Mullard

DATA SHEETS

ELECTRO-OPTICAL PRODUCTS

With the compliments of

MULLARD LTD.

Mullard House · Torrington Place · London WC1E 7HD

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ELECTRO-OPTICAL PRODUCTS

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MULLARD HOUSE, TORRINGTON PLACE, LONDON, WC1E 7HD
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MULLARD TECHNICAL HANDBOOK

The data sheets in this booklet are part of the Mullard data handbook system which is made up of three sets of books, each comprising several parts.

Descriptive leaflets and order forms may be obtained from Central Technical Services at the following address:

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VIDICON GENERAL OPERATIONAL RECOMMENDATIONS

A. PRINCIPLES OF OPERATION OF VIDICONS WITH MAGNETIC FOCUSING AND MAGNETIC DEFLECTION

1. With integral mesh

Mechanical design

The schematic arrangement of the vidicon with its accessories is shown in Fig.1.

The vidicon may be assumed to consist of three sections, namely, the electron gun, the scanning section, and the target section.

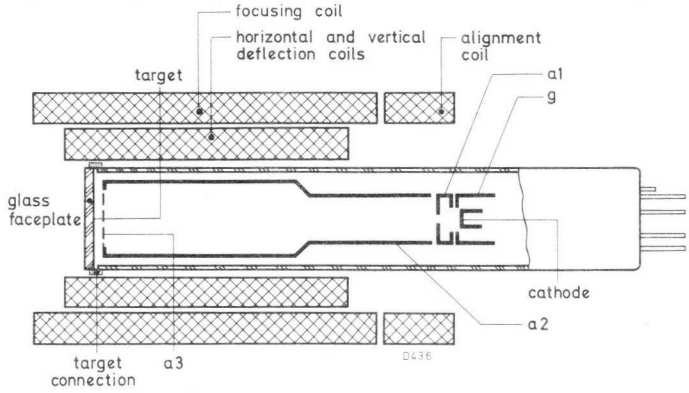


Fig.1. Schematic electrode and coil arrangement

The **electron gun** contains a thermionic cathode, a grid g controlling the beam current, and a limiter electrode a1 which accelerates the electrons and releases them in a fine beam through its diaphragm.

The scanning section. The electron beam released by a1 enters the space enclosed by the cylindrical electrode a2. By means of the combined action of the adjustable electrical field of a2 (beam focus control) and a fixed axial magnetic field produced by the focusing coil, the electrons are focused in one loop on to the target.

The far end of the a2 cylinder is closed with a fine metal mesh, a3, electrically connected to a2, which produces a uniform, decelerating field in front of the target. The focused beam is magnetically deflected by two pairs of deflection coils so that it scans the target. Proper alignment of the beam with the axial magnetic field is achieved either by an adjustable magnet, or, as shown in Fig.1, by two sets of alignment coils producing an adjustable transverse magnetic field.

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

The optical image to be televised is focused on the conductive film by means of a lens system.

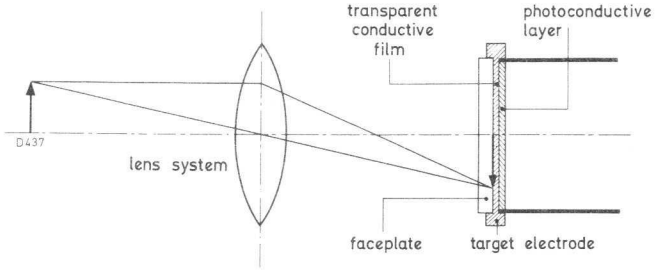


Fig.2. Target section

Operation

The external target-electrode ring is connected via a load resistor to a positive voltage of the order of 30V (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 consists of a small capacitor (C_e), connected on one side to the target electrode via the transparent conductive film and shunted by a light-dependent resistor (R_{ld}), see Fig.3).

When the target is scanned by the beam its surface will be "stabilised" at approximately the cathode potential (low-velocity stabilisation) and a potential difference will be established across the photoconductive layer, in other words, each elementary capacitor will be charged to nearly the same potential as applied to the electrode ring.

In the dark, the photoconductive material is a fairly good insulator, so that only a minute fraction of the charge of the elementary capacitors will leak away between successive scans. This charge will be restored by the beam; the resulting current to the target electrode is termed "dark current".

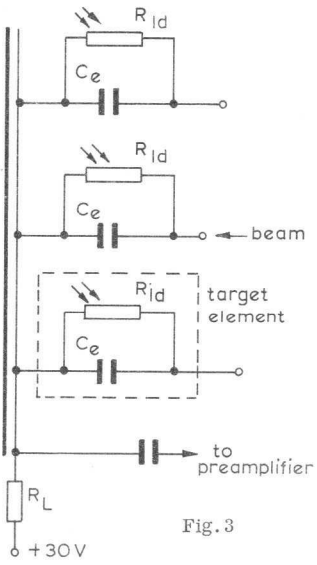


Fig.3

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

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 target electrode and hence a voltage across the load resistor R_L. This voltage, negative going for the highlights, is the video signal and is fed to the pre-amplifier.

A vidicon is called "stabilised" when the magnitude of the beam current applied is just sufficient to restore the scanned surface to cathode potential, so that all elementary capacitors, including those at the highlights in the image, are recharged successively.

During the retrace periods the beam electrons should be prevented from landing on the target since otherwise the scan retraces will appear as dark lines in the picture obtained on the monitor. This may be achieved either by cutting off the beam with suitable negative blanking pulses on the control grid or by cutting off the target with adequate positive blanking pulses applied to the cathode.

2. **With a separate mesh construction**

The focus coils commonly used in vidicon cameras do not produce an ideal focus field distribution in the vicinity of the vidicon's photoconductive target.

The resulting "landing errors" of the scanning beam reduce the sensitivity and resolution at the periphery of the picture. The beam landing errors can be corrected by electron-optical means. A lens for this purpose may be formed by the cylindrical electrode (a2) and the mesh electrode (a3). In the vidicons with a separate mesh electrode a3 is electrically insulated from a2 and connected to a separate base pin.

The mesh electrode (a3) should be made positive with respect to the cylindrical electrode (a2); the optimum potential difference depends on:
a. the operating mode of the vidicon (choice of the focusing field and V_{a2});
b. the particular type of deflection coil unit used.
As a rule, to obtain the best resolution and **most uniform whites** the V_{a3} should be from 1.1 to 1.5 times higher than V_{a2}. Fig.4 shows a typical curve revealing the effect of the ratio V_{a3}/V_{a2} on the resolution measured on a vidicon type XQ1040 in a coil unit type AT1101. The fall-off in resolution at $V_{a3}/V_{a2}=1$, corresponding to the situation with conventional vidicons, is caused by the defocusing effect of a space charge at the cathode side of the mesh electrode, produced by secondary electrons released from the mesh. This space charge can be prevented from building up by making a3 at least 15 volts positive relative to a2.

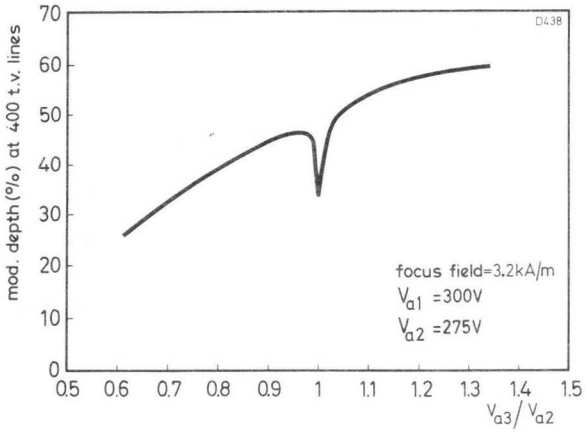


Fig.4. Effect of the V_{a3}/V_{a2} ratio on the resolution of a vidicon type XQ1040

Operation of a3 at a negative potential with respect to a2 must be avoided in any case, since this would cause permanent damage to the target, due to ion bombardment. A higher potential applied to a3 will slightly raise the required deflection currents but these will usually remain well within the ratings of the camera deflection circuits.

Caution If the camera wiring has been adapted* for the use of vidicons with separate mesh, insertion of an integral-mesh vidicon will result in normal performance of the tube and do no harm to the tube or the wiring of the camera. However, it should be borne in mind that the insertion of a separate-mesh vidicon in an unmodified camera may be detrimental to the vidicon, its target being damaged by ion bombardment; moreover, performance will be unsatisfactory.

*A leaflet is available on request giving suggestions for making cameras suitable for incorporating separate-mesh tubes.

B. EQUIPMENT DESIGN AND OPERATING CONSIDERATIONS

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

The target-electrode voltage should be limited to such a value that the peak dark current does not exceed 0.25μA.

This is of particular importance for the design and adjustment of vidicon cameras with automatically controlled sensitivity (automatic control of the target-electrode voltage).

Operation of vidicons at excess dark current will result in damage to the photoconductive target and hence shorten the tube life.

VIDICON GENERAL OPERATIONAL RECOMMENDATIONS

The deflection yoke and the focus coil used must be so designed that the beam lands perpendicular to the target at all points of the scanned area, to ensure high uniformity of sensitivity and focus.

The deflection circuits must provide constant scanning speeds in order to obtain good black-level reproduction. The dark-current signal being proportional to the velocity of scanning, any change in this velocity will produce a black-level error.

The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside and at the image end of the focusing coil.

The alignment coil assembly should be located on the tube so that its centre is at a distance of approx. 94mm from the face of the tube, and be positioned so that its axis coincides with the axis of the tube, the deflecting yoke and the focusing coil.

The temperature of the faceplate should never exceed 80°C, either during operation or storage. Operation at a faceplate temperature of 25 to 35°C is recommended.

The temperature of the faceplate is determined by the heating effects of the incident illumination, the associated components and the environment and, to a minor extent, by the tube itself.

To reduce these heating effects and to permit operation in the preferred temperature range, under conditions of high light levels and high ambient temperatures respectively, the use of an infra-red filter between object and camera lens, or a flow of cooling air directed across the faceplate, is recommended.

Scanning amplitude

Full-size scanning of the 9.6mm × 12.8mm area of the photoconductive layer should always be applied.

Underscanning of the photoconductive layer, i.e. scanning of an area of less than 9.6mm × 12.8mm or failure of scanning for even a short duration should always be avoided, since this may cause permanent damage to the specified full-size area.

The resolution of a vidicon generally decreases with decreasing V_{a2} and V_{a3}. The voltage range will depend on the design of the focusing coil, which should be such as to provide a field strength within the range 2.9 to 3.5kA/m.

Definition, focus uniformity and picture quality also decrease with decreasing V_{a2} and V_{a3}. In general a2 and a3 should be operated above 250V.

A substantial increase in both limiting resolution and amplitude response may be obtained by increasing the operating voltage of a2 and a3 to 750V. With this mode of operation, the focusing field strength must be increased to approx. 5.6kA/m.

Since beam-landing errors increase with increasing V_{a2} and V_{a3}, such operation will show a reduced signal output in the corners of the scanned area. When a vidicon with integral mesh is operated in this manner, the deflecting and focusing coils employed must be designed in such a way that beam-landing errors are minimised.

Compensation of residual beam-landing errors can be obtained by supplying modulating voltages of parabolic shape and of both horizontal and vertical scanning frequencies to the cathode and additionally, in order to prevent beam-modulation, to g, a1, a2, and a3.

A suitable amplitude for this mixed parabolic waveform is approximately 4V peak-to-peak. The polarity should be chosen such that the potential of the cathode is lowered as the beam approaches the edges of the scanned area. The use of this modulating waveform also improves the centre-to-edge focus of the vidicon.

Operation with V_{a2} and V_{a3} at 750V and a field strength of 5.6kA/m requires increased power for the deflecting and focusing coils, which will result in a higher tube temperature unless adequate provisions for cooling are made.

Compensation of beam-landing errors by means of mixed modulating voltages of parabolic shape is in general not needed for vidicons with separate mesh since the beam-landing errors may be sufficiently reduced by a proper choice of V_{a3}.

C. INSTRUCTIONS FOR USE FOR VIDICONS WITH MAGNETIC FOCUSING AND MAGNETIC DEFLECTION

1. In the case of a separate-mesh vidicon make certain that the camera is adapted for separate-mesh vidicons.
2. Clean the faceplate of the tube.
3. Insert the tube in the deflection unit so that the straight sides of the masked portions of the faceplate are essentially parallel to the line scan.
4. Press the socket firmly on to the base pins.
5. Cap lens and close iris.
6. Set: (a) grid-bias control at maximum negative bias (beam cut-off)
   (b) target-electrode voltage to approximately 25V
   (c) scanning amplitude to maximum scan.
7. Switch on camera equipment and monitor; allow a few minutes for heating up.
8. Adjust monitor to produce a faint, non-overscanned, raster.
9. Direct camera to the scene to be televised and uncap lens.
10. Turn grid-bias control slowly until a picture is produced on the monitor. If this picture appears washed out, increase beam current. If the picture is too faint, increase lens aperture.
11. Adjust beam focus (V_{a2} and V_{a3} for integral-mesh tubes, V_{a2} for separate-mesh tubes) and optical focus alternately for best possible focus.
12. Adjust scanning amplitudes:
    (a) by means of a mask of 9.6mm × 12.8mm, which is in contact with and centred at the faceplate. Decrease horizontal and vertical deflecting currents until the periphery of this mask is just outside the raster on the monitor. This procedure may be facilitated by small adjustments of the centring controls;

(b) if no mask is available, direct the camera to a test chart having the correct aspect ratio (4:3) and adjust the centring controls in such a way that the target ring is just visible in the corners of the picture. Adjust distance from camera to test chart and optical focus alternately, until the picture of the test chart completely fills the scanned raster on the monitor.

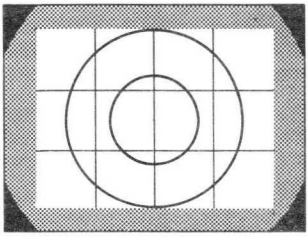


Fig.5

13. Adjust alignment controls so that the centre of the picture does not move when beam focus (V_{a2} and V_{a3} for integral-mesh tubes, V_{a2} for separate-mesh tubes) is varied.
14. Cap lens and adjust target-electrode voltage to such a value that further increase would cause the background signal to become unacceptably high or non-uniform.
15. Uncap lens. Adjust beam focus control for optimum picture uniformity in respect of picture whites and resolution.
16. Adjust iris for a picture of sufficient contrast and adjust beam current to the minimum value which will give details in the picture highlights.
17. Check alignment, beam focus and optical focus.

Always:

- make sure the camera wiring is adapted for a separate-mesh tube before installation;
- make sure that the deflection circuits are operative before adjusting beam current;
- maintain the same scanned target area, hence avoid rotating the tube;
- use full size (9.6mm × 12.8mm) scanning of the target, hence avoid under-scanning;
- use sufficient beam current to stabilize the picture highlights;
- adjust V_{a3} of separate-mesh tubes to a value positive with respect to V_{a2};
- avoid peak dark currents in excess of 0.25μA;
- avoid directing the camera at the sun;
- keep lens capped when transporting the camera.

D. VIDICON TUBES WITH OTHER ELECTRODE-GUN SYSTEMS

To facilitate the construction of compact, low power or light weight cameras vidicons with the following electron gun systems have been developed.

Type of electron gun	Focus	Deflection	Main features	Available type
hybrid gun	E	M	uniform high resolution no focus power required	-
reverse hybrid gun	M	E	uniform very high resolution no deflection power short tube	-
fully electrostatic gun	E	E	no deflection power no focus power	XQ1010

E = electrostatic, M = magnetic

E. PROPERTIES OF THE PHOTOCONDUCTIVE TARGETS AS USED IN THE VIDICONS OF THE XQ1010, XQ1030, XQ1040, XQ1050 SERIES

Spectral response

The spectral response of the targets used in the above tubes is shown in Fig.6.

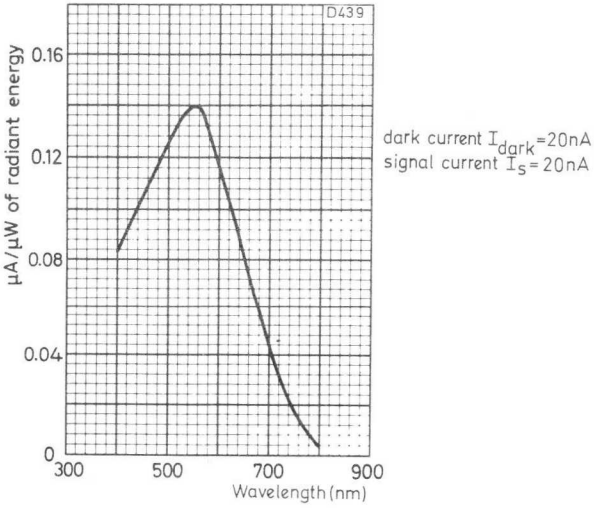


Fig.6

Dark current

The range of dark currents determined at a faceplate temperature of $30 \pm 2^{o}C$ is shown in Fig. 7.

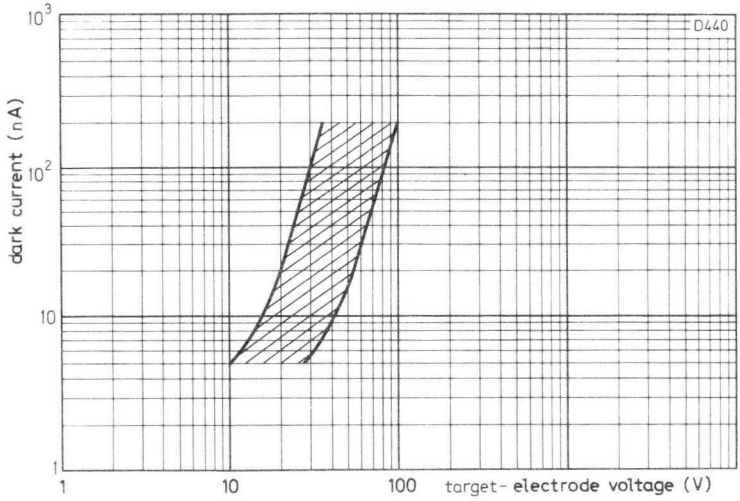


Fig. 7

Transfer characteristics

The light transfer characteristics of a typical vidicon with three dark current settings as parameters are given in Fig.8.

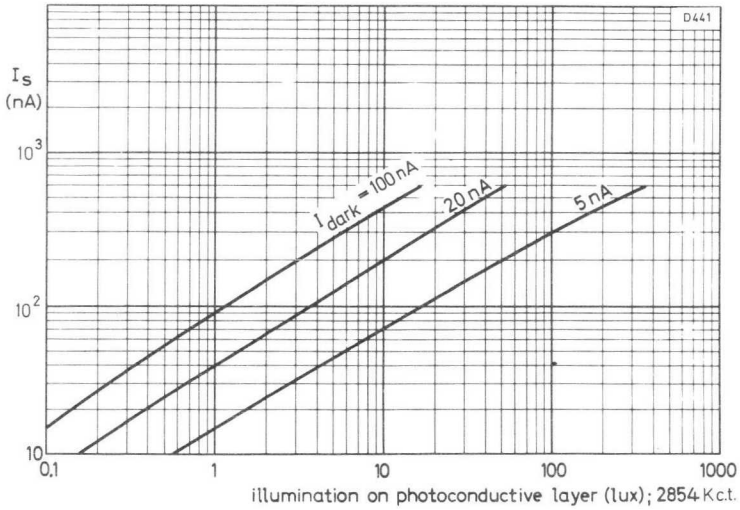


Fig. 8

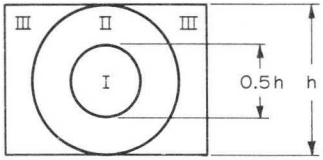
SPURIOUS SIGNAL SPECIFICATION FOR VIDICON TUBES

SECTION A Vidicons for telecine, other broadcast applications and critical industrial applications.

Test conditions

1. A back illuminated test transparency, with an aspect ratio of 4:3, with three quality zones (see Fig.1) is projected on to the specified target area ($9.6 \times 12.8 mm^2$), producing even illumination.

Fig.1



2. Light level adjusted to produce a total target current of 0.3μA, target voltage adjusted for a dark current of approx. 20nA, temperature $30^{o} \pm 2^{o}C$, colour temperature of light source 2854K.
3. Tube aligned and focused in accordance with the published instructions for use.
4. Video-amplifier system having a bandwidth of 5.5MHz.
5. Monitor adjusted for a non-blooming white.
6. In the evaluation of blemishes the following definitions apply:
   a) a **spot** (black or white) is a blemish with a maximum linear dimension measured in any direction of 0.75% of the picture height (0.8% for industrial grade tubes, 1% for low cost tubes)
   b) a **smudge** (black or white) is a blemish with a maximum linear dimension measured in any direction exceeding 0.75% of picture height (0.8% for industrial grade tubes, 1% for low cost tubes)

Permitted number, size and location of blemishes*

Dimensions of blemishes in % of picture height	Permitted number of blemishes		
	Zone I	Zone II	Zone III
>0.75%	0	0	0
≤0.75% but > 0.45%	0	0	1
≤0.45% but > 0.2%	0	2†	2
≤0.2%	‡	‡	‡

Notes

*Spots (black and white) and smudges (black and white) are not counted when their contrast expressed in % of picture white as measured on a waveform oscilloscope is less than 25% and 10% respectively.

†Sum of diameters of these spots shall not exceed 0.75%.

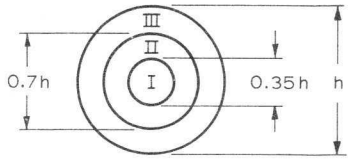
‡Spots of this size are allowed unless concentration causes a smudgy appearance. Such concentrations are evaluated as smudges, and, as contrast, the average contrast of the concentration is taken.

SECTION B Vidicons for medical X-ray applications

Test conditions

1. A back illuminated test transparency with three quality zones (see Fig.2) is projected on to the specified target area (15mm dia circular) producing an even illumination.

Fig.2



2. Light level adjusted to produce a total target current of 0.2μA, target voltage adjusted for a dark current of approx. 20nA, temperature $30^{O} \pm 2^{O}C$.

3. Tube aligned and focused in accordance with the published instructions for use.

4. Video-amplifier system having a bandwidth of 5.5MHz.

5. Monitor adjusted for a non-blooming white.

6. As Section A, test condition 6.

Permitted number, size and location of blemishes*

Dimensions of blemishes in % of picture height	Permitted number of blemishes		
	Zone I	Zone II	Zone III
>0.75%	0	0	0
≤0.75% but > 0.45%	0	1	3
≤0.45% but > 0.2%	2	3	6
≤0.2%	‡	‡	‡

Notes

*Spots (black and white) and smudges (black and white) are not counted when their contrast expressed in % of picture white as measured on a waveform oscilloscope is less than 25% and 5% respectively.

‡Spots of this size are allowed unless concentration causes a smudgy appearance. Such concentrations are evaluated as smudges, and, as contrast, the average contrast of the concentration is taken.

Sum of numbers of spots in zones II and III shall not exceed 6.

SECTION C Vidicons for industrial applications

Test conditions

As Section A

Permitted number, size and location of blemishes*

Dimensions of blemishes in % of picture height	Permitted number of blemishes	
	Zone I + Zone II	Zone III
>0.8%	0	0
≤0.8% but > 0.6%	0	1
≤0.6% but > 0.2%	2	3
<0.2%	‡	‡

Notes

*Spots (black and white) and smudges (black and white) are not counted when their contrast expressed in % of picture white as measured on a waveform oscilloscope is less than 50%.

‡Spots of this size are allowed unless concentration causes a smudgy appearance. Such concentrations are evaluated as smudges, and, as contrast, the average contrast of the concentration is taken.

SECTION D Vidicons for low cost closed-circuit television cameras

Test conditions

As Section A

Permitted number, size and location of blemishes*

Dimensions of blemishes in % of picture height	Permitted number of blemishes	
	Zone I + Zone II	Zone III
>1%	0	0
≤1% but > 0.6%	1	3
≤0.6% but > 0.2%	4	6
≤0.2%	‡	‡

Notes

*Spots (black and white) and smudges (black and white) are not counted when their contrast expressed in % of picture white as measured on a waveform oscilloscope is less than 50%.

‡Spots of this size are allowed unless concentration causes a smudgy appearance. Such concentrations are evaluated as smudges, and, as contrast, the average contrast of the concentration is taken.

CAMERA TUBE VIDICON

XQ1010

DEVELOPMENT SAMPLE DATA

QUICK REFERENCE DATA

25.5mm diameter ruggedised vidicon camera tube with separate mesh, electrostatic focusing and deflection. Intended for use in compact TV systems and other applications where vibration and shock conditions are experienced.

Resolution capability	$\geq$600	TV lines

This data should be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - VIDICON CAMERA TUBES

HEATER

Suitable for series or parallel operation, a.c. or d.c.

V_h	6.3 ±10%	V
I_h	300	mA

NOTE (applies to series operation only). The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain, a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

FOCUSING

Electrostatic

DEFLECTION

Electrostatic

PHOTOCONDUCTIVE LAYER (see note 1)

Maximum diagonal of rectangle on photoconductive layer (aspect ratio 3:4)	16	mm

For correct orientation of the image on the photoconductive layer, the horizontal scan should be essentially parallel to the plane passing through the tube axis and pin 2.

CAPACITANCE

Target electrode to all other electrodes	4.5	pF
x_1 to x_2	20	pF
y_1 to y_2	20	pF

The target electrode capacitance, which is effectively the output impedance, increases when the tube is inserted in the coil assembly.

TYPICAL OPERATION

Operating conditions

V_{a4} (mesh)	425	V
V_{a3} (collector)	225	V
V_{a2} (focus)	100	V
V_{a1} (accelerator)	425	V
V_g adjusted for sufficient beam current to stabilise highlights.		
V_x, V_y (deflection electrodes) (see note 2)	225	V
Maximum correction voltage for		
centring (see note 3)	20	V
astigmatism (see note 4)	10	V
Peak-to-peak deflection voltage		
x-deflection (12.8mm scan per electrode)	55 ±10%	V
y-deflection (9.6mm scan per electrode)	42 ±10%	V
Scanned area	9.6 × 12.8	mm
Faceplate temperature	30 ±2	°C

TYPICAL OPERATION (contd.)

Typical performance

Target electrode voltage for dark current of 20nA		
range	20 to 55	V
typical	30	V
Decay (see note 5)		
Residual signal current after dark pulse of 200ms	8	%
Resolution (see note 6)		
Typical modulation depth measured for 400 TV lines, without aperture correction but corrected for losses introduced by the optical system.		
centre of picture	>30	%
typical	40	%
corner of picture	>15	%
typical	25	%
Resolution capability (see note 7)	>600	TV lines
Grid voltage for picture cut-off with no blanking applied	-30 to -200	V
Average gamma of transfer characteristic for signal currents between 10nA and 300nA	0.7	
Geometry distortion	$\leq$2.0	%
Signal current (see note 8)	150	nA
Wavelength at maximum response (approx.)	550	nm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	100	V
V_{a4} max.	750	V
V_{a3} max.	750	V
V_{a2} max.	750	V
V_{a1} max.	750	V
$-V_g$ max.	200	V
$+V_g$ max.	0	V

RATINGS (contd.)

V_{h-k} max.	50	V
Maximum voltage between any combination of deflection electrodes	200	V
Output current peak, max. (see note 9)	600	nA
Dark current peak, max.	250	nA
Cathode current max.	2.0	mA
Maximum faceplate illumination	5000	lux
Maximum faceplate temperature (operation and storage) (see note 10)	80	^{o}C

SHOCK AND VIBRATION

Shock

The tube will function satisfactorily after being subjected three times to a shock pulse of 30g for 11ms in each of six directions:- along the axis both directions and perpendicular to the axis along four mutually perpendicular directions.

Vibration

The tube will function satisfactorily when vibrated at a frequency of 25 to 500Hz with an acceleration of 20g in each of three mutually perpendicular directions one of which coincides with the axis of the tube. The rate of change of frequency is logarithmic and such that a complete cycle occupies approximately 10 minutes. The duration of the test is twelve complete cycles in each of the three directions.

MOUNTING POSITION

Any

WEIGHT

Tube alone (approx.)	65	g

ACCESSORIES

Socket (provisional)	2422 505 00001

NOTES

1. Underscanning of the useful target area of 9.6 × 12.8mm or failure of scanning should be avoided, since this may cause damage to the photoconductive layer. The boundaries outside this area should preferably be covered by a mask.

2. Average d.c. voltage of the four deflection electrodes before correction for astigmatism.

3. Some centring of the scanned area of the target will be generally needed. The d.c. voltage difference between the electrodes x_1 and x_2 and the electrodes y_1 and y_2 needed for centring will not exceed the given value.

4. Astigmatism correction may be achieved by applying a voltage difference between the x-deflection and y-deflection pair of electrodes. The correction voltage will not exceed the given value.

5. Tube is exposed to an illumination of 8 lux at a colour temperature of 2854K with the target electrode voltage set for a dark current of 20nA.

6. Square wave response. Measured with a peak signal current of 200nA. Corners defined as 0.35 of diagonal from centre.

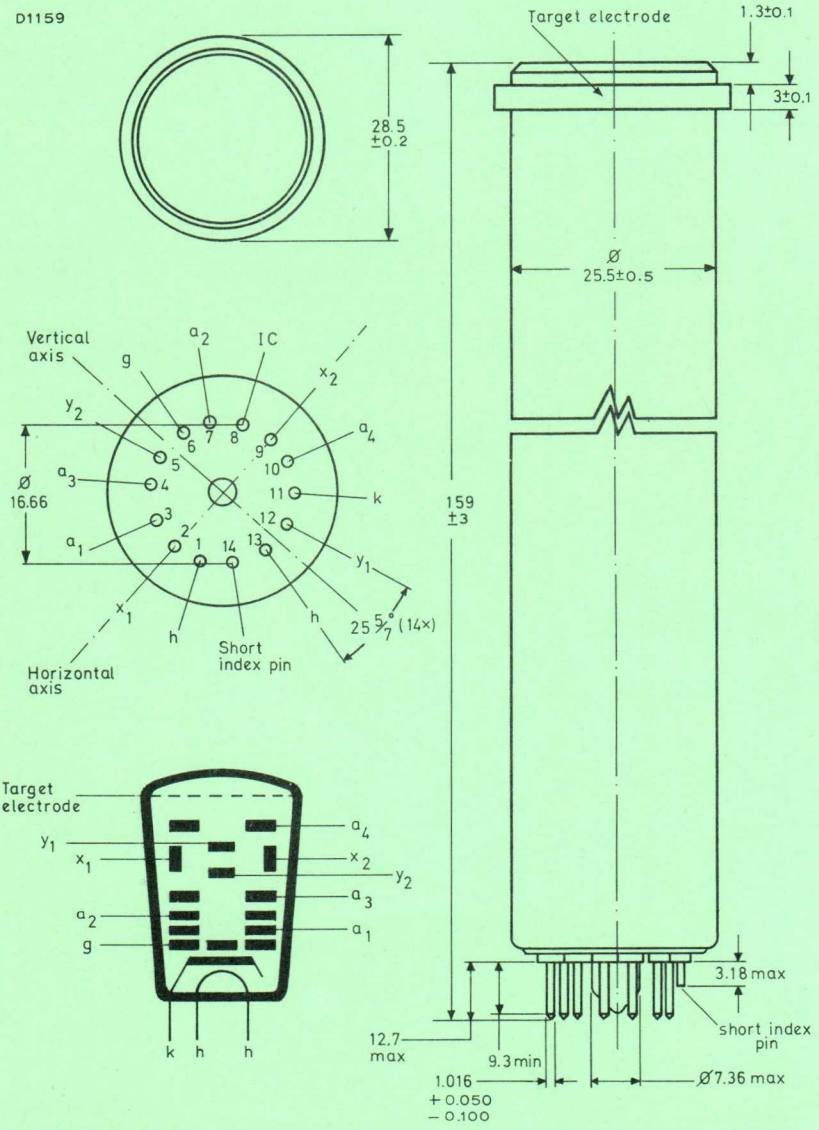
7. Measured with a video amplifier having an appropriate bandwidth.

8. With 8 lux, colour temperature 2854K on the faceplate.

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

10. Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces appropriate infrared filters should be used.

D1159



All dimensions in mm

CAMERA TUBES
VIDICON

XQ1240
XQ1241

DEVELOPMENT SAMPLE DATA

Vidicon television camera tube with low heater consumption, separate mesh construction, magnetic focusing, magnetic deflection and 25.4 mm (1 in) diameter intended for use in black-and-white and colour television cameras in industrial, medical and broadcast applications.

QUICK REFERENCE DATA	
Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	25.4 mm (1 in)
Length	159 mm ($6\frac{1}{4}$ in)
Heater	6.3 V, 95 mA
Resolution	$\geq$ 1000 TV lines

The electrical and mechanical properties of the two types are essentially identical, the differences being found in the degree of freedom from blemishes of the photoconductive layers, in the sensitivity and the signal electrode voltage range.

XQ1240 - intended for use in industrial, medical and broadcast applications in which a high standard of performance is required.

XQ1241 - general purpose tube for less critical industrial applications, experiments, amateur use etc.

OPTICAL

Diagonal of quality rectangle on photoconductive layer (aspect ratio 3 : 4)	max.	16	mm

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

Photoconductive layer	type A		
Spectral response, max. response at	approx.	550	nm

HEATING

Indirect by A.C. or D.C.; parallel and series supply

Heater voltage	V_f	6.3	V±10%
Heater current	I_f	95	mA

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

CAPACITANCES

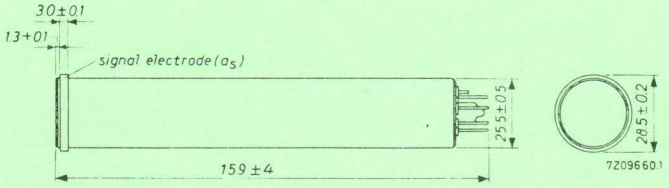
Signal electrode to all C_{as} 4.5 pF

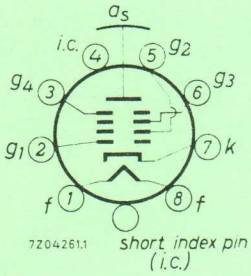
This capacitance, which effectively is the output impedance of the tube, increases when the tube is inserted into the deflection and focusing coil unit.

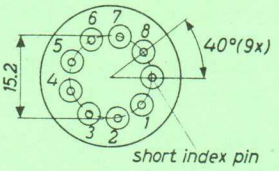
MECHANICAL DATA

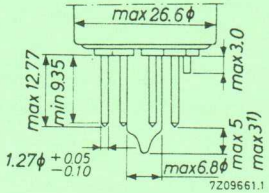
Dimensions in mm

Base: JEDEC no. E8-11 except for pumping stem
IEC 67-I-33a









Mounting position: any

Net weight approx. 55 g

ACCESSORIES

Socket — TE1004, Cinch no. 54A18088 or equivalent.

Deflection and focusing coil unit — AT1102/01, AT1003 or equivalent

DEFLECTION magnetic

FOCUSSING magnetic

LIMITING VALUES (Absolute max. rating system)
for scanned area of 9.6 mm x 12.8 mm (3/8 in x 1/2 in)

"Full-size scanning", i.e. scanning of a 9.6 mm x 12.8 mm area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area less than 9.6 mm x 12.8 mm, may cause permanent damage to the specified full-size area.

Signal-electrode voltage	V_{a_s}	max.	100	V	
Grid no. 4 voltage	V_{g4}	max.	1000	V	
Grid no. 3 voltage	V_{g3}	max.	850	V	
Grid no. 2 voltage	V_{g2}	max.	450	V	
Grid no. 1 voltage, negative	$-V_{g1}$	max.	125	V	
positive	V_{g1}	max.	0	V	
Cathode-to-heater voltage,					
peak positive	V_{kf_p}	max.	125	V	
negative	$-V_{kf_p}$	max.	10	V	
Dark current, peak	I_{dark_p}	max.	0.25	μA	
Output current, peak	I_{as_p}	max.	0.6	μA	1)
Faceplate illumination	E	max.	5000	lx	
Faceplate temperature, storage and operation	t	max.	80	°C	2)3)

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

2) Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended.

3) Under conditions of high heat irradation the use of a infra-red absorbing filter is recommended.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9.6 mm x 12.8 mm and a faceplate temperature of 30 ±2 °C.

CONDITIONS		Normal operation	Operation for high resolution	
Mesh voltage	V_{g4}	375[1])	850[1])	V
Focusing electrode voltage	V_{g3}	250 to 300	550 to 650	V
Accelerator voltage	V_{g2}	300	300	V
Grid no. 1 voltage	V_{g1}	Adjusted for sufficient beam current to stabilize highlights		
Blanking voltage, peak-to-peak				
when applied to g1		50		V
when applied to cathode		20		V
Field strength at centre of focusing coil (nominal)	H	3200 (40)	4800[2]) (60)[2])	A/m[3]) Oe[3])
Field strength of adjustable alignment coils	H	0 to 320 (0 to 4)	0 to 320 (0 to 4)	A/m[4]) Oe[4])

PERFORMANCE		min.	typ.	max.	
Signal electrode voltage for dark current of 20 nA	V_{as}				
	XQ1240	30	45	60	V
	XQ1241	20	40	60	V
Grid no. 1 voltage for picture cut-off, with no blanking applied	V_{g1}	-30	-55	-100	V
Signal current faceplate illumination 8 lx c.t. 2854 K	I_s				
	XQ1240	150	200		nA[5)6)]
	XQ1241	110	180		nA
Decay: residual signal current 200 ms after cessation of the illumination (8 lx, 2854 K)			8	15	% [5)]

Notes: see page 5.

		Normal operation	Operation for high resolution	
Limiting resolution at picture centre		750	1000	TV lines [7]
Modulation depth at 400 TV lines at picture centre	typ.	50	65	% [8]
Average γ of transfer characteristic for signal currents between 0.01 µA and 0.3 µA		0.7	0.7	
Spurious signals (spots and blemishes)		See note 9)		

NOTES

1) The optimal grid no. 4 voltage for best uniformity of black and white level depends on the type of coil unit used and will be 1.4 times V_{g3} for the coil units mentioned under "Accessories".
Under no circumstances should grid no. 4 (mesh) be allowed to operate at a voltage level below the V_{g3} level, since this may damage the target.

