PHILIPS

Data handbook

Electronic components and materials

Electron tubes

Part 10 May 1983

Camera tubes and accessories

Image intensifiers

Infrared detectors

ELECTRON TUBES

PART 10 — MAY 1983

CAMERA TUBES, IMAGE INTENSIFIERS, INFRARED DETECTORS

INDEX AT THE BACK OF THE BOOK

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 four series of handbooks each comprising several parts.

ELECTRON TUBES	BLUE
SEMICONDUCTORS	RED
INTEGRATED CIRCUITS	PURPLE
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.

ELECTRON TUBES (BLUE SERIES)

The blue series of data handbooks is comprised of the following parts:

T1	**Tubes for r.f. heating**
T2	**Transmitting tubes for communications**
T3	**Klystrons, travelling-wave tubes, microwave diodes**
ET3	**Special Quality tubes, miscellaneous devices** (will not be reprinted)
T4	**Magnetrons**
T5	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
T6	**Geiger-Müller tubes**
T7	**Gas-filled tubes** Segment indicator tubes, indicator tubes, dry reed contact units, thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes, associated accessories
T8	**Picture tubes and components** Colour TV picture tubes, black and white TV picture tubes, colour monitor tubes for data graphic display, monochrome monitor tubes for data graphic display, components for colour television, components for black and white television and monochrome data graphic display
T9	**Photo and electron multipliers** Photomultiplier tubes, phototubes, single channel electron multipliers, channel electron multiplier plates
T10	**Camera tubes and accessories, image intensifiers**
T11	**Microwave components and assemblies**

SEMICONDUCTORS (RED SERIES)

The red series of data handbooks is comprised of the following parts:

S1 **Diodes**
Small-signal germanium diodes, small-signal silicon diodes, voltage regulator diodes($<$ 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes

S2 **Power diodes, thyristors, triacs**
Rectifier diodes, voltage regulator diodes ($>$ 1,5 W), rectifier stacks, thyristors, triacs

S3 **Small-signal transistors**

S4 **Low-frequency power transistors and hybrid IC modules**

S5 **Field-effect transistors**

S6 **R.F. power transistors and modules**

S7 **Microminiature semiconductors for hybrid circuits**

S8 **Devices for optoelectronics**
Photosensitive diodes and transistors, light-emitting diodes, displays, photocouplers, infrared sensitive devices, photoconductive devices.

S9 Taken into handbook T11 of the blue series

S10 **Wideband transistors and wideband hybrid IC modules**

INTEGRATED CIRCUITS (PURPLE SERIES)

The purple series of data handbooks is comprised of the following parts:

IC1 **Bipolar ICs for radio and audio equipment**

IC2 **Bipolar ICs for video equipment**

IC3 **ICs for digital systems in radio, audio and video equipment**

IC4 **Digital integrated circuits**
LOCMOS HE4000B family

IC5 **Digital integrated circuits – ECL**
ECL10 000 (GX family), ECL100 000 (HX family), dedicated designs

IC6* **Professional analogue integrated circuits**

IC7 **Signetics bipolar memories**

IC8 **Signetics analogue circuits**

IC9 **Signetics TTL logic**

* This handbook will be available later this year.

COMPONENTS AND MATERIALS (GREEN SERIES)

The green series of data handbooks is comprised of the following parts:

C1 **Assemblies for industrial use**
PLC modules, PC20 modules, HNIL FZ/30 series, NORbits 60-, 61-, 90-series, input devices, hybrid ICs

C2 **Television tuners, video modulators, surface acoustic wave filters**

C3 **Loudspeakers**

C4 **Ferroxcube potcores, square cores and cross cores**

C5 **Ferroxcube for power, audio/video and accelerators**

C6 **Electric motors and accessories**
Permanent magnet synchronous motors, stepping motors, direct current motors

C7 **Variable capacitors**

C8 **Variable mains transformers**

C9 **Piezoelectric quartz devices**
Quartz crystal units, temperature compensated crystal oscillators, compact integrated oscillators, quartz crystal cuts for temperature measurements

C10 **Connectors**

C11 **Non-linear resistors**
Voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC)

C12 **Variable resistors and test switches**

C13 **Fixed resistors**

C14 **Electrolytic and solid capacitors**

C15 **Film capacitors, ceramic capacitors**

C16 **Piezoelectric ceramics, permanent magnet materials**

CAMERA TUBES, GENERAL SECTION A

PRINCIPLES OF OPERATION

1 PHOTOCONDUCTIVE CAMERA TUBES

1.1 General description

A lens system focuses an image of the scene to be televised onto the faceplate of the camera tube. A photoconductive layer on the faceplate converts this image into a charge distribution which is then scanned line-by-line by an electron beam and transformed into an electrical signal.

Figure 1 illustrates the electrode and coil arrangement for a vidicon or Plumbicon tube with magnetic focusing and deflection. An electron gun produces the scanning electron beam, which is directed by the focusing and deflection coils to land upon a target containing the photoconductive layer.

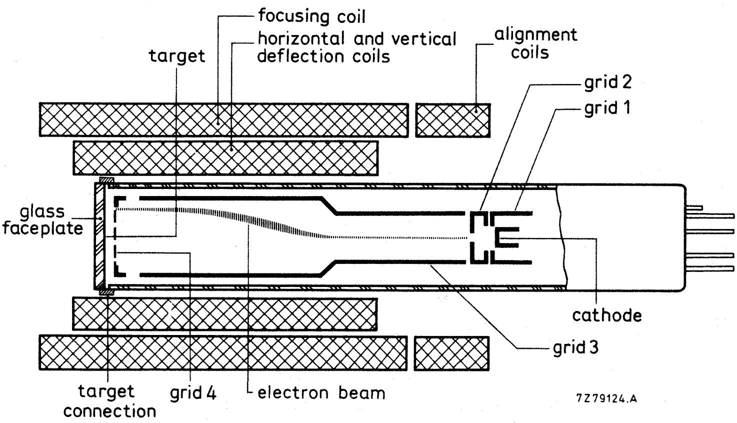


Fig. 1 Electrode and coil arrangement of a vidicon or Plumbicon tube.

The electron gun comprises an indirectly heated cathode and grids 1 to 4. The voltage on grid 1 controls the electron beam current. Grid 2 (first anode) accelerates the electrons, which subsequently pass through a cylindrical electrode (grid 3) and a fine mesh (grid 4), which establishes a uniform decelerating field in front of the target.

The focusing coil produces an axial magnetic field that, in combination with an appropriate voltage applied to grid 3, focuses the beam on the target. Focusing can be adjusted by varying either the grid 3 voltage or the focusing coil current.

Two sets of alignment coils produce an adjustable transverse magnetic field, enabling the beam to be aligned parallel to the tube axis so that it lands perpendicularly on the target.

Finally, two sets of deflection coils supply the varying magnetic field needed to deflect the beam for line-by-line scan of the target.

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.

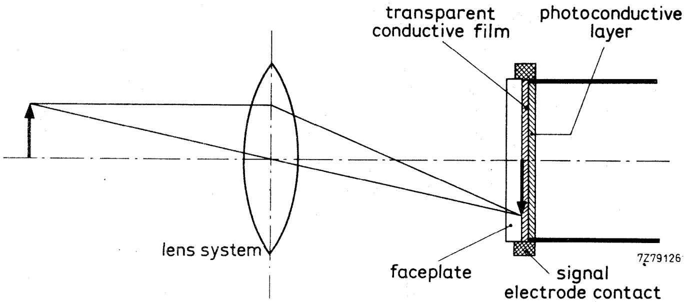


Fig. 2 Target section.

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.

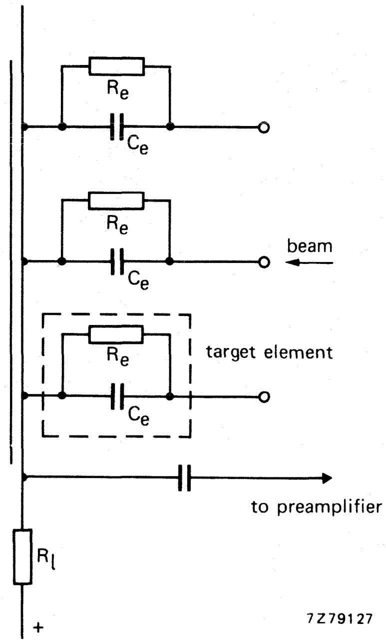


Fig. 3.

1.3 Separate mesh construction

The focusing coils commonly used do not produce an ideal focusing field distribution in the vicinity of the 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. An electron-optical lens formed between grids 3 and 4 can correct these landing errors. The grids are electrically separated with grid 4 (the mesh) positive relative to grid 3. Lens action is governed by the ratio of voltages on grids 3 and 4, the optimum ratio depending upon factors such as electron gun construction and type of coil assembly used.

Besides eliminating landing errors, separate-mesh construction reduces the space charge in the field-free region near the mesh, and so provides the bonus of improved resolution compared with the integral mesh (in which grids 3 and 4 are internally connected). Moreover, since this space charge increases with increasing beam current, separate mesh tubes can operate with higher beam currents than integral mesh tubes.

All currently available Plumbicon tubes have separate mesh construction. Some vidicon tubes, however, have integral meshes.

1.4 Electrostatic focus

Focusing and deflection may both be electrostatic. Figure 4 shows a possible arrangement of electrodes and coils for a camera tube with electrostatic focusing and magnetic deflection.

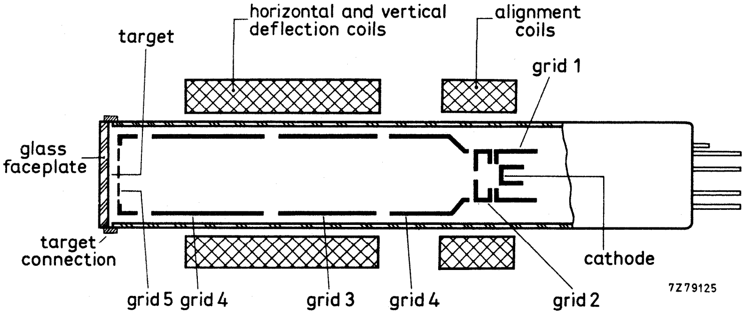


Fig. 4 Schematic electrode and coil arrangement with electrostatic focusing.

As in the magnetically focused tube, the electron gun includes an indirectly heated cathode, a control electrode (grid 1), a first anode (grid 2), a cylindrical electrode (grid 4) and a fine mesh (grid 5). Grid 4 is split into two parts between which a low voltage focusing electrode (grid 3) is inserted to form an electron-optical lens.

Since this tube uses no focusing coils, it dissipates significantly less power than the magnetically focused tube.

1.5 Anti-comet-tail gun

To cope with extreme highlights, which cannot be stabilized with normal beam currents, a special electron gun known as the anti-comet-tail (ACT) gun has been developed. The General Operational Notes on Plumbicon tubes give a short description of this gun.

1.6 The diode gun

In the diode gun grid 1 is made positive relative to the cathode. This modifies the electron beam and provides larger beam reserve for highlight handling. A brief description of the diode gun will be found in the General Operational Notes on Plumbicon tubes.

2 MAIN PROPERTIES

2.1 Luminous sensitivity

The *luminous sensitivity*, S_L, of a camera tube is defined as the *average* signal current, I_s, generated per unit luminous flux falling uniformly on the scanned area, A, of its target; i.e.

$$S_L = \frac{I_s}{AB_{ph}} \quad \mu A/\text{lumen}$$

in which B_{ph} is the illuminance of the photoconductive layer (in lumens/m^2).

Often, what is of interest to the camera designer is not the average signal current, but the current, I_p, over the active scanning line, since this is a better indication of the peak signal currents likely to occur in practice. For a camera tube with a blanking period β (given as a percentage of the total line period), the signal current I_p is given by:

$$I_p = \frac{100}{100 - \beta} \; I_s = \alpha \, I_s.$$

For the CCIR system $\alpha = 1{,}3$.

For a black/white camera, the illuminance, B_{ph}, of the photoconductive layer is related to the scene illuminance, B_{SC}, by:

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

in which: R is the average scene reflectivity, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target.

A similar relationship holds for the red, green and blue channels of a colour camera, but in this case the situation is complicated by the extra components that must be included in the optical system.

2.2 Radiant sensitivity and spectral response

The *radiant sensitivity*, S_r, of a camera tube is the average signal current generated per unit radiant energy falling uniformly on the scanned area of its target. Radiant energy is commonly expressed in mA/W, and at a given wavelength λ it is related to the *luminous* sensitivity, S_L by:

$$S_r(\lambda) = 0{,}680\,V(\lambda) S_L(\lambda)$$

in which $V(\lambda)$ is the normalized spectral sensitivity of the eye at wavelength λ. Note: $V(\lambda)$ is an empirical function that has been internationally agreed; its peak value is unity which occurs at a wavelength of 555 nm.

The radiant sensitivity of a camera tube varies with wavelength. The *spectral response* curves given in Fig. 5 show this variation for some typical camera tubes; these curves are merely exemplary, and for spectral response details of specific tubes the relevant data sheet should be consulted.

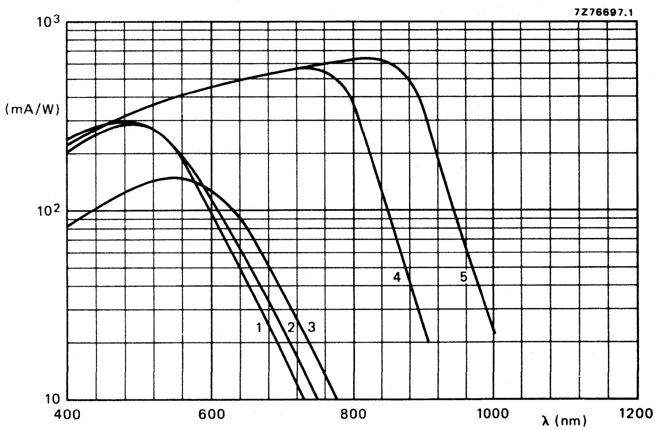


Fig. 5 Spectral response of various camera tubes. (1) Plumbicon tube XQ1073; (2) Sb_2S_3 vidicon XQ1280; (3) Sb_2S_3 vidicon XQ1240; (4) Newvicon tube XQ1274; (5) Newvicon tube XQ1276.

2.3 Resolution

The resolution of a camera tube is commonly expressed in terms of its *modulation depth*, which is defined as the ratio (expressed as a percentage) of the amplitudes of a 5 MHz and a 0,5 MHz square-wave signal as measured on a waveform monitor.

The square-wave signal can be produced by a test pattern comprising vertical black and white bars of equal thickness. The pattern may be specified in terms of the video frequency, or in terms of the corresponding number of TV lines, i.e. the number of bars that will fill a TV picture when arranged horizontally. For the CCIR system (52 μs scan), 5 MHz corresponds to about 530 vertical bars or 400 TV lines, and 0,5 MHz corresponds to about 40 TV lines.

A pattern can also be specified by the number of line-pairs per mm (lp/mm), a line-pair being an adjacent pair of black and white bars. 400 TV lines corresponds to:

- 15,6 lp/mm for a 30 mm tube (scanned area 12,8 mm x 17,1 mm);
- 20,8 lp/mm for a 25 mm (1 inch) tube (scanned area 9,6 mm x 12,8 mm);
- 30,3 lp/mm for a 18 mm (2/3 inch) tube (scanned area 6,6 mm x 8,8 mm).

The modulation depth values given in this handbook include the slight degradation produced by the camera lens. For the purpose of these measurements, a lens aperture of 5,6 is taken.

2.4 Lag

In a camera tube there is always a delay in establishing a new signal current following a rapid change in target illumination. This is the phenomenon of *lag.* Two types of lag occur in a photoconductive camera tube: *photoconductive lag* determined principally by the nature of the target, and *discharge* (or *capacitive*) *lag* attributed to the way in which the electron beam discharges the target.

We define two forms of lag for measurement purposes:

- *decay lag* occurring at the transition from light to dark. This is measured after the target has been illuminated for at least 5 s, and is usually given as the ratio (expressed as a percentage) of the residual signal current to the initial current, the residual current being measured 60 ms and 200 ms (at 50 Hz) after the light is cut off.
- *build-up lag* occurring at the transition from dark to light. This is measured after 10 s of darkness, and is given as the ratio (expressed as a percentage) of the intermediate signal current to the final current, the intermediate current being measured 60 ms and 200 ms (at 50 Hz) after restoring the light.

3 Camera tube types

3.1 Plumbicon tube - lead oxide photoconductive layer

The photoconductive layer forms a continuous array of reverse-biased PIN-diodes, giving it an extremely low dark current. Its linear transfer characteristic, high sensitivity, very low photoconductive lag, excellent resolution and low burn-in make it pre-eminently suited to colour TV. Lead oxide does not respond to wavelengths greater than about 650 nm, but a small amount of sulphur included in the layer extends its response to wavelengths in the deep red (*extended red* Plumbicon tubes).

3.2 Vidicon tube - antimony trisulphide (Sb_2S_3) photoconductive layer

The sensitivity of an Sb_2S_3 layer depends on the target voltage (the voltage across the layer), so it is possible to control the sensitivity by varying this voltage. The dark current is strongly dependent upon target voltage as well as upon temperature.

The Sb_2S_3 layer suffers from photoconductive lag and is prone to burn-in. The layer also has a non-linear transfer characteristic and so is less suited to colour TV. However, since the layer is thin its resolution is high.

Standard vidicons are relatively inexpensive to manufacture, so despite their drawbacks they are used extensively in less critical applications. Variants of the standard vidicon have been developed for use in medical X-ray equipment where they are coupled to an X-ray image intensifier.

3.3 Newvicon tube - heterojunction photoconductive layer

The photoconductive layer contains sublayers of zinc selenide (ZnSe) and of a zinc telluride (ZnTe) cadmium telluride (CdTe) mixture. In operation the layer is reverse-biased. The layer produces a non-negligible dark current that is temperature dependent.

The Newvicon tube has very high sensitivity which extends into the near infrared. It is not possible to adjust this sensitivity by varying the target voltage. The tube has a linear transfer characteristic and low burn-in. Its photoconductive layer is thin, so it has high lag and and high resolution.

4 Equipment design and operating conditions

4.1 Signal electrode connection

The signal electrode connection should be made by a spring contact that bears against the target connection. The spring contact may be part of the coil assembly.

4.2 Deflection circuitry

The signal current is a function of target illumination and of scanning speed. The deflection circuitry must therefore provide constant scanning speed to ensure that the variation in signal current is a true representation of the intensity profile across the target.

4.3 Electrostatic shielding

To avoid interference in the picture the signal electrode must be electrostatically shielded, e.g. 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 the focusing coil should be such that the target end will attract (for 30 mm tubes, repel) a north seeking pole.

4.5 Full size scanning

The full scanning area should always be covered during scan; underscanning of the photoconductive layer or failure to scan, even for a short time, can cause permanent damage.

To prevent the electron beam landing on the target during vertical and horizontal flyback (which would remove some picture information from the target), a blanking pulse must be applied - either a negative pulse to the control grid or a positive pulse to the cathode.

In tubes with a separate mesh construction corner resolution can be improved by applying suitable pulses to grid 3 (*dynamic focusing* or *focus modulation*).

The resolution of most types of photoconductive camera tube increases with increasing voltage on grids 3 and 4. High voltage operation, however, requires increased power for the deflection and focusing coils.

RECOMMENDATIONS

- When the tube is used in a series heater chain, the heater voltage must not exceed 9,5 V (r.m.s.) when the supply is switched on. Preferably, each heater should be shunted by a zener diode.
- If cathode-current stabilization is used to stabilize beam current, the cathode heater should be arranged to operate for at least 1 minute before any beam current is drawn.

CAUTION

Camera tubes with photoconductive layers contain toxic compounds. Dispose of them with care. If a tube is broken, take suitable precautions in collecting and disposing of fragments. Avoid direct contact or inhalation of particles.

RATING SYSTEM

(in accordance with IEC Publication 134)

ABSOLUTE MAXIMUM RATING SYSTEM

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 variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

CLASSIFICATION

The devices are classified as follows:

N = **New type.** Recommended for new equipment design. Data is derived from development samples, made available for evaluation. It does not necessarily imply that the device will go into regular production.

D = **Design type.** Recommended for equipment design; production quantities available at date of publication.

C = **Current type.** No longer recommended for equipment design; available for equipment production and for use in existing equipment.

M = **Maintenance type.** No longer recommended for equipment production; available for maintenance of existing equipment.

O = **Obsolescent type.** Available until present stocks are exhausted.

Obsolescent types of which all stocks are exhausted are called **obsolete**; any data still published on these types is for reference purposes only.

The status of all types is given in a type survey at the end of the general section, together with data in condensed form.

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** (see tables on following pages)

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.
6. Add suffix /05 for rear loading type, without provisions for adjustable light bias.

® Registered Trade Mark for television camera tube.

PLUMBICON TUBES - 30 mm (1¼ inch)

Maintenance types 300 mA; (including adapter)
6,3 V

type	photo-conductive layer	quality grade: Br	Ind	Med	applications: B/W	L	R	G	B	Med	notes
XQ1020	S	●			●	●	●	●	●		
XQ1021	S		●		●		●	●	●		
XQ1022	S			●						●	1
XQ1023	ER	●			●	●	●				
XQ1024	ER		●		●		●				
XQ1025	ER(F)	●			●	●	●				2
XQ1026	ER(F)		●		●		●				2

Design types 190 mA; 6,3 V
- provision for both fixed and adjustable light bias
- high resolution

type	photo-conductive layer	quality grade: Br	Ind	Med	applications: B/W	L	R	G	B	Med	notes
XQ1410	SHR	●			●	●	●	●	●		
XQ1413	ER	●			●	●	●				
XQ1415	ER(F)	●			●	●	●				2

Design types 190 mA; 6,3 V
- anti-comet-tail electron gun (ACT)
- provision for both fixed and adjustable light bias
- high resolution

type	photo-conductive layer	quality grade: Br	Ind	Med	applications: B/W	L	R	G	B	Med	notes
XQ1520	SHR	●			●	●	●	●	●		
XQ1523	ER	●			●	●	●				
XQ1525	ER(F)	●			●	●	●				2

Notes on page B2.

PLUMBICON TUBES - 25 mm (1 inch)

→ Maintenance types 95 mA
6,3 V

○ front and rear loading types, with or without provision for adjustable light bias

front loading type	for front or 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	●			●	●	●	●	●	
XQ1083	XQ1093	ER	●			●		●			
XQ1085	XQ1095	ER(F)	●			●		●			2

→ Design types 190 mA;
6,3 V

○ high resolution anti-comet-tail electron gun
○ provision for adjustable light bias

XQ1500	XQ1510	SHR	●			●	●	●	●	●	
XQ1503	XQ1513	ER	●			●		●			
XQ1505	XQ1515	ER(F)	●			●		●			2

→ New design types 95 mA;
6,3 V

○ high resolution, "diode" gun (DBC)
○ provision for adjustable light bias

XQ2070/02	XQ2070/03	SHR	●			●	●	●	●	●		6
XQ2072/02	XQ2072/03	SHR						●	●	●	●	6
XQ2073/02	XQ2073/03	ER	●			●		●			●	6
XQ2075/02	XQ2075/03	ER(F)	●			●		●				2, 6

New design types 95 mA;
6,3 V

○ high resolution, "diode" gun (DBC)
○ provision for adjustable light bias
○ low output capacitance (LOC)

XQ3070/02	SHR	●			●	●	●	●	●	6
XQ3073/02	ER	●			●		●			6
XQ3075/02	ER(F)	●			●		●			6

Notes on page B2.

PLUMBICON TUBES - 18 mm (2/3 inch)

Design types	95 mA; 6,3 V									
type		photo-conductive layer	quality grade: Br	Ind	Med	applications: B/W	L	R	G	B
XQ1427		ER	●			●		●	●	
		SHR	●			●			●	●
XQ1428		ER		●		●		●	●	
		SHR		●		●			●	●
New design types	95 mA; 6,3 V	○ high resolution, "diode" gun (DBC)								
XQ2427		ER	●			●		●	●	
		SHR	●			●			●	●
XQ2428		ER		●		●		●	●	
		SHR		●		●			●	●
New design types	95 mA; 6,3 V	○ high resolution, "diode" gun (DBC) ○ low output capacitance (LOC)								
XQ3427		ER	●			●		●	●	
		SHR	●			●			●	●
XQ3428		ER		●		●		●	●	
		SHR		●		●			●	●

Notes on page B2.

Accessories for Plumbicon tubes

	30 mm (1¼″) dia. all magnetic		25 mm (1″) dia. all magnetic						18 mm (2/3″) dia. all magnetic	
	light bias	ACT and light bias	/02 versions light bias	/03 versions light bias	ACT and light bias	ACT and light bias	DBC light bias LOC	DBC and light bias	DBC	DBC LOC
	rear loading	rear loading	rear loading	front loading	rear loading	front loading	rear loading	front loading	front loading	front loading
example	XQ1410	XQ1520	XQ1070/02	XQ1070/03	XQ1080	XQ1090	XQ3070/02	XQ2070/03	XQ2427	XQ3427
coil unit B/W	AT1113/01		AT1116S (front loading) AT1119/01 (rear loading)						AT1109/01S	AT1109/10S
coil unit colour	AT1130/..*		AT1116/..* (front loading) AT1126/..* (rear loading						AT1109/..* AT1106*	AT1109/10
socket	56021 56025	56025	56098		56026		56098		56049	56049
light bias lamp	56106		56106		56027		56106		–	–
adapters** R G B	 56123 56124 56125 56126▲ 56139▲▲									
mask	56029		56028						56033	56030

* Computer selected triplet, various versions.
** Adapters for fixed light bias for XQ1410 series and XQ1520.
▲ Adapter for adjustable light bias for XQ1410 series for use in Marconi Mark VIII camera (variant).
▲▲ Adapter for fixed light bias for XQ1410 series for use in RCA TK47 camera.

GENERAL OPERATIONAL NOTES

1 Properties of the lead oxide photoconductive layer

The Plumbicon tube has a lead oxide photoconductive layer. In tubes with extended red response a small amount of sulphur is added to the lead oxide.

1.1 Sensitivity

Since the Plumbicon tube has a linear light transfer characteristic, its sensitivity can be specified completely by the number of μA/lumen delivered to the signal electrode. A typical value for a standard layer (without extended red response) in tungsten light with a colour temperature of 2856 K would be 400 μA/lumen (d.c. value).

Sensitivity increases with target voltage, but at the recommended voltage (45 V) it is almost at maximum and rises only slightly with further voltage increases.

For a given target illumination, the signal current is a function of the scanned area; but it can be shown that in the Plumbicon tube with its linear light transfer characteristic, camera sensitivity is independent of tube size for the same depth of field and viewing angle.

1.2 Spectral response

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

Because the sensitivity of the XQ1413 is high in the deep red region, an infrared reflecting filter should be used for proper colour rendition. The XQ1415, whose spectral response is given by curve 3, already has such a filter provided with the anti-halation disc cemented to its faceplate (see 1.5 below).

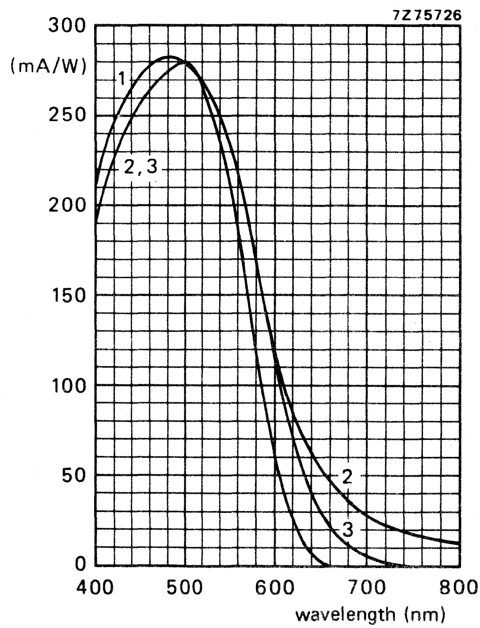


Fig. 1 Typical spectral response curves of 30 mm Plumbicon tubes.

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.

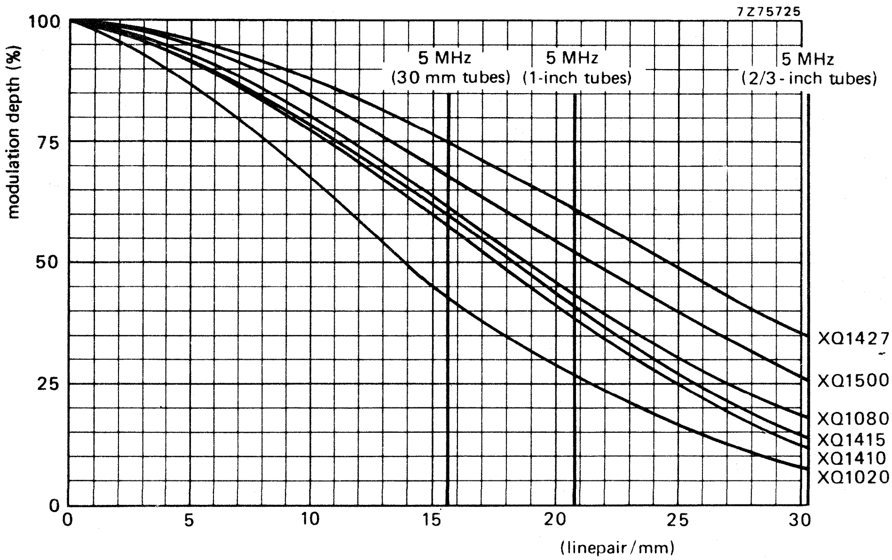


Fig. 2 Typical square-wave modulation transfer curves of some Plumbicon tubes.

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 than 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).

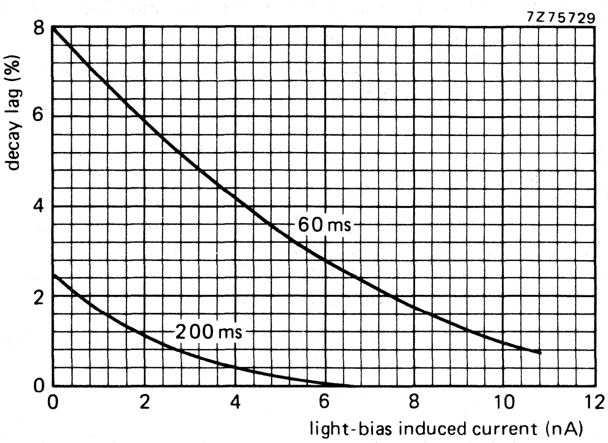


Fig. 3 Typical influence of light bias on decay lag in XQ1410.

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.

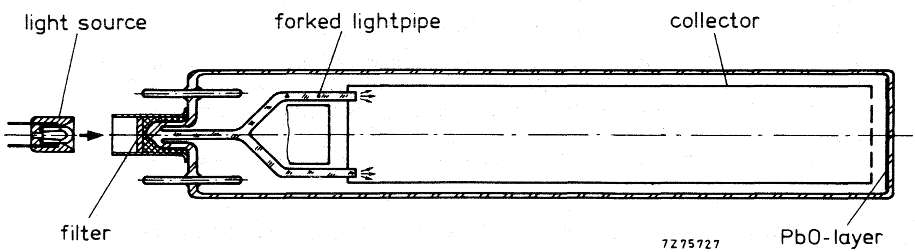


Fig. 4 Light bias in the XQ1410.

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.

1.4.1 Considerations

1.4.1.1 WITH ADJUSTABLE LIGHT BIAS (VIA PUMPING STEM)

For this purpose a light bias lamp, type 56106, is available.

Amount of light bias

Black and white cameras

The amount of light bias required in a black/white camera is not critical (see published data) and may be 3 to 5 nA(p) the upper limit being determined by the onset of objectionable black shading.

Colour cameras without black shading compensation circuitry

Depending on the type of camera and the subjective judgement of the camera engineer, the light bias should generally be set to 3 nA(p) for R, 2 nA(p) for G, and 3,5 nA(p) for B tubes respectively.

A suggested procedure is as follows:
The camera is focused onto a metronome, placed in front of a dark background, and carrying a small white square, which produces a peak output current in the green channel of, for instance, 30 nA. About 2 nA(p) of light bias is applied to the green tube by adjusting the current through its lamp. Subsequently the currents through the light bias lamps of the R and B tubes are adjusted for the best compromise with respect to build-up and decay lag aiming at non-coloured lag phenomena as observed on a colour monitor. Infrared light with a wavelength $>$ 600 nm should be avoided.

Colour cameras with black shading compensation circuitry

In colour cameras with black shading compensation still higher bias currents, and hence better lag performance, can be achieved.

1.4.1.2 WITH FIXED LIGHT BIAS

Also available for 30 mm tubes is an adapter for fixed light bias operation. The adapter carries a colour code in accordance with the application for which the tube is intended. The adapter is slipped over the pins of the tube before putting on the socket (see drawing) and connects a light bias lamp via a series resistor to the heater pins.
The light bias induced dark currents (at 6,30 ± 0,05 V) will be approximately:

- 4,5 nA(p) for B/W tubes
- 3 nA(p) for R tubes
- 2 nA(p) for G, L tubes
- 3,5 nA(p) for B tubes

whereas an extra 95 mA (approx.) will be drawn from the heater supply.

Provided the heater voltage supply is capable of delivering a well stabilized voltage when these extra lamp currents are drawn, the tubes XQ1410, XQ1413, and XQ1415 – operated with the adapter – can be considered as plug-in replacements for standard tubes, however, with clearly improved lag (and resolution).
Optimum performance with repsect to non-coloured lag phenomena is obtained only when adjustable light bias is applied.

1.4.1.3 WITH LIGHT BIAS (FIXED OR ADJUSTABLE) APPLIED VIA THE OPTICAL SYSTEM

Though excellent performance with respect to speed of response can be obtained it appears to be difficult to produce sufficient uniformity of the light bias induced dark currents and, in a colour camera, to adjust the light bias per tube for neutral i.e. non-coloured lag phenomena, when televising moving objects.

1.4.1.4 WITHOUT LIGHT BIAS

Acceptable performance with respect to speed of response will only be achieved with adequate scene illumination.
The envelopes of the tubes are blackened underneath the plastic base to prevent direct transfer from light bias — if this is applied to the pumping stem — through the envelope to the target, which would cause objectionable peak white shading (often referred to as 'ears') on the black level in the picture corners. This blackening, however, also absorbs the light emitted by the heater of the cathode, light which in tubes like XQ1020 induces some artificial dark current. This absence of heater light causes a slightly increased beam discharge lag in tubes XQ1410, XQ1413, and XQ1415.

REMARK

The life expectancy of the lamps used in 56106 and the adapter is, as stated by the manufacturer, $> 2 \times 10^4$ h at full rating, i.e. 5,5 V, 110 mA, and they will therefore generally outlive the camera tubes. Spares and replacements can be supplied.

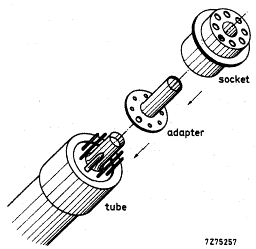


Fig. 5.

adapter for	R tubes	56123	9390 270 10XX00
	G, L tubes	56124	9390 270 20XX00
	B tubes	56125	9390 270 30XX00

1.4.1.5 INSTRUCTIONS FOR USE OF LIGHT BIAS LAMP TYPE 56106

Light bias lamp type 56106 is intended for use with those Plumbicon tubes that have a thin metal tube (provided with a filter) cemented to the pumping stem, e.g. XQ1410 series.

INSTALLING THE LAMP

Using the XQ1410 series as an example, the following installation procedure is recommended (Fig. 5).

1. Insert tube A into the deflection/focusing assembly.
2. Push lamp B firmly into the metal tube on the pumping stem.
3. Mate socket C with the base pins of the tube, allowing the lamp wires to pass through the pumping stem clearance hole in the socket.

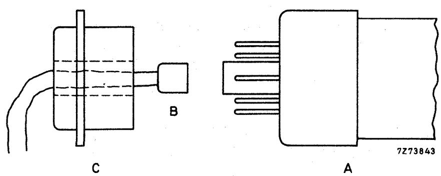


Fig. 6 Installing the light bias lamp.

SUPPLYING THE LAMP

Black/white cameras

Extreme stability is generally not needed. Lamp current can be supplied from a.c. or d.c. sources. Figure 7 shows suggested circuits.

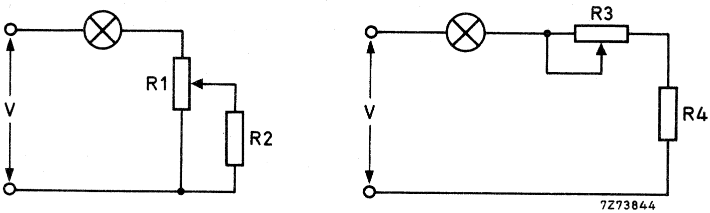


Fig. 7 Supplying the lamp in black/white cameras.

The values of R2 and R4 should limit the lamp current to its maximum value of 110 mA at 5 V. Thus:

$$\frac{R1\ R2}{R1 + R2} = \frac{V - 5}{0,11}\ \Omega, \text{ and } \quad R4 = \frac{V - 5}{0,11}\ \Omega.$$

When fully in series with the lamp, resistors R1 and R3 should decrease the lamp current to a value which causes negligible bias light, e.g. 50 mA. Thus:

$$R1_{min} = \frac{V}{0,05}\ \Omega, \text{ and } R3_{min} = \frac{V}{0,05} - R4\ \Omega.$$

Colour cameras

A stabilized d.c. supply is preferred. In cameras with automatic black level compensation, the circuits shown in Fig. 7 may be used. For long-term stability in cameras not having black level compensation, it should be noted that the bias current, set at about 10 nA, changes by 0,5 nA when the voltage across the lamp changes by about 50 mV, and also when the current through the lamp changes by about 0,6 mA.

Figure 8 shows a recommended circuit. The maximum voltage on the base of the transistor should be about 5,5 V.

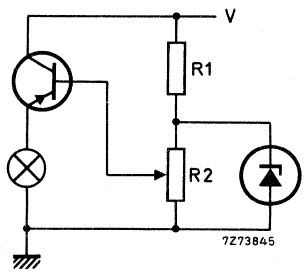


Fig. 8 Supplying the lamp in colour cameras.

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. 9.

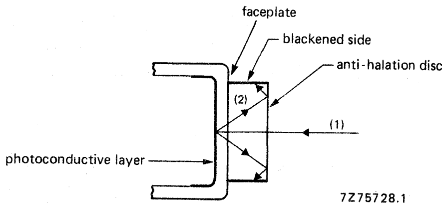


Fig. 9 Anti-halation disc on faceplate.

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 The anti-comet-tail gun

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 10 shows the principle of an ACT gun.

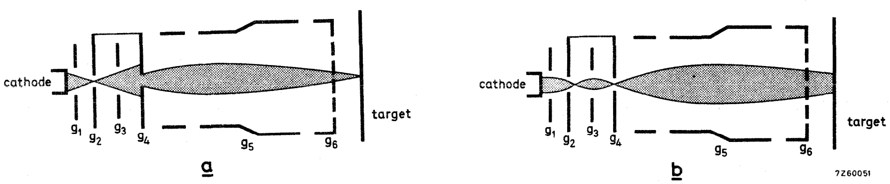


Fig. 10 Anti-comet-tail (ACT) gun; a = read-out mode; b = flyback mode.

The first anode - see Fig. 10 - 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. 10a.

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. 10b. 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) scans 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 encounter target potentials higher than the cathode potential during flyback. Therefore stabilization is possible everywhere and blooming and comet-tails are strongly reduced.

1.7 The diode gun and Dynamic Beam Control (DBC)

In the conventional triode gun, grid 1 and the anode converge the electrons emitted by the cathode to produce a crossover in the electron beam. Electron interaction in the beam, particularly in the vicinity of the crossover, increases the differential beam resistance and so increases beam-discharge lag. In the *diode gun* grid 1 is made positive relative to the cathode. This reduces beam convergence and so eliminates the crossover. The result is reduced differential beam resistance and a larger beam reserve. The consequent reduction in lag permits the use of thinner photoconductive layers to improve resolution (particularly in smaller tubes used in portable cameras for outside broadcasts etc.).

Moreover, with the larger beam reserve of the diode gun tube, excessive highlights can be handled using *Dynamic Beam Control* (DBC). Figure 11 shows the principle of DBC. When the beam encounters a highlight, the sharp rise in signal current is detected by a feedback network which then increases the control grid voltage (V_{g1}), so raising the beam current to read out the highlight.

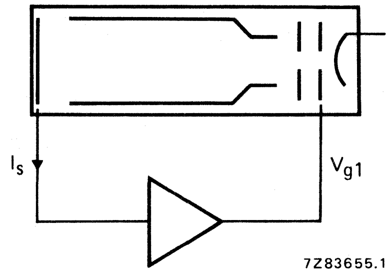


Fig. 11.

1.8 Low output-capacitance tubes

An important factor governing the performance of a TV camera is its signal-to-noise (S/N) ratio; the higher the S/N ratio the better the operational sensitivity of the camera. One way of increasing the S/N ratio is by reducing the total output capacitance of the tube/yoke assemblies within the camera.

In the range of low output-capacitance (LOC) Plumbicon tubes the capacitance of the tube in the deflection yoke is reduced by reducing the size on the transparent conductive film in the target.

1.9 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.

1.10 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, excessive 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 °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.

2.10 During long standby periods, the following procedure should be adopted:
- Cap the camera lens.
- Adjust the grid 1 voltage to its maximum negative value to cut off the beam.
- Reduce the heater voltage to about 4 V.

To resume normal operation, reverse the above sequence as follows:
- Increase heater voltage to 6,3 V.
- After allowing heater to operate at 6,3 V for at least 1 minute, adjust the grid 1 voltage to restore the beam current to its required level.
- Uncap the camera lens.

SPURIOUS SIGNAL SPECIFICATION FOR PLUMBICON ® TUBES

(with plain glass faceplate)

SECTION A

Test conditions

Spurious signal tests on Plumbicon tubes are carries 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.

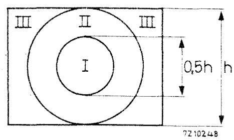


Fig. 1.

A circular test transparency is used 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.

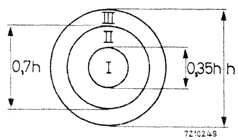


Fig. 2.

4. *The video amplifier frequency response* is essentially flat up 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 1.
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 1.
9. *Monitor.* The obtained picture is observed on a monitor producing a non-blooming white.

® Registered Trade Mark for television camera tube.

Table I
I_s and I_b settings

			Tube diameter 30 mm (1¼ in)		Tube diameter 25 mm (1 in)		18 mm (2/3 in)
Tube diameter			Tube diameter 30 mm (1¼ in)		Tube diameter 25 mm (1 in)		18 mm (2/3 in)
Scanned area			Scanned area 12,8 x 17,1 mm^2		Scanned area 9,6 x 12,8 mm^2		6,6 x 8,8 mm
			I_s μA	I_b μA	I_s μA	I_b μA	I_b μA
Broadcast quality tubes	Luminance		0,30	0,60	0,2	0,4	0,30
	Black and white		0,30	0,60	0,2	0,4	0,30
	Chrominance tubes	Red R	0,15	0,30	0,1	0,2	0,15
		Green G	0,30	0,60	0,2	0,4	0,30
		Blue B	0,15	0,30	0,1	0,2	0,15
Industrial quality tubes	Black and white		0,30	0,60	0,2	0,4	0,15
	Chrominance tubes	Red R	0,15	0,30	0,1	0,2	0,15
		Green G	0,30	0,60	0,2	0,4	0,30
		Blue B	0,15	0,30	0,1	0,2	0,15
X-ray medical tubes (for use in combination with an X-ray image intensifier)	P20 light source		Scanned area* 18 mm circular		Scanned area* 16,2 mm circular		
			0,15	0,30	0,1	0,2	

* 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	notes
					1
To be neglected	size	≤ 0,2%	≤ 0,2%	≤ 0,2%	2
	contrast	≤ 5%	≤ 8%	≤ 8%	
S.N.V. of	white blemish	2 x M.V.	1 x M.V.		3
	dark blemish	1 x M.V.			
Max. S.N.V.	per blemish	20	20	20	

Table III

	bl/wh, L, G, R				B				notes
									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.	0	30	50	60	20	45	80	90	5

Tubes with 18 mm diameter (2/3 inch)

Table II

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

Notes see next page.

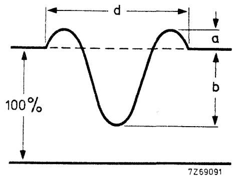
Table III

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

ADDENDUM

Black blemishes with a white surrounding and white blemishes with a black core. On the oscilloscope 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).

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. $\geqslant$ 10 shall be 5% of picture height.
5. Arithmetic sum individual S.N.V.s.

SECTION D

notes

Industrial quality tubes 1

Number, size, and location of blemishes allowed.

Dimensions of blemishes in % of picture height	Permitted number of blemishes				
	Zone I	Zone II	Zone III	Total	
⩽ 2% but > 1%	0	1	2	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
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
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.

30 mm dia. PLUMBICON TUBES C

CAMERA TUBES

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	190	mA

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	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 C10		

HEATING

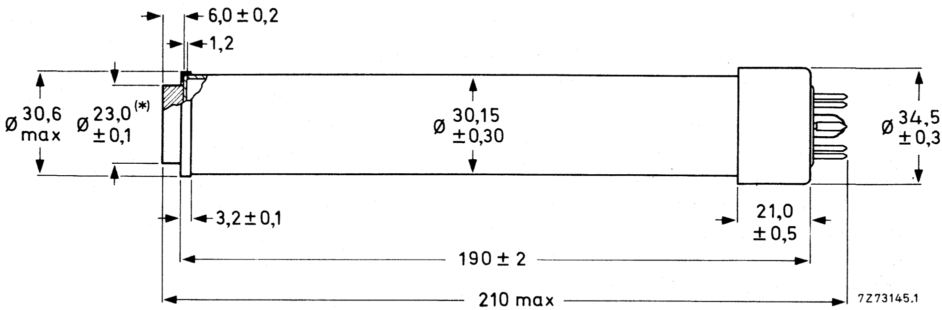
Indirect by a.c. or d.c.; parallel supply

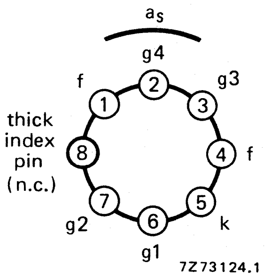
Heater voltage	V_f	6,3 V ± 5%
Heater current tube	I_f	190 mA
Heater current with shunt adapter		300 mA

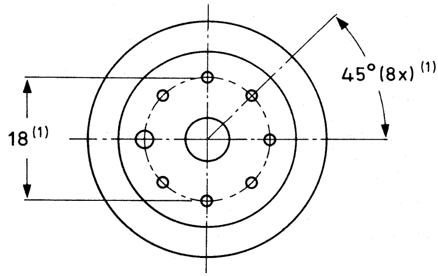
® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm

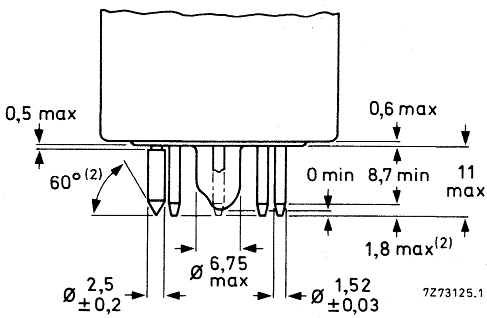






Mounting position: any

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

					notes
Socket	type 56021 or 56025				
Focusing and deflection coil assembly	type AT1130				

For optimal screening of the target from the live end of the line deflection coils the use of AT1130 is recommended.

CAPACITANCE

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

FOCUSING magnetic 6

DEFLECTION magnetic 6

CHARACTERISTICS

Grid 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 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	
Dark current at V_{as} = 45 V	I_{as}	⩽	0,003	μA	

LIMITING VALUES (Absolute maximum rating system)

Signal electrode voltage	V_{as}	max.	50	V	8
Grid 4 voltage	V_{g4}	max.	1100	V	8
Grid 3 voltage	V_{g3}	max.	800	V	8
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	350	V	8
Grid 2 voltage	V_{g2}	max.	350	V	8
Grid 2 dissipation	W_{g2}	max.	1	W	
Grid 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

OPERATING CONDITIONS AND PERFORMANCE

				notes
Conditions				
Cathode voltage	V_k	0	V	
Grid 2 voltage	V_{g2}	300	V	
Signal electrode voltage	V_{as}	45	V	10
Beam current	I_b			11
Focusing coil current at given values of grid 4 and grid 3 voltages				12
Line coil current and frame coil current				12
Faceplate illumination				13, 14
Faceplate temperature	T	20 to 45	^oC	

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%

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

notes 16,17

	build-up lag				decay-lag			
	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

16,17

	build-up lag				decay-lag			
	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

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 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 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 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.

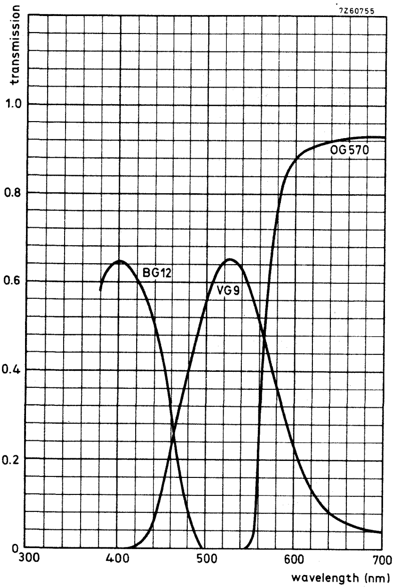
    N.B. The signal currents are measured with an integrating instrument connected in the signal electrode lead and a uniform illumination on the scanned area. The peak signal currents as measured on a wave-form oscilloscope will be a factor α larger.

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

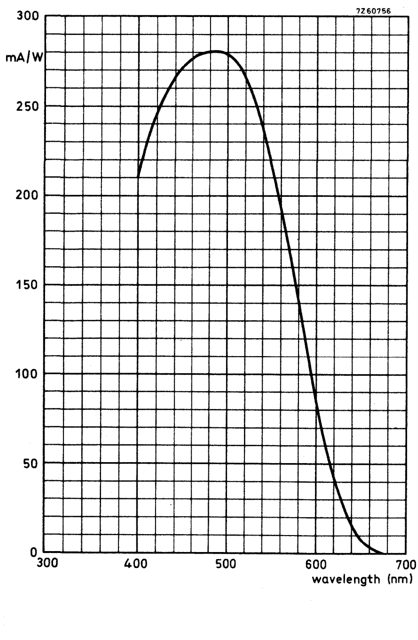
12. See chapter "Deflection assemblies".
13. Typical faceplate illumination level for the XQ1020 and XQ1020L to produce 300 nA signal current will be approx. 4 lx. The signal currents stated for the colour tubes XQ1020R, G, B respectively will be obtained with an incident white level (2856 K) on the 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 TUBES

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	190	mA
Without anti-halation glass disc			

OPTICAL DATA

		notes
Quality area on photoconductive target	circle of 18 mm diameter	1, 2
Orientation of image on photoconductive target	by means of mark on tube base	2
Sensitivity, measured with a fluorescent light source having P_{20} distribution	min. 200; typ. 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 page C18	

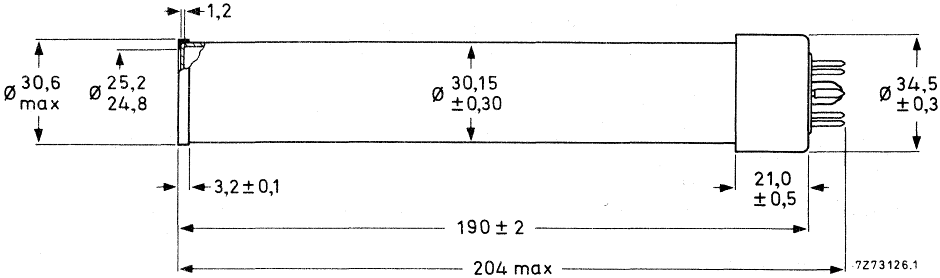
HEATING

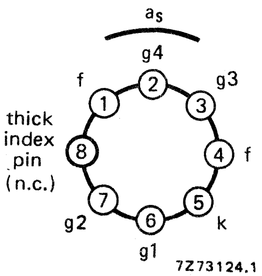
Indirect by a.c. or d.c.; parallel supply	
Heater voltage	V_f 6,3 V ± 5%
Heater current tube	I_f 190 mA
Heater current with shunt adapter	300 mA

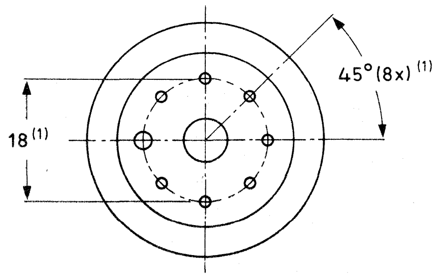
® Registered Trade Mark for TV camera tube.

MECHANICAL DATA

Dimensions in mm

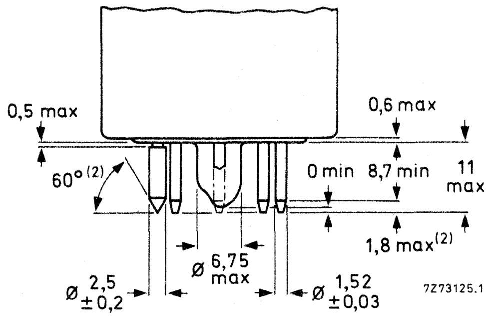






Mounting position: any

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 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

					notes
Socket	type 56021 or 56025				
Focusing and deflection coil assembly	type AT1130				4

CAPACITANCE

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

FOCUSING magnetic — 6

DEFLECTION magnetic — 6

CHARACTERISTICS

Grid 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 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	
Dark current	I_{as}		3	nA	11

LIMITING VALUES (Absolute maximum rating system)

Signal electrode voltage	V_{as}	max.	50	V	8
Grid 4 voltage	V_{g4}	max.	1100	V	8
Grid 3 voltage	V_{g3}	max.	800	V	8
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	350	V	8
Grid 2 voltage	V_{g2}	max.	350	V	8
Grid 2 dissipation	W_{g2}	max.	1	W	
Grid 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

OPERATING CONDITIONS AND PERFORMANCE

Conditions

				notes
Cathode voltage	V_k	0	V	
Grid 2 voltage	V_{g2}	300	V	
Grid 3 voltage	V_{g3}	600	V	
Grid 4 voltage	V_{g4}	675	V	
Signal electrode voltage	V_a	15-45	V	11
Beam current	I_b			12
Focusing coil current				
Line coil current and frame coil current				13
Highlight signal electrode current	I_{as}	0,1 to 0,5	μA	
Average signal output		≈ 0,06	μA	14
Faceplate temperature	T	25 to 45	^oC	
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

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 AT1130. 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 $V_k = 0$ V.
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.
11. The target voltage should be adjusted to the value indicated by the tube manufacturer on the test sheet accompanying 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. See chapter "Deflection assemblies".
14. Subtraction 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.

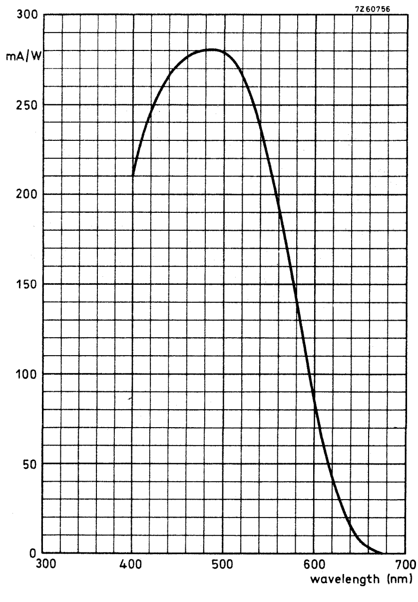


Fig. 1 Spectral response curve

CAMERA TUBES

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	190	mA
Spectral response, cut-off	>	850	nm
Provided with anti-halation glass disc			

OPTICAL DATA

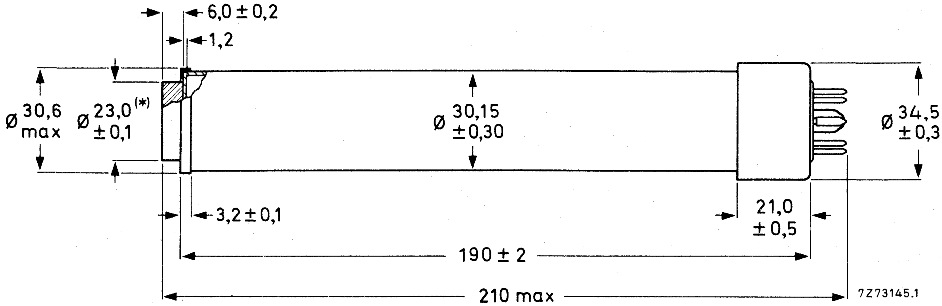
				notes
Quality rectangle on photoconductive target (aspect ratio 3:4)		12,8 mm x 17,1 mm		1
Orientation of image on photoconductive target		by means of mark on tube base		2
Sensitivity (colour temperature of light source 2856 K)		min.	typ.	
	XQ1023	390	450 μA/lmF	3, 4
	XQ1023L	390	450 μA/lmF	3, 4
	XQ1023R	120	150 μA/lmF	5
Gamma of transfer characteristic		0,95 ± 0,05		
Spectral response		See page C26		
max. response at		≈ 500 nm		

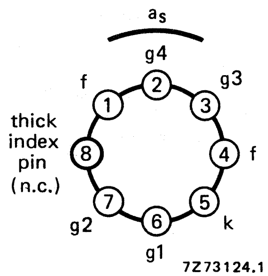
HEATING

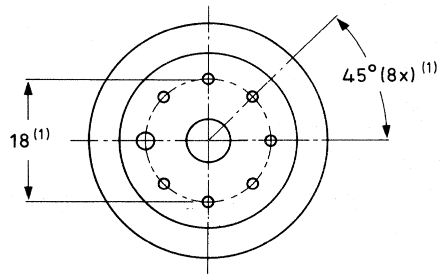
Indirect by a.c. or d.c.; parallel supply		
Heater voltage	V_f	6,3 V ± 5%
Heater current tube	I_f	190 mA
Heater current with shunt adapter	300 mA	

® Registered Trade Mark for TV camera tube.

MECHANICAL DATA Dimensions in mm

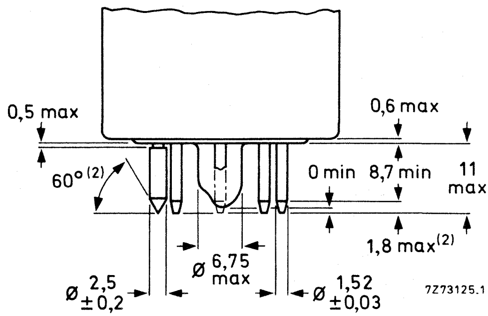






Mounting position: any

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.

					notes
ACCESSORIES					
Socket	type 56021 or 56025				
Focusing and deflection coil assembly	type AT1130				7 ←
CAPACITANCES					
Signal electrode to all	C_a		3 to 6	pF	8
FOCUSING magnetic					9
DEFLECTION magnetic					9
CHARACTERISTICS					
Grid 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100	V	10,11
Blanking voltage peak to peak on grid 1	V_{g1pp}		50 ± 10	V	
on cathode	V_{kpp}		25	V	
Grid 2 current at normally required beam currents	I_{g2}	max.	1	mA	
Dark current at V_{as} = 45 V	I_{as}	max.	0,003	μA	
LIMITING VALUES (Absolute maximum rating system)					
Signal electrode voltage	V_{as}	max.	50	V	11
Grid 4 voltage	V_{g4}	max.	1100	V	11
Grid 3 voltage	V_{g3}	max.	800	V	11
Potential difference between grid 4 and 3	$V_{g4/g3}$	max.	350	V	
Grid 2 voltage	V_{g2}	max.	350	V	11
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	12

					notes
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 2 voltage	V_{g2}	300	V	
Signal electrode voltage	V_{as}	45	V	14
Grid 3 voltage	V_{g3}	600	V	
Grid 4 voltage	V_{g4}	675	V	
Beam current	I_b			16
Focusing coil current				15
Line and frame deflection coil current				15
Faceplate illumination				17, 18
Faceplate temperature	T	20 to 45	°C	

Performance

Resolution

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

	XQ1023, XQ1023L	XQ1023R	notes
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

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.

Low key conditions

notes 20,21

	build-up lag				decay-lag			
	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

20,21

	build-up lag				decay lag			
	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

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 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 C26.
4. Measured with 4,54 lux on the specified target area, when the infrared reflecting 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 C27.
6. The use of gamma-stretching circuitry is recommended.
7. For optimal screening of target from live end of line deflection coil type AT1130 is 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.

15. See chapter "Deflection assemblies".

16. The beam current I_b, as obtained by adjusting the control grid (grid 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 a larger.

($a = \dfrac{100}{100 - \beta}$, 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 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.

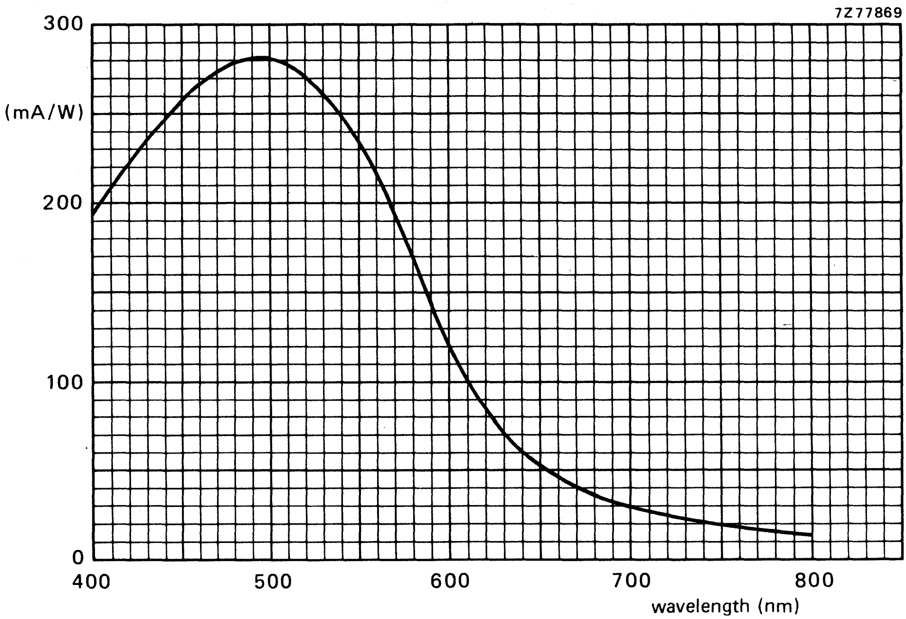


Fig. 1 Typical spectral sensitivity characteristic.

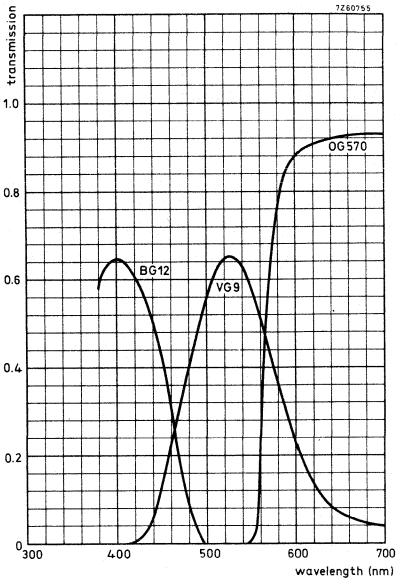


Fig. 2 Transmission curve of filters.

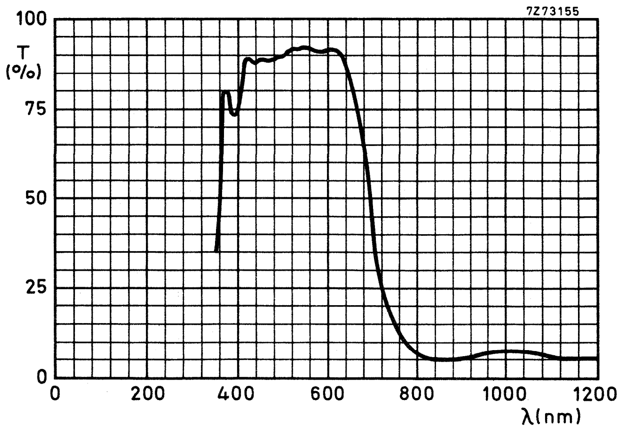


Fig. 3 Typical transmission curve of infrared reflecting interference filter type CALFLEX B1/K1.

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 TUBES

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
Deflection	magnetic
Diameter	≈ 30 mm
Heater	6,3 V, 190 mA
Cut-off of spectral response	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 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 spectral responses in the long wavelength region as published for the XQ1023 tubes (see date XQ1023) is 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.

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

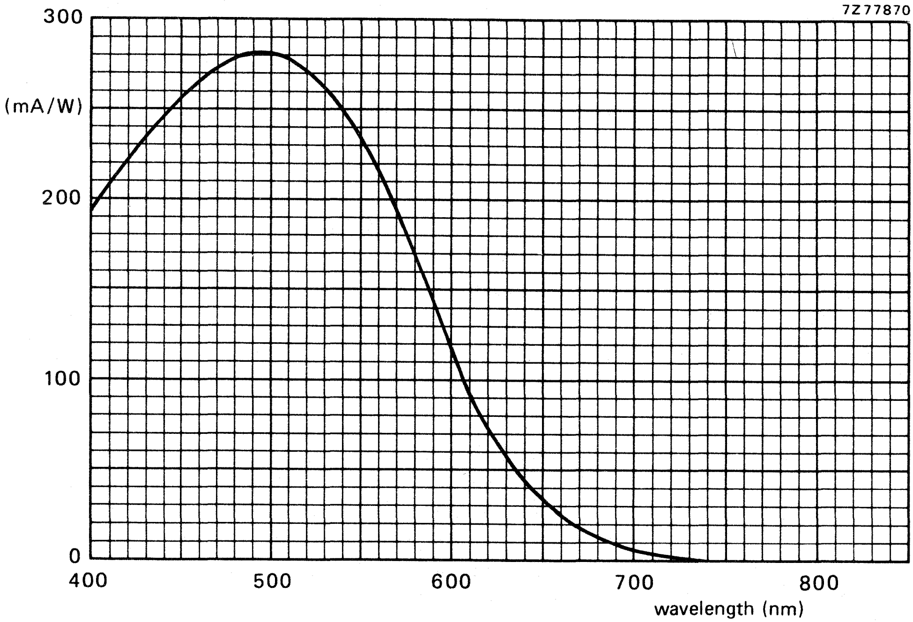
® Registered Trade Mark for television camera tube.

OPTICAL

Spectral response at	see below
Max. response at	approx. 500 nm
Cut-off	≈ 750 nm*

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.

* 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 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 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, 190 mA
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.	190 mA	3b

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		
R tubes	type 56123	3b
G,L tubes	type 56124	
B tubes	type 56125	
→ Deflection and focusing coil unit	type AT1130 (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

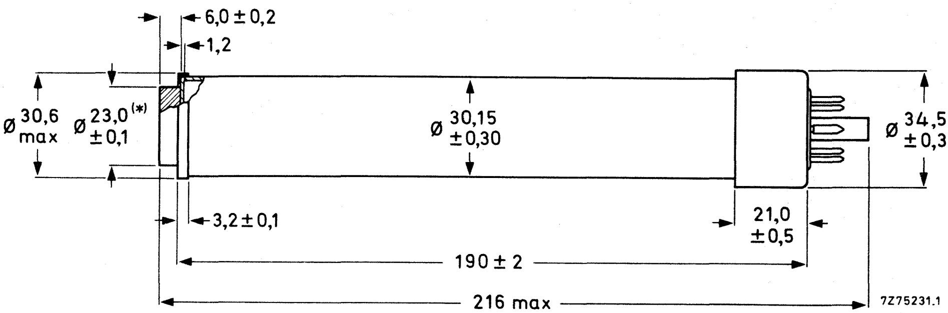
LIMITING VALUES (Absolute maximum rating system)

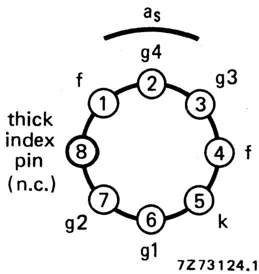
Unless otherwise stated, all voltages are referred to the cathode.

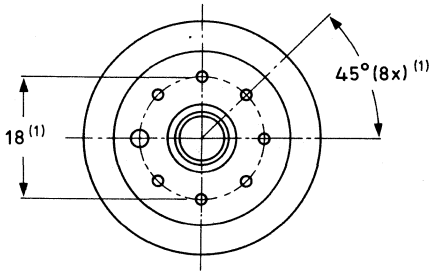
					notes
Signal electrode voltage	V_{as}	max.	50	V	
Grid 4 voltage	V_{g4}	max.	1100	V	
Grid 3 voltage	V_{g3}	max.	800	V	
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	350	V	
Grid 2 voltage	V_{g2}	max.	350	V	
Grid 2 dissipation	W_{g2}	max.	1	W	
Grid 1 voltage					
positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	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

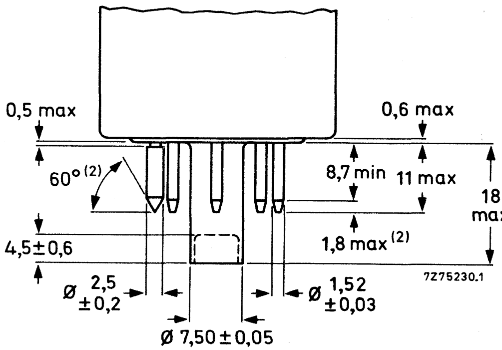






Mounting position: any

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

For a scanned area of 12,8 mm x 17,1 mm

			notes
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	min.	typ.		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

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. See chapter "Deflection assemblies".

8. Typical faceplate illumination level for the XQ1410 and XQ1410L to produce 300 nA 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.

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.

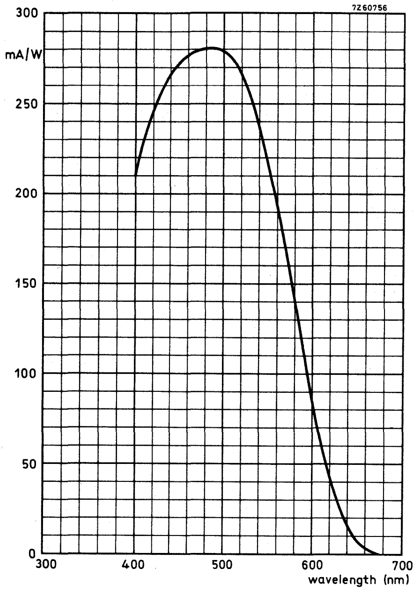


Fig. 1 Spectral response curve.

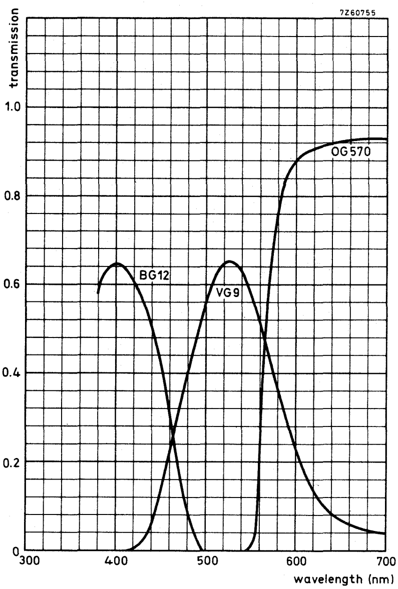


Fig. 2 Transmission of filters BG12, VG9, and OG570.

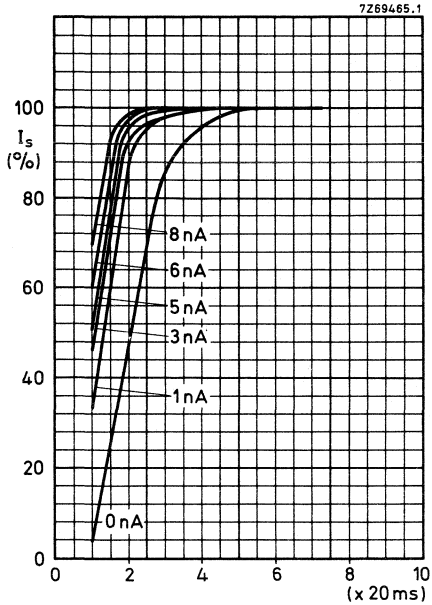


Fig. 3.

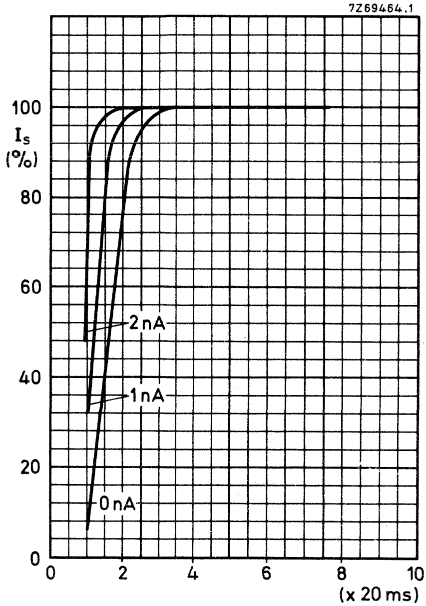


Fig. 4.

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.

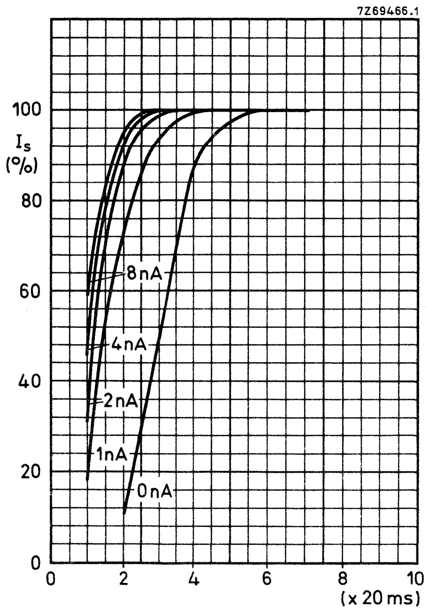


Fig. 5.

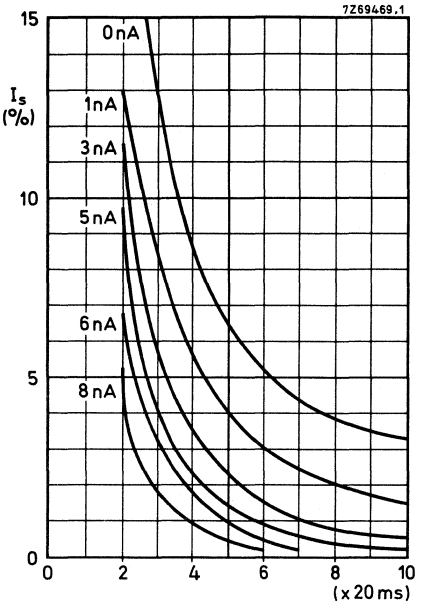


Fig. 6.

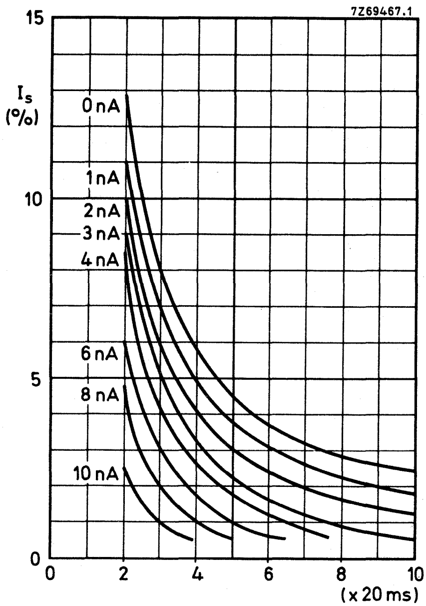


Fig. 7.

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.

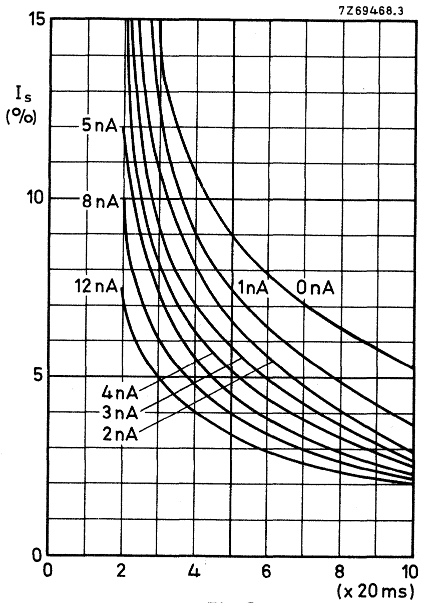


Fig. 8.

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, 190 mA
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.	190 mA	3b

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
R tubes	type 56123	
→ Deflection and focusing coil unit	type AT1130 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

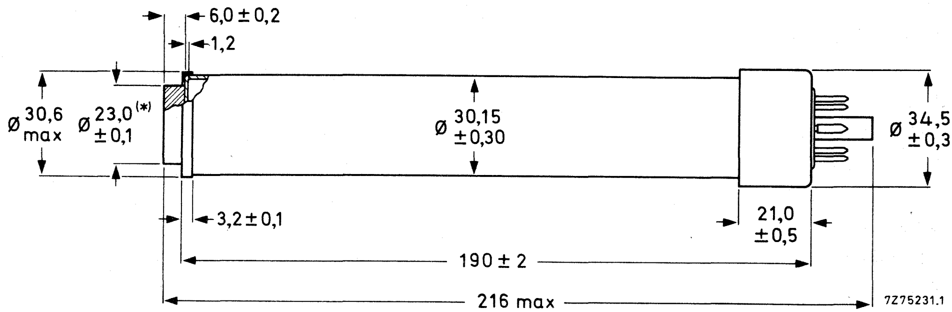
LIMITING VALUES (Absolute maximum rating system)

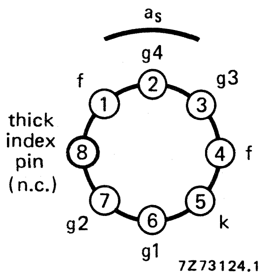
Unless otherwise stated, all voltages are referred to the cathode

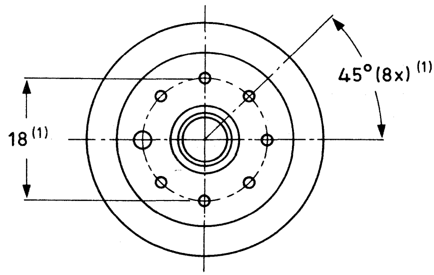
Signal electrode voltage	V_{as}	max.	50 V
Grid 4 voltage	V_{g4}	max.	1100 V
Grid 3 voltage	V_{g3}	max.	800 V
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	350 V
Grid 2 voltage	V_{g2}	max.	350 V
Grid 2 dissipation	W_{g2}	max.	1 W
Grid 1 voltage			
positive	V_{g1}	max.	0 V
negative	$-V_{g1}$	max.	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

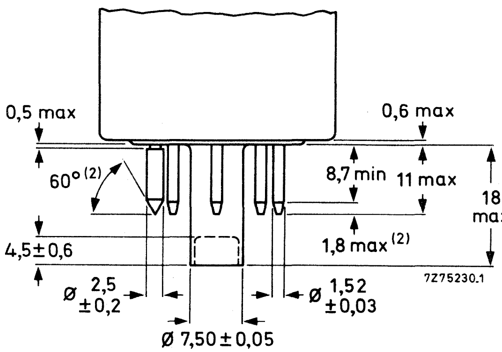






Mounting position: any

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 ^{o}C	
Blanking voltage on grid 1, peak-to-peak	V_{g1p-p}	50 V	

Performance

	min.	typ.		notes
Dark current (without light bias)		⩽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		≈ 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

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.
   ($\alpha = 100/100 - \beta$, β being the total blanking time in %): for the CCIR system α amounts to 1,3.
7. See chapter "Deflection assemblies".

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 nor 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 tubes 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 $\approx$ 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.

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.

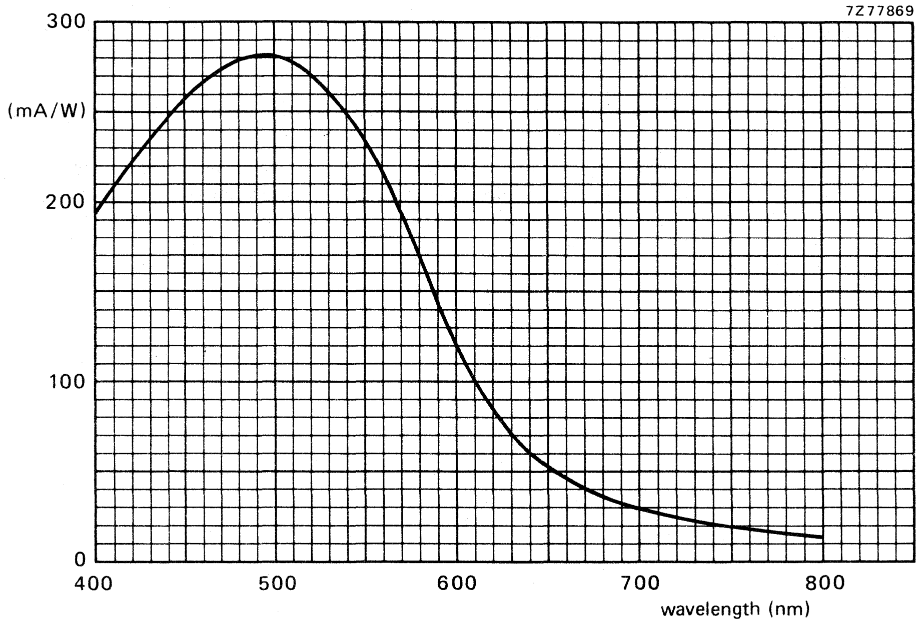


Fig. 1 Spectral sensitivity characteristic.

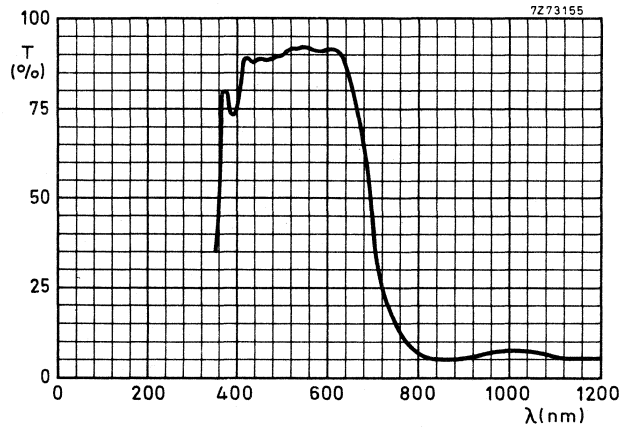
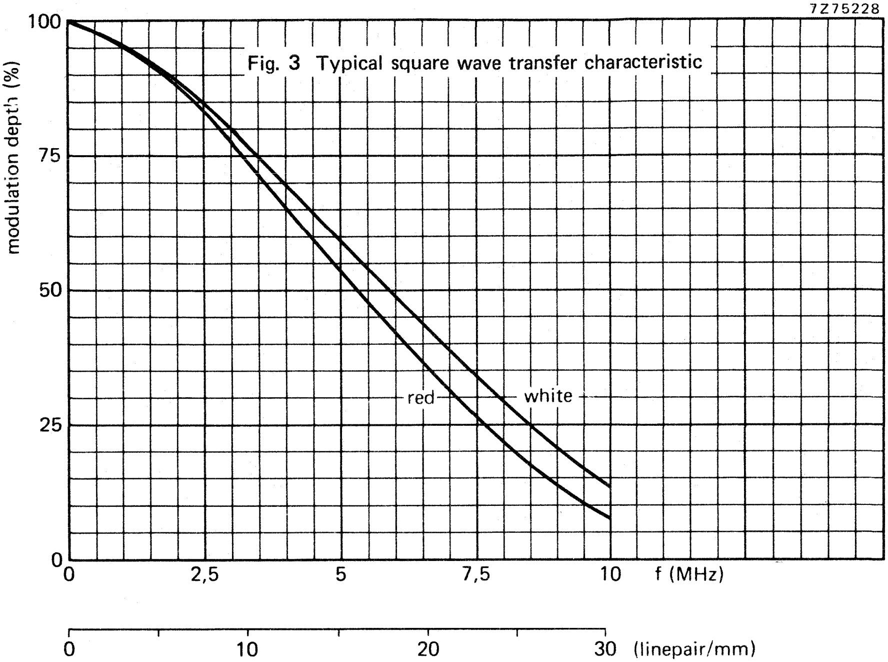


Fig. 2 Typical transmission curve of heat reflecting filter type CALFLEX B1/K1.



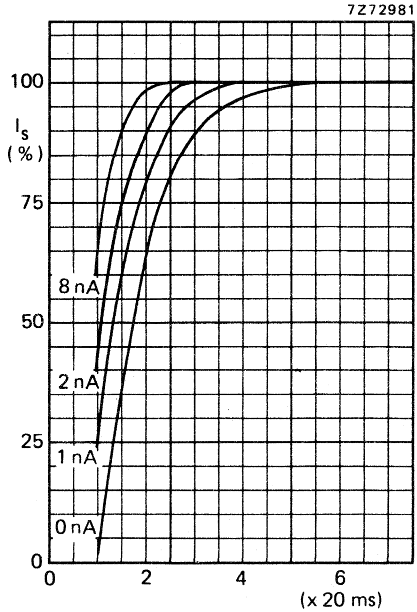


Fig. 4 Build-up lag: XQ1413L I_s/I_b = 40/600 nA.

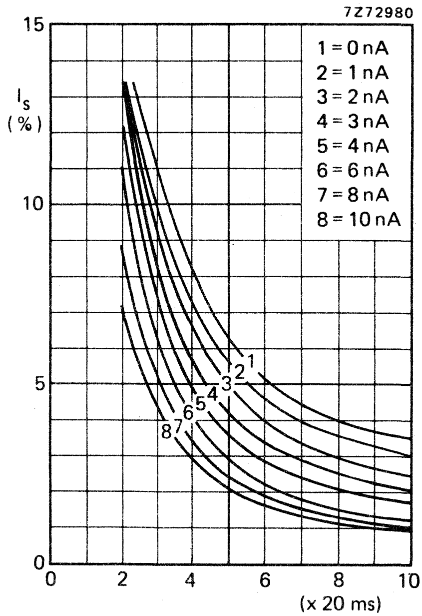
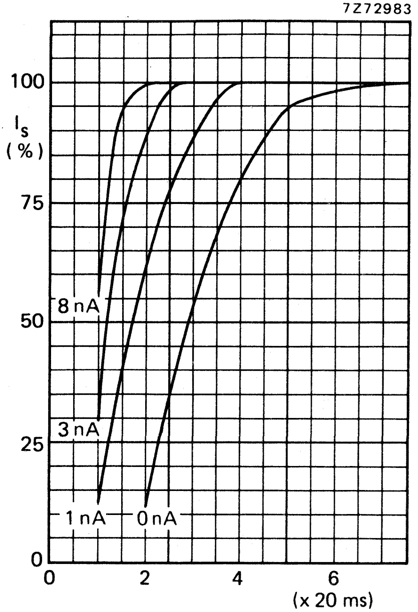


Fig. 5 Decay lag: XQ1413L I_s/I_b = 40/600 nA.



→ Fig. 6 Build-up lag: XQ1413R I_s/I_b = 20/300 nA.

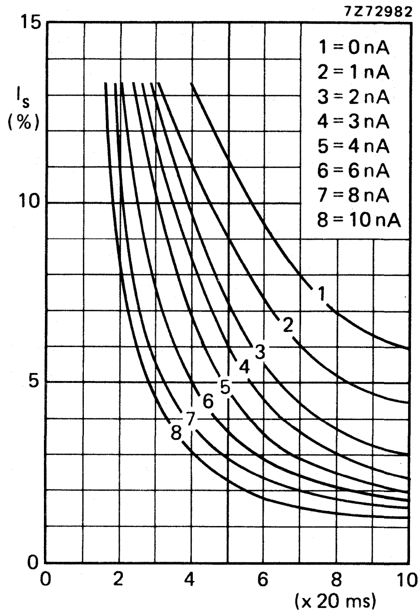


Fig. 7 Decay lag: XQ1413R I_s/I_b = 20/300 nA.

