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	^{o}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)

Mullard

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	^{o}C

Scanning of a 6.6mm $\times$ 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.

Mullard

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.
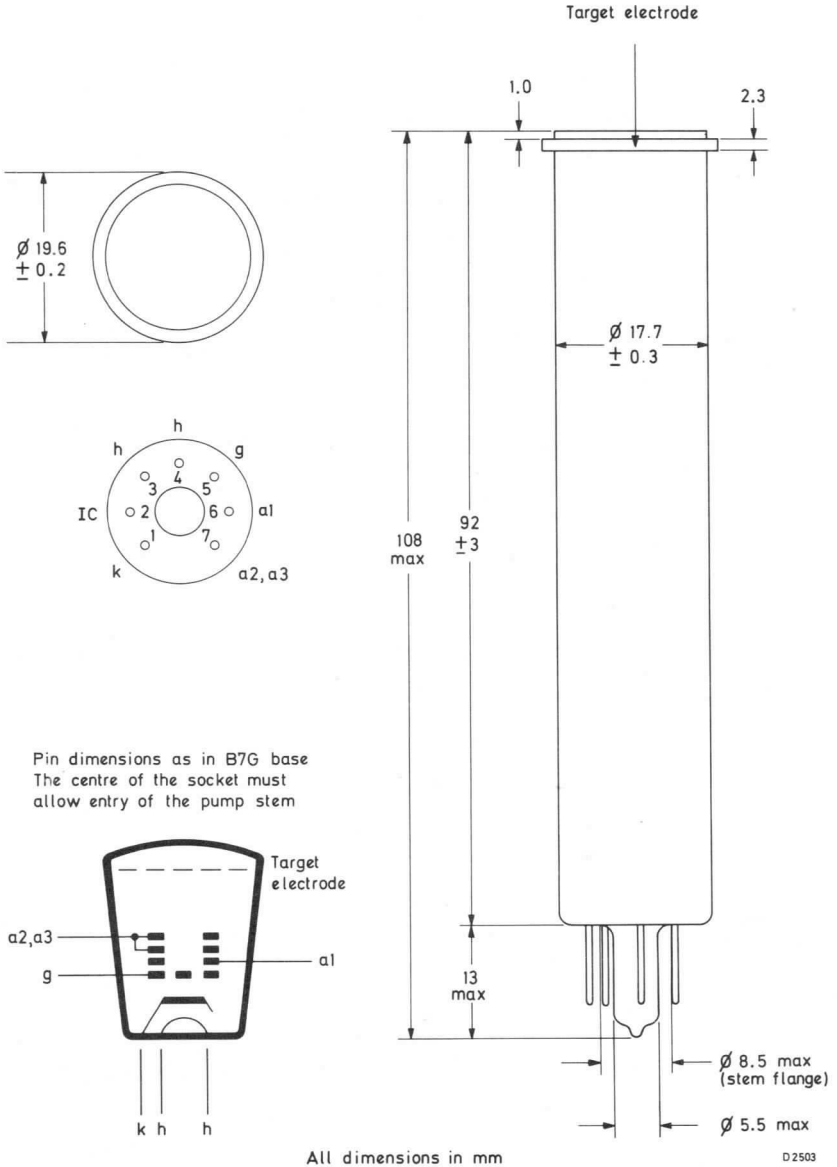
Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots are counted unless the amplitude is less than 50% of the peak white signal.
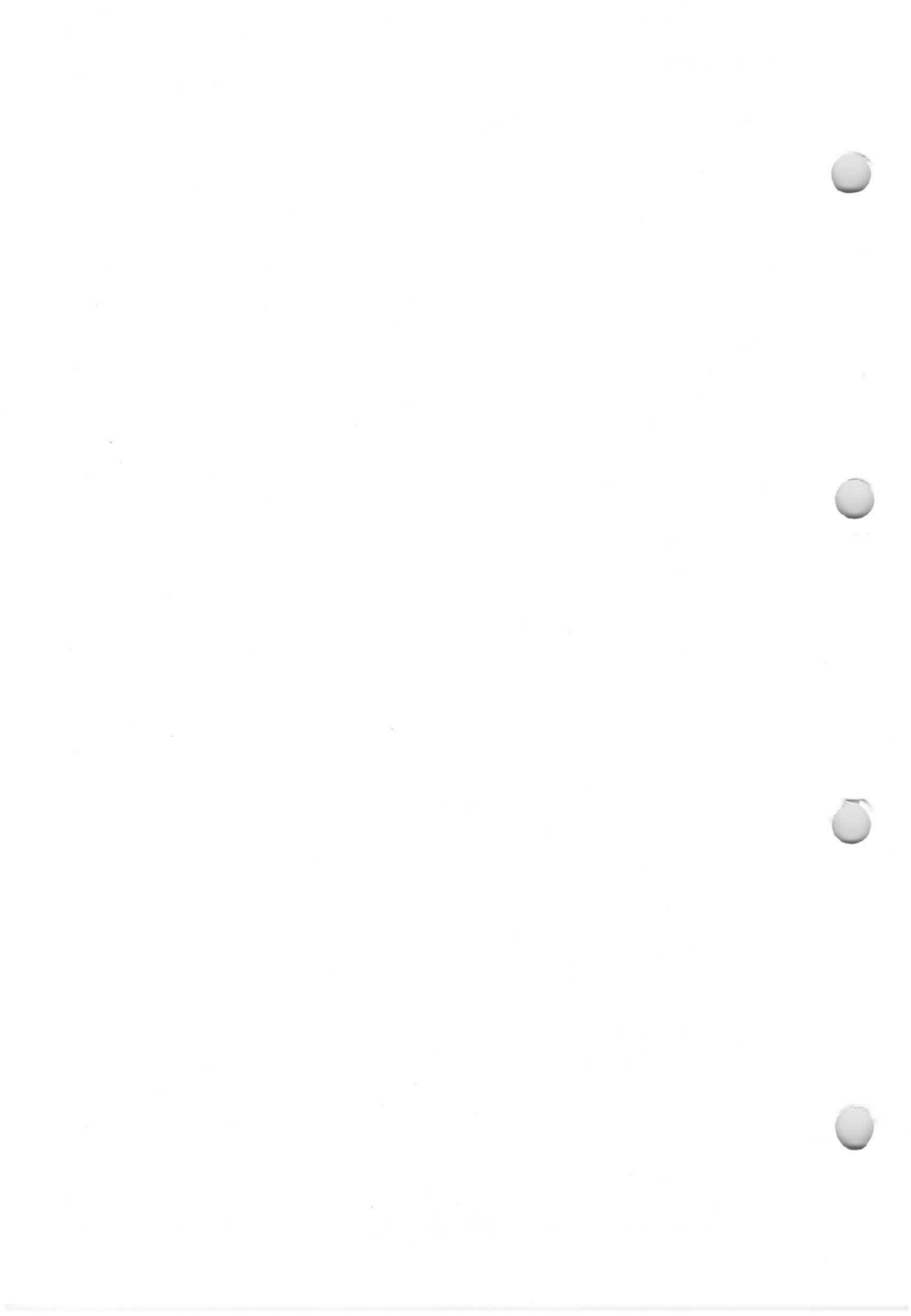
Spot size in % of raster height	Maximum number of spots	
	Zone 1	Zone 2
>0.8	none	1
0.8 to 0.6	2	2
0.6 to 0.3	2	3
<0.3	*	*

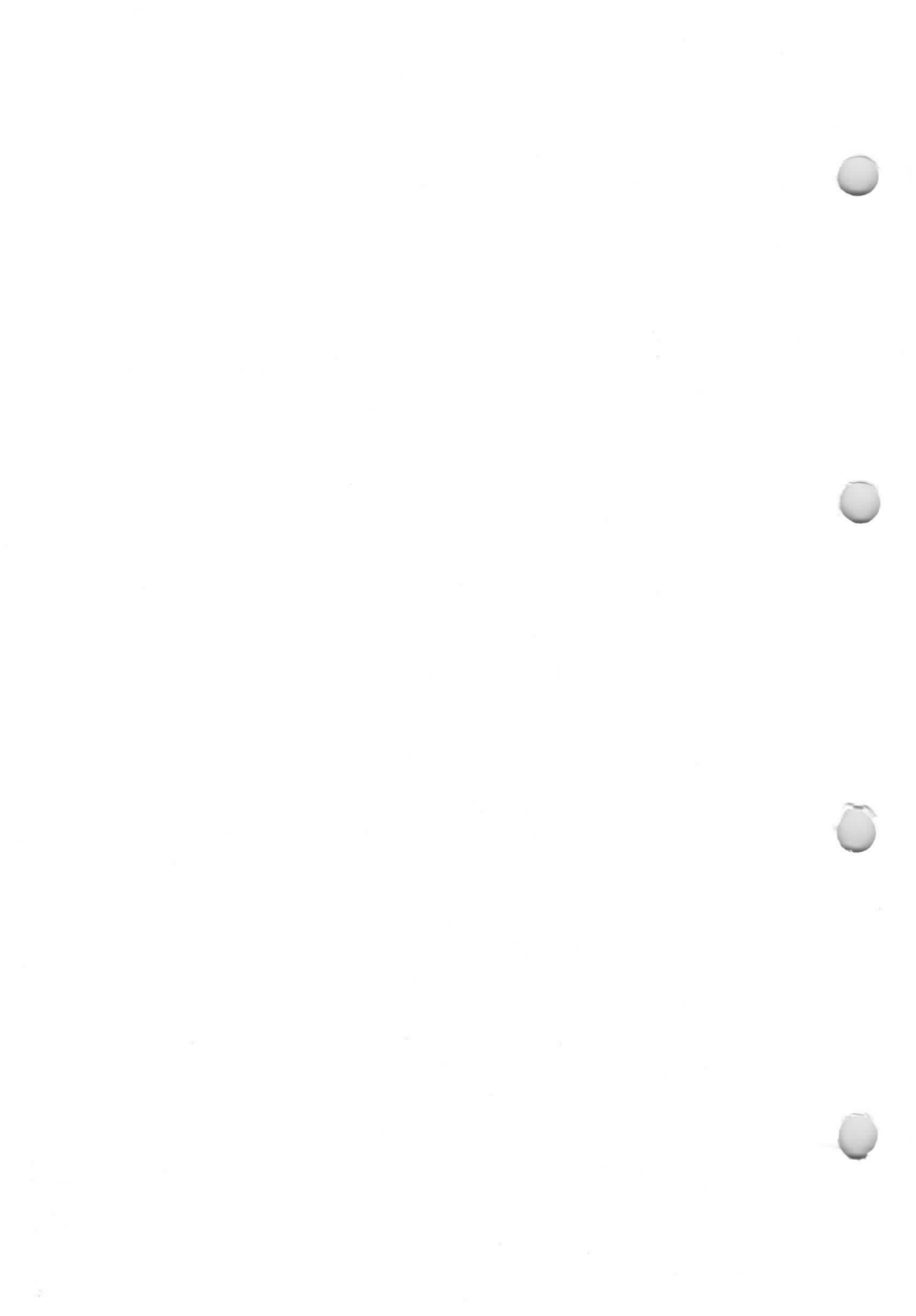*Spots of this size are not counted unless their concentration is so high as to cause a smudgy appearance.

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.

Mullard

OUTLINE DRAWING OF 20PE11

Target electrode

Ø 19.6 ± 0.2

Ø 17.7 ± 0.3

1.0

2.3

108 max

92 +3

13 max

h

h   g

IC   2   6   a1

3   4   5

1   7

k   a2, a3

Pin dimensions as in B7G base
The centre of the socket must
allow entry of the pump stem

a2, a3

g

Target
electrode

a1

k   h   h

Ø 8.5 max
(stem flange)

Ø 5.5 max

All dimensions in mm

D 2503

Mullard

CAMERA TUBE
VIDICON

20PE13

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.

Mullard

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	^{o}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)

Mullard

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	^{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 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.

Mullard

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.
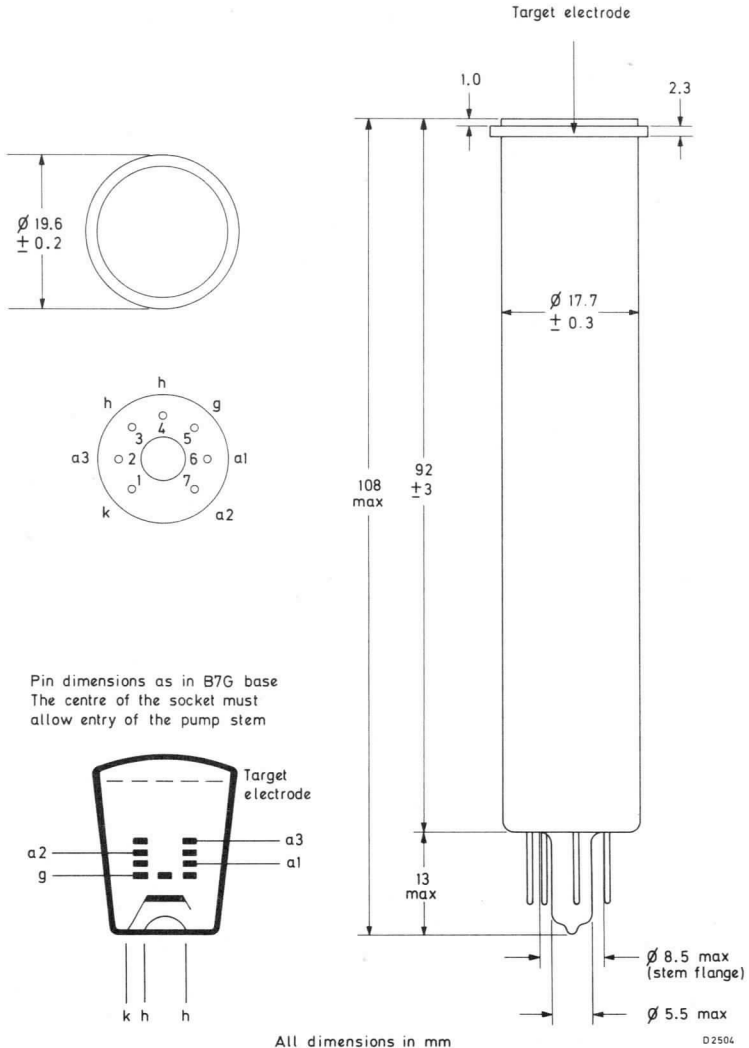
Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots are counted unless the amplitude is less than 50% of the peak white signal.

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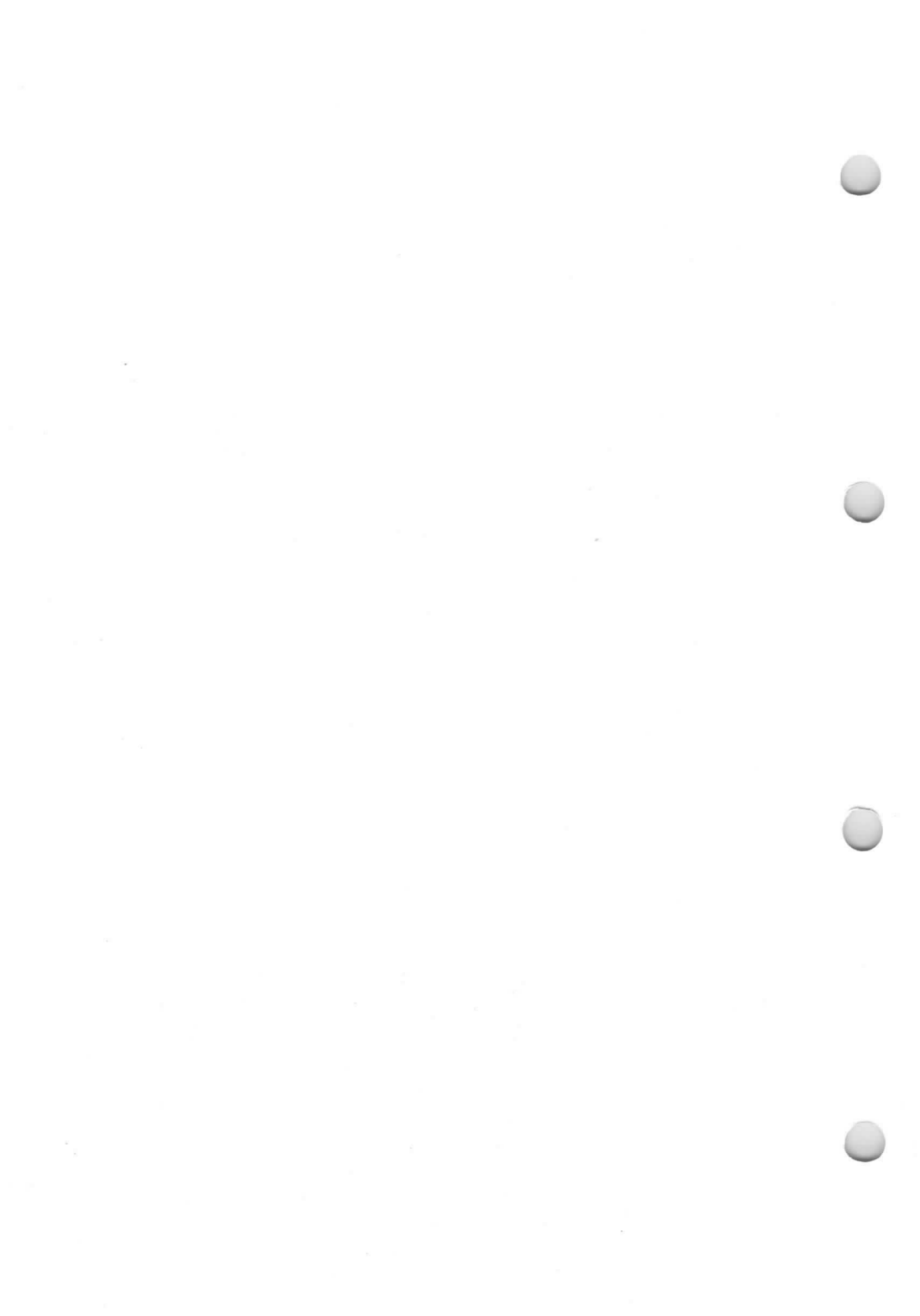
8. Video amplifiers should be capable of handling target-electrode currents of this magnitude without overloading the amplifier or distorting the picture.

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.

Mullard

OUTLINE DRAWING OF 20PE13

Target electrode

1.0

2.3

Ø 19.6
± 0.2

Ø 17.7
± 0.3

h

h   g
3 4 5

a3   2   6   a1
1   7

k   a2

108
max

92
± 3

13
max

Pin dimensions as in B7G base
The centre of the socket must
allow entry of the pump stem

Target
electrode

a2   a3
g   a1

k h   h

Ø 8.5 max
(stem flange)

Ø 5.5 max

All dimensions in mm

D2504

CAMERA TUBE
INTENSIFIER VIDICON
(INTENSICON)

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.

Mullard

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	^{o}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

Mullard

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
$V_{h-k(pk)}$ 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
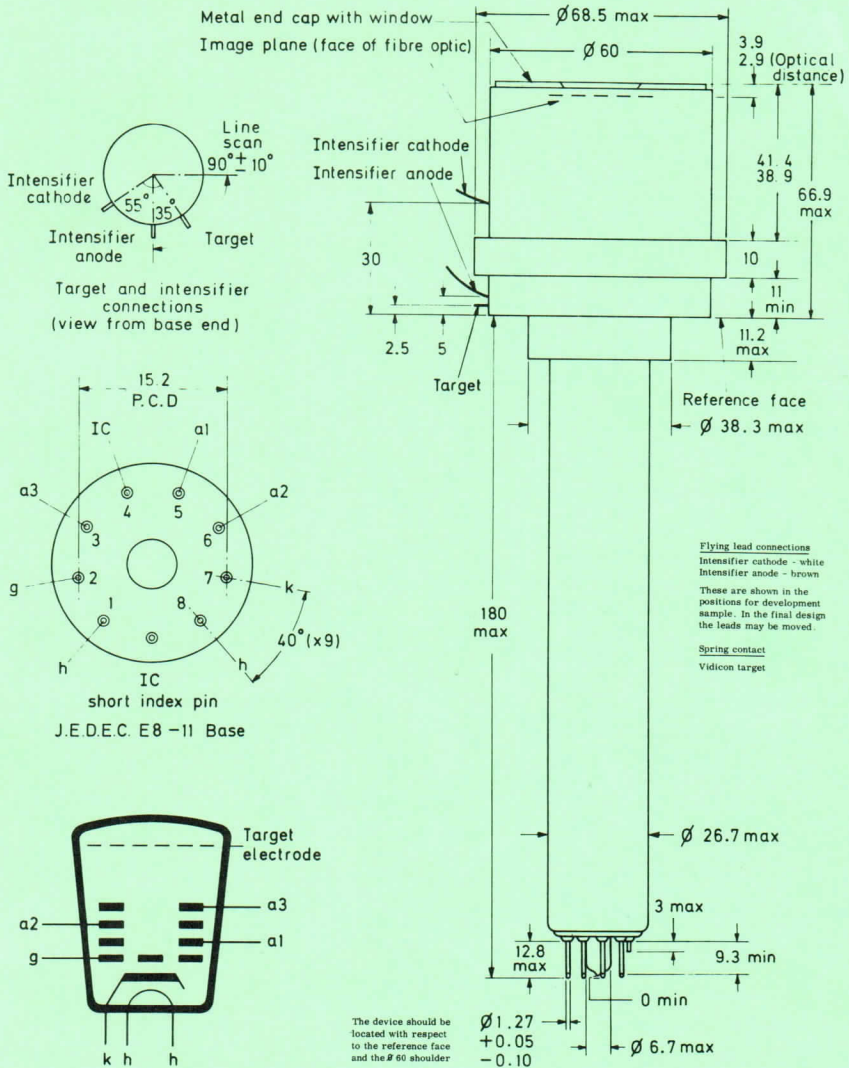   or equivalent

Mullard

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)
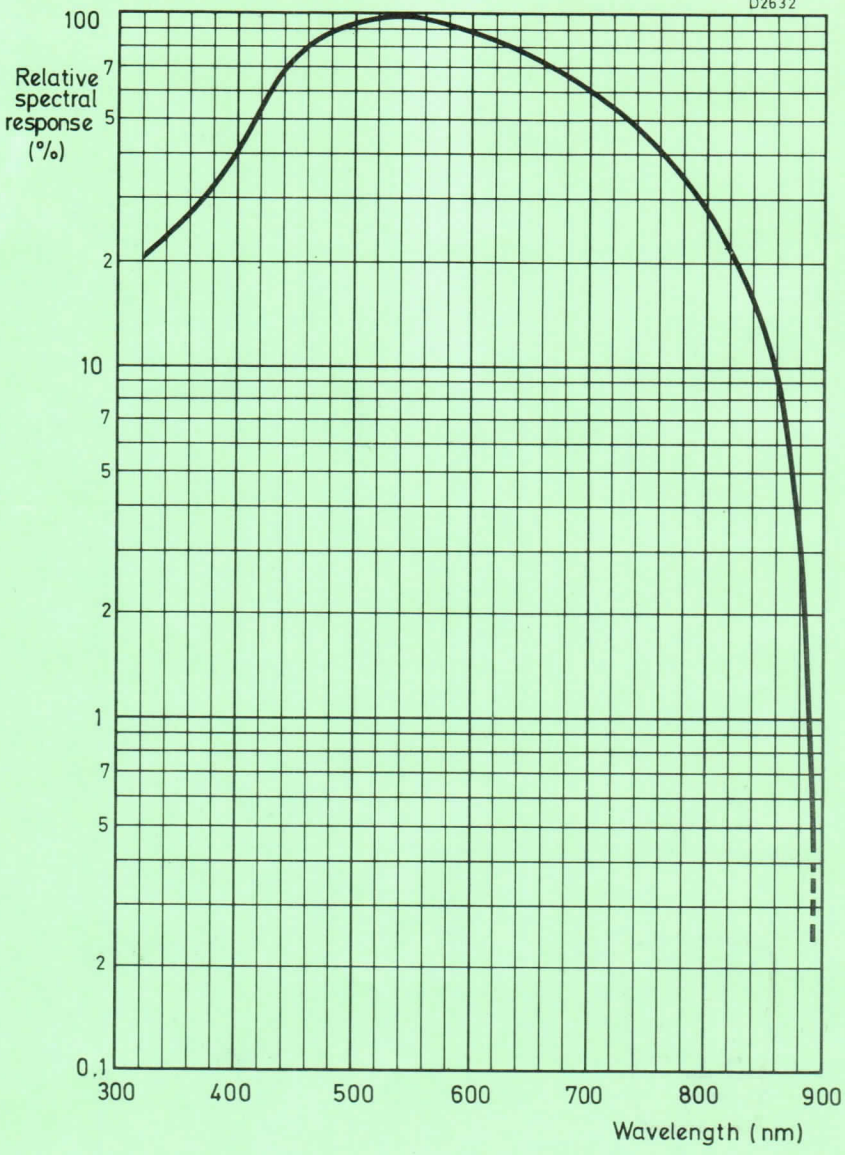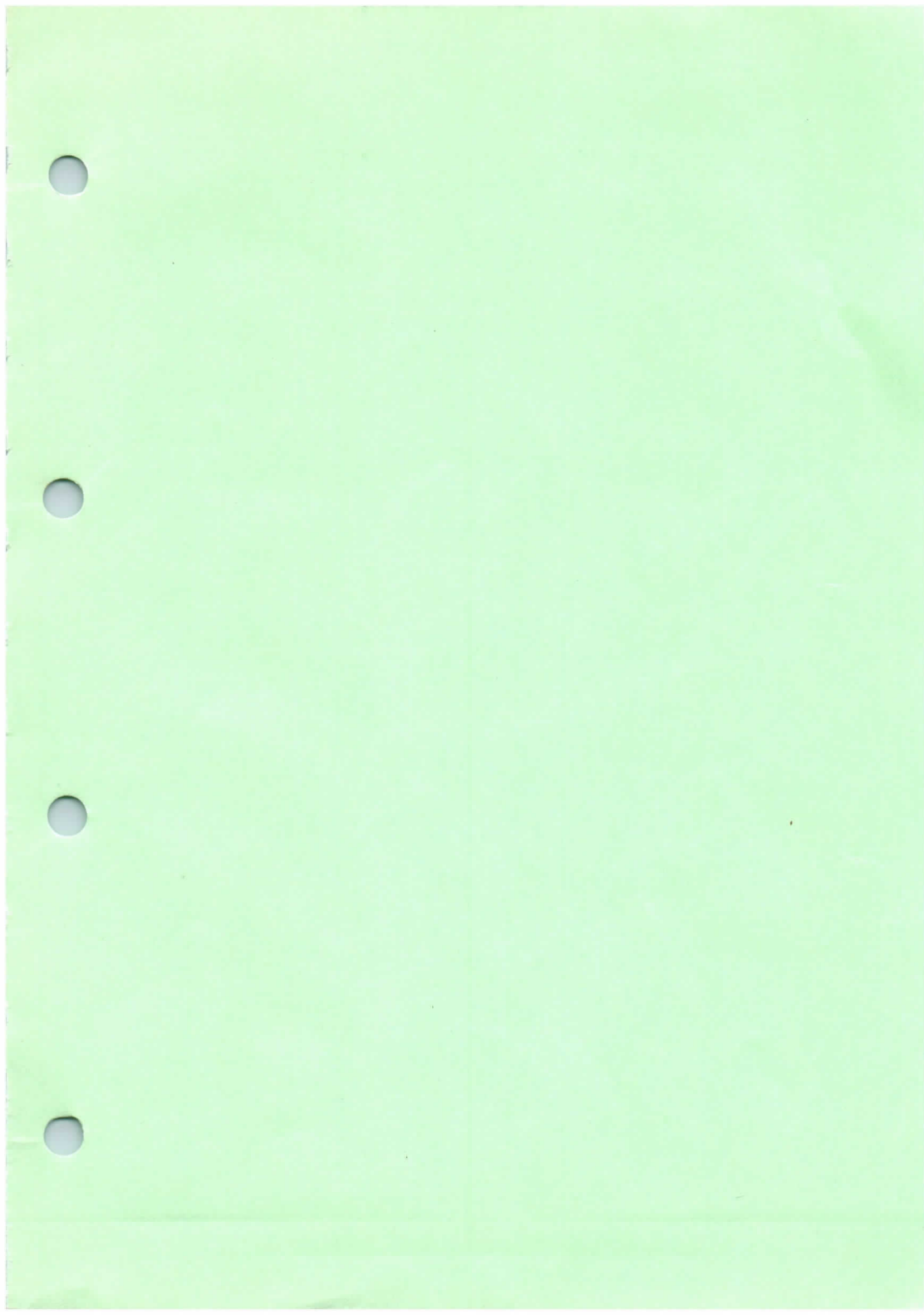
50MXQ
(Dev. No.)

OUTLINE DRAWING OF 50MXQ

←

Metal end cap with window
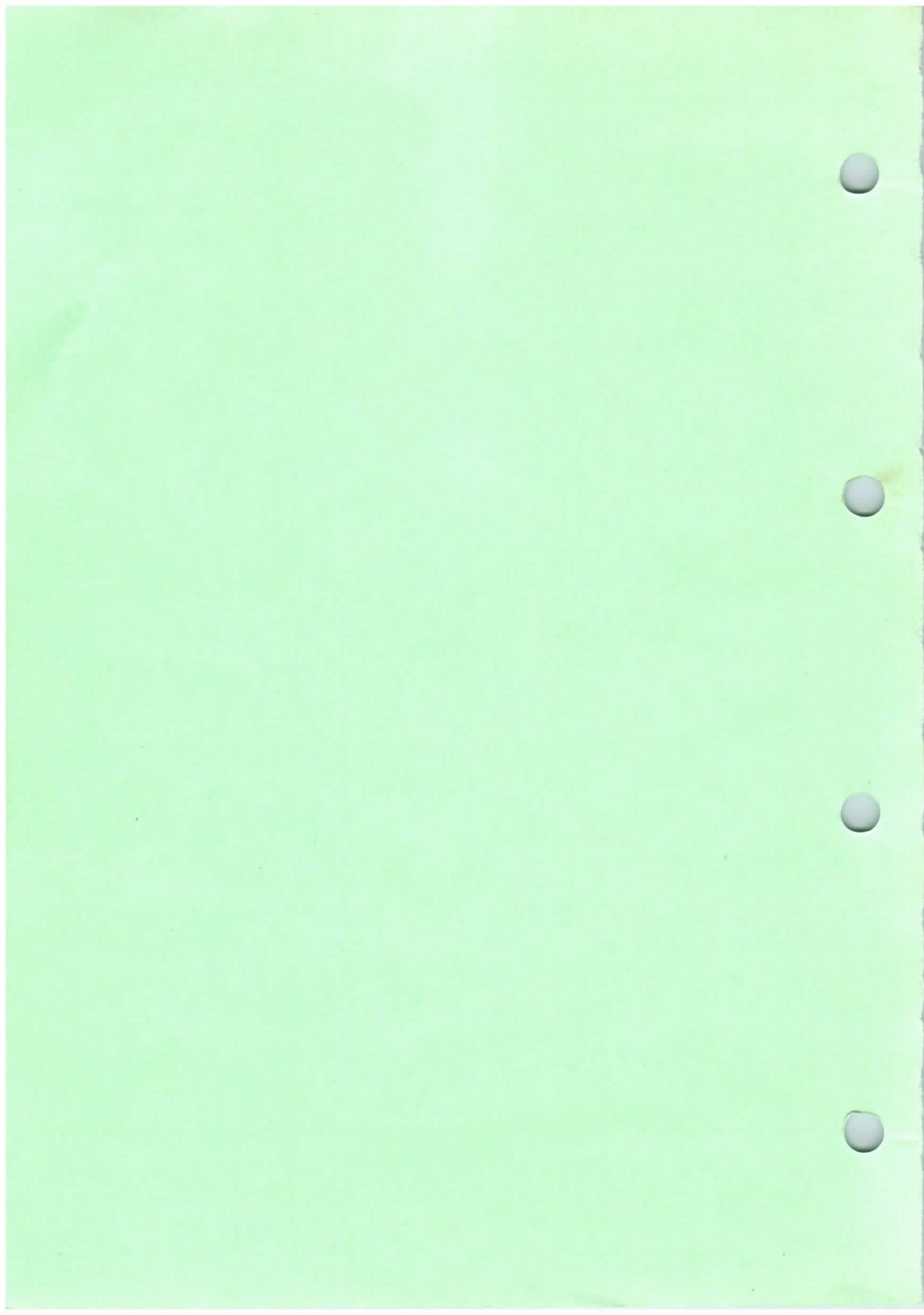Image plane (face of fibre optic)

Ø68.5 max
Ø 60

3.9
2.9 (Optical distance)

Line scan
90° ± 10°

Intensifier cathode

Intensifier cathode
Intensifier anode

41.4
38.9

66.9 max

55°   35°

Intensifier anode

Target

30

10

11 min

Target and intensifier connections
(view from base end)

2.5   5

Target

11.2 max

15.2
P.C.D

Reference face
Ø 38.3 max

IC   a1

a3   a2

4   5

3   6

g   2   7   k

1   8

40° (x9)

h   h

IC
short index pin

J.E.D.E.C. E8 −11 Base

180 max

Flying lead connections
Intensifier cathode - white
Intensifier anode - brown

These are shown in the positions for development sample. In the final design the leads may be moved.

Spring contact
Vidicon target

Ø 26.7 max

Target electrode

a2   a3
g   a1

3 max

12.8 max

9.3 min

0 min

k   h   h

The device should be located with respect to the reference face and the Ø 60 shoulder

Ø 1.27
+0.05
−0.10

Ø 6.7 max

All dimensions in mm

D4288

Mullard

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CURVE

Mullard

IMAGE INTENSIFIER ASSEMBLY

50MXX
(Dev. No.)

QUICK REFERENCE DATA

High gain self-focusing image intensifier assembly for night vision systems.

Minimum luminance gain	1500	
Photocathode	S20 with enhanced red response	
Screen phosphor	P20	
Useful cathode and screen diameters	25	mm
Supply voltage (p-p) at 1500Hz	2.7	kV
Overall dimensions (approx.)	$\varnothing 70 \times 135$	mm
Weight (approx.)	600	g

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - IMAGE INTENSIFIER AND IMAGE
CONVERTER TUBES

PHOTOCATHODE

Surface	S20 with enhanced red response	
Wavelength at maximum response	500	nm
Minimum useful diameter	25	mm
External surface of cathode window	Flat to within 20μm over entire diameter	

SCREEN

Surface	Metal-backed P20
Fluorescent colour	Yellow-green
Overall persistence	Medium

The screen luminance falls to 36% (e^{-1}) of the initial peak value 5ms after the excitation is removed.

Minimum useful diameter	25	mm
External surface of screen window	Flat to within 20μm over entire diameter	

FOCUSING

Self-focusing electrostatic with image inversion

Mullard

CHARACTERISTICS (Measured at $V_{supply(p-p)} = 2700V \pm 0.5\%$,
$f_{supply} = 1500 \pm 100Hz$, $T_{amb} = -50$ to $+30^{o}C$)

Minimum luminance gain (see note 1)	1500	
Minimum photocathode sensitivity (measured using a tungsten lamp of colour temperature 2850K)	175	$\mu A/lm$
Minimum radiant sensitivity at $\lambda = 800nm$	10	mA/W
at $\lambda = 850nm$	3.0	mA/W
Centre magnification, M_c (see note 2)	0.91 ± 0.09	
Maximum distortion (see note 3)	25	%
Minimum centre resolution (see note 4)	40 line pairs/mm	
Minimum edge resolution (see note 5)	30 line pairs/mm	
Minimum contrast transfer at cathode centre		
at 2.5 line pairs/mm	90	%
at 7.5 line pairs/mm	70	%
at 16 line pairs/mm	30	%
Maximum background equivalent illumination (see note 6)	0.2	μlux

Axial eccentricity

A point at the centre of the photocathode will form an image within a concentric circle of 1.5mm diameter on the screen.

Maximum screen luminance ratio (see note 7)	3:1	

TYPICAL OPERATING CONDITIONS

$V_{supply(p-p)}$	2.7	kV
f_{supply}	1500	Hz
Cathode illumination	20	mlux

The cathode must be connected to the instrument housing.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

$V_{supply(p-p)}$ max.	2850	V
f_{supply} max.	1800	Hz
f_{supply} min.	1200	Hz
Maximum photocathode illumination (see note 8)	50	mlux
T_{amb} max. (for 2 hours max.)	+70	^{o}C

Mullard

IMAGE INTENSIFIER ASSEMBLY

50MXX
(Dev. No.)

MOUNTING POSITION

Any. The tube is contained in a cylindrical housing and radially positioned by the locating pin. The axial position is determined by the bearing surface. The force on the bearing surface must not exceed 100 newtons (10kg force).

WEIGHT (approx.)   600   g

NOTES

1. Luminance gain is defined as: $\dfrac{\pi . L_o}{E_i}$

   where L_o = luminance (cd/m^2) in a direction normal to the screen, measured with an eye-corrected photometer having an acceptance angle of less than 2 degrees.

   and E_i = illumination (lux) incident on a 19mm diameter concentric area of the cathode, produced by a tungsten lamp at a colour temperature 2850K.

2. The magnification of a 2mm diameter concentric circle on the photocathode, as measured on the screen.

3. Percentage distortion = $(\dfrac{M_d}{M_c} -1) \times 100$, where M_d is the magnification of a 20mm diameter concentric circle on the photocathode, as measured on the screen and M_c is the centre magnification at a distance of 1mm from the centre of the photocathode.

4. Measured at the centre of the photocathode.

5. Measured at the photocathode at a distance of 7mm from the centre.

6. The value of input illumination required to give an increase in screen luminance equivalent to the background luminance.

7. The screen luminance ratio is defined as the ratio of the maximum and minimum screen luminance over a 20mm diameter concentric area on the screen, for uniform cathode illumination.

8. Intermittent flashes producing much higher cathode illuminations are allowed, but the tube must not be used in full daylight.

Mullard

OUTLINE DRAWING OF 50MXX

Dimensions in mm

Mullard

50MXX Page 4

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CURVES

Mullard

PHOTOMULTIPLIER TUBES 56TUVP 56TVP

QUICK REFERENCE DATA

56TUVP 14 stage photomultiplier tube with quartz window, intended for use in applications such as telecommunications and ranging, and in optical experiments where a high sensitivity in the whole visible and ultra-violet regions is required, combined with a high degree of time definition.

56TVP 14 stage photomultiplier tube intended for use in laser applications, working in the orange, yellow and green range.

Spectral response	56TUVP	Type TU (extended S20)
	56TVP	Type T (S20)
Photocathode useful diameter	42	mm
Gain (at V_b = 2.5kV)	10^8	

Unless otherwise stated, data is applicable to both types

This data should be read in conjunction with
OPERATING NOTES - PHOTOMULTIPLIER TUBES

PHOTOCATHODE

Surface	semi-transparent, sodium potassium caesium antimony	
Minimum useful diameter	42	mm
Spectral response 56TUVP	Type TU (extended S20)	
56TVP	Type T (S20)	
Wavelength at maximum response	420 ±30	nm
*Luminous sensitivity		
average	115	μA/lm
minimum	90	μA/lm
Average radiant sensitivity at		
420nm	65	mA/W
700nm	12	mA/W

*Measured using a tungsten lamp of colour temperature 2854K.

MULTIPLIER SYSTEM

Number of stages	14
Dynode material	silver magnesium oxygen caesium

Mullard

CHARACTERISTICS

VOLTAGE DIVIDER AS IN FIG. 1

Supply voltage for gain = 10^8

average	2.5	kV
maximum	2.75	kV
*Maximum dark current at gain = 10^8	5.0	μA
Maximum anode pulse amplitude for linearity with input light pulse	100	mA

*Measured at 25°C

VOLTAGE DIVIDER AS IN FIG. 2   ←

Maximum anode pulse amplitude for linearity with input light pulse	300	mA
Anode pulse rise time (at V_b = 2.5kV)	2.0	ns
Anode pulse width at half height (at V_b = 2.5kV)	3.5	ns
Maximum transit time difference between the centre of the photocathode and 18mm from the centre (at V_b = 2.5kV)	0.8	ns
Total transit time (at V_b = 2.5kV)	43	ns
Maximum peak current	0.5 to 1.0	A

Note - These time characteristics are for an infinitely short light pulse, fully illuminating the photocathode.
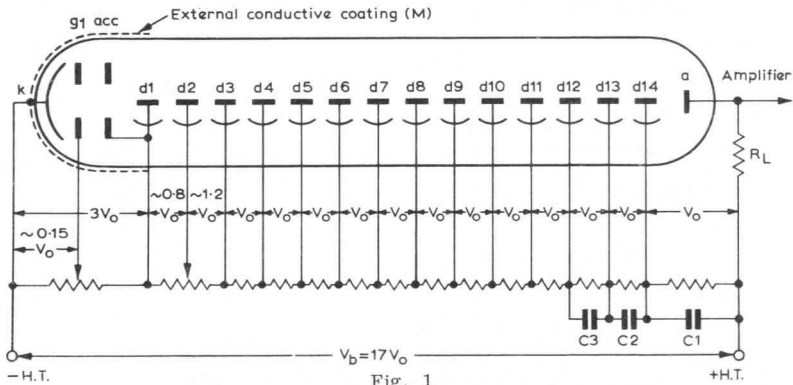
Fig. 1

Mullard
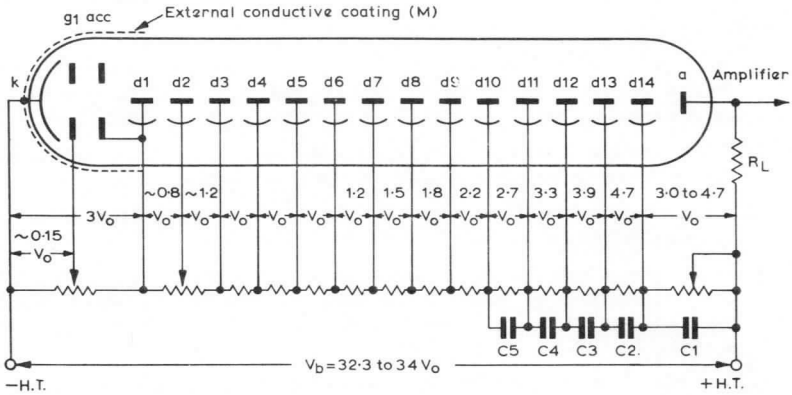
Fig. 2

The voltage between the cathode and the focusing electrode (g1) should be adjusted around $0.15V_o$; the voltage between d1 and d2 should be adjusted around $0.8V_o$.