2) Because of the higher deflecting and focusing power required to produce adequate field strength the tube temperature will increase and adequate provisions for cooling should be made.

3) The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with this pole located outside of and at the image end of the focusing coil.

4) The alignment coil unit should be positioned on the tube so that its centre is at a distance of approx. 94 mm (3 11/16 in) from the face of the tube and that its axis coincides with the axis of the tube, the deflecting yoke and the focusing coil.

5) Signal-electrode voltage adjusted for a dark current of 20 nA.

6) Signal current is defined as the component of the output current after the dark current has been subtracted.

7) Measured with a video amplifier system having an appropriate bandwidth.

8) Square wave response. Measured with a lens aperture of f5.6, a peak signal current I_{sp} = 0.15 µA and a beam current sufficient to stabilize a signal current 0.5 µA.

9) Conditions :

The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area. Signal electrode voltage adjusted for a dark current of 20 nA, illumination on the target 8 lx, (c.t. = 2854 ^{o}K).

Scanning amplitudes of the monitor adjusted to obtain a raster with an aspect ratio of 3 : 4.

Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped, and for non-blooming bright raster when lens of camera is uncapped.

Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted unless the amplitude is less than 10% (XQ1240), or less than 25% (XQ1241) of the peak white signal.

XQ1240

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1	none	none
1 to 0.6	none	none
0.6 to 0.2	1	2
⩽ 0.2	*	*

XQ1241

Spot size in % of raster height	Maximum number of spots zone 1	zone 2
> 1	none	none
1 to 0.6	1	3
m 0.6 to 0.2	3	5
⩽ 0.2	*	*
	max. 8	

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

a) Minimum separation between any two spots greater than 0.2% of raster height is limited to a distance equivalent to 5% of raster height.

b) Tubes are rejected for smudge, lines, streaks, mottled, grainy or uneven background having contrast ratios in excess of 10% (XQ1240), respectively 25% (XQ1241).

CAMERA TUBE
VIDICON

20PE11

TENTATIVE DATA

QUICK REFERENCE DATA		
17.7mm diameter vidicon television camera tube with integral mesh, low heater consumption, magnetic focusing, and magnetic deflection. Intended for use in low-cost industrial cameras, home cameras and for amateur use.		
Decay - residual signal after 50ms	20	%
Resolution capability	>400	TV lines

HEATER

Suitable for parallel or series operation, a.c. or d.c.

V_h	6.3 ±10%	V
I_h	95 ±10%	mA

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

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

Maximum diagonal of quality rectangle on photoconductive layer (aspect ratio 3:4)	11	mm

The direction of the horizontal scan should be essentially parallel to the plane defined by the short index pin and the longitudinal tube axis, unless rotation of the tube is found necessary to minimise the number of blemishes in the picture.

CAPACITANCE

Target electrode to all other electrodes	2.0	pF

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

TYPICAL OPERATION

Operating conditions

$V_{a2, a3}$ (see note 1)	250 to 300	V
V_{a1}	300	V
V_g	adjusted for sufficient beam current to stabilise highlights	
Minimum peak-to-peak blanking voltage		
when applied to the grid	75	V
when applied to the cathode	20	V
Field strength at centre of focus coil (see note 2)	4.0	A/mm
Field strength of adjustable alignment coils or magnets	0 to 320	A/m
Scanned area	6.6 × 8.8	mm
Faceplate temperature	30 to 35	°C

Typical performance

	Min.	Typ.	Max.	
Target electrode voltage for a dark current of 20nA	10	-	80	V
Output current at 20nA dark current (see note 3)	60	120	-	nA
Decay: residual signal current after dark pulse of 50ms (see notes 4, 5, 6)	-	20	30	%
Resolution capability at centre of picture	400	-	-	TV lines
Grid voltage for picture cut-off with no blanking applied	-20	-60	-80	V
Average gamma of transfer characteristic for signal currents between 20nA and 200nA	-	0.65	-	
Wavelength at maximum response (approx.)	-	550	-	nm

Spurious signals - shading

Tubes are rejected for smudge, lines, streaks, mottled background, grainy background, or uneven background having contrast ratios greater than 1.5:1.

Spurious signals - spots and blemishes (see notes 5, 7)

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	80	V
$V_{a2,a3}$ max.	750	V
V_{a1} max.	350	V
$-V_g$ max.	350	V
$+V_g$ max.	0	V
v_{h-k}(pk) max.		
cathode positive	125	V
cathode negative	10	V
Maximum peak output current (see note 8)	0.5	μA
Maximum peak dark current	150	nA
Maximum faceplate illumination	10 000	lux
Maximum faceplate temperature during storage and operation (see note 9)	70	°C

Scanning of a 6.6mm × 8.8mm area of the photoconductive layer should always be applied. The use of a mask of these dimensions is recommended. Scanning of an area less than this may cause permanent damage to the specified full-size area.

MOUNTING POSITION

Any

WEIGHT

Tube alone (approx.)	18	g

ACCESSORIES

Socket	Special miniature 7 pin (J.E.D.E.C. E7-1)
Coil assembly	M10AT or equivalent

NOTES

1. Beam focus is obtained by the combined effect of the focus electrode (a2), the voltage of which should be adjustable over the indicated range, and a focus coil having an average field strength of 4A/mm.
2. The polarity of the focus coil should be such that a north-seeking pole, located outside but adjacent to the image end of the focus coil, will be attracted to the image end of the focus coil.

NOTES (contd.)

3. With 10 lux (colour temperature = 2854K) on the faceplate.

4. With a dark current of 20nA and an initial signal current of 200nA.

5. The deflection circuit must provide sufficiently linear scanning for good black-level reproduction. Since the output current is proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.

6. Signal current is defined as the component of the output current after the dark current has been subtracted.

7. Conditions:

   Dark current 20nA and output current of 220nA.

   The camera is focused on a uniformly illuminated two-zone test pattern. Zone 1 at the centre has a diameter equal to the raster height. Zone 2 occupies the remainder of the scanned area.

   The scanning amplitudes of a rectangular monitor are adjusted to obtain a raster with an aspect ratio of 3:4. The monitor set-up and contrast control are adjusted for a faint raster when the lens of the camera is capped, and for a non-blooming bright raster when 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 are counted unless the amplitude is less than 50% of the peak white signal.

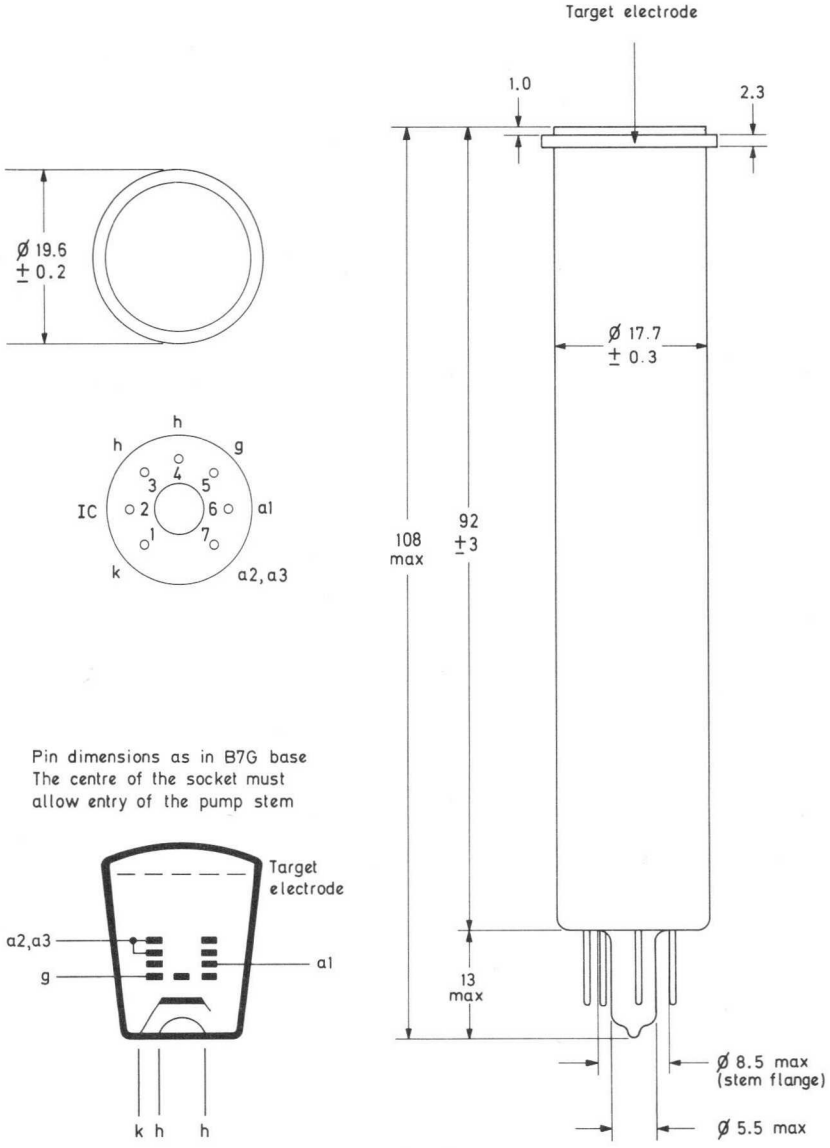
Spot size in % of raster height	Maximum number of spots	
	Zone 1	Zone 2
>0.8	none	1
0.8 to 0.6	2	2
0.6 to 0.3	2	3
<0.3	*	*

*Spots of this size are not counted unless their concentration is so high as to cause a smudgy appearance.

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

9. Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces appropriate infrared filters should be used.

OUTLINE DRAWING OF 20PE11



All dimensions in mm

D2503

CAMERA TUBE VIDICON

20PE13

TENTATIVE DATA

QUICK REFERENCE DATA

17.7mm diameter vidicon television camera tube with separate mesh, low heater consumption, magnetic focusing and magnetic deflection. Intended for use in low-cost industrial cameras, home cameras and for amateur use.

Resolution capability	>550	TV lines

HEATER

Suitable for parallel or series operation, a.c. or d.c.

V_h	6.3 ±10%	V
I_h	95 ±10%	mA

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

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

Maximum diagonal of quality rectangle on photoconductive layer (aspect ratio 3:4)	11	mm

The direction of the horizontal scan should be essentially parallel to the plane defined by the short index pin and the longitudinal tube axis, unless rotation of the tube is found necessary to minimise the number of blemishes in the picture.

CAPACITANCE

Target electrode to all other electrodes	2.0	pF

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

TYPICAL OPERATION

Operating conditions

V_{a3}	400	V
V_{a2} (see note 1)	250 to 300	V
V_{a1}	300	V
V_g	adjusted for sufficient beam current to stabilise highlights	
Minimum peak-to-peak blanking voltage		
when applied to the grid	75	V
when applied to the cathode	20	V
Field strength at centre of focus coil (see note 2)	4.0	A/mm
Field strength of adjustable alignment coils or magnets	0 to 320	A/m
Scanned area	6.6 × 8.8	mm
Faceplate temperature	30 to 35	°C

Typical performance

	Min.	Typ.	Max.	
Target electrode voltage for a dark current of 20nA	10	-	80	V
Output current at 20nA dark current (see note 3)	100	-	-	nA
Decay: residual signal current after dark pulse of 50ms (see notes 4, 5, 6)	-	20	30	%
Resolution capability at centre of picture	550	-	-	TV lines
Grid voltage for picture cut-off with no blanking applied	-35	-60	-80	V
Average gamma of transfer characteristic for signal currents between 20nA and 200nA	-	0.65	-	
Wavelength at maximum response (approx.)	-	550	-	nm

Spurious signals - shading

Tubes are rejected for smudge, lines, streaks, mottled background, grainy background, or uneven background having contrast ratios greater than 1.5:1.

Spurious signals - spots and blemishes (see notes 5, 7)

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	80	V
V_{a3} max.	750	V
V_{a2} max.	750	V
V_{a1} max.	350	V
$-V_g$ max.	125	V
$+V_g$ max.	0	V
v_{h-k}(pk) max.		
cathode positive	125	V
cathode negative	10	V
Maximum peak output current (see note 8)	0.5	μA
Maximum peak dark current	150	nA
Maximum faceplate illumination	10 000	lux
Maximum faceplate temperature during storage and operation (see note 9)	70	°C

Scanning of a 6.6mm × 8.8mm area of the photoconductive layer should always be applied. The use of a mask of these dimensions is recommended. Scanning of an area less than this may cause permanent damage to the specified full-size area.

MOUNTING POSITION

Any

WEIGHT

Tube alone (approx.)	20	g

ACCESSORIES

Socket	Special miniature 7 pin (J.E.D.E.C. E7-1)
Coil assembly	M10AT or equivalent

NOTES

1. Beam focus is obtained by the combined effect of the focus electrode (a2), the voltage of which should be adjustable over the indicated range, and a focus coil having an average field strength of 4A/mm.
2. The polarity of the focus coil should be such that a north-seeking pole, located outside but adjacent to the image end of the focus coil, will be attracted to the image end of the focus coil.

NOTES (contd.)

3. With 10 lux (colour temperature = 2854K) on the faceplate.

4. With a dark current of 20nA and an initial signal current of 200nA.

5. The deflection circuit must provide sufficiently linear scanning for good black-level reproduction. Since the output current is proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.

6. Signal current is defined as the component of the output current after the dark current has been subtracted.

7. Conditions:

   Dark current 20nA and output current of 220nA.

   The camera is focused on a uniformly illuminated two-zone test pattern. Zone 1 at the centre has a diameter equal to the raster height. Zone 2 occupies the remainder of the scanned area.

   The scanning amplitudes of a rectangular monitor are adjusted to obtain a raster with an aspect ratio of 3:4. The monitor set-up and contrast control are adjusted for a faint raster when the lens of the camera is capped, and for a non-blooming bright raster when 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 are counted unless the amplitude is less than 50% of the peak white signal.

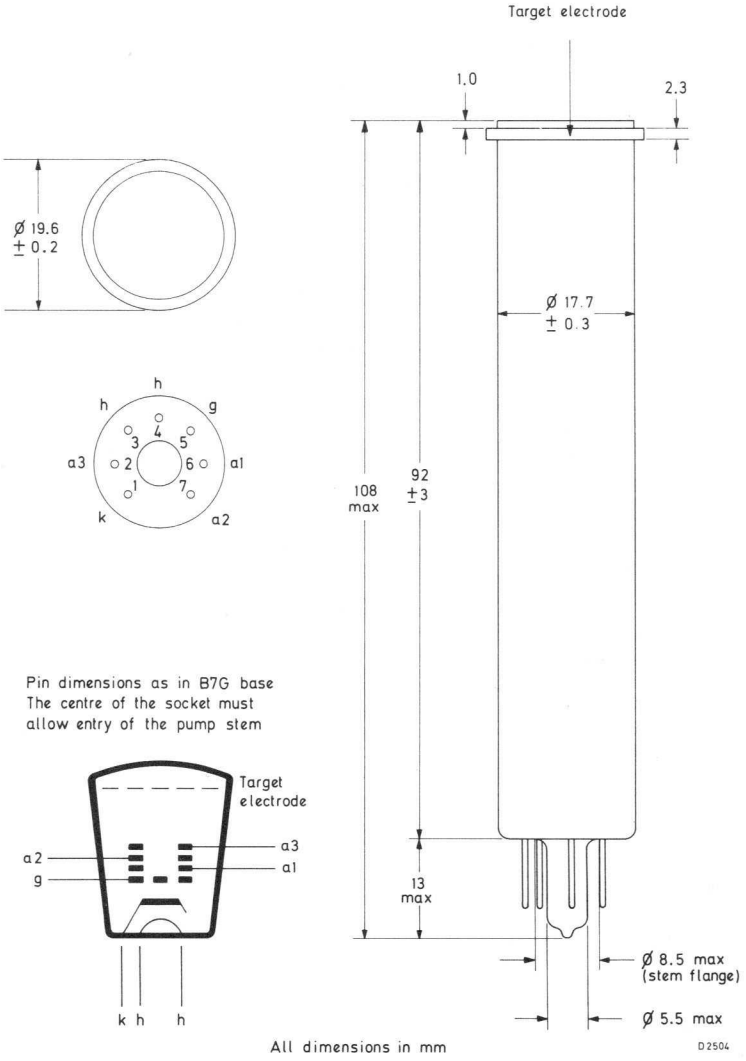
Spot size in % of raster height	Maximum number of spots	
	Zone 1	Zone 2
>0.8	none	1
0.8 to 0.6	2	2
0.6 to 0.3	2	3
<0.3	*	*

*Spots of this size are not counted unless their concentration is so high as to cause a smudgy appearance.

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

9. Under difficult environmental conditions a flow of cooling air directed at the face-plate is recommended. When televising flames and furnaces appropriate infrared filters should be used.

OUTLINE DRAWING OF 20PE13



CAMERA TUBE
VIDICON

20PE14

DEVELOPMENT SAMPLE DATA

17.7mm diameter vidicon television camera tube with separate mesh, low heater consumption, electrostatic focusing and magnetic deflection. Intended for use in low-cost industrial cameras, home cameras and for amateur use, where small size and low power consumption are important parameters.

Resolution capability	550	tv lines

HEATER

Suitable for parallel or series operation, a.c. or d.c.

V_h	6.3 ±10%	V
I_h	95 ±10%	mA

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

FOCUSING

Electrostatic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

Maximum diagonal of quality rectangle

on photoconductive layer (aspect ratio 3:4)	11	mm

The direction of the horizontal scan should be essentially parallel to the plane defined by the short index pin and the longitudinal tube axis, unless rotation of the tube is found necessary to minimise the number of blemishes in the picture.

CAPACITANCE

Target electrode to all other electrodes	2.0	pF

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

TYPICAL OPERATION (LIVE SCENE PICK-UP)

Operating conditions

V_{a4}	500	V
V_{a3} (beam focusing electrode)	45 to 65	V
$V_{a1,a2}$	300	V
Maximum peak to peak blanking voltage		
when applied to grid	75	V
when applied to cathode	20	V
Field strength of adjustable alignment coil	0 to 320	A/m
Faceplate illumination (highlight)	10	lx

Performance

V_g (for picture cut-off) with no blanking applied	-35 to -80	V
Average gamma of transfer characteristic for signal currents between 10 and 100nA	0.65	
Target voltage	10 to 45	V
Dark current	20	nA
Signal current (see note 1)		
typical	200	nA
minimum	100	nA
Limiting resolution at picture centre	550	tv lines

Spurious signals - shading

Tubes are rejected for smudge, lines, streaks, mottled background, grainy background, or uneven background having contrast ratios greater than 1.5:1.

Spurious signals - spots and blemishes
(see notes 2, 4)

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	80	V
V_{a4} max.	600	V
V_{a3} max.	350	V
$V_{a1,a2}$ max.	350	V
$-V_g$ max.	200	V
$+V_g$ max.	0	V
v_{h-k} (pk) max.		
cathode positive	125	V
cathode negative	10	V
Maximum peak dark current	150	nA
Maximum peak output current	500	nA
Maximum faceplate illumination	10 000	lx
Maximum faceplate temperature during storage and operation	70	^{o}C

Scanning of a 6.6mm × 8.8mm area of the photoconductive layer should always be applied. The use of a mask of these dimensions is recommended. Scanning of an area less than this may cause permanent damage to the specified full size area.

MOUNTING POSITION

Any

WEIGHT

Tube only (approx.)	23	g

ACCESSORIES

Socket	Special miniature 7 pin (J.E.D.E.C. E7-1)
Deflection yoke	KV19B

NOTES

1. With 10 lux (colour temperature = 2854K) on the faceplate.
2. The deflection circuit must provide sufficiently linear scanning for good black level reproduction. Since the output current is proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.
3. Signal current is defined as the component of the output current after the dark current has been subtracted.

NOTES (contd.)

4. The camera is focused on a uniformly illuminated two zone test pattern. Zone 1 at the centre has a diameter equal to the raster height. Zone 2 occupies the remainder of the scanned area.

   The scanning amplitudes of a rectangular monitor are adjusted to obtain a raster with an aspect ratio of 3:4. The monitor set-up and contrast controls are adjusted for a faint raster when the lens of the camera is capped and for a non-blooming bright raster when 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 are counted unless the amplitude is less than 50% of the peak white signal.

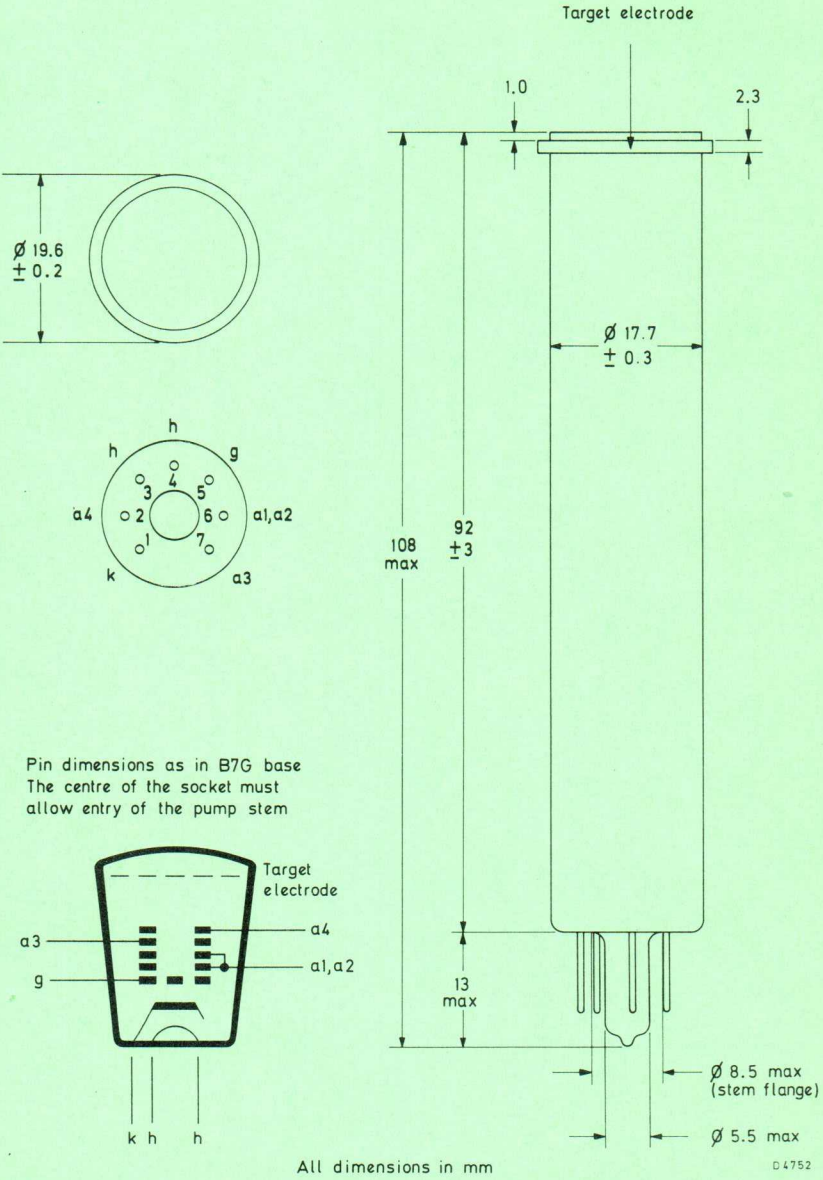
Spot size in % of raster height	Maximum number of spots	
	Zone 1	Zone 2
>0.8	none	1
0.8 to 0.6	2	2
0.6 to 0.3	2	3
<0.3	*	*

*Spots of this size are not counted unless their concentration is so high as to cause a smudgy appearance.

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

6. Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces appropriate infrared filters should be used.

OUTLINE DRAWING OF 20PE14



All dimensions in mm

D 4752

CAMERA TUBE
INTENSIFIER VIDICON
(INTENSICON)

50MXQ
(Dev. No.)

DEVELOPMENT SAMPLE DATA

QUICK REFERENCE DATA

25mm vidicon tube with unity magnification image intensifier tube with S25 photocathode intended for TV surveillance.

Sensitivity	A signal current of 150nA is produced with a photocathode illumination of 0.1 lux at 20nA dark current	
Resolution	>500	TV lines
Image format	10 × 13.3	mm

HEATER

Suitable for series or parallel operation, a.c. or d.c.

V_h	6.3 ±10%	V
I_h	95	mA

NOTE (applies to series operation only). The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain, a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

FOCUSING

Intensifier	self focusing electrostatic
Vidicon	magnetic

DEFLECTION

Vidicon	magnetic

PHOTOCATHODE

Type	S25 (see page 6)	
Maximum diagonal of rectangle on photocathode fibre optic faceplate (3:4 aspect ratio)	17	mm

For correct orientation of the image on the photoconductive layer, the horizontal scan should be essentially parallel to the plane passing through the tube axis and the reference line.

CAPACITANCE

Target electrode to all other electrodes	20	pF

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

TYPICAL OPERATION

Operating conditions (all voltages with respect to vidicon cathode)

Mesh voltage (see note 1)	V_{a3}	300 to 450	V
Focus electrode voltage	V_{a2}	250 to 300	V
First anode voltage	V_{a1}	300	V
Grid voltage - adjusted for stabilisation			
Field strength at centre of focusing coil		3.2	kA/m
Field strength of alignment coils or magnet		0 to 320	A/m
Minimum peak-to-peak blanking voltage			
when applied to the grid		75	V
when applied to the cathode		20	V
Intensifier cathode voltage		-12	kV
Intensifier screen voltage		0	V
Scanned area (see note 2)		10 × 13.3	mm
Operating temperature		30 ±2	°C

Typical performance

Target electrode voltage for dark current of 20nA	20 to 70	V
Grid voltage for picture cut-off	-30 to -100	V
Signal current		
With photocathode illumination of 0.1 lux of colour temperature 2854K	150	nA
Decay		
Residual signal after dark pulse of 200ms	10	%
Average gamma of transfer characteristic for signal currents between 10nA and 300nA	0.7	
Wavelength at maximum response	500	nm
Limiting resolution at centre of picture	>500	TV lines

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Intensifier cathode voltage max. (see note 3)	-15	kV
V_{a3} max. (see note 2)	1.0	kV
V_{a2} max.	750	V
V_{a1} max.	450	V
$-V_g$ max.	125	V
$+V_g$ max.	0	V
I_k max.	2.0	mA
$V_{h\text{-}k(pk)}$ max.		
cathode positive	100	V
cathode negative	10	V
V_{target} max.	100	V
$i_{target(pk)}$ max. (see note 4)	600	nA
Maximum peak dark current	250	nA
Maximum continuous photocathode illumination (operational - assumes uniform illumination - see note 5)	1.0	lux
Maximum temperature (operational and storage - see note 5)	50	^oC

MOUNTING POSITION

Any

WEIGHT

Tube alone (approx.)	350	g

ACCESSORIES

Socket	Cinch No. 54A 18088 or equivalent

NOTES

1. Under no circumstances should the mesh (a3) be allowed to operate at a lower voltage than the final anode (a2), since this may damage the photoconductive layer. The minimum voltage difference (a3 with respect to a2) to produce an attractive gain in resolution is 15V. The optimum value for the maximum resolution and the best uniformity of black and white level will depend on the type of coil unit used, and will be within the range 1.2 to 1.5 times V_{a2}.

2. Underscanning of the useful target area of 10×13.3mm or failure of scanning should be avoided, since this may cause damage to the photoconductive layer.

3. Permanent damage may result from a temporary reversal of polarity.

4. Video amplifiers should be capable of handling signal electrode currents of this magnitude without overload or picture distortion.

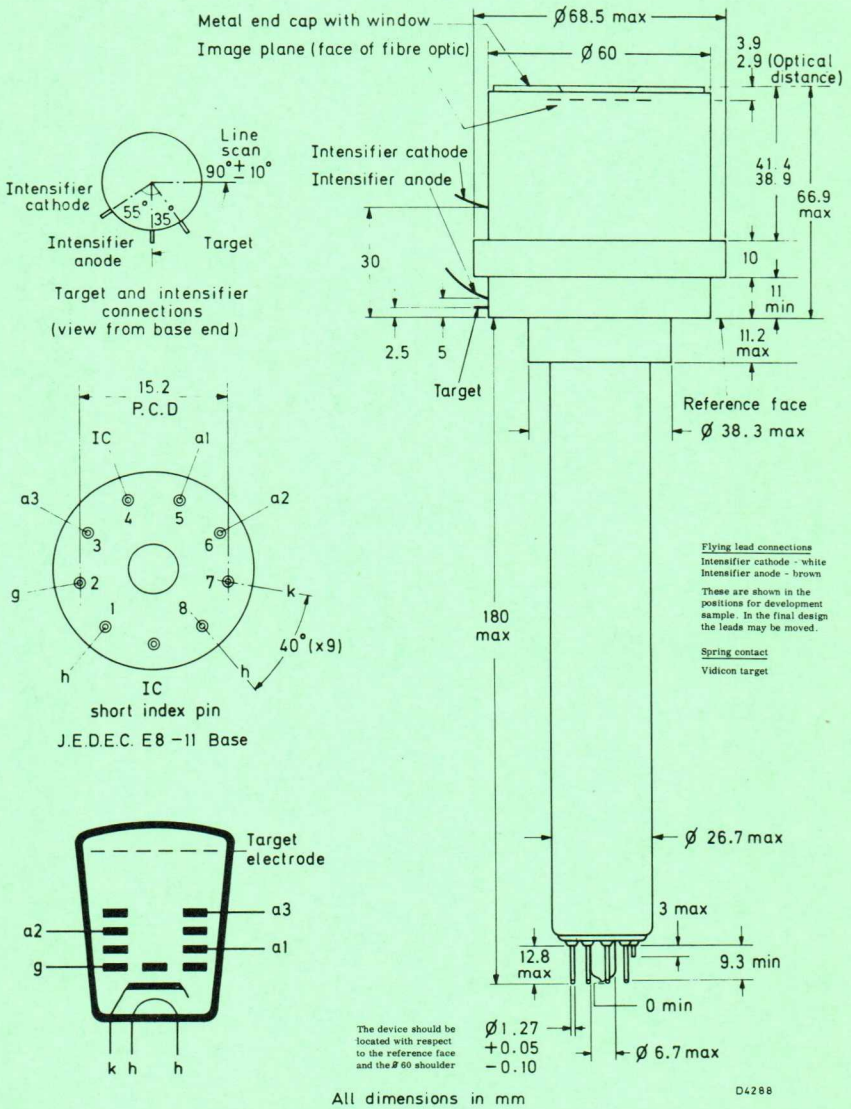
5. When the photocathode illumination rating is exceeded this may lead to permanent damage of the device.

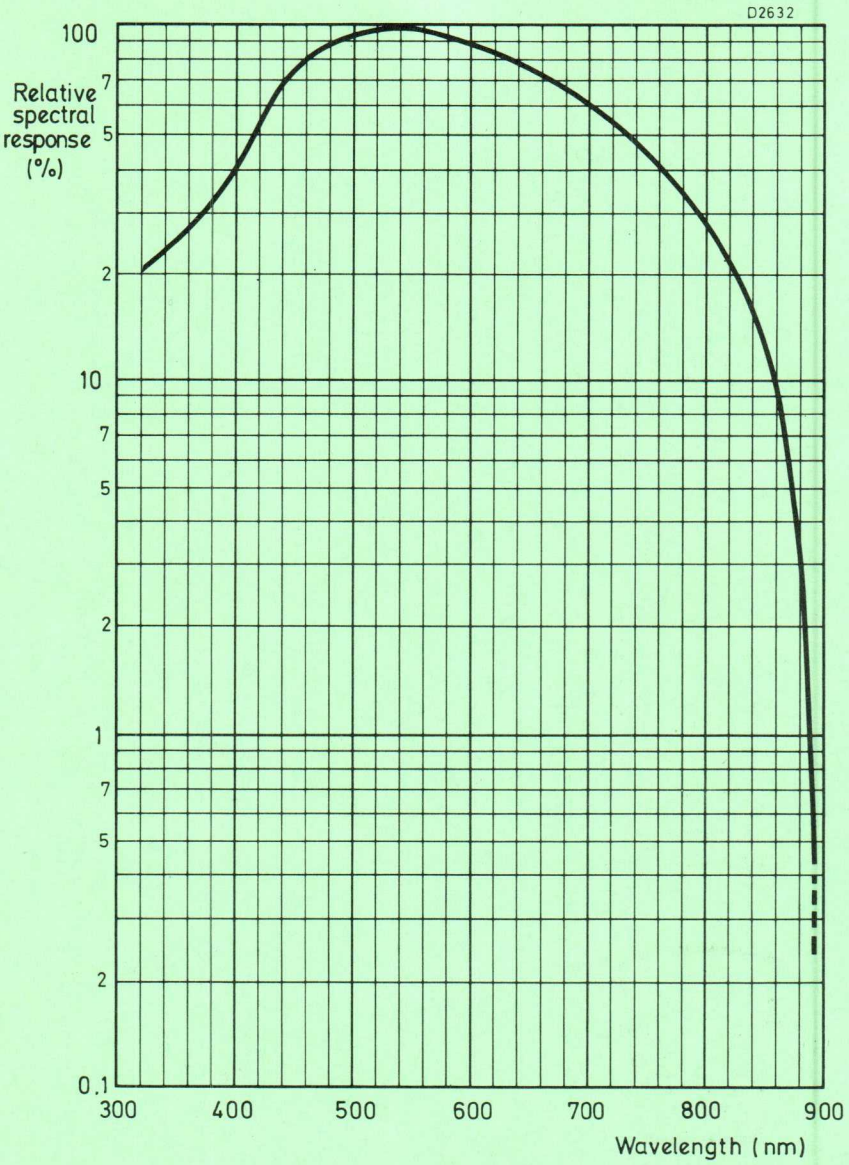
6. The metal end cap should be connected to chassis. ←

CAMERA TUBE
INTENSIFIER VIDICON
(INTENSICON)

50MXQ
(Dev. No.)

OUTLINE DRAWING OF 50MXQ





TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CURVE

Table I - Highlight signal and beam current settings

			Tube diameter 30mm		Tube diameter 25mm	
			Scanned area $12.8 \times 17.1mm^2$		Scanned area $9.6 \times 12.8mm^2$	
			Highlight signal current (μA)	Beam current (μA)	Highlight signal current (μA)	Beam current (μA)
Broadcast quality tubes	Black and white		0.3	0.6	0.2	0.4
	Luminance	L	0.3	0.6	0.2	0.4
	Chrominance tubes	Red R	0.15	0.3	0.1	0.2
		Green G	0.3	0.6	0.2	0.4
		Blue B	0.15	0.3	0.1	0.2
Industrial quality tubes	Black and white		0.3	0.6	0.2	0.4
	Chrominance tubes	Red R	0.15	0.3	0.1	0.2
		Green G	0.3	0.6	0.2	0.4
		Blue B	0.15	0.3	0.1	0.2
	P20 light source		Scanned area 18mm circular		Scanned area 15mm circular	
X-ray medical tubes (for use in combination with an X-ray intensifier)			0.15	0.3	0.1	0.2

SECTION B

Definitions

Blemishes, can be regarded as either spots or smudges.

Spots and smudges are small areas of uneven modulation of any signal current between black level (dark current) and white level (peak signal current). For broadcast quality tubes and tubes for medical X-ray equipment a spot is defined as a blemish with a maximum linear dimension in any direction of 0.7% of the picture height, a smudge as a blemish with a maximum linear dimension in any direction exceeding 0.7% of the picture height.

For industrial quality tubes a spot is defined as a blemish with a maximum linear dimension in any direction of 1% of the picture height and a contrast in excess of 10% of 100% white level (highlight signal current as given in Section A, table I), as measured on a waveform oscilloscope (bandwidth 5.5MHz), black level being defined as 0%.

SPURIOUS SIGNAL SPECIFICATION FOR PLUMBICON TUBES

SECTION A

Test conditions

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

1. Light source: 2854K 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 on to 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 4:3 for the evaluation of broadcast and industrial quality tubes. The area of the chart is divided into three quality zones by two concentric circles as shown in Fig.1.

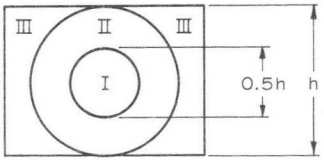


Fig.1

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

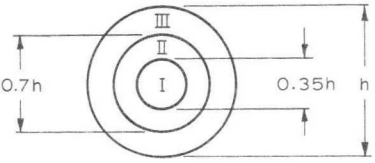


Fig.2

4. The video amplifier frequency response is essentially flat to 5MHz, with a sharp fall-off to 6MHz.
5. No gamma correction or aperture correction is applied in the video amplifier.
6. Light level. The light level on the Plumbicon target is adjusted to produce a peak highlight signal current in accordance with table I.
7. Beam current. The beam current should be adjusted for current stability according to the values quoted in table I.
8. Monitor. The obtained picture is observed on a monitor producing a non-blooming white.

*Registered trade mark for television camera tubes

Uniformity in Dark Field

Zone 1	2 na max.
Zone 2 and Zone 1	5 na max.
Total Scanned Area	10 na max.

Uniformity When Illuminated

Zone 1	10%
Zone 2 and Zone 1	20%
Total Scanned Area	40%

HALATION AND BLOOMING

The S50XQ is subjected to the following test: A circular spot 0.5 mm in diameter (2% of the useful photocathode diameter) is projected on the faceplate of the tube. The intensity of the illuminated spot is adjusted to produce a peak (highlight) signal current of 200 na. The beam current was previously set to handle a peak white signal of 500 na. The intensity of the 0.5 mm illuminated spot on the faceplate is then raised 4 orders of magnitude. The following criteria must be met.

a) The diameter of the circle which encloses the 100 na video signal level must be no more than three times the original spot diameter (the spot diameter before the intensity was increased 4 orders of magnitude.)

b) The area which encloses the 30 na signal level must not exceed at any point 15% of the useful picture diagonal. This corresponds to 4% of picture area.

