larger.
   ($\alpha = \frac{100}{100 - \beta}$, β being the total blanking time in %: for the CCIR system α = 1,3).

7a. The operating conditions and performance quoted in these data relate to operation in the coil unit AT1106.

7b. The optimum voltage ratio V_{g4}/V_{g3} to minimize beam landing errors (preferably < 1 V) depends on the type of coil unit used. In the KV12S unit a ratio of 1,5 to 1,6 is recommended, whereas the coil unit AT1106 will require a ratio of 1,6 to 1,7.
Under no circumstances should grid 4 (mesh) be allowed to operate at a voltage below that of grid 3 as this may damage the target.

7c. An attractive gain in resolving power is obtained when the tubes are operated with higher grid 3 and grid 4 potentials.
N.B. Since such operation requires increased focusing and deflection power, special measures (air cooling, heatsinks) have to be taken in the camera design to prevent faceplate temperatures exceeding the limiting value of 50 °C, which would otherwise affect tube performance and life. (see also General operational notes Plumbicon tubes, paragraph 1.8).

8. Values measured:

	low-voltage mode		high-voltage mode		
	KV12S	AT1106	KV12S	AT1106	
Line deflection current, peak to peak	160	180	200	230	mA
Frame deflection current, peak to peak	25	40	32	50	mA
Focus coil current*	150	110	190	135	mA
Flux density of adjustable alignment**			0 to $2{,}5 \times 10^{-4}$		T
			(0 to 2,5)		Gs

* The polarity of the focusing coil current should be such that its image end attracts an external north-seeking pole.

** The alignment unit (coils or magnets) should be positioned so that its centre is at a distance of approximately 75 mm (3 in) from the face of the tube and that its axis coincides with the axis of the tube, the deflecting yoke and the focusing coil.

9. In the case of a black/white camera, the illuminance of the photoconductive layer, B_{ph}, is related to scene illuminance, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{RT}{4F^2\,(m+1)^2}$$

in which
R = the average scene reflectivity or the object reflectivity whichever is relevant;
T = lens transmission factor;
F = lens aperture;
m = linear magnification from scene to target.

A similar formula may be derived for the illuminance level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the entire optical system have been taken into account.

10. Measuring conditions.
Illuminance level before the filter ≈ 10,5 lx (luminous flux at scanned area ≈ 0,5 mlm) at a colour temperature of 2856K. Additional filters are inserted in the light path for the chrominance tubes.
Filters used for
XQ1427R : Schott OG570, thickness 3 mm and B1/K1;
XQ1427G : Schott VG9, thickness 1 mm;
XQ1427B : Schott BG12, thickness 3 mm.
For transmission curves see Figs 6 and 7.

11. Gamma stretching circuitry is recommended.

12. For true tonal rendition in black/white cameras, and for true colorimetry in colour cameras, an integral filter to eliminate response to near infrared radiation should be incorporated in the optical system.

13. The horizontal amplitude response can be raised by means of suitable correction circuits, which affect neither the vertical resolution nor the limiting resolution.
14. After 10 s of darkness. The figures are typical percentages of the ultimate signal current obtained 60 ms or 200 ms, respectively, after introduction of the illuminance.
15. After the target has been illuminated for at least 5 s. The figures represent typical signals in percentages of the original signal current 60 ms or 200 ms, respectively, after removal of the illuminance.

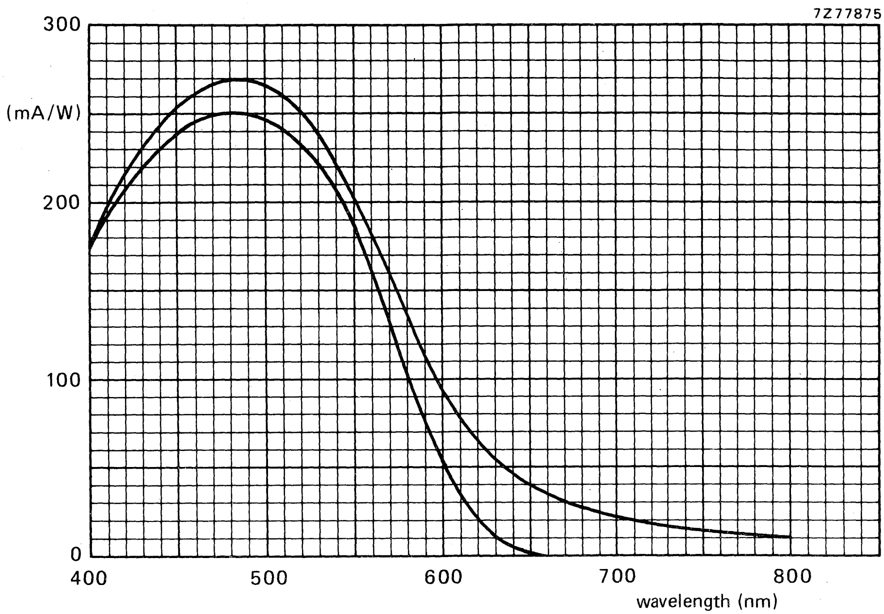


Fig. 1 Typical spectral response curve XQ1427 and XQ1427G.

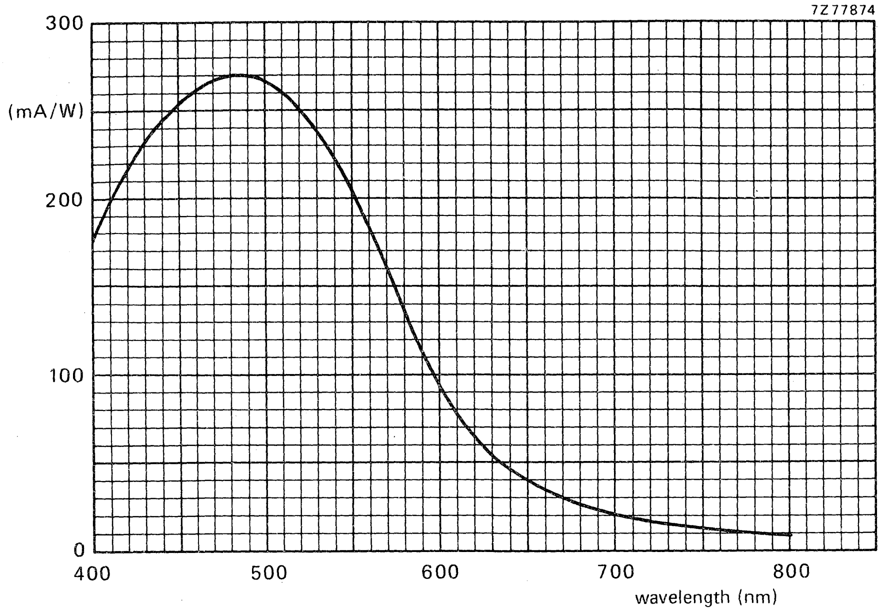


Fig. 2 Typical spectral response curve XQ1427R.

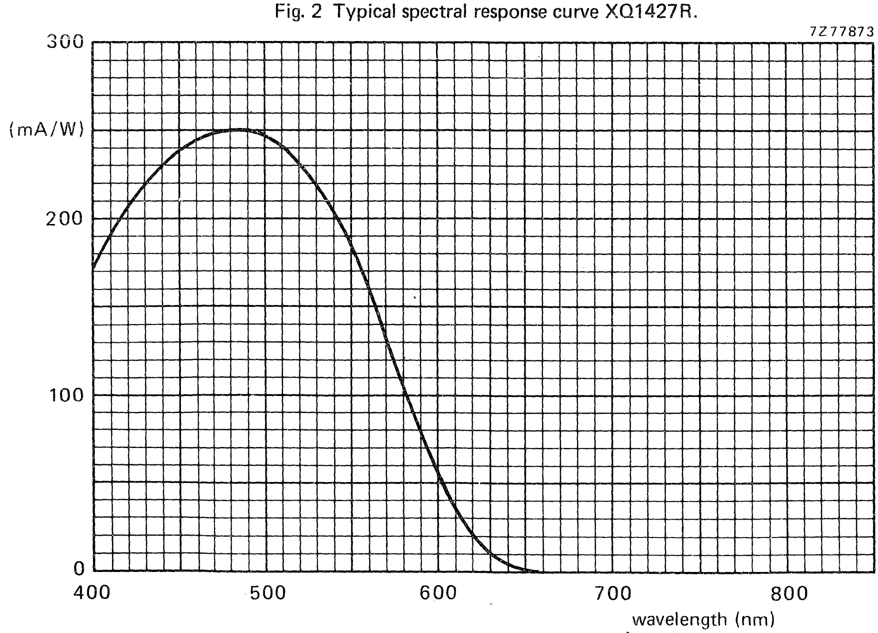


Fig. 3 Typical spectral response curve XQ1427B.

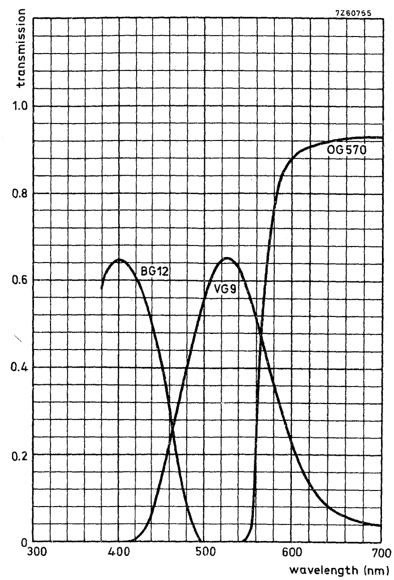


Fig. 4 Transmission of filters BG12, VG19, and OG570.

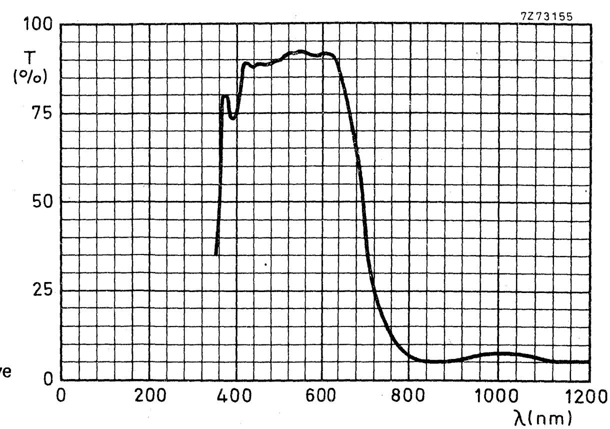


Fig. 5 Typical transmission curve of heat reflecting interference filter CALFLEX B1/K1.

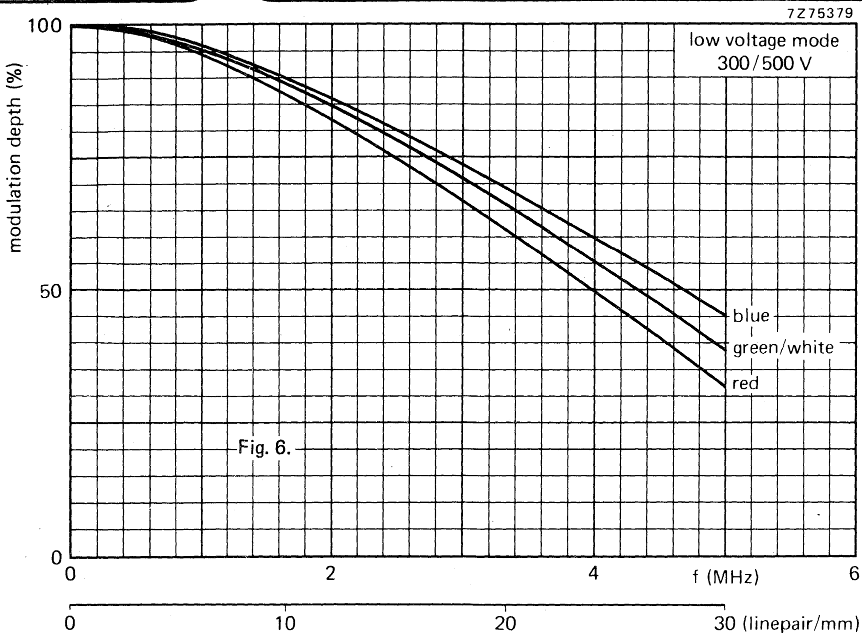


Fig. 6.

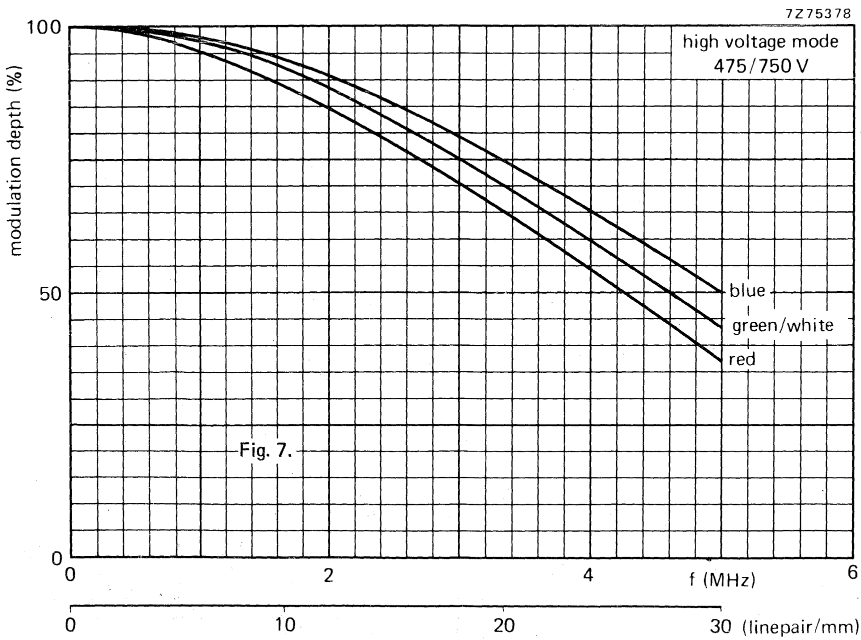


Fig. 7.

Typical square-wave response curves.

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1427 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial, educational or ENG cameras.

The series comprises the following versions:

XQ1428	for use in black and white cameras
XQ1428R XQ1428G XQ1428B	for use in the chrominance channels of colour cameras

For all further information see data of the XQ1427 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon ®, 25,4 mm (1 in) diameter television camera tube with high resolution lead oxide photoconductive target, magnetic deflection, magnetic focus. The tubes of the XQ1500 series are interchangeable with the tubes of the XQ1080 series, are however provided with an electron gun system with a 1,2 W cathode for increased resolving power and feature:

- Anti-Comet-Tail electron gun for highlight handling.
- Extremely low lag.
- Provisions for adjustable light bias to minimize lag under low-key conditions.
- Increased resolving power as compared to XQ1080 tubes.
- Ceramic centring ring for precise optical alignment.
- Electrode system with precision construction.
- Low output capacitance for optimum S/N ratio.

The tubes of the XQ1500 series are rear-loading tubes, i.e. to be inserted at the rear end of a special coil unit, and they have slightly different dimensions and pin connections than other 1 in diameter Plumbicon tubes, e.g. XQ1070.

The XQ1500 is intended for use in black and white cameras, XQ1500L, R, G and B are intended for use in colour cameras in broadcast, educational and high quality industrial applications in which high contrast ratios may occur.

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length, excluding anti-halation glass disc	158 mm (6¼ in)
Special features:	Anti-Comet-Tail gun Light bias Anti-halation glass disc Ceramic centring ring Rear loading construction
Heater	6,3 V, 190 mA
Resolution	1000 TV lines
Cut-off of spectral response	≈ 650 nm

® Registered Trade Mark for television camera tube.

OPTICAL DATA

Quality rectangle on photoconductive target (note 1) (aspect ratio 3 : 4)		9,6 x 12,8 mm^2

Orientation of image on photoconductive target:
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the protecting sleeve at the base (note 2a).

Optical alignment		see note 2b
Faceplate		
Thickness		1,2 mm
Refractive index	n	1,49
Refractive index of anti-halation disc	n	1,52

HEATING

Indirect by a.c. or d.c.; parallel or series supply.

Heater voltage	V_f	6,3 V ± 5%
Heater current at V_f = 6,3 V	nom. I_f	190 mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on. To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE

Signal-electrode to all	C_{as}	2,5 to 3,5 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

DEFLECTION

magnetic

FOCUSING

magnetic

ACCESSORIES

Socket		type 56026
Light bias lamp in holder		type 56027
Deflection, focusing and alignment coil unit	black/white	type AT1119/01
	colour	type AT1115/01

AT1115/01 is a computer selected triplet of AT1119/01 units.

Mask	type 56028

ELECTRON-GUN CHARACTERISTICS

			notes
Cut-off			
Grid 1 voltage for cut-off at $V_{g2,4}$ = 300 V, without blanking or ACT pulses	V_{g1}	−40 to −110 V	
Blanking voltage, peak to peak at $V_{g2,4}$ = 300 V, on grid 2	$V_{g1p\text{-}p}$	50±10 V	3
Grids 2 and 4 current (d.c. values)	$I_{g2,4}$	<0,2 mA	4
Grids 3, 5 and 6 currents			4
Pulse timing and amplitude requirements (ACT)			10

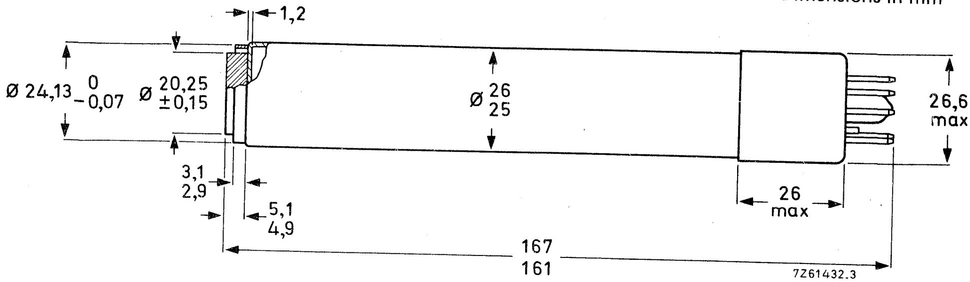
LIMITING VALUES (Absolute maximum rating system)

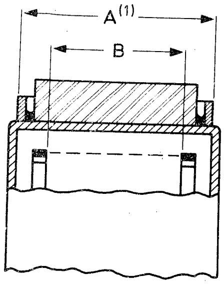
All voltages are referred to the cathode, unless otherwise stated.

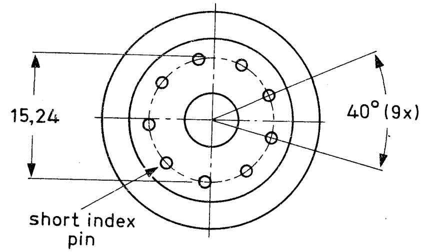
Signal electrode voltage	V_{as}	max	50 V	5
Grid 6 (mesh) voltage	V_{g6}	max	1100 V	12
Grid 5 (collector) voltage	V_{g5}	max	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max	350 V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max	350 V	
Grid 3 (auxiliary grid) voltage	V_{g3}	max	350 V	
Grid 1 (control grid) voltage, positive	V_{g1}	max	0 V	
negative	$-V_{g1}$	max	200 V	
Cathode heating time before drawing cathode current	T_h	min	1 min	
Cathode-to-heater voltage, positive peak	$V_{kf\,p}$	max	50 V	
Cathode-to-heater voltage, negative peak	$-V_{kf\,p}$	max	50 V	
Ambient temperature, storage and operation	t_{amb}	max	50 °C	
		min	−30 °C	
Faceplate temperature, storage and operation	t	max	50 °C	
		min	−30 °C	
Faceplate illuminance	E	max	500 lx	6

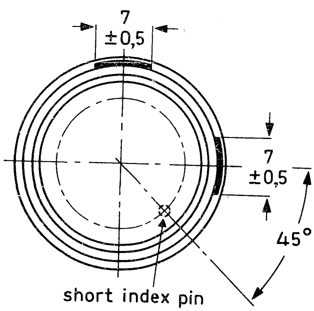
MECHANICAL DATA

Dimensions in mm

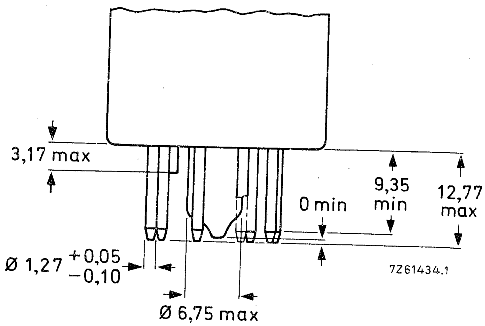








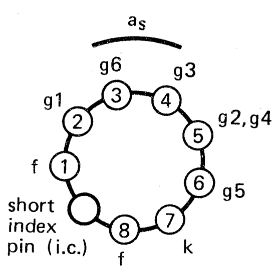
FRONT VIEW 7Z61433.3



Mounting position: any

Mass: ≈ 70 g

Base: IEC67-I-33a (JEDEC E8-11)



7Z61431.1

The distance between the geometrical centres of the diameter A of the reference ring and the diameter B of the mesh-electrode ring is < 100 μm.

OPERATING CONDITIONS AND PERFORMANCE

Conditions (with ACT action: note 7)

For a scanned area of 9,6 mm x 12,8 mm. All voltages are specified with respect to the cathode potential during the read-out mode, unless otherwise indicated. See notes 8, 9, 10.

			notes
Cathode voltage,			
during read-out mode	V_k	0 V	
during ACT mode	V_k	0 to 15 V	
Signal electrode voltage	V_{as}	45 V	5
Grid 6 (mesh) voltage	V_{g6}	750 V	11 12
Grid 5 (collector) voltage	V_{g5}	475 V	11 12
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300 V	
Grid 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}		10
during ACT mode	V_{g3}		
Grid 1 (control grid) voltage,			
during read-out mode	V_{g1}		13
during ACT mode	V_{g1}		10
blanking on grid 1, peak	V_{g1p}	50 V	

Typical beam current, signal current and pulse settings (note 10)

		XQ1500, L	XQ1500R	XQ1500G	XQ1500B
Signal current, peak	$I_{s\ p}$	200 nA	100 nA	200 nA	100 nA
Beam current, peak	$I_{b\ p}$	200 nA	200 nA	400 nA	200 nA
ACT level (peak)		280 nA	140 nA	280 nA	140 nA
Cathode pulse	$V_{k\ p}$	8 V	4 V	8 V	4 V
Grid 1 pulse	$V_{g1\ p}$	28 V	24 V	28 V	24 V
Grid 3 pulse	$V_{g3\ p}$		see note 10		

		notes
Faceplate illuminance		14
Light bias		15
Temperature of faceplate	20 to 45 °C	
Deflection, focusing and alignment coil unit	AT1119/01	16

Deflection, focusing and alignment currents

V_{g6}/V_{g5} V	focus current mA	line current p-p mA	frame current p-p mA
750/475	32	290	35

Line and frame alignment currents max. 15 mA, corresponding to a flux density of approx. 4×10^{-4}T (4 Gs).

DEVELOPMENT SAMPLE DATA

Performance notes

				notes
Dark current	⩽	3	nA	
Sensitivity at colour temperature of illuminance = 2856K	min.	typ.		17
XQ1500	375	400	μA/lm	
XQ1500L	375	400	μA/lm	
XQ1500R	70	85	μA/lmF	
XQ1500G	130	165	μA/lmF	
XQ1500B	35	38	μA/lmF	
Gamma of transfer characteristic	0,95 ± 0,05			18
Light transfer characteristics with ACT	see Fig. 9			
Highlight handling	⩾ 5 lens stops			19
Spectral response: max. response at		≈ 500	nm	
Spectral response: cut-off at		≈ 650	nm	
Spectral response curve	see Fig. 1			

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures represent the horizontal amplitude response as measured with a lens aperture of F: 5,6 (notes 13, 20, 21).

		XQ1500	XQ1500R	XQ1500G	XQ1500B
Highlight signal current	$I_{s\,p}$	0,2 μA	0,1 μA	0,2 μA	0,1 μA
Beam current	$I_{b\,p}$	0,4 μA	0,2 μA	0,4 μA	0,2 μA
Modulation depth at 400 TV lines in %	typ.	50	40	50	55
	min.	45	35	45	50

Modulation transfer characteristics	see Fig. 10
Limiting resolution	1000 TV lines

Lag (typical values)

Light source with a colour temperature of 2856K. Appropriate filter inserted in the light path for the chrominance tubes R, G and B.

Low key conditions (without light bias)

	build-up lag note 22				decay lag note 23			
	I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1500, L, G			98%	≈ 100%			5%	2%
XQ1500R, B	95%	≈100%			8%	3%		

Low key conditions (with light bias: note 24)

See curves of Figs 3, 4, 5, 6, 7 and 8.

High key conditions (with and without light bias)

	build-up lag note 22				decay lag note 23			
	I_s/I_b=100/200 nA		I_s/I_b=200/400 nA		I_s/I_b=100/200 nA		I_s/I_b=200/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1500, L, G			98%	≈ 100%			1,5%	0,6%
XQ1500R	97%	≈ 100%			2,5%	1%		
XQ1500B					3,5%	2%		

Shading of light bias induced dark current 12,5% (note 25)

NOTES

1. Underscanning of the specified useful area of 9,6 mm x 12,8 mm, or failure of scanning, should be avoided so as not to damage the photoconductive layer.

2a. The position of this marker line corresponds to the position of one of the small area contacts on the ceramic centring ring. The spring contact in the coil units AT1115 (AT1119) is located accordingly in the plane of the vertical scan, preferred for the construction of colour cameras with a horizontal spider design. A second small area contact at 90° with the first is provided on the ceramic centring ring for operation of the tube with a contact spring in the plane of the horizontal scan, as preferred for the construction of colour cameras with a vertical spider design. Total possible rotation of the tube while maintaining contact is approx. 35°.

2b. The outer periphery of the ceramic centring ring is concentric with the inner periphery of the mesh ring (grid 6). In the AT1115 (AT1119) coil units the tube is centred with this ring as a reference; this ensures proper optical alignment of the tube in the optical system of the camera.

3. Blanking can also be applied to the cathode:
   - **without** ACT action: required cathode pulse ≈ 25 V.
   - **with** ACT action: timing, polarity and amplitudes of the ACT pulses will have to be adapted.

4. The d.c. voltage supply and/or pulse supply to these electrodes should have a sufficiently low impedance to prevent distortion caused by the peak currents drawn during the ACT mode. These peak currents may amount to:

cathode	2 mA
grid 1	0 mA
grids 2 and 4	1 mA
grid 3	150 μA
grid 5	300 μA
grid 6	300 μA

The cathode impedance should preferably be chosen ⩽ 300 Ω.

5. Plumbicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters).
   If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set at 45 V.

6. For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.

7. When the tube is to be used without Anti-Comet-Tail action, grid 3 (auxiliary grid) should be connected to grids 2 and 4 and no ACT pulses should be applied to the cathode and grid 1 (control grid). The performance of the tube will then be as described herein with the exception of the highlight handling.

8a. For proper ACT action the d.c. voltage supply and/or pulse supply to the various electrodes should have sufficiently low impedance: see note 4.

8b. **Video pre amplifier:** In the presence of highlights, peak signal currents of the order of 15 to 45 μA may be offered to the preamplifier during flyback. Special measures have to be taken in the pre-amplifier to prevent temporary overloading.

9a. **Read-out mode**: Defined as the operating conditions during the active line scan (full line period-line blanking interval). For the CCIR system this will amount to 64 μs – 12 μs = 52 μs.

9b. **ACT mode**: Defined as the operating conditions during that part of the line blanking interval during which the ACT electrode gun is fully operative. The ACT interval is equal to or slightly within the line flyback time.

10. **Pulse timing (CCIR) and amplitudes for ACT action** (blanking applied to grid 1: note 3).

10a. For proper operation and setting up of the ACT electron gun three electrodes have to be pulsed:

- **Cathode:** A positive-going pulse, $V_{k\ p}$, with an adjustable amplitude of 0 to 20 V.
  This pulse can be chosen to coincide with the camera blanking period ($\approx$ 11 μs).
  The amplitude of this pulse determines the ACT cutting level and may in general be preset to 8, 4, 8, 4 V for black/white, R, G, B application respectively. An amplitude of 20 V should be available to preset the I_s/I_b (see note 13).
- **Grid 1:** A positive-going pulse, V_{g1p}, with such an amplitude that during the ACT mode the grid 1 bias is effectively reduced by 20 V, (V_{g1p} = 20 V + $V_{k\ p}$), to produce an extra amount of cathode current. The duration of this pulse should be so chosen that it is just within the fly-back period ($\approx$ 5 μs).
- **Grid 3:** A negative-going pulse, $V_{g3\ p}$, timing and duration coinciding with V_{g1p},
  - with either an **adjustable amplitude** and superimposed on a **fixed grid 3 voltage** of 250 to 300 V.
  - or with **fixed amplitude** and superimposed on an **adjustable grid 3 voltage** of 250 to 300 V.

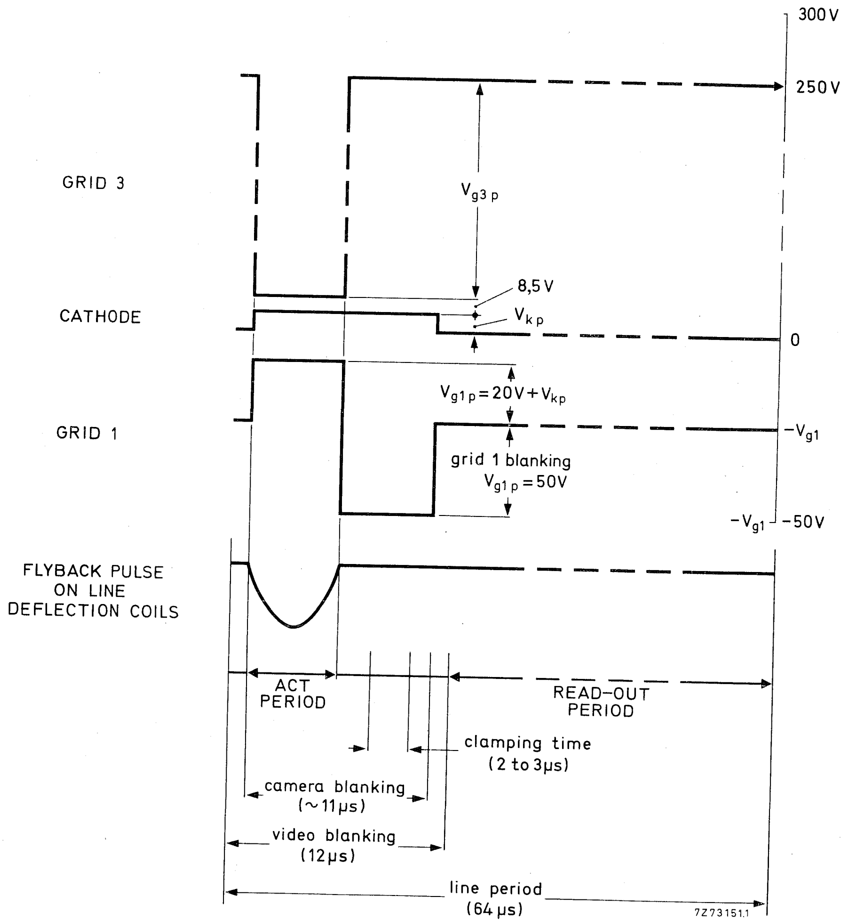
  In either case, adjusted to result in a grid 3 voltage of 8,5 V with respect to the cathode voltage during the ACT mode.

  This pulse ensures that an adequate amount of beam current is drawn from the cathode current.

10b. A suggested pulse timing and amplitude diagram is shown on page B200.

11. The optimum voltage ratio V_{g6}/V_{g5} to minimize beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. For type AT1119 a ratio of 1,5 : 1 to 1,6 : 1 is recommended.

12. Operation with ACT at $V_{g6} >$ 750 V is not recommended since this may introduce dark current.


GRID 3
CATHODE
GRID 1
FLYBACK PULSE ON LINE DEFLECTION COILS
300 V
250 V
Vg3 p
8,5 V
Vk p
0
Vg1 p = 20V + Vkp
−Vg1
grid 1 blanking
Vg1 p = 50V
−Vg1
−50V
ACT PERIOD
READ-OUT PERIOD
clamping time
(2 to 3μs)
camera blanking
(~11μs)
video blanking
(12μs)
line period
(64 μs)
7Z73151.1

13. Adjusted with the ACT made inoperative, e.g. by setting the cathode pulse to 20 V. The control grid voltage is adjusted to produce a beam current just sufficient to allow a peak signal current of twice the typical value, $I_{s\,p}$, as observed and measured on a waveform oscilloscope. The amount of beam current is termed $I_{b\,p}$.
N.B. The signal current, I_s, and beam current, I_b, conditions quoted with the performance figures for e.g., lag, relate to measurements with an integrating instrument connected in the signal-electrode lead and a uniform illuminance on the scanned area. The corresponding peak currents, $I_{s\,p}$ and $I_{b\,p}$, as measured on a waveform oscilloscope will be a factor μ larger (α = 100/100-β), β being the total blanking time in %; for CCIR system α = 1,3.

14. In the case of a black/white camera the illuminance on the photoconductive layer, B_{ph}, is related to scene illuminance, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{RT}{4F^2 (m + 1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target. A similar formula may be derived for the illuminance level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the complete optical system have been taken into account.

15. The light bias lamp in its holder fits into the socket type 56026 and requires maximum 5 V, 110 mA. Its light is projected onto the pumping stem via a blue-green transmitting filter and is conducted to cause a bias illuminance on the target. The required amount of light bias can be obtained by adjusting the filament current of the lamp.

16. Focus current adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.

17. Measuring conditions:
Illuminance ≈ 4 lx (luminous flux = 0,5 mlm) at a colour temperature of 2856K the appropriate filter inserted in the light path.
Filter used:

XQ1500R	Schott	OG570	thickness	3 mm
XQ1500G	Schott	VG9	thickness	1 mm
XQ1500B	Schott	BG12	thickness	3 mm

For transmission curves see Fig. 2.

18. Below the knee caused by ACT operation. Gamma stretching circuitry is recommended.

19. With pulses applied as indicated in note 10, the tube will properly handle a highlight with a diameter of 10% of picture height and with an illuminance corresponding to 32 times peak signal white, $I_{s\,p}$.

20. Typical faceplate illuminance level for the XQ1500 to produce 0,2 μA signal current will be approx. 4lx. The signal current stated for the colour tubes R, G, B will be obtained with an incident white light level (c.t. = 2856K) on the filter of approx. 10 lx. These figures are based on the filters described in note 17. For filter BG12, however, a thickness of 1 mm is chosen.

21. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affects neither the vertical resolution nor the limiting resolution.

22. After 10 seconds of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms and 200 ms respectively after the illumination has been applied.

23. After a minimum of 5 s of illuminance on the target. The figures given represent typical residual signals in % of the original signal current 60 ms and 200 ms respectively after the illuminance has been removed.

24. For black/white operation a light bias corresponding to 2 to 3 nA extra dark current is usually adequate for excellent speed of response. In a colour camera the speeds of response of the tubes can be balanced by adjusting the amount of light bias per tube. A typical setting in a 3-tube colour camera could be R, G, B: 3, 5, 8 nA.

25. Deviation of the level of any of the four corners, i.e. 10% inwards in L. and V. directions, from the level in picture centre. The observed shading is composed of slight parabolic and sawtooth components in both line and frame direction which can be sufficiently compensated by suitable black shading compensation circuitry.

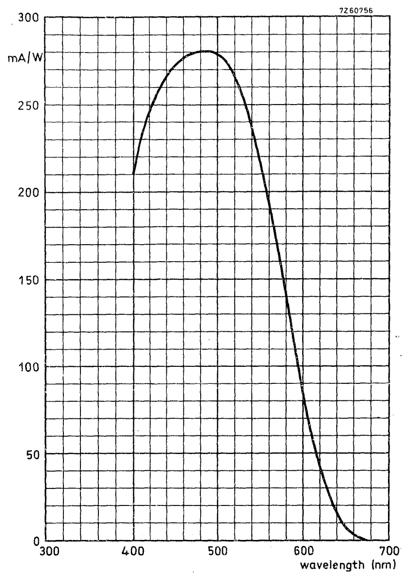


Fig.1 Typical spectral response curve.

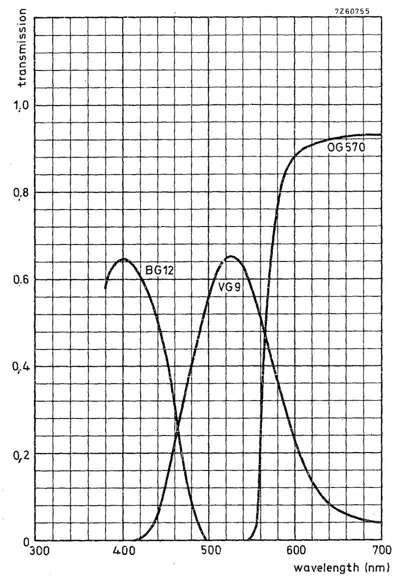


Fig.2 Transmission of filters OG570, VG9, and BG12 see note 17.

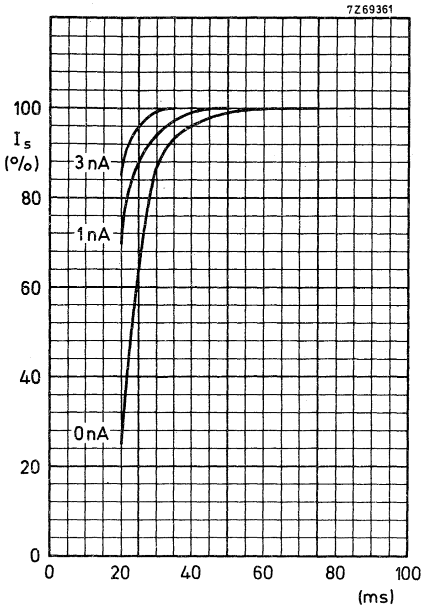


Fig. 3.

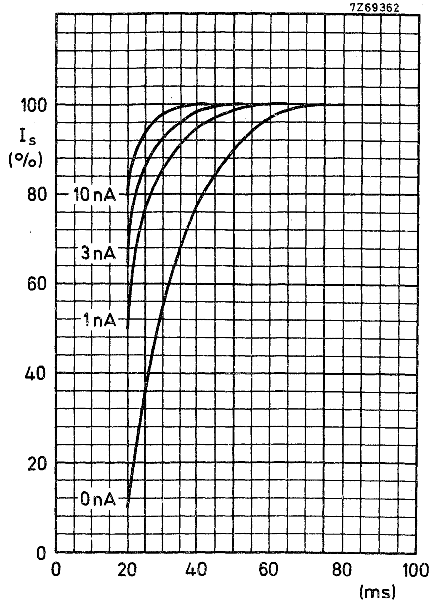


Fig. 4.

Build-up lag (note 22)

Light-bias induced dark current as parameter.

Fig. 3 XQ1500, XQ1500L, XQ1500G:
I_s/I_b = 40/400 nA.

Fig. 4 XQ1500R:
I_s/I_b = 20/200 nA.

Fig. 5 XQ1500B:
I_s/I_b = 20/200 nA.

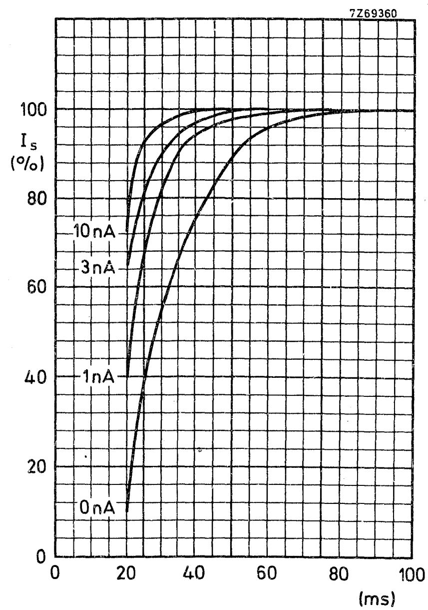


Fig. 5.

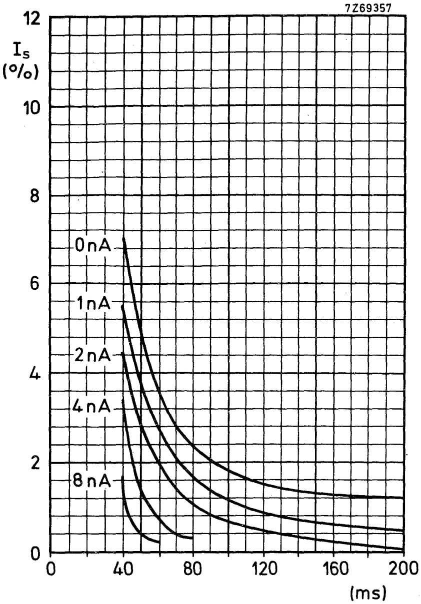


Fig. 6.

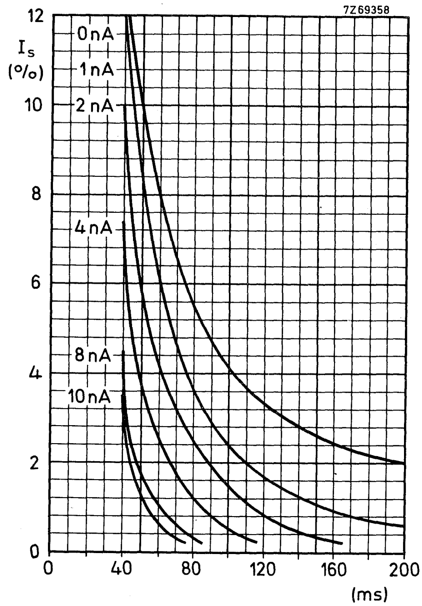


Fig. 7.

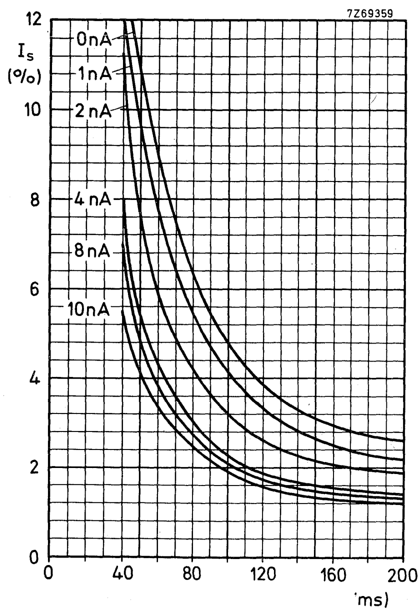


Fig. 8.

Decay lag (note 23)

Light-bias induced dark current as parameter.

Fig. 6 XQ1500, XQ1500L, XQ1500G: I_s/I_b = 40/400 nA.

Fig. 7 XQ1500R: I_s/I_b = 20/200 nA.

Fig. 8 XQ1500B: I_s/I_b = 20/200 nA.

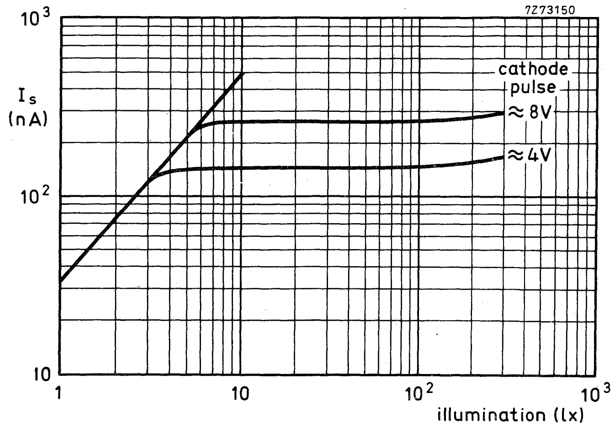


Fig. 9 Typical light transfer characteristics with ACT applied.

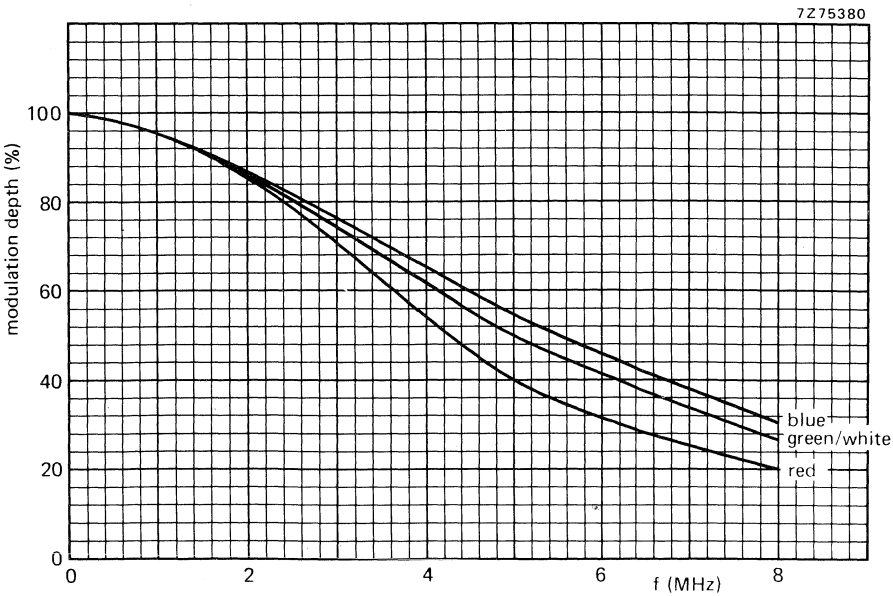


Fig. 10 Typical square-wave modulation response curve.

DEVELOPMENT SAMPLE DATA

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1500 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1501	for use in black and white cameras.
XQ1501R XQ1501G XQ1501B	for use in the chrominance channels of colour cameras.

For all further information see data of the XQ1500 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon® television camera tubes identical to the tubes of the XQ1083 series, hence provided with an ACT electron gun, provisions for light bias, and a ceramic centring ring, and a high resolution lead-oxide photoconductive target with extended red response as used in the XQ1073 series.
The tubes of the XQ1503 series are interchangeable with the tubes of the XQ1083 series; they are, however, provided with an electron gun system with a 1,2 W cathode for optimum resolving power.

The XQ1503 is intended for use in black and white cameras, and the XQ1503R for use in the red chrominance channel of colour cameras in broadcast, educational and high-quality industrial applications in which high contrast ratios may occur.

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length, excluding anti-halation glass disc	158 mm (6¼ in)
Special features	Anti-Comet-Tail gun Light bias Anti-halation glass disc Ceramic centring ring Rear loading construction
Heater	6,3 V, 190 mA
Resolution	1000 TV lines
Cut-off of spectral response	850 to 950 nm

® Registered Trade Mark for television camera tube.

OPTICAL DATA

Quality rectangle on photoconductive target (note 1) (aspect ratio 3:4)		9,6 mm x 12,8 mm

Orientation of image on photoconductive target:
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the protecting sleeve at the base (note 2a).

Optical alignment		see note 2b
Faceplate		
Thickness		1,2 mm
Refractive index	n	1,49
Refractive index of anti-halation disc	n	1,52

HEATING

Indirect by a.c. or d.c.; parallel or series supply.

Heater voltage		V_f	6,3 V
Heater current at $V_f = 6,3$ V	nom.	I_f	190 mA

When the tube is used in a series heater chain the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on. To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE

Signal electrode to all	C_{as}	2,5 to 3,5 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

DEFLECTION — magnetic

FOCUSING — magnetic

ACCESSORIES

Socket		type 56026
Light bias lamp in holder		type 56027
Deflection, focusing and	black/white	type AT1119/01
alignment coil unit	colour	type AT1115/01

AT1115/01 is a computer selected triplet of AT1119/01 coil units.

Mask	type 56028

ELECTRON GUN CHARACTERISTICS

				notes
Cut-off				
Grid 1 voltage for cut-off at $V_{g2,4}$ = 300 V, without blanking or ACT pulses	V_{g1}		−40 to −110 V	
Blanking voltage, peak to peak at $V_{g2,4}$ = 300 V, on grid 1	$V_{g1\,p\text{-}p}$		50 ± 10 V	3
Grids 2 and 4 current (d.c. values)	$I_{g2,4}$	max	0,2 mA	4
Grids 3, 5 and 6 currents				4
Pulse timing and amplitude requirements (ACT)				10

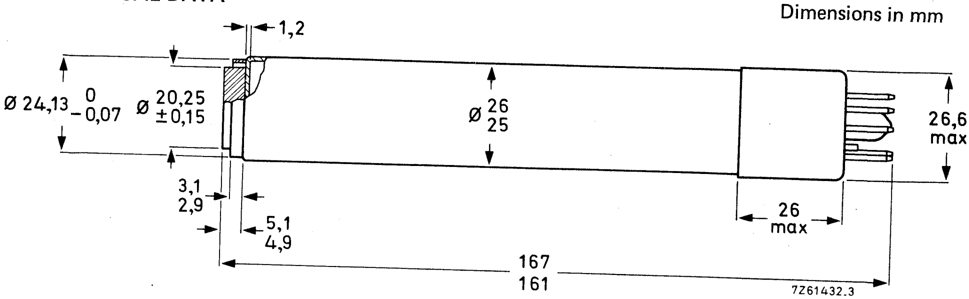
LIMITING VALUES (Absolute maximum rating system)

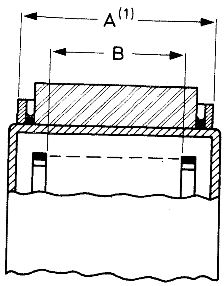
All voltages are referred to the cathode, unless otherwise stated.

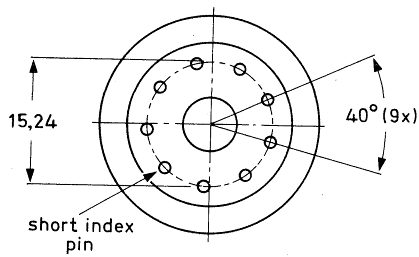
Signal electrode voltage	V_{as}	max	50 V	5
Grid 6 (mesh) voltage	V_{g6}	max	1100 V	12
Grid 5 (collector) voltage	V_{g5}	max	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max	350 V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max	350 V	
Grid 3 (auxiliary grid) voltage	V_{g3}	max	350 V	
Grid 1 (control grid) voltage, positive	V_{g1}	max	0 V	
negative	$-V_{g1}$	max	200 V	
Cathode heating time before drawing cathode current	T_h	min	1 min	
Cathode-to-heater voltage, positive peak	$V_{kf\,p}$	max	50 V	
Cathode-to-heater voltage, negative peak	$-V_{kf\,p}$	max	50 V	
Ambient temperature, storage and operation	t_{amb}	max	50 °C	
		min	−30 °C	
Faceplate temperature, storage and operation	t	max	50 °C	
		min	−30 °C	
Faceplate illuminance	E	max	100 lx	6

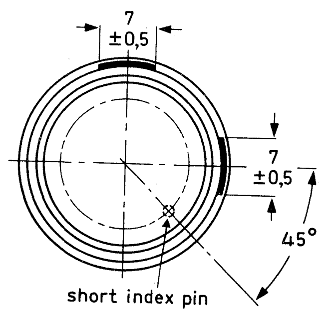
MECHANICAL DATA

Dimensions in mm



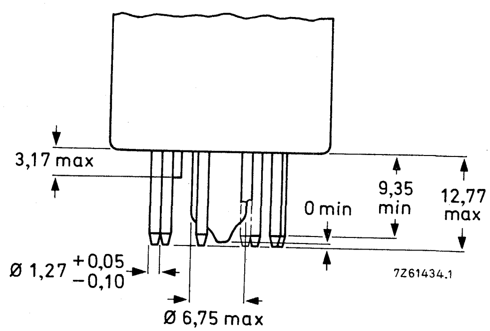






FRONT VIEW

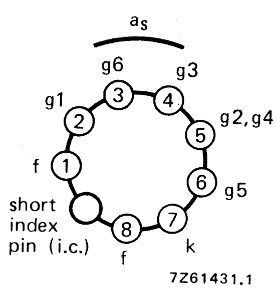
7Z61433.3



Mounting position: any

Mass: ≈ 70 g

Base: IEC67-I-33a (JEDEC E8-11)



The distance between the geometrical centres of the diameter A of the reference ring and the diameter B of the mesh-electrode ring is < 100 μm.

DEVELOPMENT SAMPLE DATA

OPERATING CONDITIONS AND PERFORMANCE

Conditions (with ACT action: note 7)

for a scanned area of 9,6 mm x 12,8 mm. All voltages are specified with respect to the cathode potential during the read-out mode, unless otherwise indicated. See notes 8, 9, 10.

			notes
Cathode voltage,			
during read-out mode	V_k	0 V	
during ACT mode	V_k	0 to 15 V	10
Signal electrode voltage	V_{as}	45 V	5
Grid 6 (mesh) voltage	V_{g6}	750 V	11,12
Grid 5 (collector) voltage	V_{g5}	475 V	11,12
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300 V	
Grid 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}		10
during ACT mode	V_{g3}		10
Grid 1 (control grid) voltage,			
during read-out mode	V_{g1}		13
during ACT mode	V_{g1}		10
blanking on grid 1, peak	V_{g1p}	50 V	

Typical beam current, signal current and pulse settings

		XQ1503	XQ1503R
Signal current, peak I_{sp}		200 nA	100 nA
Beam current, peak I_{bp}		400 nA	200 nA
ACT level (peak)		280 nA	140 nA
Cathode pulse	V_{kp}	6 V	3 V
Grid 1 pulse	V_{g1p}	26 V	23 V
Grid 3 pulse	V_{g3p}	see note 10	

		notes
Faceplate illuminance		14
Light bias		15
Temperature of faceplate	20 to 45 °C	
Deflection, focusing and alignment coil unit	AT1119/01	

Deflection, focusing and alignment currents

V_{g6}/V_{g5}	focus current mA	line current p-p mA	frame current p-p mA
750/475	32	290	35

Line and frame alignment currents maximum 15 mA, corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

Performance

			notes
Dark current (without light bias)		$\leq$ 3 nA	
Sensitivity at colour temperature of illuminance = 2856K	min.	typ.	
XQ1503	350	400 μA/lmF	17a
XQ1503R	75	115 μA/lmF	17b
Gamma of transfer characteristic	0,95 ± 0,05		18
Light transfer characteristic with ACT	see Fig. 5		
Highlight handling	$\geq$ 5 lens stops		19
Spectral response: max. response at	$\approx$	500 nm	
	$\approx$ 850 to 950 nm		20
Spectral response curve	see Fig. 1		

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures represent the horizontal amplitude response as measured with a lens aperture of F: 5,6 (notes 13, 21, 22).

		XQ1503	XQ1503R
Highlight signal current	I_{sp}	0,2 μA	0,1 μA
Beam current	I_{bp}	0,4 μA	0,2 μA
Modulation depth at 400 TV lines in %	typ.	55	50
	min.	50	45

Modulation transfer characteristics	see Fig. 4
Limiting resolution	1000 TV lines

Lag (typical values), without light bias

Light source with a colour temperature of 2856K. Appropriate filter inserted in the light path for the chrominance tube.

Low key conditions (without light bias)

	build-up lag note 23				decay lag note 24			
	I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1503			98	100			7	2,5
XQ1503R	95	100			8	2,5		

Low key conditions (with light bias: note 25)

See curves in Figs 6, 7, 8 and 9.

High key conditions

	build-up lag note 23				decay lag note 24			
	I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1503			98	100			2	1
XQ1503R	98	100			3	1,5		

Shading of light bias induced dark current 12,5% (note 26)

NOTES

1. Underscanning of the specified useful area of 9,6 mm x 12,8 mm, or failure of scanning, should be avoided so as not to damage the photoconductive layer.

2a. The position of this marker line corresponds to the position of one of the small area contacts on the ceramic centring ring. The spring contact in the coil units AT1115 (or AT1119) is located accordingly in the plane of the vertical scan, preferred for the construction of colour cameras with a horizontal spider design.
A second small area contact at 90° with the first is provided on the ceramic centring ring for operation of the tube with a contact spring in the plane of the horizontal scan, as preferred for the construction of colour cameras with a vertical spider design. Total possible rotation of the tube while maintaining contact is approx. 35°.

2b. The outer periphery of the ceramic centring ring is concentric with the inner periphery of the mesh ring (grid 6). In the AT1115 (AT1119) coil units the tube is centred with this ring as a reference; this ensures proper optical alignment of the tube in the optical system of the camera.

3. Blanking can also be applied to the cathode:
– without ACT action: required cathode pulse approx. 25 V.
– with ACT action: timing, polarity and amplitudes of the ACT pulses will have to be adapted.

4. The d.c. voltage supply and/or pulse supply to these electrodes should have a sufficiently low impedance to prevent distortion caused by the peak currents drawn during the ACT mode. These peak currents may amount to:

cathode	2 mA
grid 1	0 mA
grids 2 and 4	1 mA
grid 3	150 μA
grid 5	300 μA
grid 6	300 μA

The cathode impedance should preferably be chosen $\leqslant 300\ \Omega$.

5. Plumbicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters). If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set at 45 V.

6. For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.

7. When the tube is to be used without ACT action, grid 3 should be connected to grids 2 and 4 and no ACT pulses should be applied to the cathode and grid 1. The performance of the tube will then be as described herein with the exception of the highlight handling.

8a. For proper ACT action the d.c. voltage supply and/or pulse supply to the various electrodes should have sufficiently low impedance: see note 4.

8b. **Video preamplifier:** In the presence of highlights, peak signal currents of the order of 15 to 45 μA may be offered to the preamplifier during flyback. Special measures have to be taken in the preamplifier to prevent temporary overloading.

9a. **Read-out mode:** Defined as the operating conditions during the active line scan (full line period— line blanking interval). For the CCIR system this will amount to 64 μs – 12 μs = 52 μs.

9b. **ACT mode:** defined as the operating conditions during that part of the line blanking interval for which the ACT electron gun is fully operative. The ACT interval is equal to or slightly within the line flyback time.

10a. For proper operation and setting up of the ACT electron gun three electrodes have to be pulsed:

- **Cathode:** A positive-going pulse, $V_{k\,p}$, with an adjustable amplitude of 0 to 20 V. This pulse can be chosen to coincide with the camera blanking period ($\approx$ 11 μs). The amplitude of this pulse determines the ACT cutting level and may in general be preset to 6, 3 V, for black/white and R application respectively. An amplitude of 20 V should be available to preset the I_s/I_b (see note 13).
- **Grid 1:** A positive-going pulse, $V_{g1\,p}$, with such an amplitude that during the ACT mode the grid 1 bias is effectively reduced by 20 V ($V_{g1\,p}$ = 20 V + $V_{k\,p}$), to produce an extra amount of cathode current. The duration of this pulse should be so chosen that it is just within the flyback period ($\approx$ 5 μs).
- **Grid 3**: A negative-going pulse, $V_{g3\,p}$, timing and duration coinciding with $V_{g1\,p}$, with either an **adjustable amplitude** and superimposed on a **fixed grid 3 voltage** of 250 to 300 V,
  – or with **fixed amplitude** and superimposed on an **adjustable grid 3 voltage** of 250 to 300 V. In either case, adjusted to result in a grid 3 voltage of 8,5 V with respect to the cathode during the ACT mode.

  This pulse ensures that an adequate amount of beam current is drawn from the cathode current.

10b. A suggested pulse timing and amplitude diagram is shown on page B216.

11. The optimum voltage ratio V_{g6}/V_{g5} to minimize beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. For type AT1115 a ratio of 1,5:1 to 1,6:1 is recommended.

12. Operation with ACT at $V_{g6} >$ 750 V is not recommended since this may introduce dark current.

13. Adjusted with the ACT made inoperative, e.g. by setting the cathode pulse to 20 V. The control grid voltage is adjusted to produce a beam current just sufficient to allow a peak signal current of twice the typical value, $I_{s\,p}$, as observed and measured on a waveform oscilloscope. This amount of beam current is termed $I_{b\,p}$.
    N.B. The signal current, I_s, and beam current, I_b, conditions quoted with the performance figures for e.g., lag, relate to measurements with an integrating instrument connected in the signal-electrode lead and a uniform illuminance on the scanned area. The corresponding peak currents, $I_{s\,p}$ and $I_{b\,p}$, as measured on a waveform oscilloscope will be a factor α larger ($\alpha = 100/100-\beta$), β being the total blanking time in %; for CCIR system α amounts to 1,3.

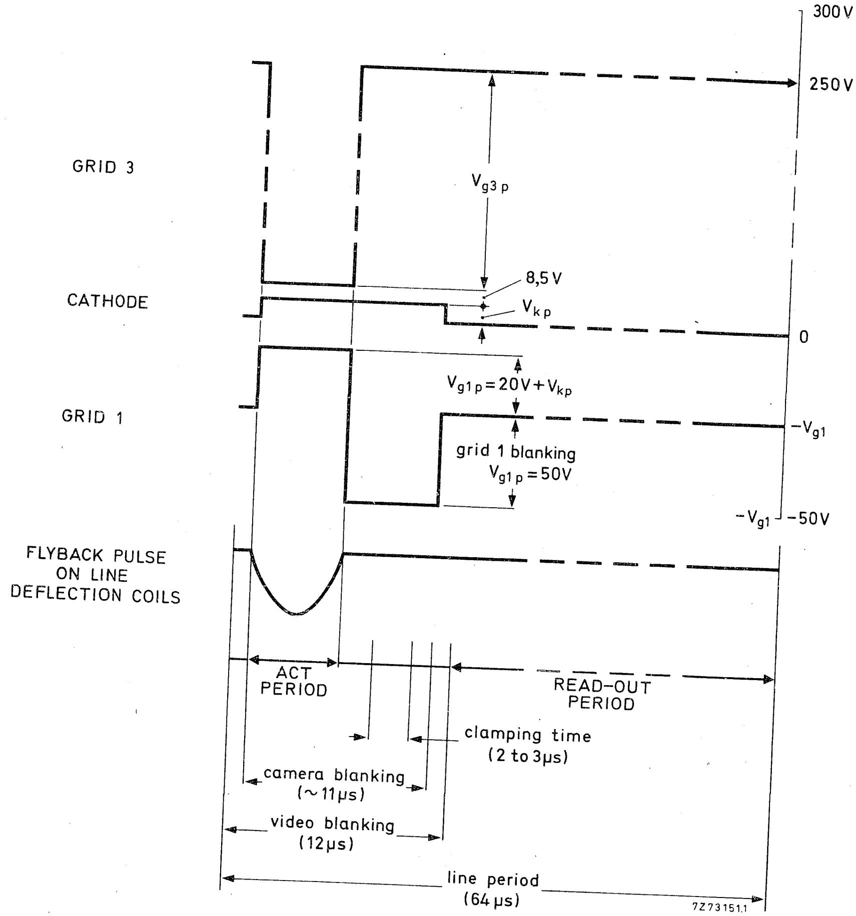
14. In the case of a black/white camera the illuminance on the photoconductive layer, B_{ph}, is related to scene illuminance, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{R\,T}{4F^2\ (m+1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant. T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target. A similar formula may be derived for the illuminance level on the photoconductive layer of the R chrominance tube in which the effects of the various components of the complete optical system have been taken into account.

15. The light bias lamp in its holder fits into the socket type 56026 and requires maximum 5 V, 110 mA. Its light is projected on to the pumping stem via a blue-green transmitting filter and is conducted to cause a bias illuminance on the target. The required amount of light bias can be obtained by adjusting the filament current of the lamp.

16. Focus current adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.


300 V
250 V
GRID 3
$V_{g3\,p}$
8,5 V
CATHODE
$V_{k\,p}$
0
$V_{g1\,p} = 20\,V + V_{kp}$
GRID 1
$-V_{g1}$
grid 1 blanking
$V_{g1\,p} = 50\,V$
$-V_{g1}$ -50 V
FLYBACK PULSE
ON LINE
DEFLECTION COILS
ACT
PERIOD
READ-OUT
PERIOD
clamping time
(2 to 3 μs)
camera blanking
(~11 μs)
video blanking
(12 μs)
line period
(64 μs)
7Z73151.1

17a. All measurements are made with an infrared reflecting filter interposed between light source and target. Balzers Calflex B1/K1 filter is chosen for this purpose since, for accurate colour reproduction in a colour camera, a similar IR reflecting filter will be required. For typical transmission curve of this filter see Fig. 3.

17b. With an additional filter (see note 17a) interposed between light source and target. Filter used is: Schott OG570 (3 mm). For transmission curve see Fig. 2.

18. Below the knee caused by ACT operation. Gamma stretching circuitry is recommended.

19. With pulses applied as indicated in note 10, the tube will properly handle a highlight with a diameter of 10% of picture height and with a luminance corresponding to 32 times peak signal white, $I_{s\,p}$.

20. Without infrared reflecting filter B1/K1.

21. Typical faceplate illuminance level for the XQ1503 to produce 0,2 μA signal current will be approx. 4 lux. The signal current stated for the chrominance tube XQ1503R will be obtained with an incident white level (c.t. 2856K) on the filter – Schott OG570 – of approx. 8 lux.

22. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affects neither the vertical resolution nor the limiting resolution.

23. After 10 seconds of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 and 200 ms after the illumination has been applied.

24. After a minimum of 5 s of illuminance on target. The figures given represent typical residual signals in % of the original signal current 60 and 200 ms after the illuminance has been removed.

25. For black/white operation a light bias corresponding to 2 to 3 nA extra dark current is usually adequate for excellent speed of response. In a colour camera the speeds of response of the tubes can be balanced by adjusting the amount of light bias per tube. A typical setting in a 3-tube colour camera could be for XQ1503R, XQ1500G, XQ1500B: 4, 3, 8 nA respectively.

26. Deviation of the level of any of the four corners, i.e. 10% inwards in L and V directions, from the level in picture centre. The observed shading is composed of slight parabolic and sawtooth components in both line and frame directions which can be sufficiently compensated by suitable black shading compensation circuitry.

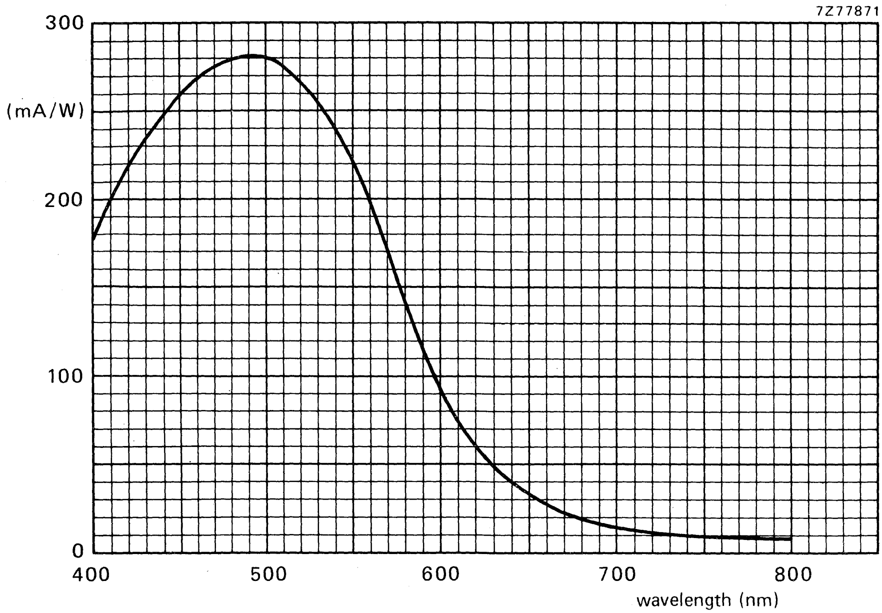
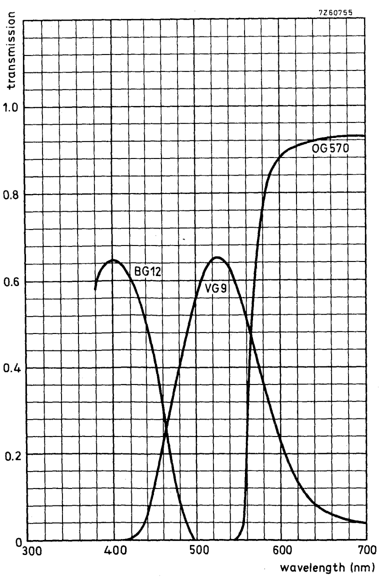


Fig.1 Typical spectral sensitivity characteristic.



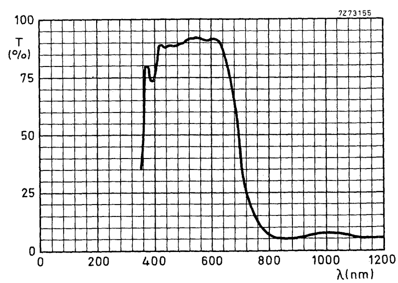


Fig.3 Typical transmission curve of heat reflecting interference filter CALFLEX B1/K1. See note 17a.

Fig.2 Transmission curve of filter OG570 See note 17b.

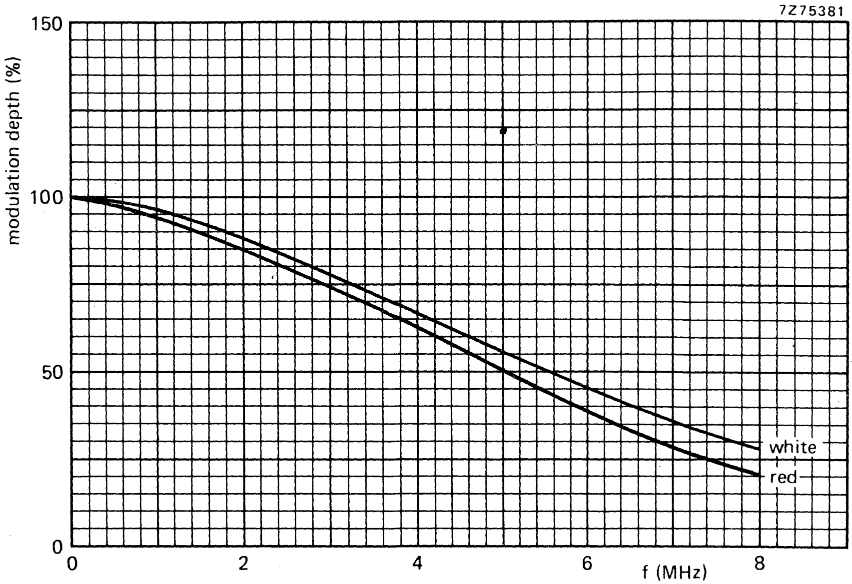


Fig.4 Typical square-wave modulation transfer characteristic.