$C_1 = 100q/V_o$, $C_2 = 100q/3V_o$, $C_3 = 100q/9V_o$, $C_4 = 100q/27V_o$, etc., where
    q = quantity of electricity transported by the anode

CAPACITANCES

c_{g1-acc}	25	pF
c_{a-d14}	7.0	pF
c_{a-all}	9.5	pF

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

*V_b max.	2.75	kV
I_a max. (continuous operation)	0.2	mA ←
V_{k-d1} max.	800	V
V_{k-d1} min.	250	V
V_{k-g1} max.	100	V
V_{d1-d2}·········$_{d13-d14}$ max.	500	V
V_{d1-d2}·········$_{d13-d14}$ min.	80	V
**V_{a-d14} max.	500	V
**V_{a-d14} min.	80	V

*Or the voltage at which the tube, when used in the circuit of Fig. 1, has a gain of about 10^9, whichever is the lower.
**When calculating the anode voltage, the voltage drop across the load resistance should not be overlooked.

Mullard

ACCESSORIES (supplied as additional items)

OPERATING NOTES

1. To achieve a stability of about 1% the ratio of the current through the voltage divider bridge to that through the heaviest loaded stage of the tube should be approximately 100.

2. The last stages of the tube must be decoupled by means of capacitors to avoid a serious voltage drop on the dynodes. A typical value for C_1 is 2nF.

3. It is advisable to screen the tube with a mu-metal cylinder against the influence of magnetic fields.

4. In the case of high counting rates and large peak outputs, and to avoid a high tension supply of large power, it is possible to supply the first stages with a high tension of low output power and the last stages with an average voltage of high output.

5. To avoid electric field distortion in the electron optical system, the external conductive coating, M (pin no. 18), must be connected to a point whose potential is close to that of the cathode.

6. If the cathode is connected to negative high tension, precautions should be taken to ensure adequate high tension insulation between the external conductive coating and the mu-metal shield.

7. Different types of voltage dividers are possible. The voltage divider in Fig.1 has the higher gain, while a higher anode current with better time characteristics can be obtained when the tube is connected as in Fig.2.

56TUVP has a quartz window

External conductive coating (M)

Incident radiation

Ø52.5 max.

Ø42 min

R=69max

170 ±5

192 max

Ø51.8 max

IC a d14 d12
d13 d10
d11 d8
d9 d6
d7 d4
d5 d2
d3 M
acc,d1 IC k g1

Special 20 pin base
Socket type FE1003

All dimensions in mm
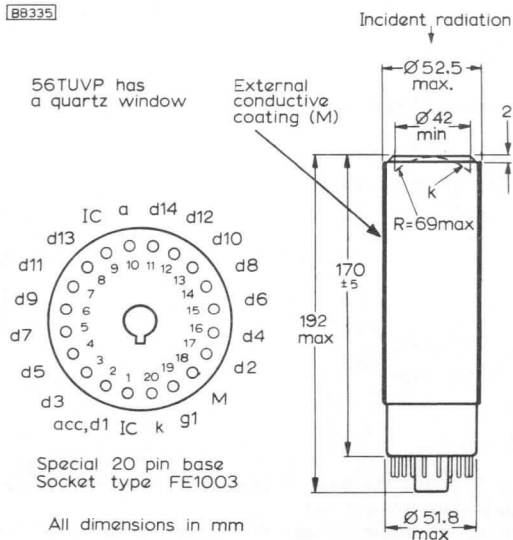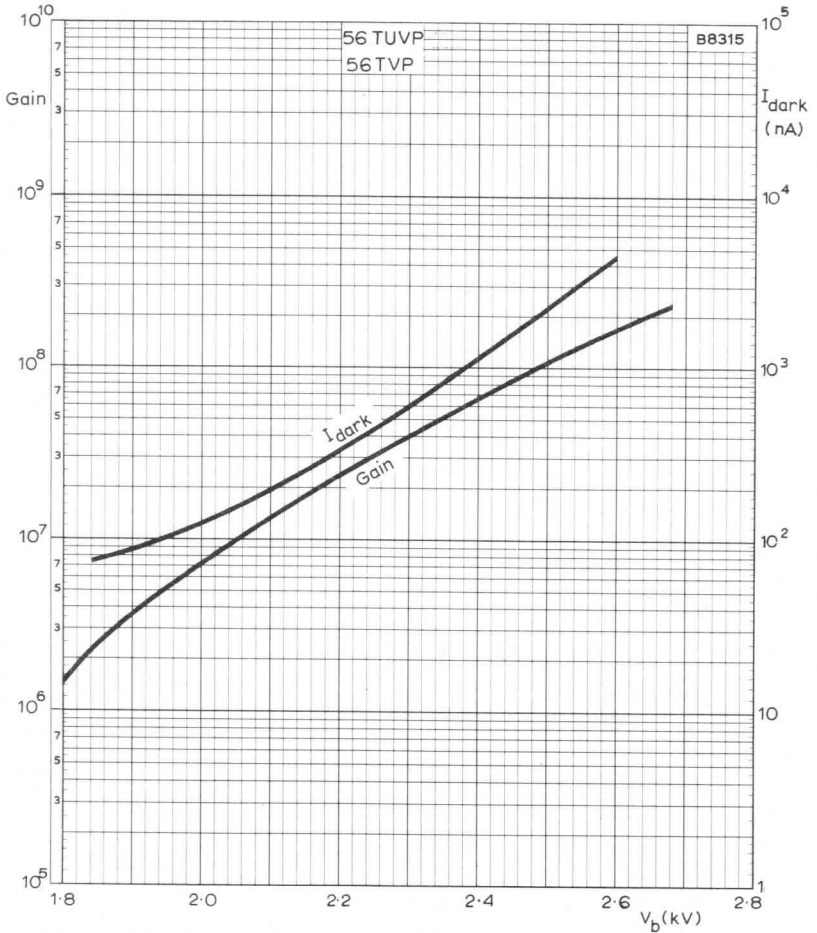
Mullard

GAIN AND DARK CURRENT
AS A FUNCTION OF TOTAL VOLTAGE

Mullard

DEVELOPMENT SAMPLE DATA

The OTH800 series is a range of compact ignistors consisting of two silicon thyristors in inverse parallel connection. The disc-type thyristors are mounted between water-cooled heat exchangers. The cooling chambers can be connected in series in the water circuit, thus avoiding problems of unequal flow that can occur in parallel water circuits. The devices are especially intended for power switching e.g. resistance welding.

QUICK REFERENCE DATA

		OTH800 –	800	1000	1200	1400	
V_{DRM}	max.		800	1000	1200	1400	V
V_{DWM}	max.		600	700	800	1000	V
$I_{T(RMS)}$	max. ($T_{water} = 40^{o}C$, water flow = 4 ℓ/min)				800		A
I_{TSM}	max. (t = 10ms, T_j = 125°C prior to surge)				5000		A
T_j	max.				125		^{o}C
$\dfrac{dI_T}{dt}$	max.				100		A/μs
$\dfrac{dV_D}{dt}$	max.				300		V/μs

Unless otherwise stated data are applicable to all types in the series

OUTLINE AND DIMENSIONS

For details see page 2

CIRCUIT DIAGRAM

Mullard

OUTLINE AND DIMENSIONS

All dimensions in millimetres

150
120
11
92
30 11.5
60
00 00
70mm²
100
176
thickness 7mm
48
12
8.5
23
25
R7
85
61
37
13
6
85
D3966

IGNISTORS

OTH800
Series

RATINGS

Limiting values of operation according to the absolute maximum system

Electrical

ANODE TO CATHODE		OTH800 –	800	1000	1200	1400	
V_{DSM} max.	Non-repetitive peak off-state voltage ($t \leq 10$ms)		800	1000	1200	1400	V
V_{DRM} max.	Repetitive peak off-state voltage ($d \leq 0.01$)		800	1000	1200	1400	V
V_{DWM} max.	Crest working off-state voltage	600	700	800	1000		V
$I_{T(RMS)}$ max.	R.M.S. on-state current at $T_{water} = 40^{o}$C, water flow = 4ℓ/min.			800			A
I_{TSM} max.	Non-repetitive peak on-state current ($t = 10$ms, half sine wave) $T_j = 125^{o}$C prior to surge			5000			A
I^2t max.	I^2t for fusing ($t = 10$ms)			125 000			$A^2 s$
$\dfrac{dI_T}{dt}$ max.	Rate of rise of on-state current after triggering with $I_G = 1.0$A, $dI_G/dt = 1.0$A/μs			100			A/μs

GATE TO CATHODE			
V_{RGM} max.	Peak reverse voltage	5.0	V
I_{FGM} max.	Peak forward current	4.0	A
$P_{G(AV)}$ max.	Average power dissipation	3.0	W
P_{GM} max.	Peak power dissipation	16	A
Temperature			
T_j	Junction temperature	125	^{o}C

THERMAL CHARACTERISTIC

$R_{th(j-w)}$	Thermal resistance from junction to water at 4ℓ/min per cell	0.13	^{o}C/W

Mullard

ELECTRICAL CHARACTERISTICS

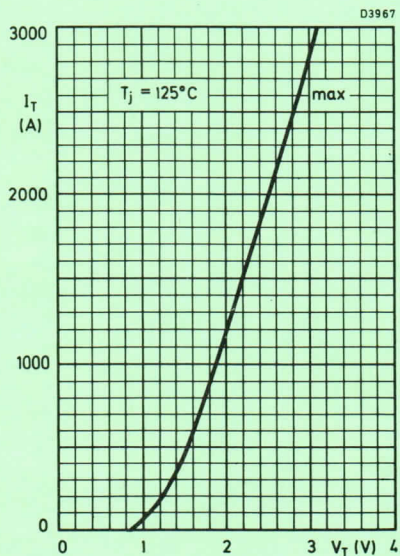|		Min.	Typ.	Max.	
ANODE TO CATHODE					
V_T	On-state voltage $I_T = 625A$, $T_j = 25^{\circ}C$	–	–	1.55	V
$\dfrac{dV_D}{dt}$	Rate of rise of off-state voltage that will not trigger the device (exponential up to 2/3 V_{DRM} max), $T_j = 125^{\circ}C$	–	–	300	V/μs
I_{RM}	Peak reverse current at $T_j = 125^{\circ}C$	–	–	15	mA
I_{DM}	Peak off-state current at $T_j = 125^{\circ}C$	–	–	15	mA
I_H	Holding current at $T_j = 25^{\circ}C$	–	100	–	mA
I_L	Latching current at $T_j = 25^{\circ}C$	–	140	–	mA
GATE TO CATHODE					
V_{GT}	Minimum voltage that will trigger all devices at $T_j = 25^{\circ}C$	3.0	–	–	V
V_{GD}	Maximum voltage that will not trigger any device, $V_D = V_{DRM}$ max., $T_j = 125^{\circ}C$	–	–	0.15	V
I_{GT}	Minimum current that will trigger all devices at $T_j = 25^{\circ}C$	150	–	–	mA
Switching characteristics					
t_{on}	Turn-on time when switched from V_{DWM} to $I_T = 100A$, $I_{GT} = 1A$, $dI_G/dt = 1A/\mu s$, $T_j = 25^{\circ}C$	–	5.0	–	μs
t_q	Circuit-commutated turn-off time when switched from $I_T = 150A$ to $V_R \leq 50V$ with $-dI_T/dt = 50A/\mu s$, $dV_D/dt = 20V/\mu s$, $T_j = 125^{\circ}C$	–	100	–	μs

WATER TEMPERATURE RISE

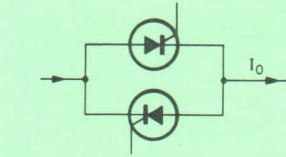Max. rise of water temperature
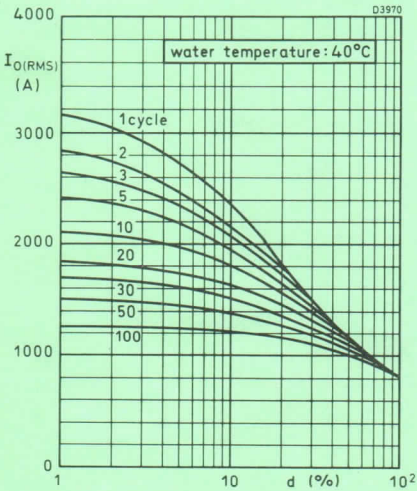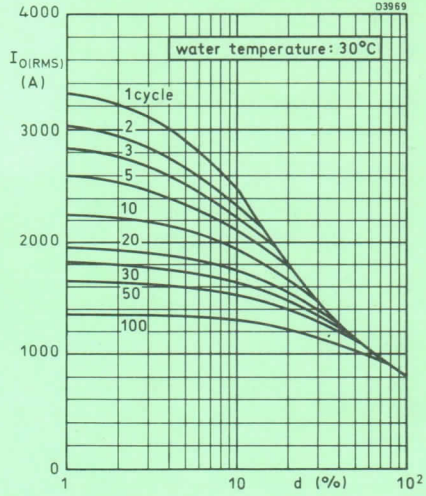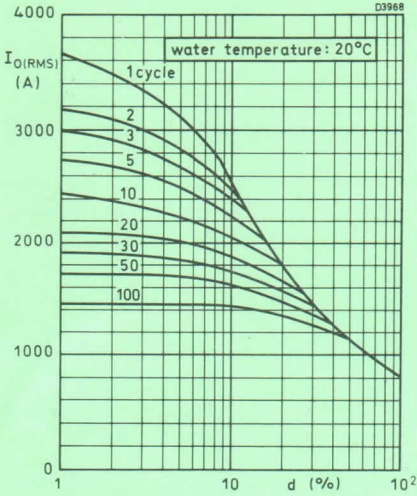4 ℓ/min (both heatsinks in series)

$$\Delta T = T_{out} - T_{in} < 6^{\circ}C$$

COOLING WATER

The cooling water must satisfy the following requirements as regards the content of solids and soluble chemicals:

1. pH value: 7 to 9

2. Max. weight of chlorides per litre: 20mg
   Max. weight of nitrates per litre: 10mg
   Max. weight of sulphates per litre: 100mg

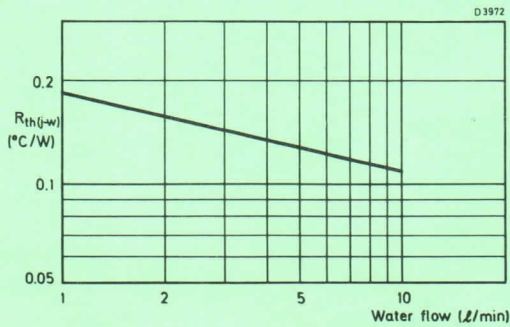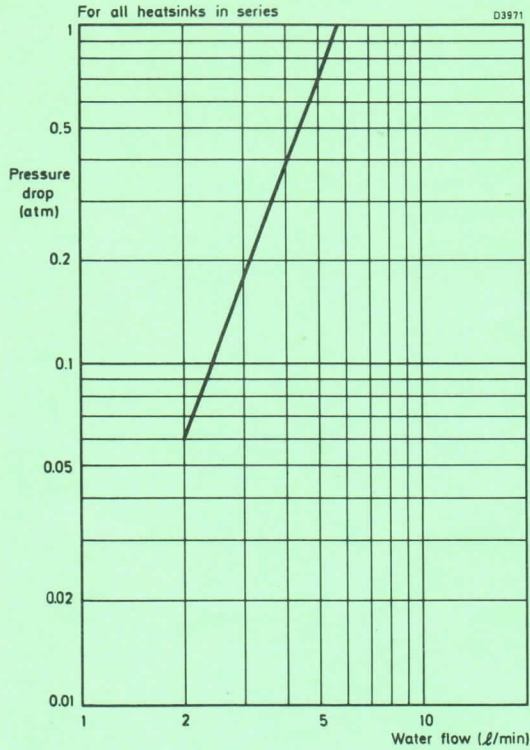3. Max. weight of insolubles per litre: 250mg

D3967

I_T (A) vs V_T (V), $T_j = 125°C$, max

Chart D3968 — water temperature: 20°C — $I_{O(RMS)}$ (A) vs d (%), curves for 1 cycle, 2, 3, 5, 10, 20, 30, 50, 100

Chart D3969 — water temperature: 30°C — $I_{O(RMS)}$ (A) vs d (%), curves for 1 cycle, 2, 3, 5, 10, 20, 30, 50, 100

Chart D3970 — water temperature: 40°C — $I_{O(RMS)}$ (A) vs d (%), curves for 1 cycle, 2, 3, 5, 10, 20, 30, 50, 100

$$d = \frac{t_p}{T} \times 100\%$$

D3963

Conduction angle : 360°
water flow   : 4ℓ/min

Mullard

For all heatsinks in series   D3971

Pressure drop (atm) vs Water flow (ℓ/min)

D3972

$R_{th(j-w)}$ (°C/W) vs Water flow (ℓ/min)

Mullard
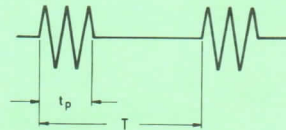
IGNISTORS

OTH1200
Series

The OTH1200 series is a range of compact ignistors consisting of two silicon thyristors in inverse parallel connection. The disc-type thyristors are mounted between water-cooled heat exchangers. The cooling chambers can be connected in series in the water circuit, thus avoiding problems of unequal flow that can occur in parallel water circuits. The devices are especially intended for power switching e.g. resistance welding.
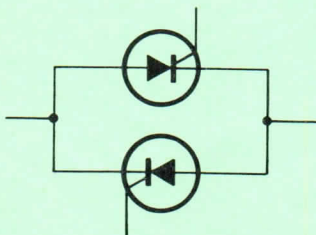
QUICK REFERENCE DATA						
		OTH1200 −	800	1000	1200	1400	
V_{DRM}	max.		800	1000	1200	1400	V
V_{DWM}	max.		600	700	800	1000	V
$I_{T(RMS)}$	max. ($T_{water} = 40^{o}C$, water flow = $4\,\ell/min$)			1200			A
I_{TSM}	max. ($t = 10ms$, $T_j = 125^{o}C$ prior to surge)			7000			A
T_j	max.			125			^{o}C
$\dfrac{dI_T}{dt}$	max.			100			$A/\mu s$
$\dfrac{dV_D}{dt}$	max.			300			$V/\mu s$

Unless otherwise stated data are applicable to all types in the series

OUTLINE AND DIMENSIONS

For details see page 2

CIRCUIT DIAGRAM

Mullard
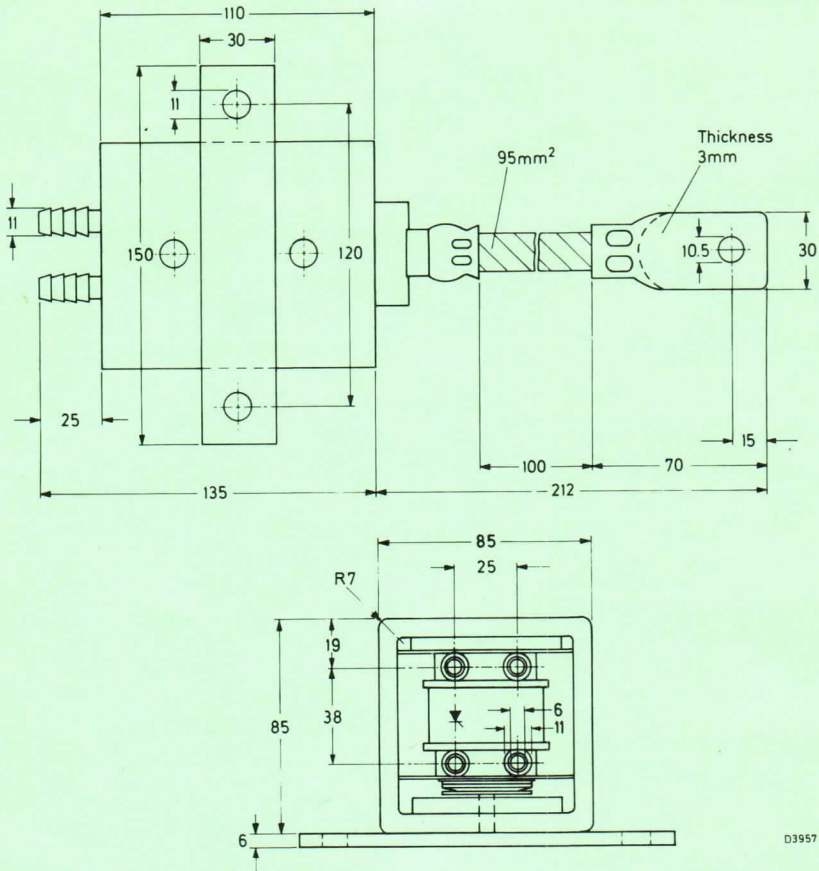
OUTLINE AND DIMENSIONS

All dimensions in millimetres

All dimensions in mm

D3957

MECHANICAL DATA

Vibration	10 to 150Hz with 5g
Shock	10g

Note.

Hose connectors with standard thread can be supplied on request.

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

ANODE TO CATHODE		OTH1200 –	800	1000	1200	1400	
V_{DSM} max.	Non-repetitive peak off-state voltage ($t \leq 10ms$)		800	1000	1200	1400	V
V_{DRM} max.	Repetitive peak off-state voltage ($d \leq 0.01$)		800	1000	1200	1400	V
V_{DWM} max.	Crest working off-state voltage		600	700	800	1000	V
$I_{T(RMS}$ max.	R.M.S. on-state current at $T_{water} = 40^{o}C$, water flow = $4\,\ell/min$			1200			A
I_{TSM} max.	Non-repetitive peak on-state current ($t = 10ms$, half sine wave) $T_j = 125^{o}C$ prior to surge			7000			A
I^2t max.	I^2t for fusing ($t = 10ms$)			245 000			A^2s
$\frac{dI_T}{dt}$ max.	Rate of rise of on-state current after triggering with $I_G = 1A$, $dI_G/dt = 1A/\mu s$			100			$A/\mu s$
GATE TO CATHODE							
V_{RGM} max.	Reverse peak voltage			5.0			V
I_{FGM} max.	Forward peak current			4.0			A
$P_{G(AV)}$ max.	Average power dissipation			3.0			W
P_{GM} max.	Peak power dissipation			16			W
Temperature							
T_j max.	Junction temperature			125			^{o}C

THERMAL CHARACTERISTIC

$R_{th(j-w)}$	Thermal resistance from junction to water at $4\,\ell/min$ per cell	0.1	$^{o}C/W$

Mullard

ELECTRICAL CHARACTERISTICS

ANODE TO CATHODE		Min.	Typ.	Max.	
V_T	On-state voltage $I_T = 625A$, $T_j = 25^{\circ}C$	–	–	1 3	V
$\dfrac{dV_D}{dt}$	Rate of rise of off-state voltage that will not trigger the device (exponential up to 2/3 V_{DRM}max) $T_j = 125^{\circ}C$	–	–	300	V/μs
I_{RM}	Peak reverse current at $T_j = 125^{\circ}C$	–	–	25	mA
I_{DM}	Peak off-state current at $T_j = 125^{\circ}C$	–	–	25	mA
I_H	Holding current at $T_j = 25^{\circ}C$	–	500	–	mA
I_L	Latching current at $T_j = 25^{\circ}C$	–	300	–	mA

GATE TO CATHODE					
V_{GT}	Minimum voltage that will trigger all devices at $T_j = 125^{\circ}C$	4 0	–	–	V
V_{GD}	Maximum voltage that will not trigger any device, $V_D = V_{DRM}$max $T_j = 125^{\circ}C$	–	–	0.15	V
I_{GT}	Minimum current that will trigger all devices at $T_j = 25^{\circ}C$	400	–	–	mA

Switching characteristics

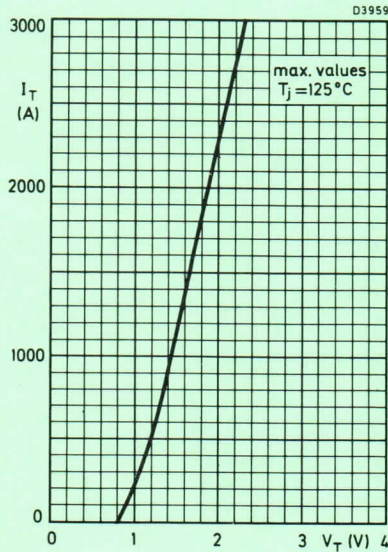| t_{on}	Turn-on time when switched to $I_T = 100A$, $I_{GT} = 1A$, $dI_G/dt = 1A/\mu s$, $T_j = 25^{\circ}C$	–	5 0	–	μs
t_q	Circuit-commutated turn-off time, when switched to $I_T = 150A$, $-dI_T/dt = 50A/\mu s$, $dV_D/dt = 20V/\mu s$, $T_j = 125^{\circ}C$	–	250	–	μs

Mullard

WATER TEMPERATURE RISE

Max. rise of water temperature
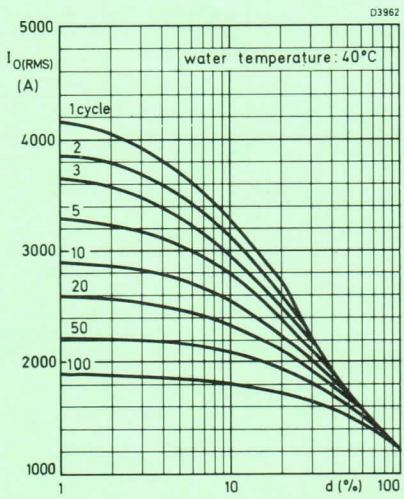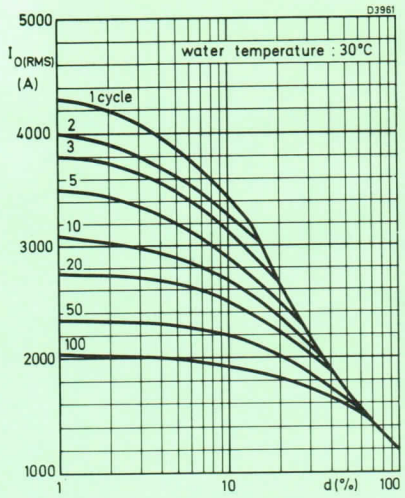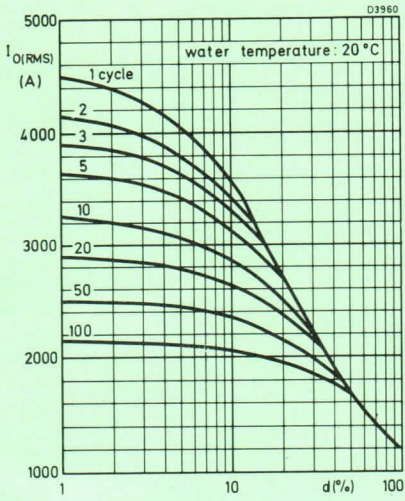at 4ℓ/min (both heatsinks in series) $\Delta T = T_{out} - T_{in} < 7.5^{o}C$

COOLING WATER

The cooling water must satisfy the following requirements as regards the content of solids and soluble chemicals:

1. pH value: 7 to 9

2. Max. weight of chlorides per litre: 20mg
   Max. weight of nitrates per litre: 10mg
   Max. weight of sulphates per litre: 100mg

3. Max. weight of insolubles per litre: 250mg

D3960

water temperature : 20 °C

D3961

water temperature : 30°C

D3962

water temperature : 40°C

$$d = \frac{t_p}{T} \times 100\%$$

D3963

Conduction angle : 360°
water flow : 4 ℓ/min

Mullard

For both heatsinks in series

D3964

Pressure
drop
(atm)

Water flow (ℓ/min)

D3965

$R_{th(j-w)}$
(°C/W)

Water flow (ℓ/min)

DEVELOPMENT SAMPLE DATA

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production
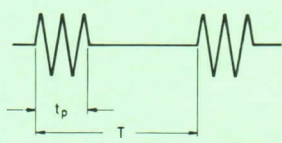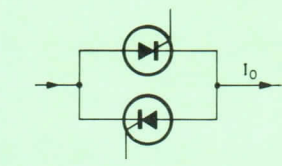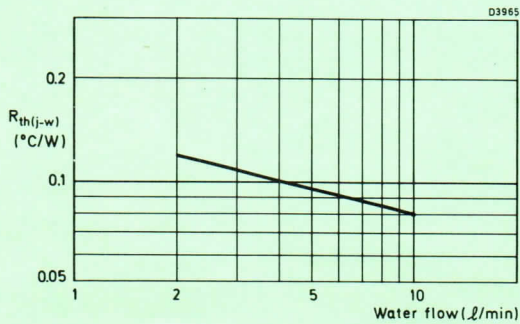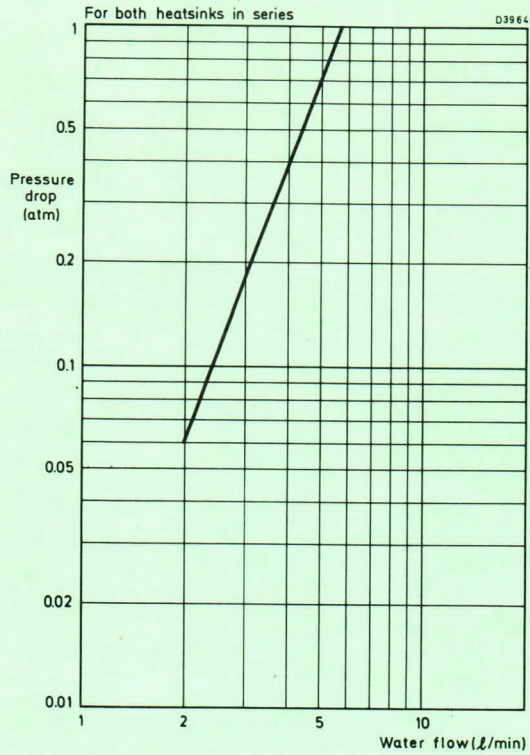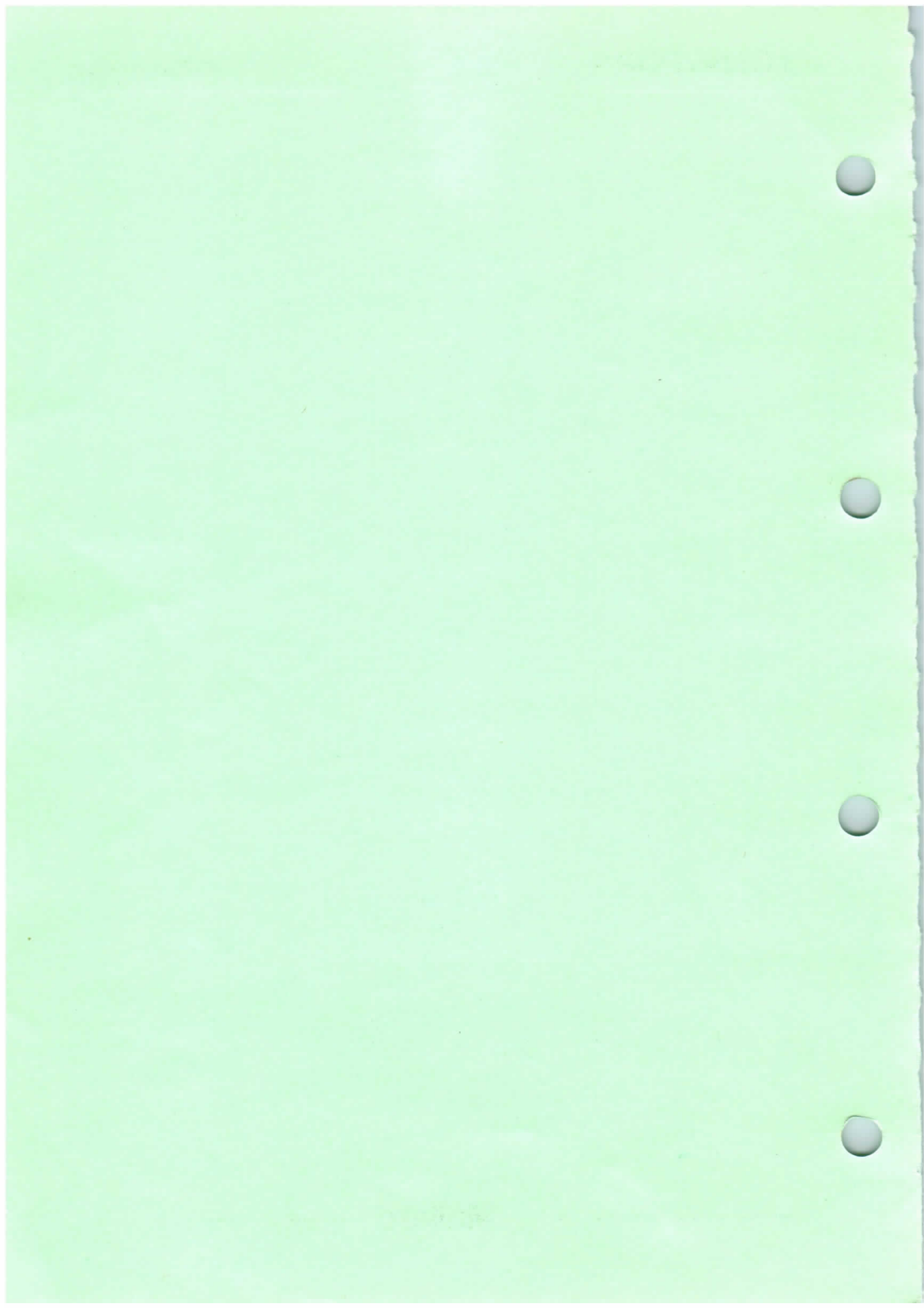
S58XQ

CAMERA TUBE

The S58XQ is an infrared sensitive pyroelectric vidicon TV camera tube. Provided with an infrared transmissive germanium window and thinned triglycine sulphate (TGS) target, this tube is sensitive to radiation in the 8 to 14 μm band. The 1-inch envelope incorporates a newly developed low beam temperature electron gun which reduces lag and improves dynamic resolution. The window is anti-reflective coated.

The tube is a hard-vacuum type in which the necessary pedestal current is produced electronically. This room temperature operation tube senses time varying changes in the thermal scene. Temporal change can be achieved by an image chopper or camera panning. Various signal processing techniques can be used to enhance the image quality.

The tube is intended for use in real time laser imagery, industrial process control, environmental monitoring, military and industrial surveillance.

QUICK REFERENCE DATA

Separate mesh	
Focusing	magnetic
Deflection	magnetic
Diameter	26,0 mm
Length	146 mm
Spectral response	8 to 14 μm
Heater	6,3 V, 100 mA

OPTICAL

|		
Dimension of useful area on photoconductive target		circle of 18 mm $\emptyset$
Dimensions of scanned area (4 : 3 aspect ratio, 10% overscan)		26,5 x 20 mm
Average δ of transfer characteristic		1
Spectral response		8 to 14 μm
Target reflectance	max.	20 %
Faceplate reflectance, optimized for 8 to 14 μm	max.	2 %

MECHANICAL DATA

Mounting position	any
Mass	approx. 70 g
Base	IEC67-I-33a (JEDEC E8-11)

Outline drawing
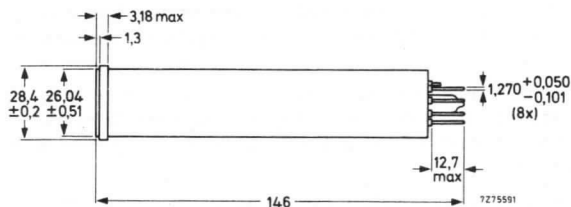
Dimensions in mm
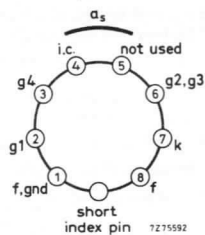
Fig. 1 The faceplate is typically 2 mm thick with a refractive index of 4,0 (germanium). The target is located max. 0,25 mm behind the inside of the faceplate.

Pin connections:
1. filament, common camera ground
2. grid 1
3. grid 4
4. internal connection
5.
6. grid 2, 3
7. cathode
8. filament
a_s. signal electrode (target)
S. short index pin

ACCESSORIES

Socket	Cinch no. 8VT or equivalent
Deflection and focusing coil	AT1116 or equivalent
FOCUSING	magnetic
DEFLECTION	magnetic

Mullard

ELECTRICAL DATA

Heating
Indirect by a.c. or d.c.

Heater voltage	V_f		6,3 V ± 5%
Heater current	I_f		100 mA

ELECTRON GUN CHARACTERISTICS

Cut-off

Grid 1 voltage for cut-off at V_{g2} = 280 V		>	−50 V
Blanking voltage, peak to peak at V_{g2} = 280 V, on grid 1		>	60 V
Grid 1 voltage, for normally beam current		typ.	15 V
Grid 1 current at normally required beam current			2 mA
Cathode voltage (for pedestal generation)			−50 to −110 V

CAPACITANCE

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

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

LIMITING VALUES (Absolute maximum rating system)

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

Signal electrode voltage (max. 5 min)	$-V_{as}$	max.	100	V
Grid 4 voltage	V_{g4}	max.	600	V
Grid 2, 3 voltage	$V_{g2,3}$	max.	350	V
Voltage between grid 4 and grid 3	$V_{g4/g3}$	max.	350	V
Grid 1 voltage,				
positive	V_{g1}	max.	30	V
negative	$-V_{g1}$	max.	100	V
Cathode-to-heater voltage,				
positive peak	V_{kfp}	max.	125	V
negative peak	$-V_{kfp}$	max.	120	V
Cathode heating time before drawing				
cathode current	T_h	min.	2	min
Cathode current	I_k	max.	5	mA
Faceplate temperature, storage and operation	t	max.	40	°C
Target temperature		max.	50	°C
Faceplate irradiance (8 to 14 μm), continuous		max.	40	W/m²
Cathode voltage,				
forward	V_k	max.	10	V
reverse	$-V_k$	max.	125	V

OPERATING CONDITIONS AND PERFORMANCE

Conditions

Cathode voltage			
forward scan	$\approx$ V_k	0	V
flyback	V_k	−100	V
Grid 1 voltage			
forward scan	V_{g1}	15	V
flyback	V_{g1}	−90	V
Grid 2, 3 voltage	$V_{g2,3}$	280	V
Grid 4 voltage	V_{g4}	400	V
Signal electrode voltage	V_{as}	−10	V
Pedestal current	I_b	100	nA
Faceplate temperature	t	30	°C
Target temperature		opt. 35	°C

Scan failure and blanking failure protection required.