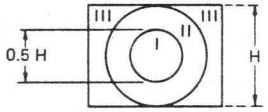
PICTURE QUALITY (due to blemishes)

Blemishes can be regarded as either spots or smudges. A spot or smudge is defined as a blemish with a maximum linear dimensions in any direction of 1% or 5% respectively, of the picture height and a contrast in excess of 10% of 100% white level as measured on a waveform oscilloscope (band width 5.5 MHz), black level being defined as zero percent.

The picture quality is evaluated in the following setting in respect of highlight signal current and applied beam current viz:

Highlight signal current	I_s = 300 nA	0
Beam current adjusted for correct stabilization of a signal current of:	I_b = 500 nA	500 nA

The specified area of 0.8 x 0.6 in. on the photocathode is evenly illuminated with light appropriate to the application through a back illuminated test transparency with aspect ratio 4:3. The area of the test chart is divided in three quality zones by two concentric circles with diameters as shown below.



The obtained picture shall be observed on a monitor producing a non-blooming white. The numbers and sizes of blemishes shall not be in excess of those tabulated below.

	Permitted number of blemishes a) c)		
Dimensions in any direction measured in percentage of picture height (approx. TV lines) at the 10% contrast point.	Zone I	Zone II	Zone III
1 TVL	b	b	b
2 to 4 TVL	4	8	15
5 to 7 TVL	1	3	4
8 to 25 TVL	0	1	2

Max. no. of permitted blemishes not to exceed 30

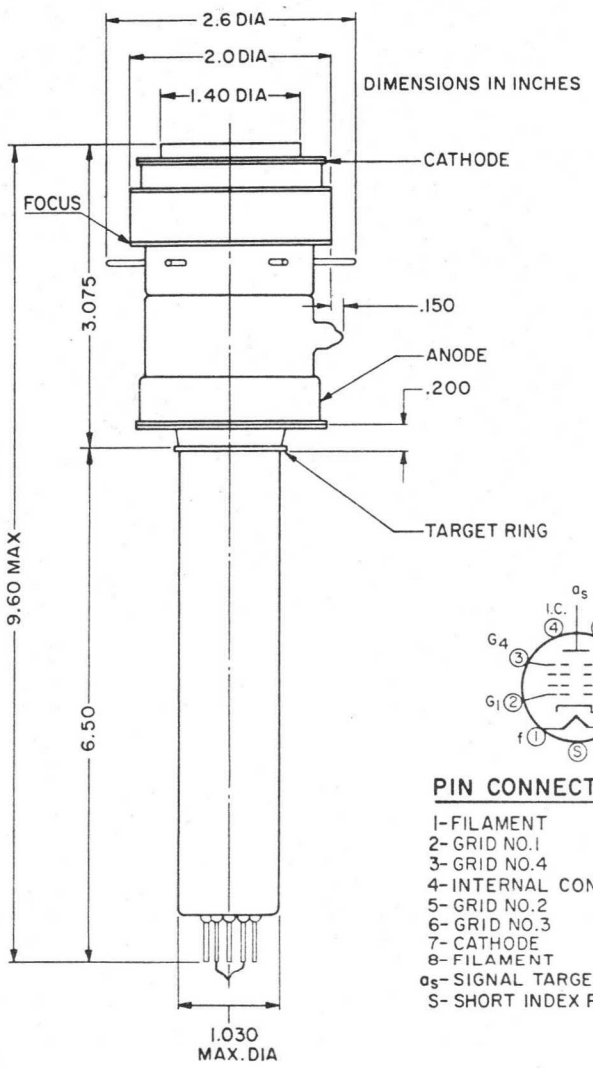
NOTES

a) The distance between any two spots shall be greater than 5 TVL of picture height in any direction.

b) Spots of this size are not counted unless concentration causes a smudge appearance. Such concentrations are evaluated as smudges. As contrast the average contrast of the concentration is taken.

c) Blemishes with a contrast less than 10% are not counted.

(OVER)



PIN CONNECTIONS

1-FILAMENT
2-GRID NO.1
3-GRID NO.4
4-INTERNAL CONNECTION
5-GRID NO.2
6-GRID NO.3
7-CATHODE
8-FILAMENT
a_s-SIGNAL TARGET
S-SHORT INDEX PIN

OUTLINE DRAWING

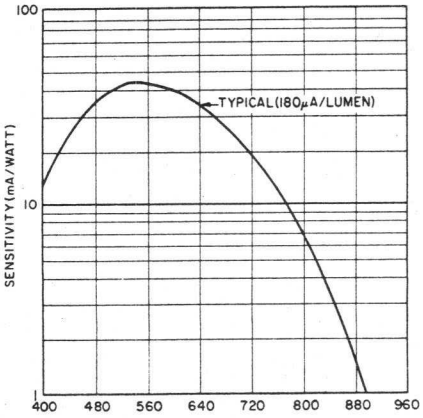


FIG.1 TYPICAL SPECTRAL RESPONSE

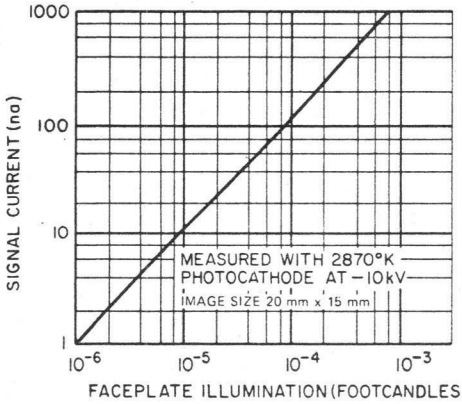


FIG.2 LIGHT TRANSFER CHARACTERISTICS

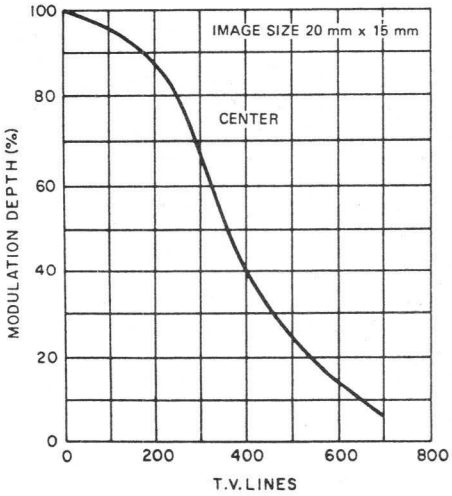


FIG.3 TYPICAL HORIZONTAL SQUARE WAVE RESPONSE

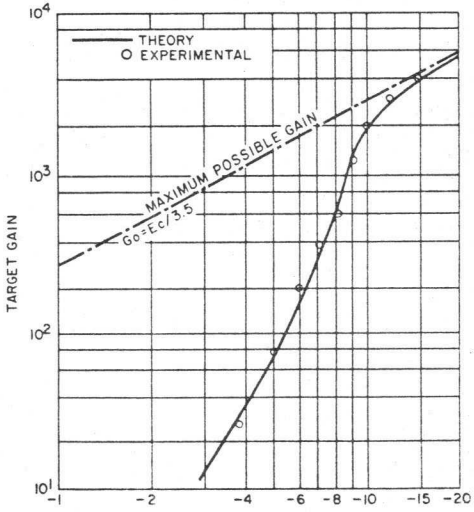


FIG.4 TYPICAL GAIN CHARACTERISTICS

FOOTNOTES

1) A supply is available

2) Focusing/deflecting coil assembly

3) The capacitance of the target to all electrodes, which effectively is the output impedance, is measured without the deflection/focusing coil assembly, and may increase when the tube is inserted into such assembly.

4) With no blanking voltage on Grid No. 1.

5) At cathode voltage = 0 volts.

6) The total signal current consists of the current due to the signal plus the dark current, i.e., $i_t = i_s + i_d$.

7) For proper orientation of the image on the photo sensitive layer, the horizontal scan should be essentially parallel to the plane passing through the tube axis and the short base pin.

8) Adjust for minimum shading. The voltage ratio of Grid No. 4 to Grid No. 3 is between 1.3 and 1.5.

9) The target voltage is individually selected and specified typically within a range and indicated for each tube. This is to achieve an optimum operating point consistent with optimal beam acceptance and to optimize other performance characteristics, such as dark current, blemishes, uniformity and lag.

10) Measured with the beam set to handle peak highlights of 500 na and a peak signal of 200 na. The sequence of measurement is as follows. The illumination is turned off at t = 0 immediately preceeding a read-out of the initial signal. This read-out is called the zeroth field. The first residual signal occurs at 16.7 ms, i.e., in the first field. The value of lag is the magnitude of the residual signal in the third field, ie., at t = 50ms.

11) Data on target voltage, dark current, and lag are supplied with each tube.

12) Grid No. 4 Voltage should exceed both Grid No. 3 and Grid No. 2 voltage. Operating Grid No. 4 less positive could result in permanent target damage due to "ion-burn".

13) The beam current as obtained by adjusting the grid No. 1 (control grid) voltage shall be adjusted for current stabilization of 2½ times the highlight signal current, i.e. 500 nA.

14) Limiting resolution is defined as the resolution at a modulation depth, i.e., uncompensated horizontal amplitude response, of 5% uncorrected for lens resolution losses. The amplitude response of the camera amplifier should be flat to well over 7.5 MHz; no gamma correction should be used.

15) Uncompensated horizontal amplitude response is measured with 100% contrast square wave test pattern, normalized at 50 TVL, and corrected for lens resolution losses. The bandwidth of the camera amplifiers used are flat beyond 5 MHz. For response curve see Figure 3.

ABSOLUTE MAXIMUM RATINGS

Photocathode voltage	−13 kilovolts
Grid No. 4	650V(4)
Grid No. 3	600V(4)
Grid No. 2	350V(4)
Grid No. 1	
Positive	0V
Negative	125V
Grid No. 4 – No. 3 difference	350
Cathode to Heater Voltage	
Positive peak to peak	125V
Netative peak to peak	10V
Cathode current	3mA
Heater Warmup	1 minute
Target Voltage	25 V(5)
Temperature	
Operation	−10°C to 50°C
Storage	−50°C to 70°C

TYPICAL OPERATING CONDITIONS

Photocathode Voltage	−10 kilovolts
Focus Electrode	93 ± 5% of photocathode potential
Anode Cone	Ground
Target Voltage	8–15 V (11)
Grid No. 4	600V(12)
Grid No. 3	430 V(8)
Grid No. 2	300 V
Beam Current	See footnote 13
Lag (persistence)	10%(11)
Residual signal 50 ms after a 200 na signal is turned off (9)(10)	20 na
Average Gamma transfer characteristic for signal output current between 1 na and 600 na (See Fig. 2)	1.0
Resolution Central (See Fig. 3)	
Limiting(14)	700 TVL/Height
Modulation Depth at 400 TVL(15)	40%
Sensitivity (See Fig. 1)	1200 μA/fc. (typ.)
Target Gain (See Fig. 4)	2000 at 10kV (typ.)
Dark Current at 30°C, 10 Volts on target	15 na(11)
Photocathode Response	
Luminous with a 2870° K Tungsten Source (See Fig. 1)	180 μA/ lm (typ.)
Luminous with a narrow band 5500 Å Source	50 μA/ lm (typ.)
Typical Spectral Sensitivity	See Fig. 1 .

GENERAL CHARACTERISTICS

MECHANICAL

Faceplate	Fibre Optics
Numerical Apeture	1.1
Useful Diameter	.984 in. (25mm)
Spectral Response	S-20
Image Section:	
Focusing Method	Electrostatic(1)
Configuration	Triode(1)
Reading Section	
Focusing Method	Magnetic(2)
Deflection Method	Magnetic(2)
Base	JEDEC No. E8-11
Mounting Position	Any
Weight	8 oz.
Socket	Cinch 54A18088
Focusing & Deflection Coil	AT1102, AT1103 or AT1116 or equivalent (2)
Dimensions	
Overall Length	9.6" (including pin)
Maximum diameter	2.6"
Diameter of reading bulb	.984 in. (25mm)
Length of Gun	6.5" (including pins)

ELECTRICAL

Heating	Indirect AC or DC parallel supply only
Heater voltage	6.3V
Heater current	100 mA max.
Capacitance	
Target to all other electrode	10 pF(3)
Grid No. 1 cutoff when Grid No. 2 is at 300 V	−30V to −100V(4)(5)
Blanking Voltage Peak to Peak	
On grid No. 1	70V min.
On Cathode	15V min.
Signal Current total (i_t)(6)	600 na
Diameter of Scanned Raster (4 x 3 aspect ratio)	.709 in. (18mm)

OPTICAL

Max. useful diameter	.984 in (25mm)
Orientation of Image on Photo Surface	See Note 7

Mullard Limited

Mullard House Torrington Place
London WC1E 7HD

Telephone 01-580 6633
Telex 264341
Cables
Mullectron London
WC1E 7HD

TUBE TYPE

S50XQ

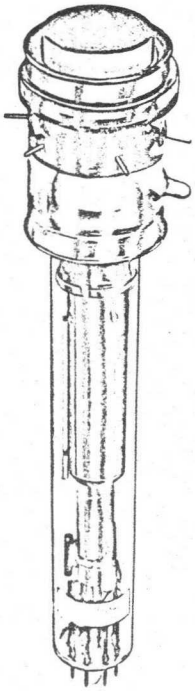
INTENSIFIED SILICON VIDICON CAMERA TUBE

DEVELOPMENT SAMPLE DATA

DESCRIPTION

Development Tube Type S50XQ is a 25 millimeter Intensified Silicon Vidicon (ISV) camera tube designed for use in low light level TV camera systems. This tube combines the high performance characteristics of the Sivicon T.M. (Silicon-Vidicon) with the essentially noiseless gain which results from high energy photo-electrons impinging upon the silicon target to create a multiplicity of hole-electron pairs.

The S50XQ features include: the capability to operate over a wide dynamic range without "halation" or "blooming"; extended tube life with freedom from internal X-ray deterioration; low decay lag; high resolution; and low uniform dark currents.



OPERATING PRINCIPLES

The operating principles of the read-out section of the camera tube are similar to those of the conventional Sivicon. The very thin silicon target consists of a two-dimensional array of p-n diodes which are scanned by a low velocity electron beam as in a vidicon. During the operation, the scanning beam deposits electronic charge on the p-type regions and establishes a negative bias of a few volts on those regions relative to the n-type substrate. The charge deposited in one scanning period is sufficient to maintain this reverse bias for a period of time greater than one frame period with normal levels of illumination.

The optical image is focused upon a flat image plane which is optically coupled to an S-20 photocathode by the use of high quality fiber-optics. The flux of photoelectrons are accelerated to energies of several thousand electron-volts and electrostatically focused upon the n-type substrate on the side opposite from the p-type regions in the image intensifier section of the tube. The incident flux of high energy photoelectrons on the target produce a multiplicity of hole-electron pairs in the substrate. The minority carriers (ie. holes) diffuse to the p-n junction and, thereby, increases the junction current in accordance with the number of incident photoelectrons. This increased junction current reduces the stored charge which was previously deposited by the low velocity scanning beam, by an amount that is proportional to the total number of incident photons throughout the entire frame period. The resulting stored charge pattern is a replica of the optical image on the photocathode.

The scanning electron beam erase thes stored charge pattern on a point-by-point basis by re-establishing the full value of reverse-bias once during each frame period. The electronic current which flows in the target lead during this erasing process constitutes the video signal that corresponds to the optical image.

The high gain provided by the image intensifier section of this new camera tube will provide a high signal-to-noise ratio at the scene illuminations which are only slightly greater than that associated with normal starlight illumination. The inherent ruggedness and small size of this tube will make it suitable for the low light levels encountered in reconnaissance and surveillance systems. The gain of the image intensifier section can be reduced from its maximum value of a few thousand to a value of the order of one hundred. This tube will then have possible applications in the areas of commercial broadcasting where marginal light levels exist such as sporting and news events.

The included data, based on the specifications and measured performance of development samples, afford a preliminary indication of the characteristics to be expected of the described product. Distribution of development samples implies no guarantee as to the subsequent availability of the product.

November 1971

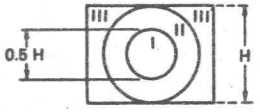
PICTURE QUALITY (due to blemishes)

Blemishes can be regarded as either spots or smudges. A spot or smudge is defined as a blemish with a maximum linear dimension in any direction of 1% or 5% (d) respectively, of the picture height and a contrast in excess of 10% of 100% white level as measured on a waveform oscilloscope (bandwidth 5.5 MHz), black level being defined as zero percent.

The picture quality is evaluated in the following setting in respect of highlight signal current and applied beam current viz:

Highlight signal current	I_s = 200 nA	0
Beam current adjusted for correct stabilization of a signal current of:	I_b = 500 nA	500 nA
Type of Blemish	Black or White	White

The specified area of 0.5 x 0.375 in. on the target is evenly illuminated with light appropriate to the application through a back illuminated test transparency with aspect ratio 4 : 3. The area of the test chart is divided in three quality zones by two concentric circles with diameters as shown below.



The obtained picture shall be observed on a monitor producing a non-blooming white. The numbers and sizes of blemishes shall not be in excess of those tabulated below.

Dimensions in any direction measured in T.V. lines (approx. percentage of picture height) at the 5% contrast point. (30)	Permitted number of blemishes a) c)		
	Zone I	Zone II	Zone III
Over 6TVL (1.2%)	0	0	0
6 TVL to but not incl. 4 TVL	0	1	2
4 TVL to but not incl. 1 TVL	3	5	7
1TVL and under (0.2%)	b)	b)	b)

Notes:

a) The distance between any two spots shall be greater than 5% of picture height in any direction.

b) Spots of this size are not counted unless concentration causes a smudge appearance. Such concentrations are evaluated as smudges. (d) As contrast the average contrast of the concentration is taken.

c) Blemishes with a contrast less than 10% are not counted.

d) Blemishes greater than 5% (25 TV lines) will be considered a local variation of uniformity.(25)

10XQA

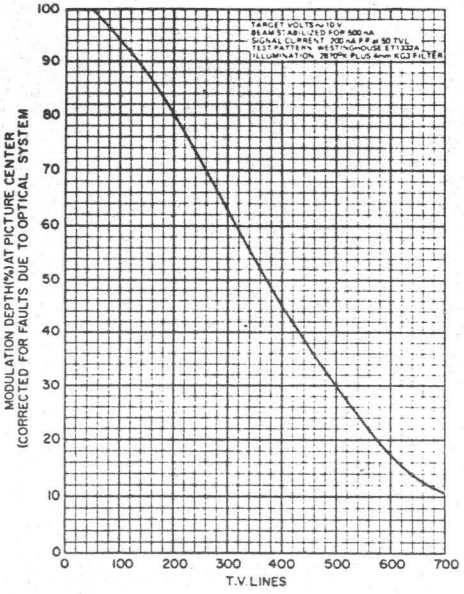


Figure 1 Sivicon Typical Uncompensated Horizontal Square Wave Response – Optically Corrected

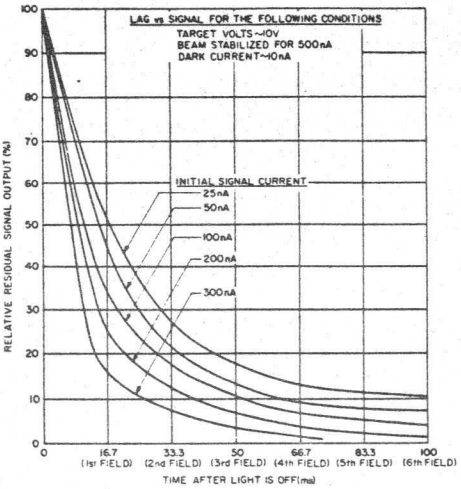


Figure 2 Typical Sivicon Decay Lag Characteristics

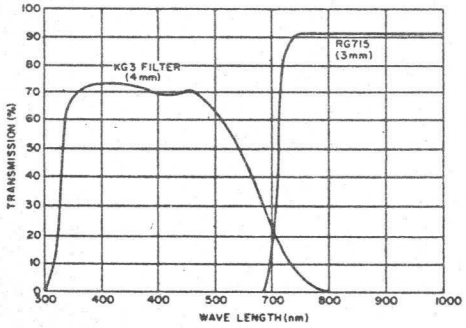


Figure 3 Filter Characteristics

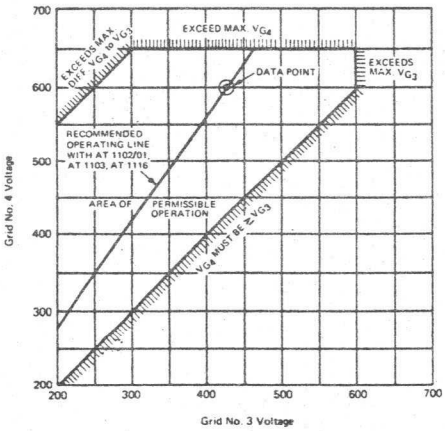


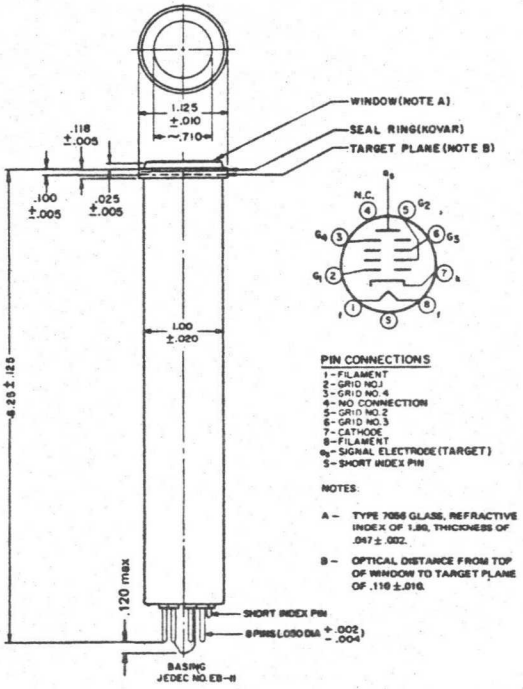
Figure 4 Area of Permissible Operation

FOOTNOTES (Continued)

29. Grid No. 4 Voltage should exceed both Grid No. 2 and Grid No. 3 voltage. Operation of Grid No. 4 less positive could result in permanent target damage due to "ion burn". For area of permissible operation see Figure 4.

30. Measured as a percentage of the highlight average signal current, i_s.

31. By definition Absolute Maximum Ratings are limited values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.
The device manufacturer chooses these values to provide acceptable serviceability of the device taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.
The equipment manufacturer should design so that initially and throughout life no Absolute Maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions and variations in device characteristics.



OUTLINE DRAWING

10XQA

FOOTNOTES (Continued)

13. With the same light source specified in Footnote 10, except an infra-red absorbing filter Fish Schurman (Schott) Filter KG3, thickness = 4 mm (.157 in.), is interposed between the light source and the faceplate of the tube. The level of illumination is that of the unfiltered light. See Figure 3 for filter transmission characteristics.

14. With the same light source specified in Footnote 10 except an infrared transmitting filter Fish Schurman (Schott) Filter RG715, thickness = 3 mm, (.118 in.) is interposed between the light source and the faceplate of the tube. The level of illumination is that of the unfiltered light. See Figure 3 for filter transmission characteristics.

15. A minimum of 1 minute warm-up time for the heater is to be observed for drawing cathode current.

16. Illumination levels in excess of 10 million foot-candles can be tolerated. This is equivalent to the image of the sun or a high intensity projection lamp being focussed onto the target. CAUTION: Care must be taken that the heat content of the focussed radiation does not cause the temperature of the target to exceed the maximum allowed level.

17. The beam current as obtained by adjusting the grid No. 1 (control grid) voltage shall be adjusted for current stabilization of 2½ times the highlight signal current, i.e. 500 nA.

18. Illumination on the photo-sensitive layer, Bph, in the case of a black/white camera is related to scene illumination, Bsc, by the formula:

$$Bph = Bsc \frac{R.T.}{4F^2 (m + 1)^2}$$

in which R represents the scene-reflectivity (average or the object under consideration, whichever is relevant), T the lens transmission factor, F the lens aperature, and m the linear magnification from scene to target.

19. Limiting resolution is defined as the resolution at a modulation depth, i.e., uncompensated horizontal amplitude response, of 5% uncorrected for lens resolution losses. The amplitude response of the camera amplifier should be flat to well over 7.5 MHz; no gamma correction should be used.

20 Measured with 100% contrast square wave test pattern, normalized at 50 TVL, and corrected for lens resolution losses. The bandwidth of the camera amplifiers used are flat to beyond 5 MHz. For response curve see Figure 1.

21. Measured with a high gain, low noise (2 nA rms) cascode-input type amplifier having a bandwidth of 5 MHz and a pulse signal output current of 200 nA. Because the noise in such a system is predominately of the high-frequency type, the "visual equivalent" of signal-to-noise ratio is used which is 3 times the ratio of highlight video-signal current to rms noise current.

22. Measured with an initial net highlight signal current of 200 nA (17). The sequence of the measurement is as follows: The illumination is turned off at t = 0 immediately preceding a read-out of the initial signal. This read-out is labeled the "zeroth" field. The first residual signal occurs subsequently at t = 16.7 msec., i.e., in the first field. The value of lag listed is the magnitude of the residual signal in the 3rd field, i.e., at t = 50 msec. For other signal currents, see Fig. 2.

23. Adjust for minimum shading. The optimum ratio of grid No. 4 to grid No. 3 is typically 1.4.

24. The target voltage (Vt) is typically in the range between 5 and 15 volts with respect to the cathode. For each tube Vt is individually selected and specified for that tube. (26) This is to achieve an optimum operating point consistent with optimal beam acceptance and to optimize other performance characteristics, such as dark current, blemishes, uniformity and lag. Sivicon tubes do not permit automatic sensitivity control by means of regulation of the target voltage. Adequate control can be achieved by other means, e.g. lens iris control, neutral density filters and/or automatic video gain control (AGC). If the Sivicon tube is to be used in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the target voltage set to the value specified for that Sivicon tube (26).

25. Local nonuniformity is defined as a picture area (smudge, streak, blotch) with dimension greater than 5% of picture height in one direction. Under uniform illumination or capped lens conditions the peak signal current of the defective area visibly differs from the peak signal current of the adjacent background or surrounding areas.

26. Data on target voltage, dark current and lag supplied with each tube.

27. The net signal current is to consist of the total signal current less the contributions due to dark current; i.e. $i_s = i_t \cdot i_d$.

28. The optical reflectivity of the silicon target is normally 35% but can be significantly reduced by the application of an anti-reflecting coatings. The value of minimum reflectivity, the wavelength at which it occurs, and the wavelength interval over which it applies can be preselected to suit various applications. For example a typical set of values would be —0.1% target reflectivity, centered at 600 nm with reflectivity < 1% over the wavelength interval 560 nm to 660 nm. It should be noted that the residual reflectivity from the faceplate is approximately 8%, independent of wavelength. For special applications it is possible to reduce the 8% to 4% or less by application of anti-reflection coatings to one or both surfaces of the faceplate.

TYPICAL OPERATING CONDITIONS AND PERFORMANCE

Operating Conditions:

Cathode Voltage	0 Volts
Grid No. 2 Voltage[29]	300 Volts
Grid No. 3 Voltage[23],[29]	430 Volts
Grid No. 4 Voltage[29]	600 Volts
Target Voltage[24][26]	10 Volts
Beam Current	See Note 17
Faceplate Temperature	20°C to 30°C
Faceplate Illumination[10] (Visible)[13]	0.13 fc
(Infrared)[14]	0.07 fc

Performance:

Signal Current Highlight (i_s), net;[27]	200 nA D.C.
Dark Current , Average[26]	10 nA, D.C.
Resolution, Central (See Figure 1)	
Limiting[19]	750 TV Lines
Modulation Depth (uncompensated Horizontal Amplitude Response) at 400 TV Lines[20]	
Optically Corrected (20)(13)	45%
Signal to Noise Ratio[21]	300:1
Lag (Persistence) (See Figure 2)	
Residual Signal after 50 msec.[26]	10% (20 nA)
Uniformity of Sensitivity (Center to Edge)[30]	10% (20 nA)
Uniformity of Dark Current (Center to Edge)[30]	5% (10 nA)
Local Nonuniformity (peak to peak above surround)[25]	
Light Field[30]	5% (10 nA)
Dark Field[30]	2½% (5 nA)

FOOTNOTES

1. Focusing/deflecting coil assembly
2. Parallel or series supply. When tube is used in a series heater chain, the heater voltage must not exceed 9.5 V_{RMS} when the supply is turned on.
3. The capacitance of the target to all electrodes, which effectively is the output impedance, is measured without the deflection/focusing coil assembly, and may increase when the tube is inserted into such assembly.
4. With no blanking voltage on Grid No. 1.
5. At cathode voltage = 0 Volts.
6. The maximum "Normally Required Beam Current" is taken as that beam current which is just sufficient to stabilize highlights with signal currents of 500 nA (peak value).
7. The total current consists of the current due to the signal plus the dark current, i.e., $i_t = i_s + i_d$.
8. The input stages of the video amplifiers coupled to the target lead of the Sivicon should be capable of handling signal currents of this magnitude without overloading the amplifiers or distorting the picture.
9. For proper orientation of the image on the photo-sensitive layer, the horizontal scan should be essentially parallel to the plane passing through the tube axis and the short base pin.
10. Light source is a tungsten filament lamp in a lime glass envelope, operated at a color temperature of 2870°K.
11. As measured under the following conditions:
Tubes are exposed to 0.0755 ft. c. illumination (light flux of .10 millilumen) of black body color temperature of 2870°K. An appropriate filter is inserted in the light path. The signal current obtained in nanoamperes x 10 denotes the luminous sensitivity expressed in terms of microamperes per lumen of white light incident on the filter. See Figure 3 for filter transmission characteristics.

Filters used:	Tungsten	No filter used	
	Visible	Schott KG3	thickness 4 mm (.157 in)
	Infrared	Schott RG715	thickness 3 mm (.118 in)

12. Radiant sensitivity is derived from the luminous sensitivity assuming a luminous efficacy of 20.4 lm/W of 2870°K. tungsten light. As with the luminous sensitivity, the level of irradiation is that before the filter where one is specified.

10XQA

OPTICAL

Dimensions of Scanned Area (4:3 Aspect Ratio)	0.500 in. x 0.375 in. (12.8 mm x 9.6 mm)
Diameter of Scanned Area	0.625 inch (16 mm)
Orientation of Image on Photo-sensitive Surface	See Note 9

SENSITIVITY (TYPICAL)

CHART A

Light Source (10)	Luminous Sensitivity (μA/lm) (11)	Radiant Sensitivity (mA/W) (12)	Net Signal Current (27) with 0.1 fc incident illumination (nA)
Tungsten	4100	84	550
Visible (13)	1100	22	150
Infrared (14)	2100	43	280

CHART B

Wavelength (nm)	Radiant Sensitivity (mA/W)	Quantum Efficiency(%)
550	320	70
750	400	65
950	150	20

Average Gamma of Transfer Characteristic	1.0
Spectral Response:	
Cut-offs at	400 and 1100 nm, approx.
Max Sensitivity at	600 nm, typ.
Index of Refraction of Faceplate	1.5
Target Optical Reflectivity	See Note 28

ABSOLUTE MAXIMUM RATINGS (31)

Grid No. 4 Voltage	650 Volts (5)
Grid No. 3 Voltage	600 Volts (5)
Grid No. 4 to Grid No. 3 Voltage Difference	350 Volts (29)
Grid No. 2 Voltage	350 Volts (5)
Grid No. 1 Voltage	
Positive	0 Volts
Negative	125 Volts
Grid No. 4 to Grid No. 2 Voltage Difference	see note 29
Cathode to Heater Voltage:	
Peak to Peak Positive	125 Volts
Peak to Peak Negative	10 Volts max.
Cathode Current	3 mA
Heater Warm-up	1 Minute min.
Target Voltage	50 Volts (24)
Dark Currents (i_d) at Specified Target Voltage (5-15 Volts) and a faceplate temp. 30°C	50 nA max.
Signal Current, Total (i_t) (7)	750 nA Peak (8)
Faceplate; illumination	10^7 fc (16)
Faceplate Temperature:	
(Operation and Storage)	−100°C to +100°C max.

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TUBE TYPE

10XQA

SIVICON™

A SILICON VIDICON CAMERA TUBE

DEVELOPMENT SAMPLE DATA

DESCRIPTION

The Sivicon, type 10XQA, is a TV camera pick-up tube with a photosensitive target in the form of a mosaic array of silicon diode elements. This pick-up tube offers the advantage of wide spectral response (including near infrared), high sensitivity, high resolution, low dark current, low lag and long life with freedom from internal X-ray deterioration when operated at typical vidicon voltages.

The 10XQA can be exposed to direct sunlight without deleterious effects. It does not exhibit image burn-in and is able to withstand exposure to 100°C environments. It employs low velocity stabilization and separate mesh construction in a 1 inch diameter "vidicon style" envelope. It is mechanically interchangeable with any 1 inch vidicon and also electrically interchangeable with any separate mesh "vidicon" such as the XQ1040

The 10XQA is intended for use in black-and-white cameras in high quality industrial, educational, and military applications. The high sensitivity of the 10XQA makes it particularly suitable for use in the low level incandescent illumination (c.a., 1 footcandle) or invisible (convert) near infrared illumination, as may be used in surveillance, monitoring and security applications.

GENERAL CHARACTERISTICS

MECHANICAL

Focusing Method	Magnetic (1)
Deflection Method	Magnetic (1)
Dimensions	See outline drawing, Pg. 5
Bulb	T8
Base	JEDEC No. E8-11
Mounting Positions	Any
Weight	2.5 oz.
Accessories	
Socket	Cinch 54A18088 or equiv.
Focusing and Deflection Coil Assembly	Type AT1102, AT1103, AT1116 or equivalent (1)

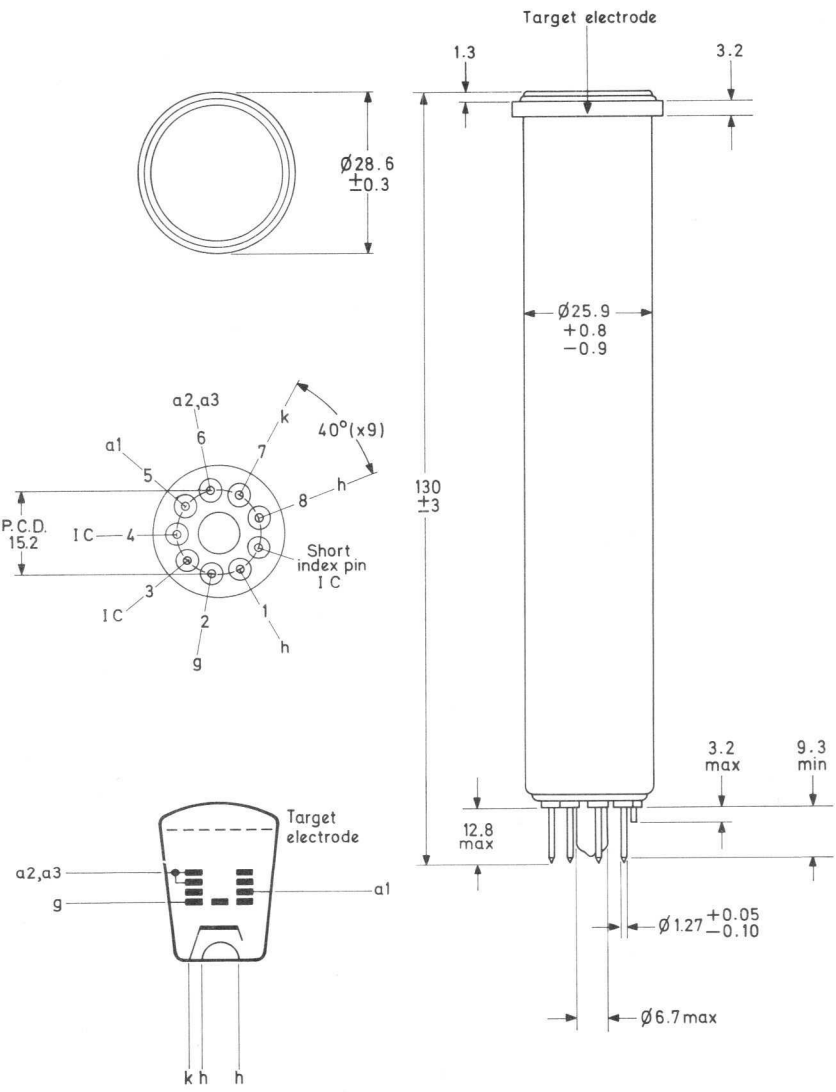
ELECTRICAL

Heating	Indirectly AC or DC (2)
Heater Voltage	6.3 Volts ± 10%
Heater Current	100 mA max.
Capacitance	
Target To All other Electrodes	3 to 5 pF (3)
Grid No. 1 Voltage for Cutoff at	
Grid No. 2 Voltage = 300 volts	−30 to −100 Volts (4), (5)
Blanking Voltage, Peak to Peak	
On Grid No. 1	70 volts min.
On Cathode	15 volts min.
Grid No. 2 Current at Normally Required Beam Current (6)	1 mA max

The included data, based on the specifications and measured performance of development samples, afford a preliminary indication of the characteristics to be expected of the described product. Distribution of development samples implies no guarantee as to the subsequent availability of the product.

(Commercial Type number for 10XQA = XQ1400)

OUTLINE DRAWING OF 7262A



All dimensions in mm

D2500

NOTES (contd.)

3. With 10 lux (colour temperature = 2854K) on the faceplate.

4. With a dark current of 20nA and a signal current of 200nA.

5. The deflection circuit must provide sufficiently linear scanning for good black-level reproduction. Since the output current is proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.

6. Signal current is defined as the component of the output current after the dark current has been subtracted.

7. Square wave response. Measured with a video amplifier system having an appropriate bandwidth.

8. Conditions:

   Dark current 20nA and output current of 220nA.