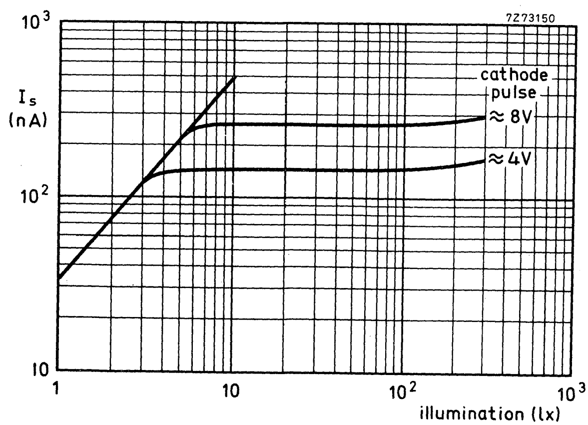


Fig. 5 Typical light transfer characteristics with ACT applied.

DEVELOPMENT SAMPLE DATA

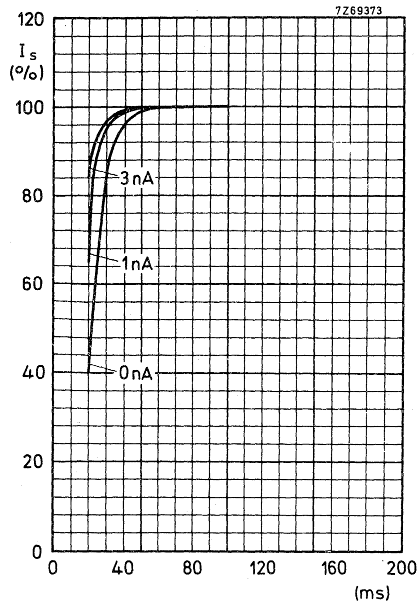


Fig. 6.

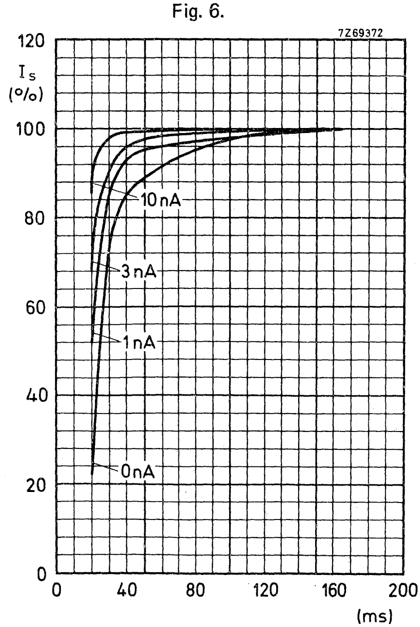


Fig. 7.

Build-up lag (note 23).

Light-bias induced dark current as parameter.

Fig. 6 XQ1503: I_s/I_b = 40/400 nA.

Fig. 7 XQ1503R: I_s/I_b = 20/200 nA.

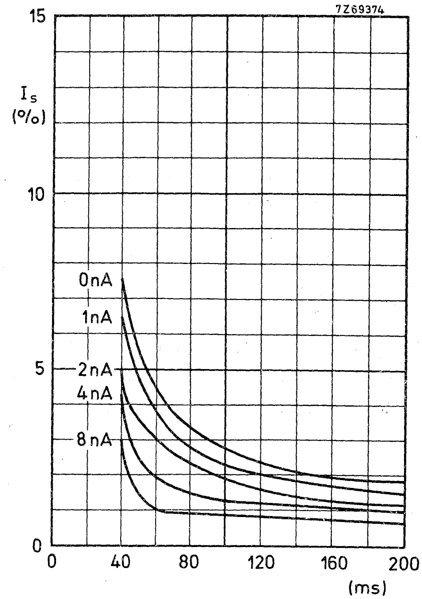


Fig. 8.

Decay lag (note 24)

Fig. 8 XQ1503: I_s/I_b = 40/400 nA.

Fig. 9 XQ1503R: I_s/I_b = 20/200 nA.

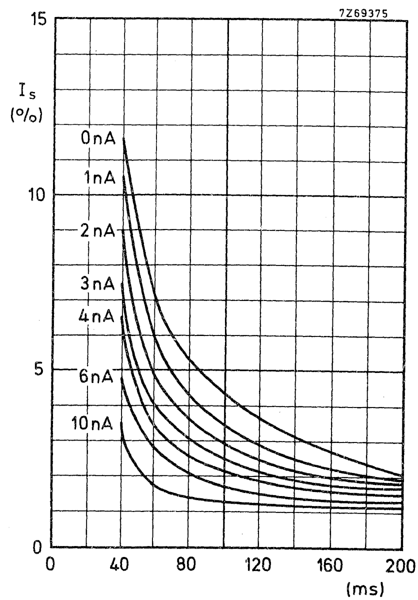


Fig. 9.

DEVELOPMENT SAMPLE DATA

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1503 series, the only difference being the degree of freedom form blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1504	for use in black and white cameras.
XQ1504R	for use in the red chrominance channel of colour cameras.

For all further information see data of the XQ1503 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon® television camera tubes identical to the tubes of the XQ1503 series, hence provided with an ACT electron gun, provisions for light bias, ceramic centring ring and a lead-oxide photoconductive target with extended red response. However, these tube types incorporate an infrared reflecting filter on the anti-halation glass disc.

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
Diameter	25,4 mm (1 in)
Length	158 mm (6¼ in)
Special features	Anti-Comet-Tail gun Provisions for light bias Anti-halation glass disc Ceramic centring ring Rear loading construction
Heater	6,3 V, 190 mA
Resolution	≈ 1000 TV lines
Spectral response, cut-off	750 nm

Provided with anti-halation glass disc with infrared reflecting filter.

The infrared reflecting filter eliminates the need for additional filters in the optical systems when the XQ1505 and XQ1505R are applied in black and white and colour cameras originally designed for tubes of the XQ1070 series.

The spread in spectral responses in the long wavelength region as published for the XQ1503 and XQ1503R tubes is greatly reduced, warranting minimum differences in colour rendition between cameras of identical manufacture.

The XQ1505 will provide black and white pictures with true tonal rendition of colours, the spectral response approaching very nearly the relative spectral sensitivity of the human eye.

The XQ1505R is intended for use in the red chrominance channel of colour cameras in broadcast, educational and high-quality industrial applications.

® Registered Trade Mark for television camera tube.

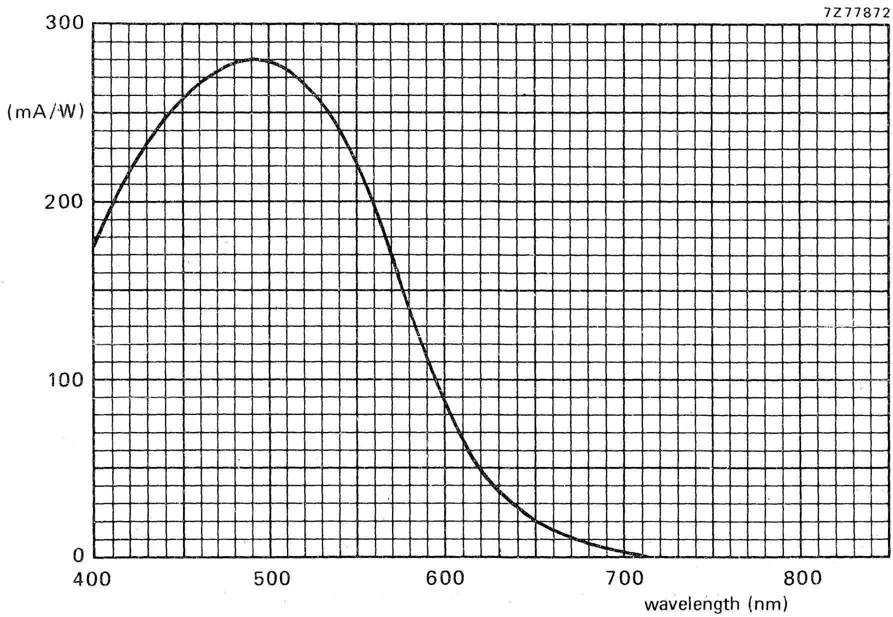
OPTICAL DATA

Spectral response	see curve below
Maximum response at	500 nm
Cut-off	750 nm*

Filter: Hard coating on anti-halation glass disc. Care in handling to avoid scratches is strongly recommended.

For further information refer to data of the XQ1503 series.

Note 17 of these data referring to Balzers B1/K1 filter does not apply.



Typical spectral sensitivity characteristic.

* Defined as the wavelength at which the spectral response has dropped to 1% of the peak response (≈ 500 nm).

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1505 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1506	for use in black and white cameras.
XQ1506R	for use in the red chrominance channel of colour cameras.

For all further information see data of the XQ1505 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon ®, 25,4 mm (1 in) diameter television camera tubes provided with a high resolution lead-oxide photoconductive target, magnetic deflection and magnetic focusing ACT electron gun and having provisions for light bias. They are similar to the XQ1500/XQ1501 series, but are front-loading types and hence have no ceramic centring ring.

The series comprises the following versions:

XQ1510
XQ1510L
XQ1510R
XQ1510G
XQ1510B — for use in black and white and colour cameras in broadcast applications.

XQ1511
XQ1511R
XQ1511G
XQ1511B — for use in black and white and colour cameras in industrial and educational applications.

The electrical and mechanical data of the tubes are identical to those of the XQ1500 and XQ1501 series, with the following exceptions:

ELECTRICAL DATA

Capacitance

Signal electrode to all	C_{as}	3 to 5 pF

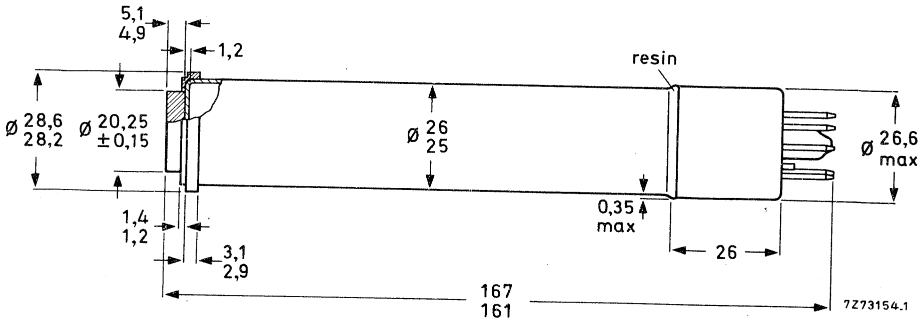
ACCESSORIES

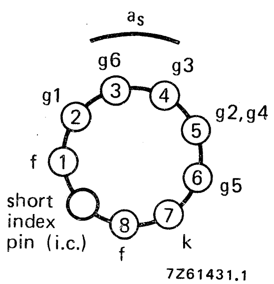
Deflection and focusing unit for B/W cameras	AT1116 or equivalent
Deflection and focusing unit for colour cameras	AT1116/06 or equivalent

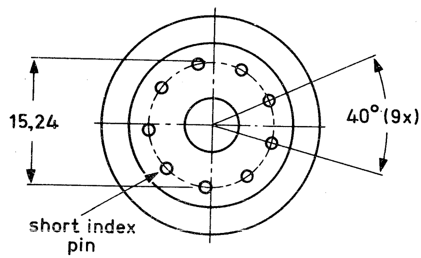
® Registered Trade Mark for television camera tube.

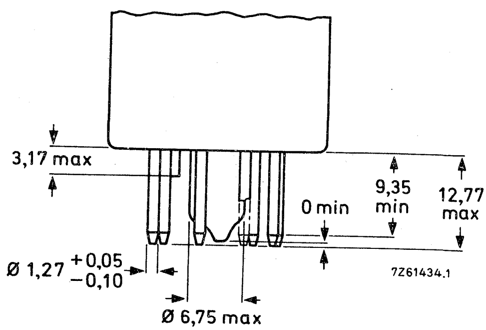
MECHANICAL DATA

Dimensions in mm









CAMERA TUBES

Plumbicon ®, 25,4 mm (1 in) diameter television camera tube with high resolution lead-oxide photoconductive target with extended red response, magnetic deflection, magnetic focusing, ACT electron gun and provisions for light bias. They are similar to the XQ1505/XQ1506 series, but they are front-loading types and hence have no ceramic centring ring.
The series comprises the following versions:

- Without infrared filter on the anti halation glass disc:

XQ1513 XQ1513R	for use in B/W and colour cameras in broadcast applications.
XQ1514 XQ1514R	for use in B/W and colour cameras in industrial applications.

- With infrared filter on the anti-halation glass disc:

XQ1515 XQ1515R	for use in B/W and colour cameras in broadcast applications.
XQ1516 XQ1516R	for use in B/W and colour cameras in industrial applications.

The electrical and mechanical data of the tubes are identical to those of the XQ1503/XQ1504 and XQ1505/XQ1506 series with the following exceptions:

ELECTRICAL DATA

Capacitance

Signal electrode to all	C_{as}	3 to 5 pF

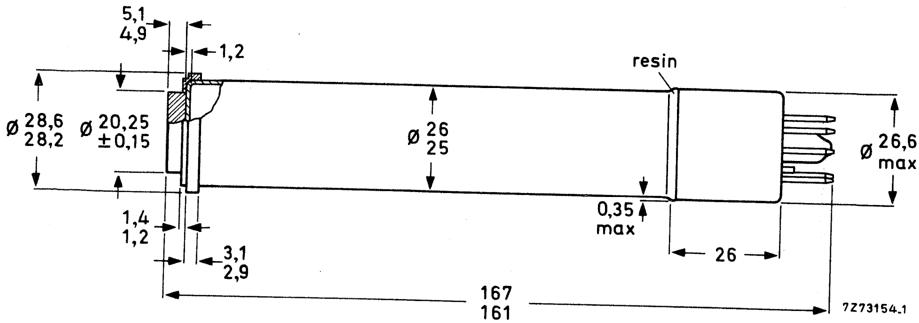
ACCESSORIES

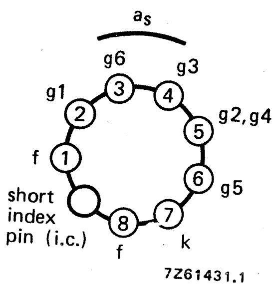
Deflection and focusing unit for B/W cameras	AT1116 or equivalent
Deflection and focusing unit for colour cameras	AT1116/06 or equivalent

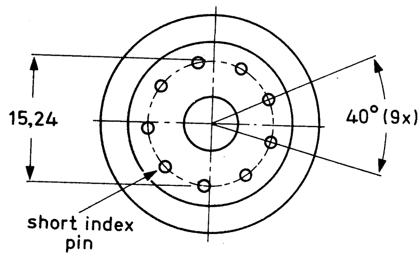
® Registered Trade Mark for television camera tube.

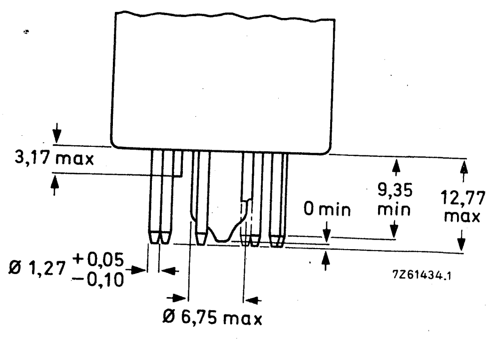
MECHANICAL DATA

Dimensions in mm









CAMERA TUBES

Plumbicon ®, 30 mm (1,2 in) diameter television camera tube with high resolution lead-oxide photoconductive target, magnetic deflection and magnetic focusing.
The tubes of the XQ1520 series feature:

- Anti-Comet-Tail electron gun for highlight handling.
- Low lag.
- Provisions for both **fixed** and **adjustable** light bias to minimize lag under low-key conditions.
- Same high resolving power as the 30 mm tubes such as the XQ1410.
- Electrode system with precision construction.

The XQ1520 is intended for use in black and white cameras, the XQ1520L, R, G and B for use in colour cameras in broadcast, educational and high-quality industrial applications in which high contrast ratios may occur.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	≈ 30 mm (1,2 in)
Length	215 mm (8,5 in)
Special features	Anti-Comet-Tail gun **Fixed** or **adjustable** light bias Anti-halation glass disc
Heater	6,3 V, 190 mA
Resolution	⩾ 1000 TV lines
Cut-off of spectral response	≈ 650 nm

OPTICAL

		note
Quality rectangle on photoconductive target (aspect ratio 3 : 4)	12,8 mm x 17,1 mm	1

Orientation of image on photoconductive target

For correct orientation of the image on the photoconductive target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the base of the tube.

Faceplate

Thickness		1,2	mm
Refractive index	n	1,49	
Refractive index of the anti-halation glass disc	n	1,59	

® Registered Trade Mark for television camera tube.

HEATING

Indirect by a.c. or d.c.; parallel supply

Heater voltage		V_f	6,3 V ± 5%
Heater current at $V_f = 6,3$ V	nom.	I_f	190 mA

To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE

Signal electrode to all	C_{as}	3 to 6 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

		note
DEFLECTION	magnetic	2
FOCUSING	magnetic	2

ACCESSORIES

Socket	type 56025	
For **adjustable** light bias: light bias lamp in holder	type 56106	3
For **fixed** light bias: adapter for XQ1520	type 56122	4
XQ1520R	type 56123	
XQ1520L and G	type 56124	
XQ1520B	type 56125	
Deflection and focusing coil unit black and white	type AT1132/01	
colour	type AT1113/01 or equivalent	

ELECTRON GUN CHARACTERISTICS

			notes
Cut-off			
Grid 1 voltage for cut-off at $V_{g2,4}$ = 300 V, without blanking, or ACT pulses	V_{g1}	−40 to −110 V	
Blanking voltage, peak to peak at $V_{g2,4}$ = 300 V on grid 1	$V_{g1p\text{-}p}$	50 ± 10 V	5
Grids 2 and 4 current	$I_{g2,4}$	< 0,2 mA	6
Grids 3, 5 and 6 current			6
Pulse timing and amplitude requirements (ACT)			10

LIMITING VALUES (Absolute maximum rating system)

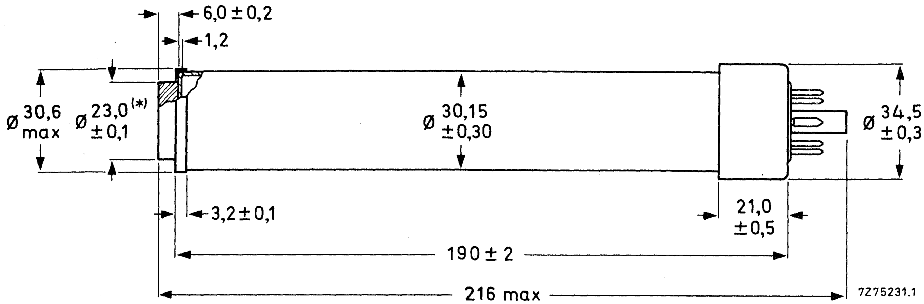
All voltages referred to the cathode, unless otherwise stated.

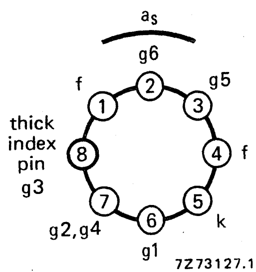
				notes
Signal electrode voltage	V_{as}	max	50 V	
Grid 6 (mesh) voltage	V_{g6}	max	1100 V	12
Grid 5 (collector) voltage	V_{g5}	max	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max	350 V	
Grid 4 (limiter) and grid 2 (accelerator, first anode) voltage	$V_{g2,4}$	max	350 V	
Grid 3 (auxiliary grid) voltage	V_{g3}	max	350 V	
Grid 1 (control grid) voltage, positive	V_{g1}	max	0 V	
negative	$-V_{g1}$	max	200 V	
Cathode heating time before drawing cathode current	T_h	min	1 min	
Cathode-to-heater voltage, positive peak	$V_{kf\,p}$	max	50 V	
negative peak	$-V_{kf\,p}$	max	50 V	
Ambient temperature, storage and operation	t_{amb}	max	50 °C	
		min	−30 °C	
Faceplate temperature, storage and operation	t	max	50 °C	
		min	−30 °C	
Faceplate illuminance	E	max	500 lx	7

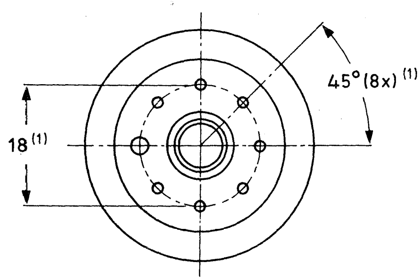
DEVELOPMENT SAMPLE DATA

MECHANICAL DATA

Dimensions in mm

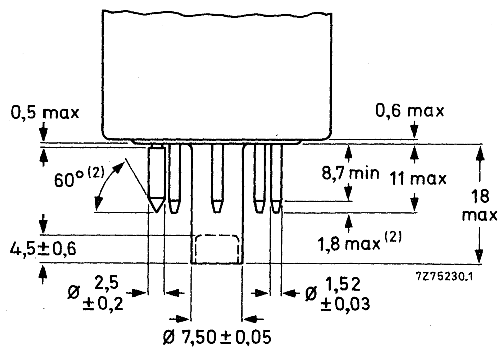






Mounting position: any

Mass: ≈ 100 g



(*) Distance between axis of anti-halation glass disc and geometrical centre of signal electrode ring, measured in plane of faceplate: max. 0,2 mm. Total glass thickness: 7,2 ± 0,2 mm.

(1) The base passes a flat gauge with a centre hole 8,230 ± 0,005 mm diameter and holes for passing the pins with the following diameters: 7 holes of 1,690 ± 0,005 mm and one hole of 2,950 ± 0,005 mm. The holes may deviate max. 0,01 mm from their true geometrical position. Thickness of gauge 7 mm.

(2) The ends of the pins are tapered and/or rounded but not brought to sharp point.

DEVELOPMENT SAMPLE DATA

OPERATING CONDITIONS AND PERFORMANCE

Conditions (with ACT action: note 8)
For a scanned area of 12,8 mm x 17,1 mm. All voltages are specified with respect to the cathode potential during the read-out mode, unless otherwise indicated: see notes 9, 10, 11.

			notes
Cathode voltage,			
during read-out mode	V_k	0 V	
during ACT mode	V_k	0 to 15 V	
Signal electrode voltage	V_{as}	45 V	
Grid 6 (mesh) voltage	V_{g6}	675 V	12
Grid 5 (collector) voltage	V_{g5}	600 V	12
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300 V	
Grid 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}		11
during ACT mode	V_{g3}		11
Grid 1 (control grid) voltage,			
during read-out mode	V_{g1}		13
during ACT mode	V_{g1}		11
blanking on grid 1, peak	V_{g1p}	50 V	
Typical beam current, signal current and pulse settings			11

		XQ1520, L	XQ1520R	XQ1520G	XQ1520B
Signal current, peak	I_{sp}	0,3 µA	0,15 µA	0,3 µA	0,15 µA
Beam current, peak	I_{bp}	0,6 µA	0,3 µA	0,6 µA	0,3 µA
ACT level, peak		0,4 µA	0,2 µA	0,4 µA	0,2 µA
Cathode pulse	V_{kp}	7 V	3,5 V	7 V	3,5 V
Grid 1 pulse	V_{g1p}	27 V	23,5 V	27 V	23,5 V
Grid 3 pulse	V_{g3p}	see note 11			

		notes
Faceplate illuminance		14
Light bias		15
Temperature of faceplate	20 to 45 °C	
Deflection, focusing and alignment coil unit	AT1113	
Deflection, focusing and alignment currents		16

V_{g6}/V_{g5} (V)	focus current (mA)	line current p-p (mA)	frame current p-p (mA)
675/600	110	235	35

Line and frame alignment currents max 5 mA, corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

Performance

				notes
Dark current (without light bias)		⩽	3 nA	
Sensitivity at colour temperature of illuminance = 2856 K				
XQ1520	min. 375	typ.	400 μA/lm	
XQ1520L	375		400 μA/lm	
XQ1520R	70		85 μA/lmF	
XQ1520G	130		165 μA/lmF	
XQ1520B	35		38 μA/lmF	
Gamma of transfer characteristic			0,95 ± 0,05	18
Light transfer characteristic with ACT			see Fig. 3	
Highlight handling		⩾	5 lens stops	19
Spectral response: max response at		≈	500 nm	
Spectral response: cut-off at		≈	650 nm	
Spectral response curve			see Fig. 1	

Resolution

Modulation depth, i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures shown represent the horizontal amplitude response as measured with a lens aperture F : 5,6, see not 20.

		XQ1520, L	XQ1520R	XQ1520G	XQ1520B
Highlight signal current	I_s	0,3 μA	0,15 μA	0,3 μA	0,15 μA
Beam current	I_b	0,6 μA	0,3 μA	0,6 μA	0,3 μA
Modulation depth at 400 TV lines in %, typ.		55	50	55	60
min.		50	40	50	50

Limiting resolution ⩾ 1000 TV lines

Lag (typical values)

Light source with a colour temperature of 2856 K. Appropriate filter inserted in the light path for the chrominance tubes R, G and B: see Fig. 2.

Low key conditions (without light bias)

	build-up lag note 21				decay lag note 22			
	I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA		I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1520, L, G			95%	≈100%			9%	3%
XQ1520R	85%	≈100%			13%	3,5%		
XQ1520B	70%	≈100%			15%	5,5%		

Low key conditions (with light bias)

Typical effect of light bias on build-up and decay lag under low key signal current and beam current settings (I_s/I_b see note 6) are shown in Figs 4 to 9: notes 15, 21, 22.

High key conditions (with and without light bias)

	build-up lag note 21				decay lag note 22			
	I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA		I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1520, L, G			99%	100%			1,2%	0,4%
XQ1520R	98%	100%			2%	0,5%		
XQ1520B	97%	100%			3,5%	2%		

Shading of light bias induced dark current 12,5 % note 23

DEVELOPMENT SAMPLE DATA

NOTES

1. Underscanning of the specified useful area of 12,8 mm x 17,1 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.
2. For focusing/deflection coil unit see under Accessories.
3. The light bias lamp assembly, type 56106, supplied with each tube, fits in the metal tube cemented to the pumping stem of the tube. The tube and the light bias lamp assembly will fit properly in the socket. The wires should be connected to a source, capable of supplying max 110 mA at 5 V. Considerations and recommendations for the choice of such a source, depending on the application are supplied with each tube. The light bias lamp projects its light via a blue-green transmitting filter on the pumping stem where it is conducted to the target to cause a bias illuminance. The desired amount of light bias can be obtained by adjusting the current through the filament of the small lamp.
4. An adapter for fixed light bias operation is packed with each tube: see also note 15.
5. Blanking can also be applied to the cathode:
   – **without** ACT action: required cathode pulse approx. 25 V.
   – **with** ACT action: timing, polarity and amplitudes of the ACT pulses will have to be adapted.
6. The d.c. voltage supply and/or pulse supply to these electrodes should have a sufficiently low impedance to prevent distortion caused by the peak currents drawn during the ACT mode.
   These peak current may amount to:

cathode	2 mA
grid 1	0 mA
grids 2 and 4	1 mA
grid 3	150 μA
grid 5	300 μA
grid 6	300 μA

   The cathode impedance should preferably be chosen $\leqslant$ 300 Ω.
7. For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.

8. When the tube is to be used without ACT action, grid 3 should be connected to grids 2 and 4 and no ACT pulses should be applied to the cathode and grid 1. The performance of the tube will then be as described herein with the exception of the highlight handling.

9. a. For proper ACT action the d.c. voltage supply and/or pulse supply to the various electrodes should have sufficiently low impedance: see note 6.

   b. **Video preamplifier:** In the presence of highlights, peak signal currents of the order of 15 to 45 μA may be offered to the preamplifier during flyback. Special measures have to be taken in the preamplifier to prevent temporary overloading.

10. a. **Read-out mode:** Defined as the operating conditions during the active line scan (full line period-line blanking interval). For the CCIR system this will amount to 64 μs - 12 μs = 52 μs.

    b. **ACT mode:** Defined as the operating conditions during that part of the line blanking interval during which the ACT electrode gun is fully operative. The ACT interval is equal to or slightly within the line flyback time.

11. **Pulse timing (CCIR) and amplitudes for ACT action:** (blanking applied to grid 1: note 5).

    a. For proper operation and setting up of the ACT electron gun three electrodes have to be pulsed:
    - **Cathode:** A positive-going pulse, V_{kp}, with an adjustable amplitude of 0 to 20 V. This pulse can be chosen to coincide with the camera blanking period ($\approx$ 11 μs).
      The amplitude of this pulse determines the ACT cutting level and may in general be preset to 7, 3,5, 7, 3,5 V, for black/white, R, G, B application respectively. An amplitude of 20 V should be available to preset the I_s/I_b (see note 13).
    - **Grid 1:** A positive-going pulse, $V_{g1\,p}$, with such an amplitude that during the ACT mode the grid 1 bias is effectively reduced by 20 to 25 V, (V_{g1p} = 20 to 25 V + $V_{k\,p}$), to produce an extra amount of cathode current. The duration of this pulse should be so chosen that it is just within the flyback period ($\approx$ 5 μs).
    - **Grid 3:** A negative-going pulse, $V_{g3\,p}$, timing and duration coinciding with $V_{g1\,p}$,
      – with either an **adjustable amplitude** and superimposed on a **fixed grid 3 voltage** of 250 to 300 V,
      – or with **fixed amplitude** and superimposed on an **adjustable grid 3 voltage** of 250 to 300 V,
      in either case, adjusted to result in a grid 3 voltage of 8,5 V with respect to the cathode voltage during the ACT mode.

      This pulse ensures that an adequate amount of beam current is drawn from the cathode current.

    b. A suggested pulse timing and amplitude diagram is shown on page B240.

12. Operation with ACT at $V_{g6} > 750$ V is not recommended since this may introduce dark current.

13. Adjusted with the ACT made inoperative, e.g. by setting the cathode pulse to 20 V. The control grid voltage is adjusted to produce a beam current just sufficient to allow a peak signal current of twice the typical value, $I_{s\,p}$, as observed and measured on a waveform oscilloscope. This amount of beam current is termed $I_{b\,p}$.
    N.B. The signal current, I_s, and beam current, I_b, conditions quoted with the performance figures for e.g., lag, relate to measurements with an integrating instrument connected in the signal-electrode lead and a uniform illuminance on the scanned area. The corresponding peak currents, $I_{s\,p}$ and $I_{b\,p}$, as measured on a waveform oscilloscope will be a factor α larger (α = 100/100–β), β being the total blanking time in %; for CCIR system α = 1,3.

14. In the case of a black/white camera the illuminance on the photoconductive layer, B_{ph}, is related to scene illuminance, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{R\,T}{4F^2\,(m+1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target. A similar formula may be derived for the illuminance level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the complete optical system have been taken into account.

15. a. For monochrome operation a light bias corresponding to 4,5 nA dark current is usually adequate for excellent speed of response. The adapter as supplied with the tube will produce a fixed light bias in the order of this magnitude.

b. **Adjustable** light bias (colour camera)
In a colour camera the speeds of response of the tubes can be balanced by adjusting the amount of light bias per tube.

In a 3-tube R, G, B camera for instance it is recommended to first adjust the tubes to their normal highlight signal current and beam current settings and then point the camera at a dark scene comprising a metronome. The moving hand of the metronome carries a small white square. The illuminance should be chosen such that the square produces a peak signal of approx. 50 nA in the green chrominance channel. A maximum of 3 nA artificial dark current shall then be introduced in the green chrominance tube. Subsequently light bias shall be applied to the tubes in the red and blue channels until the lag of the three tubes is neutralized.

c. **Fixed** light bias (colour camera).
A typical setting for correct speeds of response in a 3-tube colour camera would be approx. 3 nA(p) (R), 2 nA(p) (G), and 3,5 nA(p) (B). The adapters as supplied with the tubes will produce fixed bias of the same magnitude.

16. a. Focus coil current adjusted for correct electrical focus.

b. The direction of the current through the focus coil should be chosen such that a north-seeking pole will be repelled at the faceplate end of the coil. The optimum voltage difference between grid 6 and grid 5 depends on the type of focusing/deflection coil unit used. For the type AT1113 a voltage difference of 50 V to 100 V is recommended.

17. Measuring conditions:
Illuminance 4,54 lx, colour temperature 2856K, appropriate filter inserted in the light path. The signal current obtained in nA is a measure of the colour sensitivity expressed in μA per lumen of white light before the filter.
Filters used:

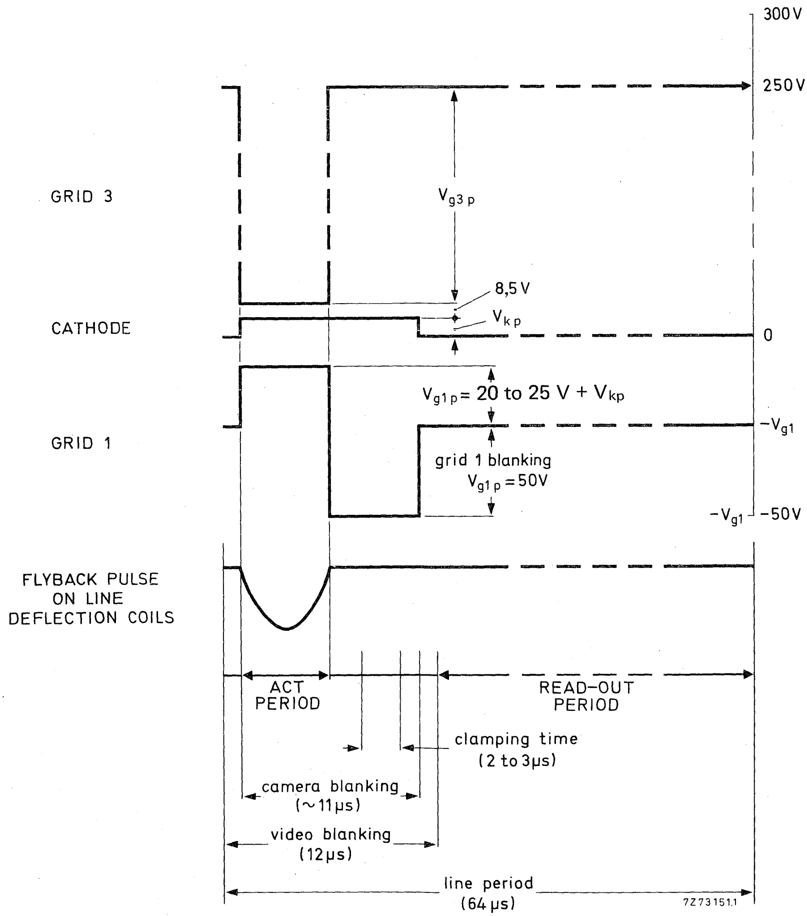
XQ1520R	Schott	OG570	thickness	3 mm
XQ1520G	Schott	VG9	thickness	1 mm
XQ1520B	Schott	BG12	thickness	3 mm

18. Below the knee caused by ACT operation. Gamma stretching circuitry is recommended.

19. With pulses applied as indicated in note 11, the tube will properly handle a highlight with a diameter of 10% of picture height and with a luminance corresponding to 32 times peak signal white, $I_{s\,p}$.

20. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affect neither the vertical resolution nor the limiting resolution.

21. **Build-up lag.** After 10 s of darkness. The values and curves shown represent the typical percentages of the ultimate signal obtained as a function of time (in units of 20 ms = field period for CCIR system) after the illuminance has been applied.
22. **Decay lag.** After a minimum of 5 s of illuminance on the target. The values and curves shown represent the residual signal currents in percentages of the original signal current as a function of time (in units of 20 ms = field period for CCIR system) after the illuminance has been removed.
23. Deviation of the level of any of the four corners, i.e. 10% inwards in L and V directions from the level in the picture centre.
    With the settings suggested in note 15, black shading compensation in the camera video processing amplifier will not normally be required. Further improvement in lag can be obtained by applying still higher light bias levels. It may then be necessary to use black shading compensation in the video processing amplifier.



DEVELOPMENT SAMPLE DATA

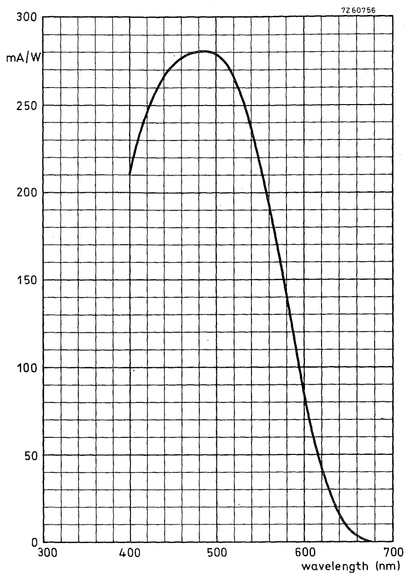


Fig. 1 Spectral response curve.

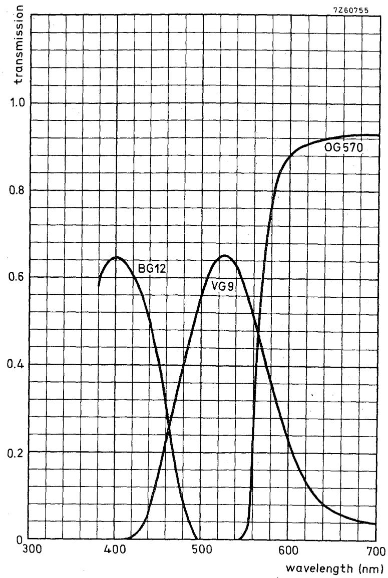


Fig. 2 Transmission of filters BG12, VG9, and OG570.

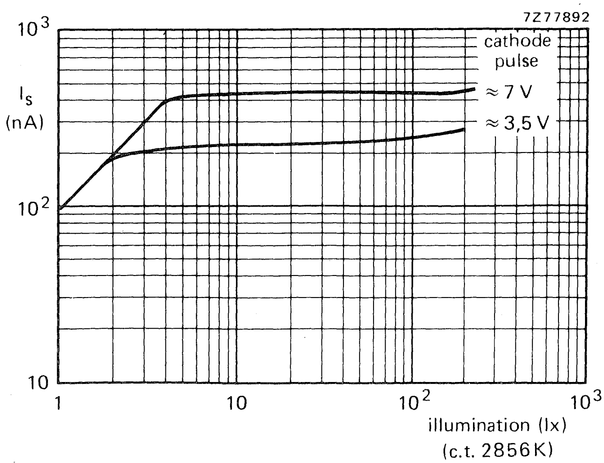


Fig. 3 Typical light transfer characteristics with ACT applied.

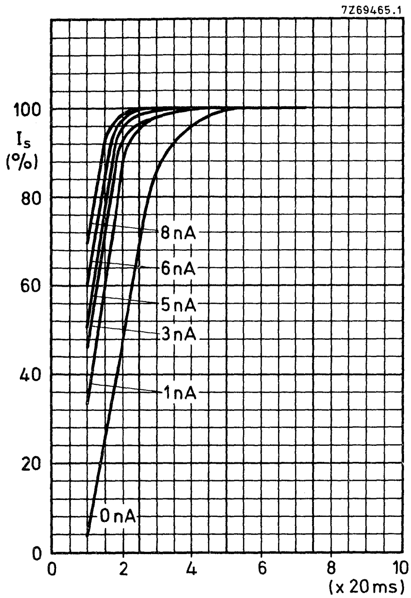


Fig. 4.

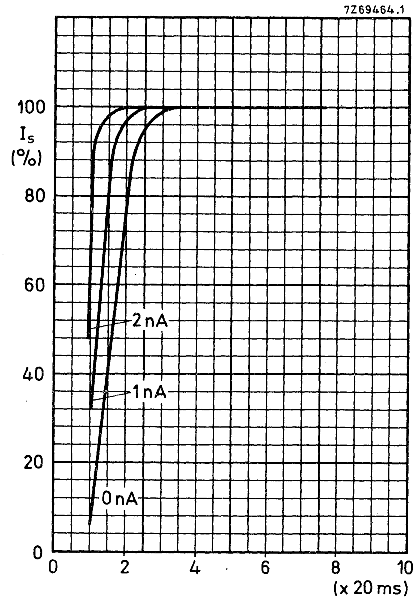


Fig. 5.

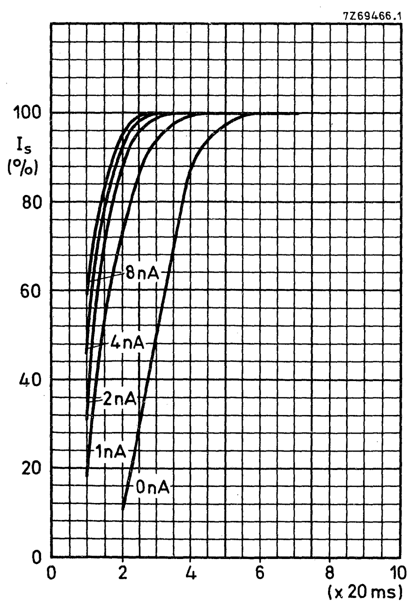


Fig. 6.

Build-up lag (note 21)

Light bias induced dark current as parameter.

Fig. 4 XQ1520R: I_s/I_b = 20/300 nA.

Fig. 5 XQ1520, XQ1520L, XQ1520G: I_s/I_b = 40/600 nA.

Fig. 6 XQ1520B: I_s/I_b = 20/300 nA.

DEVELOPMENT SAMPLE DATA

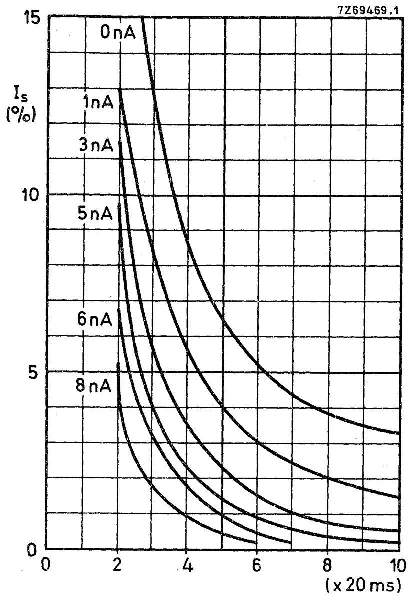


Fig. 7.

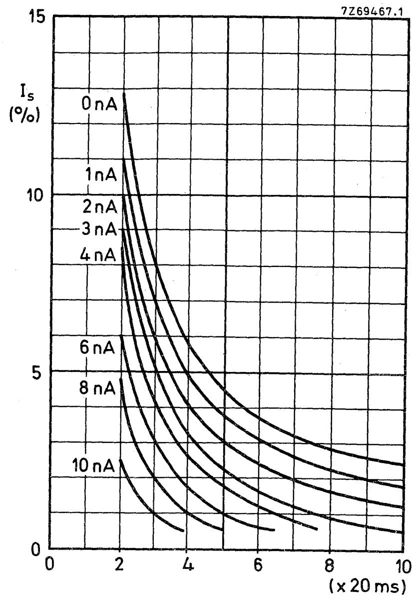


Fig. 8.

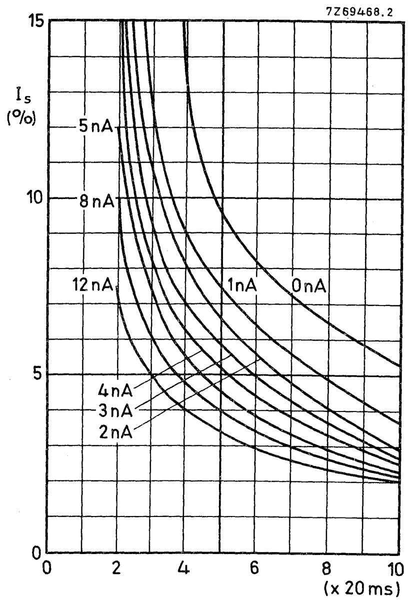


Fig. 9.

Decay lag (note 22)

Light bias induced dark current as parameter.

Fig. 7 XQ1520R: I_s/I_b = 20/300 nA.

Fig. 8 XQ1520, XQ1520L, XQ1520G: I_s/I_b = 40/600 nA.

Fig. 9 XQ1520B: I_s/I_b = 20/300 nA.

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1520 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1521	for use in black and white cameras.
XQ1521R XQ1521G XQ1521B	for use in the chrominance channels of colour cameras.

For all further information see data of the XQ1520 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon ®, 30 mm (1,2 in) diameter television camera tube with high-resolution lead-oxide photoconductive target with extended red response, separate mesh, magnetic deflection, and magnetic focusing. The tubes of the XQ1523 series feature:

- Anti-Comet-Tail electron gun for highlight handling.
- Low lag.
- Provisions for both **fixed** and **adjustable light bias** to minimize lag under low key conditions.
- Same high resolving power as the 30 mm tubes such as XQ1415.
- Electrode system with precision construction.

The XQ1523 is intended for use in black and white cameras, the XQ1523L for use in the luminance channel of 4-tube colour cameras, the XQ1523R for use in the red channel of both 3 and 4-tube colour cameras in broadcast, educational and high-quality industrial applications in which high contrast ratios may occur.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	≈ 30 mm (1,2 in)
Length	215 mm (8,5 in)
Special features	Anti-Comet-Tail gun **Fixed** and **adjustable** light bias Anti-halation glass disc
Heater	6,3 V, 190 mA
Resolution	⩾ 1000 TV lines
Cut-off of spectral response	850 to 950 nm

OPTICAL

Quality rectangle photoconductive target (aspect ratio 3 : 4) 12,8 mm x 17,1 mm (note 1)

Orientation of image on photoconductive target

For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the base of the tube.

® Registered Trade Mark for television camera tube.

Faceplate		
Thickness		1,2 mm
Refractive index	n	1,49
Refractive index of the anti-halation glass disc	n	1,52

HEATING

Indirect by a.c. or d.c.; parallel supply

Heater voltage	V_f	6,3 V ± 5%
Heater current at V_f = 6,3 V	nom. I_f	190 mA

To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

CAPACITANCE

Signal electrode to all	C_{as}	3 to 6 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

DEFLECTION

magnetic (note 2)

FOCUSING

magnetic (note 2)

ACCESSORIES

Socket	type 56025	
For adjustable light bias		
Light bias lamp in holder	type 56106	(note 3)
For fixed light bias		(note 4)
Adapter for XQ1523	type 56122	
Adapter for XQ1523L	type 56124	
Adapter for XQ1523R	type 56123	
Deflection and focusing coil unit, black/white	type AT1132/01	
Deflection and focusing coil unit, colour	type AT1113/01 or equivalent	

ELECTRON GUN CHARACTERISTICS

			note
Cut-off			
Grid 1 voltage for cut-off at $V_{g2,4}$ = 300 V without blanking or ACT pulses	V_{g1}	−40 to −110 V	
Blanking voltage, peak to peak at $V_{g2,4}$ = 300 V, on grid 1	V_{g1p}	50 ± 10 V	5
Grids 2 and 4 current (d.c. values)	$I_{g2,4}$	< 0,2 mA	6
Grids 3, 5 and 6 current			6
Pulse timing and amplitude requirements (ACT)			11

LIMITING VALUES (Absolute maximum rating system)

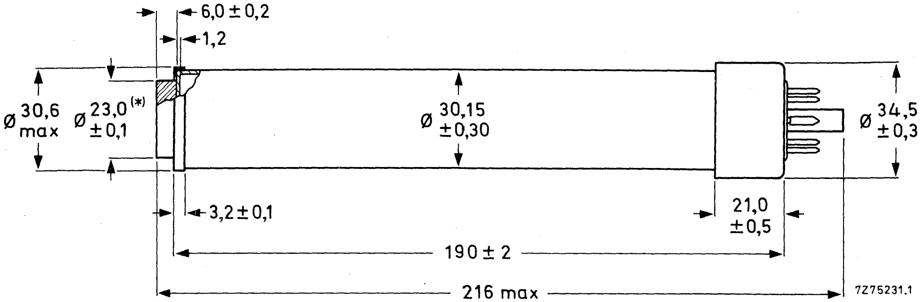
All voltages are referred to the cathode, unless otherwise stated.

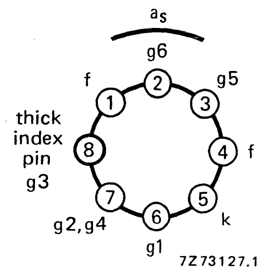
Signal electrode voltage	V_{as}	max	50 V	
Grid 6 (mesh) voltage	V_{g6}	max	1100 V	12
Grid 5 (collector) voltage	V_{g5}	max	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max	350 V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max	350 V	
Grid 3 (auxiliary grid) voltage	V_{g3}	max	350 V	
Grid 1 (control grid) voltage, positive	V_{g1}	max	0 V	
negative	$-V_{g1}$	max	200 V	
Cathode heating time before drawing cathode current	T_h	min	1 min	
Cathode to heater voltage, positive peak	$V_{kf\,p}$	max	50 V	
Cathode to heater voltage, negative peak	$-V_{kf\,p}$	max	50 V	
Ambient temperature, storage and operation	t_{amb}	max	50 °C	
		min	−30 °C	
Faceplate temperature, storage and operation	t	max	50 °C	
		min	−30 °C	
Faceplate illuminance	E	max	100 lx	7

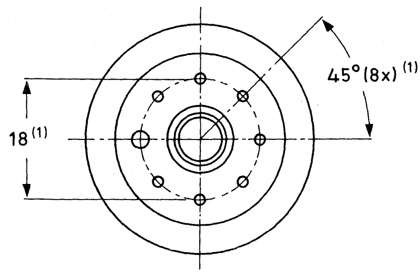
DEVELOPMENT SAMPLE DATA

MECHANICAL DATA

Dimensions in mm

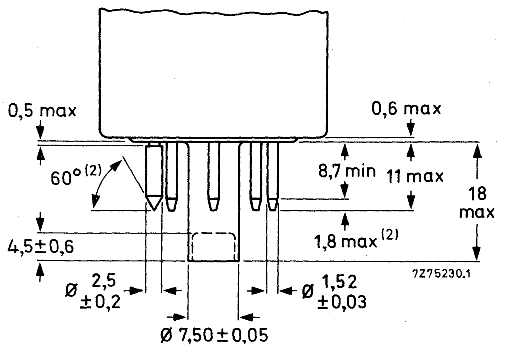






Mounting position: any

Mass: ≈ 100 g



(*) Distance between axis of anti-halation glass disc and geometrical centre of signal electrode ring, measured in plane of faceplate: max. 0,2 mm. Total glass thickness: 7,2 ± 0,2 mm.

(1) The base passes a flat gauge with a centre hole 8,230 ± 0,005 mm diameter and holes for passing the pins with the following diameters: 7 holes of 1,690 ± 0,005 mm and one hole of 2,950 ± 0,005 mm. The holes may deviate max. 0,01 mm from their true geometrical position. Thickness of gauge 7 mm.

(2) The ends of the pins are tapered and/or rounded but not brought to a sharp point.

OPERATING CONDITIONS AND PERFORMANCE

Conditions (with ACT action: note 8)
For a scanned area of 12,8 mm x 17,1 mm. All voltages are specified with respect to the cathode potential during the read-out mode, unless otherwise indicated. See notes 9, 10, 11.

			note
Cathode voltage,			
during read-out mode	V_k	0 V	
during ACT mode	V_k	0 to 15 V	
Signal electrode voltage	V_{as}	45 V	
Grid 6 (mesh) voltage	V_{g6}	675 V	12
Grid 5 (collector) voltage	V_{g5}	600 V	12
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300 V	
Grid 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}		11
during ACT mode	V_{g3}		
Grid 1 (control grid) voltage,			
during read-out mode	V_{g1}		13
during ACT mode	V_{g1}		11
blanking on grid, peak	V_{g1p}	50 V	

Typical beam current, signal current and pulse settings: note 11

		XQ1523 XQ1523L	XQ1523R
Signal current (peak)	I_{sp}	0,3 μA	0,15 μA
Beam current (peak)	I_{bp}	0,6 μA	0,3 μA
ACT level (peak)		0,4 μA	0,2 μA
Cathode pulse	V_{kp}	7 V	3,5 V
Grid 1 pulse	V_{g1p}	27 V	23,5 V
Gird 3 pulse	V_{g3p}	See note 11	

		note
Faceplate illuminance		14
Light bias		15
Temperature of faceplate	20 to 45 °C	
Deflection, focusing and alignment coil unit	AT1113	16

Deflection, focusing and alignment current

V_{g6}/V_{g5} V	focus current mA	line current p-p mA	frame current p-p mA
675/600	110	235	35

Line and frame alignment currents max. 6 mA, corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

DEVELOPMENT SAMPLE DATA

Performance			note
Dark current (without light bias)	≤	3 nA	
Sensitivity at colour temperature of illumination = 2856K	min.	typ.	17
XQ1523	390	450 μA/lmF	
XQ1523L	390	450 μA/lmF	
XQ1523R	120	150 μA/lmF	
Gamma of transfer characteristic	0,95 ± 0,05		18
Light transfer characteristics with ACT	see Fig. 2		
Highlight handling	≥ 5 lens stops		19
Spectral response: max. response at	≈500 nm		
Spectral response cut off at	850 to 950 nm		
Spectral response curve	see Fig. 1		

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures represent the horizontal amplitude response as measured with a lens aperture of F: 5,6, see note 20.

		XQ1523 XQ1523L	XQ1523R
Highlight signal current	I_s	0,3 μA	0,15 μA
Beam current	I_b	0,6 μA	0,3 μA
Modulation depth at 400 TV lines in %,	typ.	55	50
	min.	50	40

Modulation transfer characteristics — see Fig. 5
Limiting resolution — ≥ 1000 TV lines

Lag (typical values)

Light source with a colour temperature of 2856K
Appropriate filter inserted in the light path for the chrominance tube XQ1523R

Low key conditions (without light bias)

	build-up lag note 21				decay lag note 22			
	I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA		I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1523, L			90%	≈100%			10%	3,5%
XQ1523R	60%	≈100%			15%	5%		

Low key conditions (with light bias)

Typical effect of light bias on both build-up and decay lag under low key signal current and beam current settings (I_s/I_b see note 13) are shown in Figs. 6 to 9: notes 15, 21, 22.

High key conditions (with and without light bias)

	build-up lag note 21				decay lag note 22			
	I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA		I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ1523, L			99%	100%			1,2%	0,4%
XQ1523R	98%	100%			2%	0,5%		

Shading of light bias induced dark current 12,5% (note 23)

DEVELOPMENT SAMPLE DATA

NOTES

1. Underscanning of the specified target area of 12,8 mm x 17,1 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive target.
2. For focusing/deflection coil unit see under Accessories.
3. The light bias lamp assembly as supplied with each tube, type 56106, fits in the metal tube cemented to the pumping stem. The tube and the light bias lamp assembly will fit properly in the socket. The wires should be connected to a source capable of supplying max. 110 mA at 5 V. Considerations and recommendations for the choice of such a source, depending on the application, are supplied with each tube. The light bias lamp projects its light via a blue-green transmitting filter on the pumping stem where it is conducted to the target to cause a bias illuminance. The desired amount of light bias can be obtained by adjusting the current through the filament of the small bulb.
4. An adapter for fixed light bias operation is packed with each tube (see also note 15).
5. Blanking can also be applied to the cathode:
   – **without** ACT action: required cathode pulse ≈ 25 V.
   – **with** ACT action: timing, polarity and amplitude of the ACT pulses will have to be adapted.
6. The d.c. voltage supply and/or pulse supply to these electrodes should have a sufficiently low impedance to prevent distortion caused by the peak currents drawn during the ACT mode. These peak currents may amount to:

cathode	2 mA
grid 1	0 mA
grids 2 and 4	1 mA
grid 3	150 μA
grid 5	300 μA
grid 6	300 μA

   The cathode impedance should preferably be chosen ⩽ 300 Ω.
7. For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.
8. When the tube is to be used without ACT action, grid 3 should be connected to grids 2 and 4 and no ACT pulses should be applied to the cathode and grid 1. The performance of the tube will then be as described herein with the exception of the highlight handling.

9a. For proper ACT action the d.c. voltage supply and/or pulse supply to the various electrodes should have sufficiently low impedance. See note 6.

9b. **Video preamplifier.** In the presence of highlights, peak signal currents of the order of 15 to 45 μA may be offered to the preamplifier during flyback. Special measures have to be taken in the preamplifier to prevent temporary overloading.

10a. **Read-out mode:** defined as the operating conditions during the active line scan (full line period-line blanking interval). For the CCIR system this will amount to 64 μs - 12 μs = 52 μs.

10b. **ACT mode:** defined as the operating conditions during that part of the line blanking interval during which the ACT electrode gun is fully operative. The ACT interval is equal to or slightly within the line flyback time.

11. **Pulse timing (CCIR) and amplitudes for ACT action** (blanking applied to grid 1 : note 5).

11a. For proper operation and setting up of the ACT electron gun three electrodes have to be pulsed:

- **Cathode.** A positive-going pulse, V_{kp}, with an adjustable amplitude of 0 to 20 V. This pulse can be chosen to coincide with the camera blanking period ($\approx$ 11 μs).

  The amplitude of this pulse determines the ACT cutting level and may in general be preset to 7, 3,5 V, respectively, for black/white and R, application. An amplitude of 20 V should be available to preset the I_s/I_b (see note 13).

- **Grid 1.** A positive-going pulse, V_{g1p}, with such an amplitude that during the ACT mode the grid 1 bias is effectively reduced by 20 to 25 V, (V_{g1p} = 20 to 25 V + V_{kp}), to produce an extra amount of cathode current. The duration of this pulse should be so chosen that it is just within the flyback period ($\approx$ 5 μs).

- **Grid 3.** A negative-going pulse, V_{g3p}, timing and duration coinciding with V_{g1p},
  – with either an **adjustable amplitude** and superimposed on a **fixed grid 3 voltage** of 250 to 300 V,
  – or with **fixed amplitude** and superimposed on an **adjustable grid 3 voltage** of 250 to 300 V,
  in either case adjusted to result in a grid 3 voltage of 8,5 V with respect to the cathode voltage during the ACT mode.

  This pulse ensures that an adequate amount of beam current is drawn from the cathode current.

11b. A suggested pulse timing and amplitude diagram is shown on page B254.

12. Operation with ACT at $V_{g6} > 750$ V is not recommended since this may introduce dark current.

13. Adjusted with the ACT made inoperative, e.g. by setting the cathode pulse to 20 V. The control grid voltage is adjusted to produce a beam current just sufficient to allow a peak signal current of twice the typical value, I_{sp}, as observed and measured on a waveform oscilloscope. This amount of beam current is termed I_{bp}.
N.B. The signal current, I_s, and beam current, I_b, conditions quoted with the performance figures for e.g., lag, relate to measurements with an integrating instrument connected in the signal-electrode lead and a uniform illuminance on the scanned area. The corresponding peak currents, I_{sp} and I_{bp} as measured on a waveform oscilloscope will be a factor α larger (α = 100/100-β), β being the total blanking time in %; for CCIR system α amounts to 1,3.

14. In the case of a black/white camera the illuminance on the photoconductive layer, B_{ph}, is related to scene illuminance, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{RT}{4F^2 (m+1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target. A similar formula may be derived for the illuminance level on the photoconductive layer of the R tube in which the effects of the various components of the complete optical system have been taken into account.

15a. For monochrome operation a light bias, corresponding to 5 nA extra dark current is usually adequate for excellent speed of response. The adapter, as supplied with the tube will produce a fixed light bias in this order of magnitude.

15b. **Adjustable light bias** (colour camera)
In a colour camera the speeds of response of the tubes can be balanced by adjusting the amount of light bias per tube. In a 3-tube R, G, B camera for example it is recommended to first adjust the tubes to their normal highlight signal current and beam current settings and then point the camera at a dark scene comprising a metronome. The moving hand of the metronome carries a small white square. The illuminance should be chosen such that the square produces a peak signal of approx. 50 nA in the green chrominance channel. A maximum of 3 nA artificial dark current shall then be induced in the green chrominance tube. Subsequently light bias shall be applied to the tubes in the red and blue channels, until the lag of the three tubes is neutralized.

15c. **Fixed light bias** (colour camera)
A typical setting for correct speeds of response in a 3-tube colour camera would be approx. 3 nA(p)(R), 2 nA(p)(G) and 3,5 nA(p)(B). The adapters, as supplied with the tubes, will produce fixed light bias in this order of magnitude.

16a. Focus coil current adjusted for correct electrical focus.

16b. The direction of the current through the focusing coil should be chosen such that a north-seeking pole will be repelled at the faceplate end of the coil. The optimum voltage difference between grid 6 and grid 5 depends on the type of focusing/deflection assembly used. For AT1113 a voltage difference of 50 V to 100 V is recommended.

17. All measurements are made with an infrared reflecting filter interposed between light source and target. Balzers Calflex B1/K1 filter is chosen for this purpose since for accurate colour reproduction in a colour camera a similar IR reflecting filter will be required. For typical transmission curve of this filter see Fig. 3.

17b. With an additional filter between light source and target. Filter used is Schott OG570 (3 mm). For transmission curve see Fig. 4.

18. Below the knee caused by ACT operation. Gamma stretching circuitry is recommended.

19. With pulses applied as indicated in note 11, the tube will properly handle a highlight with a diameter of 10% of picture height and with a brightness corresponding to 32 times peak signal white, I_{sp}.

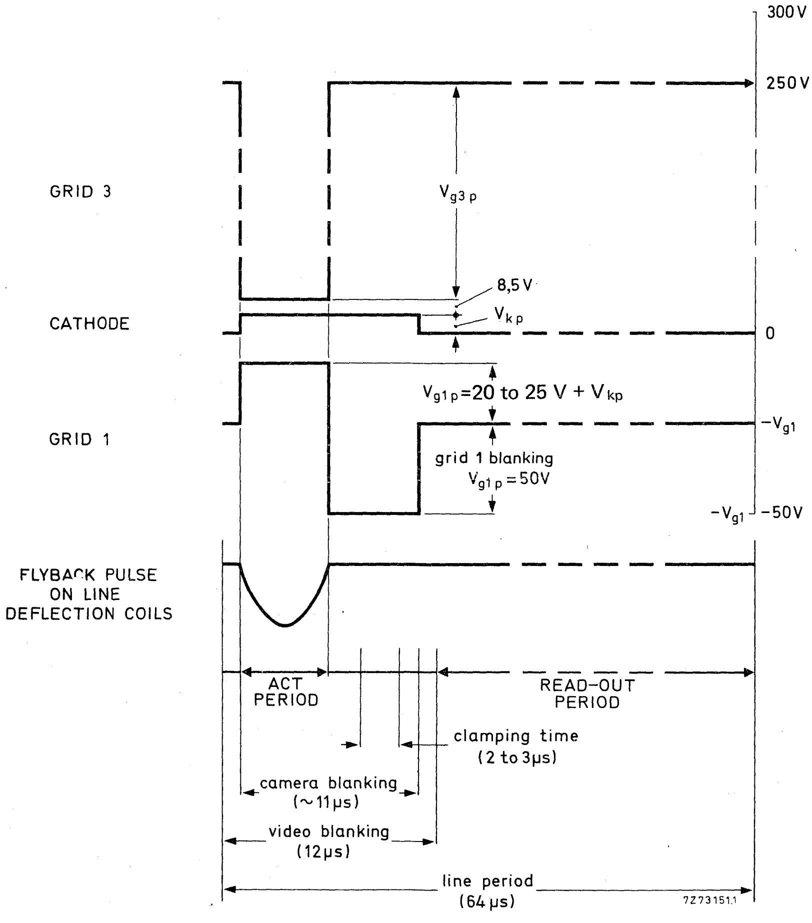
20. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affect neither the vertical resolution nor the limiting resolution.

21. **Build-up lag.** After 10 s of darkness. The values and curves shown represent the typical percentages of the ultimate signal obtained as a function of the time (in units of 20 ms = field period for CCIR system) after the illumination has been supplied.

22. **Decay lag.** After a minimum of 5 s of illuminance on the target. The values and curves shown represent the residual signal currents in percentages of the original signal current as a function of time (in units of 20 ms = field period for CCIR system) after the illuminance has been removed.

23. Deviation of the level of any of the four corners, i.e. 10% inwards in L and V direction from the level in picture centre. With the settings suggested in note 15 black shading compensation in the camera video processing amplifier will not normally be required. Further improvement in lag can be obtained by applying still higher light bias levels. It may then be necessary to use black shading compensation in the video processing amplifier.

DEVELOPMENT SAMPLE DATA


300 V
250 V
GRID 3
V_{g3p}
8,5 V
CATHODE
V_{kp}
0
V_{g1p}=20 to 25 V + V_{kp}
GRID 1
$-V_{g1}$
grid 1 blanking
V_{g1p} = 50V
$-V_{g1}$ −50V
FLYBACK PULSE
ON LINE
DEFLECTION COILS
ACT
PERIOD
READ-OUT
PERIOD
clamping time
(2 to 3μs)
camera blanking
(~11μs)
video blanking
(12μs)
line period
(64 μs)
7Z73151.1

DEVELOPMENT SAMPLE DATA

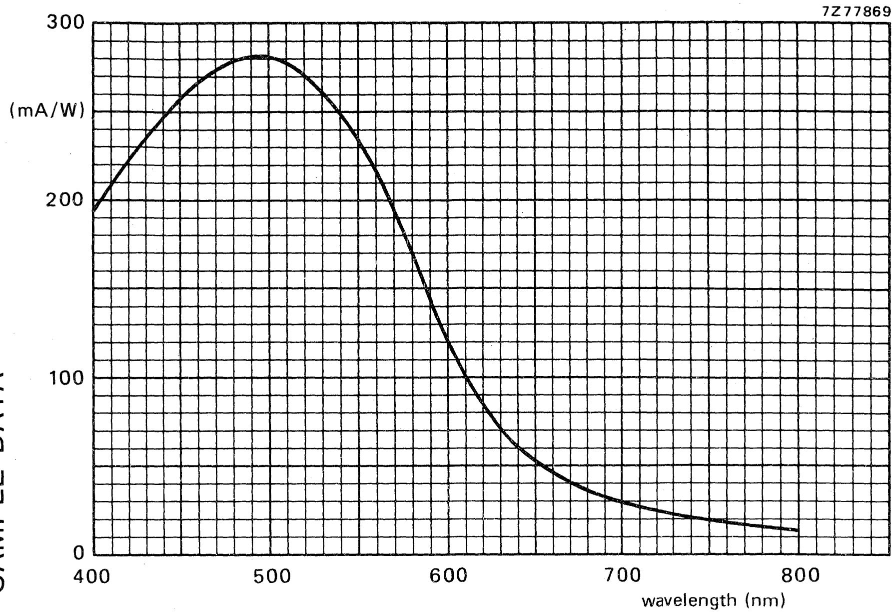


Fig.1 Spectral sensitivity characteristic.

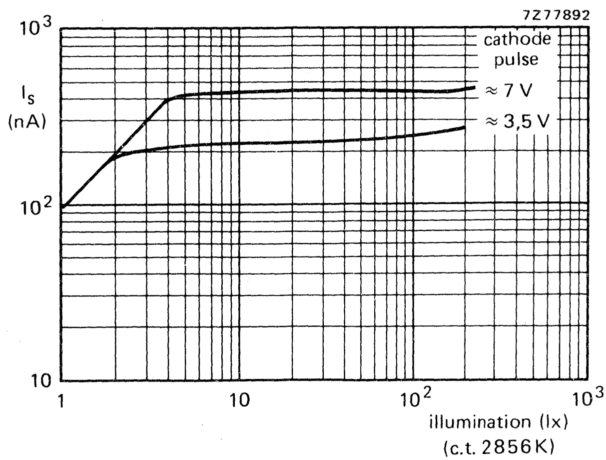
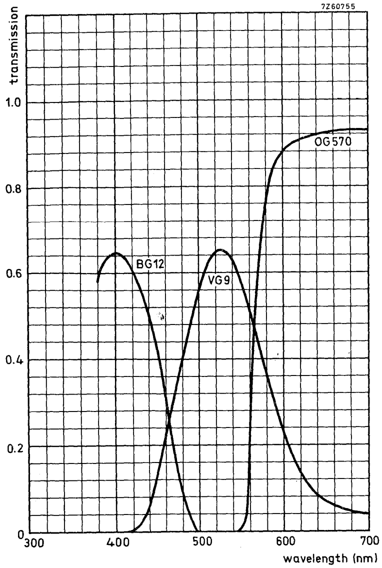


Fig.2 Typical light transfer characteristic with ACT applied.



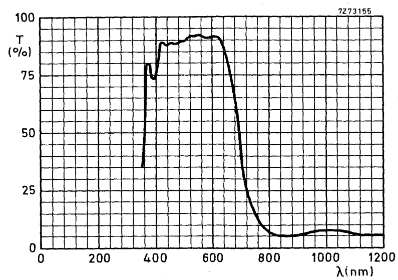


Fig.3 Typical transmission curve of heat reflecting filter type CALFLEX B1/K1.

Fig.4 Transmission of filters BG12, VG9 and OG570.