Performance ; data based on U.S. = 525 line, 30 frame/s (operation)

When operated in a panned mode camera with a panning speed of 3 mm/s, the tube will typically have the following performance if:
- the lens has an aperture of f: 1
- scanned area 20 x 26,5 mm
- the scene contrast is 10 °C with reference to a 300 K black body source
- the camera has a bandwidth of 4 MHz
- imaged area Ø 18 mm
- 100 nA peak pedestal current

Sensitivity (peak, large area)	4,0 nA/°C
Responsivity	5,0 µA/W
Minimum resolvable temperature	0,5 °C at 200 TVL, see Fig. 3
Resolution, limiting ($\Delta T = 30$ °C)	300 TVL, see Fig. 2
Lag, residual signal after 50 ms	10%, 3rd field
	45%, 1st field
Uniformity of responsivity	± 25%
Uniformity of pedestal current	± 10%

SPURIOUS SIGNALS

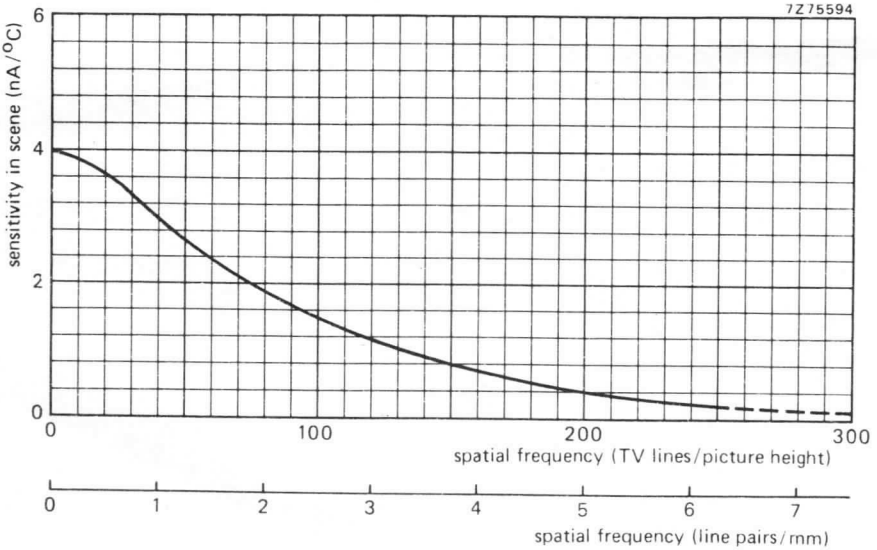See separate data: *Spurious signal specification pyroelectric vidicons.*

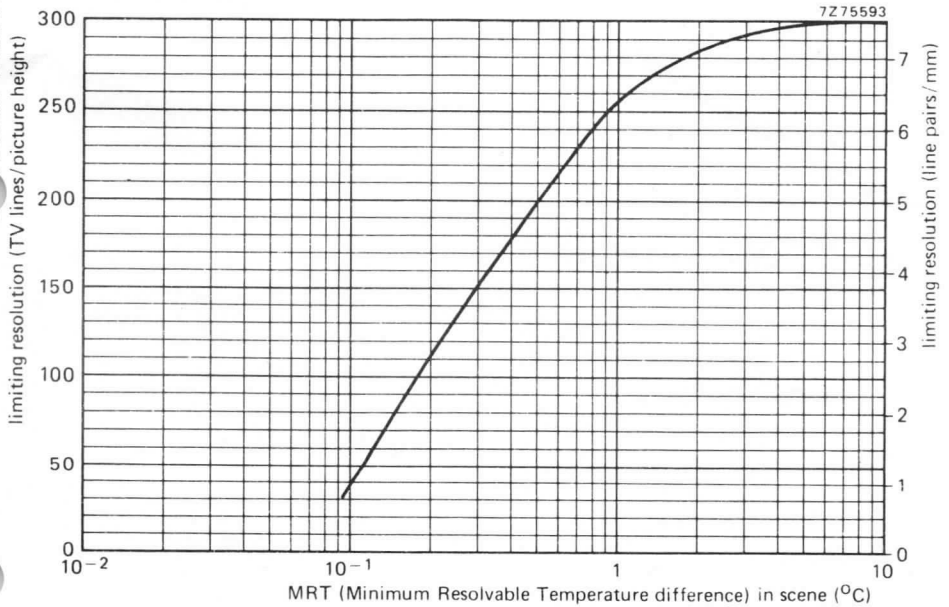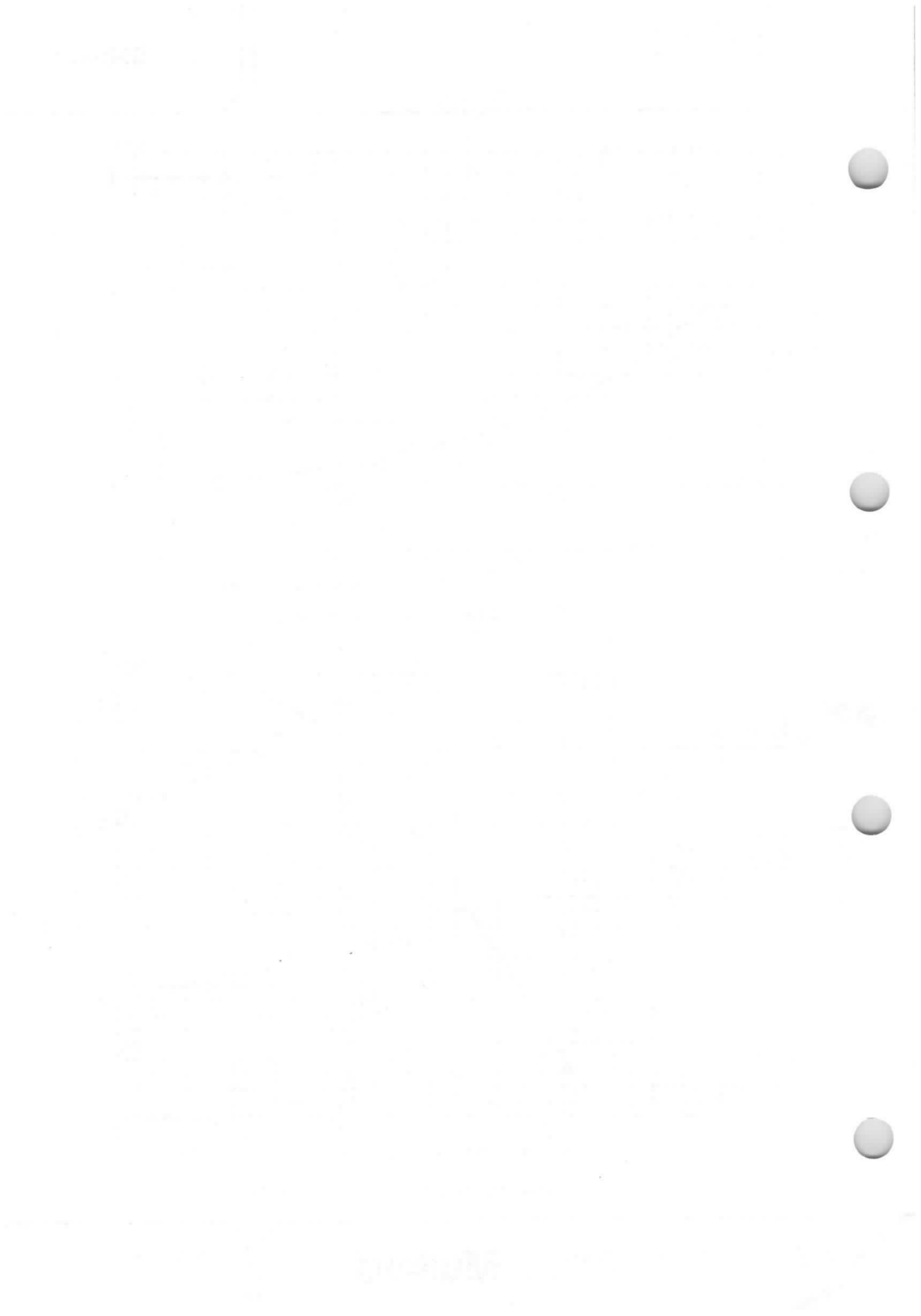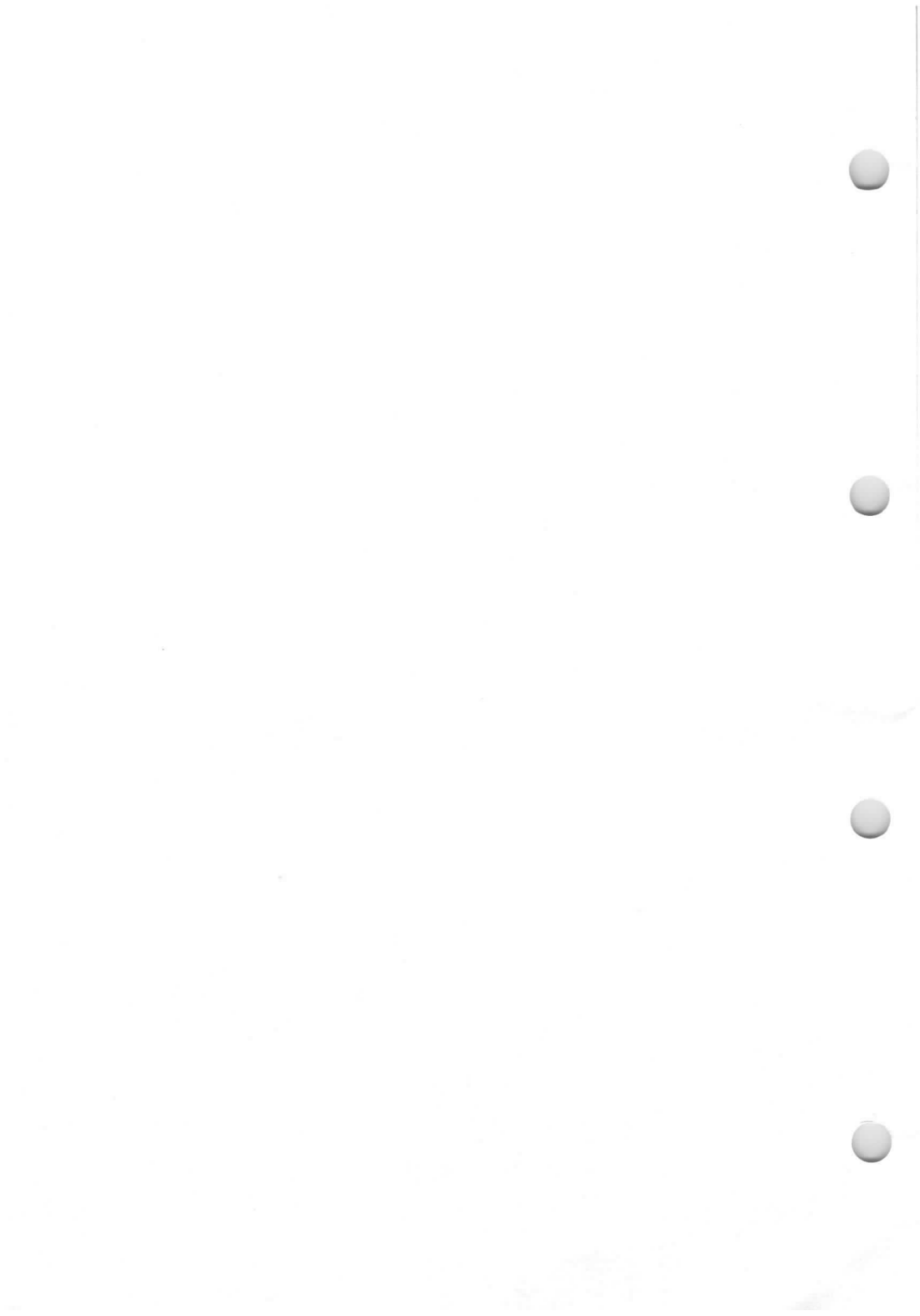Fig. 2 Typical spatial sensitivity characteristics.

Fig. 3 Typical limiting resolution as a function of MRT.

SINGLE CHANNEL ELECTRON MULTIPLIERS

Channel electron multipliers in the form of a glass planar spiral tube with a 10 mm diameter input cone.
The X919AL has an open-ended output.
The X919BL has a closed output.

QUICK REFERENCE DATA

Typical gain at 2.5 kV		2.0×10^8	
Typical resistance		6.0×10^8	Ω
Operating voltage	max.	4.0	kV

Unless otherwise stated, data is applicable to both types.
This data should be read in conjunction with GENERAL EXPLANATORY NOTES — CHANNEL ELECTRON MULTIPLIERS.

CHARACTERISTICS (measured at 2.5 kV and 10 000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	4.0	6.0	8.0	$\times 10^8 \ \Omega$
Gain (note 1)	1.0	2.0	—	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	—	0.15	0.5	pulse/s
Starting voltage with an equivalent threshold of 2.0×10^7 electrons	1.4	1.6	1.8	kV
Resolution (F.W.H.M.) at a modal gain of 2.0×10^8	—	50	70	%
Effective input diameter	9.0	10	—	mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Operating voltage	max.	4.0	kV
Temperature, operating and storage	max.	70	°C
Bake temperature in vacuo (note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50	mN/m²
		3.7×10^{-4}	torr

MASS

4.0   g

MOUNTING POSITION

Any. In environments where vibration may be encountered, the device should not be supported by the leads alone.

NOTES

1. The gain of a typical multiplier will increase by a factor of approx. 2 for an increase of operating voltage of 500 V.

2. X919 AL only: to ensure efficient collection of electrons, a collector should be used, biased at 100 to 200 V positive with respect to the multiplier output.

NOTES (continued)

3. Baking will cause a permanent slight loss of gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 ºC could reduce the gain by approximately a factor of 2.

MECHANICAL DATA   X919AL   Dimensions in mm

outer layer removed

Ø 4.5 max

11.4
10.0

1.8 max

8.0
5.0

29.0
26.0

* 1.0 x 0.1 Inconel strip
(length 50)

27.5
24.5

0.5 max

1.0 max

Ø 3.65 / 3.35 ext.

Ø 2.3 / 2.1 int.

35.5
34.5

M0208

Mullard

MECHANICAL DATA   X919BL

Dimensions in mm

Ø 4.5 max

outer layer removed

1.8 max

8.0
5.0

* 1.0 x 0.1 Inconel strip
(length 50)

27.5
24.5

35.5
34.5

11.4
10.0

29.0
26.0

0.5 max

Ø 3.65 / 3.35 ext.
Ø 2.3 / 2.1 int.

3.5 max

M0209

DEVELOPMENT SAMPLE DATA

This information is derived from development samples
made available for evaluation. It does not necessarily
imply that the device will go into regular production.

X919CL

SINGLE CHANNEL ELECTRON MULTIPLIER

Channel electron multiplier in the form of a glass planar spiral tube with a 10 mm diameter input cone
and a closed output.

QUICK REFERENCE DATA

Typical gain at 2.5 kV		1.5×10^8	
Typical resistance		7.5×10^8	Ω
Operating voltage	max.	4.0	kV

Unless otherwise stated, data is applicable to both types.
This data should be read in conjunction with GENERAL EXPLANATORY NOTES — CHANNEL
ELECTRON MULTIPLIERS.

CHARACTERISTICS (measured at 2.5 kV and 10 000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	6.0	7.5	9.0	$\times 10^8\ \Omega$
Gain (note 1)	0.8	1.5	—	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	—	0.15	0.5	pulse/s
Starting voltage with an equivalent threshold of 2.0×10^7 electrons	1.3	1.5	1.7	kV
Resolution (F.W.H.M.) at a modal gain of 2.0×10^8	—	50	70	%
Effective input diameter	9.0	10	—	mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Operating voltage	max.	4.0	kV
Temperature, operating and storage	max.	70	°C
Bake temperature in vacuo (note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50	mN/m²
		3.7×10^{-4}	torr

MASS

4.0 g

MOUNTING POSITION

Any. In environments where vibration may be encountered, the device should not be supported by the
leads alone.

NOTES

1. The gain of a typical multiplier will increase by a factor of approx. 2 for an increase of operating
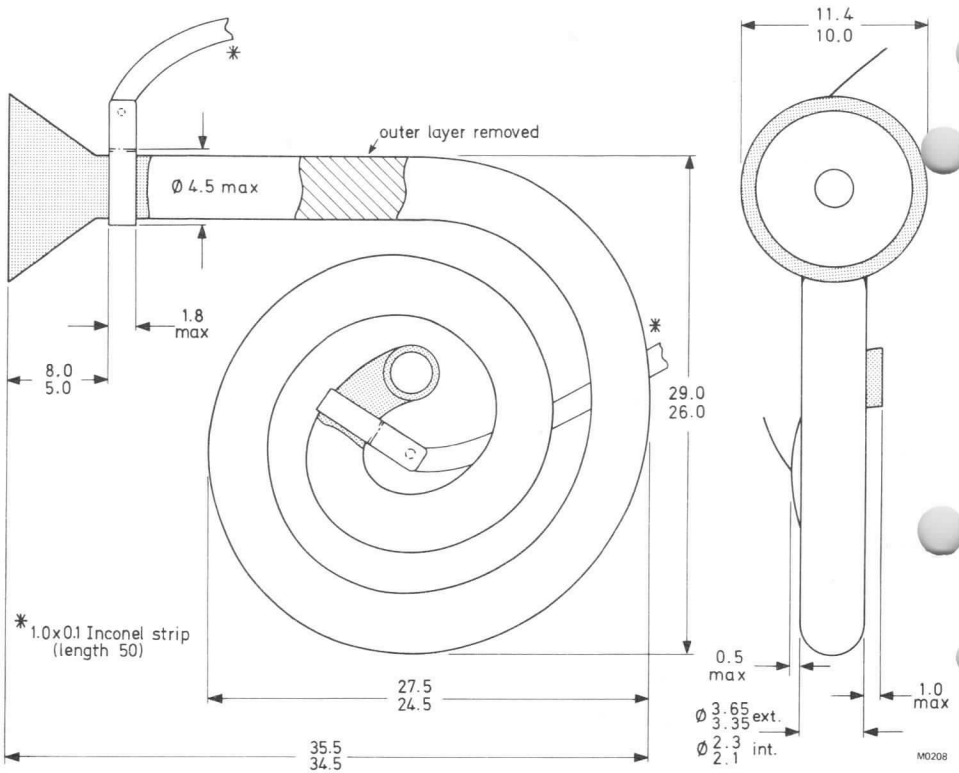   voltage of 500 V.

NOTES (continued)

2. Baking will cause a permanent slight loss of gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 $^\circ$C could reduce the gain by approximately a factor of 2.
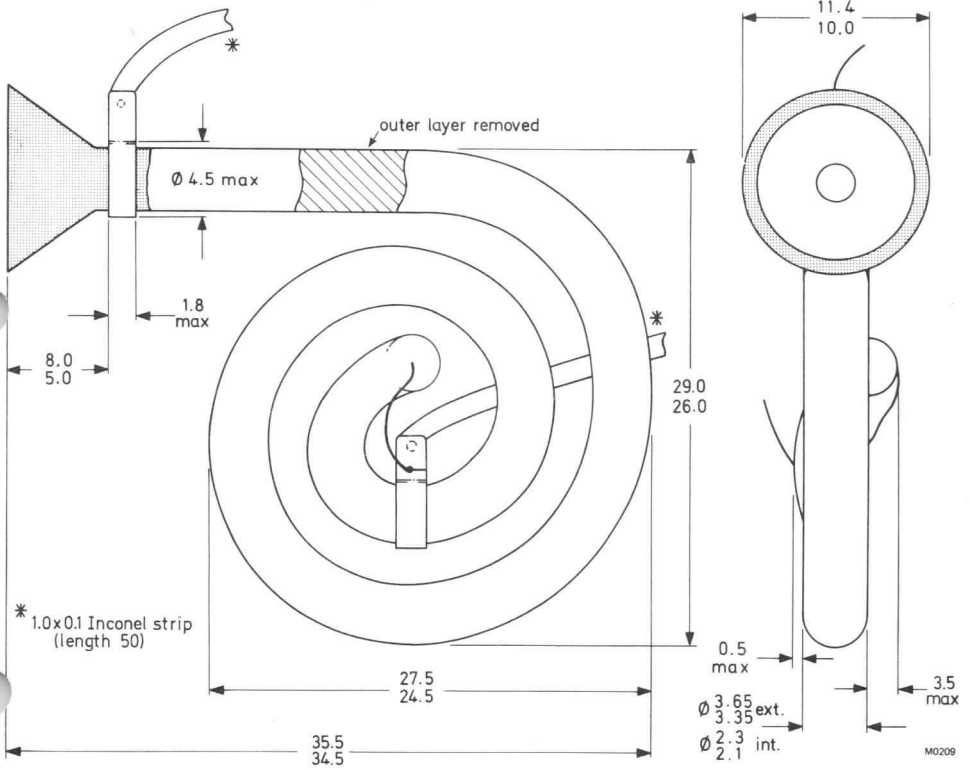
OUTLINE DRAWING   Dimensions in mm

outer layer removed

Ø 4.5 max

11.4
10.0

1.8 max

8.0
5.0

29.0
26.0

*
Ø 0.25 copper–nickel wire
(length 50)

*

27.5
24.5

35.5
34.5

Ø 3.65 / 3.35 ext.
Ø 2.3 / 2.1 int.

M0210

Mullard   M82-1191 Y

CAMERA TUBES
PLUMBICON*

<div align="right">

XQ1020
XQ1020L   XQ1020G
XQ1020R   XQ1020B

</div>

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	$6.3 \pm 5\%$	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

Mullard

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	^{o}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	$\mu A/lm$
XQ1020R	> 60	$\mu A/lm$
XQ1020G	> 125	$\mu A/lm$
XQ1020B	> 32	$\mu A/lm$

Mullard

CAMERA TUBES
PLUMBICON

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	^{o}C
Minimum	-30	^{o}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 XQ1020 L, R, G, B	AT1113/01

Mullard

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.

Mullard

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

All dimensions in mm

* Total glass thickness = 7.2 ± 0.2
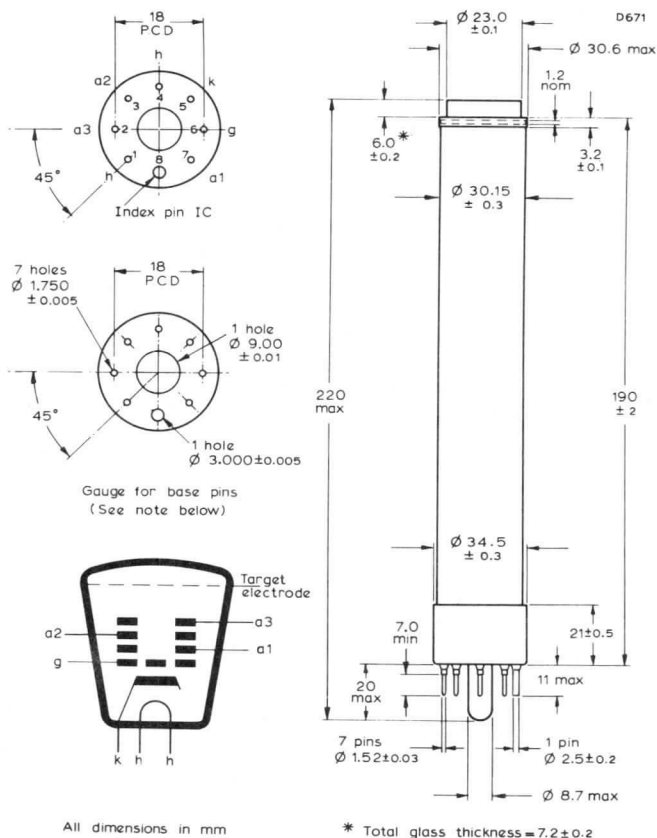
The maximum distance between the axis of anti-reflection glass disc and geometrical centre of the target electrode ring, measured in the plane of faceplate is 0.2mm. The base will fit a gauge as shown above. The holes in the gauge may deviate 0.01mm max. from their true geometric positions. The thickness of the gauge is 7mm. The ends of the pins are tapered or rounded but not brought to a sharp point.

Mullard

GENERAL OPERATIONAL RECOMMENDATIONS

Transport, handling and storage

During transport, handling or storage, the tube should be placed so that the face-plate 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.
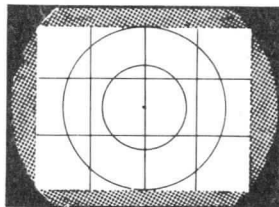
OPERATING INSTRUCTIONS

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.

Mullard

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.

Mullard

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.

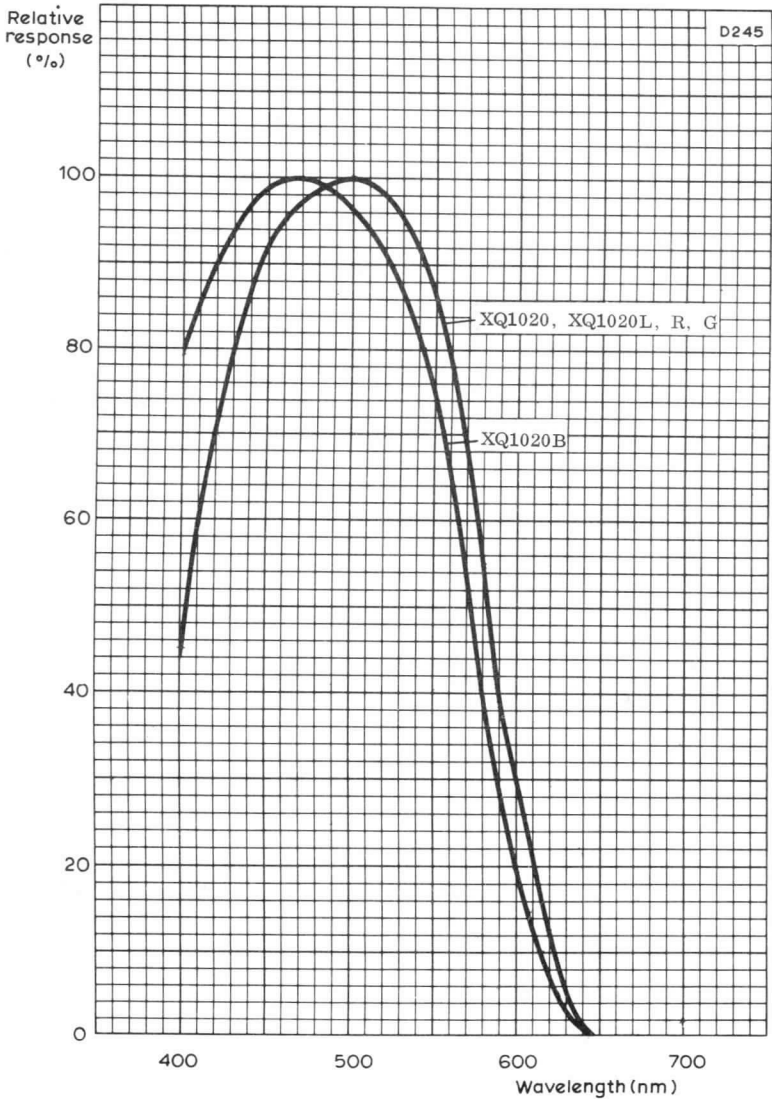Operate a3 at a voltage equal to or more positive than a2.

Avoid pointing the camera directly into the sun.

Keep the lens capped when transporting the camera.

Relative
response
(%)

D245   ←

100

80   XQ1020, XQ1020L, R, G

                                XQ1020B

60

40

20

0

400   500   600   700

Wavelength (nm)

TYPICAL SPECTRAL RESPONSE CURVES

Mullard

TRANSMISSION CURVES FOR SCHOTT FILTERS

Mullard
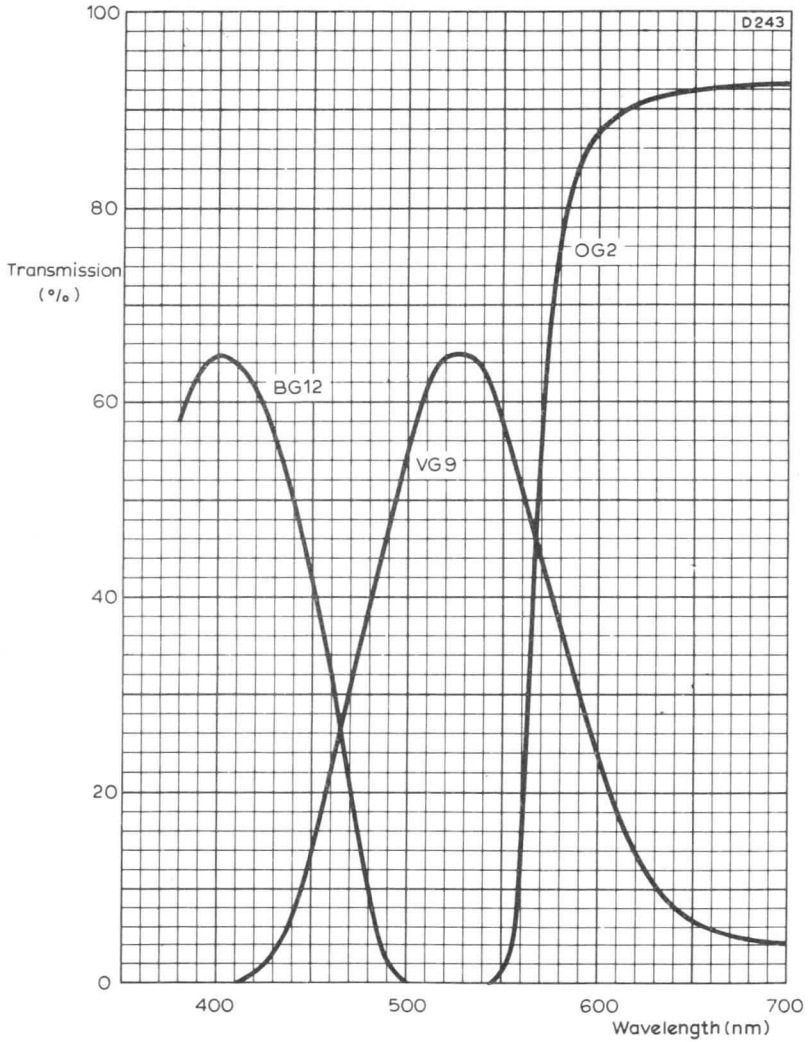
CAMERA TUBES
PLUMBICON*

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

Mullard

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	^oC

	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

Mullard

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	^{o}C
Minimum faceplate temperature (operation and storage)	-30	^{o}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}	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

Mullard

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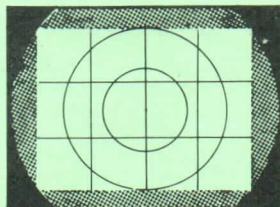   XQ1070 and /01G Schott VG9   thickness 1mm
        XQ1070 and /01B Schott BG12 thickness 3mm
    Transmission curves for these filters are given on page 10.

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} 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} (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 9.6×12.8mm 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.

OPERATING INSTRUCTIONS (contd.)

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 $(9.6 \times 12.8\text{mm})$ 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.

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
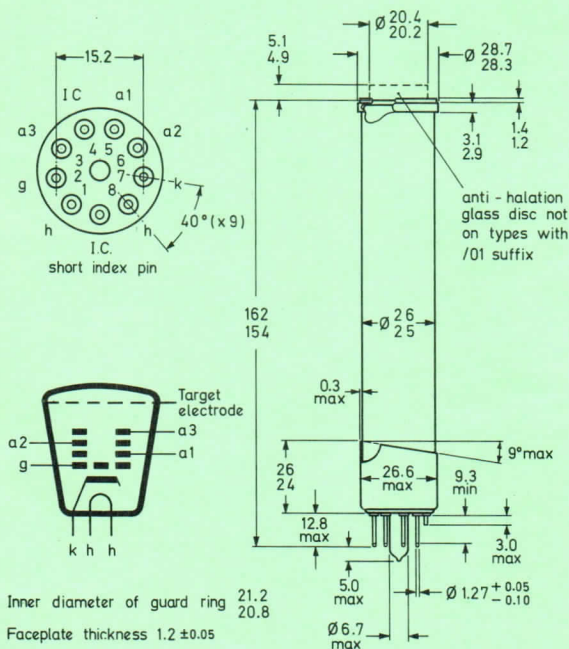
All dimensions in mm   D634

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.

GENERAL OPERATIONAL RECOMMENDATIONS

Transport, handling and storage

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

Base pins

The pins of this tube are of Kovar. Accordingly, care must be taken when the tube and socket are matched, in order to avoid damaging the pins or 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 deterio-rate 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.
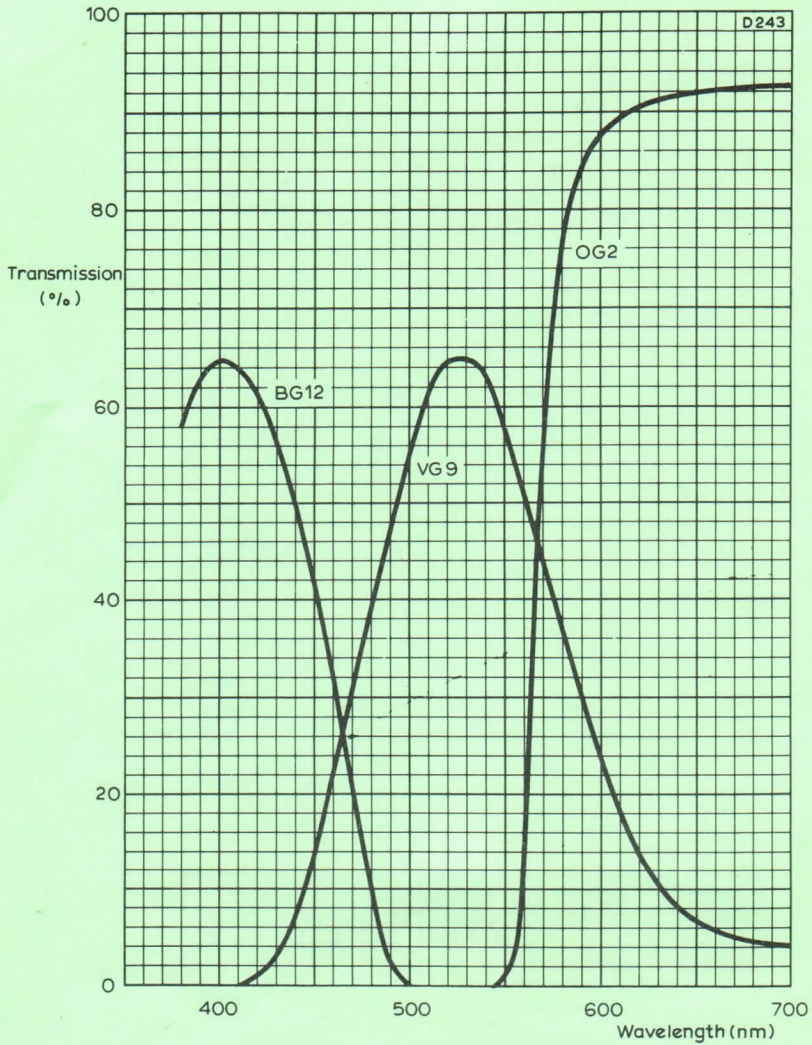
OPERATING INSTRUCTIONS

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.
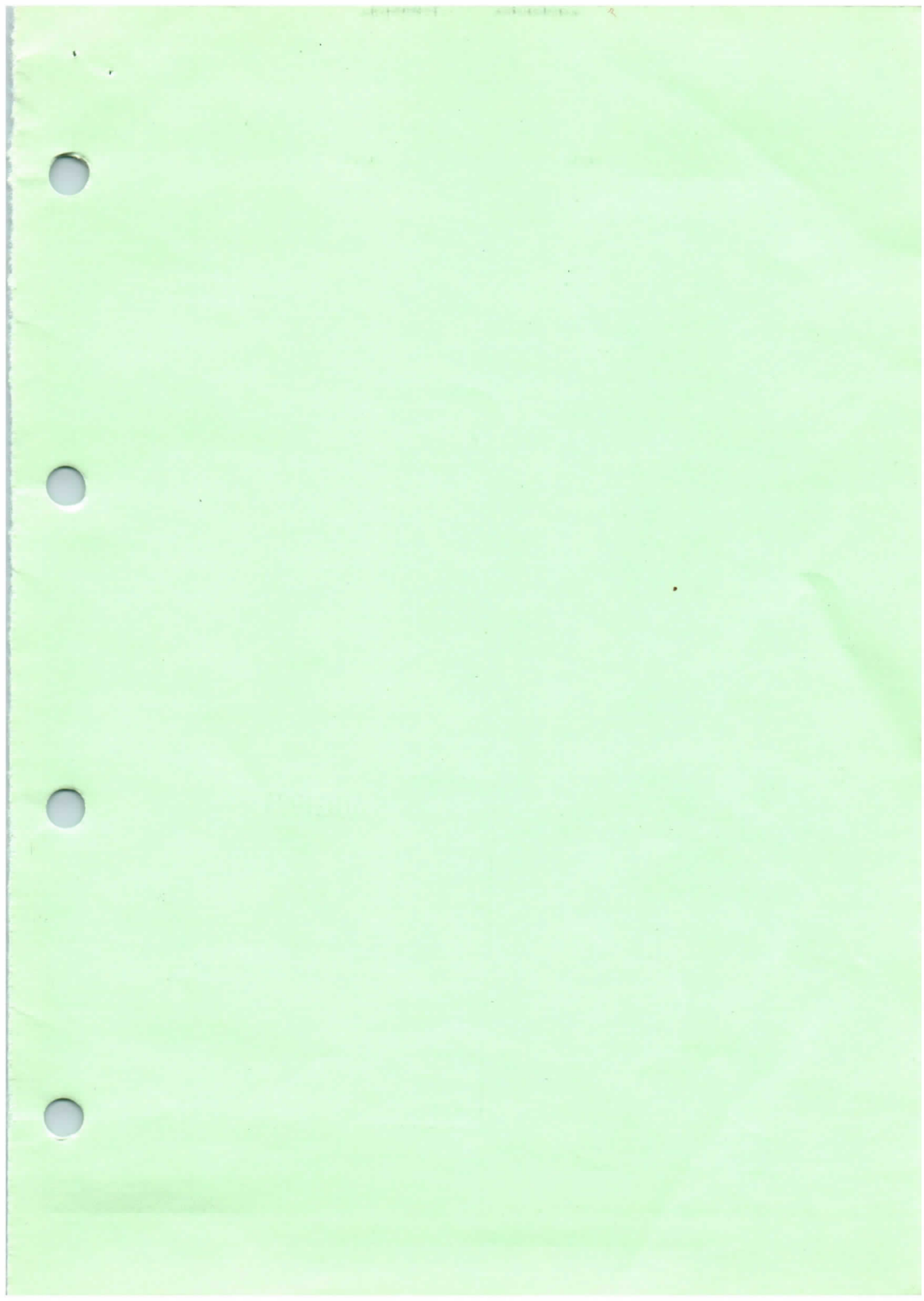
3. Cap the lens and close the iris.

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
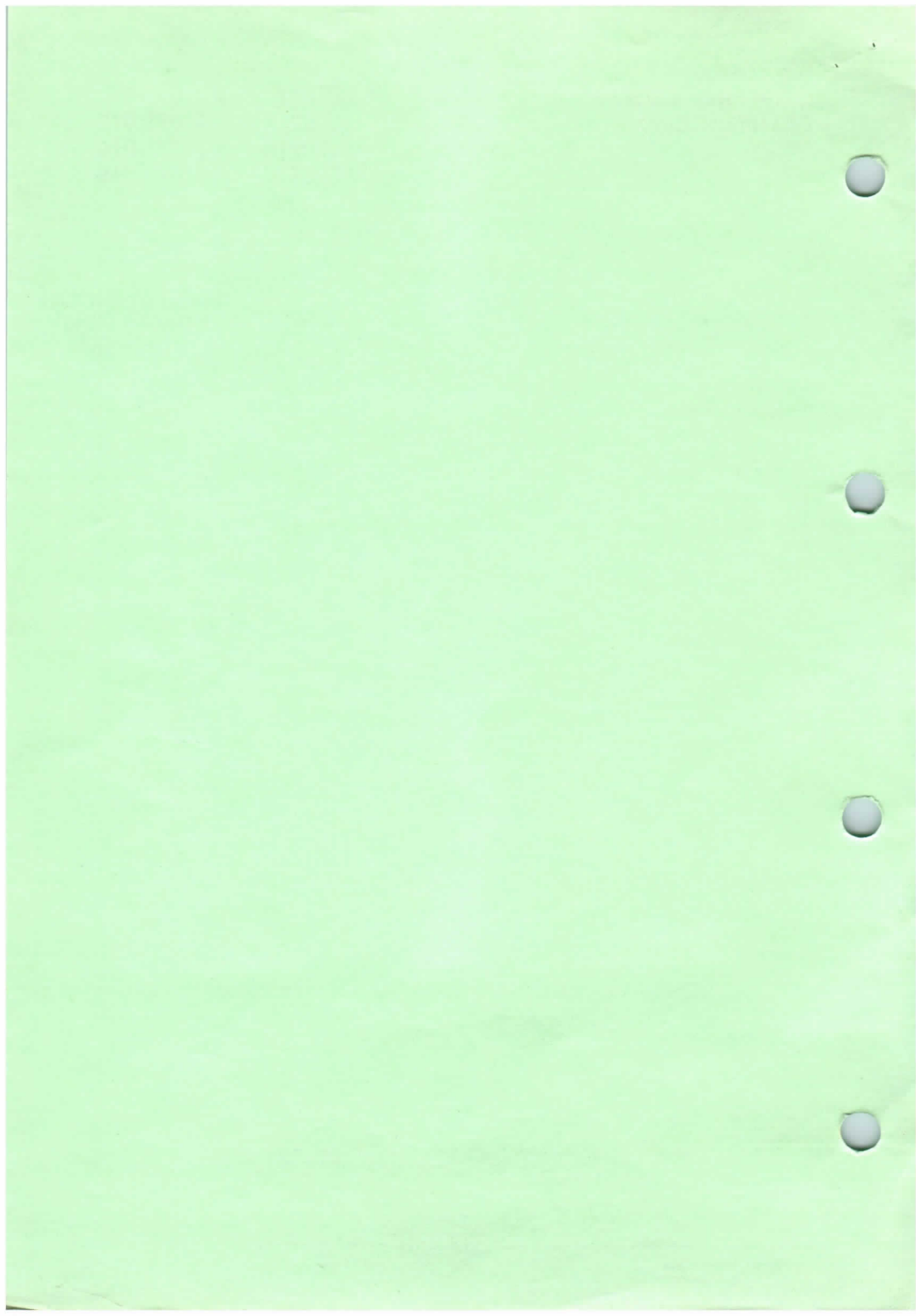
IMAGE INTENSIFIER ASSEMBLY XX1063

QUICK REFERENCE DATA

High gain self-focusing image intensifier assembly with automatic brightness control for night vision systems.

Typical luminance gain	30 000	
Photocathode	S20 with enhanced red response	
Screen phosphor	P20	
Useful cathode and screen diameters	25	mm
Supply voltage	6.75	V
Overall dimensions (approx.)	Ø70 × 195	mm
Weight (approx.)	900	g

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - IMAGE INTENSIFIER AND IMAGE CONVERTER TUBES

PHOTOCATHODE

Surface	S20 with enhanced red response	
Wavelength at maximum response	500	nm
Minimum useful diameter	25	mm
External surface of cathode window	flat to within 20μm over entire diameter	

SCREEN

Surface	metal-backed P20	
Fluorescent colour	yellow-green	
Overall persistence	medium	

The screen luminance falls to 36% (e^{-1}) of the initial peak value 5ms after the excitation is removed.

Minimum useful diameter	25	mm
External surface of screen window	flat to within 20μm over entire diameter	

FOCUSING

Self-focusing electrostatic with image inversion

Mullard

CHARACTERISTICS (measured at $V_{supply} = 6.75V$, $T_{amb} = -50$ to $+30^{\circ}C$)

Typical luminance gain measured with photocathode illumination of 0.2mlux (see note 1)	30 000	
Minimum photocathode sensitivity (measured using a tungsten lamp of colour temperature 2850K)	175	$\mu A/lm$
Minimum radiant sensitivity at $\lambda = 800nm$	10	mA/W
at $\lambda = 850nm$	3.0	mA/W
Minimum screen luminance for 10 lux photocathode illumination	10	cd/m^2
Centre magnification, M_c (see note 2)	0.91 ± 0.09	
Maximum distortion (see note 3)	25	%
Minimum centre resolution (see note 4)	25 line pairs/mm	
Minimum edge resolution (see note 5)	23 line pairs/mm	
Minimum contrast transfer at cathode centre		
at 2.5 line pairs/mm	85	%
at 7.5 line pairs/mm	60	%
at 16 line pairs/mm	10	%
Maximum background equivalent illumination (see note 6)	0.2	μlux

Axial eccentricity

A point at the centre of the photocathode will form an image within a concentric circle of 1.5mm diameter on the screen.

Maximum screen luminance ratio (see note 7)	4:1	

TYPICAL OPERATING CONDITIONS

V_{supply}	6.75	V
T_{amb} max. (for 2 hours max.)	+70	$^{\circ}C$
Cathode illumination	1 to 1000	mlux

The cathode must be connected to the instrument housing.

Mullard

MOUNTING POSITION

Any. The tube is contained in a cylindrical housing and radially positioned by the locating pin. The axial position is determined by the bearing surface. The force on the bearing surface must not exceed 100 newtons (10kg force).