   The camera is focused on a uniformly illuminated two-zone test pattern. Zone 1 at the centre has a diameter equal to the raster height. Zone 2 occupies the remainder of the scanned area.

   The scanning amplitudes of a rectangular monitor are adjusted to obtain a raster with an aspect ratio of 3:4. The monitor set-up and contrast control are adjusted for a faint raster when the lens of the camera is capped, and for a non-blooming bright raster when 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 are counted unless the amplitude is less than 50% of the peak white signal.

Spot size in % of raster height	Maximum number of spots	
	Zone 1	Zone 2
>0.9	none	none
0.9 to 0.6	2	2
0.6 to 0.3	2	3
<0.3	*	*

*Spots of this size are not counted unless their concentration is so high as to cause a smudgy appearance.

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

10. Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces appropriate infrared filters should be used.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	100	V
$V_{a2, a3}$ max.	750	V
V_{a1} max.	750	V
$-V_g$ max.	300	V
$+V_g$ max.	0	V
I_k max.	2	mA
v_{h-k}(pk) max.		
Cathode positive	125	V
Cathode negative	10	V
Maximum peak output current (see note 9)	0.55	μA
Maximum peak dark current	250	nA
Maximum faceplate illumination	10 000	lux
Maximum faceplate temperature during storage and operation (see note 10)	70	°C

Scanning of a 9.6mm × 12.8mm area of the photoconductive layer should always be applied. The use of a mask of these dimensions is recommended. Scanning of an area less than this may cause permanent damage to the specified full-size area.

MOUNTING POSITION

Any

WEIGHT

Tube alone (approx.)	50 g

ACCESSORIES

Socket	Cinch No.54A18088 or equivalent
Coil assembly	AT1102 or equivalent

NOTES

1. Beam focus is obtained by the combined effect of the focus electrode (a2), the voltage of which should be adjustable over the indicated range, and a focus coil having an average field strength of 3.2A/mm.
2. The polarity of the focus coil should be such that a north-seeking pole, located outside but adjacent to the image end of the focus coil, will be attracted to the image end of the focus coil.

TYPICAL OPERATION

Operating conditions

$V_{a2,a3}$ (see note 1)	250 to 300	V
V_{a1}	300	V
V_g	adjusted for sufficient beam current to stabilise highlights	
Minimum peak-to-peak blanking voltage		
when applied to the grid	75	V
when applied to the cathode	20	V
Field strength at centre of focus coil (see note 2)	3.2	A/mm
Field strength of adjustable alignment coils or magnets	0 to 320	A/m
Scanned area	9.6 × 12.8	mm
Faceplate temperature	30 to 35	°C

Typical performance

	Min.	Typ.	Max.	
Target electrode voltage for a dark current of 20nA	10	-	100	V
Output current at 20nA dark current (see note 3)	150	-	-	nA
Decay: residual signal current after dark pulse of 50ms (see notes 4, 5, 6)	-	25	35	%
Amplitude response at picture centre for 400 TV lines (see note 7)	25	40	-	%
Resolution capability at centre of picture	500	-	-	TV lines
Grid voltage for picture cut-off with no blanking applied	-45	-60	-110	V
Average gamma of transfer characteristic for signal currents between 20nA and 200nA	-	0.65	-	
Wavelength at maximum response (approx.)	-	550	-	nm

Spurious signals - shading

Tubes are rejected for smudge, lines, streaks, mottled background, grainy background, or uneven background having contrast ratios greater than 1.5:1.

Spurious signals - spots and blemishes
(see notes 5 and 8)

CAMERA TUBE
VIDICON

7262A

TENTATIVE DATA

QUICK REFERENCE DATA

25.5mm (1 inch) diameter vidicon television camera tube with integral mesh, low heater consumption, magnetic focusing, and magnetic deflection. Intended for use in low-cost industrial cameras, home cameras and for amateur use.

Decay - residual signal after 50ms	25	%
Resolution capability	>500	TV lines

HEATER

Suitable for parallel or series operation, a.c. or d.c.

V_h	6.3 ± 10%	V
I_h	110 ± 10%	mA

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

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

Maximum diagonal of quality rectangle on photoconductive layer (aspect ratio 3:4)	16	mm

The direction of the horizontal scan should be essentially parallel to the plane defined by the short index pin and the longitudinal tube axis.

CAPACITANCE

Target electrode to all other electrodes	4.6	pF

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

SECTION C

Number, size, location and contrast of blemishes

I. Broadcast quality tubes

Dimensions of blemishes in % of picture height	Permitted number of blemishes*					
	Black and white Luminance (L) tubes Red, Green (R, G)			Blue tubes (B)		
	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
>0.7%	0	0	0	0	0	0
≤0.7% but >0.45%	0	0	1	0	1**	3**
≤0.45% but >0.2%	0	2†	2	1	2**	4**
≤0.2%	‡	‡	‡	‡	‡	‡

*The distance between any two spots shall be greater than 5% of the picture height.

**The sum of the number of spots in zones II and III shall not exceed 5.

†The sum of the diameters of these spots shall not exceed 0.7% of the picture height.

‡Spots of this size are not counted unless the concentration causes a smudgy appearance. Such concentrations are evaluated as smudges, and, as contrast, the average contrast of the concentration is taken.

The maximum contrasts allowed for blemishes are shown in Figs. 3 and 4.

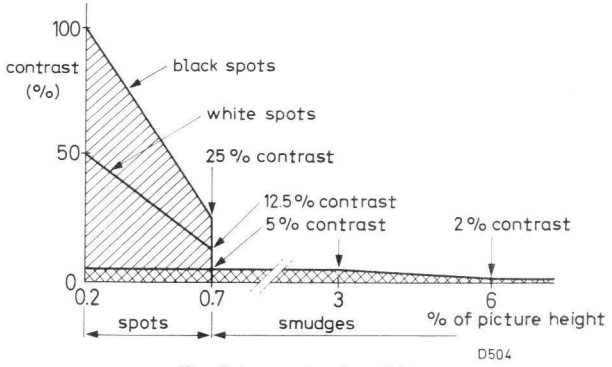


Fig. 3 (see notes 1 and 2)
Maximum contrasts allowed for spots and smudges for tubes for monochrome, luminance and green channels

Notes

1. Spots and smudges with a maximum size of 3% of the picture height with contrasts less than 5% for the monochrome, green and luminance tubes or less than 8% for red and blue tubes are not counted.
2. Smudges with sizes over 3% of the picture height are allowed provided their contrasts remain within the cross-hatched areas.

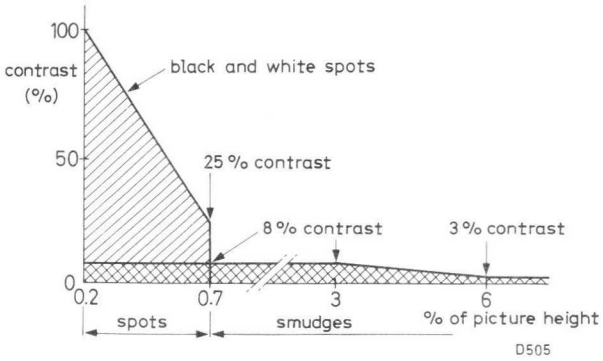


Fig.4 (see notes 1 and 2)
Maximum contrasts allowed for spots and smudges
for tubes for red and blue channels

1. Spots and smudges with a maximum size of 3% of the picture height with contrasts less than 5% for the monochrome, green and luminance tubes or less than 8% for red and blue tubes are not counted.

2. Smudges with sizes over 3% of the picture height are allowed provided their contrasts remain within the cross-hatched areas.

II. Industrial quality tubes

Dimensions of blemishes in % of picture height	Permitted number of blemishes*			
	Zone I	Zone II	Zone III	Total
>1%	0	0	0	0
≤1% but >0.7%	0	1	2	2
≤0.7% but >0.45%	1	2	4	4
≤0.45% but >0.2%	2	4	6	6
≤0.2%	‡	‡	‡	‡
Total permitted number of blemishes	2	4	6	6†

*The distance between any two spots shall be greater than 5% of the picture height in any direction.

‡Spots of this size are not counted unless concentration causes a smudgy appearance. Such concentrations are evaluated as smudges, and as contrast, the average contrast of the concentration is taken.

Blemishes with contrasts ≤10% are not counted.

†For 30mm diameter tubes only.

III. Tubes for medical X-ray equipment

Dimensions of blemishes in % of picture height	Permitted number of blemishes		
	Zone I	Zone II	Zone III
≤1% but >0.7%	0	0**	0**
≤0.7% but >0.45%	0	1**	3**
≤0.45% but >0.2%	2	3**	6**
≤0.2%	‡	‡	‡

**The sum of the number of spots in zones II and III shall not exceed 6.

‡Spots of this size are not counted unless concentration causes a smudgy appearance. Such concentrations are evaluated as smudges, and, as contrast, the average contrast of the concentration is taken.

The maximum contrasts allowed for blemishes are shown in the Fig.5.

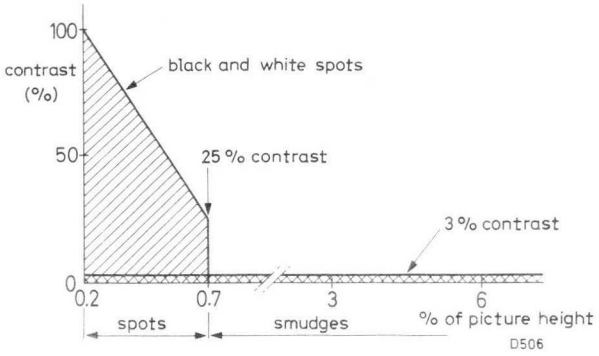


Fig.5
Blemishes with contrasts ≤3% are not counted

CAMERA TUBES
PLUMBICON*

XQ1020
XQ1020L XQ1020G
XQ1020R XQ1020B

QUICK REFERENCE DATA

30mm diameter Plumbicon separate mesh construction camera tubes with photoconductive layer and low velocity stabilisation. They are capable of use at high beam currents giving sensitive, high definition pick-up in monochrome and colour broadcast cameras.

XQ1020 - for use in monochrome television cameras

XQ1020L - provides the luminance component of a colour picture

XQ1020R - provides the red component of a colour picture

XQ1020G - provides the green component of a colour picture

XQ1020B - provides the blue component of a colour picture

Dark current	<3	nA
Resolution capability	>600	TV lines
Transfer characteristic	linear	

GENERAL OPERATIONAL RECOMMENDATIONS AND INSTRUCTIONS FOR USE are given on pages 6 to 8.

HEATER

Suitable for parallel operation only

V_h	6.3 ± 5%	V
I_h	300	mA

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

Image dimensions on photoconductive layer
3:4 aspect ratio (see note 1) 12.8 × 17.1 mm

For correct orientation of the image on the photoconductive layer, the horizontal scan should be essentially parallel to the plane passing through the tube axis and the index pin.

CAPACITANCE

Target electrode to all other electrodes 3 to 6 pF

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

*Registered trade mark for television camera tubes

TYPICAL OPERATION

Operating conditions

V_k	0	V
V_{target}	45	V
V_{a3}	675	V
V_{a2}	600	V
V_{a1}	300	V
V_g adjusted to give the required beam current		
Scanned area	12.8 × 17.1	mm
Faceplate illumination	See note 2	
Faceplate temperature	20 to 45	°C

	XQ1020, XQ1020L, G	XQ1020R, B	
Highlight signal current	300	150	nA

Typical performance

Dark current	< 3	nA
Resolution		

Typical modulation depth measured at centre of picture for 400 TV lines, without aperture correction but corrected for losses introduced by the optical system:-

XQ1020, XQ1020L	40	%
XQ1020R	35	%
XQ1020G	40	%
XQ1020B	50	%
Resolution capability	> 600	TV lines
Signal-to-noise ratio	See note 3	
Gamma of transfer characteristic (see note 4)	0.95 ± 0.05	
Wavelength at maximum response (approx.)	500	nm

Lag (see note 5)

	XQ1020, XQ1020L, R, G	XQ1020B	
Max. residual signal after dark pulse of 60ms	5	6	%
Max. residual signal after dark pulse of 200ms	2	3	%

Sensitivity (see note 6)

XQ1020, XQ1020L	> 275	μA/lm
XQ1020R	> 60	μA/lm
XQ1020G	> 125	μA/lm
XQ1020B	> 32	μA/lm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	50	V
V_{a3} max.	1100	V
V_{a2} max.	800	V
V_{a3-a2} max.	350	V
V_{a1} max.	350	V
$-V_g$ max.	125	V
$+V_g$ max.	0	V
I_k max.	6.0	mA
$V_{h-k(pk)}$ max.		
Cathode positive	50	V
Cathode negative	50	V
Maximum faceplate illumination (see note 7)	500	lux
Faceplate temperature (operation and storage)		
Maximum	50	°C
Minimum	-30	°C
Minimum warm-up time of heater to be observed before drawing cathode current	1.0	min

EQUIPMENT DESIGN RECOMMENDATIONS

V_{target} (see note 8)	25 to 45	V
V_{a3}	650 to 700	V
V_{a2}	550 to 600	V
V_g	0 to -100	V
Minimum peak-to-peak blanking voltage		
when applied to the grid	70	V
when applied to the cathode	25	V

The current drawn by the tube from the first anode supply will not exceed 2.0mA.

MOUNTING POSITION

Any

WEIGHT

Tube alone (approx.)	100	g

ACCESSORIES (see separate data sheets)

Socket	56021
Coil assembly	
for XQ1020	AT1132
for XQ1020L, R, G, B	AT1113/01

NOTES

1. Underscanning of the useful target area of 12.8×17.1mm, or failure of scanning, should be avoided, since this may cause damage to the photoconductive layer. The boundaries outside this area should preferably be covered by a mask to reduce the effects of internal reflections in the faceplate.

2. Adjusted to give the required peak signal current. For a typical XQ1020 or XQ1020L the required illumination will be approximately 4 lux. The signal currents stated for the XQ1020R, G, B will be obtained with an incident illumination of approximately 10 lux (2854K colour temperature), this figure being based on the use of the following filters:

   for XQ1020R Schott OG2 thickness 3mm
   XQ1020G Schott VG9 thickness 1mm
   XQ1020B Schott BG12 thickness 1mm
   Transmission curves for these filters are given on page 10.

   For a monochrome camera, the faceplate illumination is related to the scene illumination by the formula

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

   where B_{sc} = scene illumination
   B_{ph} = faceplate illumination
   R = scene reflectivity (average or that of the object under consideration, whichever is relevant)
   T = lens transmission factor
   F = lens aperture
   m = linear magnification from scene to target

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

3. The noise contribution of the Plumbicon tube is negligible compared with that of the head amplifier. A well designed head amplifier having a bandwidth of 5MHz will give an r.m.s. noise current of about 1.5nA, and at a peak signal current of 150nA this will result in a visual equivalent signal-to-noise ratio of 43dB.

4. Gamma is to a certain extent dependent on the wavelength of the incident illumination. The use of gamma-correcting circuits is recommended.

5. Measured with a 100% signal current of 100nA and with a light source of colour temperature 2854K. The appropriate filter is inserted in the light path when measuring colour tubes.

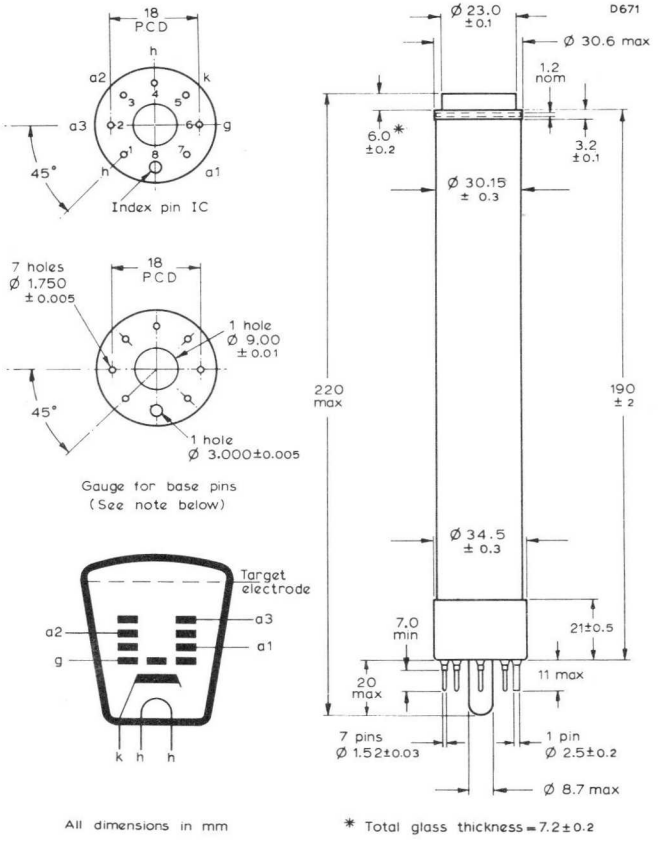
6. As measured under the following conditions:

   Tubes are exposed to an illumination of 4.54 lux at a colour temperature of 2854K. The appropriate filter is inserted in the light path. The current obtained is a measure of the colour sensitivity, and is expressed in micro-amperes per lumen of white light before the filter.

   Filters used:
   for XQ1020R Schott OG2 thickness 3mm
   XQ1020G Schott VG9 thickness 1mm
   XQ1020B Schott BG12 thickness 3mm
   Transmission curves for these filters are given on page 10.

7. For short intervals. During storage the tube face should be covered with the plastic hood provided. When the camera is idle the lens should be capped.
8. The target electrode voltage should be adjusted to 45V. If the scene to be televised contains excessive highlights, the target electrode voltage may be reduced to a minimum of 25V; this, however, will result in some reduction in performance, particularly in respect of sensitivity.

OUTLINE DRAWING OF XQ1020 SERIES



The maximum distance between the axis of anti-reflection glass disc and geometrical centre of the target electrode ring, measured in the plane of faceplate is 0.2mm. The base will fit a gauge as shown above. The holes in the gauge may deviate 0.01mm max. from their true geometric positions. The thickness of the gauge is 7mm. The ends of the pins are tapered or rounded but not brought to a sharp point.

GENERAL OPERATIONAL RECOMMENDATIONS

Transport, handling and storage

During transport, handling or storage, the tube should be placed so that the faceplate is not below the level of the base.

Base pins

The pins of this tube are of tungsten. Accordingly, care must be taken when the tube and socket are mated, in order to avoid breaking the pins or damaging the glass-to-metal seals.

Target electrode

The connection to the target electrode is made at the face end of the tube by a spring contact which is part of the coil assembly.

Photoconductive layer

In some instances the properties of the photoconductive layer may slightly deteriorate during long idle periods, such as encountered between the manufacturer's last test and the first time of operation by the user. It is therefore recommended to operate the tube at approximately monthly intervals from receipt. To restore the photoconductive layer, the tube should be operated for a few hours with normal voltage settings and a signal current of 150nA, and should be adjusted to overscan an evenly illuminated target.

Light transfer

Because the light transfer characteristic has a gamma of approximately unity, it may be desirable for broadcast applications to incorporate a gamma-correcting circuit in the video system, with a gamma adjustable from 0.4 to 1.0. In addition, provision should be made for limiting the video signal above 100% of peak white level, in order to prevent overloading of the video amplifier system when the tube is exposed to scenes containing small peaked highlights as caused by reflections from shiny objects.

Signal-to-noise ratio

Since the tube does not generate noise to any noticeable extent, the signal-to-noise ratio will be determined mainly by the noise factor of the video amplifier system.

Under normal studio lighting conditions the high sensitivity of the tube produces a high signal-to-noise ratio provided that the output of the tube is fed into a well designed input stage of the video amplifier system. In such a system horizontal and vertical aperture correction may be incorporated to ensure sufficient gain in resolving power without significantly impairing the signal-to-noise ratio.

OPERATING INSTRUCTIONS

1. Clean the faceplate of the tube and insert in the coil assembly in such a way that the plane defined by the tube axis and the index pin is essentially parallel to the direction of the horizontal scan.

2. Carefully mate the socket with the base pins.

3. Cap the lens and close the iris.

OPERATING INSTRUCTIONS (contd.)

4. Adjust the operating conditions as follows:

   (a) Grid bias control to maximum negative bias (beam cut-off)

   (b) Target electrode voltage to 45V

   (c) Scanning amplitudes to maximum (overscanning)

5. Switch on camera and picture monitor equipment. Allow a few minutes for warming up.

6. Adjust the monitor to produce a faint, non-overscanned raster.

7. Direct the camera towards the scene to be televised and uncap the lens.

8. Slowly adjust the grid bias control until a picture is produced on the monitor. If the picture is too faint, increase the lens aperture.

9. Adjust V_{a2} and V_{a3} control (beam focus) and optical focus alternately for optimum focus.

10. Align the beam of the Plumbicon tube by one of the following methods:

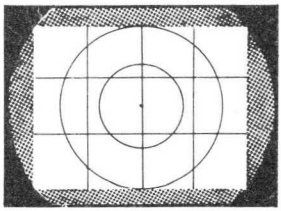
    (a) Adjust the alignment fields in such a way that the centre of the picture on the monitor does not move when V_{a2} and V_{a3} (beam focus) is varied. This is catered for automatically in some cameras.

    (b) Reduce the target electrode voltage to a very low value. Adjust the alignment fields until the most uniform picture is obtained, as observed on the monitor or an oscilloscope.

11. Adjust the scanning amplitudes as follows:

    (a) By means of a 12.8×17.1mm mask which is in contact with and centred on the faceplate. Decrease the horizontal and vertical scanning amplitudes until the periphery of the mask is just outside the raster on the monitor. This may be facilitated by small adjustments of the centring controls.

    (b) If no mask is available, direct the camera towards a test chart having an aspect ratio of 4:3 and adjust the centring controls in such a way that the target ring is just visible in the corners of the picture. Adjust the distance from camera to test chart, and re-focus until the image of the test chart is positioned on the faceplate as indicated on the adjoining figure.



    Decrease both scanning amplitudes until the image of the test chart completely fills the scanned raster on the monitor.

12. Adjust the iris for a picture of sufficient contrast and adjust the beam current to a value at which all highlights are stabilised.

13. Check alignment, beam focus and optical focus.

14. **Procedure for standby operation**

From operation to standby -

(a) Cap lens

(b) Set V_g for beam cut-off

(c) Reduce heater voltage to 4V or less

From standby to normal operation -

(a) Restore heater voltage to 6.3V

(b) Wait 1 minute

(c) Increase beam current to normal value

(d) Uncap lens

ALWAYS

Use full size (12.8 × 17.1mm) scanning of the target and avoid underscanning.

Adjust sufficient beam current to stabilise the picture highlights.

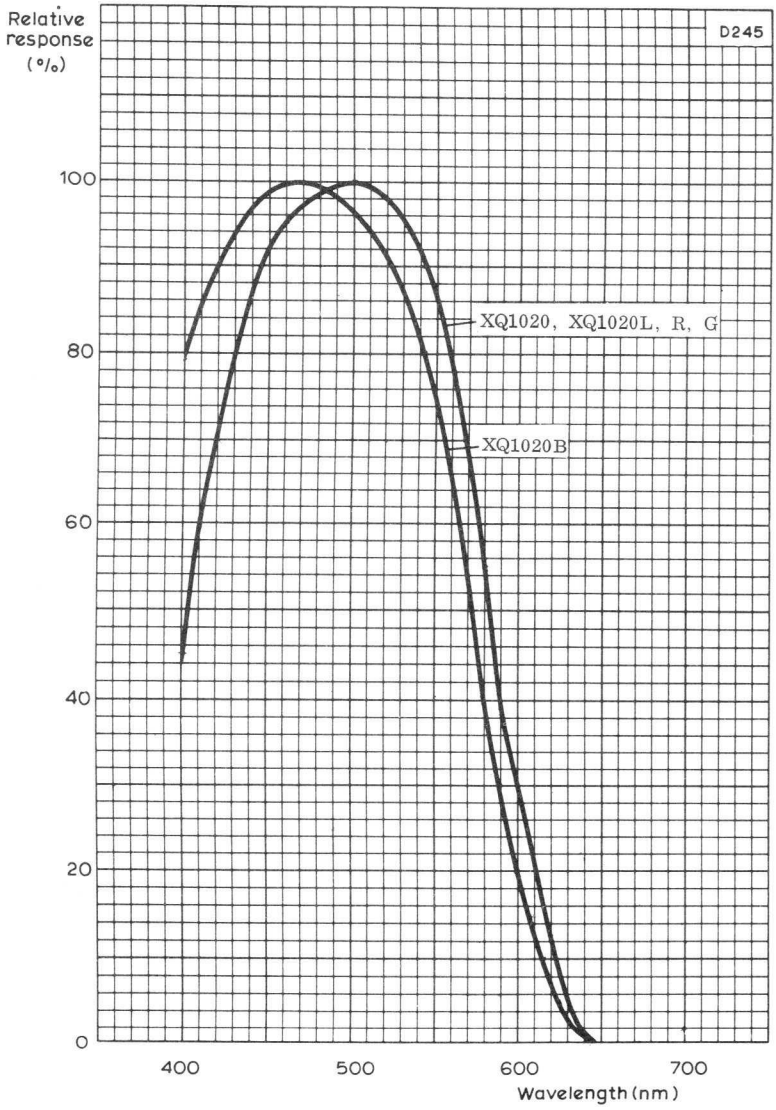
Ensure that the deflection circuits are operative before turning on the beam current.

Operate a3 at a voltage equal to or more positive than a2.

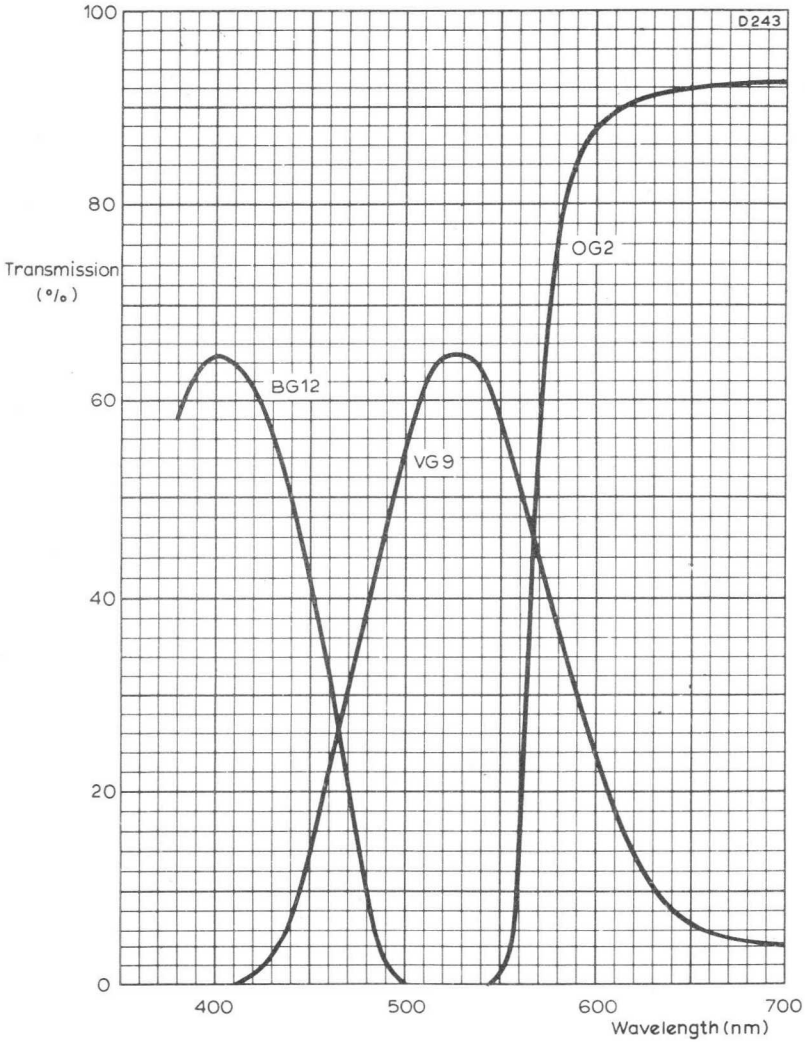
Avoid pointing the camera directly into the sun.

Keep the lens capped when transporting the camera.

XQ1020
XQ1020L XQ1020G
XQ1020R XQ1020B



TYPICAL SPECTRAL RESPONSE CURVES



TRANSMISSION CURVES FOR SCHOTT FILTERS

CAMERA TUBES
PLUMBICON*

XQ1021 XQ1021G
XQ1021R XQ1021B

QUICK REFERENCE DATA

These tubes are identical to the XQ1020 series, except for the quality of the photoconductive layer and are intended for industrial and educational cameras.

XQ1021 - for use in monochrome television cameras

XQ1021R - provides the red component of a colour picture

XQ1021G - provides the green component of a colour picture

XQ1021B - provides the blue component of a colour picture

Dark current	<3	nA
Resolution capability	>600	TV lines
Transfer characteristic	linear	

Data identical to that of XQ1020 series

*Registered trade mark for television camera tubes.

CAMERA TUBE
PLUMBICON*

XQ1022

QUICK REFERENCE DATA

30mm diameter Plumbicon camera tube with photoconductive layer, low velocity stabilisation, and separate mesh construction giving sensitive, high definition pick-up. This tube is exclusively intended for use with X-ray image intensifiers in medical equipment.

Dark current	< 3	nA
Transfer characteristic	linear	

GENERAL OPERATIONAL RECOMMENDATIONS AND INSTRUCTIONS FOR USE are given on pages 6 to 8

HEATER

Suitable for parallel operation only

V_h	6.3 ±5%	V
I_h	300	mA

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

Diameter of the circular area on photoconductive layer (see note 1)	18	mm

CAPACITANCE

Target electrode to all other electrodes	3 to 6	pF

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

*Registered trade mark for television camera tubes

TYPICAL OPERATION

Operating conditions

V_k	0	V
V_{target}	15 to 45	V
V_{a3}	675	V
V_{a2}	600	V
V_{a1}	300	V
V_g adjusted to give the required beam current		
Scanned area	18 × 18	mm
Faceplate illumination (see note 3) approx.	2	lux
Faceplate temperature	25 to 40	°C
Highlight target electrode current	100 to 500	nA
Average signal output	60	nA

Typical performance

Dark current	<3	nA
Resolution (see note 4)		
Typical modulation depth measured at centre of picture for 625 lines, without aperture correction but corrected for losses introduced by the optical system.		
	<30	%
Signal-to-noise ratio	See note 5	
Gamma of transfer characteristic (see note 6)	0.95 ±0.05	
Wavelength at maximum response (approx.)	500	nm
Lag (see note 7)		
Residual signal after dark pulse of 60ms		
Maximum	10	%
Typical	5	%
Residual signal after dark pulse of 200ms		
Maximum	4	%
Typical	2	%
Sensitivity (see note 8)		
Minimum	200	μA/lm
Typical	275	μA/lm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	50	V
V_{a3} max.	1100	V
V_{a2} max.	800	V
V_{a3-a2} max.	350	V
V_{a1} max.	350	V
$-V_g$ max.	125	V
$+V_g$ max.	0	V
I_k max.	6.0	mA
$V_{h-k(pk)}$ max.		
Cathode positive	50	V
Cathode negative	50	V
Maximum faceplate illumination (see note 9)	100	lux
Faceplate temperature (operation and storage)		
Maximum	50	°C
Minimum	-30	°C
Maximum first anode dissipation	1.0	W
Minimum warm-up time of heater to be observed before drawing cathode current	1.0	min

EQUIPMENT DESIGN RECOMMENDATIONS

V_{target} (see note 2)	15 to 45	V
V_{a3}	650 to 700	V
V_{a2}	550 to 600	V
V_g	0 to -100	V
Minimum peak-to-peak blanking voltage		
when applied to the grid	70	V
when applied to the cathode	25	V

The current drawn by the tube from the first anode supply will not exceed 1.0mA.

MOUNTING POSITION: Any

WEIGHT

Tube alone (approx.)	100	g

ACCESSORIES (see separate data sheets)

Socket	56021
Coil assembly	AT1122, AT1132

NOTES

1. Underscanning of the useful target area of 18mm diameter, or failure of scanning, should be avoided, since this may cause damage to the photoconductive layer. The boundaries outside this area should preferably be covered by a mask to reduce the effects of internal reflections in the faceplate.

2. The target electrode voltage should be adjusted to the value indicated on the test sheet as delivered with each individual tube.

3. For a monochrome camera, the faceplate illumination is related to the scene illumination by the formula

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

where B_{sc} = scene illumination

B_{ph} = faceplate illumination

R = scene reflectivity (average or that of the object under consideration, whichever is relevant)

T = lens transmission factor

F = lens aperture

m = linear magnification from scene to target

4. With a signal current of 100nA and a beam current of 500nA. 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.

5. The noise contribution of the Plumbicon tube is negligible compared with that of the head amplifier. A well designed head amplifier having a bandwidth of 5MHz will give an r.m.s. noise current of about 1.5nA, and at a peak signal current of 150nA this will result in a visual equivalent signal-to-noise ratio of 43dB.

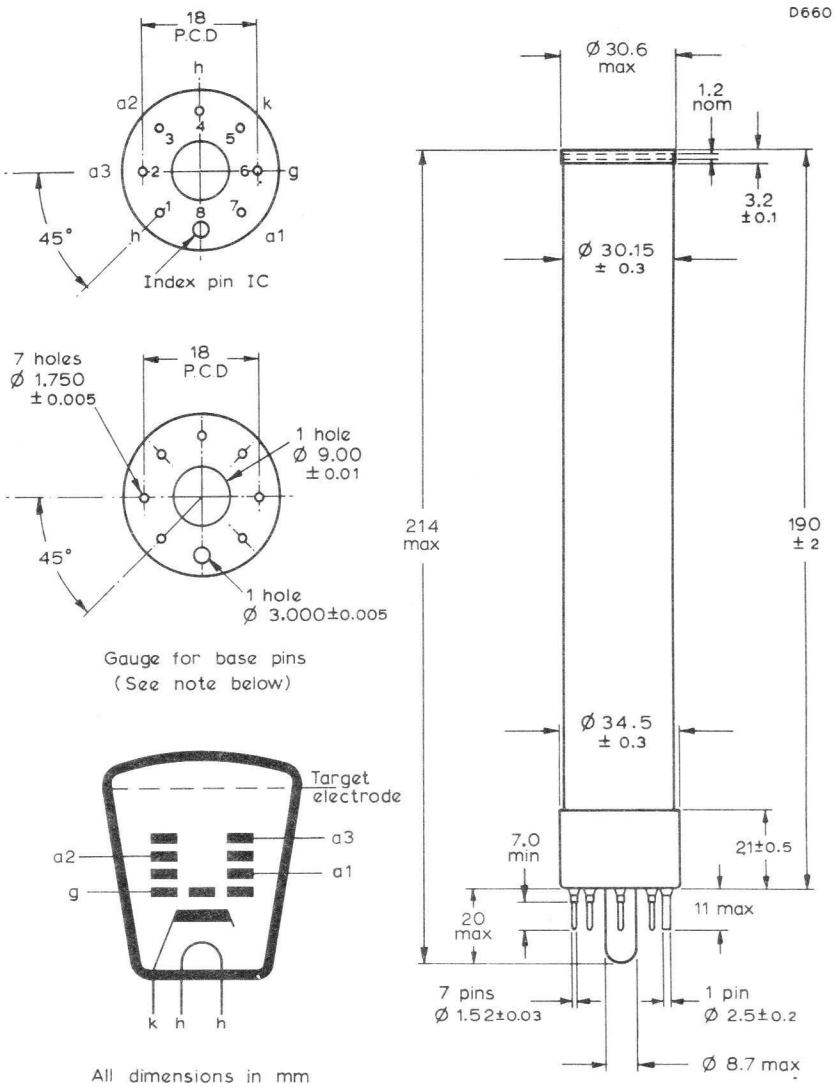
6. The near unity gamma ensures good contrast when televising low contrast X-ray image intensifier pictures as encountered in radiology. Further contrast improvement may be obtained by the use of gamma-correcting circuits.

7. Measured with a 100% signal current of 100nA which has been flowing through the layer for a minimum of 5 seconds, and with a light source having P20 distribution. The beam should be adjusted for correct stabilisation.

8. Measured with a fluorescent light source having P20 distribution.

9. For short intervals. During storage the tube face should be covered with the plastic hood provided. When the camera is idle the lens should be capped.

OUTLINE DRAWING AND DIMENSIONS



The base will fit a gauge as shown above. The holes in the gauge may deviate 0.01mm max. from their true geometric positions. The thickness of the gauge is 7mm. The ends of the pins are tapered or rounded but not brought to a sharp point.

GENERAL OPERATIONAL RECOMMENDATIONS

Transport, handling and storage

During transport, handling or storage, the tube should be placed so that the faceplate is not below the level of the base.

Base pins

The pins of this tube are of tungsten. Accordingly, care must be taken when the tube and socket are mated, in order to avoid breaking the pins or damaging the glass-to-metal seals.

Target electrode

The connection to the target electrode is made at the face end of the tube by a spring contact which is part of the coil assembly.

Photoconductive layer

In some instances the properties of the photoconductive layer may slightly deteriorate during long idle periods, such as encountered between the manufacturer's last test and the first time of operation by the user. It is therefore recommended to operate the tube at approximately monthly intervals from receipt. To restore the photoconductive layer, the tube should be operated for a few hours with normal voltage settings and a signal current of 150nA, and should be adjusted to overscan an evenly illuminated target.

Signal-to-noise ratio

Since the tube does not generate noise to any noticeable extent, the signal-to-noise ratio will be determined mainly by the noise factor of the video amplifier system.

Under normal operation the high sensitivity of the tube produces a high signal-to-noise ratio provided that the output of the tube is fed into a well designed input stage of the video amplifier system. In such a system horizontal and vertical aperture correction may be incorporated to ensure sufficient gain in resolving power without significantly impairing the signal-to-noise ratio.

OPERATING INSTRUCTIONS

1. Clean the faceplate of the tube and insert in the coil assembly.
2. Carefully mate the socket with the base pins.
3. Place mask in front of and in close contact with faceplate.
4. Adjust the operating conditions as follows:
   (a) Grid bias control to maximum negative bias (beam cut-off).
   (b) Target electrode voltage to zero volts.
   (c) Scanning amplitudes to maximum (overscanning).