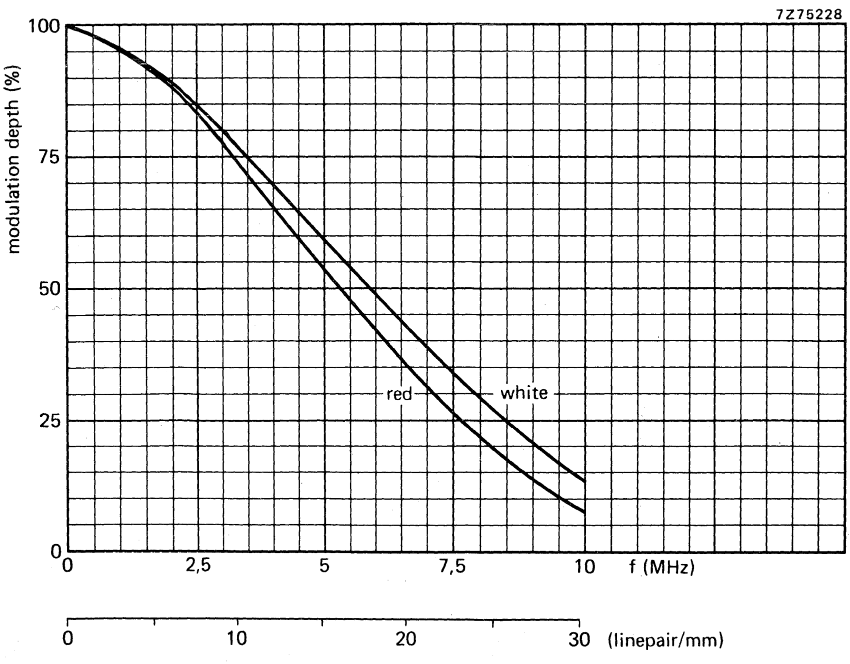
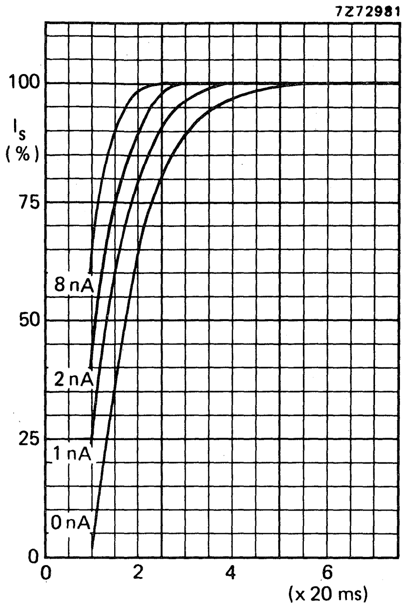
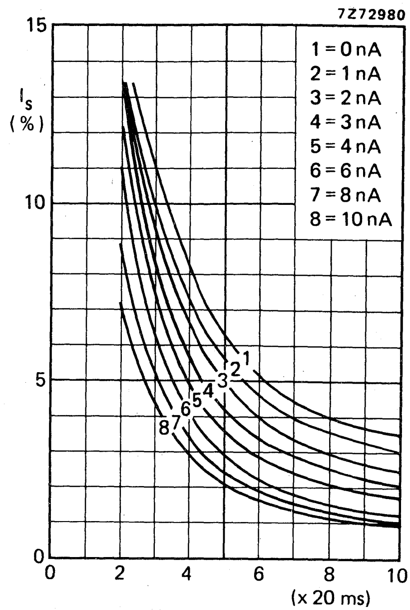


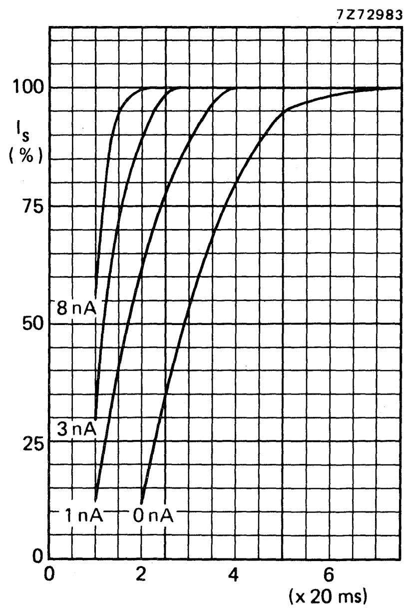
Fig.5 Typical square-wave transfer characteristic.

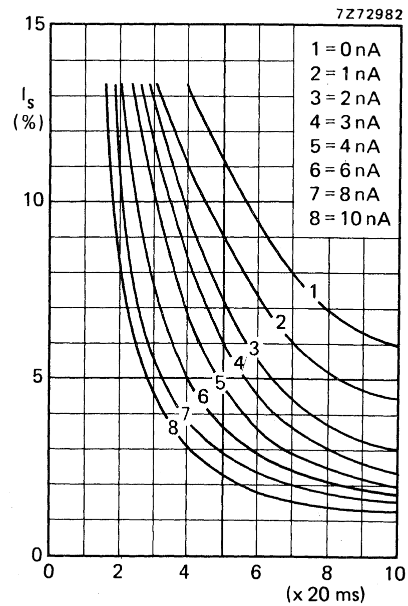
DEVELOPMENT SAMPLE DATA





XQ1523, L Fig.6 Build-up lag. I_s/I_b = 40/600 nA Fig.7 Decay lag.





XQ1523R Fig.8 Build-up lag. I_s/I_b = 20/300 nA Fig.9 Decay lag.

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1523 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1524	for use in black and white cameras.
XQ1524R	for use in the red chrominance channel of colour cameras.

For all further information see data of the XQ1523 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

Plumbicon ®, 30 mm (1,2 in) diameter television camera tube with high resolution lead oxide photoconductive target with extended red response, separate mesh, magnetic deflection, magnetic focusing. The tubes of the XQ1525 series are identical to the tubes of the XQ1523 series, featuring provisions for both **fixed** and **adjustable light bias** and an Anti-Comet-Tail electron gun, but have an infrared reflecting filter on the anti-halation disc.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	≈ 30 mm (1,2 in)
Length	215 mm (8,5 in)
Special features	Anti-Comet-Tail gun **Fixed** and **adjustable** light bias
Heater	6,3 V, 190 mA
Resolution	⩾ 1000 TV lines
Cut-off of spectral response	≈ 750 nm

Provided with anti-halation glass disc with infrared reflecting filter.

The infrared reflecting filter eliminates the need for additional filters in the optical systems when the XQ1525L and XQ1525R are applied in colour cameras originally designed for tubes of the XQ1020 series.

The spread in spectral responses in the long wavelength region as published for the XQ1523 and XQ1523R tubes is greatly reduced, warranting minimum differences in colour rendition between cameras of identical manufacture.

The XQ1525 will provide black and white pictures with true tonal rendition of colours, the spectral response approaching very nearly the relative spectral sensitivity of the human eye.

The XQ1525L is intended for use in the luminance channel of 4-tube colour cameras, the XQ1525R for use in the red channel of both 3 and 4-tube colour cameras in broadcast, educational and high-quality industrial applications.

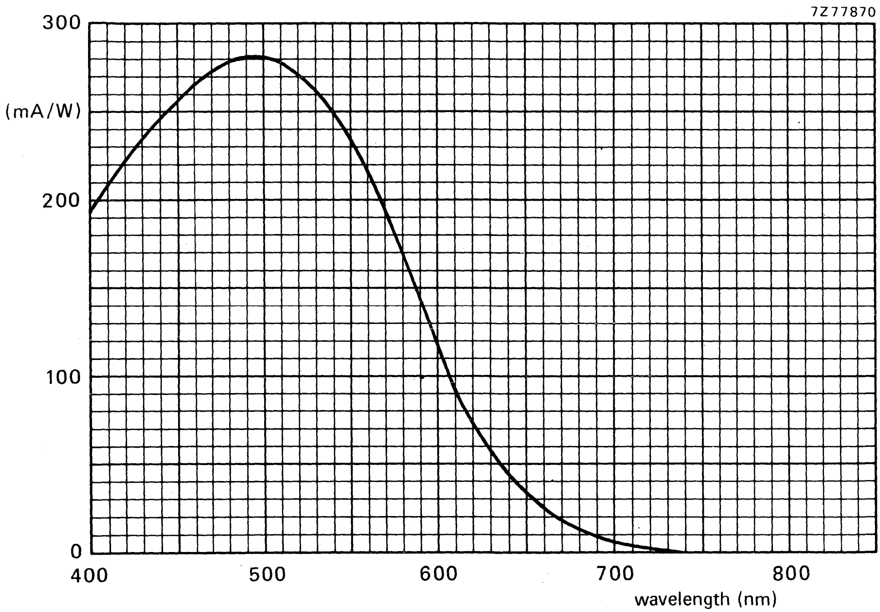
® Registered Trade Mark for television camera tube.

OPTICAL

Spectral response	
max. response at	≈ 500 nm
cut-off at	≈ 750 nm*
Spectral response curve	see below

Filter: Hard coating on anti-halation glass disc. Care in handling to avoid scratches is strongly recommended.

For all further data see data sheets XQ1523 series.
Note 17 referring to the Balzers B1/K1 filter does not apply.



Typical spectral response.

* Defined as the wavelength at which the spectral response has dropped to ⩽ 1% of the peak response (≈ 500 nm).

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the XQ1525 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

XQ1526	for use in black and white cameras.
XQ1526R	for use in the red chrominance channel of colour cameras.

For all further information see data of the XQ1525 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon *, sensitive high-definition pick-up tube with photoconductive target and low velocity stabilization.
The 55875 is intended for use in black and white, the L, R, G, and B versions for use in four and three tube colour studio cameras.

QUICK REFERENCE DATA	
Focusing	magnetic
Deflection	magnetic
Diameter	approx. 30 mm
Heater	6,3 V, 95 mA

OPTICAL

Dimensions of quality rectangle on photoconductive layer (aspect ratio 3:4) — 12,8 mm x 17,1 mm 1)

Orientation of image on photoconductive layer — by means of mark on tube base 2)

Sensitivity at colour temperature of illumination = 2856 K

type	min.	typ.		
55875, 55875L	375	400	μA/lm	3)
55875R	70	85	μA/lm	3)
55875G	130	165	μA/lm	3)
55875B	35	38	μA/lm	3)

Gamma of transfer characteristic — 0,95 ± 0,05 4)

Spectral response; max. response at	≈	500	nm
cut-off at	≈	650	nm
curve	see Fig. 1		

HEATING

Indirect by a.c. or d.c.; parallel or series supply

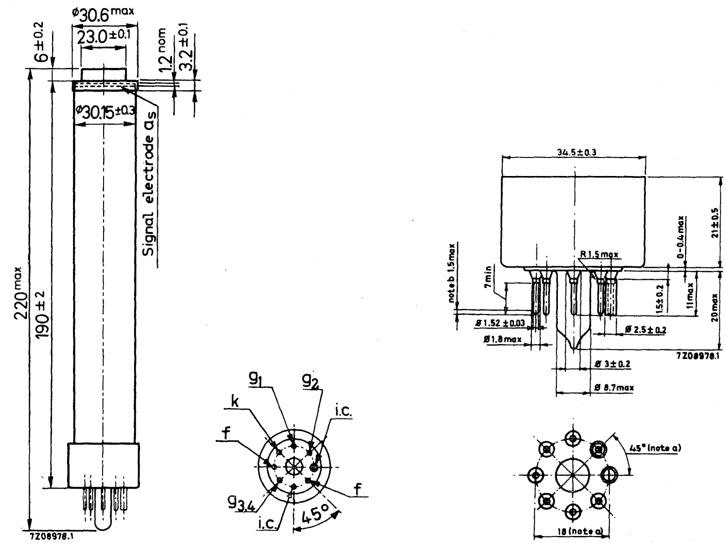
Heater voltage	V_f	6,3	V ± 5%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.
To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

* Registered Trade Mark for TV camera tube.

MECHANICAL DATA Dimensions in mm

Distance between axis of anti-reflection glass disc and geometrical centre of signal electrode ring, measured in plane of faceplate: max. 0,2 mm.
total glass thickness 7,2 ± 0,2 mm n = 1,5.



a) The base passes a flat gauge with a centre hole of ϕ 9,00 ± 0,01 mm and holes for passing the pins with the following diameters: 7 holes of ϕ 1,750 ± 0,005 mm and one hole of ϕ 3,000 ± 0,005 mm.
The holes may deviate max. 0,01 mm from their true geometrical position. Thickness of gauge 7 mm.

b) The ends of the pins are tapered and/or rounded but not brought to a sharp point.

Mounting position: any

Net mass	approx. 100 g

ACCESSORIES

Socket	type 56021
Focusing and deflection coil assembly	
for 55875	type AT1132/01
for 55875L, R, G, B	type AT1113/01

CAPACITANCE

Signal electrode to all	C_{as}		3 to 6	pF	5)

FOCUSING magnetic 6)

DEFLECTION magnetic 6)

CHARACTERISTICS

Grid no. 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100	V	7) 8)
Blanking voltage, peak to peak on grid no. 1	V_{g1p-p}		50 ± 10	V	
on cathode	V_{kp-p}		25	V	
Grid no. 2 current at normally required beam currents	I_{g2}	≤	0,5	mA	
Dark current at V_{as} = 45 V	I_{as}	≤	0,003	μA	

LIMITING VALUES (Absolute max. rating system)

Signal electrode voltage	V_{as}	max.	50	V	8)
Grid no. 4 and no. 3 voltage	V_{g4}, V_{g3}	max.	750	V	8)
Grid no. 2 voltage	V_{g2}	max.	450	V	8)
Grid no. 1 voltage, positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Cathode heating time before drawing cathode current	T_h	min.	1	min	
Cathode to heater voltage,					
positive peak	V_{kfp}	max.	125	V	
negative peak	$-V_{kfp}$	max.	10	V	
Ambient temperature, storage and operation	t_{amb}	max.	50	°C	
		min.	−30	°C	
Faceplate temperature, storage and operation	t	max.	50	°C	
		min.	−30	°C	
Faceplate illumination		max.	500	lx	9)

OPERATING CONDITIONS AND PERFORMANCE

Conditions

Cathode voltage	V_k	0	V	
Grid no. 2 voltage	V_{g2}	300	V	
Signal electrode voltage	V_{as}	45	V	10)
Beam current	I_b	see note 11		
Grid no. 4 and grid no. 3 voltage	$V_{g4,g3}$	600	V	
Blanking on grid no. 1, peak to peak	V_{p1p-p}	50	V	
Focusing coil current at given values of grid no. 4 and grid no. 3 voltage		see note 12		
Line coil current and frame coil current		see note 12		
Faceplate illumination	see notes 13 and 14			
Faceplate temperature	t	20 to 45	°C	

Performance

Resolution

Modulation depth i.e. uncompensated horizontal amplitude response at 400 TV lines, at centre of picture.

The figures shown represent the horizontal amplitude response of the tube as obtained with a lens aperture of F: 5,6, see notes 11 and 15.

		55875 55875L	55875R	55875G	55875B
Highlight signal current,	I_s	0,3 μA	0,15 μA	0,3 μA	0,15 μA
Beam current	I_b	0,6 μA	0,3 μA	0,6 μA	0,3 μA
Modulation depth at 400 TV lines in %	typ.	40	35	40	50
	min.	35	30	35	40

Limiting resolution ≥ 600 TV lines

Lag (typical values)

Light source with a colour temperature of 2856K.
Appropriate filter inserted in the light path for the chrominance tubes R, G, and B.

Low key conditions

	build-up lag 16)				decay lag 17)			
	I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA		I_s/I_b = 20/300 nA		I_s/I_b = 40/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
55875 55875L 55875G			85	≈ 100			9	3
55875R	80	≈ 100			12	4,5		
55875B	60	≈ 100			15	6		

High key conditions

	build-up lag 16)				decay lag 17)			
	I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA		I_s/I_b = 150/300 nA		I_s/I_b = 300/600 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
55875 55875L 55875G			99	100			1,2	0,4
55875R	98	100			2	0,5		
55875B	97	100			3,5	2		

NOTES

1) Underscanning of the specified useful target area of 12,8 mm x 17,1 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.

2) For correct orientation of the image on the photoconductive layer the vertical scan should be essentially parallel to the plane passing through the tube axis and the mark on the tube base.

3) Measuring conditions:

Illumination 4,54 lx at black body colour temperature of 2856 K; the appropriate filter inserted in the light path. The signal current obtained in nA is a measure of the colour sensitivity expressed in μA per lumen of white light before the filter.
Filters used:

55875R	Schott	OG570	thickness	3 mm
55875G	Schott	VG9	thickness	1 mm
55875B	Schott	BG12	thickness	3 mm

See Fig. 2 for transmission curves.

4) The use of gamma stretching circuitry is recommended.

5) The capacitance C_{as} to all, which effectively is the output impedance, increases when the tube is inserted into the deflecting/focusing coil assembly.

6) For focusing/deflection coil assembly, see under "Accessories".

7) Without blanking voltage on grid No. 1.

8) At $V_k = 0$ V.

9) For short intervals. During storage the tube face shall be covered with the plastic hood provided; when the camera is idle the lens shall be capped.

10) The signal electrode voltage shall be adjusted to 45 V. To enable the tube to handle excessive highlights in the scene to be televised the signal electrode voltage may be reduced to a minimum of 25 V, this will, however, result in some reduction in performance.

11) The beam current I_b, as obtained be adjusting the control grid (grid no. 1) voltage is set to 300 nA for R and B tubes, 600 nA for black- and white, L, and G tubes. I_b is not the actual current available in the scanning beam, but is defined as the maximum amount of signal current, I_s, that can be obtained with this beam.

In the performance figures, e.g. for resolution and lag, the signal current conditions are given, e.g. as $I_s/I_b = 20/300$ nA. This hence means : with a signal current of 20 nA and a beam setting which just allows a signal current of 300 nA.

N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area. The peak signal currents as measured on a waveform oscilloscope will be a factor α larger.
($\alpha = \frac{100}{100-\beta}$, β being the total blanking time in %, for the CCIR system α amounts to 1,3).

12)

	Focus current mA *	Line current$_{pp}$ mA	Frame current$_{pp}$ mA
Black/white coil assembly AT1132/01 $V_{g4}, V_{g3} = 600$ V	25	235	35
Colour coil assemblies, AT1113/01 $V_{g4}, V_{g3} = 600$ V	100	235	35

(approx. values)

*) Adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is repelled at the image end of the focusing coil.

13) Typical faceplate illumination level for the 55875 and 55875L to produce 0,3 μA signal current will be approx. 4 lx. The signal currents stated for the colour tubes 55875R, G, B respectively will be obtained with an incident white light level (2856 K) on the filter of approx. 10 lx. These figures are based on the filters described in note 3, for filter BG12 however a thickness of 1 mm is chosen.

14) In the case of a black/white camera the illumination on the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{R.T}{4F^2\,(m+1)^2}$$

in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target.
A similar formula may be derived for the illumination level on the photoconductive layers of the R, G, and B tubes in which the effects of the various components of the complete optical system have been taken into account.

15) The horizontal amplitude response can be raised by the application of suitable correction circuits, which affects neither the vertical resolution, not the limiting resolution.

16) After 10 s of darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms respectively 200 ms after the illumination has been applied.

17) After a minimum of 5 s of illumination on the target. The figures represent typical residual signals in percents of the original signal current 60 ms respectively 200 ms after the illumination has been removed.

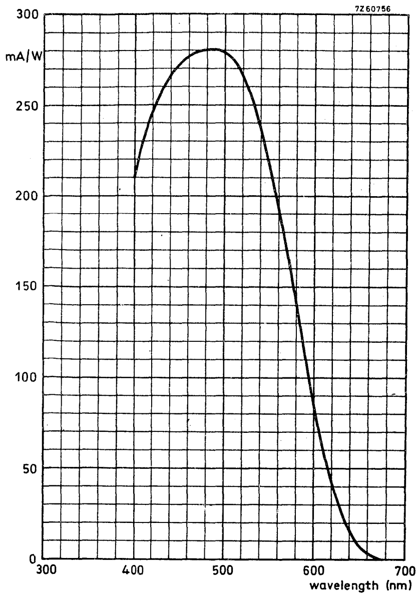


Fig. 1 Typical spectral response curve.

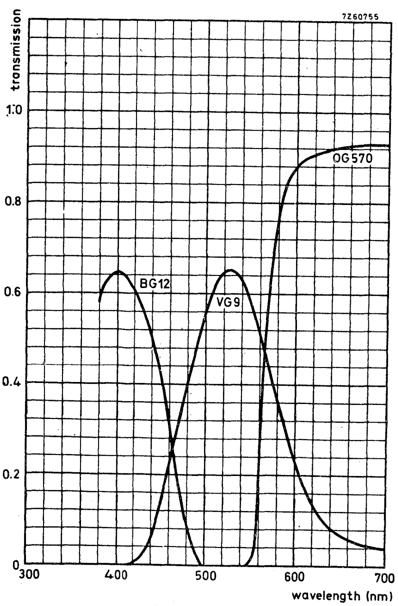


Fig. 2 Transmission of filters BG12, VG9, and OG570. See note 3.

CAMERA TUBES

Plumbicon ® television camera tubes, mechanically and electrically identical to the tubes of the 55875 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for use in black and white and colour cameras in less critical applications, e.g. in industrial or educational cameras.

The series comprises the following versions:

55875-IG	for use in black and white cameras.
55875R-IG 55875G-IG 55875B-IG	for use in the chrominance channels of colour cameras.

For all further information see data of the 55875 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBE

Plumbicon *, pick-up tube with photoconductive target and low velocity stabilisation exclusively intended for use with X-ray image intensifier in medical equipment.

QUICK REFERENCE DATA	
Focusing	magnetic
Deflection	magnetic
Diameter	30 mm
Heater	6,3 V, 95 mA
Without anti-halation glass disc	

OPTICAL

Image dimensions on photoconductive layer — circle of 18,0 mm diameter [1] [2] [3]

	min.	typ.	
Sensitivity, measured with a fluorescent light source having P20 distribution	200	275	μA/lumen

Gamma of transfer characteristic — 0,95 ± 0,05 [4]

Spectral response,	max. response	500 nm
	cut-off	≈ 650 nm
	response curve	see 55875 data

HEATING

Indirect by a.c. or d.c.; parallel or series supply.

Heater voltage	V_f	6,3	V ± 5%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed value of 9,5 V when the supply is switched on.
an r.m.s. value of 9,5V when the supply is switched on.

---

[1] All underscanning of the specified useful target-area of 18,0mm diameter or failure of scanning, should be carefully avoided, since this may cause permanent damage to the photoconductive layer.

[2] The area beyond the 18,0 mm circular optical image preferably to be covered by a mask.

[3] Direction of vertical scan should be essentially parallel to the plane passing through the tube axis and the mark on the tube base.

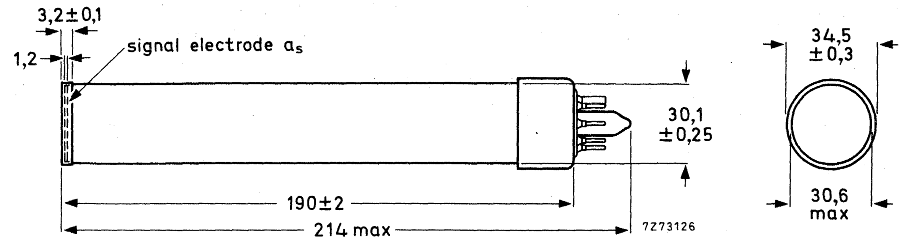
[4] The near unity gamma of the 55876 ensures good contrast when televising low contrast X-ray image-intensifier pictures as encountered in radiology. Further contrast improvement may be obtained when an adjustable gamma expansion circuitry is incorporated in the video amplifier system.

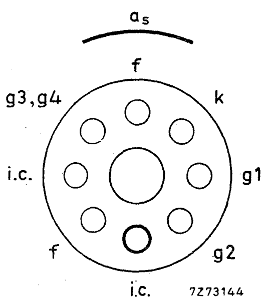
* Registered Trade Mark for TV camera tube.

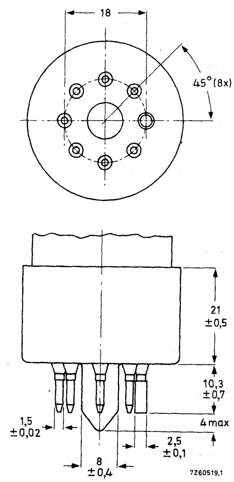
CAPACITANCES

Signal electrode to all	C_{a_s}	3 to 6 pF [1]

MECHANICAL DATA Dimensions in mm







Mounting position: any

Net mass: ≈ 100 g

ACCESSORIES

Socket	type 56021, 56025
Focusing and deflection coil unit	type AT1132/01

FOCUSING magnetic

DEFLECTION magnetic

[1]) Cap. a_s - all, which effectively is the output impedance, increases when the tube is inserted into the deflection/focusing coil assembly.

CHARACTERISTICS

Grid no. 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100	V	[1])
Blanking voltage, peak to peak on grid no. 1	V_{g1p-p}		50 ± 10	V	
	V_{kp-p}		25	V	
Grid no. 2 current at normally required beam current	I_{g2}	<	0,5	mA	
Dark current	I_{as}	<	0,003	μA	[2])

LIMITING VALUES (Absolute max. rating system)

Signal electrode voltage	V_{as}	max.	50	V	[3])
Grid no. 4 and grid no. 3 voltage	V_{g4}, V_{g3}	max.	750	V	[3])
Grid no. 2 voltage	V_{g2}	max.	450	V	[3])
Grid no. 1 voltage, positive	V_{g1}	max.	0	V	[3])
negative	$-V_{g1}$	max.	125	V	[3])
Cathode heating time before drawing cathode current	T_h	min.	1	min	
Cathode to heater voltage, positive peak	V_{kf_p}	max.	125	V	
negative peak	$-V_{kf_p}$	max.	10	V	
Faceplate illumination		max.	500	lx	[4])
Ambient temperature, storage and operation	t_{amb}	max.	50	°C	
		min.	-30	°C	
Faceplate temperature, storage and operation	t	max.	50	°C	
		min.	-30	°C	

---

[1]) With no blanking voltage on g_1

[2]) Target voltage adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each individual tube.

[3]) At V_k = 0 V.

[4]) For short intervals. During storage the tube face shall be covered with the plastic hood provided.

OPERATING CONDITIONS AND PERFORMANCE

Conditions

Cathode voltage	V_k	0	V	
Grid no. 2 voltage	V_{g2}	300	V	
Grid no. 4 and grid no. 3 voltage	V_{g4}, V_{g3}	600	V	
Signal electrode voltage	V_{a_s}	15 to 45	V	[1]
Blanking voltage on grid no. 1, peak to peak	V_{g1p-p}	50	V	
Beam current	I_b	see note 2		
Focusing coil current		see note 3		
Line coil and frame coil current		see note 4		
Highlight signal electrode current	I_{a_s}	0, 1 to 0, 5	μA	[5]
Average signal output		≈ 0, 06	μA	[5]
Face-plate temperature	t	25 to 40	°C	
Face-plate illumination		≈ 2	lx	[6]

[1] The target voltage should be adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each individual tube.

[2] Operation of the tube with beam currents I_b not sufficient to stabilize the brighest highlight picture elements must be carefully avoided in order to prevent loss of highlight-detail and/or "sticking" effects.
Operation at excessively high beam currents will result in loss of resolution.

[3] Adjusted for correct eletrical focus. The direction of the focusing current shall be such that a north-seeking pole is repelled at the image end of the focusing coil.

[4] For AT1132/01:

Focus coil current	25 mA	approx. values at $V_{g3, g4} = 600$ V for 24 mm x 18 mm scanning , as required for circular picture on monitor.
Line deflection current p-p	: 330 mA	
Frame deflection current p-p :	50 mA	

[5] Substraction of dark current is unnecessary because of the extremely small value.

[6] Illumination of the photoconductive layer, B_{ph}, is related to scene-illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{R.T.}{4.F^2.(m+1)^2}$$

in which R represents the scene-reflexivity (average or of the object under consideration, whichever is relevant). T the lens transmissionfactor, F the lens aperture and m the linear magnification from scene to target.

OPERATING CONDITIONS AND PERFORMANCE (continued)

Performance

Resolution

Modulation depth, i.e. uncompensated horizontal amplitude response (see note 1) at 5 MHz 10,5 lp/mm in picture centre (625 lines, 50 fields system)	> 55 %	2)
Signal to noise ratio at signal current of 0,15 μA	≈ 200 : 1	3)

Persistence (or lag)
Low persistence renders tube very suitable for medical X-ray applications in combination with X-ray image intensifier
Persistence is basically independent of illumination level

Decay
Measured with 100 % video signal current of 0,1 μA to zero signal after 5 s peak video signal. Beam current adjusted for correct stabilisation. Fluorescent light source having P20 distribution.

Residual signal after dark pulse of 60 ms	< 10%	typ. 5%
Residual signal after dark pulse of 200 ms	< 4%	2%

1) With a signal current of 0,10 μA and a beam current of 0,20 μA.

2) Horizontal amplitude response can be raised by the application of suitable phase-and-aperture correction circuits. Such compensation, however, does not affect vertical resolution, nor does it influence the limiting resolution.

3) The specified ratio represents the "visual equivalent signal-to-noise ratio", which is taken as the ratio of highlight video-signal current to r.m.s. noise-current, multiplied by a factor of 3. (Assuming an r.m.s. noise-current of the video pre-amplifier of 2×10^{-9} A, bandwidth 5 MHz).

Newvicon tubes C

SURVEY NEWVICON® TUBES

1 inch - magnetic focusing and deflection — All types 95 mA; 6,3 V

type	mesh	photo-conductive layer	quality grade HI	quality grade Ind	applications MS	
XQ1440	S	Nw	●	●	●	
XQ1442 *	S	Nw		●	●	* Fibre-optic faceplate
2/3 inch - magnetic focusing and deflection						
XQ1274	S	Nw	●	●	●	
XQ1276 **	S	Nw		●	●	** Extended red response
2/3 inch - electrostatic focusing and magnetic deflection						
XQ1275	S	Nw	●	●	●	

Accessories for Newvicon tubes

type	deflection (and focusing) coil unit	socket
XQ1440, XQ1442	AT1102/01, AT1103 AT1116 or equivalent	56098 or equivalent
XQ1274, XQ1276	KV12S or equivalent	56049 or equivalent
XQ1275	KV19G or equivalent	

Abbreviations used in the tables

S = separate mesh
Nw = cadmium and zinc telluride layer (Newvicon tubes)

HI = for high-quality black and white and colour cameras in sub-broadcast, medical, educational and industrial applications
Ind = for black and white and colour cameras in non-critical industrial applications

MS = in cameras for military, surveillance, and scientific applications

® Newvicon is a registered trade mark for TV camera tubes.

GENERAL OPERATIONAL NOTES

1 PROPERTIES OF THE NEWVICON PHOTOCONDUCTIVE LAYER

The Newvicon photoconductive layer is a heterojunction layer, consisting of a sublayer of zinc selenide (ZnSe) and a sublayer formed by a mixture of zinc telluride (ZnTe) and cadmium telluride (CdTe).

In the Newvicon tubes described in this Data Handbook two layer variants are found, differing mainly in spectral response and sensitivity in the infrared region.

1.1 Sensitivity

The Newvicon tube has a high sensitivity in the entire visible spectral region. The sensitivity for white light (colour temperature 2856 K) filtered by an infrared eliminating filter, type B1/K1, is 3 to 4 times as high as that of a Plumbicon tube.

The light transfer characteristic of the Newvicon tube is linear, except for a slight saturation in the high signal current region.

1.2 Spectral response

Typical spectral responses of the two Newvicon layers are found in Fig. 1.

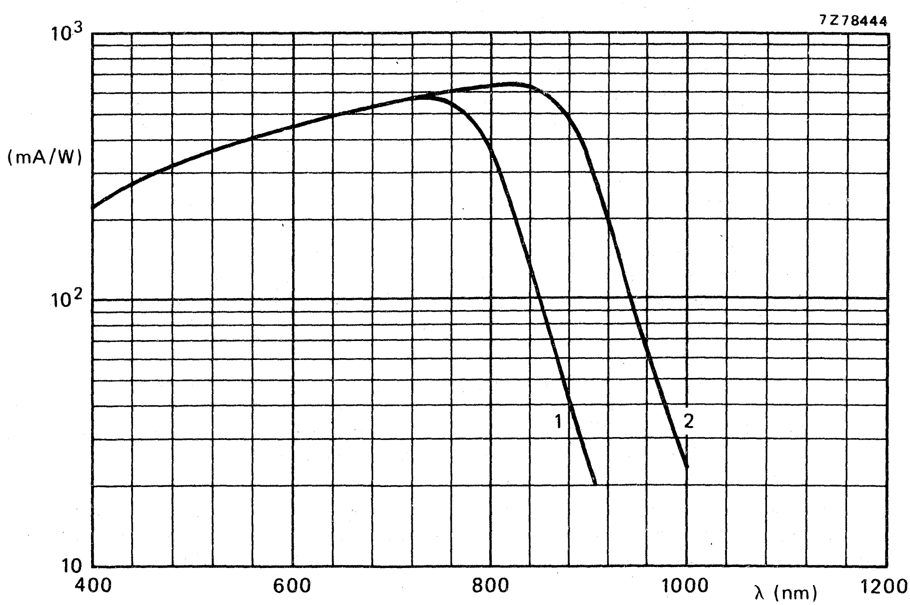


Fig. 1 Typical Newvicon spectral response curves. Curve 1: XQ1274, XQ1275, XQ1440 and XQ1442. Curve 2: XQ1276.

1.3 Dark current

The dark current in a Newvicon tube is lower than in a vidicon, but it is not negligible. A typical value at 30 ^{o}C for a 2/3-inch tube is 5 nA; for a 1-inch tube: 10 nA.

Roughly, the dark current doubles with every 7 to 8 ^{o}C temperature increase.

1.4 Resolution

The resolution of a Newvicon tube is determined mainly by the construction of the electron gun and by the operating conditions. Typical modulation transfer characteristics are given in the data sheets.

1.5 Lag

Because of its much larger target capacitance, the lag of a Newvicon tube is significantly higher than that of a Plumbicon tube. As it does not show photoconductive lag like vidicons, however, a Newvicon tube is faster than a vidicon.

Typical values of decay at 200 nA signal current can be found in the data sheets.

1.6 Stray light

The reflectance of the photoconductive layer in a Newvicon tube being low, halation effects in the faceplate of the tube are practically negligible.

1.7 Burn-in

In normal operating conditions, Newvicon tubes show negligible burn-in.

2 EQUIPMENT DESIGN AND OPERATING CONDITIONS

The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each tube, or as printed on the envelope (E_{sj} = . . . V).

The signal electrode voltage should be adjusted within an accuracy of ±2 V; in the case of cathode blanking, the voltage drop across the cathode resistor during read-out should be taken into account. Too low a signal electrode voltage will cause picture sticking effects, whereas too high a voltage may result in picture defects (spots).

A ready way of adjusting the signal electrode voltage, which usually gives satisfactory results, is as follows:

- apply an even illumination to the target, resulting in a signal current of about 0,15 μA;
- increase the signal electrode voltage until a grainy structure just becomes visible;
- reduce the signal electrode voltage by 5 V, or, alternatively, reduce the signal electrode voltage until slightly above the point where, as observed on an oscilloscope, the signal amplitude commences to decrease.

As Newvicon tubes do not permit sensitivity control by means of regulation of the signal electrode voltage, adequate control is to be achieved by other means (iris control and neutral density filters). If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated by the tube manufacturer.

The input light level on the target of a 2/3-inch Newvicon tube should be adjusted at approximately 0,8 lx at the highlight level of the scene. This means that a signal current of 200 nA at highlight level is preferred for optimum operation. For a 1-inch tube the input light level should be set at approximately 0,5 lx.

If the solar image, or a spot image of similar intensity, is focused on the target through a lens opening wider than f : 11, instantaneous breakdown of the target will occur. If it is possible that such a situation may arise, protection measures are necessary, e.g. a lens cap, a neutral density filter or a shutter.

The temperature of the faceplate should not exceed 70 ^{o}C, neither during operation nor storage. Whilst dark current doubles at every 7 to 8 ^{o}C temperature increase, lag decreases and resolution remains practically constant.

CAMERA TUBE

NEWVICON *) television camera tube with a photoconductive target composed of cadmium and zinc tellurides featuring high resolution and an extremely high sensitivity.

The XQ1274 is a 2/3 in diameter camera tube with low heater power, separate mesh, magnetic focusing and deflection, and is mechanically interchangeable with vidicons like the XQ1271 and has the same pin connections.

The XQ1274 is intended for use in ultra-compact cameras for security and surveillance applications, for example, where its high sensitivity and resolution, small size and low power consumption are essential.

QUICK REFERENCE DATA			
Separate mesh			
Focusing		magnetic	
Deflection		magnetic	
Diameter		17,7	mm
Length		108	mm
Spectral response, max. at		750	nm
cut-off at	approx.	900	nm
Heater		6,3 V, 95	mA
Resolution		650	TV lines

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)	≤	11	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane passing through the longitudinal tube axis and the gap between the pins 1 and 7.

Spectral response, curve see Fig. 1; max. response at	approx.	750	nm
cut-off at	approx.	900	nm

HEATING Indirect by a.c. or d.c.; parallel or series supply

Heater voltage	V_f	6,3	V ± 10%
Heater current, at V_f = 6,3 V	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

*) Registered Trade Mark for television camera tube. Data based on pre-production tubes.

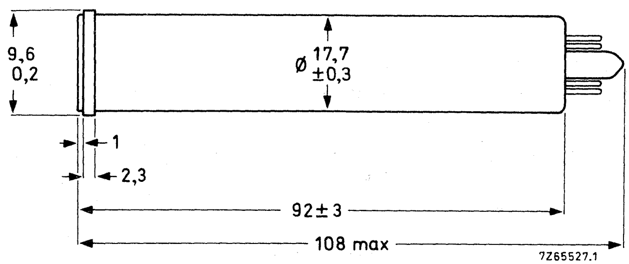
CAPACITANCES

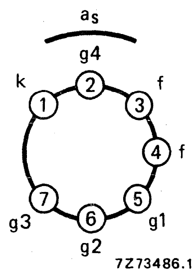
Signal electrode to all	C_{as}	2	pF

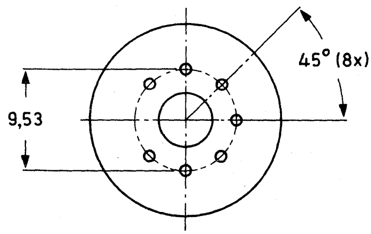
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted in the deflection and focusing coil unit.

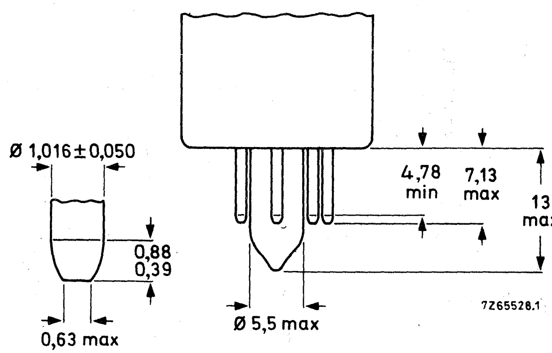
MECHANICAL DATA

Dimensions in mm









Mounting position: any

Net mass: ≈ 23 g

Base: Small button miniature 7-pin (IEC 67-I-10a, JEDEC E7-1) with pumping stem.

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection and focusing coil unit	KV12S or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES (Absolute max. rating system) for a scanned area of 6,6 mm x 8,8 mm.

"Full-size scanning" i.e. scanning of a 6,6 mm x 8,8 mm area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area smaller than 6,6 mm x 8,8 mm, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max.	50	V	1)
Grid no. 4 voltage	V_{g4}	max.	750	V	
Grid no. 3 voltage	V_{g3}	max.	750	V	
Grid no. 2 voltage	V_{g2}	max.	350	V	
Grid no. 1 voltage, negative	$-V_{g1}$	max.	300	V	
positive	V_{g1}	max.	0	V	
Cathode-to-heater voltage, peak positive	V_{kfp}	max.	125	V	
peak negative	$-V_{kfp}$	max.	10	V	
Output current, peak	I_{asp}	max.	0,8	μA	2)
Faceplate illumination	E	max.	10 000	lx	3)
Faceplate temperature, storage and operation	t	max.	70	°C	
Cathode heating time before drawing cathode current	T_h	min.	1	min	

1) Newvicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters). If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated by the tube manufacturer, see also General operational notes.

2) Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

3) White light, uniformly diffused over entire tube face.
Care must be taken not to focus the solar image on the target through a lens opening wider than F : 11 to avoid instantaneous breakdown.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 mm x 8,8 mm and a faceplate temperature of 30 ± 5 °C.

Conditions

Signal electrode voltage	V_{as}	10 to 25	V	1)
Grid no. 4 (decelerator) voltage	V_{g4}	400	V	2)
Grid no. 3 (beam focus electrode) voltage	V_{g3}	300	V	3)
Grid no. 2 (accelerator) voltage	V_{g2}	300	V	
Blanking voltage, peak to peak				
when applied to grid no. 1		50	V	
when applied to cathode		20	V	
Flux density at centre of focusing coil		5,0	mT	4)
Flux density of adjustable alignment coil or magnet		0 to 0,4	mT	

Performance

		min.	typ.	max.	
Dark current (at 25 °C)			5		nA
Signal current faceplate illumination 1 lx c.t. 2856 K	I_s	200	260		nA
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K), initial signal current 0,2 μA			10		%
Limiting resolution, in picture centre 4)		550	650		TV lines
at picture corners 4)		350	450		TV lines
Grid no. 1 voltage for picture cut-off with no blanking voltage applied	V_{g1}	−35		−80	V
Average γ of transfer characteristic			≈ 1		
Spurious signals (spots and blemishes)		see note 5			

Notes

1) The signal electrode voltage adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each tube or as printed on the envelope (E_{sj} = . . . V). To minimize picture sticking effects the signal electrode voltage should be adjusted with an inaccuracy of ± 2 V; in case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.

2) Grid no. 4 voltage must always be higher than grid no. 3 voltage. The recommended ratio of grid no. 4 voltage to grid no. 3 voltage both for best geometry and most uniform signal output depends upon the type of coil unit used and will be 4 : 3 for the recommended type (see "Accessories").

3) Beam focus is obtained by the combined effect of grid no. 3 and the focus coil; the focus current should be adjusted to approx. 120 mA (KV12S).

4) On RETMA resolution test chart; faceplate illumination adjusted for a peak output current of 0,2 μA.

5) Conditions

The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area.
Faceplate illumination adjusted to produce 0,2 μA signal current, beam current adjusted for correct stabilization.
Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped and for non-blooming bright raster when lens of camera is uncapped.

Under above conditions the number and size of spots per zone as visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless their contrast is less than 50% of peak white signal as observed on a waveform oscilloscope. Spots having a contrast ≥ 100% are fully counted, spots having a contrast > 50% but < 100% will be considered as having half their actual size.

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1,2	none	none
≤ 1,2 to 0,7	none	1
≤ 0,7 to 0,35	4	5
≤ 0,35 to 0,2	5	5
≤ 0,2	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance. Tubes are rejected for: smudges, lines, streaks, mottled, grainy or uneven background having contrast > 50%.

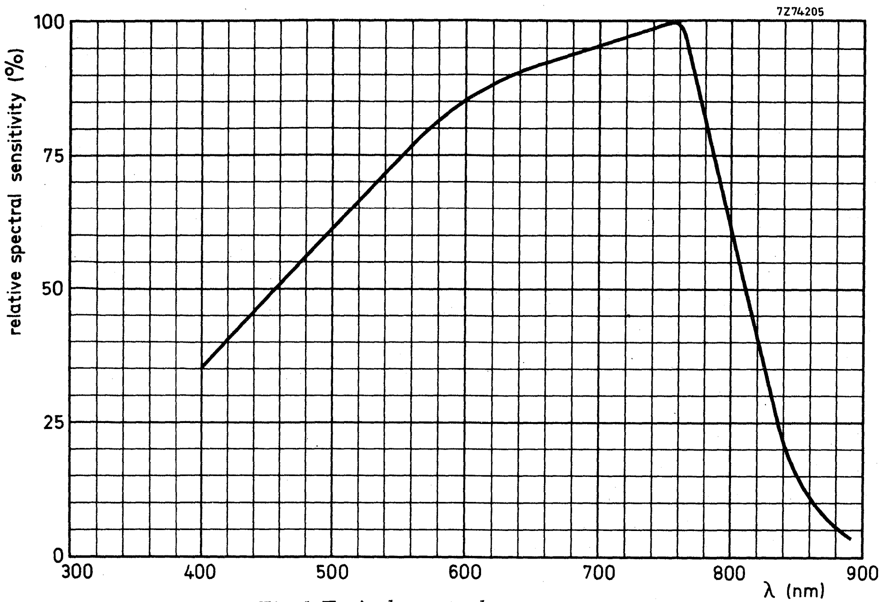


Fig. 1 Typical spectral response curve

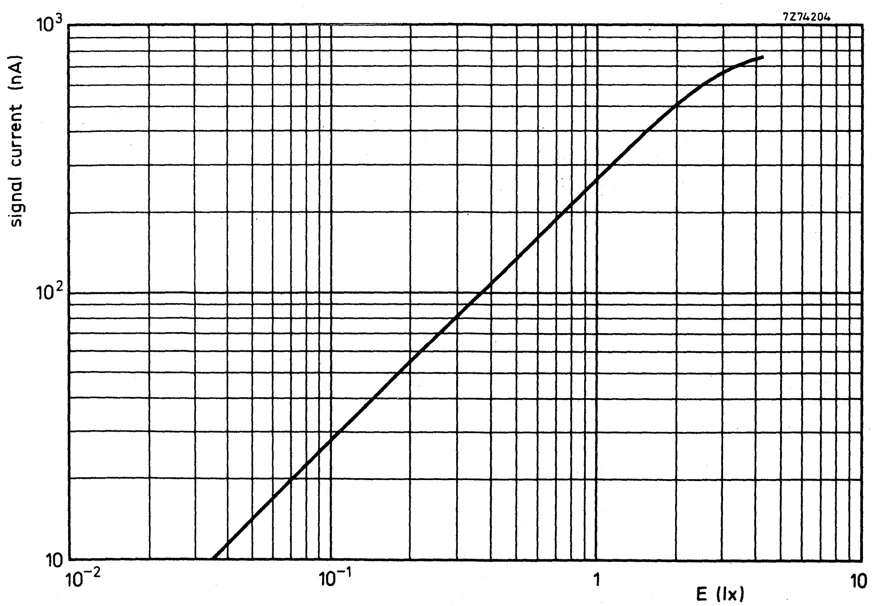


Fig. 2 Typical light transfer characteristic

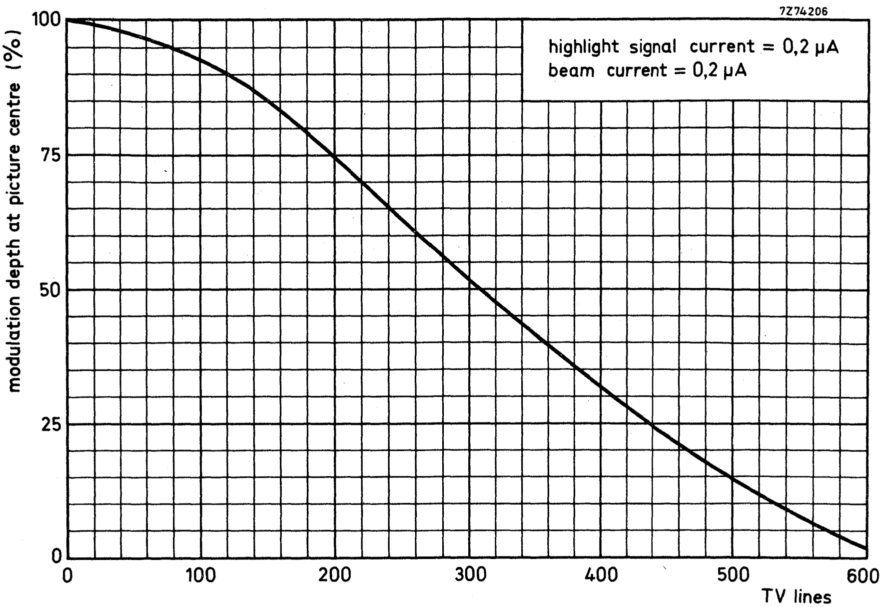


Fig. 3 Typical uncompensated square wave response curve

CAMERA TUBE

NEWVICON* television camera tube with a photoconductive target composed of cadmium and zinc tellurides featuring high resolution and an extremely high sensitivity.

The **XQ1275** is a 2/3 in diameter camera tube with low heater power, separate mesh, electrostatic focusing and magnetic deflection. It is mechanically interchangeable with vidicons like XQ1272 and has the same pin connections.

The **XQ1275** is intended for use in ultra-compact cameras for security and surveillance applications, for example, where its high sensitivity and resolution, small size and low power consumption are essential.

QUICK REFERENCE DATA			
Separate mesh			
Focusing		electrostatic	
Deflection		magnetic	
Diameter		17,7	mm
Length		108	mm
Spectral response, max. at		750	nm
cut-off at	approx.	900	nm
Heater		6,3 V, 95	mA
Resolution		600	TV lines

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)	≤	11	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane passing through the longitudinal tube axis and pin 4.

Spectral response, curve see Fig. 1; max. response at	approx.	750	nm
cut-off at	approx.	900	nm

HEATING Indirect by a.c. or d.c.; parallel series supply

Heater voltage	V_f	6,3	V ± 10%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

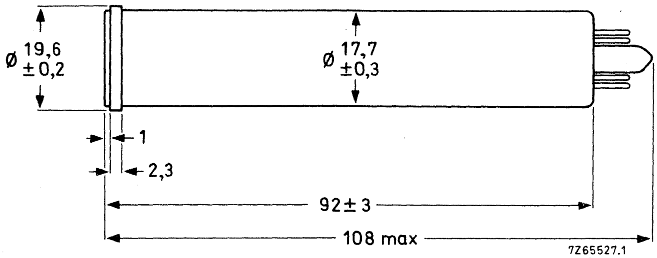
*) Trade Mark for television camera tube. Data based on pre-production tubes.

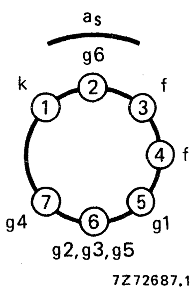
CAPACITANCES

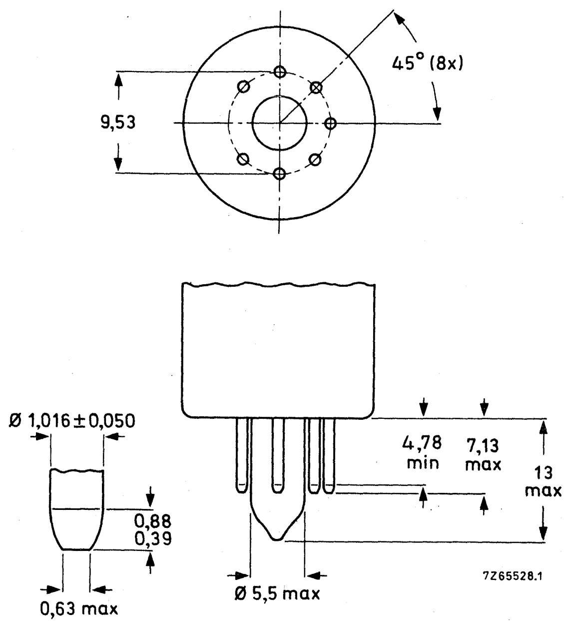
Signal electrode to all C_{as} 2 pF

This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted in the deflection and focusing coil unit.

MECHANICAL DATA Dimensions in mm







Mounting position: any

Net mass: ≈ 23 g

Base: Small button miniature 7-pin (IEC 67-1-10a, JEDEC E7-1) with pumping stem

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection and focusing coil unit	KV19G or equivalent

DEFLECTION magnetic

FOCUSING electrostatic

LIMITING VALUES (Absolute max. rating system)
for a scanned area of 6, 6 mm x 8, 8 mm.

"Full-size scanning" i.e. scanning of a 6, 6 mm x 8, 8 mm area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area smaller than 6, 6 mm x 8, 8 mm, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max.	50	V	1)
Grid no. 6 voltage	V_{g6}	max.	600	V	
Grid no. 4 voltage	V_{g4}	max.	350	V	
Grid no. 2, 3 and 5 voltage	$V_{g2,3+5}$	max.	350	V	
Grid no. 1 voltage, negative	$-V_{g1}$	max.	300	V	
positive	V_{g1}	max.	0	V	
Cathode-to-heater voltage, peak positive	V_{kfp}	max.	125	V	
peak negative	$-V_{kfp}$	max.	10	V	
Output current, peak	I_{asp}	max.	0, 8	μA	2)
Faceplate illumination	E	max.	10 000	lx	3)
Faceplate temperature, storage and operation	t	max.	70	°C	
Cathode heating time before drawing cathode current	T_h	min.	1	min	

1) Newvicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters). If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated in the test sheet.

2) Video amplifiers should be capable of handling signal electrode currents of this magnitude without overloading the amplifier or distorting the picture.

3) White light, uniformly diffused over entire tube face.
Care must be taken not to focus the solar image on the target through a lens opening wider than F : 11 to avoid instantaneous breakdown.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 mm x 8,8 mm and a faceplate temperature of 30 ± 5 °C.

Conditions

Signal electrode voltage	V_{as}	10 to 25	V	1)
Grid no. 6 (decelerator) voltage	V_{g6}	500	V	2)
Grid no. 4 (beam focus electrode) voltage	V_{g4}	35 to 55	V	3)
Grids no. 2, 3 and 5 voltage	V_{g2+3+5}	300	V	4)
Blanking voltage, peak to peak				
when applied to grid no. 1		50	V	
when applied to cathode		20	V	
Flux density of adjustable alignment coil or magnet		0 to 0,4	mT	

Performance

		min.	typ.	max.	
Dark current (at 25 °C)			5		nA
Signal current faceplate illumination 1 lx c.t. 2856 K	I_s	200	260		nA
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K), initial signal current 0,2 μA			10		%
Limiting resolution, in picture centre 5)		500	600		TV lines
at picture corners 5)		350	450		TV lines
Grid no. 1 voltage for picture cut-off with no blanking voltage applied	V_{g1}	-30	-55	-80	V
Average γ of transfer characteristic				≈ 1	
Spurious signals (spots and blemishes)		see note 6			

Notes

[1]) The signal electrode voltage adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each tube or as printed on the envelope (E_{sj} = ...V). To minimize picture sticking effects the signal electrode voltage should be adjusted with an inaccuracy of ± 2 V; in the case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.

[2]) Grid no. 6 voltage must always be higher than grids no. 2 + 3 + 5 voltage. The recommended ratio of grid no. 6 voltage to grids no. 2 + 3 + 5 voltage for best geometry and most uniform signal output depends upon the type of coil used and will be 5 : 3 for the recommended types (see "Accessories").

[3]) Adjusted for correct electrical focus.

[4]) Grids no. 2 + 3 + 5 voltage should be > 250 V to provide sufficient beam current.

[5]) On RETMA resolution test chart; faceplate illumination adjusted for a peak output current of 0, 2 μA.

[6]) Conditions

The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area.
Faceplate illumination adjusted to produce 0, 2 μA signal current, beam current adjusted for correct stabilization.
Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped and for non-blooming bright raster when lens of camera is uncapped.

Under above conditions the number and size of spots per zone as visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless their contrast is less than 50% of peak white signal as observed on a waveform oscilloscope. Spots having a contrast ≥ 100% are fully counted, spots having a contrast > 50% but < 100% will be considered as having half their actual size.

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1, 2	none	none
≤ 1, 2 to 0, 7	none	1
≤ 0, 7 to 0, 35	4	5
≤ 0, 35 to 0, 2	5	5
≤ 0, 2	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance. Tubes are rejected for: smudges, lines, streaks, mottled, grainy or uneven background having contrast > 50%.

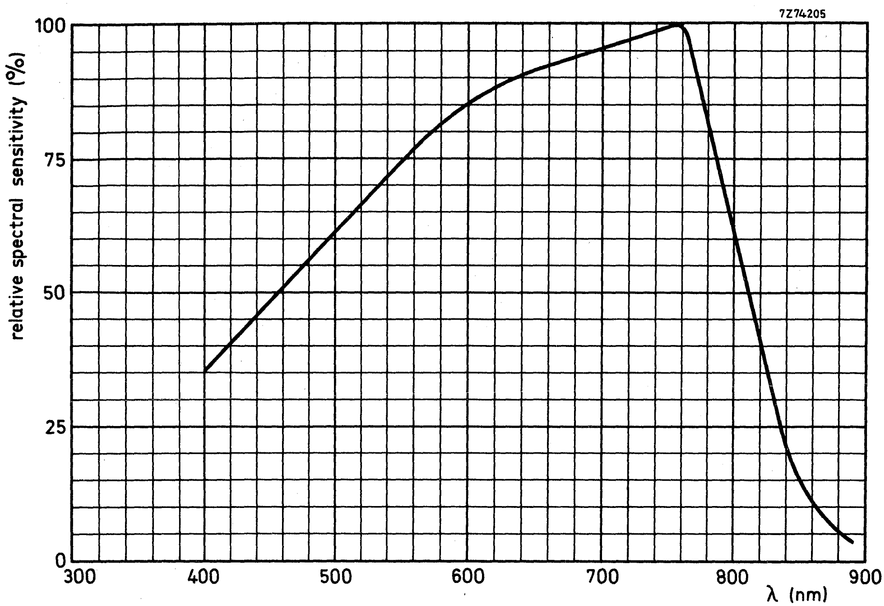


Fig. 1 Typical spectral response curve.

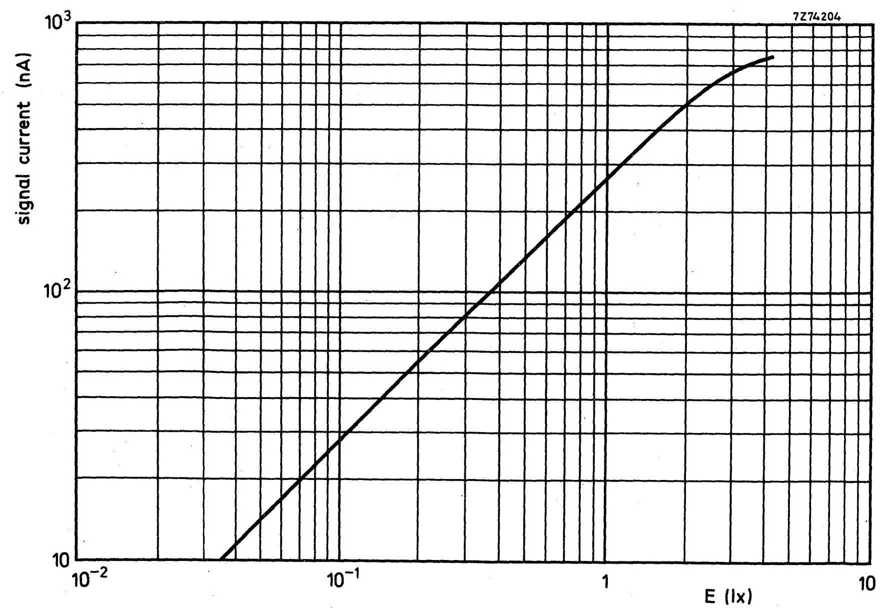


Fig. 2 Typical light transfer characteristic.

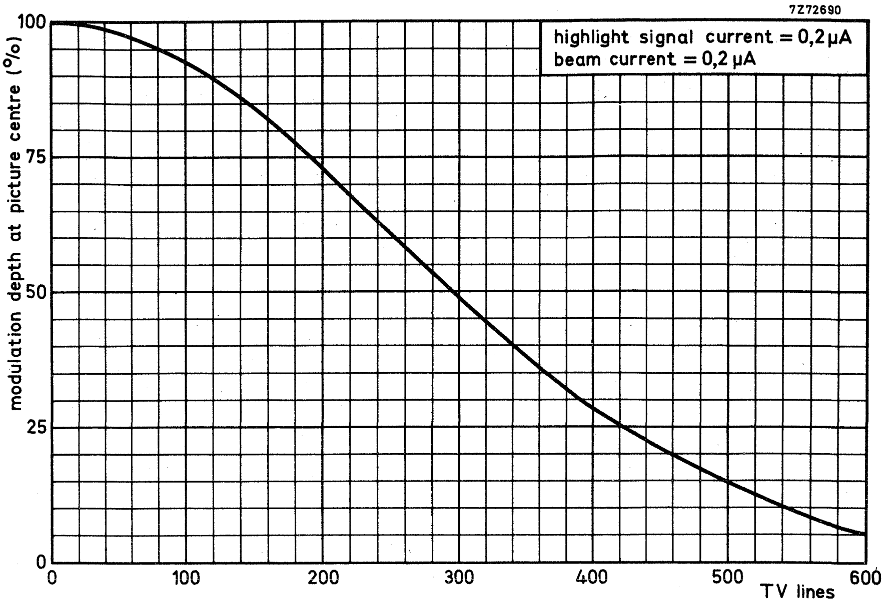


Fig. 3 Typical uncompensated square wave response curve.

CAMERA TUBE

NEWVICON® television camera tube with a photoconductive target composed of cadmium and zinc tellurides featuring high resolution and an extremely high sensitivity extending into the near infrared region.
The XQ1276 is a 2/3 in diameter camera tube with low heater power, separate mesh, magnetic focusing and deflection, and is mechanically interchangeable with vidicons like the XQ1271 and Newvicon tubes XQ1274 and has the same pin connections.
The XQ1276 is intended for use in ultra-compact cameras for security and surveillance applications, for example, where its high sensitivity extending into the near infrared, and its high resolution, small size and low power consumption are essential.

QUICK REFERENCE DATA

Separate mesh			
Focusing		magnetic	
Deflection		magnetic	
Diameter		17,7	mm
Length		108	mm
Spectral response, max at	approx.	775	nm
Spectral response, cut-off at	approx.	1000	nm
Heater		6,3 V, 95	mA
Resolution		650	TV lines

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)		11	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane passing through the longitudinal tube axis and the gap between the pins 1 and 7.

Spectral response, max response at	approx.	775	nm
Spectral response, cut-off at	approx.	1000	nm

Spectral response curve see Fig. 1

HEATING

Indirect by a.c. or d.c.; parallel or series supply

Heater voltage	V_f	6,3	V
Heater current at V_f = 6,3 V	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

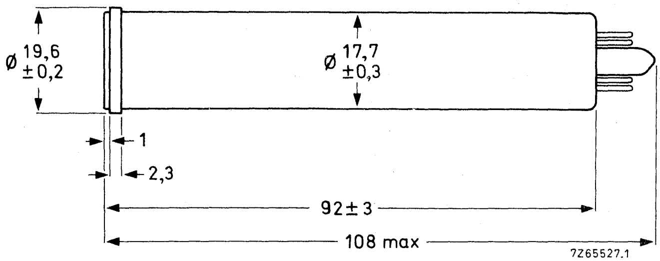
® Registered Trade Mark for television camera tube. Data based on pre-production tubes.

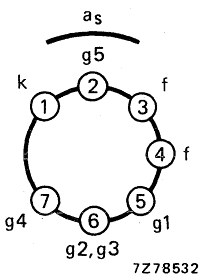
CAPACITANCES

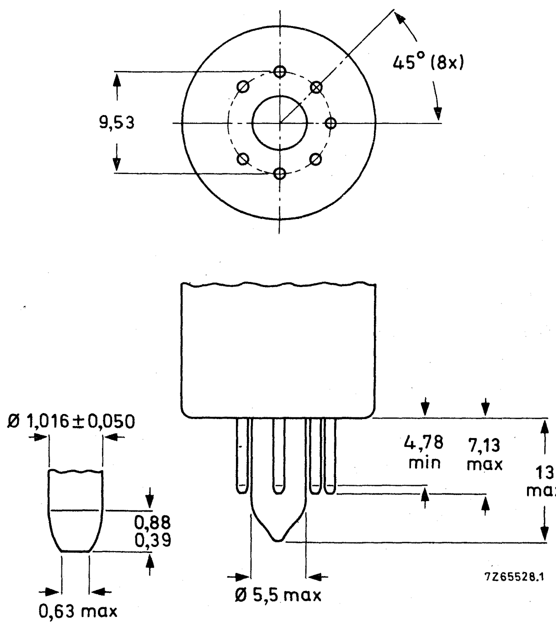
Signal electrode to all	C_{as}	≈ 2	pF

This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted in the deflection and focusing coil unit.

MECHANICAL DATA Dimensions in mm







Mounting position: any

Net mass: ≈ 23 g

Base: Small button miniature 7-pin (IEC 67-I-10a) with pumping stem (JEDEC E7-91)

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection and focusing coil unit	KV12S or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES (Absolute max rating system)
for a scanned area of 6,6 mm x 8,8 mm.

'Full-size scanning' i.e. scanning of a 6,6 mm x 8,8 mm area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area smaller than 6,6 mm x 8,8 mm, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max	50	V *
Grid 4 voltage	V_{g4}	max	750	V
Grid 3 voltage	V_{g3}	max	750	V
Grid 2 voltage	V_{g2}	max	350	V
Grid 1 voltage, negative	$-V_{g1}$	max	300	V
Grid 1 voltage, positive	V_{g1}	max	0	V
Cathode-to-heater voltage, peak positive	V_{kfp}	max	125	V
Cathode-to-heater voltage peak negative	$-V_{kfp}$	max	10	V
Output current, peak	I_{asp}	max	0,8	μA **
Faceplate illumination	E	max	10 000	lx †
Faceplate temperature, storage and operation	t	max	60	°C
Cathode heating time before drawing cathode current	T_h	min	1	min

* Newvicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters). If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated by the tube manufacturer.

** Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

† White light, uniformly diffused over entire tube face.
Care must betaken not to focus the solar image on the target through a lens opening wider than F : 11 to avoid instantaneous breakdown.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 mm x 8,8 mm and a faceplate temperature of 30 ± 5 °C.

Conditions

						note
Signal electrode voltage	V_{as}	10	to	25	V	1
Grid 4 (decelerator) voltage	V_{g4}			400	V	2
Grid 3 (beam focus electrode) voltage	V_{g3}			300	V	3
Grid 2 (accelerator) voltage	V_{g2}			300	V	
Blanking voltage, peak to peak						
when applied to grid 1				50	V	
when applied to cathode				20	V	
Flux density at centre of focusing coil				5,0	mT	
Flux density of adjustable alignment coil or magnet		0	to	0,4	mT	

Performance

		min	typ	max	
Dark current (at 25 °C)			7		nA
Signal current, white light faceplate illumination 1 lx c.t. 2856 K	I_s	250	320		nA
Signal current, near infrared illumination 1 lx, c.t. 2856 K infrared transmitting filter interposed (transmission curve see Fig.2)	I_s	50	80		nA
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K) initial signal current 0,2 μA			10		%
Limiting resolution, in picture centre (note 4)		550	650		TV lines
Limiting resolution, at picture corners (note 4)		350	450		TV lines
Grid 1 voltage for picture cut-off with no blanking voltage applied	V_{g1}	−35		−80	V
Average γ of transfer characteristic			≈ 1		
Spurious signals (spots and blemishes)			see note 5		

Notes

1. The signal electrode voltage adjusted to the value indicated by the tube manufacturer on the test sheet accompanying each tube or as printed on the envelope (E_{sj} = . . . V).
   To minimize picture sticking effects the signal electrode voltage should be adjusted with an inaccuracy of ± 2 V, in case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.
2. Grid 4 voltage must always be higher than grid 3 voltage. The recommended ratio of grid 4 voltage to grid 3 voltage both for best geometry and most uniform signal output depends upon the type of coil unit used and will be 4 : 3 for the recommended type (see 'Accessories').
3. Resolution decreases with decreasing grid 3 voltage. In general grid 3 should be operated above 250 V.
4. On RETMA resolution test chart; faceplate illumination adjusted for a peak output current of 0,2 μA.
5. **Conditions**

   The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area.
   Faceplate illumination adjusted to produce 0,2 μA signal current, beam current adjusted for correct stabilization.
   Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped and for non-blooming bright raster when lens of camera is uncapped.

   Under above conditions the number and size of spots per zone as visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless their contrast is less than 50% of peak white signal as observed on a waveform oscilloscope. Spots having a contrast ⩾100% are fully counted, spots having a contrast >50% but <100% will be considered as having half their actual size.

spot size in % of raster height	maximum number of spots zone 1	zone 2
> 1,2	none	none
⩽ 1,2 to 0,7	1	2
⩽ 0,7 to 0,35	4	5
⩽ 0,35 to 0,2	7	10
⩽ 0,2	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance.
Tubes are rejected for: smudges, lines, streaks, mottled, grainy or uneven background having contrast >50%.

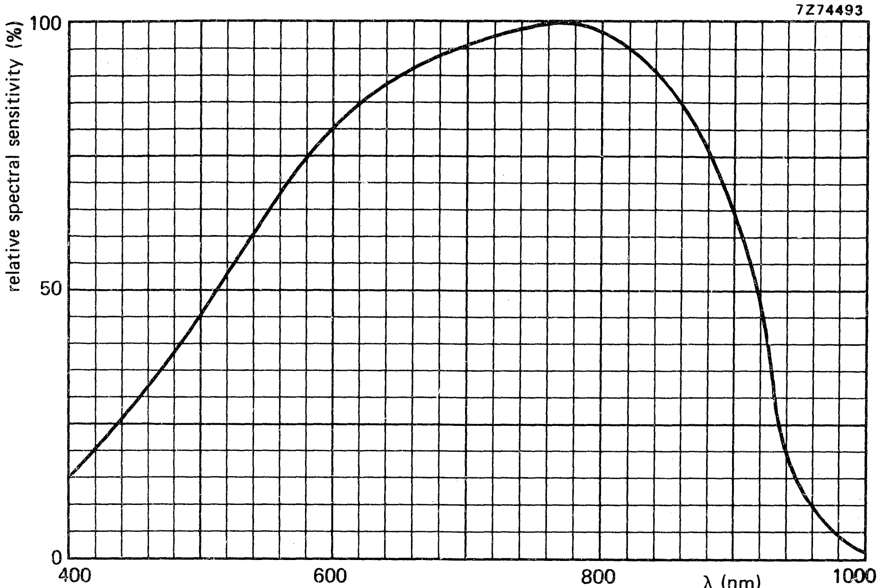


Fig.1 Typical spectral response curve.

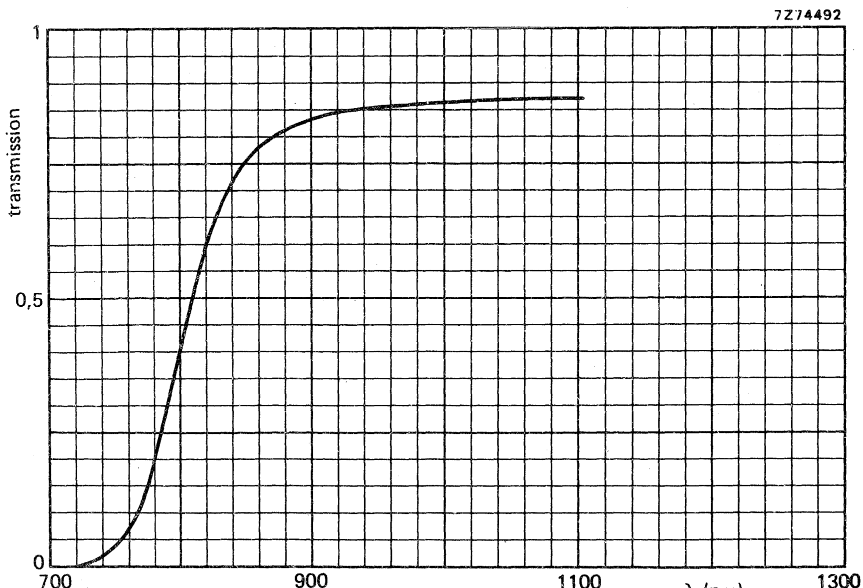


Fig.2 Transmission curve of infrared filter.

