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

XQ1020
XQ1020L XQ1020G
XQ1020R XQ1020B

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.

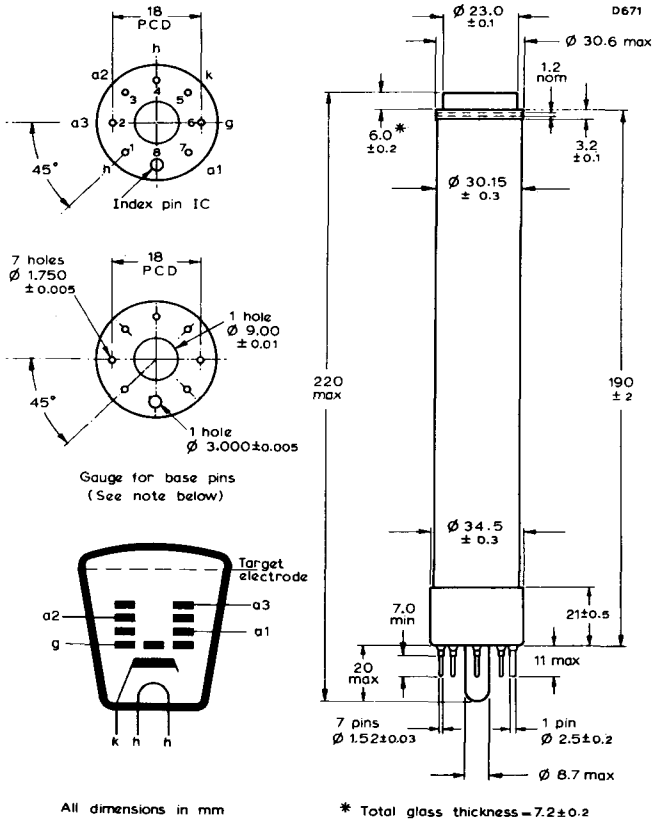
6. As measured under the following conditions:

   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

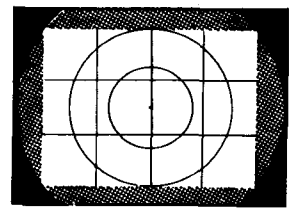
1. Clean the faceplate of the tube and insert in the coil assembly in such a way that the plane defined by the tube axis and the index pin is essentially parallel to the direction of the horizontal scan.

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.

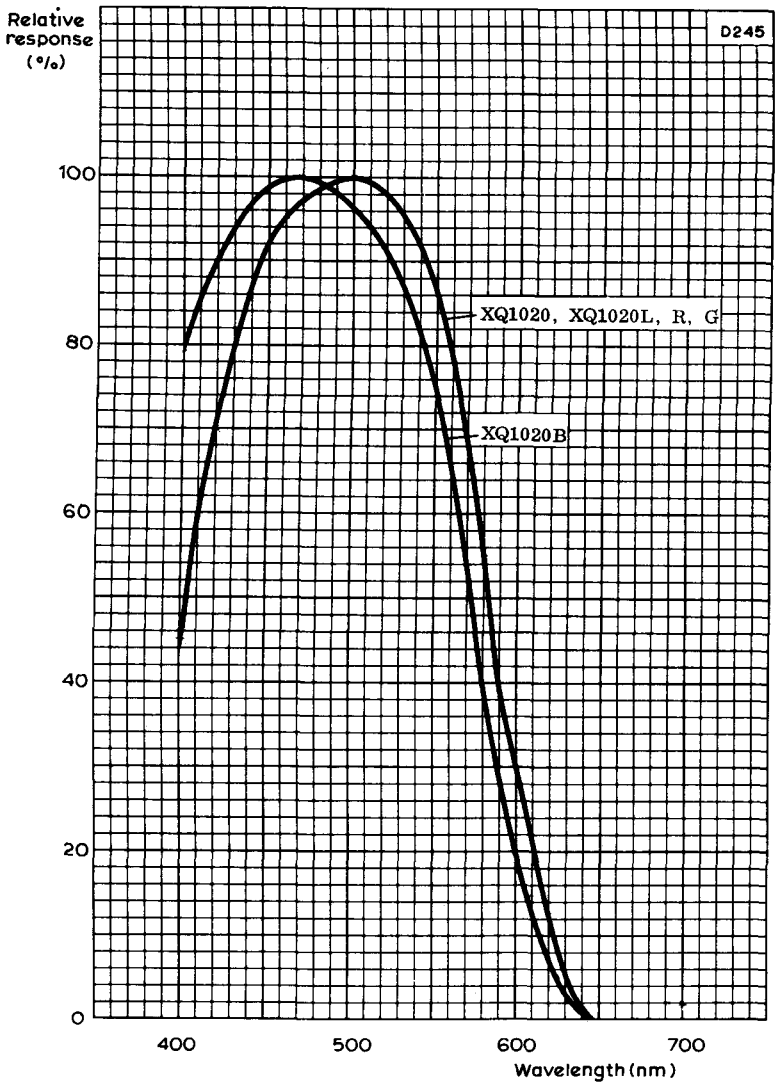
Ensure that the deflection circuits are operative before turning on the beam current.