OPERATING INSTRUCTIONS (contd.)

5. Switch on camera and picture monitor equipment. Allow a few minutes for warming up.

6. Adjust the monitor to produce a faint, non-overscanned raster.

7. Remove camera head from image intensifier unit.

8. Direct camera to lightbox or place suitable lightbox on objective holder. Switch on light and adjust illumination level to correspond to approximately 3 lux for the whites of the testchart on the faceplate.

9. Adjust target electrode voltage to the value indicated on the tube's test sheet.

10. Slowly adjust the grid bias control until a picture is produced on the monitor. If the picture is too faint, increase the lens aperture.

11. Adjust $V_{a2,a3}$ control (beam focus) and optical focus alternately for optimum focus.

12. Align the beam of the Plumbicon by one of the following methods:

    (a) Adjust the alignment fields in such a way that the centre of the picture on the monitor does not move when $V_{a2,a3}$ (beam focus) is varied. This is catered for automatically in some cameras.

    (b) Reduce the target electrode voltage to a very low value. Adjust the alignment fields until the most uniform picture is obtained, as observed on the monitor or an oscilloscope.

13. Decrease scanning amplitudes until a perfectly circular picture is produced on the monitor, with its diameter equal to the height of the monitor raster. This procedure may be facilitated by a small adjustment of the vertical centring control. Adjust the horizontal centring control until the circular picture is properly centred in the centre of the monitor raster.

14. Remove lightbox and attach camera head to image intensifier unit.

15. Place suitable image intensifier testchart in front of image intensifier. Switch on image intensifier and X-ray source.

16. Adjust optical focus and beam focus for maximum picture detail.

ALWAYS

Use full size scanning of the target and avoid underscanning.

Adjust sufficient beam current to stabilise the picture highlights.

Ensure that the deflection circuits are operative before turning on the beam current.

Avoid pointing the camera directly into the sun.

Keep the lens capped when transporting the camera.

CAMERA TUBES
PLUMBICON*

XQ1023
XQ1023L
XQ1023R

TENTATIVE DATA

QUICK REFERENCE DATA

30mm diameter Plumbicon sensitive pick-up tubes with photoconductive layer, extended red response and high resolution. The tubes are provided with separate mesh for good uniformity of signal and resolution, good highlight handling and low velocity target stabilisation. An anti-halation glass disc is fitted.

XQ1023 - for use in monochrome television cameras
XQ1023L - provides the luminance component of a colour picture
XQ1023R - provides the red component of a colour picture

Dark current	<3	nA
Resolution capability	>700	TV lines
Transfer characteristic	linear	

GENERAL OPERATIONAL RECOMMENDATIONS AND INSTRUCTIONS FOR USE are given on pages 6 to 8.

HEATER

Suitable for parallel operation only

V_h	6.3 ±5%	V
I_h	300	mA

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

Image dimensions on photoconductive layer
3:4 aspect ratio (see note 1) 12.8 × 17.1 mm

For correct orientation of the image on the photoconductive layer, the horizontal scan should be essentially parallel to the plane passing through the tube axis and the index pin.

CAPACITANCE

Target electrode to all other electrodes 3 to 6 pF

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

*Registered trade mark for television camera tubes

TYPICAL OPERATION

Operating conditions

V_k	0	V
V_{target}	45	V
V_{a3}	675	V
V_{a2}	600	V
V_{a1}	300	V
V_g adjusted to give the required beam current		
Scanned area	12.8 × 17.1	mm
Faceplate illumination	See note 2	
Faceplate temperature	20 to 45	°C
Highlight signal current	300	nA
Beam current	600	nA

Typical performance

Dark current	<3	nA
Resolution		

Typical modulation depth measured at centre of picture for 400 TV lines, without aperture correction but corrected for losses introduced by the optical system:-

Highlight signal current	300	nA
Beam current	600	nA
Picture centre	55	%
Picture corners	40	%
Resolution capability	>700	TV lines
Signal-to-noise ratio	See note 3	
Gamma of transfer characteristic (see note 4)	0.95 ±0.05	
Wavelength at maximum response (approx.)	500	nm

Lag (see note 5)	XQ1023		XQ1023L		XQ1023R		
Signal current	300		40		150	40	nA
Beam current		600			300		nA
Typical residual signal after dark current of 60ms	3		14		5	13	%
Typical residual signal after dark pulse of 200ms	1.5		5		2	5	%

Sensitivity

XQ1023, XQ1023L (see note 6)	450	μA/lm
XQ1023R (see note 7)	160	μA/lm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	50	V
V_{a3} max.	1100	V
V_{a2} max.	800	V
V_{a3-a2} max.	350	V
V_{a1} max.	350	V
$-V_g$ max.	125	V
$+V_g$ max.	0	V
I_k max.	6	mA
$V_{h-k(pk)}$ max.		
Cathode positive	50	V
Cathode negative	50	V
Maximum faceplate illumination (see note 8)	500	lux
Faceplate temperature (operation and storage)		
Maximum	50	°C
Minimum	-30	°C
Minimum warm-up time of heater to be observed before drawing cathode current	1.0	min

EQUIPMENT DESIGN RECOMMENDATIONS

V_{target} (see note 9)	25 to 45	V
V_{a3}	650 to 700	V
V_{a2}	550 to 600	V
V_g	0 to -100	V
Minimum peak-to-peak blanking voltage		
when applied to the grid	70	V
when applied to the cathode	25	V

The current drawn by the tube from the first anode supply will not exceed 1.0mA.

MOUNTING POSITION — Any

WEIGHT

Tube alone (approx.)	100	g

ACCESSORIES (see separate data sheets)

Socket	56021
Coil assembly	
for XQ1023	AT1132, AT1132/01
for XQ1023L, R	AT1113/01

NOTES

1. Underscanning of the useful target area of 12.8×17.1mm, or failure of scanning, should be avoided, since this may cause damage to the photoconductive layer. The boundaries outside this area should preferably be covered by a mask to reduce the effects of internal reflections in the faceplate.

2. Adjusted to give the required peak signal current. For a typical XQ1023 or XQ1023L the required illumination will be approximately 3 lux. The signal currents stated for the XQ1023R will be obtained with an incident illumination of approximately 10 lux (2854K colour temperature), this figure being based on the use of the Schott OG2 3mm thick filter.

   Transmission curves for the filter are given on page 10.

   For a monochrome camera, the faceplate illumination is related to the scene illumination by the formula

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

   where B_{sc} = scene illumination

   B_{ph} = faceplate illumination

   R = scene reflectivity (average or that of the object under consideration, whichever is relevant)

   T = lens transmission factor

   F = lens aperture

   m = linear magnification from scene to target

   A similar formula may be derived for the illumination on the photoconductive layers of the XQ1023L, XQ1023R tubes, in which the effects of the various components in the complete optical system are taken into account.

3. The noise contribution of the Plumbicon tube is negligible compared with that of the head amplifier. A well designed head amplifier having a bandwidth of 5MHz will give an r.m.s. noise current of about 1.5nA, and at a peak signal current of 150nA this will result in a visual equivalent signal-to-noise ratio of 43dB.

4. Gamma is to a certain extent dependent on the wavelength of the incident illumination. The use of gamma-correcting circuits is recommended.

5. Measured with a signal current which has been flowing through the target for at least 30 seconds and the beam current sufficient to just stabilise the signal current. The figures in columns 2 and 4 are for the performance of the tubes under low-key conditions when overbeamed.

6. All measurements are made with an infra-red absorbing filter, Balzers, Calflex B1/K1 interposed between light source and target. Measured with 4.54 lux on the specified target area, when the infra-red absorbing filter is removed. The transmission curve for this filter is given on page 9.

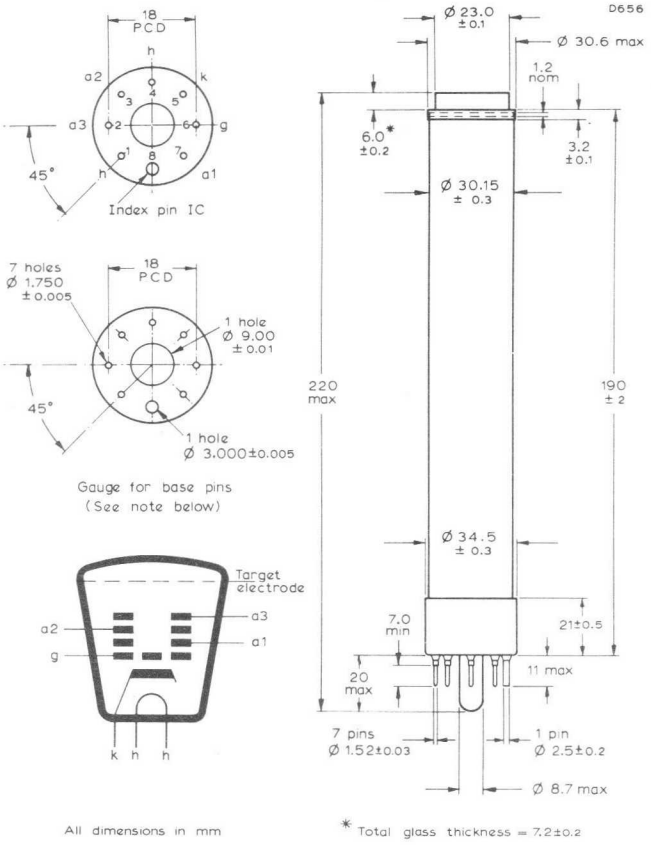
7. Measured as in (6) but with Schott OG2 3mm thick filter interposed between light source and target.

   Transmission curve for the filter is given on page 10.

8. For short intervals. During storage the tube face should be covered with the plastic hood provided. When the camera is idle the lens should be capped.

9. The target electrode voltage should be adjusted to 45V. If the scene to be televised contains excessive highlights, the target electrode voltage may be reduced to a minimum of 25V; this, however, will result in some reduction in performance, particularly in respect of sensitivity.

OUTLINE DRAWING OF XQ1023 SERIES



All dimensions in mm

* Total glass thickness = 7.2±0.2

The maximum distance between the axis of anti-reflection glass disc and geometrical centre of the target electrode ring, measured in the plane of faceplate is 0.2mm. The base will fit a gauge as shown above. The holes in the gauge may deviate 0.01mm max. from their true geometric positions. The thickness of the gauge is 7mm. The ends of the pins are tapered or rounded but not brought to a sharp point.

GENERAL OPERATIONAL RECOMMENDATIONS

Transport, handling and storage

During transport, handling or storage, the tube should be placed so that the faceplate is not below the level of the base.

Base pins

The pins of this tube are of tungsten. Accordingly, care must be taken when the tube and socket are mated, in order to avoid breaking the pins or damaging the glass-to-metal seals.

Target electrode

The connection to the target electrode is made at the face end of the tube by a spring contact which is part of the coil assembly.

Photoconductive layer

In some instances the properties of the photoconductive layer may slightly deteriorate during long idle periods, such as encountered between the manufacturer's last test and the first time of operation by the user. It is therefore recommended to operate the tube at approximately monthly intervals from receipt. To restore the photoconductive layer, the tube should be operated for a few hours with normal voltage settings and a signal current of 150nA, and should be adjusted to overscan an evenly illuminated target.

Light transfer

Because the light transfer characteristic has a gamma of approximately unity, it may be desirable for broadcast applications to incorporate a gamma-correcting circuit in the video system, with a gamma adjustable from 0.4 to 1.0. In addition, provision should be made for limiting the video signal above 100% of peak white level, in order to prevent overloading of the video amplifier system when the tube is exposed to scenes containing small peaked highlights as caused by reflections from shiny objects.

Signal-to-noise ratio

Since the tube does not generate noise to any noticeable extent, the signal-to-noise ratio will be determined mainly by the noise factor of the video amplifier system.

Under normal studio lighting conditions the high sensitivity of the tube produces a high signal-to-noise ratio provided that the output of the tube is fed into a well designed input stage of the video amplifier system. In such a system horizontal and vertical aperture correction may be incorporated to ensure sufficient gain in resolving power without significantly impairing the signal-to-noise ratio.

OPERATING INSTRUCTIONS

1. Clean the faceplate of the tube and insert in the coil assembly in such a way that the plane defined by the tube axis and the index pin is essentially parallel to the direction of the horizontal scan.
2. Carefully mate the socket with the base pins.
3. Cap the lens and close the iris.

OPERATING INSTRUCTIONS (contd.)

4. Adjust the operating conditions as follows:

   (a) Grid bias control to maximum negative bias (beam cut-off).

   (b) Target electrode voltage to 45V.

   (c) Scanning amplitudes to maximum (overscanning).

5. Switch on camera and picture monitor equipment. Allow a few minutes for warming up.

6. Adjust the monitor to produce a faint, non-overscanned raster.

7. Direct the camera towards the scene to be televised and uncap the lens.

8. Slowly adjust the grid bias control until a picture is produced on the monitor. If the picture is too faint, increase the lens aperture.

9. Adjust V_{a2} and V_{a3} control (beam focus) and optical focus alternately for optimum focus.

10. Align the beams of the Plumbicon by one of the following methods:

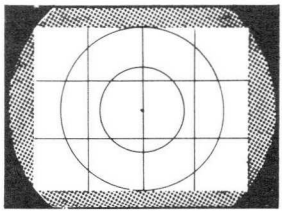
    (a) Adjust the alignment fields in such a way that the centre of the picture on the monitor does not move when V_{a2} and V_{a3} (beam focus) is varied. This is catered for automatically in some cameras.

    (b) Reduce the target electrode voltage to a very low value. Adjust the alignment fields until the most uniform picture is obtained, as observed on the monitor or an oscilloscope.

11. Adjust the scanning amplitudes as follows:

    (a) By means of a 12.8×17.1mm mask which is in contact with and centred on the faceplate. Decrease the horizontal and vertical scanning amplitudes until the periphery of the mask is just outside the raster on the monitor. This may be facilitated by small adjustments of the centring controls.

    (b) If no mask is available, direct the camera towards a test chart having an aspect ratio of 4:3 and adjust the centring controls in such a way that the target ring is just visible in the corners of the picture. Adjust the distance from camera to test chart, and re-focus until the image of the test chart is positioned on the faceplate as indicated on the adjoining figure.



    Decrease both scanning amplitudes until the image of the test chart completely fills the scanned raster on the monitor.

12. Adjust the iris for a picture of sufficient contrast and adjust the beam current to a value at which all highlights are stabilised.

13. Check alignment, beam focus and optical focus.

14. Procedure for standby operation

From operation to standby -

(a) Cap lens

(b) Set V_g for beam cut-off

(c) Reduce heater voltage to 4V or less

From standby to normal operation -

(a) Restore heater voltage to 6.3V

(b) Wait 1 minute

(c) Increase beam current to normal value

(d) Uncap lens

ALWAYS -

Use full size (12.8 × 17.1mm) scanning of the target and avoid underscanning.

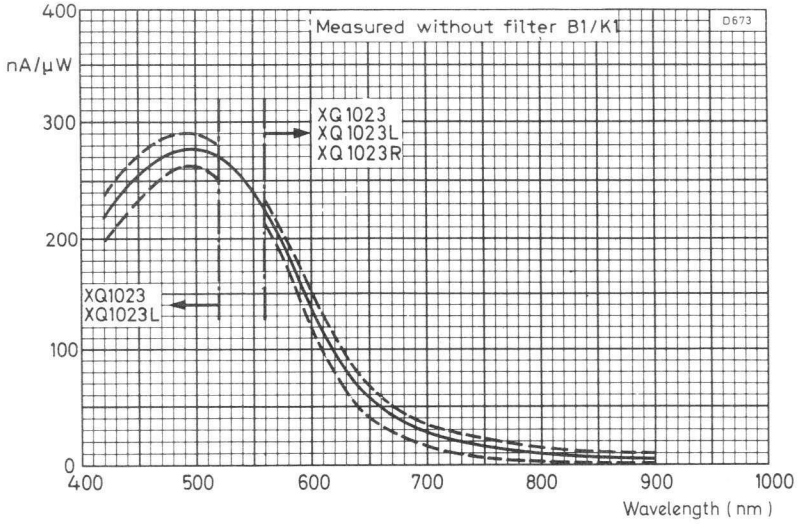
Adjust sufficient beam current to stabilise the picture highlights.

Ensure that the deflection circuits are operative before turning on the beam current.

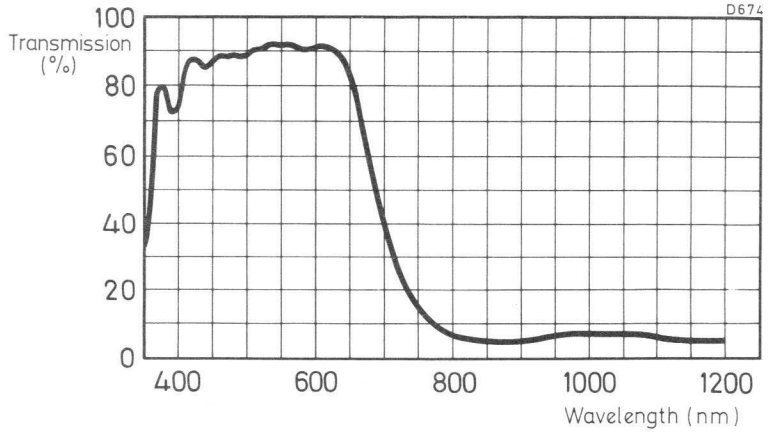
Operate a3 at a voltage equal to or more positive than a2.

Avoid pointing the camera directly into the sun.

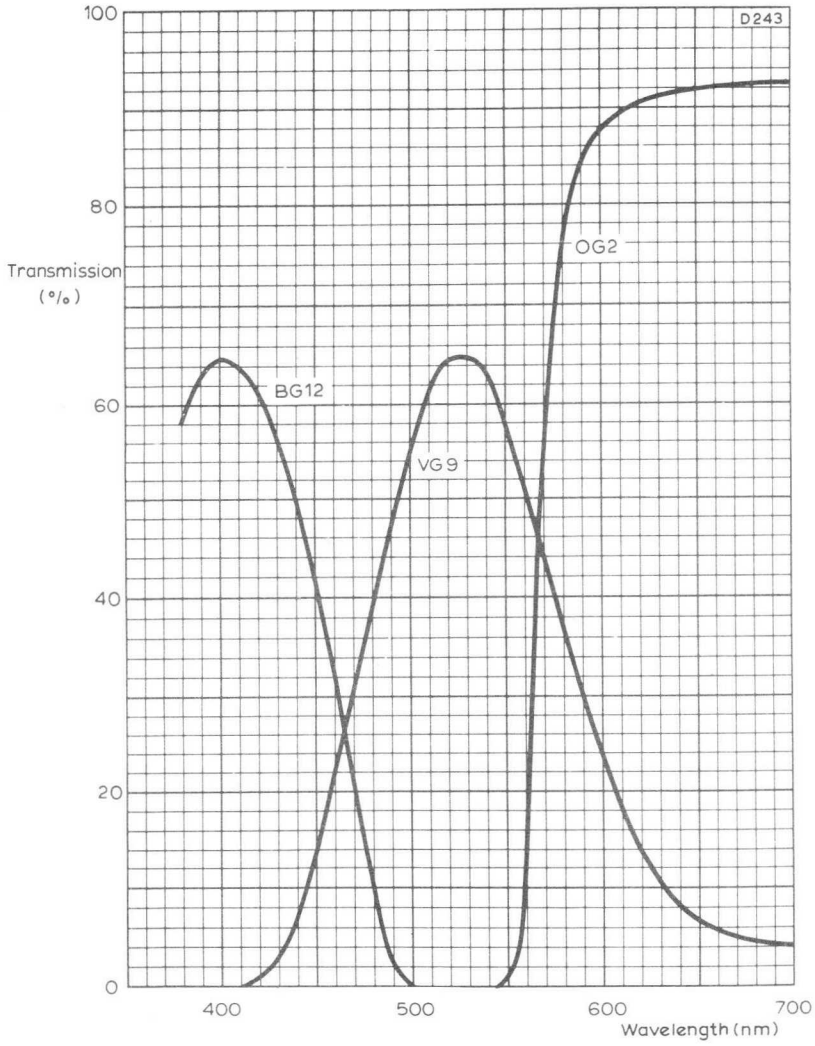
Keep the lens capped when transporting the camera.



Spectral sensitivity characteristic measured at a constant signal output of 50nA from 12.8 × 17mm (except at low sensitivity values)



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



TRANSMISSION CURVES FOR SCHOTT FILTERS

CAMERA TUBES
PLUMBICON*

XQ1024
XQ1024R

QUICK REFERENCE DATA

These tubes are identical to XQ1023 series except for the quality of photo-conductive layer and are intended for industrial and educational cameras.

XQ1024 - for use in monochrome television cameras

XQ1024R - provides the red component of a colour picture

Dark current	<3	nA
Resolution capability	>700	TV lines
Transfer characteristic	linear	

Data identical to that of XQ1023 series

*Registered trade mark for television camera tubes.

CAMERA TUBES
PLUMBICON*

XQ1025
XQ1025L
XQ1025R

DEVELOPMENT SAMPLE DATA

QUICK REFERENCE DATA

30mm diameter Plumbicon sensitive pick-up tubes with photoconductive layer, extended red response and high resolution. The tubes are provided with separate mesh for good uniformity of signal and resolution, good highlight handling and low velocity stabilisation. The tubes are identical to XQ1023 series tubes but incorporate an infrared reflection filter on the anti-halation glass disc.

XQ1025 - provides monochrome pictures with true rendering of colour tones

XQ1025L - provides the luminance component of a colour picture

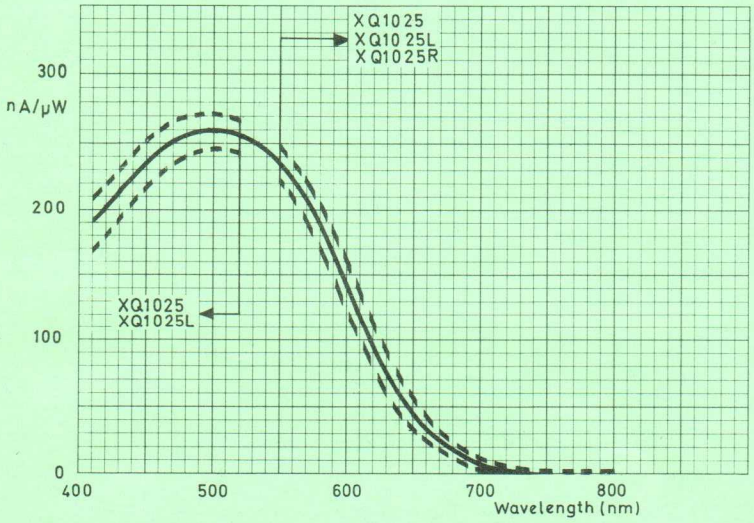
XQ1025R - provides the red component of a colour picture

Data identical to that of XQ1023 series tubes except for spectral response curves.

*Registered trade mark for television camera tubes.

NOTES

1. The infrared reflecting filter eliminates the need for additional filters in the colour splitting system when XQ1025L and XQ1025R are used in colour cameras originally designed for XQ1020 series tubes. If applicable, an infrared absorbing filter for wavelengths in excess of 900nm should be incorporated in the optical system of the camera.
2. The filters for individual tubes have been selected so that the spreads in the spectral response in the longer wavelength region of XQ1023 series tubes are greatly reduced, thereby producing minimum differences in colour rendering between colour cameras of identical manufacture.
3. The filter consists of a hard coating on the anti-halation glass disc. Care must be taken to avoid scratches during handling and cleaning.
4. The data of XQ1023 series referring to B1/K1 filter does not apply.



TYPICAL SPECTRAL RESPONSE CURVES

CAMERA TUBES
PLUMBICON*

XQ1070 XQ1070/01
XQ1070L XQ1070/01L
XQ1070R XQ1070/01R
XQ1070G XQ1070/01G
XQ1070B XQ1070/01B

DEVELOPMENT SAMPLE DATA

QUICK REFERENCE DATA

25.4mm (1 in) diameter Plumbicon camera tubes with photoconductive layer and separate mesh construction for broadcast, educational and high quality industrial applications. The basic types XQ1070, L, R, G, B are provided with an anti-halation glass disc, while the types XQ1070/01, L, R, G, B are without. These tubes are mechanically interchangeable with 1 inch vidicons with separate mesh and have the same pin connections.

XQ1070 - for use in monochrome television cameras
XQ1070L - provides the luminance component of a colour picture
XQ1070R - provides the red component of a colour picture
XQ1070G - provides the green component of a colour picture
XQ1070B - provides the blue component of a colour picture

Dark current	<3	nA
Resolution capability	>600	TV lines
Transfer characteristic	linear	

GENERAL OPERATIONAL RECOMMENDATIONS AND INSTRUCTIONS FOR USE are given on pages 6 to 8.

HEATER

Suitable for parallel or series operation, a.c. or d.c.

V_h	6.3 ±10%	V
I_h	95	mA

When the tube is used in a series chain, the heater voltage must not exceed 9.5Vr.m.s. when the supply is switched on. To avoid registration errors in colour cameras, stabilisation of the heater voltage is recommended.

FOCUSING — Magnetic

DEFLECTION — Magnetic

PHOTOCONDUCTIVE LAYER

Image dimensions on photoconductive layer
3:4 aspect ratio (see note 1) — 9.6 × 12.8 mm

For correct orientation of the image on the photoconductive layer, the horizontal scan should be essentially parallel to the plane passing through the tube axis and the short index pin.

CAPACITANCE

Target electrode to all other electrodes — 4.5 ±1.0 pF

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

*Registered trade mark for television camera tubes

This Development Sample Data is derived from Development Samples provided for initial circuit work, it does not form part of the Mullard technical handbook system and does not necessarily imply that the device will go into production

TYPICAL OPERATION

Operating conditions

V_k	0	V
V_{target}	45	V
V_{a3} (see note 2)	850	V
V_{a2} (see note 2)	600	V
V_{a1}	300	V
V_g adjusted to give the required beam current		
Scanned area	9.6 × 12.8	mm
Faceplate illumination	See note 3	
Faceplate temperature	20 to 45	°C

	XQ1070, L, G, XQ1070/01, L, G	XQ1070R, B, XQ1070/01R, B	
Highlight signal current	200	100	nA
Beam current	400	200	nA

Typical performance

Dark current	<3	nA
Resolution		

Typical modulation depth measured at centre of picture for 400 TV lines, without aperture correction but corrected for losses introduced by the optical system.

XQ1070 and /01, XQ1070L and /01L	30	%
XQ1070R, XQ1070/01R	25	%
XQ1070G, XQ1070/01G	30	%
XQ1070B, XQ1070/01B	35	%
Resolution capability	>600	TV lines
Gamma of transfer characteristic (see note 4)	0.95 ± 0.05	
Wavelength (approx.) (see page 9)		
at maximum response	500	nm
at cut-off	650	nm

Lag (see note 5)

	XQ1070, XQ1070L, R, G XQ1070/01, XQ1070/01L, R, G	XQ1070B and /01B	
Max. residual signal after dark pulse of 60ms	5	6	%
Max. residual signal after dark pulse of 200ms	2	3	%

Sensitivity (see note 6)

	Minimum	Typical	
XQ1070 and /01, XQ1070L and /01L	275	400	μA/lm
XQ1070R, XQ1070/01R	60	80	μA/lm
XQ1070G, XQ1070/01G	125	165	μA/lm
XQ1070B, XQ1070/01B	32	35	μA/lm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max. (see note 7)	50	V
V_{a3} max.	1100	V
V_{a2} max.	800	V
V_{a3-a2} max.	450	V
V_{a1} max.	350	V
$-V_g$ max.	125	V
$+V_g$ max.	0	V
I_k max.	3.0	mA
$V_{h-k(pk)}$ max.		
Cathode positive	125	V
Cathode negative	50	V
Maximum faceplate illumination (see note 8)	500	lux
Maximum faceplate temperature (operation and storage)	50	^oC
Minimum faceplate temperature (operation and storage)	-30	^oC
Minimum warm-up time of heater to be observed before drawing cathode current	1.0	min

EQUIPMENT DESIGN RECOMMENDATIONS

V_{target} (see note 9)	25 to 45	V
V_{a3}	820 to 880	V
V_{a2}	570 to 630	V
V_g	0 to -100	V
Minimum peak-to-peak blanking voltage		
when applied to the grid	70	V
when applied to the cathode	25	V

The current drawn by the tube from the first anode supply will not exceed 1mA.

MOUNTING POSITION

Any

WEIGHT

Tube alone (approx.)	60	g

ACCESSORIES (see separate data sheets)

Socket	Cinch no. 54A18088 or equivalent
Coil assembly	AT1102 or equivalent

NOTES

1. Underscanning of the useful target area of 9.6 × 12.8mm, or failure of scanning, should be avoided, since this may cause damage to the photoconductive layer. The boundaries outside this area should preferably be covered by a mask to reduce the effects of internal reflections in the faceplate.

2. V_{a2} and V_{a3} are adjusted for optimum beam focus. The optimum voltage V_{a3-a2} to obtain minimum beam landing errors (should be ≤2) depends on the type of coil assembly used. For the type AT1102 a ratio of 1.3:1 to 1.5:1 is recommended, and this ratio should be maintained when focusing.

3. Adjusted to give the required peak signal current. For a typical XQ1070 or XQ1070/01 the required illumination will be approximately 5 lux. The signal currents stated for the XQ1070R, G, B and XQ1070/01R, G, B will be obtained with an incident illumination of approximately 12.5 lux (2854K colour temperature), this figure being based on the use of the following filters:

   for XQ1070R and /01R Schott OG2 thickness 3mm
   XQ1070G and /01G Schott VG9 thickness 1mm
   XQ1070B and /01B Schott BG12 thickness 1mm
   Transmission curves for these filters are given on page 10.

   For a monochrome camera, the faceplate illumination is related to the scene illumination by the formula

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

   where B_{sc} = scene illumination
   B_{ph} = faceplate illumination
   R = scene reflectivity (average or that of the object under consideration, whichever is relevant)
   T = lens transmission factor
   F = lens aperture
   m = linear magnification from scene to target

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

4. Gamma is to a certain extent dependent on the wavelength of the incident illumination. The use of gamma-correcting circuits is recommended.

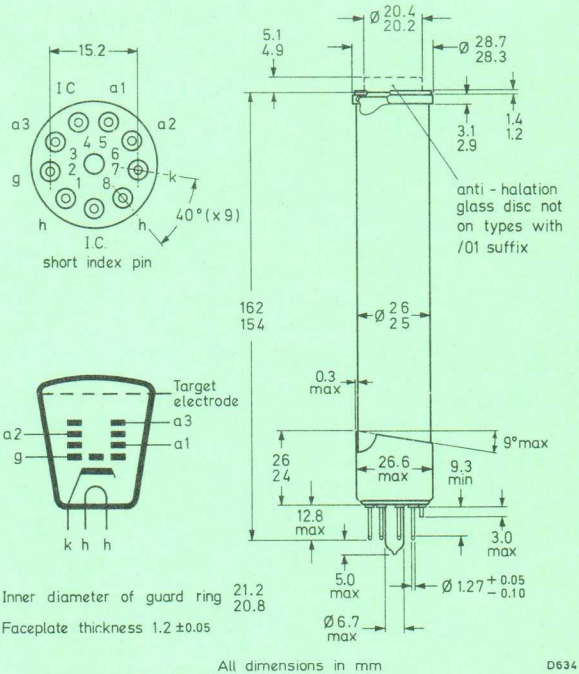
5. Measured with a 100% signal current of 100nA and with a light source of colour temperature 2854K. The appropriate filter is inserted in the light path when measuring colour tubes.

6. As measured under the following conditions:
   Tubes are exposed to an illumination of 8.15 lux at a colour temperature of 2854K. The appropriate filter is inserted in the light path. The current obtained is a measure of the colour sensitivity, and is expressed in micro-amperes per lumen of white light before the filter.

   Filters used:
   for XQ1070 and /01R Schott OG2 thickness 3mm
   XQ1070 and /01G Schott VG9 thickness 1mm
   XQ1070 and /01B Schott BG12 thickness 3mm
   Transmission curves for these filters are given on page 10.

7. Automatic sensitivity control cannot be obtained in Plumbicon tubes by regulating the target electrode voltage. Adequate control can be achieved by iris control and neutral density filters.
   When a Plumbicon tube is used in cameras originally designed for vidicon tubes, the automatic sensitivity control circuits should be made inoperative and the target electrode voltage set to 45V.
8. For short intervals. During storage the tube face should be covered with the plastic hood provided. When the camera is idle the lens should be capped.
9. The target electrode voltage should be adjusted to 45V. If the scene to be televised contains excessive highlights, the target electrode voltage may be reduced to a minimum of 25V; this, however, will result in some reduction in performance, particularly in respect of sensitivity.

OUTLINE DRAWING OF XQ1070 SERIES



The anti-halation glass disc (for types XQ1070, L, R, G, B) is located within a circle of diameter 20.6mm, concentric with the target electrode ring.
The base seal of the tube is protected by a metal sleeve, which is cut-off obliquely at the top. Rotating the tube while pulling will free the tube without damage to the centring or target-electrode springs.

12. Adjust the iris for a picture of sufficient contrast and adjust the beam current to a value at which all highlights are stabilised.

13. Check alignment, beam focus and optical focus.

14. Procedure for standby operation

From operation to standby -

(a) Cap lens

(b) Set V_g for beam cut-off

(c) Switch off heater

From standby to normal operation -

(a) Restore heater voltage to 6.3V

(b) Wait 1 minute

(c) Increase beam current to normal value

(d) Uncap lens

ALWAYS -

Use full size (9.6 × 12.8mm) scanning of the target and avoid underscanning.

Adjust sufficient beam current to stabilise the picture highlights.

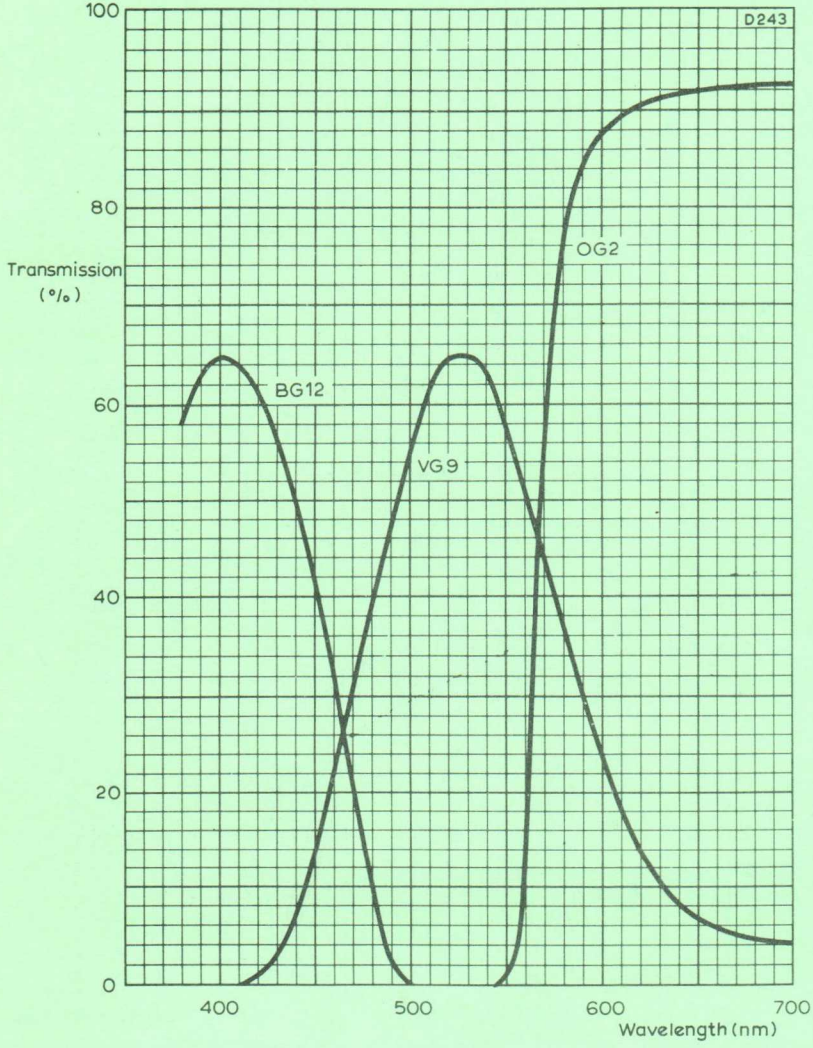
Ensure that the deflection circuits are operative before turning on the beam current.

Operate a3 at a voltage equal to or more positive than a2.

Avoid pointing the camera directly into the sun.

Keep the lens capped when transporting the camera.

TYPICAL SPECTRAL RESPONSE CURVES



TRANSMISSION CURVES FOR SCHOTT FILTERS

CAMERA TUBES
PLUMBICON*

XQ1071 XQ1071/01
XQ1071R XQ1071/01R
XQ1071G XQ1071/01G
XQ1071B XQ1071/01B

DEVELOPMENT SAMPLE DATA

QUICK REFERENCE DATA

25.4mm (1 in) diameter Plumbicon camera tubes with photoconductive layer and separate mesh construction for industrial, educational and medical applications. The basic types XQ1071, R, G, B are provided with an anti-halation glass disc, while the types XQ1071/01 R, G, B are without. These tubes are mechanically interchangeable with 1 inch vidicons with separate mesh and have the same pin connections.

XQ1071 - for use in monochrome television cameras
XQ1071R - provides the red component of a colour picture
XQ1071G - provides the green component of a colour picture
XQ1071B - provides the blue component of a colour picture

Dark current	<3	nA
Resolution capability	>600	TV lines
Transfer characteristic	linear	

Data identical to that of XQ1070 and XQ1070/01 series.

*Registered trade mark for television camera tubes

CAMERA TUBE PLUMBICON*

XQ1072

DEVELOPMENT SAMPLE DATA

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

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

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

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

OPTICAL

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

Orientation of image on photoconductive target

For correct orientation of the image on the target the horizontal scan should be essentially parallel to the plane passing through the tube axis and the short index pin.