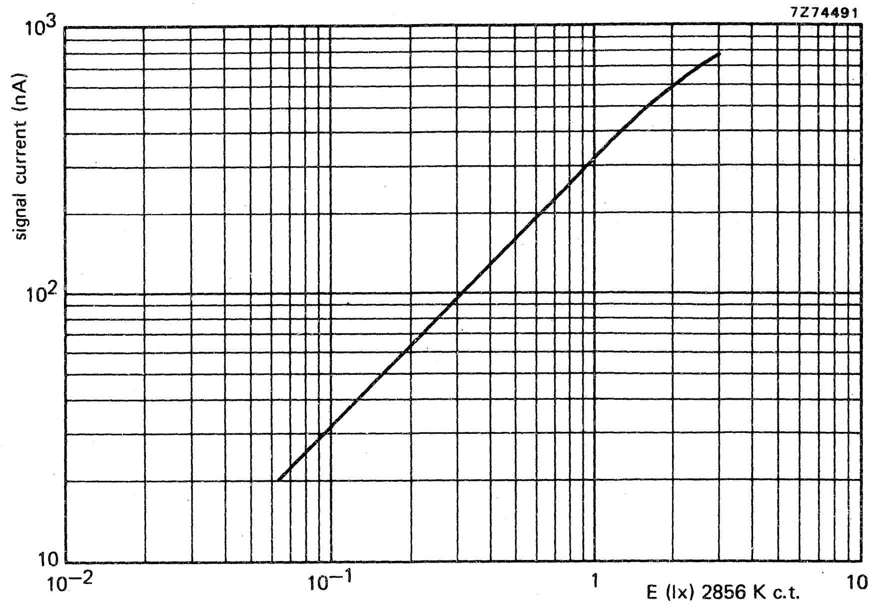


Fig.3 Typical light transfer characteristic.

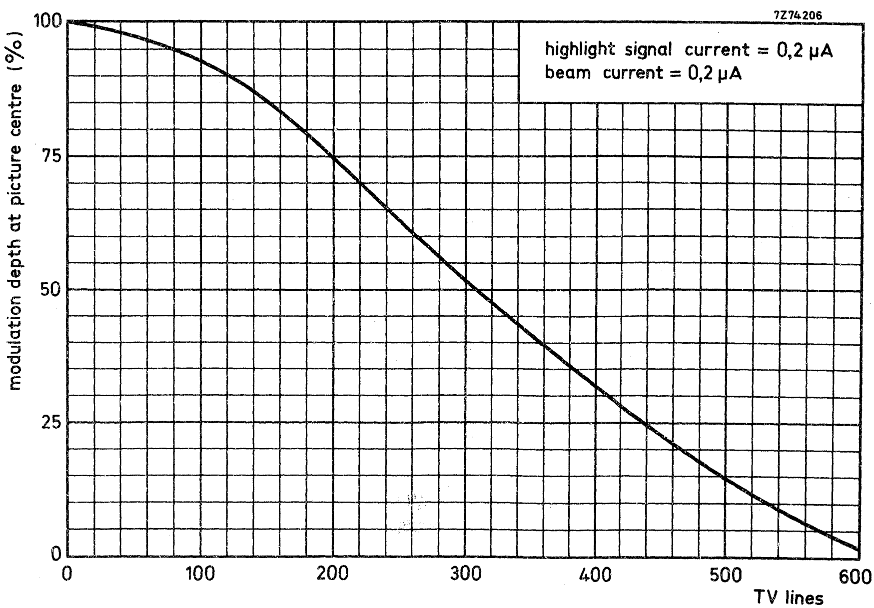


Fig.4 Typical uncompensated square wave response curve.

CAMERA TUBE

NEWVICON*) television camera tube with a photoconductive target composed of cadmium and zinc tellurides featuring high resolution and an extremely high sensitivity.

The **XQ1440** is a 1 in diameter camera tube with low heater power, separate mesh, magnetic focusing and deflection, and is mechanically interchangeable with vidicons like the XQ1240 and has the same pin connections.

The **XQ1440** is intended for use in cameras for security and surveillance applications, for example, where its high sensitivity and resolution are essential.

QUICK REFERENCE DATA			
Separate mesh			
Focusing		magnetic	
Deflection		magnetic	
Diameter		25, 4	mm (1 in)
Length		159	mm ($6\frac{1}{4}$ in)
Spectral response, max. at		750	nm
cut-off at	approx.	900	nm
Heater		6, 3 V, 95	mA
Resolution		800	TV lines

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3:4)	≤	16	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane passing through the longitudinal tube axis and the short index pin.

Spectral response; curve see Fig. 1: max. response at	approx.	750	nm
cut-off at	approx.	900	nm

HEATING

Indirect by a.c. or d.c.; parallel or series supply

Heater voltage	V_f	6, 3	V ± 10%
Heater current, at V_f = 6, 3 V	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9, 5 V when the supply is switched on.

*) Trade Mark for television camera tube. Data based on pre-production tubes.

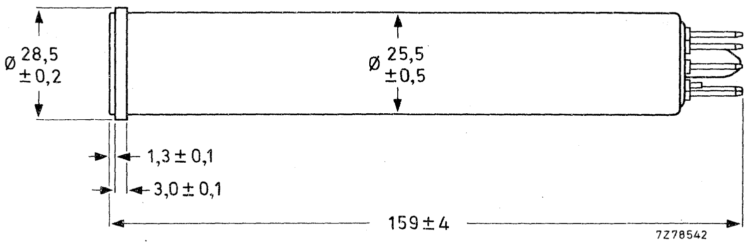
CAPACITANCES

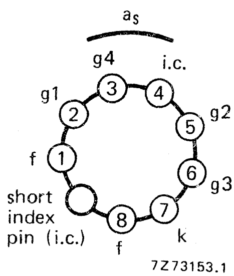
Signal electrode to all | C_{as} | 4, 5 | pF

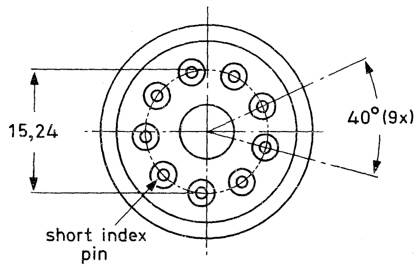
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted in the deflection and focusing coil unit.

MECHANICAL DATA

Dimensions in mm



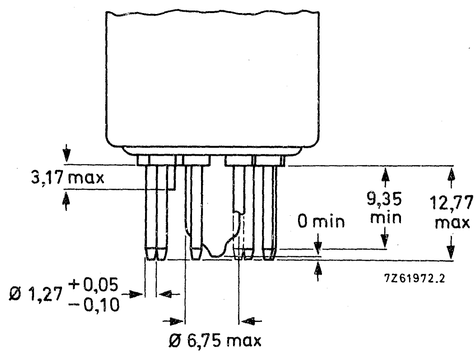




Base: IEC 67-I-33a,
JEDEC E8-11 except for pumping stem

Mounting position: any

Net mass: ≈ 55 g



ACCESSORIES

Socket	56098, Cinch no. 54A18088 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1103 or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES (Absolute max. rating system)
for a scanned area of 9,6 mm x 12,8 mm.

"Full-size scanning" i.e. scanning of a 9,6 mm x 12,8 mm area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area smaller than 9,6 mm x 12,8 mm, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max.	50	V	1)
Grid no. 4 voltage	V_{g4}	max.	1000	V	
Grid no. 3 voltage	V_{g3}	max.	1000	V	
Grid no. 2 voltage	V_{g2}	max.	750	V	
Grid no. 1 voltage, negative	$-V_{g1}$	max.	300	V	
positive	V_{g1}	max.	0	V	
Cathode-to-heater voltage, peak positive	V_{kfp}	max.	125	V	
peak negative	$-V_{kfp}$	max.	10	V	
Output current, peak	I_{asp}	max.	0,8	μA	2)
Faceplate illumination	E	max.	10 000	lx	3)
Faceplate temperature, storage and operation	t	max.	70	°C	
Cathode heating time before drawing cathode current	T_h	min.	1	min	

1) Newvicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters). If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated by the tube manufacturer, see General operational notes.

2) Video amplifiers should be capable of handling signal electrode currents of this magnitude without overloading the amplifier or distorting the picture.

3) White light, uniformly diffused over entire tube face.
Care must be taken not to focus the solar image on the target through a lens opening wider than F:11 to avoid instantaneous breakdown.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9,6 mm x 12,8 mm and a faceplate temperature of 30 ± 5 °C.

Conditions

Signal electrode voltage	V_{as}	10 to 25	V	[1])
Grid no. 4 (decelerator) voltage	V_{g4}	500	V	[2])
Grid no. 3 (beam focus electrode) voltage	V_{g3}	300	V	[3])
Grid no. 2 (accelerator) voltage	V_{g2}	300	V	
Blanking voltage, peak to peak				
when applied to grid no. 1		50	V	
when applied to cathode		20	V	
Flux density at centre of focusing coil		4,5	mT	
Flux density of adjustable alignment coil or magnet		0 to 0,4	mT	

Performance

			min.	typ.	max.	
Dark current (at 25 °C)				10		nA
Signal current faceplate illumination 0,5 lx c.t. 2856 K		I_s	200	240		nA
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K), initial signal current 0,2 μA				20		%
Limiting resolution, in picture centre	[4])		650	800		TV lines
at picture corners	[4])		400	500		TV lines
Grid no. 1 voltage for picture cut-off with no blanking voltage applied		V_{g1}	−45	−65	−100	V
Average γ of transfer characteristic				1		
Spurious signals (spots and blemishes)			see note 5			

Notes to page 4

1) The signal electrode voltage adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each tube or on the envelope (E_{sj} = . . . V).
To minimize picture sticking effects the signal electrode voltage should be adjusted with an inaccuracy of < ± 5%; in the case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.

2) Grid no. 4 voltage must always be higher than grid no. 3 voltage. The recommended ratio of grid no. 4 voltage to grid no. 3 voltage both for best geometry and most uniform signal output depends upon the type of coil unit used and will be 5 : 3 for the recommended type (see "Accessories").

3) Beam focus is obtained by the combined effect of grid no. 3 and the focus coil.

4) On RETMA resolution test chart; faceplate illumination adjusted for a peak output current of 0, 2 μA.

5) Conditions

The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area.
Faceplate illumination adjusted to produce 0, 2 μA signal current, beam current adjusted for correct stabilization.
Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped and for non-blooming bright raster when lens of camera is uncapped.

Under above conditions the number and size of spots per zone as visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless their contrast is less than 50% of peak white signal as observed on a waveform oscilloscope. Spots having a contrast ≥100% are fully counted, spots having a contrast > 50% but < 100% will be considered as having half their actual size.

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1, 2	none	none
≤ 1, 2 to 0, 7	none	1
≤ 0, 7 to 0, 35	4	5
≤ 0, 35 to 0, 2	5	5
≤ 0, 2	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance.
Tubes are rejected for: smudges, lines, streaks, mottled, grainy or uneven background having contrast >50%.

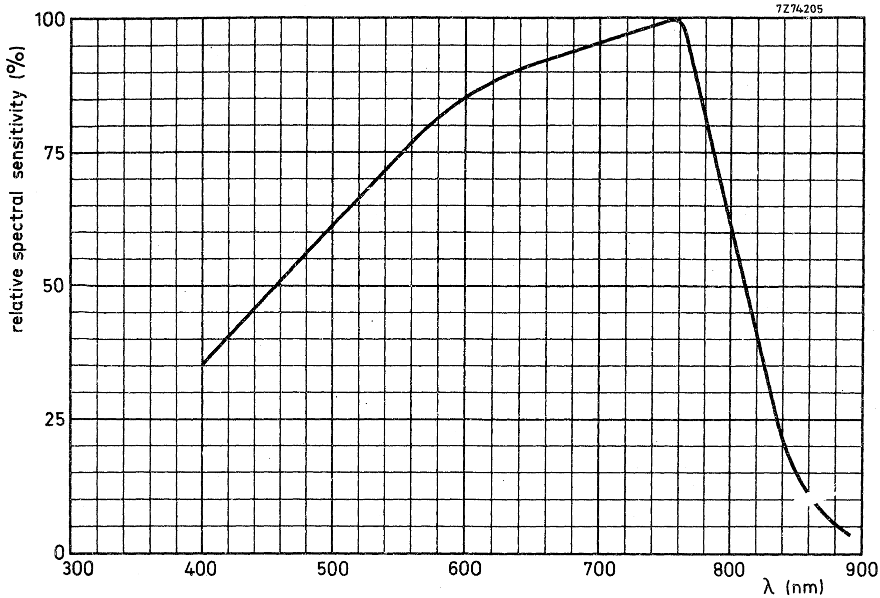


Fig. 1 Typical spectral response curve.

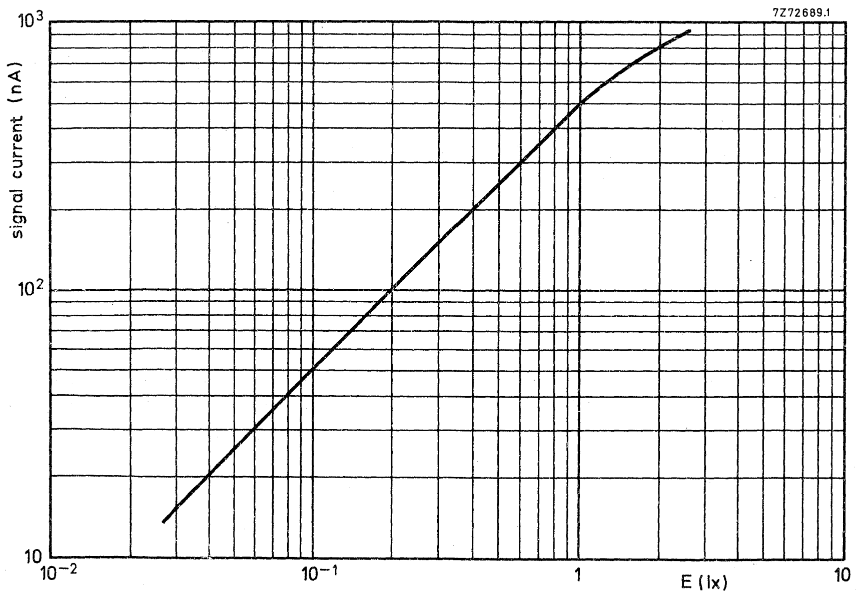


Fig. 2 Typical light transfer characteristic.

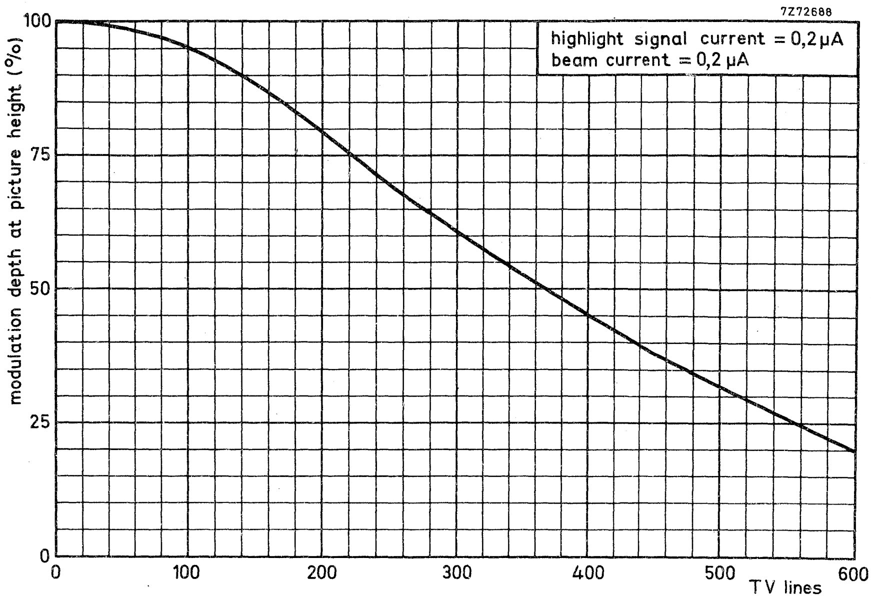


Fig. 3 Typical uncompensated square wave response curve.

CAMERA TUBE

NEWVICON® television camera tube with a photoconductive target composed of cadmium and zinc tellurides featuring high resolution and an extremely high sensitivity.

The XQ1442 is a 1 in diameter camera tube with low heater power, separate mesh, magnetic focusing and deflection, a fibre optic faceplate, and is mechanically and electrically interchangeable with the Newvicon tube type XQ1440.

The XQ1442 is intended for use in very-low light level cameras, in which it is coupled directly to a fibre optic output window of an image intensifier, for scientific, industrial, surveillance and security applications.

QUICK REFERENCE DATA

Separate mesh		
Focusing	magnetic	
Deflection	magnetic	
Diameter	25,4	mm (1 in)
Length	160	mm (6¼ in)
Faceplate	fibre optic	
Spectral response, max at	750	nm
cut-off at	≈ 900	nm
Heater	6,3 V, 95	mA
Resolution	650	TV lines

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3:4)	⩽	16	mm

Orientation of image on photoconductive layer
The direction of the horizontal scan should be essentially parallel to the plane passing through the longitudinal tube axis and the short index pin.

Spectral response; max response at	≈	750	nm
Spectral response, cut-off at	≈	900	nm

Spectral response curve see Fig. 1

HEATING

Indirect by a.c. or d.c. parallel or series supply

Heater voltage	V_f	6,3	V ±10%
Heater current, at V_f = 6,3 V	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

® Registered Trade Mark for television camera tubes.

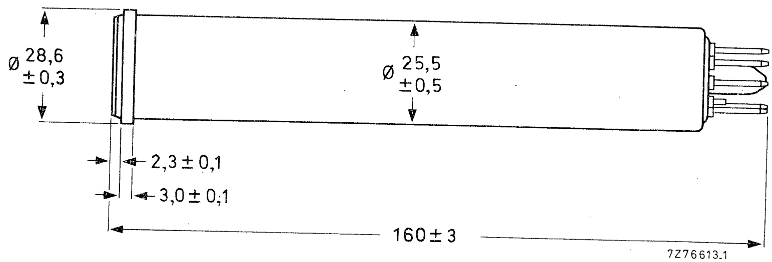
CAPACITANCES

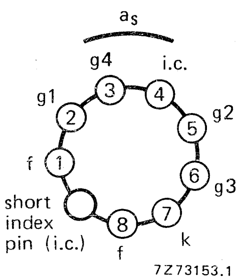
Signal electrode to all $\qquad C_{as} \quad 4{,}5 \text{ pF}$

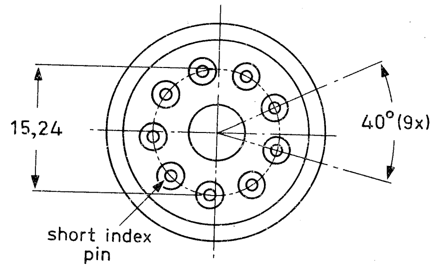
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted in the deflection and focusing coil unit.

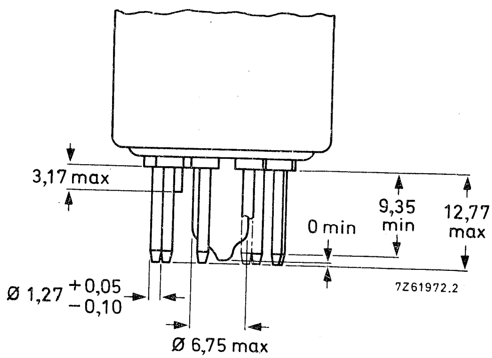
MECHANICAL DATA

Dimensions in mm









Base:	IEC67-1-33a, JEDEC E8-11 except for pumping stem
Mounting position:	any
Net mass:	≈ 60 g

ACCESSORIES

Socket	56098, Cinch no. 54A18088 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1103 or equivalent
DEFLECTION	magnetic
FOCUSING	magnetic

LIMITING VALUES (Absolute max. rating system)
for a scanned area of 9,6 mm x 12,8 mm.

'Full-size scanning' i.e. scanning of a 9,6 mm x 12,8 mm area of the photoconductive layer should always be applied. Underscanning i.e. scanning of an area smaller than 9,6 mm x 12,8 mm, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max	50	V*
Grid 4 voltage	V_{g4}	max	1000	V
Grid 3 voltage	V_{g3}	max	1000	V
Grid 2 voltage	V_{g2}	max	750	V
Grid 1 voltage, negative	$-V_{g1}$	max	300	V
Grid 1 voltage, positive	V_{g1}	max	0	V
Cathode-to-heater voltage, peak positive	V_{kfp}	max	125	V
Cathode-to-heater voltage, peak negative	$-V_{kfp}$	max	10	V
Output current, peak	I_{asp}	max	0,8	μA**
Faceplate illuminance	E	max	10 000	lx†
Faceplate temperature, storage and operation	t	max	70	°C
Cathode heating time before drawing cathode current	T_h	min	1	min

* Newvicon tubes do not permit automatic sensitivity control by means of regulation of the signal electrode voltage. Adequate control is therefore to be achieved by other means (iris control and neutral density filters). If the tube is applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated by the tube manufacturer. (see General operational notes newvicon).

** Video amplifiers should be capable of handling signal electrode currents of this magnitude without overloading the amplifier or distorting the picture.

† White light, uniformly diffused over entire tube face. Care must be taken not to focus the solar image on the target through a lens opening wider than F:11 to avoid instantaneous breakdown.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9,6 mm x 12,8 mm and a faceplate temperature of 30 ± 5 °C.

Conditions

				note
Signal electrode voltage	V_{as}	10 to 25	V	1
Grid 4 (decelerator) voltage	V_{g4}	500	V	2
Grid 3 (beam focus electrode) voltage	V_{g3}	300	V	3
Grid 2 (accelerator) voltage	V_{g2}	300	V	
Blanking voltage, peak to peak				
when applied to grid 1		50	V	
when applied to cathode		20	V	
Flux density at centre of focusing coil		4,5	mT	
Flux density of adjustable alignment coil or magnet		0 to 0,4	mT	

Performance

		min	typ	max	
Dark current (at 25 °C)			7	16	nA
Signal current, white light faceplate illuminance 0,5 lx, c.t. 2856 K	I_s	130	170		nA
Decay: residual signal current 60 ms after cessation of the luminance (c.t. 2856 K), initial signal current 0,2 μA			20	26	%
Limiting resolution, in picture centre (note 4)		550	650		TV lines
Limiting resolution, at picture corners (note 4)			450		TV lines
Grid 1 voltage for picture cut-off with no blanking voltage applied	V_{g1}	−45	−65	−100	V
Average γ of transfer characteristic			≈ 1		
Spurious signals (spots and blemishes)			see note 5		

Notes to page 4.

1. The signal electrode voltage adjusted to the value indicated by the tube manufacturer on the test sheet accompanying each tube, or as printed on the envelope (E_{sj} = . . . V).
   To minimize picture sticking effects the signal electrode voltage should be adjusted with an inaccuracy of $<\pm5\%$. In the case of cathode blanking, the voltage drop across the cathode resistor during read-out should be taken into account.
2. Grid 4 voltage must always be higher than grid 3 voltage. The recommended ratio of grid 4 voltage to grid 3 voltage both for best geometry and most uniform signal output depends upon the type of coil unit used and will be 5:3 for the recommended types (see 'Accessories').
3. Beam focus is obtained by the combined effect of grid 3 and the focus coil.
4. On RETMA resolution test chart; faceplate illuminance adjusted for a peak output current of 0,2 μA.
5. **Conditions**

   The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area.
   Faceplate illuminance adjusted to produce 0,2 μA signal current, beam current adjusted for correct stabilization.
   Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped and for non-blooming bright raster when lens of camera is uncapped.

   Under the above conditions the number and size of spots per zone as visible in the monitor picture, under both capped and uncapped conditions will not exceed the limits stated below. Both black and white spots must be counted unless their contrast is less than 10% of peak white signal as observed on a waveform oscilloscope.
   Background lines, originating from the structure of the fibre optic faceplate will have a contrast of $\leqslant$ 25% of peak white signal and will not exceed a width of 0,35%, or a length of 5% of picture height.

	spot size in % of raster height	maximum number of spots zone 1	zone 2
white and black spots	> 1,2	none	none
	$\leqslant$ 1,2 to 0,7	none	1
	$\leqslant$ 0,7 to 0,45	2	3
white spots	$\leqslant$ 0,45 to 0,2	4	6
	$\leqslant$ 0,2	*	*
black spots	$\leqslant$ 0,45 to 0,35	8	10
	$\leqslant$ 0,35	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance.

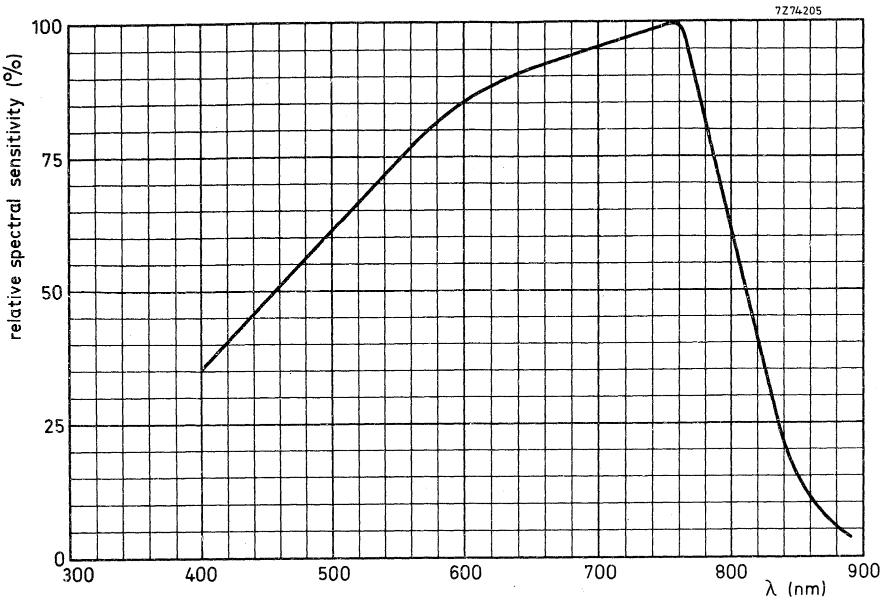


Fig.1 Typical spectral response curve.

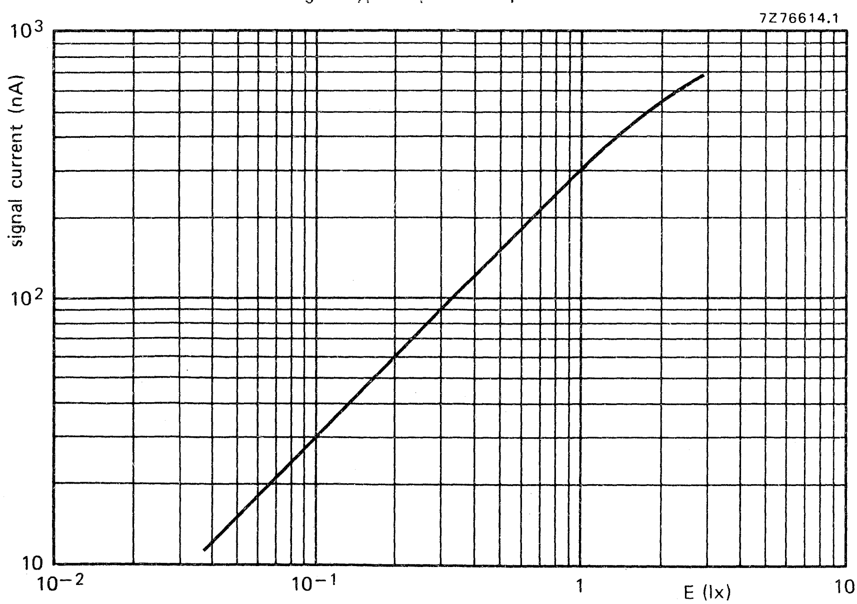


Fig.2 Typical light transfer characteristic.

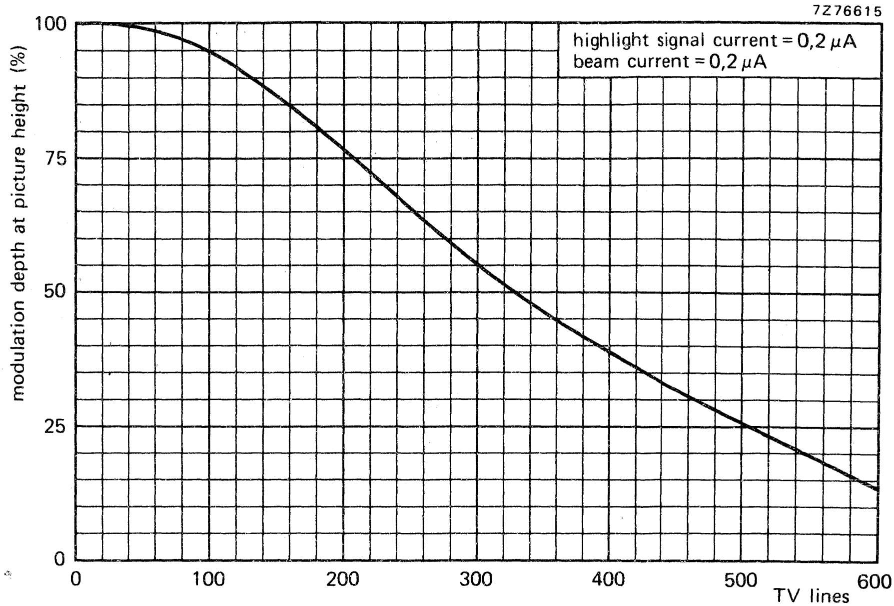


Fig.3 Typical uncompensated square-wave response curve.

Vidicon tubes

D

SURVEY VIDICON TUBES

1 inch - magnetic focusing and deflection — All types 95 mA; 6,3 V

type	mesh	photo-conductive layer	Br	HI	Ind	Med	MS	GP	
XQ1031	I	A		●	●		●		
XQ1032	I	A			●		●	●	
XQ1240	S	A	●	●			●		
XQ1241	S	A			●		●	●	
XQ1280	S	B				●			
XQ1285 *	S	B				●			* Fibre-optic faceplate

2/3 inch - magnetic focusing and deflection

type	mesh	photo-conductive layer	Br	HI	Ind	Med	MS	GP
XQ1270	I	A			●		●	●
XQ1271	S	A			●		●	●

2/3 inch - electrostatic focusing and magnetic deflection

type	mesh	photo-conductive layer	Br	HI	Ind	Med	MS	GP
XQ1272	S	A			●		●	●

Accessories for Vidicon tubes

type	deflection (and focusing) coil unit	socket
XQ1031, XQ1032 XQ1240, XQ1241 XQ1280, XQ1285	AT1102/01, AT1103 AT1116 or equivalent	56098 or equivalent
XQ1270, XQ1271 XQ1272	KV12S or equivalent KV19G or equivalent	56049 or equivalent

Abbreviations used in the tables

- I = integral mesh
- S = separate mesh
- A = standard layer
- B = layer with peak response at approx. 475 nm
- Si = silicon multi-diode layer
- Br = for black and white and colour broadcast cameras, telecine
- HI = for high-quality black and white and colour cameras in sub-broadcast, medical, educational and industrial applications
- Ind = for black and white and colour cameras in non-critical industrial applications
- Med = in medical or industrial X-ray equipment, coupled with an image intensifier
- MS = in cameras for military, surveillance, and scientific applications
- GP = general purpose tube for low-cost cameras

GENERAL OPERATIONAL NOTES

1 PROPERTIES OF THE VIDICON PHOTOCONDUCTIVE LAYER

The vidicon photoconductive layer consists mainly of antimony trisulphide (Sb_2S_3). It is built up of a number (2 to 4) of sublayers. Its properties are dependent on the antimony-sulphur ratios and the porosities of the sublayers.

In the vidicons, described in this Data Handbook, two layer variants are found, denominated layer A and layer B. The standard vidicons intended e.g. for industrial and educational applications contain layer A., the vidicons for medical applications in conjunction with X-ray image intensifiers contain layer B.

1.1 Sensitivity

The light transfer characteristic of a vidicon is not linear and depends strongly on the target voltage. A single value for the sensitivity can therefore not be given, but a series of transfer curves is required with e.g. the dark current as a parameter.

For a 1-inch size vidicon with layer A typical light transfer characteristics for three dark current settings are given in Fig. 1.

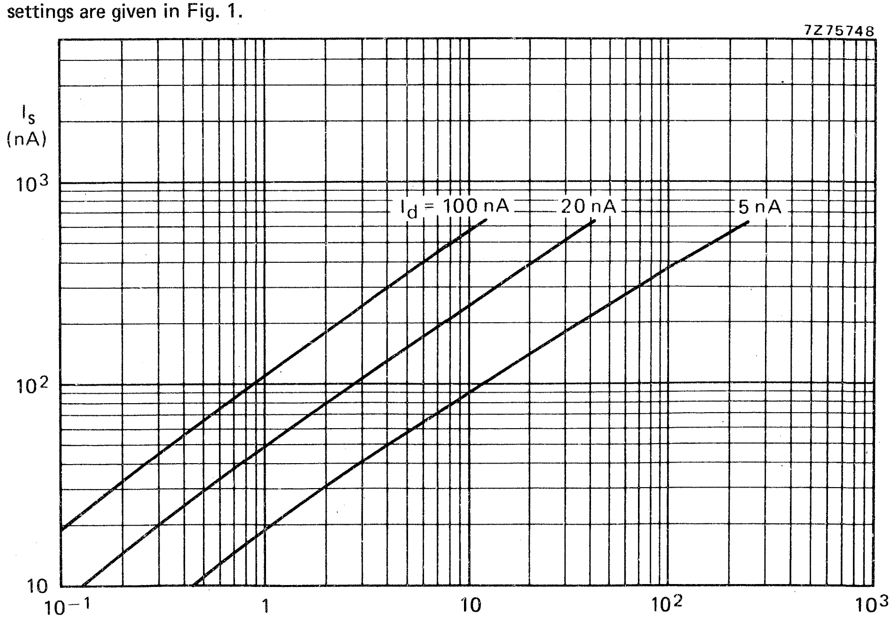


Fig. 1 Typical light transfer characteristics for 1-inch size vidicons with layer A.

(Note: A comparison can be made with Plumbicon tubes: at an input light level on the layer of approx. 8 lx the signal current in nA is equal to the sensitivity in μA/lumen.)

Vidicons with type B layer are intended mainly for use in X-ray equipment, coupled to an X-ray image intensifier equipped with a P11 or P20 output phosphor. Detailed information on the light transfer characteristics in such situations is found in the data sheets for these tubes: the XQ1280 with plain glass faceplate and the XQ1285 with fibre-optic faceplate.

1.2 Spectral response

Typical relative spectral responses of the layers type A and type B are found in Fig. 2.

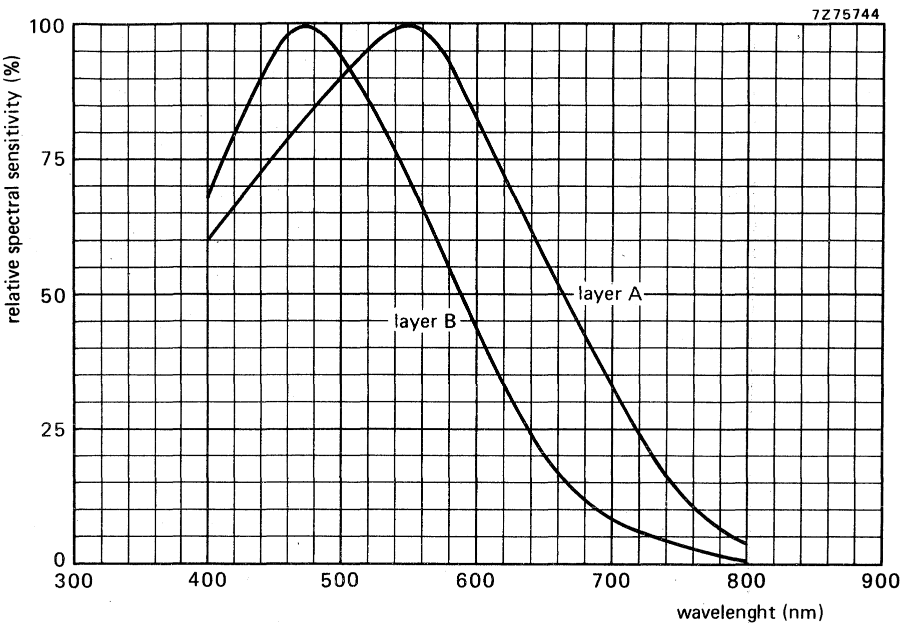


Fig. 2 Typical spectral response curves.

The response has been measured at constant signal output current.

1.3 Dark current

The range of dark currents as a function of signal plate voltage for 1-inch vidicons with layer type A is shown in Fig. 3. The dark currents are measured at a faceplate temperature of 30 ± 2 °C.

The influence of temperature on dark current for layer type A is shown in Fig. 4. Roughly, the dark current doubles with every 7 to 8 °C temperature increase (this applies also to layer type B).

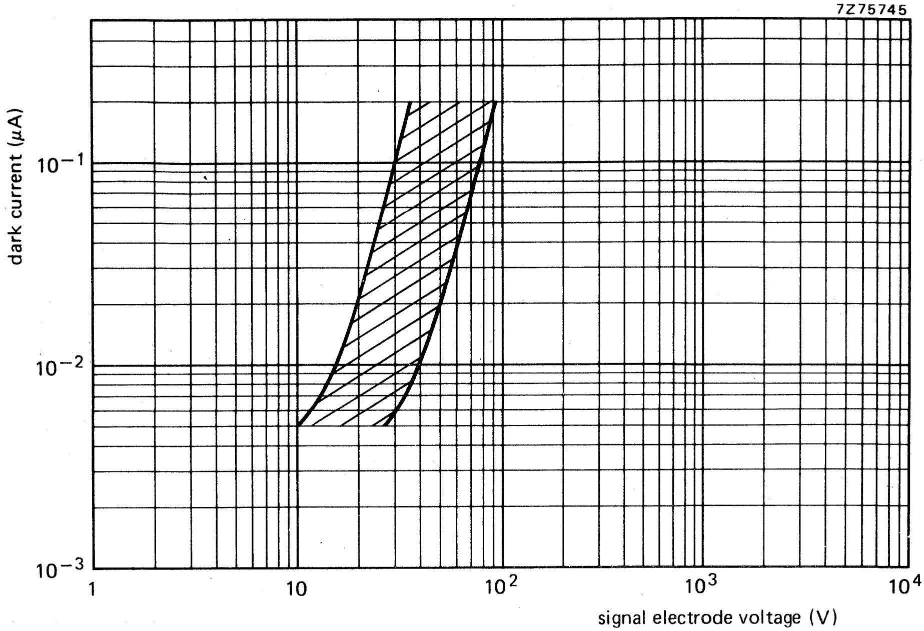


Fig. 3 Dark current range in XQ1240.

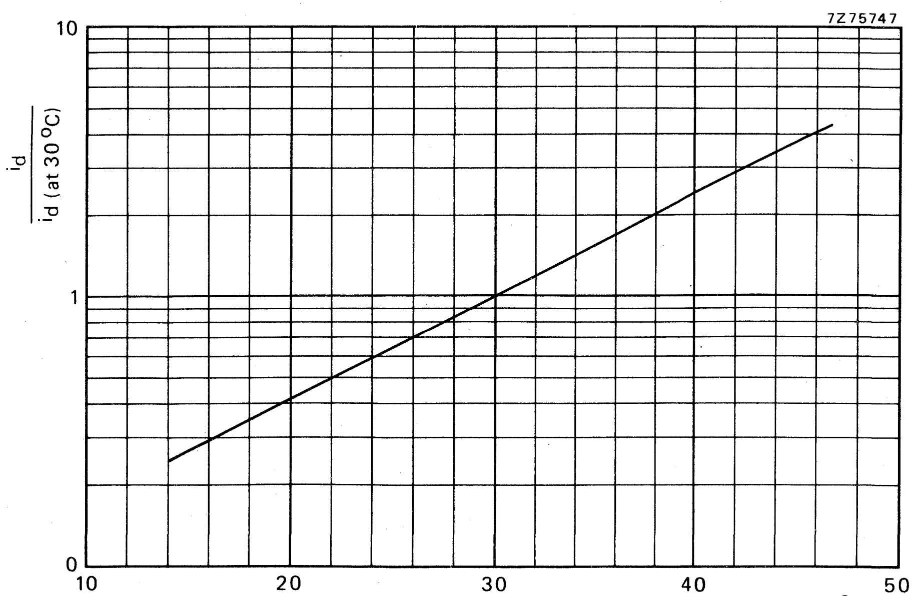


Fig. 4 Temperature dependency of dark current.

1.4 Resolution

The photoconductive layer in a vidicon being very thin (2 to 3 μm), gun construction and operating conditions are the determining factors for resolution. As an example, Fig. 5 shows typical modulation transfer characteristics for the 1-inch tube XQ1280 in the low voltage mode and in the high voltage mode (scanning area 9,6 x 12,8 mm).

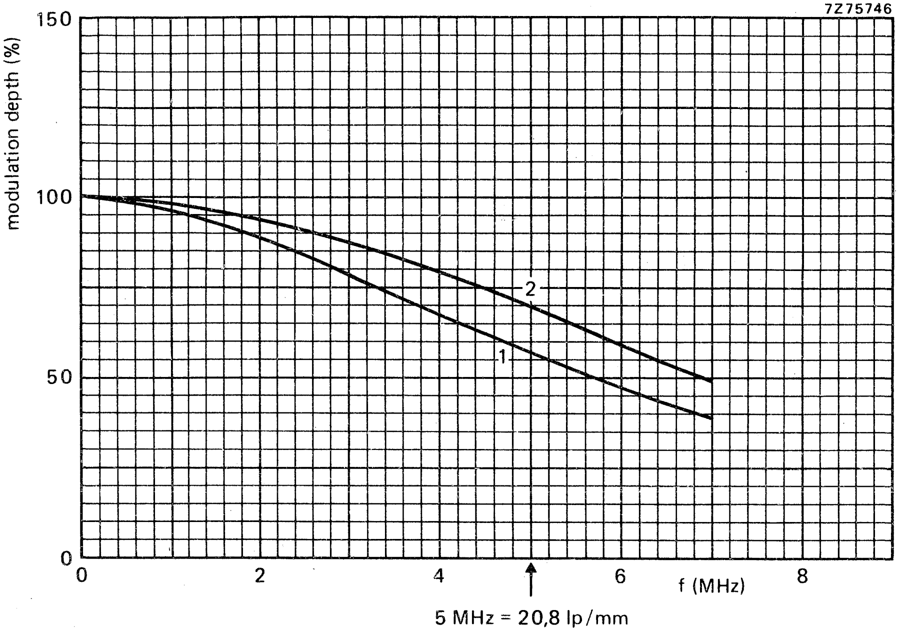


Fig. 5 Typical modulation transfer characteristics for XQ1280.
Curve 1: V_{g3} = 375 V, V_{g4} = 600 V; curve 2: V_{g3} = 600 V, V_{g4} = 960 V.

1.5 Lag

Lag is dependent on signal current, dark current and temperature. At low signal currents discharge lag dominates whereas at high signal currents photoconductive lag is preponderant. A typical residual signal level, 200 ms after cessation of an illumination giving a signal current of 200 nA, for the 1-inch vidicon type XQ1240 with layer type A, at a dark current of 20 nA is 8% (16 nA).

2 EQUIPMENT DESIGN AND OPERATING CONDITIONS

(See also General Operational Notes Camera Tubes.)

The signal electrode voltage should be limited to such a value that the peak dark current does not exceed 0,25 μA for tubes with layer A and 0,1 μA for tubes with layer B.

This is of particular importance for the design and adjustment of vidicon cameras with automatically controlled sensitivity (automatic control of the signal-electrode voltage).

Operation of vidicons at excess dark current may result in damage to the photoconductive target and hence shorten the tube life.

The temperature of the faceplate should never exceed 80 °C, neither during operation nor storage.

Operation at a faceplate temperature of 25 to 30 °C is recommended.

The temperature of the faceplate is determined by the heating effects of the environment, the associated components, the incident illumination and, to a minor extent, by the tube itself.

Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. Under conditions of high heat irradiation, an infrared filter between object and camera lens should be used.

A cathode heating time of at least a minute is advised before drawing cathode current. During prolonged idle periods, (days or weeks) gas pressure may very slowly build up in the tube due to residual gas molecules emerging from the electrodes and the glass wall. There is then a slight risk that the pressure is sufficiently high to cause cathode damage by ion bombardment if cathode current is drawn immediately after switching on the camera.

CAMERA TUBE

Vidicon television camera tube with low heater consumption, integral mesh construction, magnetic focusing, magnetic deflection, short length (130 mm, 5 in), and 25.4 mm (1 in) diameter.

QUICK REFERENCE DATA	
Integral mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25.4 mm (1 in)
Length	130 mm (5 in)
Heater	6.3 V, 95 mA
Resolution	≥600 TV lines

The electrical and mechanical properties of the two types are essentially identical, the main difference being found in the degree of freedom from blemishes of the photoconductive layers.

XQ1031 – intended for use in industrial and broadcast applications in which a high standard of performance is required.

XQ1032 – general purpose tube for less critical industrial applications, experiments, amateur use etc.

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)	max.	16	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane defined by the short index pin and the longitudinal axis of the tube, unless rotation of the tube is found necessary to minimize the number of blemishes in the picture.

Photoconductive layer	type A		
Spectral response, max. response at	approx.	550	nm

HEATING

Indirect by A.C. or D.C.; parallel and series supply

Heater voltage	V_f	6.3	V±10%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed 9.5 V_{rms} when the supply is switched on.

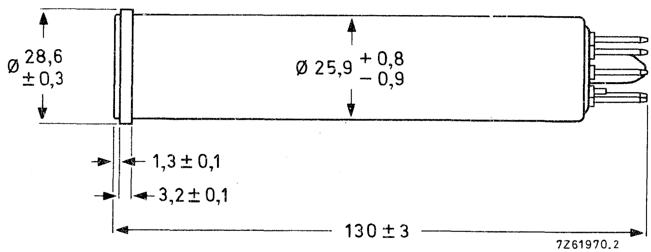
Data based on pre-production tubes.

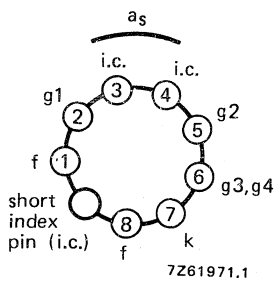
CAPACITANCES

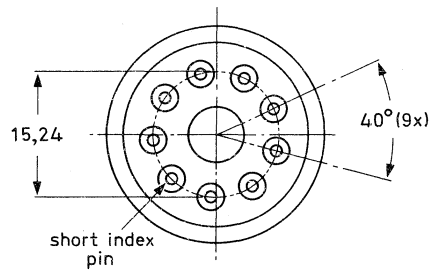
Signal electrode to all | C_{as} | 4,5 | pF

This capacitance, which effectively is the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

MECHANICAL DATA Dimensions in mm



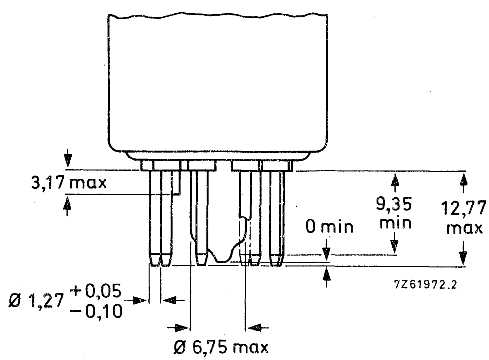




Base: JEDEC no. E8-11, IEC 67-I-33a

Mounting position: any

Net mass: ≈ 50 g



ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1103 or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES (Absolute max. rating system)
for scanned area of 9,6 mm x 12,8 mm (3/8 in x 1/2 in)

"Full-size scanning", i.e. scanning of a 9,6 mm x 12,8 mm area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area less than 9,6 mm x 12,8 mm, may cause permanent damage to the specified full-size area.

Signal-electrode voltage	V_{as}	max.	100	V
Grid no. 4 voltage and grid no. 3 voltage	$V_{g4,g3}$	max.	800	V
Grid no. 2 voltage	V_{g2}	max.	450	V
Grid no. 1 voltage, negative	$-V_{g1}$	max.	125	V
positive	V_{g1}	max.	0	V
Cathode-to-heater voltage, peak positive	V_{kf_p}	max.	125	V
negative	$-V_{kf_p}$	max.	10	V
Dark current, peak	I_{dark_p}	max.	0,25	μA
Output current, peak	I_{as_p}	max.	0,6	μA 1)
Faceplate illumination	E	max.	5000	lx
Faceplate temperature, storage and operation	t	max.	70	°C 2)
Cathode heating time before drawing cathode current	T_h	min.	1	min

1) Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

2) Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces appropriate infrared absorbing filters should be used.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9.6 mm x 12.8 mm and a faceplate temperature of 30 ± 2 °C

CONDITIONS

Grid no. 4 and grid no. 3 (beam focus electrode) voltage	V_{g4}, V_{g3}	250 to 300	V	1)
Grid no. 2 (accelerator) voltage	V_{g2}	300	V	
Grid no. 1 voltage	V_{g1}	adjusted for sufficient beam-current to stabilize highlights		
Blanking voltage, peak to peak				
when applied to grid no. 1		50	V	
when applied to the cathode		20	V	
Field strength at centre of focusing coil	H	3200 (40 Oe)	A/m	2)
Field strength of adjustable alignment coils	H	0 to 320 (0 to 4 Oe)	A/m	3)
Deflection		see note 4)		

PERFORMANCE

		min.	typ.	max.		
Signal electrode voltage for dark current of 20 nA	V_{as}	20	30	50	V	
Signal current faceplate illumination 8 lx c.t. 2856 K, dark current 20 nA	I_s	125	200		nA	5)
Decay: residual signal current 200 ms after cessation of the illumination (8 lx, c.t. 2856 K)			10	15	%	
Amplitude response at 400 TV lines in picture centre		30	40		%	6)
Limiting resolution in picture centre		600			TV lines	
Grid no. 1 voltage for picture cut-off with no blanking applied	V_{g1}	−40	−60	−100	V	
Average γ of transfer characteristic for signal currents between 0.02 and 0.2 µA			0.65			
Spurious signals (spots and blemishes)			see note 7)			

NOTES

1) Beam focus is obtained by the combined effect of grid no. 3, the voltage of which should be adjustable over the indicated range, and a focus coil having a field strength of 3200 A/m (40 Oe).

2) The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.

3) The alignment coil unit should be positioned on the tube so that its centre is at a distance of approx. 94 mm (3 11/16 in) from the face of the tube and that its axis coincides with the axis of the tube, the deflecting yoke and the focusing coil.

4) The deflection circuits must provide sufficiently linear scanning for good black-level reproduction. The output current being proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.

5) Signal current is defined as the component of the output current after the dark current has been subtracted.

6) **Square-wave response.** Measured with a video amplifier system having an appropriate bandwidth. 8 lux on specified target area, target voltage adjusted for a dark current of 20 nA, beam set for correct stabilization.

7) Conditions:
The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area. Signal electrode voltage adjusted for a dark current of 20 nA, illumination on target 8 lx (c.t. = 2856 K).

Scanning amplitudes of the monitor adjusted to obtain a raster with an aspect ratio of 3 : 4.

Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped, and for non-blooming bright raster when lens of camera is uncapped.

Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless the amplitude is less than 50 % of the peak white signal.

<u>XQ1031</u>

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1	none	none
1 to 0.6	none	none
0.6 to 0.2	1	2
$\leqslant 0.2$	*	*

XQ1032

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1	none	none
1 to 0.6	1	3
0.6 to o.2	3	5
⩽ 0.2	*	*
	max. 8	

* Do not count spots of this size unless concentration causes a smudgy appearance.

a) Minimum separation between any 2 spots greater than 0.3 % of raster height is limited to a distance equivalent to 4 % of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy, or uneven background having contrast ratios greater than 1.5 to 1.

CAMERA TUBE

Vidicon television camera tube with low heater consumption, separate mesh construction, magnetic focusing, magnetic deflection and 25.4 mm (1 in) diameter intended for use in black-and-white and colour television cameras in industrial, medical and broadcast applications.

QUICK REFERENCE DATA	
Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25.4 mm (1 in)
Length	159 mm ($6\frac{1}{4}$ in)
Heater	6.3 V, 95 mA
Resolution	$\geq$ 1000 TV lines

The electrical and mechanical properties of the two types are essentially identical, the differences being found in the degree of freedom from blemishes of the photoconductive layers, in the sensitivity and the signal electrode voltage range.

XQ1240 - intended for use in industrial, medical and broadcast applications in which a high standard of performance is required.

XQ1241 - general purpose tube for less critical industrial applications, experiments, amateur use etc.

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)	max.	16	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane defined by the short index pin and the longitudinal axis of the tube.

Photoconductive layer	type A		
Spectral response, max. response at	approx.	550	nm

HEATING

Indirect by A.C. or D.C.; parallel and series supply

Heater voltage	V_f	6.3	V±10%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed 9.5 V_{rms} when the supply is switched on.

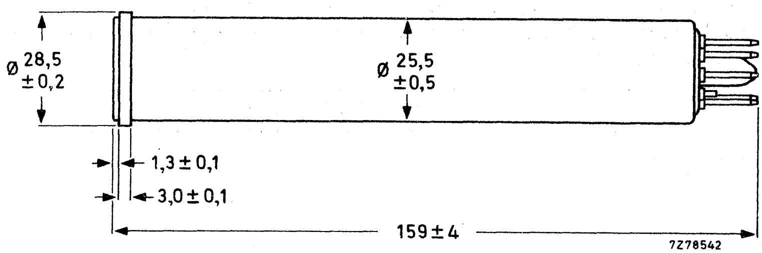
CAPACITANCES

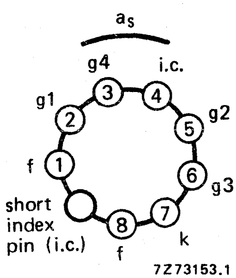
Signal electrode to all | C_{as} | 4,5 | pF

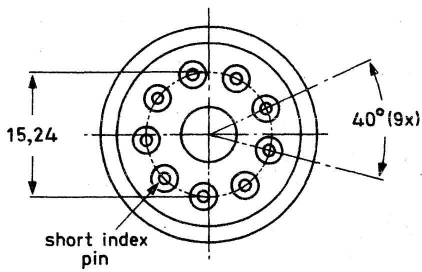
This capacitance, which effectively is the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

MECHANICAL DATA

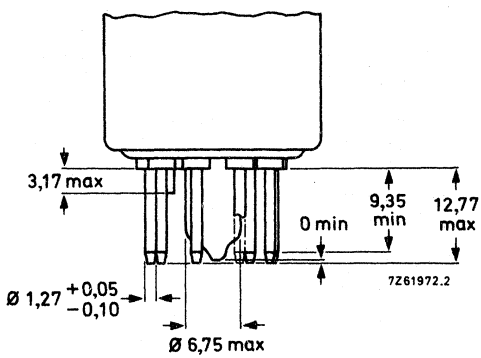
Dimensions in mm







Base: JEDEC no. E8-11 except for pumping stem IEC 67-I-33a



Mounting position: any

Net mass: ≈ 55 g

ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1103 or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES (Absolute max. rating system)
for scanned area of 9,6 mm x 12,8 mm (3/8 in x 1/2 in)

"Full-size scanning", i.e. scanning of a 9,6 mm x 12,8 mm area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area less than 9,6 mm x 12,8 mm, may cause permanent damage to the specified full-size area.

Signal-electrode voltage	V_{a_s}	max.	100	V	
Grid no. 4 voltage	V_{g4}	max.	1000	V	
Grid no. 3 voltage	V_{g3}	max.	850	V	
Grid no. 2 voltage	V_{g2}	max.	450	V	
Grid no. 1 voltage, negative	$-V_{g1}$	max.	125	V	
positive	V_{g1}	max.	0	V	
Cathode-to-heater voltage, peak positive	V_{kf_p}	max.	125	V	
negative	$-V_{kf_p}$	max.	10	V	
Dark current, peak	I_{dark_p}	max.	0,25	μA	
Output current, peak	I_{as_p}	max.	0,6	μA	1)
Faceplate illumination	E	max.	5000	lx	
Faceplate temperature, storage and operation	t	max.	80	°C	2)3)
Cathode heating time before drawing cathode current	T_h	min.	1	min	

1) Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading.

2) Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended.

3) Under conditions of high heat irradation the use of a infra-red absorbing filter is recommended.

OPERATING CONDITIONS AND PERFORMANCE
for a scanned area of 9.6 mm x 12.8 mm and a faceplate temperature of 30 ±2 °C.

CONDITIONS

		Normal operation	Operation for high resolution	
Mesh voltage	V_{g4}	425 [1]	950 [1]	V
Focusing electrode voltage	V_{g3}	250 to 300	550 to 650	V
Accelerator voltage	V_{g2}	300	300	V
Grid no. 1 voltage	V_{g1}	Adjusted for sufficient beam current to stabilize highlights		
Blanking voltage, peak-to-peak				
when applied to g1		50		V
when applied to cathode		20		V
Field strength at centre of focusing coil (nominal)	H	3200 (40)	4800 [2] (60) [2]	A/m [3] Oe [3]
Field strength of adjustable alignment coils	H	0 to 320 (0 to 4)	0 to 320 (0 to 4)	A/m [4] Oe [4]

PERFORMANCE

		min.	typ.	max.	
Signal electrode voltage for dark current of 20 nA	V_{as}				
	XQ1240	30	45	60	V
	XQ1241	20	40	60	V
Grid no. 1 voltage for picture cut-off, with no blanking applied	V_{g1}	-30	-55	-100	V
Signal current faceplate illumination 8 lx c.t. 2856 K	I_s				
	XQ1240	150	200		nA [5)6)]
	XQ1241	110	180		nA
Decay: residual signal current 200 ms after cessation of the illumination (8 lx, 2856 K)			8	15	% [5]

		Normal operation	Operation for high resolution	
Limiting resolution at picture centre		750	1000	TV lines 7)
Modulation depth at 400 TV lines at picture centre	typ.	50	65	% 8)
Average γ of transfer characteristic for signal currents between 0.01 μA and 0.3 μA		0.7	0.7	
Spurious signals (spots and blemishes)		See note 9)		

NOTES

1) The optimal grid no. 4 voltage for best uniformity of black and white level depends on the type of coil unit used and will be 1.6 times V_{g3} for the coil units mentioned under "Accessories".
   Under no circumstances should grid no. 4 (mesh) be allowed to operate at a voltage level below the V_{g3} level, since this may damage the target.

2) Because of the higher deflecting and focusing power required to produce adequate field strength the tube temperature will increase and adequate provisions for cooling should be made.

3) The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.

4) The alignment coil unit should be positioned on the tube so that its centre is at a distance of approx. 94 mm (3 11/16 in) from the face of the tube and that its axis coincides with the axis of the tube, the deflecting yoke and the focusing coil.

5) Signal-electrode voltage adjusted for a dark current of 20 nA.

6) Signal current is defined as the component of the output current after the dark current has been subtracted.

7) Measured with a video amplifier system having an appropriate bandwidth.

8) Square wave response. Measured with a lens aperture of f5.6, a peak signal current I_{sp} = 0.15 μA and a beam current sufficient to stabilize a signal current of 0.5 μA.

9) Conditions :

The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area. Signal electrode voltage adjusted for a dark current of 20 nA, illumination on the target 8 lx, (c.t. = 2856 K).

Scanning amplitudes of the monitor adjusted to obtain a raster with an aspect ratio of 3 : 4.

Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped, and for non-blooming bright raster when lens of camera is uncapped.

Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted unless the amplitude is less than 10% (XQ1240), or less than 25% (XQ1241) of the peak white signal.

<u>XQ1240</u>

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1	none	none
1 to 0.6	none	none
0.6 to 0.2	1	2
⩽ 0.2	*	*

<u>XQ1241</u>

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1	none	none
1 to 0.6	1	3
m 0.6 to 0.2	3	5
⩽ 0.2	*	*
	max. 8	

* Do not count spots of this size unless concentration causes a smudgy appearance.

a) Minimum separation between any two spots greater than 0.2% of raster height is limited to a distance equivalent to 5% of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrast ratios in excess of 10% (XQ1240), respectively 25% (XQ1241).

CAMERA TUBE

Small size vidicon television camera tube with low heater consumption, integral mesh construction, magnetic focusing and magnetic deflection. Overall length 108 mm (4-1/4 in) and diameter 17,7 mm (2/3 in).
The XQ1270 is intended for use in ultra compact TV cameras for industrial and consumer applications.

QUICK REFERENCE DATA		
Integral mesh		
Focusing	magnetic	
Deflection	magnetic	
Diameter	17,7	mm
Length	108	mm
Heater	6,3 V, 110	mA
Resolution	≥ 400	TV lines

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)	max.	11	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane defined by the gap between the pins 1 and 7 and the longitudinal axis of the tube, unless rotation of the tube is found necessary to minimize the number of blemishes in the picture.

Photoconductive layer	type A		
Spectral response, max. response at	approx.	550	nm

HEATING

Indirect by a.c. or d.c.; parallel or series supply

Heater voltage	V_f	6,3	V ± 10%
Heater current	I_f	110	mA

When the tube is used in a series heater chain, the heater voltage must not exceed a r.m.s. value of 9,5 V when the supply is switched on.

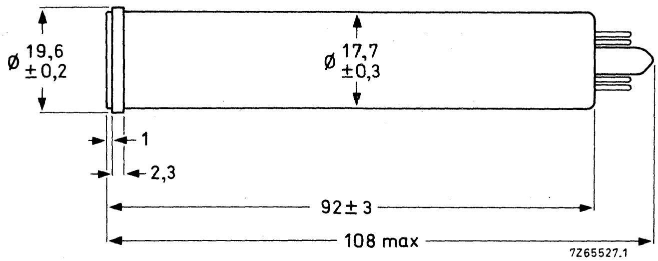
CAPACITANCES

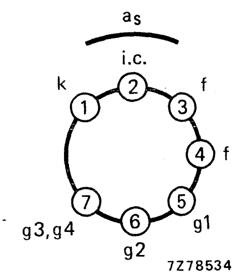
Signal electrode to all	C_{as}	2	pF

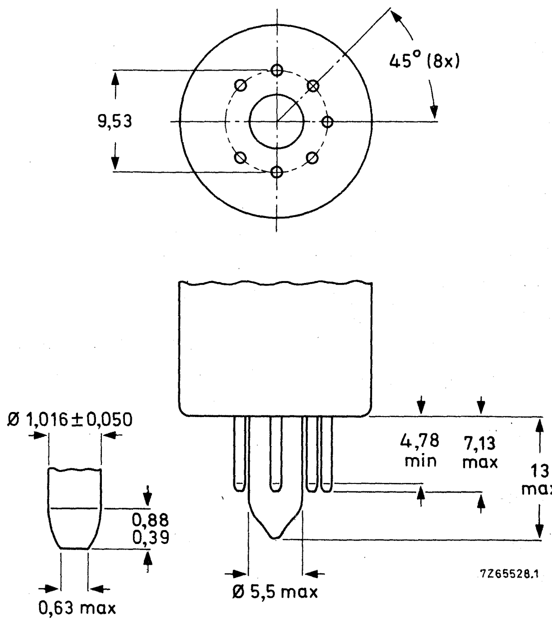
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

MECHANICAL DATA

Dimensions in mm







Base: Small button miniature 7-pin (IEC 67-I-10a, JEDEC E7-1) with pumping stem.

Mounting position: any

Net mass : ≈ 18 g

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection and focusing coil unit	KV12S or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES (Absolute max. rating system) for scanned area of 6,6 x 8,8 mm^2.

"Full-size scanning" i.e. scanning of a 6,6 x 8,8 mm^2 area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area smaller than 6,6 x 8,8 mm^2, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max.	80	V
Grid no.4 and grid no.3 voltage	$V_{g4,g3}$	max.	750	V
Grid no.2 voltage	V_{g2}	max.	350	V
Grid no.1 voltage, negative	$-V_{g1}$	max.	125	V
positive	V_{g1}	max.	0	V
Cathode-to-heater voltage, peak positive	V_{kf_p}	max.	125	V
peak negative	$-V_{kf_p}$	max.	10	V
Dark current, peak	I_{d_p}	max.	0,15	μA
Output current, peak	I_{as_p}	max.	0,5	μA [1]
Faceplate illumination	E	max.	5000	lx
Faceplate temperature, storage and operation	t	max.	70	°C [2]
Cathode heating time before drawing cathode current	Th	min.	1	min

[1] Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

[2] Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces, appropriate infra-red absorbing filters should be used.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 x 8,8 mm^2 and a faceplate temperature of 30 ± 2 °C.

Conditions

Grid no.4 and grid no.3 (beam focus electrode) voltage	$V_{g4,g3}$	250 to 300	V	1)
Grid no.2 (accelerator) voltage	V_{g2}	300	V	
Grid no.1 voltage	V_{g1}	adjusted for sufficient beam current to stabilize highlights		
Blanking voltage, peak to peak				
when applied to grid no.1		50	V	
when applied to the cathode		20	V	
Field strength at centre of focusing coil	H	3850 (50	A/m Oe)	2)
Field strength of adjustable alignment magnets (KV12S)	H	0 to 320 (0 to 4	A/m Oe)	
Deflection		see note 3		

Performance

		min.	typ.	max.	
Signal electrode voltage for dark current of 20 nA (see Fig.1)	V_{as}	10	25	40	V
Signal current faceplate illumination 8 lx c.t. 2856 K, dark current 20 nA	I_s	80	150		nA 4)
Decay: residual signal current 200 ms after cessation of the illumination (8 lx, c.t. 2856 K)			10		%
Limiting resolution in picture centre		400	450		TV lines 5)
Grid no.1 voltage for picture cut-off with no blanking applied	V_{g1}	-20	-60	-80	V
Average γ of transfer characteristic for signal currents between 0,02 and 0,2 μA (see Fig. 2)			0,7		
Spurious signals (spots and blemishes)		see note 6			

NOTES

1) Beam focus is obtained by the combined effect of grid no.3, the voltage of which should be adjustable over the indicated range, and a focus coil having a field strength of 3850 A/m (50 Oe).

2) The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.

3) The deflection circuits must provide sufficiently linear scanning for good black-level reproduction. The output current being proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.

4) Signal current is defined as the component of the output current after the dark current has been subtracted.

5) Measured with a video amplifier system having an appropriate bandwidth, 8 lx on specified target area, target voltage adjusted for a dark current of 20 nA, beam set for correct stabilization.

6) Conditions:
The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area. Signal electrode voltage adjusted for a dark current of 20 nA, illumination on target 8 lx (c.t. 2856 K).

Scanning amplitudes of the monitor adjusted to obtain a raster aspect ratio of 3 : 4.

Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped, and for non-blooming bright raster when lens of camera is uncapped.

Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless the amplitude is less than 50 % of the peak white signal.

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1	none	none
≤ 1 to 0,8	none	1
≤ 0,8 to 0,6	2	2
≤ 0,6 to 0,3	2	3
≤ 0,3	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance.

a) Minimum separation between any 2 spots greater than 0,4 % of raster height is limited to a distance equivalent to 4 % of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrast ratios greater than 1,5 to 1.

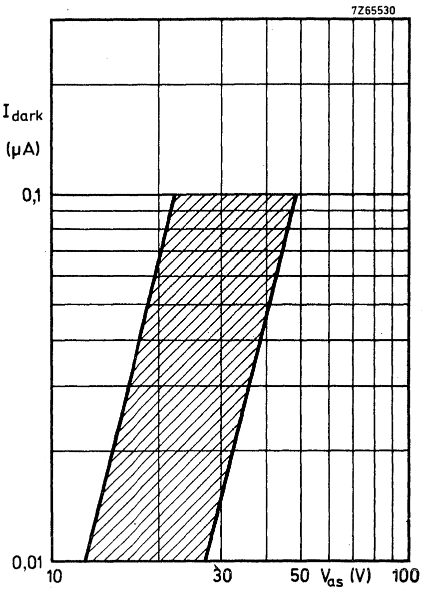


Fig. 1

Dark current range

Scanned area 6, 6 x 8, 8 mm^2
Faceplate temperature ≈ 30 °C

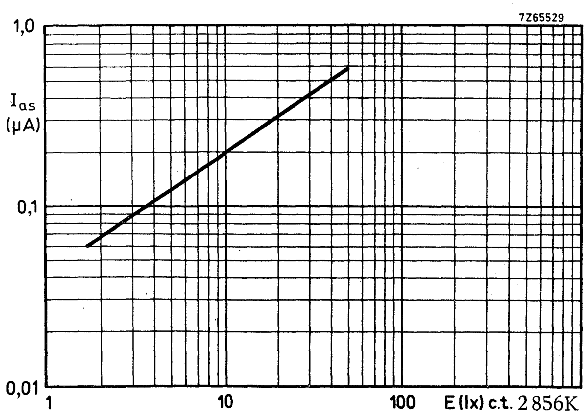


Fig. 2

Typical light transfer characteristic

Scanned area 6, 6 x 8, 8 mm^2
Faceplate temperature ≈ 30 °C

CAMERA TUBE

Small size vidicon television camera tube with low heater consumption, separate mesh construction for improved resolution, magnetic focusing and magnetic deflection.
Overall length 108 mm (4-1/4 in) and diameter 17,7 mm (2/3 in).
The XQ1271 is intended for use in ultra compact TV cameras for industrial and consumer applications.