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

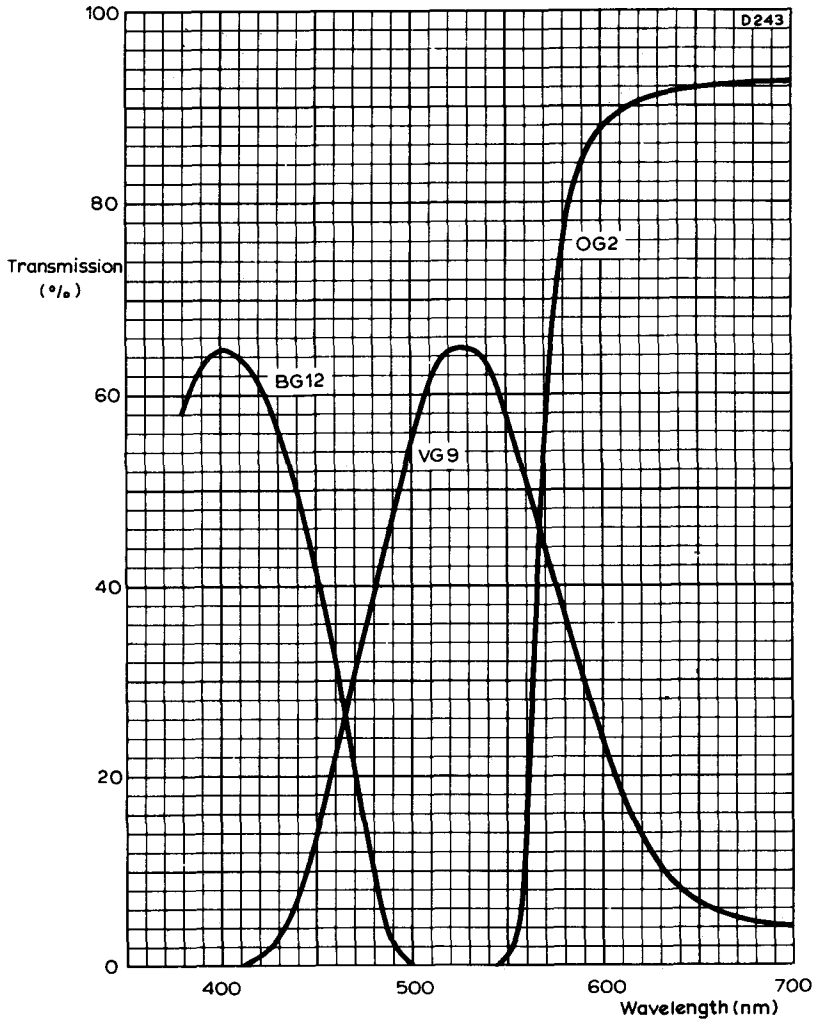
Avoid pointing the camera directly into the sun.

Keep the lens capped when transporting the camera.

XQ1020
XQ1020L XQ1020G
XQ1020R XQ1020B



TYPICAL SPECTRAL RESPONSE CURVES



TRANSMISSION CURVES FOR SCHOTT FILTERS