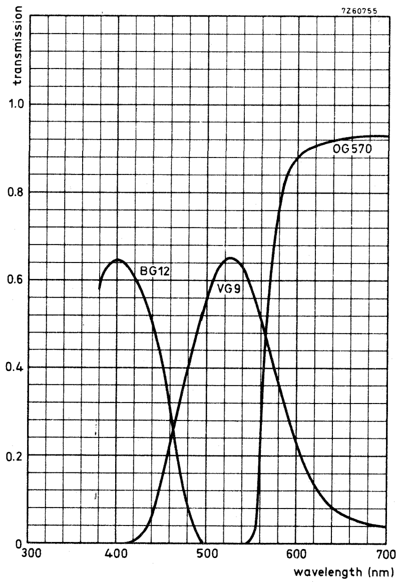


Fig. 8 Transmission of filters BG12, VG9 and OG570.

CAMERA TUBES

Plumbicon®, 30 mm (1,2 inch) diameter television camera tubes 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, 190 mA
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.

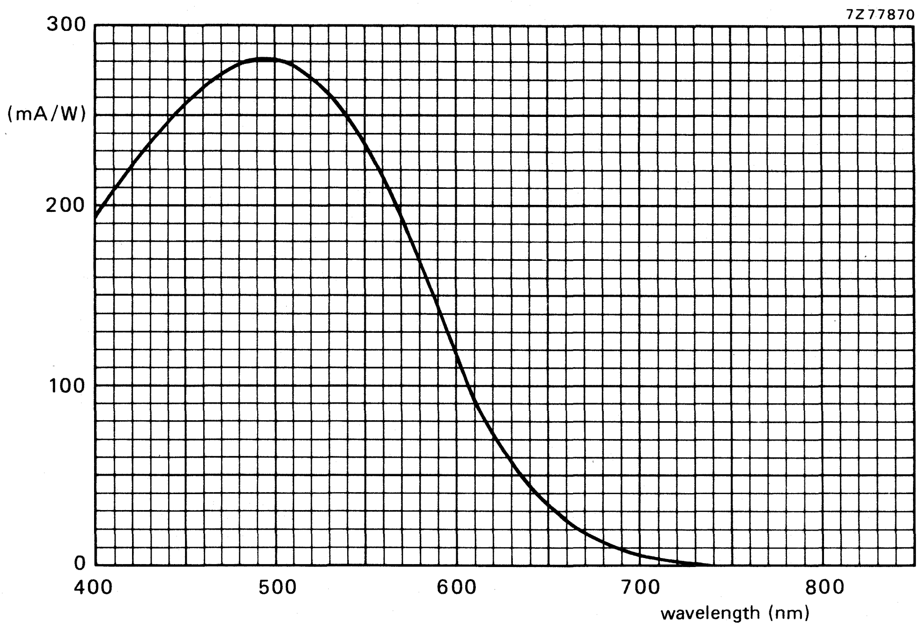
OPTICAL DATA

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 ®, 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
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	1,52	

® 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		
XQ1520R	type 56123	4
XQ1520L and G	type 56124	
XQ1520B	type 56125	
→ Deflection and focusing coil unit	type AT1130 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

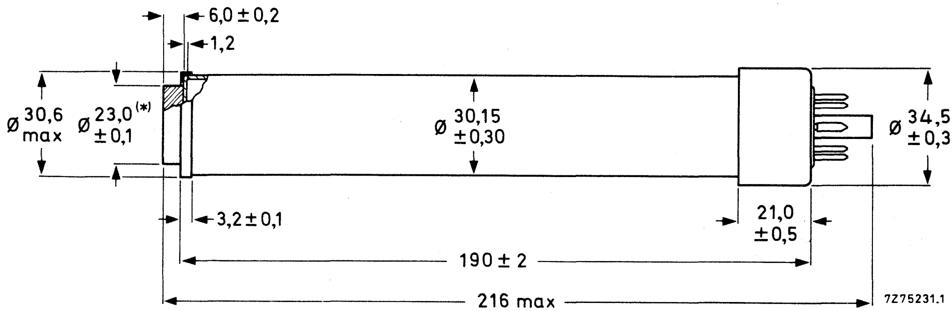
LIMITING VALUES (Absolute maximum rating system)

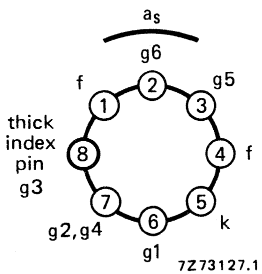
All voltages referred to the cathode, unless otherwise stated.

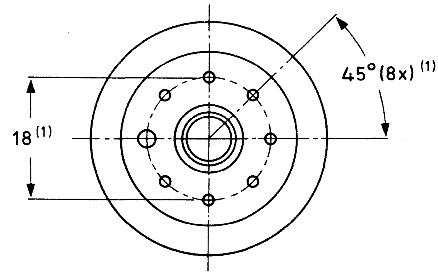
				notes
Signal electrode voltage	V_{as}	max	50 V	
Grid 6 (mesh) voltage	V_{g6}	max	1100 V	12
Grid 5 (collector) voltage	V_{g5}	max	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max	350 V	
Grid 4 (limiter) and grid 2 (accelerator, first anode) voltage	$V_{g2,4}$	max	350 V	
Grid 3 (auxiliary grid) 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

MECHANICAL DATA

Dimensions in mm

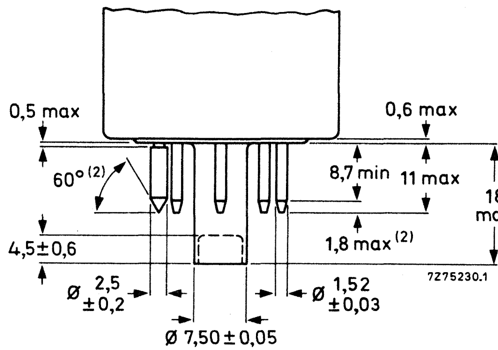






Mounting position: any

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.

			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	$I_{s\,p}$	0,3 μA	0,15 μA	0,3 μA	0,15 μA
Beam current, peak	$I_{b\,p}$	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	$V_{k\,p}$	7 V	3,5 V	7 V	3,5 V
Grid 1 pulse	$V_{g1\,p}$	27 V	23,5 V	27 V	23,5 V
Grid 3 pulse	$V_{g3\,p}$	see note 11	see note 11	see note 11	see note 11

			notes
Faceplate illuminance			14
Light bias			15
Temperature of faceplate		20 to 45 °C	
Deflection, focusing and alignment coil unit	AT1130		16

Performance

			notes
Dark current (without light bias)		⩽ 1 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	135	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 note 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

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

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 ≤ 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_{g1p}, with such an amplitude that during the ACT mode the grid 1 bias is effectively reduced by 25 V, (V_{g1p} = 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 C68.

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. 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.

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:

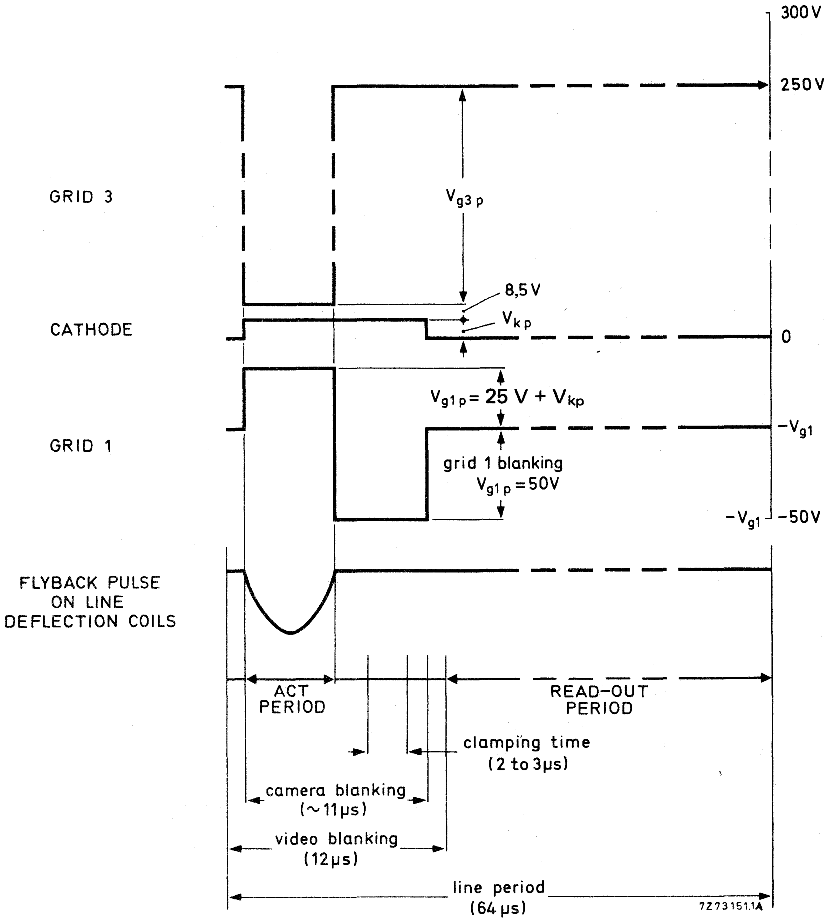
XQ1520R	Schott	OG570	thickness	3 mm
XQ1520G	Schott	VG9	thickness	1 mm
XQ1520B	Schott	BG12	thickness	3 mm

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.



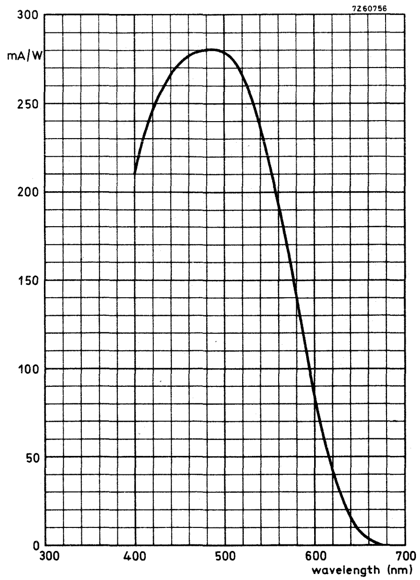


Fig. 1 Spectral response curve.

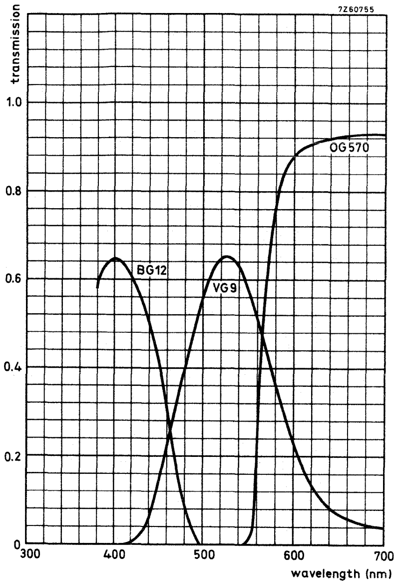


Fig. 2 Transmission of filters BG12, VG9, and OG570.

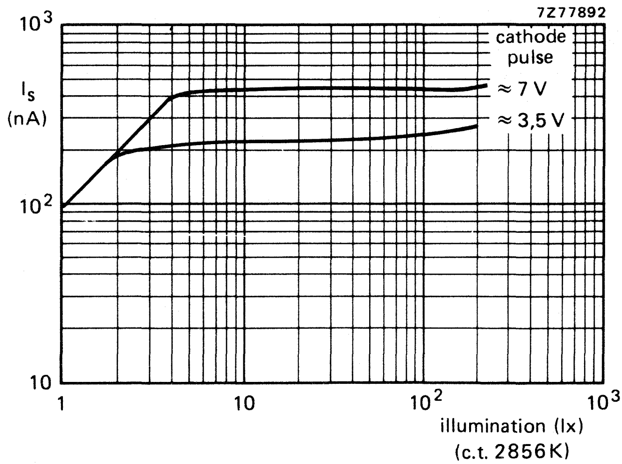


Fig. 3 Typical light transfer characteristics with ACT applied.

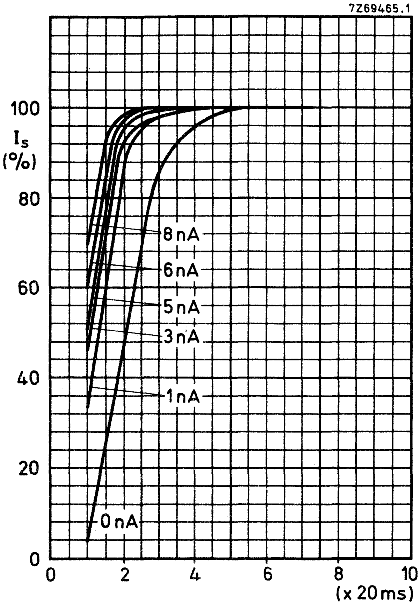


Fig. 4.

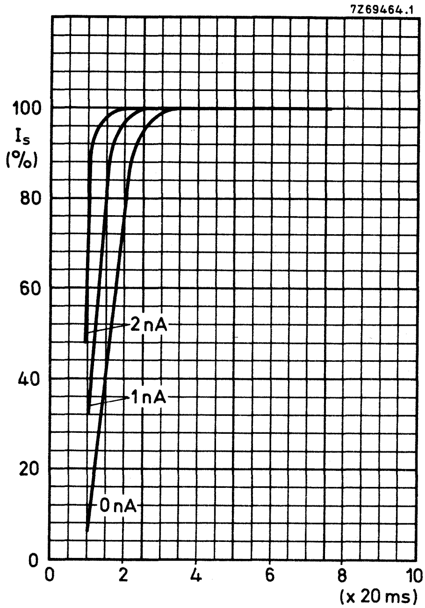


Fig. 5.

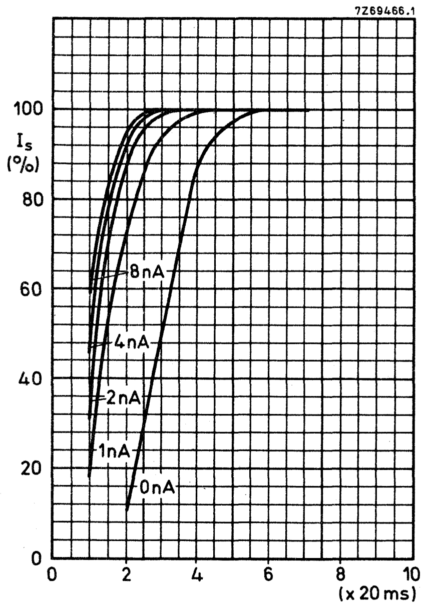


Fig. 6.

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.

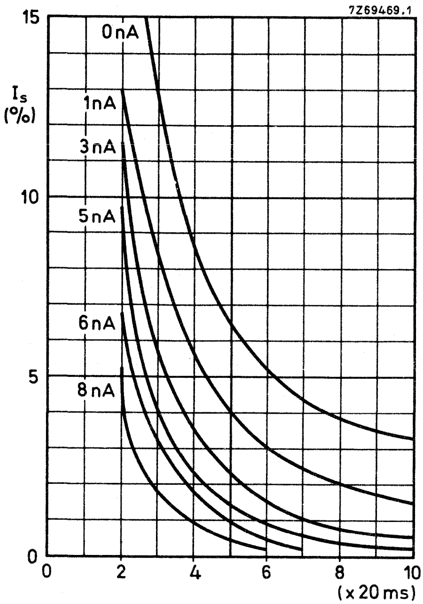


Fig. 7.

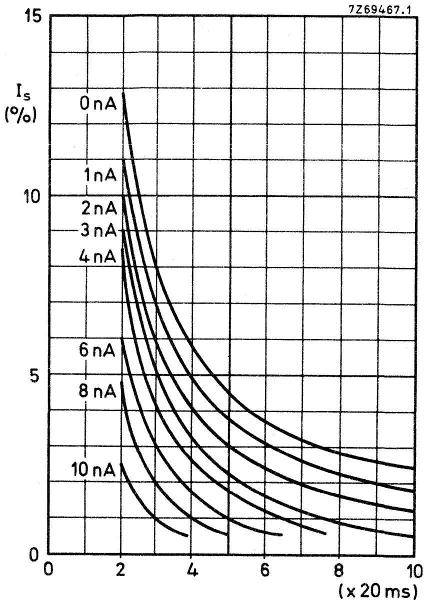


Fig. 8.

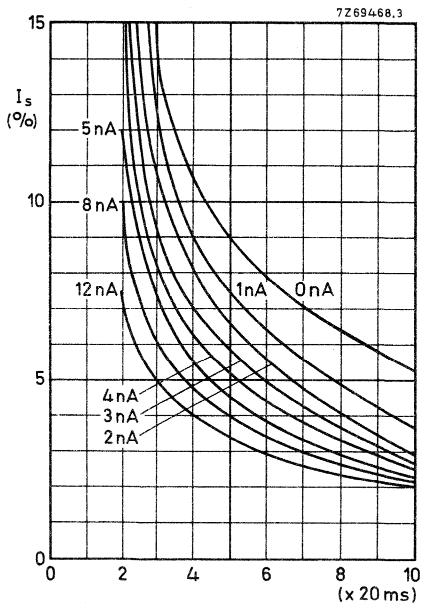


Fig. 9.

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 ®, 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 XQ1413.
- 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
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 XQ1523L	type 56124	
Adapter for XQ1523R	type 56123	
→ Deflection and focusing coil unit	type AT1130 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

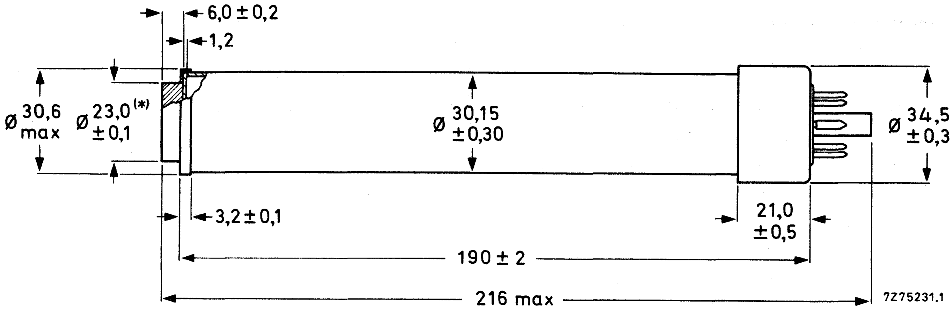
LIMITING VALUES (Absolute maximum rating system)

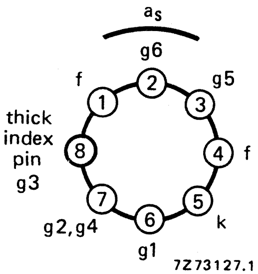
All voltages are referred to the cathode, unless otherwise stated.

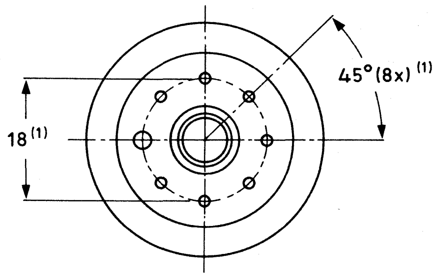
Signal electrode voltage	V_{as}	max	50	V	
Grid 6 (mesh) voltage	V_{g6}	max	1100	V	12
Grid 5 (collector) voltage	V_{g5}	max	800	V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max	350	V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max	350	V	
Grid 3 (auxiliary grid) voltage	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

MECHANICAL DATA

Dimensions in mm

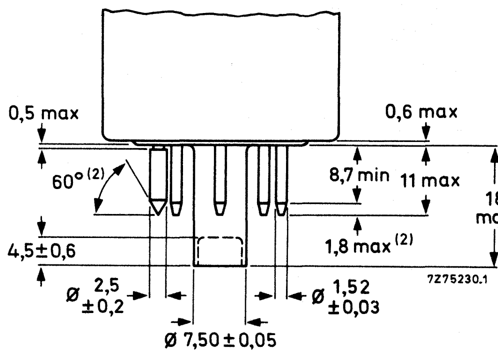






Mounting position: any

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 ^{o}C	
Deflection, focusing and alignment coil unit	AT1130	16 ←

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.	60	55
	min.	50	45

Modulation transfer characteristics — see Fig. 5

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)

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 25 V, (V_{g1p} = 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 C82.

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.

16. 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.

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 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.

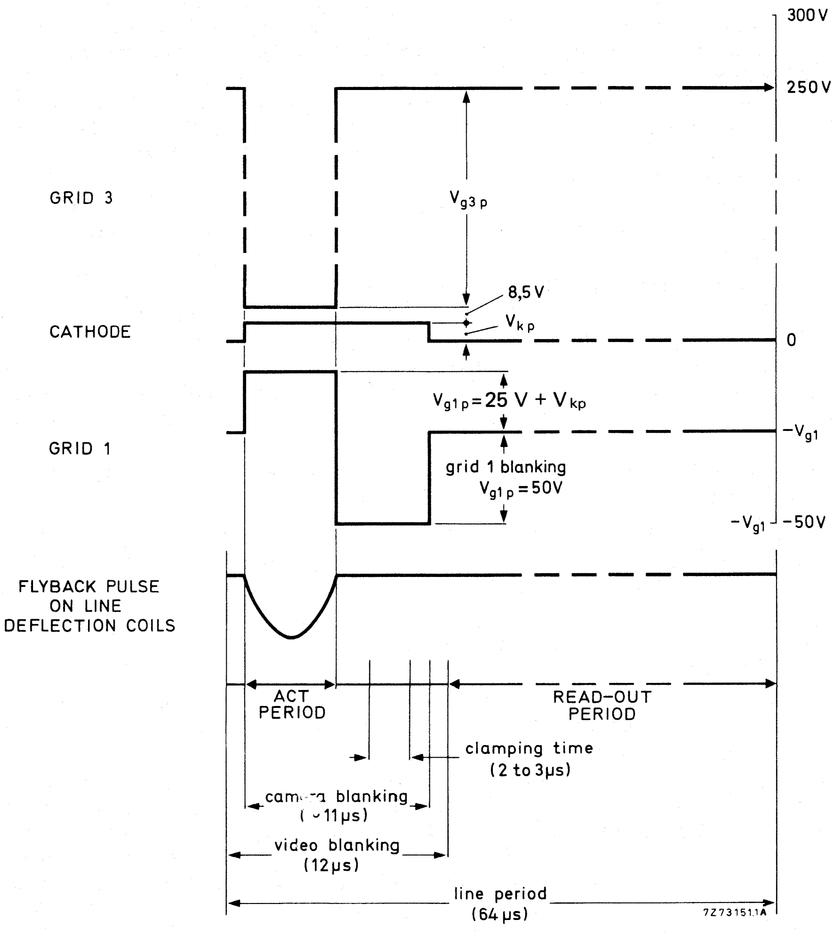
19. With pulses applied as indicated in note 11, the tube will properly handle a highlight with a diameter of 10% of picture height and with a brightness corresponding to 32 times peak signal white, I_{sp}.

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.



300 V
250 V
GRID 3
$V_{g3\,p}$
8,5 V
CATHODE
V_{kp}
0
$V_{g1\,p} = 25$ V + V_{kp}
$-V_{g1}$
GRID 1
grid 1 blanking
$V_{g1\,p} = 50$V
$-V_{g1}$ −50V
FLYBACK PULSE
ON LINE
DEFLECTION COILS
ACT
PERIOD
READ-OUT
PERIOD
clamping time
(2 to 3μs)
camera blanking
video blanking
(12 μs)
line period
(64 μs)
7Z73151.1A

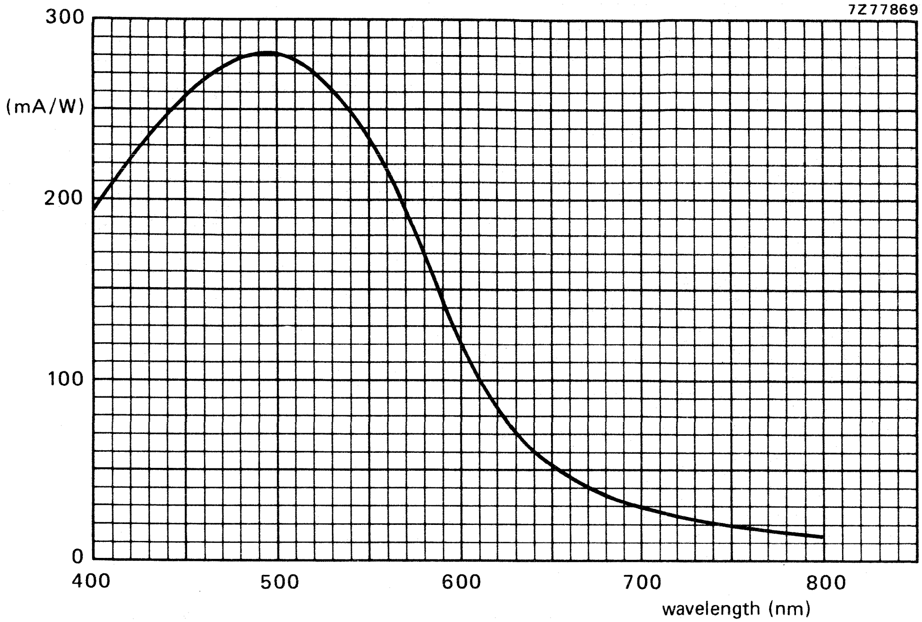


Fig.1 Spectral sensitivity characteristic.

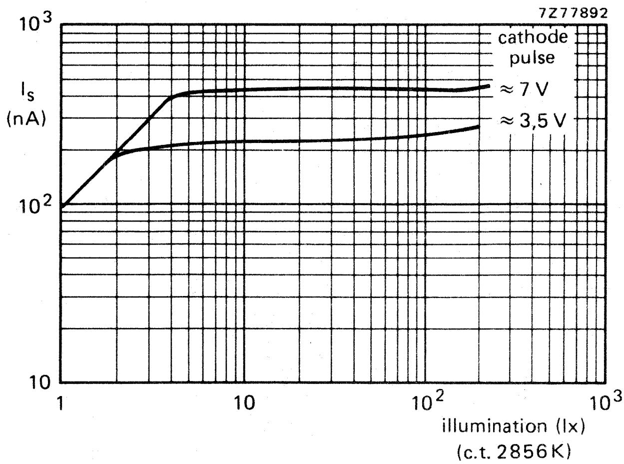
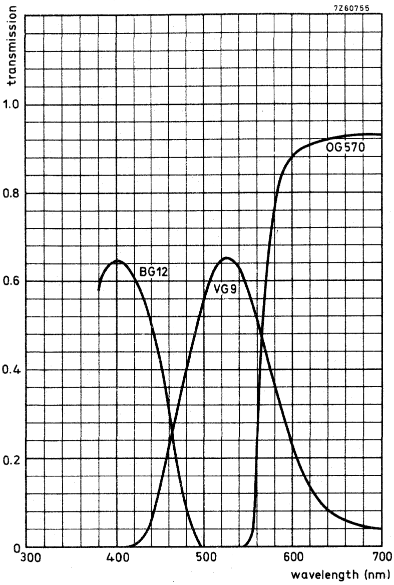


Fig.2 Typical light transfer characteristic with ACT applied.



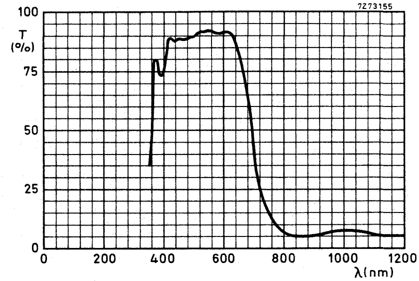


Fig.3 Typical transmission curve of heat reflecting filter type CALFLEX B1/K1.

Fig.4 Transmission of filters BG12, VG9 and OG570.

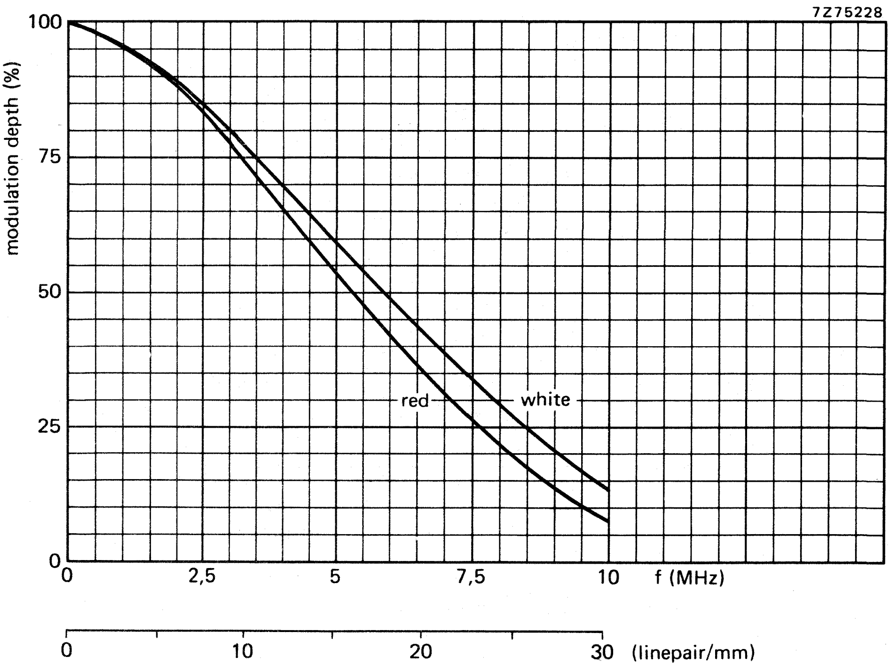
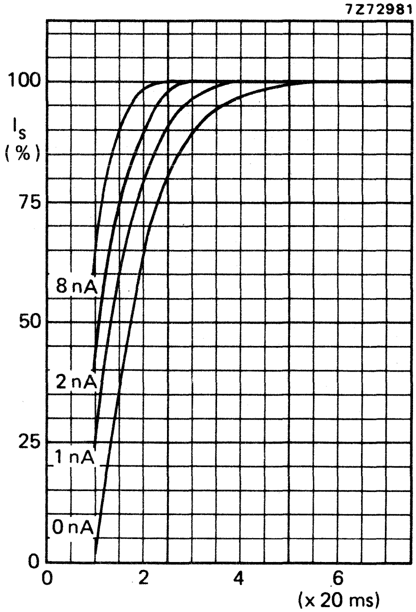
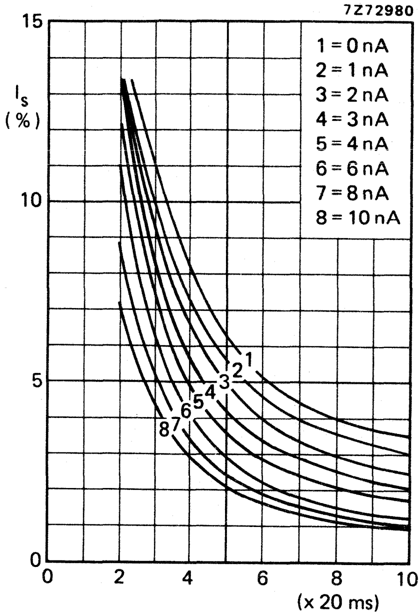
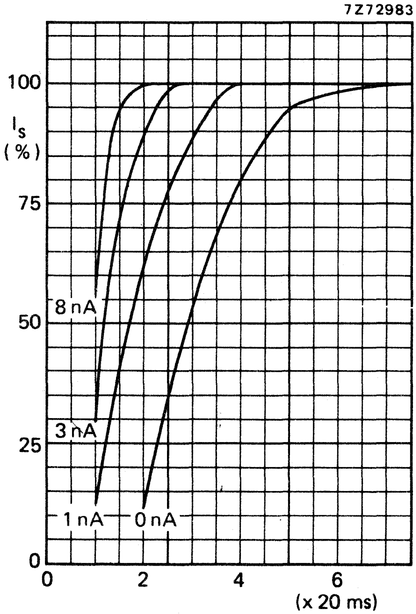


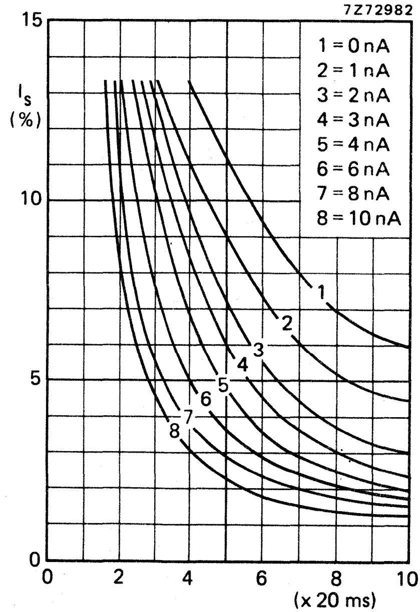
Fig.5 Typical square-wave transfer characteristic.





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 ®, 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
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.

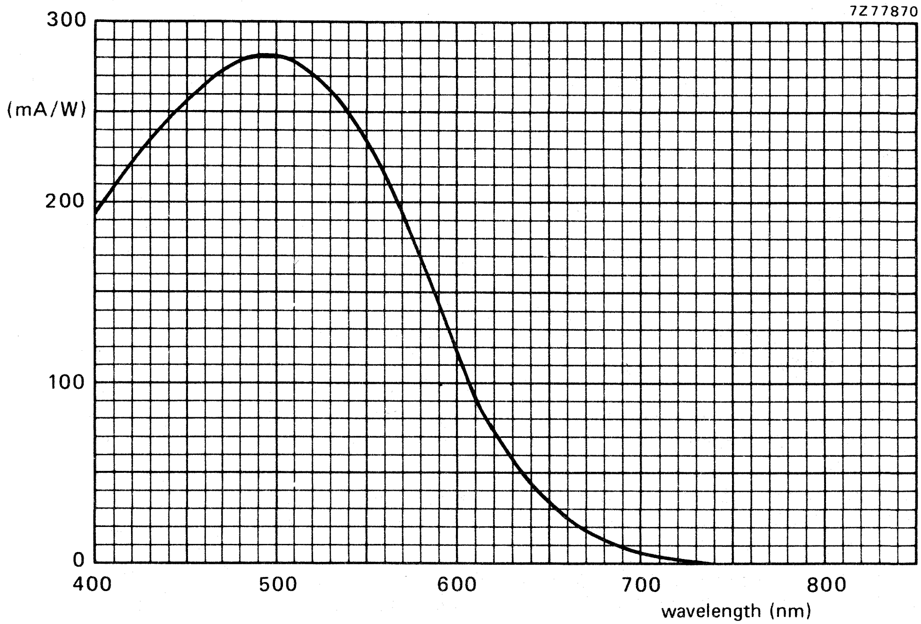
® Registered Trade Mark for television camera tube.

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).

25,4 mm dia. PLUMBICON TUBES

D

CAMERA TUBES

Plumbicon® television camera tubes 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

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 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 tubes.

ELECTRICAL

notes

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 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}	−35 to −100 V	
Blanking voltage, peak to peak			
on grid 1	$V_{g1p\text{-}p}$	50 ± 10 V	
on cathode	$V_{kp\text{-}p}$	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

					notes
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	
negative	$-V_{g1}$	max.	125	V	
Cathode to heater voltage					
positive peak	V_{kfp}	max.	125	V	
negative peak	$-V_{kfp}$	max.	50	V	
External resistance between cathode and heater at $-V_{kfp} > 10$ V	R_{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 or equivalent.
For colour cameras AT1116/06 or equivalent.

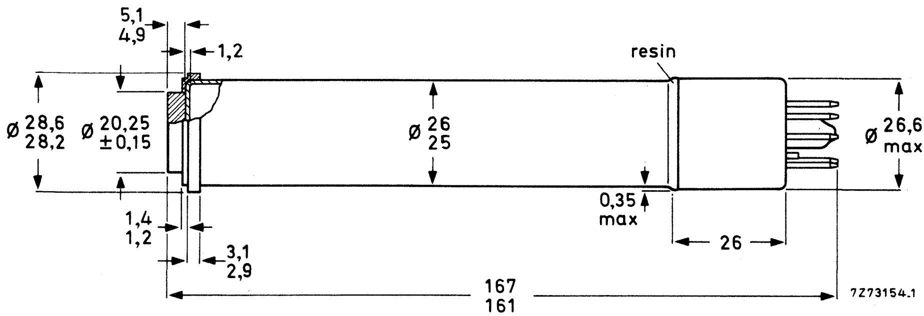
MECHANICAL DATA

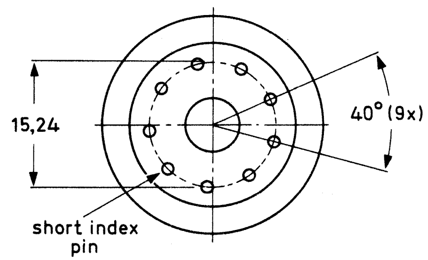
Dimensions in mm

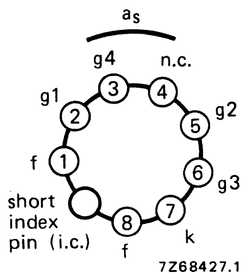
Mounting position: any

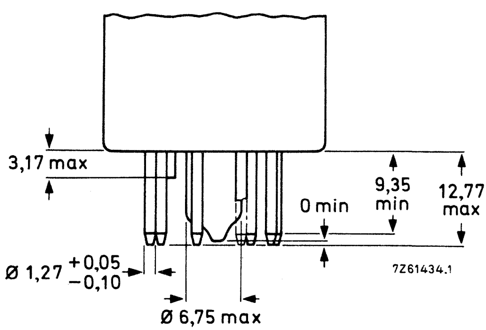
Mass: approx. 60 g

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









OPERATING CONDITIONS AND PERFORMANCE

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

			notes
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
Face plate temperature	T	20 to 45 °C	

	low voltage mode	high voltage mode	notes
Grid 4 voltage	600	960 V	9
Grid 3 voltage	370	600 V	9
Grid 1 voltage			6

Blanking voltage on grid 1, peak to peak	V_{g1pp}	50 V	

Performance

Dark current ⩽ 3 nA

Sensitivity at colour temperature of illumination = 2856 K (note 10)

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

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

Spectral response

maximum response at	approx. 500 nm
cut-off at	approx. 650 nm
response curve	see page D11

Resolution notes

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 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 TV lines in % typical	40	35	40	50
minimum	35	30	35	40

Modulation transfer characteristics see page D11

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 note 14				decay lag note 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 note 14				decay lag note 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	97	≈ 100			2,5	1		
XQ1070B	97	≈ 100			3,5	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 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 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 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. See chapter "Deflection assemblies".
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 $\leqslant$ 1 V) depends on the type of coil unit used. For types AT1102/01 and AT1116/06 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 D11

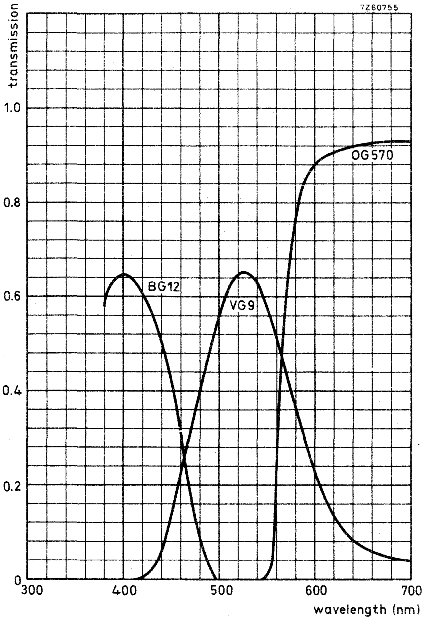
11. Gamma-stretching circuitry is recommended.

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.

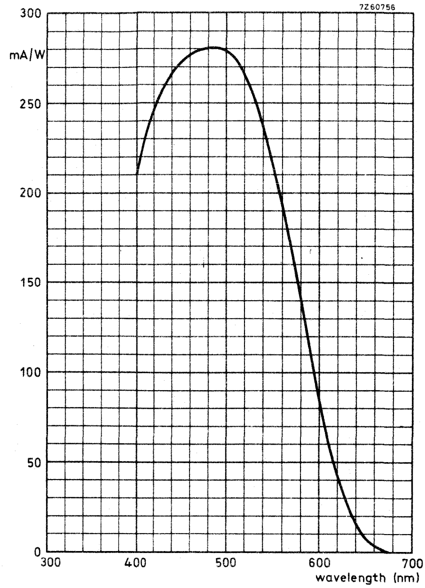
13. The horizontal amplitude response can be raised by the application of suitable correction circuits, which affect neither the vertical resolution nor the limiting resolution.

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.

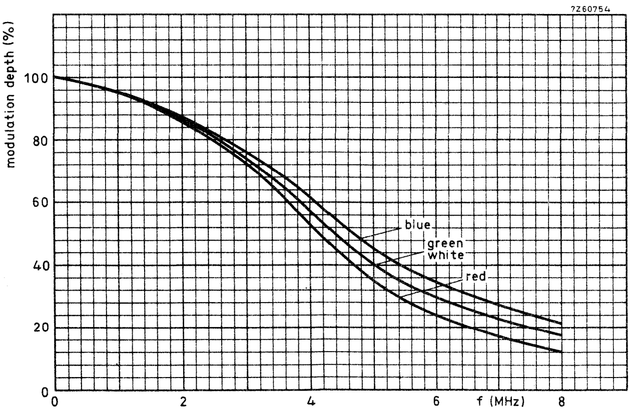
15. After a minimum of 5 s of illumination on the target. The figures given represent typical residual signals in percents of the original signal current 60 ms respectively 200 ms after the illumination has been removed.



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

For all further information see data of the XQ1070 series.

® Registered Trade Mark for television camera tubes.

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	$\geqslant$ 35 lp/mm

OPTICAL

		notes
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 tubes.

ELECTRICAL

			notes
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 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}	−35 to −100 V	
Blanking voltage, peak to peak on grid 1	$V_{g1p\text{-}p}$	50 ± 10 V	
on cathode	$V_{kp\text{-}p}$	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.

					notes
Signal electrode voltage	V_{as}	max.	50	V	3
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.	450	V	
Grid 2 voltage	V_{g2}	max.	350	V	
Grid 1 voltage					
positive	V_{g1}	max.	0	V	
negative	$-V_{g1}$	max.	125	V	
Cathode to heater voltage					
positive peak	V_{kfp}	max.	125	V	
negative peak	$-V_{kfp}$	max.	50	V	
External resistance between cathode and heater at $-V_{kfp} > 10$ V	R_{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, AT1116S or equivalent

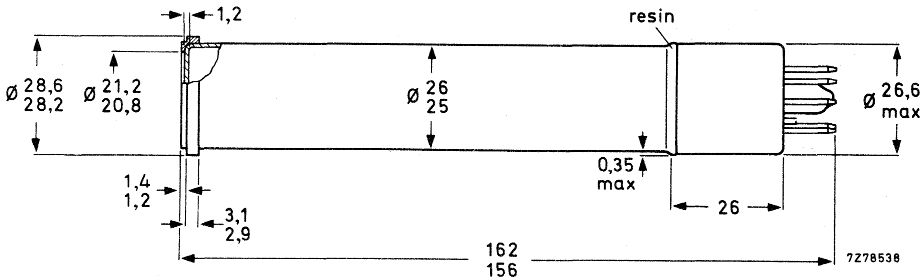
MECHANICAL DATA

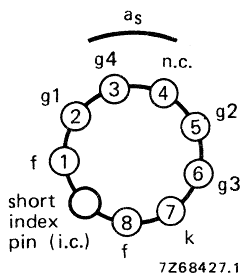
Dimensions in mm

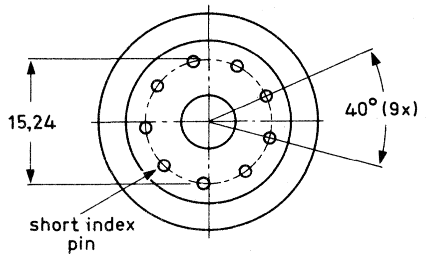
Mounting position: any

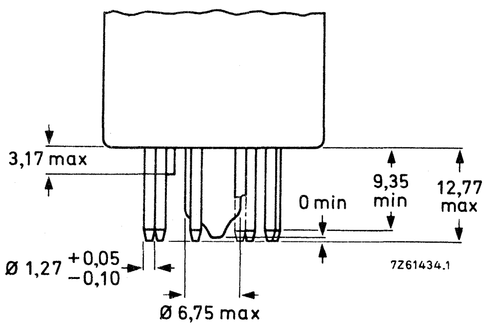
Net mass: approx. 60 g

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









OPERATING CONDITIONS AND PERFORMANCE

Conditions

			notes
Conditions			5
Cathode voltage	V_k	0 V	
Grid 2 voltage	V_{g2}	300 V	
Signal electrode voltage	V_{as}	20 to 45 V	3, 8
Beam current	I_b		6a
Focusing coil current at given values of grid 4 and grid 3 voltages			9
Deflection and alignment current			9
Faceplate illumination (P20 light source)	E	1 lx	
Faceplate temperature	T	20 to 45 °C	

		low voltage mode	high voltage mode	notes
				7
Grid 4 voltage	V_{g4}	600	960 V	
Grid 3 voltage	V_{g3}	375	600 V	
Grid 1 voltage				6a

Blanking voltage on grid 1, peak to peak	$V_{g1p\text{-}p}$	50 V	

Performance

				notes
Dark current			≤ 3 nA	
Signal current, E = 1 lx (P20) peak	I_{sp}	min.	160 nA	6a, 6b
		typ.	200 nA	6a, 6b
Gamma of transfer characteristic			0,95 ± 0,05	10
Spectral response				
maximum 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	notes
		11a
65%	70%	

Modulation transfer characteristic see page D20 11b

Decay		notes
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 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 mm x 20 mm), see note 5, this ratio amounts to δ = 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. 395 μA/lm, typical 500 μA/lm. These values refer to signal currents measured with an integrating instrument connected in the signal-electrode lead.

7. 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, AT1116S 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 mApp		Frame current mApp	
V_{g4}/V_{g3}	600/375	960/600	600/375	960/600	600/375	960/600
AT1102/01	18	23	310	390	42	53
AT1116S	83	105	400	510	59	75
	Approx. values for scanning amplitudes corresponding to 15 mm x 20 mm scanned area					

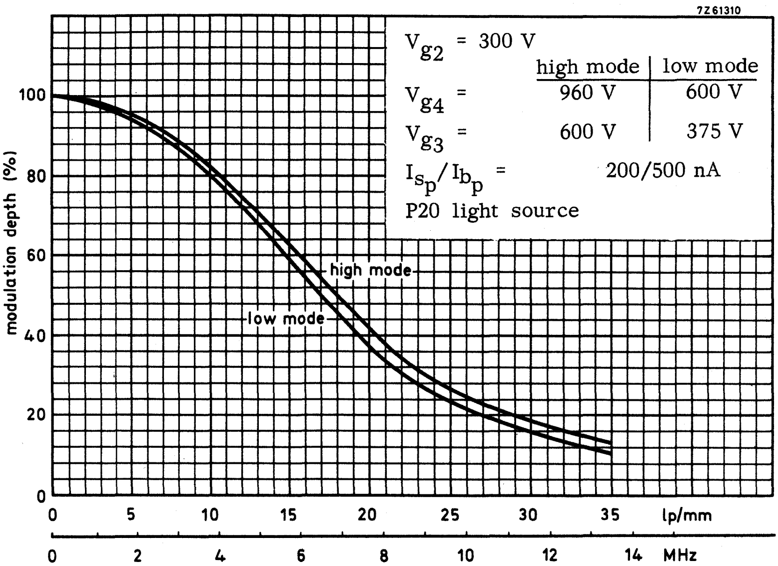
* Adjusted for correct electrical focus. The direction of the focusing current shall be such that a north-seeking pole is attracted towards the image end of the focusing coil.
Line and frame alignment coil currents max. 15 mA (AT1116S) corresponding to a flux density of approx. 4×10^{-4} T (4 Gs).

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

OPTICAL DATA

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

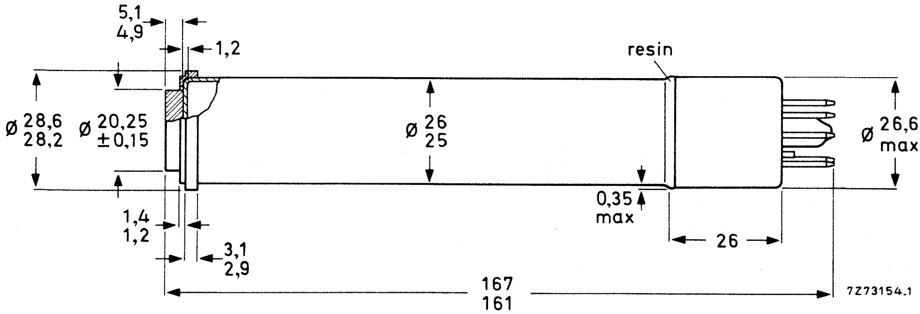
Orientation of image on photoconductive target
For correct orientation of the image on the target the vertical scan should be essentially parallel to the plane passing through the tube axis and the marker line on the metal sleeve on the base end of the tube.

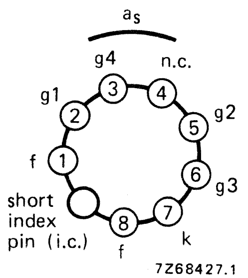
Faceplate
Refractive index — n 1,49
Refractive index of anti-halation glass disc — n 1,52

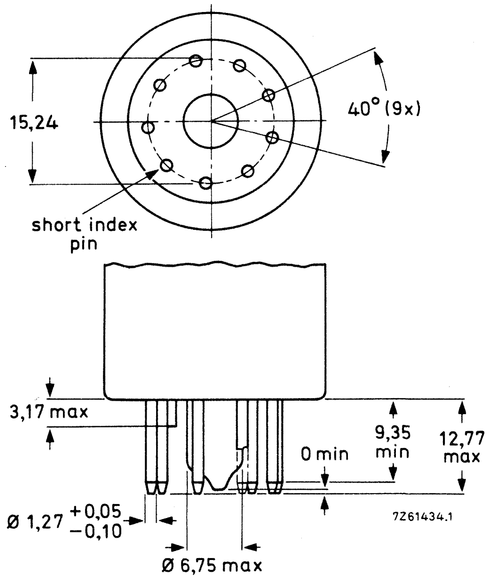
® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm







Mounting position: any

Mass: approx. 60 g

→ Base: JEDEC E8-11, IEC67-I-33a

ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit	
for black and white cameras	AT1102/01, or equivalent
for colour cameras	AT1116/06, 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

				notes
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.

				notes
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	
External resistance between cathode and heater at $-V_{kf\,p} > 10$ V	R_{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	

OPERATING CONDITIONS AND PERFORMANCE

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

					notes
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	
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

				notes
Dark current		$\leqslant$ 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 D29			

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

Modulation transfer characteristics see page D29

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

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. See chapter deflection assemblies.

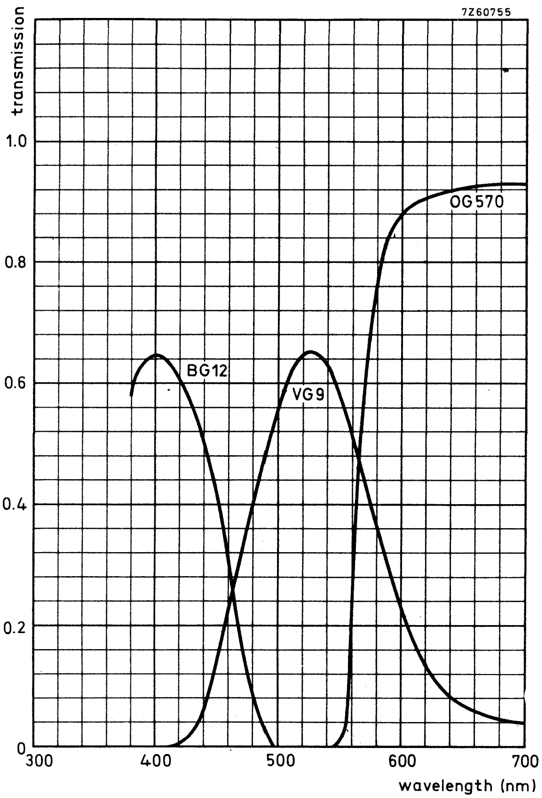
8. In the case of a black/white camera the illumination of the photoconductive layer, B_{ph}, is related to scene illumination, B_{sc}, by the formula:

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

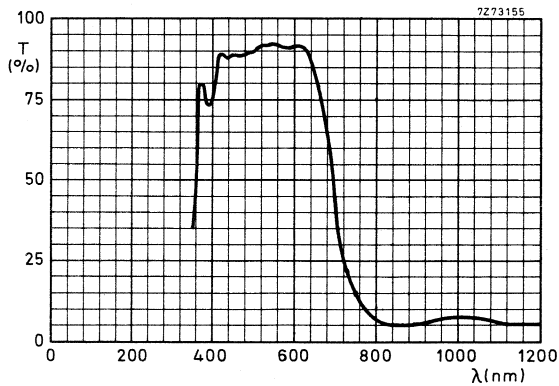
in which R represents the average scene reflectivity or the object reflectivity, whichever is relevant, T the lens transmission factor, F the lens aperture, and m the linear magnification from scene to target.

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.

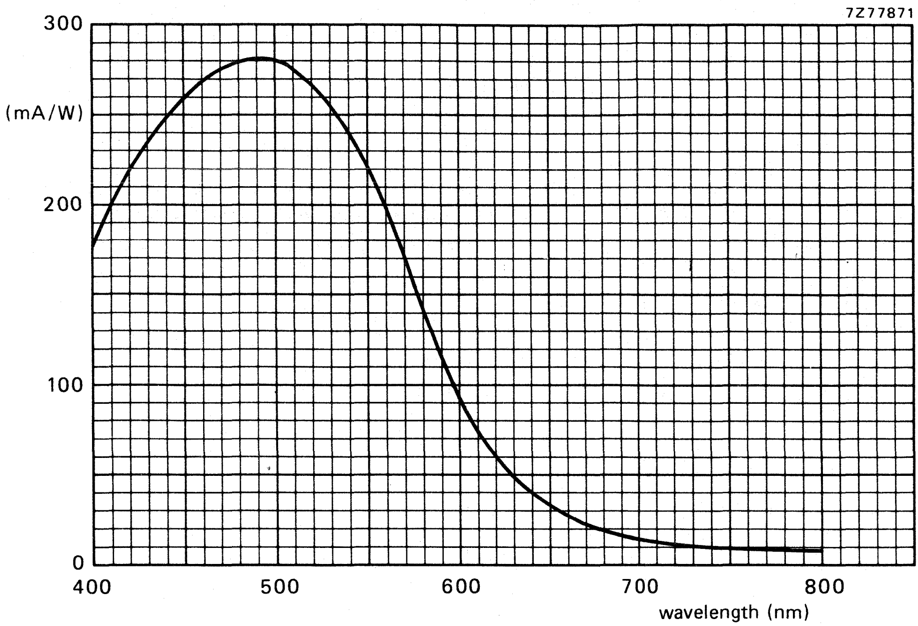
9. The optimum voltage ratio V_{g4}/V_{g3} to obtain minimum beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. For types AT1102/01 and AT1116/06 a ratio of 1,5: 1 to 1,6: 1 is recommended.
10. All measurements are made with an infrared reflecting filter interposed 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 D28.
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 D28.
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.



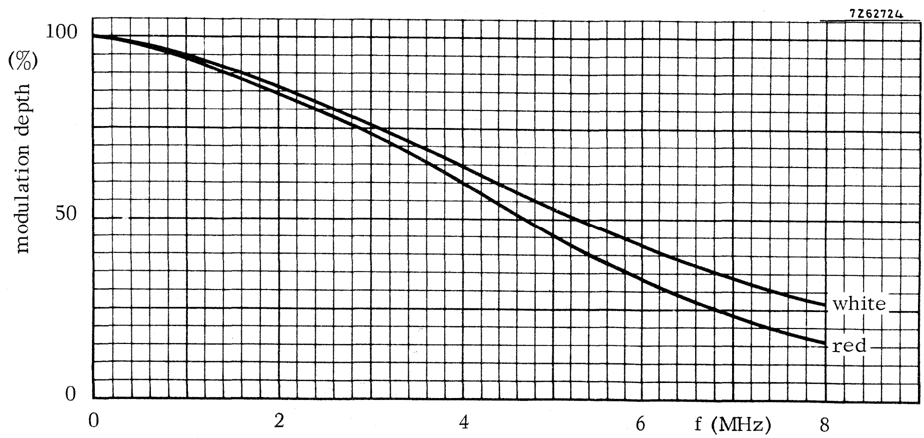
Transmission of filters BG12. VG9 and OG570. See note 11.



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

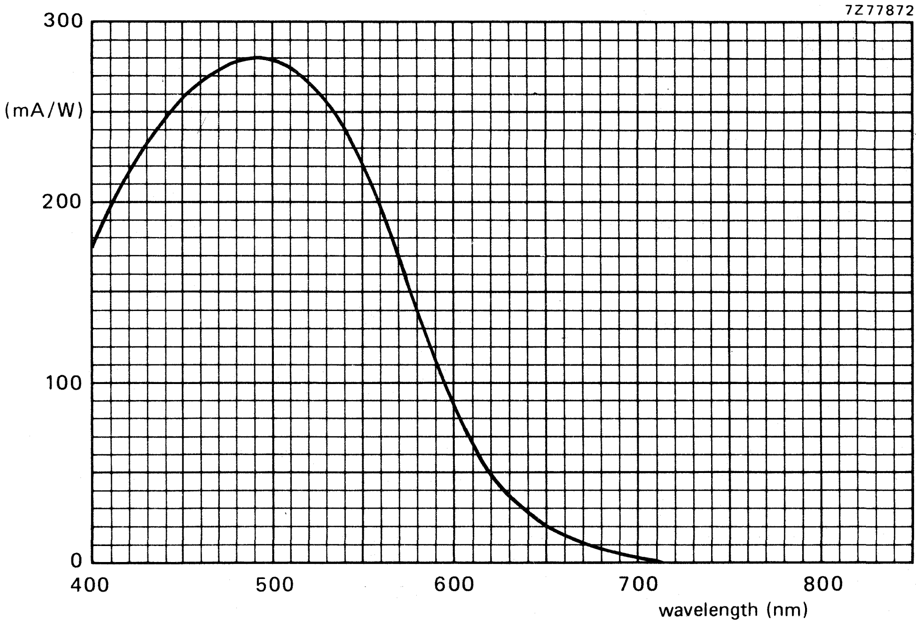
Spectral response	see curve below
Maximum response at	500 nm
Cut-off	750 nm*

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.

* 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:

/02	rear loading and with provisions for adjustable light bias
/03	front loading 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
XQ1070/02	L	R	G	B	Figs 1, 3, 4 and 5
XQ1071/02		R	G	B	
XQ1073/02		R			
XQ1074/02		R			
XQ1075/02		R			
XQ1076/02		R			
XQ1070/03	L	R	G	B	Figs 2, 3 and 4
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:

- /02 : Reduced output capacitance; less lag when light bias applied.
- /03 : Less lag when light bias applied.

ACCESSORIES

versions	socket	defl. and focusing unit B/W	colour	mask	light bias
/02	56098	AT1119/01	AT1126 triplet	56028	56106*
/03	56098	AT1116/..	AT1116/06 triplet	56028	56106*

* Fits into metal cylinder cemented on to pumping stem.

MECHANICAL DATA

Dimensions in mm

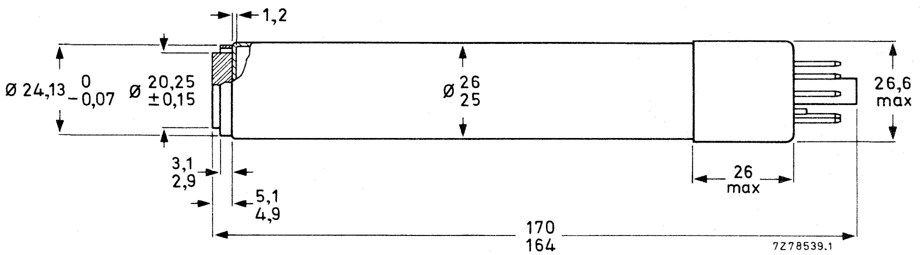


Fig. 1.

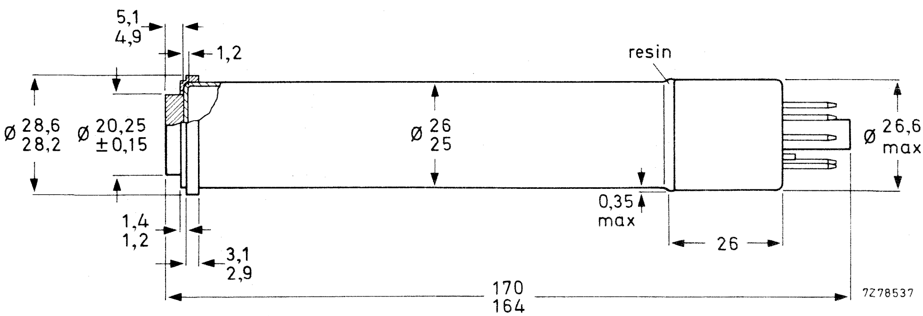


Fig. 2.

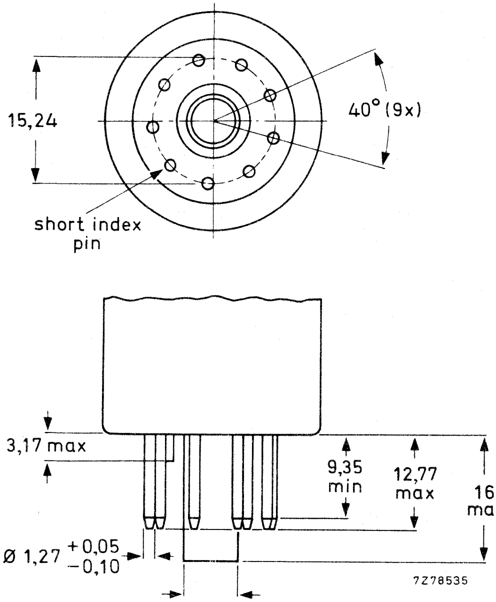


Fig. 3.

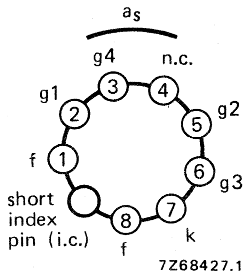
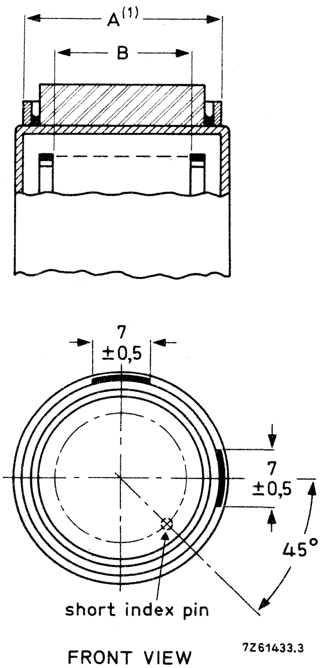


Fig. 4.



(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. 5.

CAMERA TUBES

Plumbicon®, 25,4 mm (1 in) diameter television camera tubes 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.
- 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.

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
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 AT1126
Mask		type 56028

ELECTRON-GUN CHARACTERISTICS

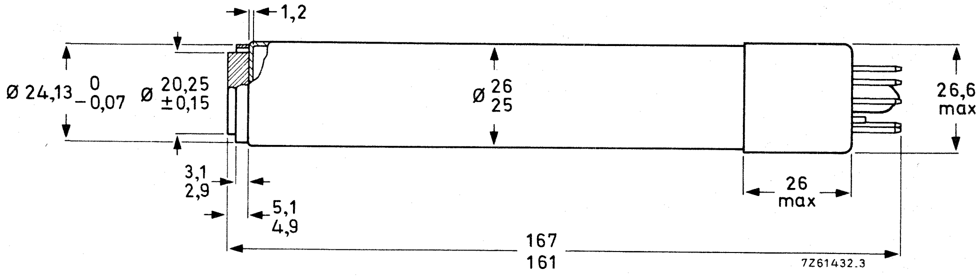
				notes
Cut-off Grid 1 voltage for cut-off at $V_{g2,4}$ = 300 V, without blanking or ACT pulses	V_{g1}		−40 to −110 V	
Blanking voltage, peak to peak at $V_{g2,4}$ = 300 V, on grid 1	$V_{g1p\text{-}p}$		50 ± 10 V	3
Grids 2 and 4 current (d.c. values)	$I_{g2,4}$	<	0,2 mA	4
Grids 3, 5 and 6 currents			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

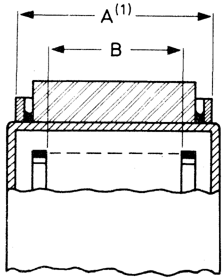
LIMITING VALUES (Absolute maximum rating system)

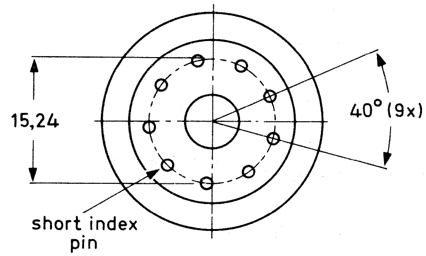
All voltages are referred to the cathode, unless otherwise stated.

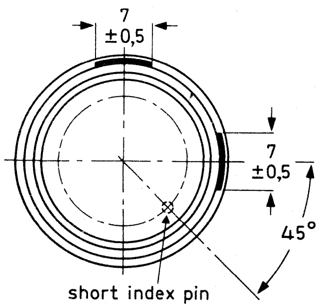
				notes
Signal electrode voltage	V_{as}	max.	50 V	5
Grid 6 (mesh) voltage	V_{g6}	max.	1100 V	
Grid 5 (collector) voltage	V_{g5}	max.	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max.	350 V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max.	350 V	
Grid 3 (auxiliary 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	
External resistance between cathode and heater at $-V_{kfp} > 10$ V	R_{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

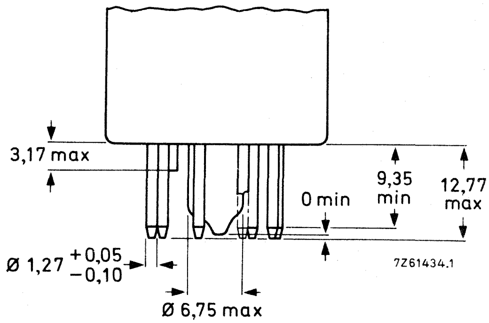








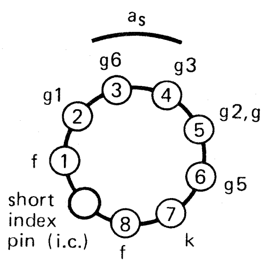
FRONT VIEW 7Z61433.3



Mounting position: any

Mass: ≈ 70 g

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



7Z61431.1

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 and AT1126	16

Performance

				notes
Dark current	≤	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 ± 0,05			18
Light transfer characteristics with ACT	see Fig. 5			
Highlight handling	≥ 5 lens stops			19
Spectral response				
maximum response at	≈	500	nm	
cut-off at	≈	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

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

<table>
<tr><td></td><td colspan="4">build-up lag
see note 22</td><td colspan="4">decay lag
see note 23</td></tr>
<tr><td></td><td colspan="2">I_s/I_b = 100/200 nA</td><td colspan="2">I_s/I_b = 200/400 nA</td><td colspan="2">I_s/I_b = 100/200 nA</td><td colspan="2">I_s/I_b = 200/400 nA</td></tr>
<tr><td></td><td>60 ms</td><td>200 ms</td><td>60 ms</td><td>200 ms</td><td>60 ms</td><td>200 ms</td><td>60 ms</td><td>200 ms</td></tr>
<tr><td>XQ1080, L, G</td><td colspan="2"></td><td>98%</td><td>≈ 100%</td><td colspan="2"></td><td>1,5%</td><td>0,6%</td></tr>
<tr><td>XQ1080R</td><td rowspan="2">>97%</td><td rowspan="2">≈ 100%</td><td colspan="2"></td><td>2,5%</td><td>1%</td><td colspan="2"></td></tr>
<tr><td>XQ1080B</td><td colspan="2"></td><td>3,5%</td><td>2%</td><td colspan="2"></td></tr>
</table>

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 AT1126 (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 AT1126 (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.

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.

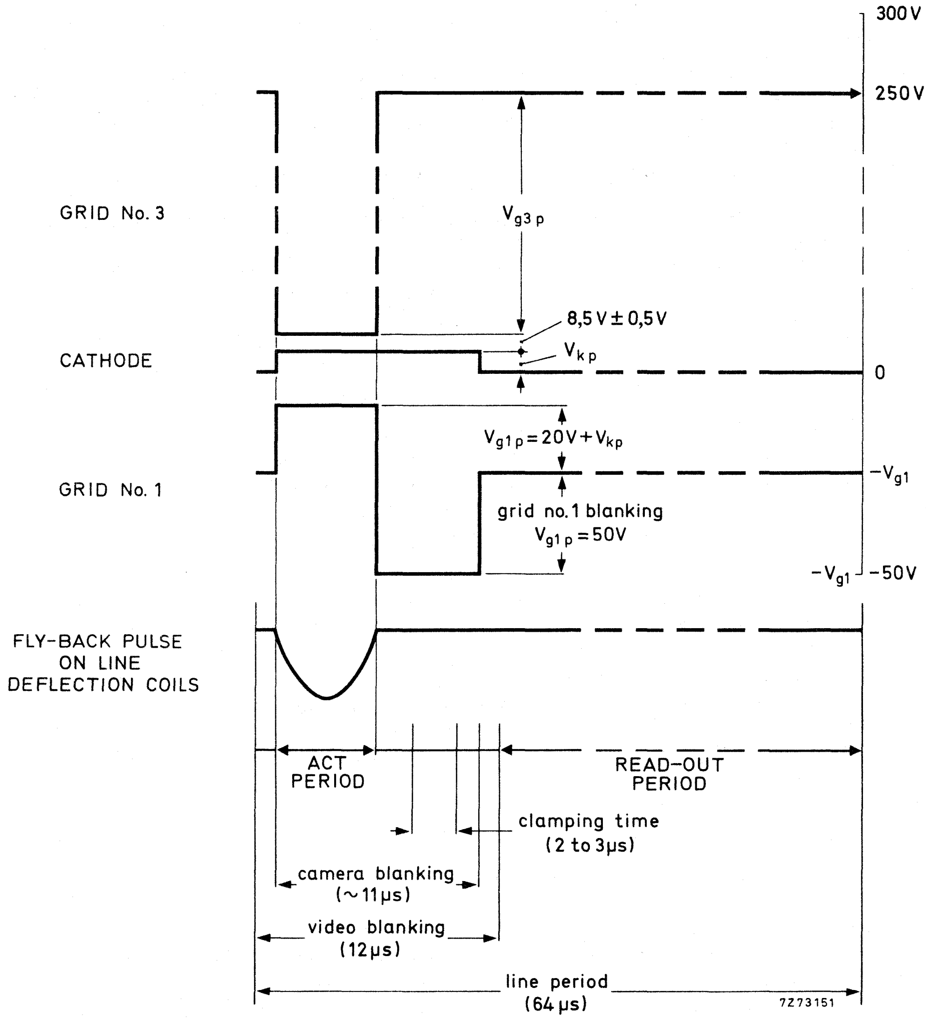


Fig. 2 Pulse timing and amplitude diagram.

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 nor 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.

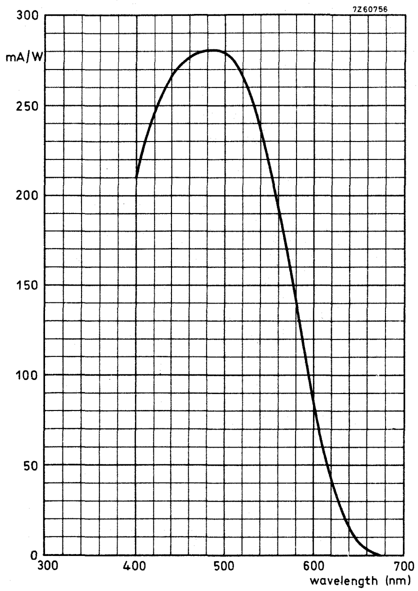


Fig. 3 Typical spectral response curve.

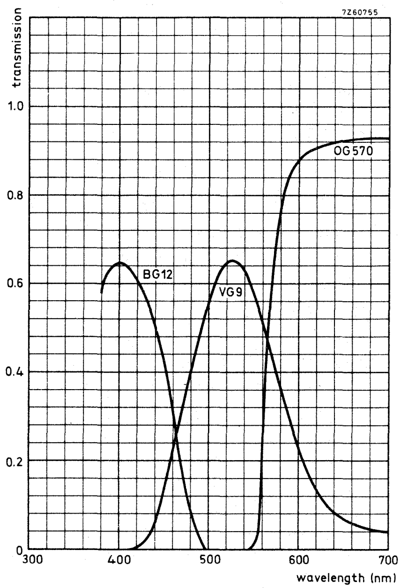


Fig. 4 Transmission of filters OG570, VG9 and BG12. See note 17.

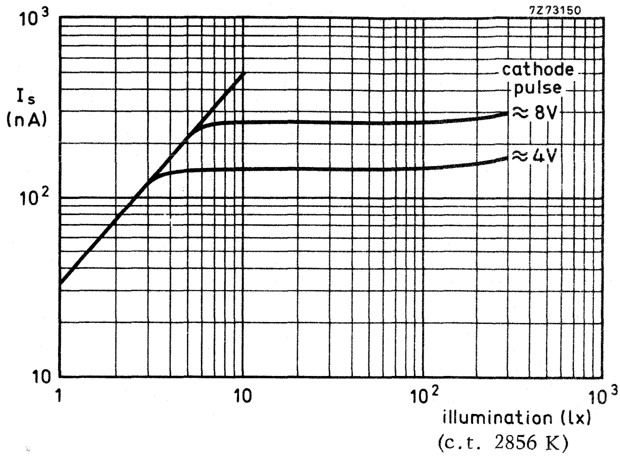


Fig. 5 Typical light transfer characteristics with ACT applied.

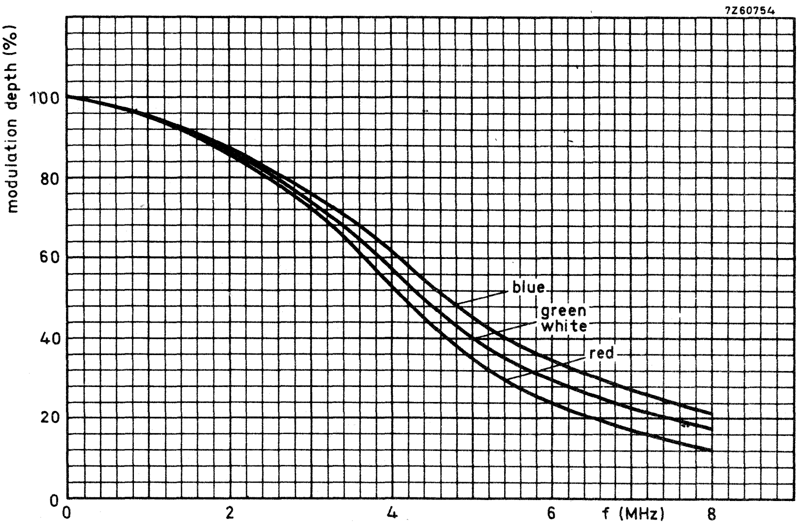


Fig. 6 Square-wave modulation transfer characteristics. $V_{g2,\,g4}$ = 300 V, V_{g5} = 475 V, V_{g6} = 750 V.

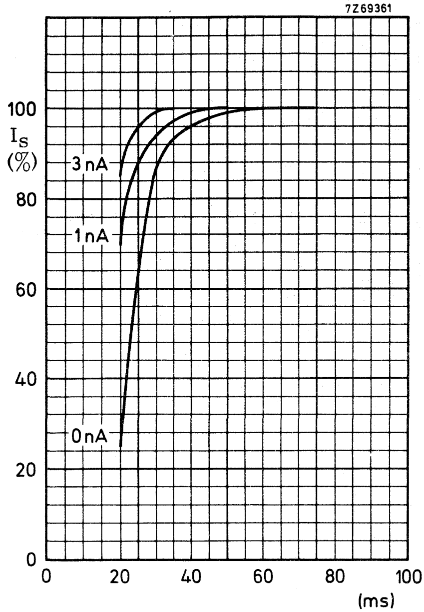


Fig. 7.

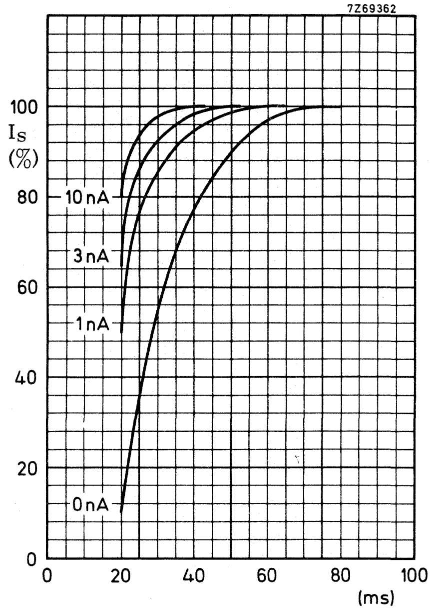


Fig. 8.

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.

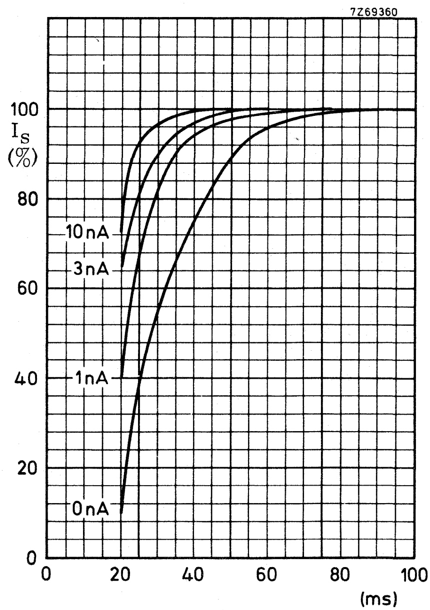


Fig. 9.

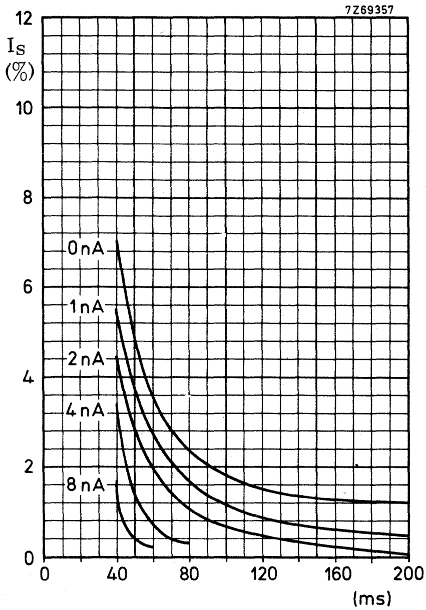


Fig. 10.

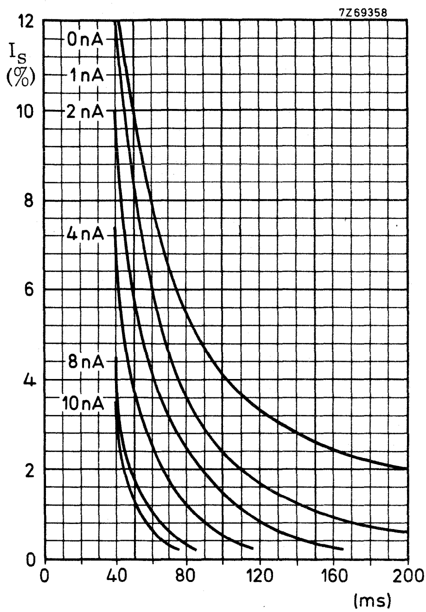


Fig. 11.

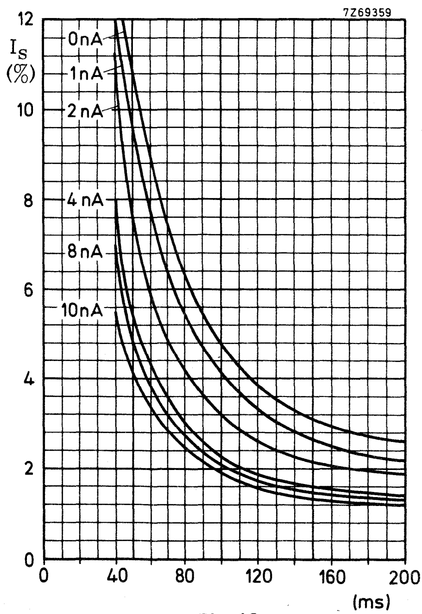


Fig. 12.

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.

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.

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
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 AT1126
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	$V_{g1p\text{-}p}$	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

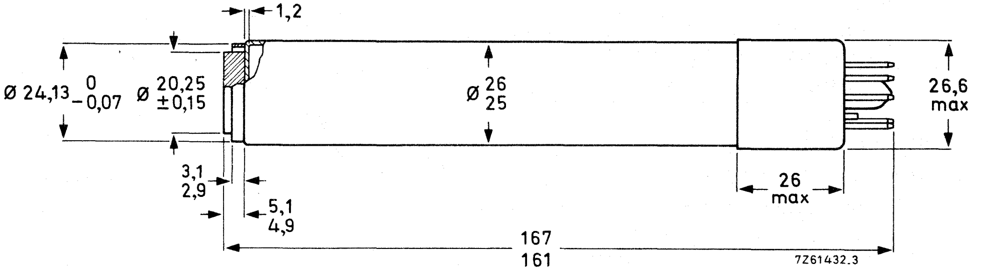
LIMITING VALUES (Absolute maximum rating system)

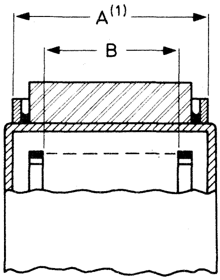
All voltages are referred to the cathode, unless otherwise stated.

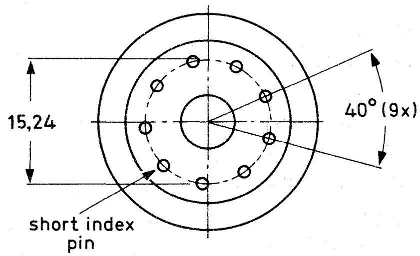
Signal electrode voltage	V_{as}	max.	50	V	5
Grid 6 (mesh) voltage	V_{g6}	max.	1100	V	
Grid 5 (collector) voltage	V_{g5}	max.	800	V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max.	350	V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max.	350	V	
Grid 3 (auxiliary grid) 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	
External resistance between cathode and heater at $-V_{kfp} > 10$ V	R_{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

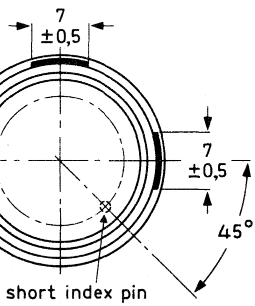
MECHANICAL DATA

Dimensions in mm

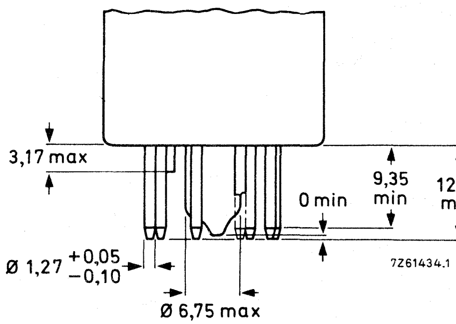








FRONT VIEW



Mounting position: any

Mass: ≈ 70 g

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

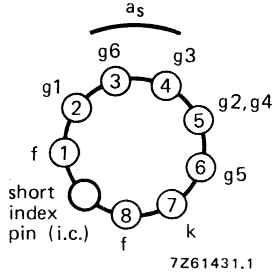


Fig. 1.

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 and AT1126	16

Performance

		notes
Dark current (without light bias)	$\leq$ 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	$\geq$ 5 lens stops	19
Spectral response		
maximum response at	≈ 500 nm	
cut-off (= 1% of peak response)	≈ 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

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 AT1126 (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 AT1126 (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, ($V_{g1p} = 20\ V + V_{kp}$), 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 AT1126 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.

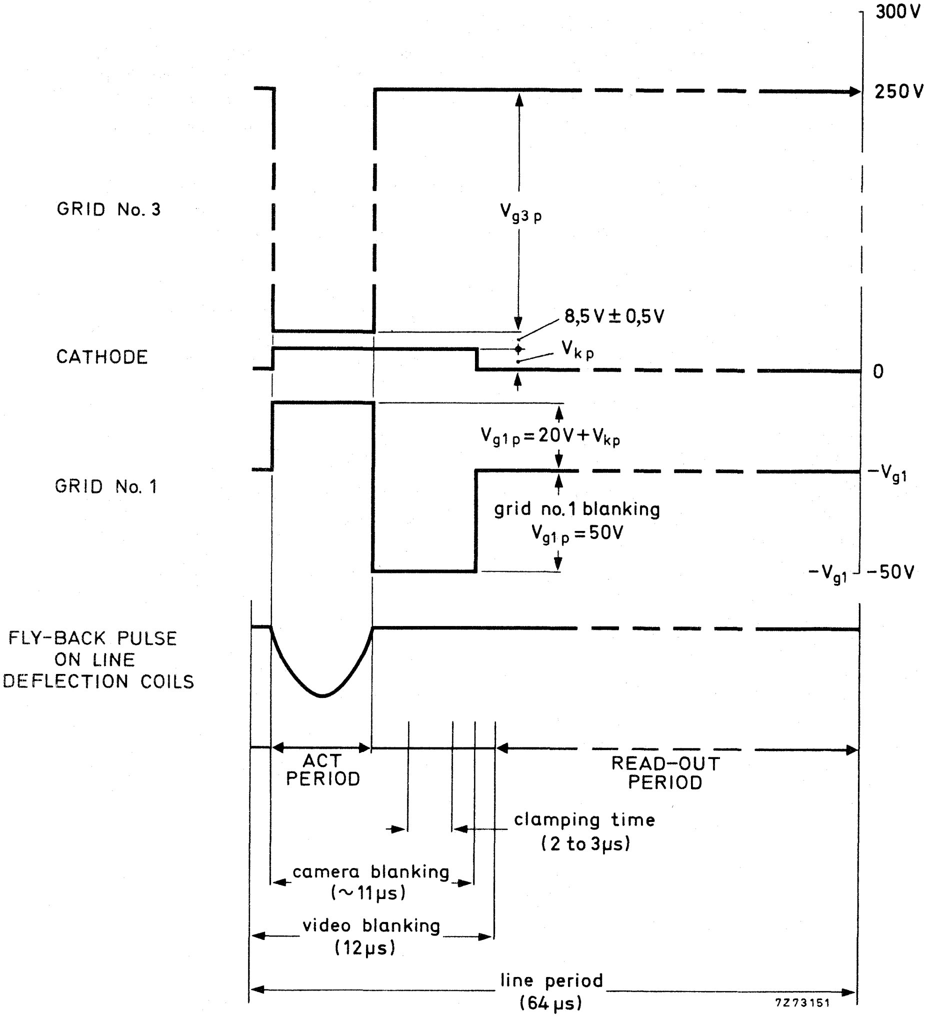


Fig. 2 Pulse timing and amplitude diagram.

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.