QUICK REFERENCE DATA		
Separate mesh		
Focusing	magnetic	
Deflection	magnetic	
Diameter	17,7	mm
Length	108	mm
Heater	6,3 V, 95	mA
Resolution	≥ 550	TV lines

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)	max.	11	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane defined by the gap between the pins 1 and 7 and the longitudinal axis of the tube, unless rotation of the tube is found necessary to minimize the number of blemishes in the picture.

Photoconductive layer	type A		
Spectral response, max. response at	approx.	550	nm

HEATING

Indirect by a.c. or d.c.; parallel or series supply

Heater voltage	V_f	6,3	V ± 10%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed a r.m.s. value of 9,5 V when the supply is switched on.

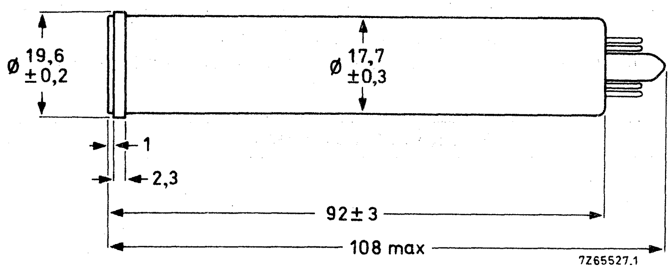
CAPACITANCES

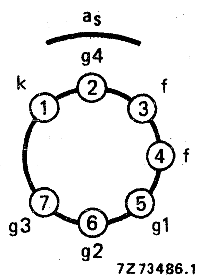
Signal electrode to all	C_{as}	2	pF

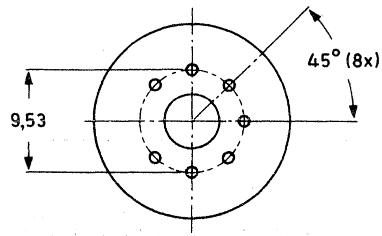
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

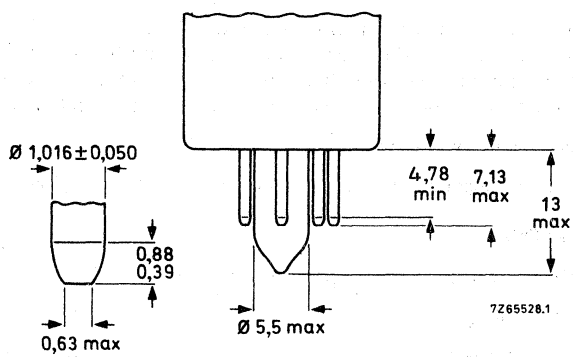
MECHANICAL DATA

Dimensions in mm









Base: Small button miniature 7-pin (IEC 67-I-10a, JEDEC E7-1) with pumping stem.

Mounting position: any

Net mass: : ≈ 18 g

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection and focusing coil unit	KV12S or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES (Absolute max. rating system)
for scanned area of 6,6 x 8,8 mm^2.

"Full-size scanning" i.e. scanning of a 6,6 x 8,8 mm^2 area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area smaller than 6,6 x 8,8 mm^2, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max.	80	V
Grid no. 4 voltage	V_{g4}	max.	750	V
Grid no. 3 voltage	V_{g3}	max.	750	V
Grid no. 2 voltage	V_{g2}	max.	350	V
Grid no. 1 voltage, negative	$-V_{g1}$	max.	125	V
positive	V_{g1}	max.	0	V
Cathode-to-heater voltage, peak positive	V_{kf_p}	max.	125	V
peak negative	$-V_{kf_p}$	max.	0	V
Dark current, peak	I_{dp}	max.	0,15	μA
Output current, peak	I_{as_p}	max.	0,5	μA 1)
Faceplate illumination	E	max.	5000	lx
Faceplate temperature, storage and operation	t	max.	70	°C 2)
Cathode heating time before drawing cathode current	T_h	min.	1	min

1) Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

2) Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces, appropriate infra-red absorbing filters should be used.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 x 8,8 mm^2 and a faceplate temperature of 30 ± 2 °C.

Conditions

Grid no. 4 voltage	V_{g4}	400	V	
Grid no. 3 (beam focus electrode) voltage	V_{g3}	250 to 300	V	2)
Grid no. 2 (accelerator) voltage	V_{g2}	300	V	
Grid no. 1 voltage	V_{g1}	adjusted for sufficient beam current to stabilize highlights		
Blanking voltage, peak to peak				
when applied to grid no. 1		50	V	
when applied to the cathode		20	V	
Field strength at centre of focusing coil	H	3850 (50	A/m Oe)	2)
Field strength of adjustable alignment magnets (KV12S)	H	0 to 320 (0 to 4	A/m Oe)	
Deflection		see note 3		

Performance

		min.	typ.	max.		
Signal electrode voltage for dark current of 20 nA (see Fig. 1)	V_{as}	10	25	40	V	
Signal current faceplate illumination 8 lx c.t. 2856 K, dark current 20 nA	I_s	80	150		nA	4)
Decay: residual signal current 200 ms after cessation of the illumination (8 lx, c.t. 2856 K)			10		%	
Limiting resolution in picture centre		550	600		TV lines	5)
Grid no. 1 voltage for picture cut-off with no blanking applied	V_{g1}	-20	-60	-80	V	
Average γ of transfer characteristic for signal currents between 0,02 and 0,2 µA (see Fig. 2)			0,7			
Spurious signals (spots and blemishes)		see note 6				

NOTES

1) Beam focus is obtained by the combined effect of grid no. 3, the voltage of which should be adjustable over the indicated range, and a focus coil having a field strength of 3850 A/m (50 Oe).

2) The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.

3) The deflection circuits must provide sufficiently linear scanning for good black-level reproduction. The output current being proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.

4) Signal current is defined as the component of the output current after the dark current has been subtracted.

5) Measured with a video amplifier system having an appropriate bandwidth, 8 lx on specified target area, target voltage adjusted for a dark current of 20 nA, beam set for correct stabilization.

6) Conditions:
The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area. Signal electrode voltage adjusted for a dark current of 20 nA, illumination on target 8 lx (c.t. 2856 K).

Scanning amplitudes of the monitor adjusted to obtain a raster aspect ratio of 3 : 4.

Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped, and for non-blooming bright raster when lens of camera is uncapped.

Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless the amplitude is less than 50 % of the peak white signal.

Spot size in % of raster height	Maximum number of spots	
	zone 1	zone 2
> 1	none	none
≤ 1 to 0,8	none	1
0,8 to 0,6	2	2
0,6 to 0,3	2	3
≤ 0,3	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance.
a) Minimum separation between any 2 spots greater than 0,4 % of raster height is limited to a distance equivalent to 4 % of raster height.
b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrast ratios greater than 1,5 to 1.

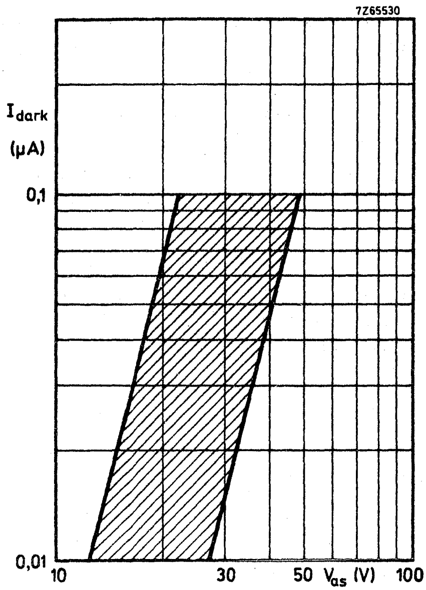


Fig. 1

Dark current range

Scanned area 6, 6 x 8, 8 mm^2
Faceplate temperature ≈ 30 °C

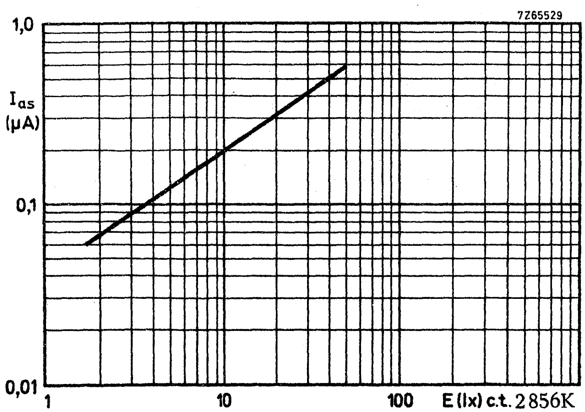


Fig. 2

Typical light transfer characteristic

Scanned area 6, 6 x 8, 8 mm^2
Faceplate temperature ≈ 30 °C

CAMERA TUBE

Small size vidicon television camera tube with low heater consumption, separate mesh construction, electrostatic focusing and magnetic deflection. Overall length 108 mm (4-1/4 in) and diameter 17,7 mm (2/3 in).
The XQ1272 is intended for use in ultra compact TV cameras for industrial and consumer applications in which a minimum of size, weight and power consumption is essential.

QUICK REFERENCE DATA

Separate mesh		
Focusing	electrostatic	
Deflection	magnetic	
Diameter	17,7	mm
Length	108	mm
Heater	6,3 V, 95	mA
Resolution	≥ 400	TV lines

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)	max.	11	mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane defined by the gap between the pins 1 and 7 and the longitudinal axis of the tube, unless rotation of the tube is found necessary to minimize the number of blemishes in the picture.

Photoconductive layer	type A		
Spectral response, max. response at	approx.	550	nm

HEATING

Indirect by a.c. or d.c.; parallel or series supply

Heater voltage	V_f	6,3	V ± 10%
Heater current, at V_f = 6,3 V	I_f	95	mA

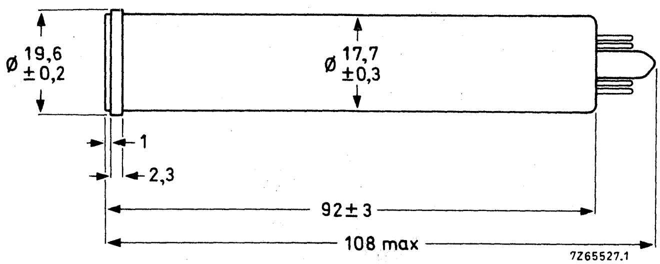
When the tube is used in a series heater chain, the heater voltage must not exceed a r.m.s. value of 9,5 V when the supply is switched on.

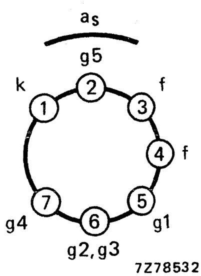
CAPACITANCES

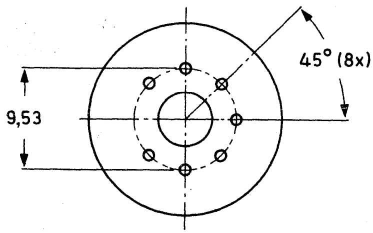
Signal electrode to all	C_{as}	2	pF

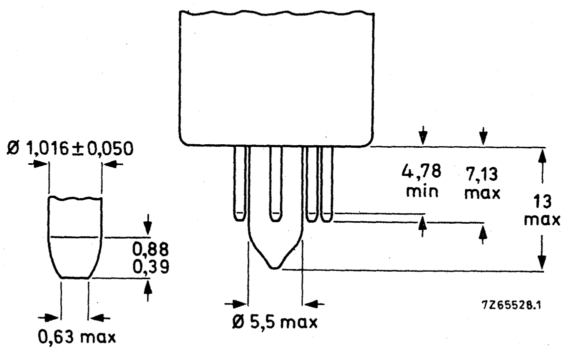
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted into the deflection coil unit

MECHANICAL DATA Dimensions in mm









Base: Small button miniature 7-pin (IEC 67-I-10a, JEDEC E7-1) with pumping stem.

Mounting positions: any

Net mass : ≈ 23 g

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection coil unit	KV19G or equivalent

DEFLECTION	magnetic
FOCUSING	electrostatic

LIMITING VALUES (Absolute max. rating system) for scanned area of 6,6 x 8,8 mm^2.

"Full-size scanning" i.e. scanning of a 6,6 x 8,8 mm^2 area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area smaller than 6,6 x 8,8 mm^2, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max.	80	V
Grid no. 5 voltage	V_{g5}	max.	600	V
Grid no. 4 (beam focus electrode) voltage	V_{g4}	max.	350	V
Grid no. 3 and Grid no. 2 voltage	$V_{g3,g2}$	max.	350	V
Grid no. 1 voltage, negative	$-V_{g1}$	max.	125	V
positive	V_{g1}	max.	0	V
Cathode-to-heater voltage, peak positive	V_{kf_p}	max.	125	V
peak negative	$-V_{kf_p}$	max.	10	V
Dark current, peak	I_{dp}	max.	0,15	µA
Output current, peak	I_{asp}	max.	0,5	µA 1)
Faceplate illumination	E	max.	5000	lx
Faceplate temperature, storage and operation	t	max.	70	°C 2)
Cathode heating time before drawing cathode current	T_h	min.	1	min

1) Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

2) Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces, appropriate infra-red absorbing filters should be used.

OPERATING CONDITIONS AND PERFORMANCE
for a scanned area of 6,6 x 8,8 mm^2 and a faceplate temperature of 30 ± 2 °C.

Conditions

Grid no. 5 voltage	V_{g5}	500	V	
Grid no. 4 voltage	V_{g4}	35 to 55	V	1)
Grid no. 3 and Grid no. 2 voltage	$V_{g3,g2}$	300	V	
Grid no. 1 voltage	V_{g1}	adjusted for sufficient beam current to stabilize highlights		
Blanking voltage, peak to peak				
when applied to grid no. 1		50	V	
when applied to the cathode		20	V	
Field strength of adjustable alignment magnets (KV19G)	H	0 to 320	A/m	
		(0 to 4	Oe)	
Deflection		see note 2		

Performance

		min.	typ.	max.		
Signal electrode voltage for dark current of 20 nA (see Fig. 1)	V_{as}	10	25	40	V	
Signal current faceplate illumination 8 lx c.t. 2856 K, dark current 20 nA	I_s	80	150		nA	3)
Decay: residual signal current 200 ms after cessation of the illumination (8 lx, c.t. 2856 K)			10		%	
Limiting resolution in picture centre		500	550		TV lines	4)
Grid no. 1 voltage for picture cut-off with no blanking applied	V_{g1}	-20	-60	-80	V	
Average γ of transfer characteristic for signal currents between 0,02 and 0,2 μA (see Fig. 2)			0,7			
Spurious signals (spots and blemishes)		see note 5				

NOTES

1) Adjusted for optimal beam focus.

2) The deflection circuits must provide sufficiently linear scanning for good black-level reproduction. The output current being proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.

3) Signal current is defined as the component of the output current after the dark current has been subtracted.

4) Measured with a video amplifier system having an appropriate bandwidth, 8 lx on specified target area, target voltage adjusted for a dark current of 20 nA, beam set for correct stabilization.

5) Conditions :
The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area. Signal electrode voltage adjusted for a dark current of 20 nA, illumination on target 8 lx (c.t. 2856 K).

Scanning amplitudes of the monitor adjusted to obtain a raster aspect ratio of 3 : 4.

Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped, and for non-blooming bright raster when lens of camera is uncapped.

Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless the amplitude is less than 50% of the peak white signal.

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1	none	none
≤ 1 to 0,8	none	1
0,8 to 0,6	2	2
0,6 to 0,3	2	3
≤ 0,3	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance.
a) Minimum separation between any 2 spots greater than 0,4% of raster height is limited to a distance equivalent to 4% of raster height.
b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrast ratios greater than 1,5 to 1.

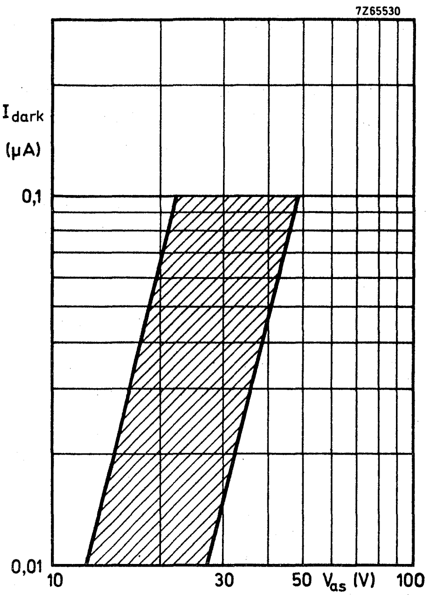


Fig. 1

Dark current range

Scanned area 6, 6 x 8, 8 mm^2
Faceplate temperature ≈ 30 °C

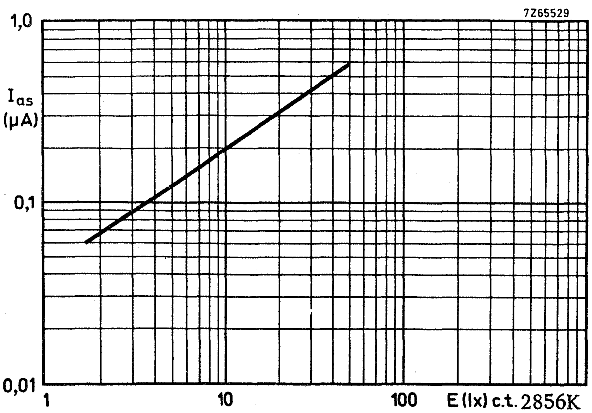


Fig. 2

Typical light transfer characteristic

Scanned area 6, 6 x 8, 8 mm^2
Faceplate temperature ≈ 30 °C

CAMERA TUBE

Vidicon TV camera tube with 25,4 mm (1 in) diameter, low heater power consumption, magnetic focusing and deflection, provided with a precision electron gun as in the 1 in diameter Plumbicon* tubes of the XQ1070 series.
The XQ1280 is intended mainly for use in medical or industrial X-ray equipment in which it is lens coupled to an X-ray image intensifier with a P11 or P20 output phosphor.
The tube is provided with a special photoconductive layer of high sensitivity in the 450 to 500 nm spectral region, and medium lag for proper X-ray noise integration.

QUICK REFERENCE DATA		
Separate mesh		
Focusing	magnetic	
Deflection	magnetic	
Diameter	25,4 mm (1 in)	
Length	159 mm ($6\frac{1}{4}$ in)	
Spectral response, max. at	450 to 500	nm
cut-off at	approx. 800	nm
Resolution	≥ 60	lp/mm
Heater	6,3 V, 95	mA

OPTICAL DATA

Dimensions of quality area on photoconductive target — circle of 16,2 mm dia [1])

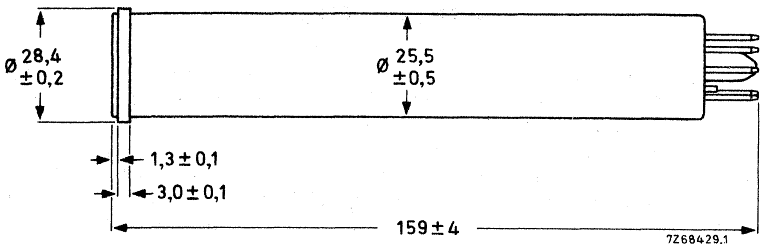
Orientation of image on target
The direction of the horizontal scan should be essentially parallel to the plane defined by the short index pin and the longitudinal axis of the tube.

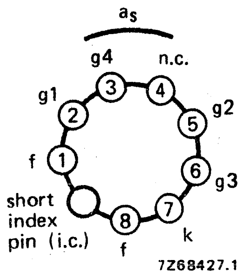
Photoconductive layer		type B	
Spectral response, max. at		approx. 475	nm
cut-off at		approx. 800	nm
Spectral response curve		see Fig. 1	
Faceplate			
Refractive index	n	1,49	
Thickness		2,3 ± 0,1	mm

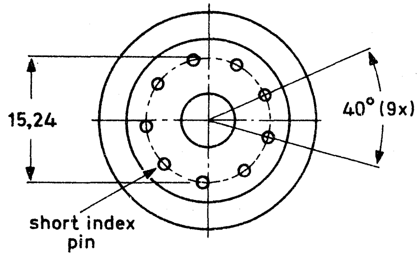
* Registered Trade Mark for TV camera tube

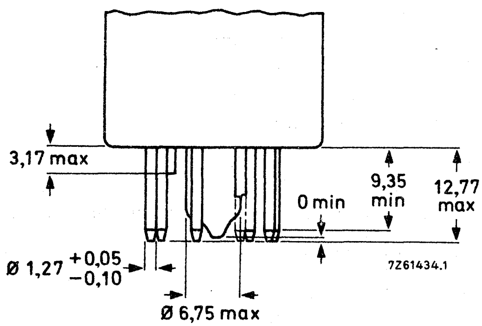
MECHANICAL DATA

Dimensions in mm









Mounting position: any

Mass: ≈55 g

Base: IEC 67-I-33a
(JEDEC E8-11)

ACCESSORIES

Socket	56098 or equivalent
Deflection and focusing coil	AT1102/01, AT1103, AT1116 or equivalent

ELECTRICAL DATA

Heating: Indirect by A.C. or D.C.; parallel or series supply

Heater voltage	V_f	6,3	V ± 10%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must never exceed an r.m.s. value of 9,5 V when the supply is switched on.

Electron gun characteristics

Cut-off				
Grid no.1 voltage for cut-off at V_{g_2} = 300 V	V_{g1}		-30 to -100	V
Blanking voltage, peak to peak				
on grid no.1	V_{g1pp}		50 ± 10	V
on cathode	V_{kpp}		20	V
Grid no.2 current at normally required beam currents	I_{g_2}	max.	0,5	mA

Focusing — magnetic; see "Accessories"

Deflection — magnetic; see "Accessories"

Capacitance

Signal electrode to all	C_{as}	3 to 5	pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

LIMITING VALUES (Absolute max. rating system)

All voltages are referred to the cathode, unless otherwise stated.

Signal electrode voltage	V_{as}	max.	100	V
Grid no.4 voltage	V_{g4}	max.	1100	V
Grid no.3 voltage	V_{g3}	max.	800	V
Voltage between grid no.4 and grid no.3	$V_{g4/g3}$	max.	450	V
Grid no.2 voltage	V_{g2}	max.	350	V
Grid no.1 voltage, negative	$-V_{g1}$	max.	125	V
positive	V_{g1}	max.	0	V

Cathode to heater voltage, positive peak	V_{kf_p}	max.	125	V
negative peak	$-V_{kf_p}$	max.	50	V
Impedance between cathode and heater at $-V_{kf_p} > 10$ V	Z_{kf}	min.	2	kΩ
Dark current, peak	I_{dark_p}	max.	0, 1	μA
Output current, peak	I_{as_p}	max.	0, 6	μA

The video amplifier should be capable of handling signal electrode currents of this magnitude without overloading.

Faceplate illumination	E	max.	5000	lx
Faceplate temperature, storage and operation	t	max.	80	°C

OPERATING CONDITIONS AND PERFORMANCE

For a target area of 15 mm diameter; faceplate temperature 30 ± 2 °C, All voltages are referred to the cathode, unless otherwise stated.

Typical operating conditions

		normal operation	operation for high resolution	
Grid no.1(control grid) voltage	V_{g_1}	Adjusted for sufficient beam current to stabilize a peak output current, I_{as_p}, of 600 nA		
Grid no.2 (accelerator) voltage	V_{g_2}	300	300	V
Grid no.3 (collector) voltage	V_{g_3}	375	600	V 2)
Grid no.4 (mesh) voltage	V_{g_4}	600	960	V 2)
Peak signal current	I_{s_p}	150	150	nA 8)9)
Peak dark current	I_{dark_p}	20	20	nA
Blanking voltage, peak to peak when applied to grid no.1	$V_{g_{1pp}}$	50		V
when applied to cathode	$V_{k_{pp}}$	20		V
Field strength at centre of focusing coil (nominal)	H	3600 (45)	4800 (60)	A/m Oe 3) 4)
Field strength of adjustable alignment coils	H	0 to 320 (0 to 4)	0 to 320 (0 to 4)	A/m Oe 5)
Deflection currents		see note 6		

Performance

			min.	typ.	max.	
Signal electrode voltage for a peak dark current of 20 nA		V_{as}	30	40	70	V
Grid no.1 voltage for picture cut-off, with no blanking applied		V_{g_1}	-30	-55	-100	V
Sensitivity Illumination required for a peak signal current of 150 nA						
	P20	E		2 4×10^{-7}	4 8×10^{-7}	lx W/cm^2
	P11	E		0,4 3×10^{-7}	0,8 6×10^{-7}	lx W/cm^2
Decay: Residual signal current 200 ms after cessation of the illumination				15	20	% [10])

Limiting resolution at picture centre, normal operation	$\geq$ 50	lp/mm	[11])
operation for high resolution	$\geq$ 60	lp/mm	[11])
Modulation transfer characteristic	see Fig.4		
Average γ of transfer characteristic for signal currents between 10 nA and 300 nA	0,7		[12])
Spurious signals	see "Spurious signal specification for XQ1280"		

1) a. The circular quality area of 16,2 mm diameter is concentric with the faceplate.

b. The scanning amplitudes must be so adjusted that a target area of about 15 mm diameter is displayed on a standard monitor as a circular area with a diameter equal to the raster height. (15 mm x 20 mm scan).

c. The displayed circular area of approximately 15 mm diameter should fall within the quality area of 16,2 mm diameter but is generally not concentric with the latter due to excentricities of the output window of the image intensifier and the optical system.

d. Underscanning of the chosen area, or failure of scanning, should be avoided, since this may cause damage to the photoconductive layer.

2) The optimal grid no.4 voltage for best uniformity of black and white level depends on the type of coil unit used and will be 1,5 to 1,6 times V_{g3} for the coil units mentioned under "Accessories". Under no circumstances should grid no.4 (mesh) be allowed to operate at a voltage level below that of grid no.3, as this may damage the target.

3) Focus current adjusted for optimal electrical focus.

4) The polarity of the focusing coil should be such that its image end attracts an external north-seeking pole.

5) The alignment coil unit should be so positioned that its centre is at a distance of approx. 94 mm (3 11/16 in) from the face of the tube and that its axis coincides with the axis of the tube, the deflecting yoke and the focusing coil.

	Focusing current (mA)		Line current$_{pp}$ (mA)		Frame current$_{pp}$ (mA)	
V_{g4}/V_{g3} (V)	600/375	960/600	600/375	960/600	600/375	960/600
AT1102/01	18	23	310	390	42	53
AT1103	20	26	310	390	46	59
AT1116	83	105	400	510	59	75
	Approx. values for scanning amplitudes corresponding to 15 x 20 mm^2 scanned area					

Line and frame alignment coil currents max. 21 mA (AT1103) resp. 15 mA (AT1116) corresponding to a flux density of approx. 4.10^{-4} T. (4 Gs)

7) The dark current is dependent on the signal electrode voltage and the temperature. This is shown in Figs. 2 and 3.

8) Signal current is output current minus dark current.

9) As measured on a waveform oscilloscope.

10) Measured with a 100% peak signal current of 150 nA.

11) Measured with a video amplifier system with suitable bandwidth and a high-quality lens adjusted to f 5, 6.

12) For typical transfer characteristics with P20 and P11 light input see Fig. 5 and 6.

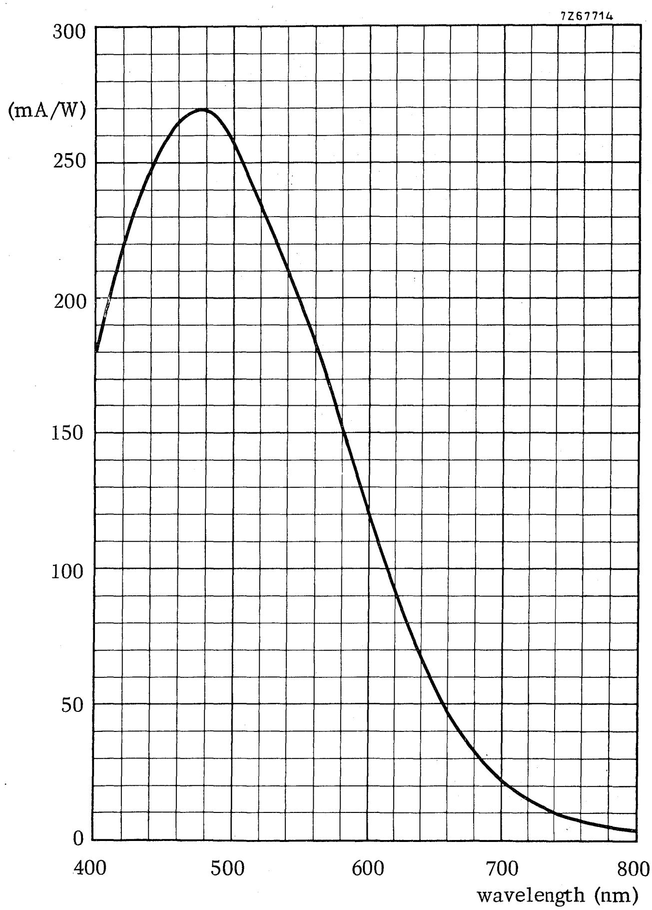


Fig. 1 Typical spectral response curve measured at constant output current I_{as} = 50 nA, with I_{dark} = 20 nA.

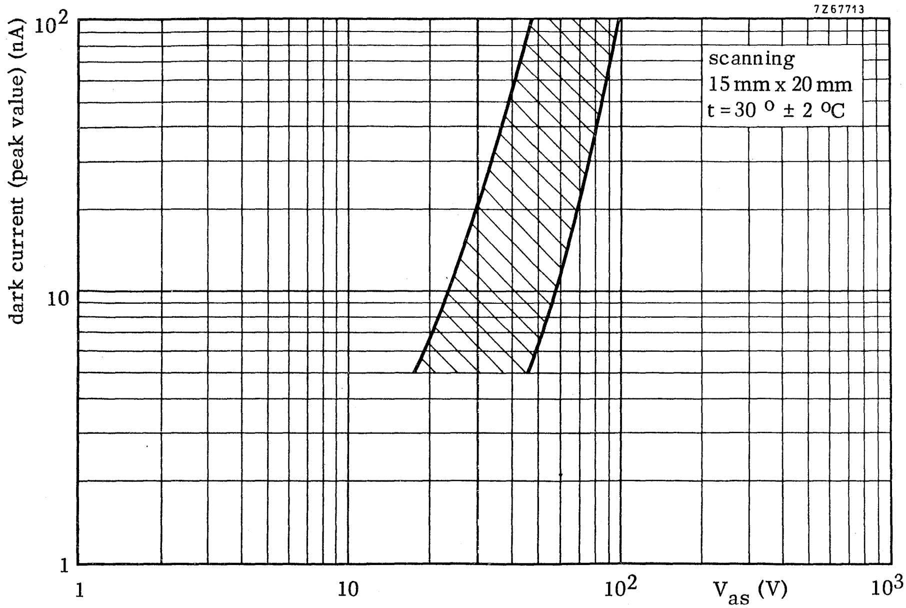


Fig.2 Dark current range / signal electrode voltage curve

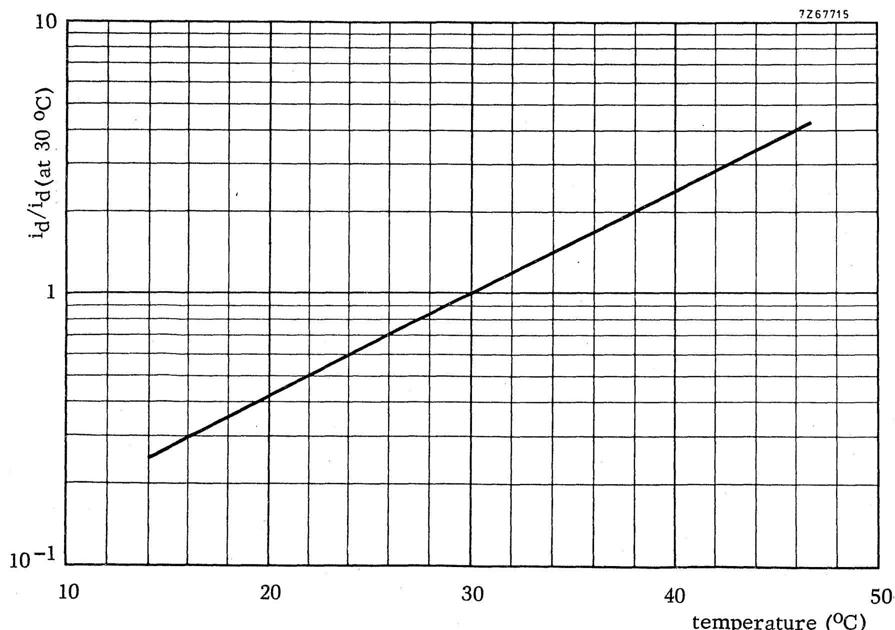


Fig.3 Temperature dependence of dark current

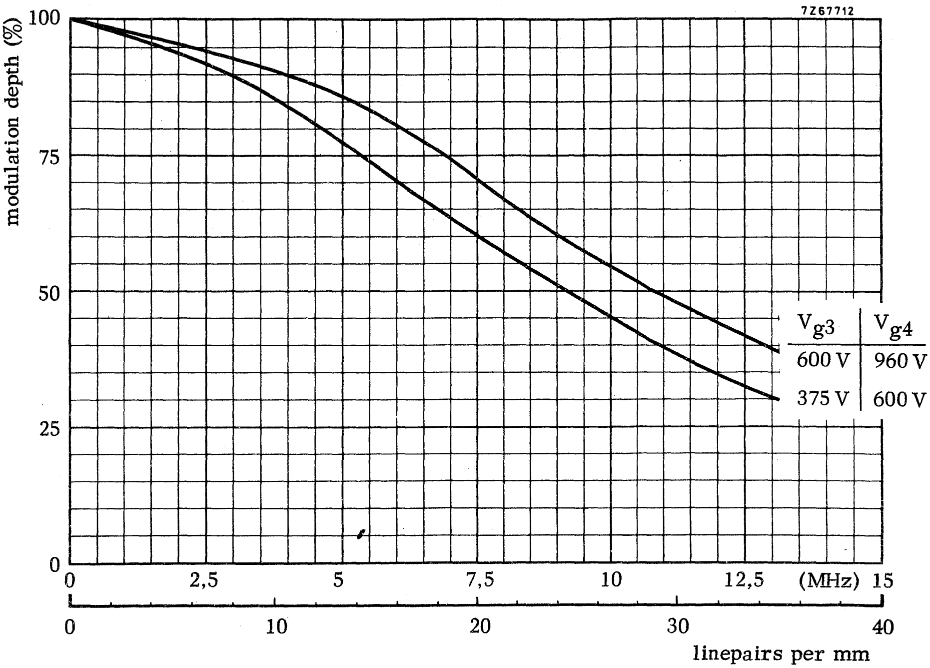


Fig. 4 Squarewave modulation transfer characteristic

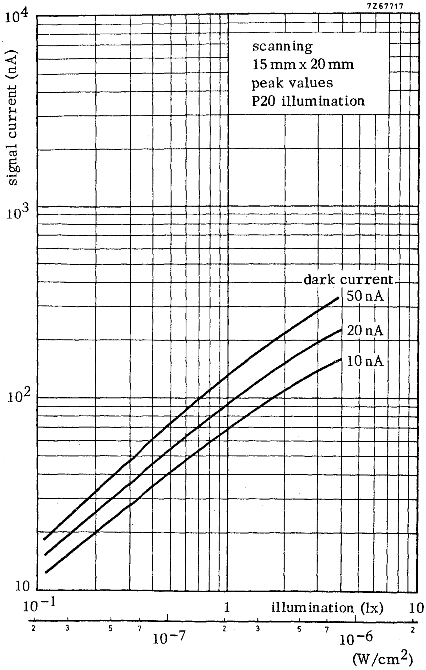


Fig. 5 Typical light transfer characteristic

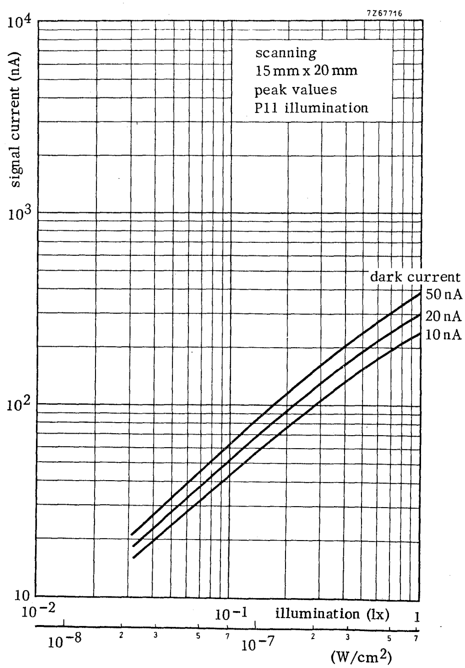
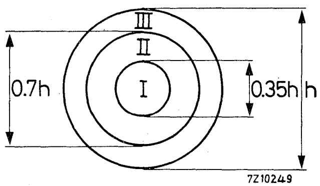


Fig. 6 Typical light transfer characteristic

Spurious signal specification

Test conditions

- The tube shall be operated in a test chain under the voltage conditions as shown in the data sheet.
- The scanning amplitudes shall be adjusted to correspond to a scanned area of 16, 2 x 21, 6 mm^2.
- The tube shall be aligned and focused in accordance with the "Instructions for use".
- A back illuminated test transparency with three quality zones (see Fig. below) is projected onto the specified target area (16, 2 mm diameter circular) producing an even illumination.



- The light level shall be adjusted to produce a peak signal current of 150 nA, the beam current shall be adjusted to just stabilize a peak signal current of 600 nA,
  the signal electrode voltage shall be adjusted for a peak dark current of 20 nA,
  the temperature of the faceplate shall be 30 ± 2 ^{o}C.
- The video amplifier system shall have a bandwidth (-3 dB) of at least 7 MHz.
- The monitor shall be adjusted for a non-blooming white.

Permitted number, size and location of blemishes

Dimensions of blemishes in % of picture height (16, 2 mm)	Zone I	Zone II	ZoneIII
> 0, 7	0	0	0
≤ 0, 7 but > 0, 45	0	1	3
≤ 0, 45 but > 0, 2	2	3	6
total	2	6	

Both black and white blemishes as observed on the monitor shall be counted. Blemishes ≤ 0,2 % of picture height [1]) and blemishes with a contrast ≤ 6 % (of 150 nA peak signal current, as measured on a waveform oscilloscope), however, shall be neglected.

---

[1]) Spots of this size are allowed unless concentration causes a smudgy appearance. The average contrast of the concentration is taken as the smudge contrast.

CAMERA TUBE

Vidicon TV camera tube with 25,4 mm (1 in) diameter, low heater power consumption, magnetic focusing and deflection, provided with a precision electron gun as in the 1 in diameter Plumbicon* tubes of the XQ1070 series.
The XQ1285 has a fibre optic faceplate and is mainly intended for use in medical or industrial X-ray equipment in which it is directly coupled to an X-ray image intensifier with a P11 or P20 phosphor on a fibre optic output window. For this purpose it is provided with a special photoconductive layer with a high sensitivity in the 450 to 500 nm spectral region and medium lag for proper X-ray noise integration.

QUICK REFERENCE DATA	
Faceplate	fibre optic
Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25, 4 mm (1 in)
Length	159 mm ($6\frac{1}{4}$ in)
Heater	6, 3 V, 95 mA
Spectral response, max. at	450 to 500 nm
cut-off at approx.	800 nm
Resolution	≥ 50 lp/mm

OPTICAL DATA

Dimensions of quality area on photoconductive target	circle of 15, 8 mm dia (see page 6)

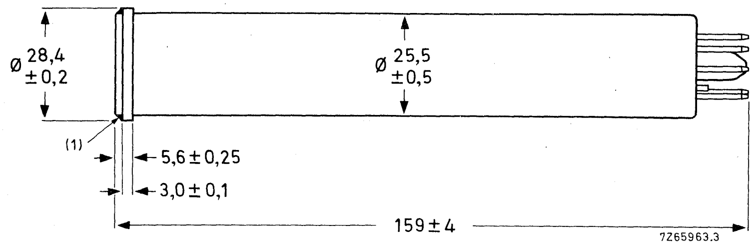
Orientation of image on target
The direction of the horizontal scan should be essentially parallel to the plane defined by the short index pin and the longitudinal axis of the tube.

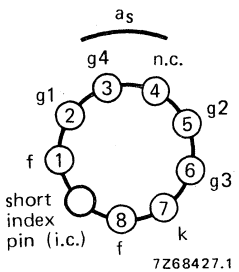
Photoconductive layer	type B
Spectral response, max. at	approx. 475 nm
cut-off	approx. 800 nm
Spectral response curve	see Fig. 1
Faceplate	
Centre to centre spacing of fibres	7, 5 μm
Flat within	1, 5 μm
Numerical aperture	1, 0

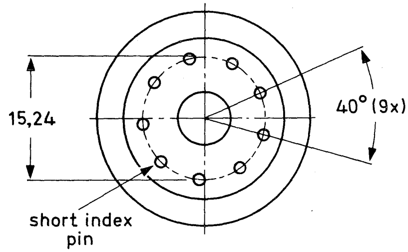
*) Registered Trade Mark for TV camera tube.

MECHANICAL DATA

Dimensions in mm



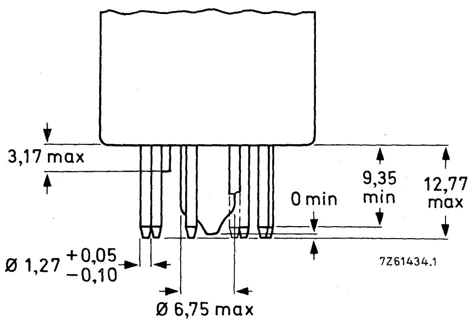




Mounting position: any

Weight: ≈ 55 g

Base: JEDEC E8-11; IEC67-I-33a



ACCESSORIES

Socket	56098 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1103, AT1116 or equivalent

(1) Epoxy resin. Proper coupling of the XQ1285 to the fibre optic output window of an image intensifier may be obtained by mechanical arrangements which either exert an evenly distributed axial forward pulling force on the signal-electrode ring or an axial forward pushing force on the base end or socket of the tube.
In either case the recommended force is in the order of 100 to 120 N.

ELECTRICAL DATA

Heating: Indirect by a.c. or d.c.; parallel or series supply.

Heater voltage	V_f	6,3	V ± 10%
Heater current, at V_f = 6,3 V	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must never exceed an r.m.s. value of 9,5 V when the supply is switched on.

Electron gun characteristics

Cut-off			
Grid no. 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}	−30 to −100	V
Blanking voltage, peak to peak			
on grid no. 1	V_{g1pp}	50 ± 10	V
on cathode	V_{kpp}	20	V
Grid no. 2 current at normally required beam currents	I_{g2}	max. 0,5	mA

Focusing — magnetic; see "Accessories"

Deflection — magnetic; see "Accessories"

Capacitance

Signal electrode to all	C_{as}	3 to 5	pF

This capacitance, which effectively is the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

LIMITING VALUES (Absolute max. rating system)

All voltages are referred to the cathode, unless otherwise stated.

Signal electrode voltage	V_{as}	max.	100	V
Grid no. 4 voltage	V_{g4}	max.	1100	V
Grid no. 3 voltage	V_{g3}	max.	800	V
Voltage between grid no. 4 and grid no. 3	$V_{g4/g3}$	max.	450	V
Grid no. 2 voltage	V_{g2}	max.	350	V
Grid no. 1 voltage, negative	$-V_{g1}$	max.	125	V
positive	V_{g1}	max.	0	V
Cathode-to-heater voltage, positive peak	V_{kpf}	max.	125	V
negative peak	$-V_{kpf}$	max.	50	V
Impedance between cathode and heater at $-V_{kfp}$ > 10 V	Z_{kf}	min.	2	kΩ

Dark current, peak	I_{darkp}	max.	0,1	µA
Output current, peak	I_{asp}	max.	0,6	µA
Axial force on signal-electrode ring in forward direction (evenly distributed)		max.	200	N
Faceplate illumination	E	max.	5000	lx
Faceplate temperature, storage and operation	t	max.	80	°C
		min.	-30	°C

OPERATING CONDITIONS AND PERFORMANCE

For a target area of 15 mm diameter; faceplate temperature 30 ± 2 °C.
All voltages are referred to the cathode, unless otherwise stated.

Typical operating conditions

		normal operation	operation for high resolution		
Grid no. 1 (control grid) voltage	V_{g1}	Adjusted for sufficient beam current to stabilize a peak output current, I_{asp}, of 600 nA			
Grid no. 2 (accelerator) voltage	V_{g2}	300	300	V	
Grid no. 3 (collector) voltage	V_{g3}	375	600	V	
Grid no. 4 (mesh) voltage	V_{g4}	600	960	V	2)
Peak signal current	I_{sp}	150	150	nA	8)
Peak dark current	I_{darkp}	20	20	nA	
Blanking voltage, peak to peak					
when applied to grid no. 1	V_{g1pp}	50	50	V	
when applied to cathode	V_{kpp}	50	50	V	
Field strength at centre of focusing coil (nominal)	H	3200 (40)	4800 (60)	A/m Oe 3)	4)
Field strength of adjustable alignment coils	H	0 to 320	0 to 320	A/m	
Deflection currents		see note 6	see note 6		

Performance

		min.	typ.	max.	
Signal electrode voltage for a peak dark current of 20 nA	V_{as}	30	40	75	V [7] [9]
Grid no. 1 voltage for picture cut-off, with no blanking applied	V_{g1}	-30	-55	-100	V
Sensitivity Illumination required for a peak signal current of 150 nA					
P20	E		3,5 7×10^{-7}	7 $1,4 \times 10^{-6}$	lx W/cm^2
P11	E		0,7 5×10^{-7}	1,4 $1,0 \times 10^{-6}$	lx W/cm^2
Decay: Residual signal current 200 ms after cessation of the illumination			15	20	% [10]

Limiting resolution at picture centre, normal operation $\geq$ 50 lp/mm [11]
operation for high resolution $\geq$ 60 lp/mm [11]

Modulation transfer characteristic see Fig. 4

Average γ of transfer characteristic for signal currents between 10 nA and 300 nA 0,7 [12]

Spurious signals see "Spurious signal specification for XQ1285"

1) a. The circular quality area of 15,8 mm diameter is concentric with the faceplate.

b. The scanning amplitudes are so adjusted that a target area of about 15 mm diameter is displayed on a standard monitor as a circular area with a diameter equal to the raster height. (15 mm x 20 mm scan).

c. The displayed circular area of approximately 15 mm diameter should fall within the quality area of 15,8 mm diameter but is generally not concentric with the latter due to eccentricities of the output window of the image intensifier and of the optical system.

d. Underscanning of the chosen target area, or failure of scanning, should be avoided, so as not to cause damage to the photoconductive layer.

2) The optimal grid no. 4 voltage for best uniformity of black and white level depends on the type of coil unit used and will be 1,5 to 1,6 times V_{g3} for the coil units mentioned under "Accessories". Under no circumstances should grid no. 4 (mesh) be allowed to operate at a voltage level below that of grid no. 3, as this may damage the target.

3) Focus current adjusted for optimal electrical focus.

4) The polarity of the focusing coil should be such that its image end attracts an external north-seeking pole.

5) The alignment coil unit should be so positioned that its centre is at a distance of approx. 94 mm (3 11/16 in) from the face of the tube and that its axis coincides with the axis of the tube, the deflecting yoke and the focusing coil.

6)

	Focusing current (mA)		Line current$_{pp}$ (mA)		Frame current$_{pp}$ (mA)	
V_{g4}/V_{g3} (V)	600/375	960/600	600/375	960/600	600/375	960/600
AT1102/01	18	23	310	390	42	53
AT1103	20	26	310	390	46	59
AT1116	83	105	400	510	59	75
	Approx. values for scanning amplitudes corresponding to 15 x 20 mm^2 scanned area					

Line and frame alignment coil currents max. 21 mA (AT1103) resp. 15 mA (AT1116) corresponding to a flux density of approx. 4.10^{-4} T. (4 Gs)

7) The dark current is dependent on the signal electrode voltage and the temperature. This is shown in Figs. 2 and 3.

8) Signal current is output current minus dark current.

9) As measured on a waveform oscilloscope.

10) Measured with a 100% peak signal current of 150 nA.

11) Obtained with a video amplifier system with adequate bandwidth.

Measured with a transparent square-wave test pattern applied directly to the faceplate and which is illuminated with P20 light of a lambertian distribution. The average transmission of the test transparency is about 50% of the transmission of the transparency's whites.
No aperture correction or gamma correction is applied.

12) For typical transfer characteristics with P20 and P11 light input see Figs. 5 and 6.

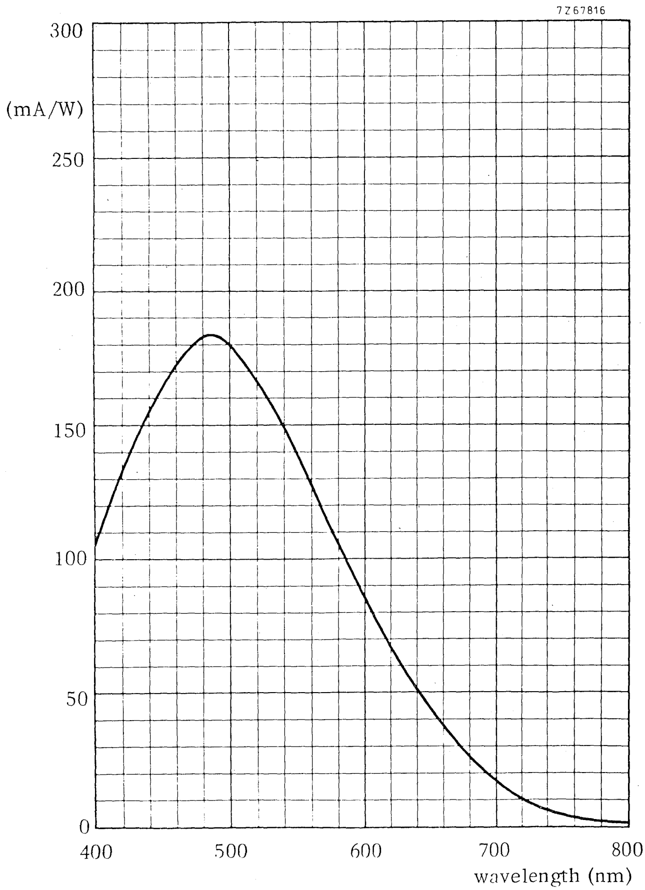


Fig. 1 Spectral response curve

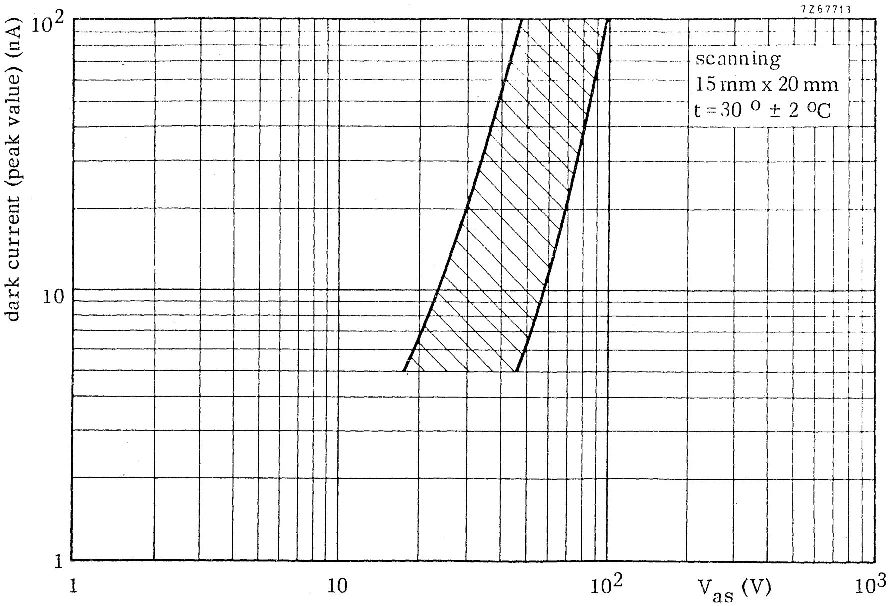


Fig.2 Dark current range versus signal electrode voltage

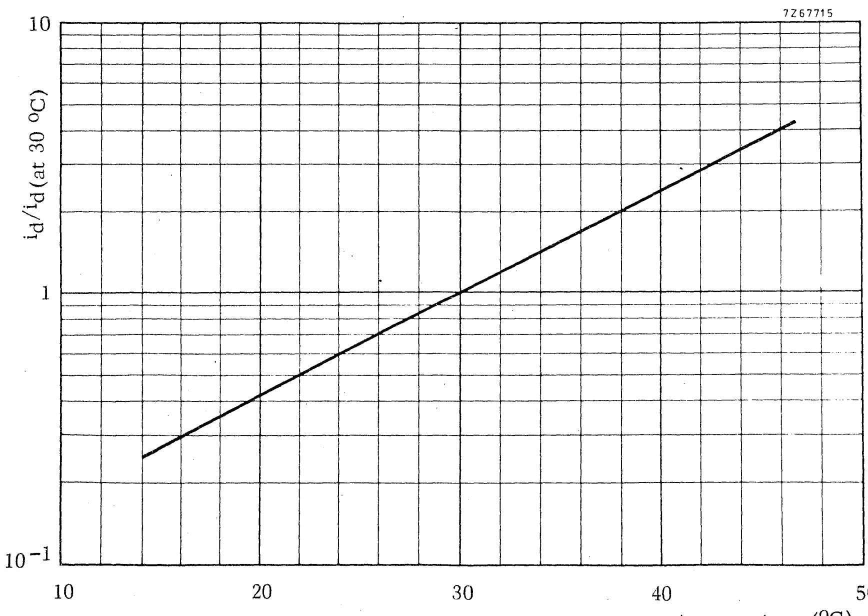


Fig.3 Temperature dependence of dark current

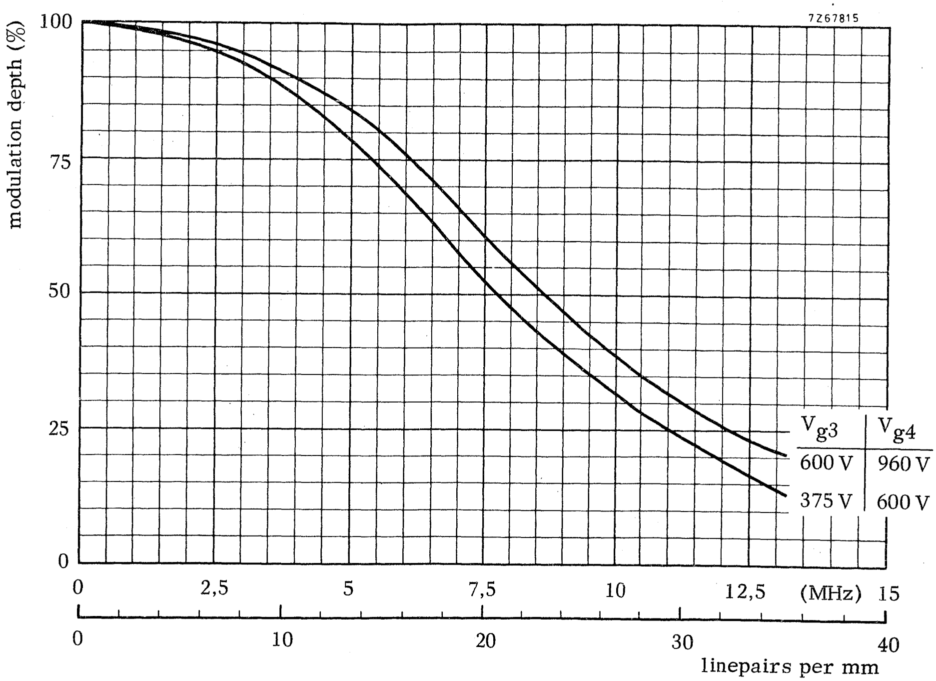


Fig.4 Square wave modulation transfer characteristic

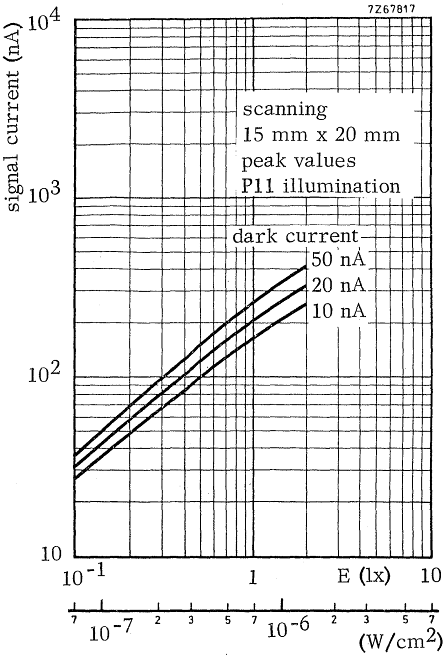


Fig.5 Typical light transfer characteristics

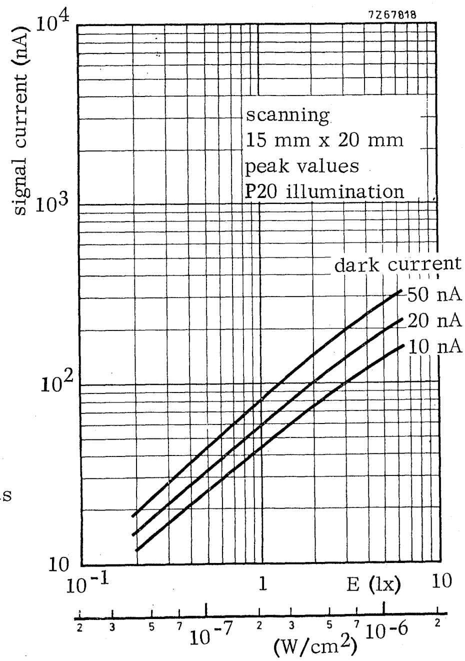
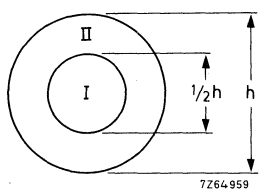


Fig.6 Typical light transfer characteristics

Spurious signal specification

Test conditions

- The tube shall be operated in a test chain under the voltage conditions as shown in the data sheet.
- The scanning amplitudes shall be adjusted to overscan the target such that it is displayed as a circle on the monitor.
- A test transparency, back illuminated with lambertian light of c.t. = 2856 K, with two quality zones(see Fig. below) is applied directly to the faceplate and positioned such that it is concentric with the target as observed on the monitor.
- The tube shall be aligned and focused.
- The scanning amplitudes shall be slightly reduced, horizontal and vertical centring controls be adjusted such that the circular area of 15, 8 mm dia just fits in the picture height of the monitor and is displayed as a circle.
- The temperature of the faceplate shall be $30 \pm 2\ ^{o}C$.
  The signal electrode voltage shall be adjusted for a peak dark current of 20 nA.
  The light level shall be adjusted to produce a peak signal current of 150 nA, the beam current shall be adjusted to just stabilize a peak signal current of 600 nA.
- The video amplifier shall have a bandwidth (-3 dB) of at least 7 MHz.
- The monitor shall be adjusted for a non-blooming white.



h = 15, 8 mm on target
$\frac{1}{2}$ h = 7, 9 mm on target

Permitted number, size and location of blemishes

The table below shows what number of blemishes, black or white, are permitted per size, per zone and total [1] [2].

Dimensions of blemishes in % of picture height	Zone I		Zone II		Total I + II
	white	black	white	black	
> 0,8	0	0	0	0	0
≤ 0,8 but > 0,5	0	1	0	2	2
≤ 0,5 but > 0,4	1	2	2	3	4
≤ 0,4 but > 0,2	2	3	4	5	6
≤ 0,2 [3]					
total	3		6		8

Background structure (e.g. chicken wire pattern) originating from the fibre-optic faceplate shall not have a contrast exceeding 2%. [2]

Notes

1) Both black and white blemishes as observed on the monitor shall be counted, however, blemishes ≤ 0,2% of picture height and black blemishes with a contrast ≤ 6%, and white blemishes with a contrast ≤ 3% shall be ignored.

2) The contrast is measured as a percentage of 150 nA peak signal current on a waveform oscilloscope. The dimensions of blemishes are determined on the monitor with a transparent blemish gauge, calibrated in percent of picture height.

3) If such blemishes form a concentration this will be evaluated as a blemish with as contrast the average contrast of the concentration.

Silicon Vidicon tubes E

SURVEY SILICON VIDICON TUBES

Vidicon tubes with silicon multi-diode array
(high sensitivity, wide spectral response, over-exposure resistant)

1 inch - magnetic focusing and deflection

All types 95 mA; 6,3 V

type	mesh	photo-conductive layer	quality grade HI	quality grade Ind	applications MS	applications GP
XQ1400	S	Si	•			
XQ1401	S	Si		•	•	
XQ1402	S	Si		•	•	•

Accessories for

type	deflection (and focusing) coil unit	socket
XQ1400, XQ1401, XQ1402	AT1102/01, AT1103 AT1116 or equivalent	56098 or equivalent

Abbreviations used in the table

S = separate mesh
Si = silicon multi-diode layer

HI = for high-quality black and white and colour cameras in sub-broadcast, medical, educational and industrial applications
Ind = for black and white and colour cameras in non-critical industrial applications

MS = in cameras for military, surveillance, and scientific applications
GP = general purpose tube for low-cost cameras

GENERAL OPERATIONAL NOTES

1 PRINCIPLES OF OPERATION

The silicon vidicon photoconductive target consists of a planar array of reverse-biased silicon diodes. A cross-section of a part of such a target is schematically represented in Fig. 1.

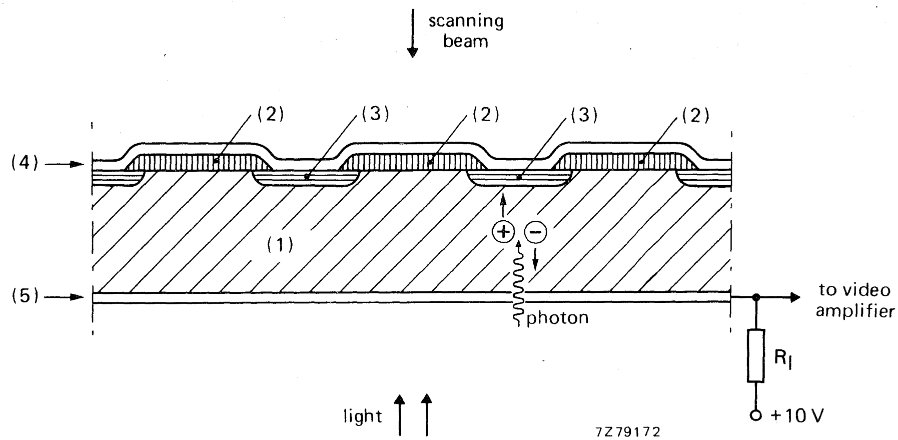


Fig. 1 Silicon vidicon target.

The main part of the target, the substrate (1), is formed by n-type silicon material. The thickness of this substrate is about 15 μm. The upper side is covered with a thin isolating layer of SiO_2 into which a large number of windows have been etched. By diffusion of boron into the n-type material through these windows, p-type regions (3) have been made behind the windows. Each p-type region forms a p-n junction with the substrate and is in effect a discrete diode.

When the target is in operation the diodes are reverse biased. An electron beam scans the target at the upper side, returning the surface of the target during scanning to cathode potential (zero voltage). The bias is obtained by connecting the substrate (which is a sufficiently good conductor for this purpose) to a positive potential, e.g. + 10 V.

Light falls on the layer from below. When photons are absorbed in the substrate, electron-hole pairs are formed. The electrons are attracted by the positive potential, the holes diffuse through the target in the direction of more negative potentials. A large part of them drift across the p-n junctions, thereby partly discharging the diodes. The charge lost by an individual diode is replenished during the scanning process. By capacitive coupling the recharge currents are passed to the video amplifier, they constitute the video signal.

The surface of the SiO_2 - layer (2) can be charged in the negative direction by electrons landing from the scanning beam. As a consequence of this the potential might fall so low that the diodes are screened off from the beam electrons. To prevent this the scanned side of the target is covered by a thin slightly conducting layer (4).

When the target is illuminated by red light, a small part of it passes through the target. For high red sensitivity, therefore, the substrate layer has to be relatively thick. Blue light, on the other hand, does not penetrate deep into the layer. A substantial part of it is absorbed close to the surface. To prevent diffusion of the generated holes to the surface, where recombination is likely, a thin layer at the light entrance side is more heavily doped: the n^+ -layer (5).

2 PROPERTIES OF THE SILICON VIDICON PHOTOCONDUCTIVE TARGET

2.1 Sensitivity

The light transfer characteristic of a silicon vidicon is linear, the output current being proportional to the incident light flux. A typical value for the sensitivity for white light (tungsten source, colour temperature 2856 K) is 4000 μA/lumen.

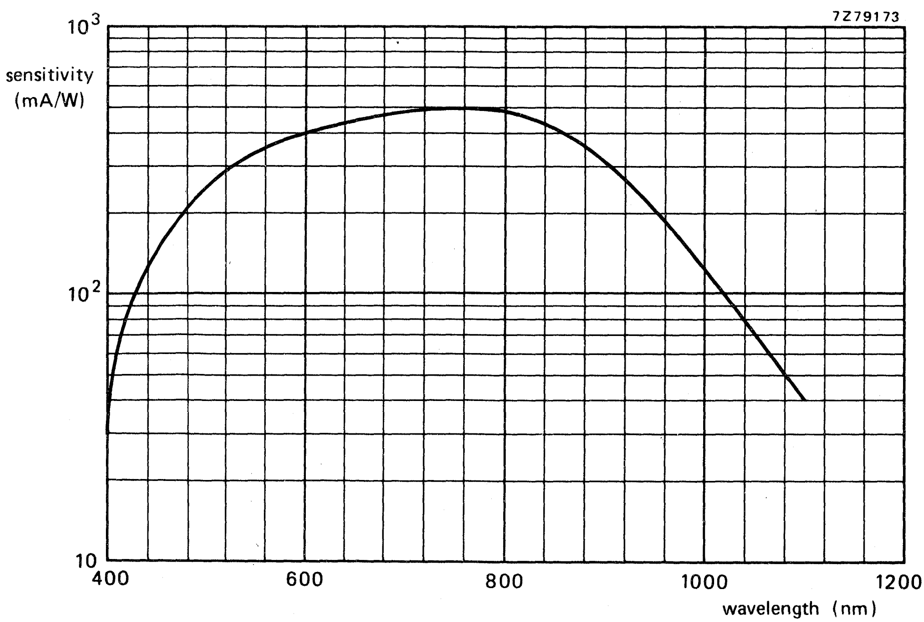


Fig. 2 Typical spectral response.

Figure 2 shows a typical spectral response curve. The response extends rather deep into the infrared. A typical sensitivity value for visible light (tungsten source, colour temperature 2856 K, filtered by a 4 mm thick KG3 filter) is 1000 μA/lumen.

2.2 Dark current

The dark current of a silicon vidicon is dependent on target voltage and temperature. Figure 3 shows a typical example of the influence of the target voltage at 30 $^{\circ}$C.

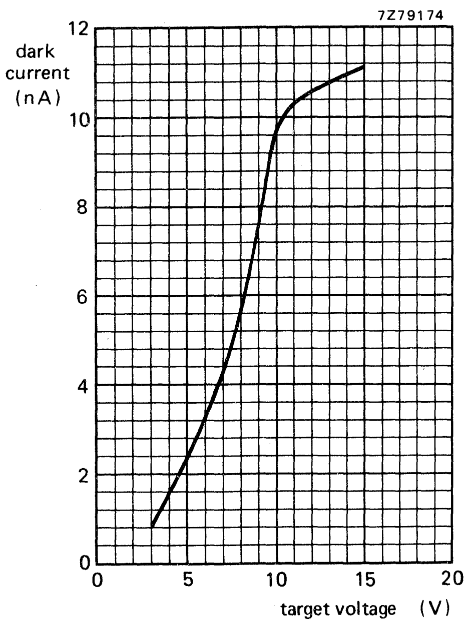


Fig. 3 Dark current as a function of signal plate voltage.

The optimum value of the target voltage depends on factors such as uniformity of signal current and dark current, lag and visibility of blemishes. It is determined for each individual tube by the manufacturer and specified on the accompanying test sheet. Generally a value slightly to the right of the steeper part of the curve in Fig. 3 is chosen. In the steep part the dark current is usually non-uniform, to the left of it the sensitivity is lower and lag is higher.

The dark current doubles with every 8 to 10 $^{\circ}$C temperature increase, as shown in Fig. 4.

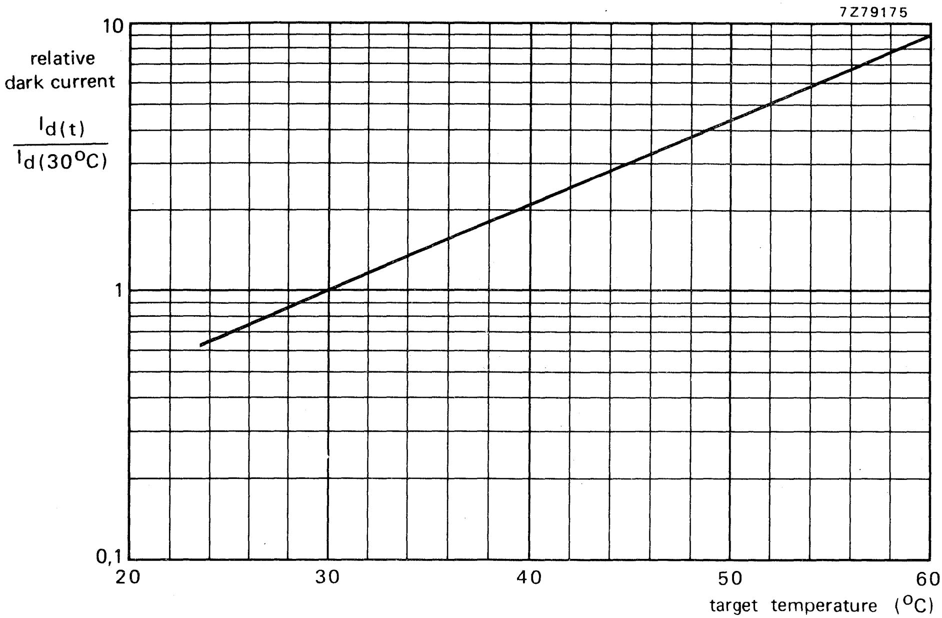


Fig. 4 Temperature dependence of dark current.