Faceplate

Thickness		1.2	mm
Refractive index	n	1.49	

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production

*Registered trade mark for television camera tubes

ELECTRICAL

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

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

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

Electron gun characteristics

Cut-off

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

Capacitance

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

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

LIMITING VALUES (Absolute max. rating system)

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

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

ACCESSORIES

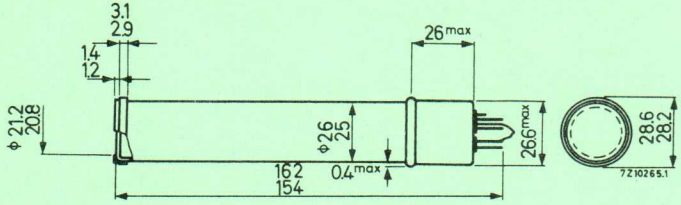
Socket	Cinch no. 54A18088 or equivalent
Deflection and focusing coil-unit	AT1102/01, AT1103, AT1116 or equivalent

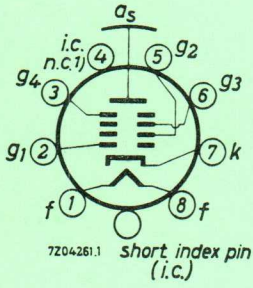
MECHANICAL Dimensions in mm

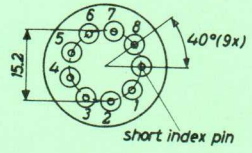
Mounting position: any

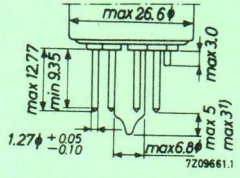
Weight: approx. 60 g

Base: JEDEC E8-11 except for stem.









1) For serial number 90000 and up. (see pin 4 and pumping stem).

OPERATING CONDITIONS AND PERFORMANCE

TYPICAL OPERATING CONDITIONS 5)

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

		low voltage mode	high voltage mode 7)	
Grid no. 4 voltage	V_{g4}	600	960	V
Grid no. 3 voltage	V_{g3}	375	600	V
Grid no. 1 voltage		see note 6a)		
Blanking voltage on grid no. 1, peak to peak	V_{g1p-p}		50	V

PERFORMANCE

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

Resolution

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

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

Modulation transfer characteristic see page 9 11b)

Decay

Measured with a peak signal current of 0.2 μA

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

NOTES

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

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

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

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

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

6a) Grid no. 1 (control grid) voltage adjusted to produce a beam current, I_{bp}, which will allow a maximum peak signal current I_{sp} of 500 nA.

N.B. The peak signal currents are measured on a waveform oscilloscope and with a uniform illumination on the 15 mm ϕ target area. When measured with an integrating instrument connected in the signal-electrode lead the average signal currents will be smaller

a) by a factor α ($\alpha = \frac{100 - \beta}{100}$), β being the total blanking time in %; for the CCIR system α amounts to 0.75.

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

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

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

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

9)

	Focusing current* (mA)		Line current (mA_{pp})		Frame current (mA_{pp})	
V_{g4}/V_{g3}	600/375	960/600	600/375	960/600	600/375	960/600
AT1102/01	18	23	310	390	42	53
AT1103	20	26	310	390	46	59
AT1116	83	105	400	510	59	75
	Approx. values for scanning amplitudes corresponding to 15 x 20 mm^2 scanned area					

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

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

11a) Measured with a transparency with a square wave test pattern with vertical bars. The figures given relate to a low frequency reference obtained from a square wave pattern of 1.0 lp/mm (385 kHz).
The aperture of the lens system adjusted for f 5.6

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

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

GENERAL AND RECOMMENDATIONS

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

2. This series of Plumbicon tubes is provided with Kovar pins and therefore requires no more care in handling than vidicon tubes.

3. During long term storage the ambient temperature should not exceed 30 °C.

4. In isolated cases the properties of a Plumbicon 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.
   - if the camera is not used for a long time.

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

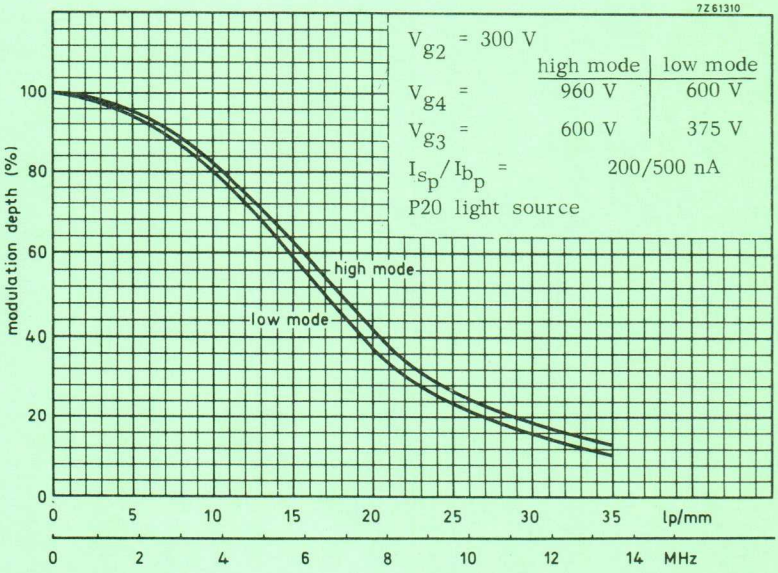
   The following procedure and conditions are recommended:
   - Set grid no. 1 bias-control to maximum negative bias (beam cut-off).
   - Allow a heating-up time of the cathode of at least one minute before turning up the grid no. 1 bias-control to produce a beam.
   - Set scanning amplitudes to overscan condition.
   - Apply an even illumination to the target to obtain a signal current of approx. 0.15 μA and adjust the beam for correct stabilization.

5. The signal electrode connection is made by a spring contact, which is part of the focusing coil assembly, and is kept pressed against the signal electrode ring.

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

INSTRUCTIONS FOR USE

Instructions for use are packed with each tube.



Modulation transfer characteristic

CAMERA TUBES
PLUMBICON*

XQ1073

DEVELOPMENT SAMPLE DATA

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 and the XQ1073/01 series respectively are mechanically interchangeable with 1 in diameter vidicons with separate mesh and have the same pin connections. The XQ1073 and XQ1073/01 are intended for use in black and white cameras, the XQ1073R and XQ1073/01R 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	XQ1073, XQ1073R
Without anti-halation glass disc	XQ1073/01, XQ1073/01R
Cut-off of spectral response	850 to 950 nm
Heater	6,3 V, 95 mA
Resolution	≥ 750 TV lines

OPTICAL

Quality rectangle on photoconductive target (aspect ratio 3:4) — 9,6 x 12,8 mm^2 [1])

Orientation of image on photoconductive target

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

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production

*Registered trade mark for television camera tubes

ELECTRICAL

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

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

When the tube is used in a series heater chain, the rms heater voltage must not exceed 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

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

Capacitance

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

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

LIMITING VALUES (Absolute max. rating system)

All voltages are referred to the cathode, unless otherwise stated

Signal electrode voltage	V_{a_s}	max.	50	V [3]
Grid no. 4 voltage	V_{g4}	max.	1100	V
Voltage between grid no. 4 and grid no. 3	$V_{g4/g3}$	max.	450	V
Grid no. 3 voltage	V_{g3}	max.	800	V
Grid no. 2 voltage	V_{g2}	max.	350	V
Grid no. 1 voltage, positive	V_{g1}	max.	0	V
negative	$-V_{g1}$	max.	125	V
Cathode to heater voltage, positive peak	V_{kf_p}	max.	125	V
negative peak	$-V_{kf_p}$	max.	50	V
Impedance between cathode and heater at $-V_{kf_p} > 10$ V	Z_{kf}	min.	2	kΩ

Ambient temperature storage and operation	t_{amb}	max. min.	50 −30	°C °C
Faceplate temperature storage and operation	t	max. min.	50 −30	°C °C
Faceplate illumination	E	max.	500	lx [4]

ACCESSORIES

Socket — Cinch no. 54A18088, TE1004, or equivalent

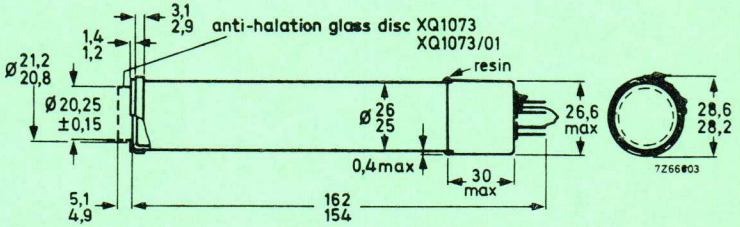
Deflection and focusing coil unit for bl/wh cameras AT1102/01, AT1103 or equivalent
for colour cameras AT1116 or equivalent

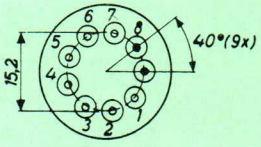
MECHANICAL — Dimensions in mm

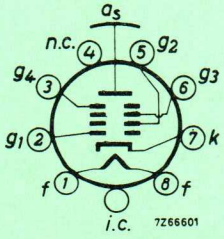
Mounting position: any

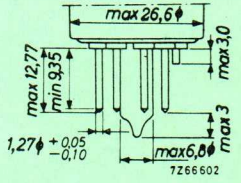
Weight: approx. 60 g

Base: JEDEC E8-11 except length of stem.









OPERATING CONDITIONS AND PERFORMANCE

Typical operating conditions (scanned area 9,6 x 12,8 mm^2)

Cathode voltage	V_k	0	V
Grid no. 2 voltage	V_{g_2}	300	V
Signal electrode voltage	V_{a_s}	45	V [5]
Beam current	I_b	see note 6	
Focusing coil current at given values of grid no. 4 and grid no. 3 voltages		see note 7	
Deflection and alignment currents		see note 7	
Faceplate illumination		see note 8	
Faceplate temperature	t	20 to 45	°C

		low voltage mode	high voltage mode	
Grid no. 4 voltage	V_{g_4}	600	960	V [9]
Grid no. 3 voltage	V_{g_3}	375	600	V [9]
Grid no. 1 voltage		see note 6		
Blanking voltage on grid no. 1, peak to peak	$V_{g_{1pp}}$	50		V

Performance

Dark current		≤	3	nA
Sensitivity at colour temperature of illumination = 2854 K				[10]
XQ1073, XQ1073/01	typical	350	min. 310	μA/lm
XQ1073R, XQ1073/01R	typical	95	min. 75	μA/lm [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 10		

Resolution

Modulation depth i.e. uncompensated amplitude response at 400 T V lines at the centre of the picture. The figures quoted refer to the conditions in the high voltage mode.

The figures typically obtained in the low voltage mode will be 2 to 3 absolute percents lower.

The figures shown represent the typical horizontal amplitude response of the tube as obtained with a lens aperture of 5,6. 6) 14).

	XQ1073 XQ1073/01	XQ1073R XQ1073/01R
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 T V lines in % typical	50	45

Limiting resolution ≥ 750 T.V. lines

Modulation transfer characteristics see page 10

Lag (typical values)

Light source with a colour temperature of 2854 K

Appropriate filter inserted in the light path for the chrominance tubes XQ1073R, XQ1073/01R.

Low key conditions

	build-up lag 15)				decay lag 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 XQ1073/01	-	-	95	≈100	-	-	7,5	3
XQ1073R XQ1073/01R	85	98	-	-	11	4	-	-

High key conditions

	build-up lag 15)				decay lag 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 XQ1073/01	-	-	98	≈ 100	-	-	2	1
XQ1073R XQ1073/01R	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 applied in cameras originally designed for vidicon tubes, the automatic sensitivity control circuitry should be made inoperative and the signal electrode voltage set to the value indicated in note 5).

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

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

6) The beam current I_b, as obtained by adjusting the control grid (grid no. 1) voltage is set to 200 nA for XQ1073 respectively XQ1073/01R, to 400 nA for XQ1073 respectively XQ1073/01.
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, 33).

7)

Coil units	V_{g4}/V_{g3}	Focusing current * (mA)		Line current (mA_{pp})		Frame current (mA_{pp})	
		600/375	960/600	600/375	960/600	600/375	960/600
AT1102/01		18	23	200	250	27	34
AT1103		20	26	200	250	29	38
AT1116		83	105	260	330	38	48
		Approx. values for scanned area of 9,6 x 12,8 mm^2					

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

8) In the case of a black/white camera the illumination 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.
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 ≤ 1 V) depends on the type of coil unit used. For types AT1102/01, AT1103 and AT1116 a ratio of 1,5:1 to 1,6:1 is recommended.

10) All measurements are made with an infra-red 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 I.R. reflecting filter will be required. For typical transmission curve of this filter see page 11.

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 12

12) Gamma stretching circuitry is recommended.

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

14) The horizontal amplitude response can be raised by the application of suitable correction circuits.

15) After 10 s of complete darkness. The figures given represent typical percentages of the ultimate signal current obtained 60 ms respectively 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 in percents of the original signal current 60 ms respectively 200 ms after the illumination has been removed.

GENERAL AND RECOMMENDATIONS

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

2. This series of Plumbicon tubes is provided with Kovar pins and therefore requires no more care in handling than vidicon tubes.

3. During long term storage the ambient temperature should not exceed 30 °C.

4. In isolated cases the properties of a Plumbicon 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 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:
   - Set grid no. 1 bias control to maximum negative bias (beam cut-off).
   - Allow a heating-up time of the cathode of at least one minute before turning up the grid no. 1 bias control to produce a beam.
   - Set scanning amplitudes to overscan condition.
   - Apply an even illumination to the target to obtain a signal current of approx. 0,15 μA and adjust the beam current for correct stabilization.

5. The signal electrode connection is made by a spring contact, which is part of the focusing coil assembly, and is kept pressed against the signal electrode ring.

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

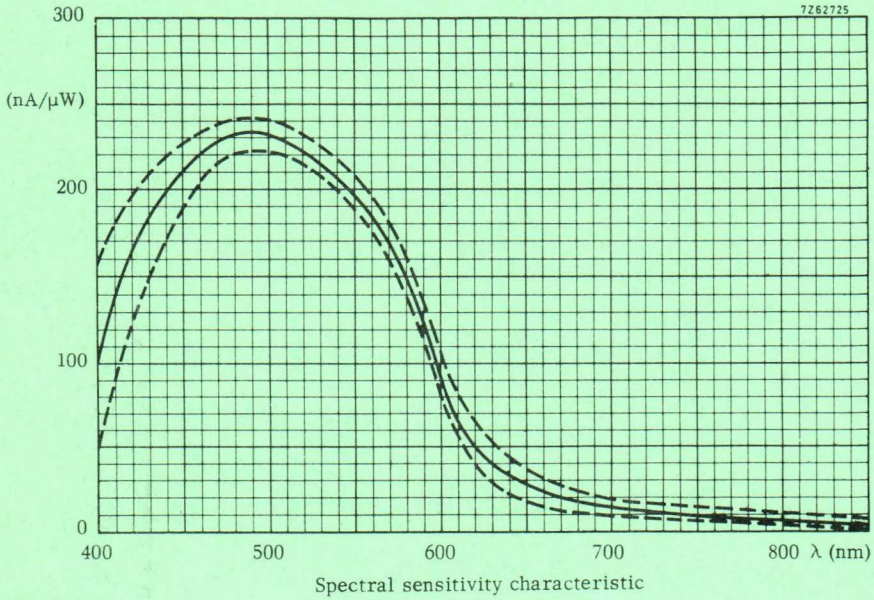
7. The light transfer characteristic of the Plumbicon tube having a gamma near unity, it may be desireable to incorporate a gamma correcting circuitry in the video-amplifier system with an adjustable gamma of 0,5 to 1.

   The Plumbicon tube not generating noise to any noticeable extent, the signal-to-noise ratio will be determined mainly by the input noise of the video-amplifier system.

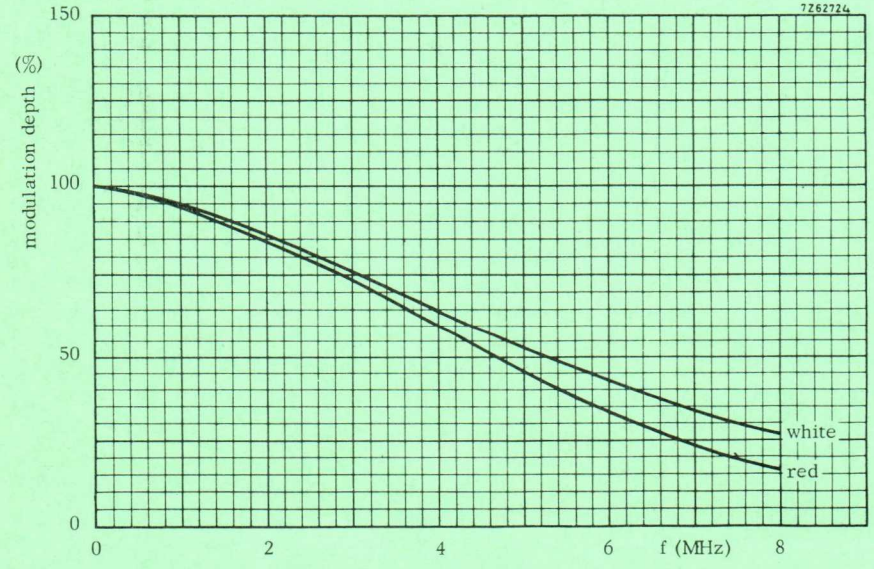
   The high sensitivity of the Plumbicon tube warrants pictures with excellent signal-to-noise ratio under normal lighting conditions provided its output is fed into a well-designed input stage of the video-amplifier system. In such a system an aperture correction may be incorporated to ensure an attractive gain in resolving power without visually impairing the signal to noise ratio.

INSTRUCTIONS FOR USE

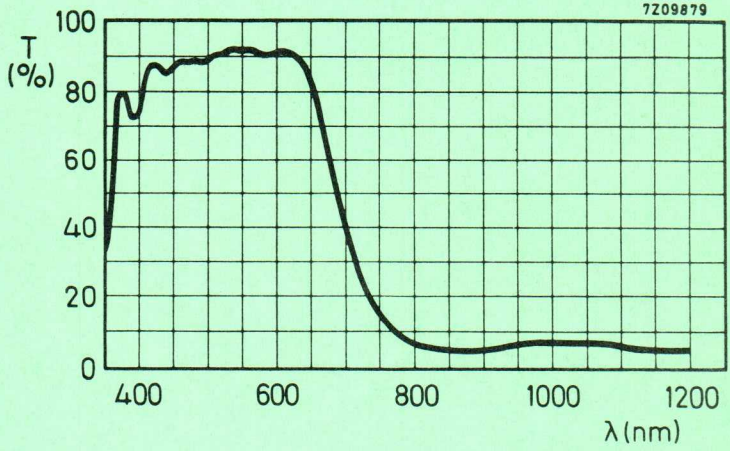
Instructions for use are packed with each tube.



Spectral sensitivity characteristic



Typical square-wave modulation transfer characteristic



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

Transmission of filters BG12, VG9 and OG570 See note 11

CAMERA TUBES
PLUMBICON*

XQ1074
XQ1074/01
Series

DEVELOPMENT SAMPLE DATA

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 this series are mechanically and electrically identical to the tubes of the XQ1073 and XQ1073/01 series, the only difference being the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for industrial and educational black and white and colour cameras. The series comprises the following versions:

XQ1074, with anti-halation glass disc XQ1074/01, without anti-halation glass disc	for use in black and white cameras
XQ1074R, with anti-halation glass disc XQ1074/01R, without anti-halation glass disc	for use in the red channel in colour cameras

For all further information see data of XQ1073, XQ1073/01 series.

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production

*Registered trade mark for television camera tubes

CAMERA TUBES
PLUMBICON*

XQ1075
XQ1075R

DEVELOPMENT SAMPLE DATA

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.

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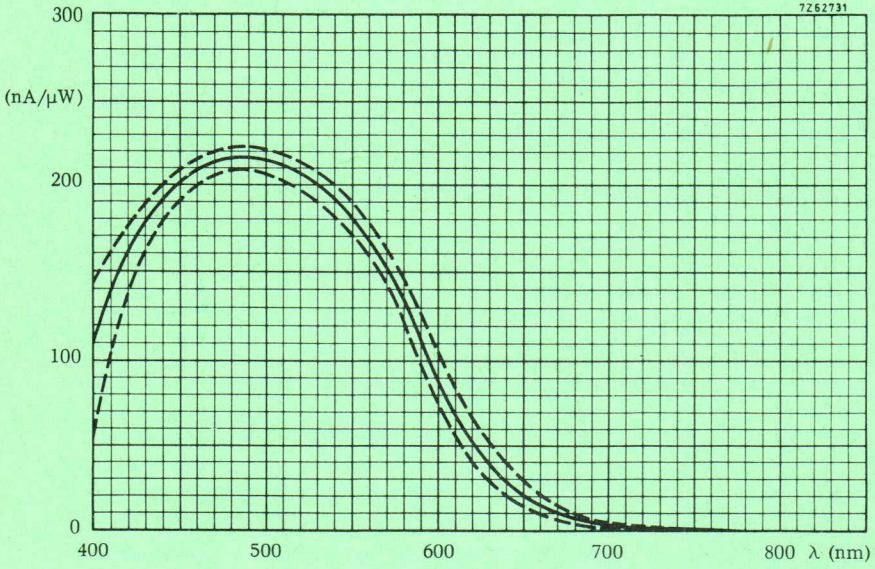
OPTICAL

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

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

For further information refer to data of the XQ1073 series.

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



Typical spectral sensitivity characteristic

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

CAMERA TUBES
PLUMBICON*

XQ1076
XQ1076R

DEVELOPMENT SAMPLE DATA

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. Provided with anti-halation disc with I.R. filter.

The tubes of this series are mechanically and electrically identical to the tubes of the XQ1075 series, the only difference being found in the degree of freedom from blemishes of the photoconductive target.

The tubes are intended for industrial and educational black and white and colour cameras. The series comprises the following versions:

XQ1076	for use in black and white cameras
XQ1076R	for use in the red channel of colour cameras

For all further information see data of XQ1075 and XQ1073 series.

*Registered trade mark for television camera tubes

CAMERA TUBES
PLUMBICON*

XQ1080
Series

DEVELOPMENT SAMPLE DATA

Plumbicon *, 25.4 mm (1 in) diameter television camera tube with high resolution lead-oxide photoconductive target, magnetic deflection, magnetic focus. The tubes of the XQ1080 series are provided with a separate mesh and a 0.6 W heater and feature:

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

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

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

QUICK REFERENCE DATA	
Focusing	magnetic
Deflection	magnetic
Diameter	25.4 mm (1 in)
Length	158 mm ($6\frac{1}{4}$ in)
Special features:	Anti-Comet-Tail gun Lightpipe Anti-halation glass disc Ceramic centring ring Rear loading construction
Heater	6.3 V, 95 mA
Resolution	$\geq$ 750 TV lines
Cut-off of spectral response	approx. 650 nm

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production

*Registered trade mark for television camera tubes

OPTICAL

Quality rectangle on photoconductive target (aspect ratio 3:4)		9.6 x 12.8	mm^2 [1]

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

ELECTRICAL

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

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

When the tube is used in a series heater chain, the heater voltage must not exceed 9.5 V_{rms} when the supply is switched on. To avoid registration errors in colour cameras, stabilization of the heater voltage is recommended.

Electron-gun characteristics

Cut-off				
Grid no. 1 voltage for cut-off at $V_{g_{2,4}}$ = 300 V, without blanking nor A.C.T. pulses	V_{g_1}	−45 to −110	V	
Blanking voltage, peak to peak at $V_{g_{2,4}}$ = 300 V, on grid no. 1	$V_{g_{1p-p}}$	50 ± 10	V	4)
Grids no. 2 and 4 current (d.c. values)	$I_{g_{2,4}}$	max. 0.2	mA	9)
Grids no. 3, 5, and 6 currents		see note 9		
Pulse timing and amplitude requirements (A.C.T.)		see notes 5 and 8		
Focusing (see under Accessories)		magnetic		
Deflection (see under Accessories)		magnetic		

Capacitance

Signal-electrode to all	C_{a_s}	2 to 3	pF

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

LIMITING VALUES (Absolute max. rating system)

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

Signal electrode voltage	V_{as}	max.	50	V
Grid no. 6 (mesh) voltage	V_{g6}	max.	1100	V
Grid no. 5 (collector) voltage	V_{g5}	max.	800	V
Voltage between grid no. 6 and grid no. 5	$V_{g6/g5}$	max.	350	V
Grid no. 4 (limiter) and grid no. 2 (accelerator, or first anode) voltage	$V_{g2,4}$	max.	350	V
Grid no. 3 (auxiliary grid) voltage	V_{g3}	max.	350	V
Grid no. 1 (control grid) voltage, positive	V_{g1}	max.	0	V
negative	$-V_{g1}$	max.	125	V
Grid no. 1 A.C.T. pulse	ΔV_{g1p}	max.	45	V [5)8)]
Cathode to heater voltage, positive peak	V_{kfp}	max.	125	V
negative peak	$-V_{kfp}$	max.	50	V
Impedance between cathode and heater at $-V_{kfp} > 10$ V	Z_{kf}	min.	2	kΩ
Ambient temperature, storage and operation	t_{amb}	max.	50	°C
		min.	-30	°C
Faceplate temperature, storage and operation	t	max.	50	°C
		min.	-30	°C
Faceplate illumination	E	max.	500	lx [6)]

ACCESSORIES

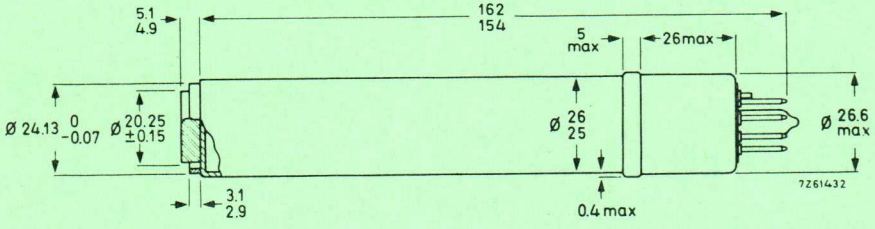
Socket	Cinch 133-98-11-015 modified for bias lighting	[22)]
Deflection, focusing and alignment coil unit	AT1115	

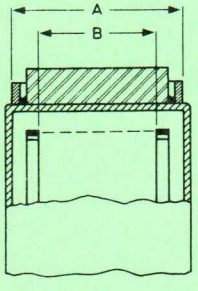
MECHANICAL Dimensions in mm

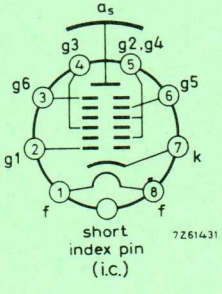
Mounting position: any

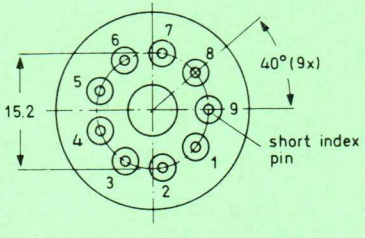
Weight: approx. 70 g

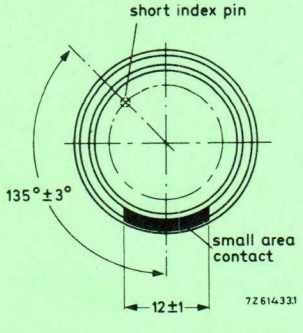
Base: JEDEC E8-11 except length of stem

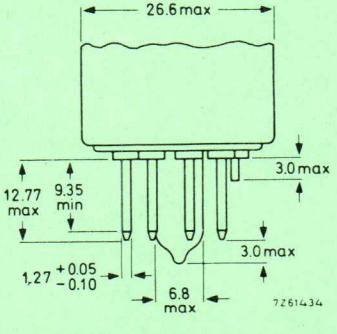












The distance between the geometrical centres of the diameter A of the reference ring and the diameter B of the mesh-electrode ring is < 100µm.

OPERATING CONDITIONS AND PERFORMANCE

TYPICAL OPERATING CONDITIONS

with A.C.T. action (scanned area 9.6 x 12.8 mm^2). All voltages are specified with respect to the cathode potential during the read-out mode. See notes 3, 5, 7, 9.

Cathode voltage,			
during read-out mode	V_k	0	V
during A.C.T. mode	V_k	0 to 15	V 8)
Signal electrode voltage	V_{a_s}	45	V 10)
Grid no. 6 (mesh) voltage	V_{g_6}	750	V 11)12)
Grid no. 5 (collector) voltage	V_{g5}	475	V 11)
Grid no. 4 (limiter) and grid no. 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300	V
Grid no. 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}	250	V
during A.C.T. mode	V_{g3}	0 to 30	V 8)
Grid no. 1 (control grid) voltage,			
during read-out mode	V_{g1}	see note 13	
during A.C.T. mode	V_{g1}	see note 8	
blanking on grid no. 1, peak	V_{g1_p}	50	V

Typical beam current, signal current and pulse settings 8)

	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
A.C.T. level (peak)	280 nA	140 nA	280 nA	140 nA
Cathode pulse V_{kp}	10 V	5 V	10 V	5 V
Grid no. 1 pulse V_{g1p}	40 V	30 V	40 V	30 V
Grid no. 3 pulse V_{g3p}	220 to 250 V	220 to 250 V	220 to 250 V	220 to 250 V

Faceplate illumination — see note 14

Bias lighting via lightpipe — see notes 22 and 23

Temperature of faceplate — 20 to 45 °C

Deflection, focusing and alignment coil unit — AT1115

Deflection, focusing and alignment currents

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

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

PERFORMANCE

Dark current			≤ 3	nA
Sensitivity at colour temperature of illumination = 2854 K				16)
XQ1080	typical 400	min.	325	μA/lm
XQ1080L	typical 400	min.	325	μA/lm
XQ1080R	typical 80	min.	70	μA/lm
XQ1080G	typical 165	min.	130	μA/lm
XQ1080B	typical 37	min.	35	μA/lm
Gamma of transfer characteristic			0.95 ± 0.05	17)
Transfer characteristics			see page 14	
Highlight handling			≥ 5 lens stops	8)
Spectral response: max. response at		approx.	500	nm
cut-off at		approx.	650	nm

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 f5.6 13), 18), 19).

	XQ1080 XQ1080L	XQ1080R	XQ1080G	XQ1080B
Highlight signal current I_{sp}	0.2 μA	0.1 μA	0.2 μA	0.1 μA
Beam current Ib_p	0.4 μA	0.2 μA	0.4 μA	0.2 μA
Modulation depth at 400 TV lines in % typical	40	35	40	45

Modulation transfer characteristics	see page 14
Limiting resolution	≥ 750 TV lines

Lag (typical values)
Light source with a colour temperature of 2854 K
Appropriate filter inserted in the light path for the chrominance tubes R, G and B.

Low key conditions

		build-up lag 20)				decay lag 21)			
		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)
22) 23)	I_d (nA)								
XQ1080	0			98%	~100%			5%	2%
XQ1080L	2.5			100 %				2.5%	1%
XQ1080G	5							1.5%	0.5%
XQ1080R	0	>95%	~100%			8%	3%		
XQ1080B	2.5	100 %				3.5%	2%		
	5					1.5%	1%		

High key conditions

	build-up lag 20)				decay lag 21)			
	I_S/I_b = 100/200 nA		I_S/I_b = 200/400 nA		I_S/I_b = 100/200 nA		I_S/I_b = 200/400 nA	
	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)
XQ1080., L, G I_d = 0 to 5 nA			98 %	~100%			1.5%	0.6%
XQ1080R I_d = 0 to 5 nA	>97%	~100%			2.5%	1%		
XQ1080B I_d = 0 to 5 nA					3.5%	2%		

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.

2a) The position of this marker line corresponds with the position of the small area contact on the ceramic centring ring. The spring contact in the coil unit, AT1115, is located accordingly. Total possible rotation of the tube while maintaining contact, is approx. 30^{o}.

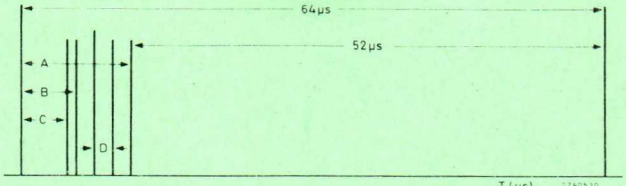
2b) The outer diameter of the ceramic centring ring is concentric with the inner diameter of the mesh ring (grid no. 6). In the AT1115 coil unit the tube is centred with this ring as a reference; this ensures proper optical alignment of the tube in the optical system of a colour camera.

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

4) Blanking can also be applied to the cathode:
   a. -without A.C.T. action (see note 3): required cathode pulse approx. 25 V.
   b. -with A.C.T. action: timing, polarity and amplitudes of the A.C.T. pulses will have to be adapted.

5) Pulse timing and amplitudes for A.C.T. action (CCIR system)
(blanking on grid no. 1) 4) 7)
For proper operation of the A.C.T. electrode gun three pulses are required, being:
   a. - A positive-going pulse on the cathode with an adjustable amplitude of 0 to 15 V. This pulse can be chosen to coincide with the full line-blanking period.
   b. - A positive-going pulse on grid no. 1 (control grid) with an adjustable amplitude of 25 to 40 V.
   The duration of this pulse should be chosen such that it just includes the fly back period ($\approx$5 µs) of the line deflection (e.g. $\approx$6 µs).
   c. - A negative-going pulse on grid no. 3 (auxiliary grid) with an amplitude of approx. 250 V, adjusted to result in a V_{g3} voltage during the A.C.T. mode of 0 to 30 V.
   Duration of this pulse should be equal to that of the grid no. 1 pulse.

The timing diagram is as follows:



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

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) 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. A.C.T. mode: defined as the operating conditions during that part of the line blanking interval during which the A.C.T. electrode gun is fully operative.
The A.C.T. interval is equal to or slightly overlaps the line flyback time.

8) Pulse amplitude settings

Cathode pulse V_k : adjusted to obtain an A.C.T. limiting level at 1.3 to 1.5 times I_{sp}.
Grid no. 3 pulse : adjusted for maximum and most uniform A.C.T. action over the total scanned area.
Grid no. 1 pulse : adjusted for proper handling of a highlight with a diameter of 10% of picture height and with a brightness corresponding to 32 times peak signal white (I_{sp}).

N.B. Extension of the A.C.T. range can be obtained by increasing the grid no. 1 pulse; this may, however, introduce dark current.

9a) 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 A.C.T. mode.
These peak currents may amount to:

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

The cathode impedance should preferably be chosen ≤ 300 Ω.

9b) Video pre-amplifier. In the presence of highlights, peak signal currents of the order of 15-45 μA may be offered to the pre-amplifier during flyback. Special measures have to be taken in the pre-amplifier to prevent temporary overloading.

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

11) The optimum voltage ratio V_{g6}/V_{g5} to obtain minimum beam landing errors (preferably $\leq$ 1 V) depends on the type of coil unit used. For type AT1115 a ratio of 1.5 : 1 to 1.6 : 1 is recommended.

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

13) Adjusted with the A.C.T. made inoperative, e.g. by setting the cathode pulse to 15 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 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 ($\alpha = 100/100-\beta$), β being the total blanking time in %; for CCIR system α amounts to 1.33.

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) 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.

16) Measuring conditions:
Illumination 4 lx (luminious flux = 0.5 mlm) at black body temperature of 2854 K; the appropriate filter inserted in the light path.

Filters used:

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

For transmission curves see page 13.

17) Gamma-stretching circuitry is recommended.

18) 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. = 2854 K) on the filter of approx. 10 lx. These figures are based on the filters described in note 16). For filter BG12, however, a thickness of 1 mm is chosen.

19) The horizontal amplitude response can be raised by the application of suitable correction circuits, whichaffectsneither the vertical resolution nor the limiting resolution.

20) After 10 seconds of complete 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 given represent typical residual signals in % of the original signal current 60 ms respectively 200 ms after the illumination has been removed.

22) The special socket incorporates a small incandescent light bulb (6 V, 1 W), which projects its light on to the pumping stem via a blue-green transmitting filter. The light is conducted via a fine glass rod (lightpipe) to cause a bias illumination on the target. The desired amount of bias light can be obtained by adjusting the current throught the filament of the small bulb.

23) For bl/wh operation a bias lighting, 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 bias lighting per tube.

GENERAL AND RECOMMENDATIONS

1. During transport, handling and storage the axis of the Plumbicon must be either vertical, with faceplate up, or horizontal; the faceplate should be covered with the hood provided.
2. This series of Plumbicon tubes is provided with Kovar pins and therefore requires no more care in handling than vidicon tubes.
3. During long term storage the ambient temperature should not exceed 30 °C.

4. In isolated cases the properties of a Plumbicon 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 changes of such deterioration are remote it is advisible to operate the tube for some hours at intervals not more than 4 weeks apart.

   The following procedure and conditions are recommended:
   - Set grid no. 1 bias control to maximum negative bias (beam cut-off).
   - Allow a heating-up time of the cathode of at least one minute before turning up the grid no. 1 bias control to produce a beam.
   - Set scanning amplitudes to overscan condition.
   - Apply an even illumination to the target to obtain a signal current of approx. o. 15 μA and adjust the beam current for correct stabilization.

   The signal electrode connection is made by a spring contact, which is part of the focusing coil assembly, and is kept pressed against the signal electrode ring.

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

   The light transfer characteristic of the Plumbicon tube having a gamma near unity, it may be desirable to incorporate a gamma correcting circuitry in the video-amplifier system with an adjustable gamma of 0. 5 of 1.