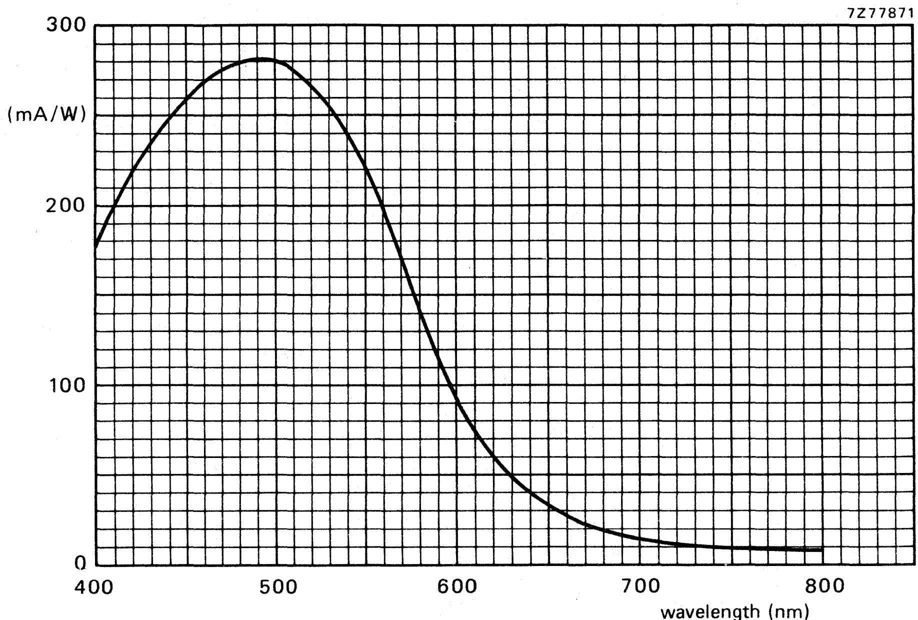


Fig. 3 Typical spectral sensitivity characteristic.

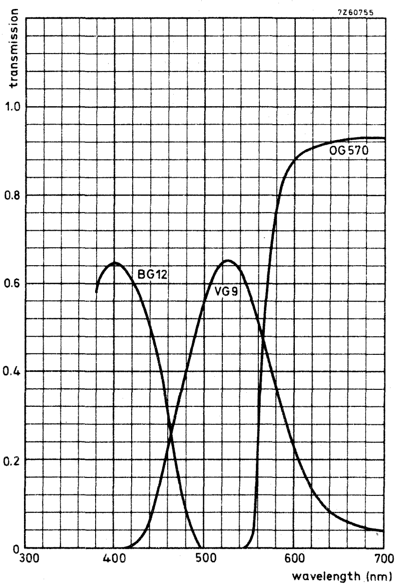


Fig. 4 Transmission curve of filter OC570. See note 17b.

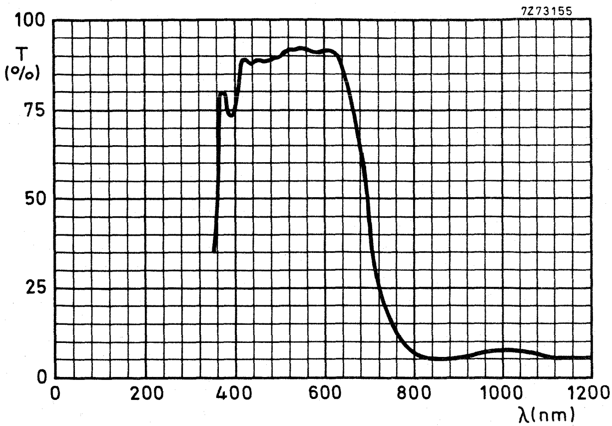


Fig. 5 Typical transmission curve of heat reflecting interference filter CALFLEX B1/K1. See note 17a.

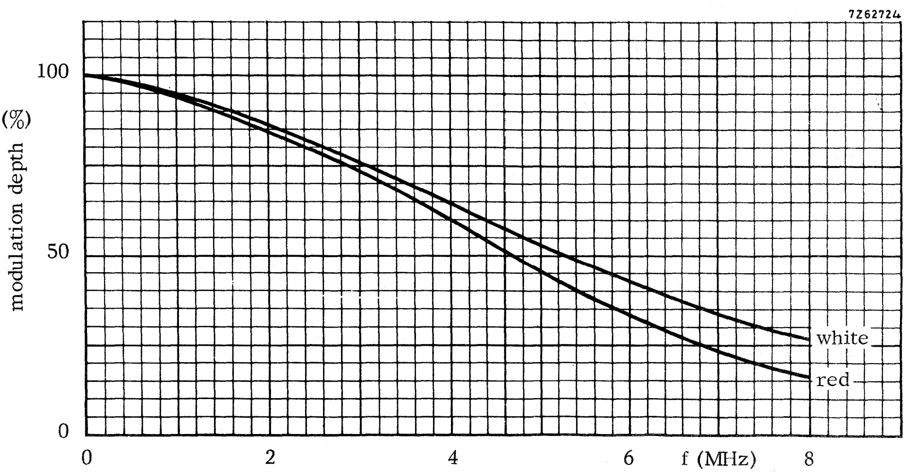


Fig. 6 Square-wave modulation transfer characteristic.

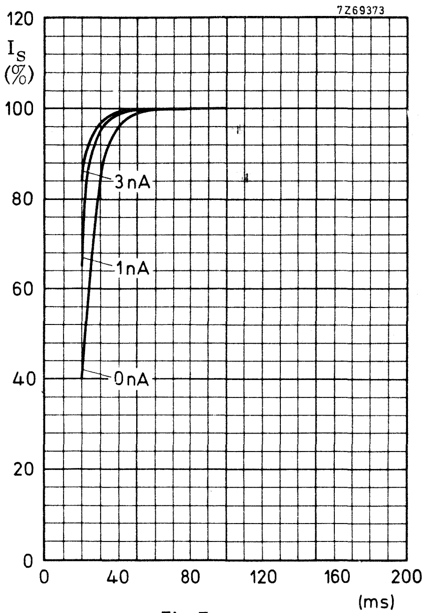


Fig. 7.

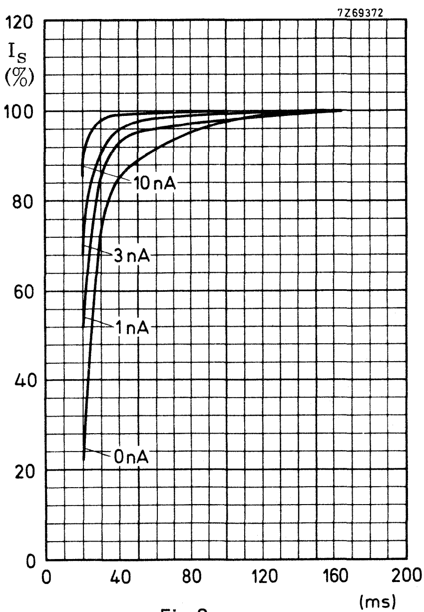


Fig. 8.

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.

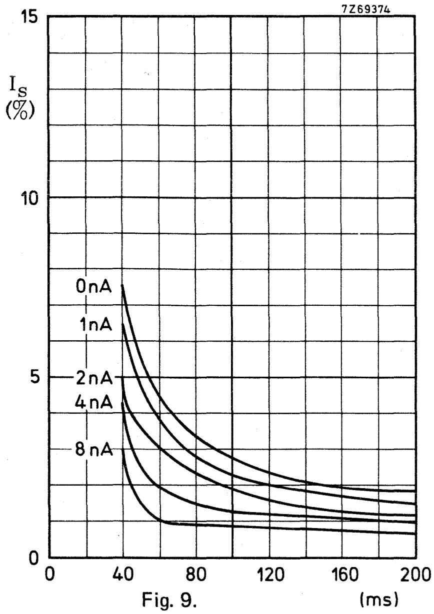


Fig. 9.

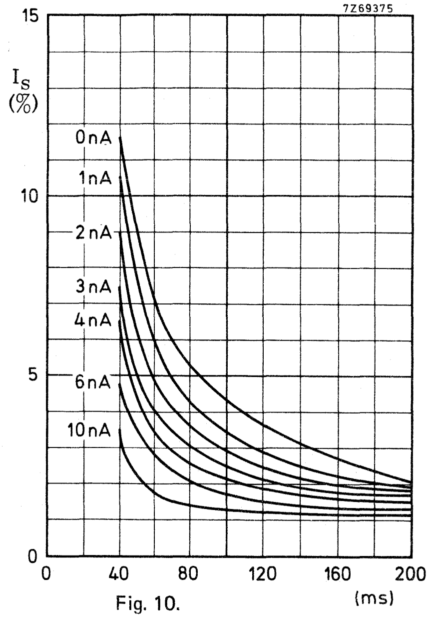


Fig. 10.

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.

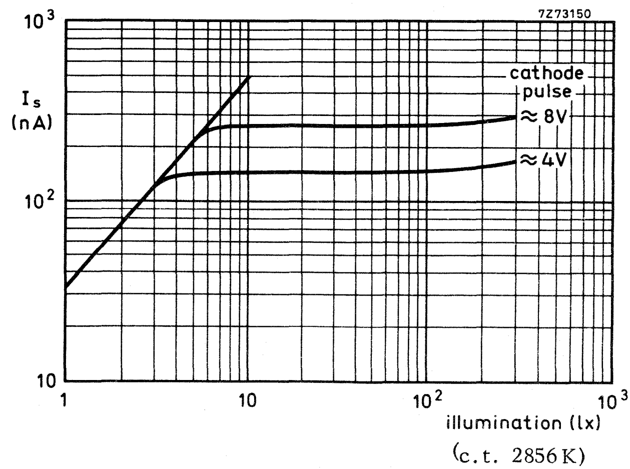


Fig. 11 Typical light transfer characteristics with ACT applied.

CAMERA TUBES

Plumbicon®, television camera tubes 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 (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, 95 mA
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.

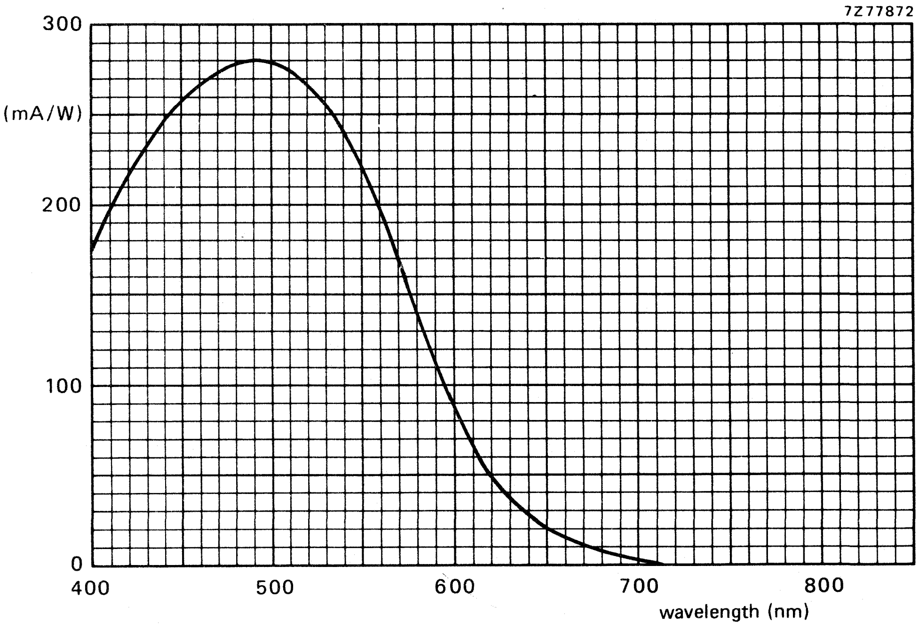
OPTICAL DATA

Spectral response	see curve below
Maximum response at	500 nm
Cut-off	750 nm*

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.

* 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 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 series are provided with an A.C.T. electron gun and provisions for light bias like the tubes of the XQ1080 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

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

ELECTRICAL DATA

Capacitance

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

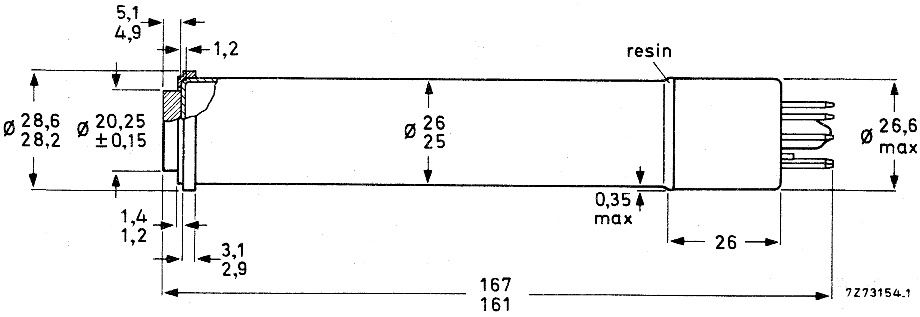
ACCESSORIES

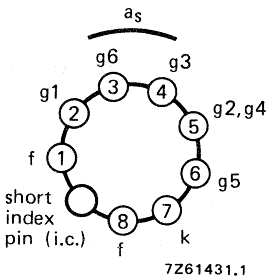
Deflection and focusing coil unit — for colour and bl/wh cameras AT1116/06 or equivalent

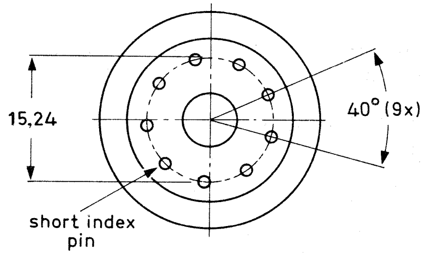
® Registered Trade Mark for camera tube.

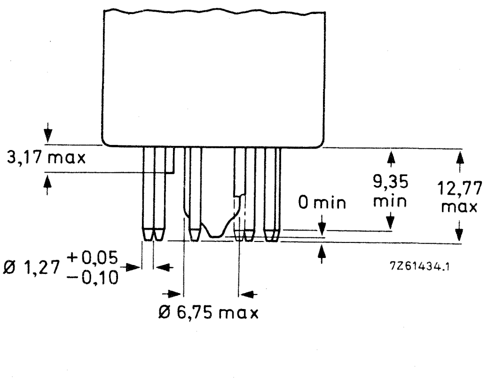
MECHANICAL DATA

Dimensions in mm









CAMERA TUBES

Plumbicon® television camera tubes 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 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

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 $\quad C_{as} \quad$ 3 to 5 pF

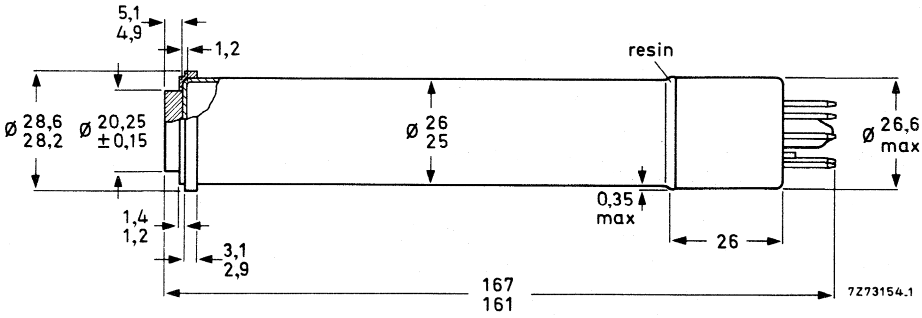
ACCESSORIES

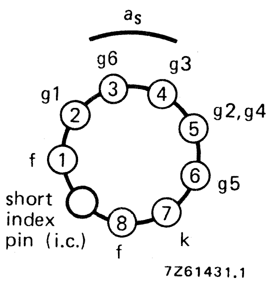
Deflection and focusing coil unit	for colour and black/white cameras: AT1116/06 or equivalent
Socket	type 56026
Bias light lamp in holder	type 56027

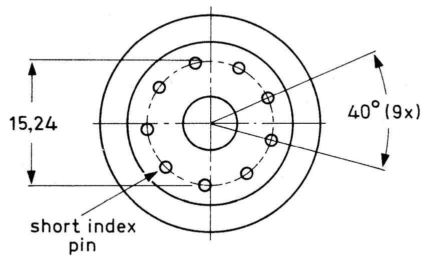
® Registered Trade Mark for television camera tube.

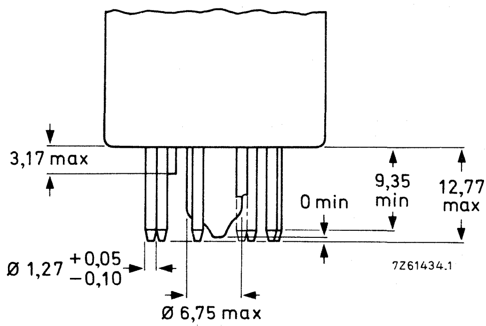
MECHANICAL DATA

Dimensions in mm









CAMERA TUBES

Plumbicon ®, 25,4 mm (1 in) diameter television camera tubes 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.

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
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 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 ± 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 AT1126
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

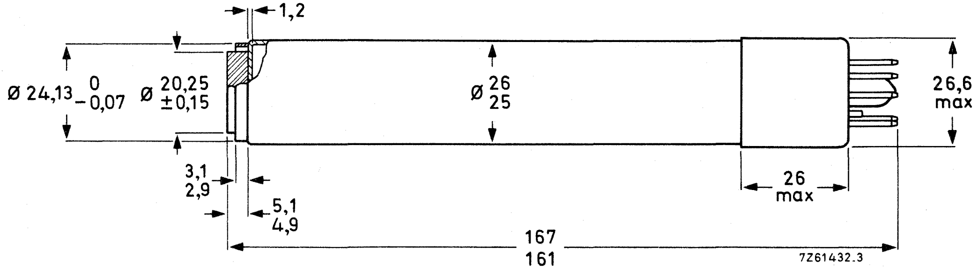
LIMITING VALUES (Absolute maximum rating system)

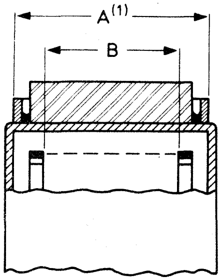
All voltages are referred to the cathode, unless otherwise stated.

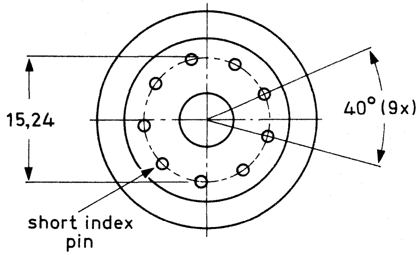
Signal electrode voltage	V_{as}	max	50 V	5
Grid 6 (mesh) voltage	V_{g6}	max	1100 V	12
Grid 5 (collector) voltage	V_{g5}	max	800 V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max	350 V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max	350 V	
Grid 3 (auxiliary grid) voltage	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

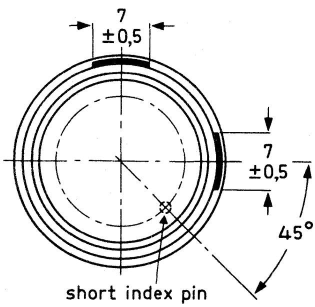
MECHANICAL DATA

Dimensions in mm

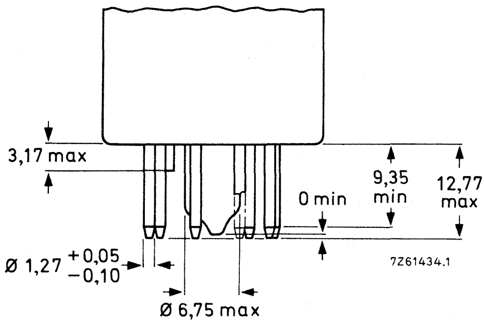








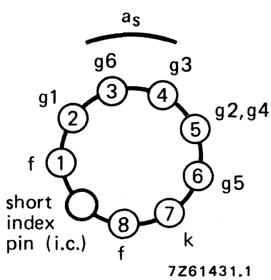
FRONT VIEW



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.

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	$I_{b\ p}$	400 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	AT1126 AT1119/01	16

Performance

			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

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)

<table>
<tr><th></th><th colspan="4">build-up lag
note 22</th><th colspan="4">decay lag
note 23</th></tr>
<tr><th></th><th colspan="2">I_s/I_b=100/200 nA</th><th colspan="2">I_s/I_b=200/400 nA</th><th colspan="2">I_s/I_b=100/200 nA</th><th colspan="2">I_s/I_b=200/400 nA</th></tr>
<tr><th></th><th>60 ms</th><th>200 ms</th><th>60 ms</th><th>200 ms</th><th>60 ms</th><th>200 ms</th><th>60 ms</th><th>200 ms</th></tr>
<tr><td>XQ1500, L, G</td><td></td><td></td><td>98%</td><td>≈100%</td><td></td><td></td><td>1,5%</td><td>0,6%</td></tr>
<tr><td>XQ1500R</td><td rowspan="2">97%</td><td rowspan="2">≈100%</td><td></td><td></td><td>2,5%</td><td>1%</td><td></td><td></td></tr>
<tr><td>XQ1500B</td><td></td><td></td><td>3,5%</td><td>2%</td><td></td><td></td></tr>
</table>

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 AT1126 (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 AT1126 (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.

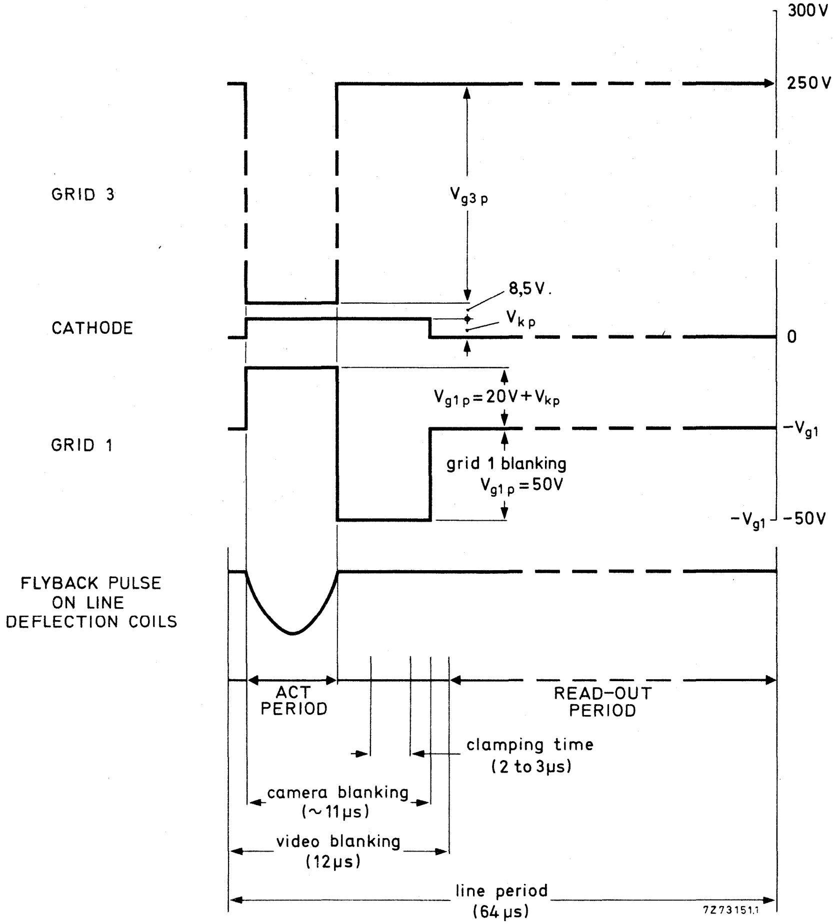
  In either case, adjusted to result in a grid 3 voltage of 8,5 V with respect to the cathode voltage during the ACT mode.

  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 the next page.

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 AT1126 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.


300 V
250 V
GRID 3
$V_{g3\,p}$
8,5 V
CATHODE
$V_{k\,p}$
0
$V_{g1\,p} = 20V + V_{kp}$
GRID 1
$-V_{g1}$
grid 1 blanking
$V_{g1\,p} = 50V$
$-V_{g1}$ -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

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.

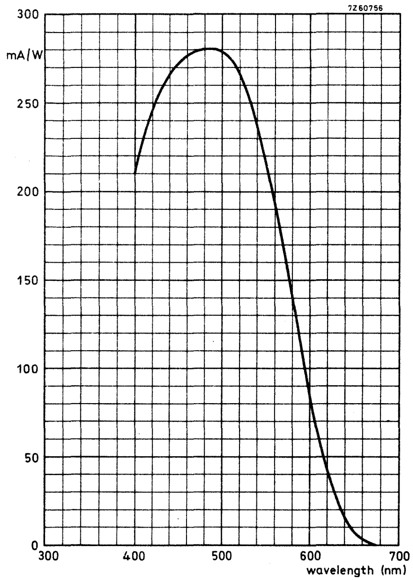


Fig.1 Typical spectral response curve.

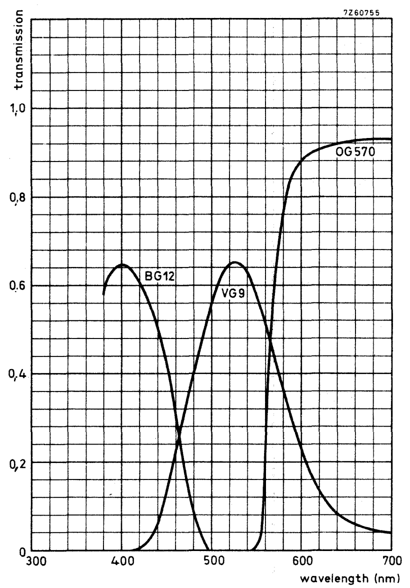


Fig.2 Transmission of filters OG570, VG9, and BG12 see note 17.

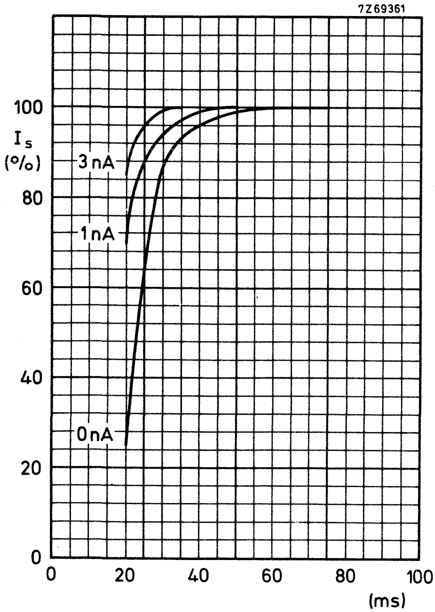


Fig. 3.

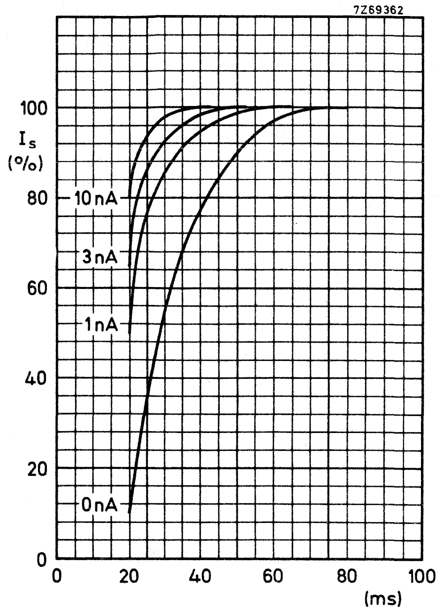


Fig. 4.

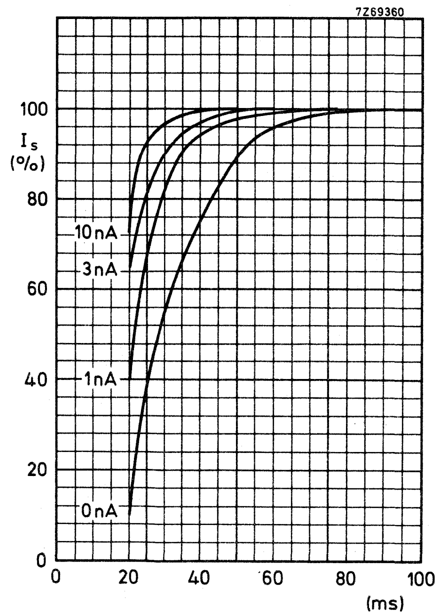


Fig. 5.

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.

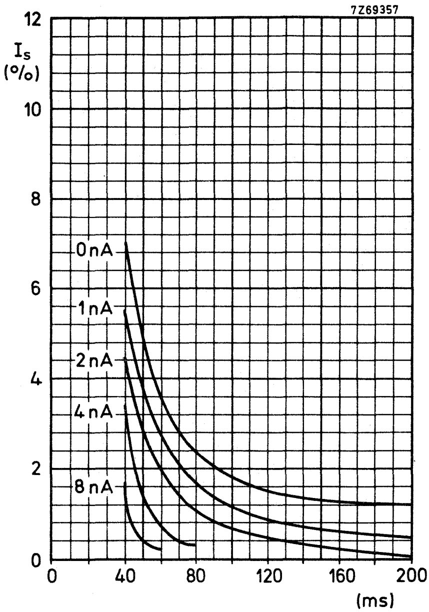


Fig. 6.

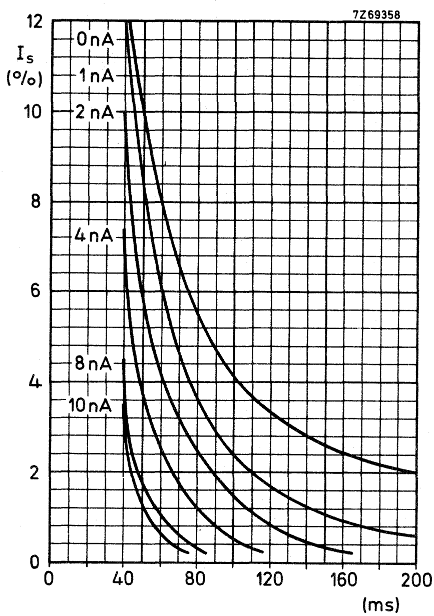


Fig. 7.

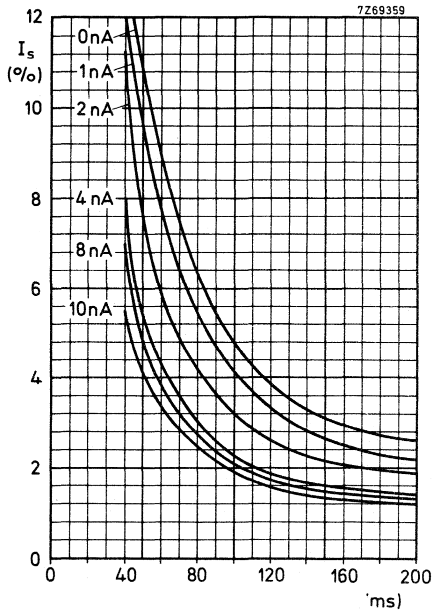


Fig. 8.

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.

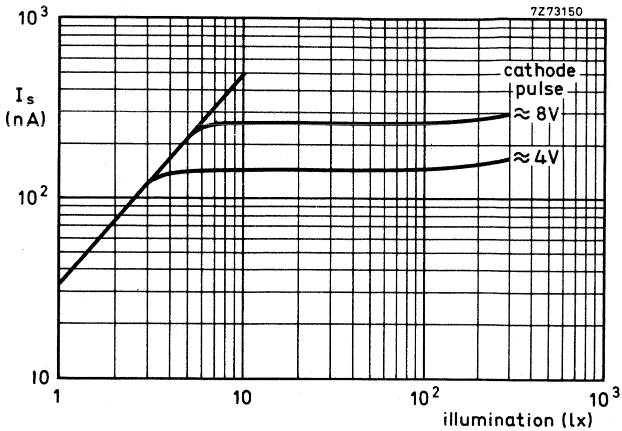


Fig. 9 Typical light transfer characteristics with ACT applied.

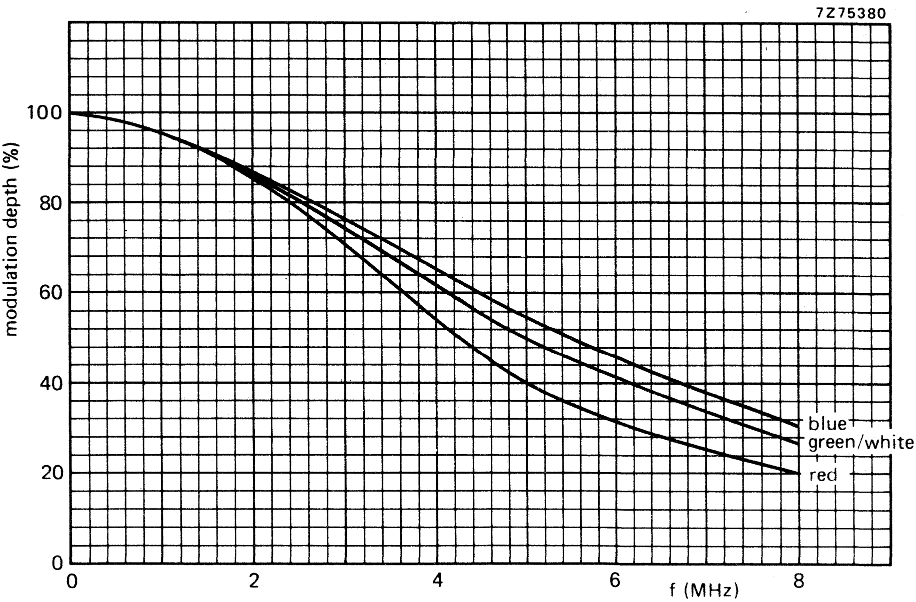


Fig. 10 Typical square-wave modulation response curve.

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.
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
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 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 alignment coil unit	black/white	type AT1119/01
	colour	type AT1126
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

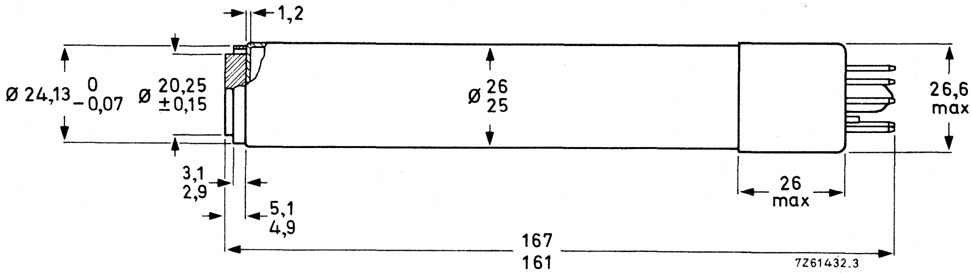
LIMITING VALUES (Absolute maximum rating system)

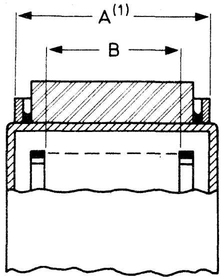
All voltages are referred to the cathode, unless otherwise stated.

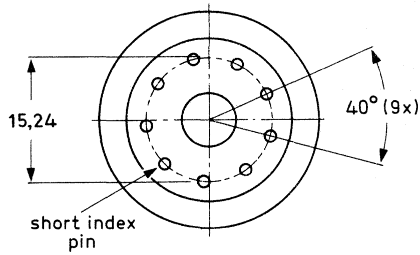
Signal electrode voltage	V_{as}	max	50	V	5
Grid 6 (mesh) voltage	V_{g6}	max	1100	V	12
Grid 5 (collector) voltage	V_{g5}	max	800	V	
Voltage between grid 6 and grid 5	$V_{g6/g5}$	max	350	V	
Grid 4 (limiter) and grid 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max	350	V	
Grid 3 (auxiliary grid) voltage	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

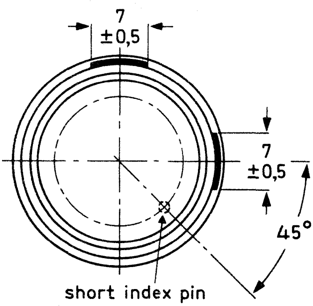
MECHANICAL DATA

Dimensions in mm



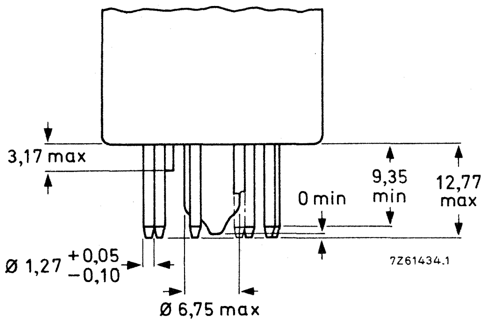






FRONT VIEW

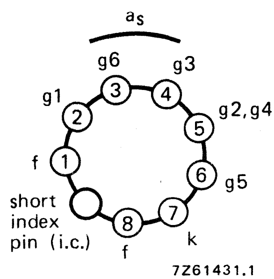
7Z61433.3



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.

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	$I_{s\,p}$	200 nA	100 nA
Beam current, peak	$I_{b\,p}$	400 nA	200 nA
ACT level (peak)		280 nA	140 nA
Cathode pulse	$V_{k\,p}$	6 V	3 V
Grid 1 pulse	$V_{g1\,p}$	26 V	23 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 and AT1126	16

Performance | notes

Dark current (without light bias)	⩽ 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	⩾ 5 lens stops		19
Spectral response: max. response at	≈	500 nm	
	≈ 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

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 AT1126 (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 AT1126 (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 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 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 the next page.

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.

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.

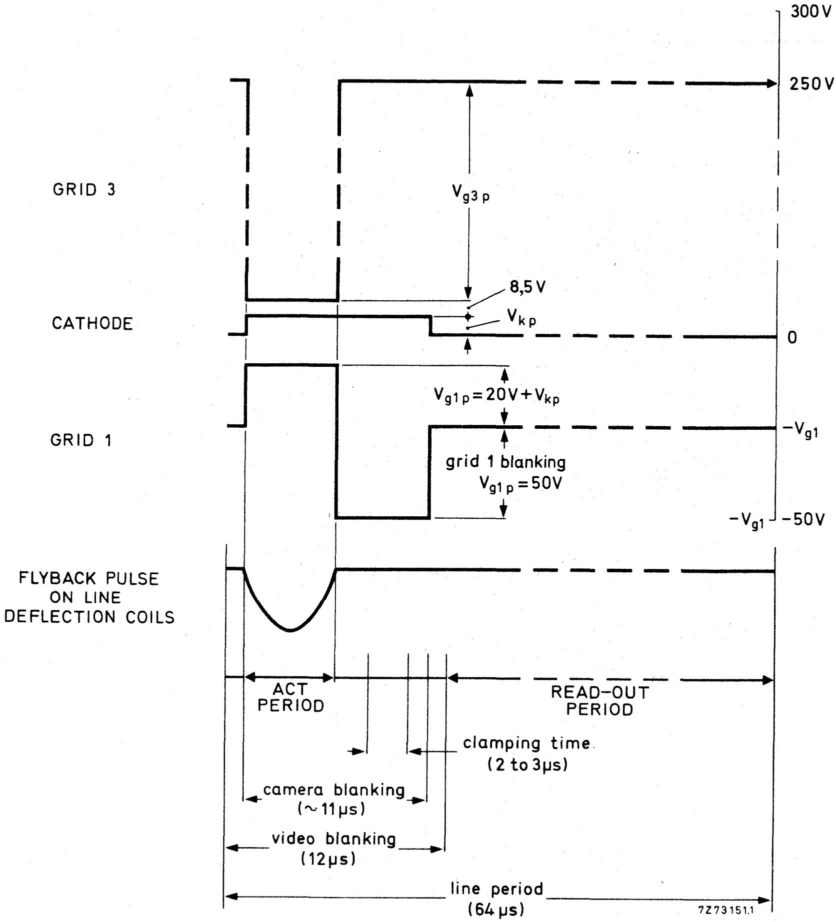
14. In the case of a black/white camera the illuminance on the photoconductive layer, B_{ph}, is related to scene illuminance, B_{sc}, by the formula:

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

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
$V_{g1\,p} = 20V + V_{kp}$
GRID 1
$-V_{g1}$
grid 1 blanking
$V_{g1\,p} = 50V$
$-V_{g1}$ −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

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.

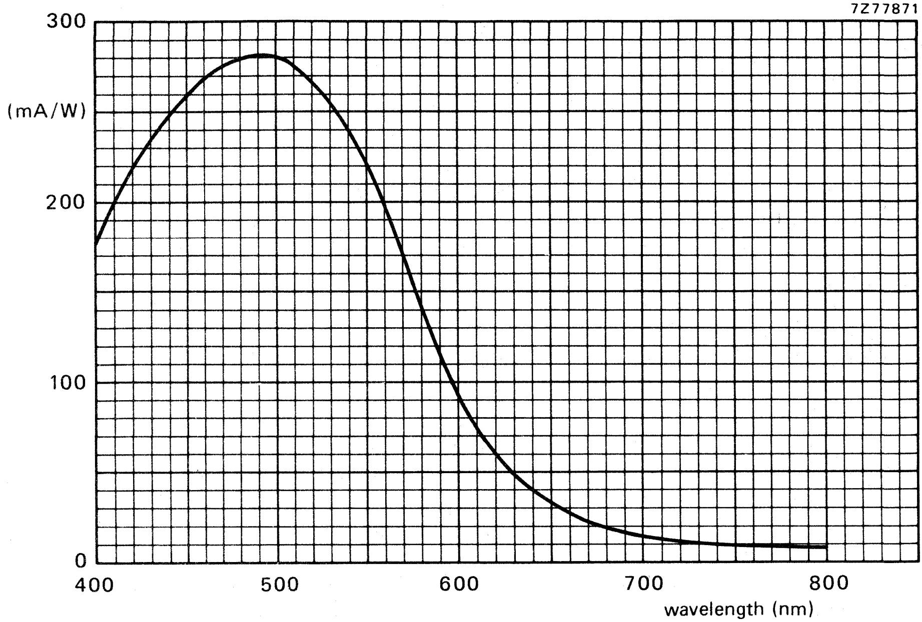
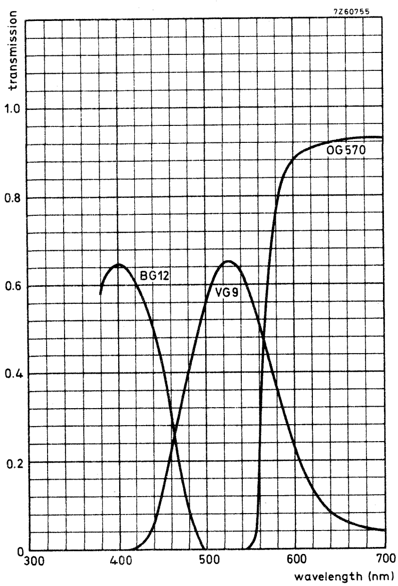


Fig.1 Typical spectral sensitivity characteristic.



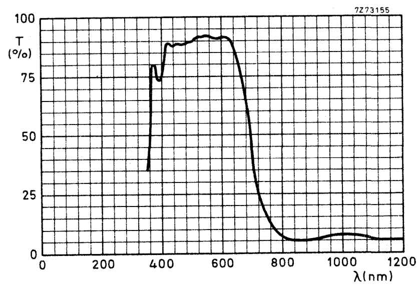


Fig.3 Typical transmission curve of heat reflecting interference filter CALFLEX B1/K1. See note 17a.

Fig.2 Transmission curve of filter OG570 See note 17b.

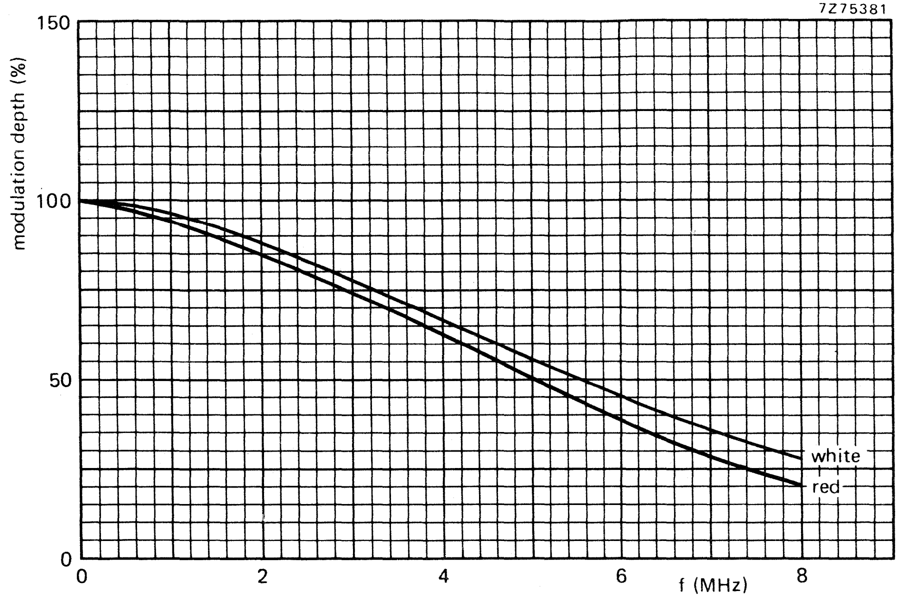


Fig.4 Typical square-wave modulation transfer characteristic.

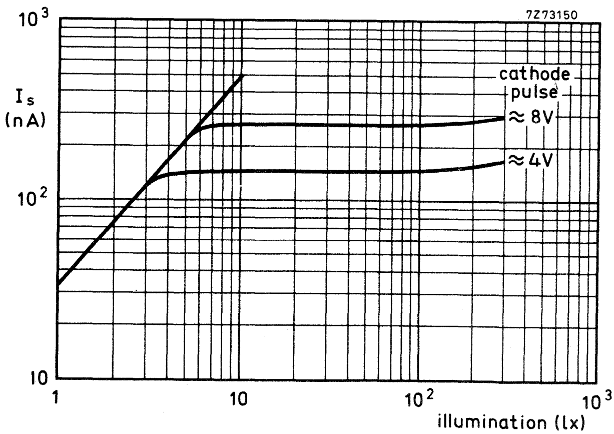


Fig. 5 Typical light transfer characteristics with ACT applied.

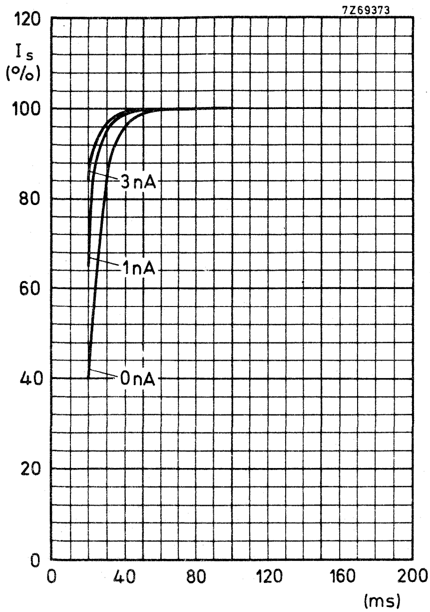


Fig. 6.

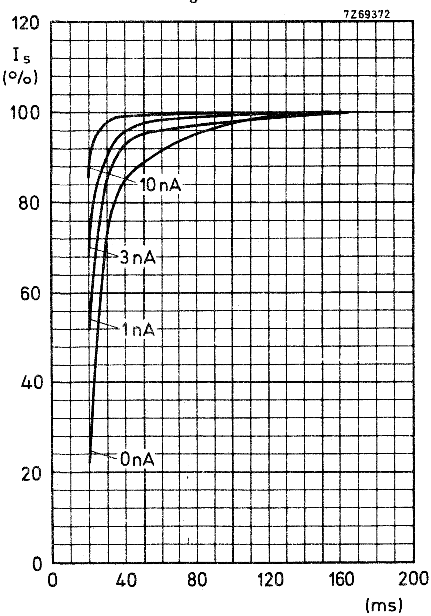


Fig. 7.

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.

Decay lag (note 24)

Fig. 8 XQ1503: I_s/I_b = 40/400 nA.

Fig. 9 XQ1503R: I_s/I_b = 20/200 nA.

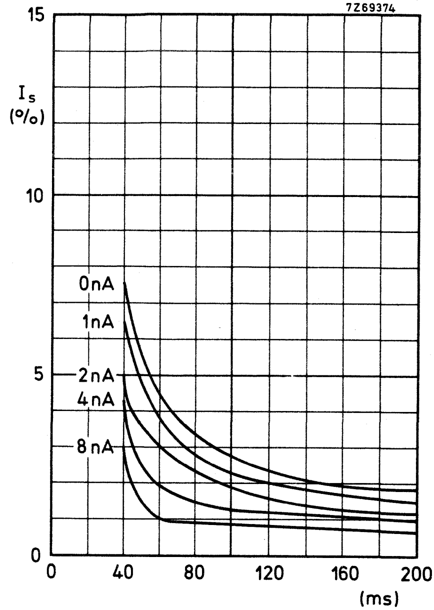


Fig. 8.

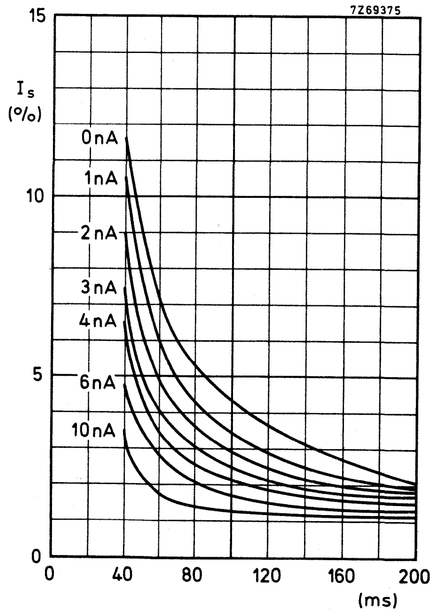


Fig. 9.

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
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.

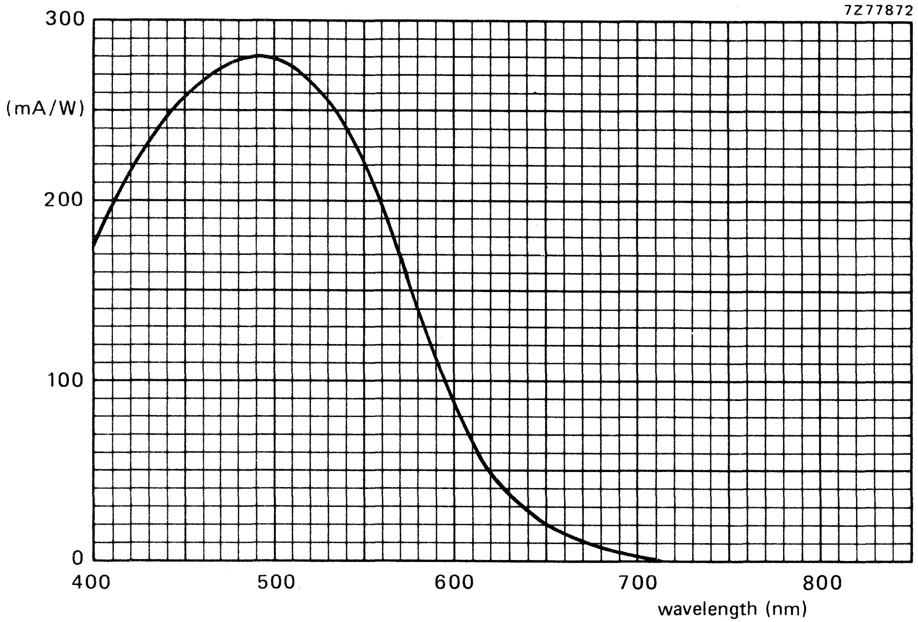
OPTICAL DATA

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 ®, 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 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.

The electrical and mechanical data of the tubes are identical to those of the XQ1500 series, with the following exceptions:

ELECTRICAL DATA

Capacitance

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

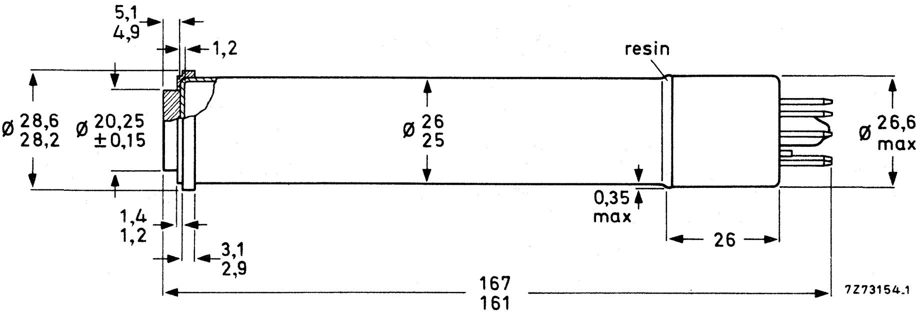
ACCESSORIES

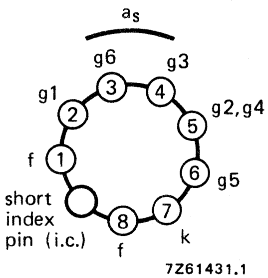
Deflection and focusing unit	AT1116/06

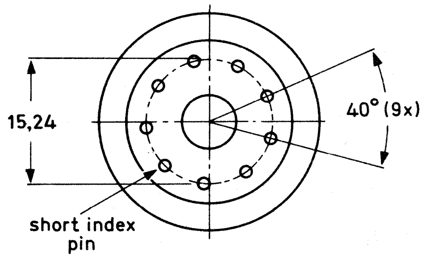
® Registered Trade Mark for television camera tube.

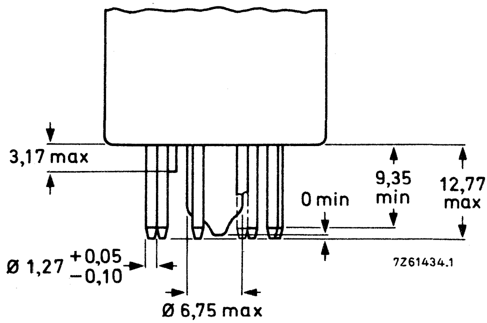
MECHANICAL DATA

Dimensions in mm









CAMERA TUBES

Plumbicon ®, 25,4 mm (1 in) diameter television camera tubes 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 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.

- With infrared filter on the anti-halation glass disc:

XQ1515, XQ1515R — for use in B/W and colour cameras in broadcast applications.

The electrical and mechanical data of the tubes are identical to those of the XQ1503 and XQ1505 series with the following exceptions:

ELECTRICAL DATA

Capacitance

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

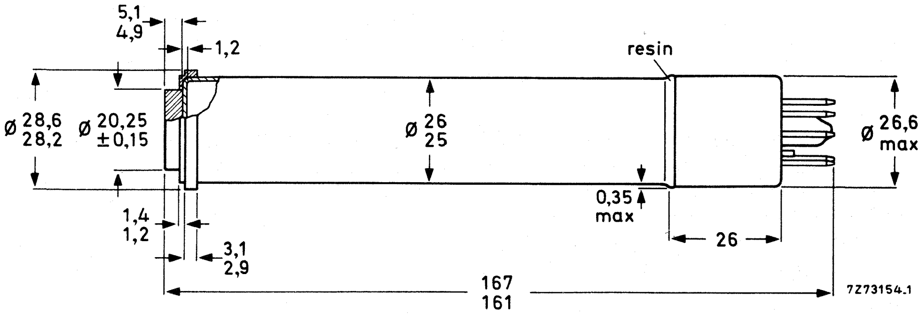
ACCESSORIES

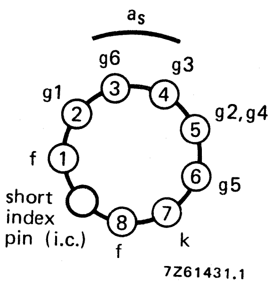
Deflection and focusing unit for B/W cameras	AT1116/06 or equivalent

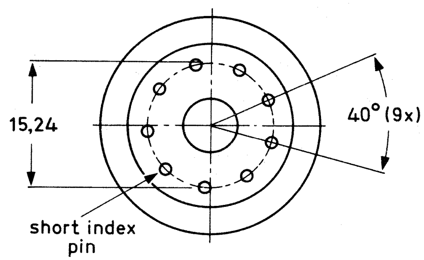
® Registered Trade Mark for television camera tube.

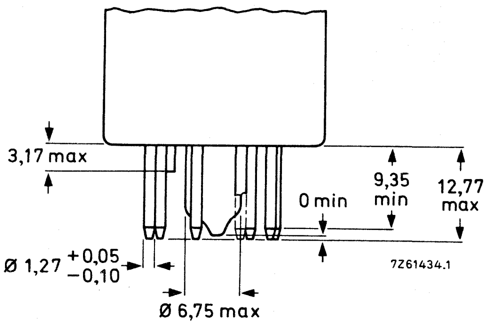
MECHANICAL DATA

Dimensions in mm









CAMERA TUBES

1 inch (25,4 mm) diameter Plumbicon® television camera tubes with special high resolution lead-oxide photoconductive target, low heater power, magnetic focusing and deflection.

Special features are:

- **New** photoconductive target for increased resolution.
- **"Diode" electron gun** for D.B.C. (dynamic beam control) to minimize comet-tailing and blooming (note 1).
- Provisions for light bias to reduce lag except for the type XQ2070/05.

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
"Diode" electron gun	
Diameter	25,4 mm (1 in)
Length, excluding anti-halation glass disc	approx. 165 mm (6½ in)
Provided with anti-halation glass disc, thickness	5 mm
Rear and front loading versions	note 3
Provisions for light bias	
Cut-off of spectral response	≈ 650 nm
Heater	6,3 V, 95 mA
Modulation depth at 400 TV lines (5 MHz)	60%

The tubes (XQ2070,R,G,B) are specially designed to meet the high picture quality standards as required for colour and monochrome cameras in broadcast and EFP (note 4), educational and high quality industrial applications. For interchangeability with other 1 in Plumbicon tubes, see notes 2 and 5.

OPTICAL

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

Orientation of image on 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.

Faceplate	
thickness	1,2 mm
refractive index	1,49
Anti-halation glass disc	
thickness	5 mm
refractive index	1,52

® Registered Trade Mark for television camera tube.

HEATING

notes

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	

The heater current and heater voltage must not exceed 150 mA r.m.s. and 9,5 V r.m.s. when switching on or at any other time. For optimum performance (lifetime and registration stability) stabilization of the heater voltage is recommended.

CAPACITANCE

Signal electrode to all

rear loader (/02, /05) C_{as}	2,5 to 4 pF	7
front loader (/03) C_{as}	3 to 5 pF	7

These capacitances, which are effectively the output impedances, increase when the tubes are inserted in the coil unit. 8

DEFLECTION magnetic 9

FOCUSING magnetic 9

ACCESSORIES

Socket	type 56098		
Deflection and focusing coil unit,	rear loading	front loading	
black/white	AT1119/01	AT1116S	
colour	AT1126	AT1116/..	10
Mask for reduction of flare	type 56028		
Light bias lamp in holder	type 56106		11

ELECTRON GUN CHARACTERISTICS

Cut-off			
Grid 1 voltage for cut-off at V_{g2} = 300 V without blanking	V_{g1}	−10 to 0 V	
Grid 1 voltage for normal beam setting	V_{g1w}	⩽ 15 V	12
Blanking voltage, peak to peak			
on grid 1	$V_{g1\ p\text{-}p}$	25 V	
on cathode	$V_{k\ p\text{-}p}$	25 V	
Grid 1 current at normally required beam currents	I_{g1}	⩽ 1,5 mA	2,14
Grid 2 current at normally required beam currents	I_{g2}	⩽ 0,1 mA	2,14

LIMITING VALUES (Absolute maximum rating system)

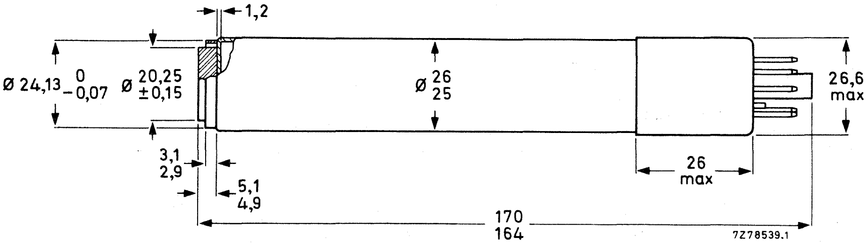
All voltages are referred to the cathode, unless otherwise stated.

					notes
Signal electrode voltage	V_{as}	max.	50	V	13
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.	450	V	
Grid 2 voltage	V_{g2}	max.	350	V	
Grid 1 voltage, positive	V_{g1}	max.	25	V	
Grid 1 voltage, negative	$-V_{g1}$	max.	200	V	
Grid 1 current ($\approx I_K$ current)	I_{g1}	max.	5	mA	14
Grid 1 current (peak current with D.B.C.)	I_{g1p}	max.	8	mA	2
Cathode to heater voltage, positive peak	V_{kfp}	max.	125	V	
Cathode to heater voltage, negative peak	$-V_{kfp}$	max.	50	V	
Cathode heating time before drawing cathode current	t_h	min.	1	min	
External resistance between cathode and heater at $V_{kfp} > 10$ V	R_{kf}	min.	2	kΩ	
Ambient temperature, storage and operation	T_{amb}	max.	50	°C	15
		min.	−30	°C	
Faceplate temperature, storage and operation	T	max.	50	°C	
		min.	−30	°C	
Faceplate illuminance	E	max.	500	lx	16

MECHANICAL DATA

Dimensions in mm

Rear loading tubes XQ2070/02



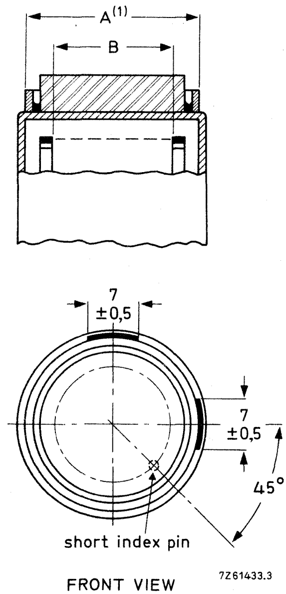


Fig. 1a.

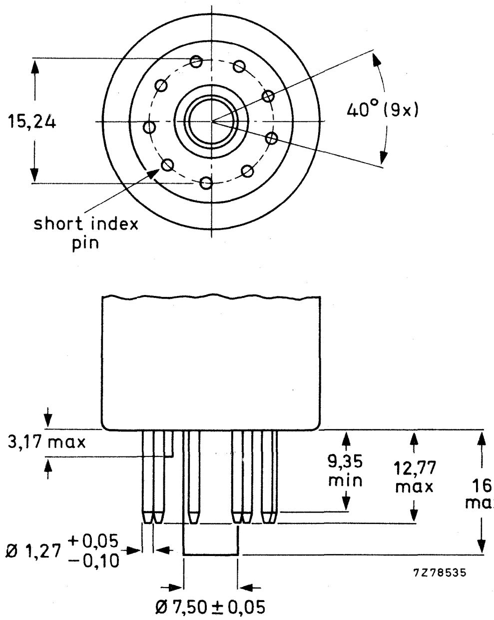


Fig. 1b.

(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.

Mounting position: any

Mass: ≈ 70 g

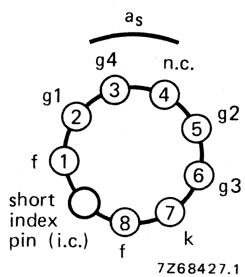
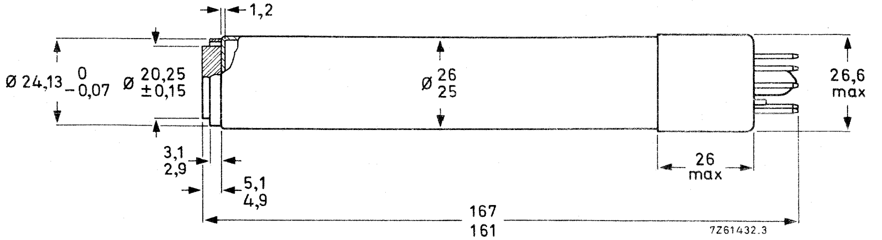


Fig. 1c.

Rear loading tubes XQ2070/05



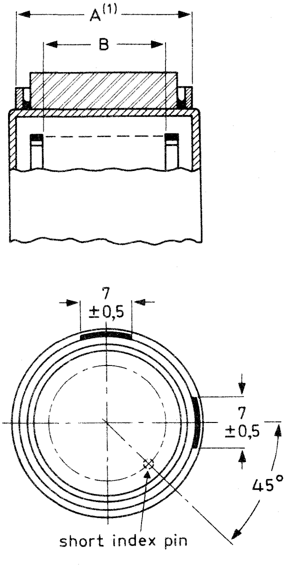


Fig. 2a.

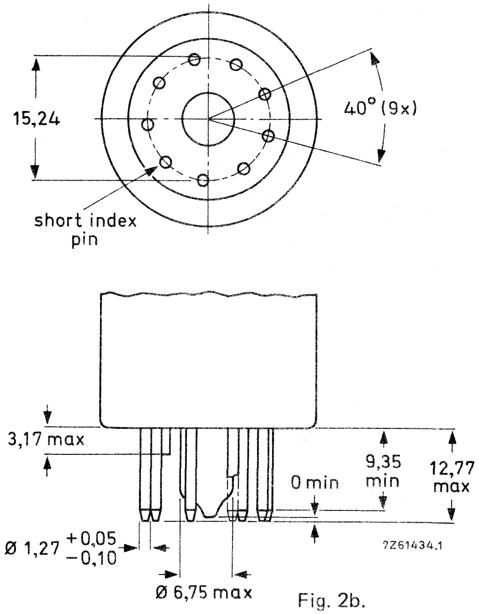


Fig. 2b.

(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.

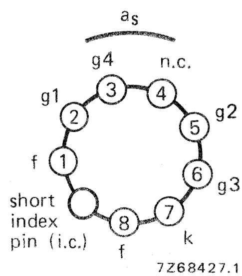


Fig. 2c.

Mounting position: any

Mass: ≈ 70 g

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

Front loading tubes XQ2070/03

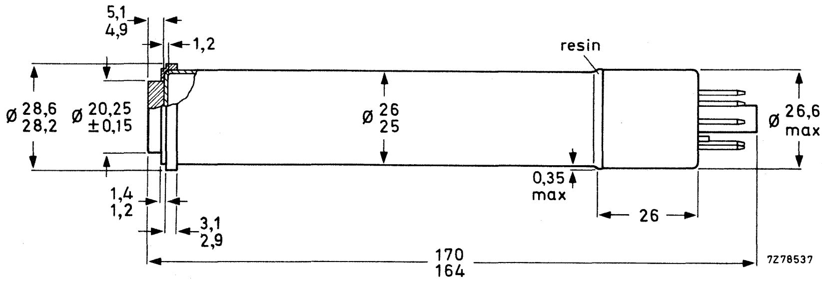


Fig. 3.

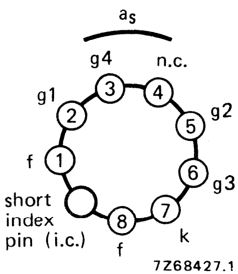


Fig. 4.

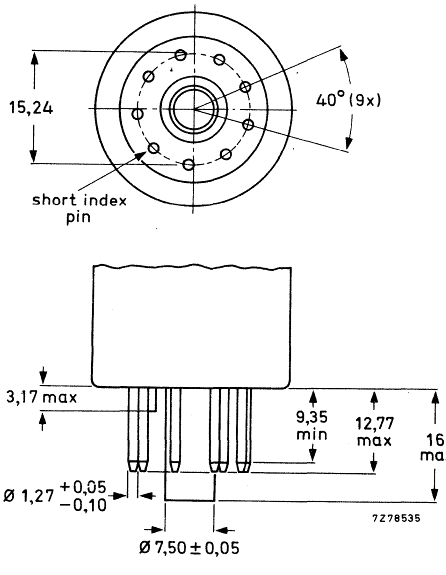


Fig. 5.

Mounting position: any

Mass: ≈ 70 g

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9,6 mm x 12,8 mm — notes 17

Conditions

			notes
Cathode voltage	V_k	0 V	
Signal electrode voltage	V_{as}	45 V	13
Beam current	I_b		12,18
Grid 4 voltage	V_{g4}	960 V	19
Grid 3 voltage	V_{g3}	600 V	19
Grid 2 voltage	V_{g2}	300 V	
Grid 1 voltage	V_{g1}		12,18
Blanking voltage on grid 1, peak to peak	$V_{g1\ p\text{-}p}$	25 V	
Focusing coil current			20
Deflection current, alignment			20
Faceplate illuminance	E		21
Faceplate temperature	T	20 to 45 °C	

Performance

				notes
Dark current	I_d		≤ 2 nA	
Sensitivity at colour temperature of illuminance = 2856 K				22
XQ2070	min.	300	typ. 350 μA/lm	
XQ2070R	min.	63	typ. 70 μA/lmF	
XQ2070G	min.	130	typ. 145 μA/lmF	
XQ2070B	min.	35	typ. 38 μA/lmF	
Gamma of transfer characteristic			0,95 + 0,05	23
Spectral response:				
max. response at			≈ 500 nm	
cut-off at			≈ 650 nm	
response curves			see Fig. 6.	

NOTES (continued)

16. 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, in stand-by also the beam will be cut-off.
17. The operating conditions and performance quoted in these data relate to operation in the coil units AT1126 and AT1116/..
18. The beam current I_b, as obtained by adjusting the control grid voltage (grid 1) is set at 200 nA for R and B tubes, 400 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 = 20/200 nA. This 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 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.)
19. The optimum voltage ratio V_{g4}/V_{g3} to minimize beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. In the AT1126, AT1116/.. and AT1119 units a ratio of 1,6 is recommended.
20. See published data of deflection/focusing assemblies.

    N.B. The polarity of the focusing coil current should be such that its image end attracts an external north-seeking pole.
21. 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.
22. Measuring conditions.
    Illuminance level ≈ 4. lx (luminous flux at scanned area ≈ 0,5 mlm) at a colour temperature of 2856K, the appropriate filter inserted in the light path.
    Filters used:

XQ2070R	Schott OG570	3 mm
XQ2070G	Schott VG9	1 mm
XQ2070B	Schott BG12	3 mm

    For transmission of the filters, see Fig. 7.
23. Gamma stretching circuitry is recommended.
24. As measured with a 50 mm Leitz Summicron lens having a sine response of approx. 85% at 20,6 lp/mm (400 TV lines at 9,6 mm picture height) at f : 5,6.
    The amplitude response can be raised by means of suitable correction circuits.
25. Adjusted for sum of dark current, leakage current and light bias current of 3 nA.

NOTES

1. "Diode" gun is a triode gun operating in a diode mode, providing a very high beam reserve.

   Warning

   Continuous operation with a high beam setting is to be avoided since this will shorten tube life. Full advantage of the high beam reserve to reduce comet-tailing and blooming can be made with D.B.C. circuitry (dynamic beam control) with which, in the case of highlights, positive-going pulses are derived from the video signal, which are fed to grid 1 to increase the beam current momentarily.
2. The "Diode" gun operates with a positive ($\leqslant$ 15 V) grid 1 voltage (adjusted for correct beam settings, see note 12), hence draws some grid 1 current:
   without D.B.C.: $\leqslant$ 1,5 mA (peak) with blanking.
   with D.B.C.: $\leqslant$ 8 mA (peak) with blanking measured with an oscilloscope.

   The D.B.C. circuitry should, in the case of highlights, supply positive-going pulses up to 7 V above V_{g1w} see note 12 and up to 8 mA peak to grid 1.

   N.B. Applying higher pulses than 7 V is not recommended since this will shorten tube life, impair resolution and may introduce oscillations.
3. Rear loading versions are finished like the tubes of the XQ1080/XQ1500 series (ceramic ring) and are branded with suffix /02 to the type number (e.g. XQ2070/02R, G, B). Front loading versions are finished like the tubes of the XQ1070 series (metal flange as signal electrode) and are branded with suffix /03 to the type number (e.g. XQ2070/03R, G, B). Rear loading versions are preferred versions.
4. EFP = Electronic Field Production.
5. The rear loading tubes closely resemble mechanically the tubes of the XQ1080/XQ1500 series. The front loading tubes resemble the tubes of the XQ1070 series. Since, however, the "Diode" gun draws some grid 1 current (see note 2), cameras designed around XQ1080/XQ1500 and XQ1070 tubes will require some modification.
6. Underscanning of the specified useful target area of 9,6 x 12,8 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.
7. Measured on the tube proper between signal-electrode contact and all other electrodes connected together.
8. Example: when a rear loading tube is inserted into an AT1126 unit, the capacitance measured at the contact spring of the unit increases to approximately 7,5 pF.
9. For focusing/deflection coil units, see under Accessories.
10. AT1126 and AT1116/.. are computer selected triplets.
11. For adjustable light bias. Lamp, type 56106, fits in the metal tube cemented to the pumping stem of the tube. The wires should be connected to a source capable of supplying max. 110 mA at 5 V. The desired amount of light bias can be obtained by adjusting the current through the lamp. 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, 2, 6 nA.
12. Beam current settings as required for one stop over normal peak white.
13. 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). The signal electrode voltage should preferably be set to 45 V.
14. Peak value measured with an oscilloscope.
15. Camera design limit. Short temperature excursions up to 70 °C during operation are allowed.

Resolution — notes

Modulation depth, i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. 22,24

		XQ2070	XQ2070R	XQ2070G	XQ2070B	notes
Highlight signal current	I_s	200 nA	100 nA	200 nA	100 nA	
Beam current	I_b	400 nA	200 nA	400 nA	200 nA	12
Modulation depth at 400 TV lines (5 MHz) in %	typ.	60	45	60	60	
	min.	55	40	55	55	

Modulation transfer characteristics — see Fig. 8

Lag (typical values, with light bias) 25

Light source with a colour temperature of 2856 K

Appropriate filter inserted in light path 22

Low key conditions (provisional) 26

	build-up lag				decay lay			
	I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ2070 XQ2070G	98	≈ 100			6	2,5		
XQ2070R			95	≈ 100			9	2,5
XQ2070B			95	≈ 100			10	3

High-key conditions (provisional) 26

	build-up lag				decay lag			
	I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ2070 XQ2070G	98	≈ 100			1,5	0,6		
XQ2070R			97	≈ 100			2,5	1
XQ2070B			97	≈ 100			3,5	2

Shading of light bias induced dark current — 12,5 % — 27

Highlight handling capability with D.B.C. 28

26. *Build-up lag:* After 10 s of darkness. The figures are typical percentages of the ultimate signal current obtained 60 ms and 200 ms, respectively, after introduction of the illuminance.
Decay lag: After the target has been illuminated for at least 5 s. The figures represent typical residual signals in percentages of the original signal current 60 ms and 200 ms, respectively, after removal of the illuminance.
27. 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.
28. a. With D.B.C. applied (see note 2) the tube will properly handle highlights with a diameter of 10% of picture height and with a brightness corresponding to 16 times peak signal white, I_{sp}.
b. The maximum peak signal currents in the case of highlights will be 2,5 μA. Video preamplifiers should be designed to accommodate these.

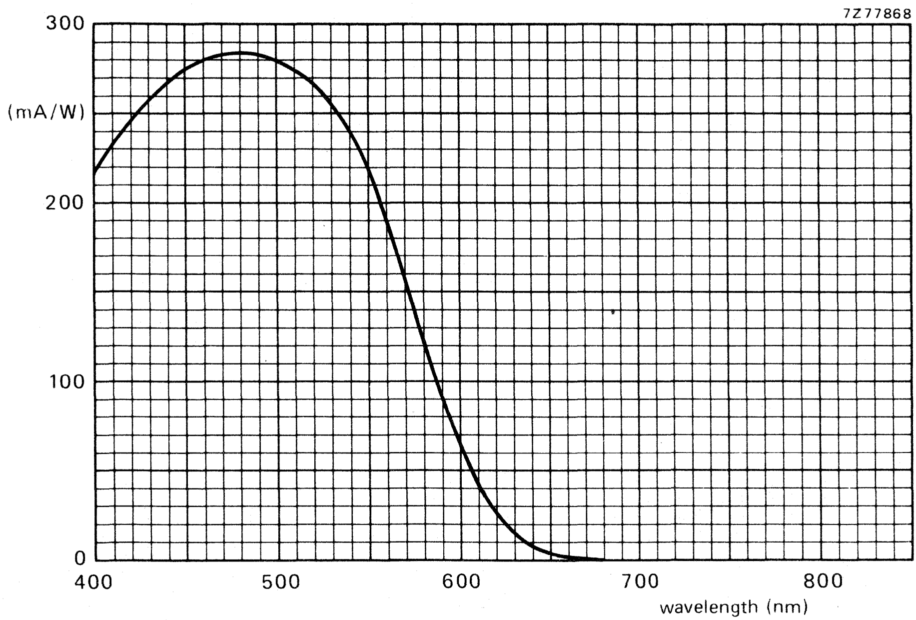


Fig. 6 Typical spectral sensitivity characteristic.

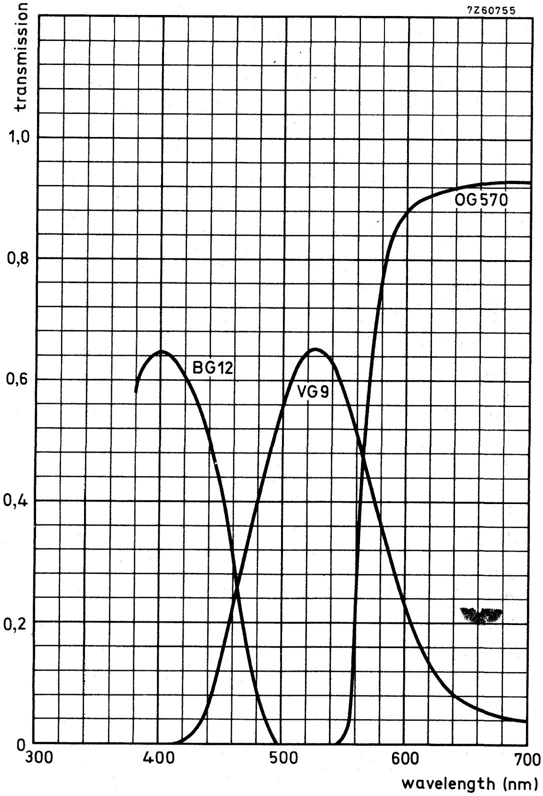


Fig. 7 Transmission of filters BG12, V̇G9 and OG570.

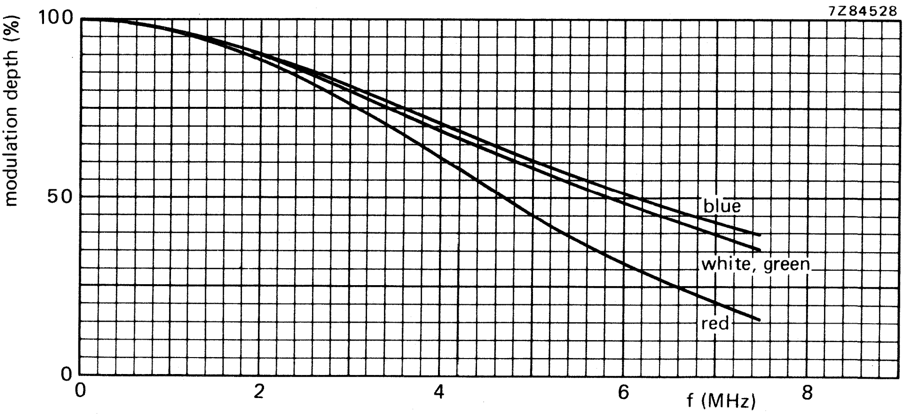


Fig. 8 Typical square-wave response curves.

CAMERA TUBES

1 inch (25,4 mm) diameter Plumbicon ® tubes identical to the tubes of the XQ2070 series but provided with a lead-oxide photoconductive target with extended red response. The tubes of the XQ2075 series feature an infrared reflecting filter on the anti-halation disc. The versions XQ2073, XQ2075 are intended for monochrome cameras and versions XQ2073R, XQ2075R for the red channel in 3-tube colour cameras, in broadcast and EFP, educational and high quality industrial applications.

All data as published for the XQ2070 series apply, except the following *performance data:*

Sensitivity at colour temperature of illuminance = 2856 K

XQ2073, XQ2075	min. 300 μA/lmF	typ. 350 μA/lmF	note 1
XQ2073R, XQ2075R	min. 80 μA/lmF	typ. 100 μA/lmF	

The type number of rear loading versions is followed by the suffix /02, /05, and these tubes are preferred types; front loading versions are denoted by /03.

Spectral response

max. response at	approx.	500 nm
cut-off XQ2073, XQ2073R		850 to 950 nm
cut-off XQ2075, XQ2075R	approx.	750 nm
response curves		see Fig. 1

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. note 2

		XQ2073 XQ2075	XQ2073R XQ2075R
Highlight signal current	I_s	200 nA	100 nA
Beam current	I_b	400 nA	200 nA
Modulation depth at 400 TV lines (5 MHz)			
typical		65 %	55 %
minimum		60 %	50 %

Modulation transfer characteristics see Fig. 2

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Lag (typical values), sum of dark current and light bias 3 nA.
Light source with a colour temperature of 2856 K. Appropriate filter inserted in the light path.

Low key conditions (provisional)

	build-up lag (note 3)				decay lag (note 3)			
	I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ2073, XQ2075	95	≈100	–	–	7	3	–	–
XQ2075R, XQ2075R	–	–	90	≈100	–	–	10	3

High key conditions (provisional)

	build-up lag (note 3)				decay lag (note 3)			
	I_s/I_b=200/400 nA		I_s/I_b=100/200 nA		I_s/I_b=200/400 nA		I_s/I_b=100/200 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ2073, XQ2075	98	100	–	–	2	1	–	–
XQ2073R, XQ2075R	–	–	98	100	–	–	3	1,5

For all further information see data of the XQ2070 series.

Notes

1. Measured with following filters in the light path:
   XQ2073 Calflex B1/K1
   XQ2073R Calflex B1/K1 and Schott OG570
   XQ2075 –
   XQ2075R Schott OG570
   For transmission curves of these filters see Figs 3 and 4.
2. As measured with a 50 mm Leitz Summicron lens having a sine response of approx. 85% at 20,6 lp/mm (400 TV lines at picture height) at f:5,6.
3. **Build-up lag**: after 10 s of darkness. The figures are typical percentages of the ultimate signal current obtained 60 ms and 200 ms after introduction of illuminance.
   Decay lag : after the target has been illuminated for at least 5 s. The figures represent typical residual signals in percentage of the original signal current, 60 ms and 200 ms after removal of the illuminance.

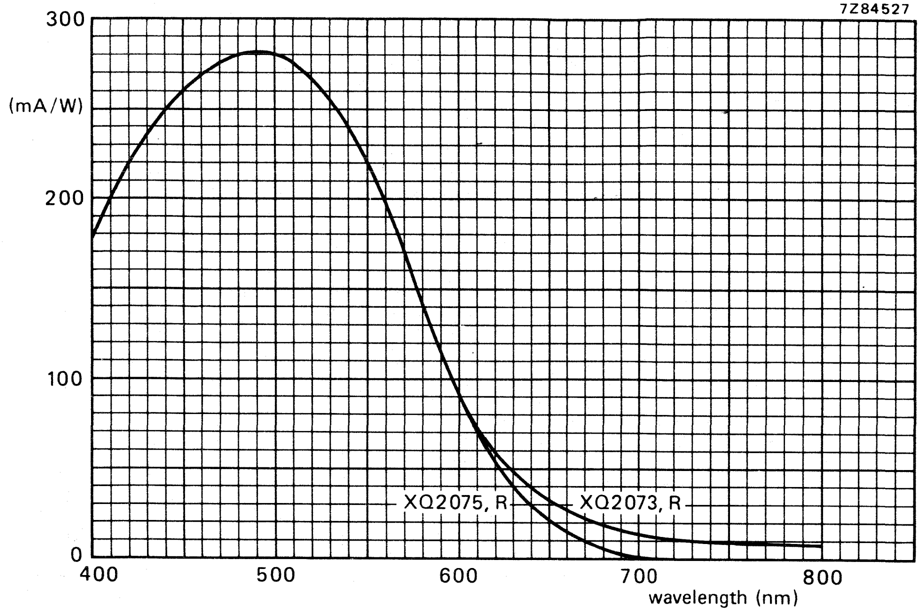

Fig. 1 Typical spectral sensitivity characteristics.

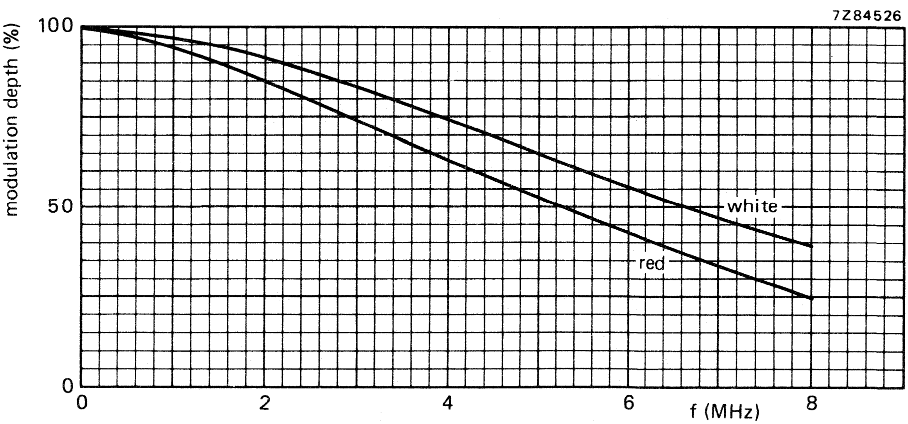

Fig. 2 Typical square-wave modulation transfer characteristic.

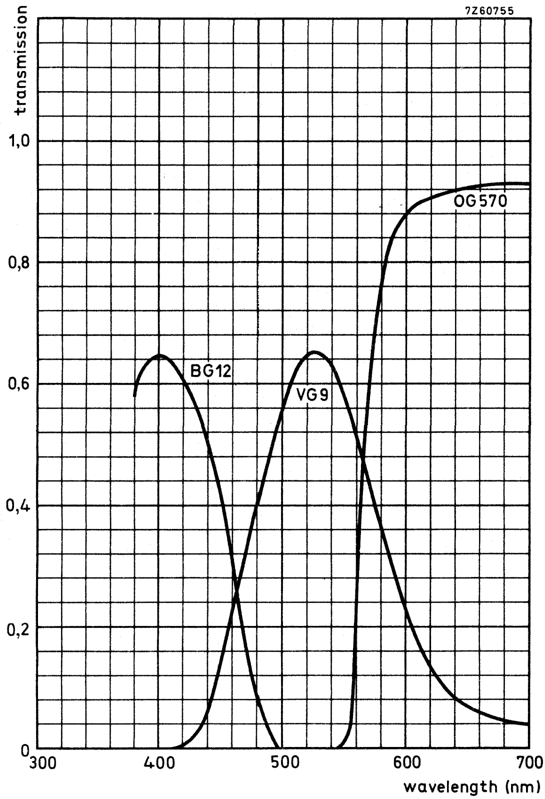

Fig. 3 Transmission of filters BG12. VG9 and OG570.

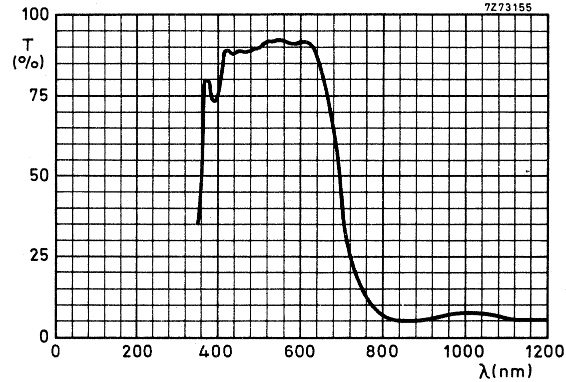

Fig. 4 Typical transmission curve of heat-reflecting interference filter, type CALFLEX B1/K1.

CAMERA TUBES

1 inch (25,4 mm) diameter Plumbicon® television camera tubes with special high resolution lead-oxide photoconductive target, low heater power, magnetic focusing and deflection, for rear loading.

Special features are:

- **New** photoconductive target for increased resolution.
- **"Diode" electron gun** for D.B.C. (dynamic beam control) to minimize comet-tailing and blooming (note 1).
- Provisions for light bias to reduce lag for type XQ3070/02.
- Low output-capacitance for high signal to noise ratio.

QUICK REFERENCE DATA

Focusing		magnetic
Deflection		magnetic
"Diode" electron gun		note 2
Diameter		25,4 mm (1 in)
Length, excluding anti-halation glass disc	approx.	165 mm (6½ in)
Anti-halation glass disc	thickness	5 mm
Rear loading		note 3
Provisions for light bias		
Spectral response cut-off	approx.	650 nm
Heater		6,3 V, 95 mA
Modulation depth at 400 TV lines (5 MHz)		60%

The tubes (XQ3070, R, G, B) meet the high picture quality standards required for colour and monochrome cameras in broadcast and EFP (note 4), educational and high quality industrial applications. For interchangeability with other 1-in Plumbicon tubes, see notes 2 and 5.