At high mesh electrode voltages the dark current increases during life due to X-ray damage. The soft X-rays responsible for this originate at the mesh electrode during bombardment by beam electrons. The recommended value for the mesh voltage during operation is therefore 350 V.

2.3 Resolution

A typical modulation transfer characteristic for a 1-inch diameter silicon vidicon camera tube is shown in Fig. 5.

The resolution of silicon vidicon camera tubes falls short of that of vidicons and Newvicon tubes because of:

- the diode structure, which gives a resolution cut-off determined by the diode spacing;
- the thin slightly conducting layer on the gun side of the target, which gives resolution loss due to lateral conductance.

Because of the diode structure the acceptance at the target of the electron beam is lower than in other camera tubes, necessitating a higher scanning beam current. As it is not allowable to apply the high electrode voltages often used in standard vidicons, this also adversely influences resolution.

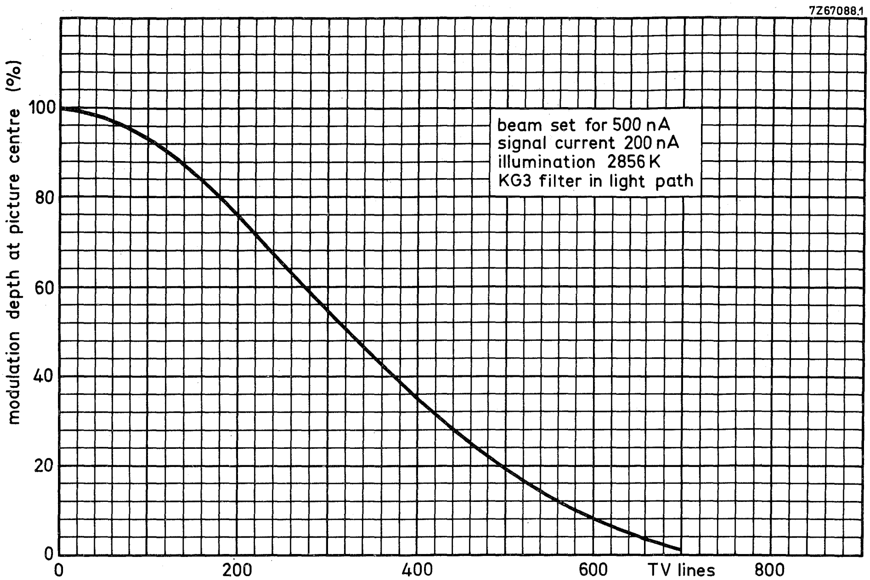


Fig. 5 Modulation transfer characteristic for visible light.

2.4 Lag

Typical decay lag characteristics can be found in the data sheets for the silicon vidicon camera tubes XQ1400, XQ1401 and XQ1402. Due to the lower beam acceptance the lag is somewhat higher than in a similar tube without diode structure.

As the diode capacitances change with target voltage, lag is dependent on target voltage. At higher target voltages the diode capacitances are smaller and hence lag is lower.

3 EQUIPMENT DESIGN AND OPERATING CONDITIONS

(See also General Operational Notes Camera Tubes.)

The signal electrode voltage (target voltage) should be adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each tube.

Silicon vidicon camera tubes therefore do not permit sensitivity control by means of regulation of the signal electrode voltage. Adequate control is to be achieved by other means (iris control and neutral density filters). If the tube is applied in cameras originally designed for standard vidicon tubes, the automatic sensitivity control should be made inoperative and the signal electrode voltage set to the value indicated in the test sheet.

The mesh electrode voltage should be chosen relatively low as at high mesh electrode voltages dark current may increase during life (for recommended value of typical operating conditions in data sheets).

Illumination levels up to 100 million lux can be tolerated. This is equivalent to the image of the sun or a high-intensity projection lamp being focused onto the target. Care must be taken that the heating effect of the focused radiation does not raise the target temperature above the maximum allowed level (approximately 250 ^{o}C). A warning indication of this is the loss of all video information. Silicon is a good heat conductor and therefore, long before the temperature of the target locally has reached the maximum allowed, the level of dark current will be so high that all video information is lost.

When determining back focus distance for a silicon vidicon camera tube it has to be taken into account that the distance from the front of the faceplate to the target plane is larger than the faceplate thickness. For the types XQ1400, XQ1401 and XQ1402 it amounts to 2,8 ± 0,2 mm.

CAMERA TUBE

Vidicon TV camera tube with a photosensitive target consisting of a mosaic array of silicon planar diodes.

This pick-up tube features a wide spectral response (including near infra-red), high resolution, low dark current and lag. It allows electronic zoom operation with a minimum risk of raster burn.

It may be exposed to direct sunlight without image burn-in and will withstand exposure to 100 °C environments.

The tube is mechanically interchangeable with any 1 in diameter vidicon tube with separate mesh construction, such as XQ1240, and has been provided with a precision electron gun as in the Plumbicon * tube XQ1070.

QUICK REFERENCE DATA

Separate mesh		
Focusing	magnetic	
Deflection	magnetic	
Diameter	25,4 mm	(1 in)
Length	159 mm	($6\frac{1}{4}$ in)
Sensitivity (2856 K tungsten)	typ. 4000	µA/lm
Cut-off of spectral response	approx. 400 and 1100	nm
Resolution	≥ 600	TV lines
Scan diagonal	max. 17,2	mm
Heater	6,3 V, 95	mA

The electrical and mechanical properties of the three types are identical, the main difference being found in the degree of freedom from blemishes of the target:

XQ1400 - for applications which require a high standard of performance

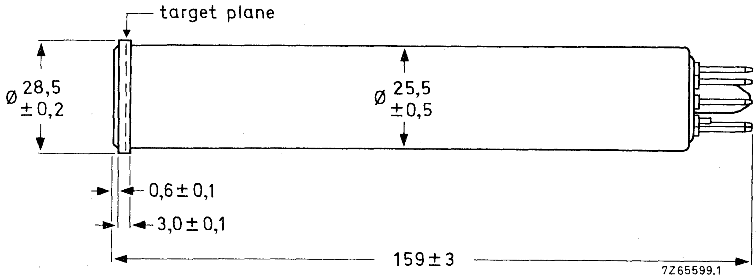
XQ1401 - for less critical applications

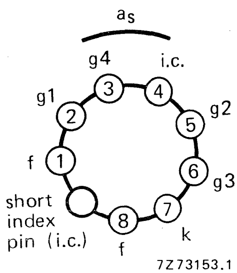
XQ1402 - general pupose tube for non-critical applications, equipment design and experiments

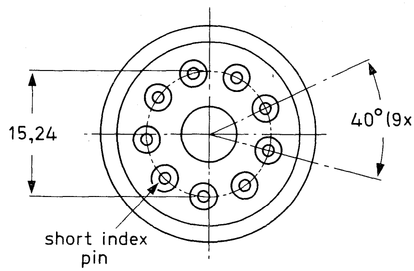
* Registered Trade Mark for TV camera tube.

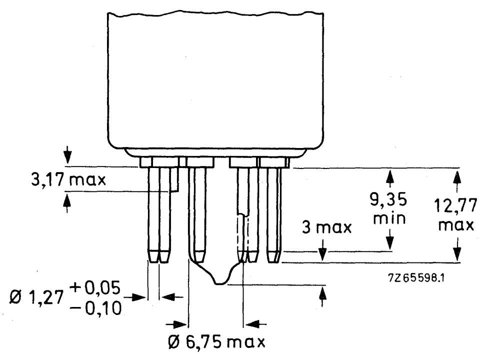
MECHANICAL DATA

Dimensions in mm









Mounting position: any

Weight: ≈ 55 g

Base: IEC67-I-33a (JEDEC E8-11)
except length of stem

OPTICAL DATA

Quality rectangle on photoconductive target (aspect ratio 3 : 4)		9,6 x 12,8	mm^2	
Diagonal of quality rectangle		16	mm	1)

Orientation of image on target
The direction of the horizontal scan should be approximately parallel to the plane defined by the short index pin and the longitudinal axis of the tube, unless some rotation of the tube or adjustment of the horizontal and vertical shift controls is found necessary to minimise the number of blemishes in the picture.

Faceplate

Refractive index	n	1,49	
Thickness		1,2 ± 0,05	mm
Optical distance from front of faceplate to target plane		2,8 ± 0,2	mm

ELECTRICAL DATA

Heating : Indirect by A.C. or D.C. ; parallel or series supply

Heater voltage	V_f	6,3	V ± 10%
Heater current	I_f	95	mA

When the tube is used in a series heater chain, the heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

Electron gun characteristics

Cut-off

Grid no.1 voltage for cut-off at V_{g2} = 300 V	V_{g1}	-30 to -100	V	
Blanking voltage, peak to peak				
on grid no.1	$V_{g1_{pp}}$	50 ± 10	V	
on cathode	$V_{k_{pp}}$	15	V	
Grid no.2 current at normally required beam currents	I_{g2}	$\leqslant$ 1,5	mA	2)

Focusing: magnetic; see "Accessories"

Deflection: magnetic; see "Accessories"

Capacitances

Signal electrode to all	C_{as}	3 to 5	pF	

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

LIMITING VALUES (Absolute max. rating system)

All voltages are referred to the cathode, unless otherwise stated.

Signal electrode voltage	V_{as}	max.	25	V	4)
Grid no.4 voltage	V_{g4}	max.	600	V	3)
Voltage between grid no.4 and grid no.3	$V_{g4/g3}$	max.	350	V	3)
Voltage between grid no.4 and grid no.2	$V_{g4/g2}$	min.	see note 3		
Grid no.3 voltage	V_{g3}	max.	550	V	
Grid no.2 voltage	V_{g2}	max.	350	V	
Grid no.1 voltage, positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Cathode to heater voltage, positive peak	V_{kf_p}	max.	125	V	
negative peak	$-V_{kf_p}$	max.	10	V	
Cathode heating time	T	min.	1	min	
Faceplate temperature, storage and operation	t	max.	100	°C	
		min.	-100	°C	

Under difficult environmental conditions cooling of the faceplate is recommended.

Faceplate illumination	E	max.	10^8	lx	5)

ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1103, AT1116 or equivalent

OPERATING CONDITIONS AND PERFORMANCE

Conditions (scanned area 9, 6 mm x 12, 8 mm)

Cathode voltage	V_k	0	V	
Grid no. 2 voltage	V_{g2}	300	V	3)
Grid no. 3 voltage	V_{g3}	225	V	3) 6)
Grid no. 4 voltage	V_{g4}	350	V	3) 6)
Signal electrode voltage	V_{as}	6 to 12	V	4)
Beam current	I_b	see note 7		
Blanking voltage, peak to peak				
when applied to grid no. 1	$V_{g1_{pp}}$	50	V	
when applied to cathode	$V_{k_{pp}}$	15	V	
Focusing coil current		see note 8		
Deflection and alignment currents		see note 8		
Faceplate illumination		see note 9		
Faceplate temperature	t	30 ± 2	^oC	

Performance

	min.	typ.	max.		
Dark current		10	20	nA	10)
Grid no. 1 voltage for picture cut-off, with no blanking	-30	-55	-100	V	
Sensitivity					11) 12)
Tungsten source (2856 K)	3500	4000		μA/lm	
Visible (KG3 filter)	750	1000		μA/lm	
Infra-red (RG715 filter)	1500	2000		μA/lm	
Signal handling capability	600	1000		nA	13)
Blooming	see note 14				
Limiting resolution in picture centre	600	700		TV lines	15)
Modulation depth at 400 TV lines in picture centre	25	35		%	15) 16)
Decay lag		10	15	%	17)
Non-uniformity of sensitivity		10	20	%	18)
Non-uniformity of dark current		5	10	%	18)
Average gamma of transfer characteristic		1			

Spectral response	
cut-off at	approx. 400 and 1100 nm
max. sensitivity at	approx. 700 nm
spectral response curve	see Fig. 1
Spurious signals	see "Spurious signal specification" for XQ1400, XQ1401 and XQ1402

NOTES

1) Electronic zoom operation by simultaneous control of both line and frame scanning amplitudes may be applied with practically no risk of raster burn when the standard raster amplitudes are restored.

The maximum scan diagonal, as dictated by the internal diameter of the mesh ring, is 17,2 mm.

All figures in these data (e.g. resolution) are based on the standard scanning conditions (9,6 x 12,8 mm^2).

2) The maximum "normally required beam current" is defined as that beam current which is just sufficient to stabilize highlights with signal currents of 750 nA (peak value).

3) When the supply is switched on, and during heating-up of the camera. Operation at grid no. 4 and grid no. 3 voltages exceeding those indicated under "Operating conditions and Performance" is not recommended since this may shorten tube life. Grid no.4 voltage should exceed both grid no.2 and grid no.3 voltages. Operation of grid no.4 at a less positive voltage may result in permanent target damage due to "ion burn".

4) The signal electrode voltage, V_{as}, is typically within the range 6 to 12 V with respect to the cathode and is individually selected and specified for each tube and indicated on its test sheet. This is to achieve an optimum operating point consistent with optimal beam acceptance and to optimise other performance characteristics such as dark current, blemishes, uniformity and lag (see Fig. 2).

Silicon diode camera tubes do not permit automatic sensitivity control by means of regulation of the target voltage. Adequate control can be achieved by other means, e.g. lens iris control, neutral density filters and/or automatic video gain control (A.G.C.). If the tube is to be used in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the target voltage set to the value specified for that tube on the test sheet.

5) Illumination levels up to 100 million lux can be tolerated. This is equivalent to the image of the sun or a high intensity projection lamp being focused onto the target. N.B. Care must be taken that the heat content of the focused radiation does not cause temperature of the target to exceed the maximum allowed level (approx. 250 °C). A warning indication of this is the loss of all video information.
Silicon is a good heat conductor and therefore, long before the temperature of the target locally has reached the maximum allowed, the level of dark current will be so high that all video information is lost.

6) The optimum voltage ratio V_{g4}/V_{g3} required to obtain minimum beam landing errors and hence best uniformity of dark current level depends on the type of coil unit used. For types AT1102/01, AT1103, and AT1116 grid no. 4 to grid no. 3 voltage ratios between 1,6 and 1,5 are recommended.

7) The beam current as obtained by adjusting the grid no. 1 (control grid) voltage shall be sufficient to correctly stabilize a highlight signal current of 500 nA (peak value).

8)

	focusing current * (mA)	line current p-p (mA)	frame current p-p (mA)
Coil units / V_{g4}/V_{g3}	350/225 V		
AT1102/01	14	160	21
AT1103	16	160	24
AT1116	65	210	30
	Approx. values for scanned area of 9,6 x 12,8 mm^2		

* Adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil.
Line and frame alignment currents max. 21 mA (AT1103) resp. 15 mA (AT1116) corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

9) The illumination incident on the faceplate, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \cdot \frac{R.T}{4F^2 (m+1)^2}$$

R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T is the lens transmission factor, F the lens aperture, and m the linear magnification factor from scene to target.

10) Dark current, I_d, at specified target voltage (6 to 12 V) and a faceplate temperature of 30°C, throughout life: 50 nA max.

For dependence of I_d upon V_{as} see Fig. 2, upon faceplate temperature see Fig. 3.

11) Light source is a tungsten filament lamp in a limeglass envelope, operated at a colour temperature of 2856 K.
A lightflux of 0,1 millilumen is incident on the scanned area. An appropriate filter is inserted in the light path. The net signal current (see note 12) obtained in nA x 10 denotes the luminous sensitivity expressed in terms of μA/lm of white light incident on the filter. See Fig. 4 for filter characteristics.

Filters used	Tungsten	No filter used
	Visible	Schott KG3 thickness 4 mm
	Infra-red	Schott RG715 thickness 3 mm

12) The net signal current is defined as the component of the output current after the dark current has been subtracted.

13) Beam current increased to achieve stabilization.

Video amplifiers should be capable of handling signal output currents of this magnitude without overloading.
For dependence of the signal handling capability of a typical tube upon V_{as} see Fig 2 .

14) Increasing the faceplate illumination in a spot to a value which would otherwise produce a signal current considerably more than the normally set beam current can stabilize, can result in an apparent increase in the diameter of the spot (blooming). With a 100 times overload the spot may bloom to the value indicated below, the diameter of the spot being determined at the 50% signal level, lens halation and camera electronics overloading excluded.

Initial spot diameter		1	2	10	% of raster diagonal
Bloomed spot diameter	typ.	4	6	14	"
with 100 x overload	max.	6	8	18	"

15) The light flux incident on the target is adjusted such that a net highlight signal current of 200 nA is obtained.

Limiting resolution is defined as the resolution at a modulation depth, i.e. uncompensated horizontal amplitude response of 5%, uncorrected for lens resolution losses. The amplitude response of the camera amplifier is flat to well over 7,5 MHz; no gamma correction is used.

16) Measured with 100% contrast square wave test pattern, normalized at 50 TVL, and corrected for lens resolution losses. The bandwidth of the camera amplifiers used are flat tobeyond5 MHz. For response curve see Fig. 5 .

17) Measured with an initial net highlight signal current of 200 nA. The sequence of the measurement is as follows:
The illumination is turned off at T = 0 immediately preceding a read-out of the initial signal. This read-out is labelled the "zeroth" field. The first residual signal occurs subsequently at T = 20 ms, i.e. in the first field. The value of lag listed is the magnitude of the residual signal in the 3^{d} field, i.e. at T = 60 ms. For other signal currents , see Fig. 6 .
For dependence of decay lag upon V_{as} see Fig. 2 .

18) Measured as a percentage of a highlight signal current of 200 nA.

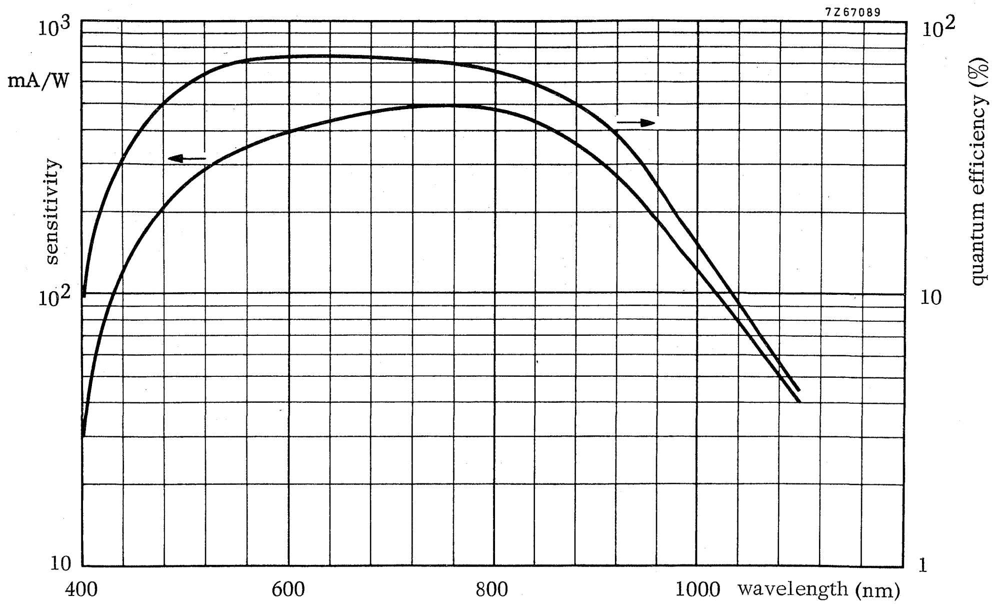


Fig. 1 Spectral response curve

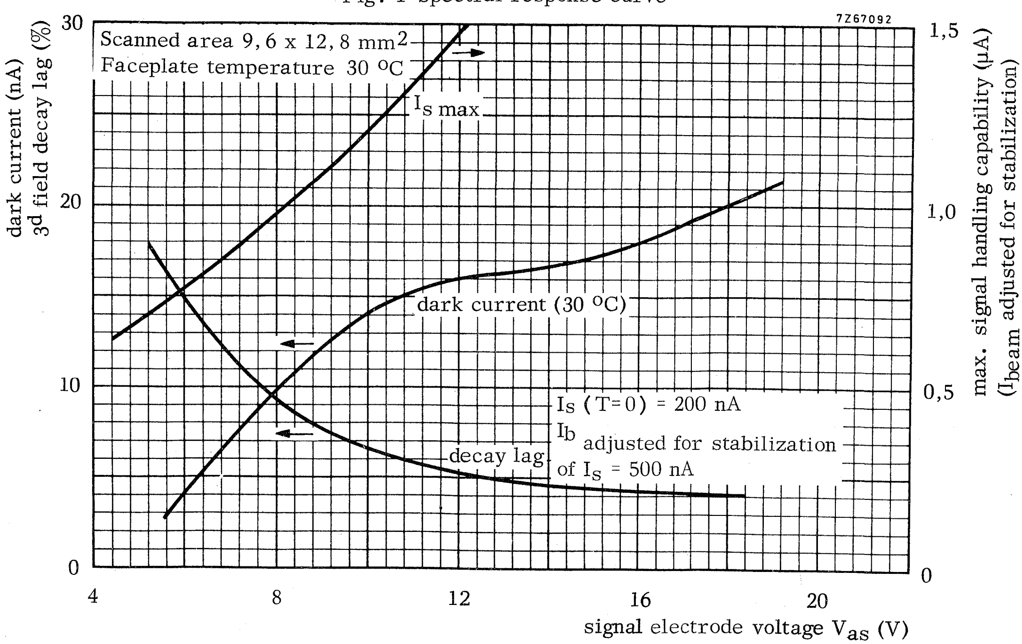


Fig. 2 Parameter dependence (typical) on signal electrode voltage

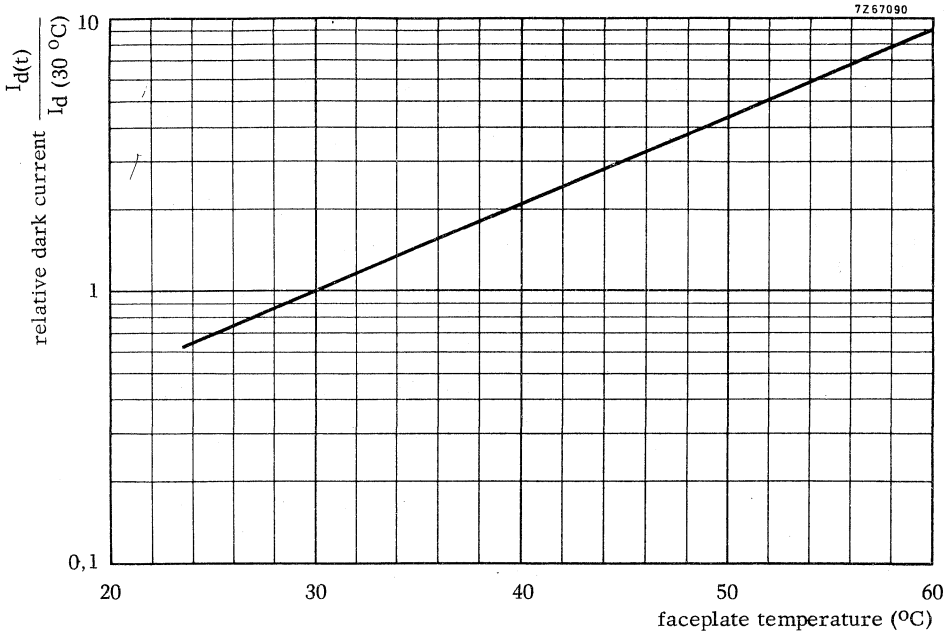


Fig. 3 Temperature dependence of dark current

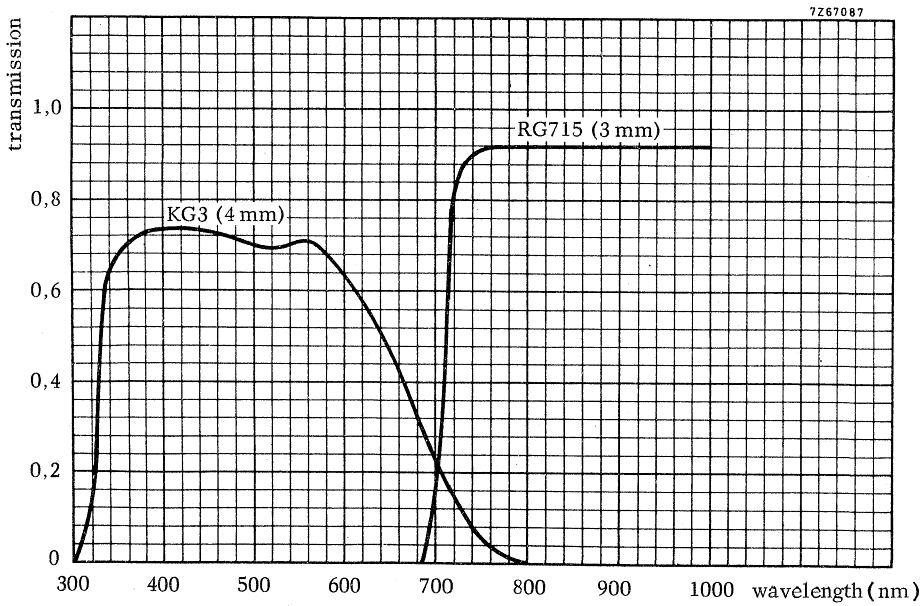


Fig. 4 Filter transmission curves

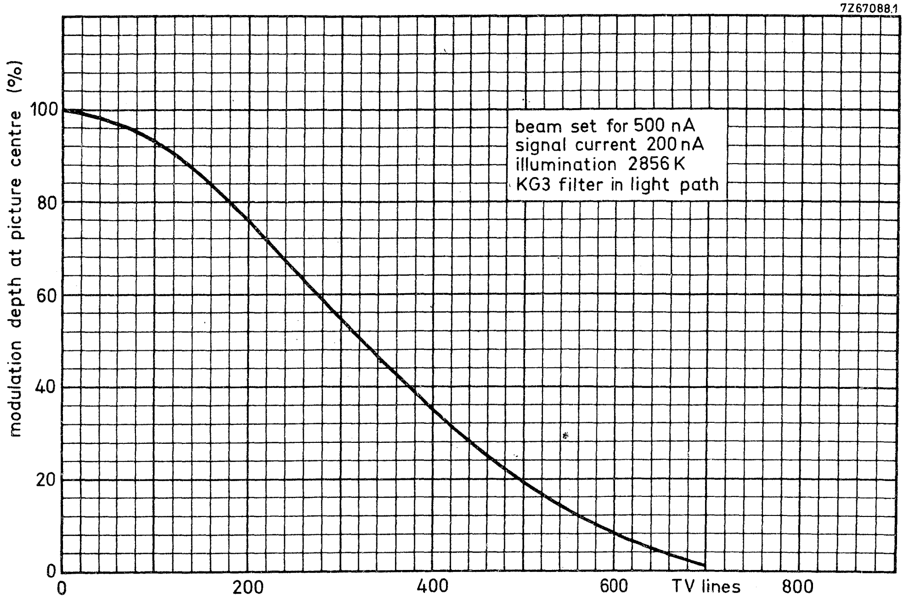


Fig. 5 Typical uncompensated horizontal square wave response- optically corrected

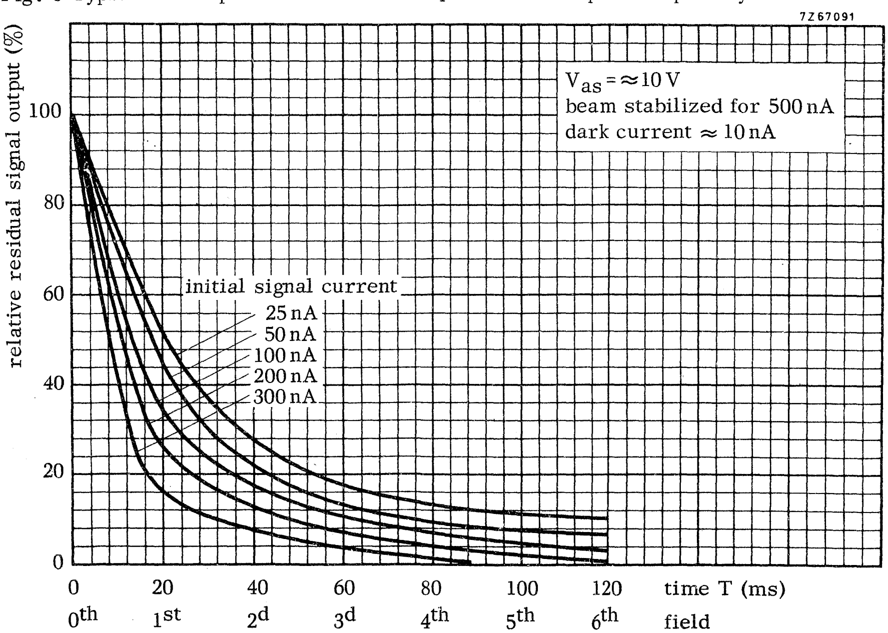


Fig. 6 Typical decay lag characteristics

Spurious signal specification XQ1400,XQ1401,XQ1402

PICTURE QUALITY (due to blemishes)

Test conditions

Test chain

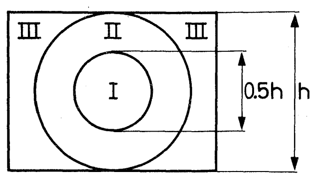
- The tube under test shall be evaluated in a test chain with a bandwidth of 5, 5 MHz.
- No aperture or gamma correction shall be applied.
- A waveform oscilloscope with a bandwidth of 5, 5 MHz shall be used to measure the contrast of blemishes as a percentage of a peak white signal current of 200 nA.
- The monitor shall be set for a just visible raster when lens capped, respectively for a non-blooming white raster when lens uncapped.

Tube settings

The picture quality is evaluated with a signal electrode voltage applied as indicated on the tube test sheet and in the following setting with respect to highlight signal current and beam current:

Highlight signal current I_s	200	0	nA
Beam current adjusted for correct stabilization of a signal current of I_b	500	500	nA
Type of blemish	black or white	white	

The specified area of 9, 6 x 12, 8 mm^2 on the target is evenly illuminated with tungsten light of 2856 K through a back illuminated test transparancy with an aspect ratio of 3 : 4. The test chart is divided in three quality zones by two concentric circles with diameters as shown below:



The obtained picture shall be observed at a monitor.

Permitted number, size and location of blemishes (see also notes 1 ÷ 5)

	Dimensions of blemishes in % of picture height	Zone 1	Zone II	Zone III	Total
XQ1400	> 1,2	0	0	0	0
	> 0,8	0	1	2	3
	> 0,2	2 *	5 *	7 *	10*
	≤ 0,2	-	-	-	-
XQ1401	> 1,6	0	0	0	0
	> 1,2	0	0	1	1
	> 0,8	0	2 *	3 *	5 *
	> 0,2	4 *	8 *	10 *	15 *
	≤ 0,2	-	-	-	-
XQ1402	> 1,6	0	0	0	0
	> 1,2	1	2	3	4
	> 0,8	2*	3*	5 *	10*
	> 0,2	6*	10*	15*	25*
	≤ 0,2	-	-	-	-

NOTES

1) Blemish size is determined at 5 % contrast level.

2) Blemishes ≤ 0,2 % of picture height are not counted unless their concentration causes a smudged appearance.

3) Blemishes with less than 10 % contrast are not counted. Blemishes >1,6 % of picture height, however, shall not have a contrast >5 % if black , or >2,5 % if white (XQ1400) respectively > 10 % if black, or >5 % if white (XQ1401, XQ1402).

4) Theminimum separation between any two allowed blemishes > 0,8 % of picture height shall be 5 % of picture height (XQ1400), respectively 3 % (XQ1401, XQ1402).

5) The spurious signal specification should be interpreted as follows:
Example Zone III of a XQ1401 may contain a maximum of 10 blemishes (of which max. 5 white ones) with a size >0,2 %. From these 10 blemishes 3 may be >0,8 % (including max. 1 white one), including one black blemish > 1,2 % but < 1,6 %.

* No more than half of these quantities may be white blemishes.

Intensified Silicon Vidicon tubes F

GENERAL OPERATIONAL NOTES

1 PRINCIPLES OF OPERATION

The Intensified Silicon Vidicon (ISV) tube consists of three main components: an image section, a silicon diode array target and a vidicon read-out section. This is shown schematically in Fig. 1 for the case of an electrostatically focused image section.

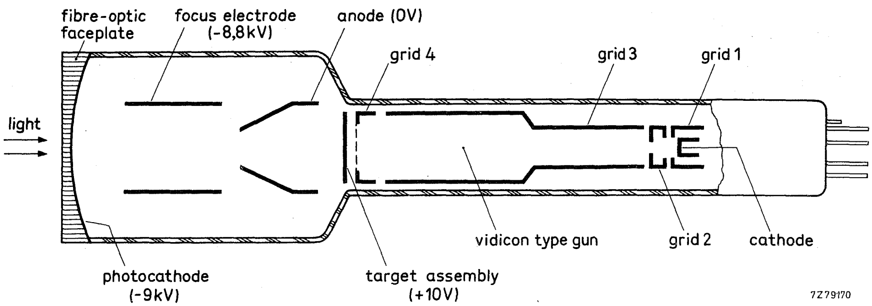


Fig. 1 Schematic representation of electrode arrangement in an ISV tube.

During operation an image of the scene which is formed on the plane entrance side of a fibre-optic faceplate is guided through the glass fibres and strikes a photocathode, which covers the curved inner side of the faceplate. The emitted photoelectrons are accelerated and focused by an electron-optical system onto the silicon target. Typical voltages for the electrodes in the image section are given in Fig. 1.

The photoelectrons strike the target with an energy of e.g. 9 keV. The target closely resembles that of a silicon vidicon camera tube, described in the General Operational Notes for these tubes. Each electron creates in the target a large number of electron-hole pairs. The holes diffuse through the target in the direction of more negative potentials. Most of them drift across the p-n functions in the target, thereby partially discharging the diodes. The replenishing of the diode charges by the scanning beam constitutes the video signal.

The scanning section is the same as is found in a standard vidicon tube with magnetic focusing and deflection.

2 PROPERTIES

(For target properties see also General Operational Notes Silicon Vidicon Tubes.)

2. 1 Sensitivity

The sensitivity of an ISV tube mainly depends on photocathode sensitivity and target gain. The photocathode used in the ISV type S70XQ has an S20 spectral response; a typical spectral sensitivity distribution is shown in the date sheets for this tube.

For tungsten light with colour temperature 2856 K a typical value for the luminous sensitivity is 180 μA/lumen.

The effective target gain (the number of holes collected per impinging photo-electron) depends on the energy with which the electrons strike the target. Typical values for the type S70XQ are:

- at an electron energy of 9 keV: 1500.
- at an electron energy of 3 keV: 10.

Theoretically, the energy needed for the production of one electron-hole pair is only about 3,5 eV. There is, however, a threshold of about 2,8 keV which has to be surpassed before hole collection starts to become significant.

As the ratio of the target gain at 9 keV to the target gain at 3 keV is over 100 to 1, automatic gain control over a large range is possible by controlling the photocathode voltage.

2. 2 Noise

The noise found in the video signal from an ISV tube has two components: amplifier noise and signal noise. Amplifier noise depends on preamplifier circuitry and tube output capacitance. Signal noise depends on target gain and is proportional to the square root of the signal current. Both increase with increasing video bandwidth.

Amplifier noise and signal noise are shown in Fig. 2 for two values of the target gain, 1500 and 150.

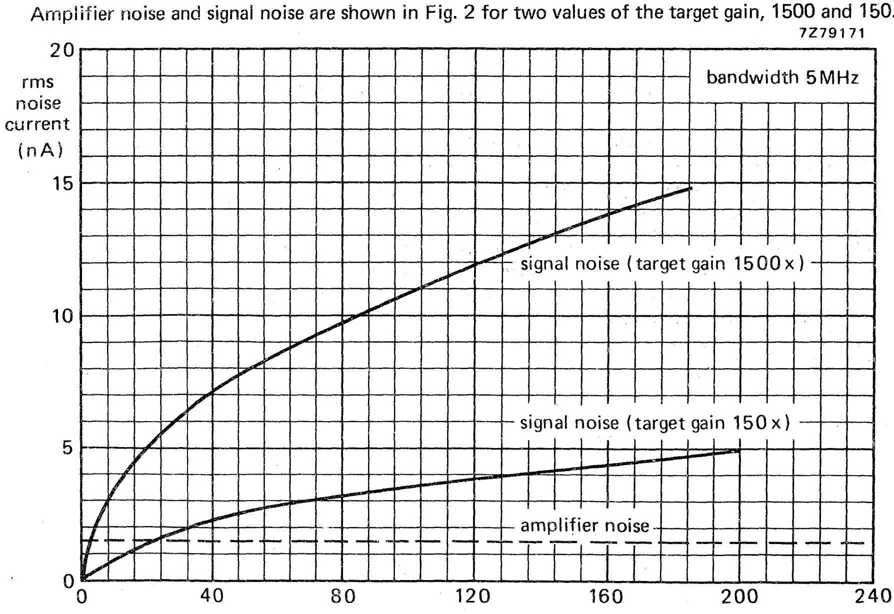


Fig. 2 Signal noise and amplifier noise.

Signal noise is given as a function of the signal current. The curves in Fig. 2 apply to a typical tube of the type S70XQ, for a video bandwidth of 5 MHz.

It is seen that, except at low values of target gain and signal current, signal noise preponderates. As seen on the monitor, signal noise is more coarse grained than amplifier noise. Amplifier noise is the noise that remains when the lens is capped; this offers a means of checking the relative importance of amplifier noise.

2. 3 Limiting resolution

The limiting resolution of the ISV type S70XQ in the picture centre is about 600 TV lines (7,5 MHz) or 30 line pairs per mm as measured on the target, at a signal current of 200 nA. This signal current is obtained at a faceplate illumination of about 5×10^{-3} lux for a photocathode sensitivity of 170 μA/lumen and a target gain of 1500 (photocathode voltage −9 kV). At lower signal currents the limiting resolution decreases because of the decreasing signal-to-noise ratio.

3 EQUIPMENT DESIGN AND OPERATING CONDITIONS

Assemblies using ISV tubes should include a means of preventing high voltage breakdown (including corona) in the region surrounding the image section. The ISV type S70XQ is available in two versions, either potted, with a resistive voltage divider chain on the intensifier, or unpotted. The potted version provides the above indicated values.

If unpotted versions are used, the system designer must consider the following points:

- These complex vacuum devices are manufactured to be as strong as possible. However, because of their construction, the glass-to-metal seals and fibre optic-to-glass seals can easily be broken if excess thermal or mechanical stress is applied. Care must be taken not only in the mounting of the tube in the system, but also in the making of contacts onto the tube.
- Metal flanges connecting to the photocathode and the focus electrode will be operated at voltages up to −10 kV. Clearances and connecting structures should be spaced, shaped or coated to provide personnel protection, prevent formation of leakage paths, especially during periods of high relative humidity, and to prevent corona. These flanges (and the anode flange) should also be protected from extended exposure to corrosive atmospheres such as salt air.
- The focus electrode operating voltage has to be adjusted individually for each tube. It can be derived from a high impedance voltage divider. External leakage is the only significant load. In the factory-potted tubes the total resistance of this voltage divider is in the order of 10^9 Ω.
- Fibre-optic faceplates should not be subjected to high voltage differences between the surfaces. Because the inner surface bears the photocathode which operates up to 10 kV below ground, the outer surface of the fibre-optic faceplate must be guarded from ground. In a high voltage field, individual fibres in the faceplate may undergo electrical breakdown resulting in a field of scintillations which excite the photocathode. Allowed to continue, this breakdown can lead to catastrophic tube failure due to air leakage. The factory-potted tubes employ a guard electrode in the form of a transparent conductive coating on a cover glass plate in contact with the outer surface of the fibre optic. This guard electrode is operated at the photocathode potential. The fibre plate is thus in a field-free region and the clear glass prevents atmospheric particles from resting in the focal plane of the optical system. Spaced away from the focal plane by the thickness of the cover glass, small particles will be sufficiently out of focus so as not to be resolved in the resulting picture.

  The photocathode should not be exposed to light radiation in excess of 10 lux. Failure to meet this requirement may cause image burn-in.

  Target voltage variations hardly affect the sensitivity of an ISV tube. The optimum target voltage is indicated on the test sheet as delivered with each tube. It is determined by trading off the increase in maximum discharge current and speed of response obtained at higher target voltages with the accompanying increase of dark current and, eventually, increase of intensity of ion spots.

  The mesh electrode voltage should be chosen relatively low as at high mesh electrode voltages dark current may increase during life (for recommended value of operating conditions in data sheets).

CAMERA TUBE

Intensified Silicon Vidicon (ISV) camera tube designed for use in low light level TV camera systems. It is available in two forms, either potted with a resistive voltage-divider chain on the intensifier, or unpotted. Two standard potting configurations are available.

QUICK REFERENCE DATA

Image intensifier section	
Useful image diameter	16 mm
Spectral response	S20
Focusing	electrostatic
Magnification	1
Camera tube section	
Separate mesh	
Focusing	magnetic
Deflection	magnetic
Heater	6,3 V, 95 mA
Resolution	600 TV lines

OPTICAL

Diagonal of quality rectangle (aspect ratio 3:4) $\leq$ 15,8 mm

Orientation of image on faceplate
The direction of the horizontal scan should be essentially parallel to the plane passing through the longitudinal tube axis and the index pin.

Spectral response
- max. response at $\lambda \approx$ 550 nm
- cut-off at $\lambda \approx$ 850 nm
- curve: see Fig. 3

MECHANICAL DATA

Base	JEDEC E8-11
Mounting position	any
Net mass	approx. 125 g (unpotted version); 270 g (potted version)

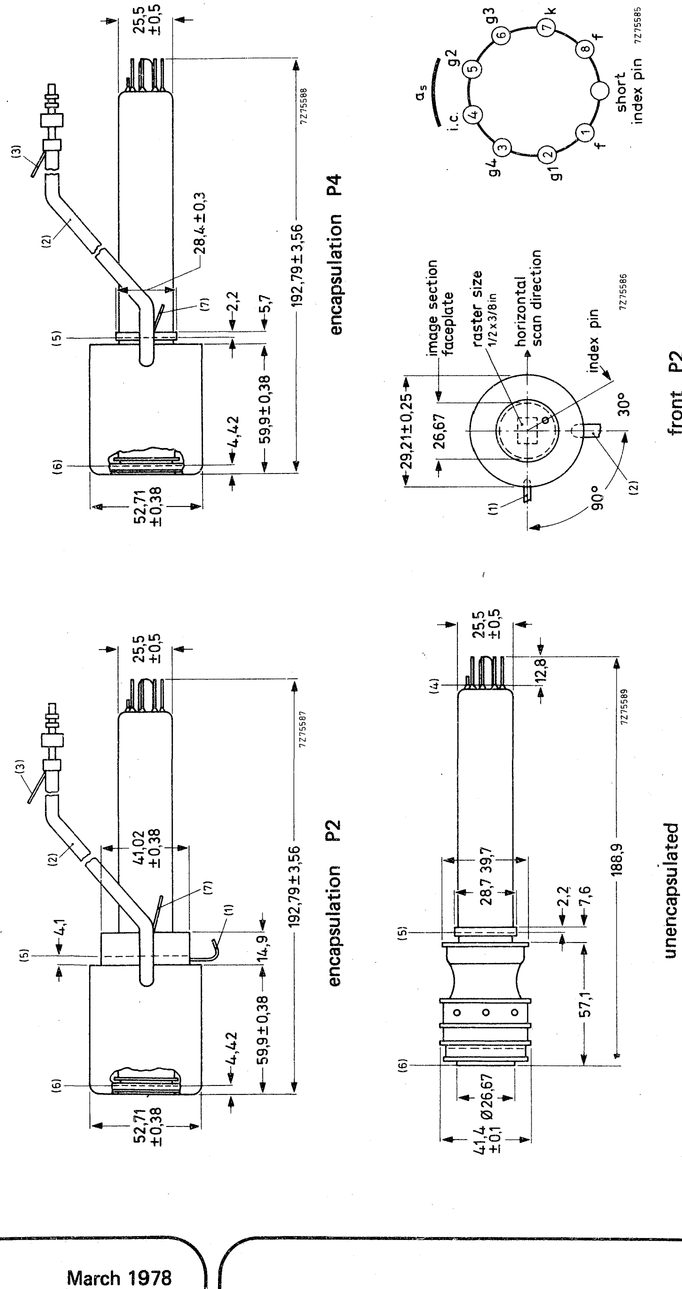


Fig. 1.

(1) Target lead, 15 cm long.
(2) Photocathode lead, 20 cm long.
(3) Anode lead, black, 30 cm long.
(4) Location of socket seating plane.
(5) Location of scanned target plane.
(6) Location of image plane.
(7) Electrostatic shield lead, grey, 30 cm.

DEVELOPMENT SAMPLE DATA

HEATING

Indirect by a.c. or d.c.; parallel supply

Heater voltage	V_f	6,3 V ± 5%
Heater current	I_f	95 mA

CAPACITANCES

Signal electrode to all	C_{as}	10 pF

ACCESSORIES

Socket	Cinch no. 8VT, or equivalent
Deflection and focusing coil unit	AT1116, or equivalent

DEFLECTION

magnetic

FOCUSING

Image intensifier section	electrostatic
Camera tube section	magnetic

LIMITING VALUES (Absolute maximum rating system)
for a scanned area of 9,6 mm x 12,8 mm

"Full-size scanning", i.e. scanning of a 9,6 mm x 12,8 mm area of the photoconductive layer, should always be applied. Underscanning, i.e. scanning of an area smaller than 9,6 mm x 12,8 mm, may cause permanent damage to the specified full-size area.

Photocathode voltage	$-V$	max.	10 kV
		min.	3 kV
Focusing electrode voltage of intensifier	98 ± 1% of photocathode voltage		
Signal electrode voltage	V_{as}	max.	12 V
		min.	8 V
Grid 4 (mesh) voltage	V_{g4}	max.	550 V
Grid 3 (collector) voltage	V_{g3}	max.	550 V
Grid 4 to grid 3 voltage	V_{g4}-V_{g3}	max.	350 V
		min.	0 V
Grid 2 voltage	V_{g2}	max.	450 V
Grid 1 voltage			
negative	$-V_{g1}$	max.	125 V
positive	V_{g1}	max.	0 V
Cathode to heater voltage			
peak positive	V_{kfp}	max.	25 V
peak negative	$-V_{kfp}$	max.	10 V
Output current, peak	I_{asp}	max.	1 μA
Faceplate temperature			
storage	t	max.	+70 °C
		min.	−30 °C
operation	t	max.	+60 °C
		min.	−25 °C
Cathode heating time before drawing cathode current	T_k	min.	1 min

TYPICAL OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9,6 mm x 12,8 mm and a faceplate temperature of 30 ± 5 °C

Conditions

Photocathode voltage of intensifier	V_{ki}	–6 kV
Focusing electrode voltage of intensifier	V_{fi}	–5,88 kV
Anode voltage of intensifier	V_{ai}	earth
Signal electrode voltage	V_{as}	8 to 12 V
Grid 4 (mesh) voltage	V_{g4}	400 V
Grid 3 (collector) voltage	V_{g3}	300 V
Grid 2 (accelerator) voltage	V_{g2}	300 V
Beam current	I_b	500 nA
Signal current	I_s	200 nA

Performance

Dark current	10 nA
Sensitivity, illumination with c.t. = 2856 K; V_{ki} = –9 kV	32 μA/lx
Luminous sensitivity, c.t. = 2856 K	180 μA/lm
Decay, residual signal current 60 ms after cessation of the illumination (c.t. = 2856 K), initial signal current = 0,2 μA	12 %
Limiting resolution, in picture centre	600 TV lines
Modulation depth, centre	
at 200 TV lines	70 %
at 400 TV lines	30 %
Blooming, 1% of diagonal spot, 10^3 overload	6 %
Target gain	
V_{ki} = –9 kV	1500
V_{ki} = –3 kV	10
Signal current capability	1000 nA
Uniformity of sensitivity	20 %
Uniformity of dark current	2 nA
Distortion	2 %

SPURIOUS SIGNAL SPECIFICATION

Picture quality (due to blemishes)

Test conditions: test chain

- The tube under test shall be evaluated in a test chain with a bandwidth of 5,5 MHz.
- No aperture or gamma correction shall be applied.
- A waveform oscilloscope with a bandwidth of 5,5 MHz shall be used to measure the contrast of blemishes as a percentage of a peak white signal current of 200 nA.
- The monitor shall be set for a just visible raster when lens is capped, and for a non-blooming white raster when lens is uncapped.

Test conditions: tube settings

The picture quality is evaluated with a signal electrode voltage applied as indicated on the tube test sheet and in the following settings with respect to highlight signal current and beam current:

highlight signal current I_s	200	0	nA
beam current adjusted for correct stabilization of a signal current of I_b	500	500	nA
type of blemish	black or white	white	

The specified area of 9,6 mm x 12,8 mm on the target is evenly illuminated with tungsten light of 2856 K through a back-illuminated test transparency with an aspect ratio of 3:4. The test chart is divided into three quality zones by two concentric circles with diameters as shown in Fig. 2.

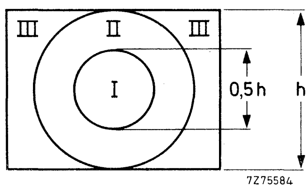


Fig. 2 Test chart.

The picture obtained shall be observed at a monitor.

BLEMISH SPECIFICATION

Blemishes are allowed to the extent indicated below.

type number	maximum contrast		blemish size	zone I		zone II		zone III		total	
	blemishes	chicken wires	% of h	white	total	white	total	white	total	white	total
S70XQA	5	10	> 1,0	0	0	0	0	0	0	0	0
			> 0,6	0	2	0	4	0	4	0	8
			> 0,2	1	6	3	11	6	11	6	15
			≤ 0,2			see note 4					
S70XQB	10	10	> 1,0	0	0	0	0	0	0	0	0
			> 0,6	0	3	0	4	1	4	1	10
			> 0,2	2	6	5	14	8	14	10	20
			≤ 0,2			see note 4					
S70XQC	10	30	> 2,1	0	0	0	0	0	0	0	0
			> 1,3	0	0	0	1	0	2	0	3
			> 1,0	0	1	0	3	0	4	0	8
			> 0,6	0	3	1	8	1	9	2	25
			> 0,2	2	9	5	18	8	18	12	30
			≤ 0,2			see note 4					

Notes
1. Blemish size is given in % of picture height.
2. Contrast is given in % of 200 nA peak white signal current.
3. Blemishes with contrast at or below the maximum contrast are not counted.
4. Blemishes of 0,2% of picture height or less are not counted unless they form a disturbing pattern which has an average contrast greater than the maximum contrast.
5. The blemish count is cumulative so that any blemish greater than 0,6% picture height counts as part of the allowed blemishes of greater than 0,2% picture height.
6. Multi-fibre boundary lines ('chicken wire') will not be counted as blemishes unless their contrast exceeds the maximum contrast.

OPERATING CONSIDERATIONS

1. The photocathode should not be exposed to light radiation in excess of 10 lux. Failure to meet this requirement may cause image burn-in.
2. The maximum d.c. electrode voltage ratings should **not be exceeded.** Failure to meet this requirement may seriously reduce the life expectancy of the tube and may cause internal breakdowns.
3. The photocathode of the ISV tube operates at a high d.c. potential. Unless adequate corona discharge suppression precautions are taken there is a high probability of permanent damage to the device.
4. If unpotted versions of this tube are purchased the following points must be considered:
   (a) These complex vacuum devices are manufactured to be as strong as is practicable. However, because of their construction, the glass-to-metal seals and fibre-optic-to-glass seals can easily be broken if excess thermal or mechanical stress is applied. Care must be taken not only in the mounting of the tube in the system, but also in the making of contacts onto the tube.
   (b) Due to the high voltages necessary to operate the intensifier section, the tube should be mounted in an assembly which is designed not only to protect the tube from corona problems but also to protect the test personnel. Care should be taken to eliminate leakage paths.
5. Any guarantee or warranty is void if evidence of external arcing, corona discharge or mechanical or thermal stress as mentioned in points 1 to 4, is present.

DEVELOPMENT SAMPLE DATA

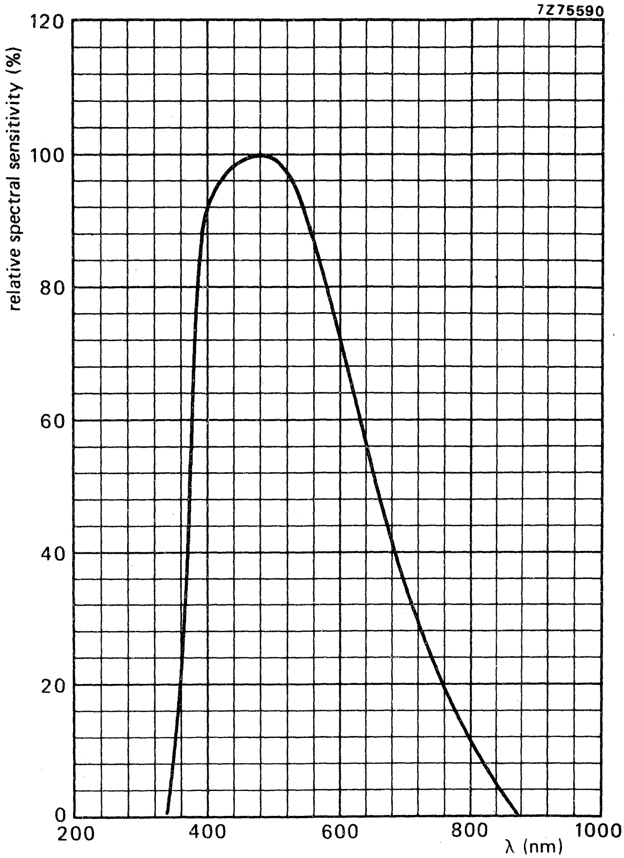


Fig. 3 Typical spectral response curve S20.

Pyroelectric Vidicon tubes G

GENERAL OPERATIONAL NOTES

To be read in conjunction with General operational notes vidicon tubes.

1 PRINCIPLES OF OPERATION

A pyroelectric vidicon (PEV) is a pick-up tube sensitive to infrared radiation. With the target materials used at present imaging is possible in principle with radiation of any wavelength between 2 and 400 μm. As the atmosphere is not transparent to all infrared wavelengths, a transparent 'window' in the atmosphere has to be selected, e.g. the wavelength band from 8 to 14 μm. Our PEVs have germanium faceplates with anti-reflection coatings optimized for this waveband. The wavelength distribution of the thermal radiation emitted at room temperature peaks in this band.

In a standard vidicon the change in photoconductivity of the target material is used for signal generation. In a PEV the temperature rise of the target material caused by absorption of infrared radiation is used. A temperature dependent property of the PEV target, its electrical polarization, detects this temperature rise.

The pyroelectric material is a non-centrosymmetric crystal which has permanent dipoles in the form of naturally polarized microscopic domains. The degree of polarization is temperature dependent. Normally these domains do not all have the same orientation, so that the polarization, averaged over a large number of domains, will be zero. By applying a strong electric field parallel to the polar axis, all domains can be orientated in the same direction. This process is called 'poling'. When the poling field is removed, a 'spontaneous' polarization remains in the pyroelectric crystal. The direction of orientation forms the 'polar axis' in the crystal.

The target of a PEV consists of a slice of pyroelectric material, cut perpendicularly to the polar axis. The electrical polarization is a bulk property of the material, but it is numerically equal to the charge density on surfaces normal to the polar axis. Therefore:

polarization P = surface charge/m^2.

Pyroelectric materials presently used in PEVs are, e.g. triglycine sulphate (TGS) and deuterated fluoroberyllate (DTGFB). Figure 1 shows the dependence of the electrical polarization on temperature in TGS.

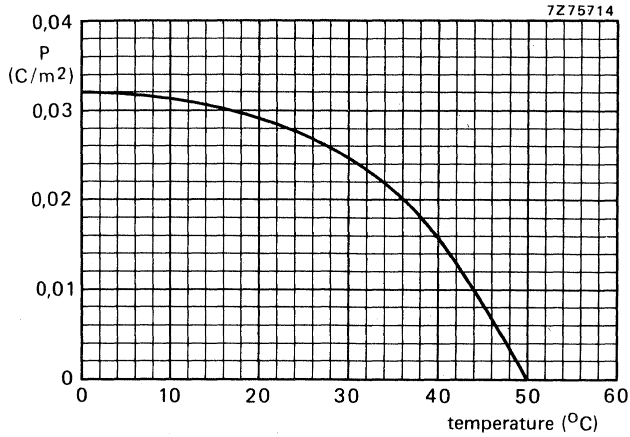


Fig. 1 Spontaneous polarization versus temperature in TGS.

For a surface area A, the surface charge Q = P x A. The change in surface charge per unit of time, i.e. the current to the surface, is

$$\frac{dQ}{dt} = A \cdot \frac{dP}{dt} = A \cdot \frac{dP}{dT} \cdot \frac{dT}{dt} = A \cdot p \cdot \frac{dT}{dt}$$

where $p = \frac{dP}{dT}$, the *pyroelectric coefficient.*

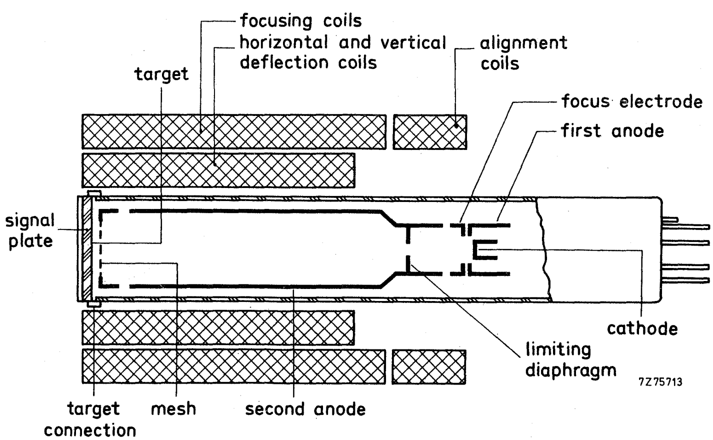


Fig. 2 Schematic electrode configuration in a PEV.

Now, let us consider a PEV, as schematically represented in Fig. 2.

The polarization of the pyroelectric target is perpendicular to the surface. Prior to operation the target has been poled in such a way that the surface facing the electron beam is negatively polarized. The irradiated side of the target is covered with a thin layer of transparent, electrically conducting material with low heat conductance, the signal plate. During operation a negative voltage, e.g. −10 V, is applied to the signal plate. The electron beam stabilizes the potential of the scanned surface to the cathode potential.

A change of the target temperature due to absorption of infrared radiation results in a change of polarization — and therefore in a change of the surface charge. This change can be read out by the electron beam, the charge deposited by the beam constitutes the video signal, as in a standard vidicon. The tube is therefore sensitive to temperature changes.

After each scan of the electron beam the potential of the target has been altered and it is therefore necessary to recharge positively the target between the scannings. This can be achieved in several ways; in the PEVs described in this handbook it is done by secondary emission during line flyback: the secondary emission pedestal method.

In this method the cathode voltage is decreased during line feedback to e.g. 80 V, and at the same time the beam current is strongly increased. As in this situation the secondary emission coefficient at the target is larger than one, the surface is charged in the positive direction. During normal read-out, with the cathode at 0 V, the positive charge supplied during flyback is removed again. A typical value for this 'pedestal current' during read-out is 100 nA. Changes in the surface charge due to temperature changes can now be read out in both directions, as they are superimposed on the pedestal current.

With a PEV only temperature changes can be observed. If temperature differences have to be seen in an object, these differences have to be converted into temperature changes. Two techniques may be employed to achieve this:

- panning the camera across the scene.
- interrupting the incoming radiation with a mechanical shutter (chopper).

To achieve optimum results it is necessary for the video signal to be electronically processed. Methods such as image difference processing, edge enhancement and contour enhancement may be useful.

The signal currents of a PEV are very small, typically 5 nA. This means that the preamplifier circuitry has to be designed very carefully and that spurious signals, such as those caused by camera microphony, must be kept at very low levels.

Two important sources of signal loss, especially at higher spatial frequencies, are found in PEVs: lateral diffusion of heat and discharge lag.

Lateral conduction of heat reduces the temperature differences in the target. The thermal conductivity of the target must therefore be small. This depends on material, thickness and size of the target; it may also be reduced by breaking the target up in small islands, this is called 'reticulation'.

The signal voltage excursions at the target are very small because of the very small signal currents and the large target capacitance (approx. 25 000 pF). Due to this, read-out by the electron beam is far from perfect. This results in image smear with moving objects (panning) and loss of signal. Two factors determine discharge lag: the target capacitance and the beam resistance. The target capacitance can be changed by changing the target material, thickness or size. The beam resistance is reduced by using a non-cross-over gun design.

2 MAIN PROPERTIES

2.1 Sensitivity

The sensitivity of a PEV may be expressed in amperes per watt incident on the scanned area of the target; this is called the 'responsivity'. The sensitivity may also be expressed in amperes per ^{o}C temperature difference in the object; this is called simply the 'sensitivity'.

The responsivity and the sensitivity depend on the mode of operation. For the panned mode of operation at optimum panning speed (about 3 mm/s, as measured on the target). Typical values for the tube type S58XQ (f:1 lens; scene contrast 10 ^{o}C with reference to a 300 K black body source) are:

responsivity: 5 $\mu A/W$;
sensitivity: 4 $nA/^{o}C$ in scene.

2.2 Spatial frequency response

Due to lateral heat conductance and discharge lag the sensitivity falls off rather fast with increasing spatial frequency. An example is given in Fig. 3 (scanning height 20 mm).

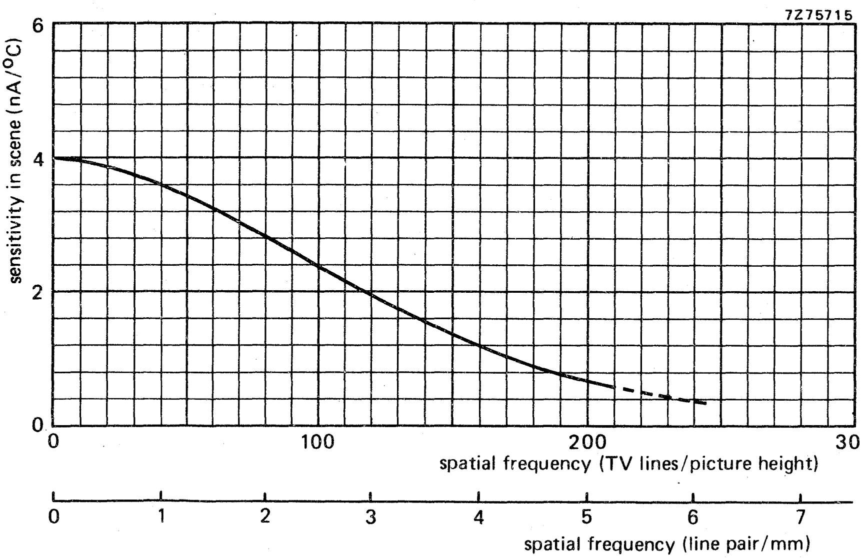


Fig. 3 Panning-mode sensitivity of PEV with TGS target.

2.3 Minimum resolvable temperature (MRT)

This important property is measured by imaging a bar pattern object of alternately hot and cold bars on the target, so that the bars in the image on the target are parallel to the vertical scanning direction. The spatial frequency of the bar pattern on the target is f_1 (in line pair/mm) or N_1 (in TV lines per picture height); the temperature difference between the hot and cold bars is such that the bars are visible. Then the temperature difference is reduced until the bars are not clearly discernible to an observer. The temperature difference at which this happens is called the MRT at the spatial frequency f_1 or at N_1 TV lines per picture height.

The MRT is a property of the entire infrared system, it is extremely dependent on the lens aperture and transmission and also on mode of operation, noise level and pedestal current level. It is usually presented as a function of the spatial frequency. Examples are given in Fig. 4.

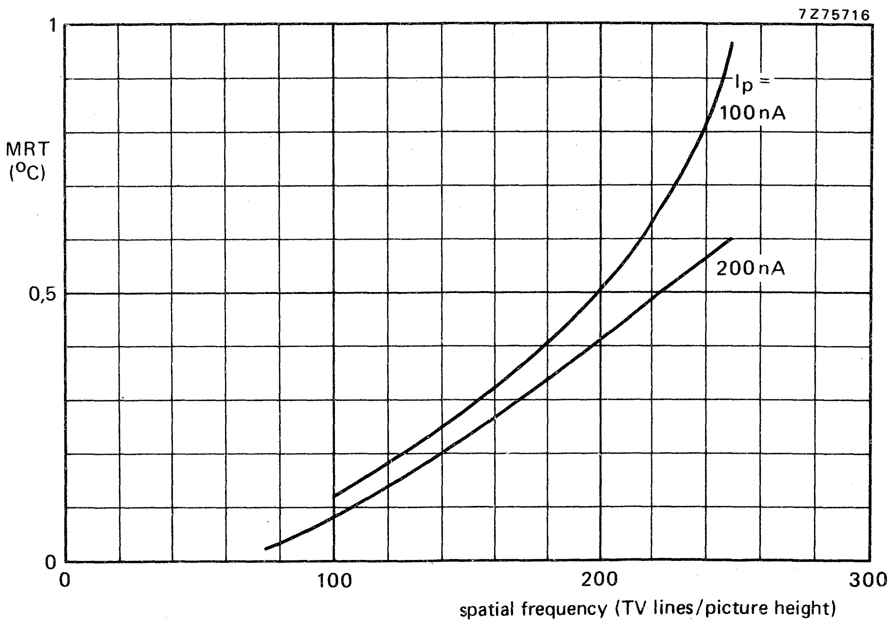


Fig. 4 Minimum resolvable temperature as a function of spatial frequency for TGS PEVs operating in the panning-mode.

3 EQUIPMENT DESIGN AND OPERATING CONDITIONS

3.1 Poling of the target

Prior to operation the target has to be poled. A momentary poling switch, in conjunction with a beam on-off switch, may be used. Operation of the poling switch disconnects the signal plate from its usual operating voltage and connects it to a potential 50 to 100 V below the grid 4 voltage. This is done while the beam is bombarding the target. By secondary emission a voltage difference of 50 to 100 V is now established across the layer, which is sufficient for poling of the target. After cutting off the beam and reducing the target voltage to its operating potential the tube is ready for operation.

3.2 Pedestal current

During line flyback positive charge is deposited on the target by secondary emission. For this purpose negative-going pulses are applied to the cathode and to grid 1, as shown in Fig. 5.

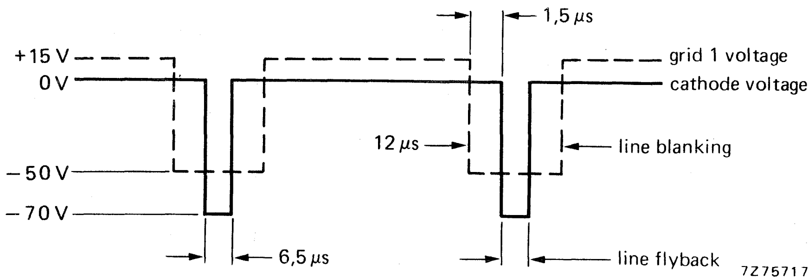


Fig. 5 Electrode voltages for pedestal generation.

The cathode voltage is reduced to about −70 V during line flyback. The beam current during this period is increased to several μA; it is set to obtain a pedestal current of e.g. 100 nA during read-out by the proper adjustment of the grid 1 voltage during the line blanking period. At lower pedestal current more discharge lag is found.

Figure 6 shows a schematic diagram of a cathode-driven pedestal current generator. In operation integrated circuit IC1A establishes the turn-on of the cathode pulse with respect to horizontal blanking which is simultaneously applied to grid 1. Integrated circuit IC1B determines the turn-off time so that R2 in conjunction with R1 controls the cathode pulse width and position (with respect to the blanking windows). Transistors Q1 and Q2 operate as a push-pull emitter-follower pair to invert and amplify the pulse, R3 controlling its amplitude, and couple it to the PEV cathode.

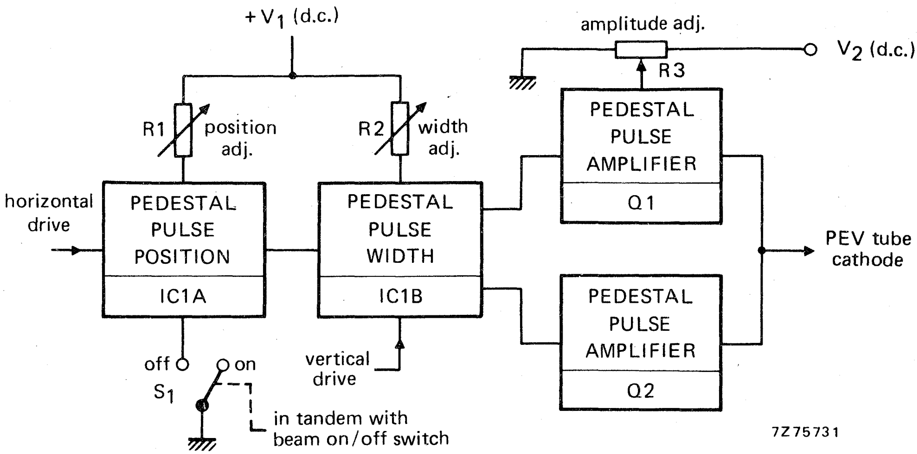


Fig. 6 Block diagram of typical cathode-driven pedestal current generator.

3.3 Shading

In order to deposit the positive charge uniformly on the target during line flyback the scanning speed in this period has to be constant. Scanning speed variations during flyback results in pedestal current variations during read-out. As the pedestal current is subtracted from the output current in the video amplifier to obtain the signal current, pedestal current variations should be kept as small as possible.

Some non-uniformity of the pedestal current, especially in the horizontal direction, however, cannot be avoided. It is therefore usually necessary to supply horizontal shading correction signals of parabolic and sawtooth shape.

3.4 Overscanning

Overscanning of the used target area is necessary to avoid edge effects connected with pedestal generation. In the case of a useful target area of 18 mm diameter, it is advisable to use a scanned area of 26,5 x 20 mm (4 – 3 ratio).