WEIGHT (approx.)   900   g

NOTES

1. Luminance gain is defined as: $\dfrac{\pi . L_o}{E_i}$

    where L_o = luminance (cd/m^2) in a direction normal to the screen, measured with an eye-corrected photometer having an acceptance angle of less than 2 degrees.

    and E_i = illumination (lux) incident on a 19mm diameter concentric area of the cathode, produced by a tungsten lamp at a colour temperature 2850K.

2. The magnification of a 2mm diameter concentric circle on the photocathode, as measured on the screen.

3. Percentage distortion = $(\dfrac{M_d}{M_c} -1) \times 100$, where M_d is the magnification of a 20mm

    diameter concentric circle on the photocathode, as measured on the screen and M_c is the centre magnification at a distance of 1mm from the centre of the photo-cathode.

4. Measured at the centre of the photocathode.

5. Measured at the photocathode at a distance of 7mm from the centre.

6. The value of input illumination required to give an increase in screen luminance equivalent to the background luminance.

7. The screen luminance ratio is defined as the ratio of the maximum and minimum screen luminance over a 20mm diameter concentric area on the screen, for uniform cathode illumination.

Mullard

D2681

* Reference points for convolution diameters

R = 0.3

Section of profile to mate with convolutions on any tube

Ø56.01 / 55.96
Ø49.45 / 49.40
Ø45.59 / 45.54
Ø39.04 / 38.99
6.35 / 6.30
Ø44.58 / 44.53
Ø40.06 / 40.01
Ø54.99 / 54.94
Ø50.72 / 50.67

Ø61.2 / 61.0
Ø50 / 49
Ø35.69 / 35.43

Concentric to ₵ within 0.50 (T.I.R.=1.0 max)

180°±30' from contact pin

Ø49.40* / 49.15
Ø56.26* / 56.01
Ø38.99* / 38.74
Ø45.85* / 45.59
Ø33.02 / 32.77
Ø35.43* / 35.18

Screen F.O. max tilt across dia. 0.430.

1.5
45°
20° / 10°
6.48 / 6.35

Window (Ref index 1.5)

1.57 / 1.47
Ø2.7
Ø10.01 / 9.81
Ø16.01 / 15.75
2.6

Concentric to ₵ within 2.0 in direction of optical axis only

Section A-A AC input pin

7.62 / 7.49
1.54 / 1.40
2.43 / 2.33

Ø40.01 / 39.75
Ø50.67 / 50.42
Ø44.83 / 44.58
Ø55.25 / 54.99

195.17 / 192.23
182.96 / 180.67
189.15 / 188.06

16.08 / 15.68

A   A

0.05

Retaining ring
NOTE: Retaining ring is not connected to cathode

Silicon rubber
Locating pin

2.54 / 2.41
6.10 / 4.32
6.17 / 6.02
45°
0.5
Ø2.36 / 2.21
1.83 / 1.57

Cathode F.O. plate
Protective chamfer
Cathode contact surface
Bearing surface

Max tilt across dia. 0.125
Annular protection for cathode fibre optic (Internal Ø29.5)
Ø29.85 / 69.60
Cathode F. optic
Bearing surface

Ø48.4 / 48.2

Dimensions in mm

Mullard

D2788

Relative spectral response (%)

Relative

Absolute

Radiant sensitivity (mA/W)

Wavelength (nm)

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CURVES

Mullard

CAMERA TUBE

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

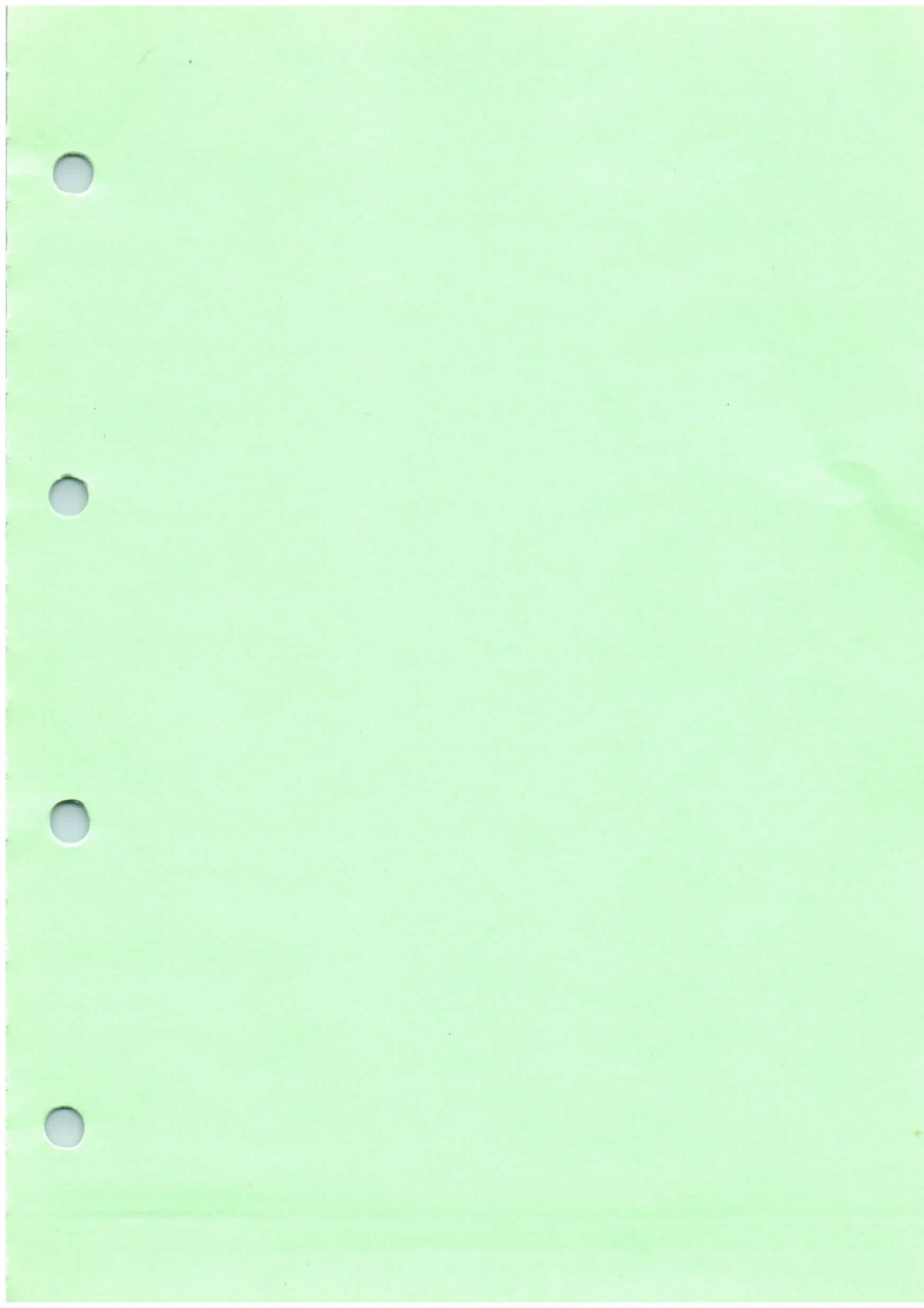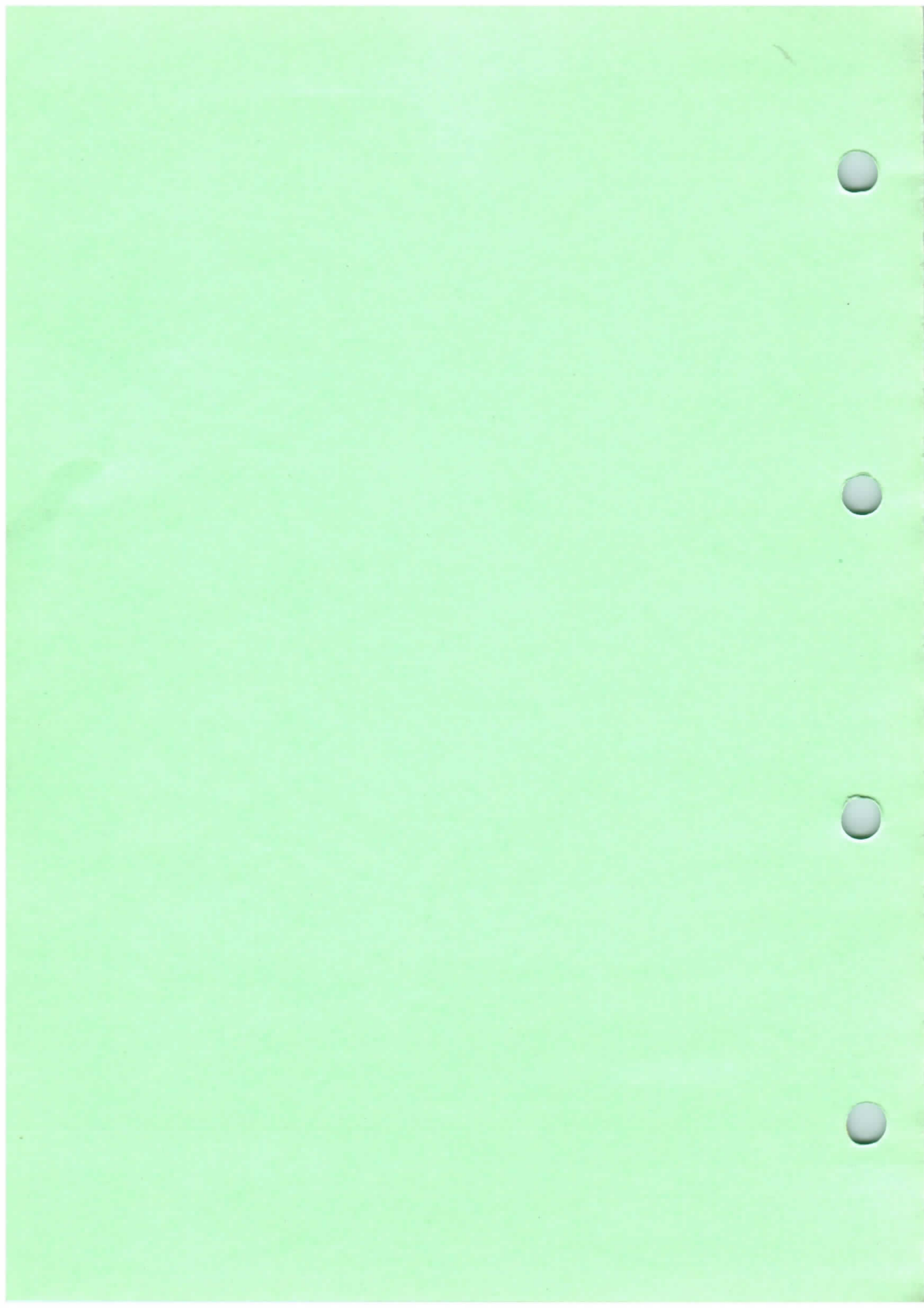The XQ1276 is a 2/3 in diameter camera tube with low heater power, separate mesh, magnetic focusing and deflection, and is mechanically interchangeable with vidicons like the XQ1271 and Newvicon tubes XQ1274 and has the same pin connections.

The XQ1276 is intended for use in ultra-compact cameras for security and surveillance applications, for example, where its high sensitivity extending into the near infrared, and its high resolution, small size and low power consumption are essential.

QUICK REFERENCE DATA

Separate mesh			
Focusing		magnetic	
Deflection		magnetic	
Diameter		17,7	mm
Length		108	mm
Spectral response, max at	approx.	775	nm
Spectral response, cut-off at	approx.	1000	nm
Heater		6,3 V, 95	mA
Resolution		650	TV lines

OPTICAL

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

Orientation of image on photoconductive layer:
The direction of the horizontal scan should be essentially parallel to the plane passing through the longitudinal tube axis and the gap between the pins 1 and 7.

Spectral response, max response at	approx. 775	nm
Spectral response, cut-off at	approx. 1000	nm
Spectral response curve see Fig. 1		

Data based on pre-production tubes.
® Registered Trade Mark for television camera tube.

HEATING

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

Heater voltage V_f 6,3 V

Heater current I_f 95 mA

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

CAPACITANCES

Signal electrode to all C_{as} ≈ 2 pF

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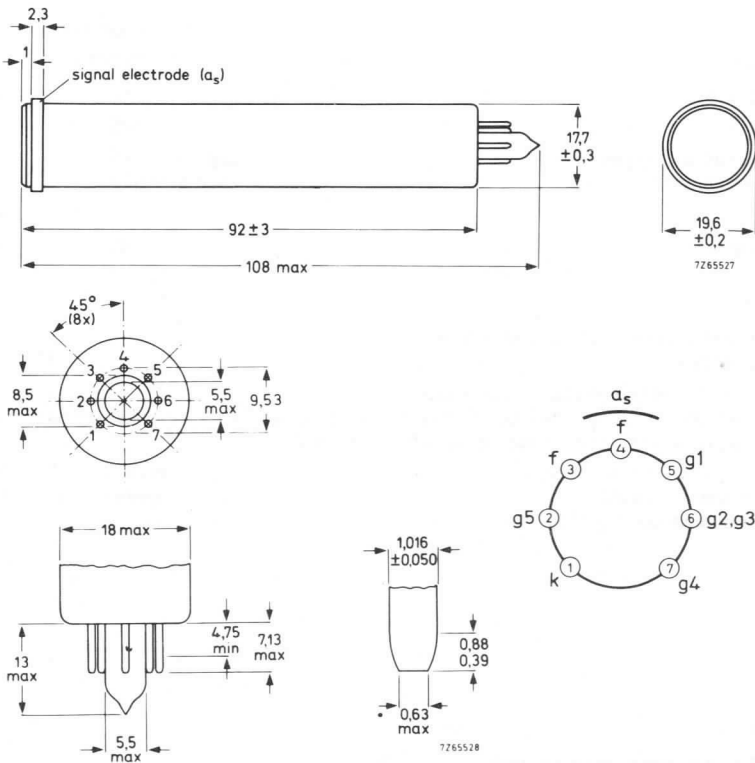
MECHANICAL DATA

Dimensions in mm

Base : Small button miniature 7-pin (IEC 67–I–10a) with pumping stem (JEDEC E7–91)

Mounting position: any

Net mass : approx. 23 g

Mullard

ACCESSORIES

Socket   special miniature 7-pin,
                                                type 56049 or equivalent

Deflection and focusing coil unit   KV12, KV12S or equivalent

DEFLECTION   magnetic

FOCUSING   magnetic

LIMITING VALUES (Absolute max rating system)
    for a scanned area of 6,6 mm x 8,8 mm.

'Full-size scanning' i.e. scanning of a 6,6 mm x 8,8 mm area of the photoconductive layer should
always be applied. Underscanning, i.e. scanning of an area smaller than 6,6 mm x 8,8 mm, may cause
permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max	50	V	*
Grid 4 voltage	V_{g4}	max	750	V	
Grid 3 voltage	V_{g3}	max	750	V	
Grid 2 voltage	V_{g2}	max	350	V	
Grid 1 voltage, negative	$-V_{g1}$	max	300	V	
Grid 1 voltage, positive	V_{g1}	max	0	V	
Cathode-to-heater voltage, peak positive	V_{kfp}	max	125	V	
Cathode-to-heater voltage peak negative	$-V_{kfp}$	max	10	V	
Output current, peak	I_{asp}	max	0,8	μA	**
Faceplate illumination	E	max	10 000	lx	†
Faceplate temperature, storage and operation	t	max	60	^{o}C	
Cathode heating time before drawing cathode current	T_h	min	1	min	

---

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

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

† White light, uniformly diffused over entire tube face.
   Care must betaken not to focus the solar image on the target through a lens opening wider than
   F : 11 to avoid instantaneous breakdown.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,6 mm x 8,8 mm and a faceplate temperature of $30 \pm 5\ ^\circ$C.

Conditions						not
Signal electrode voltage	V_{as}	10	to	25	V	1
Grid 4 (decelerator) voltage	V_{g4}			400	V	2
Grid 3 (beam focus electrode) voltage	V_{g3}			300	V	3
Grid 2 (accelerator) voltage	V_{g2}			300	V	
Blanking voltage, peak to peak						
when applied to grid 1				50	V	
when applied to cathode				20	V	
Flux density at centre of focusing coil				5,0	mT	
Flux density of adjustable alignment coil or magnet			0 to	0,4	mT	

Performance		min	typ	max	
Dark current (at 25 $^\circ$C)			7		nA
Signal current, white light faceplate illumination 1 lx c.t. 2856 K	I_s	250	320		nA
Signal current, near infrared illumination 1 lx, c.t. 2856 K infrared transmitting filter interposed (transmission curve see Fig.2)	I_s	50	80		nA
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K) initial signal current 0,2 μA			10		%
Limiting resolution, in picture centre (note 4)		550	650		TV lines
Limiting resolution, at picture corners (note 4)		350	450		TV lines
Grid 1 voltage for picture cut-off with no blanking voltage applied	V_{g1}	−35		−80	V
Average γ of transfer characteristic			≈ 1		
Spurious signals (spots and blemishes)			see note 5		

Notes see page 5.

Mullard

Notes to page 4.

1. The signal electrode voltage adjusted to the value indicated by the tube manufacturer on the test sheet accompanying each tube.

   To minimize picture sticking effects the signal electrode voltage should be adjusted with an inaccuracy of $<\pm5\%$, in case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.

2. Grid 4 voltage must always be higher than grid 3 voltage. The recommended ratio of grid 4 voltage to grid 3 voltage both for best geometry and most uniform signal output depends upon the type of coil unit used and will be 4 : 3 for the recommended type (see 'Accessories').

3. Resolution decreases with decreasing grid 3 voltage. In general grid 3 should be operated above 250 V.

4. On RETMA resolution test chart; faceplate illumination adjusted for a peak output current of 0,2 μA.

5. **Conditions**

   The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area.

   Faceplate illumination adjusted to produce 0,2 μA signal current, beam current adjusted for correct stabilization.

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

   Under above conditions the number and size of spots per zone as visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless their contrast is less than 50% of peak white signal as observed on a waveform oscilloscope. Spots having a contrast $\geqslant$100% are fully counted, spots having a contrast $>$50% but $<$100% will be considered as having half their actual size.

spot size in % of raster height	maximum number of spots zone 1	zone 2
$>$ 1,2	none	none
$\leqslant$ 1,2 to 0,7	1	2
$\leqslant$ 0,7 to 0,35	4	5
$\leqslant$ 0,35 to 0,2	7	10
$\leqslant$ 0,2	*	*

* Do not count spots of this size unless concentration causes a smudgy appearance.
  Tubes are rejected for: smudges, lines, streaks, mottled, grainy or uneven background having contrast $>$50%.
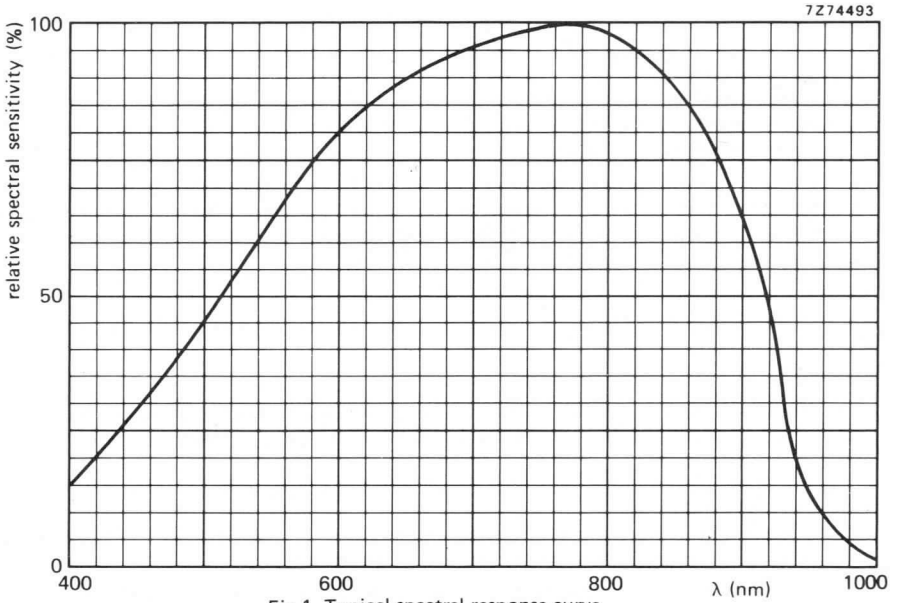
7Z74493

Fig.1 Typical spectral response curve.

7Z74492

Fig.2 Transmission curve of infrared filter.

Mullard

7Z74491

Fig.3 Typical light transfer characteristic.

signal current (nA)

E (lx) 2856 K c.t.

7Z74206

highlight signal current = 0,2 μA
beam current = 0,2 μA

modulation depth at picture centre (%)
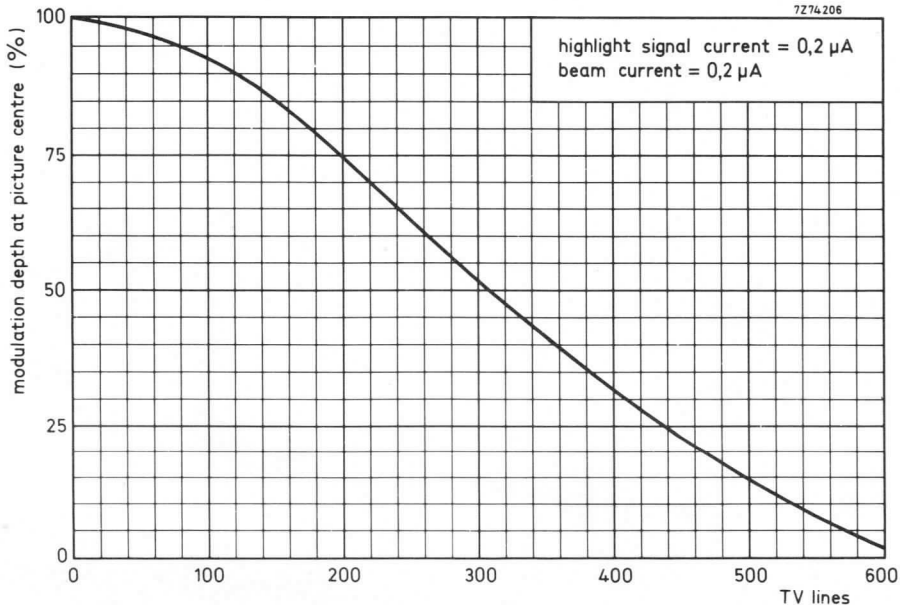
TV lines
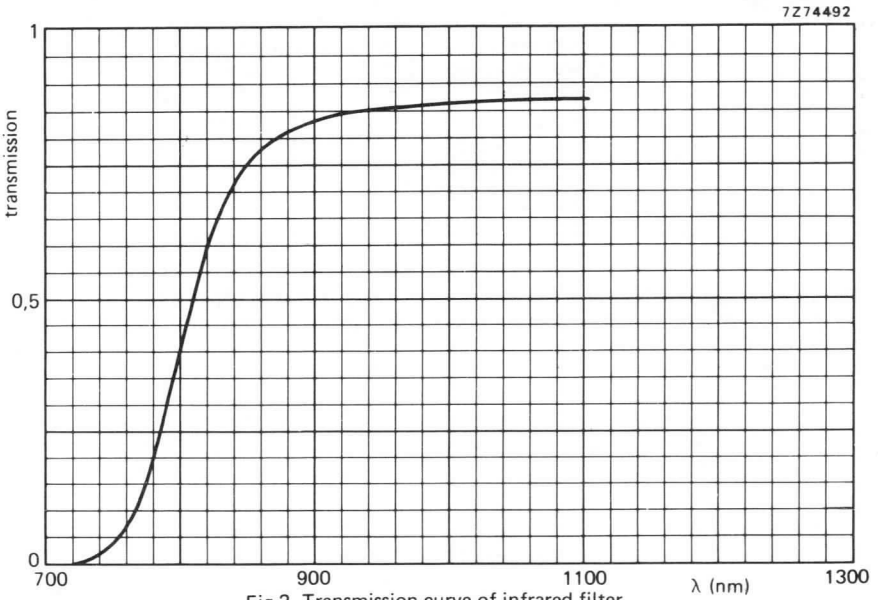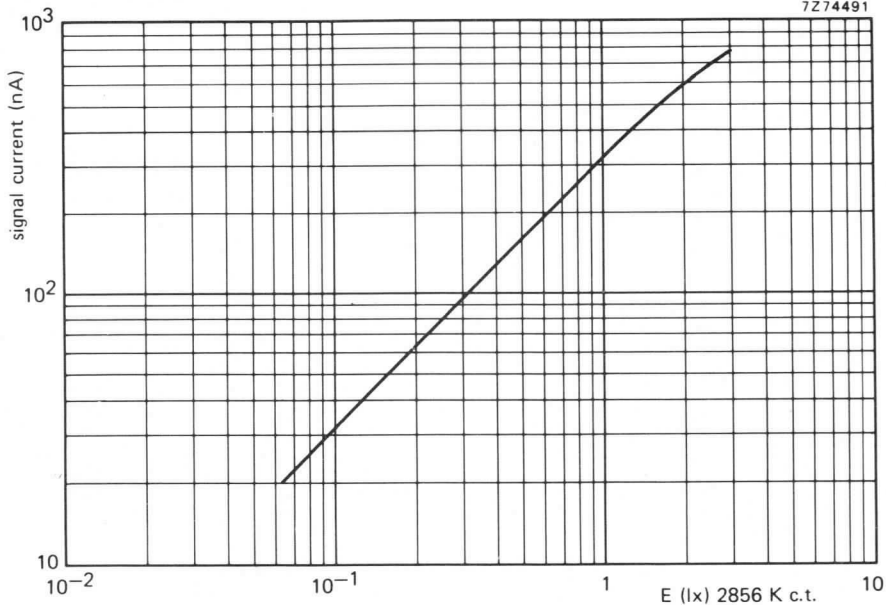
Fig.4 Typical uncompensated square wave response curve.

CAMERA TUBE

NEWVICON® television camera tube with a photoconductive target composed of cadmium and zinc tellurides featuring high resolution and an extremely high sensitivity.

The XQ1442 is a 1 in diameter camera tube with low heater power, separate mesh, magnetic focusing and deflection, a fibre optic faceplate, and is mechanically and electrically interchangeable with the Newvicon tube type XQ1440.

The XQ1442 is intended for use in very-low light level cameras, in which it is coupled directly to a fibre optic output window of an image intensifier, for scientific, industrial, surveillance and security applications.

QUICK REFERENCE DATA

Separate mesh		
Focusing	magnetic	
Deflection	magnetic	
Diameter	25,4	mm (1 in)
Length	160	mm (6¼ in)
Faceplate	fibre optic	
Spectral response, max at	750	nm
cut-off at	≈ 900	nm
Heater	6,3 V, 95	mA
Resolution	650	TV lines

OPTICAL

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

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

Spectral response; max response at	≈	750	nm
Spectral response, cut-off at	≈	900	nm
Spectral response curve see Fig. 1			

® Registered Trade Mark for television camera tubes.

blue binder, tab 5

HEATING

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

Heater voltage V_f 6,3 V ±10%

Heater current I_f 95 mA

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

CAPACITANCES

Signal electrode to all C_{as} 4,5 pF

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

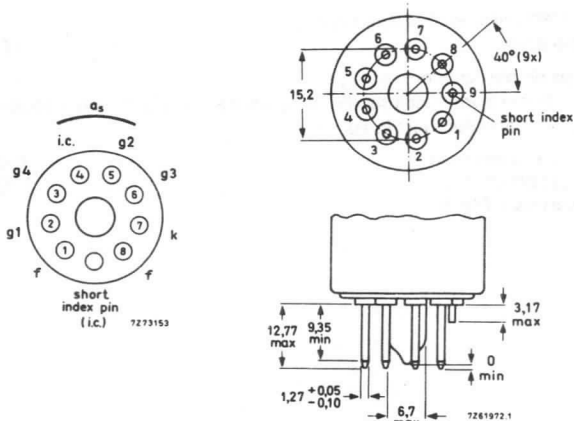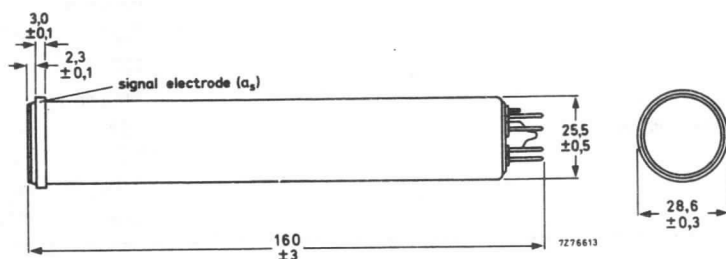## MECHANICAL DATA   Dimensions in mm

Base: IEC67-1-33a, JEDEC E8-11 except for pumping stem

Mounting position: any

Net mass: approx. 60 g

Mullard

ACCESSORIES

Socket	56098, Cinch no. 54A18088 or equivalent
Deflection and focusing coil unit	AT1102/01, AT1103 or equivalent

DEFLECTION magnetic

FOCUSING magnetic

LIMITING VALUES (Absolute max. rating system)
for a scanned area of 9,6 mm x 12,8 mm.

'Full-size scanning' i.e. scanning of a 9,6 mm x 12,8 mm area of the photoconductive layer should always be applied. Underscanning i.e. scanning of an area smaller than 9,6 mm x 12,8 mm, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max	50 V*
Grid 4 voltage	V_{g4}	max	1000 V
Grid 3 voltage	V_{g3}	max	1000 V
Grid 2 voltage	V_{g2}	max	750 V
Grid 1 voltage, negative	$-V_{g1}$	max	300 V
Grid 1 voltage, positive	V_{g1}	max	0 V
Cathode-to-heater voltage, peak positive	V_{kfp}	max	125 V
Cathode-to-heater voltage, peak negative	$-V_{kfp}$	max	10 V
Output current, peak	I_{asp}	max	0,8 μA**
Faceplate illuminance	E	max	10 000 lx†
Faceplate temperature, storage and operation	t	max	70 °C
Cathode heating time before drawing cathode current	T_h	min	1 min

---

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

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

† White light, uniformly diffused over entire tube face. Care must be taken not to focus the solar image on the target through a lens opening wider than F:11 to avoid instantaneous breakdown.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 6,8 mm x 8,8 mm and a faceplate temperature of 30 ±5 °C.

Conditions				note
Signal electrode voltage	V_{as}	10 to 25	V	1
Grid 4 (decelerator) voltage	V_{g4}	500	V	2
Grid 3 (beam focus electrode) voltage	V_{g3}	300	V	3
Grid 2 (accelerator) voltage	V_{g2}	300	V	
Blanking voltage, peak to peak				
when applied to grid 1		50	V	
when applied to cathode		20	V	
Flux density at centre of focusing coil		4,5	mT	
Flux density of adjustable alignment coil or magnet		0 to 0,4	mT	

Performance		min	typ	max	
Dark current (at 25 °C)			7	16	nA
Signal current, white light faceplate illuminance 0,5 lx, c.t. 2856 K	I_s	130	170		nA
Decay: residual signal current 60 ms after cessation of the luminance (c.t. 2856 K), initial signal current 0,2 µA			20	26	%
Limiting resolution, in picture centre (note 4)		550	650		TV lines
Limiting resolution, at picture corners (note 4)			450		TV lines
Grid 1 voltage for picture cut-off with no blanking voltage applied	V_{g1}	−45	−65	−100	V
Average γ of transfer characteristic			≈ 1		
Spurious signals (spots and blemishes)			see note 5		

Notes see page 5.

Mullard

Notes to page 4.

1. The signal electrode voltage adjusted to the value indicated by the tube manufacturer on the test sheet accompanying each tube.
   To minimize picture sticking effects the signal electrode voltage should be adjusted with an inaccuracy of $<\pm5\%$. In the case of cathode blanking, the voltage drop across the cathode resistor during read-out should be taken into account.

2. Grid 4 voltage must always be higher than grid 3 voltage. The recommended ratio of grid 4 voltage to grid 3 voltage both for best geometry and most uniform signal output depends upon the type of coil unit used and will be 5:3 for the recommended types (see 'Accessories').

3. Beam focus is obtained by the combined effect of grid 3 and the focus coil.

4. On RETMA resolution test chart; faceplate illuminance adjusted for a peak output current of $0,2 \mu A$.

5. **Conditions**

   The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area.
   Faceplate illuminance adjusted to produce $0,2 \mu A$ signal current, beam current adjusted for correct stabilization.
   Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped and for non-blooming bright raster when lens of camera is uncapped.

   Under the above conditions the number and size of spots per zone as visible in the monitor picture, under both capped and uncapped conditions will not exceed the limits stated below. Both black and white spots must be counted unless their contrast is less than 10% of peak white signal as observed on a waveform oscilloscope.
   Background lines, originating from the structure of the fibre optic faceplate will have a contrast of $\leqslant 25\%$ of peak white signal and will not exceed a width of 0,35%, or a length of 5% of picture height.

	spot size in % of raster height	maximum number of spots zone 1	zone 2
white and black spots	$> 1,2$ $\leqslant 1,2$ to 0,7 $\leqslant 0,7$ to 0,45	none none 2	none 1 3
white spots	$\leqslant 0,45$ to 0,2 $\leqslant 0,2$	4 *	6 *
black spots	$\leqslant 0,45$ to 0,35 $\leqslant 0,35$	8 *	10 *

* Do not count spots of this size unless concentration causes a smudgy appearance.
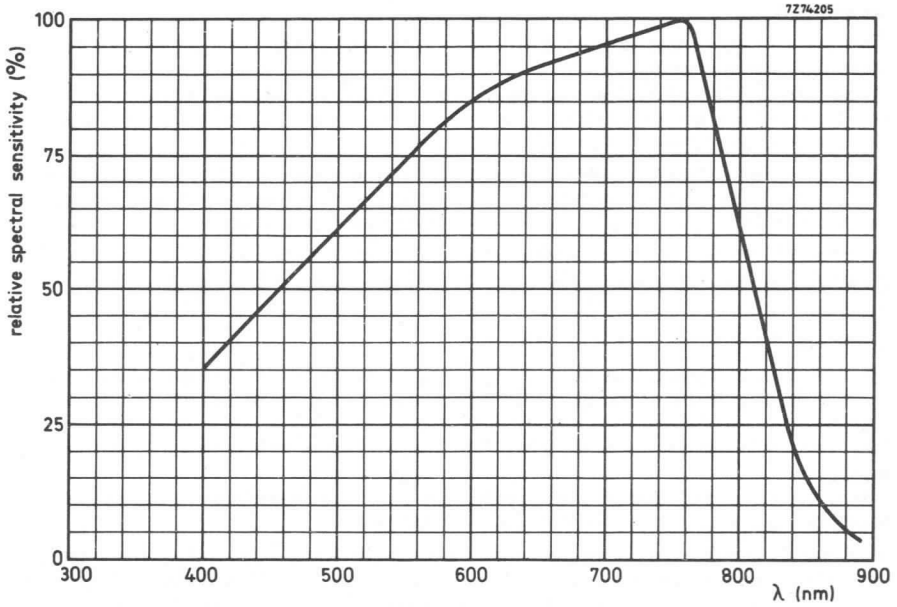
7Z74205

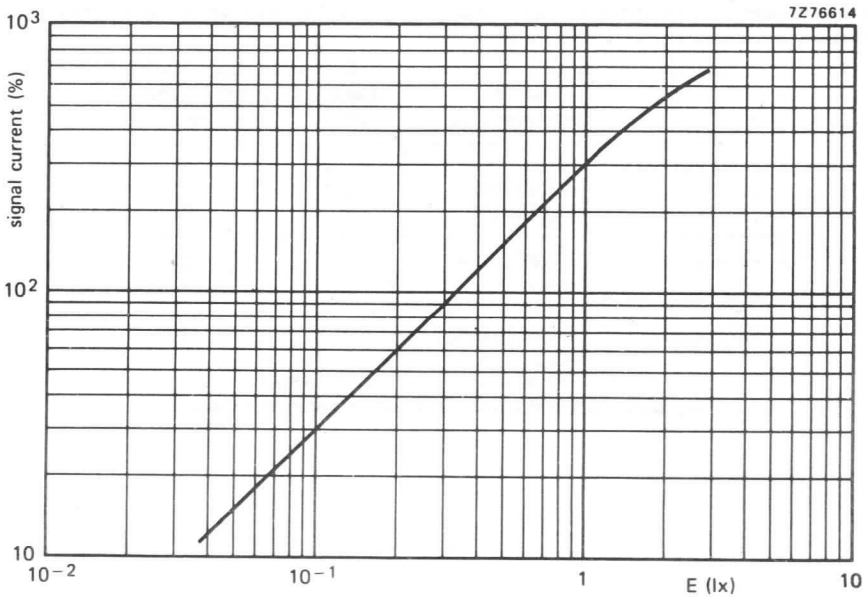Fig.1 Typical spectral response curve.

7Z76614

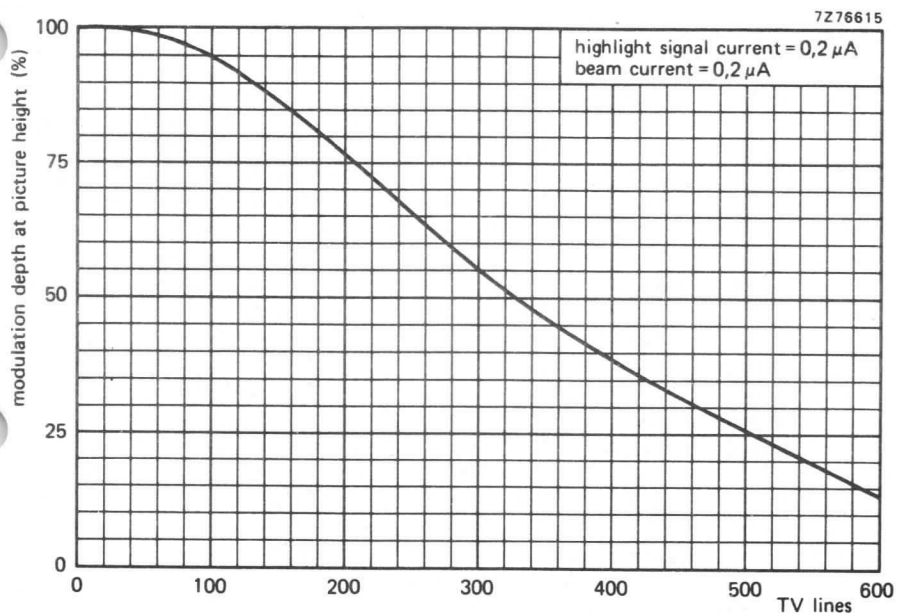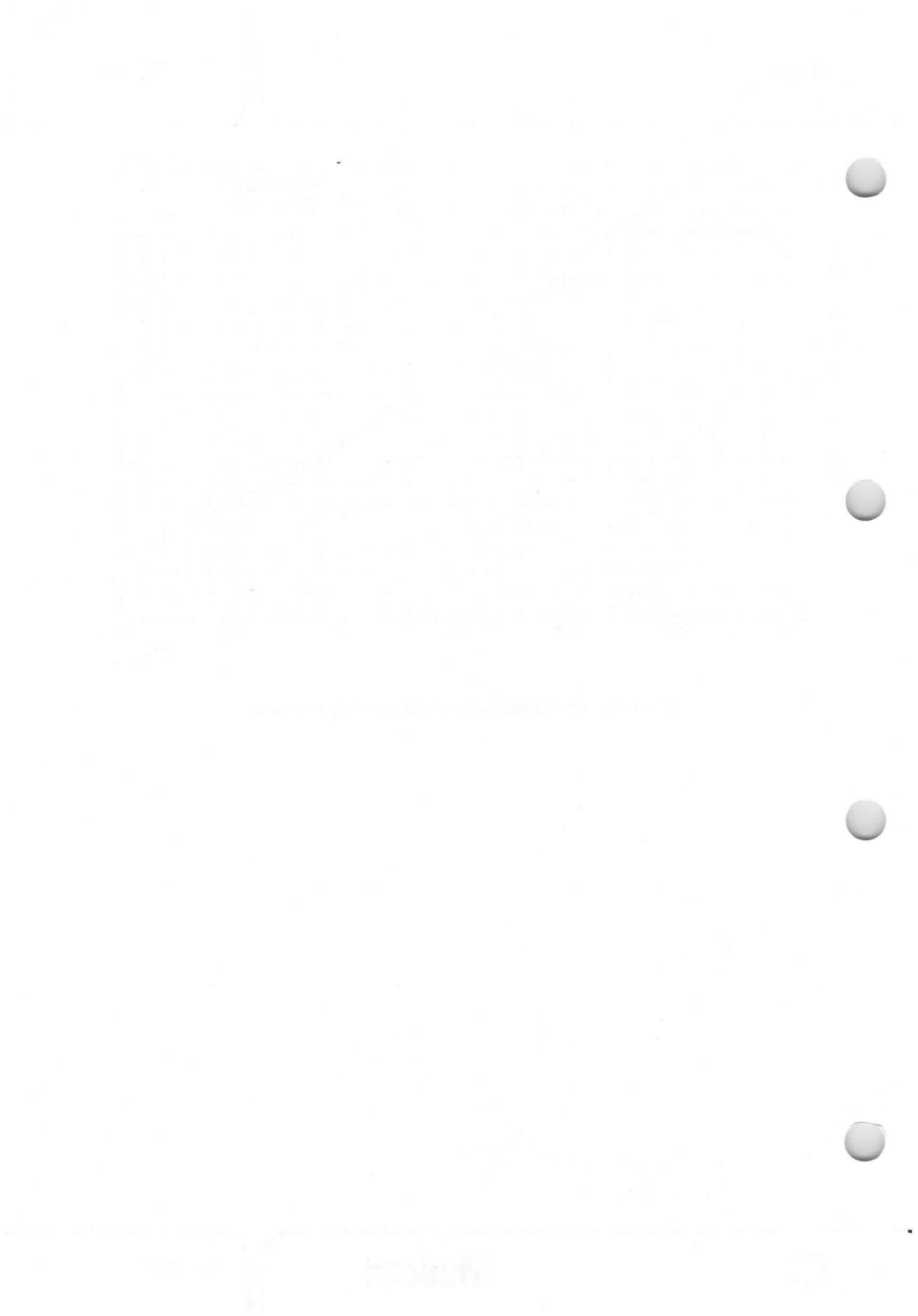Fig.2 Typical light transfer characteristic.