OPTICAL

Useful target area (aspect ratio 3 : 4)	9,6 mm x 12,8 mm (note 6)

Orientation of image on 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.

Faceplate	
thickness	1,2 ± 0,1 mm
refractive index	1,49
Anti-halation glass disc	
thickness	5 ± 0,1 mm
refractive index	1,52

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HEATING

notes

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	

The heater current and heater voltage must never exceed 150 mA r.m.s. and 9,5 V r.m.s. when switching on or at any other time. For optimum performance (lifetime and registration stability) use a stabilized supply.

CAPACITANCE

Signal electrode to all C_{as}		≈	2,1 pF	7

This capacitance increases when the tube is inserted in the coil unit. 8

DEFLECTION

magnetic 9

FOCUSING

magnetic 9

ACCESSORIES

Socket	type 56098	
Deflection and focusing coil unit	AT1126	10
Mask for reduction of flare	type 56028	
Light bias lamp in holder	type 56106	11

ELECTRON GUN CHARACTERISTICS

Cut-off

Grid 1 voltage for cut-off at V_{g2} = 300 V without blanking	V_{g1}		−10 to 0 V	
Grid 1 voltage for normal beam current	V_{g1w}	⩽	15 V	12
Blanking voltage with respect to V_{g1w}, peak to peak				
on grid 1	$V_{g1\,p\text{-}p}$		25 V	
on cathode	$V_{k\,p\text{-}p}$		25 V	
Grid 1 current at normally required beam currents	I_{g1}	⩽	1,5 mA	12,18
Grid 2 current at normally required beam currents	I_{g2}	⩽	0,1 mA	12,18

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	13
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.	450	V	
Grid 2 voltage	V_{g2}	max.	350	V	
Grid 1 voltage, positive	V_{g1}	max.	25	V	
Grid 1 voltage, negative	$-V_{g1}$	max.	200	V	
Grid 1 current ($\approx I_K$ current)	I_{g1}	max.	5	mA	14
Grid 1 current (peak current with D.B.C.)	I_{g1p}	max.	8	mA	2
Cathode to heater voltage, positive peak	V_{kfp}	max.	125	V	
Cathode to heater voltage, negative peak	$-V_{kfp}$	max.	50	V	
Cathode heating time before drawing cathode current	t_h	min.	1	min	
External resistance between cathode and heater at $V_{kfp} > 10$ V	R_{kf}	min.	2	kΩ	
Ambient temperature, storage and operation	T_{amb}	max.	50	°C	15
		min.	−30	°C	
Faceplate temperature, storage and operation	T	max.	50	°C	
		min.	−30	°C	
Faceplate illuminance	E	max.	500	lx	16

DEVELOPMENT SAMPLE DATA

MECHANICAL DATA

Dimensions in mm

→ **Rear loading tubes XQ3070/02** (note 29)

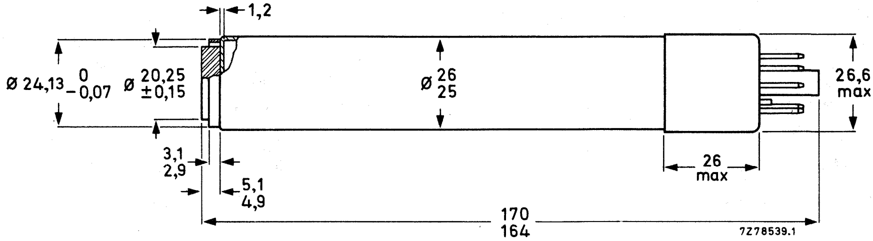
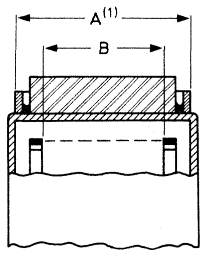


Fig. 1.



(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.

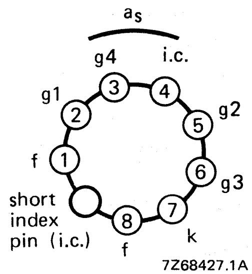


Fig. 3.

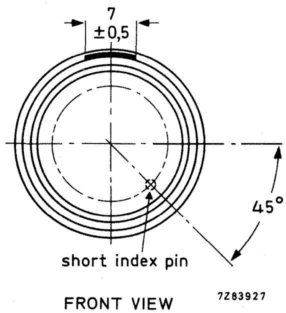


Fig. 2 Front view.

Mounting position: any

Mass: ≈ 70 g

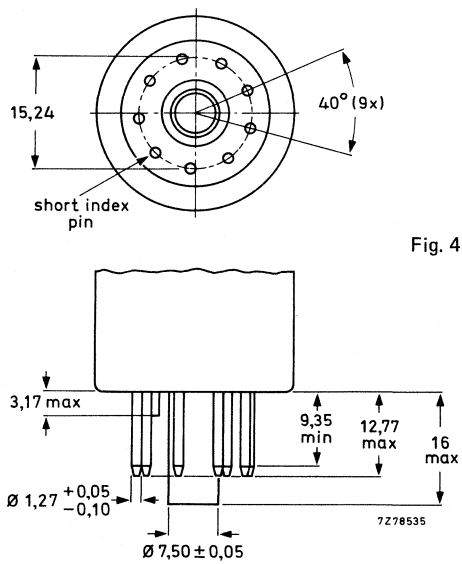


Fig. 4.

DEVELOPMENT SAMPLE DATA

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9,6 mm x 12,8 mm — notes 17

Conditions

				notes
Cathode voltage	V_k		0 V	
Signal electrode voltage	V_{as}		45 V	13
Beam current	I_b			12,18
Grid 4 voltage	V_{g4}		960 V	19
Grid 3 voltage	V_{g3}		600 V	19
Grid 2 voltage	V_{g2}		300 V	
Grid 1 voltage	V_{g1}			12,18
Blanking voltage on grid 1, peak to peak	$V_{g1\ p\text{-}p}$		35 V	
Focusing coil current				20
Deflection current, alignment				20
Faceplate illuminance	E			21
Faceplate temperature	T		20 to 45 °C	

Performance

				notes
Dark current	I_d		⩽ 2 nA	
Sensitivity at colour temperature of illuminance = 2856 K				22
XQ3070		min. 300	typ. 350 µA/lmF	
XQ3070R		min. 63	typ. 70 µA/lmF	
XQ3070G		min. 130	typ. 145 µA/lmF	
XQ3070B		min. 35	typ. 38 µA/lmF	
Gamma of transfer characteristic			0,95 + 0,05	23
Spectral response:				
max. response at			≈ 500 nm	
cut-off at			≈ 650 nm	
response curves			see Fig. 5.	

Resolution notes

Modulation depth, i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. 22,24

		XQ3070	XQ3070R	XQ3070G	XQ3070B	notes
Highlight signal current	I_s	200 nA	100 nA	200 nA	100 nA	
Beam current	I_b	400 nA	200 nA	400 nA	200 nA	12
Modulation depth at 400 TV lines (5 MHz) in %	typ.	60	45	60	60	
	min.	55	40	55	55	

Modulation transfer characteristics see Fig. 8

Lag (typical values, with light bias) 25

Light source with a colour temperature of 2856 K

Appropriate filter inserted in light path 22

Low key conditions (provisional) 26

	build-up lag				decay lag			
	I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ3070 XQ3070G	98	≈ 100			6	2,5		
XQ3070R			95	≈ 100			9	2,5
XQ3070B			95	≈ 100			10	3

High-key conditions (provisional) 26

	build-up lag				decay lag			
	I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ3070 XQ3070G	98	≈ 100			1,5	0,6		
XQ3070R			97	≈ 100			2,5	1
XQ3070B			97	≈ 100			3,5	2

Shading of light bias induced dark current 12,5% 27

Highlight handling capability with D.B.C. 28

DEVELOPMENT SAMPLE DATA

NOTES

1. "Diode" gun is a triode gun operating in a diode mode, providing a very high beam reverse.

   Warning

   Avoid continuous operation at high beam currents since this will shorten tube life. Full advantage of the high beam reserve to reduce comet-tailing and blooming can be made with D.B.C. circuitry which, during highlights feeds positive-going pulses derived from the video signal, to grid 1 to increase the beam current momentarily.
2. The "Diode" gun operates with a positive ($\leqslant$ 15 V) grid 1 voltage (adjusted for correct beam settings, see note 12), hence draws some grid 1 current:
   without D.B.C.: $\leqslant$ 1,5 mA (peak) with blanking
   with D.B.C.: $\leqslant$ 8 mA (peak) with blanking measured with an oscilloscope

   The D.B.C. circuitry should, in the case of highlights, supply positive-going pulses up to 7 V above V_{g1w} (see note 12) and up to 8 mA peak-to grid 1.

   N.B. Applying higher pulses than 7 V is not recommended since this will shorten tube life, impair resolution and may introduce oscillations.
3. The XQ3070 tubes are finished like the tubes of the XQ1080/XQ1500 series (ceramic ring), but for only one target contact.
4. EFP = Electronic Field Production.
5. Since the "Diode" gun draws some grid 1 current (see note 2), cameras designed around XQ1080/ XQ1500 and XQ1070 tubes will require some modification.
6. Underscanning of the specified useful target area of 9,6 x 12,8 mm, or failure of scanning, should be avoided since this may cause damage to the photoconductive layer.
7. Measured on the tube proper between signal-electrode contact and all other electrodes connected together.
8. Example: when the tube is inserted into an AT1126 unit, the capacitance measured at the contact spring of the unit increases to approximately 4,5 pF.
9. For focusing/deflection coil units, see under Accessories.
10. AT1126 is a computer selected triplet.
11. For adjustable light bias. Lamp, type 56106, fits in the metal tube cemented to the pumping stem of the tube. The wires should be connected to a source capable of supplying max. 110 mA at 5 V. The desired amount of light bias can be obtained by adjusting the current through the lamp. For black/white operation a light bias corresponding to 2 to 3 nA extra dark current is usually adequate for 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, 2, 6 nA.
12. Beam current settings as required for one stop over normal peak white.
13. 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). The signal electrode voltage should preferably be set to 45 V.
14. Peak value measured with an oscilloscope.
15. Camera design limit. Short temperature excursions up to 70 ^{o}C during operation are allowed.
16. 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, in stand-by also the beam will be cut-off.
17. The operating conditions and performance quoted in these data relate to operation in the coil units AT1126.

NOTES (continued)

18. The beam current I_b, as obtained by adjusting the control grid voltage (grid 1) is set at 200 nA for R and B tubes, 400 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 = 20/200 nA. This 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 of the scanned area.
    The peak signal currents as measured on an 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.)

19. The optimum voltage ratio V_{g4}/V_{g3} to minimize beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. In the AT1126 unit a ratio of 1,6 is recommended.
20. See published data of deflection/focusing assemblies.

    N.B. The polarity of the focusing coil current should be such that its image end attracts an external north-seeking pole.

21. 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 reflectively whichever is relevant;
    T = lens light transmission;
    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.

22. Measuring conditions.
Illuminance level ≈ 4. lx (luminous flux at scanned area ≈ 0,5 mlm) at a colour temperature of 2856K, the appropriate filter inserted in the light path.
Filters used:

XQ3070R	Schott OG570	3 mm
XQ3070G	Schott VG9	1 mm
XQ3070B	Schott BG12	3 mm.

    For transmission of the filters, see Fig. 6.

23. Gamma stretching circuitry is recommended.
24. As measured with a 50 mm Leitz Summicron lens having a sine response of approx. 85% at 20,6 lp/mm (400 TV lines at 9,6 mm picture height) at f : 5,6.
The amplitude response can be raised by means of suitable correction circuits.
25. Adjusted for sum of dark current, leakage current and light bias current of 3 nA.
26. *Build-up lag:* After 10 s of darkness. The figures are typical percentages of the ultimate signal current obtained 60 ms and 200 ms, respectively, after introduction of the illuminance.
Decay lag: After the target has been illuminated for at least 5 s. The figures represent typical residual signals in percentages of the original signal current 60 ms and 200 ms, respectively, after removal of the illuminance.

27. 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.

28. a. With D.B.C. applied (see Note 2) the tube will properly handle highlights with a diameter of 10% of picture height and with a brightness corresponding to 16 times peak signal white, I_{sp}.
    b. The maximum peak signal currents in the case of highlights will be 2,5 μA. Video preamplifiers should be designed to accommodate these.

29. Refer to type XQ3070/05, overall length max. 167 mm, for tube without bias light provisions.

DEVELOPMENT SAMPLE DATA

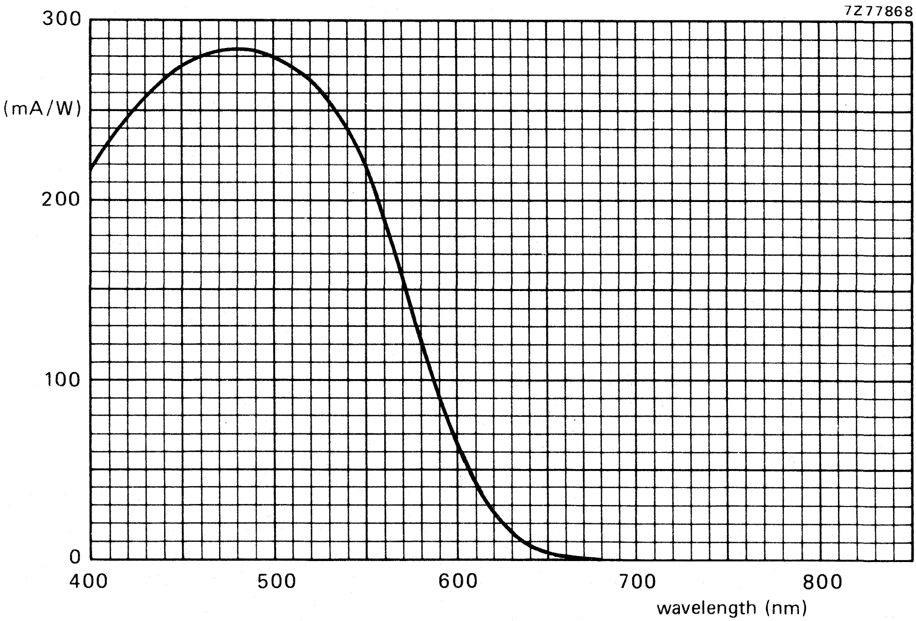


Fig. 5 Typical spectral sensitivity characteristic.

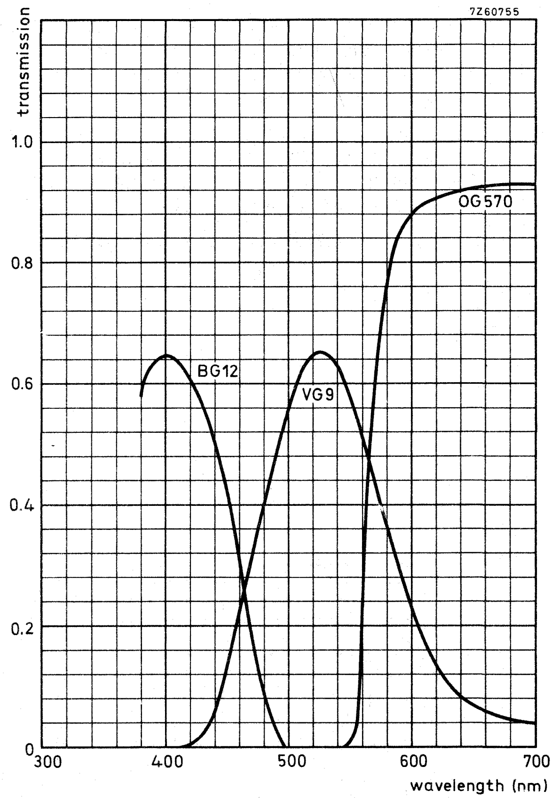


Fig. 6 Transmission of filters BG12, VG9 and OG570.

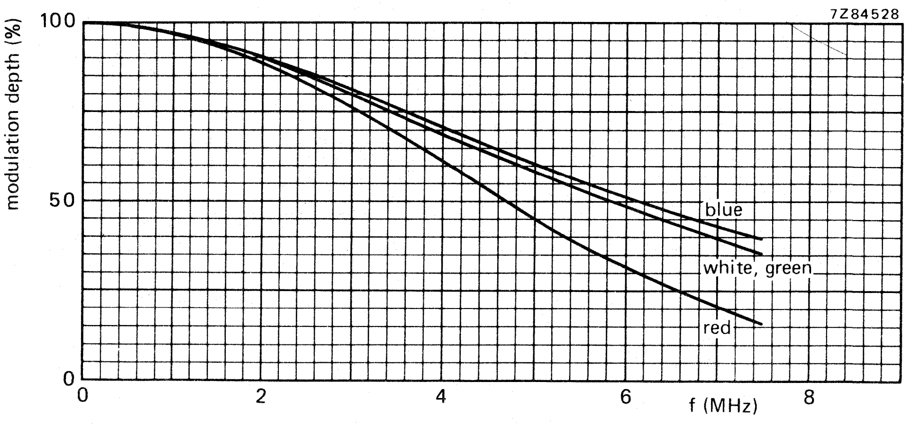


Fig. 7 Typical square-wave response curves.

CAMERA TUBES

1 inch (25,4 mm) diameter Plumbicon® tubes provided with a lead-oxide photoconductive target with extended red response. The tubes of the XQ3075 series feature an infrared reflecting filter on the anti-halation disc. The versions XQ3073, XQ3075 are intended for monochrome cameras and versions XQ3073R, XQ3075R for the red channel in 3-tube colour cameras, in broadcast and EFP, educational and high quality industrial applications.

All data as published for the XQ3070 series apply, except the following *performance data:*

Sensitivity at colour temperature of illuminance = 2856 K

XQ3073, XQ3075	min. 300 μA/lmF	typ. 350 μA/lmF	note 1
XQ3073R, XQ3075R	min. 80 μA/lmF	typ. 100 μA/lmF	←

Spectral response

max. response at	approx.	500 nm
cut-off XQ3073, XQ3073R		850 to 950 nm
cut-off XQ3075, XQ3075R	approx.	750 nm
response curves		see Fig. 1

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture — note 2

		XQ3073 XQ3075	XQ3073R XQ3075R
Highlight signal current	I_s	200 nA	100 nA
Beam current	I_b	400 nA	200 nA
Modulation depth at 400 TV lines (5 MHz)			
typical		65 %	55 %
minimum		60 %	50 %

Modulation transfer characteristics — see Fig. 2

® Registered Trade Mark for television camera tube.

Lag (typical values), sum of dark current and light bias 3 nA.
Light source with a colour temperature of 2856 K. Appropriate filter inserted in the light path.

Low key conditions (provisional)

	build-up lag (note 3)				decay lag (note 3)			
	I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA		I_s/I_b = 40/400 nA		I_s/I_b = 20/200 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ3073, XQ3075	95	≈ 100	–	–	7	3	–	–
XQ3073R, XQ3075R	–	–	90	≈ 100	–	–	10	3

High-key conditions (provisional)

	build-up lag (note 3)				decay lag (note 3)			
	I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA		I_s/I_b = 200/400 nA		I_s/I_b = 100/200 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ3073, XQ3075	98	100	–	–	2	1	–	–
XQ3073R, XQ3075R	–	–	98	100	–	–	3	1,5

For all further information see data of the XQ3070 series.

Notes

1. Measured with following filters in the light path:
   XQ3073 Calflex B1/K1
   XQ3073R Calflex B1/K1 and Schott OG570
   XQ3075 –
   XQ3075R Schott OG570
   For transmission curves of these filters see Figs 3 and 4.
2. As measured with a 50 mm Leitz Summicron lens having a sine response of approx. 85% at 20,6 lp/mm (400 TV lines at picture height) at f : 5,6.
3. **Build-up lag:** after 10 s of darkness. The figures are typical percentages of the ultimate signal current obtained 60 ms and 200 ms after introduction of illuminance.
   Decay lag: after the target has been illuminated for at least 5 s. The figures represent typical residual signals in percentage of the original signal current, 60 ms and 200 ms after removal of the illuminance.

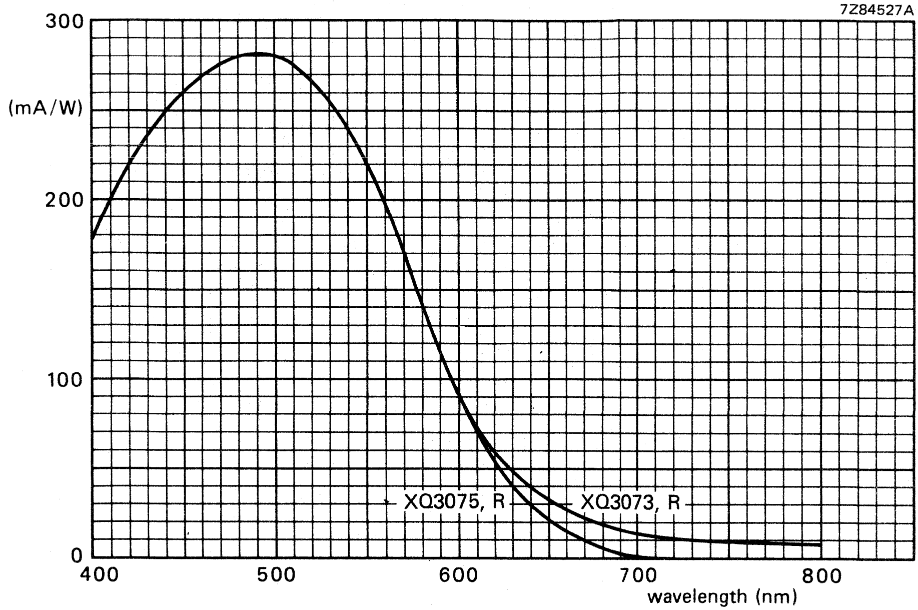


Fig. 1 Typical spectral sensitivity characteristics.

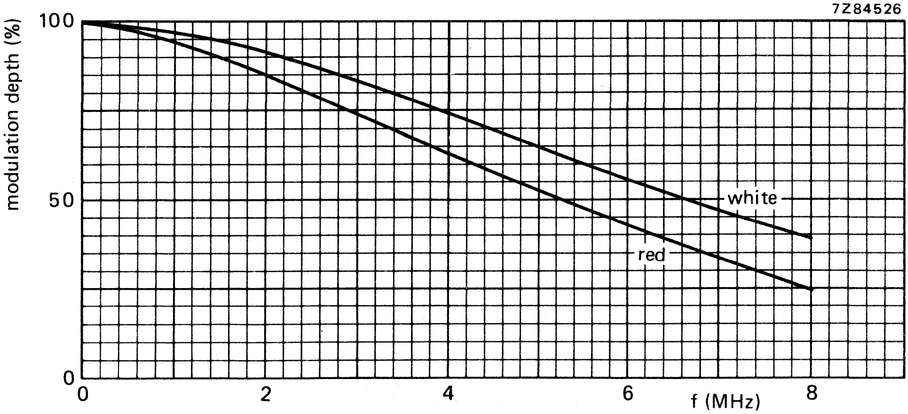


Fig. 2 Typical square-wave modulation transfer characteristic.

DEVELOPMENT SAMPLE DATA

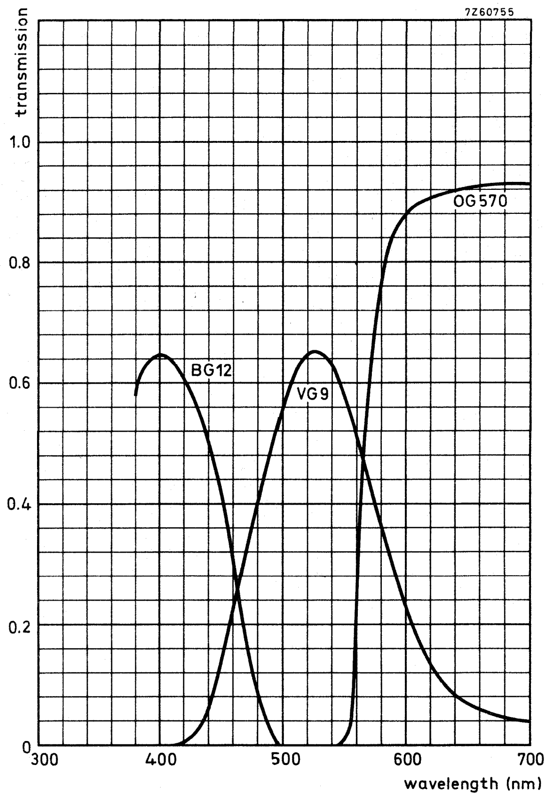


Fig. 3 Transmission of filters BG12, VG9 and OG570.

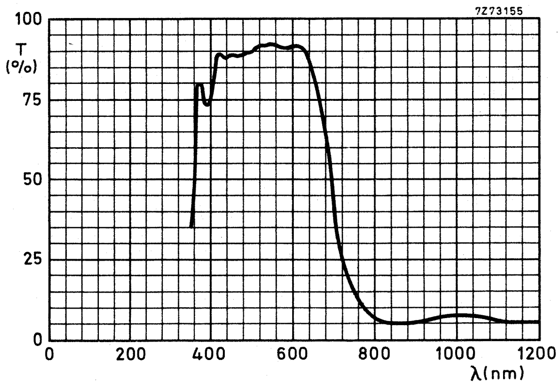


Fig. 4 Typical transmission curve of heat-reflecting interference filter, type CALFLEX B1/K1.

18 mm dia. PLUMBICON TUBES E

CAMERA TUBES

Small size Plumbicon® television camera tubes 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 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. 105 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

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	type AT1106 or AT1109/.. 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

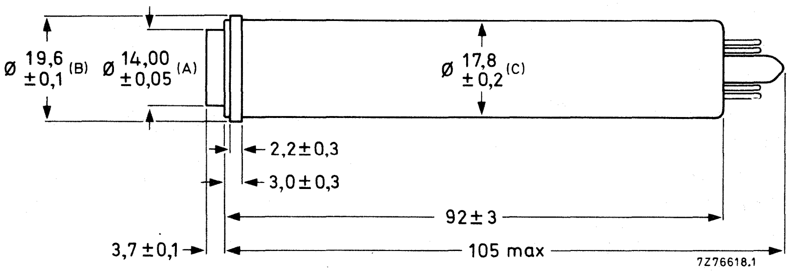
LIMITING VALUES (Absolute maximum rating system)

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

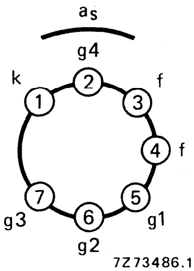
					note
Signal electrode voltage	V_{as}	max	50	V	3
Grid 4 voltage	V_{g4}	max	1000	V	
Grid 3 voltage	V_{g3}	max	750	V	
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max	400	V	
Grid 2 voltage	V_{g2}	max	350	V	
Grid 1 voltage, positive	V_{g1}	max	0	V	
Grid 1 voltage, negative	$-V_{g1}$	max	200	V	
Cathode to 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	
External resistance between cathode and heater at $V_{kf\,p} > 10$ V	R_{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

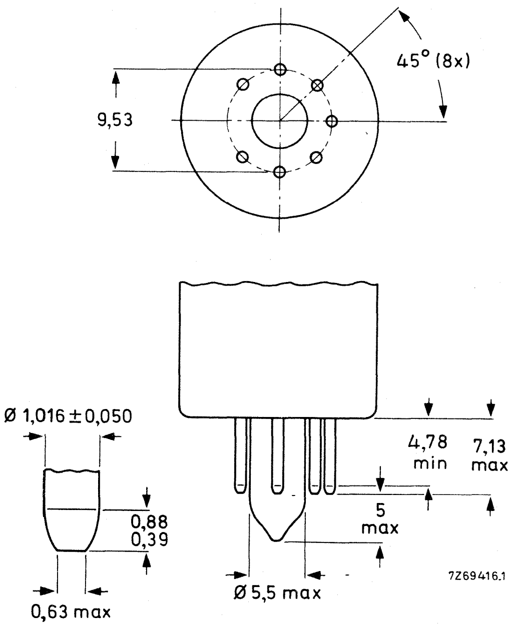
MECHANICAL DATA

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: EIA E7-91

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				6
		low voltage mode	high voltage mode		
Grid 4 voltage	V_{g4}	500	750	V	7b, 7c
Grid 3 voltage	V_{g3}	285	430	V	7b, 7c
Grid 1 voltage	V_{g1}				6
Blanking voltage on grid 1, peak to peak	$V_{g1\ p\text{-}p}$	50		V	
Focusing coil current					
Deflection current, alignment					8
Faceplate illuminance	E				8
Faceplate temperature	T	20 to 45		°C	9

Performance

						note
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		≈		500	nm	
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. 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

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, 16)			
	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, 16)			
	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 AT1109.

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 coil unit AT1109 a ratio of 1,75 is required.

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. See chapter "Deflection assemblies".

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.

→ 16. A reduction of lag, especially under low key conditions, is obtained when light bias (up to 5 nA peak) is applied via the optical system. Infrared light with a wavelength > 600 nm in the light bias should be avoided.

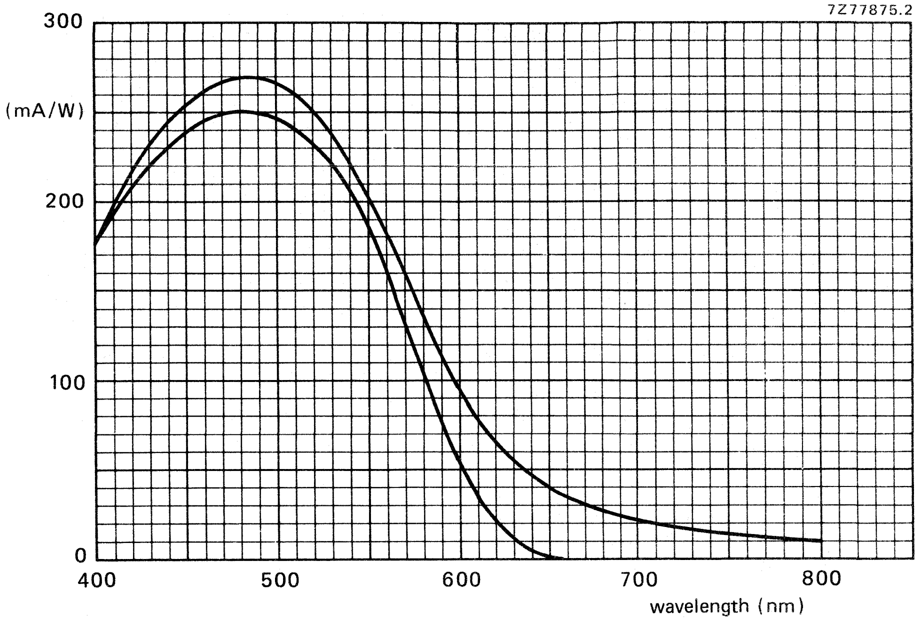


Fig. 1 Typical spectral responses for XQ1427G.

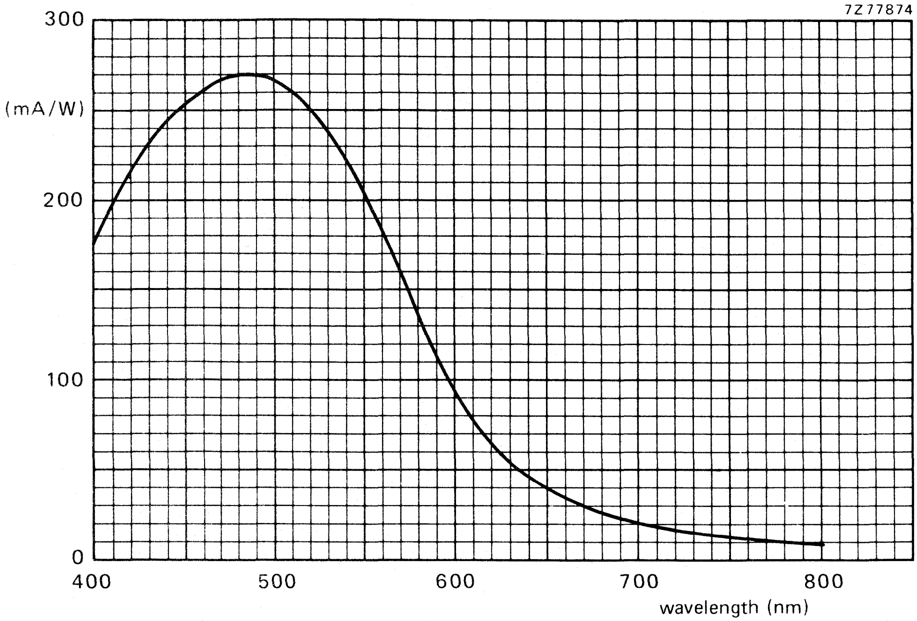


Fig. 2 Typical spectral response curve XQ1427R.

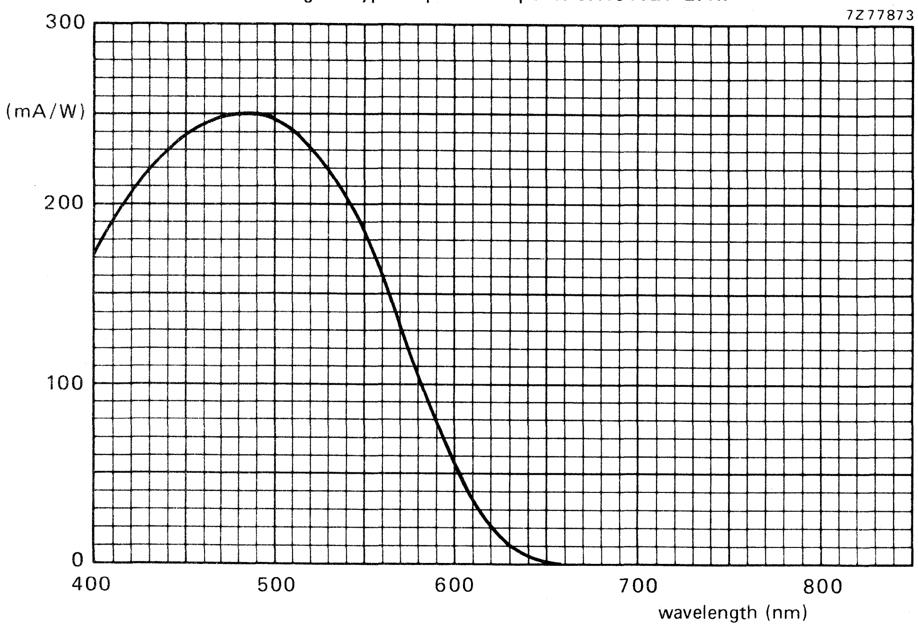


Fig. 3 Typical spectral response curve XQ1427B.

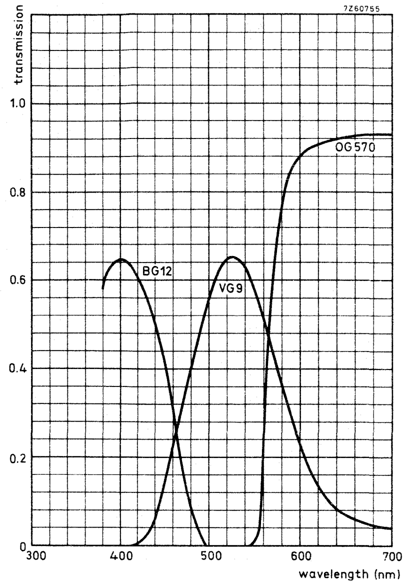


Fig. 4 Transmission of filters BG12, VG19, and OG570.

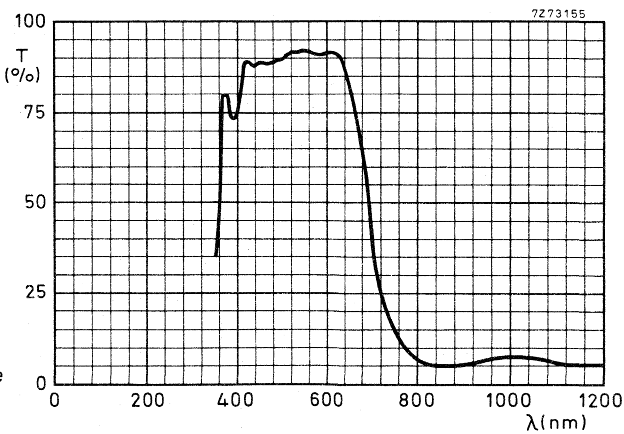


Fig. 5 Typical transmission curve of heat reflecting interference filter CALFLEX B1/K1.

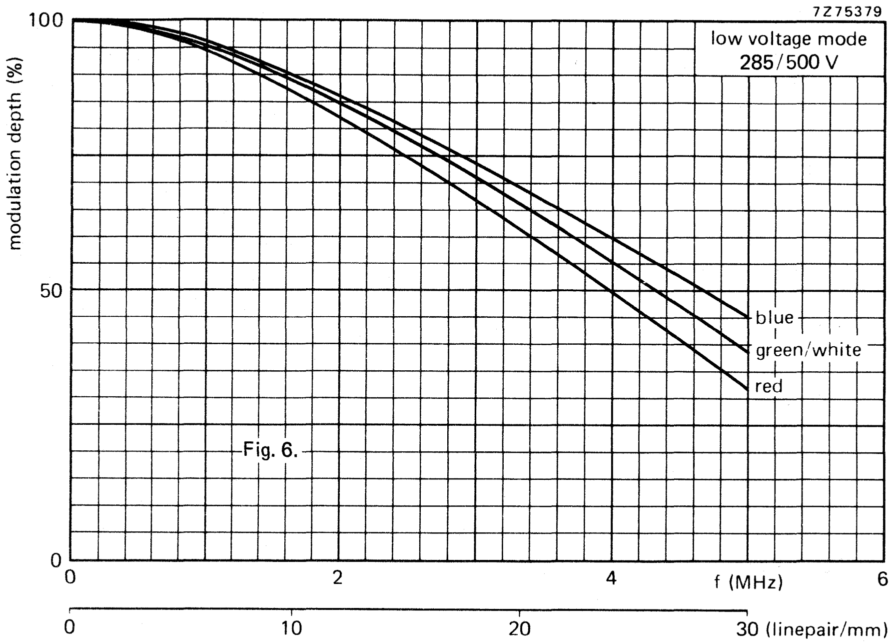

7Z75379
low voltage mode
285/500 V
modulation depth (%)
100
50
0
blue
green/white
red
0
2
4
f (MHz)
6
0
10
20
30 (linepair/mm)

Fig. 6.

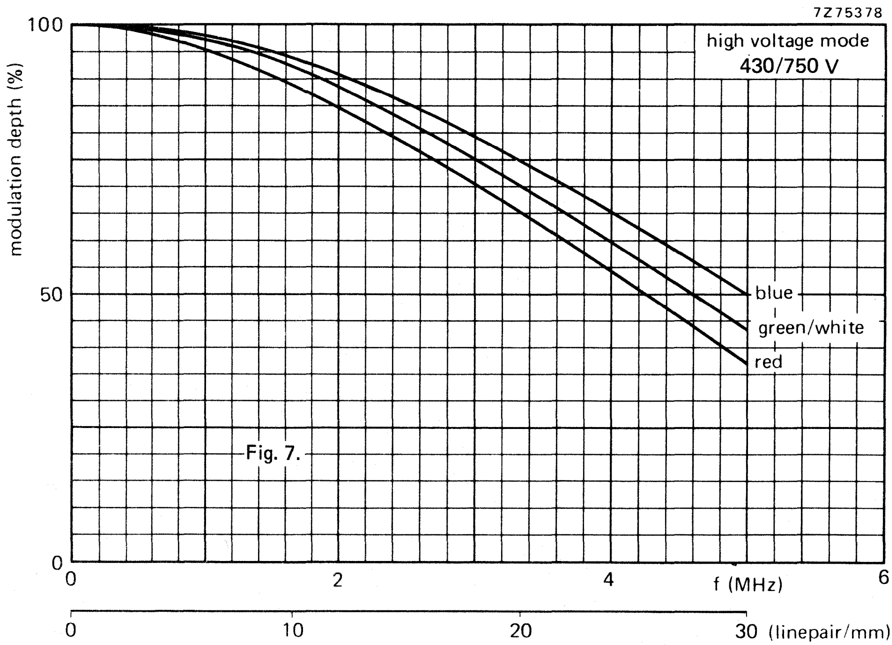

7Z75378
high voltage mode
430/750 V
modulation depth (%)
100
50
0
blue
green/white
red
0
2
4
f (MHz)
6
0
10
20
30 (linepair/mm)

Fig. 7.

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

2/3 inch (17,8 mm) diameter Plumbicon® television camera tubes with special high resolution lead-oxide photoconductive target, low heater power, magnetic focusing and deflection.

Special features are:

- **New** photoconductive target for increased resolution.
- **"Diode" electron gun** for D.B.C. (dynamic beam control) to minimize comet-tailing and blooming (note 1).

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
"Diode" electron gun	
Diameter	17,8 mm (2/3 in)
Length	approx. 105 mm (4¼ in)
Provided with anti-halation glass disc, thickness	2,5 mm (note 3)
Cut-off of spectral response	
XQ2427R	≈ 850 nm
XQ2427, XQ2427G	≈ 650 to 850 nm
XQ2427B	≈ 650 nm
Heater	6,3 V, 95 mA
Modulation depth at 400 TV lines (5 MHz)	50 %

The tubes XQ2427, R, G, B meet the high picture quality standards required for colour and monochrome cameras in broadcast (ENG, EFP: note 4), educational and high quality industrial applications. For interchangeability with the tubes of the XQ1427 series, see notes 2 and 3.

OPTICAL

Quality rectangle on photoconductive target (aspect ratio 3 : 4)	6,6 mm x 8,8 mm (note 5)

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	
thickness	2,3 ± 0,1 mm
refractive index	1,49
Anti-halation glass disc with AR-coating	
thickness	2,5 mm (note 3)
refractive index	1,52

® Registered Trade Mark for television camera tube.

HEATING

			notes
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	

The heater current and heater voltage must not exceed 150 mA r.m.s. and 9,5 V r.m.s. when switching on or at any other time. For optimum performance (lifetime and registration stability) 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	6
FOCUSING	magnetic	6

ACCESSORIES

Socket	type 56049
Deflection and focusing coil unit,	type AT1106, AT1109 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}	−10 to 0 V	
Grid 1 voltage for normal beam setting	V_{g1w}	⩽ 15 V	7
Blanking voltage, peak to peak			
on grid 1	$V_{g1\,p\text{-}p}$	25 V	
on cathode	$V_{k\,p\text{-}p}$	25 V	
Grid 1 current at normally required beam currents	I_{g1}	⩽ 1,5 mA	7
Grid 2 current at normally required beam currents	I_{g2}	⩽ 0,1 mA	7

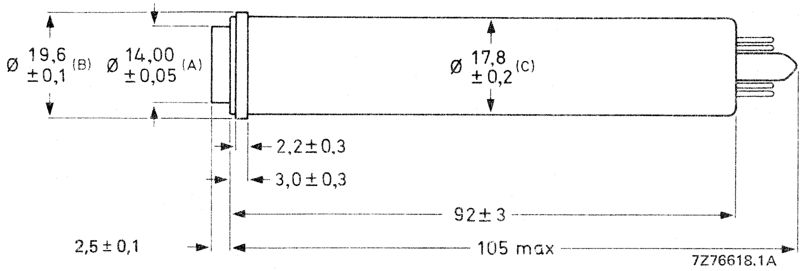
LIMITING VALUES (Absolute maximum rating system)

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

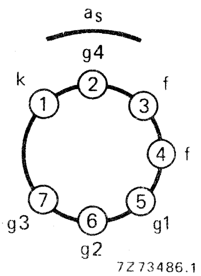
				notes
Signal electrode voltage	V_{as}	max.	50 V	8
Grid 4 voltage	V_{g4}	max.	1000 V	
Grid 3 voltage	V_{g3}	max.	750 V	
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	400 V	
Grid 2 voltage	V_{g2}	max.	350 V	
Grid 1 voltage, positive	V_{g1}	max.	25 V	
Grid 1 voltage, negative	$-V_{g1}$	max.	200 V	
Grid 1 current (≈ I_K current)	I_{g1}	max.	5 mA	9
Grid 1 current (peak current with D.B.C.)	I_{g1p}	max.	8 mA	2
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	
External resistance between cathode and heater at $V_{kf\,p} > 10$ V	R_{kf}	max.	2 kΩ	
Ambient temperature, storage and operation	T_{amb}	max.	50 °C	10
		min.	−30 °C	
Faceplate temperature, storage and operation	T	max.	50 °C	
		min.	−30 °C	
Faceplate illuminance	E	max.	500 lx	11

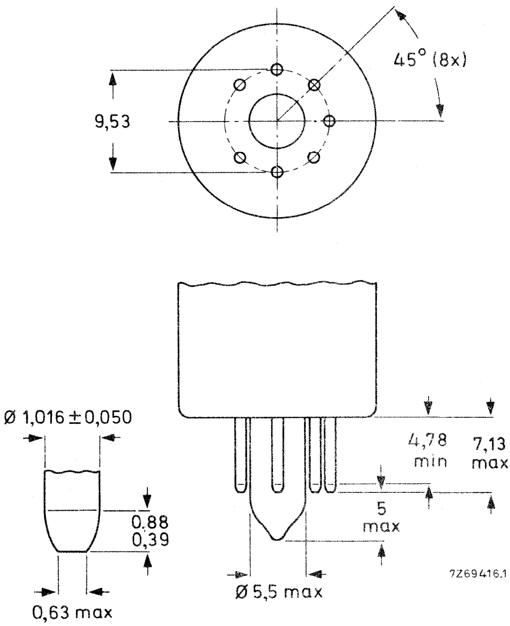
MECHANICAL DATA

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:** EIA E7-91

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 mm x 8,8 mm — notes 12

Conditions

					notes
Cathode voltage	V_k	0		V	
Signal electrode voltage	V_{as}	45		V	8
Beam current	I_b				7,13
		low-voltage mode	high-voltage mode		
Grid 4 voltage	V_{g4}	500	750	V	
Grid 3 voltage	V_{g3}	285	430	V	14,15
Grid 2 voltage	V_{g2}	300	300	V	
Grid 1 voltage	V_{g1}				7,13
Blanking voltage on grid 1, peak to peak	$V_{g1\,p\text{-}p}$	25		V	
Focusing coil current					16
Deflection current, alignment					16
Faceplate illuminance	E				17
Faceplate temperature		20 to 45		°C	

Performance

							notes
Dark current			≤ 1,0			nA	
Sensitivity at colour temperature of illuminance = 2856 K							18
XQ2427	min.	275		typ.	320	μA/lmF	
XQ2427R	min.	80		typ.	100	μA/lmF	
XQ2427G	min.	95		typ.	125	μA/lmF	
XQ2427B	min.	35		typ.	38	μA/lmF	
Gamma of transfer characteristic			0,95 + 0,05				19
Spectral response:							
max. response at			≈		500	nm	
cut-off XQ2427R			≈		850	nm	20
cut-off XQ2427, XQ2427G			≈	650 to	850	nm	20
cut-off XQ2427B			≈		650	nm	
response curves			see Figs 1, 2 and 3				

notes

Resolution

Modulation depth, i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures shown represent the amplitude response of the tubes operated in low and high-voltage mode respectively. 21

		XQ2427	XQ2427R	XQ2427G	XQ2427B	notes
Highlight signal current	I_s	200 nA	150 nA	200 nA	150 nA	7
Beam current	I_b	400 nA	300 nA	400 nA	300 nA	
Modulation depth at 400 TV lines (5 MHz) in %						
low-voltage mode	typ.	45	43	45	50	
	min.	40	38	40	45	
high-voltage mode	typ.	50	48	50	55	
	min.	45	43	45	50	

Modulation transfer characteristics (high voltage mode) see Fig. 6

Lag (typical values, no light bias applied)

Light source with a colour temperature of 2856 K

Appropriate filter inserted in light path 18

Low key conditions

	build-up lag				decay lag				notes
	I_s/I_b = 20/400 nA		I_s/I_b = 20/300 nA		I_s/I_b = 20/400 nA		I_s/I_b = 20/300 nA		13,22 23
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	
XQ2427 XQ2427G	90	≈ 100			10	4			
→ XQ2427R			95	≈ 100			9	3,5	
→ XQ2427B			95	≈ 100			10	4	

High-key conditions

	build-up lag				decay lag				notes
	I_s/I_b = 200/400 nA		I_s/I_b = 150/300 nA		I_s/I_b = 200/400 nA		I_s/I_b = 150/300 nA		13,22 23
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	
XQ2427 XQ2427G	98	≈ 100			2	0,5			
XQ2427R XQ2427B			98	≈ 100			2,5	0,5	

Highlight handling capability with D.B.C. 24

NOTES

1. "Diode" gun is a triode gun operating in a diode mode, providing a very high beam reserve.

   Warning

   Continuous operation with a high beam setting is to be avoided since this will shorten tube life. Full advantage of the high beam reserve to reduce comet-tailing and blooming can be made with D.B.C. circuitry (dynamic beam control) with which, in the case of highlights, positive-going pulses are derived from the video signal, which are fed to grid 1 to increase the beam current momentarily.

2. The "Diode" gun operates with a positive ($\leqslant$ 15 V) grid 1 voltage (adjusted for correct beam settings, see note 7), hence draws some grid 1 current:
   without D.B.C.: $\leqslant$ 1,5 mA (peak) with blanking
   with D.B.C.: $\leqslant$ 8 mA (peak) with blanking measured on an oscilloscope

   The D.B.C. circuitry should, in the case of highlights, supply positive-going pulses of 10 V above V_{g1w} (see note 7) and up to 8 mA peak to grid 1.

   N.B. Applying higher pulses than 10 V is not recommended since this will shorten tube life, impair resolution and may introduce oscillations.

3. Mechanically the tubes are interchangeable with the tubes of the XQ1427 series (except for thickness of the anti-halation glass disc). Since the "Diode" gun operates with a positive grid 1 voltage, causing some grid current, cameras designed around XQ1427 tubes will require some modification.

4. ENG = Electronic News Gathering.
   EFP = Electronic Field Production.

5. 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.

6. For focusing/deflection coil unit see under Accessories.

7. Beam current settings as required for one stop over normal peak white.

8. 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 45 V.

9. Peak value, measured with an oscilloscope.

10. Camera design limit. Short temperature excursions up to 70 $^{\circ}$C during operation are allowed.

11. 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, in stand-by also the beam will be cut off.

12. The operating conditions and performance quoted in these data relate to operation in the coil unit AT1109.

NOTES (continued)

13. The beam current I_b, as obtained by adjusting the control grid voltage (grid 1) is set at 300 nA for R and B tubes, 400 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.)

14. The optimum voltage ratio V_{g4}/V_{g3} to minimize beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. In the coil unit AT1109 a ratio of 1,74 is required.

15. Voltage setting for high-voltage mode for optimum resolution:
    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).

16. See published data of deflection/focusing assemblies.
    N.B. The polarity of the focusing coil current should be such that its image end attracts an external north-seeking pole.

17. 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.

18. Measuring conditions.
    Illuminance level ≈ 10,5 lx (luminous flux at scanned area ≈ 0,5 mlm) at a colour temperature of 2856K. Filters are inserted in the light path for the chrominance tubes.
    Filters used for
    XQ2427R: B_1/K_1 and Schott OG570, 3 mm
    XQ2427G: B_1/K_1 and Schott VG9, 1 mm
    XQ2427B: Schott BG12, 3 mm

19. Gamma stretching circuitry is recommended.
20. 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.
21. As measured with a 50 mm Leitz Summicron lens having a sine response of approx. 80% at 30,3 lp/mm (400 TV lines at 6,6 mm x 8,8 mm) at f : 5,6.

    The horizontal amplitude response can be raised by means of suitable correction circuits, which affect neither the vertical resolution nor the limiting resolution.
22. *Build-up lag*: After 10 s of darkness. The figures are typical percentages of the ultimate signal current obtained 60 ms and 200 ms, respectively, after introduction of the illuminance.
    Decay lag: 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 and 200 ms, respectively, after removal of the illuminance.
23. An attractive reduction of lag, especially under low key conditions may be obtained when lightbias (up to 5 nA_p) is applied via the optical system. Red light with a wavelength of > 600 nm should be avoided.
24. a. With D.B.C. applied (see note 2) the tube will properly handle highlights with a diameter of 10% of picture height and with a brightness corresponding to 16 times peak signal white, I_{sp}.
    b. The maximum peak signal currents in the case of highlights will be 2,5 μA. Video preamplifiers should be designed to accommodate these.

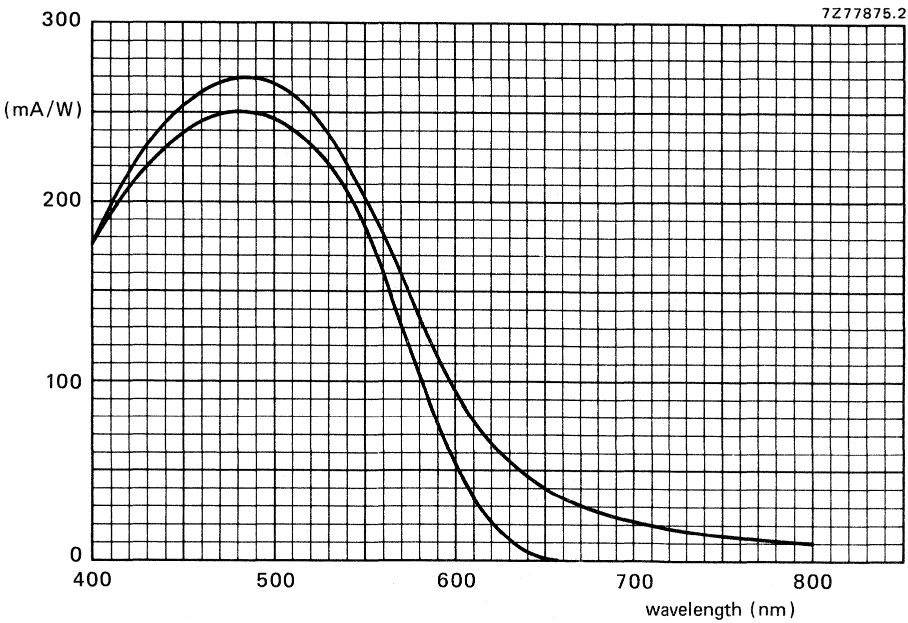


Fig. 1 Typical spectral responses for XQ2427G.

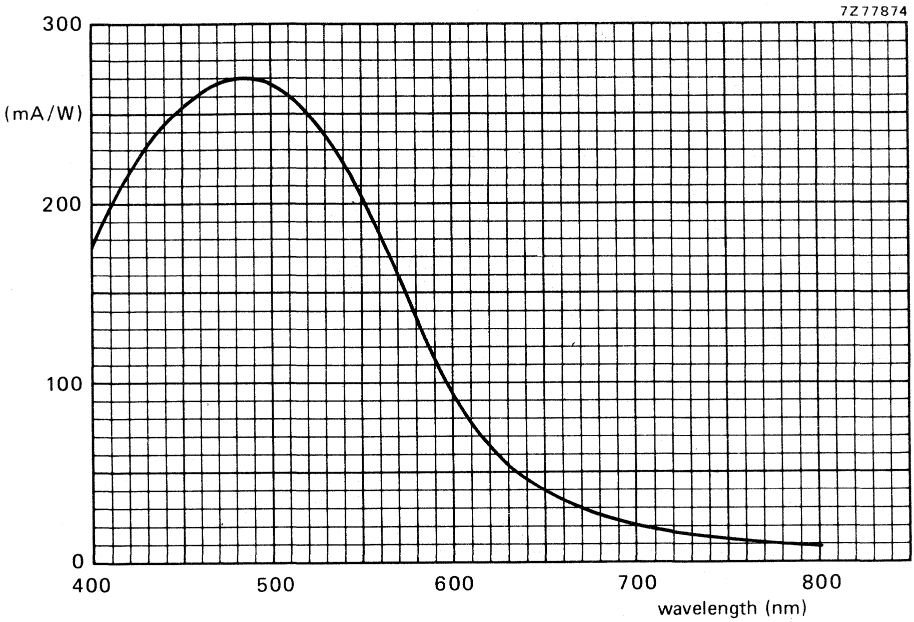


Fig. 2 Typical spectral response curve of XQ2427R (without B_1/K_1 filter).

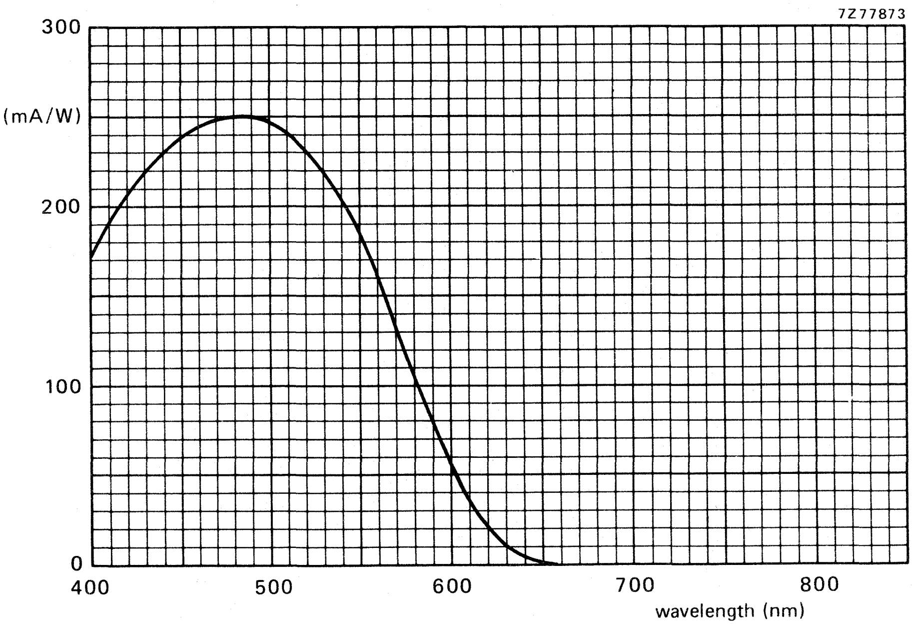


Fig. 3 Typical spectral response curve XQ2427B.

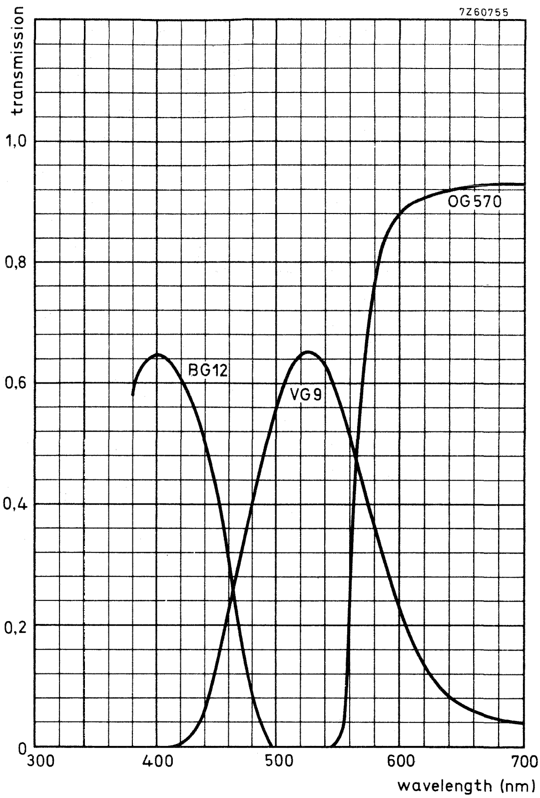


Fig. 4 Transmission of filters BG12, VG9, and OG570.

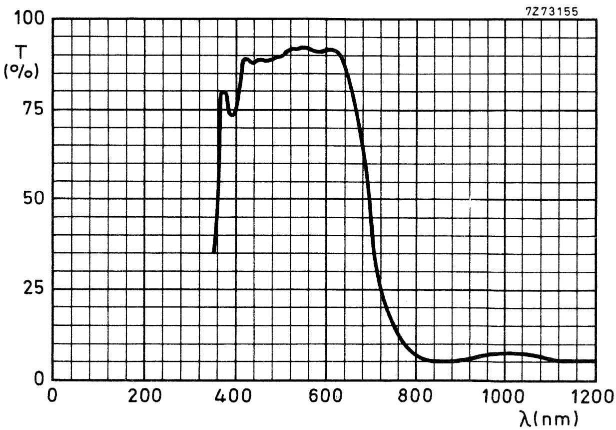


Fig. 5 Typical transmission curve of heat reflecting interference filter CALFLEX B1/K1.

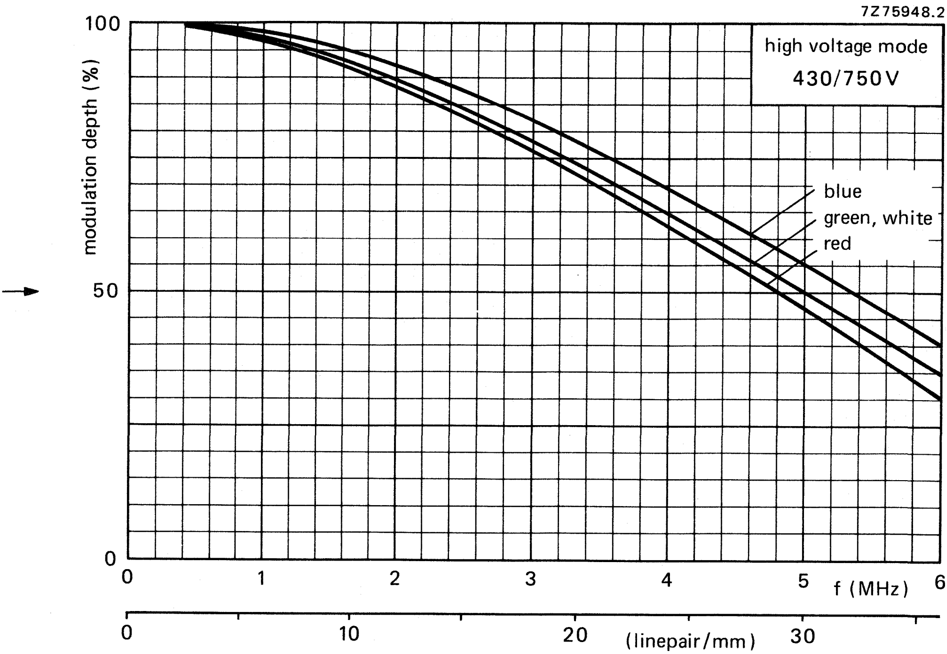


Fig. 6 Typical square-wave response curves.

CAMERA TUBES

Plumbicon® television camera tubes, mechanically and electrically identical to the tubes of the XQ2427 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:

XQ2428	for use in black and white cameras
XQ2428R XQ2428G XQ2428B	for use in the chrominance channels of colour cameras

For all further information see data of the XQ2427 series.

® Registered Trade Mark for television camera tube.

CAMERA TUBES

2/3 inch (17,8 mm) diameter Plumbicon® television camera tubes with special high resolution lead-oxide photoconductive target, low heater power, magnetic focusing and deflection.

Special features are:

- **New** photoconductive target for increased resolution.
- **"Diode" electron gun** for D.B.C. (dynamic beam control) to minimize comet-tailing and highlight blooming (notes 1 and 3)
- Low output capacitance for high signal to noise ratio.

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
"Diode" electron gun	notes 1, 2
Diameter	17,8 mm (2/3 in)
Length	approx. 105 mm (4¼ in)
Anti-halation glass disc thickness	2,5 mm
Spectral response cut-off	
XQ3427R	≈ 850 nm
XQ3427, XQ3427G	≈ 650 to 850 nm
XQ3427B	≈ 650 nm
Heater power	6,3 V, 95 mA
Modulation depth at 400 TV lines (5 MHz)	50%

The tubes meet the high picture quality standards required for colour and black & white cameras in broadcast (ENG, EFP: note 4) educational and high quality industrial applications (note 1).

OPTICAL

Useful target area (aspect ratio 3 : 4)	6,6 mm x 8,8 mm (note 5)

Orientation of image on target

For correct orientation of the image on the target the horizontal scan should be essentially parallel to the long side of the signal plate. note 3

Faceplate	
thickness	2,3 ± 0,1 mm
refractive index	1,49
Anti-halation glass disc with AR-coating	
thickness	2,5 ± 0,1 mm
refractive index	1,52

® Registered Trade Mark for television camera tube.

				notes
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	

The heater current and heater voltage must never exceed 150 mA r.m.s. and 9,5 V r.m.s.
For optimum performance (lifetime and registration stability) use a stabilized supply.

INTER-ELECTRODE CAPACITANCE

→ Signal electrode to any other contact	C_{as}	typ.	1,5 pF	25

This capacitance increases slightly when the tube is inserted in the coil unit AT1109/10.

DEFLECTION	magnetic	6
FOCUSING	magnetic	6

ACCESSORIES

Socket	type 56049
Deflection and focusing coil unit,	type AT1109/10 or equivalent
Mask for reduction of flare	type 56030

ELECTRON GUN CHARACTERISTICS

Cut-off				
Grid 1 voltage for cut-off at V_{g2} = 300 V without blanking	V_{g1}		−10 to 0 V	
Grid 1 voltage for normal beam current	V_{g1w}	⩽	15 V	7
Blanking voltage with respect to V_{g1W}, peak to peak				
on grid 1	$V_{g1\,p\text{-}p}$		25 V	
on cathode	$V_{k\,p\text{-}p}$		25 V	
Grid 1 current at normally required beam currents	I_{g1}	⩽	1,5 mA	7
Grid 2 current at normally required beam currents	I_{g2}	⩽	0,1 mA	7

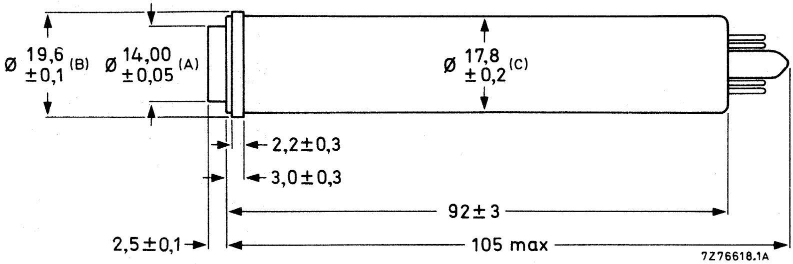
LIMITING VALUES (Absolute maximum rating system)

All voltages are referred to the cathode, unless otherwise stated

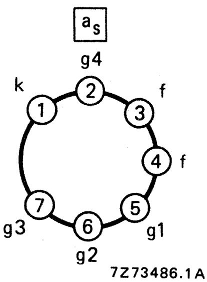
					notes
Signal electrode voltage	V_{as}	max.	50	V	8
Grid 4 voltage	V_{g4}	max.	1000	V	
Grid 3 voltage	V_{g3}	max.	750	V	
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	400	V	
Grid 2 voltage	V_{g2}	max.	350	V	
Grid 1 voltage, positive	V_{g1}	max.	25	V	
Grid 1 voltage, negative	$-V_{g1}$	max.	200	V	
Grid 1 current ($\approx I_K$ current)	I_{g1}	max.	5	mA	9
Grid 1 current (peak current with D.B.C.)	I_{g1p}	max.	8	mA	2
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	
External resistance between cathode and heater at $V_{kf\,p} > 10$ V	R_{kf}	max.	2	kΩ	
Ambient temperature, storage and operation	T_{amb}	max. min.	50 −30	°C °C	10
Faceplate temperature, storage and operation	T	max. min.	50 −30	°C °C	
Faceplate illuminance (intermittent)	E	max.	500	lx	11

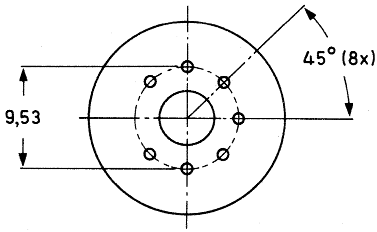
MECHANICAL DATA

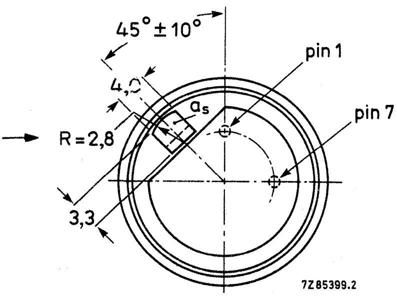
Dimensions in mm

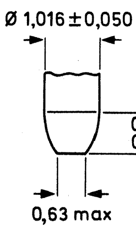


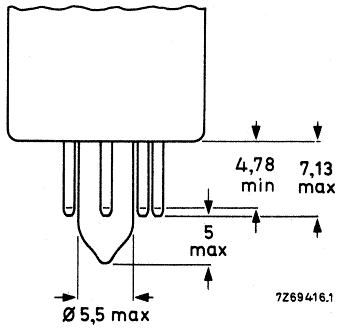
The distance between the geometrical centres of diameters A (anti-halation disc), B (metal ring), and the geometrical centre of diameter C (tube envelope) is ⩽ 200 μm.











Mounting position: any

Mass: ≈ 23 g

Base: EIA E7-91

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 mm x 8,8 mm — notes 12

Conditions

					notes
Cathode voltage	V_k		0	V	
Signal electrode voltage	V_{as}		45	V	8
Beam current	I_b				7,13
		low-voltage mode	high-voltage mode		
Grid 4 voltage	V_{g4}	500	750	V	
Grid 3 voltage	V_{g3}	285	430	V	14,15
Grid 2 voltage	V_{g2}	300	300	V	
Grid 1 voltage	V_{g1}				7,13
Blanking voltage on grid 1, peak to peak	$V_{g1\ p\text{-}p}$		25	V	
Focusing coil current					16
Deflection current, alignment					16
Faceplate illuminance	E				17
Faceplate temperature	T		20 to 45	°C	

Performance

						notes
Dark current			$\leqslant$ 1,0		nA	
Sensitivity at colour temperature of illuminance = 2856 K						18
XQ3427	min.	275	typ.	320	μA/lmF	
XQ3427R	min.	80	typ.	100	μA/lmF	
XQ3427G	min.	95	typ.	125	μA/lmF	
XQ3427B	min.	35	typ.	38	μA/lmF	
Gamma of transfer characteristic			0,95 + 0,05			19
Spectral response:						
max. response at			≈	500	nm	
cut-off XQ3427R			≈	850	nm	20
cut-off XQ3427, XQ3427G			≈	650 to 850	nm	20
cut-off XQ3427B			≈	650	nm	
response curves			see Figs 1, 2 and 3			

Resolution — notes

Modulation depth, i.e. uncompensated amplitude response at 400 TV lines at the centre of the picture. The figures shown represent the amplitude response of the tubes operated in low and high-voltage mode respectively. 21

		XQ3427	XQ3427R	XQ3427G	XQ3427B
Highlight signal current	I_s	200 nA	150 nA	200 nA	150 nA
Beam current	I_b	400 nA	300 nA	400 nA	300 nA
Modulation depth at 400 TV lines (5 MHz) in %					
low-voltage mode	typ.	45	43	45	50
	min.	40	38	40	45
high-voltage mode	typ.	50	48	50	55
	min.	45	43	45	50

Modulation transfer characteristics (high voltage mode) — see Fig. 6

Lag (typical values, no light bias applied)

Light source with a colour temperature of 2856 K

Appropriate filter inserted in light path 18

Low key conditions (percentages) — 13,22 23

	build-up lag				decay lag			
	$I_s I_b$ = 20/400 nA		I_s/I_b = 20/300 nA		I_s/I_b = 20/400 nA		I_s/I_b = 20/300 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ3427 XQ3427G	90	≈ 100			10	4		
XQ3427R			95	≈ 100			9	3,5
XQ3427B			95	≈ 100			9	3,5

High-key conditions (percentages) — 13,22 23

	build-up lag				decay lag			
	I_s/I_b = 200/400 nA		I_s/I_b = 150/300 nA		I_s/I_b = 200/400 nA		I_s/I_b = 150/300 nA	
	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms	60 ms	200 ms
XQ3427 XQ3427G	98	≈ 100			2	0,5		
XQ3427R XQ3427B			98	≈ 100			2,5	0,5

Highlight handling capability with D.B.C. 24

NOTES

1. "Diode" gun is a triode gun operating in a diode mode, providing a very high beam reserve. Since the "Diode" gun operates with a positive grid 1 voltage, causing some grid current, cameras designed around XQ1427 tubes will require modification.

   Warning

   Avoid continuous operation at high beam currents since this will shorten tube life. Full advantege of the high beam reserve to reduce comet-tailing and blooming can be made with D.B.C. circuitry which, during highlights, feeds positive-going pulses derived from the video signal, to grid 1 to increase the beam current momentarily.

2. The "Diode" gun operates with a positive ($\leqslant$ 15 V) grid 1 voltage (adjusted for correct beam settings, see note 7), hence draws some grid 1 current:
   without D.B.C.: $\leqslant$ 1,5 mA (peak) with blanking
   with D.B.C.: $\leqslant$ 8 mA (peak) with blanking measured with an oscilloscope

   The D.B.C. circuitry should, in the case of highlights, supply positive-going pulses of 10 V above V_{g1w} (see note 7) and up to 10 mA peak to grid 1.

   N.B. Applying higher pulses than 10 V is not recommended since this will shorten tube life, impair resolution and may introduce oscillations.

3. Adjustment to be done in overscan mode.

4. ENG = Electronic News Gathering.
   EFP = Electronic Field Production.

5. Underscanning the 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.

6. For focusing/deflection coil unit see under Accessories.

7. Beam currents as required for one stop over normal peak white.

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

   N.B. To prevent permanent damage or destruction of the target, when the tube is used in a camera originally designed for vidicons, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to 45 V.

9. Peak value measured with an oscilloscope.

10. Short temperature excursions up to 70 °C during operation are allowed.

11. During storage, cover the tube face with the plastic hood provided; when the camera is idle, cap the lens. In stand-by also the beam should be cut-off.

12. The operating conditions and performance quoted in these data relate to operation in the coil unit AT1109/10.

13. The beam current I_b, as obtained by adjusting the control grid voltage (grid 1) is set at 300 nA for R and B tubes, 400 nA for black/white, and G tubes. I_b is not the total current available in the scanning beam, but is the maximum 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 an 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.)

NOTES (continued)

14. The optimum voltage ratio V_{g4}/V_{g3} to minimize beam landing errors (preferably $\leqslant$ 1 V) depends on the type of coil unit used. In the coil unit: AT1109/10 a ratio of 1,74 is required.
15. Voltage setting for high-voltage mode for optimum resolution:
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 ^{o}C, which would otherwise affect tube performance and life (see also General operational notes Plumbicon tubes, paragraph 1,8).
16. See published data of deflection/focusing assemblies.
N.B. The polarity of the focusing coil current should be such that its image end attracts an external north-seeking pole.
17. 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 light transmission;
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.

18. Measuring conditions.
Illuminance level $\approx$ 10,5 lx (luminous flux at scanned area $\approx$ 0,5 mlm) at a colour temperature of 2856K. Filters are inserted in the light path for the chrominance tubes.
Filters used for
XQ3427R: B_1/K_1 and Schott OG570, 3 mm
XQ3427G: B_1/K_1 and Schott VG9, 1 mm
XQ3427B: Schott BG, 12,3 mm
19. Gamma stretching circuitry is recommended.
20. 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 in combination with a heat reflecting interference filter B_1/K_1 (Fig. 5) should be incorporated in the optical system.
21. As measured with a 50 mm Leitz Summicron lens having a sine response of approx. 80% at 30 lp/mm (400 TV lines at 6,6 mm x 8,8 mm) at f : 5,6.
The horizontal amplitude response can be raised by means of suitable correction circuits, which affect neither the vertical resolution nor the limiting resolution.
22. *Build-up lag:* After 10 s of darkness: The figures are typical percentages of the ultimate signal current obtained 60 ms and 200 ms, respectively, after introduction of the illuminance.
Decay lag: 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 and 200 ms, respectively, after removal of the illuminance.
23. A reduction of lag, especially under low key conditions is obtained when lightbias (up to 5 nA_p) is applied via the optical system. Infrared light with a wavelength > 600 nm in the light bias should be avoided.

24. a. With D.B.C. applied (see note 2) the tube will properly handle highlights with a diameter of 10% of picture height and with a brightness corresponding to 16 times peak signal white, I_{sp}.
    b. The maximum peak signal currents in the case of highlights will be 2,5 μA. Video preamplifiers should be designed to accommodate these.
25. Metal ring not electrically connected.

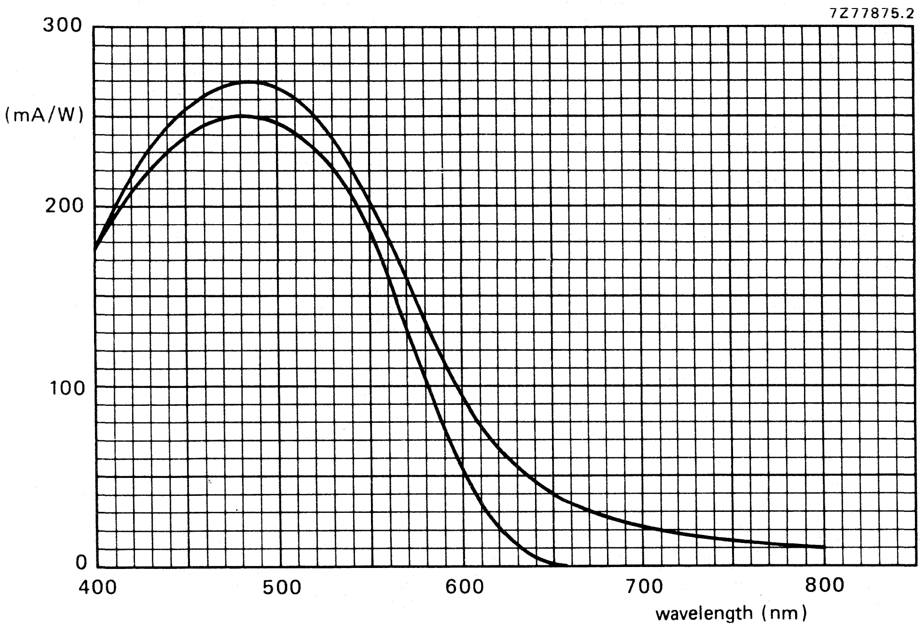


Fig. 1 Typical spectral responses for XQ3427G.

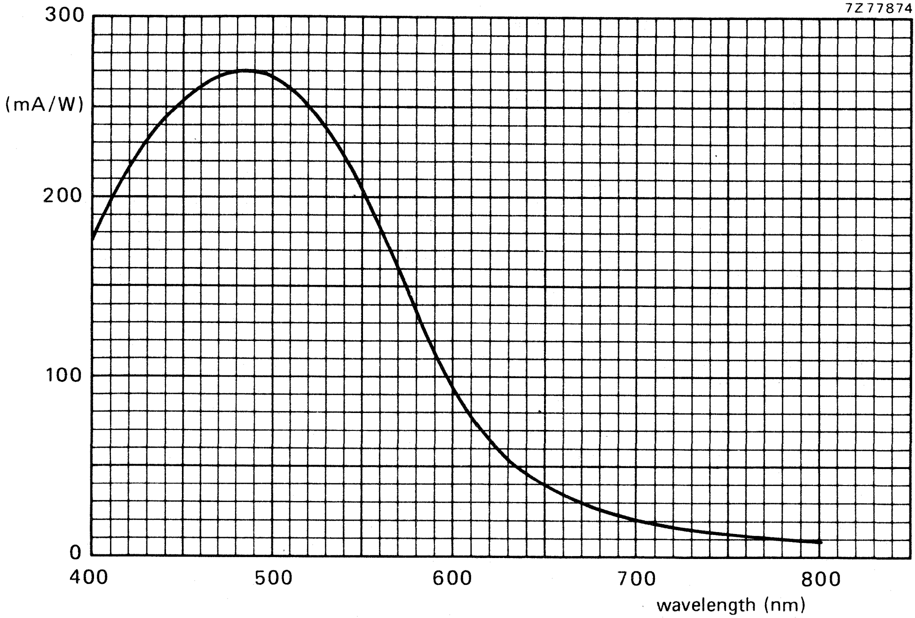


Fig. 2 Typical spectral response curve of XQ3427R.

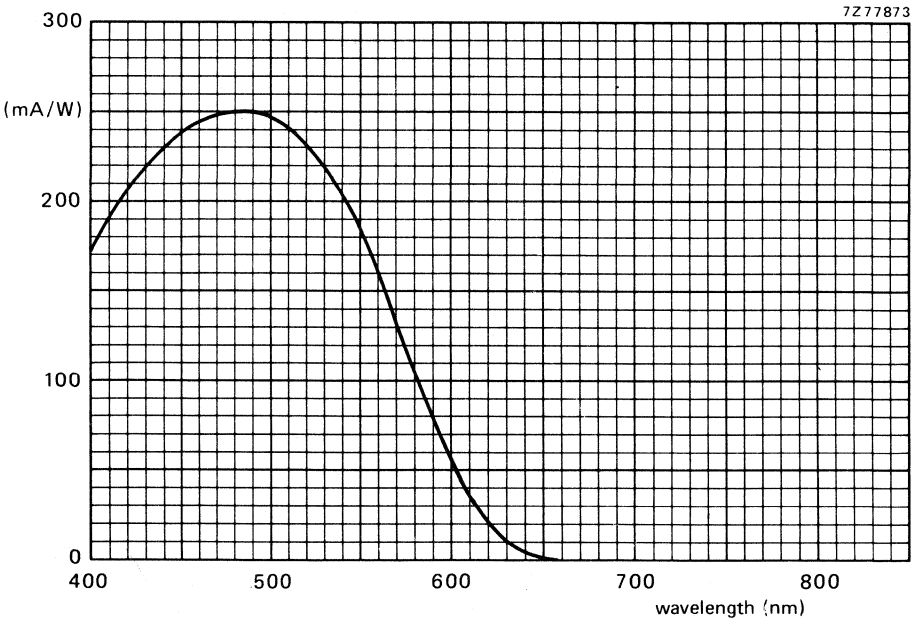


Fig. 3 Typical spectral response curve XQ3427B.

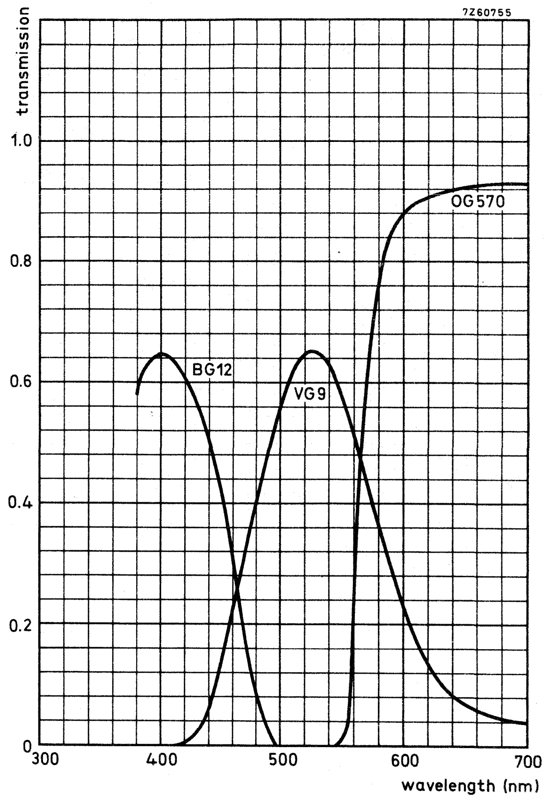


Fig. 4 Transmission of filters BG12, VG9, and OG570.

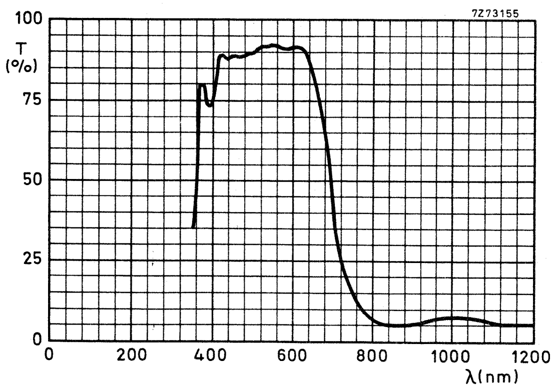


Fig. 5 Typical transmission curve of heat reflecting interference filter CALFLEX B1/K1.

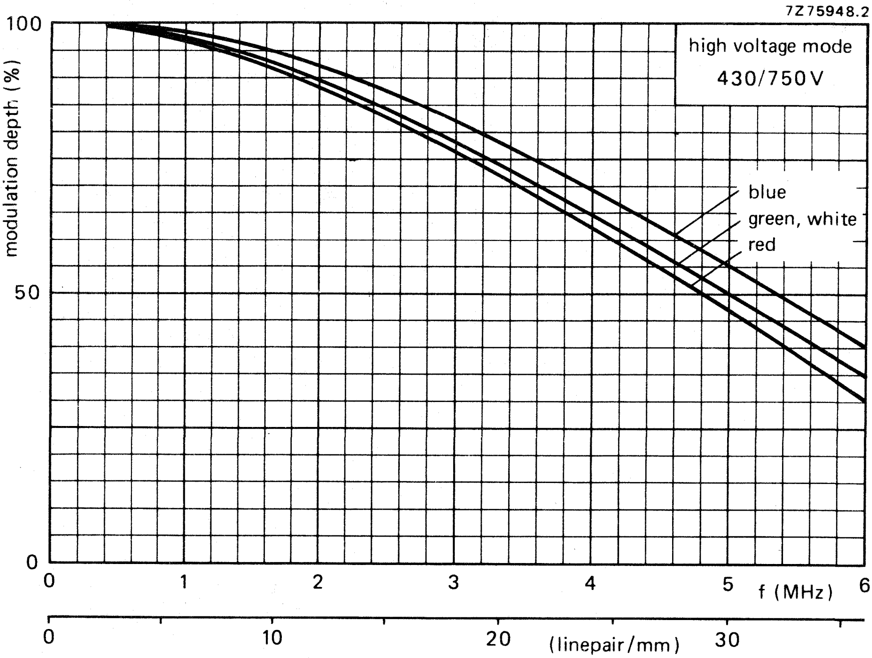


Fig. 6 Typical square-wave response curves.

NEWVICON TUBES F

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	application MS
XQ1440	S	Nw	•	•	•
XQ1442*	S	Nw		•	•
XQ1443**	S	Nw		•	•
XQ1444▲	S	Nw		•	•

* Fibre-optic faceplate
** Extended near IR response
▲ Radiation resistent faceplate

2/3 inch - magnetic focusing and deflection

type	mesh	photo-conductive layer	HI	Ind	MS
XQ1274	S	Nw	•	•	•
XQ1276**	S	Nw		•	•
XQ1380▲	S	Nw		•	•

2/3 inch - electrostatic focusing and magnetic deflection

type	mesh	photo-conductive layer	HI	Ind	MS
XQ1275	S	Nw	•	•	•
XQ1277▲▲	S	Nw		•	•
XQ1278▲▲	S	Nw	•	•	•
XQ1381▲	S	Nw		•	•

▲▲ Bipotential electrostatic focusing lens

Accessories for Newvicon tubes

type	deflection (and focusing) coil units	sockets
XQ1440, XQ1442, XQ1443 XQ1444	AT1102/01, KV9G AT1116/06S or equivalent	56098 or equivalent
XQ1274, XQ1276, XQ1380 XQ1275, XQ1277, XQ1278, XQ1381	KV12S or equivalent KV19G or equivalent	56049 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.

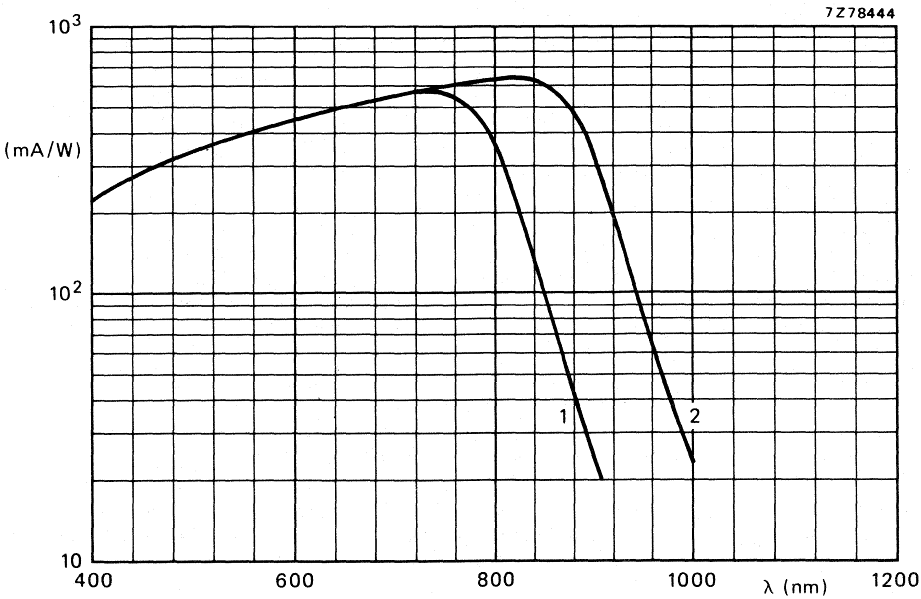


Fig. 1 Typical Newvicon spectral response curves. Curve 1: XQ1274, XQ1275, XQ1278, XQ1380, XQ1381, XQ1440, XQ1442, XQ1444. Curve 2: XQ1276, XQ1277, XQ1443.