3.5 Blanking

As the cathode is used for pedestal generation, blanking has to be applied to grid 1. The blanking voltages should be chosen so as to obtain the required pedestal current during read-out.

To eliminate the bright ring caused by the beam striking the target edge during overscan, circular blanking is advised.

3.6 Preamplifier

Since the output signal currents are very low, a very low-noise preamplifier with high gain is necessary. It must also accommodate the 100 nA or 200 nA pedestal current without being overloaded.

3.7 Panning and chopping

The panning mode of operation is the simplest to implement: without signal processing it results in the best temperature sensitivity. It has three disadvantages however:

- the image of the scene is continuously moving on the monitor;
- since cooling of the target produces a signal of opposite polarity, the panned image of a hot target is often followed by a black trail;
- horizontal panning causes information loss for horizontal objects, since these are not modulated in a horizontal scan.

With faster panning discharge lag increases, with slower panning there will be more time for thermal diffusion. Therefore, an optimum panning rate exists which forms the best compromise between the effects of discharge lag and thermal diffusion. In practice, for the optimum a velocity of a few mm/s, as measured on the target, is found.

The chopping mode of operation is somewhat more difficult to implement. The chopper blade must be synchronized with the scanning beam to produce maximum signal. During the open portion of the chopper cycle a positive signal is produced. During the closed portion a negative signal results. This latter signal should be electrically inverted to produce a positive signal. If this were not done the eye would integrate both the positive and negative signals resulting in signal cancellation.

The chopping frequency may be 25 Hz (30 Hz) or lower. In the latter case the signal-to-noise ratio can improve due to signal integration.

3.8 Target temperature

As can be seen in Fig. 1, above a certain temperature (the Curie temperature) the polarization disappears. The optimum temperature for the target is slightly below this point. For TGS target the Curie temperature is about 49 ^{o}C, the operating temperature of the target should be between 35 ^{o}C and 45 ^{o}C. A temperature in this range is usually reached due to the heating of the target by the power dissipation of the camera and tube electronics.

The Curie temperature of DTGFB is dependent on the deuterium content and is between 73 ^{o}C and 82 ^{o}C. The operating temperature of a DTGFB target should be about 60 ^{o}C. To obtain this temperature, additional heating is necessary. Tubes with DGTFB targets are equipped with a target heater for this purpose. The camera system must provide a means for sensing the target temperature and for stabilizing this temperature by control of the target heater power.

If the Curie temperature is exceeded, the PEV is not damaged. It returns to normal operation when the target temperature returns below the Curie temperature.

3.9 Clamping

Clamping is used to establish a black reference in the picture. The clamp position should be set just before the left edge of the picture, the leading edge of the pedestal signal should be clamped to black.

SPURIOUS SIGNAL SPECIFICATION

for pyroelectric Vidicons S58XQ, S66XQ, S67XQ

PICTURE QUALITY

When used as the infrared imaging element in a properly designed and correctly operated thermal imaging system, the pyroelectric Vidicons will produce an image which has a minimal spurious signal level. The limitations on the allowed spurious signals are given in the table.

Definitions

The spurious signals of concern consist only of PEV target and window blemishes which result in:

a) small areas (called spots, if they are sharply defined; smudges, if otherwise) producing a spurious signal, i.e., an uneven modulation of any signal current between black level (pedestal level) and white level (average signal current), and

b) smears, streaks, mottled, or grainy background or other fixed background patterns.

Spots and smudges are evaluated only if their contrasts with respect to their surround exceed 10% of the reference white (hot) signal level (50 nA) and only if their sizes (diameter, or length plus width, divided by 2) exceed the equivalent of 0,4% of the picture height. As such, they are only allowed to the extent shown below.

Smears, streaks, mottled, or grainy background or other fixed background patterns (fixed pattern "noise") are not allowed if their average contrasts with respect to their surround exceed 5% of the reference average white signal level (50 nA).

CONDITIONS FOR EVALUATION

The tube must be operated in accordance with the "Typical Operating Conditions" with the recommended secondary electron emission generated pedestal current (see below), an 18 mm maximum diameter image size, a 20 mm x 26,5 mm minimum raster size, in a 625 line, 50 field/s system, either in panned (3 mm/s velocity for S58XQ) or chopped (25 or 30 Hz for S66XQ and S67XQ) modes. The camera system must be adjusted for optimum resolution, bandwidth and minimum noise and have no gamma correction, aperture correction, dynamic focusing, contour enhancement or contrast enhancement or suppression applied. The tube must be optically and electronically aligned and stabilized at its optimum operating temperature.

PROCEDURE FOR EVALUATION

The target will be either "capped" or evenly illuminated with 8 to 14 micron radiation adjusted to produce a reference white (hot) signal level of 50 nA. The camera black level will be set to 10% below the recommended pedestal level (see below). The size of the blemish will be determined by its mean width at 10% contrast level. Contrast will be measured peak to peak. Bright spots and smudges are measured with the tube "capped"; dark spots and smudges and other blemishes are measured with the tube first "capped", and then evenly illuminated.

Recommended pedestal current

tube type	pedestal current	set black level
S58XQ	100 nA	90 nA
S66XQ	200 nA	180 nA
S67XQ	200 nA	180 nA

Allowed spots and smudges table

Contrast > 10% (note 1)

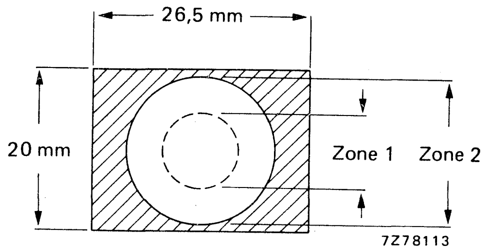


Fig. 1 Quality zones. Zone 1 = 9 mm diameter (or ½ of image diameter). Zone 2 = 18 mm diameter (or full image diameter).

blemish size (note 2) % of picture height	zone 1 bright	zone 1 total	zone 2 bright	zone 2 total	zone 1 & 2 bright	zone 1 & 2 total
over 5, 3 (note 3)	0	0	0	0	0	0
over 2,1	0	1	1	2	1	2
over 1, 3	2	5	5	10	5	10
over 0, 8	5	10	15	25	15	25
over 0, 4	10	20	25	50	25	50
0, 4 or less	not evaluated (note 4)					

Notes
1. Blemishes with contrasts 10% or less, or with sizes 0, 4% or less at any contrast are not evaluated.
2. The separation between any two blemishes of sizes over 0, 4% shall be over 5, 3%.
3. Blemishes with sizes over 5, 3% will be evaluated as local variation of uniformity.
4. Spots of this size are not evaluated unless their concentration causes a smeared appearance. Such concentrations are evaluated as smears and as contrast, the average contrast of the concentration is taken.

TUBE SELECTION

This tube is available in two operating selections plus a setting-up quality. Full specification (FSQ) tubes as described in the spurious signal specification are recommended for use in high quality applications. Evaluation quality (EVQ) tubes are of a somewhat poorer picture quality and sensitivity and are suitable for camera development and evaluation purposes. Setting-up grade (SUQ) tubes are intended for use only by equipment makers who wish to align cameras before delivery.

WARRANTY

FSQ and EVQ grade tubes are warranted to perform as described in this data sheet when correctly used in properly designed thermal imaging equipment. Should an FSQ or EVQ tube fail within six months of shipment, it may be replaced free of charge. Replacement or credit for FSQ and EVQ grade PEVs may also be made on a pro-rata basis over the next 6 to 12 months.

SUQ grade PEV tubes are warranted to work for six months from date of delivery but only for the purposes intended. Replacement will be at the sole discretion of the manuafacturer.

CAMERA TUBE

The S58XQ is an infrared sensitive pyroelectric vidicon TV camera tube. Provided with an infrared transmissive germanium window and thinned triglycine sulphate (TGS) target, this tube is sensitive to radiation in the 8 to 14 μm band. The 1-inch envelope incorporates a newly developed low beam temperature electron gun which reduces lag and improves dynamic resolution. The window is anti-reflective coated.

The tube is a hard-vacuum type in which the necessary pedestal current is produced electronically. This room temperature operation tube senses time varying changes in the thermal scene. Temporal change can be achieved by an image chopper or camera panning. Various signal processing techniques can be used to enhance the image quality.

The tube is intended for use in real time laser imagery, industrial process control, environmental monitoring, military and industrial surveillance.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	26,0 mm
Length	146 mm
Spectral response	8 to 14 μm
Heater	6,3 V, 100 mA

OPTICAL

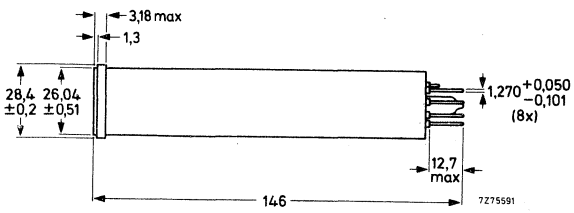
Dimension of useful area on photoconductive target		circle of 18 mm Ø
Dimensions of scanned area (4 : 3 aspect ratio, 10% overscan)		26,5 x 20 mm
Average δ of transfer characteristic		1
Spectral response		8 to 14 μm
Target reflectance	max.	20 %
Faceplate reflectance, optimized for 8 to 14 μm	max.	2 %

MECHANICAL DATA

Mounting position	any
Mass	approx. 70 g
Base	IEC67-I-33a (JEDEC E8-11)

Outline drawing

Dimensions in mm



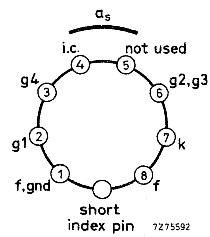


Fig. 1 The faceplate is typically 2 mm thick with a refractive index of 4,0 (germanium). The target is located max. 0,25 mm behind the inside of the faceplate.

Pin connections:
1. filament, common camera ground
2. grid 1
3. grid 4
4. internal connection
5.
6. grid 2, 3
7. cathode
8. filament

a_S. signal electrode (target)
S. short index pin

ACCESSORIES

Socket	Cinch no. 8VT or equivalent
Deflection and focusing coil	AT1116 or equivalent
FOCUSING	magnetic
DEFLECTION	magnetic

ELECTRICAL DATA

Heating
Indirect by a.c. or d.c.

Heater voltage	V_f		6,3 V ± 5%
Heater current	I_f		100 mA

ELECTRON GUN CHARACTERISTICS

Cut-off			
Grid 1 voltage for cut-off at V_{g2} = 280 V		>	−50 V
Blanking voltage, peak to peak at V_{g2} = 280 V, on grid 1		>	60 V
Grid 1 voltage, for normally beam current		typ.	15 V
Grid 1 current at normally required beam current			2 mA
Cathode voltage (for pedestal generation)			−50 to −110 V

CAPACITANCE

Signal electrode to all other electrodes	C_{as}	3 to 5 pF

This capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil unit.

LIMITING VALUES (Absolute maximum rating system)

All voltages are referred to the cathode, unless otherwise stated.

Signal electrode voltage (max. 5 min)	$-V_{as}$	max.	100 V
Grid 4 voltage	V_{g4}	max.	600 V
Grid 2, 3 voltage	$V_{g2,3}$	max.	350 V
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	350 V
Grid 1 voltage,			
positive	V_{g1}	max.	30 V
negative	$-V_{g1}$	max.	100 V
Cathode-to-heater voltage,			
positive peak	V_{kfp}	max.	125 V
negative peak	$-V_{kfp}$	max.	120 V
Cathode heating time before drawing cathode current	T_h	min.	2 min
Cathode current	I_k	max.	5 mA
Faceplate temperature, storage and operation	t	max.	40 °C
Target temperature		max.	50 °C
Faceplate irradiance (8 to 14 μm), continuous		max.	40 W/m²
Cathode voltage,			
forward	V_k	max.	10 V
reverse	$-V_k$	max.	125 V

OPERATING CONDITIONS AND PERFORMANCE

Conditions

Cathode voltage			
forward scan	≈ V_k	0	V
flyback	V_k	−100	V
Grid 1 voltage			
forward scan	V_{g1}	15	V
flyback	V_{g1}	−90	V
Grid 2, 3 voltage	$V_{g2,3}$	280	V
Grid 4 voltage	V_{g4}	400	V
Signal electrode voltage	V_{as}	−10	V
Pedestal current	I_b	100	nA
Faceplate temperature	t	30	°C
Target temperature		opt. 35	°C

Scan failure and blanking failure protection required.

Performance ; data based on U.S. = 525 line, 30 frame/s (operation)

When operated in a panned mode camera with a panning speed of 3 mm/s, the tube will typically have the following performance if:
- the lens has an aperture of f: 1
- scanned area 20 x 26,5 mm
- the scene contrast is 10 °C with reference to a 300 K black body source
- the camera has a bandwidth of 4 MHz
- imaged area Ø 18 mm
- 100 nA peak pedestal current

Sensitivity (peak, large area)	4,0 nA/°C
Responsivity	5,0 μA/W
Minimum resolvable temperature	0,5 °C at 200 TVL, see Fig. 3
Resolution, limiting (ΔT = 30 °C)	300 TVL, see Fig. 2
Lag, residual signal after 50 ms	10%, 3rd field 45%, 1st field
Uniformity of responsivity	± 25%
Uniformity of pedestal current	± 10%

SPURIOUS SIGNALS

See separate data: *Spurious signal specification pyroelectric vidicons.*

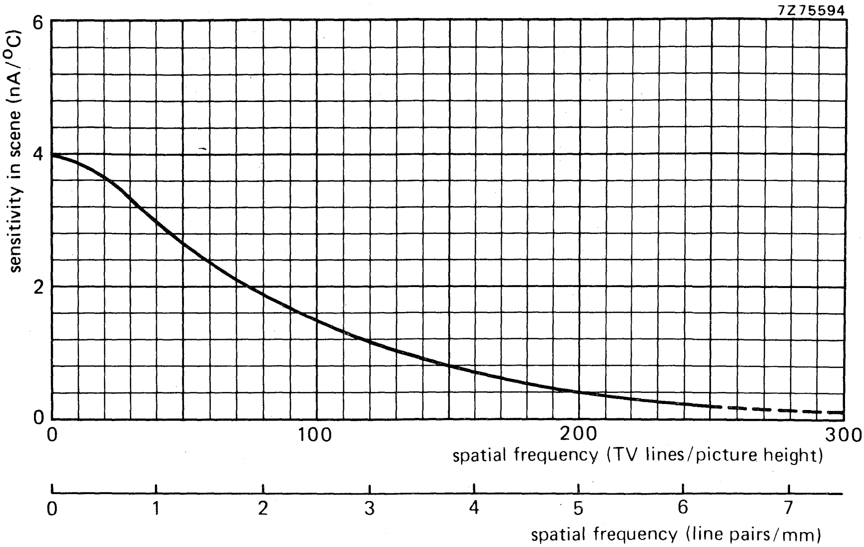


Fig. 2 Typical spatial sensitivity characteristics.

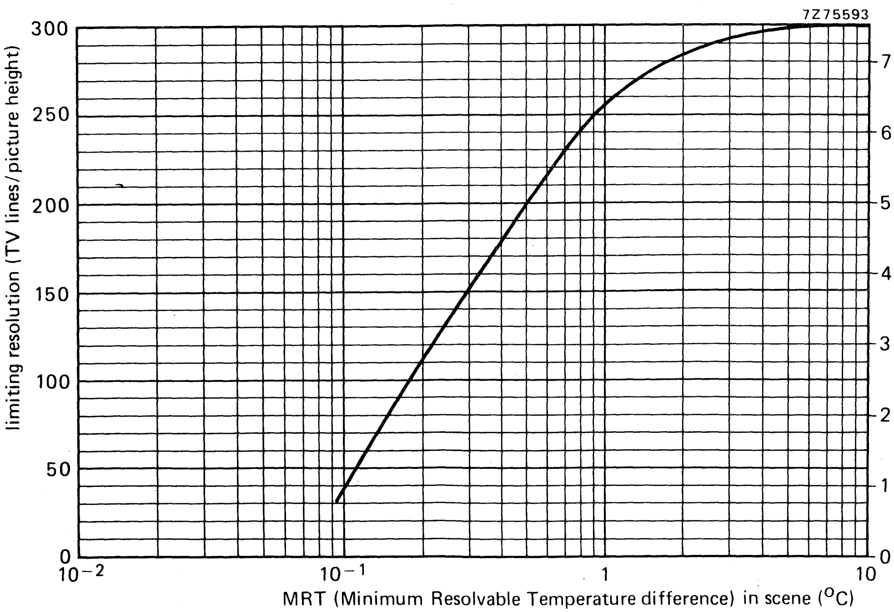


Fig. 3 Typical limiting resolution as a function of MRT.

Image Intensifiers H

GENERAL OPERATIONAL RECOMMENDATIONS

1 INTRODUCTION

Image intensifiers are electron-optical devices in which the image of a scene, after being focused on to a photocathode, is intensified electronically. The intensified image is displayed on a luminescent screen. An intensifier consists of a photocathode, an electron-optical lens and a luminescent screen.

There are two families of passive image intensifiers:

- First-generation passive image intensifiers. These are available either as single or as three-stage (cascade) inverting intensifiers.
- Second-generation passive image intensifiers. These are microchannel plate types.

1.1 The photocathode

The properties of the photocathode are described by the spectral response and the sensitivity. The sensitivity is expressed in two ways: luminous sensitivity (μA/lm) and radiant sensitivity (mA/W).

Measurements of sensitivity are made using a tungsten lamp at a nominal colour temperature of 2856 K. Filters are used to obtain the radiant sensitivity at wavelengths of 800 nm and 850 nm. Passive night vision applications require photocathodes with high luminous and radiant sensitivities. The S25 photocathode assures optimum performance in passive night viewing systems. In our image intensifiers the S25 multi-alkali photocathode is laid on the inner surface of the input window.

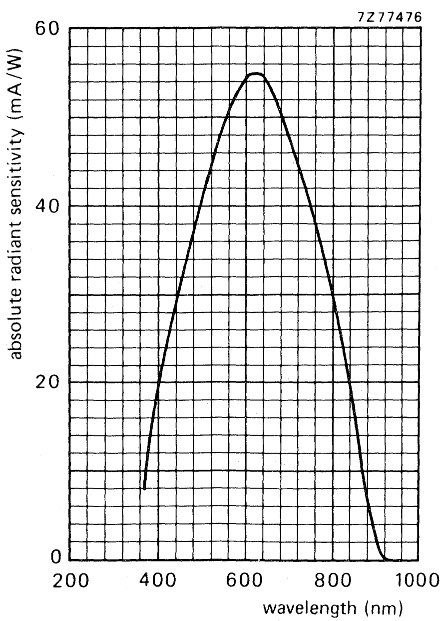


Fig. 1 Typical S25 spectral response.

1.2 The electron-optical lens

All our image intensifiers are electrostatically focused. The design of the electron-optics determines parameters such as gain, magnification, distortion, resolution and image alignment.

1.3 The luminescent screen

Since, in the majority of applications for image intensifiers, the screen is to be viewed directly, the spectral emissivity of the screen phosphor should lie within the eye's spectral response. The yellow-green phosphor of the P20 type, as used in our image intensifiers, meets this requirement.

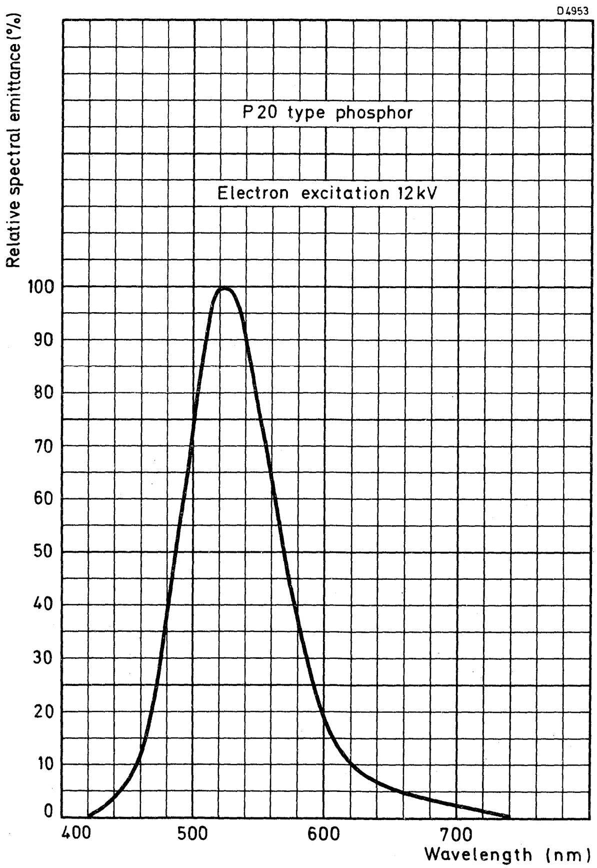


Fig. 2 P20 spectral emissivity.

The decay time of the output phosphor of an image intensifier is the time taken for the screen luminance to fall to 36% (e^{-1}) of the initial peak value, after the excitation due to the incident electron beam is removed. For single-stage image intensifiers, this is approximately 0,5 ms. In the case of cascade image intensifiers there are three intensifiers in series. Hence the persistence of the output phosphor will appear to be much longer than for a single phosphor.

2 CHARACTERISTICS

2.1 Gain

The gain of an image intensifier is expressed as gain = $(\pi L_o)/E_i$, where L_o is luminescence (cd/m^2) in a direction normal to the screen, measured with an eye-corrected photometer having an acceptance angle of 10^o. The screen luminance is measured over a diameter of ϕ_G. E_i is the uniform illuminance (lx) incident on the entire photocathode area. The illuminance is produced by a tungsten lamp at a nominal colour temperature of 2856 K. The data sheets describing the characteristics of a particular image intensifier state the values of E_i and ϕ_G. Gain is dimensionless.

2.2 Mean screen luminance (cd/m^2)

This is the mean luminous intensity (cd) of the screen over the specified area (m^2). This characteristic is given only for intensifiers with an integral power supply and is a function of the properties of the power supply. Where appropriate, the ABC characteristics are given in the data.

2.3 Magnification and distortion

The electron-optical lens used in some image intensifiers normally introduces a small amount of distortion in the image. This is caused by the variation in magnification across the diameter of the device and is normally seen as a pin cushion effect.

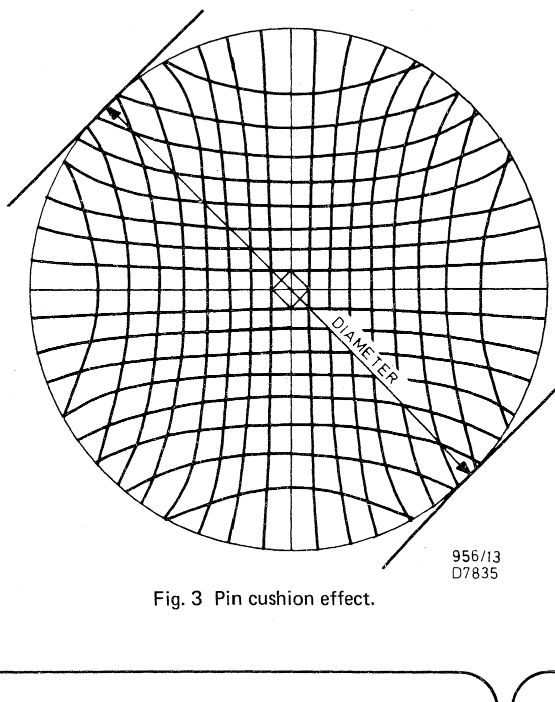


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Fig. 3 Pin cushion effect.

The magnification of the device is normally measured at two points. The centre magnification is found by measuring on the screen the diameter ϕ_s of the image of a concentric circle of diameter ϕ_d incident on the photocathode. The centre magnification is then $M_d = \phi_s/\phi_d$. Similarly the edge magnification is measured for a circle of diameter ϕ_D on the photocathode. This will present a circle of diameter ϕ_E at the screen. The edge magnification is $M_D = \phi_E/\phi_D$. Due to the difficulty in measuring small differences in the diameter ϕ_s there can be a significant variation in the value of M_d unless very careful precautions are taken. Distortion in image intensifiers is expressed as percentage distortion $\{(M_D/M_d) - 1\} \times 100$.
→ Proximity MCP image intensifiers may introduce distortion due to the "twister" fibre optics.

2.4 Resolution and modulation transfer factors

An important characteristic of any image device is its ability to present information without degrading the image. Resolution and modulation transfer factors both provide indications of this ability. The resolution measurement is made by viewing a standard resolution test chart. The resolution figures given in the data refer to the photocathode and apply to a bar pattern (usually black bars on a white background with a mark to space ratio of one and contrast approaching 100%). The resolution pattern is imaged on the photocathode using a high quality projection system and the screen is examined using a microscope of at least x10 magnification. Two figures are normally given (in line pairs/mm); the centre resolution and the resolution at a distance from the centre $\frac{1}{2}\phi_E$. The latter is known as edge resolution.

Specifying limiting resolution is a practice that has been adopted from photography. A more appropriate method is to measure the modulation transfer function (m.t.f.), referred to the photocathode. This is a measure of the ratio of the contrast of a specified pattern at the output to that at the input. Specific points of this function are known as modulation transfer factors.

3 EQUIVALENT BACKGROUND ILLUMINATION

With the supply voltage applied and no input illumination incident on the photocathode the screen will have a finite background brightness which may be caused by one of many effects. The Equivalent Background Illumination (EBI) is the input illuminance required to give an increase in screen brightness equivalent to the background brightness.

4 NOISE

In an image intensifier the signal-to-noise ratio at the output will be inferior to that at the input. The signal-to-noise ratio of the illuminance reaching the input window deteriorates as it passes through the intensifier. The deterioration of the signal-to-noise ratio is different for first and second-generation devices. In first-generation devices electrons are only lost as a result of reflection from the luminescent screen. In second-generation devices the microchannel plate severely affects the ratio.

Signal-to-noise ratio is measured only on some types of microchannel plate intensifiers. A 0,2 mm diameter spot is uniformly illuminated on the photocathode, and the resultant image is measured for the signal-to-noise ratio.

5 PICTURE QUALITY

In all image intensifiers some blemishes are likely to occur:

(a) Fixed pattern noise

This is an effect caused by the fibre-optic components used in the devices. There are two types of pattern that may be observed when viewing the screen of an intensifier with a 5 power magnifier:

- Multi-multi-pattern variation; discernible spatial gain variation between individual multifibres, or between groups of multifibres.
- Multi-boundary pattern noise; more commonly known as "chicken wire" it is seen as a dark or bright boundary between multifibres.

(b) Field emission

Field is a spurious emission (excluding thermionic emission) which is visible as bright spots or patterns that may flicker or appear intermittently on the image screen in one general position. Field emission is voltage dependent and is best observed with no radiation incident on the photocathode.

(c) Switched-on channel

This effect occurs only in microchannel plate image intensifiers. It causes small, bright spots on the screen. The spots are stationary and their brightness depends on the gain of the intensifier.

(d) Screen luminance ratio

Sometimes known as output brightness uniformity this is the ratio of the luminance at the centre of the screen to the luminance at any point on a concentric circle of diameter ϕ_R. The aperture used for this measurement has an area of 2,5 mm^2.

(e) Other blemishes

These include spots, streaks and non-uniformities. A blemish is defined as a dark or bright area with a contrast greater than 30% with respect to the immediate surrounding area. The picture quality of all intensifiers is assessed using a magnifier of approximately power 5. There is a significant difference in the subjective appearance of an image intensifier viewed directly, compared with the appearance as viewed through a TV system. This is due to the transfer characteristic of the TV camera tube.

6 IMAGE ALIGNMENT

The geometrical and optical axes of the intensifier may not coincide. Image alignment is a measure of this. It is the distance on the screen between the geometric axis and the image of a point at the geometric centre of the photocathode.

7 MAXIMUM PHOTOCATHODE ILLUMINANCE

The figure given in the data refers to a uniform continuous illuminance. All intensifiers will tolerate intermittent bursts of cathode illuminance which are much higher than the rated maximum value. However, prolonged exposure to any source of bright illumination will shorten the life of the intensifier. Some intensifiers incorporate automatic control of brightness or gain. (ABC or AGC). These reduce the screen luminance but they do not necessarily reduce the photocathode current. Whenever possible the photocathode illuminance should comply with the recommended operating conditions given in the data.

8 STORAGE AND HANDLING

Intensifiers should be stored in a desiccated air-tight container in a room with the temperature controlled at approximately 20 °C. They must be handled with great care. In particular, the case must not be compressed and the fibre-optic windows should be protected from damage by dust, grit, etc. The protective plastic and caps should not be removed until the intensifier is mounted in the equipment.

9 MOUNTING ORIENTATION

There is no restriction on the orientation of an intensifier when mounted in equipment. However, for some types every care should be taken to ensure that no conductive component of the equipment is within 10 mm of the input and output windows. The intensifier should be mounted in equipment in such a way that any axial forces are applied to the bearing surfaces only and never to the input or output windows.

10 HIGH POTENTIALS

Image intensifiers operate at high potentials, hence precautions must be taken to ensure that when the supply voltage is connected, or when residual high potentials may exist on the connectors or faceplates of the intensifier, the atmosphere surrounding the intensifier is dry. Some microchannel plate image intensifiers remain at a d.c. potential of several kV for up to one hour after switching off. Under no circumstances should the faceplate be connected to the input terminal of the intensifier as irreparable damage may occur.

In cascade image intensifiers the input connector may remain at a d.c. potential of several kV even after the supply is removed. It is advisible to discharge this connector by connecting it to the cathode contact ring.

11 SUPPLY VOLTAGE

The supply voltage required to operate an image intensifier is given in the data. Under no circumstances should the Absolute Maximum Rating be exceeded. Precautions should be taken to protect the device against switching transients.

An intensifier which is encapsulated with a power supply will not function but will not be damaged if the supply voltage is reversed for up to one minute.

In normal operation one of the supply terminals should be connected to the chassis of the equipment. The photocathode and screen may operate at high potentials with respect to the chassis. In cascade intensifiers the screen is at +45 kV and the photocathode at the chassis potential. The screen and cathode windows of microchannel plate image intensifiers are at opposite potentials of up to 6 kV with respect to the input terminals. In diode image intensifiers the potential difference between the input and output windows is approximately 15 kV. As the operation of all these devices is very sensitive to corona discharge it is recommended that suitable anti-corona measures be taken.

To increase battery life it is advisable to minimize the length of the connecting leads to the intensifier terminals. In microchannel plate image intensifiers a 10 μF capacitor should also be connected in parallel with the intensifier.

12 RECOVERY TIME

Recovery time for integral oscillator cascade intensifiers is defined in the data. In microchannel plate image intensifiers the recovery time is the time taken for a useful image to be restored on the screen after the photocathode illuminance is changed rapidly from 100 μlx to the maximum rated photocathode illuminance, or vice versa.

13 OUTLINE DRAWING

The outline drawing in the data shows only the major dimensions of the intensifier. The supplier should be consulted when equipment is being designed.

14 SAFETY

Image intensifiers with integral power supplies offer no risk during normal operation within night vision equipment. However, an operator may be temporarily dazzled when night vision equipment using certain types of cascade image intensifiers is subjected to a sudden increase in photocathode illumination. Precautions should be taken in the design of the equipment to avoid any sudden large increase in illumination of the photocathode. This phenomenon does not occur in microchannel plate image intensifiers.

The power supplies in encapsulated intensifiers operate at frequencies between 1 and 40 kHz. The noise produced is not annoying.

Unencapsulated intensifiers operate at high d.c. potentials. Under no circumstances should they be used without prior reference to the supplier.

15 ADDITIONAL INFORMATION

Comprehensive details of the mode of operation and usage of image intensifiers are given in the booklet entitled *Technical Information Image Intensifiers*.

IMAGE INTENSIFIER

The XX1050 is an inverting single-stage diode image intensifier with fibre-optic input and output windows. It is primarily intended for use in night vision systems but is also suitable for many low light level applications.

This data must be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - IMAGE INTENSIFIERS

CHARACTERISTICS (Measured under Recommended Operating Conditions)

Photocathode			
Surface		S25	
Useful diameter	min.	23	mm
Sensitivity			
white light	min.	175	μA/lm
λ = 800 nm	min.	10	mA/W
λ = 850 nm	min.	3	mA/W
Screen			
Phosphor		P20	
Useful diameter	min.	25	mm
Gain $\emptyset_G$ = 19 mm, $E_i \approx 1$ lx	min.	85	
Centre magnification $\emptyset_d$ = 2 mm		0.95 ± 0.02	
Distortion $\emptyset_D$ = 20 mm	max.	7.5	%
Centre resolution	min.	60	line pairs/mm
Edge resolution $\emptyset_E$ = 14 mm	min.	50	line pairs/mm

CHARACTERISTICS (Contd.)

Modulation transfer factors			
2.5 cycles/mm	min.	92	%
7.5 cycles/mm	min.	86	%
16 cycles/mm	min.	70	%
Equivalent background illumination [1]	max.	0.2	μlx
Image alignment	max.	0.75	mm
Mass	max.	145	g

RECOMMENDED OPERATING CONDITIONS

Supply voltage	15	kV
Photocathode illuminance	100	mlx
T_{amb}	23 ± 4	°C

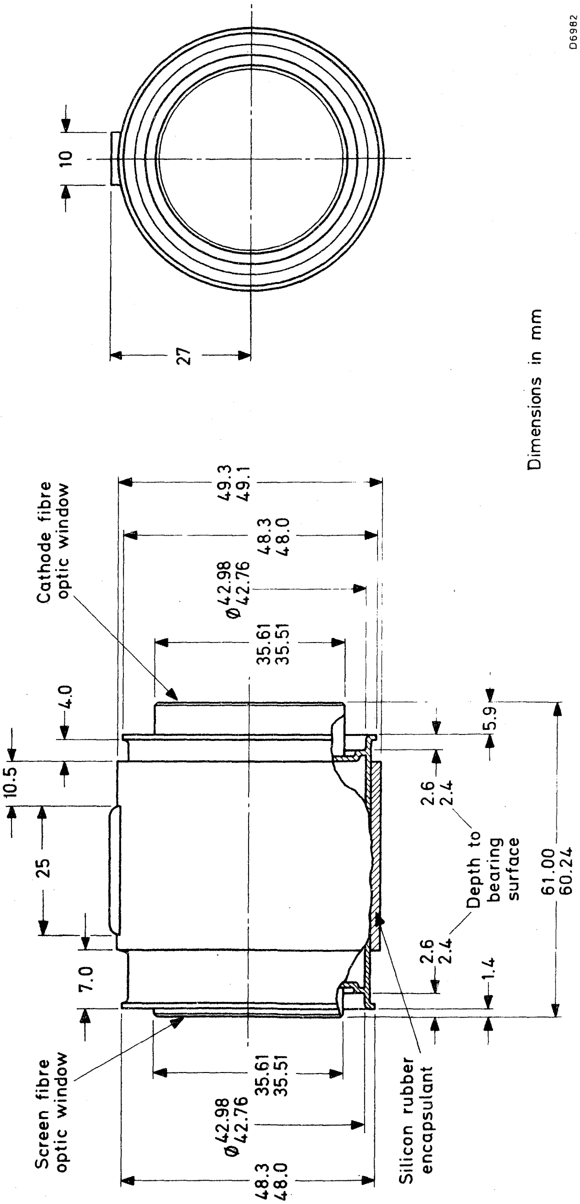
RATINGS (limiting values in accordance with the Absolute Maximum System IEC 134)

Supply voltage	max.	16	kV
Photocathode illuminance	max.	2	lx
T_{amb} (for storage, 2 hours max.)	max.	68	°C
T_{amb} (for continuous operation)	max.	35	°C
T_{amb} (for long term storage) [2]	max.	35	°C
T_{amb} (for storage, 2 hours max.)	min.	-54	°C

[1] It is recommended that if a metal housing is used, the cathode is connected to it to obtain the lowest possible background brightness.

[2] The recommended storage conditions are given in the General Operational Recommendations - Image Intensifiers.

OUTLINE DRAWING



Contacts to cathode and screen should preferably be made to the respective bearing surfaces.

Contact rings should be kept well clear of the fibre-optic windows.

Maximum contact force must not exceed 10 N.

IMAGE INTENSIFIER

The XX1060/01 is a three-stage fibre-optically coupled inverting electrostatically self-focused cascade image intensifier. It is primarily intended for use in night vision systems but is also suitable for many very low light level applications.
This high gain intensifier is encapsulated with a high voltage multiplier. It operates with automatic brightness control (a.b.c.) when used with an a.c. supply having a controlled regulation characteristic.

This data must be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - IMAGE INTENSIFIERS

CHARACTERISTICS (Measured under Recommended Operating Conditions)

Photocathode			
Surface		S25	
Useful diameter	min.	23	mm
Sensitivity			
white light	min.	220	μA/lm
λ = 800 nm	min.	15	mA/W
λ = 850 nm	min.	6	mA/W
Screen			
Phosphor		P20	
Useful diameter	min.	25	mm
Gain $\emptyset_G$ = 14 mm, $E_i \approx 200$ μlx	min.	50 000	
Centre magnification $\emptyset_d$ = 2 mm		0.85 ± 0.05	
Distortion $\emptyset_D$ = 20 mm	max.	25	%
Centre resolution	min.	28	line pairs/mm
Edge resolution $\emptyset_E$ = 14 mm	min.	28	line pairs/mm

CHARACTERISTICS (Contd.)

Modulation transfer factors [1]			
2.5 cycles/mm	min.	86	%
7.5 cycles/mm	min.	65	%
16 cycles/mm	min.	35	%
Equivalent background illumination	max.	0.2	μlx
Image alignment	max.	0.75	mm
Input capacitance (measured with no input illumination)	min.	25	pF
	max.	50	pF
Screen luminance ratio, $\varnothing_R$ = 20 mm	max.	5:1	
Mass	max.	880	g

RECOMMENDED OPERATING CONDITIONS

Supply voltage, p-p [2]	2.7	kV ± 100 V
Supply frequency	1.6	kHz ± 600 Hz
Photocathode illuminance	5	mlx
T_{amb}	23 ± 4	°C

RATINGS (Limiting values in accordance with the Absolute Maximum System IEC134)

Supply voltage, p-p instantaneous	max.	2.9	kV
continuous	max.	2.8	kV
Supply frequency	max.	2.5	kHz
Photocathode illuminance	max.	10	lx
T_{amb} (for storage, 2 hours max.)	max.	68	°C
T_{amb} (for continuous operation)	max.	35	°C
T_{amb} (for long term storage) [3]	max.	35	°C
T_{amb} (for storage, 2 hours max.)	min.	-54	°C

QUALIFICATION APPROVAL

This intensifier may be supplied to DEF STAN 59-60 (part 90), specification No. 086.

NOTES

1) These values are obtained using the standard method adopted in MIL specifications whereby the m.t.f. values are normalized at approximately 1.5 cycles/mm. When the m.t.f. is measured with the values normalized at zero spatial frequency, the following typical results are obtained:

at 2.5 cycles/mm	88	%
at 7.5 cycles/mm	70	%
at 16 cycles/mm	38	%

2) The intensifier must be supplied from an a.c. source having the following characteristics:

Load condition	Output voltage, p-p
50 pF	2.7 kV ± 200 V
50 pF in parallel with 25 MΩ	1.9 kV ± 400 V

The supply voltage must be applied between the input contact and the cathode contact ring.

Warning: After switching off, the d.c. potential at the input contact will rise to several kV. It is advisable to discharge this to the cathode contact ring.

3) The recommended storage conditions are given in the General Operational Recommendations - Image Intensifiers.

OUTLINE DRAWING

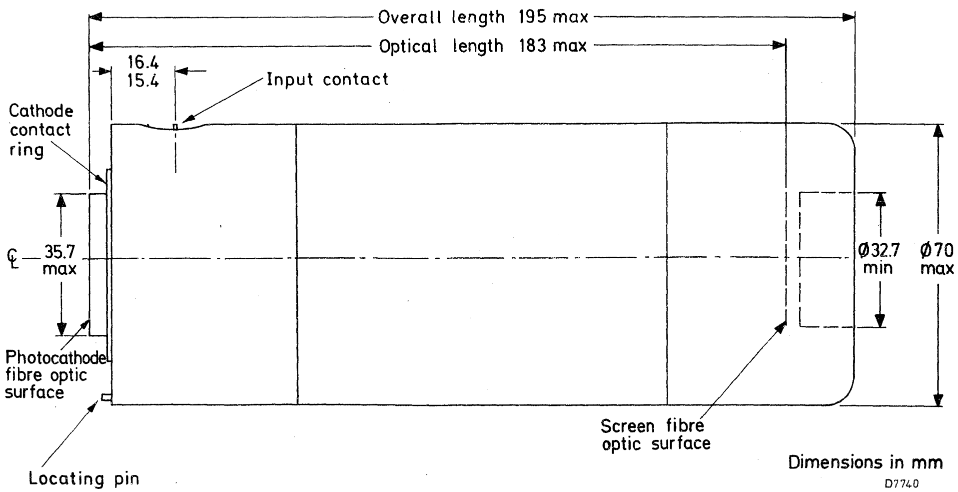


IMAGE INTENSIFIER

The XX1063 is a three-stage fibre-optically coupled inverting electrostatically self-focused cascade image intensifier, incorporating an integral power supply and automatic brightness control. It is primarily intended for use in night vision systems but is also suitable for many very low light level applications.

This data must be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - IMAGE INTENSIFIERS

CHARACTERISTICS (Measured under Recommended Operating Conditions)

Photocathode			
Surface		S25	
Useful diameter	min.	23	mm
Sensitivity			
white light	min.	220	µA/lm
λ = 800 nm	min.	15	mA/W
λ = 850 nm	min.	6	mA/W
Screen			
Phosphor		P20	
Useful diameter	min.	25	mm
Gain $\varnothing_G$ = 14 mm, $E_i \approx$ 200 µlx	min.	50 000	
Centre magnification $\varnothing_d$ = 2 mm		0.85 ± 0.05	
Distortion $\varnothing_D$ = 20 mm	max.	25	%
Centre resolution	min.	28	line pairs/mm
Edge resolution $\varnothing_E$ = 14 mm	min.	28	line pairs/mm

CHARACTERISTICS (Contd.)

Modulation transfer factors 1)			
2.5 cycles/mm	min.	86	%
7.5 cycles/mm	min.	65	%
16 cycles/mm	min.	35	%
Equivalent background illumination	max.	0.2	μlx
Image alignment	max.	0.75	mm
Recovery time 2)	max.	1.5	s
Mean screen luminance averaged over useful screen area	max.	550	cd/m^2
Screen luminance ratio, $\varnothing_R$ = 20 mm	max.	5:1	
Power consumption		120	mW
Mass	max.	880	g

RECOMMENDED OPERATING CONDITIONS

Supply voltage 3)	6.5	V d.c.
Photocathode illuminance	5	mlx
T_{amb}	23 ± 4	°C

RATINGS (Limiting values in accordance with the Absolute Maximum System IEC134)

Supply voltage 3)	max.	6.75	V d.c.
Photocathode illuminance	max.	10	lx
T_{amb} (for storage, 2 hours max.)	max.	68	°C
T_{amb} (for continuous operation)	max.	35	°C
T_{amb} (for long term storage) 4)	max.	35	°C
T_{amb} (for storage, 2 hours max.)	min.	-54	°C

QUALIFICATION APPROVAL

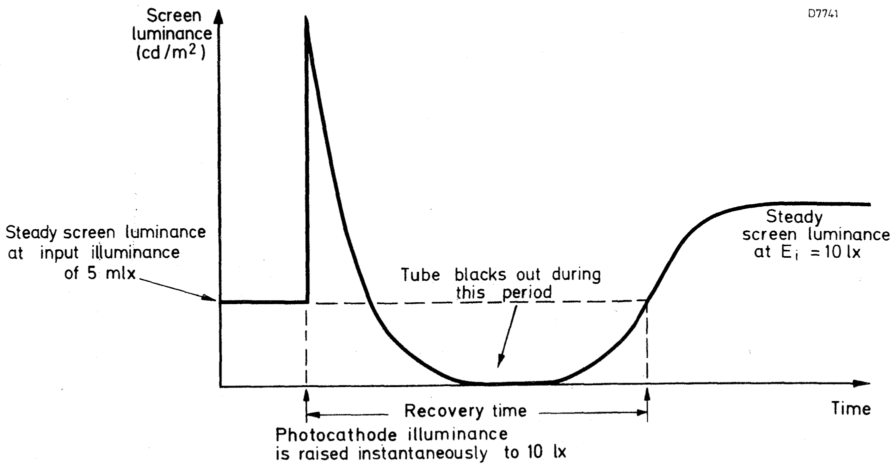
This intensifier may be supplied to DEF STAN 59-60 (part 90), specification No. 077A.

NOTES

1) These values are obtained using the standard method adopted in MIL specifications whereby the m.t.f. values are normalized at approximately 1.5 cycles/mm. When the m.t.f. is measured with the values normalized at zero spatial frequency, the following typical results are obtained:

at 2.5 cycles/mm	88	%
at 7.5 cycles/mm	70	%
at 16 cycles/mm	38	%

2) With an input illuminance of $E_i = 5 \times 10^{-3}$ lx.
E_i is increased in less than 10 ms to a value of 10 lx; the screen will flash instantaneously and then black out for a brief period. Thereafter the screen luminance will increase to a steady value. The recovery time is defined as the interval between the instant of the increase of E_i and the instant at which the screen luminance reaches a value of 5 cd/m^2 following blackout, see below:

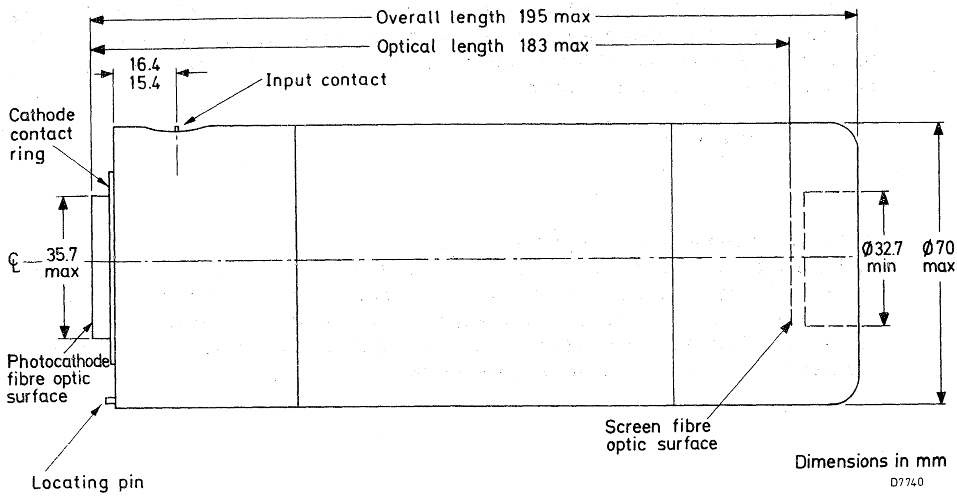


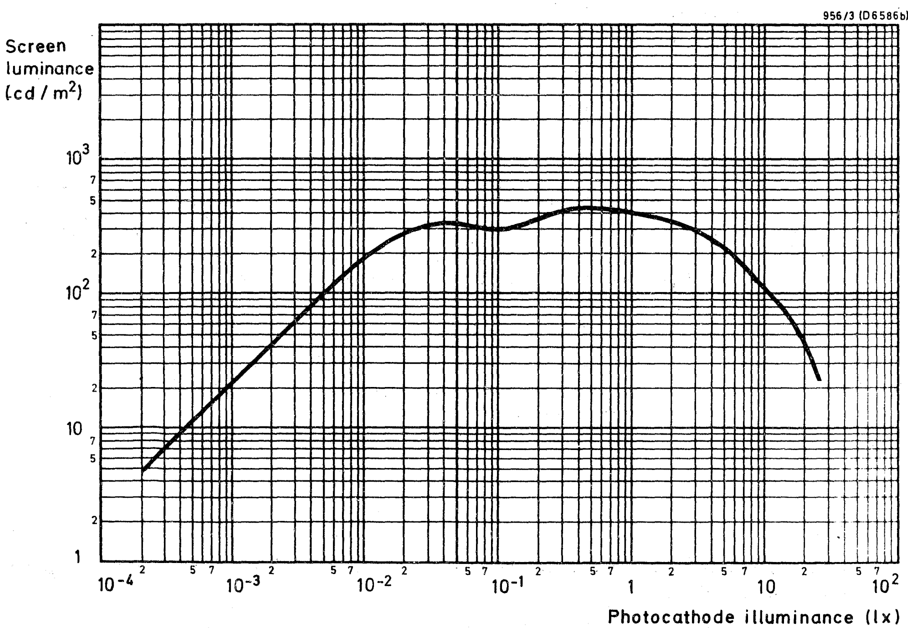
3) The supply voltage must be applied between the input contact (positive) and the cathode contact (negative) ring.

Warning: After switching off, the d.c. potential at the input contact will rise to several kV. It is advisable to discharge this to the cathode contact ring.

4) The recommended storage conditions are given in the General Operational Recommendations - Image Intensifiers.

OUTLINE DRAWING





Typical transfer characteristic.

IMAGE INTENSIFIER

The XX1306 is a miniature, electrostatically self-focused, inverting micro-channel plate image intensifier. It has 18 mm fibre-optic input and output windows, an integral power supply and automatic gain control. Point highlight saturation and bright source protection are features of this intensifier. It is primarily intended for use in night vision systems, but is suitable for many very low light level applications.

This data must be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - IMAGE INTENSIFIERS

CHARACTERISTICS (Measured under Recommended Operating Conditions)

Photocathode

Surface		S25	
Useful diameter	min.	17.5	mm
Sensitivity			
white light	min.	200	μA/lm
λ = 800 nm	min.	10	mA/W
λ = 850 nm	min.	6	mA/W

Screen

Phosphor		P20	
Useful diameter	min.	17	mm

CHARACTERISTICS (Contd.)

Gain $\varnothing_G$ = 10 mm, $E_i \approx 50\ \mu lx$	min.	23 000	
	max.	46 000	
Mean screen luminance E_i = 20 mlx	min.	4	cd/m^2
	max.	10	cd/m^2
Edge magnification $\varnothing_D$ = 14.4 mm	min.	0.88	
	max.	0.94	
Centre resolution	min.	25	line pairs/mm
Edge resolution $\varnothing_E$ = 10 mm	min.	25	line pairs/mm
Modulation transfer factors*			
2.5 cycles/mm	min.	87	%
7.5 cycles/mm	min.	70	%
16 cycles/mm	min.	38	%
Equivalent background illumination	max.	0.2	μlx
Image alignment	max.	0.8	mm
Recovery time	max.	0.5	s
Power consumption	max.	110	mW
Mass	max.	200	g

RECOMMENDED OPERATING CONDITIONS

Supply voltage	2.6	V
Photocathode illuminance	100	μlx
T_{amb}	22 ± 3	^{o}C

WARNING

Immediately after operation, the screen will remain electrostatically charged for approximately 1 hour, during which time the intensifier should not be handled. Any attempt to discharge the intensifier by any means may result in irreparable damage.

IMPORTANT

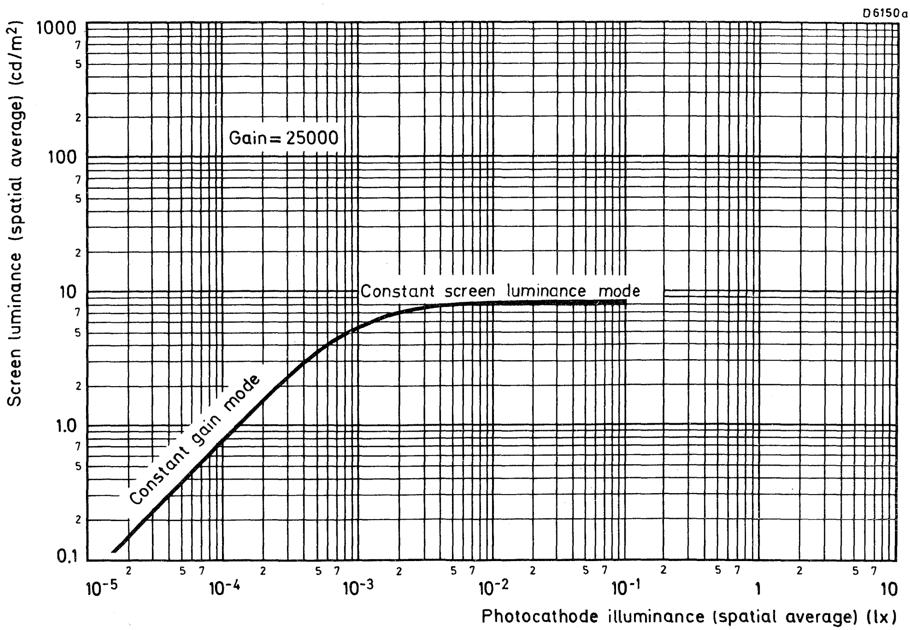
In addition to Operating Conditions, the General Operational Recommendations for Image Intensifiers contain instructions relating to precautions to be taken to avoid irreparable damage to the intensifier.

*Measured before the power supply is fitted.

RATINGS (Limiting values in accordance with the Absolute Maximum System IEC 134)

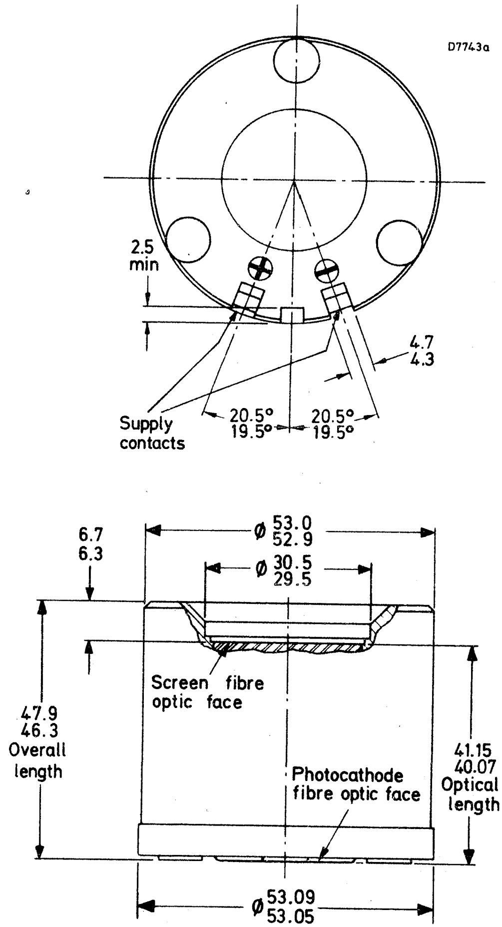
Supply voltage [1])	max.	2.70	V
Photocathode illuminance	max.	0.1	lx
T_{amb} (for storage, 2 hours max.)	max.	68	^oC
T_{amb} (for continuous operation)	max.	35	^oC
T_{amb} (for long term storage)	max.	35	^oC
T_{amb} (for storage, 2 hours max.)	min.	-20	^oC
T_{amb} (for long term storage)	min.	-5	^oC
Axial force between bearing surfaces	max.	100	N

[1]) If the supply voltage falls below 2.0 V, the intensifier will not be damaged, but may not function.



Typical transfer characteristic.

OUTLINE DRAWING



Maximum contact force must not exceed 10 N.

IMAGE INTENSIFIER

The XX1332 is an electrostatically self-focused, inverting micro-channel plate image intensifier. It has a 50 mm fibre-optic input window and a 40 mm fibre-optic screen window. It incorporates an integral power supply and automatic gain control. Point highlight saturation and bright source protection are features of this intensifier. This device is primarily intended for use in night vision systems.

This data must be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - IMAGE INTENSIFIERS

CHARACTERISTICS (Measured under Recommended Operating Conditions)

Photocathode

Surface		S25	
Useful diameter	min.	48.8	mm
Sensitivity			
white light	min.	200	μA/lm
λ = 800 nm	min.	15	mA/W
λ = 850 nm	min.	6	mA/W

Screen

Phosphor		P20	
Useful diameter	min.	38.8	mm

CHARACTERISTICS (Contd.)

Gain $\emptyset_G$ = 22.5 mm, $E_i \approx 50\ \mu lx$	min.	15 000	
	max.	30 000	
Mean Screen luminance $\emptyset_G$ = 22.5 mm, $E_i \approx 20$ mlx	min.	4	cd/m^2
	max.	8	cd/m^2
Centre Magnification $\emptyset_d$ = 4.0 mm	min.	0.61	
	max.	0.71	
Edge magnification $\emptyset_D$ = 40 mm	min.	0.71	
	max.	0.77	
Centre resolution	min.	18	line pairs/mm
Edge resolution $\emptyset_E$ = 28 mm	min.	18	line pairs/mm
Modulation transfer factors *			
5 cycles/mm	min.	80	%
10 cycles/mm	min.	55	%
20 cycles/mm	min.	20	%
Equivalent background illumination	max.	0.2	μlx
Image alignment	max.	2.0	mm
Recovery time	max.	0.5	s
Power consumption	max.	340	mW
Mass	max.	850	g

RECOMMENDED OPERATING CONDITIONS

Supply voltage	6.5	V
Photocathode illuminance	100	μlx
T_{amb}	22 ± 3	^{o}C

WARNING

Immediately after operation, the screen will remain electrostatically charged for approximately 1 hour, during which time the intensifier should not be handled. Any attempt to discharge the intensifier by any means may result in irreparable damage.

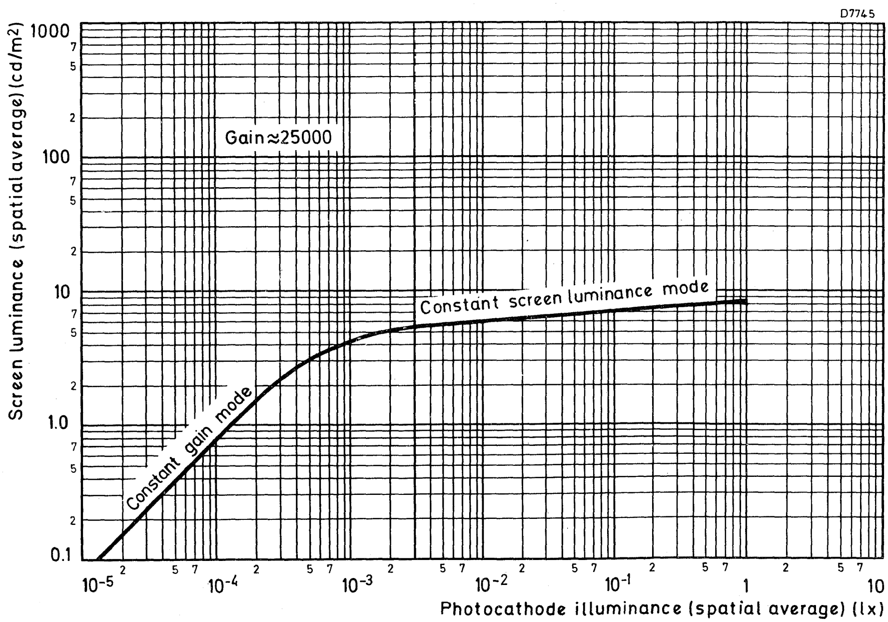
QUALIFICATION APPROVAL

The intensifier may be supplied to DEF STAN 59-60 (part 90) specification No. 089.

* Measured before the power supply is fitted.

RATINGS (Limiting values in accordance with the Absolute Maximum System IEC 134)

Supply voltage [1])	max.	6.75	V
Photocathode illuminance	max.	1.0	lx
T_{amb} (for storage, 2 hours max.)	max.	70	^oC
T_{amb} (for continuous operation)	max.	35	^oC
T_{amb} (for operation, 2 hours max.)	max.	52	^oC
T_{amb} (for long term storage)	max.	35	^oC
T_{amb} (for storage, 2 hours max.)	min.	-40	^oC
T_{amb} (for long term storage)	min.	-5	^oC
Axial force between bearing surfaces	max.	150	N



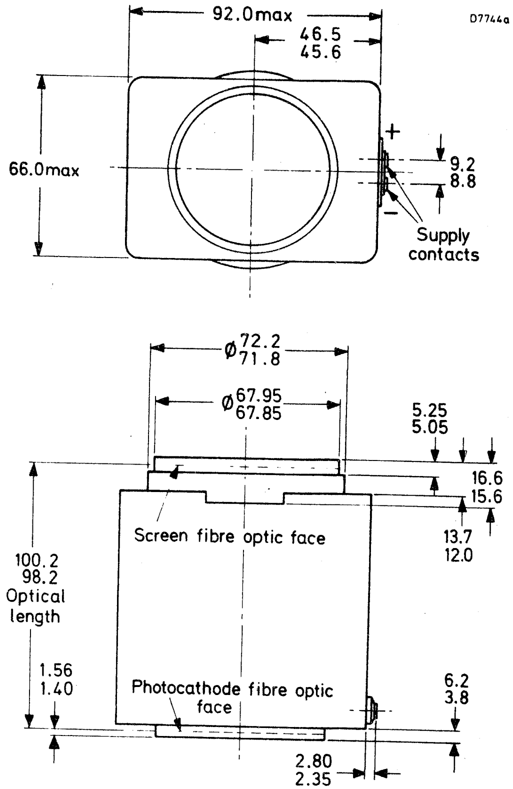
Typical transfer characteristic

IMPORTANT

In addition to Operating Conditions, the General Operational Recommendations for Image Intensifiers contain instructions relating to precautions to be taken to avoid irreparable damage to the intensifier.

[1]) If the supply voltage falls below 6.0 V, the intensifier will not be damaged, but may not function.

OUTLINE DRAWING



Maximum contact force must not exceed 10 N

IMAGE INTENSIFIER

Self-focusing magnifying compact micro-channel plate image intensifier with integral power supply, incorporating automatic gain control, intended for use in lightweight night vision systems for visible light and near-infrared radiation.

Particular features of this intensifier include adjustable gain, point highlight saturation, low distortion, high resolution, and precision engineered reference surfaces. The intensifier has plane fibre-optic input and output windows and a medium or medium-long persistence phosphor screen.

This data must be read in conjunction with *General operational recommendations — Image intensifiers.*

CHARACTERISTICS

Measured under recommended operating conditions.

	notes			
Photocathode				
Surface			S25	
Useful diameter		min.	19,5	mm
Sensitivity				
white light		min.	225	μA/lm
λ = 800 nm		min.	15	mA/W
λ = 850 nm		min.	11	mA/W
Screen				
Phosphor			aluminized P20 type	
Overall persistence			medium or medium-long	
Useful diameter		min.	30	mm
Gain, ϕ_G = 7,5 mm, $E_i \approx 50\ \mu$lx	1,2		3000 to 25 000 (1000 to 8000 nit/lx)	
Mean screen luminance, $E_i \approx 10$ mlx, Fig. 2			1 to 3	cd/m^2
Linear screen luminance	3		10	cd/m^2
Centre magnification, ϕ_d = 2,5 mm			1,5	
Distortion, ϕ_D = 16 mm	4	typ.	2	%
		max.	3	%
Centre resolution		min.	45	linepair/mm
Edge resolution, ϕ_E = 16 mm		min.	45	linepair/mm
Reduced area modulation transfer factors, Fig. 3	5,6			
at 2,5 cycle/mm		min.	95	%
at 7,5 cycle/mm		min.	80	%
at 15 cycle/mm		min.	50	%

CHARACTERISTICS (continued)

	notes			
Equivalent background illumination (EBI)		max.	0,2	μlx
Image alignment		max.	1,0	mm
Screen luminance ratio		max.	2	
Signal-to-noise ratio	7	min.	2,8	
Mass		max.	350	g
Mounting position			any	
Supply current		max.	40	mA

RECOMMENDED OPERATING CONDITIONS

Supply voltage (negative to case)	2,6	V d.c.
Photocathode illuminance	100	μlx
Ambient temperature	25 ± 5	°C

LIMITING VALUES

(Absolute maximum rating system)

Supply voltage	8	max.	3,4	V d.c.
Photocathode illuminance during storage	9	max.	5000	lx
Ambient operating temperature		max.	52	°C
		min.	−40	°C
Ambient storage temperature		max.	60	°C
		min.	−55	°C
Axial bearing force between surfaces M and N		max.	250	N

SHOCK AND VIBRATION RESISTANCE

The following test conditions are applied on a sampling basis to assess the mechanical quality of the intensifier.

Shock 1

The device is subjected 6 times to a peak acceleration of 500g in each of the following directions:

a. // longitudinal axis;
b. ⊥ longitudinal axis.

Pulse shape: half-sinusoidal.
Pulse duration: 0,30 ± 0,05 ms measured between the 10% of peak amplitude values.

Shock 2

The device is subjected 6 times to a peak acceleration of 140g in each of the following directions:

a. // longitudinal axis;
b. ⊥ longitudinal axis.

Pulse shape: half-sinusoidal.
Pulse duration: 9,0 ± 0,9 ms measured between the 10% of peak amplitude values.

Vibration

The device is subjected to a vibration frequency of 10 Hz to 3500 Hz with an acceleration of 2,5g in the following directions:
a. // longitudinal axis;
b. ⊥ longitudinal axis.

Duration of vibration: 30 min.
Sweep rate: 10 Hz to 3500 Hz to 10Hz in a logarithmic sweep rate of 30 min.

Notes

1. Gain may be defined as L_o/E_i nit/lx or as $\pi L_o/E_i$. The latter is dimensionless. (1 nit = 1 cd/m^2.)
2. The intensifier is provided with adjustable gain by means of a potentiometer (accessible with a screwdriver). The gain can only be set prior to embodiment of the intensifier in the equipment.
3. Below this level the local screen luminance and photocathode illuminance are linearly related.
4. The same limits also apply at ϕ_D = 19 mm.
5. The measurement is referred to the centre of the photocathode.
6. Measuring the modulation transfer factors in a reduced area gives a negligible low frequency drop.
7. The signal-to-noise ratio is measured by uniformly illuminating, with illuminance E_i, a circular spot of known area on the photocathode. The resultant output photocurrent from the screen is filtered with a four-pole Butterworth low-pass filter set for a 3 dB point at 20 Hz. The output from the filter is measured with a d.c. and r.m.s. meter. The combination of the filter and the P20 phosphor has a bandwidth of 17,5 Hz. Signal-to-noise ratio is defined as:

$$\frac{S}{N} = K \frac{S_o - S_b}{\sqrt{(N_o^2 - N_b^2)}} \cdot \sqrt{\left(\frac{1,24 \times 10^{-5}}{E_i} \times \frac{3,14 \times 10^{-8}}{A}\right)}$$

   K = correction factor for filter (1,32), to obtain equivalent bandwidth of 10 Hz.
   N_o = r.m.s. signal output.
   S_o = d.c. signal output.
   N_b = r.m.s. signal output } when the intensifier photocathode is capped.
   S_b = d.c. signal output
   E_i = photocathode illuminance.
   A = area of circular spot.

   The figure in the data refers to a P20 phosphor with medium decay.
8. The intensifier will not be damaged but may not function if the supply voltage falls below 2,3 V.
9. Exposure to focused intense light or infrared radiation should be avoided.

MECHANICAL DATA

Dimensions in mm

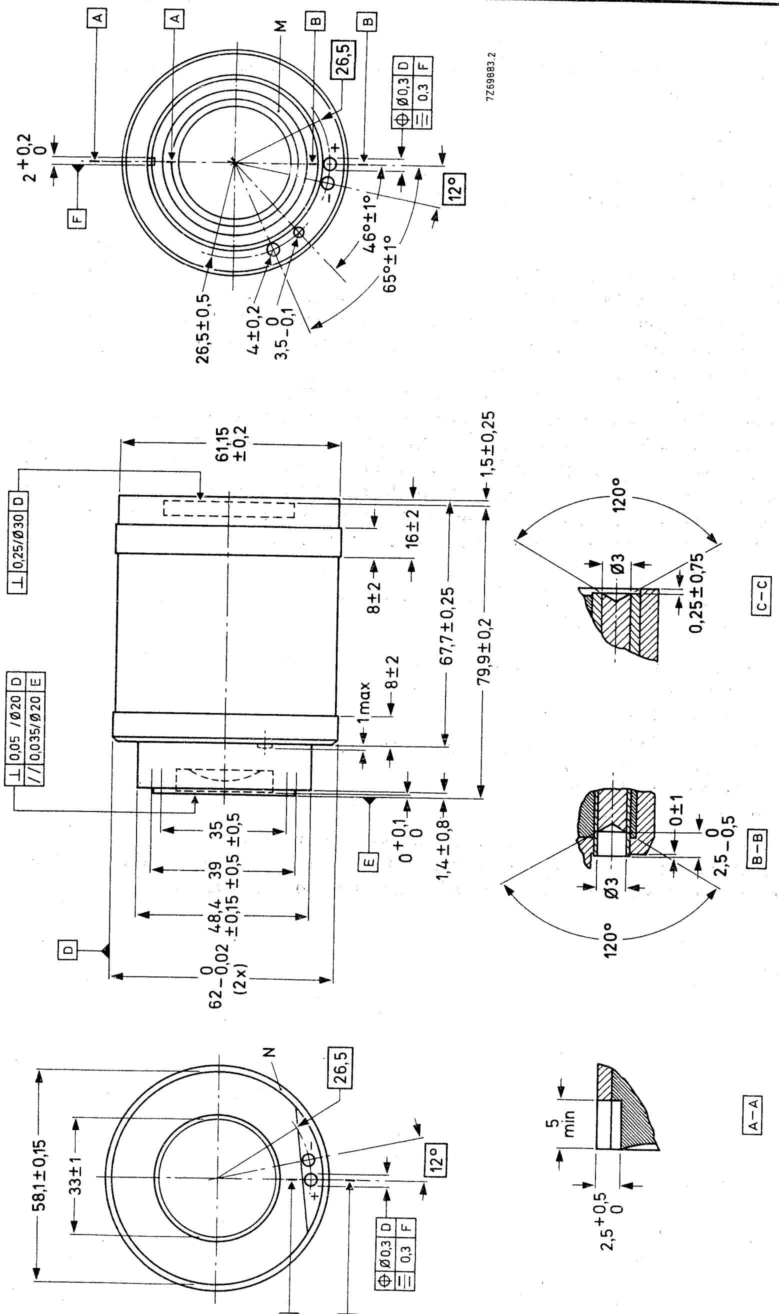


Fig. 1.