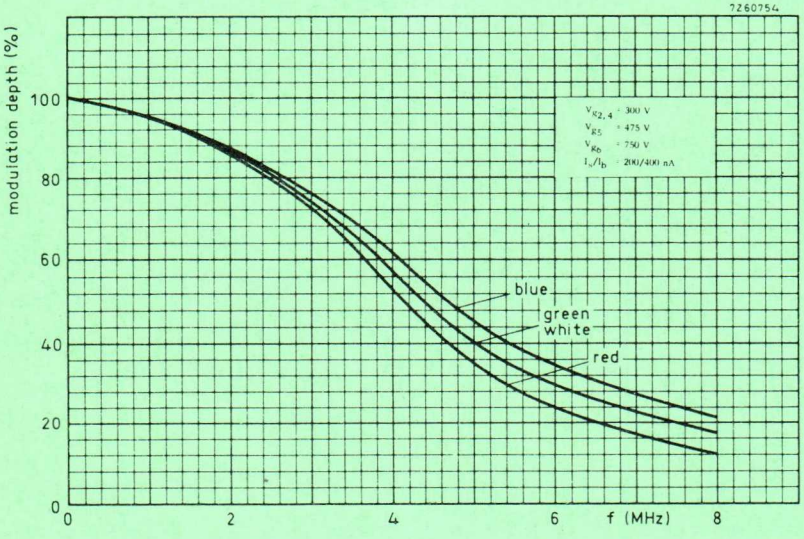
   The Plumbicon tube not generating noise to any noticeable extent, the signal-to-noise ratio will be determined mainly by the input noise of the video-amplifier system.

   The high sensitivity of the Plumbicon tube warrants pictures with excellent signal-to-noise ratio under normal lighting conditions provided its output is fed into a well-designed input stage of the video-amplifier system. In such a system an aperture correction may be incorporated to ensure an attractive gain in resolving power without impairing the signal to noise ratio.

INSTRUCTIONS FOR USE

Instructions for use are packed with each tube.

Transmission of filters OG570, VG9 and BG12. See note 16



Square wave modulation transfer characteristic

CAMERA TUBES
PLUMBICON*

XQ1220
XQ1230
Series

DEVELOPMENT SAMPLE DATA

Plumbicon*, sensitive high-definition pick-up tube with lead-oxide photoconductive target. Provided with: separate mesh construction for good overall resolution; Anti-Comet Tail electron gun for improved highlight handling; lightpipe for reduced lag under low-key conditions; fibre optic faceplate. The tubes of the XQ1220 and XQ1230 series can be used in medical, scientific and low light level T.V. systems in which they can be coupled direct to, e.g., X-ray image intensifiers and light intensifiers with fibre optic output windows.

QUICK REFERENCE DATA

Focusing	magnetic
Deflection	magnetic
Diameter	approx. 30 mm
Length	approx. 210 mm

Available types:

Quality area	12.8 x 17.1 mm²		18 mm ϕ		21 mm ϕ	
Grade	A	B	A	B	A	B
Non-cladded fibre optic	XQ1220	XQ1223	XQ1221	XQ1224	XQ1222	XQ1225
Black-cladded fibre optic	XQ1230	XQ1233	XQ1231	XQ1234	XQ1232	XQ1235

Resolution	≥ 25 lp/mm
Heater	6.3 V, 300 mA
Cut-off of spectral response	approx. 650 nm

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production

*Registered trade mark for television camera tubes

OPTICAL

Quality rectangle on photoconductive target (aspect ratio 3 : 4)		12.8 x 17.1 mm^2 [1]

Orientation of image on photoconductive 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 index pin (grid no. 3)

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

ELECTRICAL

Heating: Indirect by A.C. or D.C.; parallel supply		
Heater voltage	V_f	6.3 V ± 5%
Heater current	I_f	approx. 300 mA

Electron gun characteristics

Cut-off		
Grid no. 1 voltage for cut-off at $V_{g2,4}$ = 300 V, without blanking nor A.C.T. pulses		−45 to −110 V
Blanking		
Applied to grid no. 1, at $V_{g2,4}$ = 300 V		50 ± 10 V_{pp} [6][9]
Grid no. 2 and no. 4 current		max. 0.2 mA [7]
Focussing (see under Accessories)		magnetic
Deflection (see under Accessories)		magnetic
Capacitance		
Signal-electrode to all	C_{a_s}	3 to 6 pF

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

LIMITING VALUES (Absolute max. rating system)

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

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

ACCESSORIES

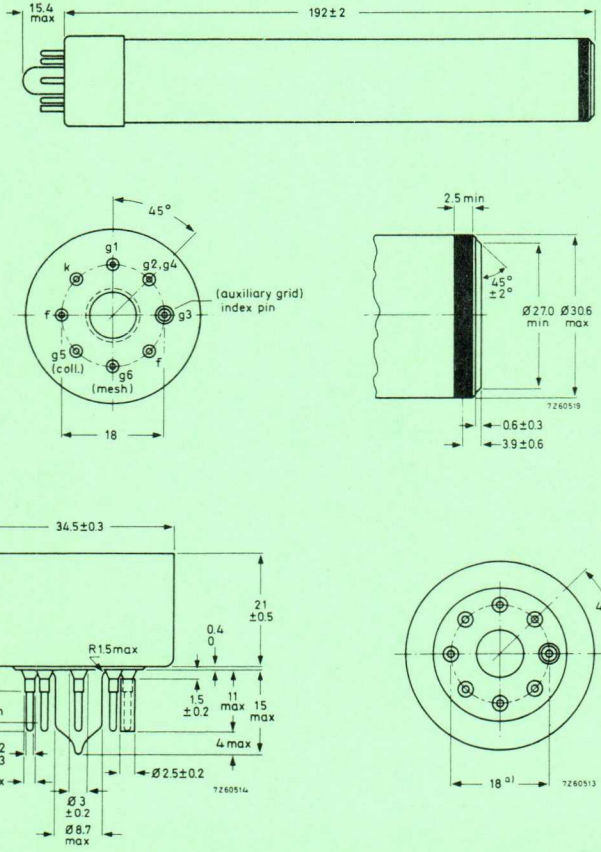
Coil unit	AT1132, AT1132/01 3)
Socket	modified version of 56021 (under development)

MECHANICAL

Dimensions in mm

Mounting position: any

Weight: approx. 110 g



a) The base passes a flat gauge with a centre hole 9.00 ± 0.01 ϕ and holes for passing the pins with the following diameters: 7 holes of 1.750 ± 0.005 ϕ and one hole of 3.000 ± 0.005 ϕ. The holes may deviate max. 0.01 from their true geometrical position. Thickness of gauge 7 mm.

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

OPERATING CONDITIONS AND PERFORMANCE

TYPICAL OPERATING CONDITIONS (with Anti-Comet Tail action) [4]
All voltages are specified with respect to cathode.

Cathode voltage,			
during read-out mode	V_k	0	V [5] [6] [7]
during A.C.T. mode	V_k	0 to 10	V
Signal electrode voltage	V_{as}	45	V
Grid no. 6 (mesh) voltage	V_{g6}	675	V [7]
Grid no. 5 (collector) voltage	V_{g5}	600	V [7]
Grid no. 4 (limiter) and grid no. 2 (accelerator, or first anode) voltage	$V_{g2,4}$	300	V [7]
Grid no. 3 (auxiliary grid) voltage,			
during read-out mode	V_{g3}	240 to 260	V [7]
during A.C.T. mode	V_{g3}	0 to 10	V
Grid no. 1 (control grid) voltage	V_{g1}	see note [8]	
blanking voltage to grid no. 1		50	V_p [6] [9]
Scanned area on target		12.8 x 17.1	mm^2
Temperature of faceplate		20 to 45	°C
Coil unit		AT1132/01	

Deflection, focusing and alignment currents

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

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

PERFORMANCE

Dark current (without bias lighting via lightpipe)		≤ 3	nA
Sensitivity			
to white light of c.t. 2854 K			
XQ1220 series	typ.	375	μA/lm
XQ1230 series	typ.	300	μA/lm
to light with P11 distribution			
XQ1220 series	typ.	20×10^{-3}	μA/μW [10]
XQ1230 series	typ.	13×10^{-3}	μA/μW [10]
to light with P20 distribution			
XQ1220 series	typ.	15×10^{-3}	μA/μW [10]
XQ1230 series	typ.	10×10^{-3}	μA/μW [10]
Transfer characteristics		see page 12	
Gamma of transfer characteristic below knee		0.95 ± 0.05	
Spectral response			
Max. response at	approx.	550	nm
Cut-off at	approx.	650	nm
Response curve		see page 13	

Resolution (I_s/I_b = 150/300 nA) [8] [11]

		P11	P20	
XQ1220 series 15 lp/mm (385 T.V. lines)	typ.	40	30	%
XQ1230 series 15 lp/mm (385 T.V. lines)	typ.	45	40	%

Modulation transfer characteristic — see page 14

Lag (typical values), white light (2854 K), P11, and P20

	build-up lag [12]				decay lag [13]				
	I_s/I_b=20/300 nA		150/300 nA		20/300 nA		150/300 nA		[8]
	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)	60 (ms)	200 (ms)	
without bias lighting	70	100	98	100	16	5	3.5	1.2	
with 2.5nA bias lighting [14]	98	100	99	100	11	2.5	2.8	0.9	
with 5 nA bias lighting [14]	99	100	100	100	8	2	2.4	0.7	

NOTES

1) All figures quoted in these data sheets refer to a scanned area of 12.8 x 17.1 mm^2. Underscanning of the once chosen area or failure of scanning should be avoided since this may cause damage to the photoconductive target.

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

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

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

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

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

6. Pulse timing and amplitudes for A.C.T. action (CCIR system)
(blanking on grid no. 1)

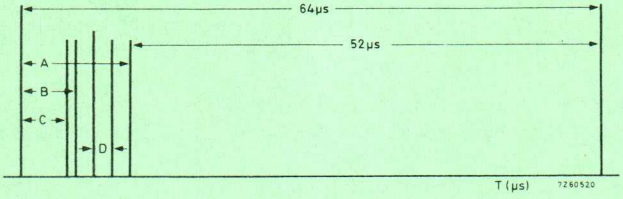
For proper operation of the A.C.T. electrode gun three pulses are required, being:

a. - a positive-going pulse on the cathode with an adjustable amplitude of 0 to 10 V.

b. - a positive-going pulse on grid no. 1 (control grid) of fixed amplitude of 30 to 35 V. The duration of this pulse should be chosen such that it just includes the flyback period (≈ 5 µs) of the line deflection (e.g. 6 µs).

c. - a negative-going pulse on grid no. 3 (auxiliary grid) with an amplitude of approx. 240 V, adjusted for a V_{g3} voltage during the A.C.T. interval of 0 to 10 V.
Duration and timing of this pulse should be equal to those of the grid no. 1 pulse.

The timing diagram is as follows:



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

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

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

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

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

N.B. The signal currents are measured with an integrating instrument connected in the signal-electrode lead, and an uniform illumination on the scanned area. The peak signal currents as measured on a waveform oscilloscope will be a factor α larger ($\alpha = \frac{100}{100 - \beta}$), β being the total blanking time in %; for CCIR system α amounts to 1.33).

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

10) The figures shown represent the signal output current in μA obtained per μW of electrical input power into a P11 or P20 phosphor on a fibre optic output window of e.g. an image intensifier or a converter tube.
Such an output window will usually be provided with non-cladded fibre optics when it feeds into an XQ1220 and with black-cladded fibre optics when it is coupled to an XQ1230.
The figures were obtained as the products $S \times T_1^2 \times \eta$ or $S \times T_2^2 \times \eta$ (see table below) whichever applied.

		symbol	P11	P20	unit
Plumbicon target	Sensitivity of photoconductive target		1800	290	μA/lm
	Conversion factor Watt to lumen		140	480	lm/W
	Sensitivity of photoconductive target	S	0.25	0.14	μA/μW
Fibre optics	Transmission of a non-cladded fibre plate	T_1 *	90	90	%
	Transmission of a black-cladded fibre plate	T_2 *	70	70	%
Phosphor	Luminous efficiency of phosphor	η **	10	14	%

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

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

11) Measured with a test transparency with the emulsion side in direct contact with the faceplate and which is illuminated with diffused light (lambertian illumination). The test transparency has square wave patterns in a white background.
The figures given relate to a low frequency reference obtained from a square wave pattern of 1.0 lp/mm (330 kHz).

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

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

14) The special socket incorporates a small incandescent light bulb (6 V, 1 W), which projects its light on the pumping stem via a blue-green transmitting filter. The light is conducted via a fine glass rod (lightpipe) to cause a bias illumination on the target. The desired amount of bias light can be obtained by adjusting the current through the filament of the small bulb.

GENERAL AND RECOMMENDATIONS

1. During transport, handling and storage the axis of the Plumbicon must be either vertical, with faceplate up, or horizontal; the faceplate must be kept covered with the hood provided for the purpose.

2. To avoid damage to the tungsten basepins, the Plumbicon should be inserted into its socket with care, avoiding undue forces and bending loads on the pins.

3. During long-term storage the ambient temperature should preferably not exceed 30 °C.

4. In isolated cases the properties of a Plumbicon 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.
   . if the camera is not used for a long time.
   Although the chances of such deterioration are remote it is advisable to operate the tube for some hours at intervals not more than 4 weeks apart.

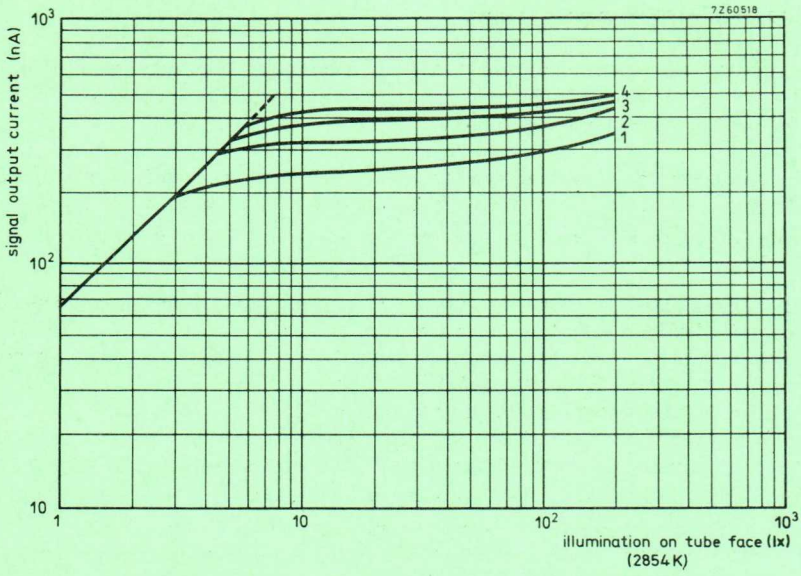
   The following procedure and conditions are recommended:
   . Set grid no. 1 bias-control to maximum negative bias (beam cut-off).
   . Allow a heating-up time of the cathode of at least one minute before turning up the grid no. 1 bias-control to produce a beam.
   . Set scanning amplitudes to overscan condition.
   . Apply an even illumination to the target to obtain a signal current of approx. 0.15μA and adjust the beam current for correct stabilization.

5. The signal electrode connection is made by a spring contact, which is part of the focusing coil unit and is kept pressed against the signal electrode ring.

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

7. The Plumbicon tube not generating own noise to any noticeable extent, the signal--to-noise ratio will be determined mainly by the input noise of the video-amplifier system.

   The high sensitivity of the Plumbicon tube warrants pictures with excellent signal--to-noise ratio under normal lighting conditions provided its output is fed into a well-designed input stage of the video-amplifier system. In such a system an aperture correction may be incorporated to ensure an attractive gain in resolving power without visually impairing the signal-to-noise ratio.



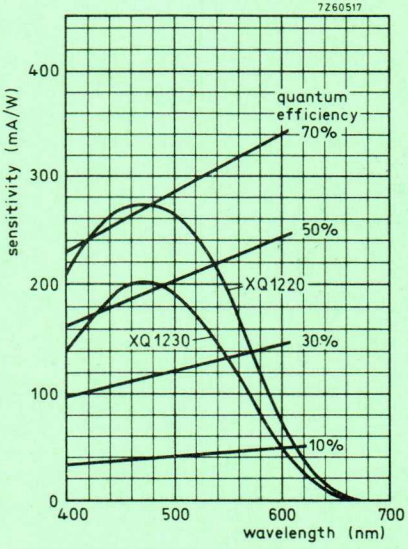
Typical signal output characteristics in A.C.T. operation

Scanning area : 12.8 x 17.1 mm^2

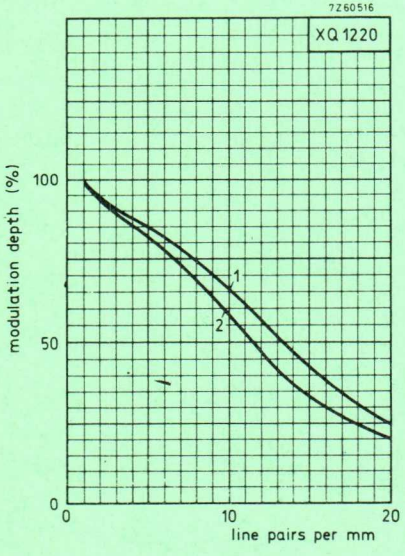
Beam current : just sufficient to stabilize 500 nA signal current

Cathode voltage during flyback :

curve 1 : 4.5 V
curve 2 : 6 V
curve 3 : 7.5 V
curve 4 : 9 V

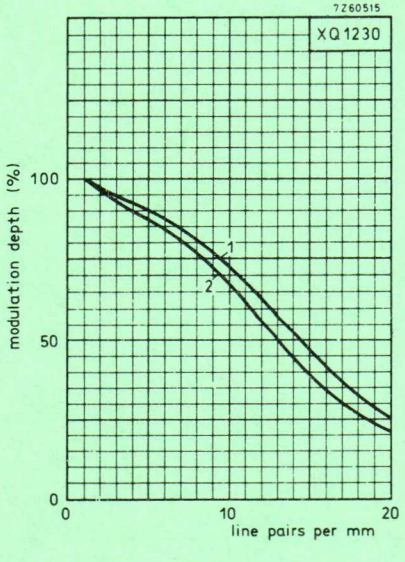


Typical spectral response characteristics



Typical square wave modulation transfer characteristics in tube centre.

(1) for blue light (P11)
(2) for green light (P20)
Measuring conditions: see note 11



CAMERA TUBES
PLUMBICON*

55875
55875L 55875G
55875R 55875B

QUICK REFERENCE DATA

30mm diameter Plumbicon camera tubes with photoconductive layer and low velocity stabilisation, giving sensitive, high definition pick-up in monochrome and colour broadcast cameras.

55875 - for use in monochrome television cameras

55875L - provides the luminance component of a colour picture

55875R - provides the red component of a colour picture

55875G - provides the green component of a colour picture

55875B - provides the blue component of a colour picture

Dark current	<3	nA
Resolution capability	>600	TV lines
Transfer characteristic	linear	

GENERAL OPERATIONAL RECOMMENDATIONS AND INSTRUCTIONS FOR USE are given on pages 6 to 8.

HEATER

Suitable for parallel operation only

V_h	6.3 ± 5%	V
I_h	90	mA

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

Image dimensions on photoconductive layer
3:4 aspect ratio (see note 1) 12.8 × 17.1 mm

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.

CAPACITANCE

Target electrode to all other electrodes 3 to 6 pF

This capacitance, which is effectively the output impedance, increases by approximately 5pF when the tube is inserted in the coil assembly.

*Registered trade mark for television camera tubes

TYPICAL OPERATION

Operating conditions

V_k	0	V
V_{target}	45	V
$V_{a2, a3}$	600	V
V_{a1}	300	V
V_g adjusted to give the required beam current		
Scanned area	12.8 × 17.1	mm
Faceplate illumination	See note 2	
Faceplate temperature	25	°C

	55875, 55875L, G	55875R, B	
Highlight signal current	300	150	nA
Beam current	600	300	nA

Typical performance

Dark current	<3	nA

Resolution

Typical modulation depth measured at centre of picture for 400 TV lines, without aperture correction but corrected for losses introduced by the optical system.

55875	40	%
55875L	40	%
55875R	35	%
55875G	40	%
55875B	50	%
Resolution capability	>600	TV lines
Signal-to-noise ratio	See note 3	
Gamma of transfer characteristic (see note 4)	0.95 ± 0.05	
Wavelength at maximum response (approx.)	500	nm

Lag (see note 5)

	55875, 55875L, R, G	55875B	
Max. residual signal after dark pulse of 60ms	5	6	%
Max. residual signal after dark pulse of 200ms	2	3	%

Sensitivity (see note 6)

55875, 55875L	>275	μA/lm
55875R	>60	μA/lm
55875G	>125	μA/lm
55875B	>32	μA/lm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{target} max.	50	V
$V_{a2,a3}$ max.	750	V
V_{a1} max.	450	V
$-V_g$ max.	125	V
$+V_g$ max.	0	V
I_k max.	3.0	mA
$V_{h-k(pk)}$ max.		
Cathode positive	125	V
Cathode negative	10	V
Maximum faceplate illumination (see note 7)	500	lux
Maximum faceplate temperature (operation and storage)	50	°C
Minimum faceplate temperature (operation and storage)	-30	°C

EQUIPMENT DESIGN RECOMMENDATIONS

V_{target} (see note 8)	25 to 45	V
$V_{a2,a3}$	550 to 650	V
V_g	0 to -100	V
Minimum peak-to-peak blanking voltage		
when applied to the grid	70	V
when applied to the cathode	25	V

The current drawn by the tube from the first anode supply will not exceed 0.5mA.

MOUNTING POSITION

Any

WEIGHT

Tube alone (approx.)	100 g

ACCESSORIES (see separate data sheets)

Socket	56021
Coil assembly	
for 55875	AT1132
for 55875L, R, G, B	AT1113, AT1113/01

NOTES

1. Underscanning of the useful target area of 12.8×17.1mm, or failure of scanning, should be avoided, since this may cause damage to the photoconductive layer. The boundaries outside this area should preferably be covered by a mask to reduce the effects of internal reflections in the faceplate.

2. Adjusted to give the required peak signal current. For a typical 55875 or 55875L the required illumination will be approximately 5 lux. The signal currents stated for the 55875R, G, B will be obtained with an incident illumination of approximately 12 lux (2854K colour temperature), this figure being based on the use of the following filters:

   for 55875R Schott OG2 thickness 3mm
   55875G Schott VG9 thickness 1mm
   55875B Schott BG12 thickness 1mm
   Transmission curves for these filters are given on page 10.

   For a monochrome camera, the faceplate illumination is related to the scene illumination by the formula

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

   where B_{sc} = scene illumination
   B_{ph} = faceplate illumination
   R = scene reflectivity (average or that of the object under consideration, whichever is relevant)
   T = lens transmission factor
   F = lens aperture
   m = linear magnification from scene to target

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

3. The noise contribution of the Plumbicon tube is negligible compared with that of the head amplifier. A well designed head amplifier having a bandwidth of 5MHz will give an r.m.s. noise current of about 1.5nA, and at a peak signal current of 150nA this will result in a visual equivalent signal-to-noise ratio of 43dB.

4. Gamma is to a certain extent dependent on the wavelength of the incident illumination. The use of gamma-correcting circuits is recommended.

5. Measured with a 100% signal current of 100nA and with a light source of colour temperature 2854K. The appropriate filter is inserted in the light path when measuring colour tubes.

6. As measured under the following conditions:

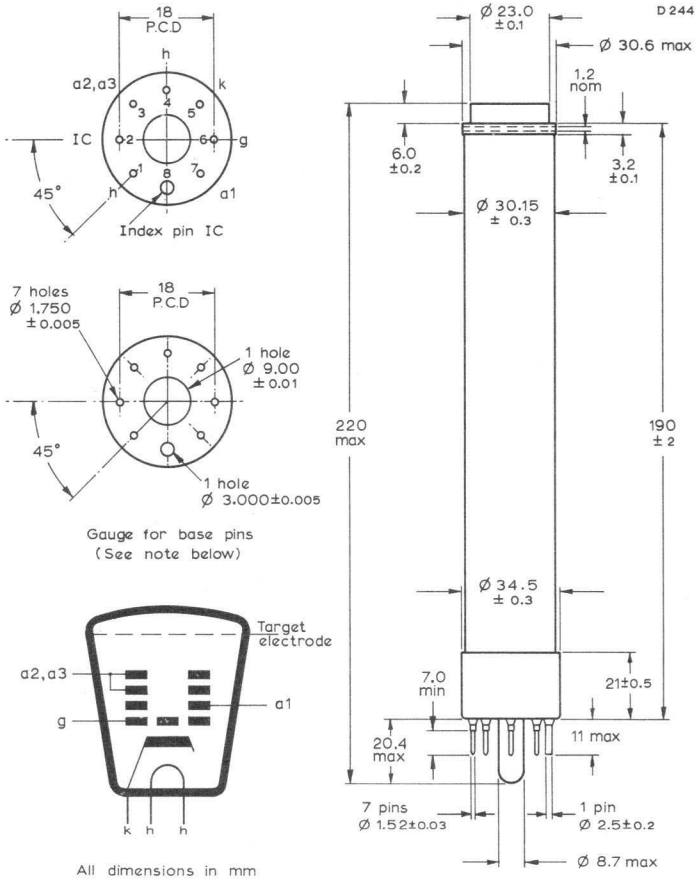
   Tubes are exposed to an illumination of 4.54 lux at a colour temperature of 2854K. The appropriate filter is inserted in the light path. The current obtained is a measure of the colour sensitivity, and is expressed in micro-amperes per lumen of white light before the filter.

   Filters used:

   for 55875R Schott OG2 thickness 3mm
   55875G Schott VG9 thickness 1mm
   55875B Schott BG12 thickness 3mm
   Transmission curves for these filters are given on page 10.

7. For short intervals. During storage the tube face should be covered with the plastic hood provided. When the camera is idle the lens should be capped.
8. The target electrode voltage should be adjusted to 45V. If the scene to be televised contains excessive highlights, the target electrode voltage may be reduced to a minimum of 25V; this, however, will result in some reduction in performance, particularly in respect of sensitivity.

OUTLINE DRAWING OF 55875 SERIES



The base will fit a gauge as shown above. The holes in the gauge may deviate 0.01mm max. from their true geometric positions. The thickness of the gauge is 7mm. The ends of the pins are tapered or rounded but not brought to a sharp point.

GENERAL OPERATIONAL RECOMMENDATIONS

Transport, handling and storage

During transport, handling or storage, the tube should be placed so that the faceplate is not below the level of the base.

Base pins

The pins of this tube are of tungsten. Accordingly, care must be taken when the tube and socket are mated, in order to avoid breaking the pins or damaging the glass-to-metal seals.

Target electrode

The connection to the target electrode is made at the face end of the tube by a spring contact which is part of the coil assembly.

Photoconductive layer

In some instances the properties of the photoconductive layer may slightly deteriorate during long idle periods, such as encountered between the manufacturer's last test and the first time of operation by the user. It is therefore recommended to operate the tube at approximately monthly intervals from receipt. To restore the photoconductive layer, the tube should be operated for a few hours with normal voltage settings and a signal current of 150nA, and should be adjusted to overscan an evenly illuminated target.

Light transfer

Because the light transfer characteristic has a gamma of approximately unity, it may be desirable for broadcast applications to incorporate a gamma-correcting circuit in the video system, with a gamma adjustable from 0.4 to 1.0. In addition, provision should be made for limiting the video signal above 100% of peak white level, in order to prevent overloading of the video amplifier system when the tube is exposed to scenes containing small peaked highlights as caused by reflections from shiny objects.

Signal-to-noise ratio

Since the tube does not generate noise to any noticeable extent, the signal-to-noise ratio will be determined mainly by the noise factor of the video amplifier system.

Under normal studio lighting conditions the high sensitivity of the tube produces a high signal-to-noise ratio provided that the output of the tube is fed into a well designed input stage of the video amplifier system. In such a system horizontal and vertical aperture correction may be incorporated to ensure sufficient gain in resolving power without significantly impairing the signal-to-noise ratio.

OPERATING INSTRUCTIONS

1. Clean the faceplate of the tube and insert in the coil assembly in such a way that the plane defined by the tube axis and the mark on the base is essentially parallel to the direction of the vertical scan.

2. Carefully mate the socket with the base pins.

3. Cap the lens and close the iris.

OPERATING INSTRUCTIONS (contd.)

4. Adjust the operating conditions as follows:

   (a) Grid bias control to maximum negative bias (beam cut-off).

   (b) Target electrode voltage to 45V.

   (c) Scanning amplitudes to maximum (overscanning).

5. Switch on camera and picture monitor equipment. Allow a few minutes for warming up.

6. Adjust the monitor to produce a faint, non-overscanned raster.

7. Direct the camera towards the scene to be televised and uncap the lens.

8. Slowly adjust the grid bias control until a picture is produced on the monitor. If the picture is too faint, increase the lens aperture.

9. Adjust $V_{a2,a3}$ control (beam focus) and optical focus alternately for optimum focus.

10. Align the beam of the Plumbicon by one of the following methods:

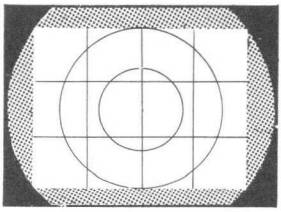
    (a) Adjust the alignment fields in such a way that the centre of the picture on the monitor does not move when $V_{a2,a3}$ (beam focus) is varied. This is catered for automatically in some cameras.

    (b) Reduce the target electrode voltage to a very low value. Adjust the alignment fields until the most uniform picture is obtained, as observed on the monitor or an oscilloscope.

11. Adjust the scanning amplitudes as follows:

    (a) By means of a 12.8×17.1mm mask which is in contact with and centred on the faceplate. Decrease the horizontal and vertical scanning amplitudes until the periphery of the mask is just outside the raster on the monitor. This may be facilitated by small adjustments of the centring controls.

    (b) If no mask is available, direct the camera towards a test chart having an aspect ratio of 4:3 and adjust the centring controls in such a way that the target ring is just visible in the corners of the picture. Adjust the distance from camera to test chart, and re-focus until the image of the test chart is positioned on the faceplate as indicated on the adjoining figure.



    Decrease both scanning amplitudes until the image of the test chart completely fills the scanned raster on the monitor.

12. Adjust the iris for a picture of sufficient contrast and adjust the beam current to a value at which all highlights are stabilised.

13. Check alignment, beam focus and optical focus.

14. Procedure for standby operation

From operation to standby -

(a) Cap lens

(b) Set V_g for beam cut-off

(c) Reduce heater voltage to 4V or less

From standby to normal operation -

(a) Restore heater voltage to 6.3V

(b) Wait 1 minute

(c) Increase beam current to normal value

(d) Uncap lens

ALWAYS -

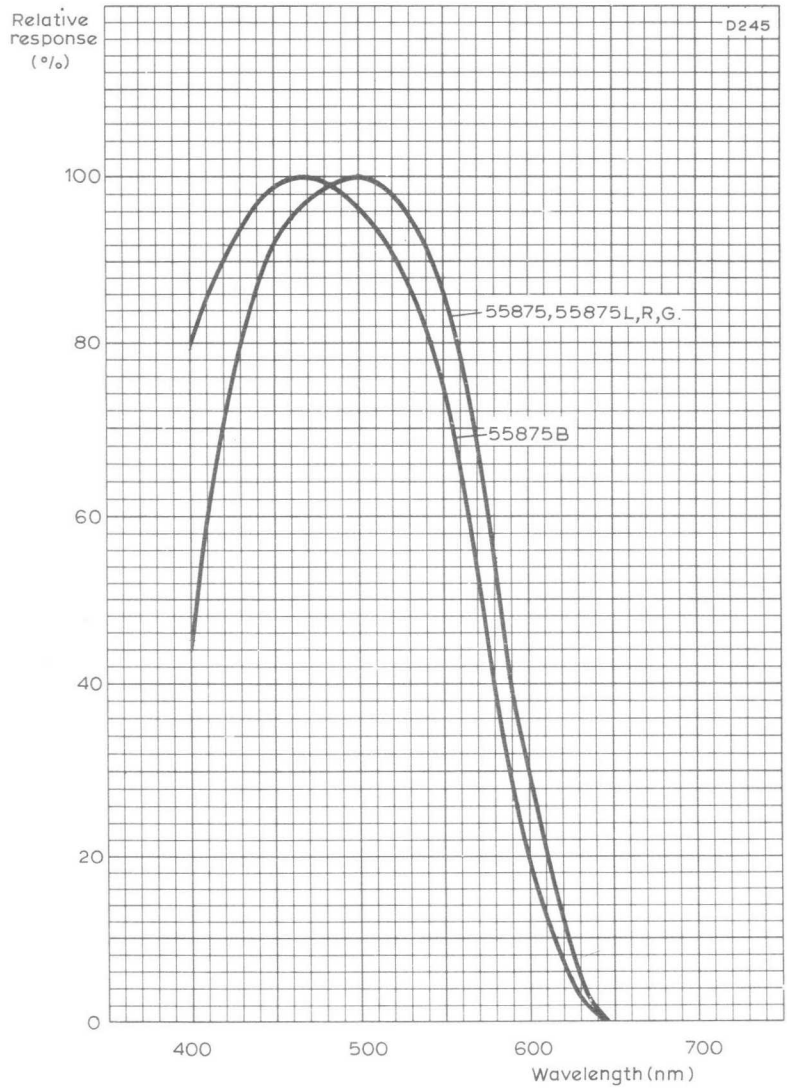
Use full size (12.8 × 17.1mm) scanning of the target and avoid underscanning.

Adjust sufficient beam current to stabilise the picture highlights.

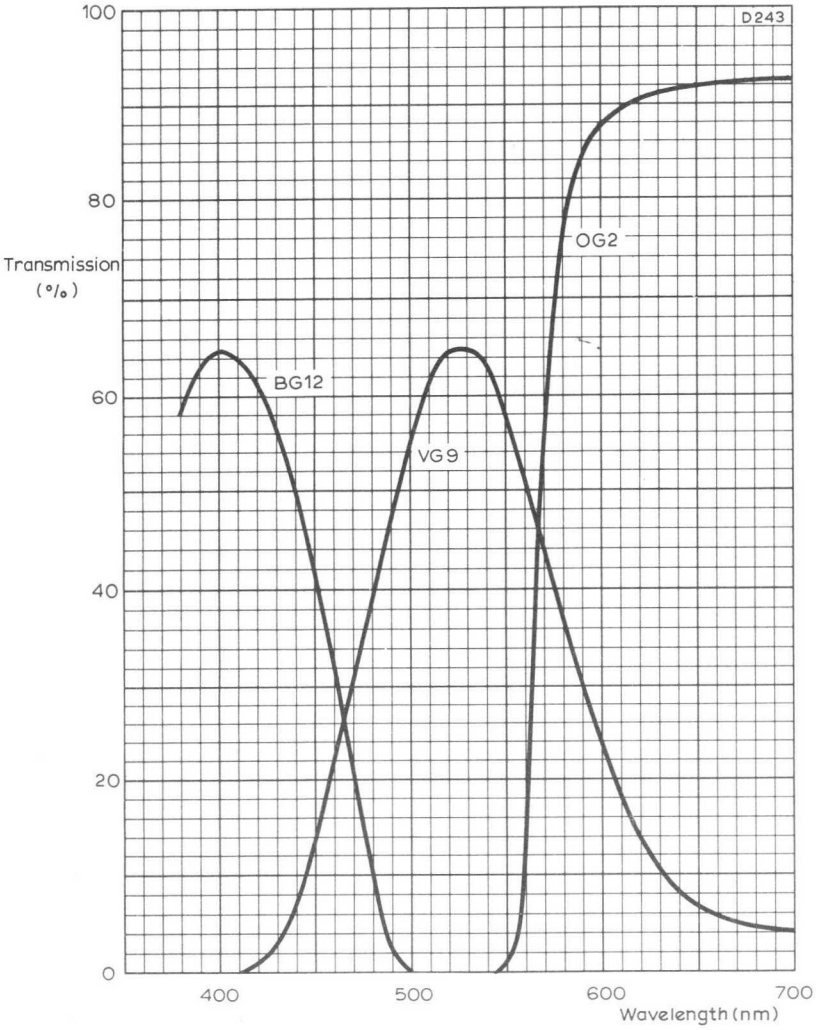
Ensure that the deflection circuits are operative before turning on the beam current.

Avoid pointing the camera directly into the sun.

Keep the lens capped when transporting the camera.



TYPICAL SPECTRAL RESPONSE CURVES



TRANSMISSION CURVES FOR SCHOTT FILTERS

Mullard Limited
Mullard House Torrington Place
London WC1E 7HD

Telephone 01-580 6633
Telex 264341
Cables
Mullectron London
WC1E 7HD

DEVELOPMENTAL DATA

S42XQ
S43XQ
(DEVELOPMENT NUMBERS)**

CAMERA TUBE

PLUMBICON*, TELEVISION CAMERA TUBE WITH HIGH RESOLUTION LEAD-OXIDE PHOTOCONDUCTIVE TARGET WITH A 40MM DIAGONAL USEFUL AREA, SEPARATE MESH CONSTRUCTION, MAGNETIC FOCUSING AND MAGNETIC DEFLECTION. PROVIDED WITH A ANTI-COMET TAIL ELECTRON GUN FOR HIGHLIGHT HANDLING AND A LIGHTPIPE FOR REDUCED LAG AT LOW KEY CONDITIONS.

THE S42XQ WILL BE PROVIDED WITH A DARK CLADDED FIBRE OPTIC FACEPLATE AND IS INTENDED FOR USE IN L.L.L.T.V. SYSTEMS FOR DIRECT COUPLING TO ONE OR MORE LIGHT IMAGE INTENSIFIERS, OR IN ONE-TUBE COLOR CAMERAS WHERE STRIPED FILTERS MAY BE EMPLOYED. THE S43XQ WILL BE PROVIDED WITH A PLAIN GLASS FACEPLATE AND IS INTENDED FOR COLOR AND BL/WH BROADCASTING, HIGH RESOLUTION C.C.T.V. SYSTEMS, DIAGNOSTIC USAGE WITH X-RAY INTENSIFIERS IN MEDICAL APPLICATIONS AND LONG-RANGE RECONNAISSANCE AND SURVEILLANCE VIEWING SYSTEMS FOR THE MILITARY.