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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 °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 °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 as printed on the envelope (E_{sj} = . . . V).

The signal electrode voltage should be adjusted within an accuracy of ±2 V; the voltage drop across R_l should be kept small. 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 150 nA;
- 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 °C, neither during operation nor storage. Whilst dark current doubles at every 7 to 8 °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	max.	108 mm
Special response, max. at	approx.	750 nm
cut-off at	approx.	900 nm
Heater		6,3 V, 95 mA
Limiting 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 pin 4.

Spectral response, curve see Fig. 1

Faceplate
- thickness — 1,5 mm
- refractive index — 1,61

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.

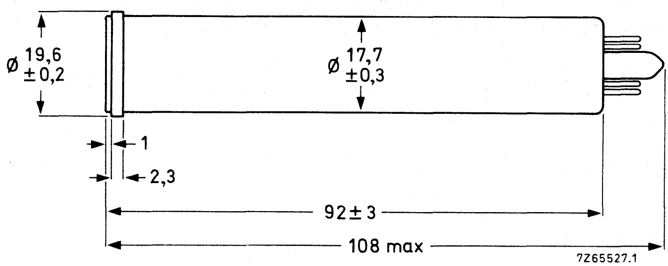
CAPACITANCES

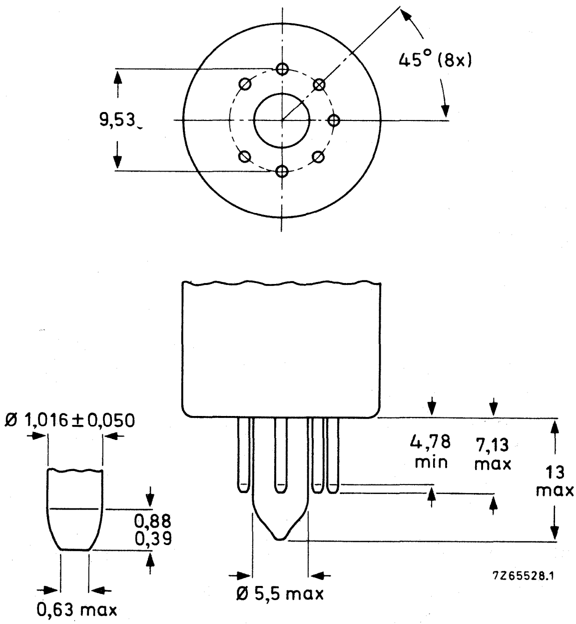
Signal electrode to all	C_{as}	≈	2 pF

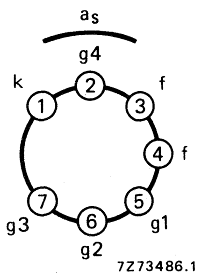
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

MECHANICAL DATA

Dimensions in mm







Mounting position: any

Net mass: ≈ 23 g

Base: JEDEC no. 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 maximum 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
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.	800	nA**
Faceplate illumination	E	max.	10 000	lx ▲
Faceplate temperature, storage and operation	T	max.	70	^{o}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 also General Operational Notes.

** 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 6,6 mm x 8,8 mm, a faceplate temperature of 25 to 35 °C and standard TV scanning rate

Conditions			notes
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	
Grid 1 voltage for picture cut-off (no blanking applied)	V_{g1}	–80 to –35 V	
Blanking voltage, peak to peak			
when applied to grid 1		75 V	
when applied to cathode		20 V	
Flux density at centre of focusing coil		5,0 to 5,6 mT	
Flux density of adjustable alignment coils or magnets		0 to 0,4 mT	

Performance		min.	typ.	max.		notes
Dark current (at 25 °C)			3	6	nA	
Signal current, white light faceplate illumination 1 lx c.t. 2856 K	I_s	200	260		nA	
Decay: residual signal current 60 ms after cessation of the illumination initial signal current 200 nA			8	13	%	
Limiting resolution, at picture centre		550	650		TV lines	4
at picture corners		350	450		TV lines	4
Average γ of transfer characteristic, see Fig. 2			≈ 1			
Spurious signals (spots and blemishes)						5

Notes

1. The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer as printed on the envelope (E_{sj} = . . . V). To minimize picture sticking effects the signal electrode should be adjusted with an inaccuracy of ± 2 V; the voltage drop across R_l should be kept small. 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 EIA resolution test chart; faceplate illumination adjusted for a peak output current of 200 nA.
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 200 nA 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 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 0,8	none	1
⩽ 0,8 to 0,4	4	5
⩽ 0,4 to 0,2	5	5
⩽ 0,2	*	*
total (max.)	5	7

* 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%.

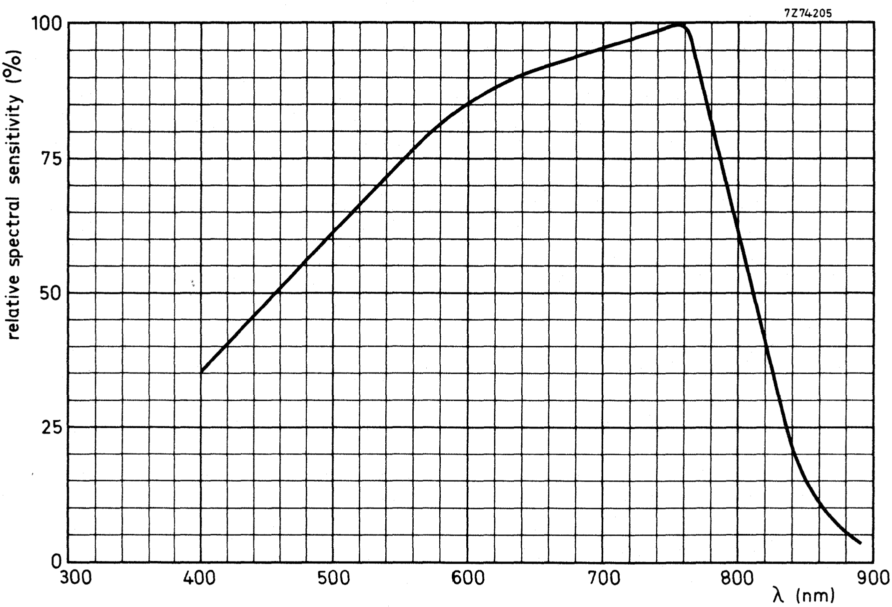


Fig. 1 Typical spectral response curve.

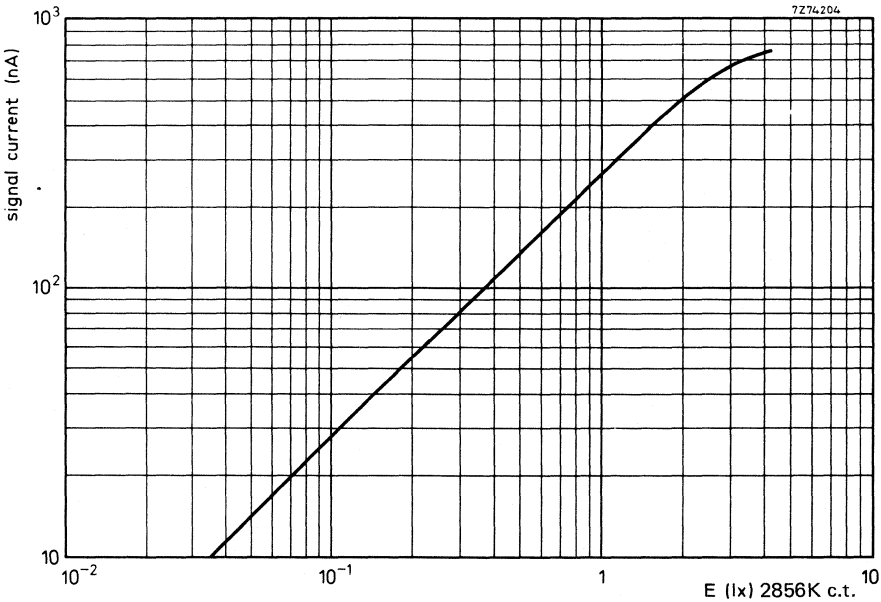


Fig. 2 Typical light transfer characteristic.

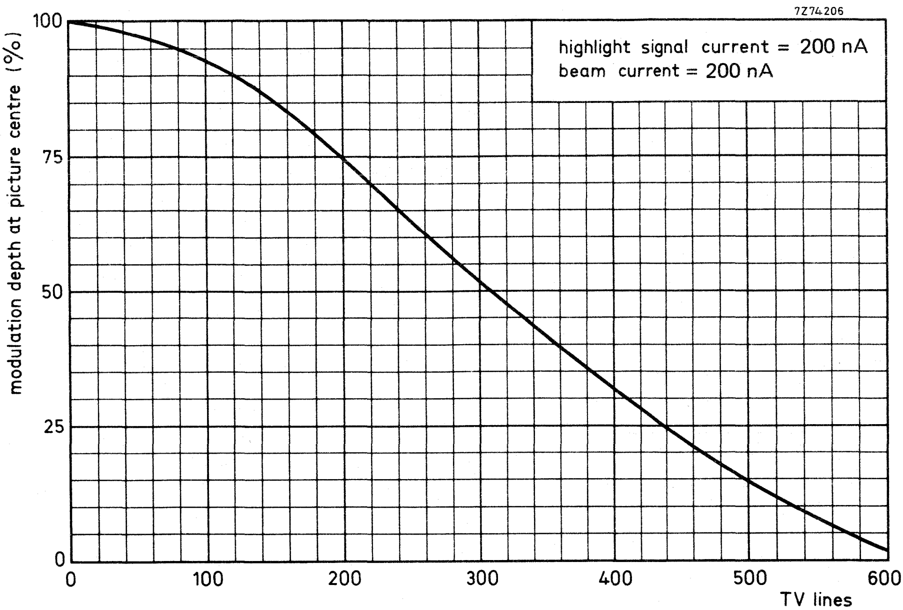


Fig. 3 Typical uncompensated square wave response curve.

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	max.	108 mm
Spectral response, max. at	approx.	750 nm
cut-off at	approx.	900 nm
Heater		6,3 V, 95 mA
Limiting 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

Faceplate	
thickness	1,5 mm
refractive index	1,61

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.

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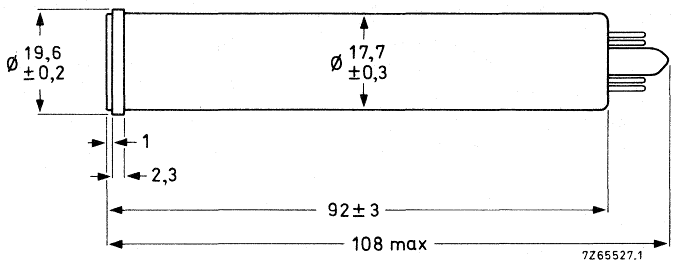
CAPACITANCES

Signal electrode to all	C_{as}	$\approx$ 2 pF

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

MECHANICAL DATA Dimensions in mm



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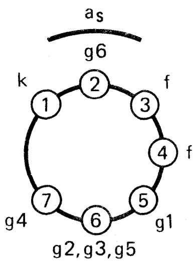

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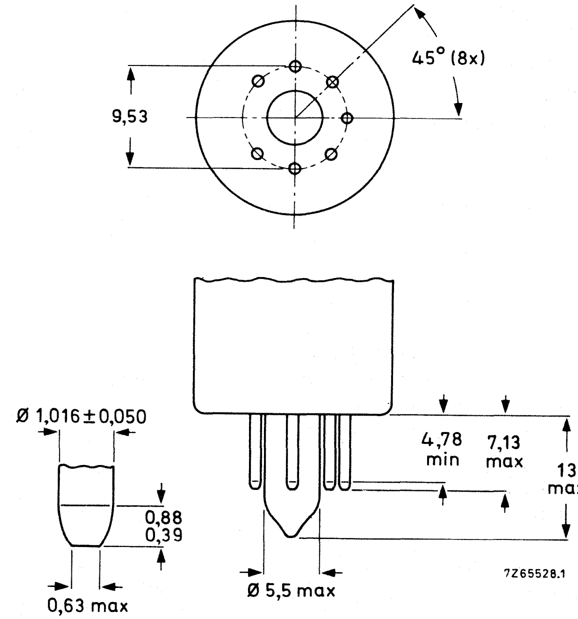


7Z65528.1

Mounting position: any

Net mass: ≈ 25 g

Base: JEDEC no. E7-91

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection coil unit	KV19G or equivalent

DEFLECTION magnetic

FOCUSING electrostatic (unipotential focusing electron optics)

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 6 voltage	V_{g6}	max.	600	V
Grid 4 (beam focus electrode) voltage	V_{g4}	max.	350	V
Grid 2, 3 and 5 voltage	$V_{g2,3+5}$	max.	350	V
Grid 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.	800	nA**
Faceplate illumination	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 in the test sheet. See General Operational Notes.

** 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 6,6 mm x 8,8 mm, a faceplate temperature of 25 to 35 °C and standard TV scanning rate.

Conditions

				notes
Signal electrode voltage	V_{as}	10 to 25	V	1
Grid 6 (decelerator) voltage	V_{g6}	500	V	2
Grid 4 (beam focus electrode) voltage	V_{g4}	35 to 55	V	3
Grid 2, 3 and 5 voltage	V_{g2+3+5}	300	V	2,4
Grid 1 voltage for picture cut off (no blanking applied)	V_{g1}	−80 to −30	V	
Blanking voltage, peak to peak				
when applied to grid 1		75	V	
when applied to cathode		20	V	
Flux density of adjustable alignment coil or magnet		0 to 0,4	mT	

Performance

		min.	typ.	max.		notes
Dark current (at 25 °C)			3	6	nA	
Signal current, white light faceplate illumination 1 lx c.t. 2856 K	I_s	200	260		nA	
Decay: residual signal current 60 ms after cessation of the illumination initial signal current 200 nA			10	15	%	
Limiting resolution,						
at picture centre		500	600		TV lines	5
at picture corners		350	450		TV lines	5
Average γ of transfer characteristic, see Fig. 2			≈ 1			
Spurious signals (spots and blemishes)						6

Notes

1. The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer as printed on the envelope (E_{sj} = . . . V). To minimize picture sticking effects the signal electrode should be adjusted with an inaccuracy of ± 2 V; the voltage drop across R_l should be kept small. In the case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.
2. Grid 6 voltage must always be higher than grids 2 + 3 + 5 voltage.
   The recommended ratio of grid 6 voltage to grids 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 type (see "Accessories").
3. Adjusted for correct electrical focus.
4. Grids 2 + 3 + 5 voltage should be > 250 V to provide sufficient beam current.
5. On EIA resolution test chart: faceplate illumination adjusted for a peak output current of 200 nA. The resolution is highly dependent on the coil used; the indicated figures are only valid for the recommended coil.
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 200 nA 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 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 0,8	none	1
≤ 0,8 to 0,4	4	5
≤ 0,4 to 0,2	5	5
≤ 0,2	*	*
total (max.)	5	7

* 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%.

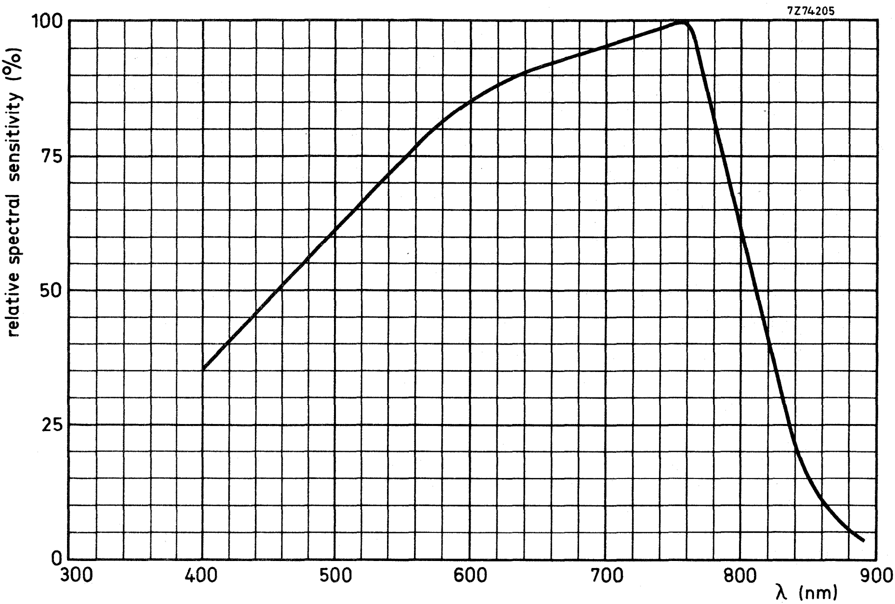


Fig. 1 Typical spectral response curve.

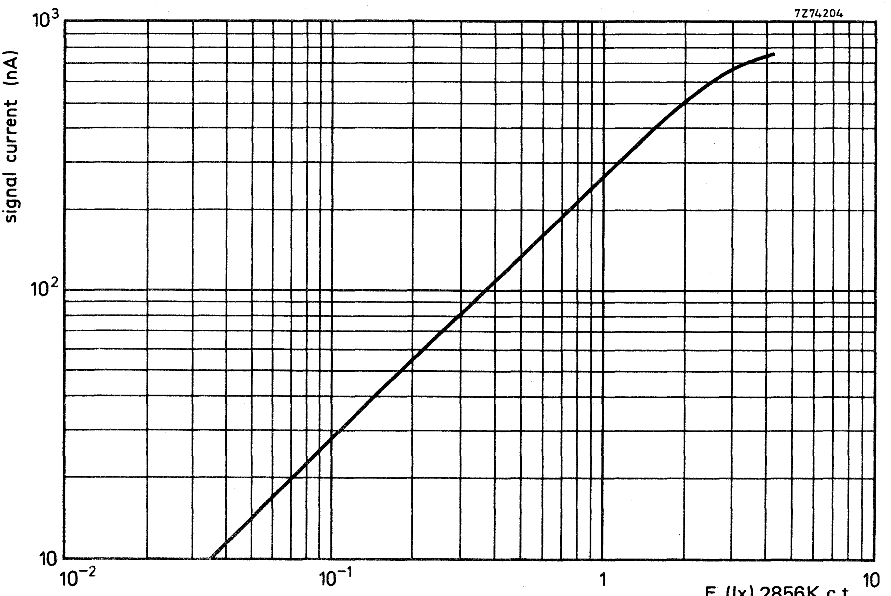


Fig. 2 Typical light transfer characteristic.

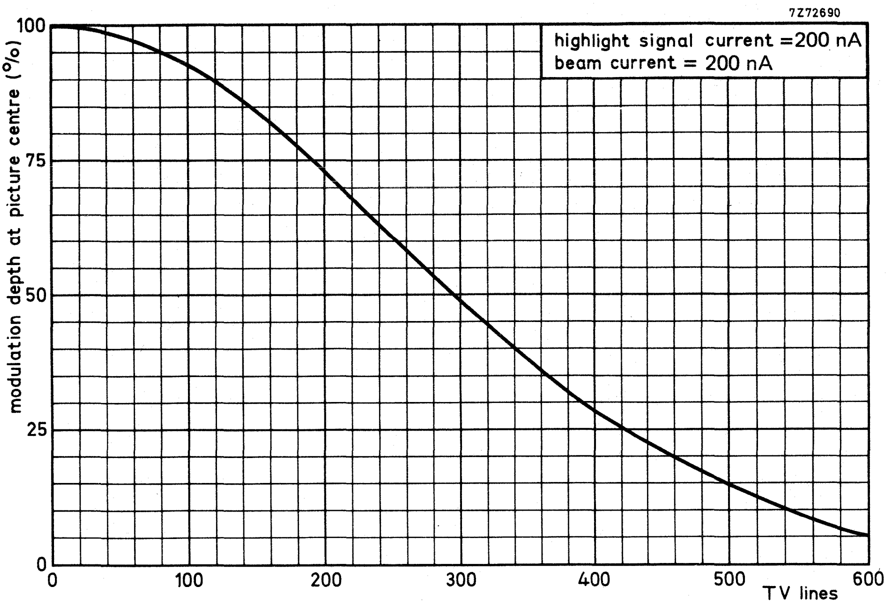


Fig. 3 Typical uncompensated square wave response curve.

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	max.	108 mm
Spectral response, max. at	approx.	775 nm
cut-off at	approx.	1000 nm
Heater		6,3 V, 95 mA
Limiting 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 pin 4.

Spectral response curve see Fig. 1.

Face plate

thickness	1,5 mm
refractive index	1,61

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.

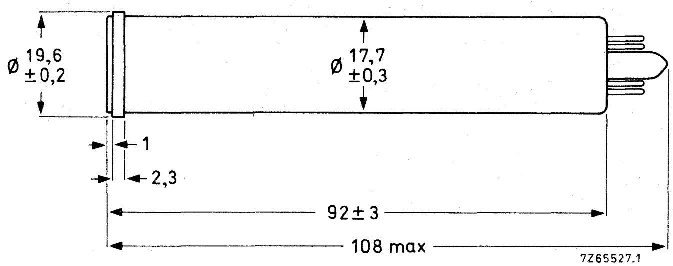
CAPACITANCES

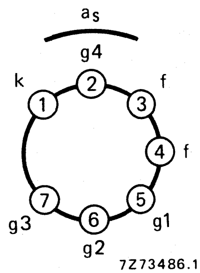
Signal electrode to all C_{as} ≈ 2 pF

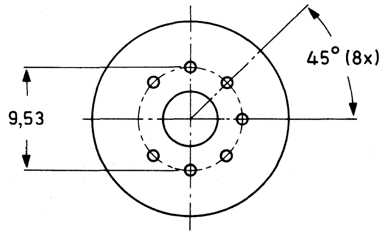
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

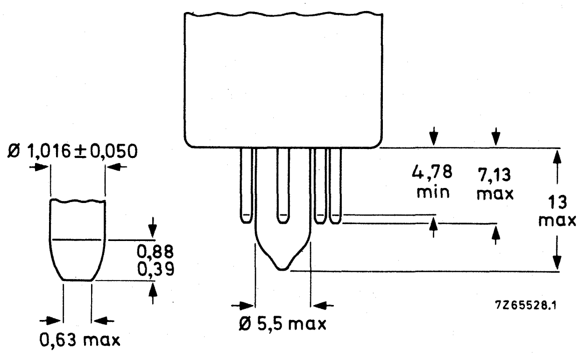
MECHANICAL DATA

Dimensions in mm









Mounting position: any

Net mass: ≈ 23 g

Base: JEDEC no. 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 maximum 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
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.	800	nA**
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. See General Operational Notes.

** 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 6,6 mm x 8,8 mm, a faceplate temperature of 25 to 35 °C and standard TV scanning rate.

Conditions

			notes
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	
Grid 1 voltage for picture cut-off (no- blanking applied)	V_{g1}	–80 to –35 V	
Blanking voltage, peak to peak			
when applied to grid 1		75 V	
when applied to cathode		20 V	
Flux density at centre of focusing coil		5,0 to 5,6 mT	
Flux density of adjustable alignment coil or magnet		0 to 0,4 mT	

Performance

		min.	typ.	max.		notes
Dark current (at 25 °C)			5	10	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 initial signal current 200 nA			8	13	%	
Limiting resolution, at picture centre		550	650		TV lines	4
at picture corners		350	450		TV lines	4
Average γ of transfer characteristic, see Fig. 3			≈ 1			
Spurious signals (spots and blemishes)						5

Notes

1. The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer 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; the voltage drop across R_l should be kept small. 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 EIA resolution test chart; faceplate illumination adjusted for a peak output current of 200 nA.
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 200 nA 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 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 0,8	none	1
⩽ 0,8 to 0,4	4	5
⩽ 0,4 to 0,2	5	5
⩽ 0,2	*	*
total (max.)	5	7

* 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%.

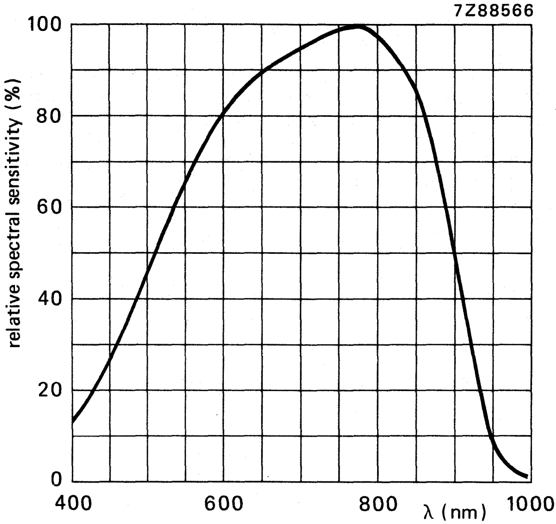


Fig.1 Typical spectral response curve.

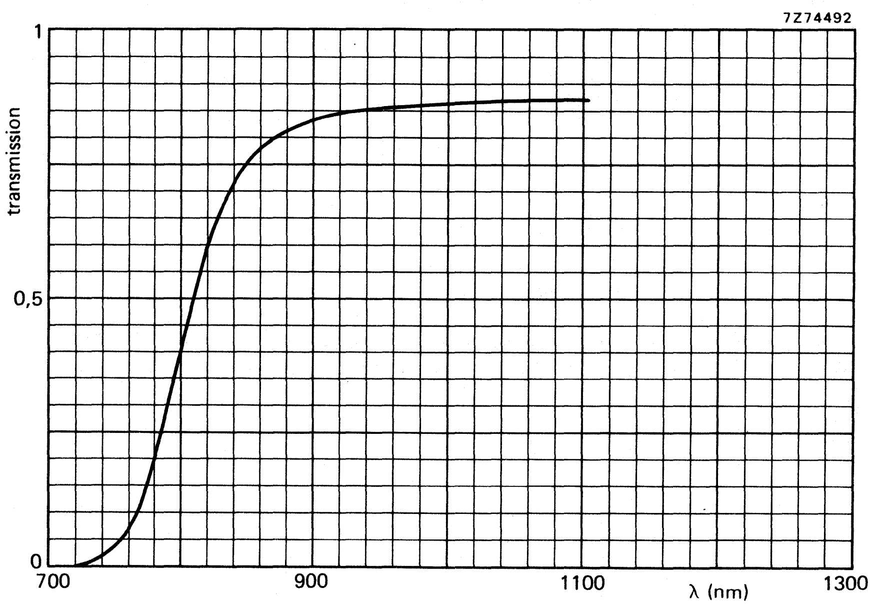


Fig.2 Transmission curve of infrared filter.

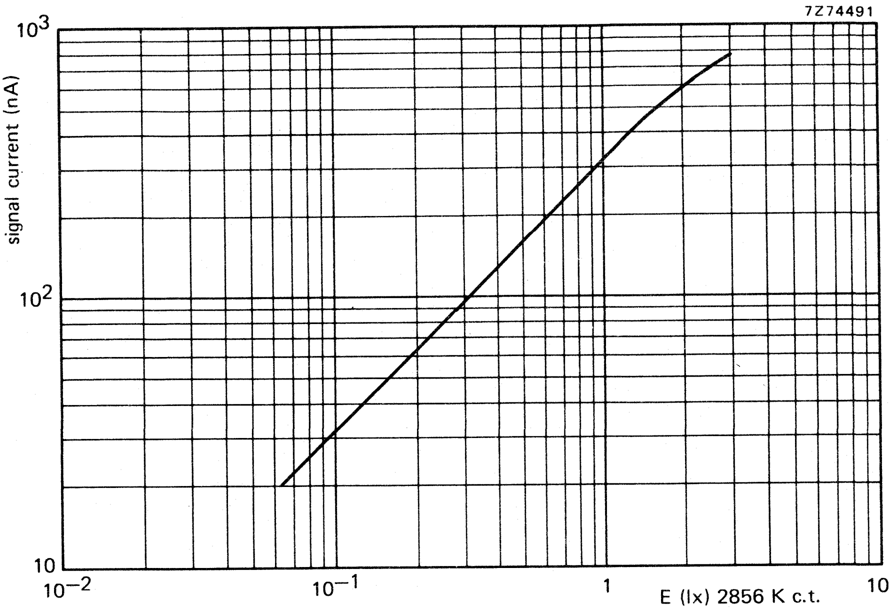


Fig.3 Typical light transfer characteristic.

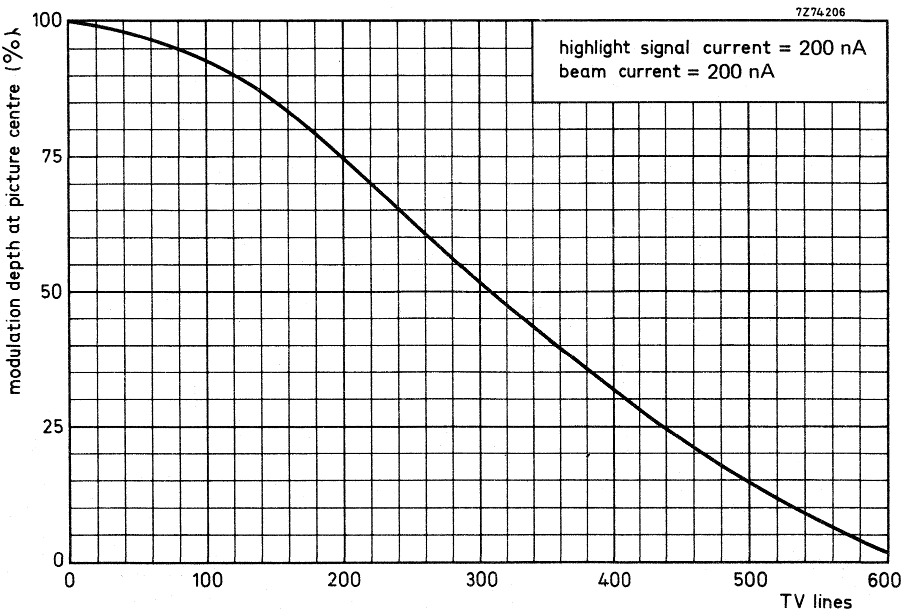


Fig.4 Typical uncompensated square wave response curve.

CAMERA TUBE

NEWVICON® television camera tube with a photoconductive target composed of cadmium and zinc tellurides featuring high resolution and an extremely high sensitivity extending into the near infrared region.

The XQ1277 is a 2/3 in diameter camera tube with low heater power, separate mesh, electrostatic focusing and magnetic deflection and is mechanically interchangeable with vidicons such as XQ1272 and newvicons XQ1275. Pin configuration is similar.

The XQ1277 is intended for use in ultra-compact cameras for security and surveillance applications, for example, where its high sensitivity extending into the near infrared, small size and low power consumption are essential.

QUICK REFERENCE DATA

Separate mesh		
Focusing		electrostatic
Deflection		magnetic
Diameter		17,7 mm
Length	max.	108 mm
Spectral response, max. at	approx.	775 nm
cut-off at	approx.	1000 nm
Heater		6,3 V, 95 mA
Limiting resolution		550 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.

Face plate

thickness	1,5 mm
refractive index	1,61

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.

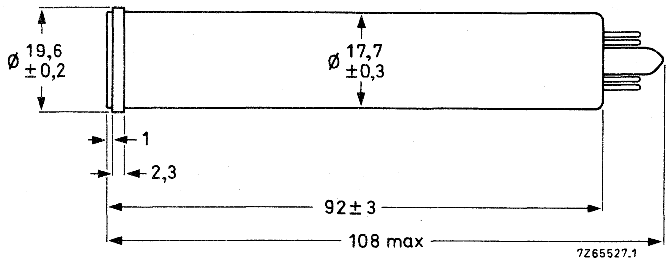
CAPACITANCES

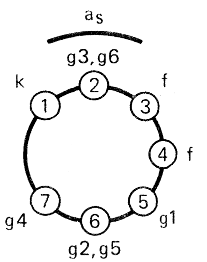
Signal electrode to all $C_{as} \approx 2$ pF

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

MECHANICAL DATA

Dimensions in mm





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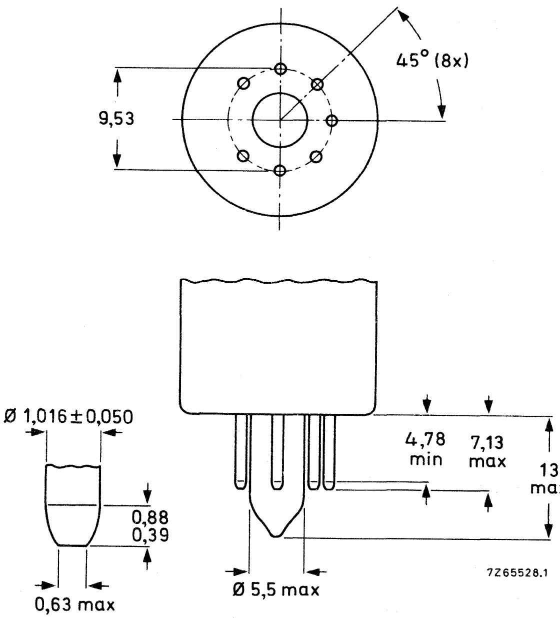


7Z65528.1

Mounting position: any

Net mass: ≈ 25 g

Base: JEDEC no. E7-91

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection coil unit	KV19G or equivalent

DEFLECTION magnetic

FOCUSING electrostatic (bipotential focusing electron optics)

LIMITING VALUES (Absolute maximum 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 3 and 6 voltage	$V_{g3,6}$	max.	750 V
Grid 4 voltage	V_{g4}	max.	350 V
Grid 2 and 5 voltage	$V_{g2,5}$	max.	350 V
Grid 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.	800 nA**
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 on the tube. See General Operational Notes.

** 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 6,6 mm x 8,8 mm, a faceplate temperature of 25 to 35 °C and standard TV scanning rate.

Conditions

			notes
Signal electrode voltage	V_{as}	10 to 25 V	1
Grid 3 and 6 (decelerator) voltage	$V_{g3,6}$	500 V	2
Grid 4 (beam focus electrode) voltage	V_{g4}	60 to 85 V	3
Grid 2 and 5 voltage	$V_{g2,5}$	300 V	2, 4
Grid 1 voltage for picture cut-off (no blanking applied)	V_{g1}	−80 to −30 V	
Blanking voltage, peak to peak			
when applied to grid 1		75 V	
when applied to cathode		20 V	
Flux density of adjustable alignment coils or magnets		0 to 0,4 mT	

Performance

		min.	typ.	max.		
Dark current (at 25 °C)			5	10	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 imposed (transmission curve, see Fig. 2)	I_s	50	80		nA	
Decay: residual signal current 60 ms after cessation of the illumination initial signal current 200 nA			10	15	%	
Limiting resolution						
at picture centre		500	550		TV lines	5
at corner of picture		400	450		TV lines	5
Average γ of transfer characteristic, see Fig. 3			≈ 1			
Spurious signals (spots and blemishes)						6

Notes

1. The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer as printed on the envelope (E_{sj} = . . . V). To minimize picture sticking effects the signal electrode should be adjusted with an inaccuracy of ± 2 V; the voltage drop across R_l should be kept small. In the case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.
2. Grids 3 + 6 voltage must always be higher than grids 2 + 5 voltage.
   The recommended ratio of grids 3 + 6 voltage to grids 2 + 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. This voltage range is higher than that of unipotential electrostatic focus, such as XQ1275.
4. Grids 2 + 5 voltage should be > 250 V to provide sufficient beam current.
5. On EIA resolution test chart: faceplate illumination adjusted for a peak output current of 200 nA. The resolution is highly dependent on the coil used; the indicated figures are only valid for the recommended coil.
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 200 nA 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 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 0,8	none	1
⩽ 0,8 to 0,4	4	5
⩽ 0,4 to 0,2	5	5
⩽ 0,2	*	*
total (max.)	5	7

* 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%.

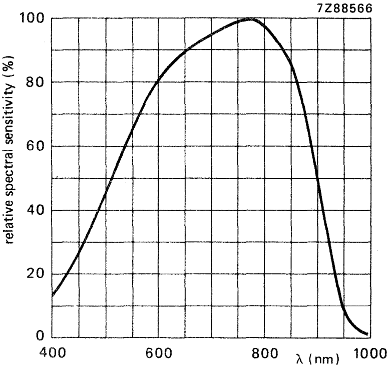


Fig. 1 Typical spectral response curve.

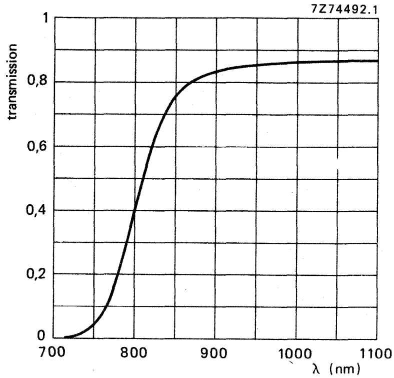


Fig. 2 Transmission curve of infrared filter.

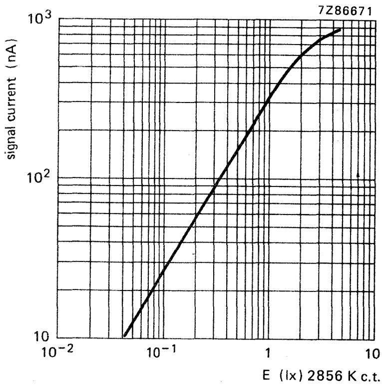


Fig. 3 Typical light transfer characteristic.

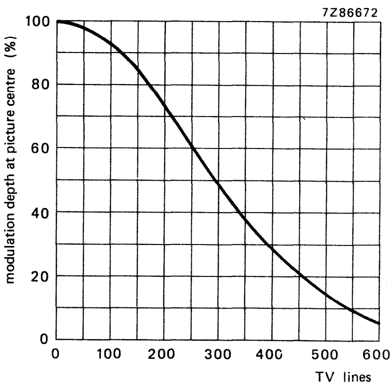


Fig. 4 Typical uncompensated square wave response curve. Highlight signal current 200 nA; beam current 200 nA.

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 XQ1278 is a 2/3 in diameter camera tube with low heater power, separate mesh, electrostatic focusing and magnetic deflection and is mechanically interchangeable with vidicons such as XQ1272 and newvicons XQ1275. Pin configuration is similar.

The XQ1278 is intended for use in ultra-compact cameras for security and surveillance applications, for example, where its high sensitivity, small size and low power consumption are essential.

QUICK REFERENCE DATA

Separate mesh	
Focusing	electrostatic
Deflection	magnetic
Diameter	17,7 mm
Length	max. 108 mm
Spectral response, max. at	approx. 750 nm
cut-off at	approx. 900 nm
Heater	6,3 V, 95 mA
Limiting resolution	550 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.

Face plate	
thickness	1,5 mm
refractive index	1,61

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.

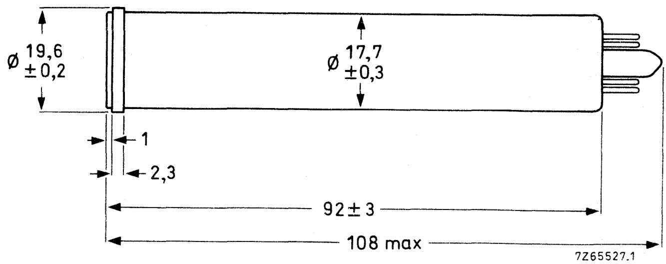
CAPACITANCES

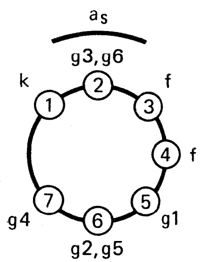
Signal electrode to all $C_{as} \approx 2$ pF

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

MECHANICAL DATA

Dimensions in mm





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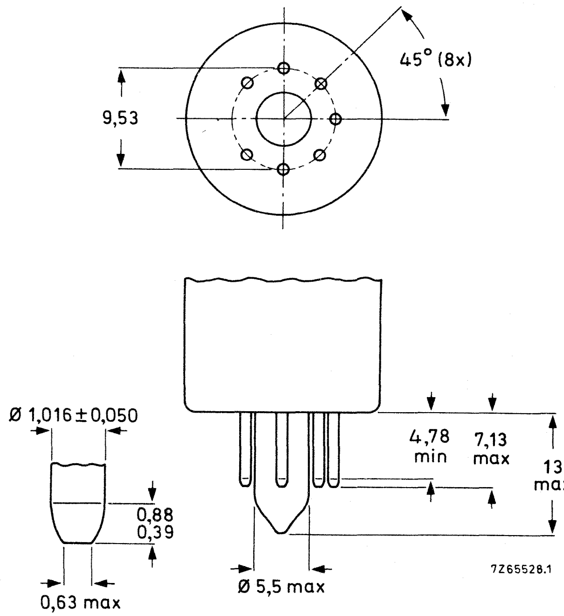


Mounting position: any

Net mass: ≈ 25 g

Base: JEDEC no. E7-91

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection coil unit	KV19G or equivalent

DEFLECTION	magnetic
FOCUSING	electrostatic (bipotential focusing electron optics)

LIMITING VALUES (Absolute maximum 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 3 and 6 voltage	$V_{g3,6}$	max.	750 V
Grid 4 voltage	V_{g4}	max.	350 V
Grid 2 and 5 voltage	$V_{g2,5}$	max.	350 V
Grid 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.	800 nA**
Faceplate illumination	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 on the tube. See General Operational Notes.

** 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 6,6 mm x 8,8 mm, a faceplate temperature of 25 to 35 °C and standard TV scanning rate.

Conditions				notes
Signal electrode voltage	V_{as}	10 to 25	V	1
Grid 3 and 6 (decelerator) voltage	$V_{g3,6}$	500	V	2
Grid 4 (beam focus electrode) voltage	V_{g4}	60 to 85	V	3
Grid 2 and 5 voltage	$V_{g2,5}$	300	V	2, 4
Grid 1 voltage for picture cut-off (no blanking applied)	V_{g1}	−80 to −30	V	
Blanking voltage, peak to peak				
when applied to grid 1		75	V	
when applied to cathode		20	V	
Flux density of adjustable alignment coil or magnet		0 to 0,4	mT	

Performance		min.	typ.	max.		notes
Dark current (at 25 °C)			3	6	nA	
Signal current, white light faceplate illumination 1 lx c.t. 2856 K	I_s	200	260		nA	
Decay: residual signal current 60 ms after cessation of the illumination initial signal current 200 nA			10	15	%	
Limiting resolution,						
at picture centre		500	550		TV lines	5
at corner of picture		400	450		TV lines	5
Average γ of transfer characteristic, see Fig. 2			≈ 1			
Spurious signals (spots and blemishes)						6

Notes

1. The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer as printed on the envelope (E_{sj} = . . . V). To minimize picture sticking effects the signal electrode should be adjusted with an inaccuracy of ± 2 V; the voltage drop across R_l should be kept small. In the case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.
2. Grids 3 + 6 voltage must always be higher than grids 2 + 5 voltage.
   The recommended ratio of grids 3 + 6 voltage to grids 2 + 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. This voltage range is higher than that of unipotential electrostatic focus, such as XQ1275.
4. Grids 2 + 5 voltage should be > 250 V to provide sufficient beam current.
5. On EIA resolution test chart: faceplate illumination adjusted for a peak output current of 200 nA. The resolution is highly dependent on the coil used; the indicated figures are only valid for the recommended coil.
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 200 nA 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 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 0,8	none	1
⩽ 0,8 to 0,4	4	5
⩽ 0,4 to 0,2	5	5
⩽ 0,2	*	*
total (max.)	5	7

* 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%.

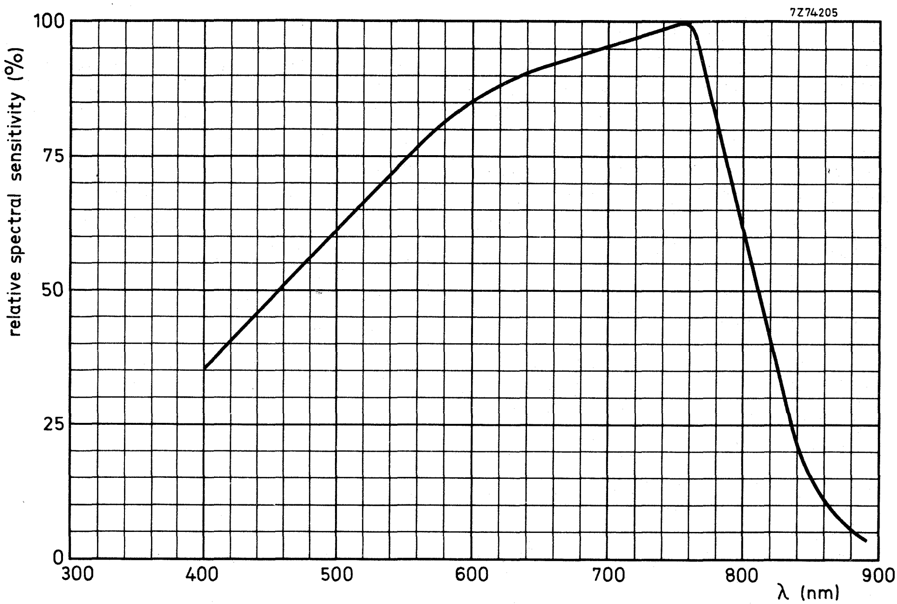


Fig. 1 Typical spectral response curve.

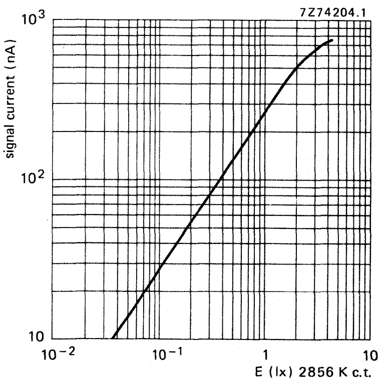


Fig. 2 Typical light transfer characteristic.

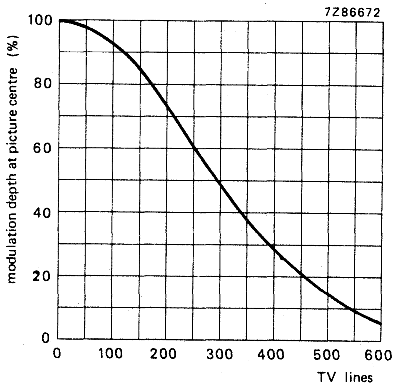


Fig. 3 Typical uncompensated square wave response curve. Highlight signal current 200 nA; beam current 200 nA.

CAMERA TUBE

Newvicon® camera tube, mechanically and electron-optically identical to the XQ1274, the major difference being the radiation resistant (anti-browning) faceplate.

The XQ1380 is intended for use in compact cameras which are subjected to high doses of ionizing radiation.

RADIATION RESISTANT FACEPLATE

The faceplate of the XQ1380 is made of a special type of glass and does not turn brown under the influence of high doses of gamma radiation.

– Maximum dose rate per hour: 5×10^5 Röntgen/hour
– Maximum cumulative dose: 5×10^7 Röntgen
– Maximum decrease of transmission of faceplate:

Maximum decrease	After a cumulative dose of
3%	10^5 Röntgen
10%	10^6 Röntgen
15%	5×10^7 Röntgen

– Maximum increase of dark current at 25 °C after a cumulative dose of 5×10^7 Röntgen: 75%

SENSITIVITY

The typical sensitivity of the XQ1380 is approximately 10% less than for the XQ1274.

For all other information see data of XQ1274.

® Registered Trade Mark for television camera tubes.

CAMERA TUBE

Newvicon® camera tube, mechanically and electron-optically identical to the XQ1275, the major difference being the radiation resistant (anti-browning) faceplate.

The XQ1381 is intended for use in compact cameras which are subjected to high doses of ionizing radiation.

RADIATION RESISTANT FACEPLATE

The faceplate of the XQ1381 is made of a special type of glass and does not turn brown under the influence of high doses of gamma radiation.

- Maximum dose rate per hour: 5×10^5 Röntgen/hour
- Maximum cumulative dose: 5×10^7 Röntgen
- Maximum decrease of transmission of faceplate:

Maximum decrease	After a cumulative dose of
3%	10^5 Röntgen
10%	10^6 Röntgen
15%	5×10^7 Röntgen

- Maximum increase of dark current at 25 °C after a cumulative dose of 5×10^7 Röntgen: 75%

SENSITIVITY

The typical sensitivity of the XQ1381 is approximately 10% less than for the XQ1275.

For all other information see data of XQ1275.

® Registered Trade Mark for television camera tubes.

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		25,9	mm
Length		159	mm
Spectral response, max. at	approx.	750	nm
cut-off at	approx.	900	nm
Heater		6,3 V, 95	mA
Limiting resolution		750	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

Faceplate
- thickness — 2,5 mm
- refractive index — 1,61

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.

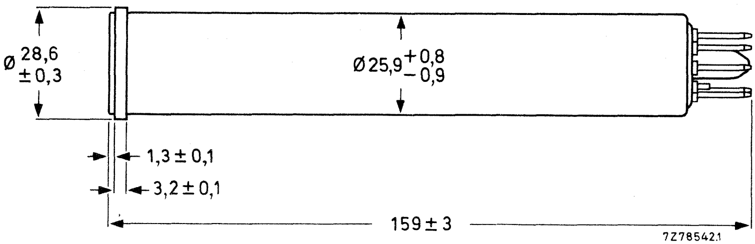
® Registered Trade Mark for television camera tubes.

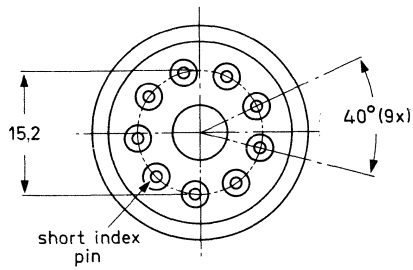
CAPACITANCES

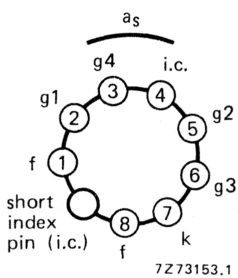
Signal electrode to all C_{as} ≈ 4,6 pF

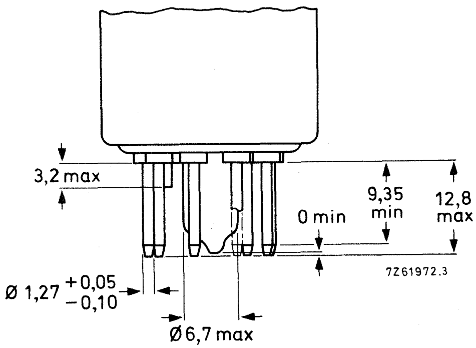
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

MECHANICAL DATA Dimensions in mm









Base: JEDEC no. E8-11

Mounting position: any

Net mass: ≈ 62 g

ACCESSORIES

Socket	56098 or equivalent
Deflection and focusing coil unit	KV9G or equivalent

DEFLECTION

magnetic

FOCUSING

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.

Signal electrode voltage	V_{as}	max.	50	V *
Grid 4 voltage	V_{g4}	max.	1000	V
Grid 3 voltage	V_{g1}	max.	1000	V
Grid 2 voltage	V_{g2}	max.	750	V
Grid 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.	800	nA**
Faceplate illumination	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.

** 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 × 12,8 mm, a faceplate temperature of 25 to 35 °C and standard TV scanning rate.

Conditions

			notes
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	
Grid 1 voltage for pictures cut-off (no blanking applied)	V_{g1}	−100 to −45 V	
Blanking voltage, peak to peak			
when applied to grid 1		75 V	
when applied to cathode		20 V	
Flux density at centre of focusing coil		3,8 to 4,4 mT	
Flux density of adjustable alignment coil or magnet		0 to 0,4 mT	

Performance

		min.	typ.	max.		notes
Dark current (at 25 °C)			4	8	nA	
Signal current, white light 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 200 nA			17		%	
Limiting resolution, at picture centre		650	750		TV lines	4
at picture corners		400	500		TV lines	4
Average γ of transfer characteristic			≈ 1			
Spurious signals (spots and blemishes)						5

Notes

1. The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer 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; the voltage drop across R_l should be kept small. 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 type (see "Accessories").
3. Resolution decreases with decreasing grid 3 voltage. In general grid 3 should be operated above 250 V.
4. On EIA resolution test chart: faceplate illumination adjusted for a peak output current of 200 nA.
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 200 nA 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 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 0,8	none	1
⩽ 0,8 to 0,4	4	5
⩽ 0,4 to 0,2	5	5
⩽ 0,2	*	*
total (max.)	5	7

* 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%.

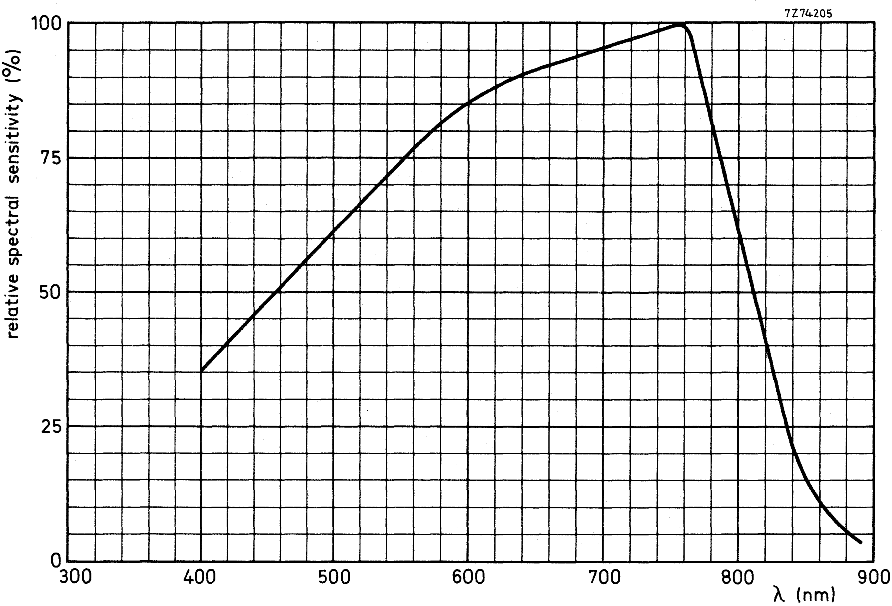


Fig. 1 Typical spectral response curve.

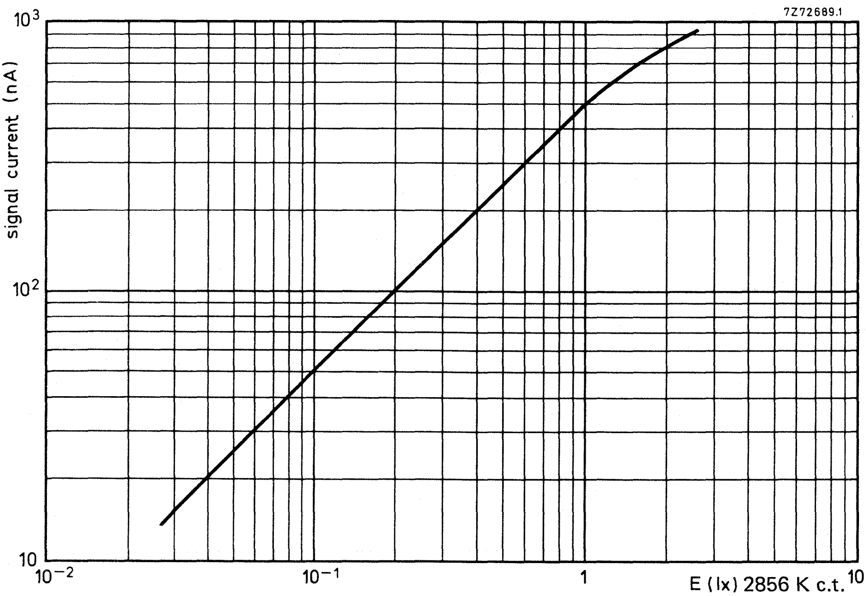


Fig. 2 Typical light transfer characteristic.

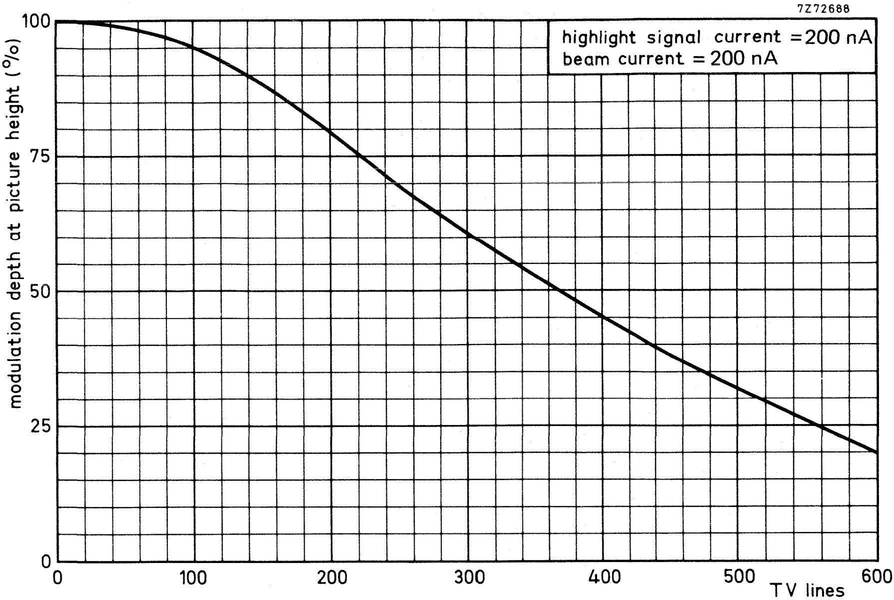


Fig. 3 Typical uncompensated square wave response curve.

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 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		25,9	mm
Length		159	mm
Faceplate		fibre optic	
Spectral response, max. at	approx.	750	nm
cut-off at	approx.	900	nm
Heater		6,3 V, 95	mA
Limiting 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 curve see Fig. 1

Faceplate
- thickness — 3,0 mm
- refractive index — 1,00

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.

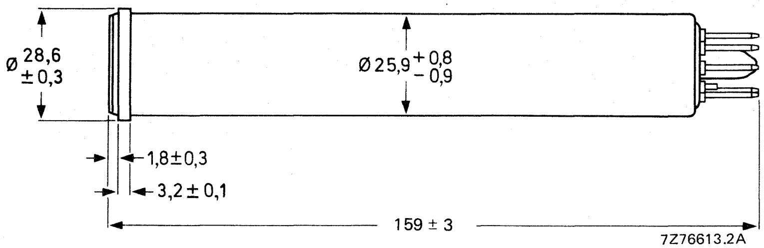
CAPACITANCES

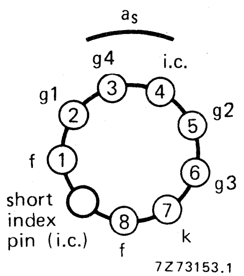
Signal electrode to all $C_{as} \approx 4,6$ pF

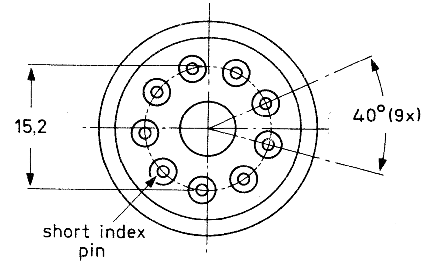
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

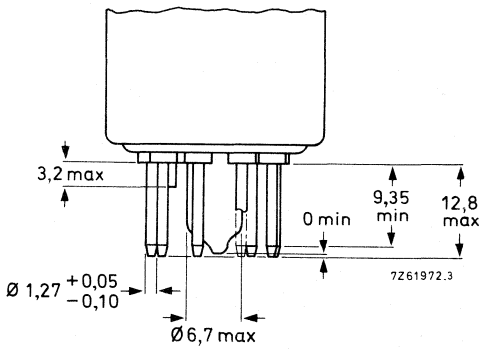
MECHANICAL DATA

Dimensions in mm









Base: JEDEC no. E8-11

Mounting position: any

Net mass: ≈ 62 g

ACCESSORIES

Socket	56098 or equivalent
Deflection and focusing coil unit	KV9G or equivalent

DEFLECTION	magnetic
FOCUSING	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.

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
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	800	nA**
Faceplate illumination	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.

** 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, a faceplate temperature of 25 to 35 °C and standard TV scanning rate.

Conditions

				notes
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	
Grid 1 voltage picture cut-off (no blanking applied)	V_{g1}	−100 to −45	V	
Blanking voltage, peak to peak				
when applied to grid 1		75	V	
when applied to cathode		20	V	
Flux density at centre of focusing coil		3,8 to 4,4	mT	
Flux density of adjustable alignment coil or magnet		0 to 0,4	mT	

Performance

		min.	typ.	max.		notes
Dark current (at 25 °C)			7	16	nA	
Signal current, white light faceplate illuminance 0,5 lx, c.t. 2856 K	I_s	140	180		nA	
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K), initial signal current 200 nA			17	22	%	
Limiting resolution,						
at picture centre		550	650		TV lines	4
at picture corners			450		TV lines	4
Average γ of transfer characteristic			≈ 1			
Spurious signals (spots and blemishes)						5

Notes

1. The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer 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, the voltage drop across R_l should be kept small. 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. Resolution decreases with decreasing grid 3 voltage. In general grid 3 should be operated above 250 V.
4. On EIA resolution test chart; faceplate illumination adjusted for a peak output current of 200 nA.
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 200 nA 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 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 ≤ 25% of peak white signal and will not exceed a width of 0,4%, or a length of 6% of picture height.

	spot size in % of raster height	maximum number of spots zone 1	zone 2
white and black spots	> 1,4	none	none
	≤ 1,4 to 0,8	none	1
	≤ 0,8 to 0,6	2	3
white spots	≤ 0,6 to 0,2	4	6
	≤ 0,2	*	*
black spots	≤ 0,6 to 0,4	8	10
	≤ 0,4	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance.

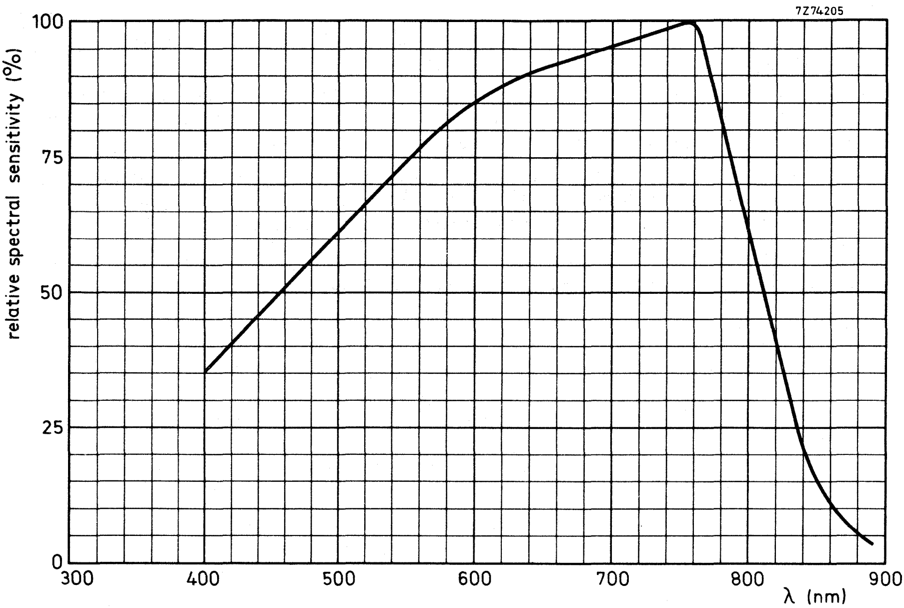


Fig.1 Typical spectral response curve.

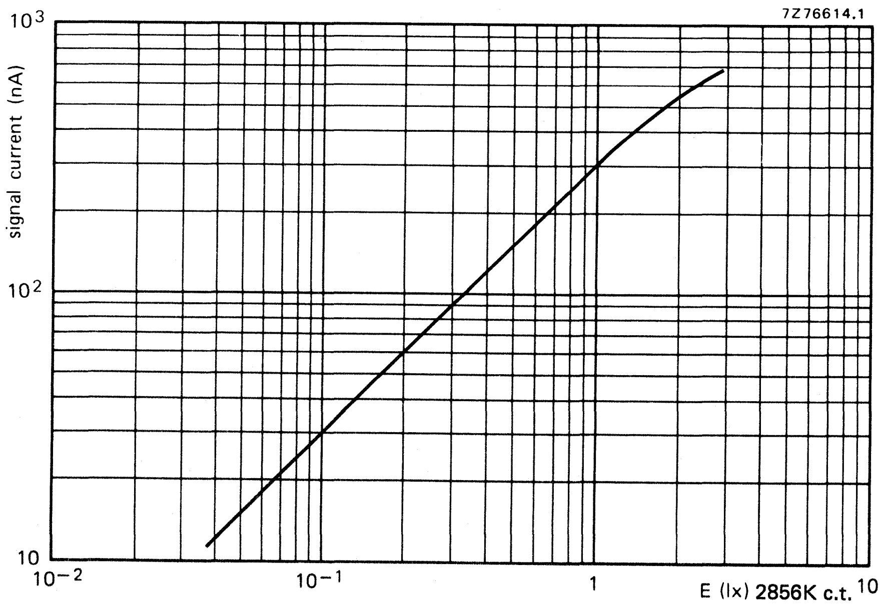


Fig.2 Typical light transfer characteristic.

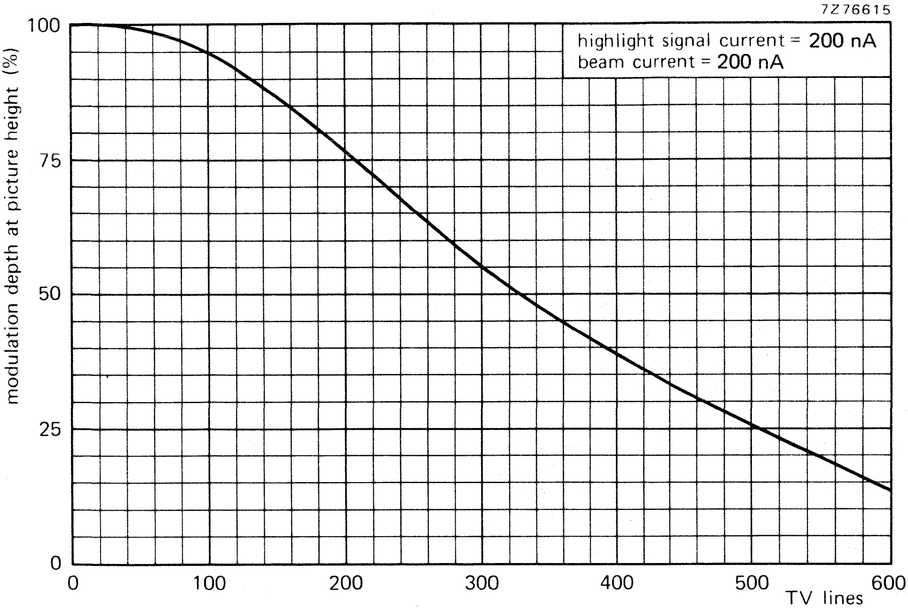


Fig.3 Typical uncompensated square-wave response curve.

CAMERA TUBE

Newvicon® camera tube, mechanically and electron-optically identical to the XQ1440, the major difference being the radiation resistant (anti-browning) faceplate.

The XQ1444 is intended for use in cameras which are subjected to high doses of ionizing radiation.

RADIATION RESISTANT FACEPLATE

The faceplate of the XQ1444 is made of a special type of glass and does not turn brown under the influence of high doses of gamma radiation.

- Maximum dose rate per hour: 5×10^5 Röntgen/hour
- Maximum cumulative dose: 5×10^7 Röntgen
- Maximum decrease of transmission of faceplate:

Maximum decrease	After a cumulative dose of
3%	10^5 Röntgen
10%	10^6 Röntgen
15%	5×10^7 Röntgen

- Maximum increase of dark current at 25 °C after a cumulative dose of 5×10^7 Röntgen: 75%

SENSITIVITY

The typical sensitivity of the XQ1444 is approximately 10% less than for the XQ1440.

For all other information see data of XQ1440.

® Registered Trade Mark for television camera tubes.

VIDICON TUBES G

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	
			quality grade			applications			
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									
XQ1270	I	A			●		●	●	110 mA; 6,3 V
XQ1271	S	A			●		●	●	
2/3 inch - electrostatic focusing and magnetic deflection									
XQ1272	S	A			●		●	●	

Accessories for Vidicon tubes

type	deflection (and focusing) coil unit	sockets
XQ1031, XQ1032 XQ1240, XQ1241 XQ1280, XQ1285	AT1102/01, KV9G AT1116S 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
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.

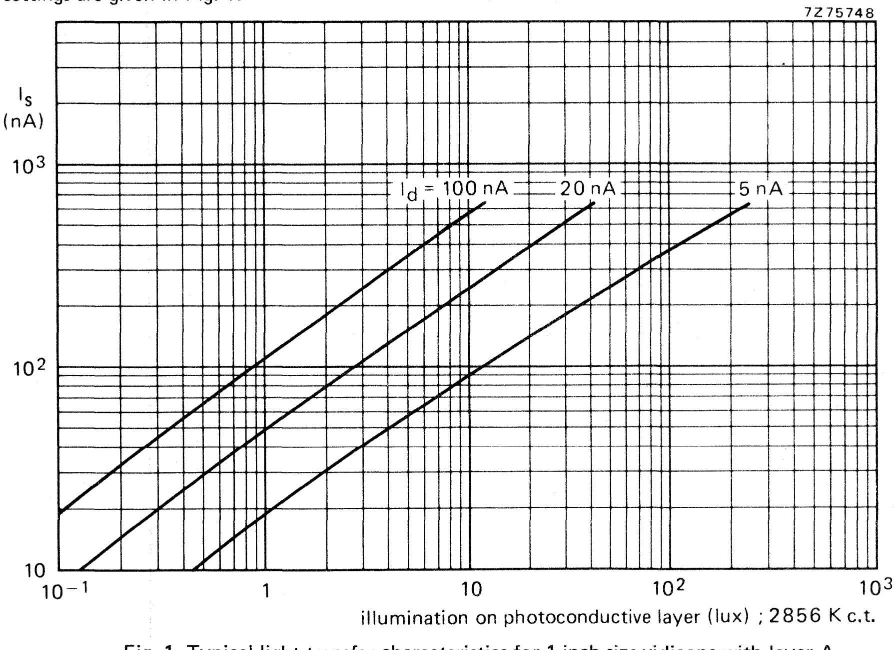


Fig. 1 Typical light transfer characteristics for 1-inch size vidicons with layer A.

(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.

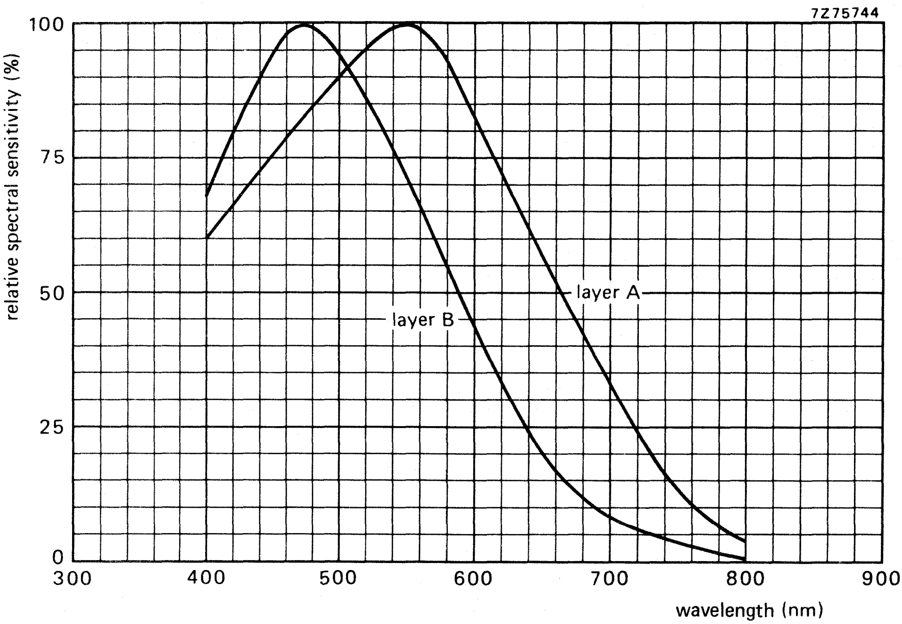


Fig. 2 Typical spectral response curves.

The response has been measured at constant signal output current.

1.3 Dark current

The influence of temperature on dark current for layer type A is shown in Fig. 3. Roughly, the dark current doubles with every 7 to 8 ^{o}C temperature increase (this applies also to layer type B).

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. shows typical modulation transfer characteristics for the 1-inch tube XQ1280 in the low voltage mode and in the high voltage mode (scanning are 9,6 mm x 12,8 mm).

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 250 nA for tubes with layer A and 100 nA 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 ^{o}C, neither during operation nor storage.

Operation at a faceplate temperature of 25 to 30 ^{o}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.

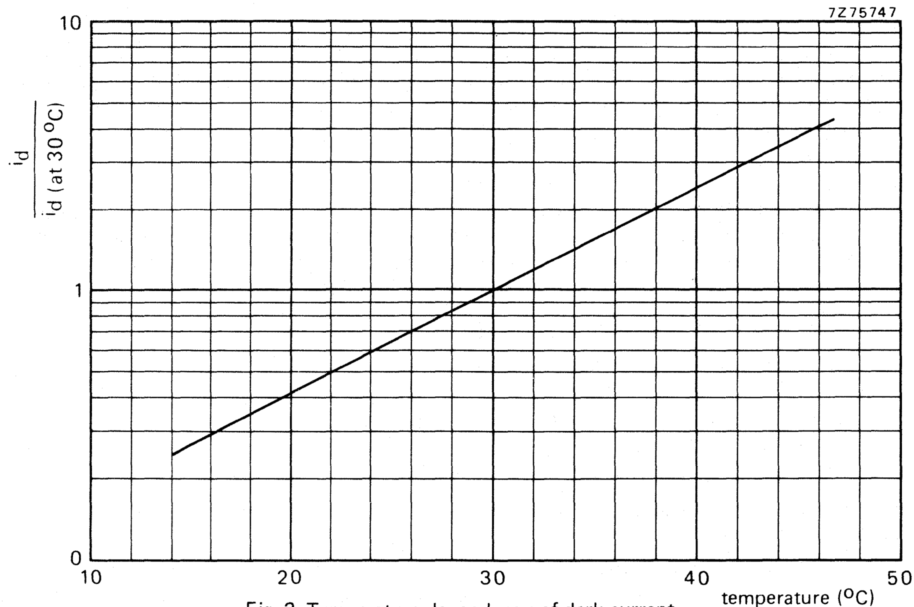


Fig. 3 Temperature dependency of dark current.

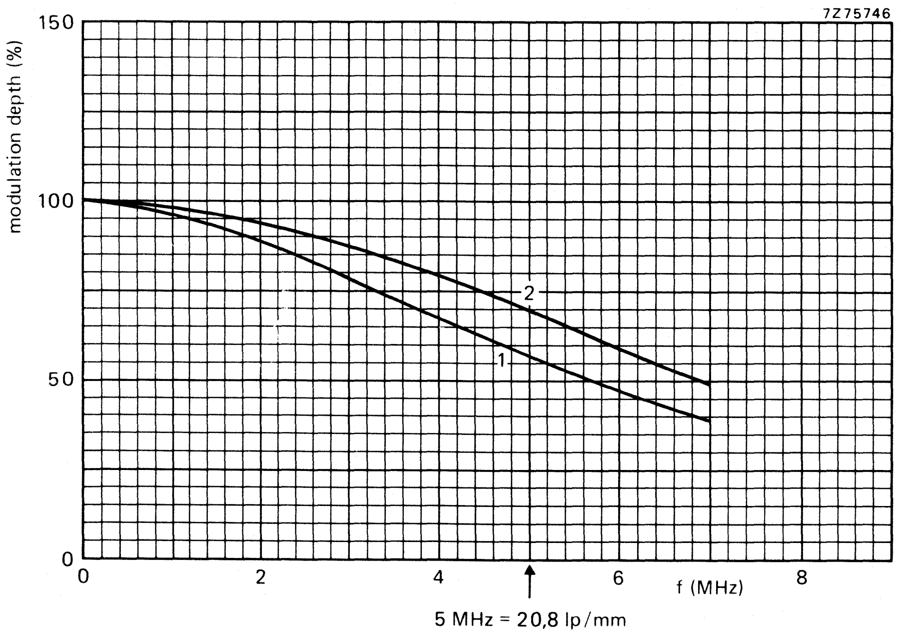


Fig. 4 Typical modulation transfer characteristics for XQ1280.
Curve 1: V_{g3} = 375 V, V_{g4} = 600 V; curve 2: V_{g3} = 600 V, V_{g4} = 960 V.

CAMERA TUBES

Vidicon television camera tubes with low heater consumption, integral mesh construction, magnetic focusing, magnetic deflection, short length (130 mm, 5 in), and 25,9 mm (1 in) diameter.

QUICK REFERENCE DATA

Integral mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25,9 mm (1 in)
Length	130 mm (5 in)
Heater	6,3 V, 95 mA
Limiting 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)		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.

Photoconductive layer		type A	
Spectral response, max. response at	approx.	550	nm
Faceplate			
thickness		2,5	mm
refractive index		1,487	←

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 9,5 V r.m.s. when the supply is switched on.

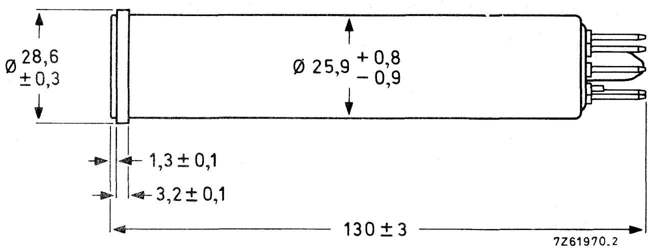
CAPACITANCES

Signal electrode to all C_{as} ≈ 4,6 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



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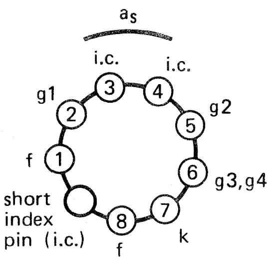

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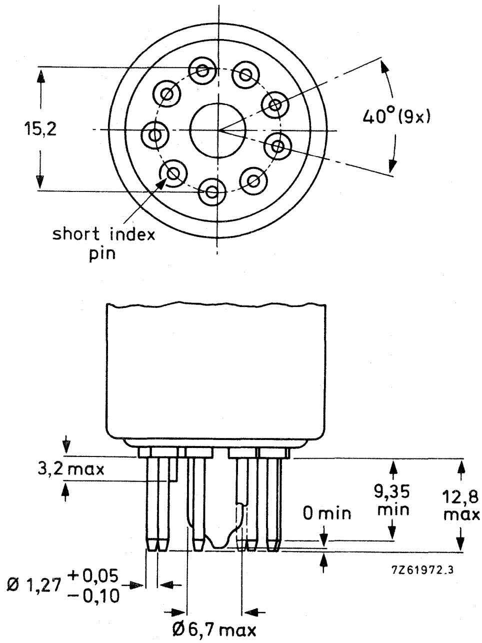


Base: JEDEC no. E8-11

Mounting position: any

Net mass: ≈ 57 g

ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit	AT1102/01, KV9G or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES

(Absolute maximum 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 4 voltage and grid 3 voltage	$V_{g4,\ g3}$	max.	750	V
Grid 2 voltage	V_{g2}	max.	750	V
Grid 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
Dark current, peak	I_{darkp}	max.	250	nA
Output current, peak	I_{asp}	max.	550	nA *
Faceplate illumination	E	max.	10 000	lx
Faceplate temperature, storage and operation	T	max.	70	^oC **
Cathode heating time before drawing cathode current	t_h	min.	1	min

* Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

** 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

notes

For a scanned area of 9,6 mm x 12,8 mm and a faceplate temperature of 25 to 35 °C.

CONDITIONS

				notes
Grid 4 and grid 3 (beam focus electrode) voltage	$V_{g4,g3}$	250 to 300	V	1
Grid 2 (accelerator) voltage	V_{g2}	300	V	
Grid 1 voltage for picture cut-off (no blanking applied)	V_{g1}	−100 to −45	V	
Blanking voltage, peak-to-peak				
when applied to grid 1		75	V	
when applied to the cathode		20	V	
Flux density at centre of focusing coil		4,0	mT	
Flux density of adjustable alignment coils		0 to 0,4	mT	

PERFORMANCE

		min.	typ.	max.		notes
Signal electrode voltage for dark current of 20 nA	V_{as}	10	30		V	
Signal current faceplate illumination 10 lx → c.t. 2856 K, dark current 20 nA	I_s	150	240		nA	
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K, initial signal current 200 nA, dark current 20 nA)			21		%	
Limiting resolution, at picture centre		500	600		TV lines	2
at picture corners		350	450		TV lines	2
Average γ of transfer characteristic for → signal currents between 20 and 200 nA			0,74			
Spurious signals (spot and blemishes)						3

Notes see next page.

NOTES

1. Resolution decreases with decreasing grid 3 and 4 voltages. In general grids 3 and 4 should be operated above 250 V.
2. On EIA resolution test chart, faceplate illumination adjusted for peak signal current of 200 nA and dark current of 20 nA.
3. 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 (c.t. = 2856 K) adjusted to provide a signal current of 200 nA. Beam current adjusted for correct stabilization.

   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. Only white and black spots with contrasts ⩾ 50% and ⩾ 100% respectively (of peak white signal) are taken into account.

XQ1031

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 0,8	none	none
⩽ 0,8 to 0,6	none	none
⩽ 0,6 to 0,2	1	2
⩽ 0,2	*	*
total (max.)	2	

XQ1032

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 0,8	none	none
⩽ 0,8 to 0,6	none	1
⩽ 0,6 to 0,2	2	3
⩽ 0,2	*	*
total (max.)	4	

* 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 3% of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy, or uneven background having contrasts > 50%.

CAMERA TUBES

Vidicon television camera tubes with low heater consumption, separate mesh construction, magnetic focusing, magnetic deflection and 25,9 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	25,9 mm (1 in)
Length	159 mm (6¼ in)
Heater	6,3 V, 95 mA
Limiting resolution	800 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) — 16 mm

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane passing through the short index pin and the longitudinal axis of the tube.

Photoconductive layer		type A
Spectral response, max. response at	approx.	550 nm
Faceplate		
thickness		2,5 mm
refractive index		1,487

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 9,5 V r.m.s. when the supply is switched on.

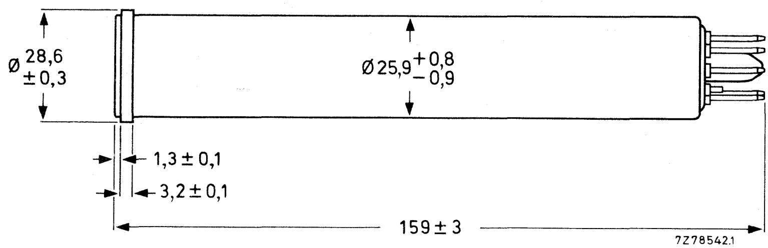
CAPACITANCES

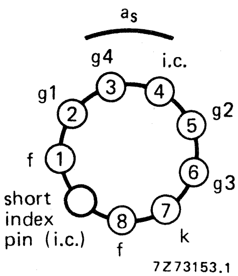
Signal electrode to all $C_{as} \approx 4{,}6$ pF

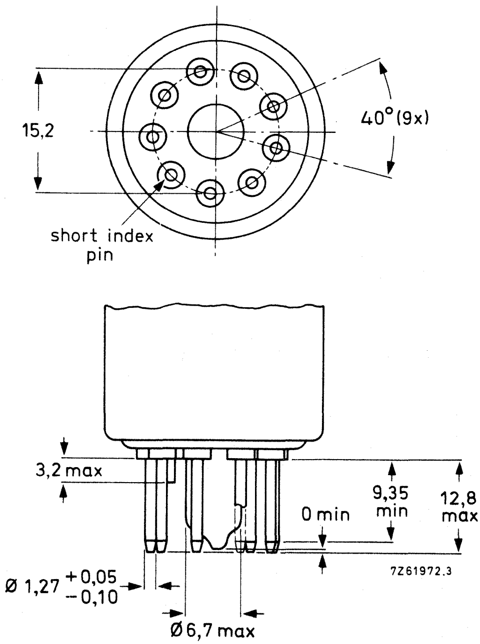
This capacitance, which effectively is the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

MECHANICAL DATA

Dimensions in mm







Base: JEDEC no. E8-11

Mounting position: any

Net mass: ≈ 70 g

ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit	AT1102/01, KV9G or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES

(Absolute maximum 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 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
positive	V_{g1}	max.	0	V
Cathode-to-heater voltage,				
peak positive	V_{kfp}	max.	125	V
peak negative	$-V_{kfp}$	max.	10	V
Dark current, peak	I_{darkp}	max.	250	nA
Output current, peak	I_{asp}	max.	550	nA*
Faceplate illumination	E	max.	10 000	lx
Faceplate temperature, storage and operation	T	max.	70	^{o}C **
Cathode heating time before drawing cathode current	t_h	min.	1	min

* Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading.

** 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

notes

For a scanned area of 9,6 mm x 12,8 mm and a faceplate temperature of 25 to 35 °C.

CONDITIONS

			notes
Grid 4 voltage	V_{g4}	500 V	1
Grid 3 (focusing electrode) voltage	V_{g3}	300 V	2
Grid 2 (accelerator) voltage	V_{g2}	300 V	
Grid 1 voltage for picture cut-off (no blanking applied)	V_{g1}	−100 to −45 V	
Blanking voltage, peak-to-peak			
when applied to grid 1		75 V	
when applied to cathode		20 V	
Flux density at centre of focusing coil		3,8 to 4,4 mT	
Flux density of adjustable alignment coils		0 to 0,4 mT	

PERFORMANCE

		min.	typ.	max.		notes
Signal electrode voltage for dark current of 20 nA						
XQ1240	V_{as}	30	45	60	V	
XQ1241	V_{as}	10	30		V	
Signal current faceplate illumination 10 lx, c.t. 2856 K, dark current 20 nA						
XQ1240	I_s	180	300		nA	
→ XQ1241	I_s	150	240		nA	
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K, initial signal current 200 nA, dark current 20 nA)			21		%	
Limiting resolution, at picture centre		650	800		TV lines	3
→ at picture corners		400	500		TV lines	3
Average γ of transfer characteristic for signal currents between 20 and 200 nA			0,74			
Spurious signals (spots and blemishes)						4

Notes see next page.

NOTES

1. Grid 4 voltage must always be higher than grid 3 voltage. The recommended ratio of grid 4 to grid 3 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").
2. Resolution decreases with decreasing grid 3 voltage. In general grid 3 should be operated above 250 V.
3. On EIA resolution test chart, faceplate illumination adjusted for peak signal current of 200 nA and dark current of 20 nA.
4. 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 (c.t. = 2856 K) adjusted to provide a signal current of 200 nA. Beam current adjusted for correct stabilization.

   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.

   Black spots having a contrast ⩾ 100% (⩾ 10% for XQ1240) and white spots having a contrast ⩾ 50% of peak white signal (⩾ 10% for XQ1240) are fully counted.

   Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below.

XQ1240

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 0,8	none	none
⩽ 0,8 to 0,6	none	none
⩽ 0,6 to 0,2	1	2
⩽ 0,2	*	*
total (max.)	2	

XQ1241

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 0,8	none	none
⩽ 0,8 to 0,6	none	1
⩽ 0,6 to 0,2	2	3
⩽ 0,2	*	*
total (max.)	4	

* Do not count spots of this size unless concentration causes a smudgy appearance.

a) Minimum separation between any two spots greater than 0,4% of raster height is limited to a distance equivalent to 3% of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrast ratios in excess of 10% (XQ1240) and 50% (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 (4¼ 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
Limiting resolution	500 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 passing through pin 4 and the longitudinal axis of the tube.