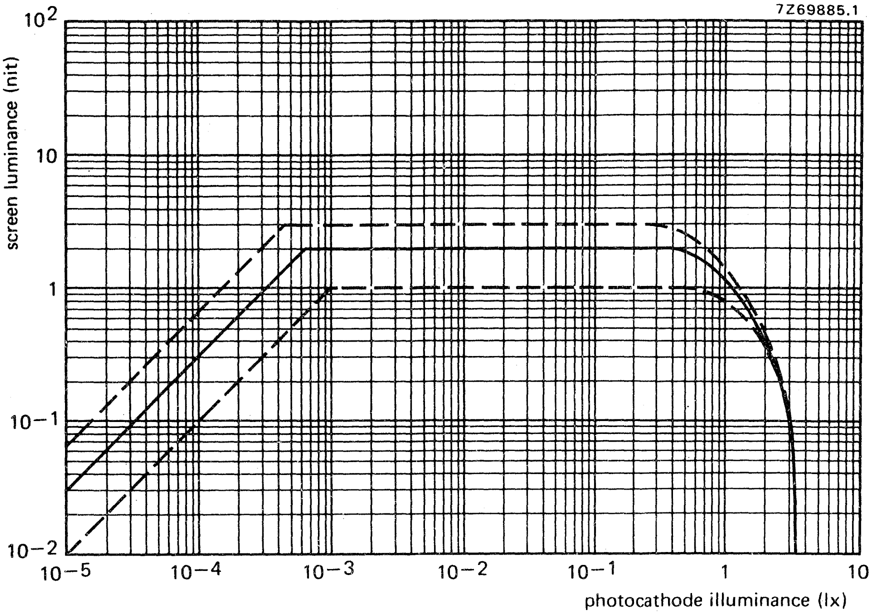


Fig. 2 Screen luminance as a function of photocathode illuminance.

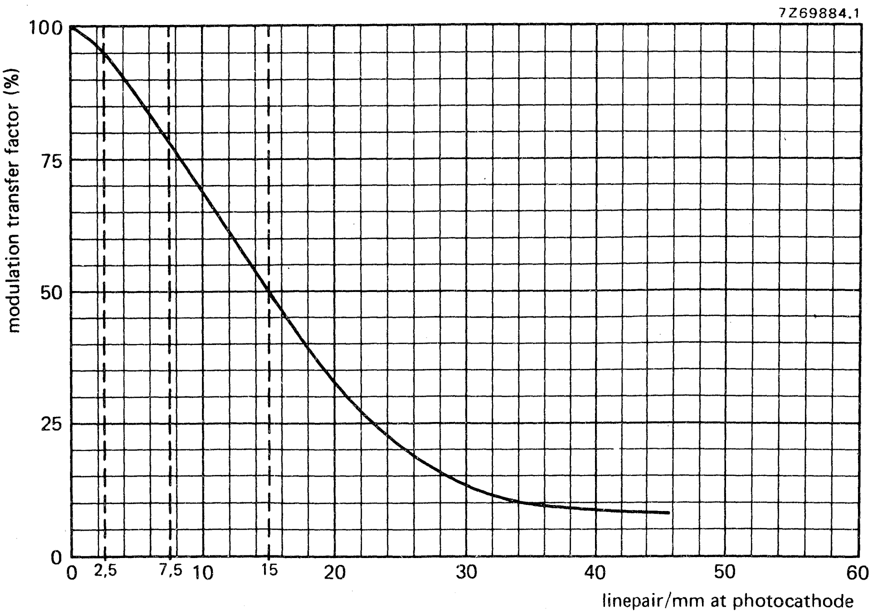


Fig. 3 Reduced area modulation transfer characteristic (minimum values).

IMAGE INTENSIFIER

The F23XX is a miniature, distortionless, electrostatic proximity focused micro-channel plate image intensifier. It has 18 mm diameter fibre-optic input and image inverting ("twister") output windows. The integral power supply incorporates automatic gain control. Point highlight saturation and bright source protection are features of this intensifier. It is primarily intended for use in lightweight night vision goggles, but is suitable for many very low light level applications.

This data must be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS – IMAGE INTENSIFIERS

CHARACTERISTICS

Measured under Recommended Operating Conditions

Photocathode

Surface		S25	
Useful diameter	min.	17,5	mm
Sensitivity *			
white light		240	μA/lm
λ = 800 nm		20	mA/W
λ = 850 nm		15	mA/W

Screen

Phosphor	Aluminized	P20	
Output window, radius of concave surface		40,00 ± 0,1	mm

* Measured before the power supply is fitted.

CHARACTERISTICS (continued)

Gain ϕ_G = 17,0 mm, $E_i \approx$ 20 μlx	min.	7 500	
	max.	15 000	
Mean screen luminance $\dot{E}_i$ = 20 mlx	min.	3	cd/m^2
	max.	1	cd/m^2
Edge magnification ϕ_D = 14 mm	min.	0,995	
	max.	1,005	
Centre resolution	min.	25	line pairs/mm
Edge resolution ϕ_E = 14 mm	min.	25	line pairs/mm
Modulation transfer factors (reduced area method)*			
2,5 cycles/mm		86	%
7,5 cycles/mm		58	%
15 cycles/mm		20	%
Equivalent background illumination	max.	0,4	μlx
Power consumption	max.	45	mW
Mass	max.	100	g

RECOMMENDED OPERATING CONDITIONS

Supply voltage (negative terminal should be grounded)		2,5	V
Photocathode illuminance	typ.	100	μlx
T_{amb}		22 ± 3	°C

WARNING

Immediately after operation, the screen will remain electrostatically charged for approximately 1 hour, during which time the intensifier should not be handled. Any attempt to discharge the intensifier by any means may result in irreparable damage.

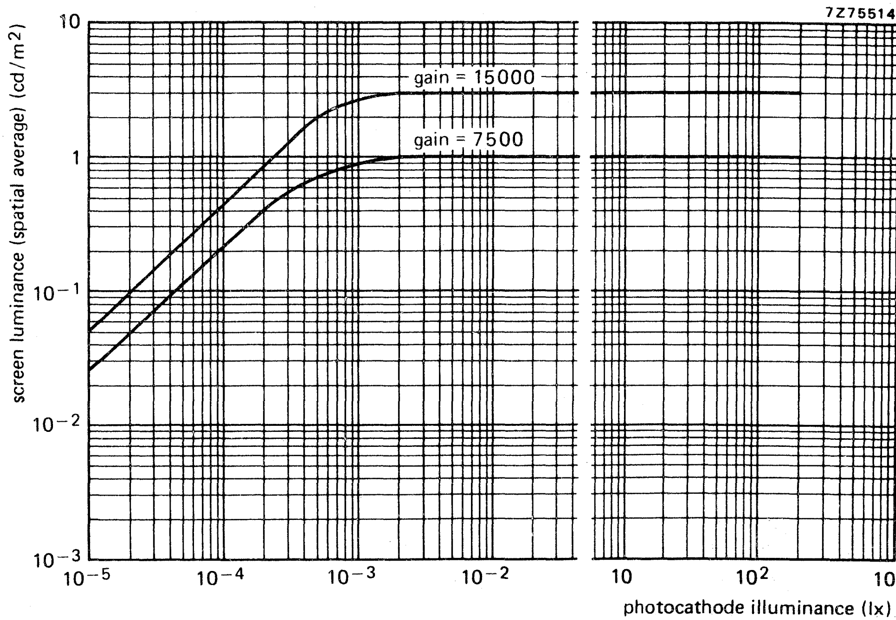
* Measured before the power supply is fitted.

RATINGS

Limiting values in accordance with the Absolute Maximum System IEC 134

Supply voltage*	max.	3,2 V
Photocathode illuminance	max.	0,1 lx
T_{amb} (for storage, 2 hours max.)	max.	65 °C
	min.	−54 °C
T_{amb} (for continuous operation)	max.	35 °C
T_{amb} (for long term storage)	max.	27 °C

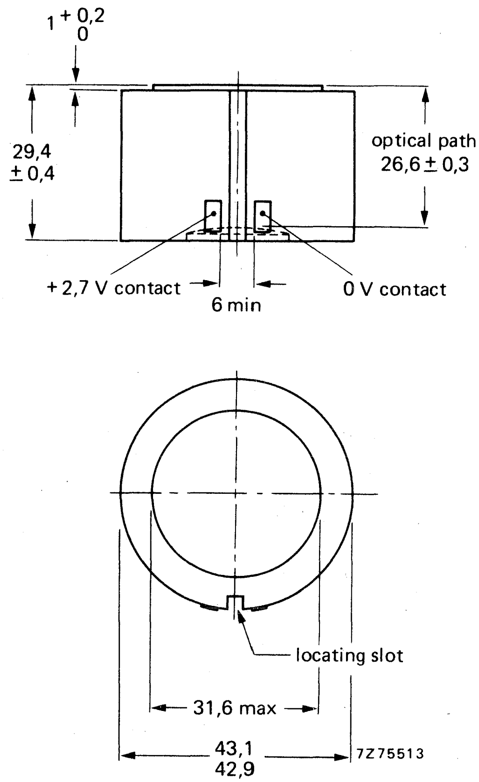
* If the supply voltage falls below 2,0 V, but remains greater than −2,7 V the intensifier will not be damaged, but may not function.



Typical automatic gain control characteristic.

OUTLINE DRAWING

Dimensions in mm



Locating slot: depth **3,05 min.**
width **3,05 min.**

contact: length 5,6
width 3,2

Maximum contact force must not exceed 10 N.

IMAGE INTENSIFIER

The 25XX is an inverting single-stage triode image intensifier with fibre-optic input and output windows. It is intended for use in various low light level applications.

This data must be read in conjunction with *General operational recommendations — Image intensifiers.*

CHARACTERISTICS

Measured under recommended operating conditions.

Photocathode

Surface		S25	
Useful diameter	min.	50	mm
Sensitivity			
white light	min.	225	μA/lm
λ = 800 nm	min.	15	mA/W
λ = 850 nm	min.	10	mA/W

Screen

Phosphor		P20	
Useful diameter	min.	16	mm

Gain, ϕ_G = 20 mm	min.	1000	
Centre magnification, ϕ_d = 10 mm	nom.	0,32	
Distortion, ϕ_D = 50 mm	max.	1	%
Centre resolution	min.	20	linepair/mm
Edge resolution, ϕ_E = 25 mm	min.	20	linepair/mm
Reduced area modulation transfer factors			
at 2,5 cycle/mm	min.	90	%
at 7,5 cycle/mm	min.	55	%
at 16 cycle/mm	min.	25	%
Equivalent background illumination (EBI)	max.	0,2	μlx
Image alignment	max.	0,5	mm
Mass	max.	200	g
Mounting position		any	

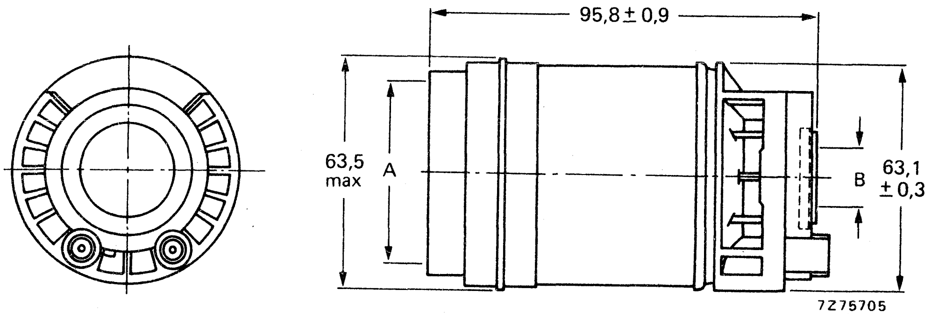
RECOMMENDED OPERATING CONDITIONS

Anode voltage		14	kV
Focusing voltage	nom.	450	V
Photocathode illuminance		100	mlx
Ambient temperature		23 ± 4	°C

LIMITING VALUES

(Absolute maximum rating system)

Supply voltage	max.	15,4	kV
Focusing voltage	max.	500	V
Photocathode illuminance	max.	1	lx
Ambient operating temperature	max.	55	°C
	min.	−40	°C
Ambient storage temperature	max.	70	°C
	min.	−55	°C



A = useful diameter of photocathode.
B = useful diameter of screen.

A = min. 50 mm
If A = 50 → B = 16 mm

Deflection assemblies J

SURVEY

type number and cat. number	inductance (mH)		resistance (Ω)			current (mA)			tube diameter
	line deflection coils	frame deflection coils	line deflection coils	frame deflection coils	focus coil	line deflection coils	frame deflection coils	focus coil	
AT1102/01 3122 137 10580	0,95	27	2,6	84	3770	250 p-p	34 p-p	23	1 inch
AT1103 3122 107 13560	0,95	27	2,6	77	2500	250 p-p	38 p-p	26	2/3 inch
AT1106 3122 137 15820	0,48	7,1	2,3	48,0	64	230 p-p	48 p-p	135	2/3 inch
AT1113/01 3122 108 84400	0,97	22	2,4	68	150	210 p-p	32 p-p	110	30 mm
AT1113/03 3122 107 10570	0,97	22	2,4	68	150	210 p-p	32 p-p	110	30 mm
AT1115/01 3122 137 12710	0,78	26	2,4	64	1760	245 p-p	34 p-p	30	1 inch
AT1116 3122 137 10970	0,78	28	2,4	62	149	330 p-p	48 p-p	105	1 inch
AT1116/06 3122 137 15040	0,78	28	2,4	62	149	300 p-p	43 p-p	105	1 inch
AT1117 3122 107 13460	0,785	13,2	10	155	—	140 p-p	25 p-p	—	5/8 inch
AT1119/01 3122 137 12700	0,78	26	2,4	64	1760	245 p-p	34 p-p	30	1 inch
AT1132/01 3122 108 87740	0,97	22,1	2,4	80	2750	210 p-p	32 p-p	25	1¼ inch
KV12S 9390 221 60000	0,86	28,7	3,2	146	55	160 p-p	25 p-p	120 p-p	2/3 inch
KV19G 9390 233 30000	0,9	23	4,6	146	—	160 p-p	25 p-p	—	2/3 inch

DEFLECTION UNIT FOR 1 inch VIDICON

QUICK REFERENCE DATA			
	inductance	resistance	current
Line deflection coils	0, 95 mH	2, 6 Ω	250 mA(p-p)
Frame deflection coils	27 mH	84 Ω	34 mA(p-p)
Focus coil		3770 Ω	23 mA

APPLICATION

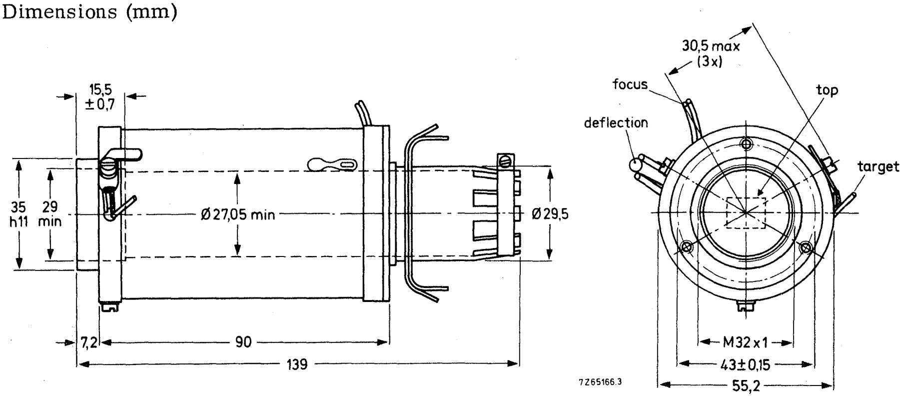
The AT1102/01 is intended for use in black and white cameras using the front-loading 1 inch Vidicons.

DESCRIPTION

The deflection unit contains the deflection and focus coils for the Plumbicon tube*) or Vidicon.

MECHANICAL DATA

Dimensions (mm)



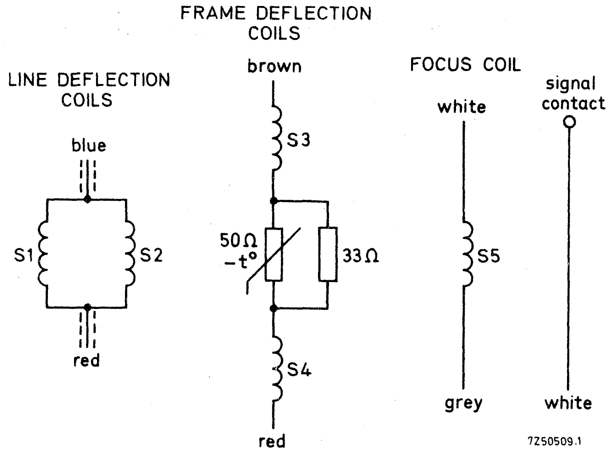
Mass per unit 536 g approx.

Body temperature

Temperature range for continuous operation -15 to +75 °C
for non-operating -25 to +85 °C

*) Registrated Trade Mark for television camera tube.

ELECTRICAL DATA (typical values)



coils	inductance (mH)	resistance (Ω)	connections
Line deflection coils	0,95 ± 3%	2,6 ± 10%	blue (screened); red (screened)
Frame deflection coils	27 ± 3%	84 ± 10%	red; brown
Focus coil		3770 ± 10%	grey (-); white (+)

Required currents for normal operation

Tube setting for Vidicon **XQ1240 :**

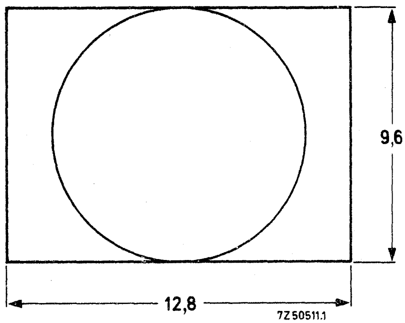
V_{g3} = 600 V, V_{g4} = 840 V } with respect to the cathode potential

Nominal scanning area: 9,6 x 12,8 mm

Line deflection current, p-p	250 mA
Frame deflection current, p-p	34 mA
Focus current	23 mA

Geometric distortion

Distortion	inside the circle	max. 1% of picture height
	outside the circle	max. 2% of picture height



Tolerances

The capacitance between the target and the tube electrodes increases less than 8 pF, when the tube is inserted in the deflection unit.

1 inch PLUMBICON/VIDICON DEFLECTION UNIT

QUICK REFERENCE DATA			
	inductance	resistance	current
Line deflection coils	0,95 mH	2,6 Ω	250 mA_{p-p}
Frame deflection coils	27 mH	77 Ω	38 mA_{p-p}
Focus coil		2500 Ω	26 mA

APPLICATION

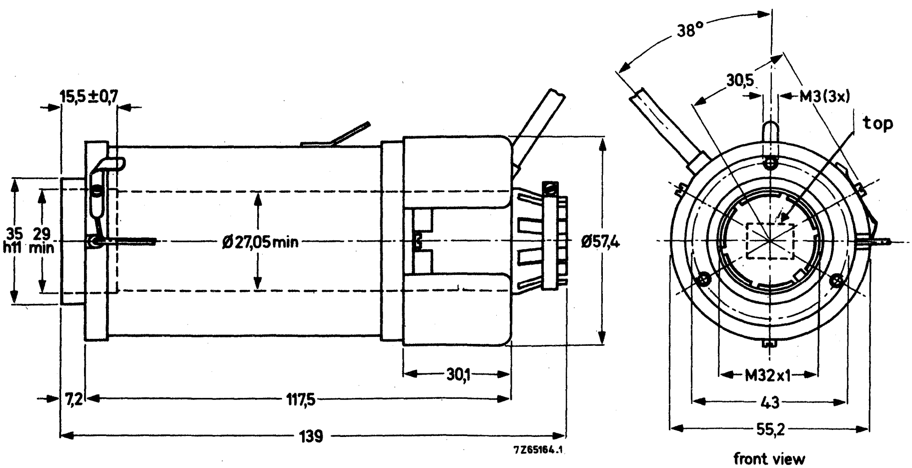
The AT1103 is intended for use in black and white cameras using the front-loading 1 inch Plumbicon XQ1070-Series or Vidicons XQ1031, XQ1041, and XQ1032.

DESCRIPTION

The deflection unit contains the deflection, alignment and focus coils for the Plumbicon or Vidicon.

MECHANICAL DATA

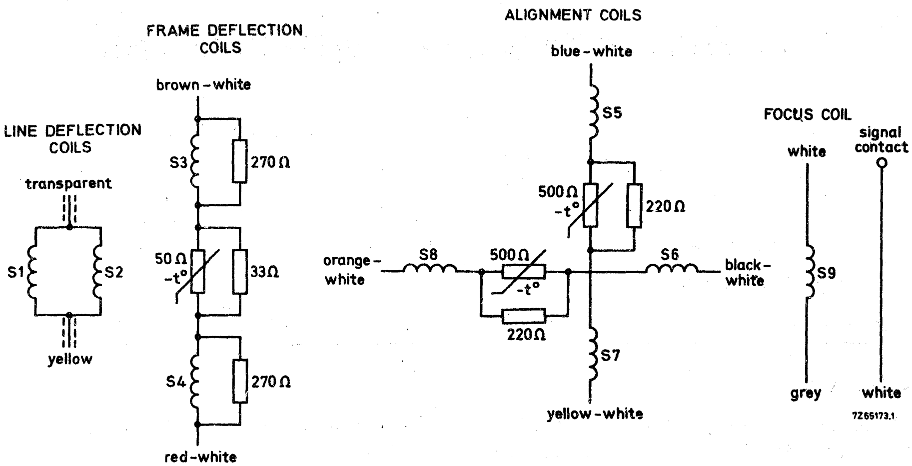
Dimensions (mm)



Body temperature

Temperature range for continuous operation	−15 to +75 °C
for non-operating	−25 to +85 °C

ELECTRICAL DATA (typical values)



coils	inductance (mH)	resistance (Ω)	connections
Line deflection coils	0,95 ± 3%	2,6 ± 10%	transparent (screened); yellow (screened)
Frame deflection coils	27 ± 3%	77 ± 10%	red-white; brown-white
Horizontal alignment coils		670 ± 10%	blue-white ; yellow-white
Vertical alignment coils		670 ± 10%	black-white ; orange-white
Focus coil		2500 ± 10%	grey (+); white (−)

Required currents for normal operation

Tube setting for Vidicon XQ1041:

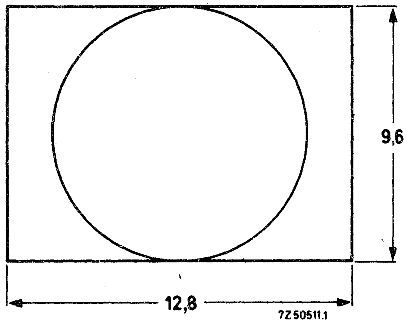
V_{g3} = 600 V, V_{g4} = 840 V } with respect to the cathode potential

Nominal scanning area: 9,6 x 12,8 mm

Line deflection current	250 mA_{p-p}
Frame deflection current	38 mA_{p-p}
Focus current	26 mA
Alignment current	1 mA will cause a shift of ≥ 0,4% of picture height

Geometric distortion

Distortions inside the circle	max. 0,5% of picture height
outside the circle	max. 1 % of picture height



Tolerances

The capacitance between the target and the tube electrodes increases less than 8 pF, when the tube is inserted in the deflection unit.

DEFLECTION UNITS FOR 2/3-INCH PLUMBICON TUBE

computer-selected triplet

QUICK REFERENCE DATA

	inductance	resistance	current
Line deflection coils	0,48 mH	2,3 Ω	230 mA (p-p)
Frame deflection coils	7,1 mH	48,0 Ω	48 mA (p-p)
Focus coil		64 Ω	135 mA
Catalogue number	3122 137 15820		

APPLICATION

The AT1106 is a computer-selected triplet of deflection units for use in colour television cameras using front-loading 2/3-inch Plumbicon* tubes (e.g. XQ1427/XQ1428), or 2/3-inch vidicons (e.g. XQ1270/XQ1271). Their small dimensions and low weight make them specially suitable for use in portable ENG cameras (Electronic News Gathering).

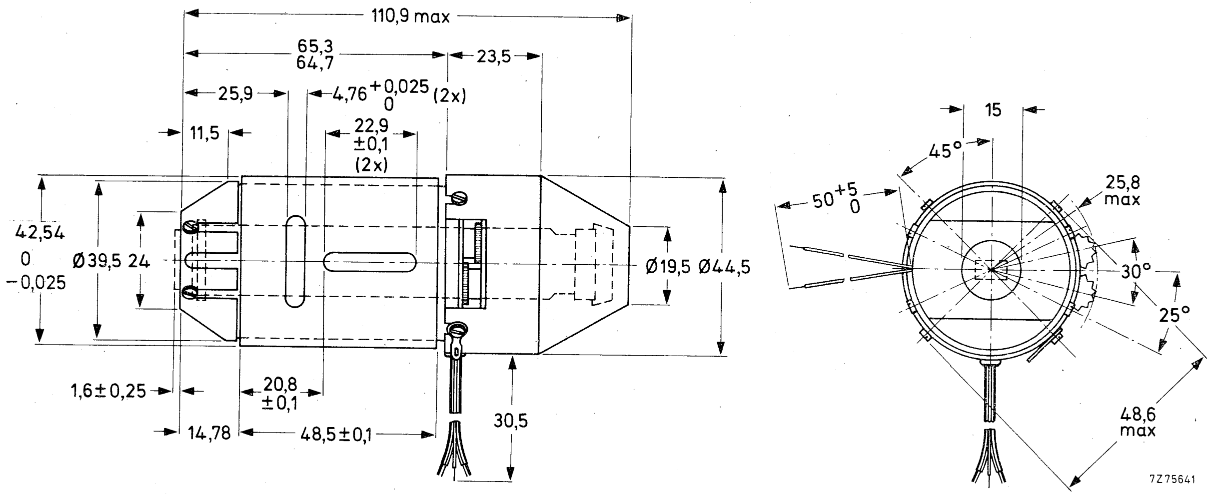
DESCRIPTION

The deflection units contain the deflection and focus coils and are provided with alignment ring-magnets. The effective alignment field intensities and directions can be adjusted with thumb wheels. The tubes are secured in position by a self-locking clamp at the rear of the units.

* Registered Trade Mark for television camera tube.

MECHANICAL DATA

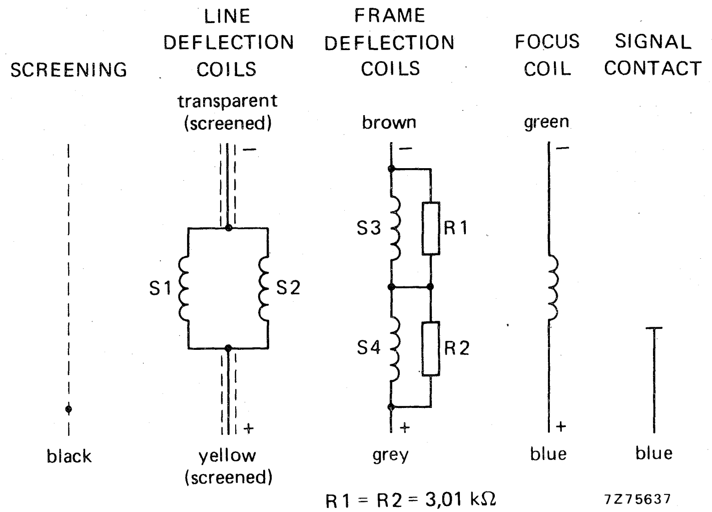
Dimensions in mm



Mass per unit 320 g

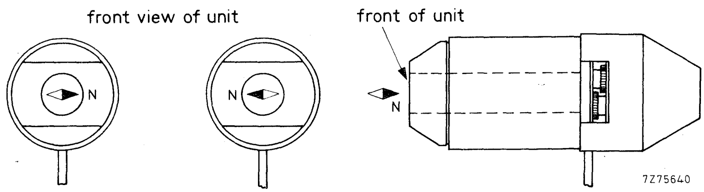
Operating body temperature range −15 to + 75 °C

ELECTRICAL DATA (typical values)



coils	inductance mH	resistance Ω	connections
Line deflection coils	0,48 ± 5%	2,3 ± 10%	transparent; yellow *
Frame deflection coils	7,1 ± 5%	48 ± 10%	brown; grey *
Focus coil		64 ± 10%	green; blue *

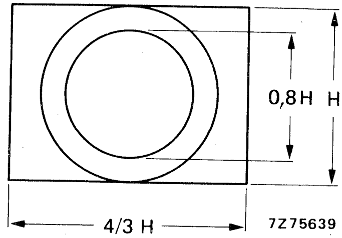
* With the yellow, grey and blue leads connected to the positive terminal of a d.c. source the north-seeking pole of a compass will indicate as shown below.



LINE COIL FRAME COIL FOCUS COIL

Requirements for normal operation

Tube setting	V_{g2}	=	300 V	with respect to cathode potential
	V_{g3}	=	440 V	
	V_{g4}*	=	750 V	
	V_{target}	=	45 V	
signal current	I_s	=	150 μA	
beam current	I_b	=	300 μA	
Line deflection current, p-p			230 mA	
Frame deflection current, p-p			48 mA	
Focus current			135 mA	
Alignment magnet field intensity	max.		0,24 mT	
	min.		0,015 mT	



Nominal scanning area: 6,6 x 8,8 (H = 6,6)

Geometric distortion

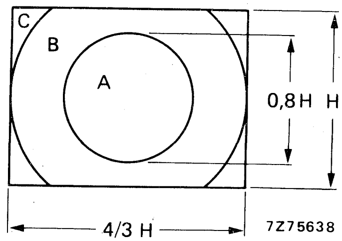
Ambient temperature 21 °C. Measured at operating temperature.

Distortion		
inside the circle	max.	0,5% of picture height
outside the circle	max.	1% of picture height
Skew error	max.	1% of picture height

Registration

The misregistration in any triplet (measured after skew correction) is not greater than:

20 ns in zone A,
40 ns in zone B,
80 ns in zone C.



The errors are measured both in horizontal and vertical direction.

* V_{g4} to be adjusted for minimum beam landing error.

DEFLECTION UNIT FOR 30 mm PLUMBICON TUBE

The deflection unit AT1113/01 is one of the three units which together form the computer-selected triplet AT1113/03.

For particulars see data sheets of deflection units AT1113/03.

DEFLECTION UNITS FOR 30 mm PLUMBICON TUBE
computer-selected triplet

QUICK REFERENCE DATA			
	inductance	resistance	current
Line deflection coils	0,97 mH	2,4 Ω	210 mA(p-p)
Frame deflection coils	22 mH	68 Ω	32 mA(p-p)
Focus coil		150 Ω	110 mA

APPLICATION

The AT1113/03 is composed out of a computer selected triplet of deflection units, for use in broadcast colour television cameras using the rear-loader 30 mm Plumbicon tube*).

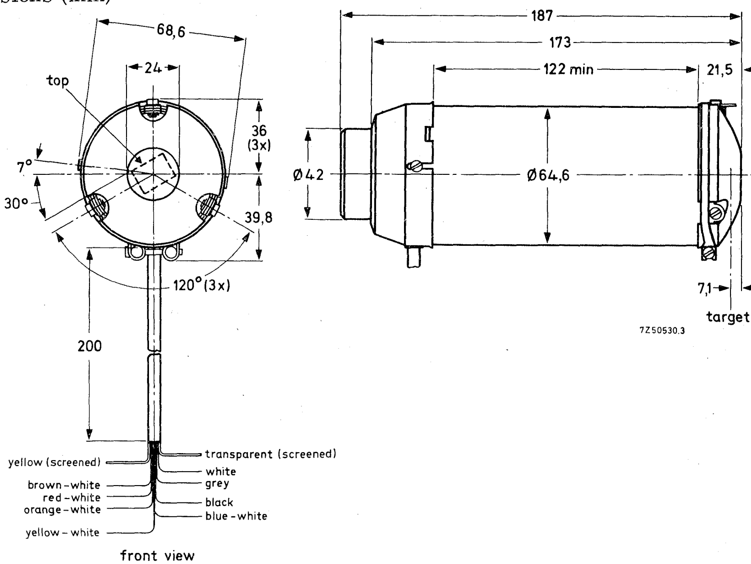
DESCRIPTION

The three deflection units contain the deflection, alignment and focus coils for the Plumbicon tubes.
The Plumbicon tube is secured in its desired position by the plastic nut ring at the rear of a unit. By turning the ring-nut the tube will automatically pushed forward until it touches the stop.

*) Registrated Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions (mm)

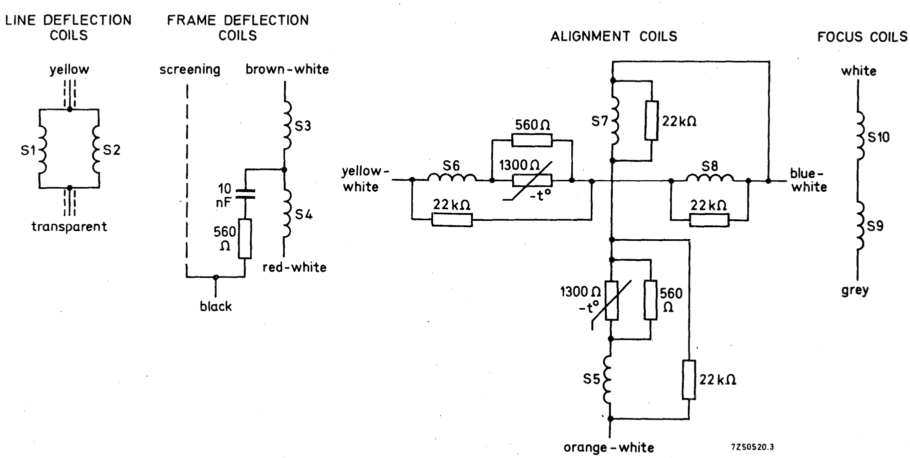


Mass per unit 1025 g approx.

Body temperature

Temperature range for continuous operation	−15 to +75 °C
for non-operating	−25 to +85 °C

ELECTRICAL DATA (typical values)



coils	inductance (mH)	resistance (Ω)	connections
Line deflection coils	0,97 ± 3%	2,4 ± 10%	yellow (screened); transparent (screened)
Frame deflection coils	22 ± 4%	68 ± 10%	brown-white; red-white
Horizontal alignment coils		2025 ± 10%	yellow-white; blue-white
Vertical alignment coils		2025 ± 10%	orange-white; blue-white
Focus coils		150 ± 10%	grey(−); white (+)

Required currents for normal operation

Tube setting for Plumbicon XQ1020/XQ1023

V_{g3} = 600 V
V_{g4} = 675 V } with respect to the cathode potential.

Nominal scanning area 12,6 x 17,1 mm
Dynamic focus on V_{g3}

Line deflection current, p-p 235 mA

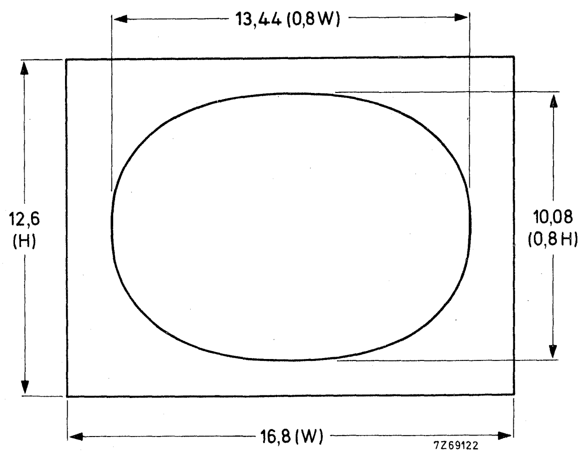
Frame deflection current, p-p 35 mA

Focus current approx. 100 mA

Alignment current 1 mA will cause a shift of ≥ 0,8% of picture height

Geometric distortion

Distortion, measured with dynamic focus
inside the circle max. 0,5% of picture height
outside the circle max. 1% of picture height



Registration

The deflection units are supplied in matched sets of three units where in the misregistration in any set is not greater than 0, 1% of picture height inside the ellipse and 0, 2% outside the ellipse.
The errors are horizontally and vertically measured.

Resolution

The resolution at the corners of the picture is not less than 75% of the resolution at the centre, measured with dynamic focus at 0, 4 of the picture diagonal out of the centre.

Tolerances

The capacitance between the target and the tube electrodes increases less than 6 pF, when the tube is inserted in the deflection unit.

DEFLECTION UNITS FOR 1 inch PLUMBICON TUBE

computer-selected triplet

QUICK REFERENCE DATA	inductance	resistance	current
Line deflection coils	0,78 mH	2,4 Ω	245 mA(p-p)
Frame deflection coils	26 mH	64 Ω	34 mA(p-p)
Focus coil		1760 Ω	30 mA

APPLICATION

The AT1115/01 is composed out of a computer selected triplet of deflection units, for use in broadcast colour television cameras using the rear-loading 1 inch Plumbicon tube *) XQ1080-Series.

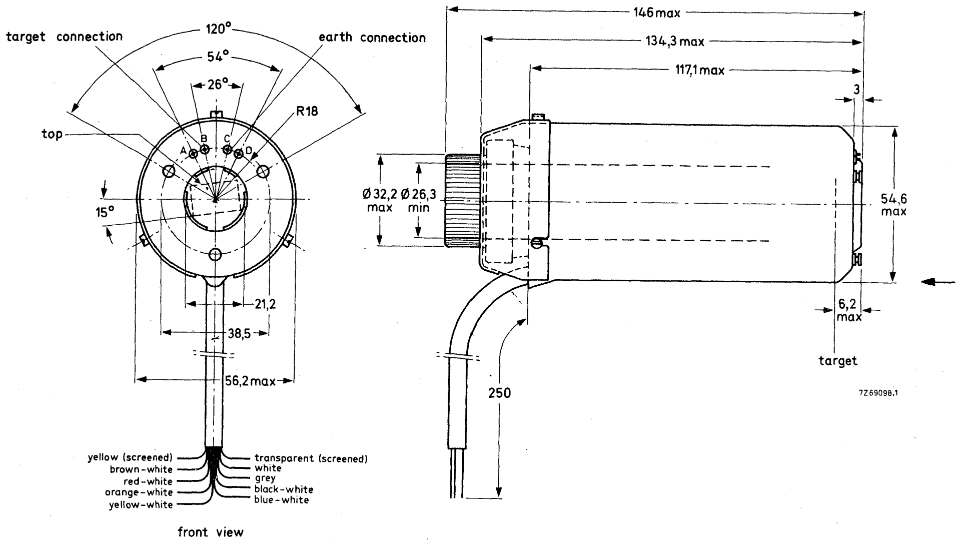
DESCRIPTION

The three deflection units contain the deflection, alignment and focus coils for the Plumbicon tubes.
Moreover each unit is provided with a locking device at the front, in which a holder for a field flattener lens can be fitted without the use of tools.
The Plumbicon tube is secured in its desired position by the plastic nut ring at the rear of a unit. By turning the ring-nut the tube will automatically pushed forward until it touches the stop. Space has been provided to built in a video pre-amplifier (connections A, C and D see dimensional drawing).

*) Registrated Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions (mm)

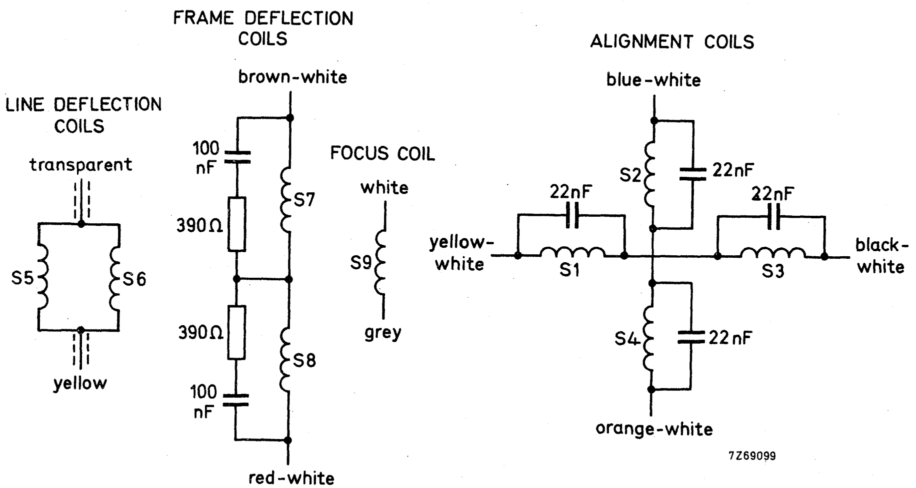


Mass per unit 560 g approx.

Body temperature

Temperature range for continuous operation	−15 to +75 °C
for non-operating	−25 to +85 °C

ELECTRICAL DATA (typical values)



coils	inductance (mH)	resistance (Ω)	connections
Line deflection coils	0,78 ± 3%	2,4 ± 5%	transparent (screened) ; yellow (screened)
Frame deflection coils	26	64 ± 8%	red-white ; brown-white
Horizontal alignment coils		550 ± 10%	yellow-white; black-white
Vertical alignment coils		550 ± 10%	orange-white; blue-white
Focus coil		1760 ± 10%	grey (+) ; white (-)

Required currents for normal operation

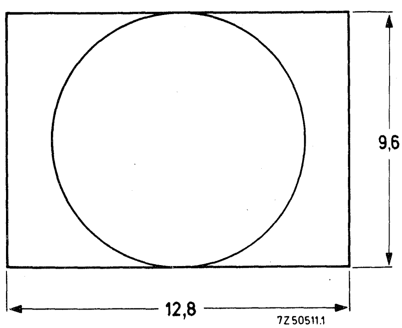
Tube setting: V_{g5} = +470 V, V_{g6} = +750 V } with respect to cathode potential

Nominal scanning area : 9,6 x 12,8 mm
Dynamic focus on V_{g5}

Line deflection current, p-p	245	mA
Frame deflection current, p-p	34	mA
Focus current	30	mA
Alignment current	1	mA will cause a shift of ≥0,6% of picture height

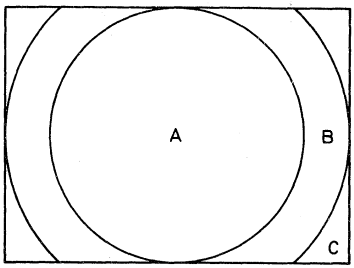
Geometric distortion

Distortion, measured with dynamic focus	
inside the circle	max. 0,5% of picture height
outside the circle	max. 1% of picture height
Skew error	max. 0,4% of picture height



Registration

The deflection units are supplied in matched sets of three units wherein the misregistration in any set is not greater than :



7Z69350

in zone A 25 ns

in zone B 40 ns

in zone C 80 ns

The errors are horizontally and vertically measured.

Resolution

The resolution at the corners of the picture is not less than 75 % of the resolution at the centre, measured with dynamic focus at 0, 4 of the picture diagonal out of the centre.

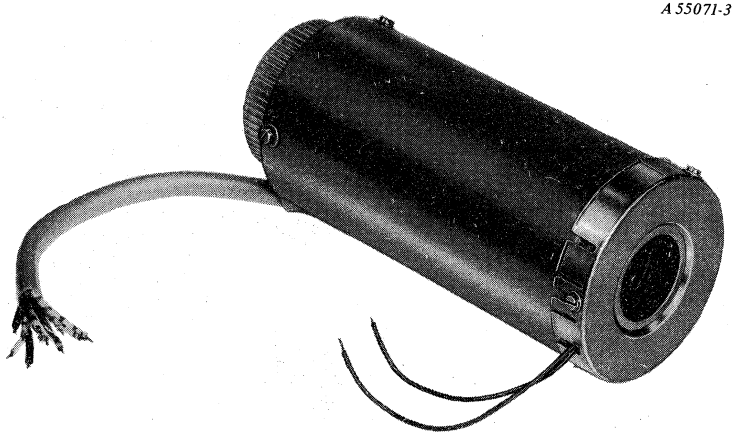
Tolerances

The difference between the focus currents of the deflection units of a selected triplet shall not exceed ± 1 %, measured at one tube as a reference.

The capacitance between the target and the tube electrodes increases less than 6 pF, when the tube is inserted in the deflection unit.

DEFLECTION UNIT FOR 1 inch PLUMBICON TUBE

A 55071-3

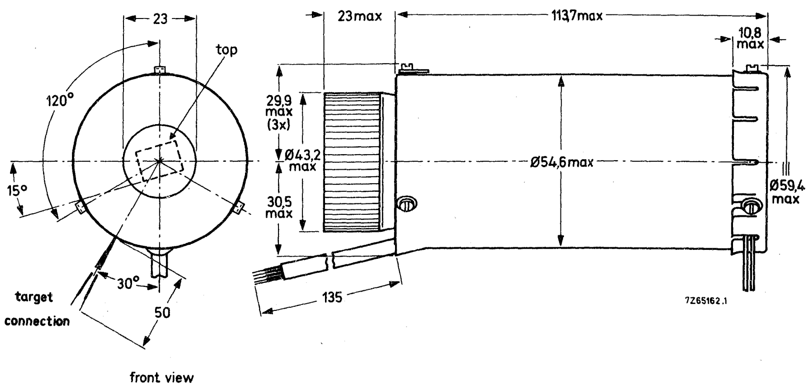


APPLICATION

Deflection unit consisting of deflection, focus and alignment coils for a front-loading 1 inch Plumbicon tube *).

MECHANICAL DATA

Dimensions (mm)

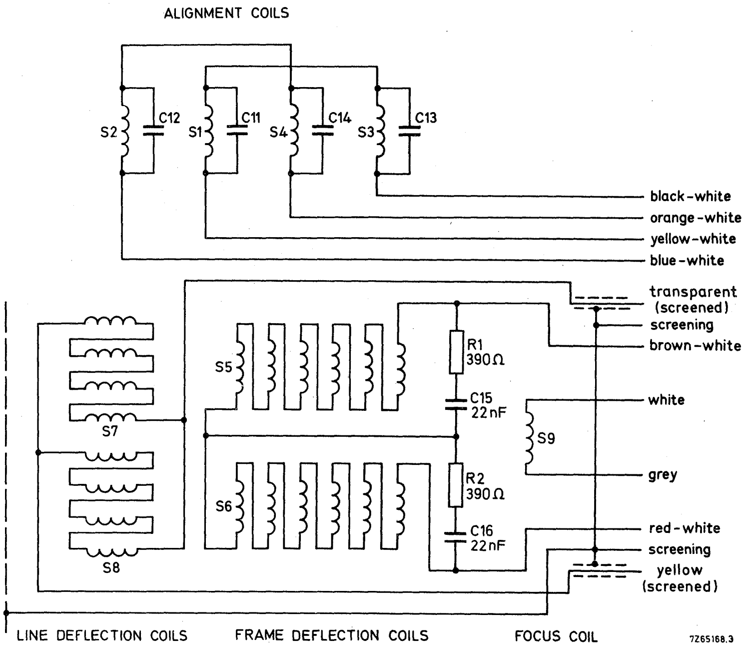


Mass per unit   615 g approx.

*) Registrated Trade Mark for television camera tube.

ELECTRICAL DATA

Maximum operating temperature 75 °C



coils		inductance (mH)	resistance (Ω)
line deflection coils	S7// S8	0, 78 ± 10 %	2, 4 ± 10 %
frame deflection coils	S5 + S6	28 ± 10 %	62 ± 10 %
alignment coils (horizontal)	S1 + S3		550 ± 10 %
alignment coils (vertical)	S2 + S4		550 ± 10 %
focus coil *)	S9		149 ± 10 %

Required currents for normal operation (V_{g3} = 600 V; V_{g4} = 960 V)

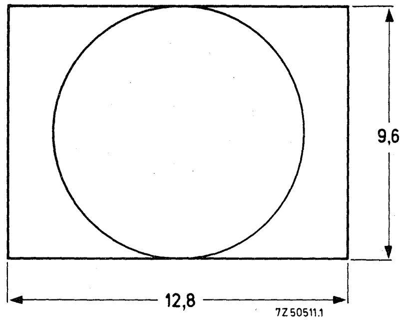
Line deflection current, p-p	330	mA
Frame deflection current, p-p	48	mA
Focus current	105	mA
Alignment current	1	mA will cause a shift of 0, 6 % of picture height

*) Polarity of focus coil: grey terminal positive. The polarity of the focus coil should be such that a north-seeking pole is attracted to the image end of the coil, with this pole located outside of and at the image end of the coil.

Geometric distortion

Distortion inside the circle max. 0,5 % of picture height

outside the circle max. 1 % of picture height



MOUNTING

To get line scanning in horizontal position the unit has to be positioned with the signal contact 225 ° clockwise with respect to north (front view).

To avoid geometric distortion the mu-metal screening may not become deformed.

To guarantee the specification the lacquered screws may not be removed.

DEFLECTION UNITS FOR 1inch PLUMBICON TUBE
computer-selected triplet

QUICK REFERENCE DATA			
	inductance	resistance	current
Line deflection coils	0,78 mH	2,4 Ω	300 mA (p-p)
Frame deflection coils	28 mH	62 Ω	43 mA (p-p)
Focus coil		149 Ω	105 mA

APPLICATION

The AT1116/06 is composed out of a computer selected triplet of deflection units, for use in broadcast colour television cameras using the front-loading 1 inch Plumbicon tube*) XQ1070 -Series.

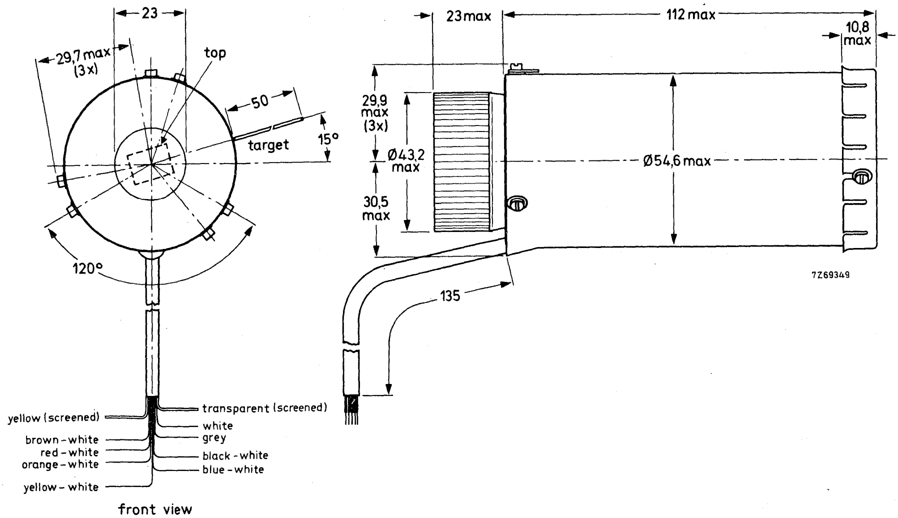
DESCRIPTION

The three deflection units contain the deflection, alignment and focus coils for the Plumbicon tubes.
The Plumbicon tube is secured in its desired position by the plastic nut ring at the rear of a unit. By turning the ring-nut the tube will automatically be pushed backward until it touches the stop.

*) Registrated Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions (mm)

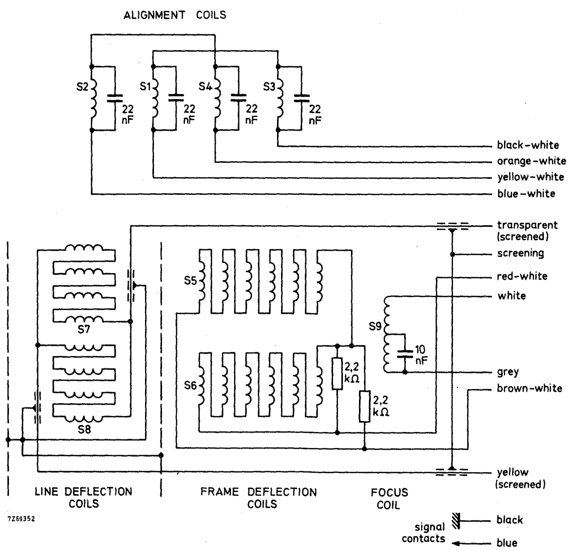


Mass per unit 615 g approx.

Body temperature

Temperature range	for continuous operation	−15 to +75 °C
	for non-operating	−25 to +85 °C

ELECTRICAL DATA (typical values)



coils	inductance (mH)	resistance (Ω)	connections
Line deflection coils	0,78 ± 5%	2,4 ± 10%	transparent (screened); yellow (screened) *)
Frame deflection coils	28 ± 5%	62 ± 10%	red-white; brown-white *)
Horizontal alignment coils		550 ± 10%	yellow-white; black-white
Vertical alignment coils		550 ± 10%	orange-white; blue-white
Focus coil		149 ± 10%	grey (+); white (-)

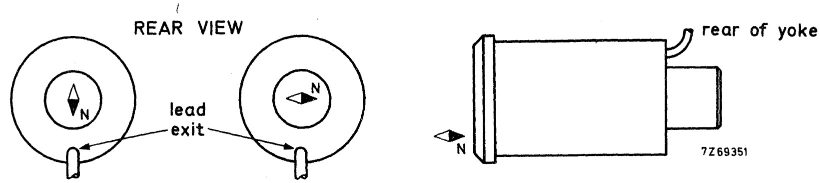
Required currents for normal operation

Tube setting: V_{g3} = +600 V, V_{g4} = +960 V } with respect to cathode potential

Nominal scanning area: 9,6 x 12,8 mm

Line deflection current, p-p	300 mA
Frame deflection current, p-p	43 mA
Focus current	105 mA
Alignment current	1 mA will cause a shift of 0,6% of picture height.

*) With the positive side of a power supply applied to the yellow, brown-white and grey leads, the north-seeking end of a compass indicates as shown.



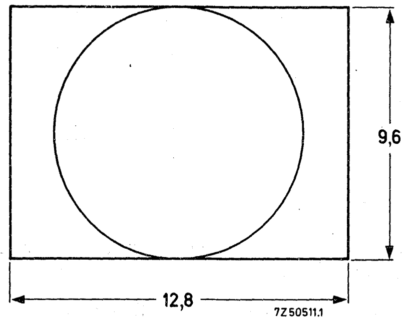
transparent (-)
yellow (+)
HORIZONTAL COIL

red-white (-)
brown-white (+)
VERTICAL COIL

white (-)
grey (+)
FOCUS COIL

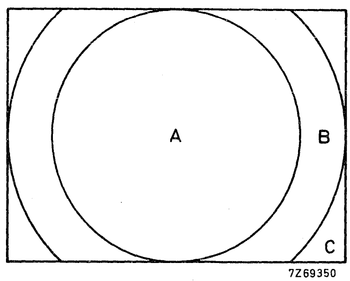
Geometric distortion

Distortion,	inside the circle	max. 0,5 % of picture height
	outside the circle	max. 1 % of picture height



Registration

The deflection units are supplied in matched sets of three units wherein the misregistration in any set is not greater than :



in zone A 25 ns

in zone B 40 ns

in zone C 80 ns

The errors are horizontally and vertically measured.

DEFLECTION UNIT FOR 5/8 inch PLUMBICON TUBE

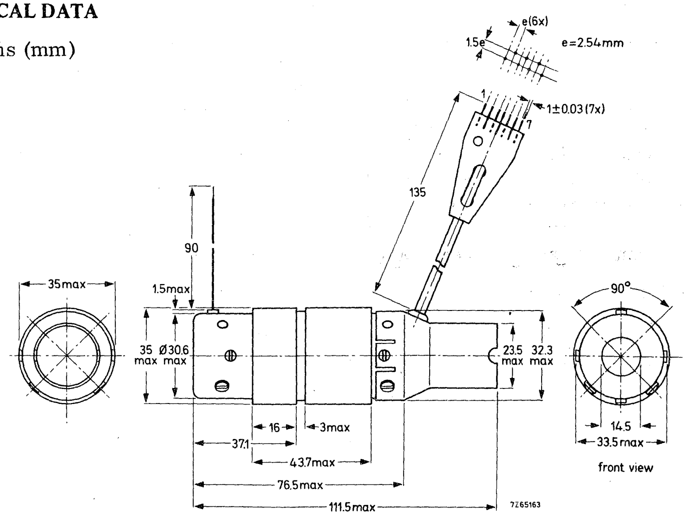
A 55071-1

APPLICATION

Deflection unit, consisting of deflection and alignment coils for a rear-loading 5/8 inch Plumbicon tube *).

MECHANICAL DATA

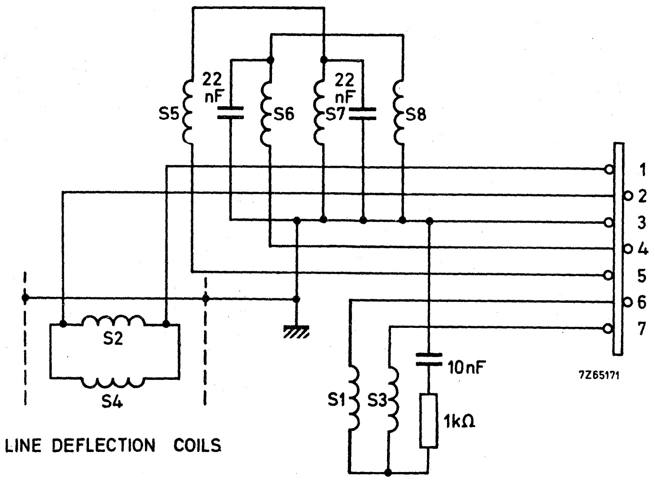
Dimensions (mm)



Mass per unit 130 g approx.

*) Registrated Trade Mark for television camera tube.

ELECTRICAL DATA



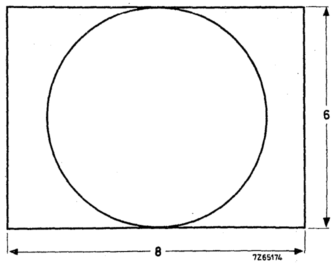
coils		inductance (mH)	resistance at 25 °C (Ω)
line deflection coils	S2 // S4	0,785 ± 10 %	10 ± 10 %
frame deflection coils	S1 + S3	13,2 ± 10 %	155 ± 10 %
alignment coils (horizontal)	S6 + S8		520 ± 10 %
alignment coils (vertical)	S5 + S7		520 ± 10 %

Required currents for normal operation (V_{g2-4} = 300 V; V_{g5} = 600 V)

Line deflection current, p-p	140 mA
Frame deflection current, p-p	25 mA
Alignment current at 0, 2 mT	7,5 mA

Geometric distortion

Distortion	inside the circle	max. 0.5 % of picture height
	outside the circle	max. 1 % of picture height



DEFLECTION UNIT FOR 1 inch PLUMBICON TUBE

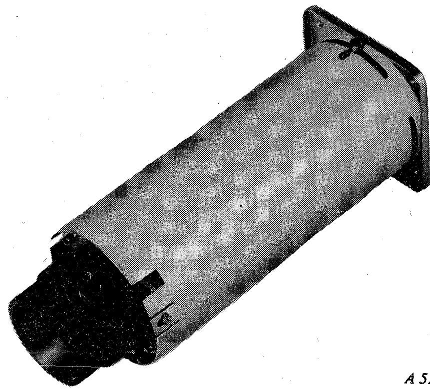
The deflection unit AT1119/01 is one of the three units which together form the computer-selected triplet AT1115/01.

For particulars see data sheets of deflection units AT1115/01.

APPLICATION

Can be used where rear-loading and good magnetic screening are required, e.g. in space-craft applications.

DEFLECTION UNIT FOR 1¼ inch PLUMBICON TUBE



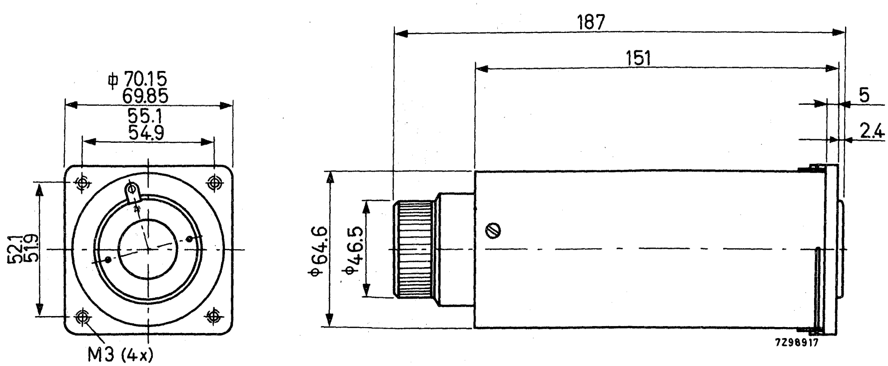
A 520 32 - 1

APPLICATION

Deflection assembly, consisting of deflection, focus and alignment coils for a Plumbicon tube *).

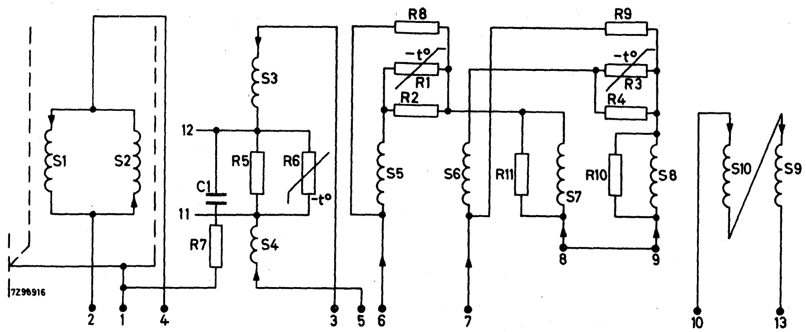
MECHANICAL DATA

Dimensions in mm

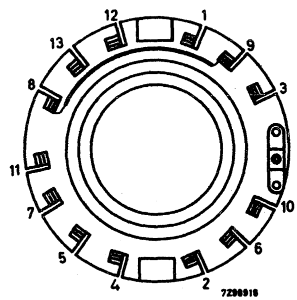


*) Registrated Trade Mark for television camera tube.

ELECTRICAL DATA (typical values)



S_1 - S_2	= line deflection coils	R_1, R_3	= 1300 Ω ± 20% at 25 °C (NTC)
S_3 - S_4	= frame deflection coils	R_2, R_4, R_7	= 560 Ω
S_5 - S_8	= alignment coils	R_5	= 33 Ω
S_9 - S_{10}	= focus coils	R_6	= 32 Ω ± 20% at 25 °C (NTC)
C_1	= 10 nF	R_8, R_9, R_{10}, R_{11}	= 22 kΩ



coils	measuring points	inductance (mH)	resistance (Ω)
$S_1 + S_2$	2 - 4	0,97 ± 3 %	2,4 ± 10 %
$S_3 + S_4$	3 - 5	22,1 ± 4 %	80 ± 10 %
$S_5 + S_7$	6 - 8		2025 ± 10 % *)
$S_6 + S_8$	7 - 9		2025 ± 10 % *)
$S_9 + S_{10}$	10 - 13		2750 ± 10 %
Internal shield	1		

*) Resistance drift between 25 and 60 °C is 0,75 %.

Required currents for normal operation

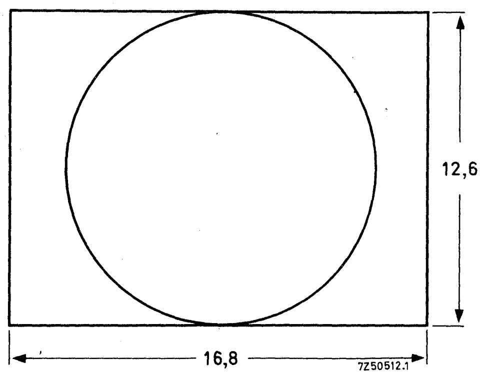
Tube setting: $V_{g3} = 600$ V, $V_{g4} = 675$ V } with respect to the cathode potential

Nominal scanning area 12, 6 x 16, 8 mm

Line deflection current, p-p	210 mA
Frame deflection current, p-p	32 mA
Focus current ($S_9 + S_{10}$ in series)	25 mA
Maximum alignment currents	1 mA will cause a shift of ≥ 0, 8 % of picture height

Geometric distortion

Distortion inside the circle	max. 0, 5 % of picture height
outside the circle	max. 1 % of picture height



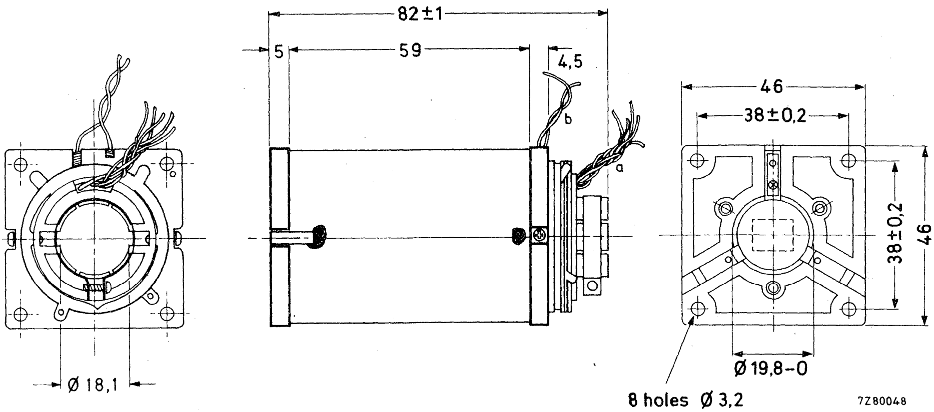
DEFLECTION UNIT FOR 2/3 inch VIDICON

APPLICATION

Deflection assembly consisting of deflection and focus coils and alignment ring magnets for 17,7 mm (2/3 in) diameter vidicon tubes, e.g. XQ1270 and XQ1271.

MECHANICAL DATA

Dimensions in mm



Mass of the unit	approx. 300 g

Alignment ring magnets

Magnet rotation torque (with one ring fixed)	0,005 to 0,15 Nm

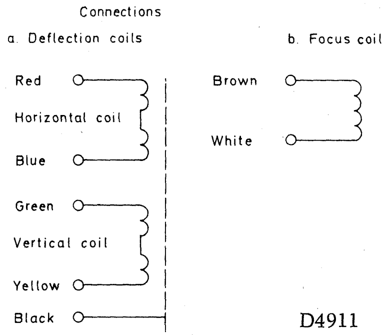
Leads

Colour coding as shown (next page)

Length from rear surface of focus flange	190 ± 10 mm

ELECTRICAL DATA

Operating temperature — −10 to +60 °C



D4911

coils	inductance (mH)	resistance (Ω)
line deflection coils [1]	0,88 ± 10%	2,9 ± 10%
field deflection coils [1]	32 ± 10%	146 ± 10%
focus coil [2]		55 ± 5%

Required currents for normal operation (XQ1270, XQ1271, scanning 8,8 mm x 6,6 mm, $V_{g3} \approx 275$ V, $V_{g2} = 300$ V)

Line deflection current, p-p	160	mA	± 5%
Field deflection current, p-p	25	mA	± 5%
Focus current at 5 mT	120	mA	
Insulation resistance between coils and between coils and earth shield	> 50	MΩ	
Flux density (at 120 mA) of focus coil	5 ± 10%	mT	
Flux density of alignment ring magnets	0,05 to 0,5 ± 0,1	mT	

Geometric distortion

Barrel, keystone and pincushion distortions are within	2%
Rectangularity	90° ± 2°

[1] If a positive going voltage is applied to the red lead (line coils) and to the green lead (field coil) normal scanning will be obtained.

[2] If a positive voltage is applied to the brown lead, the south pole is at the front of the coil.

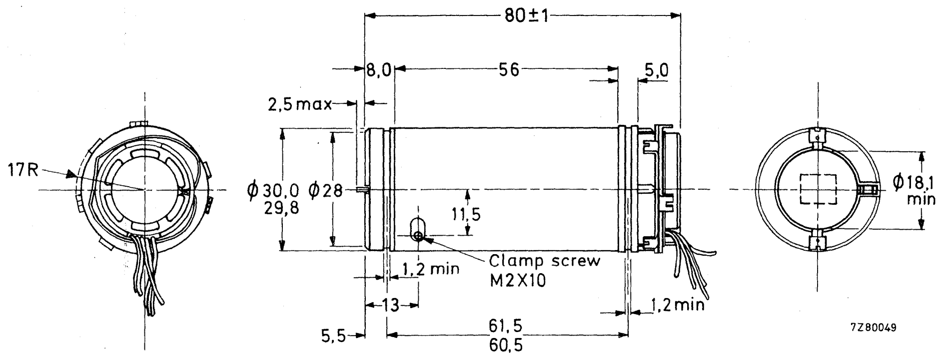
DEFLECTION UNIT FOR 2/3 inch VIDICON

APPLICATION

Deflection coil assembly consisting of deflection coils and alignment ring magnets for 17,7 mm (2/3 in) diameter vidicon tubes with magnetic deflection and electrostatic focusing, e.g. XQ1272.

MECHANICAL DATA

Dimensions in mm



Mass of the unit	approx. 56 g

Alignment ring magnets

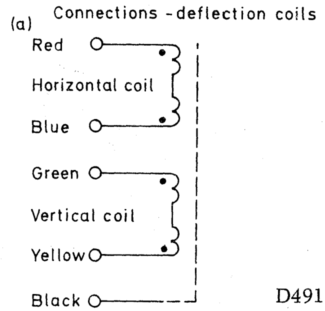
Magnet rotation torque (with one ring fixed)	0,005 to 0,15 Nm

Leads

Colour coding as shown (next page)	
Length from rear of deflection unit	190 ± 10 mm

ELECTRICAL DATA

Operating temperature -10 to +60 °C



D4912

coils	inductance (mH)	resistance (Ω)
Line deflection coils [1]	0,9 ± 10%	4,4 ± 10%
Field deflection coils [1]	26 ± 10%	145 ± 10%

Required currents for normal operation (XQ1272, scanning 8,8 mm x 6,6 mm, V_{g5} = 500 V, $V_{g3} = V_{g2}$ = 300 V)

Line deflection current, p-p	160	mA	± 5%
Field deflection current, p-p	25	mA	± 5%
Insulation resistance between coils and between coils and earth shield	> 50	MΩ	
Flux density of alignment ring magnets	0,3 to 3 ± 0,1	mT	

Geometric distortion

Barrel, keystone and pincushion distortions are within 2%

Rectangularity $90^{\circ} \pm 2^{\circ}$

[1]) If a positive going voltage is applied to the red lead (line coils) and to the green lead (field coil), normal scanning will be **obtained.**

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J = Deflection assemblies

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