Mullard

Fig.3 Typical uncompensated square-wave response curve.

CAMERA TUBE

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

The XQ1443 is a 1 in diameter camera tube with low heater power, separate mesh, magnetic focusing and deflection, and is mechanically interchangeable with vidicons like the XQ1240/XQ1241 and Newvicon tube XQ1443 and has the same pin connections.

The XQ1443 is intended for use in ultra-sensitive cameras for security and surveillance applications, for example, where its high sensitivity extending into the near infrared, and its high resolution, small size and low power consumption are essential.

QUICK REFERENCE DATA

Separate mesh		
Focusing		magnetic
Deflection		magnetic
Diameter		25,9 mm
Length		159 mm
Spectral response, max. at	approx.	775 nm
Spectral response, cut-off at	approx.	1000 nm
Heater		6,3 V, 95 mA
Resolution		750 TV lines

OPTICAL

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

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

Faceplate
  thickness   2,5 mm
  refractive index   1,61

Spectral response curve see Fig. 1

HEATING

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

Heater voltage	V_f	6,3 V ± 10%
Heater current at V_f = 6,3 V	I_f	95 mA

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

® Registered Trade Mark for television camera tubes.

orange binder, tab 5

CAPACITANCES

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

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

MECHANICAL DATA

Dimensions in mm

$\varnothing 28,6 \pm 0,3$

$\varnothing 25,9 {}^{+0,8}_{-0,9}$

1,3

3,2

159 ± 3

7Z85559

a_s

g4　i.c.

g1

3　4

2　5

g2

f　1

6　g3

short index pin (i.c.)

8　7

f　k

7Z73153.1

15,2

$40°(9x)$
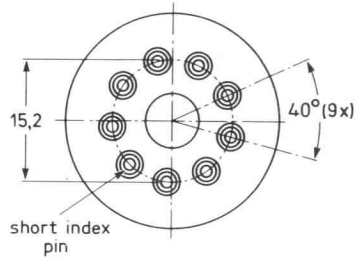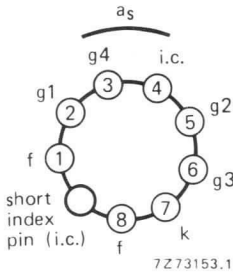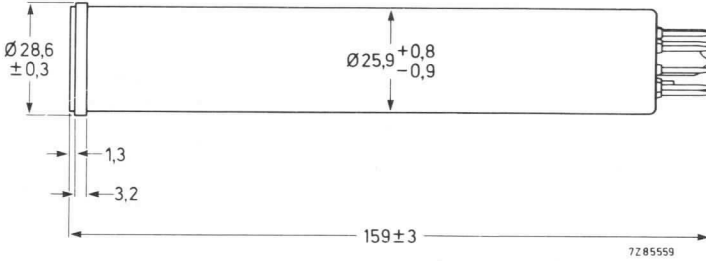
short index pin

BASE PIN CONNECTIONS (Bottom view)

Pin 1:	Heater
Pin 2:	Grid No. 1
Pin 3:	Grid No. 4
Pin 4:	i.c. (inner connected)
Pin 5:	Grid No. 2
Pin 6:	Grid No. 3
Pin 7:	Cathode
Pin 8:	Heater
Short index pin:	i.c.
Flange:	Target (signal electrode)

3,2 max

12,8 max

$\varnothing 1,27 {}^{+0,05}_{-0,1}$

$\varnothing 6,7$ max

0 min

7Z85560
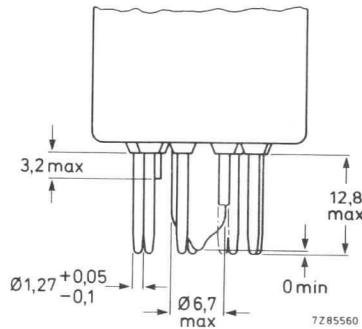
Mounting position: any

Net mass: ≈ 70 g

Base: Small button ditetral 8-pin base (JEDEC E8-11)

Mullard

ACCESSORIES

Socket	type 56098 or equivalent
Deflection and focusing coil unit	KV8 or equivalent

DEFLECTION

magnetic

FOCUSING

magnetic

LIMITING VALUES (Absolute maximum rating system)
for a scanned area of 9,6 mm x 12,8 mm.

'Full-size scanning' i.e. scanning of a 9,6 mm x 12,8 mm area of the photoconductive layer should always be applied. Underscanning, i.e. scanning of an area smaller than 9,6 mm x 12,8 mm, may cause permanent damage to the specified full-size area.

Signal electrode voltage	V_{as}	max.	50	V *
Grid 4 voltage	V_{g4}	max.	1000	V
Grid 3 voltage	V_{g3}	max.	1000	V
Grid 2 voltage	V_{g2}	max.	750	V
Grid 1 voltage, negative	$-V_{g1}$	max.	300	V
Grid 1 voltage, positive	V_{g1}	max.	0	V
Cathode-to-heater voltage	V_{kfp}	max.	125	V
Cathode-to-heater voltage	$-V_{kfp}$	max.	10	V
Output current, peak	I_{asp}	max.	0,8	μA**
Faceplate illumination	E	max.	10000	lx ▲
Faceplate temperature, storage and operation	T	max.	70	°C
Cathode heating time before drawing cathode current	t_h	min.	1	min

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

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

▲ White light, uniformly diffused over entire tube face.
Care must be taken not to focus the solar image on the target through a lens opening wider than f : 11 to avoid instantaneous breakdown.

OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9,6 mm x 12,8 mm and a faceplate temperature of 25 to 35 °C and standard TV scanning rate.

Conditions				notes
Signal electrode voltage	V_{as}		10 to 25 V	1
Grid 4 mesh voltage	V_{g4}		500 V	2
Grid 3 beam focus electrode voltage	V_{g3}		300 V	3
Grid 2 accelerator voltage	V_{g2}		300 V	
Blanking voltage, peak to peak				
when applied to grid 1		min.	75 V	
when applied to cathode		min.	25 V	
Flux density at centre of focusing coil			4,1 mT	
Flux density of adjustable alignment coil or magnet			0 to 0,4 mT	

Performance		min.	typ.	max.	
Dark current (at 25 °C)			10	15 nA	
Signal current, white light faceplate illumination 0,5 lx c.t. 2856 K	I_s	240	270	nA	
Signal current, near infrared illumination 0,5 lx, c.t. 2856 K infrared transmitting filter interposed (transmission curve see Fig. 2)	I_s	50	75	nA	
Decay: residual signal current 60 ms after cessation of the illumination (c.t. 2856 K) initial signal current 0,2 μA			20	%	
Limiting resolution, in picture centre		650	750	TV lines	4
Limiting resolution, at picture corners		400	500	TV lines	4
Grid 1 voltage for picture cut-off with no blanking voltage applied	V_{g1}	−45		−100 V	
Average γ of transfer characteristic			≈ 1		
Spurious signals (spots and blemishes)					5

Notes

1. The signal electrode voltage should be adjusted to the value indicated by the tube manufacturer as printed on the envelope (E_{sj} = . . . V).
   To minimize picture sticking effects the signal electrode voltage should be adjusted within a tolerance of ± 2 V; the voltage drop across R_l should be kept small. In case of cathode blanking the voltage drop across the cathode resistor during read-out should be taken into account.

2. Grid 4 voltage must always be higher than grid 3 voltage. The recommended ratio of grid 4 voltage to grid 3 voltage both for best geometry and most uniform signal output depends upon the type of coil unit used and will be 5 : 3 for the recommended type (see 'Accessories').

3. Resolution decreases with decreasing grid 4 voltage. In general grid 3 should be operated above 250 V.

4. On EIA resolution test chart; faceplate illumination adjusted for a peak output current of 0,2 μA.

5. Conditions

   The camera focused on a uniformly illuminated two-zone test pattern, the diameter of the centre zone (1) being equal to the raster height. Zone (2) being defined as the remainder of the scanned area.
   Faceplate illumination adjusted to produce 0,2 μA signal current, beam current adjusted for correct stabilization.
   Monitor set-up and contrast control adjusted for faint raster when lens of camera is capped and for non-blooming bright raster when lens of camera is uncapped.

   Under above conditions the number and size of spots per zone as visible in the monitor picture will not exceed the limits stated below. Both black and white spots must be counted, unless their contrast is less than 50% of peak white signal as observed on a waveform oscilloscope. Spots having a contrast $\geqslant$ 100% are fully counted, spots having a contrast > 50% but < 100% will be considered as having half their actual size.

spot size in % of raster height	maximum number of spots zone 1	zone 2
> 1,2	none	none
$\leqslant$ 1,2 to 0,8	none	1
$\leqslant$ 0,8 to 0,4	4	5
$\leqslant$ 0,4 to 0,2	5	5
$\leqslant$ 0,2	*	*

   * Do not count spots of this size unless concentration causes a smudgy appearance.
   Tubes are rejected for: smudges, lines, streaks, mottled, grainy or uneven background having contrast > 50%.

7Z74493
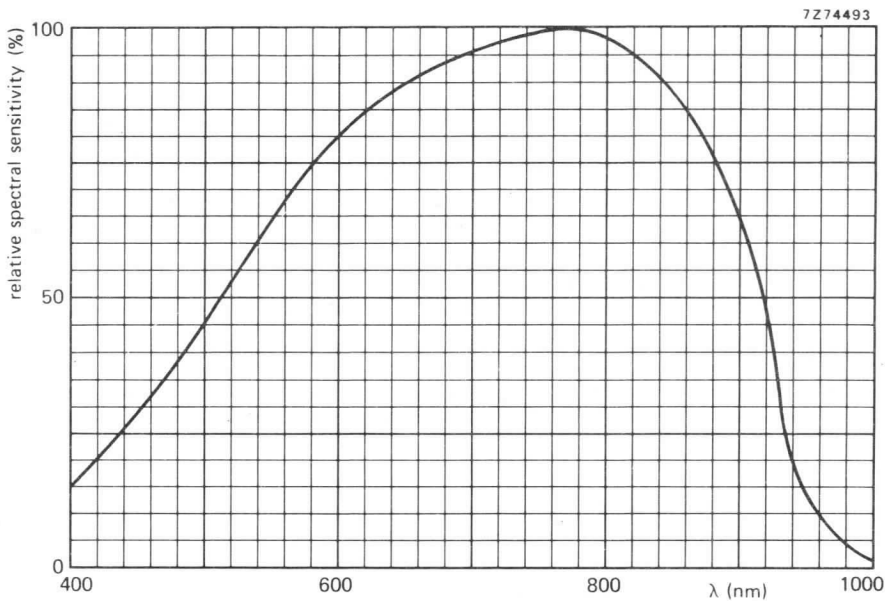
Fig. 1 Typical spectral response curve, C2.

7Z74492
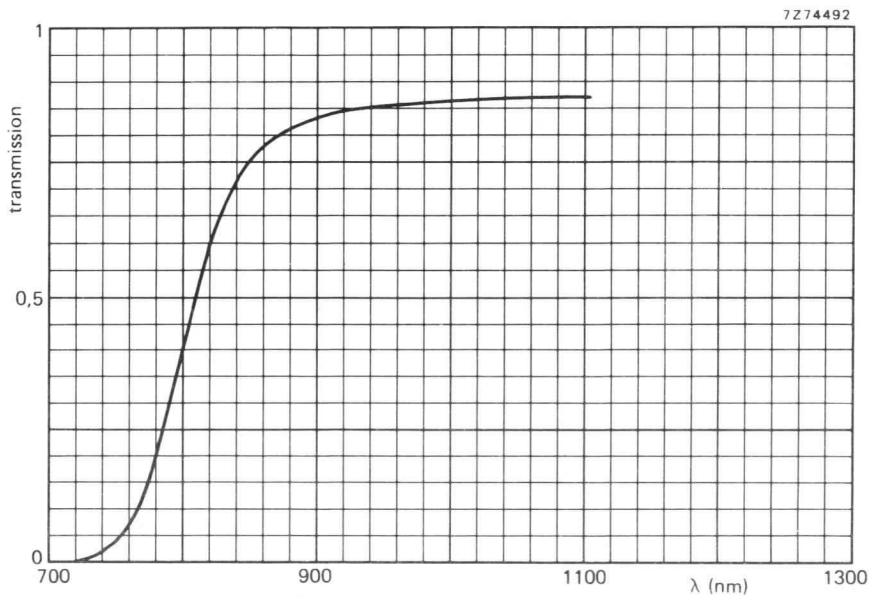
Fig. 2 Transmission curve of infrared filter. (Hoya IR80).
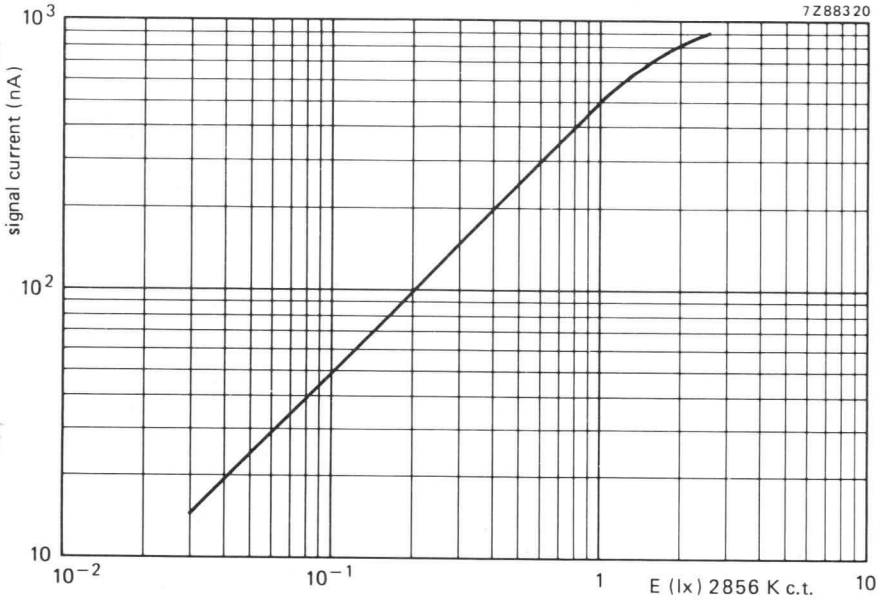
Mullard

7Z88320

Fig. 3 Typical light transfer characteristic.
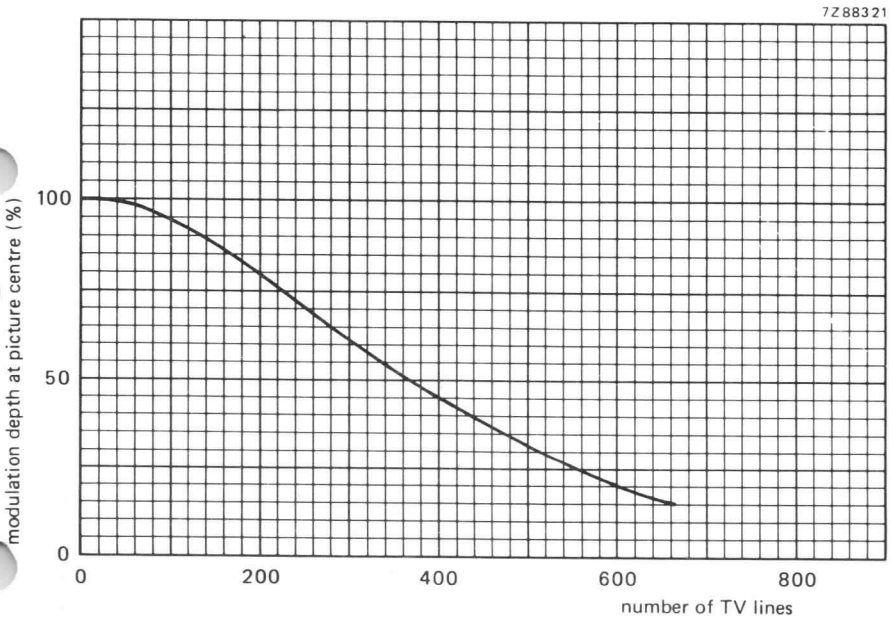
(Graph: vertical axis "signal current (nA)" from 10 to 10³; horizontal axis "E (lx) 2856 K c.t." from 10⁻² to 10.)

7Z88321

Fig. 4 Typical uncompensated square wave response curve.

(Graph: vertical axis "modulation depth at picture centre (%)" from 0 to above 100; horizontal axis "number of TV lines" from 0 to 800.)
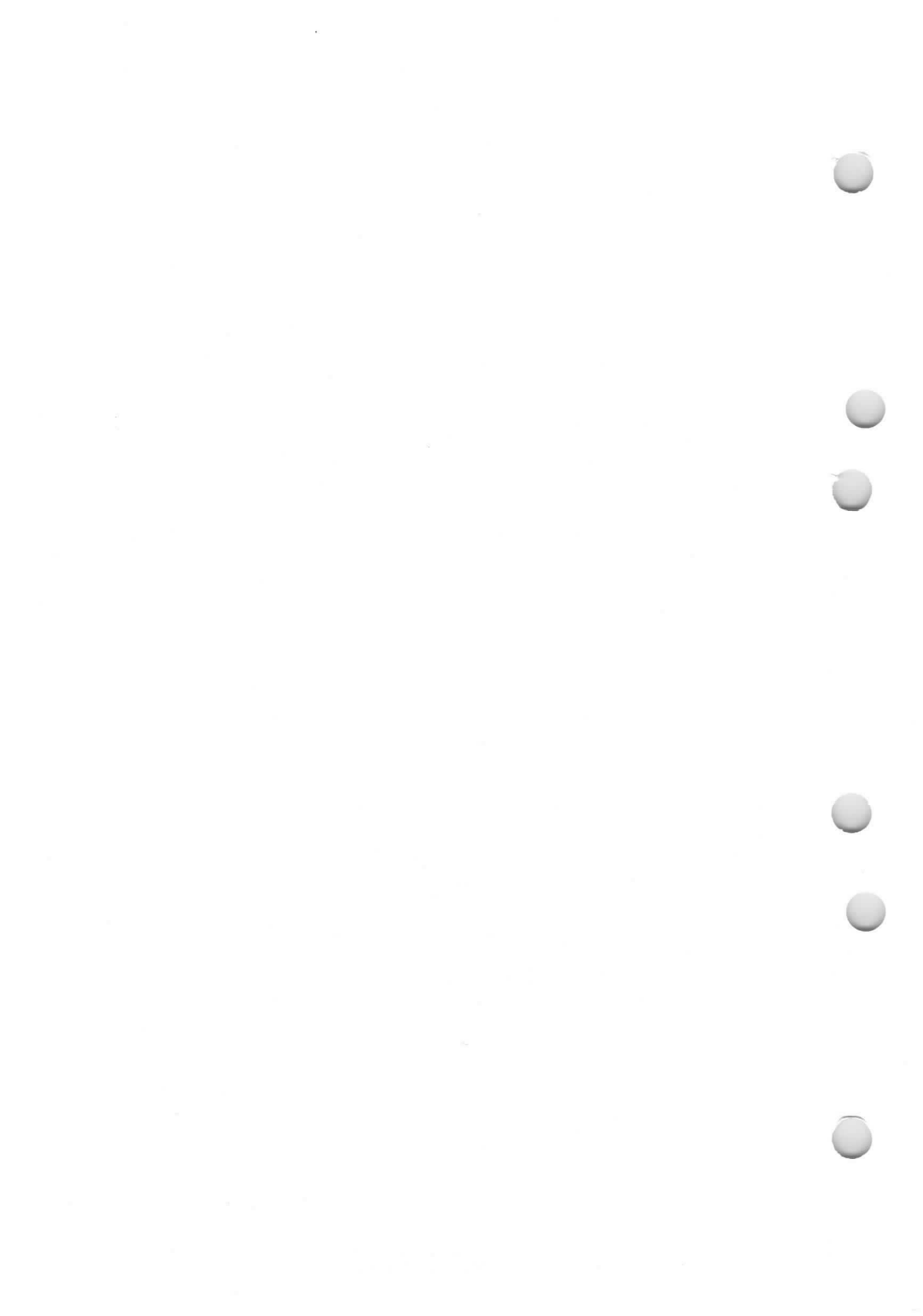
DEVELOPMENT SAMPLE DATA

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

XX1410
(development no. F23XX)

IMAGE INTENSIFIER

The F23XX is a miniature, distortionless, electrostatic proximity focused micro-channel plate image intensifier. It has 18 mm diameter fibre-optic input and image inverting ("twister") output windows. The integral power supply incorporates automatic gain control. Point highlight saturation and bright source protection are features of this intensifier. It is primarily intended for use in lightweight night vision goggles, but is suitable for many very low light level applications.

This data must be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS — IMAGE INTENSIFIERS

CHARACTERISTICS
Measured under Recommended Operating Conditions

Photocathode

Surface		S25	
Useful diameter	min.	17,5	mm
Sensitivity *			
white light		240	μA/lm
λ = 800 nm		20	mA/W
λ = 850 nm		15	mA/W

Screen

Phosphor	Aluminized	P20
Output window, radius of concave surface	40,00 ± 0,1	mm

* Measured before the power supply is fitted.

CHARACTERISTICS (continued)

Gain ϕ_G = 17,0 mm, $E_i \approx 20\ \mu lx$	min.	7 500	
	max.	15 000	
Mean screen luminance $\dot{E}_i$ = 20 mlx	min.	3	cd/m^2
	max.	1	cd/m^2
Edge magnification ϕ_D = 14 mm	min.	0,995	
	max.	1,005	
Centre resolution	min.	25	line pairs/mm
Edge resolution ϕ_E = 14 mm	min.	25	line pairs/mm
Modulation transfer factors (reduced area method)*			
2,5 cycles/mm		86	%
7,5 cycles/mm		58	%
15 cycles/mm		20	%
Equivalent background illumination	max.	0,4	μlx
Power consumption	max.	45	mW
Mass	max.	100	g

RECOMMENDED OPERATING CONDITIONS

Supply voltage (negative terminal should be grounded)		2,5	V
Photocathode illuminance	typ.	100	μlx
T_{amb}		22 ± 3	°C

WARNING

Immediately after operation, the screen will remain electrostatically charged for approximately 1 hour, during which time the intensifier should not be handled. Any attempt to discharge the intensifier by any means may result in irreparable damage.

* Measured before the power supply is fitted.

Mullard

RATINGS

Limiting values in accordance with the Absolute Maximum System IEC 134

Supply voltage *	max.	3,2 V
Photocathode illuminance	max.	0,1 lx
T_{amb} (for storage, 2 hours max.)	max.	65 °C
	min.	−54 °C
T_{amb} (for continuous operation)	max.	35 °C
T_{amb} (for long term storage)	max.	27 °C

* If the supply voltage falls below 2,0 V, but remains greater than −2,7 V the intensifier will not be damaged, but may not function.

7Z75514
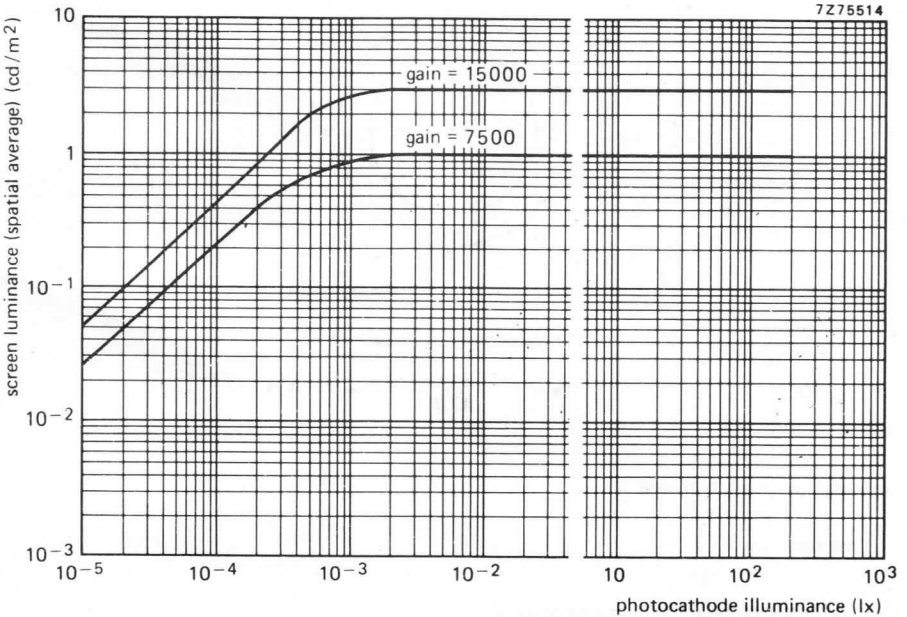
Typical automatic gain control characteristic.

OUTLINE DRAWING

$1 {}^{+\,0,2}_{\,0}$

29,4
± 0,4

optical path
26,6 ± 0,3

+ 2,7 V contact

0 V contact

6 min

locating slot

◄— 31,6 max —►

43,1
42,9

7Z75513
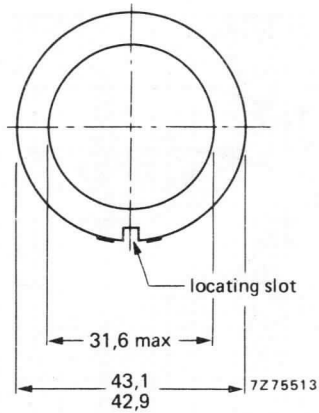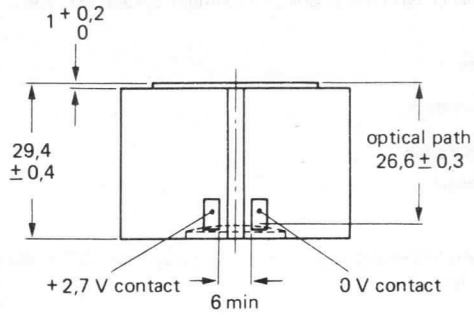
Locating slot: depth **3,05 min.**
width **3,05 min.**

contact: length 5,6
width 3,2

Maximum contact force must not exceed 10 N.

Mullard

QUICK REFERENCE DATA

External anode triodes of ceramic-metal construction, intended for use as industrial oscillators.

YD1195 is forced-air cooled.

YD1197 is water cooled by an integral cooler.

f	30	MHz
P_{out}(less P_{drive})	90	kW
*f max.	100	MHz
V_a max.	14.4	kV
p_a max.		
YD1195	30	kW
YD1197	40	kW

*For use at frequencies above 30MHz, Mullard Ltd should be consulted for more detailed information.

Unless otherwise stated, data is applicable to both types

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES

INDUSTRIAL OSCILLATOR, CLASS 'C'

f	30	30	30	MHz
P_{out}	62.6	76	92.1	kW
P_{out}(less P_{drive})	60.6	74	90	kW
η_a	73.6	76	78.8	%
η_{osc}	71.2	74	77	%
V_a	8.5	10	12	kV
I_a	10	10	9.75	A
$-V_g$	500	550	600	V
I_g on load	2.4	2.3	2.3	A
R_{g-f}	210	240	260	Ω
Feedback ratio $v_g(pk)/v_a(pk)$	0.13	0.11	0.09	
P_a	22.4	24	24.9	kW
P_g	760	730	720	W
P_{Rg}	1.2	1.27	1.38	kW
P_{in}	85	100	117	kW

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

$*f$ max.	100	MHz
V_a max.	14.4	kV
P_{in} max.	144	kW
$-V_g$ max.	1.5	kV
I_g max. on load	2.5	A
off load	3.5	A
I_a max.	12	A
I_k max.	14	A
$i_k(pk)$ max.	70	A
p_a max.		
YD1195	30	kW
YD1197	40	kW
p_g max.	1.0	kW
R_{g-f} max.	10	kΩ

*For use at frequencies above 30MHz, Mullard Ltd should be consulted for more detailed information.

CATHODE

Directly heated, thoriated tungsten, mesh construction

$**V_f$	8.4	V
I_f	235	A
$i_f(pk)$ max.	1.5	kA
r_f (cold)	3.9	mΩ

**The filament has been designed to accept temporary fluctuations of supply voltage +5 and -10%.

To ensure that the cathode temperature remains constant irrespective of the operating frequency, it may be necessary to reduce the filament voltage at higher frequencies. When doing so, it must be borne in mind that the filament voltage-to-current ratio measured under all operating conditions should be the same as when only the normal filament voltage was applied.

It is extremely important that the filament is properly decoupled. This should be so done that the resonance of the circuit formed by the filament and decoupling elements remains below the fundamental oscillator frequency. In grounded grid circuits this resonance should be below the grid-cathode resonance. For further information please contact Mullard Ltd.

Mullard

R.F. INDUSTRIAL TRIODES

CAPACITANCES

c_{a-f}	1.2	pF
c_{a-g}	33	pF
c_{g-f}	100	pF

CHARACTERISTICS

g_m	80	mA/V
μ	50	

COOLING

Anode

YD1195 - forced air.

YD1197 - water cooled by an integral cooler

Seals

At frequencies above 4MHz a low velocity air flow should be directed at the filament and grid seals.

Temperatures (absolute maximum)

Envelope	200	^{o}C
YD1195 air inlet	45	^{o}C
YD1197 water inlet	50	^{o}C

YD1195 COOLING CHARACTERISTICS

See curves on pages 4 and 5.

With insulating pedestal type 40729.

Anode and grid dissipation (kW)	Height above sea level (m)	Inlet air temperature (^{o}C)	Minimum rate of air flow (m^3/min)	Pressure difference (mm water)	Outlet temperature (^{o}C)
30	0	35	34.0	120	84
25	0	35	27.2	78	87
20	0	35	21.4	48	89
30	0	45	38.0	150	91
25	0	45	30.4	98	93
20	0	45	23.9	60	95
30	1500	35	41.0	138	84
25	1500	35	32.7	90	87
20	1500	35	25.7	55	89
30	3000	25	43.0	135	79
25	3000	25	34.4	88	83
20	3000	25	27.0	54	85

Mullard

YD1197 COOLING CHARACTERISTICS

Anode and grid dissipation (kW)	Inlet water temperature (°C)	Outlet water temperature (°C)	Minimum rate of water flow (ℓ/min)	Pressure drop (atm)
40	20	51	20.0	0.5
	50	70	30.0	1.0
30	20	53	14.0	0.27
	50	72	21.0	0.55
20	20	56	9.0	0.12
	50	74	13.5	0.25

PHYSICAL DATA

	YD1195	YD1197	
Weight of tube (approx.)	20	6.5	kg
Weight of insulating pedestal	8.2	-	kg

ACCESSORIES

Filament connector	40705
Filament/cathode connector	40706
Grid connector	40736
Filament cables (both required)	40718
	40719
Insulating pedestal (YD1195)	40729

D4309
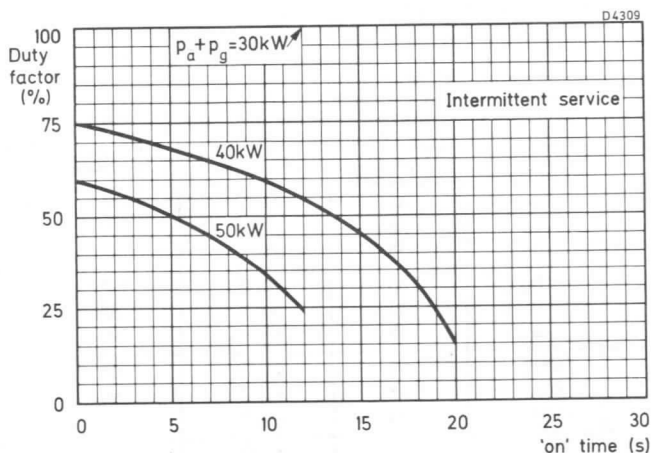
YD1195 Effect of duty factor on cooling for
30kW continuous service conditions

Mullard

R.F. INDUSTRIAL TRIODES YD1195 YD1197

D4308

Duty factor (%) vs 'on' time (s)

$p_a + p_g = 25kW$ 30kW Intermittent service 40kW 50kW

D4307

Duty factor (%) vs 'on' time (s)

$p_a + p_g = 20kW$ 25kW 30kW Intermittent service 40kW 50kW
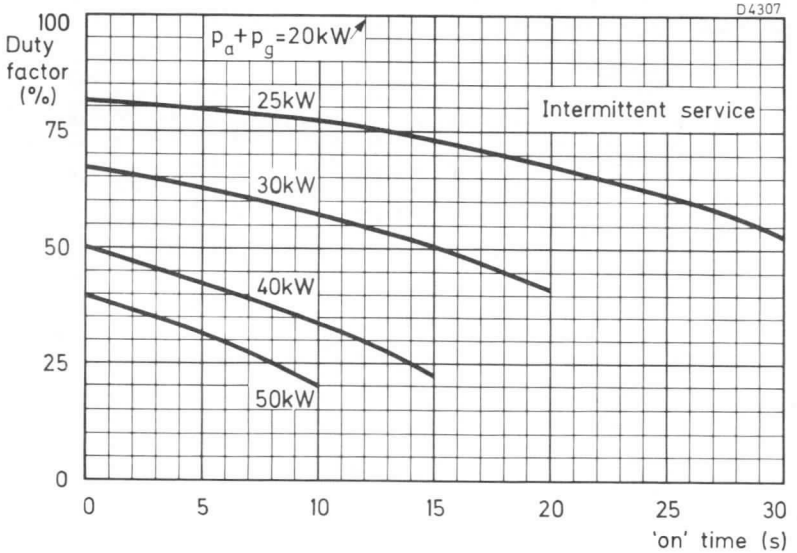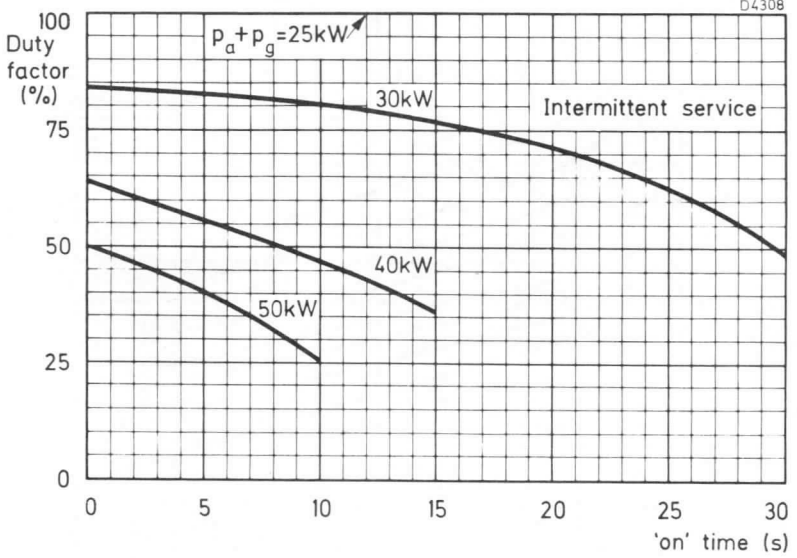
YD1195 Effect of duty factor on cooling for
25 and 20kW continuous service conditions

Mullard
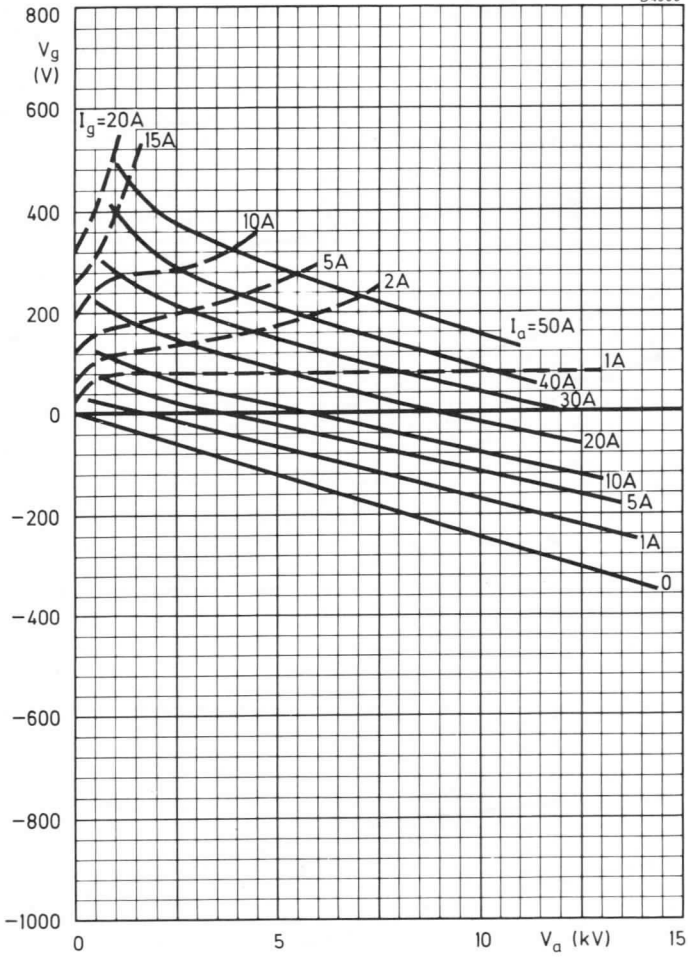
Constant current characteristics

R.F. INDUSTRIAL TRIODES YD1195 YD1197

OUTLINE DRAWING OF YD1195

Ø125 max

Ø$^{105.3}_{104.7}$

Ø$^{86.2}_{85.8}$

Ø$^{42.2}_{41.8}$

12 24 — Filament

— Filament/cathode

14 — Grid

140.5 max 106 84

Preferred direction of air flow

290 max

— Anode

111 109

27 max

Ø100 max

116 max

Ø$^{216}_{214}$

All dimensions in mm

D4304

Mullard

OUTLINE DRAWING OF YD1197

Slot 7x14(8x)
for bolt M6

45°

54

Ø136

Ø160.5max

Ø125max

Ø$^{105.3}_{104.7}$

Ø$^{86.2}_{85.8}$

Ø$^{42.2}_{41.8}$

12 24

— Filament

— Filament/cathode

14

— Grid

140.5
max 106 84

360max

4

— Anode

115max

35min

36

19

Ø$^{108.7}_{107.3}$

All dimensions in mm

D4305

When tube is used with anode up, the water connections should be interchanged.

Mullard

QUICK REFERENCE DATA

High power linear amplifier for television transposer service with common vision and sound transmission in the U.H.F. bands IV and V (470-860MHz).

Frequency range	470 to 860	MHz
*Output power, peak sync (CCIR system G)	220	W
*Gain (approx.)	30	dB
*Intermodulation product (ref. peak sync)	-54	dB
Construction		Unpackaged
tube		metal-ceramic
mount		permanent magnet
Input and output connector		50Ω, type N

*With phase compensation unit type 55382

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES
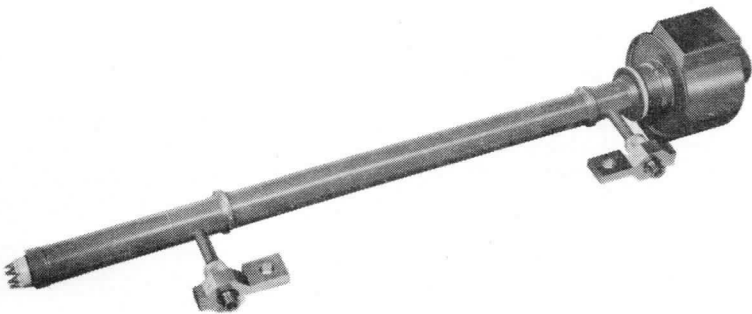
TYPICAL OPERATION

Vision and sound combined (CCIR system G) using phase compensation unit type 55382.

Operating conditions (electrode potentials measured with respect to cathode)

Frequency of vision carrier	550	615	780	MHz
Helix voltage	3.65	3.5	3.3	kV
Collector voltage	3.65	3.5	3.3	kV
Grid 1 voltage	-100	-100	-100	V
Grid 2 voltage (approx.) (see note 1)	560	610	680	V
Cathode current	850	850	850	mA
Helix current	10	10	10	mA

Typical performance

Output power, peak sync	220	220	220	W
Output power, sound	44	44	44	W
Gain (see note 2)	30	31	32	dB
Intermodulation product (ref. peak sync) (see note 3)	-54	-54	-54	dB
Low frequency linearity (see note 4)	≥ 95	≥ 95	≥ 95	%
Differential gain (see note 4)	≥ 95	≥ 95	≥ 95	%
Differential phase of colour subcarrier	≤ 3.0	≤ 3.0	≤ 3.0	deg

CATHODE

Indirectly heated dispenser cathode

Heater voltage (a.c. or d.c.)	6.5 ±2%	V
Heater current (V_h = 6.5V) (approx.)	3.2	A
Pre-heating time (minimum)	300	s

The heater starting current should never exceed a peak value of 8A with an a.c. supply, or 6A when a d.c. supply is used. When operated from d.c. the cathode must be connected to the positive side of the heater supply.

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.

	Min.	Max.	
Grid 1 voltage	-200	0	V
Grid 2 voltage	-	1.0	kV
Grid 2 current	-	3.0	mA
Helix voltage	-	4.2	kV
Helix current	-	20	mA
Collector to helix voltage	-	500	V
Collector dissipation	-	4.0	kW
Power reflected from load	-	20	W
Cathode current	-	1.0	A
Altitude	-	3.0	km

MOUNTING POSITION

Any (but see cooling). The barrel of the mount must be protected from strong magnetic fields such as from isolators, and should be several centimetres from steel plates.

COOLING

Forced-air

Minimum airflow (at sea level and for
inlet temperatures up to $45^{\circ}C$)

3.5 m^3/min
50 mm of water

for other altitudes

see page 7

Temperature

Reference point on mount cooler
max. (see outline drawing)

200 $^{\circ}C$

AMBIENT TEMPERATURE

	Min.	Max.	
Operation to full specification	-20	+50	^{o}C
Storage for tube and mount	-40	-	^{o}C

PHYSICAL DATA

Tube

	kg	lb
Weight (approx.)	3.5	7.7

Mount

	kg	lb
Weight (approx.)	53	117

ACCESSORIES

Permanent magnet mount	55380
Base connector with 5 core cable (2m long)	55381
Phase compensation unit for 19 in. rack	55382

NOTES

1. To be adjusted for indicated cathode current.

2. Including a loss of approximately 3dB in the phase compensation unit.

3. The intermodulation products of the input test signals are -70dB with respect to peak sync. The signals are set at f_v = -8dB, f_s = -7dB and f_{sb} = -17dB with respect to peak sync level. Vision/sound ratio 5:1.