Photoconductive layer		type A	
Spectral response, max. response at	approx.	550	nm
Faceplate			
thickness		1,5	mm
refractive index		1,487	

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	110	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.

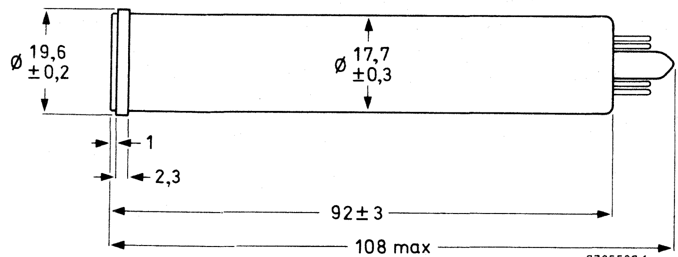
CAPACITANCES

Signal electrode to all $C_{as} \approx 2$ 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



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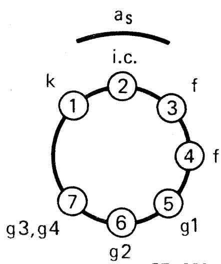
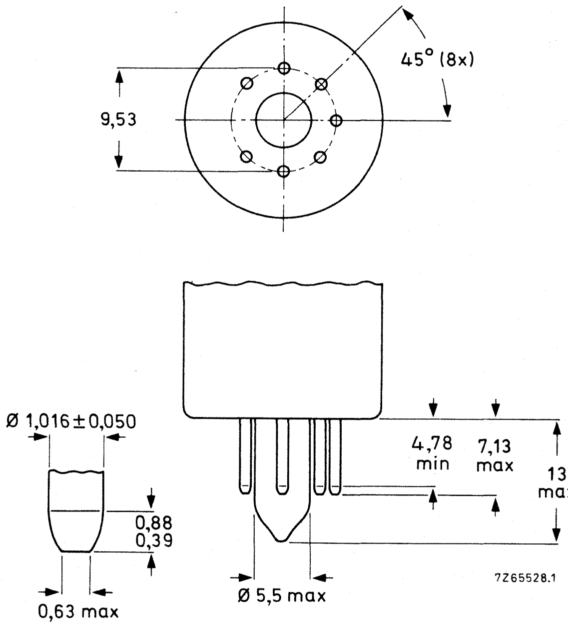


7Z78534



7Z65528.1

Base: JEDEC no. E7-91.

Mounting position: any

Net mass: ≈ 22 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 maximum rating system) for 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.	80	V
Grid 4 and grid 3 voltage	$V_{g4,g3}$	max.	750	V
Grid 2 voltage	V_{g2}	max.	350	V
Grid 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
Dark current, peak	I_{dp}	max.	150	nA
Output current, peak	I_{asp}	max.	500	nA*
Faceplate illumination	E	max.	10 000	lx
Faceplate temperature, storage and operation	T	max.	70	^oC **
Cathode heating time before drawing cathode current	t_h	min.	1	min

* Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

** 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 mm x 8,8 mm and a faceplate temperature of 25 to 35 °C.

CONDITIONS

			notes
Grid 4 and grid 3 (beam focus electrode) voltage	$V_{g4,g3}$	250 to 300 V	1
Grid 2 (accelerator) voltage	V_{g2}	300 V	
Grid 1 voltage for picture cut-off (no blanking applied)	V_{g1}	−80 to −20 V	
Blanking voltage, peak-to-peak			
when applied to grid 1		75 V	
when applied to the cathode		20 V	
Flux density at centre of focusing coil		5 mT	
Flux density of adjustable alignment magnets		0 to 0,4 mT	

PERFORMANCE

		min.	typ.	max.		notes
Signal electrode voltage for dark current of 20 nA	V_{as}	10	30		V	
Signal current faceplate illumination 10 lx c.t. 2856 K, dark current 20 nA	I_s	100	200		nA	
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K, initial signal current 200 nA, dark current 20 nA			17		%	
Limiting resolution, at picture centre		400	500		TV lines	2
at picture corners		300	400		TV lines	
Average γ of transfer characteristic for signal currents between 20 and 200 nA (see Fig. 1)			0,74			
Spurious signals (spots and blemishes)						3

Notes see next page.

NOTES

1. Resolution decreases with decreasing grid 3 and 4 voltages. In general grids 3 and 4 should be operated above 250 V.
2. On EIA resolution test chart, faceplate illumination adjusted for peak signal current of 200 nA and dark current of 20 nA.
3. 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 (c.t. 2856 K) adjusted to provide a signal current of 200 nA. Beam current adjusted for correct stabilization.

   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. Only white and black spots with contrasts ⩾ 50% and ⩾ 100% respectively (of peak white signal) are taken into account.

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 0,8	none	none
⩽ 0,8 to 0,6	none	1
⩽ 0,6 to 0,2	2	3
⩽ 0,2	*	*
total (max.)	4	

* 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 3% of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrasts > 50%.

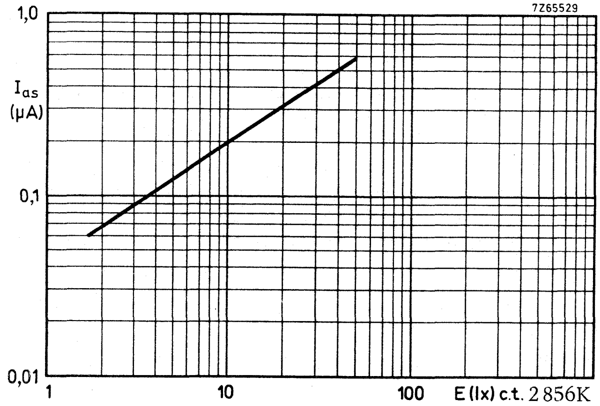


Fig. 1 Typical light transfer characteristic. Scanned area 6,6 mm x 8,8 mm. Faceplate temperature ≈ 30 °C.

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 (4¼ 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
Limiting 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 pin 4 and the longitudinal axis of the tube.

Photoconductive layer		type A	
Spectral response, max. response at	approx.	550	nm
Faceplate			
thickness		1,5	mm
refractive index		1,487	

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 = 63 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.

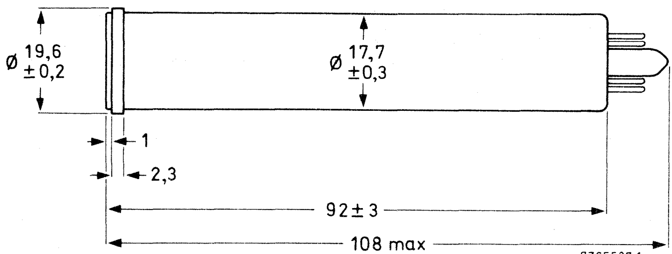
CAPACITANCES

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



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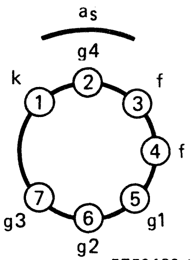

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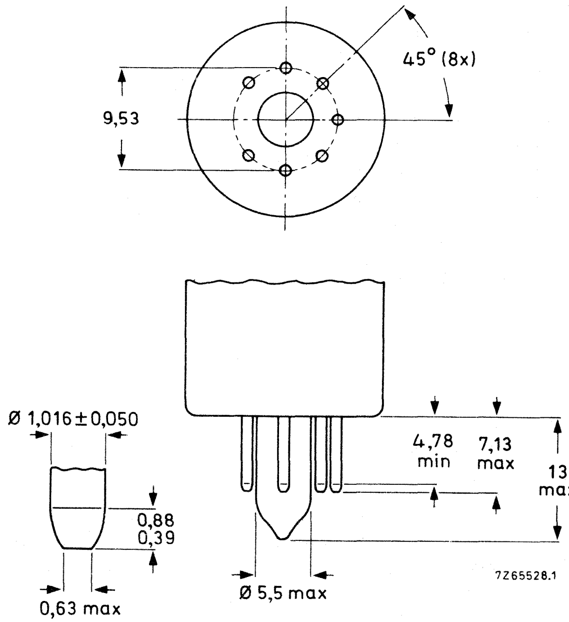

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Base: JEDEC no. E7-91

Mounting position: any

Net mass: ≈ 23 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 maximum rating system) for 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.	80	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
positive	V_{g1}	max.	0	V
Cathode-to-heater voltage,				
peak positive	V_{kfp}	max.	125	V
peak negative	$-V_{kfp}$	max.	10	V
Dark current, peak	I_{dp}	max.	150	nA
Output current, peak	I_{asp}	max.	500	nA*
Faceplate illumination	E	max.	10 000	lx
Faceplate temperature, storage and operation	T	max.	70	^{o}C **
Cathode heating time before drawing cathode current	t_h	min.	1	min

* Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

** 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 6,6 mm x 8,8 mm and a faceplate temperature of 25 to 35 °C.

CONDITIONS

				notes
Grid 4 voltage	V_{g4}	400	V	1
Grid 3 (beam focus electrode) voltage	V_{g3}	300	V	1,2
Grid 2 (accelerator) voltage	V_{g2}	300	V	
Grid 1 voltage for picture cut-off (no blanking applied)	V_{g1}	–80 to –35	V	
Blanking voltage, peak-to-peak				
when applied to grid 1		75	V	
when applied to the cathode		20	V	
Flux density at centre of focusing coil		5,0 to 5,6	mT	
Flux density of adjustable alignment magnets		0 to 0,4	mT	

PERFORMANCE

		min.	typ.	max.		notes
Signal electrode voltage for dark current of 20 nA	V_{as}	10	30		V	
Signal current faceplate illumination 10 lx c.t. 2856 K, dark current 20 nA	i_s	130	200		nA	
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K, initial signal current 200 nA, dark current 20 nA			17		%	
Limiting resolution at picture centre		550	600		TV lines	3
at picture corners		350	450		TV lines	3
Average γ of transfer characteristic for signal currents between 20 and 200 nA (see Fig. 1)			0,74			
Spurious signals (spots and blemishes)						4

Notes see next page.

NOTES

1. 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 used and will be 4 : 3 for the recommended type (see "Accessories").
2. Resolution decreases with decreasing grid 3 voltage. In general grid 3 should be operated above 250 V.
3. On EIA resolution test chart; faceplate illumination adjusted for peak signal current of 200 nA and dark current of 20 nA.
4. 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 (c.t. 2856 K) adjusted to provide a signal current of 200 nA. Beam current adjusted for correct stabilization.

   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. Only white and black spots with contrasts ⩾ 50% and ⩾ 100% respectively (of peak white signal) are taken into account.

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 0,8	none	none
⩽ 0,8 to 0,6	none	1
⩽ 0,6 to 0,2	2	3
⩽ 0,2	*	*
total (max.)	4	

* 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 3% of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrasts > 50%.

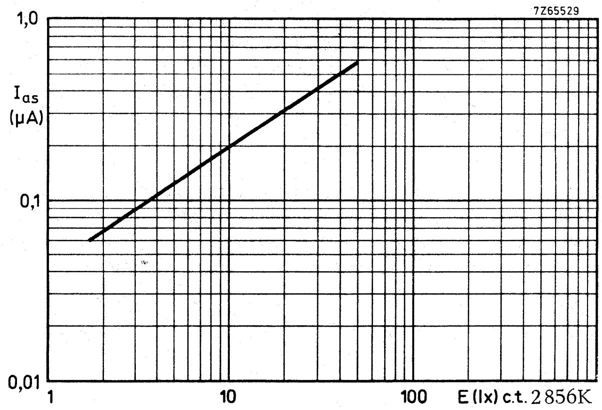


Fig. 1 Typical light transfer characteristic. Scanned area 6,6 mm x 8,8 mm. Faceplate temperature ≈ 30 °C.

CAMERA TUBE

Small size vidicon television camera tube with low heater consumption, separate mesh construction, electrostatic focusing and magnetic deflection. Overall length 108 mm (4¼ 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
Limiting resolution	550 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 pin 4 and the longitudinal axis of the tube.

Photoconductive layer		type A	
Spectral response, max. response at	approx.	550	nm
Faceplate			
thickness		1,5	mm
refractive index		1,487	

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.

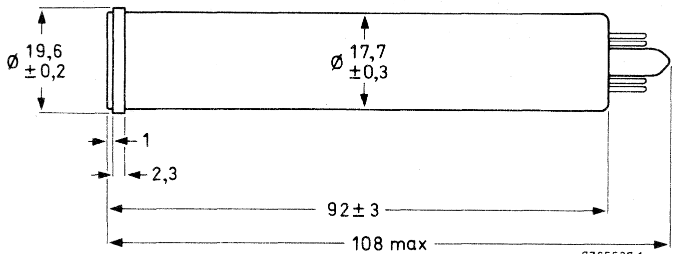
CAPACITANCES

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



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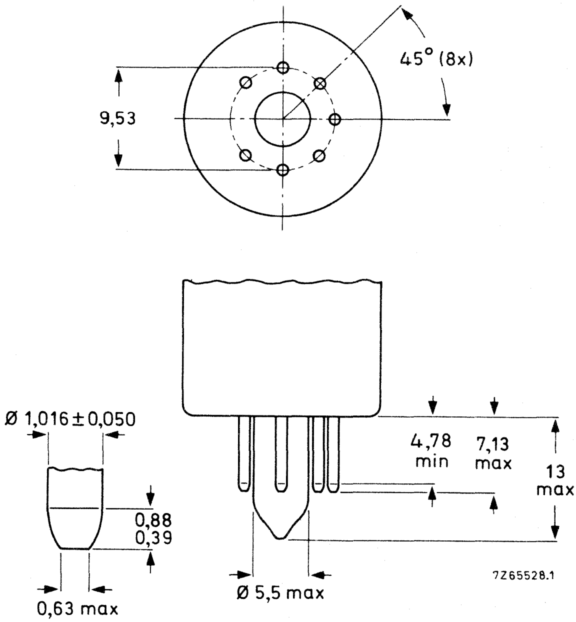

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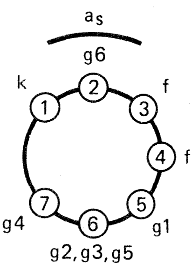

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Base: JEDEC no. E7-91

Mounting position: any

Net mass: ≈ 25 g

ACCESSORIES

Socket	special miniature 7-pin, type 56049 or equivalent
Deflection coil unit	KV19G or equivalent

DEFLECTION magnetic

FOCUSING electrostatic

LIMITING VALUES

(Absolute maximum rating system) for 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.	80	V
Grid 6 voltage	V_{g6}	max.	600	V
Grid 4 (beam focus electrode) voltage	V_{g4}	max.	350	V
Grid 5, grid 3 and grid 2 voltage	$V_{g5,g3,g2}$	max.	350	V
Grid 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
Dark current, peak	I_{dp}	max.	150	nA
Output current, peak	I_{asp}	max.	500	nA*
Faceplate illumination	E	max.	10 000	lx
Faceplate temperature, storage and operation	T	max.	70	^{o}C **
Cathode heating time before drawing cathode current	t_h	min.	1	min

* Video amplifiers should be capable of handling signal-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

** 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 6,6 mm x 8,8 mm and a faceplate temperature of 25 to 35 °C.

CONDITIONS

			notes
Grid 6 (decelerator) voltage	V_{g6}	500 V	1
Grid 4 (beam focus electrode) voltage	V_{g4}	35 to 55 V	
Grid 5, grid 3 and grid 2 voltage	$V_{g5,g3,g2}$	300 V	
Grid 1 voltage for picture cut-off (no blanking applied)	V_{g1}	−80 to −30 V	1,2
Blanking voltage, peak-to-peak			
when applied to grid 1		75 V	
when applied to the cathode		20 V	
Flux density of adjustable alignment magnets		0 to 0,4 mT	

PERFORMANCE

		min.	typ.	max.		notes
Signal electrode voltage for dark current of 20 nA	V_{as}	10	30		V	
Signal current faceplate illumination 10 lx c.t. 2856 K, dark current 20 nA	I_s	130	200		nA	
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K, initial signal current 200 nA, dark current 20 nA)			17		%	
Limiting resolution at picture centre			550		TV lines	3
at picture corners			450		TV lines	
Average γ of transfer characteristic for signal currents between 20 and 200 nA (see Fig. 1)			0,74			
Spurious signals (spots and blemishes)						4

Notes see next page.

NOTES

1. Grid 6 voltage must always be higher than grid 5, 3 and 2 voltages. The recommended voltage ratio of grid 6 to grids 5, 3 and 2 both for best geometry and most uniform signal output current depends upon the type of coil used and will be 5 : 3 for the recommended type (see "Accessories").
2. Grid 5, 3 and 2 voltages must be operated above 250 V to provide sufficient beam current.
3. On EIA resolution test chart, faceplate illumination adjusted for peak signal current of 200 nA and dark current of 20 nA.
4. 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 (c.t. 2856 K) adjusted to provide a signal current of 200 nA. Beam current adjusted for correct stabilization.

   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 condions 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. Only white and black spots with contrasts ⩾ 50% and ⩾ 100% respectively (of peak white signal) are taken into account.

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 0,8	none	none
⩽ 0,8 to 0,6	none	1
⩽ 0,6 to 0,2	2	3
⩽ 0,2	*	*
total (max.)	4	

* 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 3% of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrasts > 50%.

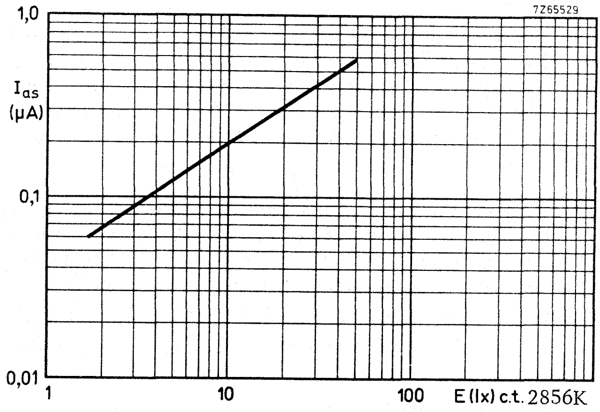


Fig. 1 Typical light transfer characteristic. Scanned area 6,6 mm x 8,8 mm. Faceplate temperature ≈ 30 °C.

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 (6¼ 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 (note 1)

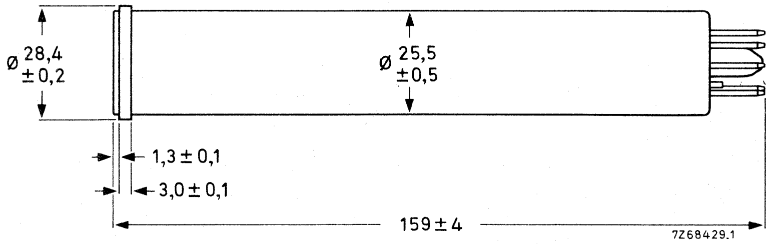
Orientation of image on target
The direction of the horizontal scan should be essentially parallel to the plane defined by pin 1 and the longitudinal axis of the tube.

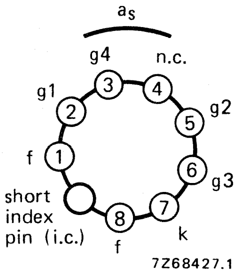
Photoconductive layer	type B	
Spectral response,		
max at	approx.	475 nm
cut-off at	approx.	800 nm
Spectral response curve	see Fig. 1	
Faceplate		
Refractive index	n	1,49
Thickness		2,3 ± 0,1 mm

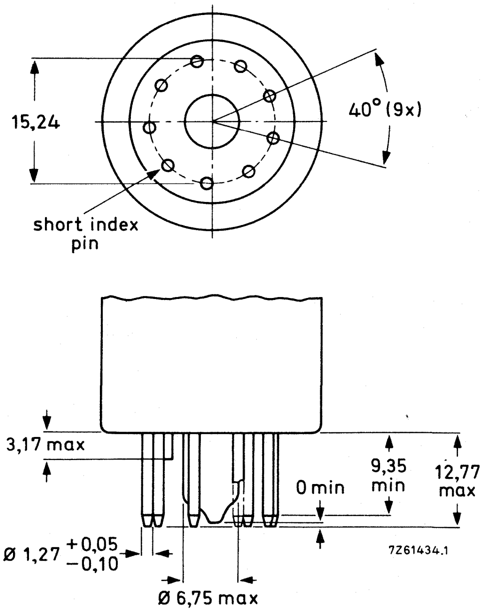
® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm







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

Mounting position: any

Mass: ≈ 55 g

ACCESSORIES

Socket	56098 or equivalent
Deflection and focusing coil	AT1102/01, AT1116S 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 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100 V
Blanking voltage, peak-to-peak			
on grid 1	V_{g1pp}		50 ± 10 V
on cathode	V_{kpp}		20 V
Grid 2 current at normally required beam currents	I_{g2}	max.	0,5 mA

Focusing magnetic

Deflection magnetic

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.

Signal electrode voltage	V_{as}	max.	100 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.	450 V
Grid 2 voltage	V_{g2}	max.	350 V
Grid 1 voltage,			
negative	$-V_{g1}$	max.	125 V
positive	V_{g1}	max.	0 V

					notes
Cathode to heater voltage,					
positive peak	V_{kfp}	max.	125	V	
negative peak	$-V_{kfp}$	m max.	50	V	
External resistance between cathode and heater at $-V_{kfp} > 10$ V	R_{kf}	min.	2	kΩ	
Dark current, peak	I_{darkp}	max.	0,1	μA	
Output current, peak	I_{asp}	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 1 (control grid) voltage	V_{g1}	adjusted for sufficient beam current to stabilize a peak output current, I_{asp}, of 600 nA			
Grid 2 (accelerator) voltage	V_{g2}	300	300	V	
Grid 3 (collector) voltage	V_{g3}	375	600	V	2
Grid 4 (mesh) voltage	V_{g4}	600	960	V	2
Peak signal current	I_{sp}	150	150	nA	8, 9
Peak dark current	I_{darkp}	20	20	nA	
Blanking voltage, peak-to-peak					
when applied to grid 1	V_{g1pp}	50		V	
when applied to cathode	V_{kpp}	20		V	
Field strength at centre of focusing coil (nominal)	H	3600	4800	A/m	3, 4
Field strength of adjustable alignment coils	H	0 to 320	0 to 320	A/m	5
Deflection currents					6

Performance

		min.	typ.	max.		notes
Signal electrode voltage for a peak dark current of 20 nA	V_{as}	30	40	70	V	
Grid 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		1	2	lx	
			2×10^{-7}	4×10^{-7}	W/cm^2	
P11	E		0,2	0,4	lx	
			$1,5 \times 10^{-7}$	3×10^{-7}	W/cm^2	
Decay:						
Residual signal current 200 ms after cessation of the illumination			15	20	%	10
Limiting resolution at picture centre,						
normal operation			⩾ 50		lp/mm	11
operation for high resolution			⩾ 60		lp/mm	11
Modulation transfer characteristic			see Fig. 4			
Average γ of transfer characteristic for signal currents between 10 nA and 200 nA			0,7			12
Spurious signals			see "Spurious signal specification for XQ1280"			

Notes see next page.

NOTES

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 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 4 (mesh) be allowed to operate at a voltage level below that of grid 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. See chapter "Deflection assemblies".
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.

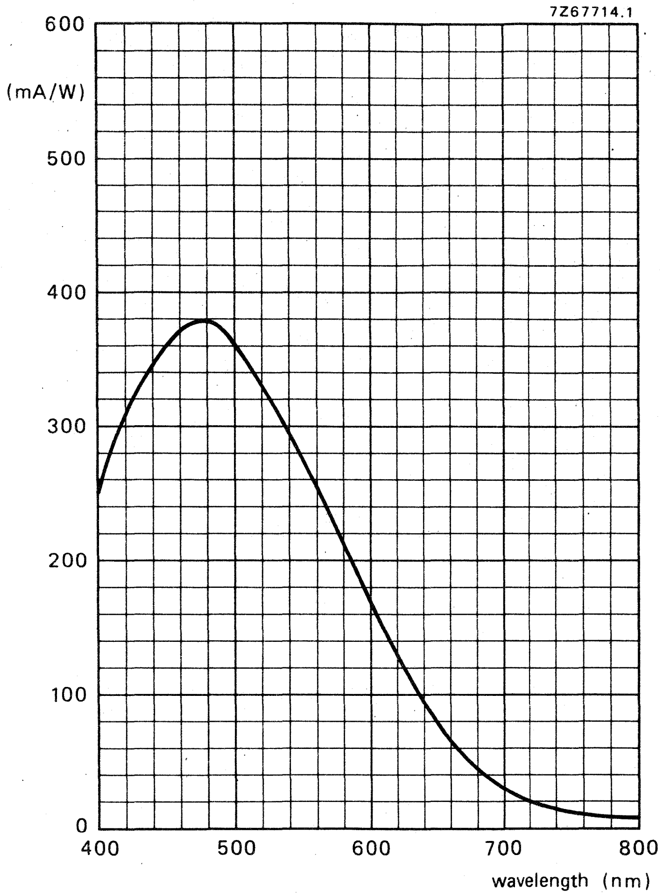


Fig. 1 Typical spectral response curve measured at constant output current I_{as} = 50 nA, with I_{dark} = 20 nA

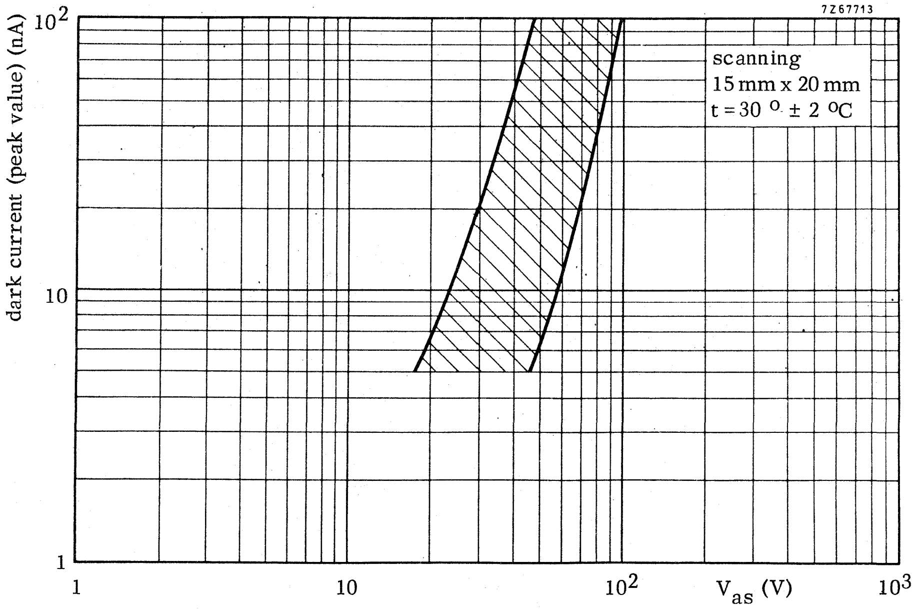


Fig. 2 Dark current range/signal electrode voltage curve.

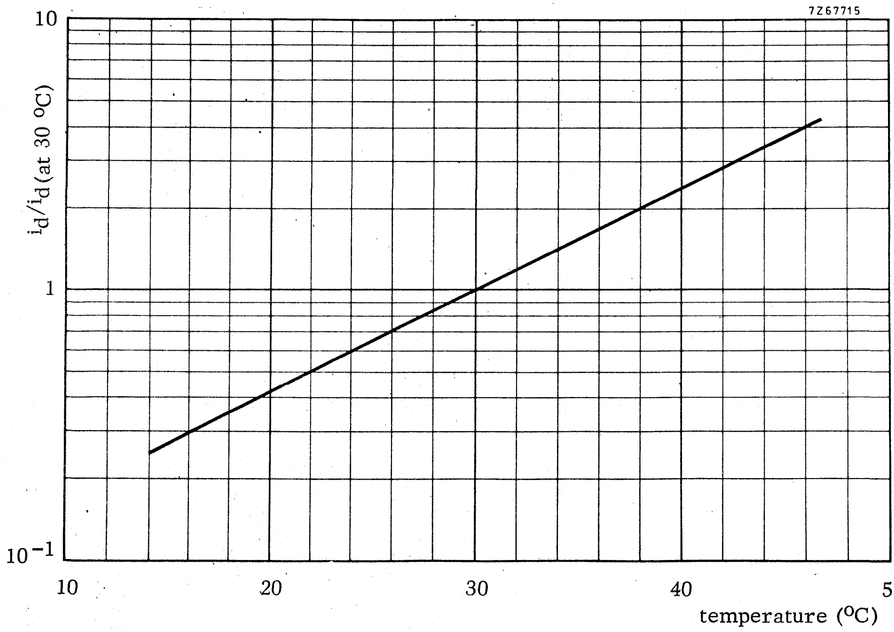


Fig. 3 Temperature dependence of dark current.

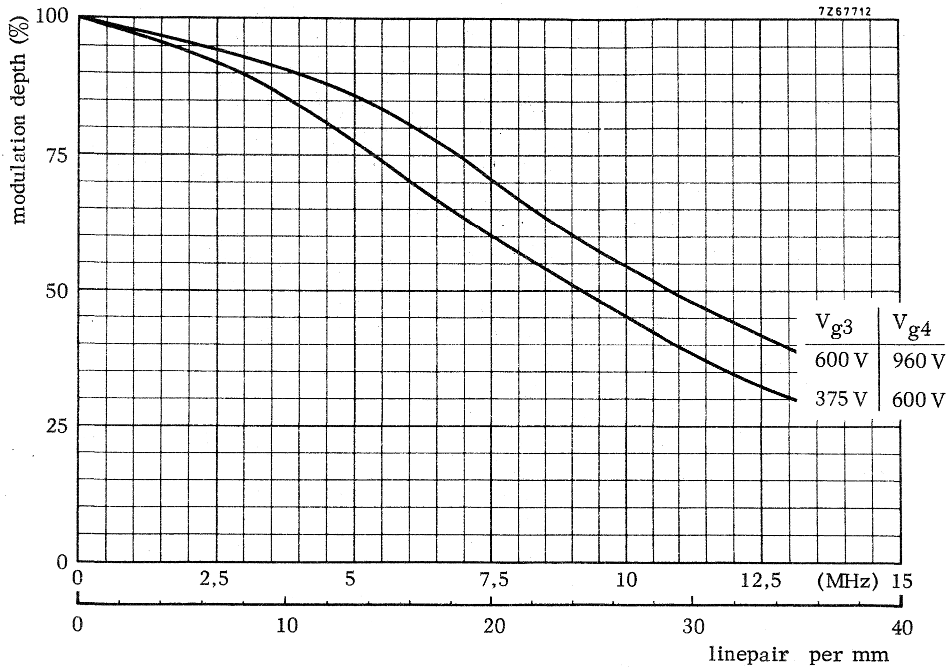


Fig. 4 Squarewave modulation transfer characteristic.

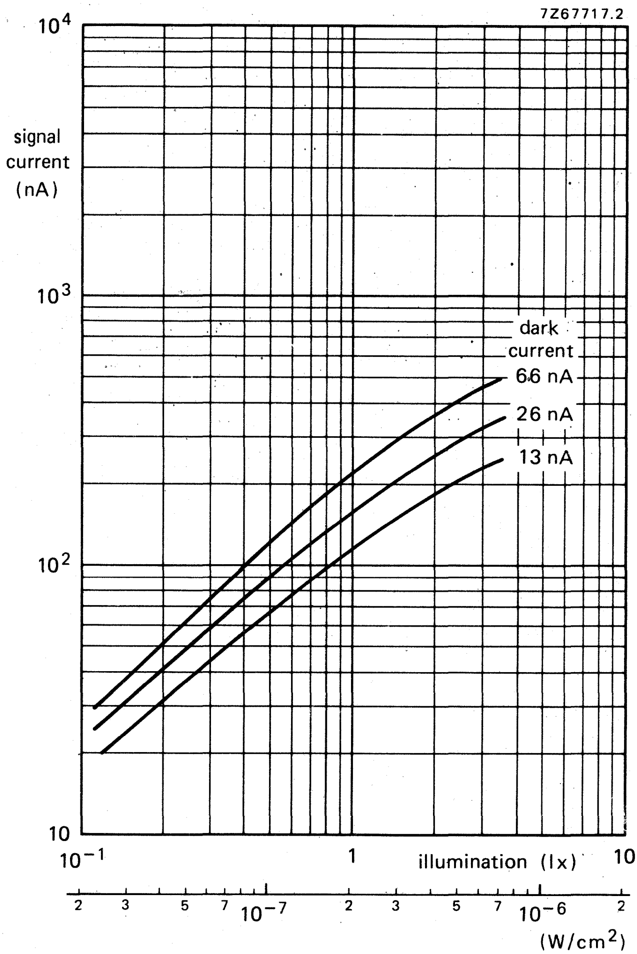


Fig. 5 Typical light transfer characteristic.
Scanning 15 mm x 20 mm; peak values;
P20 illumination.

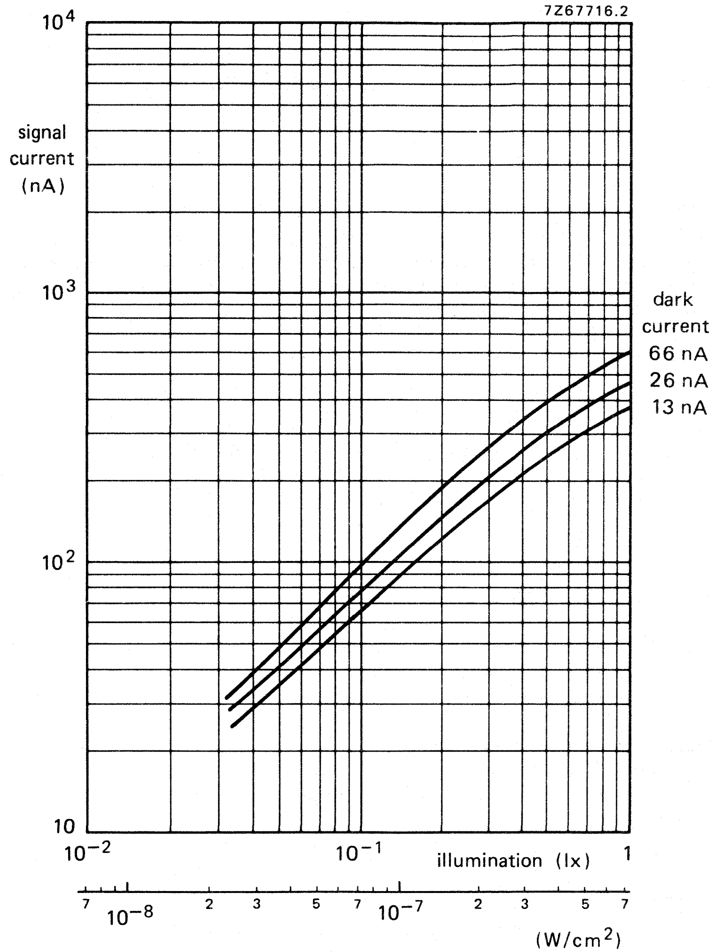
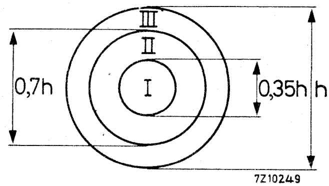


Fig. 6 Typical light transfer characteristic.
Scanning 15 mm x 20 mm; peak values;
P11 illumination.

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 mm x 21,6 mm.
- 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 °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	Zone III
$> 0{,}7$	0	0	0
$\leqslant 0{,}7$ but $> 0{,}45$	0	1	3
$\leqslant 0{,}45$ but $> 0{,}2$	2	3	6
total	2	6	

Both black and white blemishes as observed on the monitor shall be counted. Blemishes $\leqslant 0{,}2\%$ of picture height* and blemishes with a contrast $\leqslant 6\%$ (of 150 nA peak signal current, as measured on a waveform oscilloscope), however, shall be neglected.

* 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 (6¼ 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 (note 1)

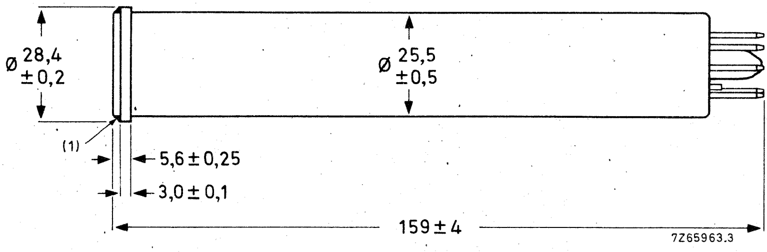
Orientation of image on target
The direction of the horizontal scan should be essentially parallel to the plane defined by pin 1 and the longitudinal axis of the tube.

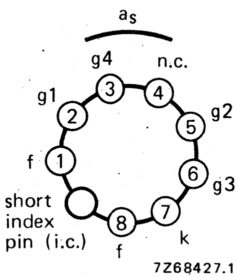
Photoconductive layer	type B
Spectral response,	
max. at	approx. 475 nm
cut-off	approx. 800 nm
Spectral response curve	see Fig. 1
Faceplate	
Centre to centre spacing of fibres	7,5 μm
Flat within	1,5 μm
Numerical aperture	1,0

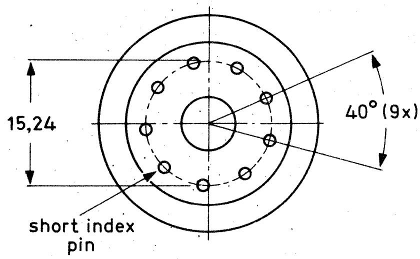
® Registered Trade Mark for television camera tube.

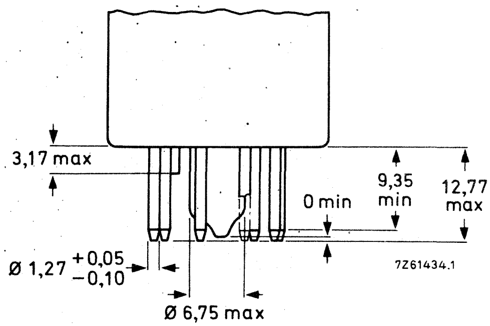
MECHANICAL DATA

Dimensions in mm









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

Mounting position: any

Weight: ≈ 55 g

ACCESSORIES

Socket	56098 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1116S 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 1 voltage for cut-off at V_{g2} = 300 V	V_{g1}		−30 to −100 V
Blanking voltage, peak-to-peak			
on grid 1	V_{g1pp}		50 ± 10 V
on cathode	V_{kpp}		20 V
Grid 2 current at normally required beam currents	I_{g2}	max.	0,5 mA

Focusing magnetic

Deflection magnetic

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 maximum rating system)

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

Signal electrode voltage	V_{as}	max.	100 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.	450 V
Grid 2 voltage	V_{g2}	max.	350 V
Grid 1 voltage,			
negative	$-V_{g1}$	max.	125 V
positive	V_{g1}	max.	0 V
Cathode-to-heater voltage,			
positive peak	V_{kfp}	max.	125 V
negative peak	$-V_{kfp}$	max.	50 V
External resistance between cathode and heater			
at $-V_{kfp} > 10$ V	R_{kf}	min.	2 kΩ

					notes
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 1 (control grid) voltage	V_{g1}	adjusted for sufficient beam current to stabilize a peak output current, I_{asp}, of 600 nA			
Grid 2 (accelerator) voltage	V_{g2}	300	300	V	
Grid 3 (collector) voltage	V_{g3}	375	600	V	
Grid 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 1	V_{g1pp}	50		V	
when applied to cathode	V_{kpp}	50		V	
Field strength at centre of focusing coil (nominal)	H	3200	4800	A/m	3, 4
Field strength of adjustable alignment coils	H	0 to 320	0 to 320	A/m	6
Deflection currents					6

Performance

		min.	typ.	max.		notes
Signal electrode voltage for a peak dark current of 20 nA	V_{as}	30	40	75	V	7, 9
Grid 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		1,5	3	lx	
			3×10^{-7}	6×10^{-7}	W/cm^2	
P11	E		0,3	0,6	lx	
			$2,3 \times 10^{-7}$	$4,5 \times 10^{-7}$	W/cm^2	
Decay: Residual signal current 200 ms after cessation of the illumination			15	20	%	10
Limiting resolution at picture centre,						
normal operation			⩾ 50		lp/mm	11
operation for high resolution			⩾ 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"			

Notes see next page.

NOTES

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 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 4 (mesh) be allowed to operate at a voltage level below that of grid 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. See chapter "Deflection assemblies".
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.

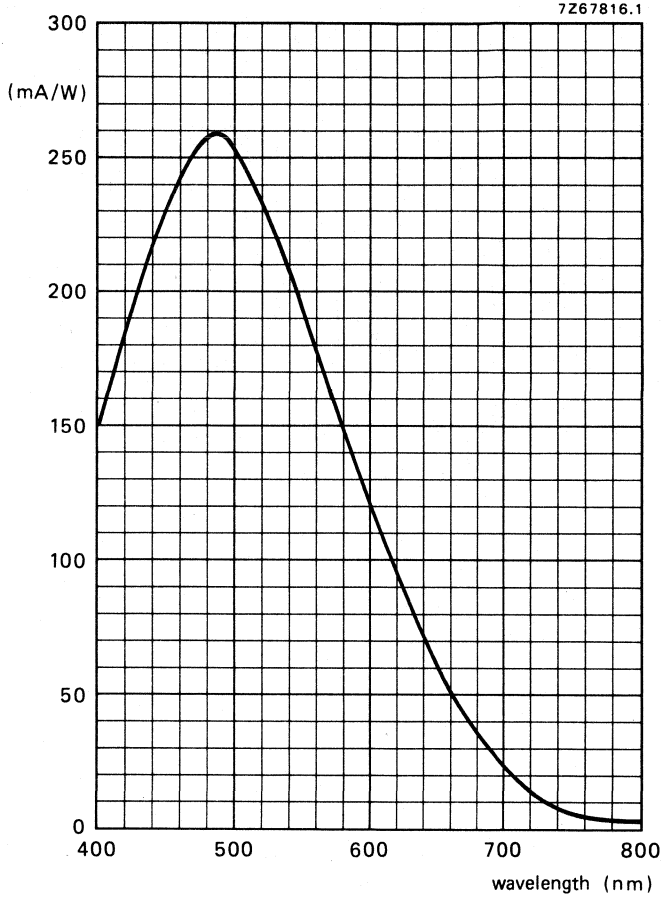


Fig. 1 Spectral response curve.

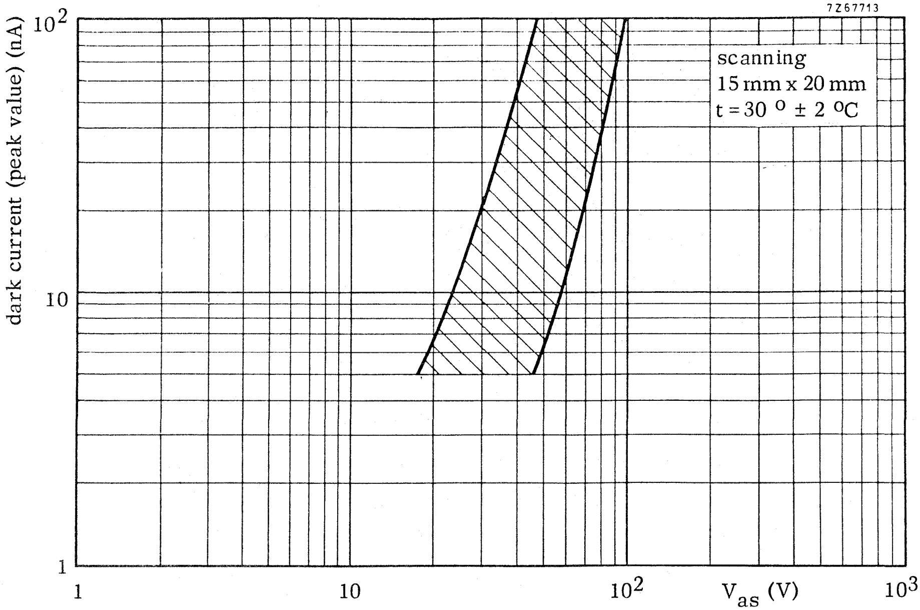


Fig. 2 Dark current range versus signal electrode voltage.

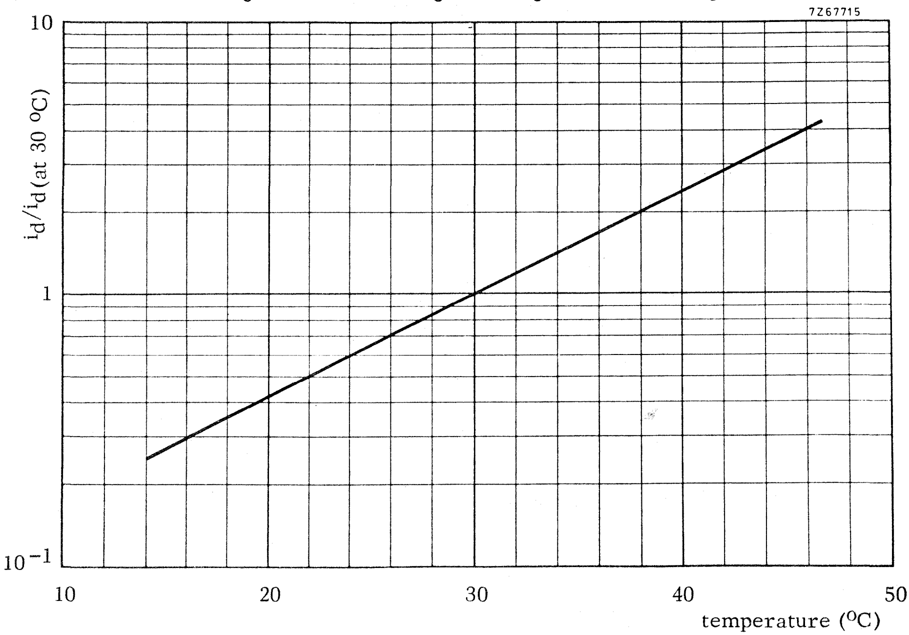


Fig. 3 Temperature dependence of dark current.

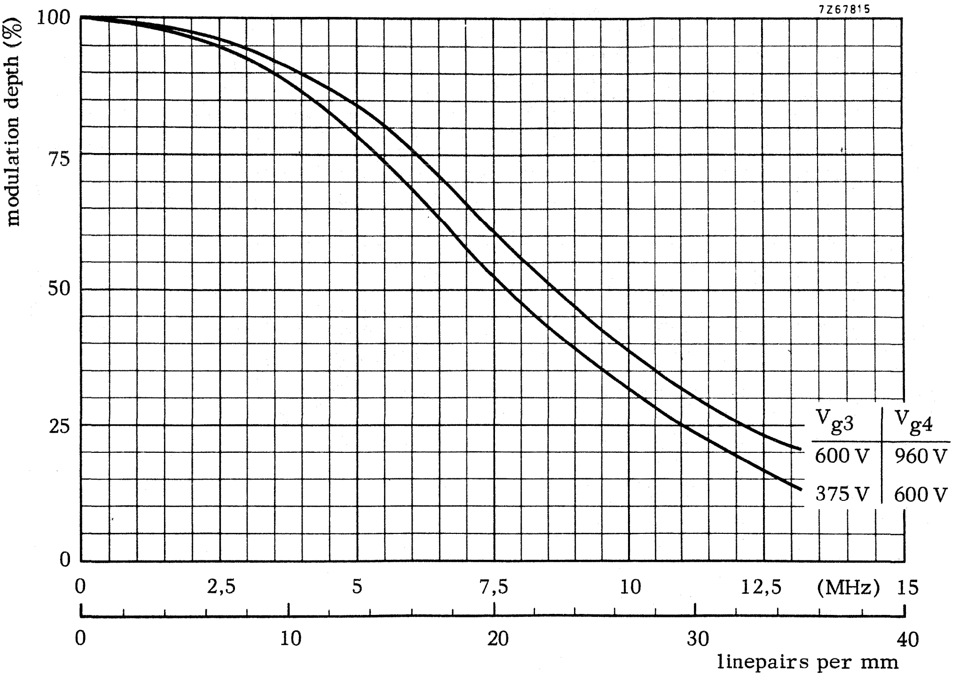


Fig. 4 Square wave modulation transfer characteristic.

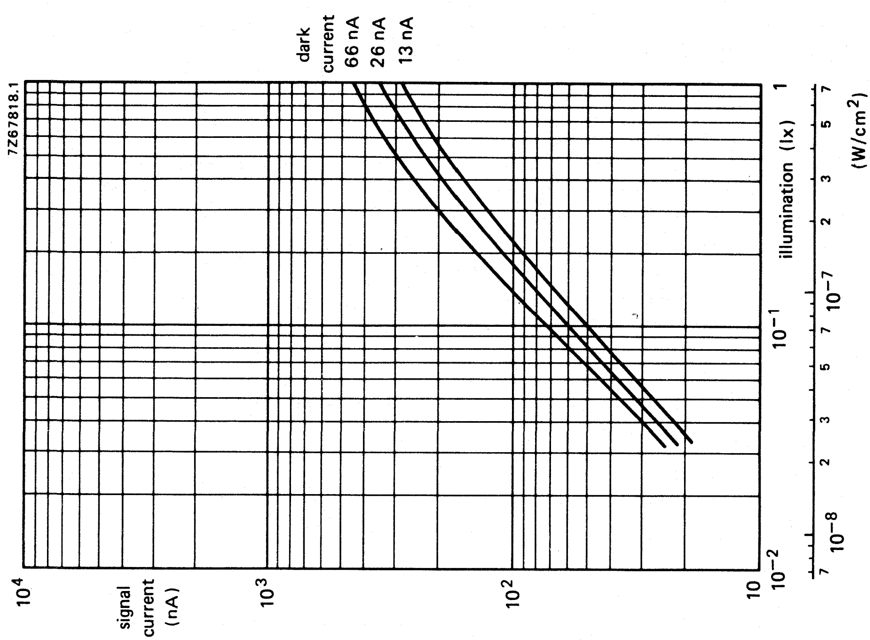


Fig. 6 Typical light transfer characteristics.

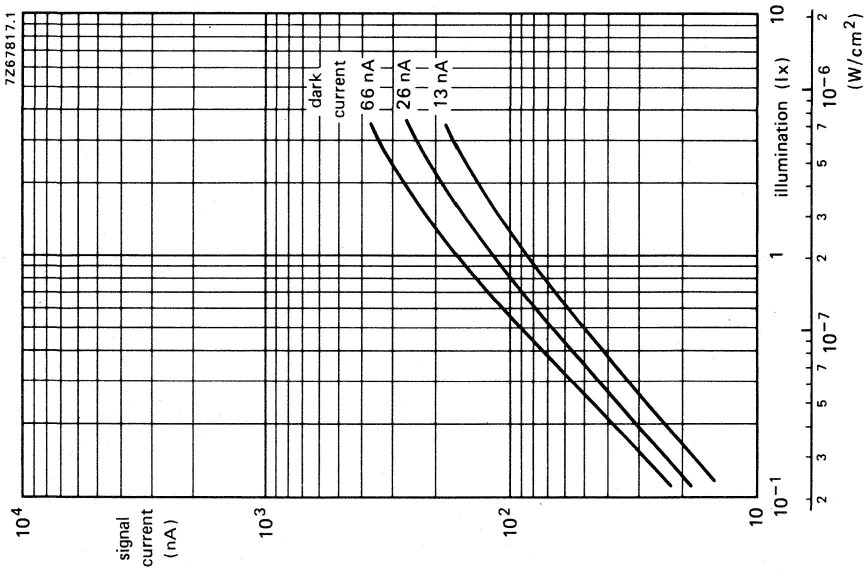
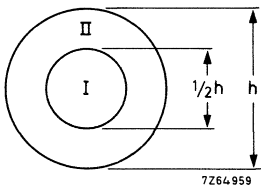


Fig. 5 Typical light transfer characteristics.

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 ± 2 °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
½h = 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 (notes 1 and 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
$\leqslant 0,8$ but $> 0,5$	0	1	0	2	2
$\leqslant 0,5$ but $> 0,4$	1	2	2	3	4
$\leqslant 0,4$ but $> 0,2$	2	3	4	5	6
$\leqslant 0,2$ (note 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%. (note 2)

NOTES

1. Both black and white blemishes as observed on the monitor shall be counted, however, blemishes $\leqslant$ 0,2% of picture height and black blemishes with a contrast $\leqslant$ 6%, and white blemishes with a contrast $\leqslant$ 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.

DEFLECTION ASSEMBLIES H

SURVEY

tube diameter	type number and cat. number	triplet or single	inductance mH		resistance Ω			current mA			remarks
			line coils	frame coils	line coils	frame coils	focus coils	p-p line	p-p frame	d.c. focus	
30 mm (1¼″)	AT1113/03 3122 107 10570	T	0,93	21	2,3	62	148	210	32	103	rear loading + alignment coils
	AT1113/06 3122 107 11040	T	0,93	22	2,3	61	148	210	32	103	rear loading + alignment coils + sleeve*
	AT1113/10 3122 137 17290	T	0,93	22	2,3	61	148	210	32	103	rear loading + alignment coils
	AT1113/01 3122 108 84400	S	0,93	21	2,3	62	148	210	32	103	rear loading + alignment coils
	AT1130 3122 137 18880	T	0,84	5,5	2,1	14,5	1125	180	55	35	rear loading + alignment coils
	AT1130S 3122 137 18890	S	0,84	5,5	2,1	14,5	1125	180	55	35	rear loading + alignment coils
25 mm (1″)	AT1115/01 3122 137 12710	T	0,79	26	2,2	62	1718	260	36	32	rear loading + alignment coils
	AT1119/01 3122 137 12700	S	0,79	26	2,2	62	1718	260	36	32	rear loading + alignment coils
	AT1116/06 3122 137 15040	T	0,79	28	2,2	62	140	280	34	108	front loading + alignment coils
	AT1116S 3122 137 15050	S	0,79	28	2,2	62	140	280	34	108	front loading + alignment coils
	AT1126 3122 137 19060	T	0,8	4,4	2,2	10	1300	230	80	30	rear loading + alignment coils
	AT1126S 3122 137 19050	S	0,8	4,4	2,2	10	1300	230	80	30	rear loading + alignment coils

	AT1102/01 3122 137 10580	S	1,1	22	2,6	84	3604	148	23	17	for Vidicon tube
	K V 9 G 9390 288 80000	S	1,6	70	4,4	125	104	200	29	140	for Vidicon tube*
18 mm ($^{2}/_{3}$″)	AT1106 3122 137 15820	T	0,48	6,9	2,3	48	64	230	48	135	front loading + alignment rings
	AT1106S 3122 137 18550	S	0,48	6,9	2,3	48	64	230	48	135	front loading + alignment rings
	AT1109/01 3122 137 18280	T	0,91	2,8	3,8	12,7	60	260	114	120	rear loading + alignment rings
	AT1109/01S 3122 137 18290	S	0,91	2,8	3,8	12,7	60	260	114	120	rear loading + alignment rings
	AT1109/10 3122 137 18730	T	0,91	2,8	3,8	12,7	60	256	112	120	for low output-capacitance tubes
	K V 12 S 9390 258 20000	S	0,86	28,7	3,2	146	55	160	25	120	for Vidicon tube*
	K V 19 G 9390 271 20000	S	0,9	23	4,6	146	–	160	25	–	for electrostatic Vidicon tube*

* Data on request.

DEFLECTION UNIT FOR 1-INCH VIDICON

QUICK REFERENCE DATA

	inductance	resistance
Line deflection coils	1,1 mH	2,6 Ω
Frame deflection coils	22 mH	84 Ω
Focus coil		3640 Ω

APPLICATION

The AT1102/01 is intended for use in black and white cameras using front-loading 1-inch Vidicons.

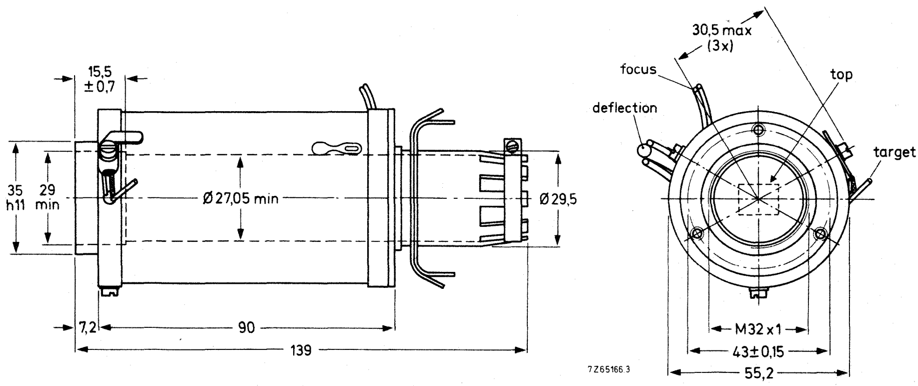
DESCRIPTION

The deflection unit contains the deflection and focus coils for cameras using Plumbicon®or Vidicon tubes.

Catalogue number: 3122 137 10580

MECHANICAL DATA

Dimensions in mm



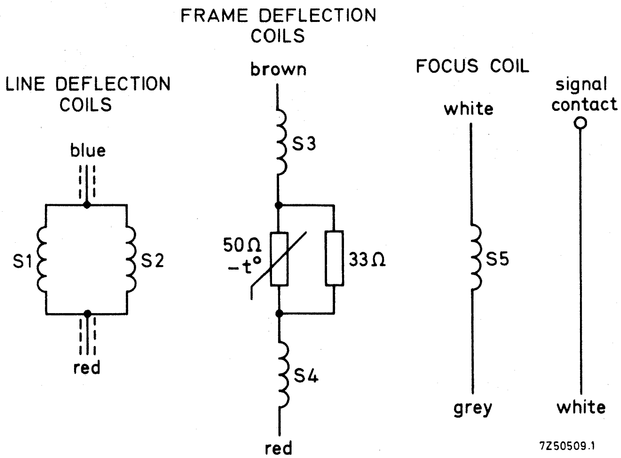
Mass per unit: 536 g approx.

Body temperature

Temperature range
- for continuous operation −15 to + 75 °C
- for non-operating −25 to + 85 °C

® Registered Trade Mark for television camera tube.

ELECTRICAL DATA (typical values)



coils	inductance mH	resistance Ω	connections
Line deflection coils	1,1 ± 3%	2,6 ± 10%	blue (screened); red (screened)
Frame deflection coils	22 ± 3%	84 ± 10%	red; brown
Focus coil		3640 ± 10%	grey (−); white (+)

Required currents for normal operation

Tube setting for Vidicon XQ1240:

$\left.\begin{array}{l} V_{g4} = 600\text{ V} \\ V_{g4} = 840\text{ V} \end{array}\right\}$ with respect to the cathode potential

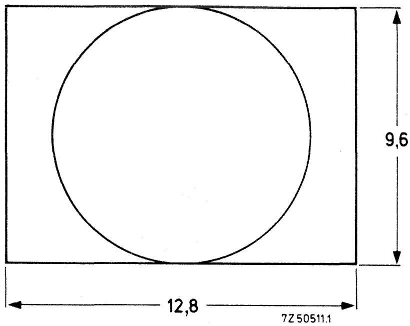
Nominal scanning area: 9,6 mm x 12,8 mm

Line deflection current, p-p	148 mA
Frame deflection current, p-p	23 mA
Focus current	17 mA

Geometric distortion

Distortion

inside the circle	max. 1% of picture height
outside the circle	max. 2% of picture height



Capacitance of the tube target

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
Line deflection coils	0,48 mH	2,3 Ω
Frame deflection coils	6,9 mH	48,0 Ω
Focus coil		64 Ω

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/XQ2427), 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.

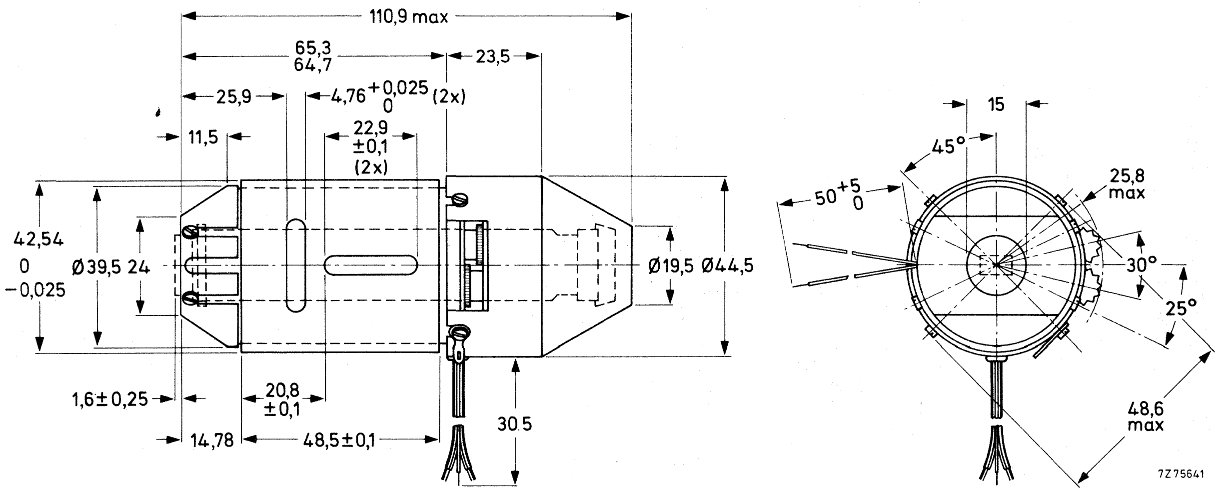
CATALOGUE NUMBER

The catalogue number of the triplet is 3122 137 15820;
The catalogue number of a single unit, AT1106S, is 3122 137 18550.

® Registered Trade Mark for television camera tube.

MECHANICAL DATA

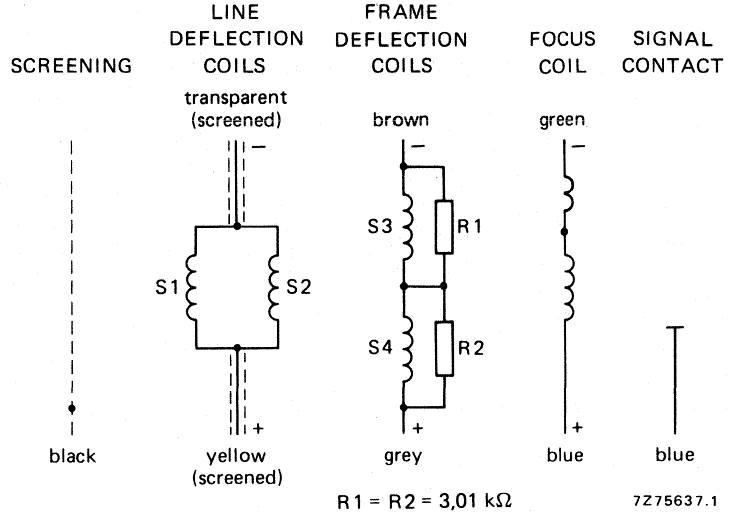
Dimensions in mm



Mass per unit 320 g

Operating body temperature range −15 to + 75 °C

ELECTRICAL DATA (typical values)

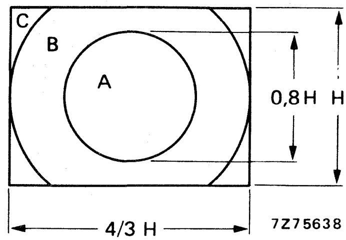


coils	inductance mH	resistance Ω	connections
Line deflection coils	0,48 ± 5%	2,3 ± 10%	transparent; yellow
Frame deflection coils	6,9 ± 5%	48 ± 10%	brown; grey
Focus coil*		64 ± 10%	green; blue

* Polarity: the north-seeking pole of a compass should be attracted to the image end of the unit.

Requirements for normal operation (XQ1427/XQ2427)

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 nA	
beam current	I_b	=	300 nA	
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 mm x 8,8 mm
(H = 6,6 mm)

Geometric distortion

Ambient temperature 21 $^{\circ}$C. Measured at operating temperature.

Distortion		
inside circle	max.	0,5% of picture height
outside 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.

Capacitance of the tube target (XQ1427, XQ2427)

The capacitance between the target and the electrodes increases less than 5 pF when the tube is inserted into the deflection unit.

* V_{g4} to be adjusted for minimum beam landing error.

DEFLECTION UNITS FOR 2/3-INCH PLUMBICON TUBE

QUICK REFERENCE DATA

	inductance	resistance
Line deflection coils	0,91 mH	3,8 Ω
Frame deflection coils	2,8 mH	12,7 Ω
Focus coil		60 Ω

APPLICATION

The AT1109/01 is a triplet of rear-loaded deflection units for use in colour television cameras using 2/3 inch pick-up tubes e.g. Plumbicon® tubes, types XQ1427 and XQ2427.

Their small dimensions and low weight make them specially suitable for use in portable ENG cameras.

DESCRIPTION

The deflection units contain the deflection and focus coils and are provided with permanent magnet alignment rings. The effective alignment field intensities and directions can be adjusted, the minimum field strength position is indicated. The focus coil is situated inside the deflection coils, hence the focus power is reduced.
The housing consists of a mu-metal can for optimum screening from external magnetic fields and to form the required magnetic circuit for the deflection fields.
The camera tubes are secured in position by an aluminium nut-ring at the rear of the units and by means of a nylon glass tube.
The target contact can be removed and replaced by a contact of own design, e.g. incorporating a video preamplifier.

Warning

No deformation of the calibrated mu-metal housing is allowed as this will strongly influence the performance and adjustments of the units.

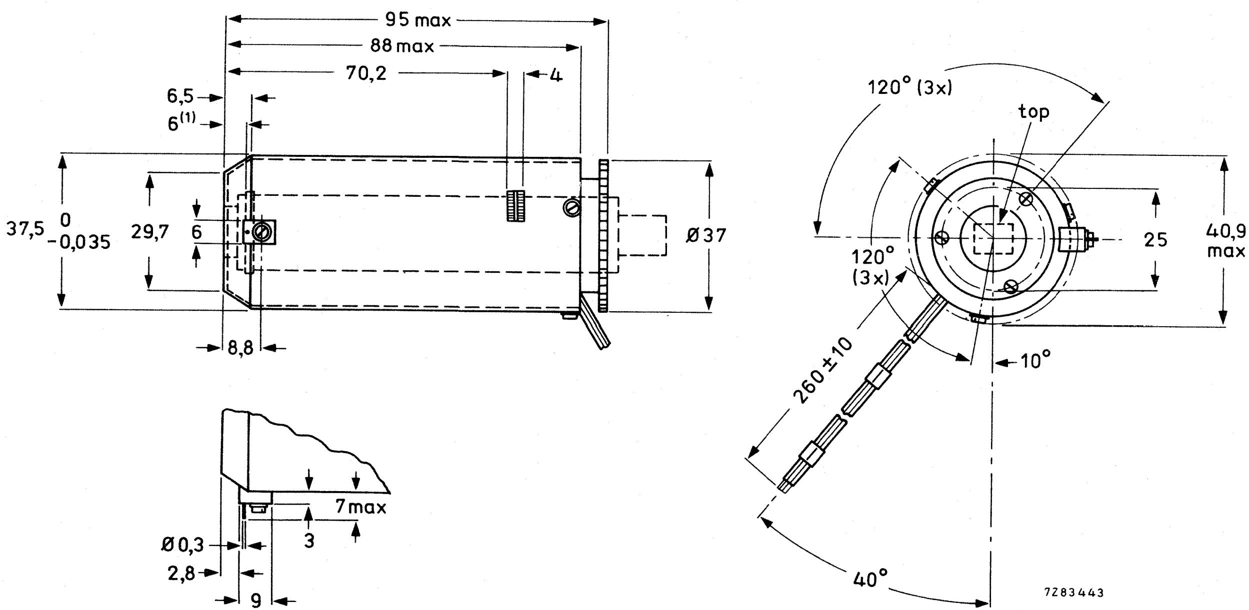
Catalogue number

The catalogue number of the triplet is 3122 137 18280.
The catalogue number of a single unit, AT1109/01S, is 3122 137 18290.

® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm



Mass per unit 230 g

Operating body temperature range −15 to + 65 °C

(1) Nominal distance tube target to front unit.

Fig. 1.

ELECTRICAL DATA (typical values)

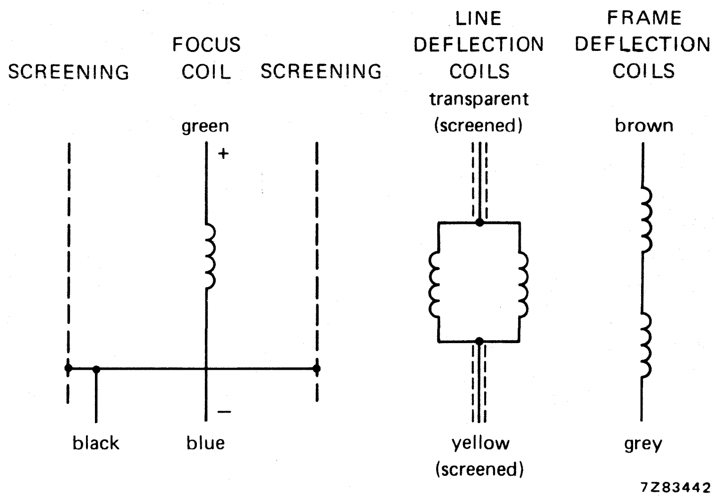


Fig. 2.

coils	inductance mH	resistance Ω	current mA	connections
Line deflection coils	0,91 ± 5%	3,8 ± 10%	260 ± 5% (p-p)	transparent; yellow
Frame deflection coils	2,8 ± 5%	12,7 ± 10%	114 ± 5% (p-p)	brown; grey
Focus coil*		60 ± 10%	120 ± 5%	green; blue

* Polarity: the north-seeking pole of a compass should be attracted to the image end of the unit.

Requirements for normal operation (XQ1427; XQ2427)

Tube setting	V_{g2}	=	300	V	with respect to cathode potential
	V_{g3}	=	430	V	
	V_{g4}*	=	750	V	
	V_{target}	=	45	V	
signal current	I_s	=	150	nA	
beam current	I_b	=	300	nA	
Alignment magnet field intensity		max.	0,24	mT	
		min.	0,015	mT	

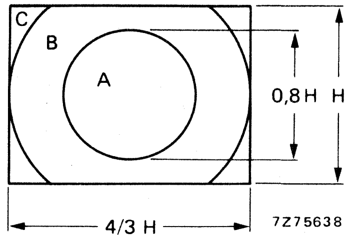


Fig. 3.

Nominal scanning area: 6,6 mm x 8,8 mm
(H = 6,6 mm)

Geometric distortion

Ambient temperature 21 °C.

Measured at operating temperature.

Distortion		
inside circle diam. H	max.	0,5% of picture height
outside circle diam. H	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:

30 ns in zone A
60 ns in zone B
120 ns in zone C

The errors are measured both in horizontal and vertical direction and are expressed in units of 1/52000 of an active scan duration which is equivalent (horizontally) to 1 ns for CCIR corresponding to approximately 0,00256% (25×10^{-6}) related to picture height.

Capacitance of tube target (XQ1427; XQ2427)

The capacitance between the target and the electrodes increases less than 3 pF when the tube is inserted into the deflection unit.

* V_{g4} to be adjusted for minimum beam landing error to compensate for tube tolerances.

DEFLECTION UNITS FOR 2/3-INCH PLUMBICON TUBE

with low output capacitance

QUICK REFERENCE DATA

	inductance	resistance
Line deflection coils	0,91 mH	3,8 Ω
Frame deflection coils	2,8 mH	12,7 Ω
Focus coil		60 Ω

APPLICATION

The AT1109/10 is a triplet of rear-loaded deflection units for use in colour television cameras using 2/3 inch pick-up tubes e.g. Plumbicon® tubes, type XQ3427, with low output capacitance (LOC).

Their small dimensions and low weight make them specially suitable for use in portable ENG cameras.

DESCRIPTION

The deflection units contain the deflection and focus coils and are provided with permanent magnet alignment rings. The effective alignment field intensities and directions can be adjusted, the minimum field strength position is indicated. The focus coil is situated inside the deflection coils, hence the focus power is reduced.
The housing consists of a mu-metal can for optimum screening from external magnetic fields and to form the required magnetic circuit for the deflection fields.
The camera tubes are secured in position by an aluminium nut-ring at the rear of the units and by means of a nylon glass tube.
The first stage of the video preamplifier is built in the yoke.

Warning

No deformation of the calibrated mu-metal housing is allowed as this will strongly influence the performance and adjustments of the units.

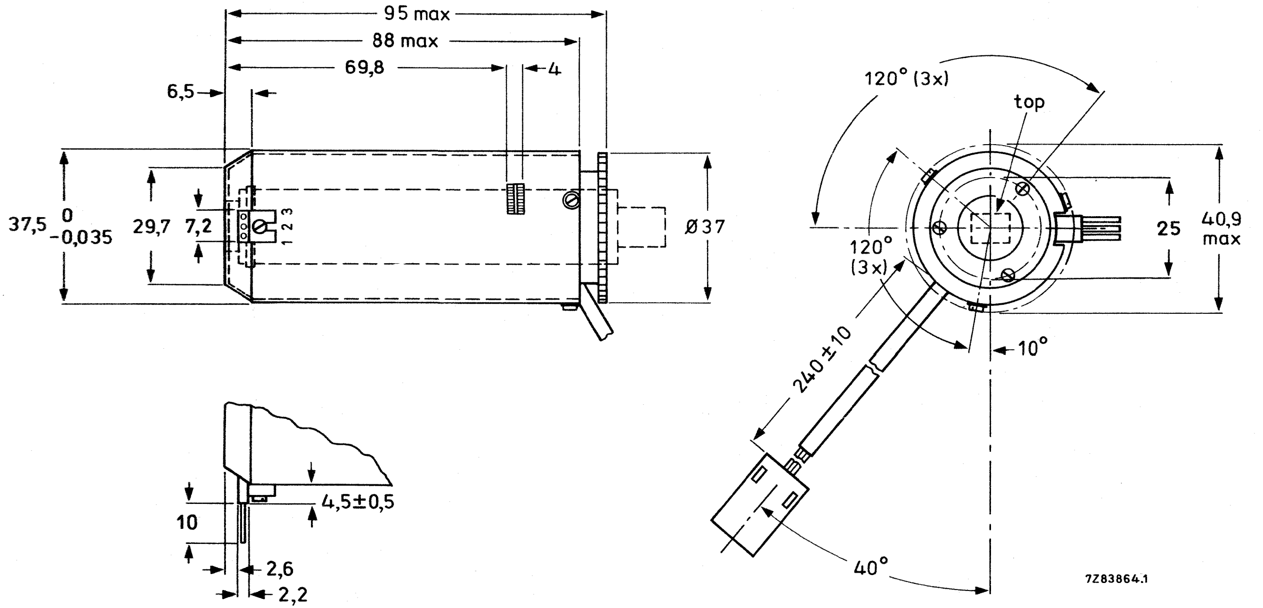
Catalogue number

The catalogue number of the triplet is 3122 137 18730.
The catalogue number of a single unit, AT1109/10S, 3122 137 18720.

® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm



Mass per unit 230 g

Operating body temperature range −15 to +65 °C

Fig. 1.

ELECTRICAL DATA (typical values)

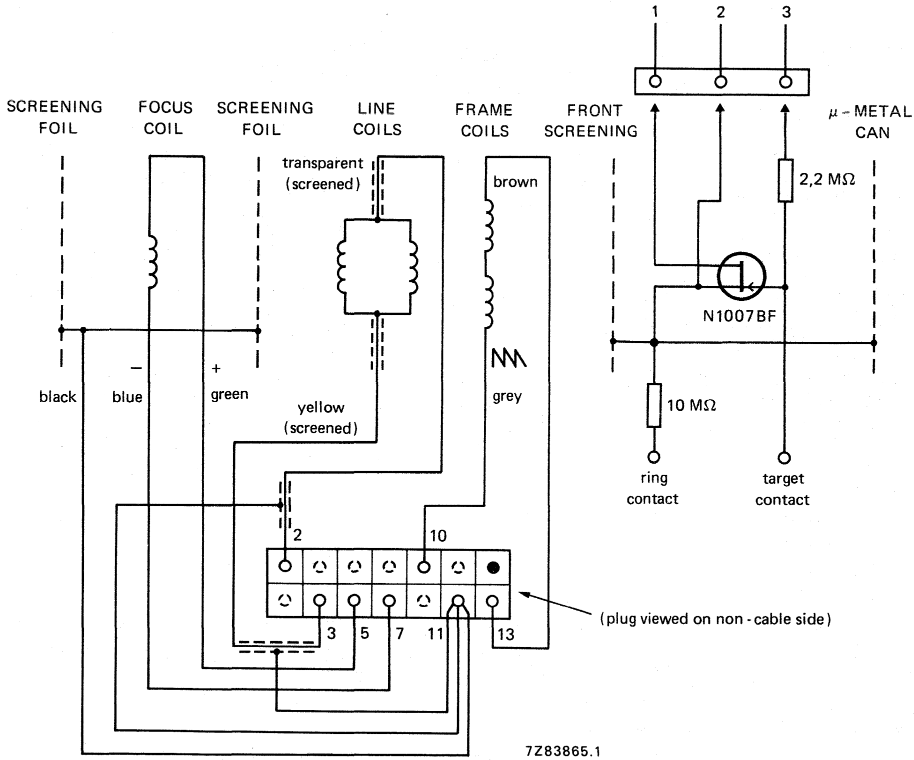


Fig. 2.

coils	inductance mH	resistance Ω	current mA	connections
Line deflection coils	0,91 ± 5%	3,8 ± 10%	230 ± 5% (p-p)	transparent; yellow
Frame deflection coils	2,8 ± 5%	12,7 ± 10%	104 ± 5% (p-p)	brown; grey
Focus coil*		60 ± 10%	115 ± 5%	green; blue

* Polarity: the north-seeking end of a compass should be attracted to the image end of the unit.

Requirements for normal operation (XQ3427).

Tube setting	V_{g2}	=	300 V	with respect to cathode potential
	V_{g3}	=	430 V	
	V_{g4}*	=	750 V	
	V_{target}	=	45 V	
signal current	I_s	=	150 nA	
beam current	I_b	=	300 nA	
Alignment magnet field intensity		max.	0,24 mT	
		min.	0,015 mT	

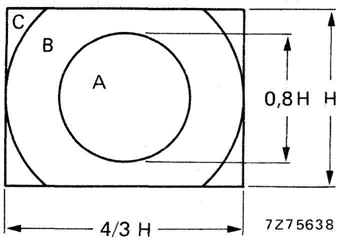


Fig. 3 Nominal scanning area:
6,6 mm x 8,8 mm (H = 6,6 mm).

Geometric distortion

Ambient temperature 21 °C..

Measured at operating temperature.

Distortion

inside circle	max.	0,5% of picture height
outside 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 and are expressed in units of 1/52000 of an active scan duration which is equivalent (horizontally) to 1 ns for CCIR corresponding to approximately 0,00256% (25×10^{-6}) related to picture height.

Capacitance of tube target (XQ3427).

The capacitance between the target and the electrodes increases less than 2 pF when the tube is inserted into the deflection unit.

* V_{g4} to be adjusted for minimum beam landing error to compensate for tube tolerances.

DEFLECTION UNITS FOR 30 mm PLUMBICON TUBE

computer-selected triplet

QUICK REFERENCE DATA

	inductance	resistance
Line deflection coils	0,93 mH	2,3 Ω
Frame deflection coils	22 mH	62 Ω
Focus coil		150 Ω

APPLICATION

The AT1113/03 is a triplet of rear-loaded deflection units for use in broadcast colour television cameras using 30 mm tubes, e.g. Plumbicon® tubes XQ1410 and XQ1520.

DESCRIPTION

The deflection units contain the deflection, alignment and focus coils.
The camera tubes are secured in position by a plastic nut-ring at the rear of a unit. By turning the ring the tube will be pushed forward until it touches the stop.

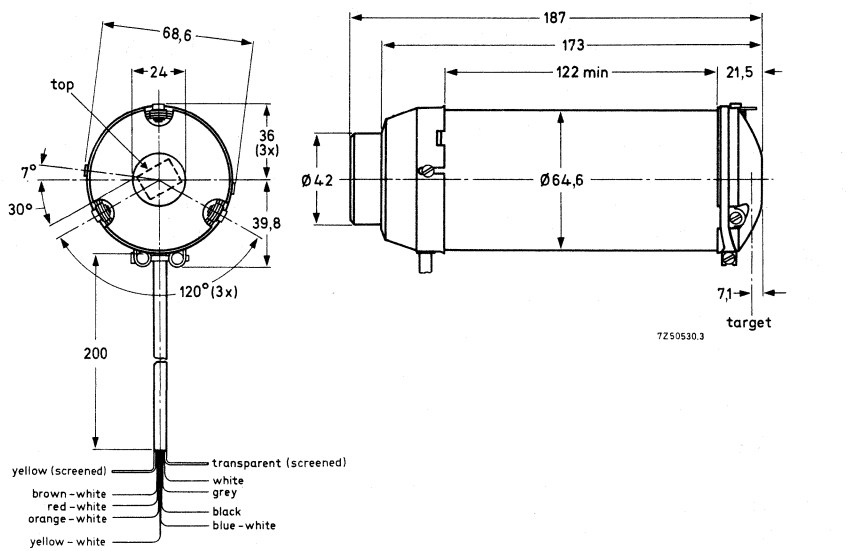
Catalogue number

The catalogue number of the triplet is 3122 107 10570.
The catalogue number of a single unit, AT1113/01, is 3122 108 84400, the alignment coils have a resistance of 390 Ω.

® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm



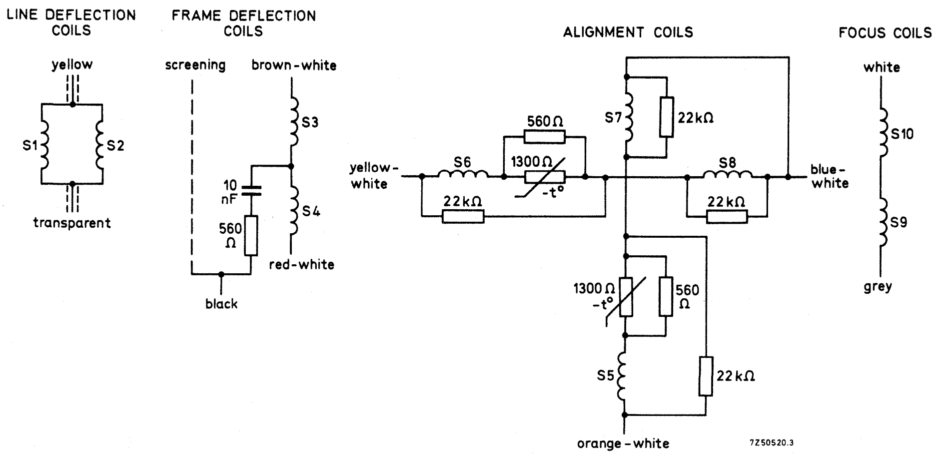
front view

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	0,93 ± 3%	2,3 ± 10%	yellow (screened); transparent (screened)
Frame deflection coils	22 ± 4%	62 ± 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 XQ1410

V_{g3} = 600 V, V_{g4} = 675 V } with respect to the cathode potential.

Nominal scanning area 12,6 mm x 17,1 mm

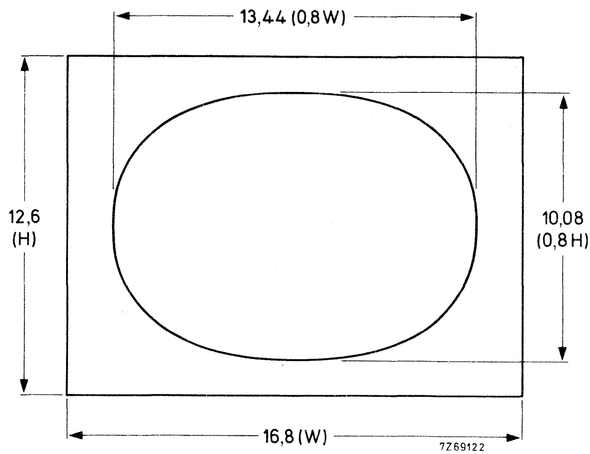
Dynamic focus on V_{g3}

Line deflection current, p-p		210 mA
Frame deflection current, p-p		32 mA
Focus current	approx.	100 mA
Alignment current		1 mA will cause a shift of ⩾ 0,8% of picture height (6,5 mA for 2.10^{-4} T)

Geometric distortion

Distortion, measured with dynamic focus

inside the circle	max. 0,5% of picture height
outside the circle	max. 1% of picture height



* Polarity: the north-seeking pole of a compass should be repelled by the image-end of the unit.

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 measured horizontally and vertically.

Capacity of the tube target

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
Line deflection coils	0,78 mH	2,4 Ω
Frame deflection coils	26 mH	64 Ω
Focus coil		1760 Ω

APPLICATION

The AT1115/01 is a triplet of rear loaded deflection units for use in broadcast colour television cameras using 1-inch tubes, e.g. Plumbicon® tubes XQ1080, XQ1500, XQ2070/02 series.

DESCRIPTION

The deflection units contain the deflection, alignment and focus coils.
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 camera tubes are secured in position by a plastic nut-ring at the rear of a unit. By turning the ring the tube will be pushed forward until it touches the stop. Space has been provided to build in a video pre-amplifier (connections A, C and D see dimensional drawing).

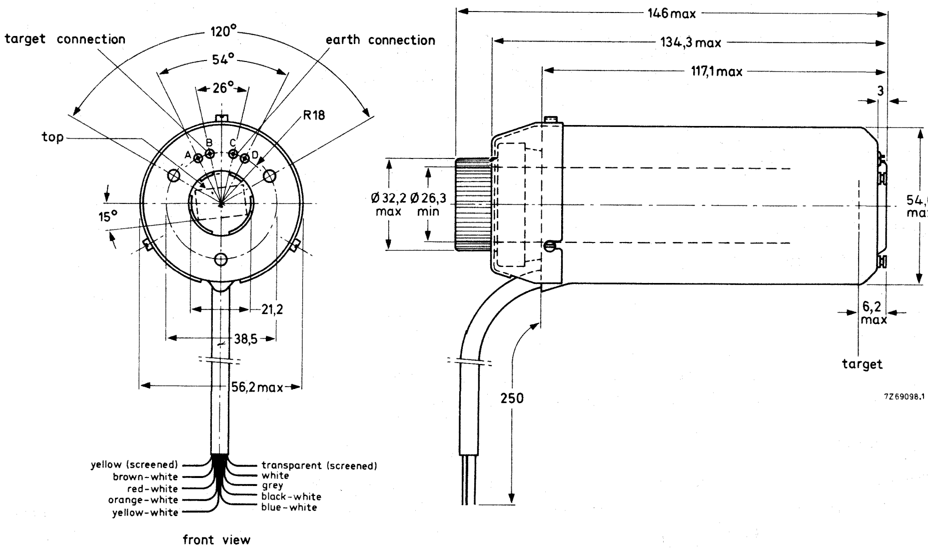
Catalogue number

The catalogue number of the triplet is 3122 137 12710.
The catalogue number of a single unit, AT1119/01, is 3122 137 12700.

® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm



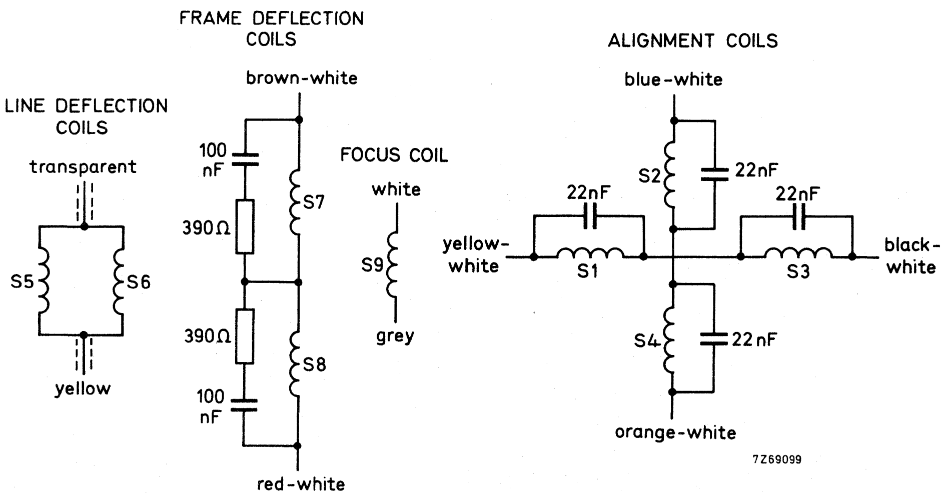
Mass per unit 560 g approx.