QUICK REFERENCE DATA

SEPARATE MESH	
FOCUSING	MAGNETIC
DEFLECTION	MAGNETIC
DIAMETER	2 IN. (≈ 52MM)
LENGTH	12.25 IN (≈312MM)
FACEPLATE	S42XQ FIBRE OPTIC
	S43XQ PLAIN GLASS (N=1.50)
SPECIAL FEATURES	ANTI-COMET TAIL GUN
	LIGHTPIPE
HEATER	6.3V, 300MA
RESOLUTION	≥1400 T.V. LINES

* REGISTERED TRADE MARK FOR TELEVISION CAMERA TUBE

JANUARY 1972

ELECTRICAL

HEATING: INDIRECT BY A.C. OR D.C.; PARALLEL SUPPLY

HEATER VOLTAGE	V_F	6.3V ± 5%
HEATER CURRENT	I_F	300 mA

ELECTRON GUN CHARACTERISTICS

CUT-OFF

GRID NO. 1 VOLTAGE FOR CUT-OFF AT $V_{G_{2,4}}$ = 300V	V_{G1}	-45 TO -100V
BLANKING VOLTAGE, PEAK TO PEAK ON GRID NO. 1	$V_{G1_{P-P}}$	50 ± 10V
GRIDS NO. 2 AND NO. 4 CURRENT, MAX D.C. VALUE FOR EQUIPMENT DESIGN	$I_{G2,4}$	5.0mA

FOCUSING — MAGNETIC

DEFLECTION — MAGNETIC

CAPACITANCE

SIGNAL ELECTRODE TO ALL	C_{A_S}	10 pF (TYPICAL)

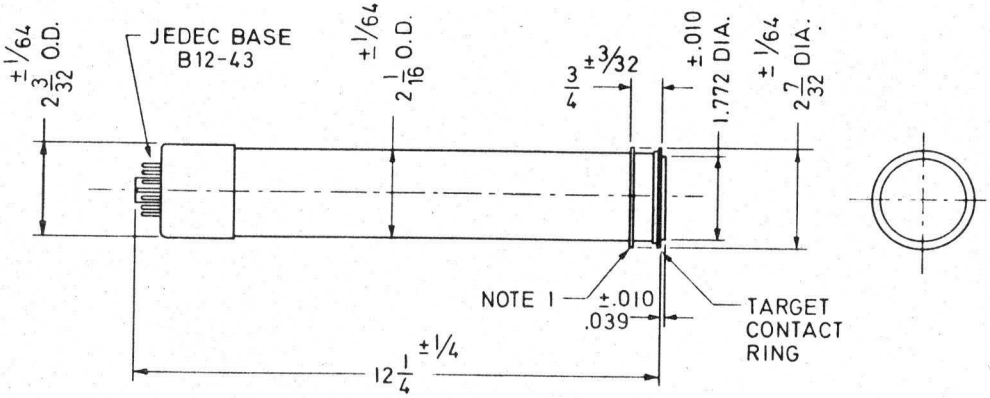
THIS CAPACITANCE, WHICH IS EFFECTIVELY THE OUTPUT IMPEDANCE, INCREASES WHEN THE TUBE IS INSERTED IN THE COIL UNIT.

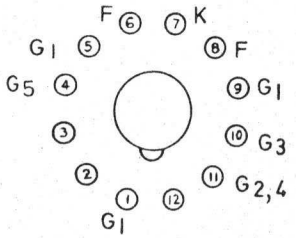
LIMITING VALUES

TO BE DEFINED

ACCESSORIES

SOCKET	TO FIT JEDEC BASE B12-43, MODIFIED TO ACCEPT LIGHT BULB FOR BIAS LIGHTING. (SUPPLIED WITH TUBE)
DEFLECTION COIL UNIT	CLEVELAND ELECTRONICS 2VYA696, OR EQUIV
FOCUSING COIL UNIT	CLEVELAND ELECTRONICS 2VF697, OR EQUIV.



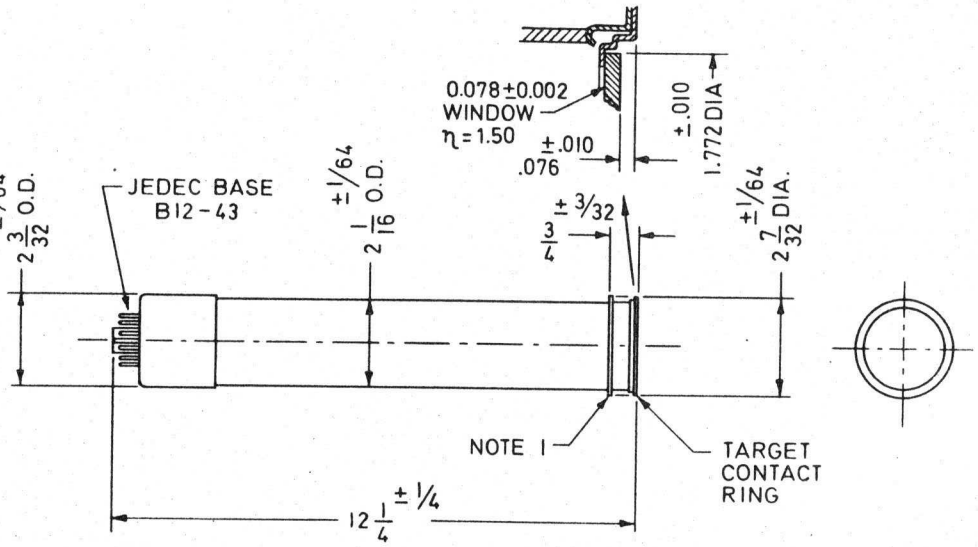


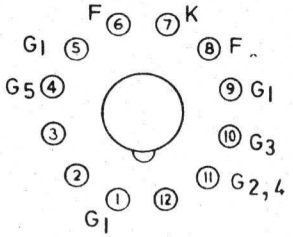
PIN CONNECTIONS

NOTE 1
G_6 CONNECTION IS MADE TO THIS FLANGE

ALL DIMENSIONS IN INCHES

OUTLINE
S42XQ





PIN CONNECTIONS

NOTE 1
G_6 CONNECTION IS MADE TO THIS FLANGE

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OUTLINE
S43XQ

OPERATING CONDITIONS AND PERFORMANCE

TYPICAL OPERATING CONDITIONS (SCANNED AREA 24 x 32MM²)

TARGET VOLTAGE	V_{A_S}	45 V
CATHODE VOLTAGE DURING READ-OUT MODE	V_K	0 V
DURING ACT MODE	V_K 5 TO	10 V
GRIDS NO. 2 AND NO. 4 VOLTAGE	$V_{G2,G4}$	300 V
GRID NO. 1 VOLTAGE	V_{G1}	SEE NOTE 1)
BLANKING VOLTAGE ON GRID NO.1 PEAK TO PEAK	$V_{G1\,PP}$	50 V
GRID NO. 3 VOLTAGE, DURING READ-OUT MODE	V_{G3}	250 V
DURING ACT MODE	V_{G3} 0 TO	20 V 2)
GRID NO. 5 VOLTAGE (FOR CORRECT BEAM FOCUS)	V_{G5} ≈	1000 V
GRID NO. 6 VOLTAGE	V_{G6}	1600 V

PERFORMANCE

BEAM LANDING ERROR	1V TYPICAL, ON TARGET
GEOMETRIC DISTORTION	1% TYPICAL
DARK CURRENT	≤5 NA 3)

SENSITIVITY

S42XQ

WHITE LIGHT (C.T. 2854K)	200	μA/LM
P20 LIGHT	0.07	μA/μW
P11 LIGHT	0.135	μA/μW

S43XQ

WHITE LIGHT (C.T. 2854K)	300	μA/LM
P20 LIGHT	0.14	μA/μW
P11 LIGHT	0.25	μA/μW

GAMMA OF TRANSFER CHARACTERISTIC (BELOW ACT KNEE) 0.95 ± 0.05

SPECTRAL RESPONSE: MAX. RESPONSE AT APPROX. 500 NM
CUT-OFF AT APPROX. 650 NM

RESOLUTION (I_S/I_B=300/600 NA), (AS PER CENT OF 1.5LP/MM=80 TV LINES)

S42XQ	10LP/MM (480 TV LINES)	70%
	20LP/MM (960 TV LINES)	25%
S43XQ	10LP/MM	75%
	20LP/MM	30%

LIMITING RESOLUTION APPROX. 30LP/MM (1400 TV LINES)

CORNER RESOLUTION (WITH DYNAMIC FOCUS) MEASURED AT 10% INSIDE CORNERS, ON DIAGONAL APPROX. 20LP/MM (1000 TV LINES)

LAG

RESIDUAL SIGNAL AFTER DARK PULSE OF 60 MS (3 FIELDS AFTER REMOVAL OF ILLUMINATION) ≤6% 4)

HIGHLIGHT HANDLING

WITH THE PROPER ACT PULSES APPLIED THE TUBE CAN HANDLE PEAKED HIGHLIGHTS UP TO AND OVER 10 TIMES THE NORMAL PEAK SIGNAL WHITE.

PICTURE QUALITY TO BE DETERMINED

NOTES

1) GRID NO. 1 VOLTAGE ADJUSTED TO PRODUCE SUFFICIENT BEAM CURRENT TO STABILIZE DURING READ-OUT A PEAK SIGNAL CURRENT OF 600 NA.

2) WITH RESPECT TO THE CATHODE VOLTAGE DURING THE READ-OUT MODE.

3) DARK CURRENT CAN BE INCREASED TO IMPROVE LAG CHARACTERISTICS WITH THE USE OF LIGHT PIPE.

4) LAG MEASURED WITH I_S=I_B=300NA AND DARK CURRENT SET FOR 10NA. LAG MAY INCREASE SLIGHTLY WHERE LIGHT PIPE IS NOT USED AND DARK CURRENT IS LESS THAN 10NA.

COIL ASSEMBLY

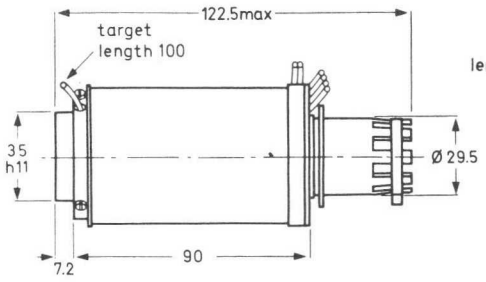
AT1102/01

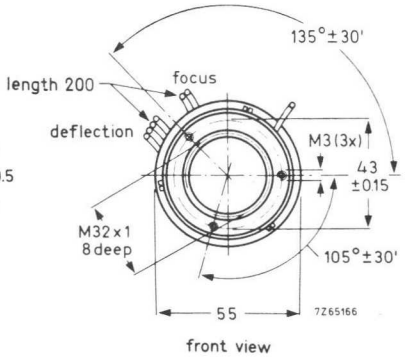
APPLICATION

Deflection assembly, consisting of deflection and focus coils and alignment ring magnets, for a 1 inch Vidicon*). It is identical to the AT1102, however it can be used for universal applications.

MECHANICAL DATA

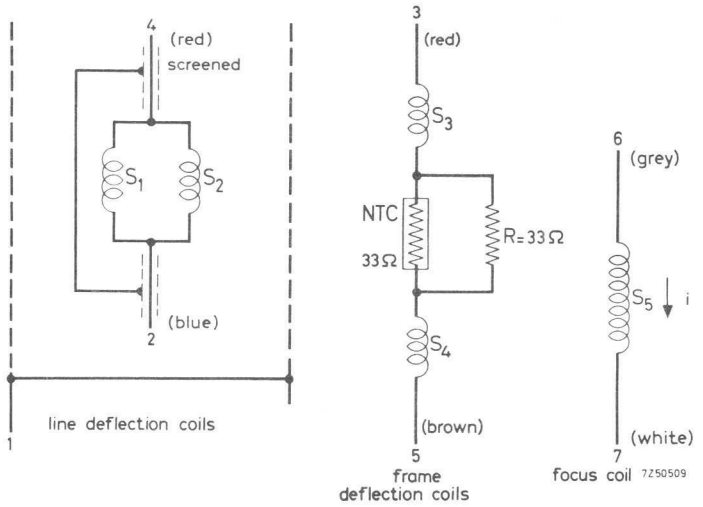
Dimensions in mm





*) Front loading

ELECTRICAL DATA (typical values)



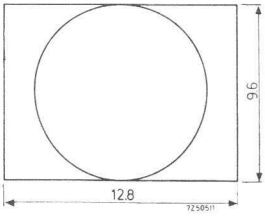
coils	measuring points	earth points	inductance (mH)	resistance (Ω)
$S_1 + S_2$	2 - 4	2	0.75	2.5
$S_3 + S_4$	3 - 5	5	23	80
S_5	6 - 7	-	-	4200

Required currents for normal operation (V_{g4} = 300 V)

Line deflection current : 170 mA p-p
Frame deflection current : 24 mA p-p
Focus current : 17 mA

Geometric distortion

Distortions inside the circle: about 1 % of picture height
Distortions outside the circle: about 2 % of picture height



Alignment range: ± ≥10 % of picture height

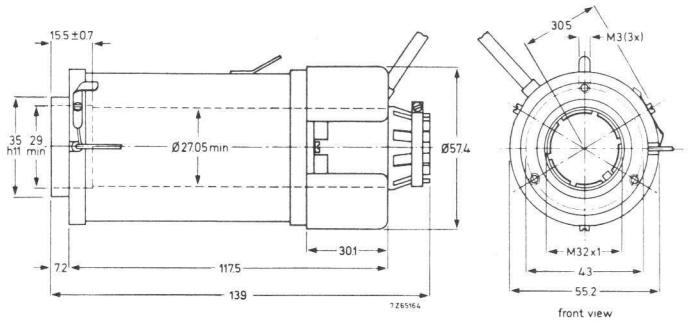
COIL ASSEMBLY AT1103

APPLICATION

Coil assembly consisting of deflection, focus and alignment coils for a 1 inch Plumbicon* tube, front loading.

MECHANICAL DATA

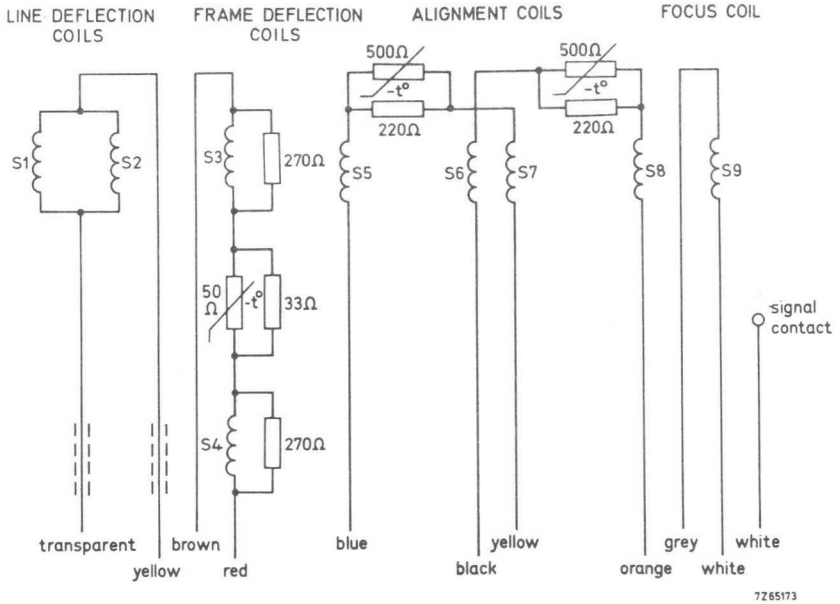
Dimensions in mm



E

Mullard

ELECTRICAL DATA (typical values)



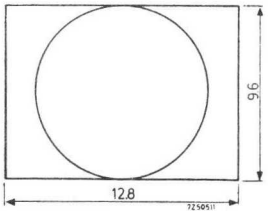
coils		inductance (mH)	resistance at 25 °C (Ω)
line deflection coils	$S_1 // S_2$	0.95 ± 3 %	2.6 ± 10 %
frame deflection coils	$S_3 + S_4$	27 ± 3 %	77 ± 10 %
alignment coils (horizontal)	$S_5 + S_7$		670 ± 10 %
alignment coils (vertical)	$S_6 + S_8$		670 ± 10 %
focus coil	S_9		2500 ± 10 %

Required currents for normal operation (V_{g3} = 600 V; V_{g4} = 840 V)

Line deflection current	250	mA p-p
Frame deflection current	38	mA p-p
Focus current at 60 gauss	26	mA
Alignment current at 2 gauss	10.5	mA

Geometric distortion

Distortions inside the circle	max. 0.5 % of picture height
Distortions outside the circle	max. 1 % of picture height



COIL ASSEMBLY

AT1113/01

QUICK REFERENCE DATA

Deflection assembly, consisting of deflection, focus and alignment coils, for use with Plumbicon* camera tubes in colour cameras.

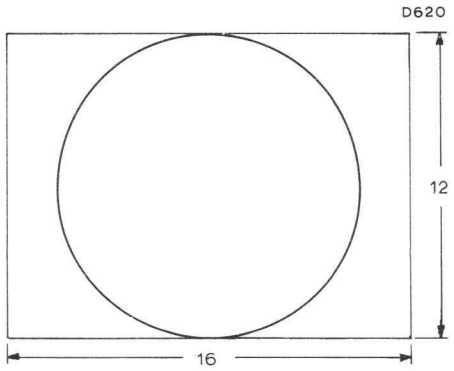
	V_{a2} = 300V	V_{a2} = 600V	
Line deflection current (p-p)	160	225	mA
Frame deflection current (p-p)	25	35	mA

OPERATING CONDITIONS

Plumbicon tube voltage	V_{a2} = 300V	V_{a2} = 600V	
Line deflection current (p-p)	160	225	mA
Frame deflection current (p-p)	25	35	mA
Focus current (L_9 and L_{10} in series)	75	100	mA
Maximum alignment currents	±5	±5	mA

LINEARITY

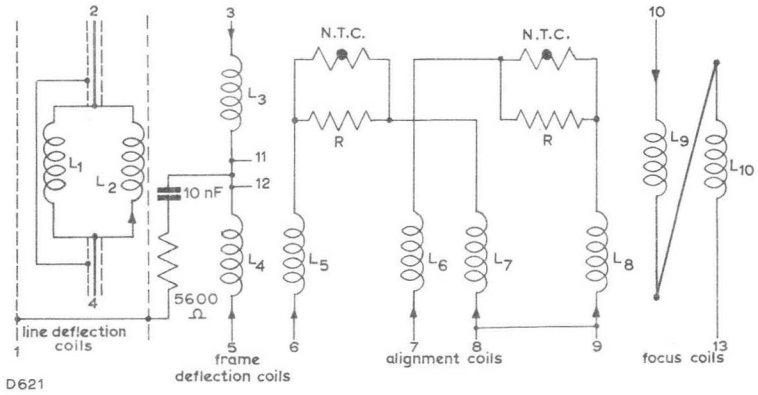
Linearity inside the circle	≤0.5% of picture height
Linearity outside the circle	≤1.0% of picture height



Scanned area of tube
Dimensions in mm

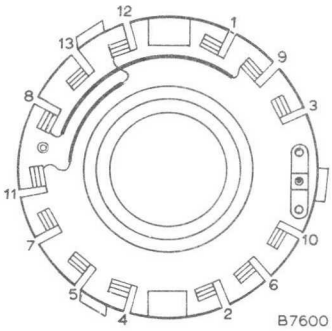
*Registered trade mark for television camera tubes.

ELECTRICAL CHARACTERISTICS



N.T.C. thermistors = 1300Ω ± 20% at 25°C
R = 560Ω ± 5%

1 = black
2 = transparent (screened)
3 = brown
4 = yellow (screened)
5 = red
6 = orange
7 = yellow
8 = 9 = blue
10 = white
11 = -
12 = -
13 = grey



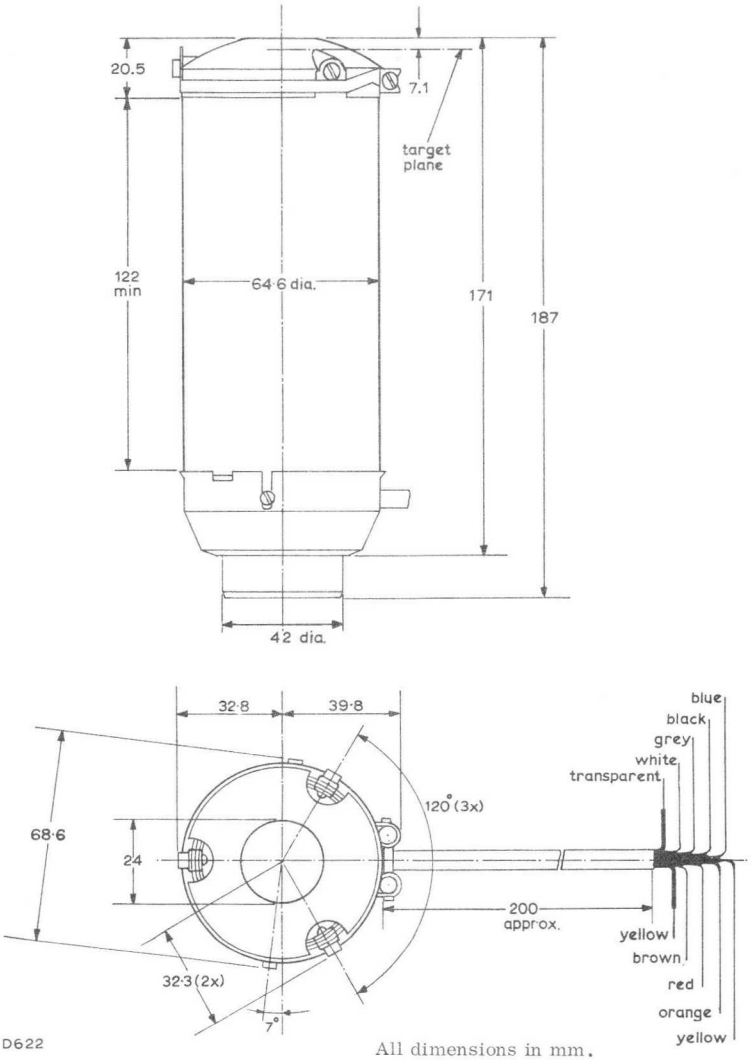
Terminating panel

Coils	Measuring points	Inductance (mH)	Resistance at 25°C (Ω)
$L_1 + L_2$	2-4	0.995 ± 3.5%	2.6 ± 10%
$L_3 + L_4$	3-5	22.1 ± 3.5%	63.8 ± 10%
$L_5 + L_7$	6-8		2143 ± 10%
$L_6 + L_8$	7-9		2143 ± 10%
$L_9 + L_{10}$	10-13		148 ± 10%
Internal shield	1		

Temperature dependence of alignment coils $L_5 + L_7$ and $L_6 + L_8$ from 25 to 60°C < 1%.

COIL ASSEMBLY AT1113/01

OUTLINE AND DIMENSIONS OF AT1113/01



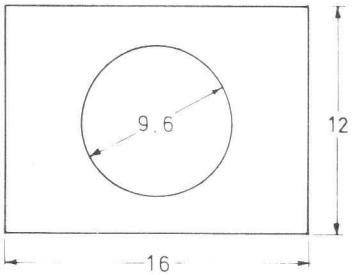
All dimensions in mm.

COIL ASSEMBLY SET AT1113/03

The AT1113/03 consists of three Plumbicon* tube coil assemblies AT1113/01, which have been selected in order to match their electrical tolerances.

Registration

The coil assemblies are supplied in matched sets of three units wherein the misregistration in any set is not greater than 0.1% of picture height inside the circle and 0.25% outside the circle.



All dimensions in mm D4753

For further data see Plumbicon tube deflection unit AT1113/01.

*Registered trade mark for television camera tubes.

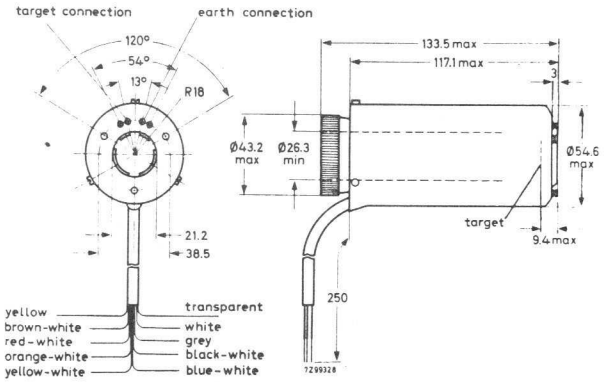
COIL ASSEMBLY SET AT1115

APPLICATION

The AT1115 is a triplet of coil assemblies each consisting of deflection, focus and alignment coils for the 1 inch Plumbicon* tube XQ1080, rear loading.

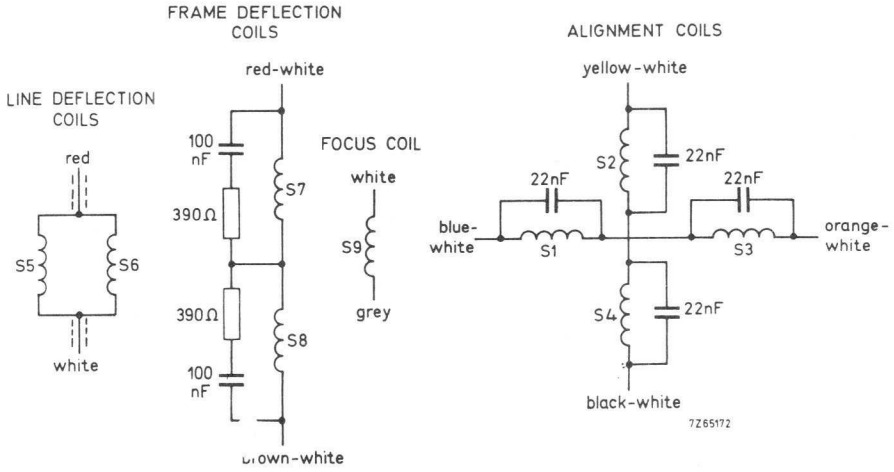
MECHANICAL DATA

Dimensions in mm



*Registered trade mark for television camera tubes

ELECTRICAL DATA (typical values)



coils	inductance (mH)	resistance (Ω)
line deflection coils	0.78	2.4 ± 10 %
frame deflection coils	26	64 ± 10 %
alignment coils (horz. and vert.)		550 ± 10 %
focus coil		1760 ± 10 %

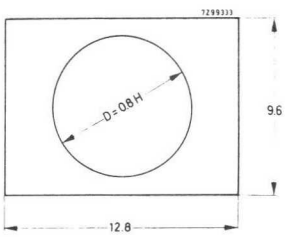
Required currents for normal operation (V_{g3} = 475 V; V_{g4} = 750 V)

An alignment current of 2 mA will cause a shift of 1 % of picture height, measured with a Plumbicon XQ1080.

Line deflection current	295	mA p-p
Frame deflection current	36	mA p-p
Focus current	32	mA
Alignment current	7.5	mA

Geometric distortion

Distortions inside the circle	max. 0.5 % of picture height
Distortions 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 0.05 % of picture height inside the circle and 0.1 % outside the circle.

COIL ASSEMBLY

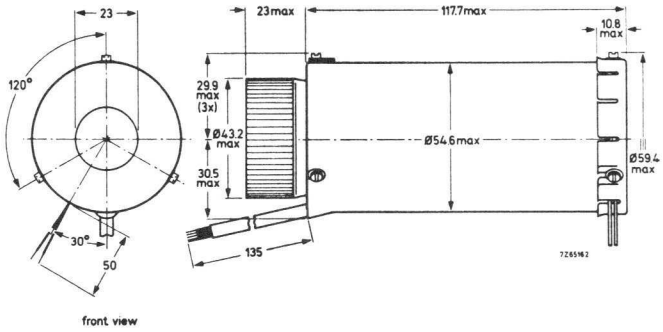
AT1116

APPLICATION

Coil assembly consisting of deflection, focus and alignment coils for a 1 inch Plumbicon* tube, front loading

MECHANICAL DATA

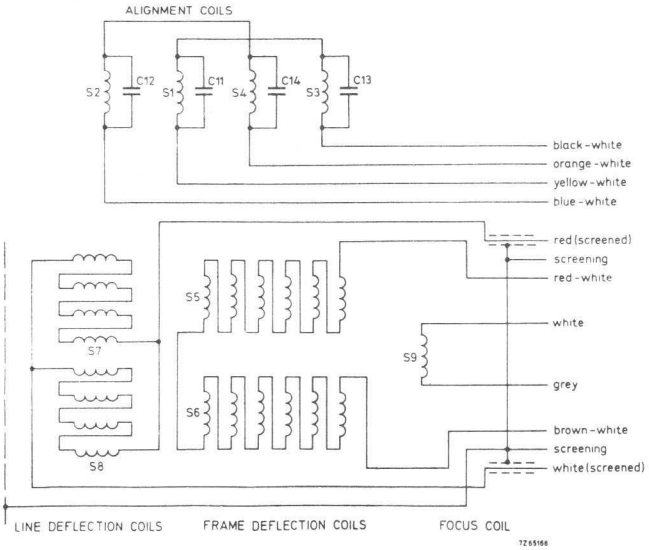
Dimensions in mm



*Registered trade mark for television camera tubes

ELECTRICAL DATA

Maximum operating temperature 75 °C



coils		inductance (mH)	resistance (Ω)
line deflection coils	S7// S8	0.78 ± 10 %	2.4 ± 10 %
frame deflection coils	S5 + S6	28 ± 10 %	62 ± 10 %
alignment coils (horizontal)	S1 + S3		550 ± 10 %
alignment coils (vertical)	S2 + S4		550 ± 10 %
focus coil *)	S9		149 ± 10 %

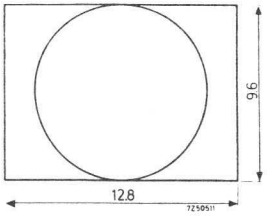
Required currents for normal operation (V_{g3} = 600 V; V_{g4} = 950 V)

Line deflection current	330	mA p-p
Frame deflection current	48	mA p-p
Focus current at 58 gauss	105	mA
Alignment current at 2 gauss	7.5	mA

*) Polarity of focus coil: grey terminal positive. The polarity of the focus coil should be such that a north-seeking pole is attracted to the image end of the coil, with this pole located outside of and at the image end of the coil.

Geometric distortion

Inside the circle	max. 0.5 % of picture height
Outside the circle	max. 1 % of picture height



MOUNTING

To get line scanning in horizontal position the unit has to be positioned with the signal contact 120 ^{o} clockwise with respect to north (front view).

To avoid geometric distortion the mu-metal screening may not become deformed.

To guarantee the specification the lacquered screws may not be removed.

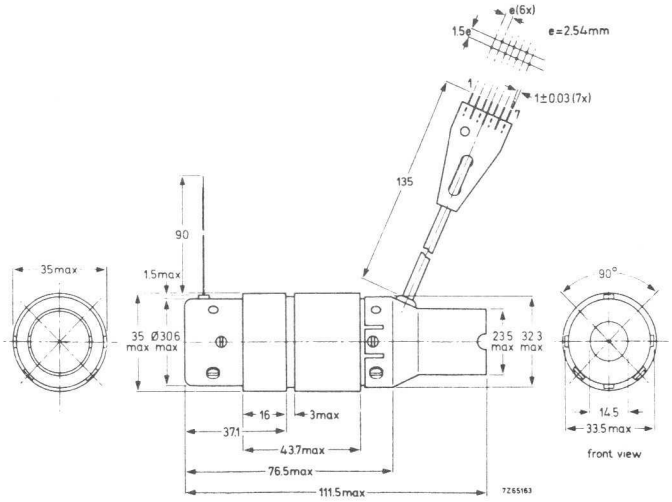
COIL ASSEMBLY AT1117

APPLICATION

Coil assembly consisting of deflection and alignment coils for a 5/8 inch Plumbicon* tube, rear loading.

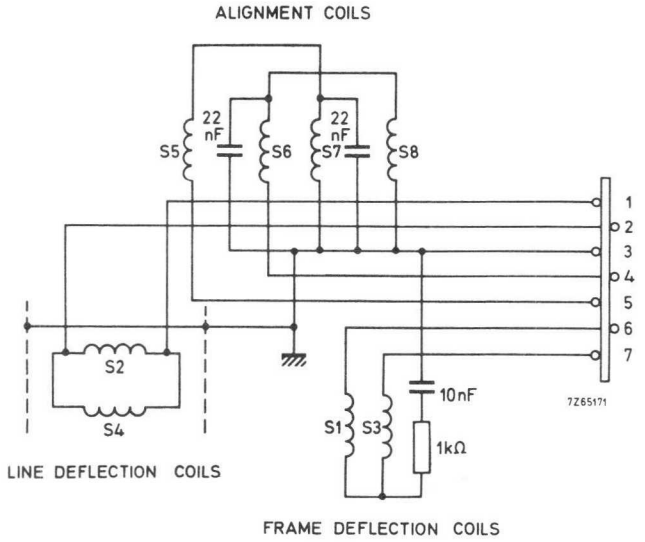
MECHANICAL DATA

Dimensions in mm



*Registered trade mark for television camera tubes

ELECTRICAL DATA



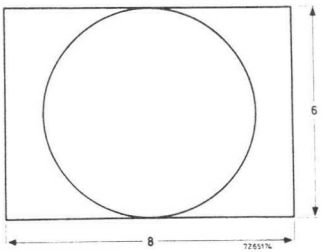
coils		inductance (mH)	resistance at 25 °C (Ω)
line deflection coils	S2 // S4	0.785 ± 10 %	10 ± 10 %
frame deflection coils	S1 + S3	13.2 ± 10 %	115 ± 10 %
alignment coils (horizontal)	S6 + S8		520 ± 10 %
alignment coils (vertical)	S5 + S7		520 ± 10 %

Required currents for normal operation (V_{g2-4} = 300 V; V_{g5} = 600 V)

Line deflection current	140 mA p-p
Frame deflection current	25 mA p-p
Alignment current at 2 gauss	7.5 mA

Geometric distortion

Distortions inside the circle	max. 0.5 % of picture height
Distortions outside the circle	max. 1 % of picture height



COIL ASSEMBLY AT1119

The Plumbicon* tube coil assembly AT1119 is one unit of the three units which together form the selected coil assembly set AT1115.

For data see data sheets of Plumbicon tube coil assembly set AT1115.

*Registered trade mark for television camera tubes.

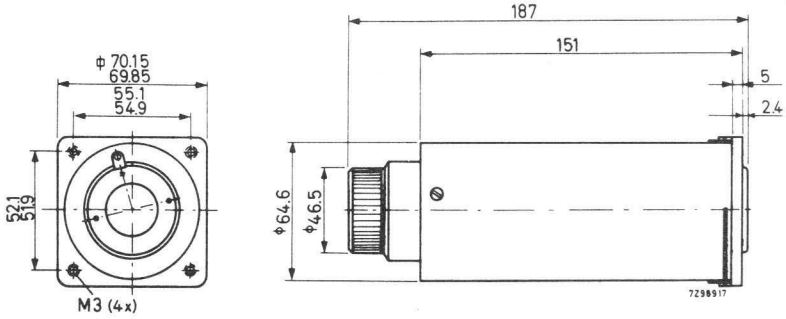
COIL ASSEMBLY AT1132/01

APPLICATION

Coil assembly consisting of deflection, focus and alignment coils for a Plumbicon* tube.

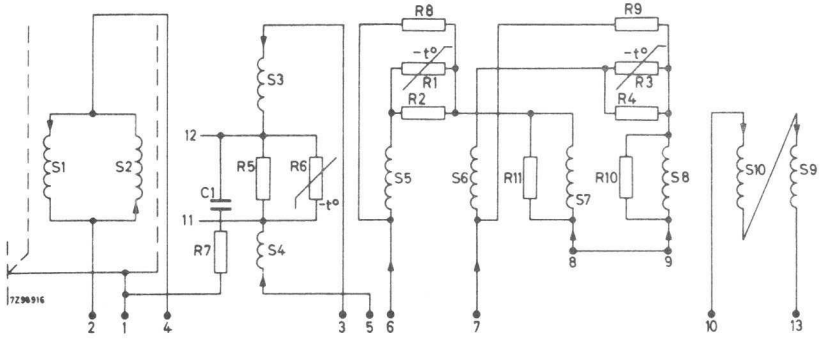
MECHANICAL DATA

Dimensions in mm

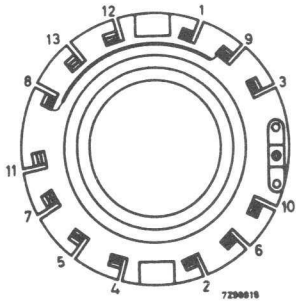


*Registered trade mark for television camera tubes

ELECTRICAL DATA (typical values)



S_1 - S_2	= line deflection coils	R_1, R_3	= 1300 Ω ± 20% at 25 °C (NTC)
S_3 - S_4	= frame deflection coils	R_2, R_4, R_7	= 560 Ω
S_5 - S_8	= alignment coils	R_5	= 33 Ω
S_9 - S_{10}	= focus coils	R_6	= 32 Ω ± 20% at 25 °C (NTC)
C_1	= 10 nF	R_8, R_9, R_{10}, R_{11}	= 22 kΩ



coils	measuring points	inductance (mH)	resistance (Ω)
$S_1 + S_2$	2 - 4	0.995	2.6
$S_3 + S_4$	3 - 5	22.1	63.8
$S_5 + S_7$	6 - 8		2143 1)
$S_6 + S_8$	7 - 9		2143 1)
$S_9 + S_{10}$	10 - 13		2750
Internal shield	1		

1) Resistance drift between 25 and 60 °C is 0.75%

Required currents for normal operation (V_{g3} = 600 V)

line deflection current	:	225 mA p-p
frame deflection current	:	35 mA p-p
focus current ($S_9 + S_{10}$ in series):		25 mA
maximum alignment currents	:	±5 mA

Geometric distortion

Distortions inside the circle : max. 0.5 % of picture height

Distortions outside the circle: max. 1 % of picture height