4. Measured with vision signal as well as with combined vision-sound signals.

OUTLINE DRAWING OF YH1210

temp. ref. point
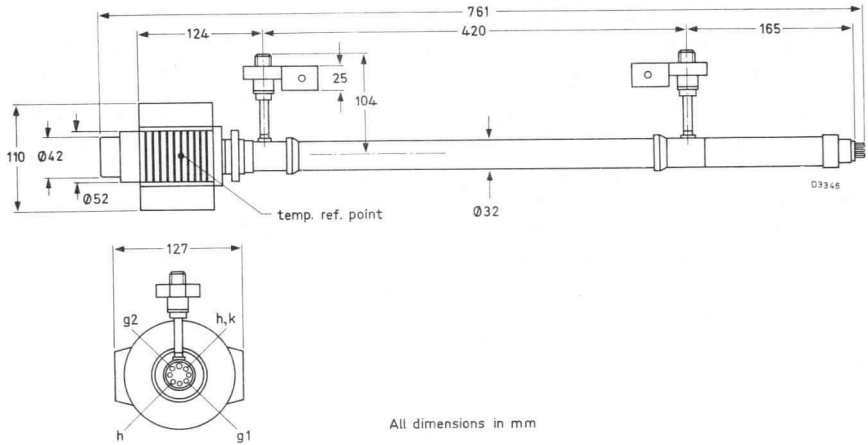
All dimensions in mm

CONVERSION TABLE

mm	in	mm	in
25	0. 98	124	4. 88
Ø 32	Ø1. 26	127	5. 00
Ø 42	Ø1. 65	165	6. 50
Ø 52	Ø2. 05	420	16. 54
104	4. 09	761	29. 96
110	4. 33		

All dimensions in mm
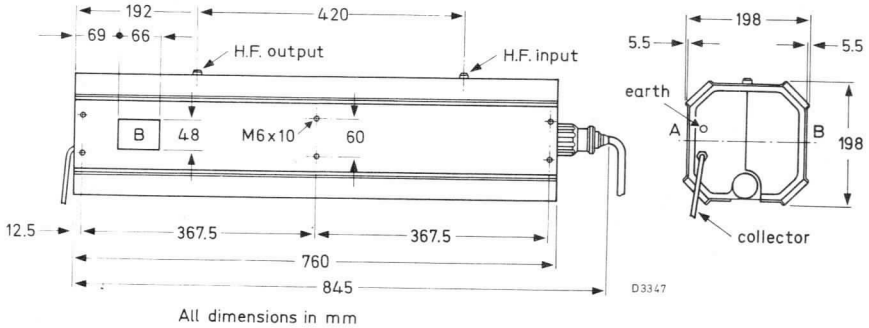
Plug connections to mount	
Heater	Brown
Heater/Cathode	Brown/Yellow
Cathode	Yellow
Grid 1	Green
Grid 2	Blue
Earth via mount	Black

The helix is internally connected to the tube body, which in turn is connected to the mount. The mount is earthed.

The collector is electrically isolated from the tube body and is connected to its power supply via the flying lead.

CONVERSION TABLE

mm	in	mm	in
5.5	0.217	192	7.56
12.5	0.492	198	7.80
48	1.89	367.5	14.47
60	2.36	420	16.53
66	2.60	760	29.92
69	2.72	845	33.27

Mullard

D3348
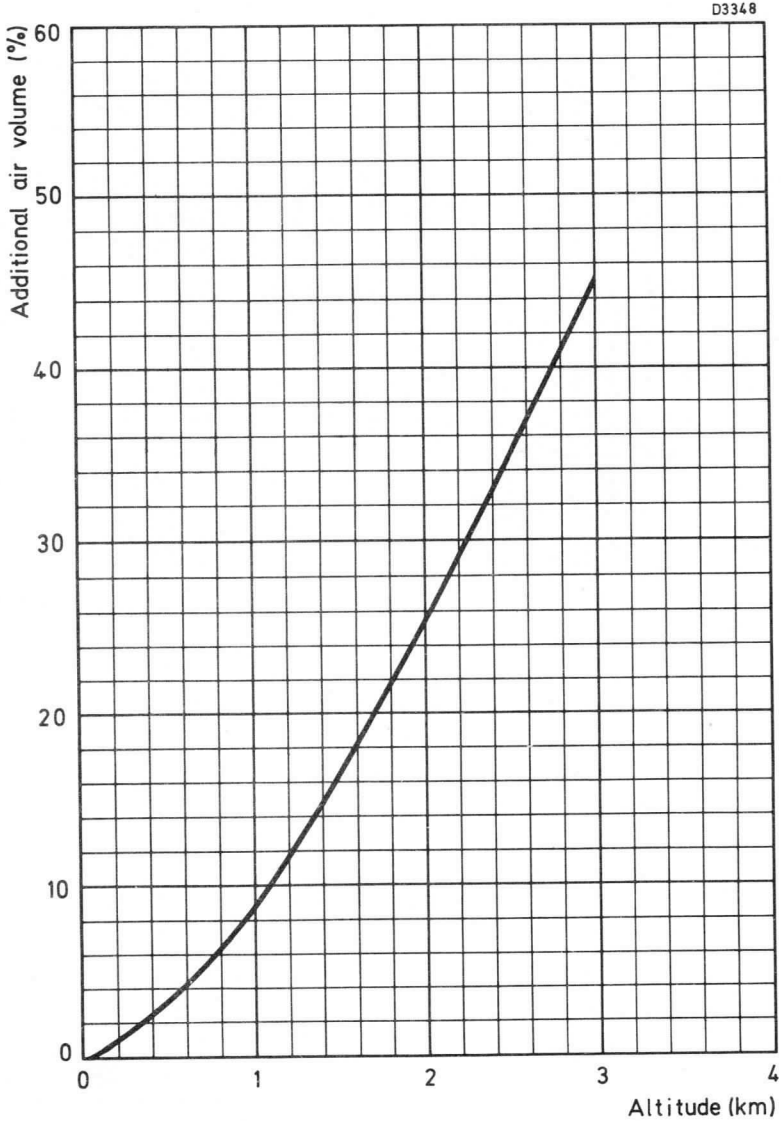
ADDITIONAL AIR VOLUME PLOTTED
AGAINST ALTITUDE

Mullard
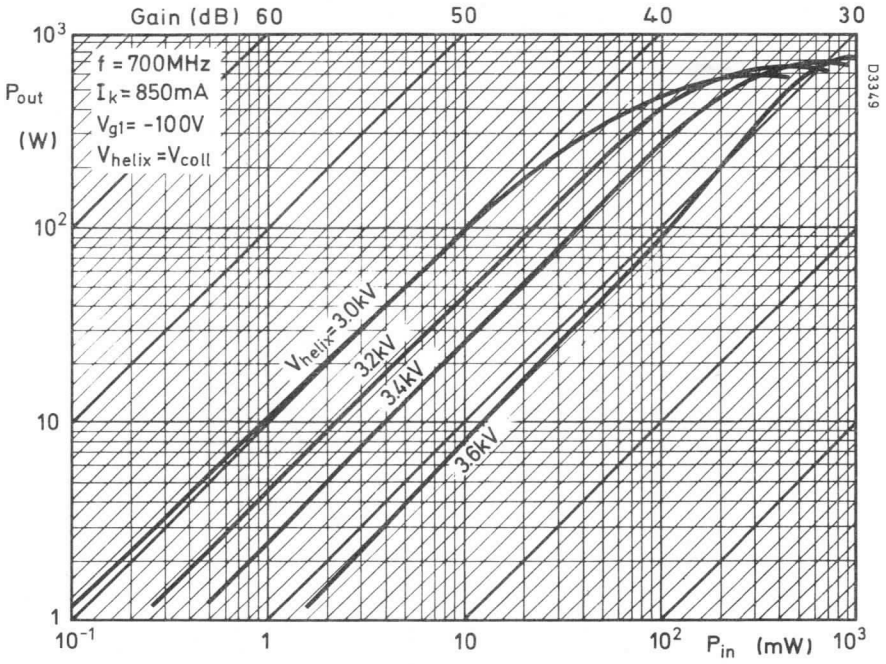
OUTPUT POWER PLOTTED AGAINST
INPUT POWER

Mullard

MAGNETRONS

QUICK REFERENCE DATA

Mechanically tunable rugged magnetron with low frequency temperature coefficient and pulling figure. Suitable for high altitude operation.

Frequency	YJ1090	9.0 to 9.5	GHz
	YJ1091	8.5 to 9.0	GHz
Power output (pulsed)		50	W

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

Unless otherwise stated, data is applicable to both types

CHARACTERISTICS

		Min.	Max.	
Frequency (tunable over the range)	YJ1090	9.0	9.5	GHz
	YJ1091	8.5	9.0	GHz
Pulse voltage ($I_{pulse} = 0.9A$)		1.025	1.350	kV
R.F. pulse power output ($I_{pulse} = 0.9A$)		30	–	W
Frequency pulling (v.s.w.r. = 1.5:1)		–	3.0	MHz
Frequency temperature coefficient over the range $T_{anode} = 60$ to $100^{o}C$		–	0.1	MHz/degC
Frequency modulation under vibration of 12g (50 to 2000Hz)		–	3.0	MHz
Input capacitance		–	6.0	pF
Frequency pushing ($I_{pulse} = 0.9A$)		–	25	kHz/mA

TYPICAL OPERATION at f = 9.25GHz (YJ1090) and f = 8.75GHz (YJ1091)

R.F. pulse power output	50	W
Duty factor	0.002	
Pulse duration	1.0	μs
Pulse repetition frequency	2000	pulse/s
Heater voltage (running)	5.0	V
Pulse current	0.9	A
Pulse voltage	1.18	kV
Pulse input power	1.06	kW
Rate of rise of voltage pulse	8.0	kV/μs
Mean input current	1.8	mA
Mean input power	2.12	W
Mean r.f. output power	100	mW
Frequency pulling (v.s.w.r. = 1.5:1)	1.9	MHz
Frequency pushing	10	kHz/mA

CATHODE

Indirectly heated

V_h	5.0	V
I_h	0.5	A

Heating time. At ambient temperatures above $0^{\circ}C$ the cathode must be heated for at least 30 seconds before the application of h.t.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	0.7	1.1	A
Pulse duration	-	2.0	μs
Duty factor	-	0.004	
Mean input power	-	6.0	W
Rate of rise of voltage pulse	-	10	$kV/\mu s$
Load mismatch (v.s.w.r.)	-	1.5:1	
Temperature of anode block	-	100	$^{\circ}C$

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:

R.F. pulse power output ($I_{pulse} = 0.9A$) .... 20 .... W

		Min.		Max.	
Over the frequency band	YJ1090	9.0	to	9.5	GHz
	YJ1091	8.5	to	9.0	GHz
Pulse voltage ($I_{pulse} = 0.9A$)		1.025	to	1.350	kV

MOUNTING POSITION .... Any

COOLING

In normal circumstances natural cooling is adequate but where the ambient temperature is abnormally high, or where convection cooling is restricted, provision for conduction cooling may be made by a clamp, of non-magnetic material, around the body.

OPERATING NOTE

Adjustment of the tuning mechanism beyond the stated frequency limits must not be attempted.

PHYSICAL DATA

	kg	lb
Weight of magnetron	0.23	0.5

OUTLINE DRAWING OF YJ1090 AND YJ1091 ←

3 holes No. 6 – 32 UNC x
3 deep max.
Equispaced on P.C.D. 27

$\varnothing$ 13.0 / 12.5

Output plug OSM201

Tuner locking screw 6 BA
hex. socket (Allen key
supplied.)

6.6 / 6.2

25.00 / 24.65

6.5 / 6.4

95.7 max

16 / 14

41.85 / 41.50

Anode temperature
measuring point

Lead length 203 min
Black lead = Cathode
Red lead = Heater

3 holes No. 6 – 32 UNC x
4.5 deep max.
Equispaced on P.C.D. 27

7.95 / 7.82

$\varnothing$ 32.5 / 30.0

Tuning nut. 6 BA hex. socket
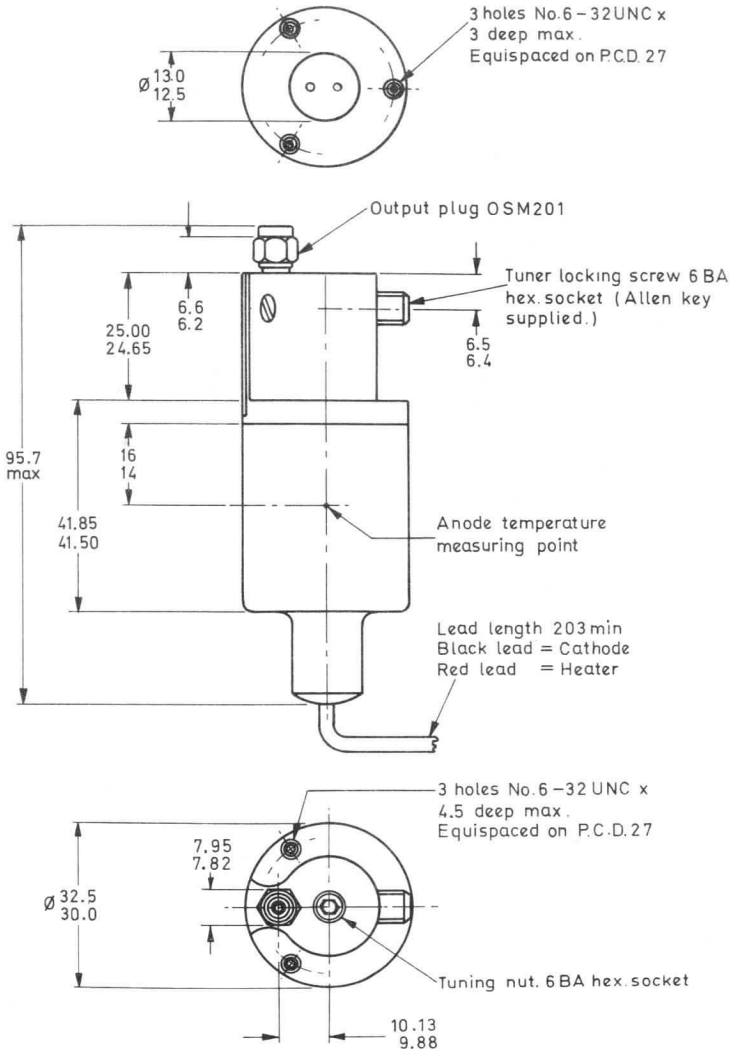
10.13 / 9.88

All dimensions in mm

D648

For conversion table see Page 4

Mullard

YJ1090–Page 3

CONVERSION TABLE
(Rounded outwards)

mm	in
3 max.	0.12 max.
4.5 max.	0.18 max.
6.6/6.2	0.260/0.244
6.5/6.4	0.256/0.252
7.95/7.82	0.313/0.308
10.13/9.88	0.399/0.389
Ø13.0/12.5	Ø0.512/0.492
16/14	0.63/0.55
25.00/24.65	0.984/0.970
27	1.06
Ø32.5/32.0	Ø1.28/1.26
41.85/41.50	1.647/1.634
95.7 max.	3.77 max.
203	8

MAGNETRON   YJ1390

QUICK REFERENCE DATA

X-Band, fixed frequency, pulsed magnetron.

Frequency (fixed within the band)	9.380 to 9.440	GHz
Power output (peak)	1.4	kW
Construction		Packaged
Output connection		Waveguide 16 flange

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

Mullard
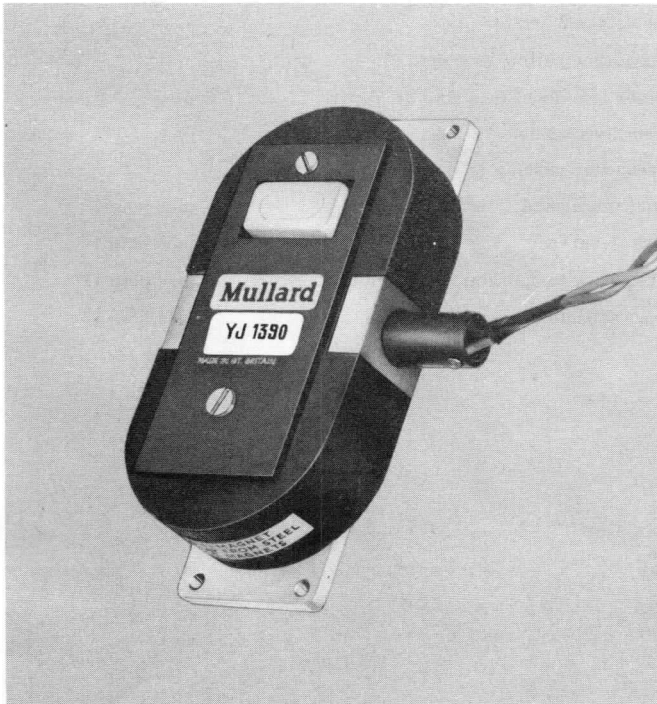
TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test conditions

Heater voltage	6.3	V
Anode current (mean)	2.25	mA
Duty factor	0.001	
Pulse duration (t_p) (see note 2)	0.5	μs
v.s.w.r. at output connection (max.)	1.05:1	
Rate of rise of voltage pulse (see note 3)	70	kV/μs

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	1.8	2.2	kV
Power output (mean)	1.2	–	W
Frequency (see note 4)	9.380	9.440	GHz
R.F. Bandwidth at 1/4 power (see notes 2 and 5)	–	$\dfrac{2.5}{t_p}$	MHz
Frequency pulling (see note 6)	–	18	MHz
Minor lobe level (see note 5)	6.0	–	dB
Stability (see note 7)	–	0.25	%
Frequency pushing (see note 8)	–	2.5	MHz/A
Cold impedance	see note 9		
Heater current	see note 10		
Frequency temperature coefficient	see note 11		
Input capacitance	see note 12		

Mullard

MAGNETRON   YJ1390

TYPICAL OPERATION

	Condition 1	Condition 2	
Operating conditions			
Heater voltage	6.3	6.3	V
Anode current (peak)	2.25	2.25	A
Pulse duration (t_p)	0.1	0.5	μs
Pulse repetition rate	1500	1500	pulse/s
Rate of rise of voltage pulse	60	60	kV/μs
Typical performance			
Anode voltage (peak)	2.0	2.0	kV
Power output (peak)	1.4	1.4	kW
Power output (mean)	0.21	1.05	W

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.4	A
Heating time (min.) (see note 1)	30	s

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.

	Min.	Max.	
Heater voltage (see note 13)	5.7	6.9	V
Anode voltage (peak)	–	2.2	kV
Anode current (peak)	1.9	2.5	A
Power input (peak)	–	5.5	kW
Pulse power input (mean)	–	8.25	W
Duty factor	–	0.0015	
Pulse duration (t_p) (see note 2)	0.05	1.0	μs
Rate of rise of voltage pulse (see note 3)	–	70	kV/μs
Anode temperature	–	120	^{o}C
v.s.w.r. at output connection	–	1.5:1	

Mullard

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from the stated test conditions, Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when tested as on page 2.

	Min.	Max.	
Anode voltage (peak)	1.8	2.2	kV
Power output (mean)	1.0	–	kW
Frequency	9.380	9.440	GHz
R.F. Bandwidth at 1/4 power	–	$\dfrac{3.5}{t_p}$	MHz
Stability	–	0.5	%

MOUNTING POSITION AND STORAGE

Mounting position	Any
Mounting and storage precautions	see note 14

OUTPUT COUPLER

The output connection of the magnetron should be directly connected to a waveguide choke flange type UG-40B/U (5985-99-083-0051).

COOLING   Natural

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.02	2.25
Weight of magnetron in storage carton	1.82	4.0
	mm	in
Dimensions of storage carton	$190 \times 190 \times 280$	$7.5 \times 7.5 \times 11$

VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. For ambient temperatures above $-15^{\circ}C$ the cathode must be heated for at least 30 seconds before the application of h.t. For ambient temperatures between -15 and $-35^{\circ}C$ the cathode heating time is 45 seconds minimum.

2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is $\pm 10\%$.

3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

Mullard

NOTES (contd.)

4. Magnetrons with other frequency ranges can be supplied to order.

5. With the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over an anode current range of 1.9 to 2.5A peak.

6. Measured at an anode current of 2.25A peak under matched conditions. A mis-match of 1.5:1 is then varied through all phases.

7. Measured as in note 5. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.380 to 9.440GHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

8. Design test only. Measured over the anode current range of 1.9 to 2.5A peak.

9. The cold impedance is measured at the operating frequency and will give a v.s.w.r. of >6:1. The position of the voltage minimum from the face of the output flange into the magnetron is 3.0 to 9.0mm.

10. Measured with a heater voltage of 6.3V and no anode input power, the heater current limits are 0.3 to 0.5A.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/degC.

12. Design test only. The maximum input capacitance is 9pF.

13. The magnetron is normally tested with a sinewave heater supply of 50Hz and is suitable for operation from 50Hz to 3kHz sine or square-wave supply. Mullard Ltd., should be consulted if the magnetron is to be operated with a heater supply having different frequency or waveform conditions.

14. When mounting and handling the magnetron, care must be taken to prevent demagnetisation. It is necessary to keep all magnetic materials as far as possible, at least 50mm (2in), from the magnet.

When storing, magnetrons should be kept as far apart as possible, at least 150mm (6in). During shipment adequate separation between magnetrons is provided by the dimensions of the inner packs of the storage cartons and it is recommended that magnetrons not in use be kept in these packs.

OUTLINE DRAWING OF YJ1390
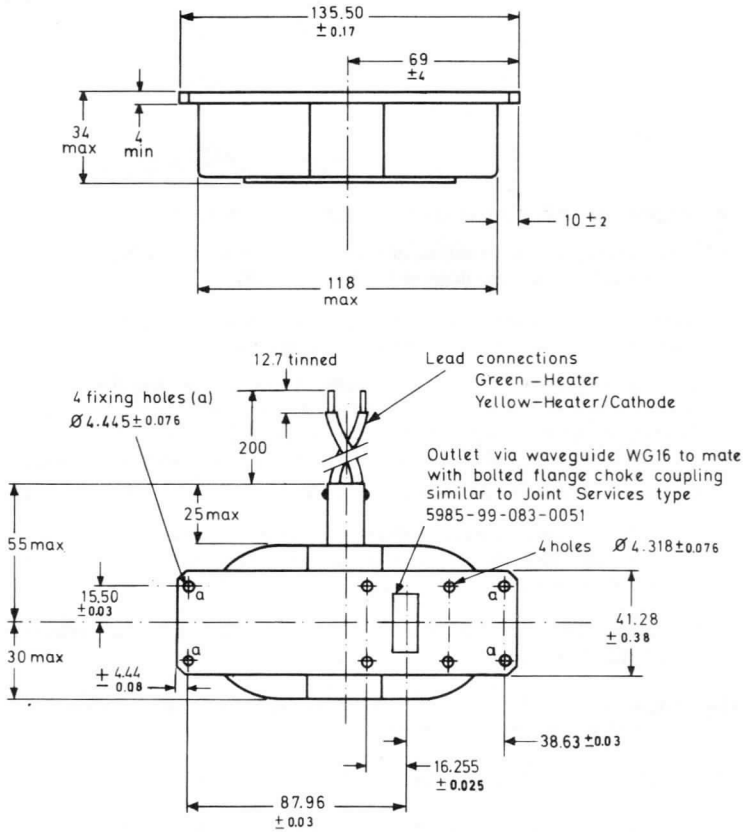
All dimensions in mm

D1184

Millimetres	Inches	Millimetres	Inches
4 min.	0.15 min.	34 max.	1.34 max.
Ø 4.318 ± 0.076	Ø 0.170 ± 0.003	38.63 ± 0.03	1.5209 ± 0.0012
4.44 ± 0.08	0.1748 ± 0.0032	41.28 ± 0.38	1.625 ± 0.015
Ø 4.445 ± 0.076	Ø 0.175 ± 0.003	55 max.	2.17 max.
10 ± 2	0.394 ± 0.079	69 ± 4	2.72 ± 0.16
12.7	0.50	87.96 ± 0.03	3.4630 ± 0.0012
15.50 ± 0.03	0.6102 ± 0.0012	118 max.	4.65 max.
16.255 ± 0.025	0.640 ± 0.001	135.50 ± 0.17	5.3347 ± 0.0067
25 max.	0.99 max.	200	7.9
30 max.	1.19 max.		

Mullard

YJ1390 Page 6

MAGNETRON   YJ1420

QUICK REFERENCE DATA

The YJ1420 is an integral magnet c. w. magnetron intended for use in domestic microwave ovens. With the L-C stabilised supply, the tube can produce up to 900W. It is cooled by forced-air and has an integral r.f. filter and thermo-switch.

Frequency	2.430 to 2.470	GHz
Power output	900	W
Construction	Packaged with integral filter	
Output connection	Probe output for coupling to waveguide or cavity	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES
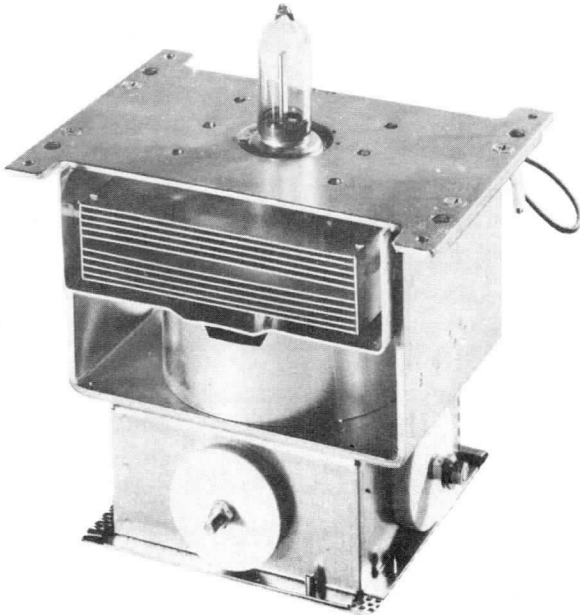
TYPICAL OPERATION (see note 1)

Operating conditions

Filament voltage (starting, standby and operating)	3.1	V
Anode current (mean) (see note 2)	340	mA
Anode current (peak) (see note 3)	0.6	A
Load v.s.w.r. (in the direction of sink)	1.5:1	

Typical performance

Frequency	2.450	GHz
Anode voltage	3.8	kV
Power output	900	W

CATHODE

Directly heated thoriated tungsten

Filament voltage (starting, standby and operating)	3.1	V
Filament current (nominal) with filament voltage of 3.1V	14	A
Filament resistance (cold) (approx.)	0.03	Ω
Pre-heating time (min.) (see note 4)	5.0	s

TEST CONDITIONS AND LIMITS

Test conditions (see note 1)

Filament voltage (operating)	3.1	V
Anode current (mean) (see note 2)	340	mA
Load v.s.w.r.	1.05:1	

Limits and characteristics

	Min.	Max.	
Power output	810	-	W
Frequency	2.430	2.470	GHz

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.

	Min.	Max.	
Filament voltage	2.8	3.4	V
Filament starting current (peak)	-	56	A
Anode current (peak) (see note 5)	-	0.7	A
Anode current (mean) (see note 2)	0.1	0.35	A
Load v.s.w.r. (continuous) (at all phases)	-	4:1	
Anode temperature (see note 6)	-	140	^{o}C

MOUNTING POSITION

Filament (cathode) axis vertical (see outline drawing). See note mounting, handling and storage.

COOLING (see outline drawing)   forced air

TYPICAL COOLING AIR FLOW

Forced air cooling flow rate	1.2	m^{3}/min
Pressure drop	25	mm water
Air inlet temperature	25	^{o}C

PHYSICAL DATA

	kg	lb
Weight of magnetron	3.1	6.8

NOTES

1. Operated from L-C stabilised supply.

2. Measured with a moving coil instrument.

3. The design of the power supply should be such that the maximum ratings of mean and peak anode current are not exceeded.

4. This is the minimum pre-heating time required by a 'cold' tube, before the application of anode voltage.

5. With a mean anode current of 340mA.

6. Measured at the point indicated on the outline drawing.

Mullard

DESIGN AND OPERATING INFORMATION

General

If it is required to operate the magnetron under conditions different from those indicated, Mullard Ltd. , should be consulted.

The equipment should be designed around the magnetron specifications given in this data and not around one particular sample, since, due to normal production variations, the design parameters of anode voltage, filament current, power output, etc. , will vary around the nominal values.

Anode supply

The magnetron should be operated from a current stabilised anode supply. The design of the unit should be such that the limiting values for the mean and peak anode currents are not exceeded.

Filament supply

The secondary of the filament transformer must be well insulated from the primary since in normal magnetron operation the cathode will be at high negative potential and the anode will be earthed. The transformer should be designed so that the filament voltage and starting current limits are not exceeded.

Filament connections

It is important to ensure that the filament connectors make good electrical and mechanical contact which will prevent the temperature of the filament terminals rising due to high contact resistance. Bad electrical connections cause voltage drop and thus lower the filament voltage which may affect the life of the magnetron.

The electrical leads to the filament and filament/cathode terminals should be flexible in order to prevent undue stress on the terminals.

Starting and standby

The anode voltage may be applied immediately after an initial warming time (5 seconds minimum) and full microwave energy is then immediately available.

Shielding

The r. f. radiation from the filament terminals is at a low level. Detailed informa - tion on power supply filtering for interference suppression may be obtained from Mullard Ltd.

Magnetron cleanliness

The r. f. output probe and filament terminals must be kept clean. The cooling air should be filtered and ducted to prevent deposits forming during operation.

HANDLING, STORAGE AND MOUNTING

Handling and storage

The original packing should be used for transporting and storing the magnetron. The magnetron should not be shipped mounted in the equipment unless precautions are taken to reduce shocks and vibrations transmitted to the tube to a value corresponding to that received in the original packing.

Mullard

HANDLING, STORAGE AND MOUNTING (contd.)

Handling and storage (contd.)

The user should be aware of the strong magnetic fields around the magnetron. When handling the tube, non-magnetic tools must be used and care should be taken to avoid damage to watches and other precision instruments.
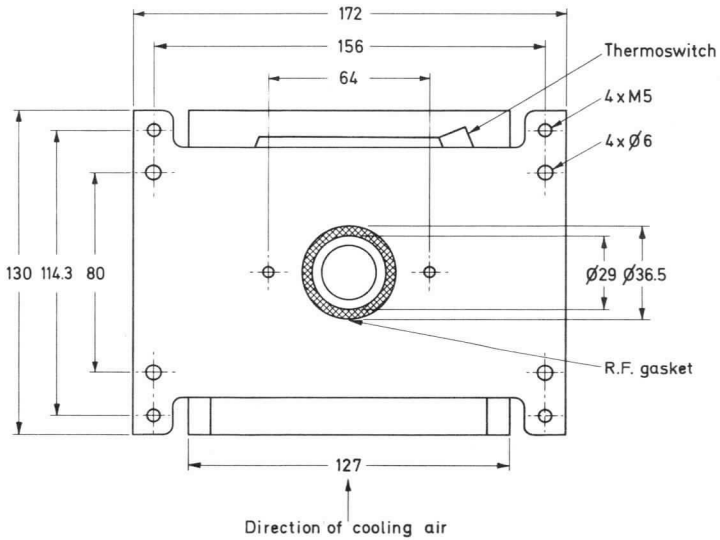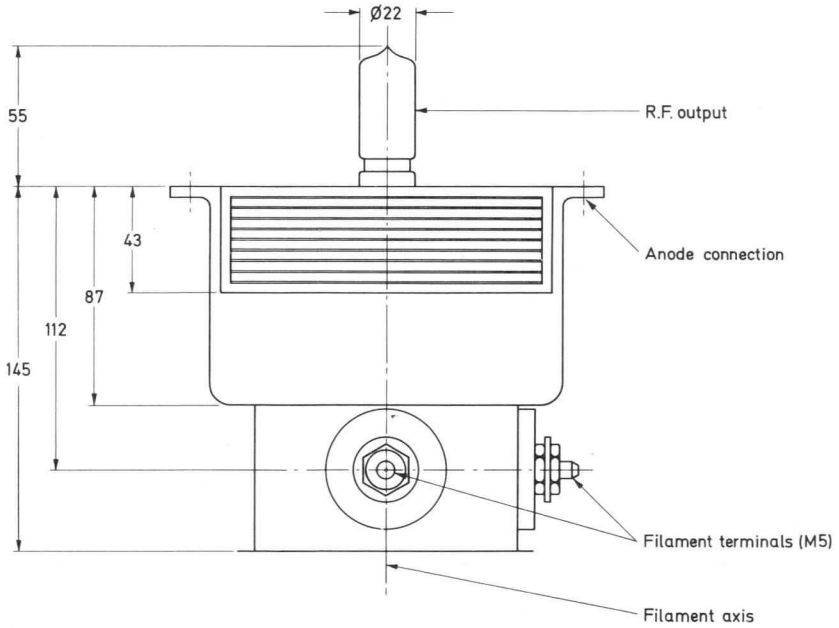
When handling and storing the magnetron, care should be taken to prevent demagnetisation. When the magnetron has to be unpacked, for example, at an assembly line or for measurement purposes, a minimum distance of 150mm (6 in) must be maintained between the magnets of adjacent tubes. It is recommended that magnetrons be stored in the original packing as the dimensions of the packs ensure adequate separation between magnets.

Mounting

The external r.f. circuit waveguide launching section should be manufactured in accordance with the dimensions given on the drawing on page 7. In order to achieve good contact between the magnetron output and external r.f. circuit it is essential to fit the r.f. gasket and to ensure that the securing screws are tight. The axes of the magnetron output must be normal to the external fitting to ensure good contact with the r.f. gasket.

The magnetron should be mounted in a position which ensures that a minimum distance of 130mm (5 in) is maintained between the magnet and any magnetic materials (for example, transformers, inductors, etc.).
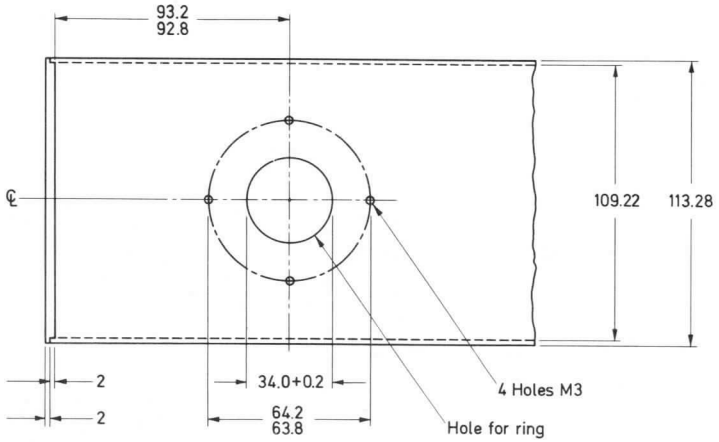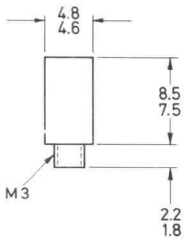
All dimensions in mm

D3507

Mullard

WAVEGUIDE LAUNCHING SECTION

93.2
92.8

109.22 113.28

2
2

34.0+0.2
64.2
63.8

4 Holes M3

Hole for ring

54.61 58.67

Centring pin (x2)

4.8
4.6

8.5
7.5

M3

2.2
1.8

Ring (to be soldered in waveguide)

31.8
31.4

34.0-02

35.8+0.2

2.6
2.4
4.6
4.4
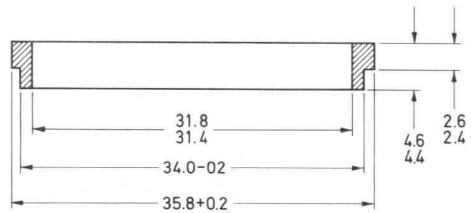
All dimensions in mm

D3508

Mullard
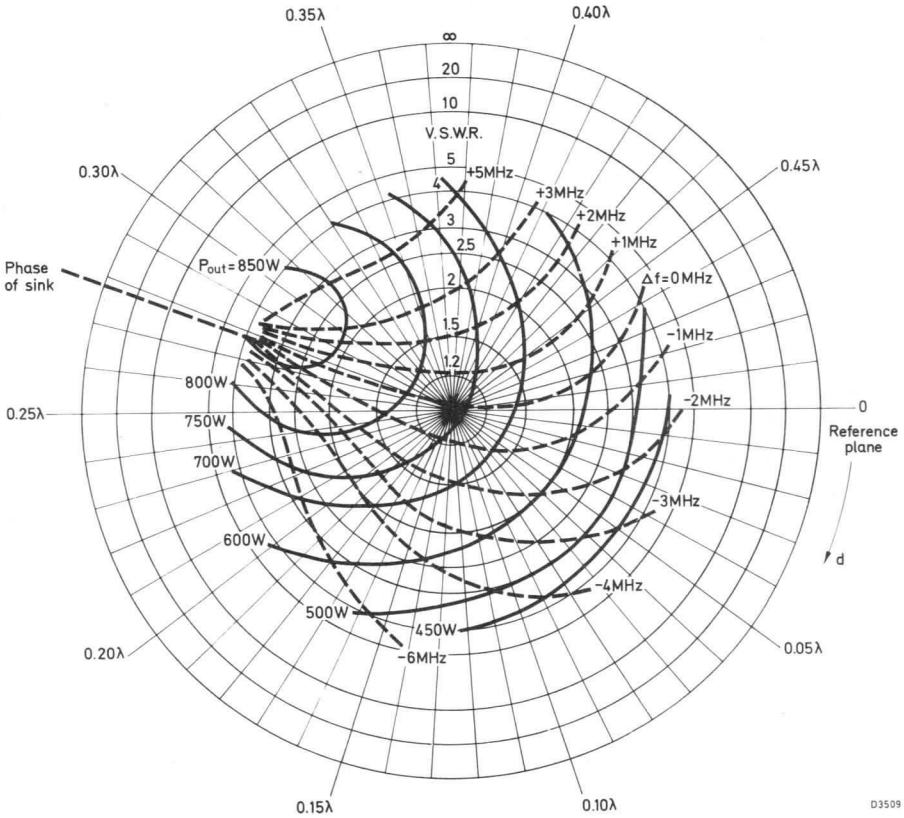
d = distance of voltage standing wave minimum
    from reference plane towards load

Reference plane axis of output coupling dome

Power supply   single phase full wave

Mean anode current 300mA

Filament voltage 3. 1V

Mullard

U.H.F. POWER KLYSTRONS

Optionally vapour, vapour condensation, or water-cooled power klystrons in metal-ceramic construction for 40 kW vision transmitters and sound transmitters in the U.H.F. bands IV/V. The tubes have four external cavities, electromagnetic focusing and a high stability dispenser-type cathode.

QUICK REFERENCE DATA

Frequency range				
YK1190			470 to 610	MHz
YK1191			590 to 720	MHz
YK1192			710 to 860	MHz
Cooling			vapour, vapour condensation, or water	

HEATING: indirect by d.c.   notes: see page 9

Cathode		dispenser type			
Heater voltage	V_f			8,5 V*	
Heater current	I_f	$\approx$	22 to 27	A	note 1
Cold heater resistance	R_{fo}	$\approx$	30	mΩ	
Waiting time					note 2
at $V_f = 8,5$ V	T_w	min.	300	s	
at stand-by, $V_f = 6$ V	T_w	min.	0	s	

FOCUSING: electromagnetic

Focusing coil current		9 to 12 A
Resistance of focusing coils		
cold (20 °C)		7,2 to 9,5 Ω
operating at an ambient temperature of 20 °C	$\leqslant$	11 Ω

BEAM CONTROL

The accelerator electrode voltage allows adjustment of the beam current between 0 and 100 %.

GETTER-ION PUMP SUPPLY   note 3

Pump voltage, no-load condition	3 to 4 kV
Internal resistance of supply	300 kΩ

* During operation the heater voltage may not fluctuate more than ± 3%.

WARNING

The ceramic part of the output cavity is made of beryllium oxide the dust of which is toxic. For the disposal of tubes observe government regulations.

Mullard

MECHANICAL DATA YK1190

Dimensions in mm

Fig. 1

Mullard

YK1191, YK1192

View X

Inlet
Section A-A

Outlet

Outlet
Section B-B

Inlet

Inlet
Section C-C

Outlet

Outlet
Section D-D

Inlet

Inlet
Section E-E

Outlet

Inlet
Inlet

Outlet

Inlet

Outlet

Inlet
Outlet

TE 1132
TE 1141
TE 1142

TE 1148 C
TE 1148 A
TE 1148 B

φ174 ±1
φ282,6
φ265
φ202 -0,5
φ158
130,2

468,9
76,2
57,2
127
22,2
127
63,5
127
78,1
127
122,5
1165

13)

Fig. 2

COOLING

Cathode socket and accelerator electrode	air ; $q \approx 0,15$ m^3/min, t_i max. 40 $^\circ$C
Collector	vapour (with boiler TE1110), note 4 volume of water converted to steam: 27 cm^3/min per kW collector dissipation resulting in 43 ℓ/min steam per kW collector dissipation water or vapour condensation (with cooler TE1194) $q = 35$ to 60 ℓ/min, t_o max. 80 $^\circ$C
Drift tubes	water; rate of flow to drift tubes and collector connected in series $q = 9$ ℓ/min, t_i max. 80 $^\circ$C, $p_i = 200$ kPa (≈ 2 at)
Cavities 3 and 4	forced air; $q = 1,5$ m^3/min, $p_i = 250$ Pa (≈ 25 mm H$_2$O), t_i max. 45 $^\circ$C

MASS (net)

Tube	approx. 80 kg
Cavities	approx. 45 kg
Magnet frame with coils and boiler or cooler	approx. 850 kg

MOUNTING

Mounting position: vertical with collector up.