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	79 ± 3%	2,1 ± 5%	transparent (screened); yellow (screened)
Frame deflection coils	26	62 ± 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*		1718 ± 10%	grey (+); white (–)

Required currents for normal operation (XQ1080)

Tube setting:

V_{g5} = + 470 V
V_{g6} = + 750 V } with respect to cathode potential

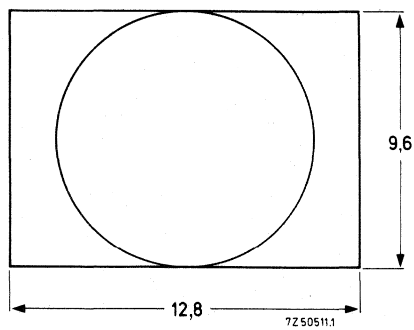
Nominal scanning area: 9,6 mm x 12,8 mm
Dynamic focus on V_{g5}

Line deflection current, p-p	260 mA
Frame deflection current, p-p	36 mA
Focus current	32 mA
Alignment current	1 mA will cause a shift of ≤ 0,6% of picture height

Geometric distortion

Distortion, measured with dynamic focus

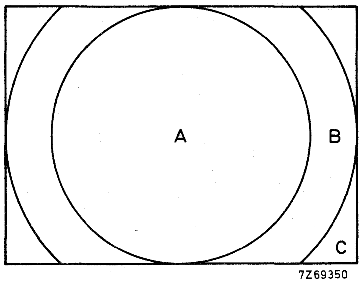
inside the circle	max. 0,5% of picture height
outside the circle	max. 1% of picture height
Skew error	max. 0,4% of picture height



* Polarity: the north-seeking pole of a compass should be attracted to the image end of the unit.

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 measured horizontally and vertically.

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.

Capacitance of the tube target

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
Line deflection coils	0,79 mH	2,2 Ω
Frame deflection coils	28 mH	62 Ω
Focus coil		140 Ω

APPLICATION

The AT1116/06 is a triplet of front loaded deflection units for use in broadcast colour television cameras using 1-inch camera tubes, e.g. Plumbicon® tubes of the XQ1070/03 and XQ2070/03 series.

DESCRIPTION

The deflection units contain the deflection, alignment and focus coils.
The camera tubes are secured in position by a plastic nut-ring at the rear of a unit. By turning the ring the tube will be pushed backward until it touches the stop.

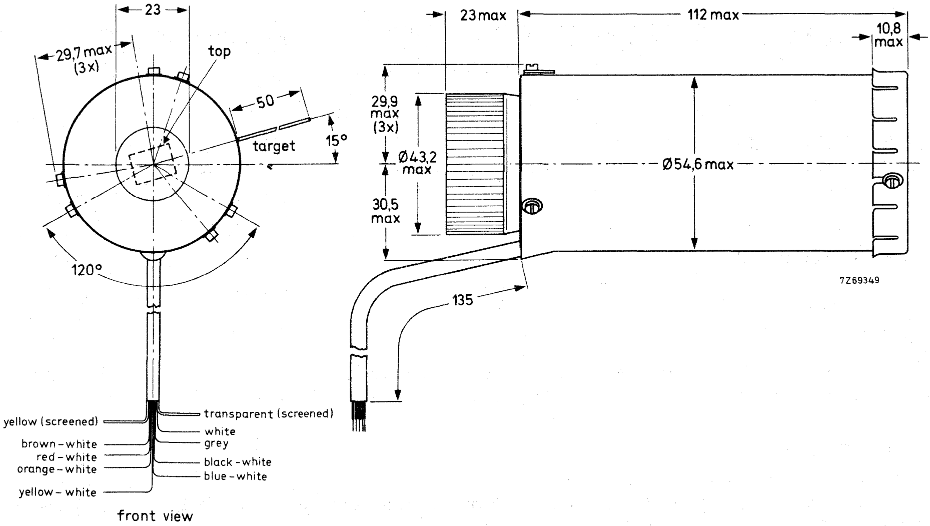
Catalogue number

The catalogue number of the triplet is 3122 137 15040.
The catalogue number of a single unit, AT1116S, is 3122 137 15050.

® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm

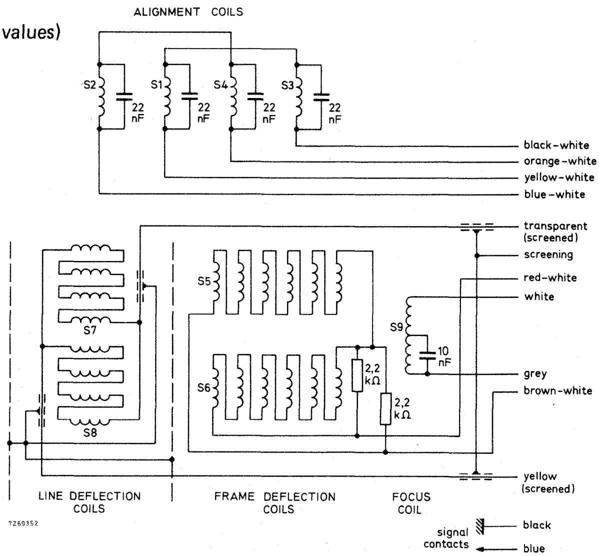


Mass per unit 615 g approx.

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	0,79 ± 5%	2,2 ± 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*		140 ± 10%	grey (+); white (–)

Required currents for normal operation (XQ1070)

Tube setting:

$$\left.\begin{array}{l} V_{g3} = +600\ V \\ V_{g4} = +960\ V \end{array}\right\}$$ with respect to cathode potential

Nominal scanning area: 9,6 mm x 12,8 mm

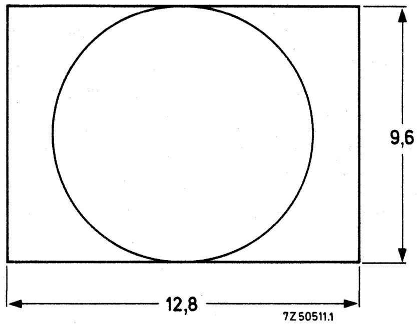
Line deflection current, p-p	280 mA
Frame deflection current, p-p	34 mA
Focus current	108 mA
Alignment current	1 mA will cause a shift of 0,6% of picture height

* Polarity: the north-seeking pole of a compass should be attracted to the image end of the unit.

Geometric distortion

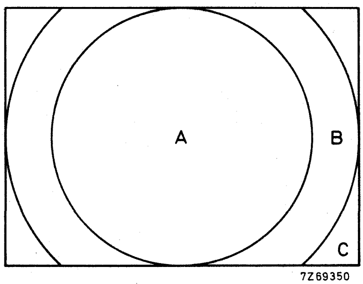
Distortion

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 measured horizontally and vertically.

DEFLECTION UNITS FOR 1-INCH PLUMBICON® TUBES

with low output capacitance

QUICK REFERENCE DATA

	inductance	resistance
Line deflection coils	0,800 mH	2,2 Ω
Field deflection coils	4,4 mH	10 Ω
Focus coil		1300 Ω

APPLICATION

The AT1126 is a triplet of rear-loaded deflection units for use in colour television cameras using 1 inch pick-up tubes e.g. Plumbicon® tubes, types XQ1500 and XQ3070, with low output capacitance (LOC).

DESCRIPTION

The deflection units contain the deflection, focus and alignment coils.
The housing is a mu-metal can for optimum screening from external magnetic fields and to form the required magnetic circuit for the deflection fields.
The camera tubes are secured in position by a threaded ring at the rear of the units.
The first stage of the video preamplifier is built into the yoke.

Warning

The mu-metal housing must not be deformed as this will strongly influence the performance and adjustments of the units.

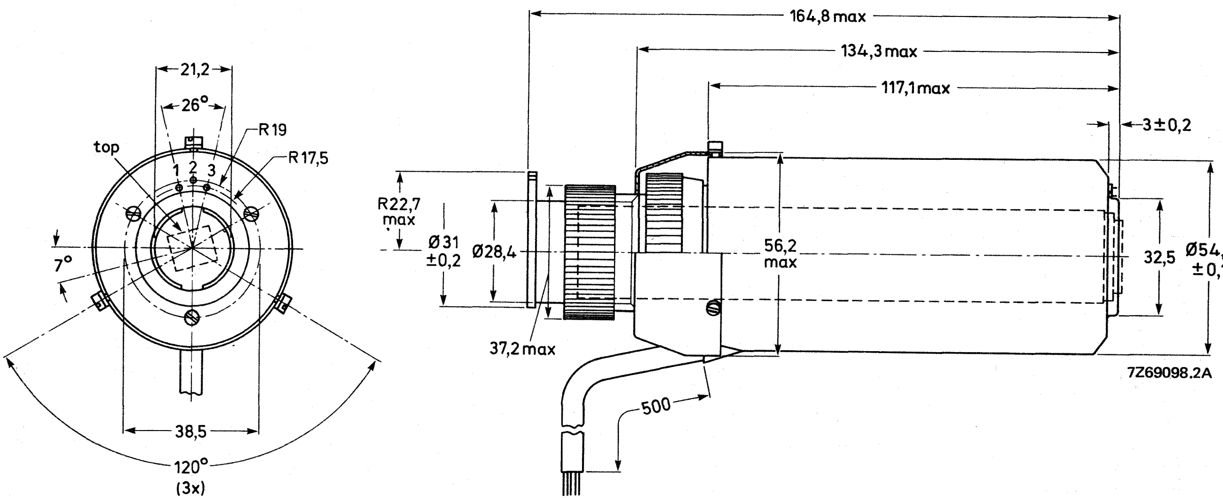
Catalogue number

Triplet AT1126: 3122 137 19060;
Single unit AT1126S: 3122 137 19050.

® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm



Mass per unit 700 g

Operating body temperature range −15 to + 65 °C

Fig. 1.

ELECTRICAL DATA (typical values)

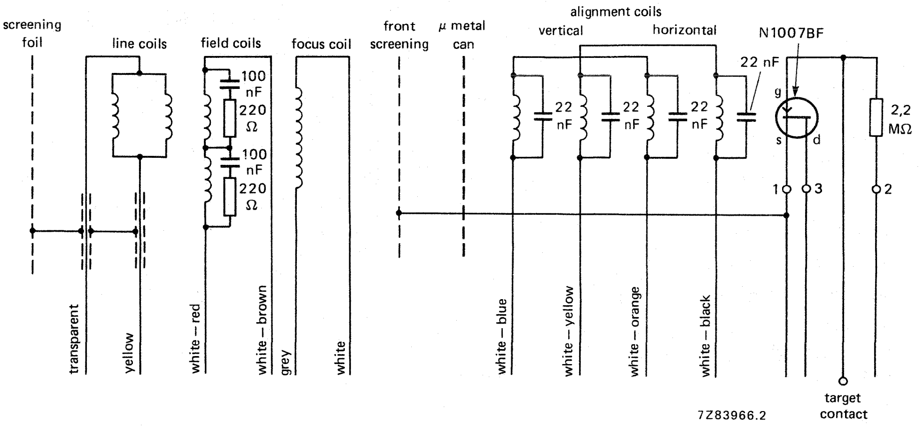


Fig. 2.

coils (see Fig. 2)	inductance mH	resistance Ω	current mA
Line deflection coils	0,800 ± 5%	2,2 ± 10%	230 ± 5% (p-p)
Field deflection coils	4,4 ± 5%	10 ± 10%	80 ± 5% (p-p)
Focus coil*		1300 ± 10%	30 ± 5%
Alignment coils		530 ± 10%	

* Polarity: the image end of the unit should attract the north pole of a compass.

Requirements for normal operation (XQ1500)

Tube setting	$V_{g2,g4}$	=	300 V	with respect to cathode potential
	V_{g5}	=	475 V	
	V_{g6}*	=	750 V	
	V_{target}	=	45 V	
signal current	I_s	=	200 nA	
beam current	I_b	=	400 nA	

Alignment current of 1 mA will cause a shift of ⩽ 0,7% of picture height.

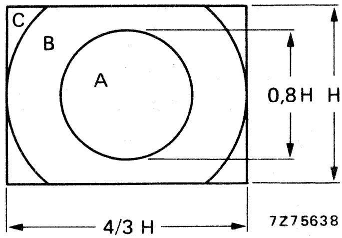


Fig. 3.

Nominal scanning area: 9,6 mm x 12,8 mm (H = 9,6 mm)

Geometric distortion

Ambient temperature 21 °C.

Measured at operating temperature.

Distortion		
inside zone A	max.	0,5% of picture height
outside zone A	max.	1% of picture height
Skew error	max.	0,5% of picture height

Registration

The misregistration in any triplet (measured after skew correction) is not greater than:

40 ns in zone A
50 ns in zone B
80 ns in zone C

The errors are measured both in horizontal and vertical direction and are expressed in units of 1/52000 of an active scan duration which is equivalent (horizontally) to 1 ns for CCIR corresponding to approximately 0,00256% (25×10^{-6}) related to picture height.

Capacitance of tube target

The capacitance between the target and the electrodes increases less than 3,5 pF, when the tube is inserted into the deflection unit, and measured without FET-preamplifier.

* V_{g6} to be adjusted for minimum beam landing error to compensate for tube tolerances.

DEFLECTION UNITS FOR 30 mm PLUMBICON® TUBE

QUICK REFERENCE DATA

	inductance	resistance
Line deflection coils	0,835 mH	2,1 Ω
Field deflection coils	5,5 mH	14,5 Ω
Focus coil		1125 Ω

APPLICATION

The AT1130 is a triplet of rear-loaded deflection units for use in colour television cameras using 30 mm pick-up tubes e.g. Plumbicon® tubes, types XQ1410, XQ1520.

DESCRIPTION

The deflection units contain the deflection, focus and alignment coils.
The housing is a mu-metal can for optimum screening from external magnetic fields and to form the required magnetic circuit for the deflection fields.
The camera tubes are secured in position by a threaded ring at the rear of the units.
The first stage of the video preamplifier is built into the yoke.

Warning

The mu-metal housing must not be deformed as this will strongly influence the performance and adjustments of the units.

Catalogue number

Triplet AT1130: 3122 137 18880;
Single unit AT1130S: 3122 137 18890.

® Registered Trade Mark for television camera tube.

MECHANICAL DATA

Dimensions in mm

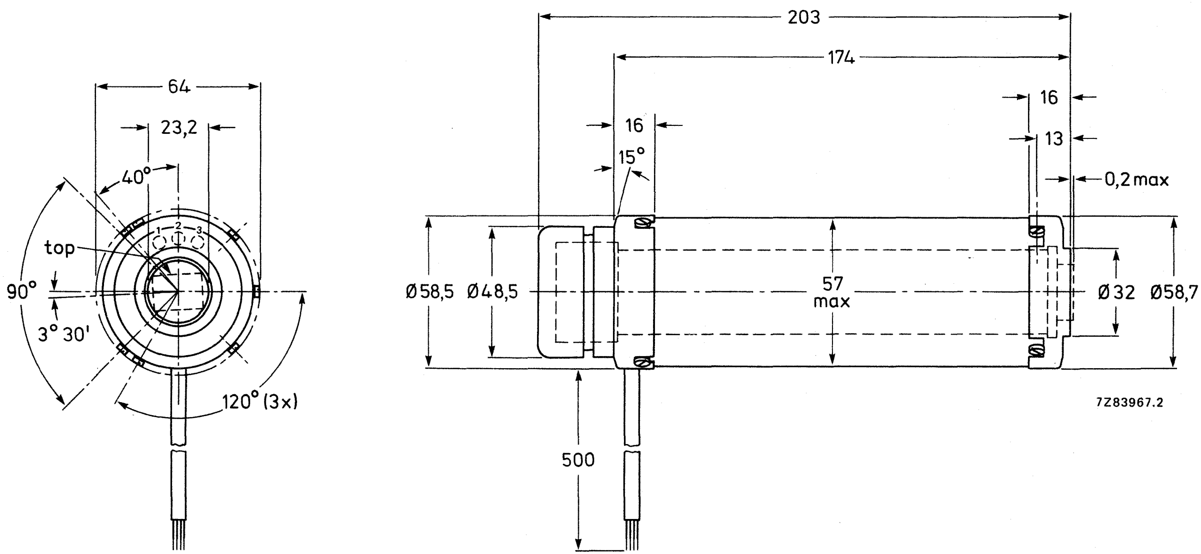


Fig. 1.

Mass per unit approx. 865 g

Operating body temperature range −15 to + 65 °C

ELECTRICAL DATA (typical values)

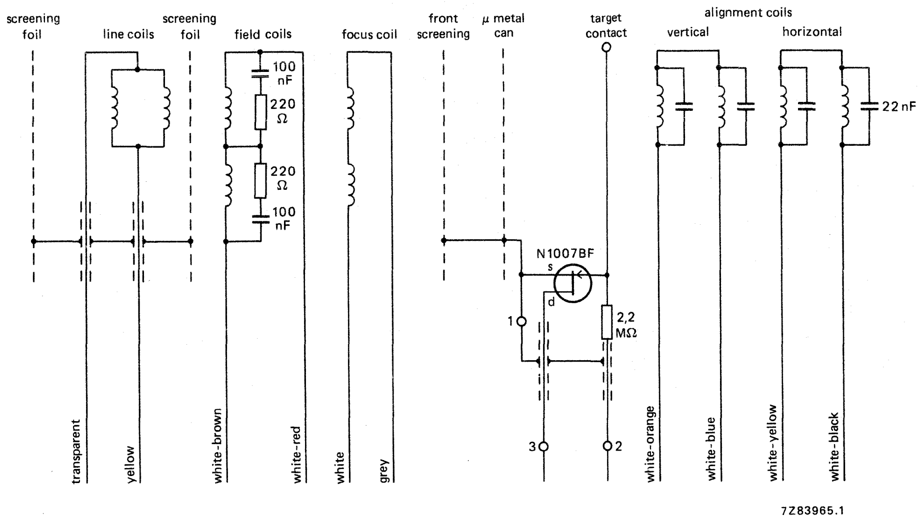


Fig. 2.

coils (see Fig. 2)	inductance mH	resistance Ω	current mA
Line deflection coils	0,835 ± 5%	2,1 ± 10%	180 ± 5% (p-p)
Field deflection coils	5,5 ± 5%	14,5 ± 10%	55 ± 5% (p-p)
Focus coil*		1125 ± 10%	35 ± 5%
Alignment coils		530 ± 10%	

* Polarity: the image end of the unit should repel the north pole of a compass.

DEVELOPMENT SAMPLE DATA

Requirements for normal operation (XQ1410)

Tube setting	V_{g2}	=	300 V	with respect to cathode potential
	V_{g3}	=	600 V	
	V_{g4}*	=	675 V	
	V_{target}	=	45 V	
signal current	I_s	=	300 nA	
beam current	I_b	=	600 nA	

Alignment current of 8,8 mA will cause a flux of 0,2 mT.

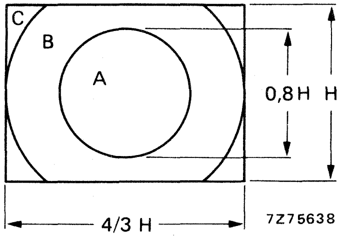


Fig. 3.

Nominal scanning area: 12,8 mm x 17,1 mm (H = 12,8 mm)

Geometric distortion

Ambient temperature 21 °C.

Measured at operating temperature.

Distortion		
inside zone A	max.	0,5% of picture height
outside zone A	max.	1% of picture height
Skew error	max.	0,5% of picture height

Registration

The misregistration in any triplet (measured after skew correction) is not greater than:

40 ns in zone A
50 ns in zone B
80 ns in zone C

The errors are measured both in horizontal and vertical direction and are expressed in units of 1/52000 of an active scan duration which is equivalent (horizontally) to 1 ns for CCIR corresponding to approximately 0,00256% (25×10^{-6}) related to picture height.

Capacitance of tube target (XQ1410, XQ1520)

The capacitance between the target and the electrodes increases less than 5,5 pF when the tube is inserted into the deflection unit.

* V_{g4} to be adjusted for minimum beam landing error to compensate for tube tolerances.

IMAGE INTENSIFIERS K

SURVEY OF TYPES

Image intensifiers

category and types	input/output dia mm	input	output	power supply unit	gain	typ. photocathode sensitivity white 2856K	800 nm	850 nm	MTF (%) at lp 2,5	7,5	15	optical length mm	mass g	catalogue number	page
I First generation, electro-optic inverter types															
25XX	50/16	FO	FO	excl	1000	175	15	10	90	55	25	105	420	9300 776 80000	K45
II Second generation, micro-channel plate (MCP)															
A. Electro-optic inverter types															
XX1332	50/40	FO	FO	incl.	45 000	310	28	17	80	55	20	100	850	9300 718 20000	K9
XX1380	20/30	FO	FO	incl.	7 000	330	32	27	92	75	45	80	350	9300 827 50000	K13
XX1381	20/30	FO	FO	incl.	7 000	330	32	27	92	75	45	80	350	9300 827 60000	K13
XX1382	20/30	FO	FO	incl.	7 000	330	32	27	92	75	45	80	350	9300 866 90000	K13
XX1383	20/30	FO	FO	incl.	7 000	330	32	27	92	75	45	80	350	9300 867 00000	K13
XX1500	18/18	FO	FO	incl.	5-50 000 adj.	350	35	25	85	65	30	54,6	185	9300 839 10000	K25
XX1500TV	15 x 11/18	FO	FO	incl.	65 000	350	35	25	85	65	30	54,6	185	9300 904 30000	K25
XX1501	18/18	FO	FO, concave	incl.	5-50 000 adj.	350	35	25	85	65	30	54,6	185	9300 904 40000	K25
B. Proximity focused types															
XX1390	18/18	glass	glass, n. inv.	n. incl.	15 000	220	12	4	25 lp/mm			2	35	9300 812 70000	K18
XX1410	18/18	FO	FO, concave inv.	incl.	10 000	350	35	20	86	58	20	26,6	< 100	9300 814 50000	K21
P453	18/18	FO	FO flat, inv.	incl.	10 000	350	35	20	86	58	20	27	< 100	9300 982 40000	K32
P454	18/18	FO	FO flat, n. inv.	incl.	10 000	350	35	20	86	58	20	19	< 100	9300 881 30000	K35
P455	18/18	FO	FO flat, n. inv.	incl.	10 000	350	35	20	86	58	20	12,3	< 100	9300 881 40000	K38
P457	18/18	FO	FO concave n. inv.	incl.	10 000	350	35	20	86	58	20		< 100	9300 982 30000	K41

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 (MCP) types.

1.1 The photocathode

The properties of the photocathode are described by the spectral response and the sensitivity.
The latter 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 colour temperature of 2856 ± 50 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 fibre-optic input window.

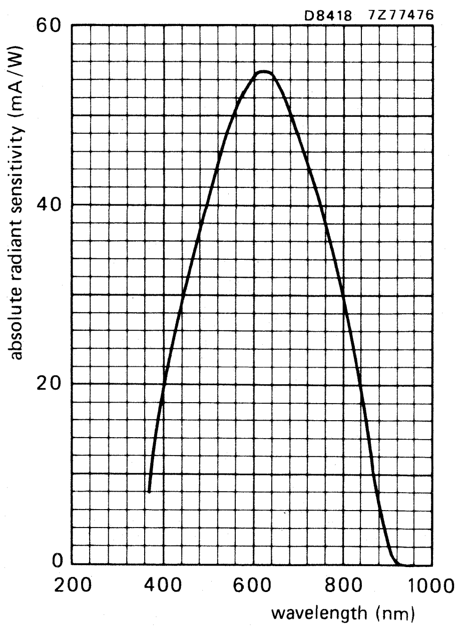


Fig.1 Typical S25 spectral response

1.2 The electron-optical lens

All our image intensifiers are electrostatically focused. The design of the electron-optics determines such parameters 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. In addition to the P20 phosphor, a mixed phosphor is used in some intensifiers. This has the same spectral emissivity as the P20 type, but has a longer decay time.

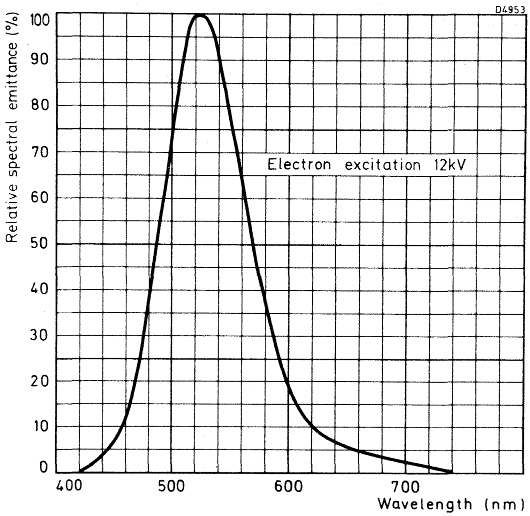


Fig.2 Typical P20 spectral emissivity

The decay time of the output phosphor of an image intensifier is the time taken for the screen luminance to fall to 37% (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 that of a single phosphor.

2. CHARACTERISTICS

2.1 Gain

The gain of an image intensifier is expressed as gain = $\frac{\pi L_o}{E_i}$ where L_o = luminance (cd/m^2) in a direction normal to the screen, measured with an eye corrected photometer having an acceptance angle of less than 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 colour temperature of 2856 ± 50 K. The data describing the characteristics of a particular image intensifier states 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.
Automatic Brightness Control (ABC) is a means of limiting the screen brightness at high levels of photocathode illuminance. Where appropriate, the ABC characteristics are given in the data.

2.3 Magnification and distortion

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 $M_d = \frac{\phi_s}{\phi_d}$. Similarly the edge magnification is measured for a circle of diameter ϕ_D on the photocathode. This will present a circle of diameter ϕ_S at the screen. The edge magnification is $M_D = \frac{\phi_S}{\phi_D}$. 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. 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 pin cushion effect (Fig.3).
This cause of distortion cannot occur in proximity microchannel plate image intensifiers, although the addition of 'twister' fibre-optics for image inversion may introduce a small amount of optical distortion. Distortion in image intensifiers is expressed as percentage distortion $(\frac{M_D}{M_d} - 1) \times 100$.

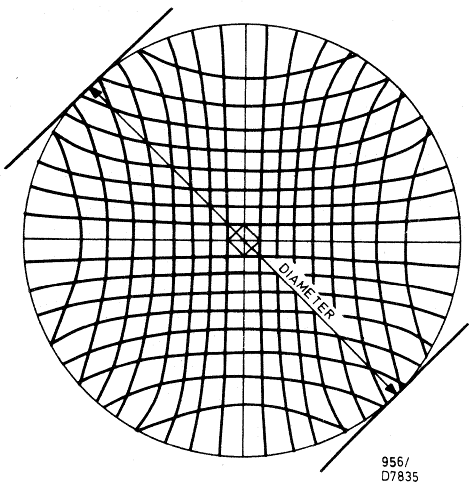


Fig.3
Exaggerated pin cushion effect

2.4 Limiting resolution and modulation transfer factors

An important characteristic of any image device is its ability to present information without degrading the image. Limiting resolution and modulation transfer factors both provide indications of this ability. The limiting resolution measurement is made by viewing a standard resolution test chart. The limiting 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 1:1 and contrast approaching 100%). The resolution pattern is imaged on the photocathode using a high quality projection system and the screen is examined with a microscope of at least x 10 magnification.
Two figures are normally given (in line pairs/mm); the centre resolution and the resolution at a distance from the centre $\frac{\phi_E}{2}$. The latter is known as the edge resolution.

Specifying limiting resolution is a practice that has been adopted from photography.
A more appropriate characteristic is the Modulation Transfer Function (MTF). This is a measurement 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. These measurements may be specified in published data with reference to the photocathode or to the screen.

3. EQUIVALENT BACKGROUND ILLUMINATION (EBI)

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 EBI is the input illuminance required to give an increase in screen brightness equivalent to the background brightness.

4. SIGNAL TO NOISE RATIO

The signal to noise ratio of the image arriving at the input window deteriorates as it passes through the intensifier. In first generation devices most of this deterioration occurs at the photocathode and is directly related to the photocathode sensitivity. In second generation devices there is additional deterioration at the input of the microchannel plate. The signal to noise ratio of the device is determined by measuring the signal to noise ratio of the image at the screen of a small, uniformly illuminated area on the photocathode.

5. PICTURE QUALITY

In all image intensifiers some minor blemishes may occur which will not affect normal use of the devices. A blemish is defined as a dark or bright area with a contrast greater than 30% with respect to the immediately surrounding area. The picture quality of all intensifiers is assessed using a magnifier of between x 5 and x 10 magnification. There is a difference in the appearance between an intensified image viewed directly through a magnifier and that viewed through a TV system.

6. SCREEN LUMINANCE RATIO

This is sometimes known as output brightness uniformity and 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 as specified (A_R).

7. IMAGE ALIGNMENT

The geometric 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.

8. 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 damage the intensifier. Some intensifiers incorporate automatic control of brightness or gain, (ABC or AGC). These reduce the screen luminance but do not necessarily reduce the photocathode current. Whenever possible, the photocathode illuminance should comply with the recommended operating conditions where given in the data.

9. STORAGE AND HANDLING

Intensifiers should be stored in a desiccated, airtight container in a room where the temperature is controlled at between 5 and 20 °C. For storage in environmental conditions differing from those specified, the manufacturer should be consulted. The devices must be handled with 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 end caps should not be removed until the intensifier is about to be mounted in the equipment.

10. MOUNTING

There is no restriction on the orientation of an intensifier when mounted in equipment. However, every care should be taken to ensure that no conductive component of the equipment is within 10 millimetres of the input and output windows (see also section 11). The intensifier should be mounted in equipment in such a way that any axial forces are applied only to the bearing surfaces and never to the input or output windows.

11. 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 throughout the operating temperature range. 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 input or output windows 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 advisable to discharge this connector by connecting it to the cathode contact ring and earth.

The photocathode and screen may operate at high potentials with respect to the chassis. In cascade image intensifiers the screen is at +45 kV and the photocathode at chassis potential. The screen and cathode windows of microchannel plate image intensifiers are at opposite potentials of approximately 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.

12. SUPPLY VOLTAGE (see also section 11)

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.

The length of the connecting leads to the intensifier should be kept to a minimum. **For non-dry battery-powered applications a 10 μF capacitor should be connected in parallel with microchannel plate image intensifiers.**

13. RECOVERY TIME

For integral oscillator cascade image intensifiers, this 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.

14. OUTLINE DRAWING

The outline drawing given in the data shows only the major dimensions of the device. The manufacturer should be consulted when equipment is being designed.

15. SAFETY

Image intensifiers with integral power supplies offer no risk during normal operation within night vision equipment. However, an operator may be dazzled temporarily when night vision equipment using certain types of cascade image intensifiers is subjected to a sudden large 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 should not be detrimental to health.
Unencapsulated intensifiers operate at high d.c. potentials. Under no circumstances should they be used without prior reference to the manufacturer.
After operation, an intensifier may retain a charge of several kV for a number of hours. Fibre-optic or glass face plates, or any metal component of the intensifier, must not be touched by the operator or allowed to come into contact with any conductive material. Failure to observe these precautions may cause irreparable damage to the intensifier and may be hazardous to the operator. In the case of cascade image intensifiers without integral oscillators, it is permissible to remove the potential at the input contact by discharging it to the cathode contact.
If the device is broken or damaged, precautions must be taken against the following hazards which may arise:

1. Broken glass. Protective clothing, such as rubber gloves, should be used.
2. Contamination by photocathode and fluorescent screen materials. In particular, skin contact and inhalation of these materials should be avoided.
3. Disposal by incineration. This is not recommended as toxic fumes may emanate.
   When any other method of disposal is used, the warnings given in 1 and 2 above must be observed.

16. ADDITIONAL INFORMATION

Comprehensive details of the mode of operation and the usage of image intensifiers are given in the publication entitled 'Technical Information — Image Intensifiers'.

17. WARNING

Image intensifiers are very high vacuum devices, and any deteriation in the vacuum will lead to a shortening of their useful life. Due to the permeability of helium it is imperative that the intensifier is not subjected to excessive concentrations of helium. This is particularly important whilst the equipment incorporating the intensifier is being purged. For this operation helium free gas must be used.

IMAGE INTENSIFIER

The XX1332 is an electrostatically self-focused, inverting microchannel 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 (AGC). Point highlight saturation and bright source protection are features of this intensifier. It is primarily intended for use in night vision systems.

This data must be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS – IMAGE INTENSIFIERS.

RECOMMENDED SUPPLY VOLTAGE	typ.	6,5	V
INPUT CURRENT	typ.	32	mA
	max.	50	mA

CHARACTERISTICS (Measured at 22 ± 3 °C with recommended supply voltage)

Photocathode

Surface: S25

	min.	typ.		
Useful diameter	48,8			mm
Sensitivity				
white light	250	310		μA/lm
λ = 800 nm	20	28		mA/W
λ = 850 nm	10	17		mA/W

Screen

Phosphor: P20, aluminized

Window: plane, fibre-optic

	min.	typ.	max.	
Useful diameter	38,8			mm
Gain, ϕ_G = 22,5 mm, $E_i \approx$ 50 μlx	30 000	45 000*	60 000	
Mean screen luminance, ϕ_G = 22,5 mm, $E_i \approx$ 20 mlx	4	6,5	8	cd/m²
Centre magnification, ϕ_d = 4,0 mm	0,61	0,66	0,71	
Edge magnification, ϕ_D = 40 mm	0,71	0,74	0,77	
Centre resolution	18	23		line pair/mm
Edge resolution, ϕ_E = 28 mm	18	20		line pair/mm
Modulation transfer factors, note 1				
5 cycles/mm	0,80	0,86		
10 cycles/mm	0,55	0,63		
20 cycles/mm	0,20	0,30		
Equivalent background illumination (EBI)		0,08	0,2	μlx
Image alignment			2,0	mm
Recovery time		0,2	0,5	s
Veiling glare		0,8	1	%
Supply current, $E_i < 1{,}0$ lx			50	mA
Mass			850	g
Mounting position		any		

* Preset by manufacturer.

RATINGS (Limiting values in accordance with the Absolute Maximum System IEC134)

Supply voltage (note 2)	max.	6,75	V
Photocathode illuminance	max.	1,0	lx
T_{amb} (for storage, 100 h cumulative)	max.	70	°C
	min.	−20	°C
T_{amb} (for operation and long term storage)	max.	35	°C
	min.	−20	°C
T_{amb} (for operation, 2 h max.)	max.	52	°C
	min.	−40	°C
Axial force between bearing surfaces	max.	150	N

QUALIFICATION APPROVAL

Qualification approval to DEF STAN 59-60/90/089, Issue 2, September 1980 has been obtained. Testing of the various characteristics is normally carried out as required by that specification. Intensifiers can be supplied with certificates of conformity to the DEF STAN specification.

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.

ENVIRONMENTAL TESTS

Shock	6 shocks, half-sinewave, pulses of peak acceleration 981 m/s^2, duration 6 ms, in 3 mutually perpendicular directions.
Vibration	Sinewave, displacement 0,15 mm over frequency range 10 to 58 Hz, peak acceleration 19,6 m/s^2 over frequency range 58 to 150 Hz, in 3 mutually perpendicular directions.
Temperature cycle	8½ h cycle including 1½ h storage at −40 °C, operation at −40 °C, 2 h storage at +70 °C, operation at 52 °C and 22 °C.

PHOTOCATHODE ILLUMINANCE

Recommended level	max. 10 mlx. The intensifier may be used at illumination levels up to 1,0 lx but for continuous operation the recommended maximum illumination is 10 mlx.
Room lighting	no damage, with no applied voltage.
Point light sources, such as car lights, flares, tracers, flashers, etc.	no damage.

Prolonged operation with illuminance exceeding 10 mlx can reduce the life of the intensifier. This corresponds to the scene illuminance of deep twilight when the intensifier is incorporated in a typical sight.

LIFE EXPECTANCY

Cathode illumination 1 mlx min. 2000 h

Cathode illumination 100 μlx min. 5000 h

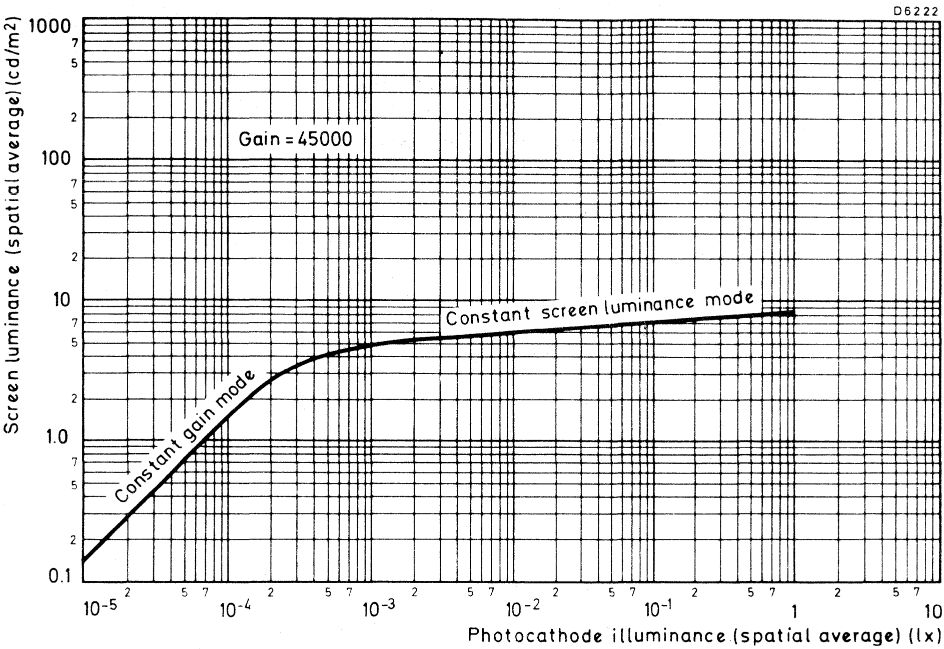


Fig. 1 Typical automatic brightness control characteristic.

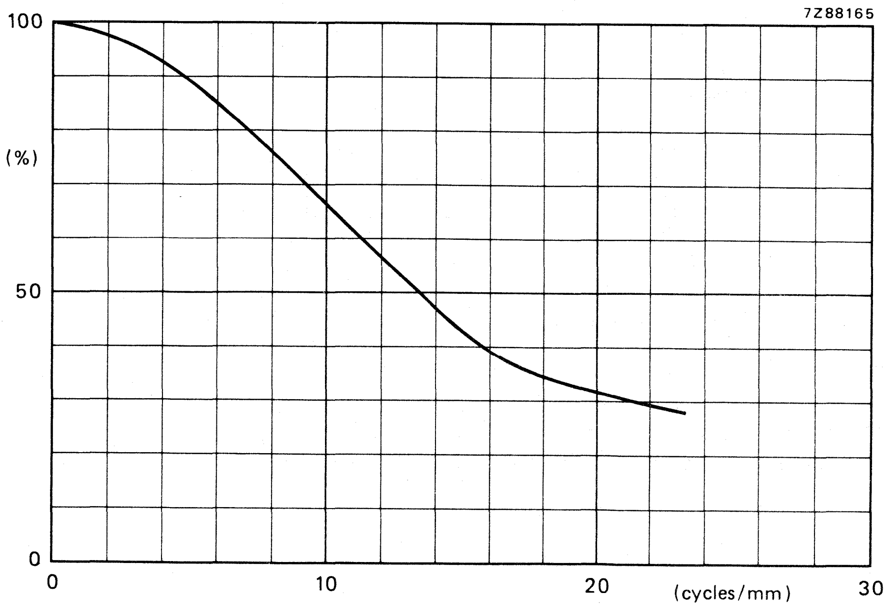
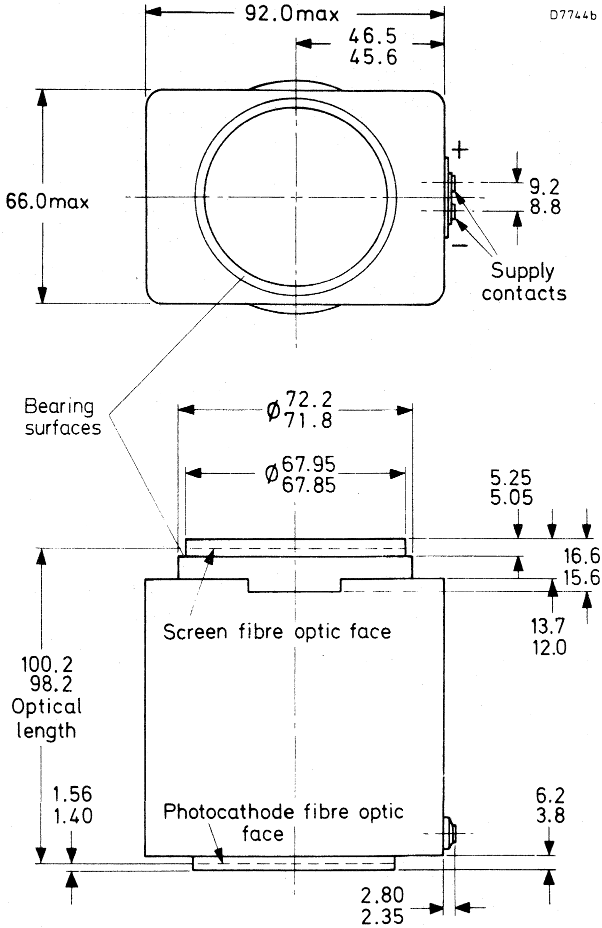


Fig. 2 Typical MTF curve.

OUTLINE DRAWING

Dimensions in mm



Force on supply contacts must not exceed 10 N

NOTES

1. Measured before the power supply is fitted. These values are normalized at zero spatial frequency and are referred to the screen.
2. If the supply voltage falls below 6,0 V, the intensifier will not be damaged, but may not function.

IMAGE INTENSIFIERS

Self-focusing magnifying compact microchannel plate image intensifiers 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 these intensifiers include, point highlight saturation, low distortion, high resolution, and precision engineered reference surfaces. The intensifiers have 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.

	min.	typ.	max.	unit	notes
Photocathode surface		S25			
Useful photocathode diameter	19,5	20		mm	
Photocathode sensitivity					
white light	225	330		μA/lm	
λ = 800 nm	20	32		mA/W	
λ = 850 nm	15	27		mA/W	
Screen phosphor	aluminized P20 type				
Overall phosphor persistence XX1380, XX1382	medium long				
XX1381, XX1382	medium				
Useful screen diameter	30			mm	
Gain, ϕ_G = 7,5 mm, $E_i \approx 50\ \mu$lx preset in the range	15 000		18 000		1
Mean screen luminance, $E_i \approx$ 10 mlx, Fig. 2					
XX1380, XX1382	1		6	cd/m^2	
XX1381, XX1383	1		3	cd/m^2	
Linear screen luminance		10		cd/m^2	2
Centre magnification, ϕ_d = 2,5 mm		1,5			
Distortion, ϕ_D = 16 mm		2	3	%	3
Centre resolution	44	48		line pair/mm	
Edge resolution, ϕ_E = 16 mm	40	45		line pair/mm	
Reduced area modulation transfer factors, Fig. 3					4, 5
at 2,5 cycle/mm	92			%	
at 7,5 cycle/mm	75			%	
at 15 cycle/mm	45			%	
Equivalent background illumination (EBI)			0,2	μlx	
Image alignment			1,0	mm	
Screen luminance ratio			2		
Signal-to-noise ratio XX1380, XX1382	4,5	6,0			6
XX1381, XX1383	2,8	3,6			6

CHARACTERISTICS (continued)

	min.	typ.	max.		notes
Mass			350	g	
Mounting position		any			
→ Supply current, XX1380, XX1381		35	42	mA	
→ XX1382, XX1383			35	mA	

RECOMMENDED OPERATING CONDITIONS

			notes
Supply voltage (negative to case), d.c.	2,6	V	9
Photocathode illuminance	100	μlx	
Ambient temperature	25 ± 5	°C	

LIMITING VALUES

(Absolute maximum rating system)	min.	typ.	max.		notes
Supply voltage (d.c.)			3,4	V	7
Photocathode illuminance during storage (max. 1 h)			5000	lx	8
Ambient operating temperature	−40°		52	°C	
Ambient storage temperature	−55°		60	°C	
Axial bearing force between surfaces M and N			250	N	

SHOCK AND VIBRATION RESISTANCE

The following test conditions are applied on a sampling basis to access the mechanical quality of the intensifiers.

Shock 1

The device is subjected 6 times to a peak acceleration of 500g parallel to the 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. ⊥ longtitudinal 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 10 Hz in a logarithmic sweep rate of 30 min.

MOUNTING

The intensifier should be mounted only between bearing surfaces M and N.
Surface M is defined by the diameters 39 mm and 35 mm at the photocathode end.
Surface N is defined by the diameters 58 mm and 61 mm at the screen end.

The tube is in its preferred position, when the slot of the tube is at the bottom. See A-A in Fig. 1.

Notes

1. Gain may be defined as L_o/E_i cd/m²/lx or as $\pi\ L_o/E_i$. The latter is dimensionless. On request the gain can be set at max. 25000.
2. Below this level the local screen luminance and photocathode illuminance are linearly related.
3. The same limits also apply at ϕ_D = 19 mm.
4. The measurement is referred to the centre of the photocathode.
5. Measuring the modulation transfer factors in a reduced area gives a negligible low frequency drop.
6. 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
   S_b = d.c. signal output
   when the intensifiers photocathode is capped.
   E_i = photocathode illuminance.
   A = area of circular spot.
7. The intensifiers will not be damaged but may not function if the supply voltage falls below 2,2 V.
8. Exposure to ficused intense light or infrared radiation should be avoided.
9. The tube will perform within 25% of the gain specification for all input voltages from 2,2 to 3,4 V.

MECHANICAL DATA: measured at 20 °C

Dimensions in mm

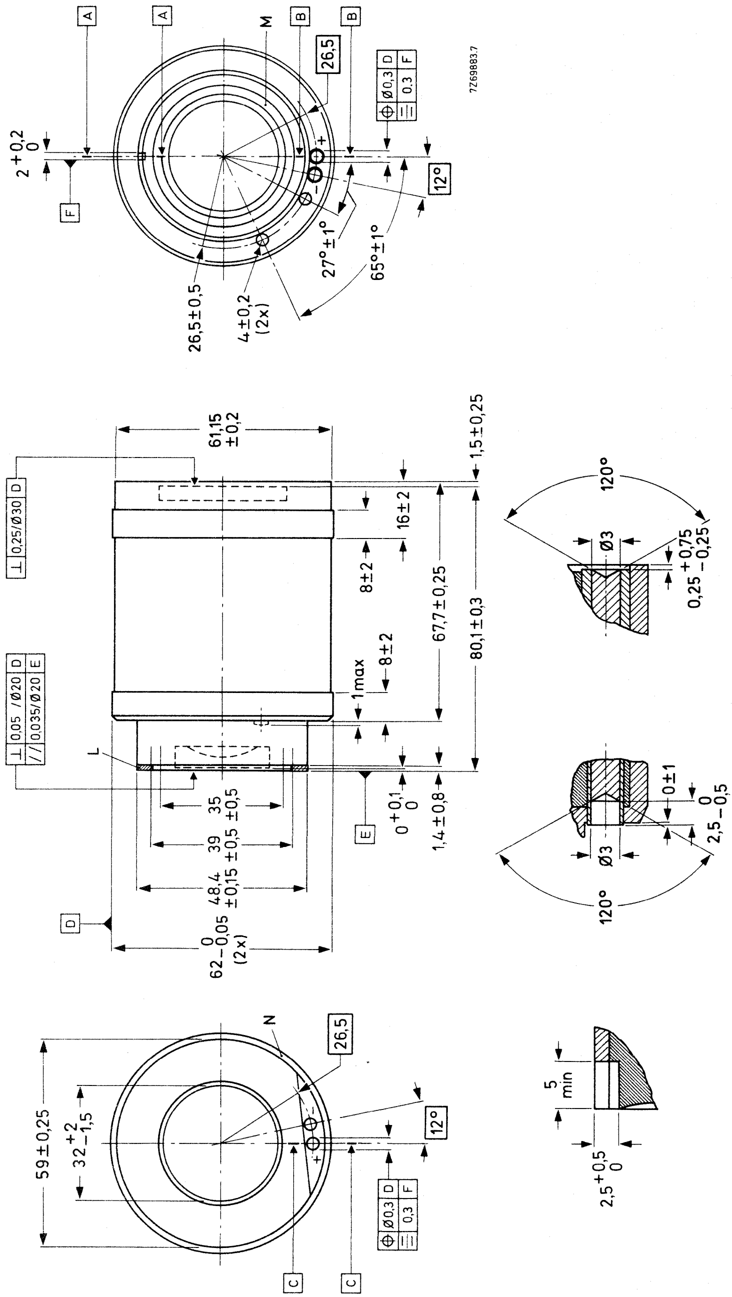


Fig. 1.

L: this space may be filled with rubber.
N and M: bearing surface.

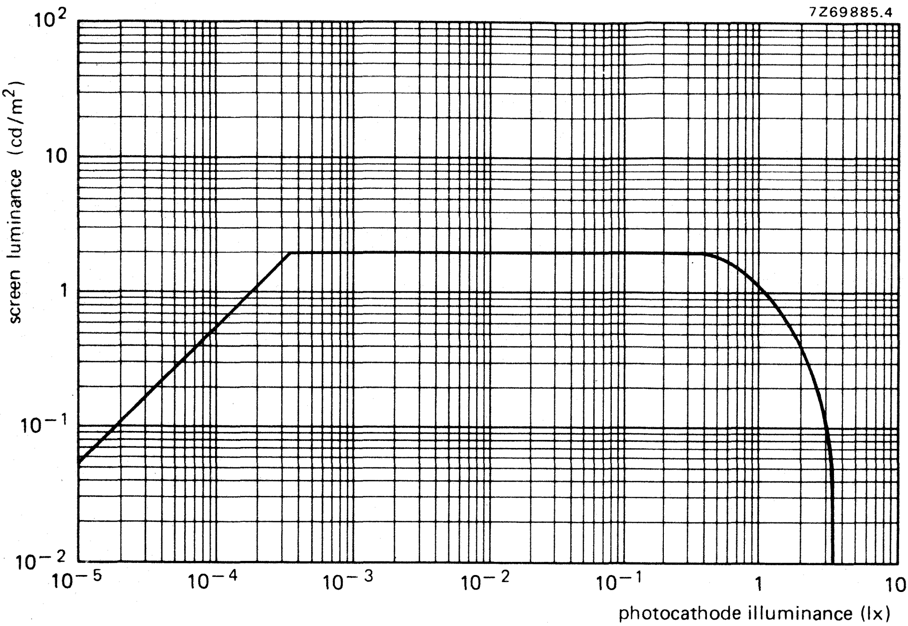


Fig. 2 Screen luminance as a function of photocathode illuminance.

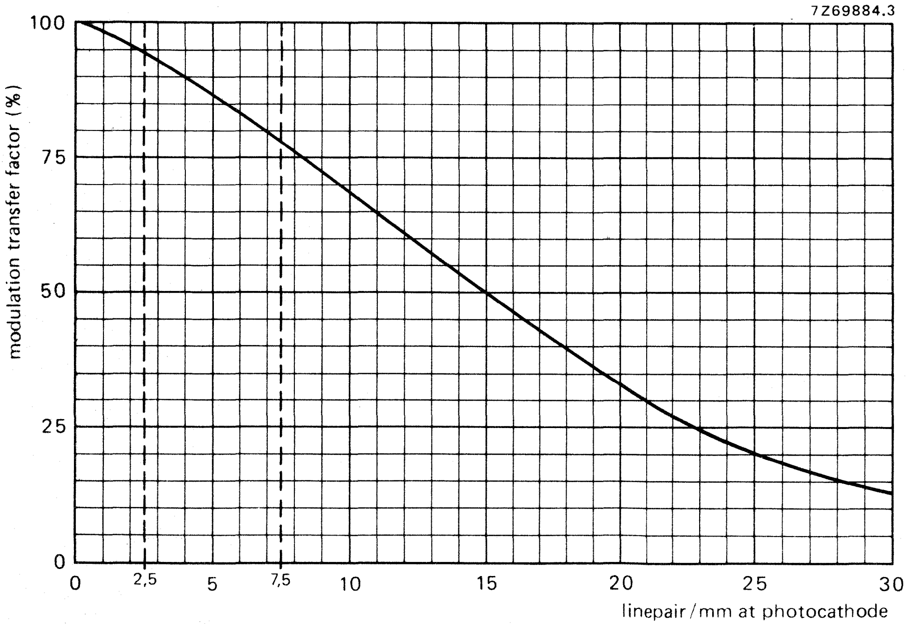


Fig. 3 Reduced area modulation transfer characteristic.

IMAGE INTENSIFIER

The XX1390 is a miniature, distortionless, electrostatic proximity focused micro-channel plate image intensifier. It has 18 mm diameter plane glass input and output windows. 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 window			
thickness		1,5	mm
refractive index		1,49	
Photocathode surface		S25	
Useful photocathode diameter	min.	18	mm
Photocathode sensitivity			
white light	min.	220	μA/lm
λ = 800 nm	min.	12	mA/W
λ = 850 nm	min.	4	mA/W
Screen window			
thickness		2	mm
refractive index		1,49	
Screen phosphor	Aluminized	P20	
Gain ϕ_G = 140 mm, $E_i \approx 100\ \mu lx$	min.	7 500	(note 1)
	typ.	15 000	
Mean screen luminance	max.	10	cd/m^2
Screen luminance ratio	max.	3:1	
Edge magnification ϕ_D = 14 mm	typ.	1,0	
Centre resolution	min.	25	line pair/mm
Edge resolution ϕ_E = 14 mm	min.	25	line pair/mm
Equivalent background illumination	max.	0,5	μlx
Mass	max.	35	g
Microchannel plate resistance	min.	150	MΩ

RECOMMENDED OPERATING CONDITIONS (note 2)

Voltages

Microchannel plate input to photocathode		50 to 100 V
Microchannel plate output to input		700 ± 200 V
Screen to microchannel plate output		5700 ± 300 V

Optimum voltages are given on the test sheet accompanying each tube.

Photocathode illuminance	typ.	100 μlx
Ambient temperature		20 ± 5 °C
Relative humidity	between 35 and 50	%

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Microchannel plate input to photocathode	max.	150 V
Microchannel plate output to input	max.	900 V
Screen to microchannel plate output	max.	6 kV
Photocathode illuminance	max.	0,1 lx

Temperatures

Ambient temperature		
for continuous		35 °C
for storage, 2 h max.	max.	65 °C
	min.	−54 °C
for long term storage	max.	27 °C
	min.	−54 °C

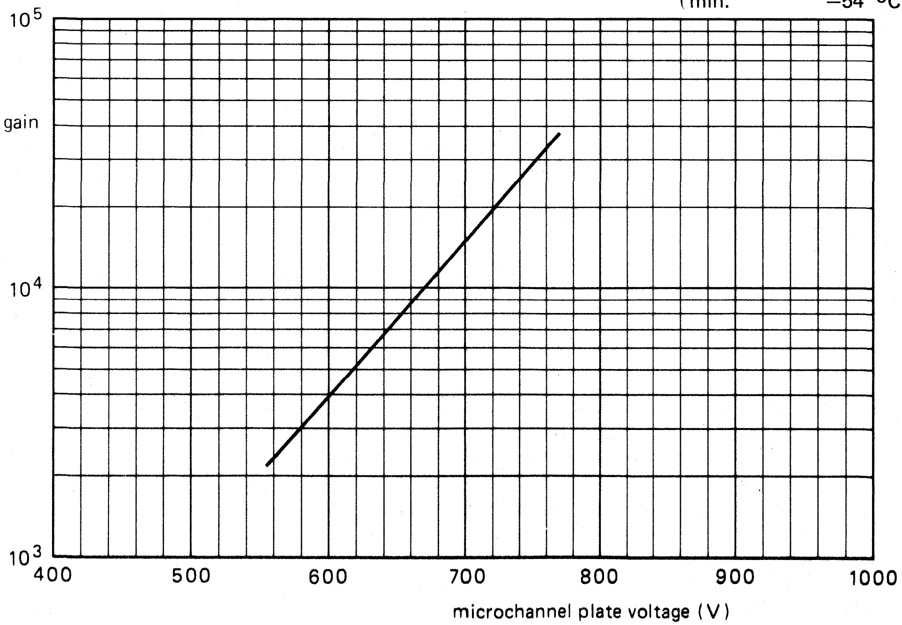


Fig. 1 Typical luminous gain characteristic.

OUTLINE DRAWING

Dimensions in mm

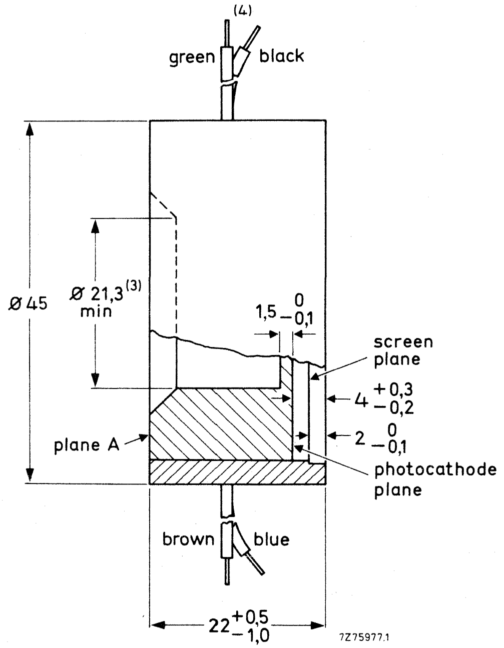


Fig. 2.

Notes

1. The gain is adjusted by varying the value of the microchannel plate voltage, see Fig. 1.
2. Each tube is accompanied by a test result sheet giving the recommended operating conditions. Particular attention should be paid to the maximum microchannel plate voltage.
3. This dimension is guaranteed not to exceed a depth of 11,5 mm from plane A.
4. The intensifier is encapsulated in a soft plastic housing. Four electrical leads exit from this housing. Their functions are:
   black: microchannel plate output
   blue: photocathode
   brown: screen
   green: microchannel plate input

IMAGE INTENSIFIER

The XX1410 is a miniature, distortionless, double electrostatic proximity focused micro-channel plate image intensifier. It has an 18 mm diameter fibre-optic input and an 18 mm image inverting ("twister") concave output window.

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 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 photocathode diameter	min.	17,5 mm
Photocathode sensitivity*	min.	typ.
white light	240	350 μA/lm
λ = 800 nm	20	35 mA/W
λ = 850 nm	12	20 mA/W
Screen phosphor	Aluminized P20	
Output window, radius of concave surface	40,00 ± 0,1 mm	
Gain ϕ_G = 17,0 mm, $E_i \approx 20$ μlx	min.	7 500
	max.	15 000
Mean screen luminance E_i = 20 mlx	min.	1 cd/m²
	max.	3 cd/m²
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	typ.	29 line pairs/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

* Measured before the power supply is fitted.

RECOMMENDED OPERATING CONDITIONS

Supply voltage (negative terminal should be grounded)		2,7 V
Photocathode illuminance	typ.	100 μlx
T_{amb}		22 ± 3 °C

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
	min.	−20 °C
T_{amb} (for long term storage)	max.	27 °C

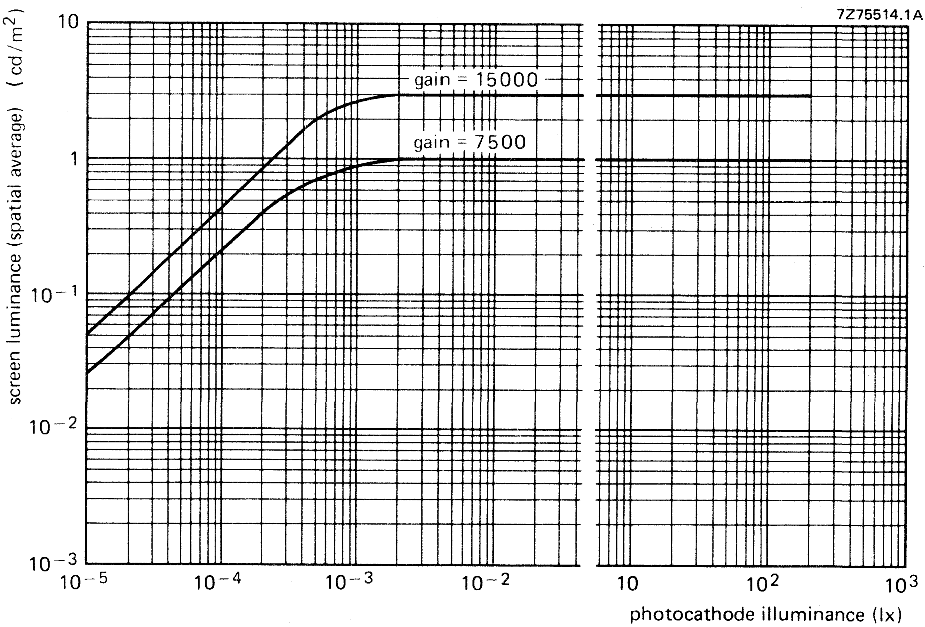


Fig. 1 Typical automatic gain control characteristic.

* If the supply voltage falls below 2,2 V, but remains greater than −2,7 V the intensifier will not be damaged, but may not function.

OUTLINE DRAWING

Dimensions in mm

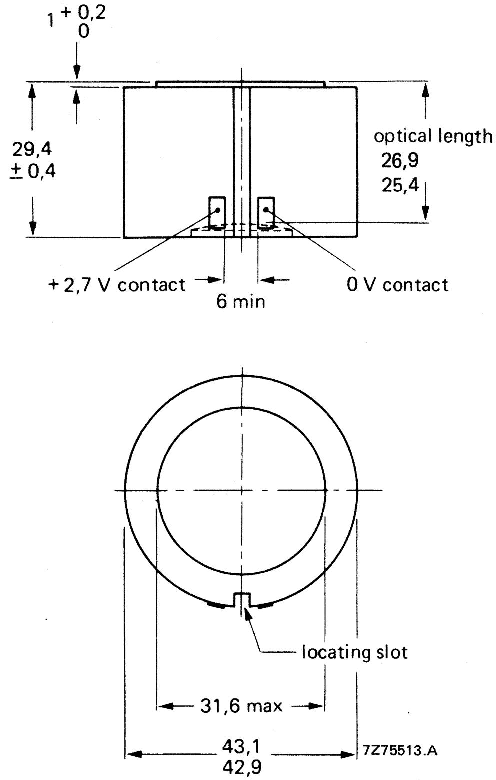


Fig. 2.

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 INTENSIFIERS

The XX1500 series is a family of miniature, electrostatically self-focused, inverting microchannel plate image intensifiers. They have an 18 mm fibre-optic input and output window, an integral power supply and automatic gain control (AGC). Particular features include as S25 photocathode, external adjustment of gain, point highlight saturation, bright source protection and low distortion. It is intended for use in direct viewing night-vision systems.

This data must be read in conjunction with *General operational recommendations — Image intensifiers.*

The XX1500 series consists of:
- XX1500: the basic version with a plane window.
- XX1501: incorporates a concave output window.
- XX1500TV: a high gain version with a plane window, intended for use in low-light-level television systems.

RECOMMENDED SUPPLY VOLTAGE 2,5 to 3,4 V

CHARACTERISTICS

Measured at 22 ± 3 °C with recommended supply voltage

Photocathode

Surface: S25 (enhanced red S20)

Window: plane fibre-optic

	min.	typ.	max.	
Useful diameter	17,5			mm
Sensitivity				
white light	280	350		μA/lm
λ = 800 nm	28	35		mA/W
λ = 850 nm	15	25		mA/W

Screen

Phosphor: P20, aluminized

Window
- XX1500: plane, fibre-optic
- XX1501: concave, fibre-optic
- XX1500TV: plane, fibre-optic

	min.	typ.	max.	
Useful diameter	17,5			mm
Gain, ϕ_G = 10 mm, $E_i \approx$ 50 μlx				
gain control at maximum	30 000	45 000	70 000	
gain control at minimum	2 000		10 000	
Mean screen luminance, E_i = 20 mlx				
XX1500, XX1501	5		10	cd/m^2
XX1500TV	12		20	cd/m^2
Edge magnification, ϕ_D = 14 mm	0,94		1,03	
Centre resolution	32	36		line pair/mm
Edge resolution, ϕ_E = 14 mm	32	36		line pair/mm
Distortion			4	%

	min.	typ.	max.	
Modulation transfer factors, see Fig. 5 (note 1)				
2,5 cycles/mm	85	92		%
7,5 cycles/mm	65	67		%
16 cycles/mm	30	33		%
Equivalent background illumination (EBI)			0,2	μlx
Image alignment			1	mm
Recovery time			0,5	s
Voltage			2,6	V
Current			26	mA
→ Mass			185	g
→ Signal-to-noise ratio	3,0	3,8		

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

	min.	typ.	max.	
Supply voltage (note 2)	2,0	2,6	3,4	V
Reverse supply voltage (60 s)			3,4	V
T_{amb}, storage 100 h cummulative			70	°C
operation and long term storage	−20		52	°C
operation, 2 h max.	−40		52	°C
Axial bearing force			100	N

WARNING

Immediately after operation, the screen will remain electrostatically charged for approximately 1 minute during which time the intensifier should not be handled. Any attempt to discharge the intensifier by any means may result in irreparable damage. The general operational recommendations for image intensifiers, referred to previously, contain instructions relating to precautions to be taken to avoid irreparable damage to the intensifier.

Notes

→ 1. These values are normalized to zero spatial frequency and are referred to the screen.

2. If the supply voltage falls below 2,0 V, the intensifier will not be damaged, but may not function.

MECHANICAL DATA, see Figs 1 and 2

The mechanical axis is defined as the perpendicular to the pads plane 'A', which passes through the centre of the cathode reference ring diameter 'B' M.M.C.

The intensifier will fit into a cylinder of 53,00 diameter or greater, concentric with reference 'B' M.M.C. and sit on a plane perpendicular to the axis of that cylinder at room temperature.

Linear expansion coefficient of reference diameter 'B' and the intensifier sleeve (dimension 56 ± 1) is less than or equal to 100×10^{-6}/K.

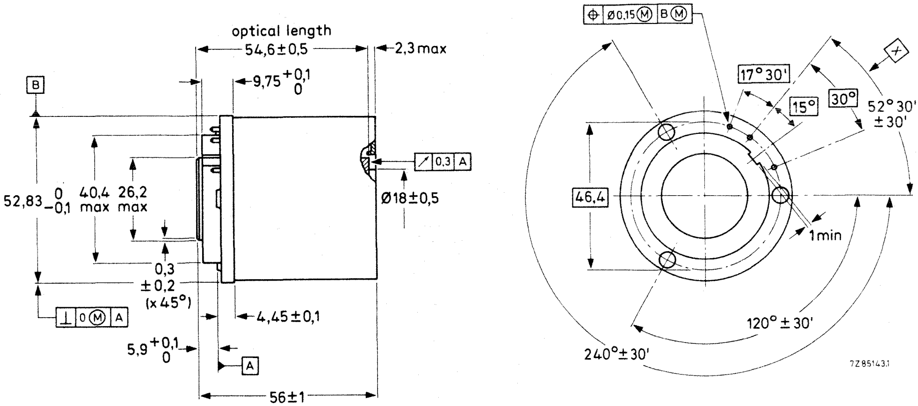
The length of the intensifier may be increased on later samples by the addition of a resilient pad at the screen end to accommodate the difference in expansion coefficient between the intensifier and the equipment mount.

For intensifiers without this pad, the onus is on the customer to ensure that the maximum mounting forces are not exceeded throughout the operational temperature range.

Orientation of keyway is identified at screen end within ± 3° by means of a mark.

Outline drawing

Dimensions in mm



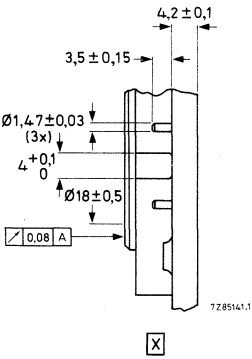


Fig. 1 XX1500
XX1500TV.

DEVELOPMENT SAMPLE DATA

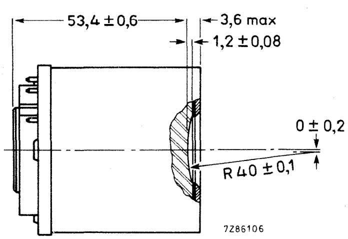
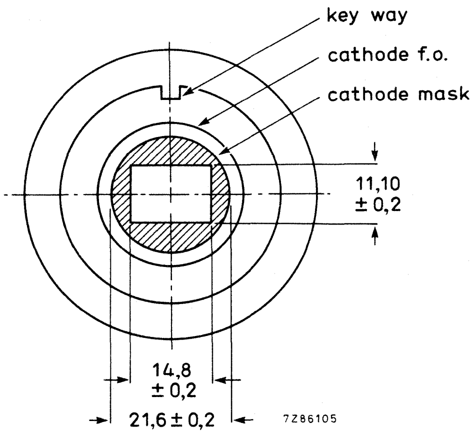


Fig. 1a Detail XX1501.



mask thickness $0,2\ ^{+0,1}_{-0}$

Fig. 1b Detail XX1500TV.

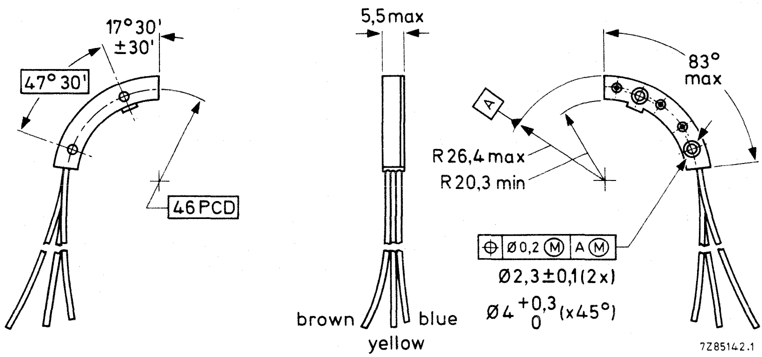


Fig. 2 Connector block assembly.
blue: earth/battery negative
brown: battery positive
yellow: customer gain control; 10 kΩ linear variable resistor to battery negative (R_S = 10 kΩ yields min. gain, R_S = 0 yields max. gain).

DEVELOPMENT SAMPLE DATA

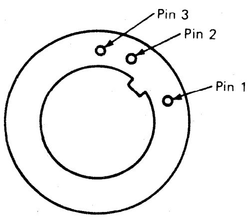


Fig. 3 Connections at photocathode and of intensifier.

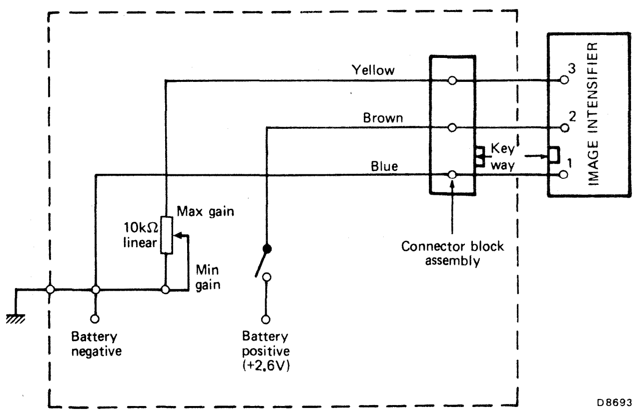


Fig. 4 Equipment wiring diagram.

ENVIRONMENTAL TESTS

Shock — 6 shocks, half-sinewave, in two directions, parallel and perpendicular to the intensifier axis, with peak acceleration 1400 m/s^2, duration 9,0 ms.

Vibration — Sinewave, in two directions, parallel and perpendicular to the intensifier axis, with peak acceleration 25 m/s^2, over frequency range 10 to 3500 Hz.

ACCESSORIES

Each intensifier in this series is supplied with a connector. Fibre optic insulator and extender plates enabling the XX1500TV to be fibre-optically coupled to a fibre-optic face plate TV camera tube are available. All XX1500 types can be supplied with a PTFE annulus around the edge of the cathode window.

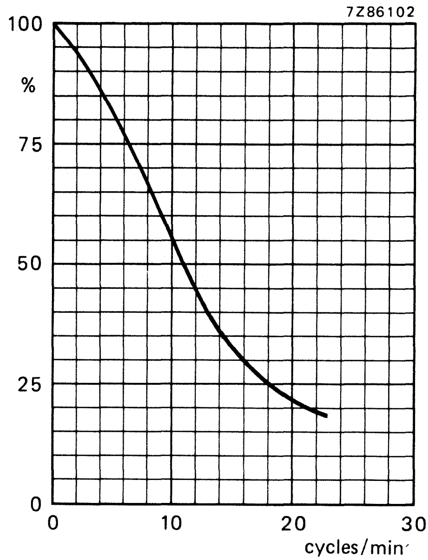


Fig. 5 Typical modulation transfer factor, XX1500.

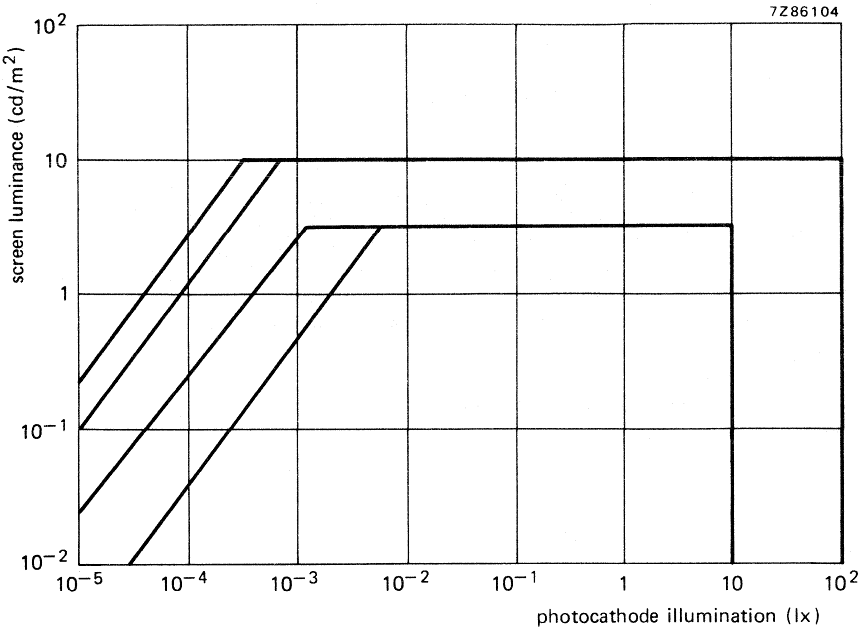


Fig. 6a Typical automatic brightness control characteristics XX1500, XX1501.

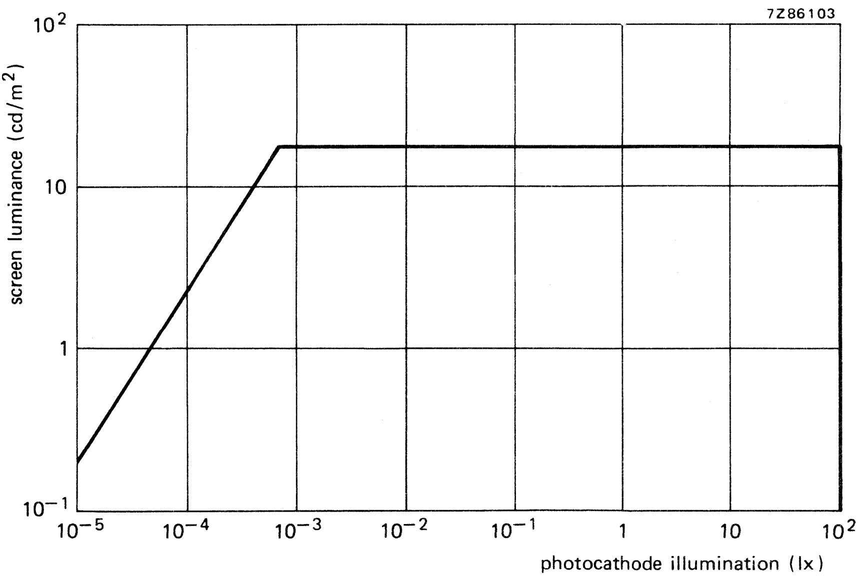


Fig. 6b Typical automatic brightness control characteristics XX1500TV.

IMAGE INTENSIFIER

The P453 is a miniature, distortionless, electrostatic proximity focused micro-channel plate image intensifier. It has an 18 mm diameter fibre-optic input and a flat image inverting ("twister") output window. 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 light-weight night vision goggles, 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 photocathode diameter	min.	17,5	mm
Photocathode sensitivity*	min.	typ.	
white light	240	350	μA/lm
λ = 800 nm	20	35	mA/W
λ = 850 nm	12	20	mA/W
Screen phosphor	Aluminized	P20	
Gain ϕ_G = 17,0 mm, $E_i \approx 20\ \mu lx$	min.	7 500	
	max.	15 000	
Mean screen luminance E_i = 20 mlx	min.	1	cd/m^2
	max.	3	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

* Measured before the power supply is fitted.

RECOMMENDED OPERATING CONDITIONS

Supply voltage (negative terminal should be grounded)		2,7	V
Photocathode illuminance	typ.	100	μlx
T_{amb}		22 ± 3	°C

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

DEVELOPMENT SAMPLE DATA

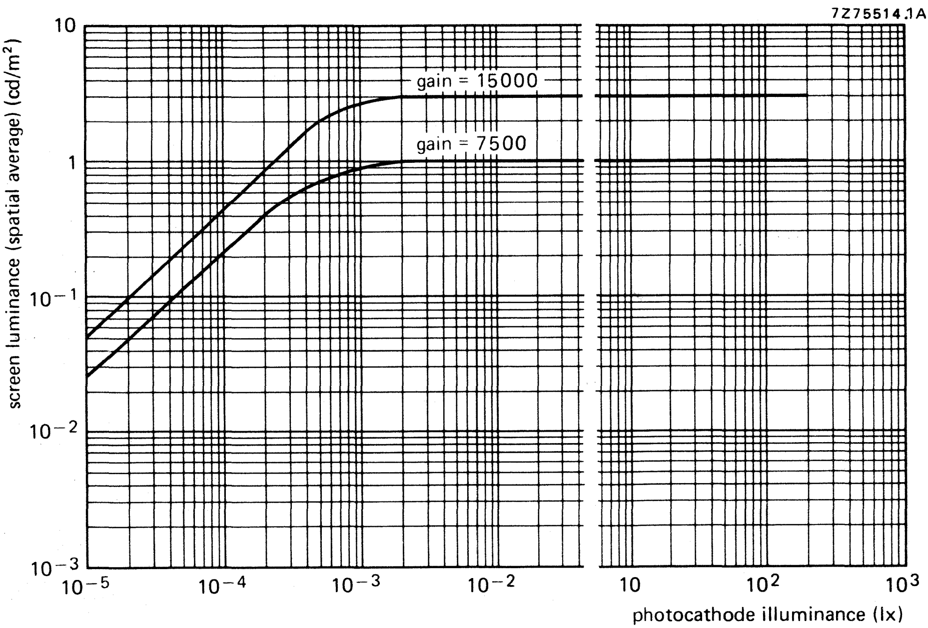


Fig. 1 Typical automatic gain control characteristic.

* If the supply voltage falls below 2,2 V, but remains greater than −2,7 V the intensifier will not be damaged, but may not function.

OUTLINE DRAWING

Dimensions in mm

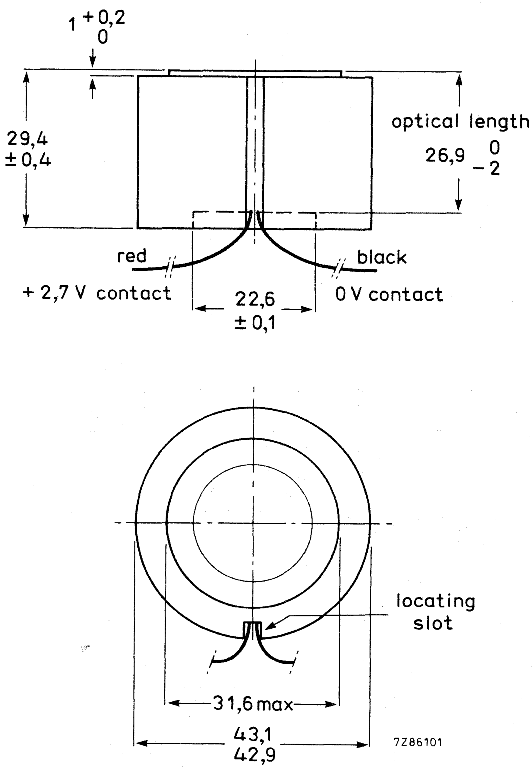


Fig. 2.

Locating slot: depth 3,05 min.
width 3,05 min.

Contact: length 260 min.

IMAGE INTENSIFIER

The P454 is a miniature, distortionless, electrostatic proximity focused micro-channel plate image intensifier. It has an 18 mm diameter fibre-optic input and a non-inverting fibre-optic output window. 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 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 photocathode diameter	min.	17,5	mm
Photocathode sensitivity*	min.	typ.	
white light	240	350	μA/lm
λ = 800 nm	20	35	mA/W
λ = 850 nm	12	20	mA/W
Screen phosphor	Aluminized	P20	
Gain ϕ_G = 17,0 mm, $E_i \approx 20\ \mu$lx	min.	7 500	
	max.	15 000	
Mean screen luminance E_i = 20 mlx	min.	1	cd/m^2
	max.	3	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

* Measured before the power supply is fitted.

RECOMMENDED OPERATING CONDITIONS

Supply voltage (negative terminal should be grounded)		2,7	V
Photocathode illuminance	typ.	100	μlx
T_{amb}		22 ± 3	°C

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

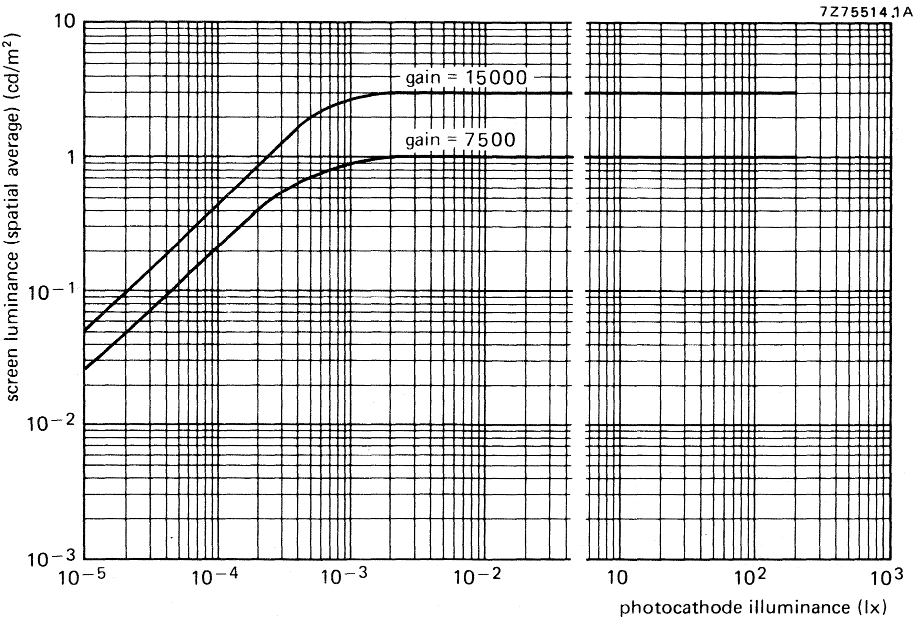


Fig. 1 Typical automatic gain control characteristic.

* If the supply voltage falls below 2,2 V, but remains greater than −2,7 V the intensifier will not be damaged, but may not function.

OUTLINE DRAWING

Dimensions in mm

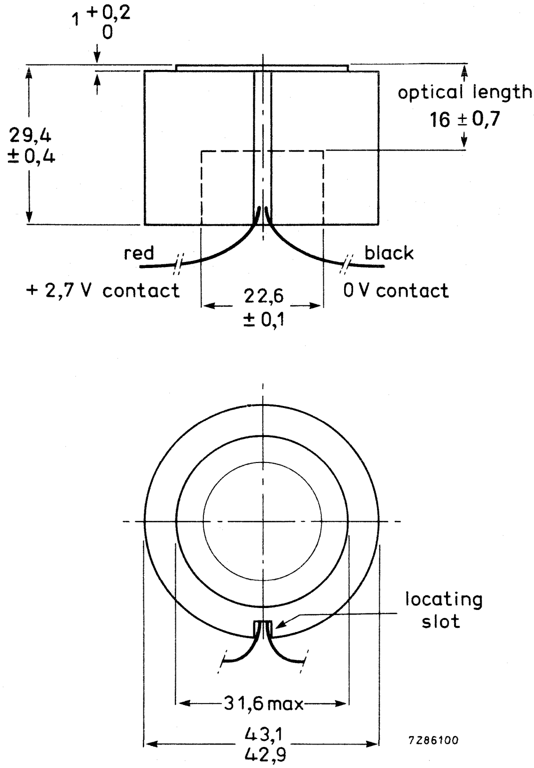


Fig. 2.

Locating slot: depth 3,05 min.
width 3,05 min.

Contact: length 260 min.

DEVELOPMENT SAMPLE DATA

IMAGE INTENSIFIER

The P455 is a miniature, distortionless, electrostatic proximity focused micro-channel plate image intensifier with an optical length of 12 mm. It has an 18 mm diameter fibre-optic input and a non-inverting fibre-optic output window. 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 also suitable for many very low light level applications. This tube is the shortest which can be designed with this structure.

This data must be read in conjunction with *General operational recommendations — Image intensifiers.*

CHARACTERISTICS

Measured under Recommended Operating Conditions

Photocathode surface		S25	
Useful photocathode diameter	min.	17,5	mm
Photocathode sensitivity*	min.	typ.	
white light	240	350	μA/lm
λ = 800 nm	20	35	mA/W
λ = 850 nm	12	20	mA/W
Screen phosphor	Aluminized	P20	
Gain ϕ_G = 17,0 mm, $E_i \approx 20\ \mu$lx	min.	7 500	
	max.	15 000	
Mean screen luminance E_i = 20 mlx	min.	1	cd/m^2
	max.	3	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

* Measured before the power supply is fitted.

RECOMMENDED OPERATING CONDITIONS

Supply voltage (negative terminal should be grounded)		2,7	V
Photocathode illuminance	typ.	100	μlx
T_{amb}		22 ± 3	°C

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

DEVELOPMENT SAMPLE DATA

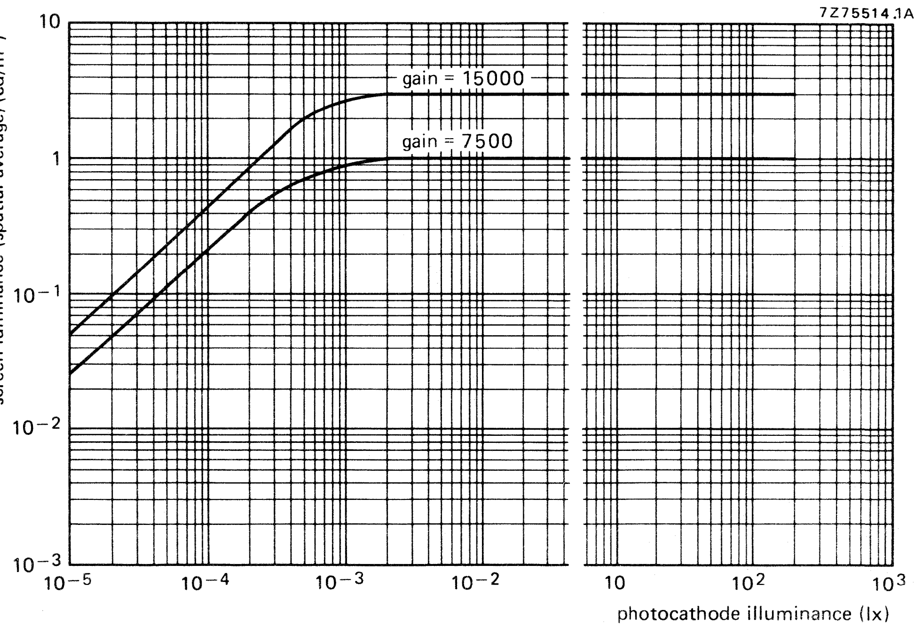


Fig. 1 Typical automatic gain control characteristic.