To remove the tube from the magnet frame a total free height of 3,5 m, excluding hoist, is required.
For detailed mounting and tuning instructions see klystron instruction manual, delivered with each tube.

ACCESSORIES (note 5)

Each tube is delivered with the following factory fitted accessories:

Collector radiation suppressor

Accelerator electrode ring

Cathode ring

Heater/cathode connection cable (red)

Heater connection cable (blue)

Accelerator electrode connection cable (yellow)

Set of sealing rings

Mullard

ACCESSORIES (continued):	YK1190	YK1191	YK1192
A. Accessories to be ordered separately when replacing equivalent other brand types			
Magnet flux ring	TE1138	TE1138	–
Spark gap	TE1140	TE1140	–
B. Accessories required for first equipment			
Magnet flux ring	TE1138	TE1138	TE1138
Spark gap	TE1140	TE1140	TE1140
Extension pipes	6x TE1133A	6x TE1133A	6x TE1133A
for drift tubes	2x TE1133B	2x TE1133B	2x TE1133B
Water interconnecting pipes between drift tubes			
T_1 - T_2	TE1134A	TE1135A	TE1135A
T_2 - T_3	TE1134B	TE1135B	TE1135B
T_3 - T_4	TE1134C	TE1135C	TE1135C
T_4 - T_5	TE1134D	TE1135D	TE1135D
Flexible water pipes			
between tube and boiler for vapour cooling	TE1145A	TE1145A	TE1145A
between frame and tube	TE1145B	TE1145B	TE1145B
tube outlet for water cooling	TE1145C	TE1145C	TE1145C
Boiler for vapour cooling	TE1110	TE1110	TE1110
or			
Cooler for water cooling	TE1194	TE1194	TE1194
Cavities	3x TE1121A	3x TE1098A	3x TE1191A
	1x TE1121D	1x TE1098D	1x TE1191B
Input coupler	TE1122A	TE1102	TE1197
Load coupler for cav. 2 and 3	2x TE1122B	2x TE1102	2x TE1197
Output coupler for cavity 4	TE1123	TE1105	TE1196
Arc detector	TE1107	TE1107	TE1107
Magnet frame with coils	TE1108	TE1108	TE1108
Tool set	TE1137	TE1137	TE1137
Spare and optional parts			
Collector radiation suppressor	TE1111	TE1132	TE1195
Accelerator electrode ring	TE1141	TE1141	TE1141
Cathode ring	TE1142	TE1142	TE1142
Heater/cathode connection cable	TE1146A	TE1146A	TE1146A
Heater connection cable	TE1146B	TE1146B	TE1146B
Accel. electr. connection cable	TE1146C	TE1146C	TE1146C
Set of sealing rings	TE1147	TE1147	TE1147
Water protection shield	TE1139	TE1139	TE1139
Recommended circulators			
470 to 600 MHz	2722 162 01551 (T100/IV-N)		
600 to 800 MHz	2722 162 01561 (T100/V-N)		
790 to 1000 MHz	2722 162 03261 (T100/V-3-N)		

LIMITING VALUES (Absolute maximum rating system)

Heater voltage	max.		9,5	V	
Beam voltage	max.	−23	−26	kV	note 6
Cold cathode voltage	max.	−27	−30	kV	note 6
Beam current	max.		7	A	
Body current	max.		150	mA	
Accelerator electrode current	max.		6	mA	note 7
Collector dissipation	max.		150	kW	
Load v.s.w.r.	max.		1,5		
Temperature of tube envelope	max.		175	°C	

Mullard

TYPICAL OPERATING CONDITIONS: YK1190/YK1191

As 40 kW vision transmitter (CCIR-G standard)

	gain-tuned operation	efficiency-tuned operation (examples)				
Output power, peak sync.	45	45	45	45	kW	
Beam voltage	−22	−20,5	−22	−25,5	kV	note 6
Beam current	6,3	5,7	4,8	3,8	A	note 8
Accelerator to cathode voltage	22	20,5	18	16	kV	
Body current						
without drive	15	15	15	15	mA	
at 45 kW peak sync., black level	30	40	40	40	mA	
Focusing coil current	10,5	10,5	10,0	9,5	A	
Drive power, peak sync.						
YK1190 - channel 21	2	10	6	6	W	note 9
channel 38	1,5	7	4	4	W	note 9
YK1191 - channel 37	1,5	7	4	4	W	note 9
channel 51	1	5	3	3	W	note 9
Bandwidth at −1 dB points	8	8	8	8	MHz	note 10
Differential gain	80	75	70	70	%	note 11
Differential phase	6	7	10	10	deg	note 11
Linearity	70	65	60	60	%	note 12
Operating efficiency	32	38,5	42,5	46,5	%	
Saturation output power	55	60	46,5	46,5	kW	
Saturation efficiency	40	43	44	48	%	

As 4 kW/8 kW sound transmitter (CCIR-G standard)

Output power	4,5	9	4,5	9	4,5	9	kW	
Beam voltage	−20,5	−20,5	−22	−22	−25,5	−25,5	kV	note 6
Beam current	1,25	1,5	1,15	1,4	1,0	1,3	A	
Accelerator cathode voltage	≈ 7,5	≈ 8,5	≈ 7	≈ 8	≈ 6,5	≈ 8	kV	note 14
Focusing coil current			9				A	
Drive power			1,5				W	note 9
Bandwidth at −1 dB points			1				MHz	

TYPICAL OPERATING CONDITIONS: YK1192

As 40 kW vision transmitter (CCIR-G standard)

Output power, peak sync.	45	45	kW	
Beam voltage	−23	−25,5	kV	note 6
Beam current	4,6	3,9	A	note 8
Accelerator to cathode voltage	18	16	kV	
Body current				
without drive	15	15	mA	
at 45 kW peak sync., black level	40	40	mA	
Focusing coil current	10	10	A	
Drive power, peak sync.	2	2	W	note 9
Bandwidth at −1 dB points	8	8	MHz	note 10
Differential gain	70	70	%	note 11
Differential phase	10	10	deg	note 11
Linearity	60	60	%	note 12
Operating efficiency	42,5	45	%	
Saturation output power	46,5	46,5	kW	
Saturation efficiency	44	46,5	%	

As 4 kW/8 kW sound transmitter (CCIR-G standard)

Output power	4,5	9	4,5	9	kW	
Beam voltage	−23	−23	−25,5	−25,5	kV	note 6
Beam current	1,1	1,3	1,0	1,3	A	
Accelerator to cathode voltage	≈ 7	≈ 8	≈ 6,5	≈ 8	kV	note 14
Focusing coil current		9			A	
Drive power		1,5			W	note 9
Bandwidth at −1 dB points		1			MHz	

For detailed mounting and tuning instructions
see klystron instruction manual,
delivered with each tube.

Mullard

Notes
1. When switching on the heater voltage, the heater current must never exceed a peak value of 65 A.
2. In cases of a mains failure an interruption up to 30 s can be tolerated without new preheating. After min. 10 minutes of stand-by heating time at 6,0 V, the beam current may be switched on; the heater voltage must be increased to its nominal value of 8,5 V simultaneously. Operation under stand-by conditions is restricted to continuous periods of 2 weeks at a time. Stand-by periods should be separated by similar periods of rest or full operation.
3. To ensure that the klystron is ready for immediate operation the ion getter pump should be operated at least every 6 months during storage, 3 months being recommended. For details see klystron instruction manual.
4. In order to avoid corrosion of the cooling system, pure deionised water must be used as the coolant (resistivity min. 10 kΩ.cm).
5. Correct operation of the tube can be guaranteed only if a set of accessories, approved by the tube manufacturer, is used. The operating tube generates X-rays which can penetrate the ceramic parts of the tube envelope. In order to reduce the radiation at any accessible points to an officially admissible, non-dangerous, level the tube must be shielded and any possible radiation path must be blocked by at least 1 mm of brass or an equivalent portion of non-magnetic X-ray absorbing material. The proper use of our accessory parts will provide the necessary shielding.
6. Pertaining to the highest value: special high-voltage protection on tube is required. When using this value please contact the tube manufacturer beforehand.
7. The accelerator electrode voltage must not be positive with respect to the body (ground).
8. If the accelerator electrode is connected to the body (ground) via a 10 kΩ resistor, the beam current is within ± 5% of the value given in the graph of Fig. 3.
9. The drive power is defined as the power delivered to a matched load.
10. Varying the input level between black and white at any sideband frequency within this bandwidth will not cause a variation of the peak sync. output power exceeding 0,5 dB.
11. Measured with a sawtooth signal from black level to peak white occurring at each line and super-imposed colour subcarrier with a 10% peak to peak amplitude.
12. Measured with a ten-step staircase signal from black level to peak white occurring at each line.
13. Where the ceramic of the output section is beryllium oxide, this is indicated on the tube. The dust of beryllium oxide is toxic. For the disposal of burnt-out tubes observe government regulations. For adjusting the beam current in sound operation a voltage divider should be dimensioned according to an accelerator electrode current of max. 1,5 mA.
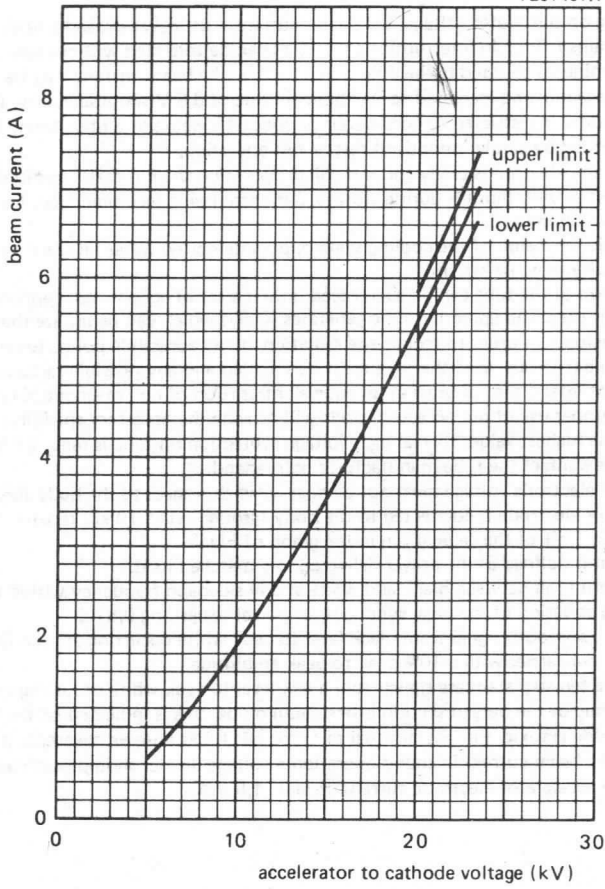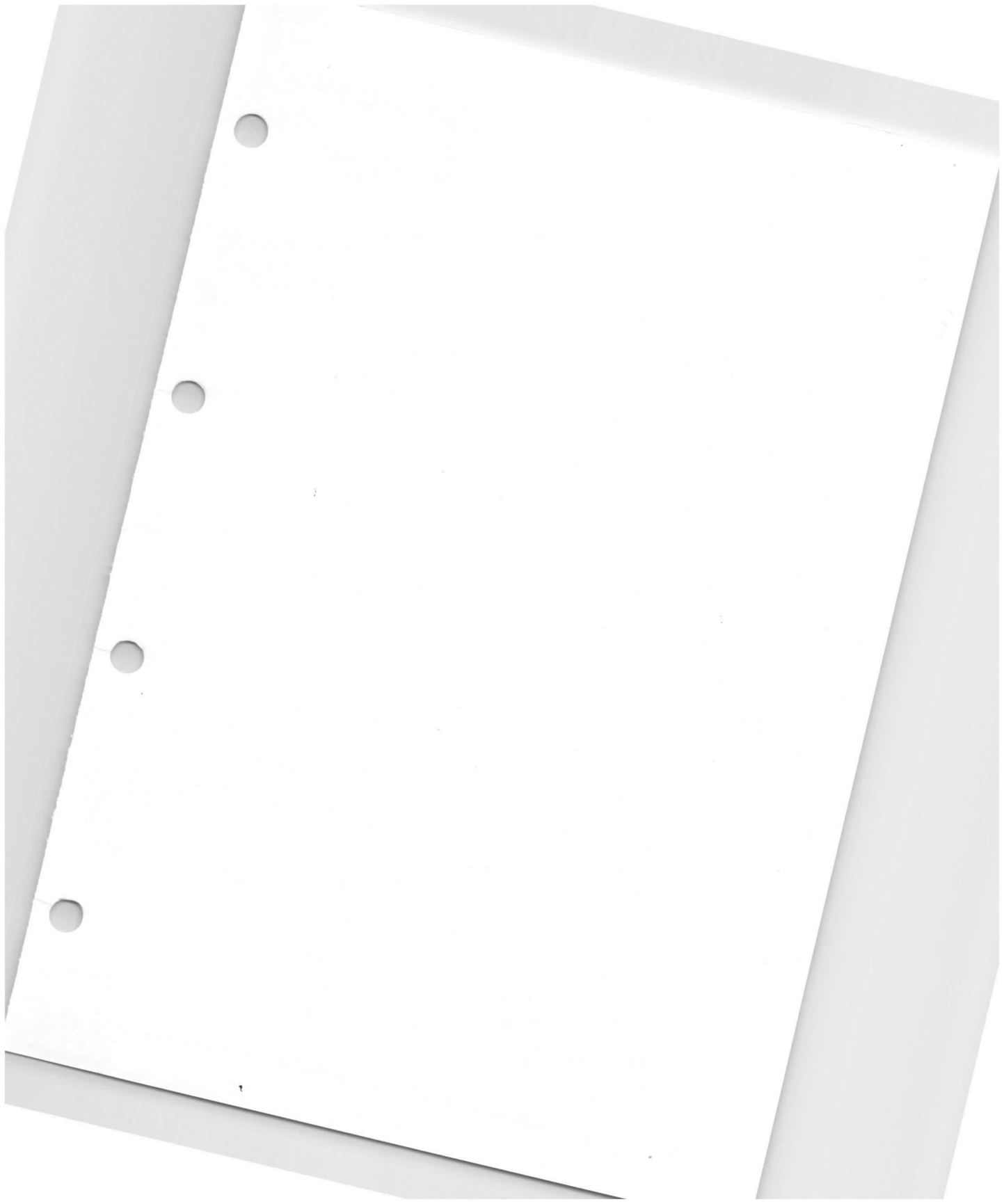
Fig. 3.

DEVELOPMENT SAMPLE DATA

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

YK1198

U.H.F. POWER KLYSTRON

Optionally vapour, vapour condensation, or water-cooled power klystron in metal-ceramic construction
for 58 kW CW amplifiers. The tube has four external cavities, electromagnetic focusing and a high
stability dispenser-type cathode.

QUICK REFERENCE DATA

Frequency range		800 MHz	
Cooling		vapour, vapour condensation, or water	

HEATING: indirect by d.c. — notes; see page 9

Cathode		dispenser type		
Heater voltage	V_f		8,5 V*	
Heater current	I_f	$\approx$	22 to 27 A	note 1
Cold heater resistance	R_{fo}	$\approx$	30 mΩ	
Waiting time				note 2
at V_f = 8,5 V	T_w	min.	300 s	
at stand-by, V_f = 6 V	T_w	min.	0 s	

FOCUSING: electromagnetic

Focusing coil current		9 to 12 A
Resistance of focusing coils		
cold (20 °C)		7,2 to 9,5 Ω
operating at an ambient temperature of 20 °C	$\leqslant$	11 Ω

BEAM CONTROL

The accelerator electrode voltage allows adjustment of the beam current between 0 and 100%.

GETTER-ION PUMP SUPPLY — note 3

Pump voltage, no-load condition	3 to 4 kV
Internal resistance of supply	300 kΩ

* During operation the heater voltage may not fluctuate more than ± 3%.

MECHANICAL DATA

Dimensions in mm

Fig. 1.

Mullard

COOLING

Cathode socket and accelerator electrode	air; $q \approx 0,15$ m^3/min, t_i max. 45 $^{\circ}$C
Collector	vapour (with boiler TE1110), note 4 volume of volume of water converted to steam: 27 cm^3/min per kW collector dissipation resulting in 43 ℓ/min steam per kW collector dissipation
	water or vapour condensation (with cooler TE1194) $q = 35$ to 60 ℓ/min, t_o max. 80 $^{\circ}$C
Drift tubes	water; rate of flow to drift tubes and collector connected in series $q \approx 9$ ℓ/min, t_i max. 80 $^{\circ}$C, $p_i = 200$ kPa (≈ 2 at)
Cavities 3 and 4	forced air; $q = 1,5$ m^3/min, $p_i = 250$ Pa (≈ 25 mm H$_2$O), t_i max. 45 $^{\circ}$C

MASS (net)

Tube	approx. 80 kg
Cavities	approx. 45 kg
Magnet frame with coils and boiler or cooler	approx. 855 kg

MOUNTING

Mounting position: vertical with collector up

To remove the tube from the magnet frame a total free height of 3,5 m, excluding hoist, is required. For detailed mounting and tuning instructions see klystron instruction manual, delivered with each tube.

DEVELOPMENT SAMPLE DATA

ACCESSORIES

Set of sealing rings	TE1147
Collector radiation suppressor (factory fitted)	TE1195
Accelerator electrode ring (factory fitted)	TE1141
Cathode ring (factory fitted)	TE1142

Water interconnecting pipes between drift tubes

$T_1 - T_2$	TE1135A
$T_2 - T_3$	TE1135B
$T_3 - T_4$	TE1135C
$T_4 - T_5$	TE1135D
Extension pipes	6 x TE1133A
for drift tubes	2 x TE1133B

Flexible water pipes	for vapour cooling	for water cooling
between tube and boilar	TE1145A	—
between frame and tube	TE1145B	TE1145B
tube outlet	—	TE1145C
Boiler for vapour cooling	TE1110	—
or		
Cooler for water cooling	—	TE1194

Magnet flux ring	TE1138
Water protection shield	TE1139
Spark gap	TE1140
Heater/cathode connection cable (red)	TE1146A
Heater connection cable (blue)	TE1146B
Accelerator electrode connection cable (yellow)	TE1146C
Cavities	3 x TE1191A
	1 x TE1191B
Input coupler	TE1102
Load coupler for cavities 2 and 3	2 x TE1102
Blind flanges	3 x TE1157
Output coupler for cavity 4	TE1192
Arc detector	TE1107
Magnet frame with coils	TE1193
Tool set	TE1137
Recommended circulator	2722 162 01561 (T100/V-N)

Mullard

LIMITING VALUES (Absolute maximum rating system)

Heater voltage	max.	9,5	V
Cathode voltage	max.	−28	kV
Cold cathode voltage	max.	−30	kV
Cathode current	max.	7	A
Drift tube current	max.	60	mA
Accelerator electrode current	max.	6	mA	note 5
Collector dissipation	max.	150	kW
Load v.s.w.r.	max.	1,5	
Temperature of tube envelope	max.	175	°C

TYPICAL OPERATING CONDITIONS

As 58 kW CW amplifier

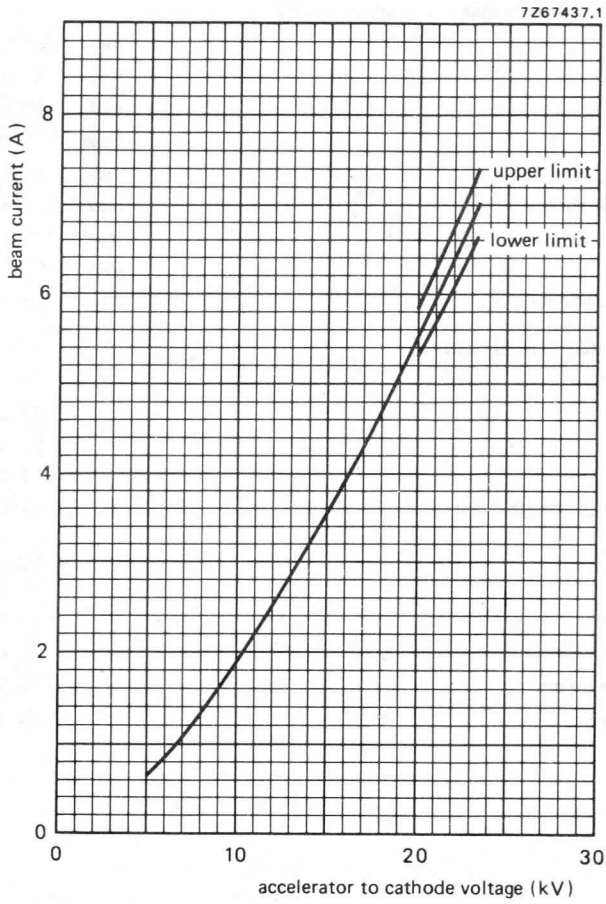|				
Output power		58	kW	
Cathode voltage		−27	kV	
Cathode current		5	A	note 6
Accelerator to cathode voltage	≈	17,5	kV	
Drift tube current				
without drive		10	mA	
at 58 kW		20	mA	
Focusing coil current	≈	10	A	
Drive power, at 800 MHz	≈	2	W	note 7
Bandwidth at −1 dB points	≈	5	MHz	
Operating efficiency	⩾	43	%	

Fig. 2.

Mullard

WARNING - Health hazard

1. X-radiation

Correct operation of the tube can be guaranteed only if a set of accessories, approved by the tube manufacturer, is used. The operating tube generates X-rays which can penetrate the ceramic parts of the tube envelope. In order to reduce the radiation at any accessible points to an officially admissible, non-dangerous, level the tube must be shielded and any possible radiation path must be blocked by at least 1 mm of brass or an equivalent portion of non-magnetic X-ray absorbing material. The proper use of our accessory parts will provide the necessary shielding.

2. R.F. radiation

R.F. power may be emitted not only through the normal output coupling but also through other apertures (e.g. r.f. leaks). This r.f. power may be sufficiently intense to cause danger to the human body, particularly to the eyes. Such radiation may be increased if the tube is functioning incorrectly.

3. Beryllia ceramic

The ceramic of the output section is beryllium oxide, the dust of which is toxic. For the disposal of burnt-out tubes government regulations must be observed.

Notes
1. When switching on the heater voltage, the heater current must never exceed a peak value of 65 A.
2. In cases of a mains failure an interruption up to 30 s can be tolerated without new preheating. After min. 10 minutes of stand-by heating time at 6,0 V, the beam current may be switched on; the heater voltage must be increased to its nominal value of 8,5 V simultaneously. Operation under stand-by conditions is restricted to continuous periods of 2 weeks at a time. Stand-by periods should be separated by similar periods of rest or full operation.
3. To ensure that the klystron is ready for immediate operation the ion getter pump should be operated at least every 6 months during storage, 3 months being recommended. For details see klystron instruction manual.
4. In order to avoid corrosion of the cooling system, pure deionized water must be used as the coolant (resistivity min. 10 kΩ.cm).
5. The accelerator electrode voltage must not be positive with respect to the body (ground).
6. If the accelerator electrode is connected to the body (ground) via a 10 kΩ resistor, the cathode current is within ± 5% of the value given in the graph of Fig. 2.
7. The drive power is defined as the power delivered to a matched load.

DEVELOPMENT SAMPLE DATA

DEVELOPMENT SAMPLE DATA

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

YK1220

U.H.F. POWER KLYSTRON

Optionally water, vapour condensation, or vapour-cooled power klystron, in metal-ceramic construction for 10 and 15 kW vision transmitters and sound transmitters in the U.H.F. bands IV/V. The tubes have four external cavities and a high stability dispenser-type cathode.

QUICK REFERENCE DATA

Frequency range	470 to 860 MHz
Cooling	vapour, vapour condensation, or water

HEATING; indirect by d.c.   notes; see page 9

Cathode	dispenser type			
Heater voltage	V_f		5,5	V*
Heater current	I_f	$\approx$	20 to 27	A note 1
Cold heater resistance	R_{fo}	$\approx$	25	mΩ
Waiting time				
at $V_f = 5,5$ V	T_w	min.	300	s
at stand-by, $V_f = 4,5$ V	T_w	min.	0	s

FOCUSING

Focusing coil current		8 to 12 A
Resistance of focusing coils		
cold (20 °C)		7,2 to 9,5 Ω
operating at an ambient temperature of 20 °C	$\leqslant$	11 Ω

BEAM CONTROL   notes 6,7

The accelerator electrode voltage allows adjustment of the beam current between 0 and 100%.

GETTER-ION PUMP SUPPLY   note 3

Pump voltage, no-load condition	3 to 4 kV
Internal resistance of supply	300 kΩ

WARNING

The ceramic part of the output cavity is made of beryllium oxide the dust of which is toxic. For the disposal of tubes observe government regulations.

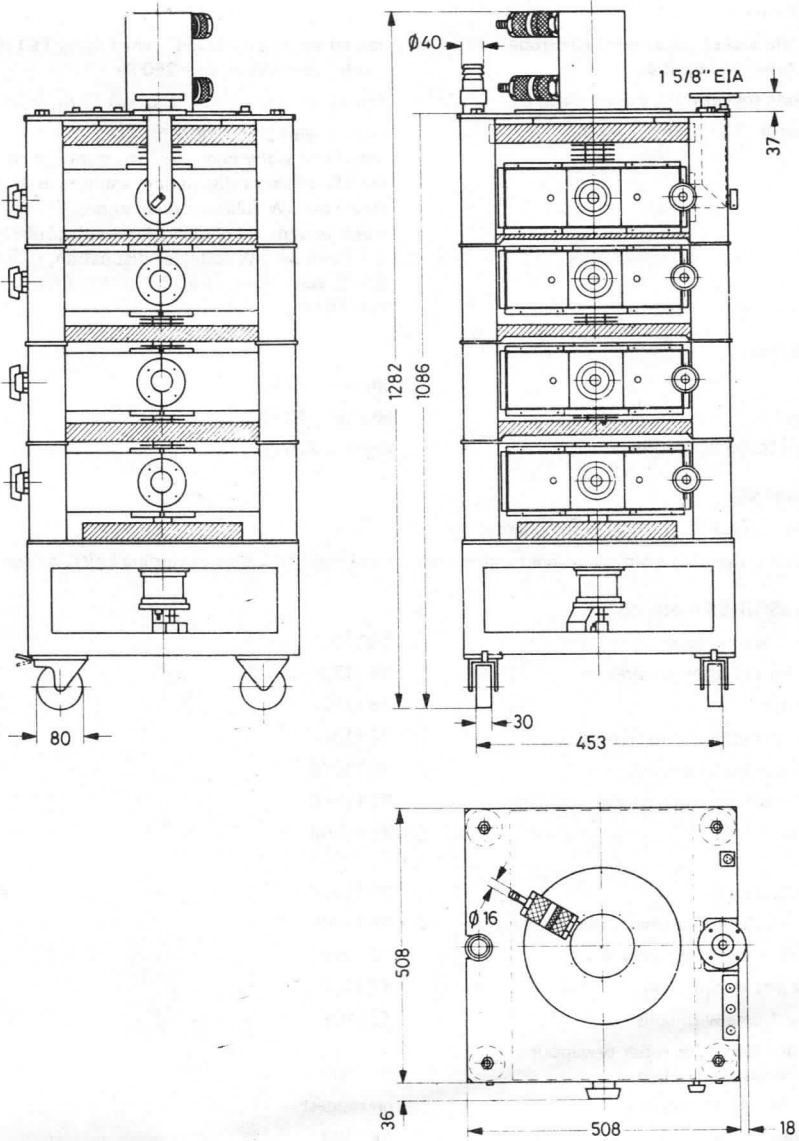* During operation the heater voltage may not fluctuate more than ± 3%.

MECHANICAL DATA

Dimensions in mm

Fig. 1.

Mullard

DE LOPMENT SAMPLE D A

Fig. 2.

COOLING

Cathode socket, accelerator electrode, drift tubes and cavities

forced air, t_i max. 50 °C; when using TE1188: $q \approx 1,5$ m^3/min, $p_i = 250$ Pa

Cathode socket only, during stand-by

forced air, t_i max. 50 °C, $q \approx 0,15$ m^3/min

Collector

vapour with boiler, note 4
volume of water converted to steam: 27 cm^3/min per kW collector dissipation resulting in 43 ℓ/min steam per kW collector dissipation; water or vapour condensation (with cooler) q min. 0,4 l/min per kW collector dissipation, t_o max. 80 °C, see graph of Fig. 3. For 10 ℓ/min, $p_i = 16$ kPa.

MASS (net)

Tube	approx. 25 kg
Cavities	approx. 45 kg
Magnet frame with coils	approx. 220 kg

MOUNTING

Mounting position: vertical with collector up

To remove the tube from the magnet frame a total free height of 2,5 m, excluding hoist, is required.

ACCESSORIES (note 10)

Set of 3 sealing rings	TE1181
Collector radiation suppressor	TE1182
Spark gap	TE1183
Heater/cathode connection cable	TE1184A
Heater connection cable	TE1184B
Accelerator electrode connection cable	TE1184C
Cavities	3 x TE1185A 1 x TE1185B
Inlet coupler	TE1186A note 10
Load coupler for cavities 2 and 3	2 x TE1186B
Output coupler for cavity 4	TE1187
Arc detector (optional)	TE1107
Magnet frame with coils	TE1188
Collector jacket for water or vapour condensation cooling	TE1189
Boiler for vapour cooling	on request
Tool set	TE1190
Isolator (optional)	I 10/IV-N or I 10/V-N

Mullard

LIMITING VALUES (Absolute maximum rating system)

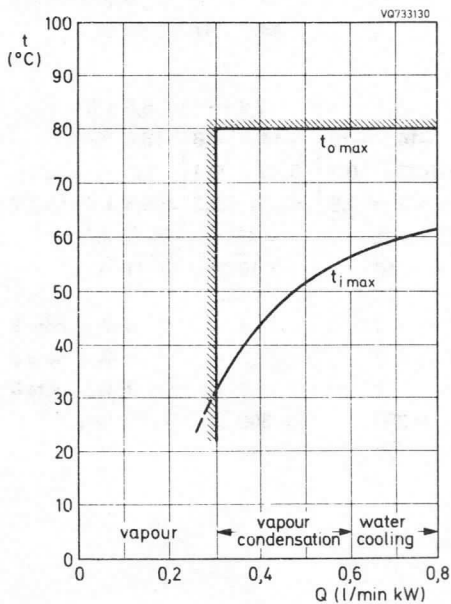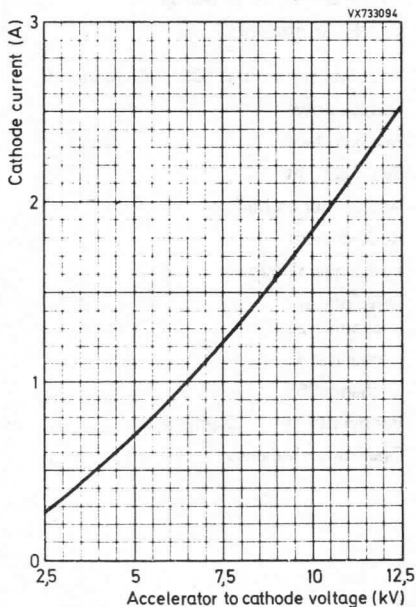|		
Heater voltage	max.	6,5 V
Beam voltage	max.	−20 kV
Cold cathode voltage	max.	−21 kV
Beam current	max.	3 A
Body current	max.	80 mA
Accelerator electrode current	max.	6 mA note 5
Collector dissipation	max.	40 kW
Load v.s.w.r.	max.	1,5
Temperature of tube envelope	max.	175 °C
Static pressure in the cooling system	max.	400 kPa (≈ 4 at)

DEVELOPMENT SAMPLE DATA

Fig. 3.

Fig. 4.

TYPICAL OPERATING CONDITIONS

As 10 kW vision transmitter (CCIR-G standard)

Channel	21	51	68		
Output power, peak sync.	11	11	11	kW	
Beam voltage	−14	−15	−16	kV	
Beam current	1,8	1,55	1,50	A	note 6
Accelerator to cathode voltage	≈ 10	≈ 9	≈ 8,5	kV	note 7
Body current					
without drive	≈ 10	≈ 9	≈ 5	mA	
at black level	≈ 40	≈ 35	≈ 30	mA	
Focusing coil current	10	9	9	A	
Drive power, peak sync.	6	3	2	W	note 8
Bandwidth at −1 dB points	8	8	8	MHz	note 9
Operating efficiency	43	47	45	%	

As sound transmitter (CCIR-G standard)

Output power	1,1		2,2		5,5	kW	
Beam voltage	−14	−16	−14	−16	−18,5	kV	
Beam current	0,35	0,3	0,45	0,4	0,8	A	note 6
Accelerator cathode voltage	≈ 3	≈ 2,5	≈ 3,5	≈ 3,5	≈ 5,5	kV	note 7
Body current	≈ 15		≈ 15		≈ 15	mA	
Focusing coil current	10		10		11	A	
Drive power							
channel 21	4		4		4	W	note 8
channel 51	2		2		2	W	note 8
channel 68	1		1		1	W	note 8
Bandwidth at −1 dB points	⩾ 300		⩾ 300		⩾ 300	kHz	
Operating efficiency	22		34		37	%	

Mullard

TYPICAL OPERATING CONDITIONS (continued)

As 15 kW vision transmitter ((CCIR-G standard)

Channel	21	51	68	
Output power, peak sync.	16,5	16,5	16,5	kW
Beam voltage	−16,5	−17,5	19,0	kV
Beam current	2,35	2,0	1,95	A note 6
Accelerator to cathode voltage	≈ 12	≈ 10,5	≈ 10,5	kV note 7
Body current				
without drive	≈ 10	≈ 7	≈ 5	mA
at black level	≈ 50	≈ 45	≈ 40	mA
Focusing coil current	10,5	9,5	9,5	A
Drive power, peak sync.	9	5	3	W note 8
Bandwidth at −1 dB points	8	8	8	MHz note 9
Operating efficiency	43	47	45	%

As sound transmitter (CCIR-G standard)

Output power	1,65		3,3		kW
Beam voltage	−16,5	−19	−16,5	−19	kV
Beam current	0,35	0,3	0,6	0,5	A note 6
Accelerator cathode voltage	≈ 3	≈ 2,5	≈ 4,5	≈ 4	kV note 7
Body current	≈ 15		≈ 15		mA
Focusing coil current	10		10		A
Drive power					
channel 21	4		4		W note 8
channel 51	2		2		W note 8
channel 68	1		1		W note 8
Bandwidth at −1 dB points	⩾ 300		⩾ 300		kHz
Operating efficiency	29		34		%

DEVELOPMENT SAMPLE DATA

WARNING — *Health hazard.*

1. X-radiation

Correct operation of the tube can be guaranteed only if a set of accessories, approved by the tube manufacturer, is used. **The operating tube** generates X-rays which can penetrate the ceramic parts of the tube envelope. In order to reduce the radiation at any accessible points to an officially admissible, non-dangerous, level the tube must be shielded and any possible radiation path must be blocked by at least 1 mm of brass or an equivalent portion of non-magnetic X-ray absorbing material. The proper use of our accessory parts will provide the necessary shielding.

2. R.F. radiation

R.F. power may be emitted not only through the normal output coupling but also through other apertures (e.g. r.f. leaks). This r.f. power may be sufficiently intense to cause danger to the human body, particularly to the eyes. Such radiation may be increased if the tube is functioning incorrectly.

Notes
1. When switching on the heater voltage, the heater current must never exceed a peak value of 70 A.
2. In cases of a mains failure an interruption up to 30 s can be tolerated without new preheating. After min. 10 minutes of stand-by heating time at 4,5 V, the beam current may be switched on; the **heater** voltage must be increased to its nominal value of 5,5 V simultaneously. Operation under stand-by conditions is restricted to continuous periods of 2 weeks at a time. Stand-by periods should be separated by similar periods of rest or full operation.
3. To ensure that the klystron is ready for immediate operation the ion getter pump should be operated at least every 6 months during storage, 3 months being recommended. For details see klystron instruction manual.
4. In order to avoid corrosion of the cooling system, pure **deionized** water must be used as the coolant (resistivity min. 10 kΩ.cm).
5. The accelerator electrode voltage must not be positive with respect to the body (ground).
6. For cathode current (tolerance ± 5%) versus accelerator to cathode voltage, see Fig. 4.
7. The accelerator electrode has to be connected to its supply (power supply or voltage divider) via a 10 kΩ resistor. For adjusting the cathode current, a voltage divider should be dimensioned according to **an** accelerator electrode current of max. 1,5 mA.
8. The drive power is defined as the power delivered to a matched load.
9. Varying the input level between black and white at any sideband frequency within this bandwidth will not cause a variation of the peak sync. output power exceeding 0,5 dB.
10. Coupling for band IV and band V included.

Mullard

DEVELOPMENT SAMPLE DATA

This information is derived from development samples ma⁻ e 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

YK1230

U.H.F. POWER KLYSTRON

Optionally water, vapour condensation, or vapour-cooled power klystron, in metal-ceramic construc-
tion for 20 and 25 kW vision transmitters and sound transmitters in the U.H.F. bands IV/V. The tubes
have four external cavities and a high stability dispenser-type cathode.

QUICK REFERENCE DATA

Frequency range	470 to 860 MHz		
Cooling	vapour, vapour condensation, or water		

HEATING; indirect by d.c.			notes; see page 8	
Cathode	dispenser type			
Heater voltage	V_f		5,5	V *
Heater current	I_f	≈	20 to 27	A note 1
Cold heater resistance	R_{fo}	≈	25	mΩ
Waiting time				
from cold, $V_f = 0$ V	T_w	min.	300	s
from black heat, $V_f = 4,5$ V	T_w	min.	0	s

FOCUSING		
Focusing coil current	8 to 12	A
Resistance of focusing coils		
cold (20 °C)	7,2 to 9,5	Ω
operating at an ambient temperature of 20 °C	≤ 11	Ω

BEAM CONTROL notes 6, 7

The accelerator electrode voltage allows adjustment of the beam current between 0 and 100%.

GETTER-ION PUMP SUPPLY		note 3
Pump voltage, no-load condition	3 to 4	kV
Internal resistance of supply	300	kΩ

WARNING

The ceramic part of the output cavity is made of beryllium oxide
the dust of which is toxic.   For the disposal of tubes observe
government regulations.

---

* During operation the heater voltage may not fluctuate more than ± 3%.
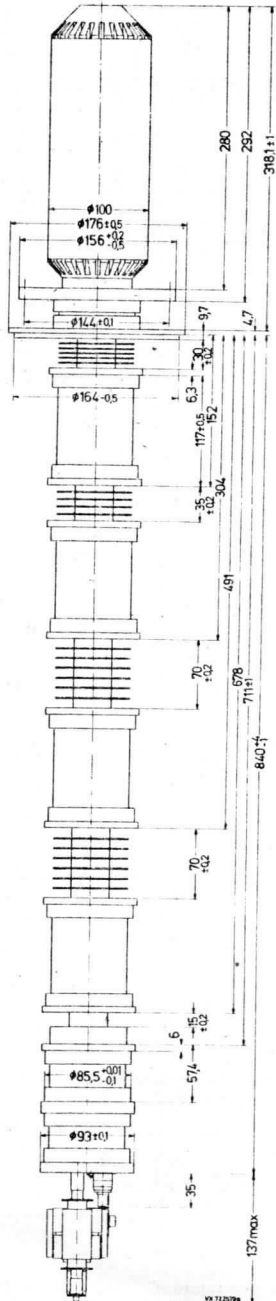
MECHANICAL DATA

Dimensions in mm

Fig. 1.

Mullard

DE ELOPMENT SAMPLE D A

Water outlet

R 1/2"

Water inlet

55

264

TE 1189 D
TE 1189 B

3 1/8" EIA

Ø40

Air
inlet

100

1382
1086

162

M5

80

234

30

453

Connection
for
focusing coils

508

Earth
connec-
tion

Cav.1
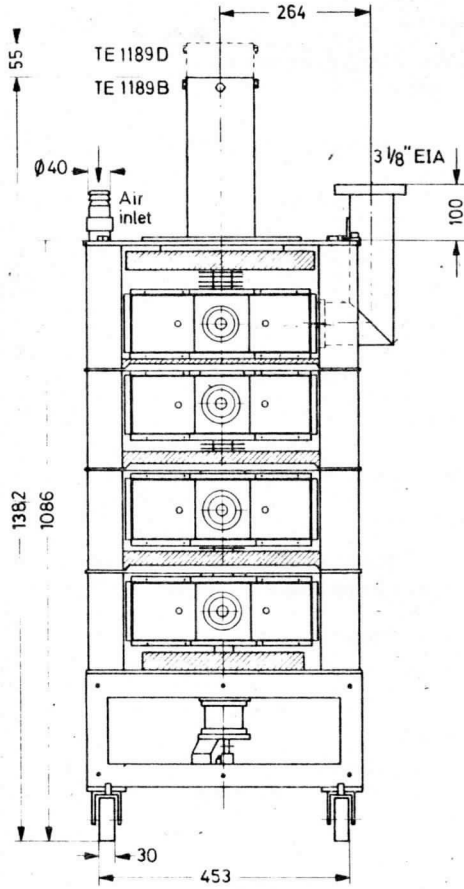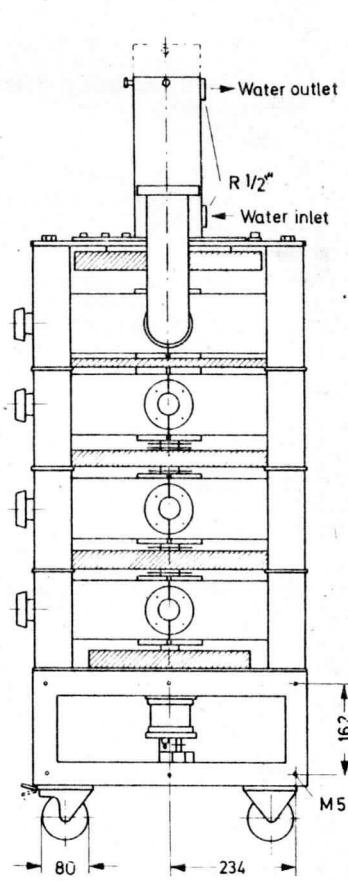Cav.2
Cav.3

RF
connections

36

508

75

VX 722585a

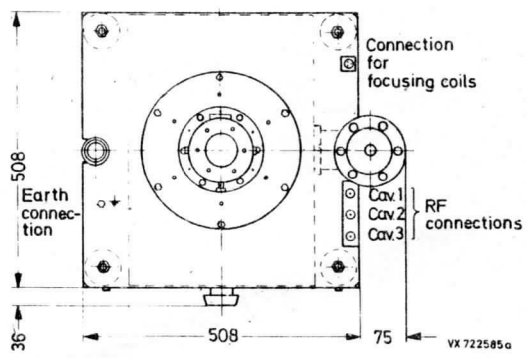Fig. 2.