* If the supply voltage falls below 2,2 V, but remains greater than −2,7 V the intensifier will not be damaged, but may not function.

OUTLINE DRAWING

Dimensions in mm

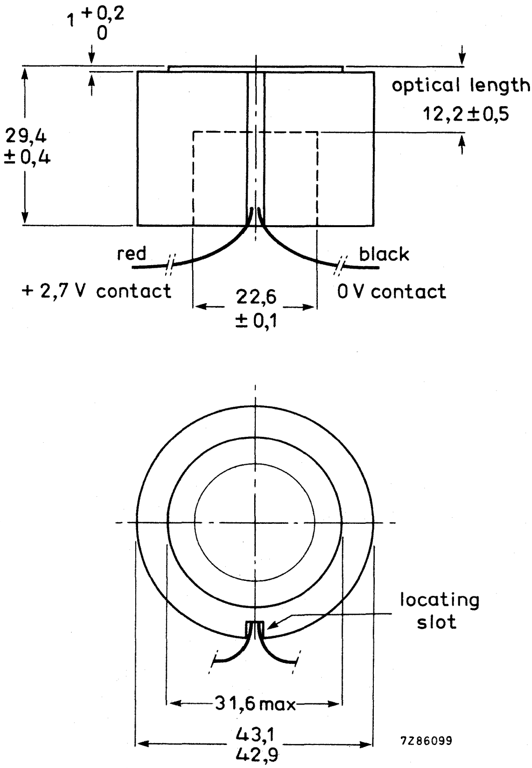


Fig. 2.

Locating slot: depth 3,05 min.
width 3,05 min.

Contact: length 260 min.

IMAGE INTENSIFIER

The P457 is a miniature, distortionless, electrostatic proximity focused micro-channel plate image intensifier. It has an 18 mm diameter fibre-optic input and an image non-inverting output window. 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 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 photocathode diameter	min.	17,5	mm
Photocathode sensitivity*	min.	typ.	
white light	240	350	μA/lm
λ = 800 nm	20	35	mA/W
λ = 850 nm	12	20	mA/W
Screen phosphor	Aluminized	P20	
Output window, radius of concave surface		40,00 ± 0,1	mm
Gain ϕ_G = 17,0 mm, $E_i \approx 20$ μlx	min.	7 500	
	max.	15 000	
Mean screen luminance E_i = 20 mlx	min.	1	cd/m^2
	max.	3	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

* Measured before the power supply is fitted.

RECOMMENDED OPERATING CONDITIONS

Supply voltage (negative terminal should be grounded)		2,7	V
Photocathode illuminance	typ.	100	μlx
T_{amb}		22 ± 3	°C

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

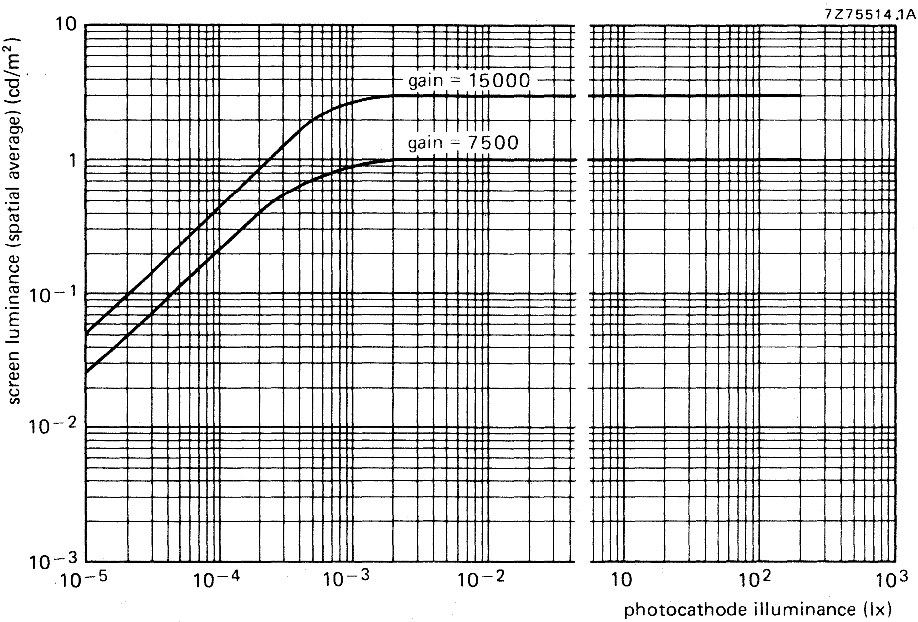


Fig. 1 Typical automatic gain control characteristic.

* If the supply voltage falls below 2,2 V, but remains greater than −2,7 V the intensifier will not be damaged, but may not function.

OUTLINE DRAWING

Dimensions in mm

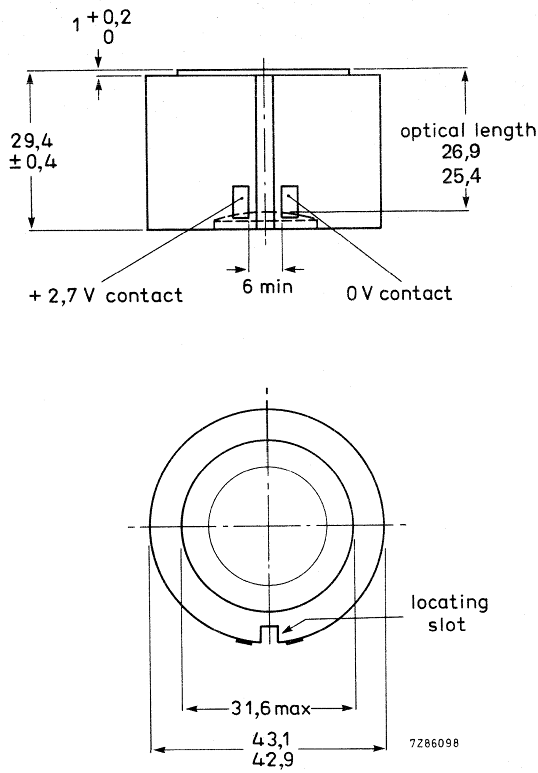


Fig. 2.

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.

DEVELOPMENT SAMPLE DATA

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.	175	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 = 40 mm	max.	7	%
Centre resolution	min.	27	linepair/mm
Edge resolution, ϕ_E = 25 mm	min.	15	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.	0,7	mm
Mass	max.	420	g
Mounting position		any	

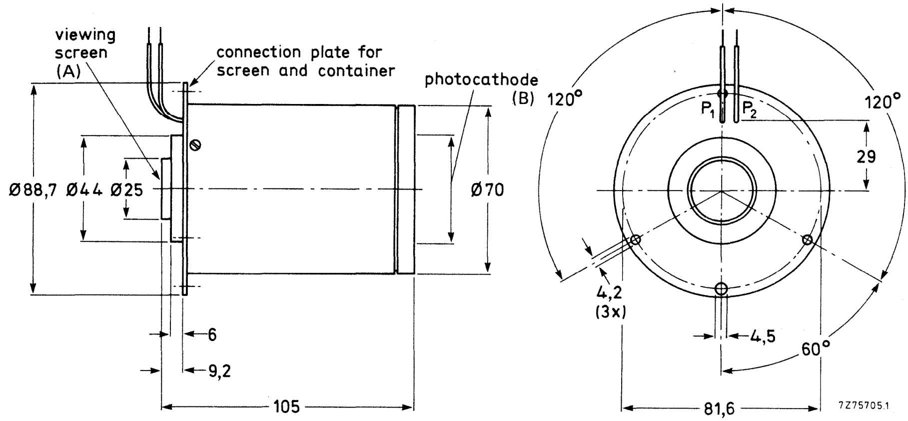
RECOMMENDED OPERATING CONDITIONS

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 (min. 50 mm).
B = useful diameter of screen (min. 16 mm).
P_1 = photocathode = −14 kV.
P_2 = focusing electrode.
Screen and container = ground potential.

INFRARED DETECTORS L

SURVEY OF TYPES

Infrared detectors

types	spectral band µm	operating temp. K	cooling method	number of elements	FOV (full angle)	page
M1RPY						L7
M101RPY	3 to 5	195	thermo-electric	10		L7
M104RPY	3 to 5	195	thermo-electric	14		L7
M2RPY	8 to 13	80	Joule-Thomson	up to 50		–
M3RPY						L13
M335RPY	8 to 13	80	Stirling engine	16 rows of 3		L19
M338RPY	8 to 13	80	Stirling engine	5 rows of 10	$26^{\circ} \times 26^{\circ}$	L21
M339RPY	8 to 13	80	Stirling engine	5 rows of 10	$26^{\circ} \times 26^{\circ}$	L23
M340RPY	8 to 13	80	Stirling engine	2 rows of 24	$30^{\circ} \times 60^{\circ}$	L25
M342RPY	8 to 13	80	Stirling engine	11 rows of 5	$43^{\circ} \times 58,5^{\circ}$	L27
M343RPY	8 to 13	80	Stirling engine	11 rows of 5	$43^{\circ} \times 58,5^{\circ}$	L29
M347RPY	8 to 13	80	Stirling engine	11 rows of 5	$43^{\circ} \times 58,5^{\circ}$	L31
M348RPY	8 to 13	80	Stirling engine	11 rows of 5	$43^{\circ} \times 58,5^{\circ}$	L33
M4RPY						L35
M401RPY	3,8,to 5,6	220	thermo-electric	1	100° min.	L35
M402RPY	3,8 to 5,6	220	thermo-electric	1	100° min.	L35
SPRITE	8 to 13	80	Stirling engine	8		L41

INFRARED DETECTORS FOR THERMAL IMAGING

INTRODUCTION

Infrared detectors for thermal imaging consist of an infrared-sensitive semiconductor element housed in a metal/glass envelope. They normally operate in either the 3 to 5 μm or 8 to 14 μm waveband, these being the wavebands within which atmospheric attenuation is relatively low.

The most widely used detector material is photoconductive cadmium mercury telluride (CMT or MCT) – a semiconductor whose composition can be readily adjusted to attain maximum sensitivity in either of the two wavebands referred to above.

For optimum performance within these wavebands, the detector element must be cooled (to about 80 K for the 8 to 14 μm band, and to about 200 K for the 3 to 5 μm band).
The envelope construction depends on the cooling method, which can be: thermo-electric, Joule-Thomson, or by means of a closed-cycle cooling engine (utilizing the Stirling cycle for example).

Thermo-electric coolers are normally used for temperatures down to 195 K. Two, three or four-stage coolers may be used, depending upon the operating temperature required, and upon the electrical cooling power allowed.

For temperatures down to 80 K, either Joule-Thomson coolers (usually working with air of high purity), or Stirling engines may be used. Joule-Thomson coolers can either be supplied with the detector, or purchased separately. Those detectors described in this documentation for engine cooling are designed for use with the Philips UA7011 engine. Thermo-electrically cooled detectors are provided with an integral cooler.

The dewars themselves can accommodate up to 120 elements, depending on the design; and the detector elements may be arranged in different configurations depending on application and on dewar design.

Infrared detectors described in the following data sheets use some of the terminology given below.

RESPONSIVITY

The purpose of an infrared detector is to convert infrared radiation into an electrical signal. The basic property defining detector performance is therefore its *responsivity*, defined as the r.m.s. output voltage produced by the detector per watt r.m.s. chopped radiant power incident on its sensitive area. It is important to distinguish between *peak responsivity* – the responsivity for monochromatic radiation at the wavelength of peak sensitivity, and *black-body responsivity* – the responsivity for black-body radiation from a source at a specified temperature (usually 500 K). In the latter case of course, some of the incident radiation will lie at wavelengths to which the detector is insensitive, but nevertheless, the total incident power is counted when calculating the responsivity. Black-body responsivity therefore will always be less than the peak responsivity. Responsivity is usually measured with a modulation frequency of 800 Hz.

NOISE

The electrical noise of a detector sets a limit on the lowest radiation level that can be detected. The noise is the r.m.s. value of the electrical output and is normally defined for 1 Hz bandwidth at a specific frequency.

NER (Noise Equivalent Resistance)

An alternative definition of the noise value is the Noise Equivalent Resistance (NER). This is the resistance which, at 20 ^{o}C, would have Johnson noise equal to that of the detector.

NEP (Noise Equivalent Power)

Detectors intended for measuring low intensity radiation may be assessed on the basis of their signal-to-noise ratio. This ratio depends on a number of test conditions: wavelength of the radiant energy incident on the detector, modulation frequency of the energy and of the noise, the energy incident, and bandwidth.

A more useful quantity for assessing detector performance is the noise equivalent power or N.E.P. This is the energy that will give a signal equal to the noise in a bandwidth of 1 Hz. It is, in general, a function of wavelength and of measuring frequency, and is equal to the noise per unit bandwidth divided by the responsivity. Note: N.E.P. may be either black-body or spectral, depending upon the reference source.

D* (D-star; AREA-NORMALIZED DETECTIVITY)

This is a figure of merit that takes account of element size and signal-to-noise ratio; it is defined by the expression:

$$D^* = \frac{\sqrt{A}}{\text{NEP}} = \frac{\text{responsivity} \times \sqrt{A}}{\text{noise}/\sqrt{\Delta f}}$$

in which A is the detector area.

This quantity is based on the fact that the NEP — for a certain type of detector at a certain temperature — is normally proportional to $\sqrt{A}$. Thus D* is normally independent of the area.

For an ideal detector, in which the noise is due only to fluctuations in the background radiation, the value of D* can be calculated (for a detector of given cut-off). This quantity is known as D^*_{BLIP}.

Thus, the use of D* enables comparison of detector performance with the maximum possible performance.

Both D^*_{BLIP} and the values obtained for D* on detectors at around 80 K are a function of the field of view, controlled by a cooled aperture in the detector.

D* is a function of the wavelength or black-body temperature of the incident radiation. The figures in brackets that follow D* refer to the measuring conditions. So D* (T,f,1) denotes normalized detectivity for incident radiation at a black-body temperature T (usually 500 K), noise measurement frequency f Hz, and unity bandwidth; and D* (λ,f,1) — sometimes called 'spectral D*' — denotes normalized detectivity for incident radiation at a wavelength λ.

TIME CONSTANT

The time constant τ of a detector is the time for the output to fall to 1/e (37%) of its value after a radiation pulse has ceased. It is related to the modulation frequency at which the responsivity falls to half of its low frequency value by $f = 1/2\pi\tau$.

GENERAL SAFETY RECOMMENDATIONS FOR INFRARED DETECTORS

1. GENERAL

When properly used and handled, infrared detectors do not constitute a risk to health or environment. Modern high technology materials have been used in the manufacture of these devices to ensure optimum performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the devices are heated to destruction and it is important that the following recommendations are observed.

Care should be taken to ensure that all personnel who may handle, use or dispose of these products are aware of the necessary precautions.

Individual product data sheets will indicate whether any specific hazards are likely to be present.

2. DISPOSAL

These devices should be disposed of in accordance with the relevant legislation.

3. FIRE

Infrared detectors themselves, when used within the specified limits, do not present a fire hazard.

Devices can contain arsenic, berrylium, cadmium, lead, mercury, selenium, tellurium or similar hazardous materials or compounds, which, if exposed to high temperatures may emit toxic or noxious fumes.

Most packaging materials are flammable and care should be taken in the disposal of such materials, some of which will emit toxic fumes if burned.

4. HANDLING

Care must be exercised with those devices incorporating glass or plastic. If these devices are broken, precautions must be taken against the following hazards that may arise: –

Broken glass or ceramic. Protective clothing such as gloves should be worn.
Contamination from toxic materials and vapours. In particular, skin contact and inhalation must be avoided.

5. BERYLLIUM COMPOUNDS

Beryllium oxide dust is toxic if inhaled or if particles enter a cut or an abrasion. At all times avoid handling beryllium oxide ceramics; if they are touched, the hands must be washed thoroughly with soap and water. Do nothing to beryllium oxide ceramics that may produce dust or fumes.

Care should be taken upon eventual disposal that they are not thrown out with general industrial waste. Users seeking disposal of devices incorporating beryllium oxide ceramics should first take advice from the manufacturer's service department.
This potential hazard is present at all times from receipt to disposal of devices.

6. CADMIUM COMPOUNDS

Cadmium compounds are toxic. In the event of accidental breakage, cadmium compound dust may be released. Gloves should be worn and the dust should be mopped up with a damp cloth. Upon disposal, the cloth should be sealed in a plastic bag and the hands washed thoroughly with soap and water. Controlled disposal of devices containing cadmium compounds should be conducted in the open air or in a well ventilated area.
Inhalation of cadmium dust must be avoided.
This potential hazard is present, if breakage occurs, at all times from receipt to disposal of devices.

7. OTHER COMPOUNDS

Other compounds, such as those containing arsenic, indium, lead, lithium, selenium, tantalum, tellurium etc., may be toxic by ingestion or inhalation.

> The above information and recommendations are given in good faith and are in accordance with the best knowledge and opinion available at the date of the compilation of the data sheets.

INFRARED DETECTORS

A series of infrared detectors comprising an array of up to 64 elements in a series of different configurations, sensitive in the 3 to 5 μm region. Mounted in a small rugged 80-lead encapsulation with a sapphire window. The sensitive material is cadmium-mercury-telluride (CMT). The detectors are cooled by a four-stage thermoelectric cooler, making the devices particularly suitable for use in hand-held thermal imaging systems. A temperature sensor is built in the detector which is hermetically sealed and fitted with a re-firable getter.

QUICK REFERENCE DATA

Material	Cd Hg Te
Operating temperature	195 K
Sensitive wavelength	3 to 5 μm
Cooling	4-stage thermoelectric cooler
Number of elements	max. 64

LIMITING VALUES (Absolute maximum rating system, not for inspection purposes)

Types	**M101RPY**	**M104RPY**	
Cooler bias current	1,3	0,7	A
Element bias current	3	3	mA
Temperature sensing diode bias current	10	10	mA
Storage temperature	−50 to + 50	−50 to + 50	°C

Mechanical and performance data for standard 3 to 5 μm infrared detectors

Typical performance data is given below. Measurements were made with the drive current to the thermo-electric cooler optimized to give the lowest possible detector temperature; this current is typically 0,6 A for the 3 W cooler and 1,1 A for the 6 W cooler.

Number of elements	10	14	
Element dimensions	50 x 50	50 x 50	μm
Spacing between element centres	62,5	62,5	μm
Array configuration	linear	linear	
Field of view (½ angle)	⩾ 37,5	⩾ 40	deg
Operating temperature (nom.)	195	195	K
Heatsink temperature	20 ± 2	20 ± 2	°C
Cooler input power	6	3	W
Cool-down time (typ.)	30	180	s
Element bias current (typ.)	0,5	0,5	mA
D* (500 K, 20 kHz, 1) (typ.)	$1,5 \times 10^{10}$	$1,5 \times 10^{10}$	$cmHz^{½}W^{-1}$
D* (500 K, 20 kHz, 1) (min. av.)	$0,9 \times 10^{10}$	$0,9 \times 10^{10}$	$cmHz^{½}W^{-1}$
D* (500 K, 20 kHz, 1) (min. any element)	$0,5 \times 10^{10}$	$0,5 \times 10^{10}$	$cmHz^{½}W^{-1}$
D* (λ_{pk}, 20 kHz, 1) (typ.)	$1,5 \times 10^{11}$	$1,1 \times 10^{11}$	$cmHz^{½}W^{-1}$
Responsivity (500 K, 800 Hz) (typ.)	$1,2 \times 10^{4}$	$1,2 \times 10^{4}$	VW^{-1}
Cut-off wavelength	4,4 ± 0,2	4,8 ± 0,2	μm
Resistance (typ.)	300	300	Ω
Time-constant (typ.)	3	3	μs
Knee frequency (typ.)	2	2	kHz
Noise equivalent resistance	1	1	kΩ

ENCAPSULATION

The outline of the M1RPY encapsulation is shown in Fig. 1. The encapsulation includes a temperature-sensing diode which enables the array temperature to be monitored.

A re-fireable getter is also fitted in the encapsulation to help sustain long vacuum life. Reactivation may be required after about 12 months operation; the current and voltage required is about 3,5 A at 5 V.

Area normalized detectivity D*

Area normalized detectivity for a typical M104RPY detector is plotted against frequency in Fig. 2, and against bias current in Fig. 3. The ratio D* (λ_{pk})/D* (500 K) as a function of cut-off wavelength (at which responsivity is 50% of peak) is shown in Fig. 4.

Noise

A typical noise spectrum for a M104RPY detector is shown in Fig. 2.

Responsivity

Responsivity as a function of frequency is shown in Fig. 2.

Spectral response

The spectral response of a typical M104RPY is shown in Fig. 5. Note that detectors are normally specified in terms of cut-off wavelength (50% of peak responsivity) rather than the peak wavelength.

Time-constant

The time-constant is obtained by applying a pulse of radiation to the detector and measuring the interval between the time of cut-off of the radiation and that at which the detector output falls to 37% of its peak value.

Noise equivalent resistance

The noise equivalent resistance (N.E.R.) is the value of resistance which at 20 °C would produce a Johnson noise voltage equivalent to the detector noise measured at the detector operating temperature.

OPERATION

A connection diagram is supplied with every device. Care should be taken to ensure that the cooler supply is connected with the correct polarity. The input voltage to the cooler should be d.c. with less than 10% peak-to-peak ripple. As stated earlier, typical optimum currents for detector operation at 195 K are 0,6 A for the 3 W cooler and 1,1 A for the 6 W cooler.

The detectors should be mounted on a flat heatsink. Use of a thermally-conducting heatsink compound is recommended; a suitable paste is Dow Corning 340. Responsivity and D* as a function of heatsink temperature are shown in Fig. 6.

A temperature-sensing diode is mounted with the detector array in the encapsulation. To measure the element temperature, this diode should be forward-biased with a constant current of 1 mA and the resulting voltage monitored. A calibration curve showing diode voltage as a function of element temperature is supplied with each device; a sample curve is given in Fig. 7. Again, care should be taken to ensure that the diode supply is correctly connected.

CUSTOMIZED DESIGNS

The encapsulation is standard, but special combinations of element size, number of elements, array configuration, cut-off wavelength, and cooler specification can be considered. These are sufficient leads on the encapsulation to allow arrays of up to 64 elements to be incorporated.

CAUTION

These devices incorporate beryllium oxide, the dust of which is toxic. The devices are entirely safe provided that they are not dismantled.

Care should be taken to ensure that all those who may handle, use, or dispose of these devices are aware of their nature and of the necessary safety precautions. In particular, they should never be thrown out with general industrial or domestic waste. Devices requiring disposal can be returned to the suppliers. Please consult us before returning any devices.

Dimensions in mm

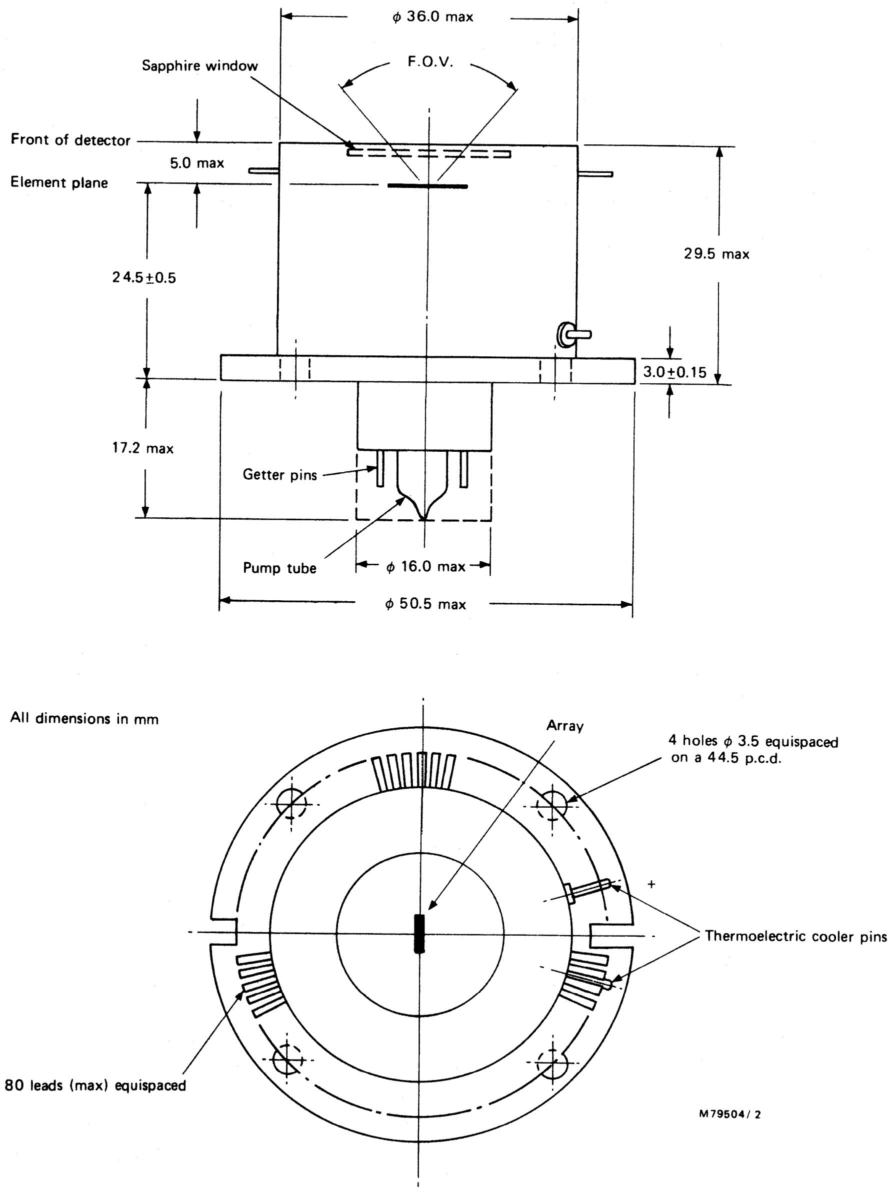


Fig. 1 Outline of M1RPY encapsulation.

The following performance curves are for a typical M104RPY; with the exception of spectral response, the curves for the M101RPY will be similar.

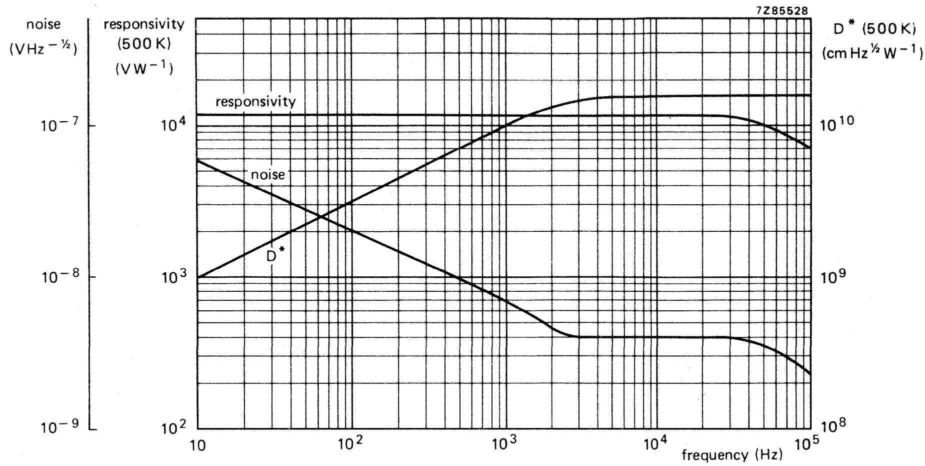


Fig. 2 Typical D* (500 K), noise, and responsivity plotted against frequency.

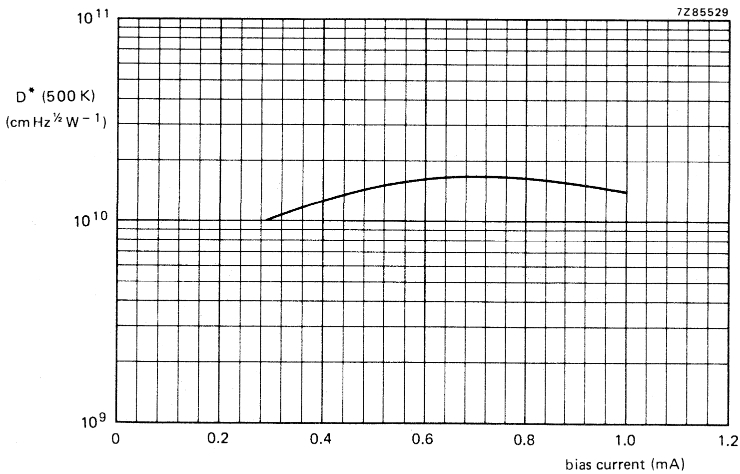


Fig. 3 Typical D* (500 K) plotted against bias current.

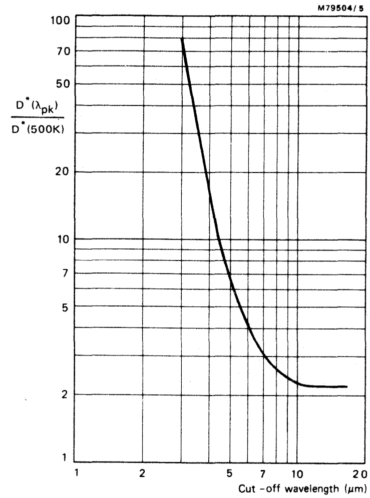


Fig. 4 Typical D* (λ_{pk})/D* (500 K) plotted against cut-off wavelength.

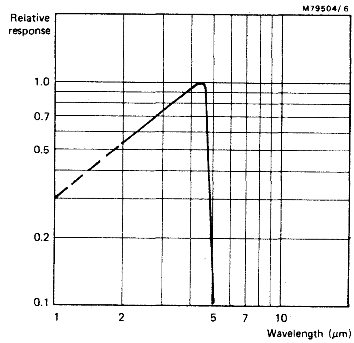


Fig. 5 Typical spectral response.

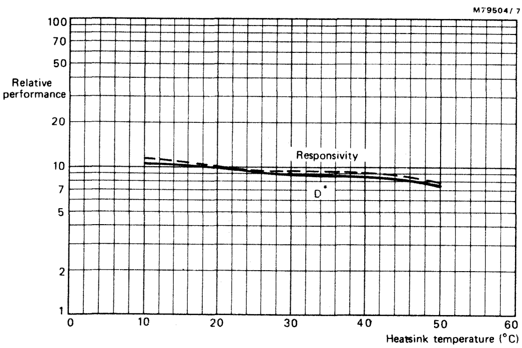


Fig. 6 Typical D* (500 K) and responsivity plotted against heatsink temperature.

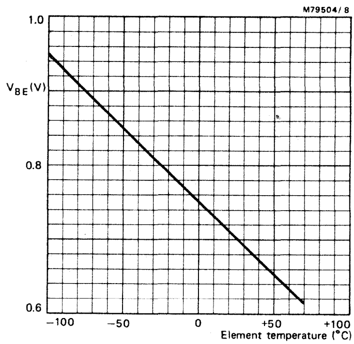


Fig. 7 Typical calibration curve showing diode voltage plotted against element temperature.

INFRARED DETECTORS

A series of infrared detectors comprising a multi-element array, in a series of different configurations, sensitive in the 8 - 13 μm region and mounted in a glass and metal dewar-type envelope. The sensitive material is cadmium-mercury-telluride (CMT). The detectors are designed to be cooled by the Philips UA7011 closed-cycle cooling engine. A temperature monitoring facility is built into the detector.

The application is in military thermal imaging systems.

QUICK REFERENCE DATA

Material	Cd Hg Te
Operating temperature	80 K
Sensitive wavelength	8 to 13 μm
Cooler	UA7011
Terminations	3 ITT Cannon Plugs MDM 21PL1B embodied in encapsulation
Bias current	4 mA
Getter reactivation current	3,6 A
Number of elements	maximum 55

LIMITING VALUES (Absolute maximum rating system, not for inspection purposes)

		min.	max.	
Detecting elements				
voltage (d.c.)	V_b	–	0,6	V
current (per element)	I_b	–	7	mA
Temperature sensors				
current	I_{ts}	–	10	mA
Storage temperature (on shelf (in special storage container) or in system)	T_{stg}	−55	70	°C
Operating ambient temperature	$T_{amb\ op}$	−40	70	°C
Element operating temperature	T_{op}	77	–	K
Envelope, thrust on substrate		–	30	N
Pressure dewar re-entrant		–	0,25	N
Getter reactivation current		–	3,8	A
(note: detailed getter reactivation instructions are supplied with each detector)				
Over pressure in-dewar re-entrant			$2,5 \times 10^5$	Pa
Helium partial pressure		–	0,53	Pa
Disassembly from engine		10	–	°C

TYPICAL CHARACTERISTICS

The ambient temperature, T_{amb} = 20 °C unless otherwise stated.

The element bias current, I_b, is 4 mA per element unless otherwise stated, with the signal contact negatively biased.

The interface temperature, T_{op}, is the temperature attained by the interface when the detector is assembled to a dummy UA7011 cold finger filled with liquid nitrogen, where the thrust on the dewar substrate is 5 to 15 N.

CRYOGENIC CHARACTERISTICS

Heat load, 50 detector elements biased (latent heat of vapourization component only)	Q T_{amb} = 20 °C	max.	220	mW
	Q T_{amb} = 55 °C	max.	280	mW
Thermal mass	ΔH_{80}^{293}	max.	840	J
	ΔH_{80}^{330}	max.	1100	J

MASS 300 g

ELECTRO-OPTICAL PERFORMANCE, element bias current, I_b, is 4 mA, signal contact negatively biased.

		min.	typ.	max.	
Long wavelength cut-off (50% point)	λ_c	11,0	11,5	14,0	µm
Cooled resistance	R_c	25	50	100	Ω
Responsivity per element (λ_{pk}, 5 kHz)	R_y	$1,1 \cdot 10^4$	$1,5 \cdot 10^4$	—	VW^{-1}
Serial average D* (λ_{pk}, 5 kHz, 1) per row of N elements, see notes					
for rows of 3 to 7 elements	D*	$3,0 \cdot 10^{10}$	$4,7 \cdot 10^{10}$		$cmHz^{1/2}W^{-1}$
for rows of 8 to 50 elements	D*	$3,3 \cdot 10^{10}$	$4,7 \cdot 10^{10}$		$cmHz^{1/2}W^{-1}$
Temperature sensor calibration, using 1,0 mA d.c. constant current bias supply; temperature sensor circuit to include trimming potentiometer					
at T_S = 80 K	V_{TS}	1,196	1,200	1,204	V
at T_S = 100 K	V_{TS}	1,155	1,160	1,165	V
Inoperative elements (in the case of electrically shorting adjacent pairs, each pair will count as one inoperative element)		—	none	1	per row
Common lead impedance			5,5	7	Ω

Notes

1. The serial average D* for N elements is calculated from:

$$D_a^* = \frac{\sum_1^N Ry\,(\lambda_{pk}, 5\text{ kHz}).\sqrt{A}}{\left\{\sum_1^N (V_n)^2\right\}^{1/2}.\sqrt{N}}$$

in which: V_n = noise per unit bandwidth at 5 kHz,
A = area of detector element (cm^2).

2. The D_a^* quoted above refers to an effective F.O.V. of 51°, see Fig. 3 for other effective F.O.V.

ENVIRONMENTAL PERFORMANCE, TESTS AND REQUIREMENTS

Unless otherwise stated, the detector conforms to the specification limits set out in the sections Cryogenic and Electro-optical Characteristics, after application of the tests, with the exception that the heat load (20 °C) may increase up to 240 mW (dewar only).

After each of the following tests a visual inspection is carried out showing that the 'good workmanship' finish is retained. Reactivation of the getter is to be done at intervals of 12 months from the date of the test certificate.

Tests marked (▲) are carried out with the detector assembled to a dummy cold finger or to a UA7011 engine. Other tests are to be carried out on the detector in its special storage container.

DEVELOPMENT SAMPLE DATA

Storage environments

Tests are based on IEC68.

test	degree of severity
Dry heat	+ 70 °C, 96 h.
Dry heat	+ 70 °C, 2 years.
Low temperature	–55 °C, 72 h.
Damp heat	10 days cycle (+ 40 °C, 92% RH, 12 h) to (+ 25 °C, > 95% RH, 5 h).
Bump	1300 bumps devided equally in each of 3 mutually perpendicular axes, 40g, 60 ms; 1 to 3 impacts per s.
▲ Thrust on dewar substrate	15 N, 600 h,
▲ Shock	50g peak, 11 ms, semisinusoidal. 4 shocks in each of 3 mutually perpendicular axes; inclusive the detector major axis.
▲ Vibration	Displacement 0,3 mm 10 to 55 Hz. Acceleration 2g, 50-500 Hz. Resonance search 10-500 Hz. 30 minutes dwell at any resonant frequency found.
Air transport	Store at –55 °C, laboratory pressure, for 14 h, then reduce pressure to 30 kPa and store for 4 h.

Operation environments

test	procedure
▲ Shock ▲ Vibration	to be repeated with the cold finger cooled with liquid nitrogen or with the engine operating.
▲ Cooling cycles	500 cycles, T_{amb} to T_{op} ± 5 K to T_{amb} cooling cycle envelope to simulate the M3RPY/UA7011 behaviour, i.e. T_{amb} to T_{op} + 5 K within 15 minutes and T_{op} to T_{amb} –5 K about 1 h. See Fig. 1.

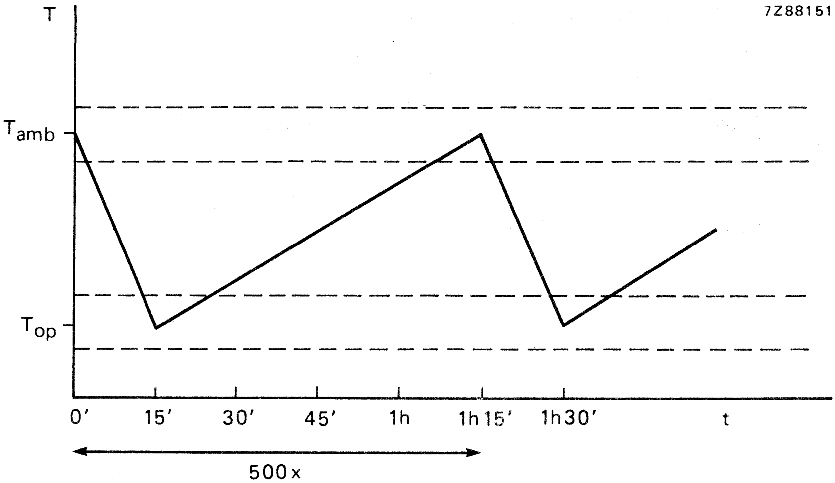


Fig. 1 Cooling cycles.

Variation of performance with T_{op}, R_c, R_y, D^*, λ_c. See Fig. 2.

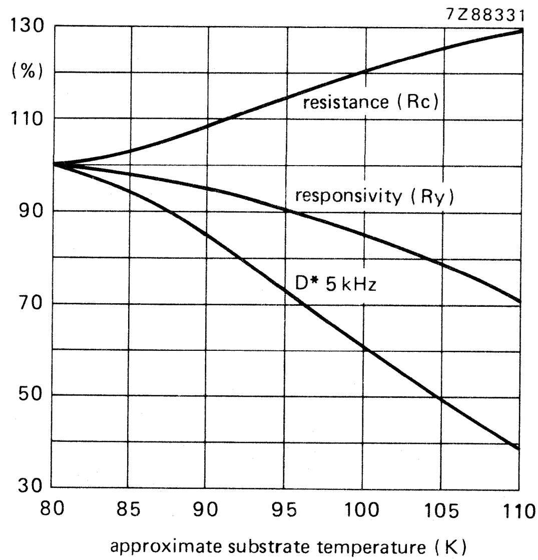


Fig. 2 Performance with temperature.

PACKAGING

The detectors are supplied in a reuseable sealed package filled with a He-free gas, at a slight over-pressure.

MAINTENANCE SCHEDULE

The getter must be reactivated at approximately yearly intervals. The detector must be stored and embodied in a He-free atmosphere.

RELIABILITY, subject to correct maintenance schedule

Storage life $>$ 5 years, in specified storage container

Useful life $>$ 5 years, assembled to cooling engine and including $>$ 8000 h at operating conditions.

Notes

Packing/unpacking instructions, getter reactivation instructions and getter reactivation leads are supplied with each detector. The detector is fitted with a protective window cap and connector caps.

PRODUCT SAFETY

Risks from implosion/explosion

The product is designed and constructed to be safe and without risk when properly used. However, it is evacuated, giving the risk to personnel if incorrectly used or handled. In particular, a risk exists from possible explosion, when combined with a cooling engine, if the engine finger/detector bore volume is not fitted with a blow-off valve or other over-pressure safety device to guard against sealing failures.

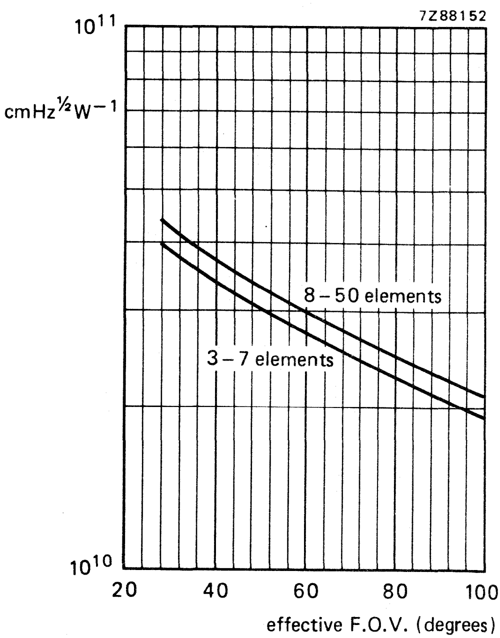
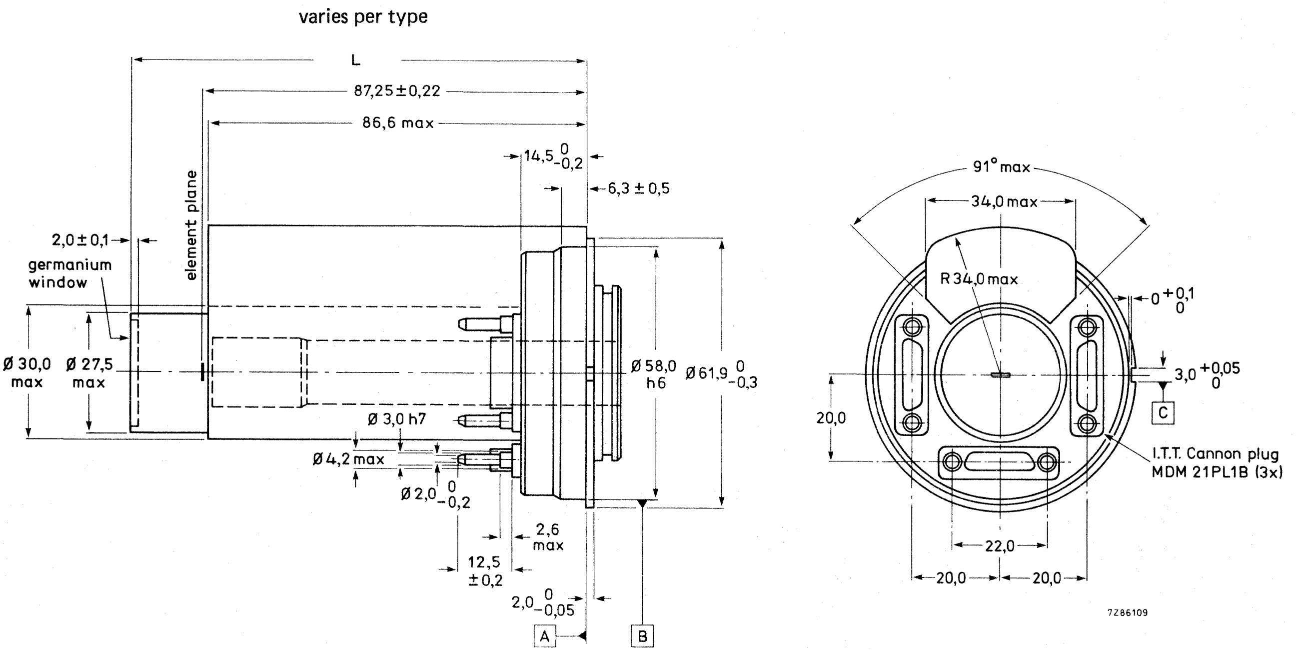


Fig. 3 Minimum D_a^* (λ_{pk}, 5 kHz, 1) as a function of F.O.V.

Interface details drawing; ref. 3313 564 59000



Notes

1. A, B and C are reference planes.
2. Tolerances and details are available upon request.
3. This detector is designed to interface with Philips Stirling cooling engine UA7011.

INFRARED DETECTOR

This infrared detector conforms to the specifications of the M3RPY series and comprises a double staircase array configuration, 16 rows of 3 elements. For this reason only changes or additions, relevant to M335RPY are given in this data sheet.

QUICK REFERENCE DATA

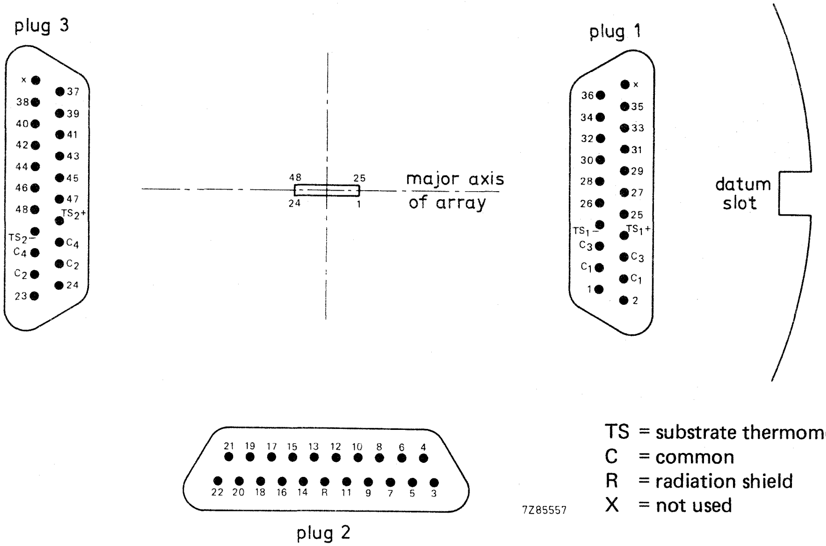
Element size	0,05 x 0,05	mm
Array configuration	double staircase, 16 rows of 3	

TECHNICAL DATA as per drawing 3313 563 20000, available on request; L = 98,0 mm.

ELECTRO-OPTICAL PERFORMANCE

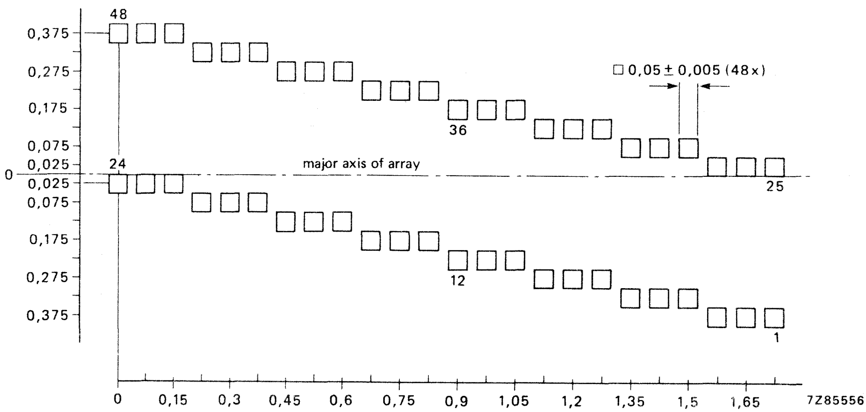
Serial average D* (λ_{pk}, 5 kHz, 1) per row of 3 elements	D^*a	min.	$2{,}0 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
		typ.	$3{,}1 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
Common lead impedance	R_{cl}	typ.	7	Ω
		max.	10	Ω

Electrical connections



TS = substrate thermometer
C = common
R = radiation shield
X = not used

Element array



INFRARED DETECTOR

This infrared detector conforms to the specifications of the M3RPY series and comprises a staggered staircase array configuration, five rows of ten elements. For this reason only changes or additions, relevant to M338RPY are given in this data sheet.

QUICK REFERENCE DATA

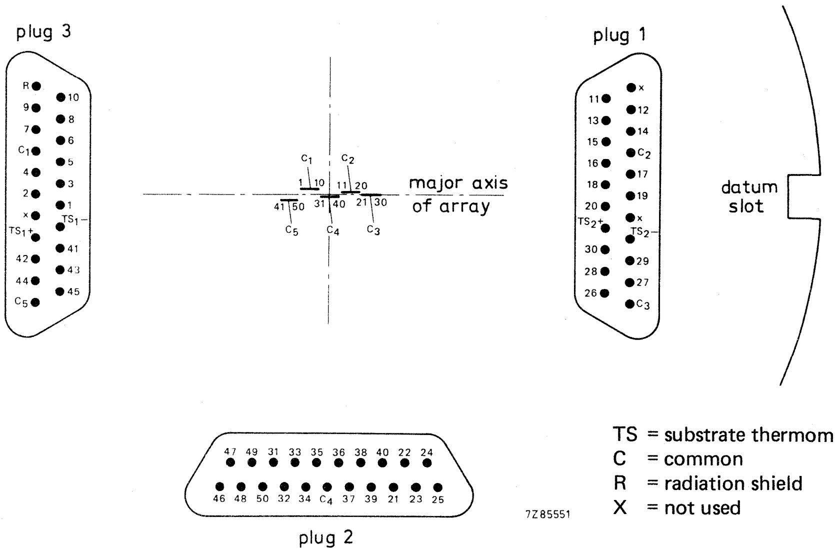
Element size	0,05 x 0,05	mm
Array configuration	staggered staircase, 5 rows of 10	
F.O.V. (half angle)	13	degrees

MECHANICAL DATA as per drawing 3313 563 22000, available on request; L = 105,0 mm.

ELECTRO-OPTICAL PERFORMANCE

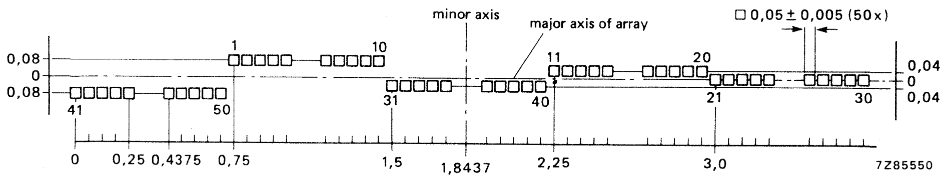
Serial average D* (λ_{pk}, 5 kHz, 1) per row of 10 elements	D*a	min.	$3{,}5 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
		typ.	$5{,}0 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
Common lead impedance	R_{cl}	typ.	5,5	Ω
		max.	7	Ω

Electrical connections



TS = substrate thermometer
C = common
R = radiation shield
X = not used

Element array



INFRARED DETECTOR

This infrared detector conforms to the specifications of the M3RPY series and comprises a double staircase array configuration, 5 rows of 10 elements. For this reason only changes or additions, relevant to M339RPY are given in this data sheet.

QUICK REFERENCE DATA

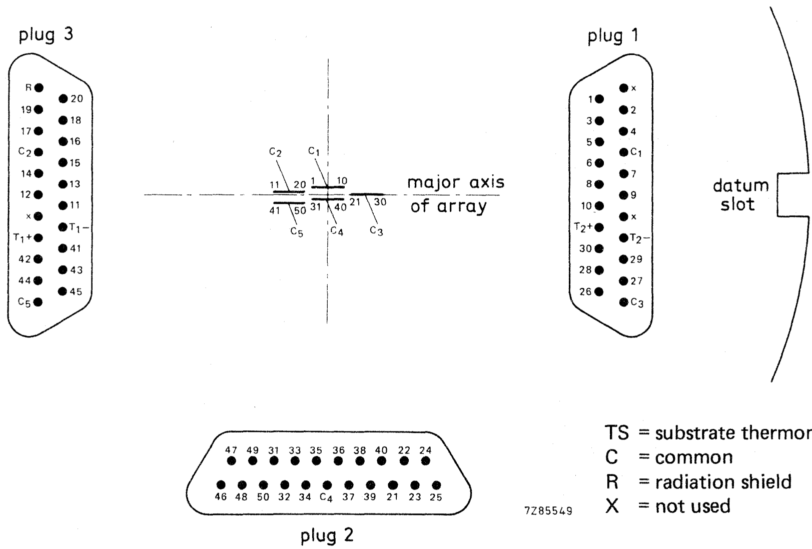
Element size	0,05 x 0,05	mm
Array configuration	double staircase, 5 rows of 10	
F.O.V. (half angle)	13	degrees

MECHANICAL DATA as per drawing 3313 563 24000, available on request; L = 105,0 mm.

ELECTRO-OPTICAL PERFORMANCE

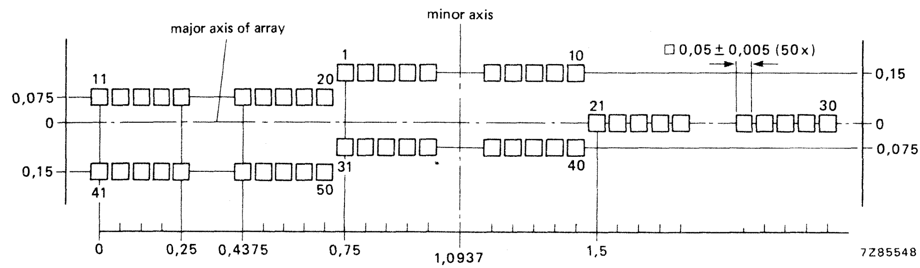
Serial average D* (λ_{pk}, 5 kHz, 1) per row of 10 elements	D*a	min.	$3,7 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
		typ.	$5,3 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
Common lead impedance	R_{cl}	typ.	5,5	Ω
		max.	7	Ω

Electrical connections



TS = substrate thermometer
C = common
R = radiation shield
X = not used

Element array



INFRARED DETECTOR

This infrared detector conforms to the specifications of the M3RPY series and comprises an array configuration of 2 rows of 24 elements. For this reason only changes or additions, relevant to M340RPY are given in this data sheet.

QUICK REFERENCE DATA

Element size	0,05 x 0,05	mm
Array configuration	2 rows of 24	
F.O.V.		
along array length	60	degrees
across array length	30	degrees

MECHANICAL DATA as per drawing 7313 520 07020, available on request; L = 93,0 mm.

ELECTRO-OPTICAL PERFORMANCE

Serial average D* (λ_{pk}, 5 kHz, 1) per row of 24 elements	D_a*	min.	$2{,}1 \cdot 10^{10}$ cmHz^{½}W^{-1}
		typ.	$3{,}0 \cdot 10^{10}$ cmHz^{½}W^{-1}
Common lead impedance	R_{cl}	typ.	1,0 Ω
		max.	2,0 Ω

INFRARED DETECTOR

This infrared detector conforms to the specifications of the M3RPY series and comprises an array configuration of 11 rows of 5 elements. For this reason only changes or additions, relevant to M342RPY are given in this data sheet.

QUICK REFERENCE DATA

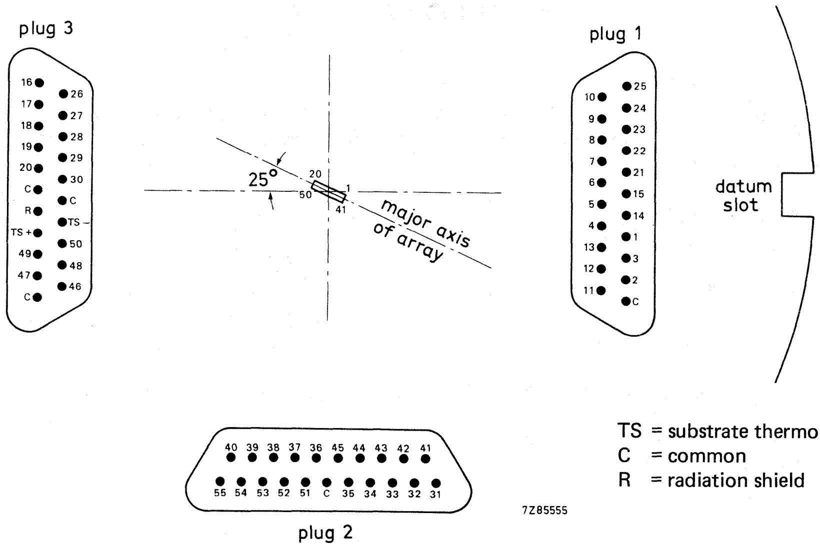
Element size	0,05 x 0,05	mm
Array configuration	11 rows of 5	
F.O.V.	43 x 58,5	degrees

MECHANICAL DATA as per drawing 3313 563 17000, available on request; L = 98,0 mm.

ELECTRO-OPTICAL PERFORMANCE

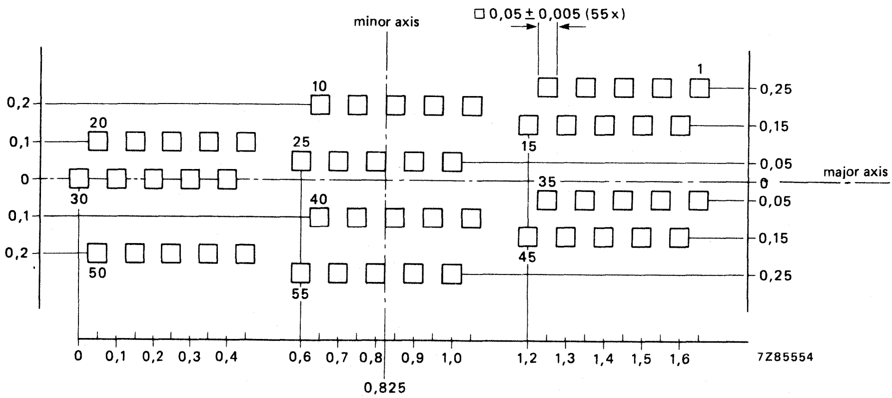
Responsivity ratio		max.	3
Serial average D* (λ_{pk}, 5 kHz, 1) per row of 5 elements	D*a	min.	$2,6 \cdot 10^{10}$ cmHz^{½}W^{-1}
		typ.	$3,9 \cdot 10^{10}$ cmHz^{½}W^{-1}
Common lead impedance	R_{cl}	typ.	1,5 Ω
		max.	3 Ω

Electrical connections



TS = substrate thermometer
C = common
R = radiation shield

Elementary array



INFRARED DETECTOR

This infrared detector conforms to the specifications of the M3RPY series and comprises an array configuration of 11 rows of 5 elements and uses a germanium window with 7 μm cut-on filter. For this reason only changes or additions, relevant to M343RPY are given in this data sheet.

QUICK REFERENCE DATA

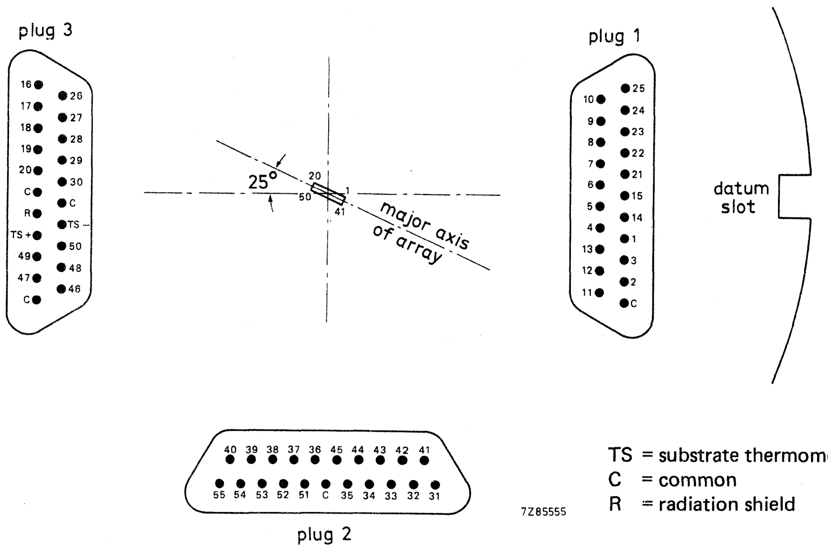
Element size	0,05 x 0,05	mm
Array configuration	11 rows of 5	
F.O.V.	43 x 58,5	degrees
Cut on filter embodied	7	μm

MECHANICAL DATA as per drawing 3313 563 17000, available on request; L = 98,0 mm.

ELECTRO-OPTICAL PERFORMANCE

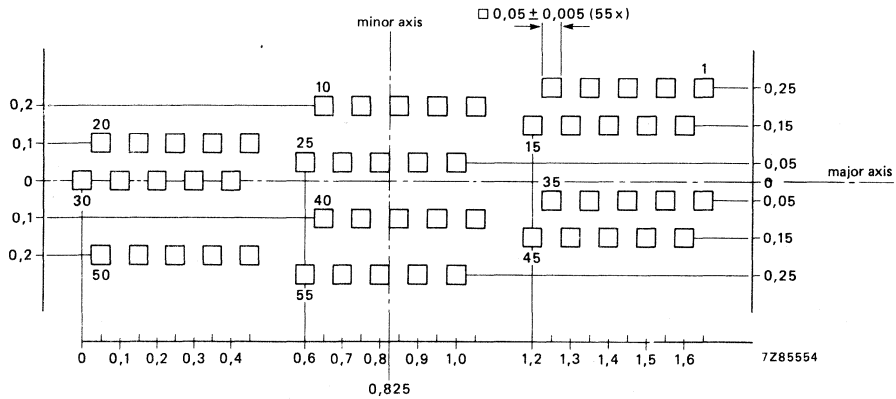
Responsivity ratio		max.	3	
Serial average D* (λ_{pk}, 5 kHz, 1) per row of 5 elements	D*a	min.	$2{,}0 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
		typ.	$3{,}0 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
Common lead impedance	R_{cl}	typ.	1,5	Ω
		max.	3	Ω

Electrical connections



TS = substrate thermometer
C = common
R = radiation shield

Elementary array



INFRARED DETECTOR

This infrared detector conforms to the specifications of the M3RPY series but comprises an array configuration of 11 rows of 5 elements. For this reason only changes or additions, relevant to M347RPY are given in this data sheet.

QUICK REFERENCE DATA

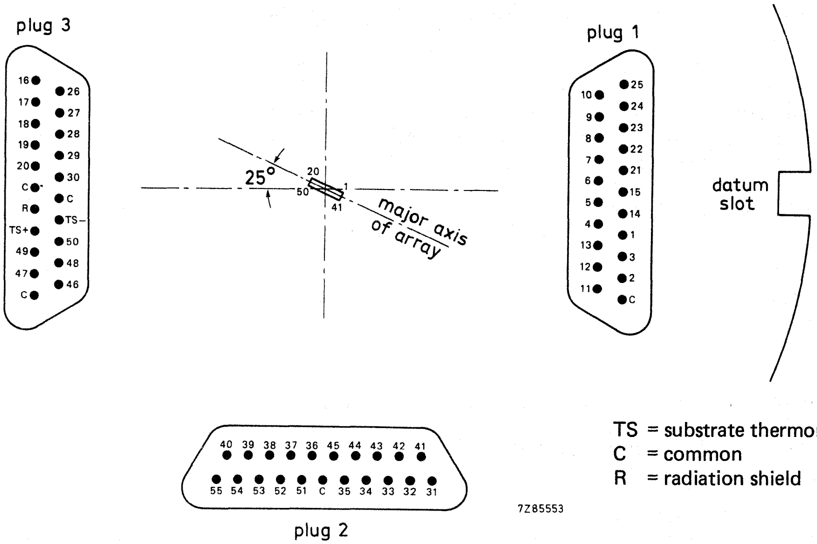
Element size	0,05 x 0,05	mm
Array configuration	11 rows of 5	
F.O.V.	43 x 58,5	degrees

MECHANICAL DATA as per drawing 3313 563 18000, available on request; L = 98,0 mm.

ELECTRO-OPTICAL PERFORMANCE

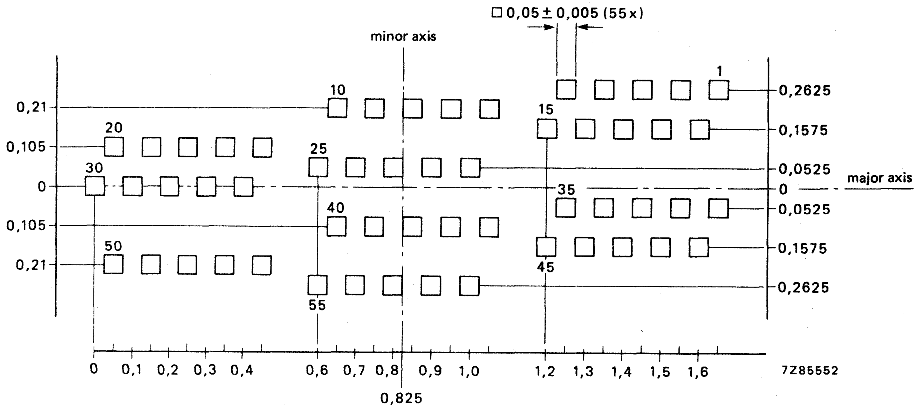
Responsivity ratio		max.	3	
Serial average D* (λ_{pk}, 5 kHz, 1) per row of 5 elements	D*a	min.	$2{,}6 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
		typ.	$3{,}9 \cdot 10^{10}$	$cmHz^{1/2}W^{-1}$
Common lead impedance	R_{cl}	typ.	1,5	Ω
		max.	3	Ω

Electrical connections



TS = substrate thermometer
C = common
R = radiation shield

Elementary array



INFRARED DETECTOR

This infrared detector conforms to the specifications of the M3RPY series and comprises an array configuration of 11 rows of 5 elements and uses a germanium window with 7 μm cut-on filter. For this reason only changes or additions, relevant to M348RPY are given in this data sheet.

QUICK REFERENCE DATA

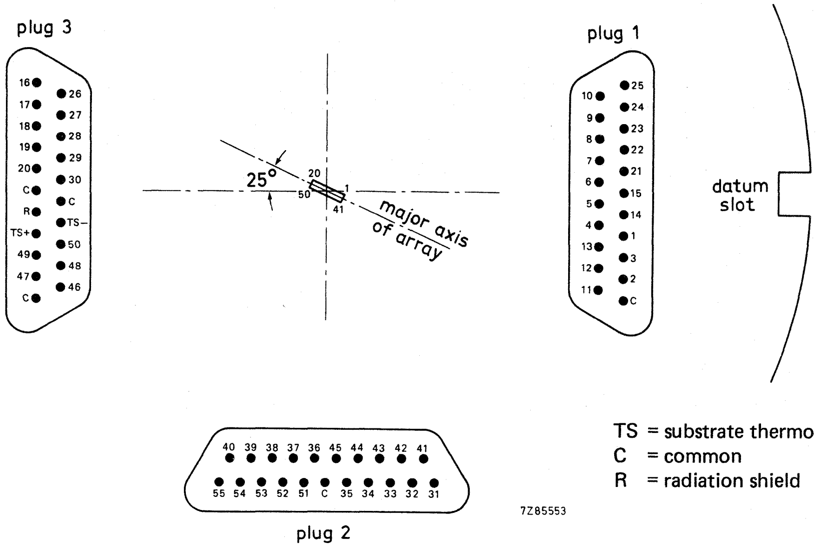
Element size	0,05 x 0,05	mm
Array configuration	11 rows of 5	
F.O.V.	43 x 58,5	degrees
Cut on filter embodied	7	μm

MECHANICAL DATA as per drawing 3313 563 18000, available on request; L = 98,0 mm.

ELECTRO-OPTICAL PERFORMANCE

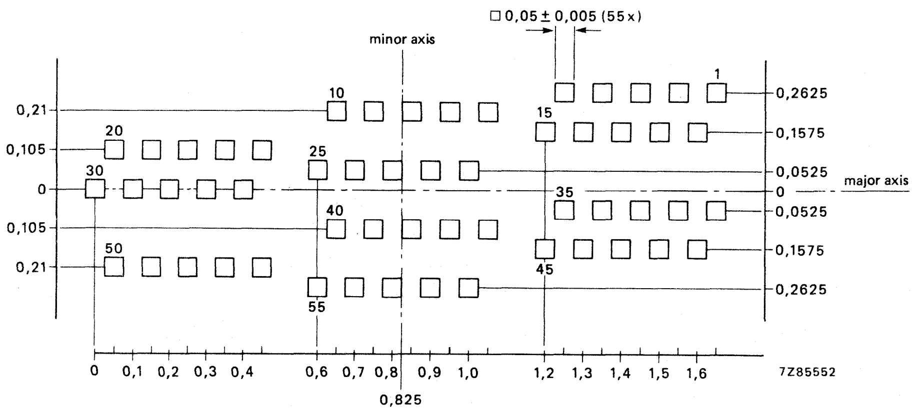
Responsivity ratio		max.	3
Serial average D* (λ_{pk}, 5 kHz, 1) per row of 5 elements	D*a	min.	$2,0 \cdot 10^{10}$ cmHz$^{1/2}$W^{-1}
		typ.	$3,0 \cdot 10^{10}$ cmHz$^{1/2}$W^{-1}
Common lead impedance	R_{cl}	typ.	1,5 Ω
		max.	3 Ω

Electrical connections



TS = substrate thermometer
C = common
R = radiation shield

Elementary array



INFRARED DETECTORS

A series of single-element cadmium-mercury-telluride (CMT) infrared detectors, sensitive in the 3,8 to 5,6 μm region. They are mounted in a rugged sapphire-windowed encapsulation, incorporating a thermoelectric cooler and a temperature sensing diode.

The applications are in industrial and military equipment.

QUICK REFERENCE DATA

Material	Cd Hg Te (CMT)
Number of elements	1
Element size	0,05 mm square to 1,25 mm square
Sensitive wavelength	3,8 to 5,6 μm
Operating temperature	220 K
Cooling method	thermoelectric, with either a one or a two-stage cooler

PERFORMANCE DATA, based on a two-stage cooled detector

Table 1

	nominal peak spectral response (μm)						unit
	4,0		4,8		5,4		
	min.	typ.	min.	typ.	min.	typ.	
D*(500K, 5 kHz, 1)(see text)	$3,0 \times 10^9$	$5,1 \times 10^9$	$2,7 \times 10^9$	$4,5 \times 10^9$	$2,4 \times 10^9$	$4,1 \times 10^9$	$cmHz^{1/2}W^{-1}$
N.E.R. (see text)	1,0	2,0	1,5	4,0	2,0	5,0	kΩ
Time-constant (see text)	–	< 5	–	< 5	–	< 5	μs
Responsivity (see text)	see Fig. 2		see Fig. 2		see Fig. 2		
Spectral response (see text)	see Fig. 5		see Fig. 5		see Fig. 5		
Detector resistance	100	200	80	200	60	160	Ω
Field of view	100	–	100	–	100	–	deg
Ratings							
Optimum bias current	0,2 to 2,0		0,2 to 2,0		0,2 to 2,0		mA
Storage temperature	–50 to + 50		–50 to + 50		–50 to + 50		°C

Values for single-stage cooled versions are identical with the exception of D* (500K) and responsivity which are both approximately 20% less, and the minimum field of view which is 75 degrees. The values of Table 1 are obtained with the detector mounted on a heatsink which is kept at 20 ± 5 °C. The drive current to the TE-cooler is set to give the lowest possible detector temperature. This current is typically about 1,2 A. The element bias current for optimum D* is then determined.

Area normalized detectivity D*

Area normalized detectivity D* (500K) for a typical detector (λ_{pk} = 4,8 μm) is plotted against frequency in Fig. 2, and against bias current in Fig. 3. The ratio of D* (λ_{pk}) to D* (500K) as a function of cut-off wavelength (50% of peak) is shown in Fig. 4.

Noise equivalent resistance

Noise equivalent resistance (N.E.R.) is the value of resistance which at 20 °C would produce a Johnson noise voltage equivalent to the detector noise measured at the detector operating temperature.

Noise

A typical noise spectrum is shown in Fig. 2.

Time-constant

The time-constant is obtained by applying a pulse of radiation to the detector and measuring the interval between the time of cut-off of the radiation and that at which the detector output falls by 63% of its peak value.

Responsivity

Responsivity as a function of frequency is plotted in Fig. 2.

Spectral response

The spectral response of a typical detector is shown in Fig. 5. Detectors are normally specified in terms of the cut-off wavelength (50% of peak responsivity), rather than the peak wavelength. When ordering, the maximum acceptable range for the cut-off wavelength should be stated; the minimum tolerance offered is ± 0,2 μm.

OPERATION

Care should be taken to ensure that the cooler supply is connected to pins 1 and 6 with the correct polarity (see Fig. 1). The input voltage to the cooler should be d.c. with less than 10% peak-to-peak ripple.

The detectors are normally operated on a heatsink. When mounting, use of a thermally-conducting compound is recommended. Responsivity and D* as a function of heatsink temperature is shown in Fig. 6. The temperature-sensing diode is the emitter-base junction of a BC107 transistor, mounted with the element in the encapsulation. To measure the element temperature, this diode is supplied with a constant current of 1 mA and the resulting voltage monitored. A typical calibration curve showing diode voltage as a function of element temperature is given in Fig. 7. Care should be taken to ensure that the diode supply is connected correctly to pins 3 and 4 (Fig. 1).

DEVELOPMENT SAMPLE DATA

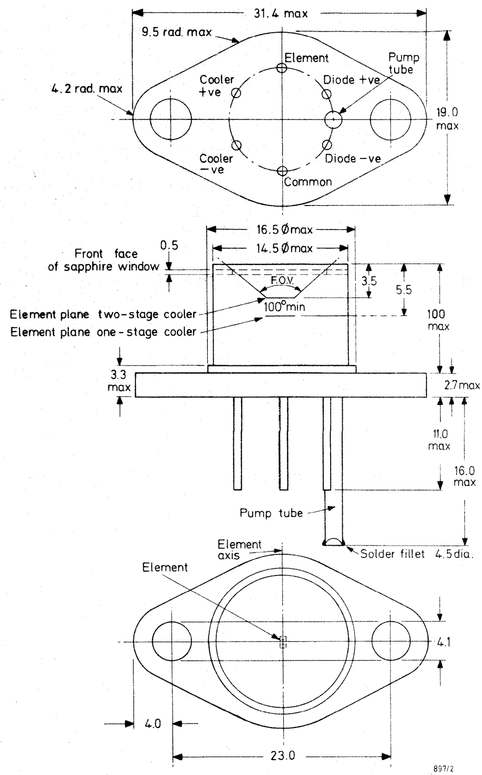


Fig. 1 Outline and pin functions.

TYPES

The range of available elements is as follows:

0,05 x 0,05 mm	0,23 x 0,23 mm
0,075 x 0,075 mm	0,30 x 0,30 mm
0,125 x 0,125 mm	1,25 x 1,25 mm.

Any combination of element size, cut-off wavelength and cooler (single- or two-stage) can be considered. However, the two-stage types shown below are preferred.

type number	element dimensions	cut-off wavelength
M401RPY	0,23 x 0,23 mm	4,8 ± 0,2 μm
M402RPY	0,50 x 0,50 mm	4,4 ± 0,3 μm

Customized types can be made.

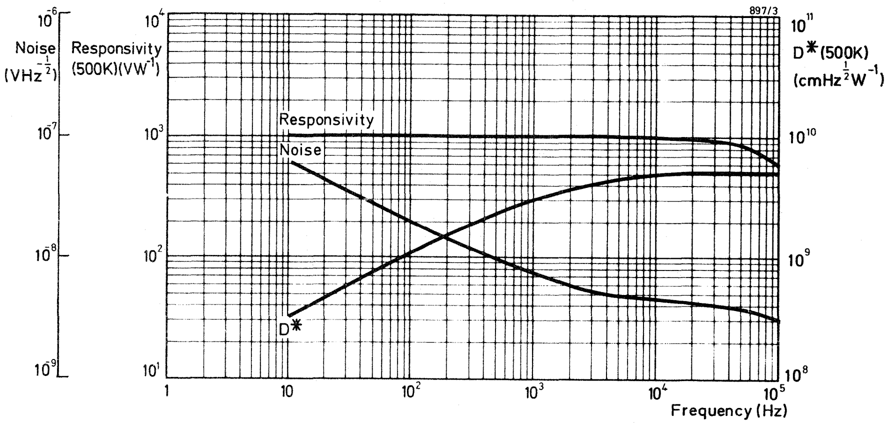


Fig. 2 Responsivity, D*(500K), and noise plotted against frequency for a detector with λ_{pk} = 4,8 μm.

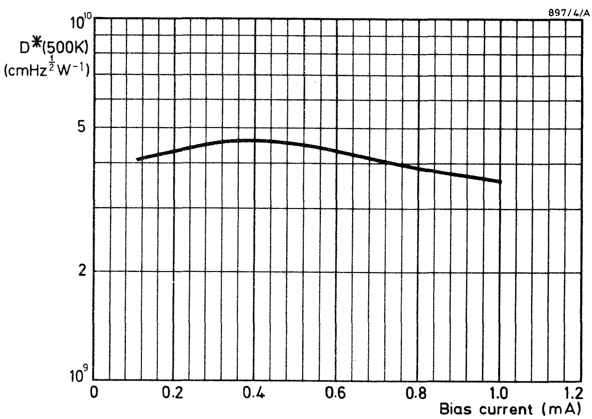


Fig. 3 D*(500K) plotted against bias current for a detector with λ_{pk} = 4,8 μm.

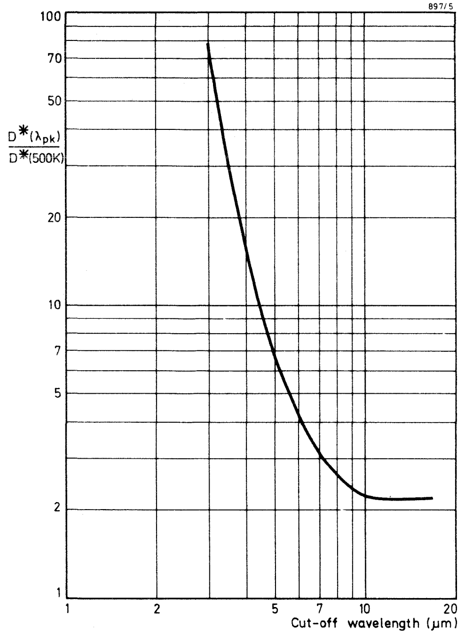


Fig. 4 The ratio D* (λ_{pk})/D* (500 K) plotted against cut-off wavelength.

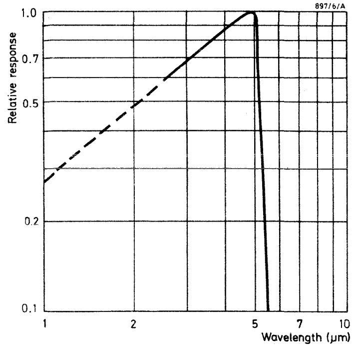


Fig. 5 Typical spectral response.

DEVELOPMENT SAMPLE DATA

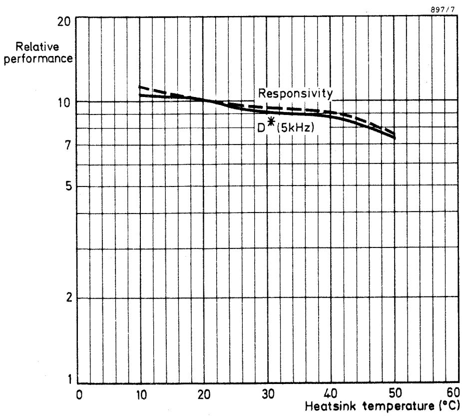


Fig. 6 D* (500K) and responsivity plotted against heatsink temperature.

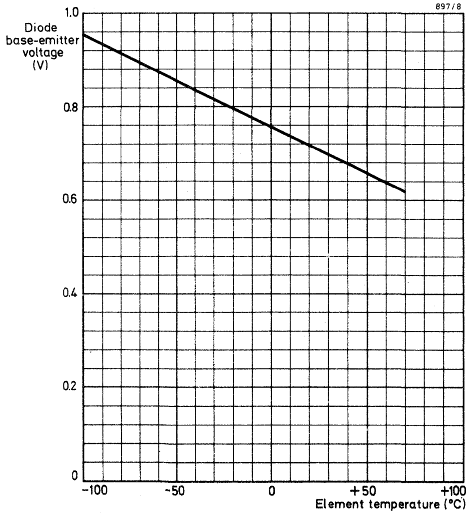


Fig. 7 Diode voltage plotted against element temperature.

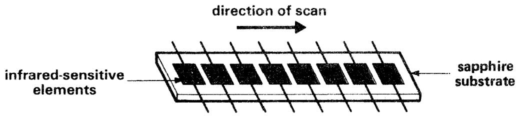
THE SPRITE* CONCEPT

An easy way of understanding the basic principles of the SPRITE detector is to compare it with the conventional in-line array of infrared-sensitive elements.

The old and new types of detector serve fundamentally the same purpose in converting thermal radiation from a scene into electrical signals, but there is a considerable difference in their complexity and their associated systems hardware.

THE CONVENTIONAL IN-LINE ARRAY

An in-line array comprises a row of separate elements of infrared-sensitive material on a sapphire substrate. Each element is provided with two electrical connections.



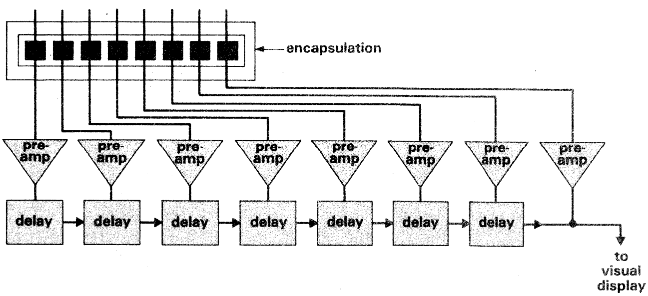
In a typical application, the infrared image is scanned along the length of the detector.

During the scan, the signal from each infrared-sensitive element is preamplified, delayed and then added to the signal which is generated in the following element.

In this way the signal for each picture point is 'built up' until the scan reaches the last element in the row. The sum of the separate signals is thus made available for amplification and visual display.

The preamplification, delay and summation circuitry (also called TDI for time delay and integration) is external to the detector. Therefore connections from the individual elements have to be brought out of the detector encapsulation.

Conventional in-line detectors need multiple-lead encapsulation and preamplification, time delay and summation circuitry.

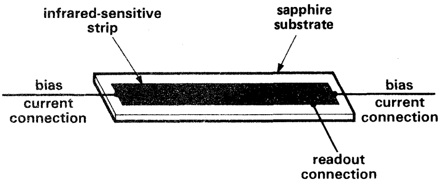


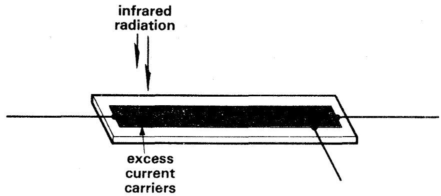
* The device described was developed at Mullard, Southampton, with support from the U.K. Ministry of Defence (Procurement Executive) sponsored by DCVD.
The SPRITE design is based on an idea from Royal Signals Research Establishment, Malvern, U.K.
For detailed information reference is made to the IEE conference proceedings on advanced IR-detectors and systems, Conf. Pub. no. 204, October 1981.

THE SPRITE DETECTOR

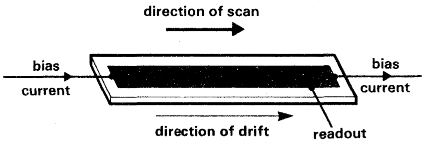
The SPRITE detector is essentially a strip of infrared-sensitive material on a sapphire substrate. There are only three electrical connections.

If a small region of the strip is exposed to infrared radiation, excess current carriers are generated in that region



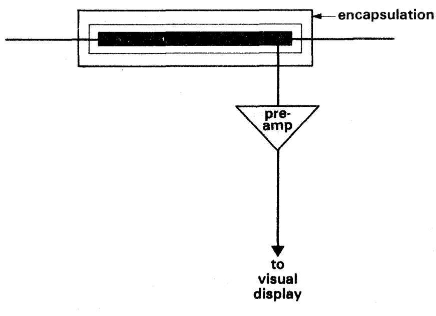


The excess current carriers 'drift' towards the readout region at a velocity which is determined by the magnitude of the bias current. The drift velocity is, in fact, quite high and is matched to the velocity at which the infrared image is scanned along the strip.



Consequently, the excess carriers are swept along the strip together with the infrared image, and all of the accumulated carriers arrive at the readout region at the same time. There is no need for time delay and summation circuitry, and only one readout connection is required. Thus, the improvement in signal-to-noise ratio obtained by summation is effected within the detector element itself.

SPRITE detector dramatically reduces the number of leads from the encapsulation, and completely dispenses with time delay and summation circuitry.



SPRITE DETECTORS

A series of infrared detectors comprising a number of cadmium-mercury-telluride (CMT) strip elements sensitive in the 8 to 13 μm region. The elements can be mounted in various encapsulations. These detectors are for high performance serial-parallel scan, thermal imaging applications.

TENTATIVE DATA

Elements

A typical configuration is shown in Fig. 1.

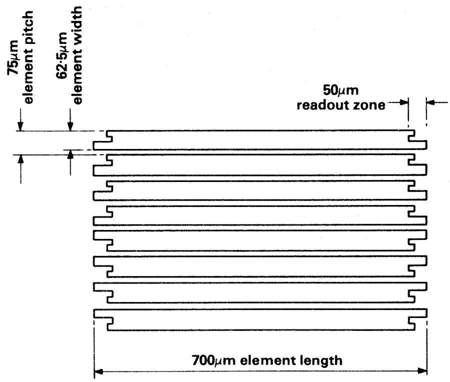


Fig. 1 Array configuration and dimensions.

Nominal sensitive area		62,5 x 62,5 μm
Cut-off wavelength	typ.	10 to 13 μm
Resistance per element		200 to 800 Ω
Bias field for operation at $1,8 \cdot 10^6$ pixel/s		3 V/mm
Operating temperature		82 K
Cold shield field of view		f/2,2

Encapsulation:

M2: Dewar vessel suitable for Joule-Thomson minicooler of 7,23 or 5,18 mm diameter. The encapsulation has an anti-reflection coated window. Two temperature sensors are mounted on the array substrate.

M3: Dewar vessel designed for use with UA7011 cooling engine. Two temperature sensors are mounted on the array substrate and a reusable getter is fitted.

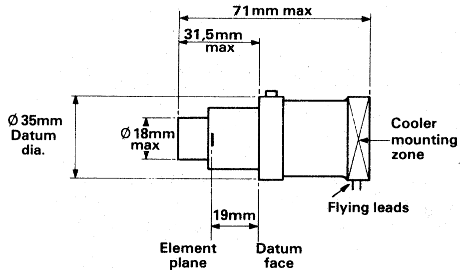


Fig. 2 M2 encapsulation outline, suitable for Joule Thomson cooling.

Performance

The performance is strongly dependent on the bias field and field of view. Performances are quoted for a bias field of 3 V/mm, which corresponds to a pixel rate per element of $1{,}8 \cdot 10^6$ pixels per second and an effective cold shield equivalent to a circular aperture f/2,2.

Because of the absence of common leads in Sprite arrays, there is no electrical crosstalk, unless pre-amplifiers mix signals.

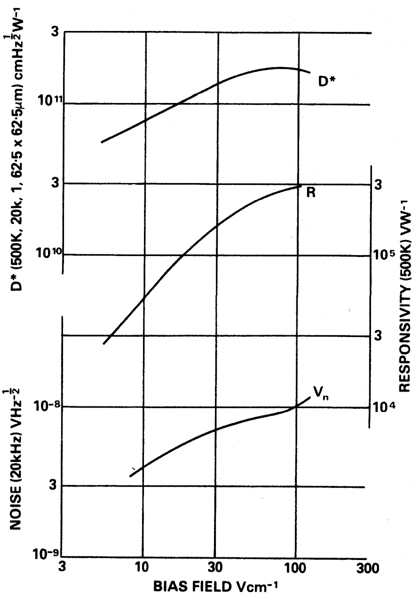


Fig. 3 Typical detector element performance with bias field.

INDEX OF TYPE NUMBERS

NOTES

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