COOLING

Cathode socket, accelerator electrode,
drift tubes and cavities

forced air, t_i max. 50 °C; when using TE1188:
$q \approx 1,5$ m³/min, $p_i = 250$ Pa

Cathode socket only, during black heat

forced air, t_i max. 50 °C, $q \approx 0,15$ m³/min

Collector

vapour with boiler TE1189D, note 4
volume of water converted to steam: 27 cm³/min
per kW collector dissipation resulting in 43 ℓ/min
steam per kW collector dissipation;

water or vapour condensation (with cooler
TE1189B) q = 16 to 36 ℓ/min, 90 °C, see graph
of Fig. 3. For 10 ℓ/min, $p_i = 16$ kPa.

MASS (net)

Tube	approx. 30 kg
Cavities	approx. 45 kg
Magnet frame with coils	approx. 220 kg

MOUNTING

Mounting position: vertical with collector up

To remove the tube from the magnet frame a total free height of 2,5 m, excluding hoist, is required.

ACCESSORIES

Set of 3 sealing rings	TE1181
Collector radiation suppressor	TE1182
Spark gap	TE1183
Set of connectors (heater, cathode, accelerator electrode)	TE1184
Cavities	TE1185
Inlet coupler	TE1186C
Load coupler for cavities 2 and 3	2 x TE1186D
Output coupler for cavity 4; $3\frac{1}{8}$ inch, 90°-elbow	TE1187C
Magnet frame with coils	TE1188
Collector jacket for water or vapour condensation cooling	TE1189B
Boiler for vapour cooling	TE1189D
Tool set and tube lifting yoke	TE1190
Arc detector	TE1107
Isolator (optional)	I 10/IV-N or I 10/V-N

LIMITING VALUES (Absolute maximum rating system)

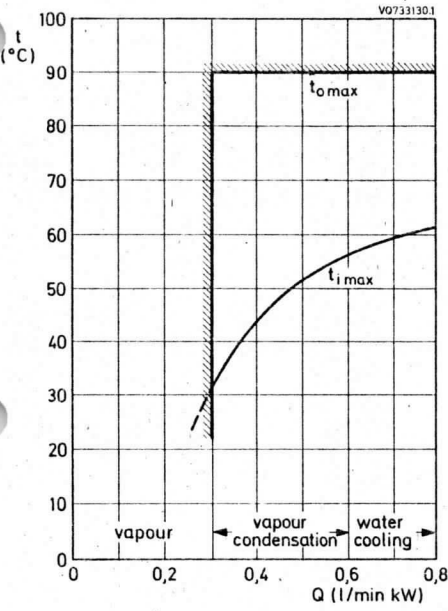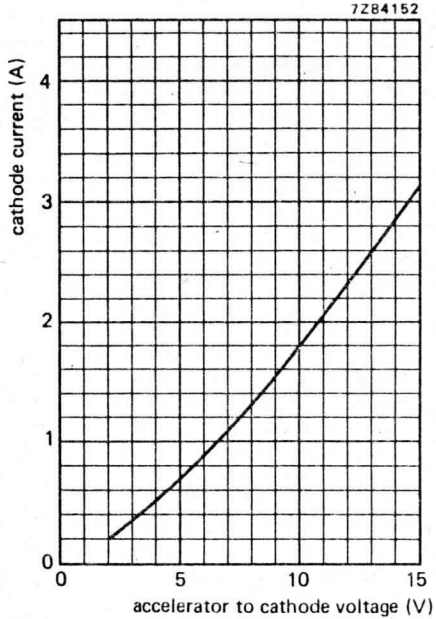|		
Heater voltage	max.	6,5 V
Beam voltage	max.	−24 kV
Cold cathode voltage	max.	−26 kV
Beam current	max.	3,5 A
Body current	max.	100 mA
Accelerator electrode current	max.	6 mA note 5
Collector dissipation	max.	70 kW
Load v.s.w.r.	max.	1,5
Temperature of tube envelope	max.	175 °C
Static pressure in the cooling system TE1189B	max.	400 kPa (≈ 4 at)

DEVELOPMENT SAMPLE DATA

Fig. 3.

Fig. 4.

TYPICAL OPERATING CONDITIONS

As 20 kW vision transmitter (CCIR-G standard)

Channel	21	45	68		
Output power, peak sync.	22	22	22	kW	
Beam voltage	−19,5	−20	−22	kV	
Beam current	2,7	2,45	2,2	A	note 6
Accelerator to cathode voltage	≈ 13,5	≈ 12,5	≈ 11,6	kV	note 7
Body current					
without drive	≈ 10	≈ 7	≈ 5	mA	
at black level	≈ 50	≈ 45	≈ 40	mA	
Focusing coil current	11	10	10	A	
Drive power, peak sync.	10	5	5	W	note 8
Bandwidth at −1 dB points	8	8	8	MHz	note 9
Operating efficiency	42	45	45	%	

As sound transmitter (CCIR-G standard)

Output power	2,2		4,4		kW	
Beam voltage	−19,5	−22	−19,5	−22	kV	
Beam current	0,4	0,35	0,6	0,55	A	note 6
Accelerator cathode voltage	≈ 3,3	≈ 3	≈ 4,5	≈ 4,3	kV	note 7
Body current	≈ 15		≈ 15		mA	
Focusing coil current	10		10		A	
Drive power						
channel 21	4		4		W	note 8
channel 45	2		2		W	note 8
channel 68	1		1		W	note 8
Bandwidth at −1 dB points	⩾ 300		⩾ 300		kHz	
Operating efficiency	29		37		%	

TYPICAL OPERATING CONDITIONS (continued)

As 25 kW vision transmitter (CCIR-G standard)

Channel	21	45	68		
Output power, peak sync.	27	27	27	kW	
Beam voltage	−21	−21,5	−23,5	kV	
Beam current	3	2,8	2,5	A	note 6
Accelerator to cathode voltage	≈ 14,7	≈ 14	≈ 12,7	kV	note 7
Body current					
without drive	≈ 10	≈ 7	≈ 5	mA	
at black level	≈ 55	≈ 50	≈ 45	mA	
Focusing coil current	11,5	11	11	A	
Drive power, peak sync.	10	5	5	W	note 8
Bandwidth at −1 dB points	8	8	8	MHz	note 9
Operating efficiency	42	45	46	%	

As sound transmitter (CCIR-G standard)

Output power		5,5	kW	
Beam voltage	21	23,5	kV	
Beam current	0,6	0,55	A	note 6
Accelerator cathode voltage	≈ 4,5	≈ 4,3	kV	note 7
Body current		≈ 15	mA	
Focusing coil current		10	A	
Drive power				
channel 21		4	W	note 8
channel 45		2	W	note 8
channel 68		1	W	note 8
Bandwidth at −1 dB points		⩾ 300	kHz	
Operating efficiency		42	%	

DEVELOPMENT SAMPLE DATA

WARNING — Health hazard.

1. X-radiation

Correct operation of the tube can be guaranteed only if a set of accessories, approved by the tube manufacturer, is used. The operating tube generates X-rays which can penetrate the ceramic parts of the tube envelope. In order to reduce the radiation at any accessible points to an officially admissible, non-dangerous, level the tube must be shielded and any possible radiation path must be blocked by at least 1 mm of brass or an equivalent portion of non-magnetic X-ray absorbing material. The proper use of our accessory parts will provide the necessary shielding, except for the cathode region. To suppress radiation from the cathode socket the lower part of the trolley TE1188 must be closed by sheet metal (e.g. 1 mm steel).

2. R.F. radiation

R.F. power may be emitted not only through the normal output coupling but also through other apertures (for example, r.f. leaks). This r.f. power may be sufficiently intense to cause danger to the human body, particularly to the eyes. Such radiation may be increased if the tube is functioning incorrectly.

Notes
1. When switching on the heater voltage, the heater current must never exceed a peak value of 70 A.
2. In case of a mains failure an interruption up to 30 s can be tolerated without new preheating. After min. 10 minutes of stand-by heating time at 4,5 V (black heat), the beam current may be switched on; the heater voltage must be increased to its nominal value of 5,5 V simultaneously.
3. To ensure that the klystron is ready for immediate operation the ion getter pump should be operated at least every 6 months during storage, 3 months being recommended. For details see klystron instruction manual.
4. In order to avoid corrosion of the cooling system, pure deionized water must be used as the coolant (resistivity min. 10 kΩ.cm).
5. The accelerator electrode voltage must not be positive with respect to the body (ground).
6. For cathode current (tolerance ± 5%) versus accelerator to cathode voltage, see Fig. 4.
7. The accelerator electrode has to be connected to its supply (power supply or voltage divider) via a 10 kΩ resistor. For adjusting the cathode current, a voltage divider should be dimensioned according to an accelerator electrode current of max. 1,5 mA.
8. The drive power is defined as the power delivered to a matched load.
9. Varying the input level between black and white at any sideband frequency within this bandwidth will not cause a variation of the peak sync. output power exceeding 0,5 dB.

Mullard

DEVELOPMENT SAMPLE DATA

This information is derived from development samples
made available for evaluation. It does not necessarily
imply that the device will go into regular production.

YL1610

AIR COOLED V.H.F. POWER TETRODE

Forced air cooled coaxial power tetrode in metal-ceramic construction primarily intended for use as linear broadband amplifier in band III TV transmitters and transposers.

QUICK REFERENCE DATA

Class-AB linear amplifier (vision)

Frequency	f	250	MHz
Anode voltage	V_a	5,5	kV
Output power in load, sync	W_ℓ	11	kW
Power gain, sync	G	17	dB

HEATING: direct; thoriated tungsten filament, mesh type.

Filament voltage	V_f		8	V
Filament current	I_f		113	A
Filament peak starting current	I_{fp}	max.	560	A
Cold filament resistance	R_{fo}		7	mΩ

Waiting time: procedure prior to switching subsequently $-V_{g1}$, V_g and V_{g2}:

V_f = 2 V	T_w	30	s
then V_f = 8 V	T_w	5	s

The filament is designed to accept temporary voltage fluctuations of ± 5%

TYPICAL CHARACTERISTICS

Anode voltage	V_a	5	kV
Grid 2 voltage	V_{g2}	500	V
Anode current	I_a	2	A
Transconductance	S	115	mA/V
Amplification factor	μ_{g2g1}	9	

CAPACITANCES

Input	C_i	75	pF
Output	C_o	17,5	pF

orange binder, tab 7

TEMPERATURE LIMITS

Absolute maximum envelope temperature	T_{env}	max.	240 °C
Recommended maximum seal temperature	T	max.	200 °C

COOLING (tube only)

W_a kW	h m	T_i °C	q m^3/min	P_i P_a
14	0	25	12	1050
10	0	25	8	500

Direction of air flow: See outline drawing. The air should be ducted so that sufficient air is directed to the seals to keep the seal temperature below the limit.

MECHANICAL DATA

Net mass: approx. 9 kg

Mounting position: vertical with anode up or down.
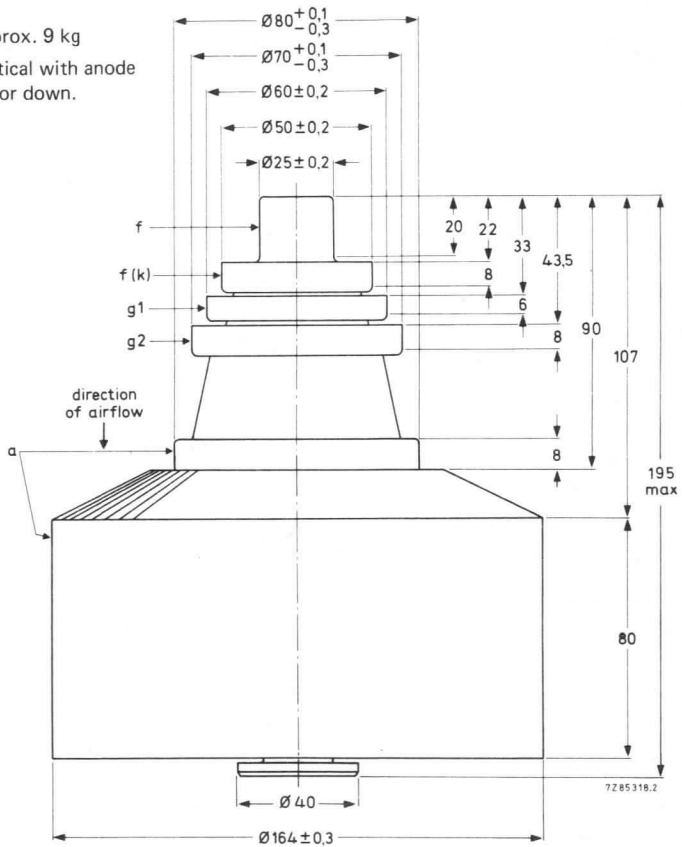
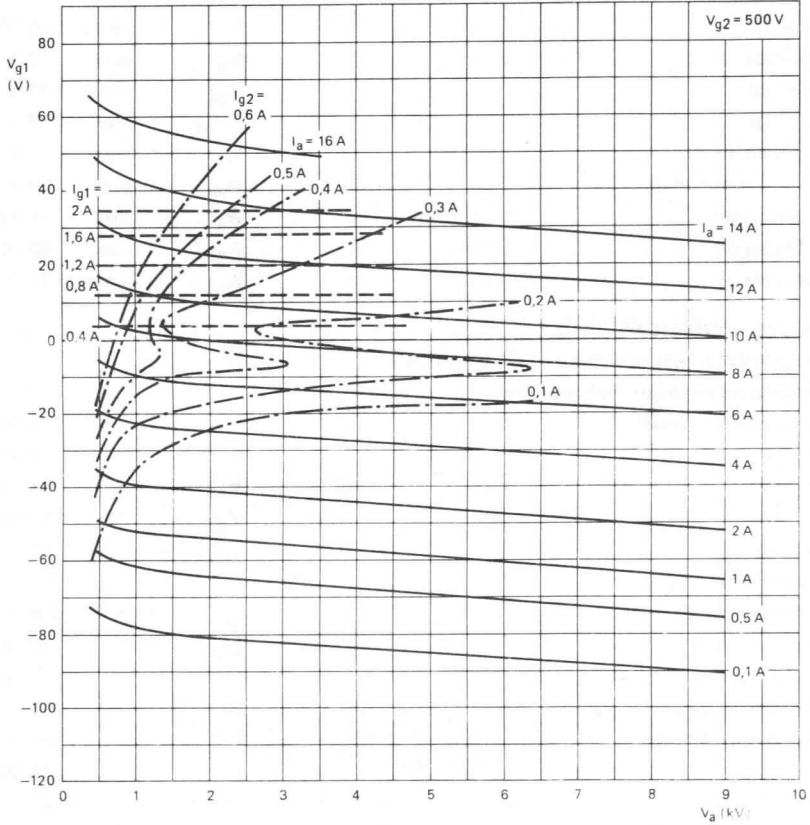## LIMITING VALUES (Absolute maximum rating system)

Frequency	f	up to	250	MHz
Anode voltage	V_a	max.	7	kV
Grid 2 voltage	V_{g2}	max.	800	V
Grid 1 voltage	$-V_{g1}$	max.	250	V
Anode current, black	I_a	max.	4	A
Anode input power, black	W_{ia}	max.	20	kW
Anode dissipation	W_a	max.	14	kW
Grid 2 dissipation	W_{g2}	max.	80	W
Grid 1 dissipation	W_{g1}	max.	80	W

OPERATING CONDITIONS

CLASS-AB AMPLIFIER FOR TELEVISION SERVICE,

Double tuned anode circuit, cathode driven

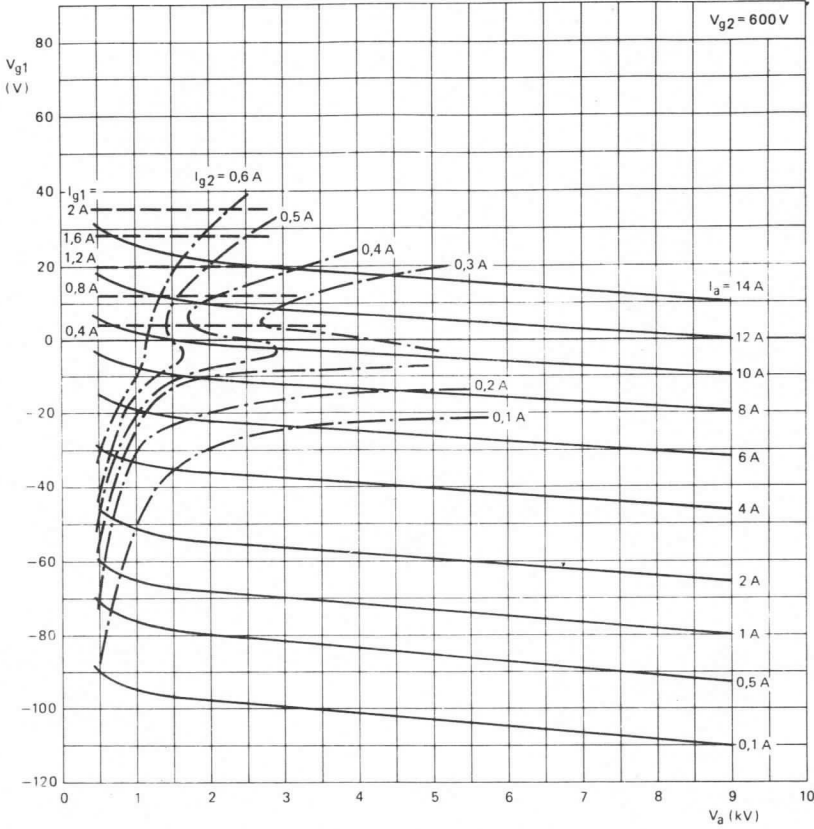|				
Frequency of vision carrier	f		250	MHz
Bandwidth (−1 dB)	B		9	MHz
Anode voltage	V_a	≈	5,5	kV
Grid 2 voltage	V_{g2}	≈	500	V
Grid 1 voltage	$-V_{g1}$	≈	50	V
Anode current, zero signal	I_a	≈	1,2	A
Anode current, black	I_a	≈	2,9	A
Grid 2 current, black	I_{g2}	≈	70	mA
Grid 1 current, black	I_{g1}	≈	5	mA
Output power in load, sync	W_ℓ		11	kW
Output power in load, black	W_ℓ		6,6	kW
Gain, black	G		17	dB
Sync compression	sync in/out	≤	30/25	
Differential phase		<	3	deg
Differential gain		⩾	90	%
L.F. linearity		⩾	90	%

7Z88077.1

$V_{g2} = 500\,V$

Mullard

7Z88076.1

$V_{g2} = 600\,V$

V_{g1} (V)

$I_{g2} = 0{,}6\,A$

$I_{g1} =$

2 A

0,5 A

1,6 A

1,2 A

0,4 A

0,3 A

0,8 A

$I_a = 14\,A$
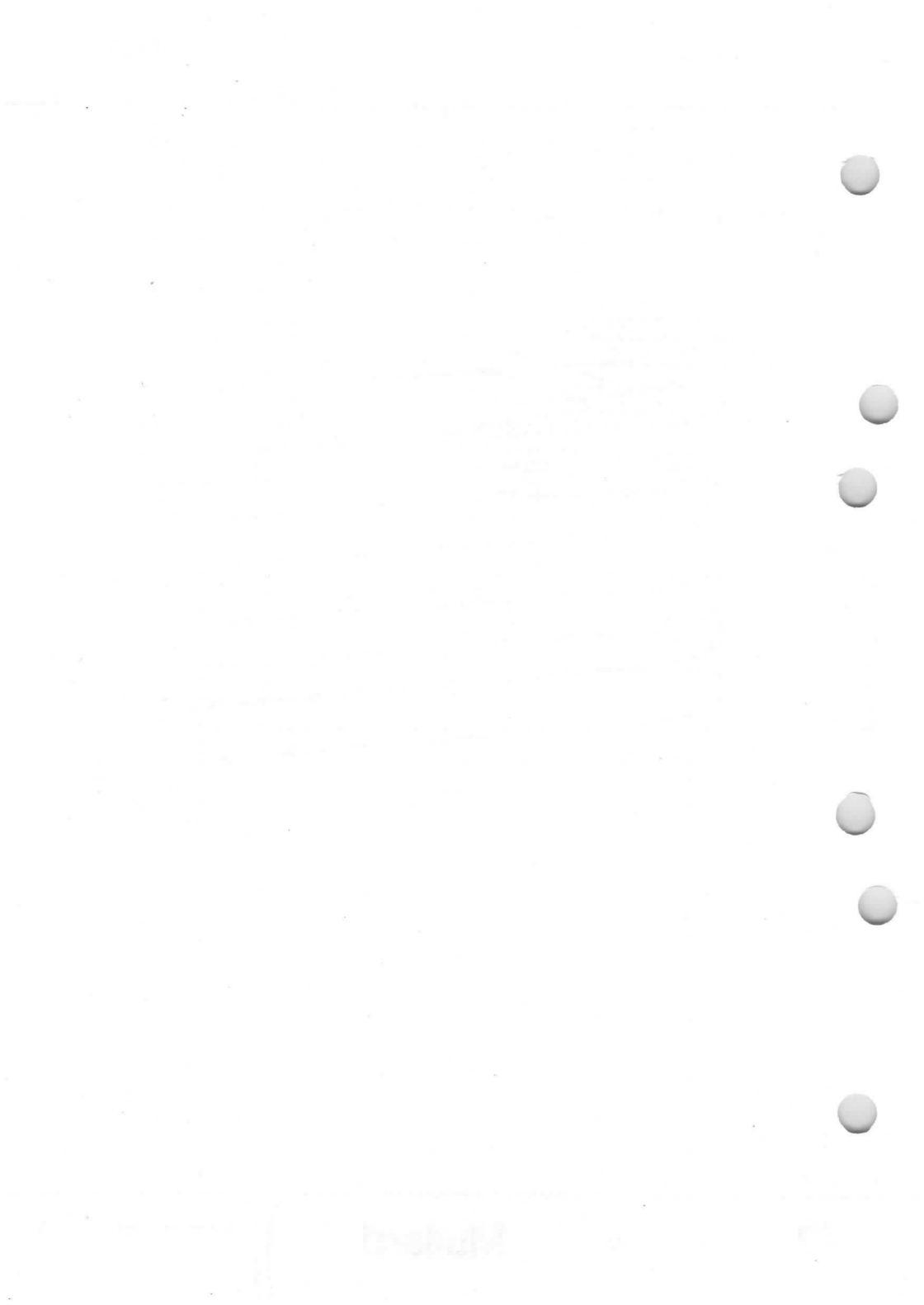
0,4 A
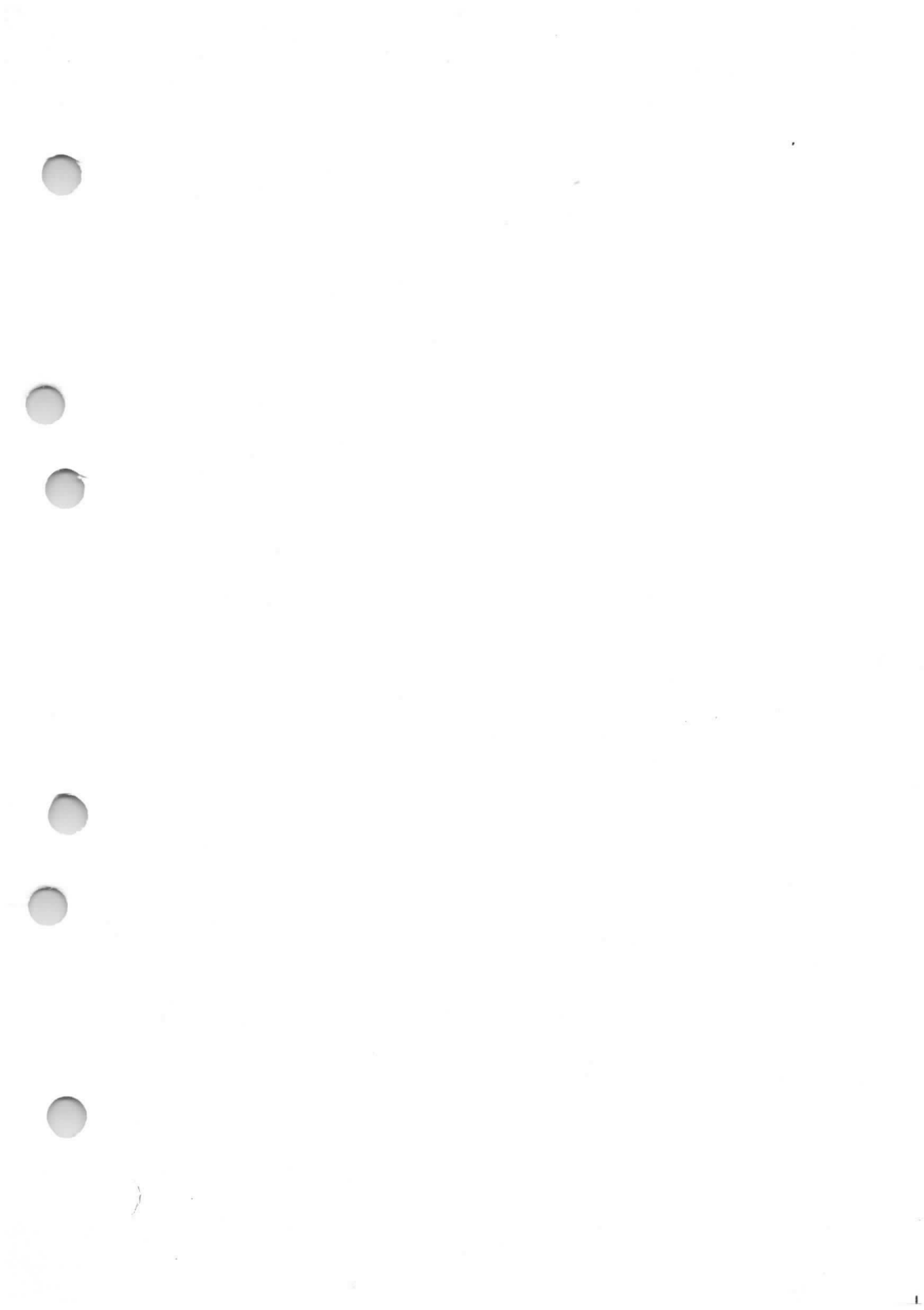
12 A

10 A

0,2 A

8 A

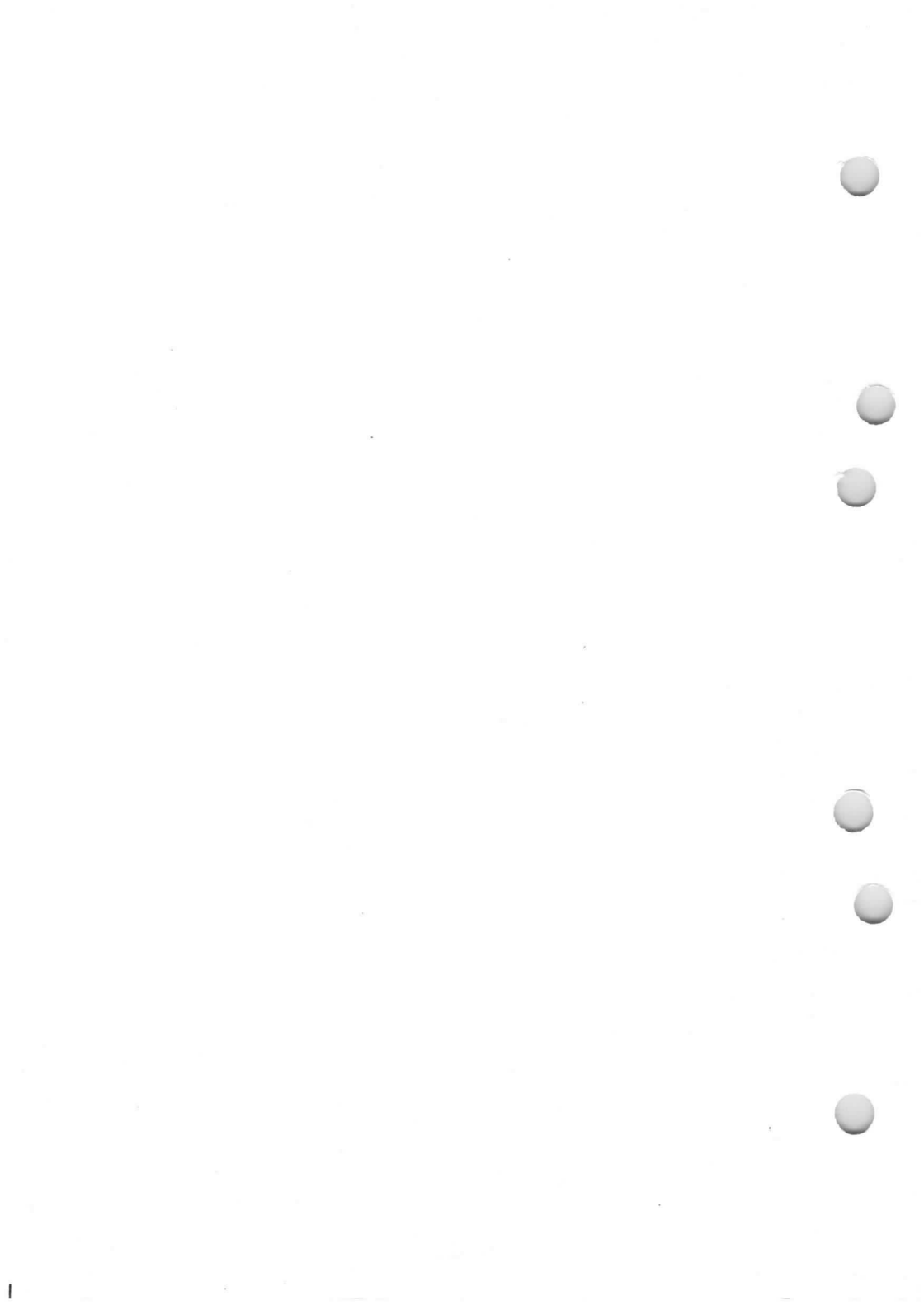0,1 A

6 A

4 A

2 A

1 A

0,5 A

0,1 A

V_a (kV)

DEVELOPMENT SAMPLE DATA

DEVELOPMENT SAMPLE DATA

This information is derived from development samples made available for evaluation. It does not necessarily imply that the device will go into regular production.

YL1630

SUPERSEDES DEVELOPMENT SAMPLE DATA OF NOVEMBER 1980

AIR COOLED V.H.F. POWER TETRODE

Forced air cooled coaxial power tetrode in metal-ceramic construction primarily intended for use as linear broadband amplifier in band III TV transmitters for vision and for combined vision and sound service.

QUICK REFERENCE DATA

TV service

Class-AB linear amplifier (vision)

Frequency	f	250	MHz
Anode voltage	V_a	7	kV
Output power in load (sync)	W_ℓ	37,5	kW
Power gain (sync)	G	17	dB

TV service (vision and sound combined)

Frequency	f	250	MHz
Anode voltage	V_a	5,5	kV
Output power in load	W_ℓ	10	kW
Power gain	G	18	dB

HEATING: direct; thoriated tungsten filament, mesh type.

Filament voltage	V_f		8	V
Filament current	I_f		185	A
Filament peak starting current	I_{fp}	max.	1000	A
Cold filament resistance	R_{fo}		4,2	mΩ

Waiting time; procedure prior to switching on subsequently $-V_{g1}$, V_a and V_{g2}:

$V_f = 2$ V	T_w	30	s
then $V_f = 8$ V	T_w	5	s

The filament is designed to accept temporary fluctuations of $\pm 5\%$

TYPICAL CHARACTERISTICS

Transconductance	S	$\approx$	130	mA/V
Amplification factor	μ_{g2g1}	$\approx$	8	

CAPACITANCES, grounded grid

Input	C_i	$\approx$	125	pF
Output	C_o	$\approx$	28	pF

orange binder, tab 7

Mullard

TEMPERATURE LIMITS

Absolute maximum envelope temperature	T_{env}	max.	240 °C
Recommended maximum seal temperature	T	max.	200 °C

COOLING

W_a kW	h m	T_i °C	q m³/min	P_i tube only Pa	$T_{o\ max.}$ °C
20	500	40	20	1000	105

Direction of air flow: See outline drawing. The air should be ducted so that sufficient air is directed to the seals to keep the seal temperature below the limit.

MECHANICAL DATA

Net mass	approx. 17 kg
Mounting position	vertical with anode up or down.
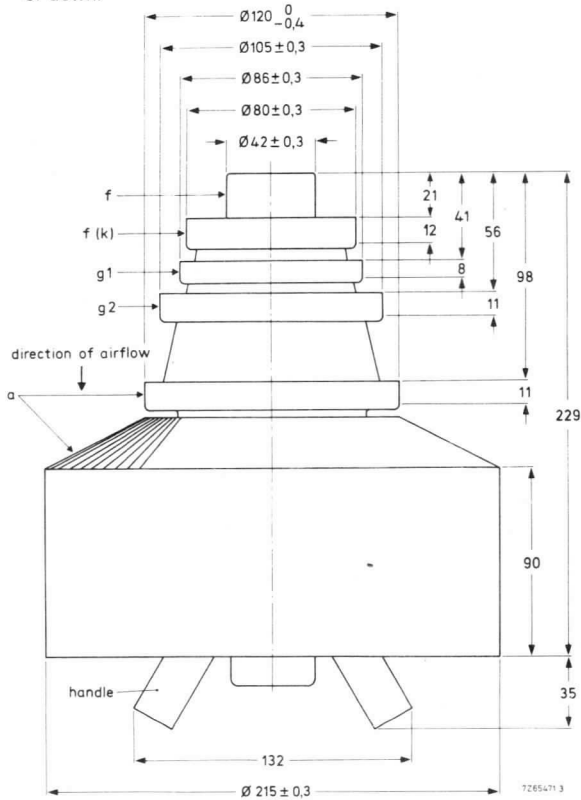
Mullard

LIMITING VALUES (Absolute maximum rating system)

Frequency	f	up to	250	MHz
Anode voltage	V_a	max.	8,5	kV
Grid 2 voltage	V_{g2}	max.	800	V
Grid 1 voltage	$-V_{g1}$	max.	250	V
Anode current	I_a	max.	8	A
Anode input power, black	W_{ia}	max.	50	kW
Anode dissipation	W_a	max.	22,5	kW
Grid 2 dissipation	W_{g2}	max.	200	W
Grid 1 dissipation	W_{g1}	max.	200	W

OPERATING CONDITIONS

CLASS-AB AMPLIFIER FOR TELEVISION SERVICE,

Double tuned anode circuit, cathode driven

Frequency of vision carrier	f		250	MHz
Bandwidth (-1 dB)	B		8	MHz
Anode voltage	V_a	$\approx$	7	kV
Grid 2 voltage	V_{g2}	$\approx$	500	V
Grid 1 voltage	V_{g1}	$\approx$	-70	V
Anode current (zero signal)	I_a	$\approx$	1,5	A
Anode current (black)	I_a	$\approx$	6	A
Grid 2 current	I_{g2}	$\approx$	100	mA
Grid 1 current	I_{g1}	$\approx$	100	mA
Output power in load, sync	W_ℓ		37,5	kW
Output power in load, black	W_ℓ		22,5	kW
Gain	G		17	dB
Sync compression	sync in/out		30/25	
Differential phase	R_a	$<$	3	deg
Differential gain		$\geqslant$	90	%
L.F. linearity		$\geqslant$	90	%

DEVELOPMENT SAMPLE DATA

CLASS-AB R.F. AMPLIFIER FOR TELEVISION SERVICE VISION AND SOUND COMBINED(10:1)

Cathode driven

Frequency	f		250	MHz
Bandwidth (−1 dB)	B		9	MHz
Anode voltage	V_a	≈	5,5	kV
Grid 2 voltage	V_{g2}	≈	500	V
Grid 1 voltage	V_{g1}	≈	50	V
Anode current (zero signal)	I_a	≈	2,5	A
Anode current, black + line sync	I_a	≈	3,9	A
Grid 2 current, black + line sync	I_{g2}	≈	50	mA
Grid 1 current, black + line sync	I_{g1}	≈	0	mA
Output power in load (sync)	W_ℓ		10	kW
Driver output power (sync)	W_{dr}		170	W
Power gain	G		18	dB
Intermodulation products	d	≤	−54	dB*

* Three-tone test method (vision carrier −8 dB, sound carrier −10 dB, sideband signal −16 dB with respect to peak sync = 0 dB), with driver input intermodulation products < −70 dB.
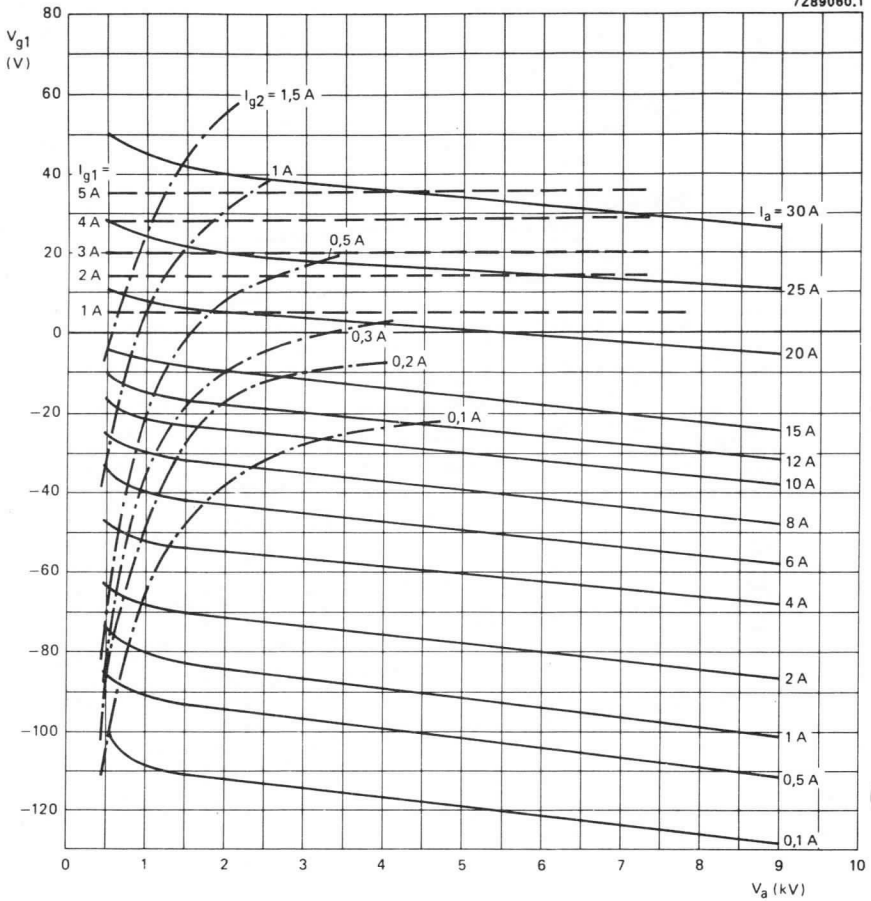
Mullard

7Z89061.1
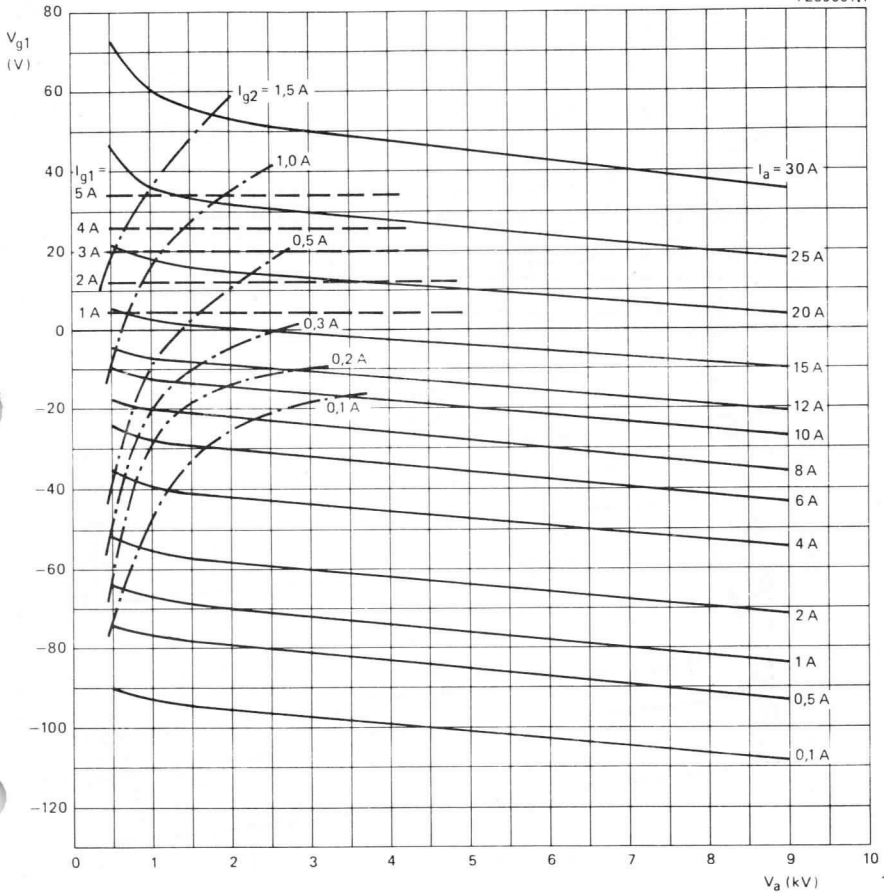
$V_{g2} = 500$ V; $V_f = 8$ V.

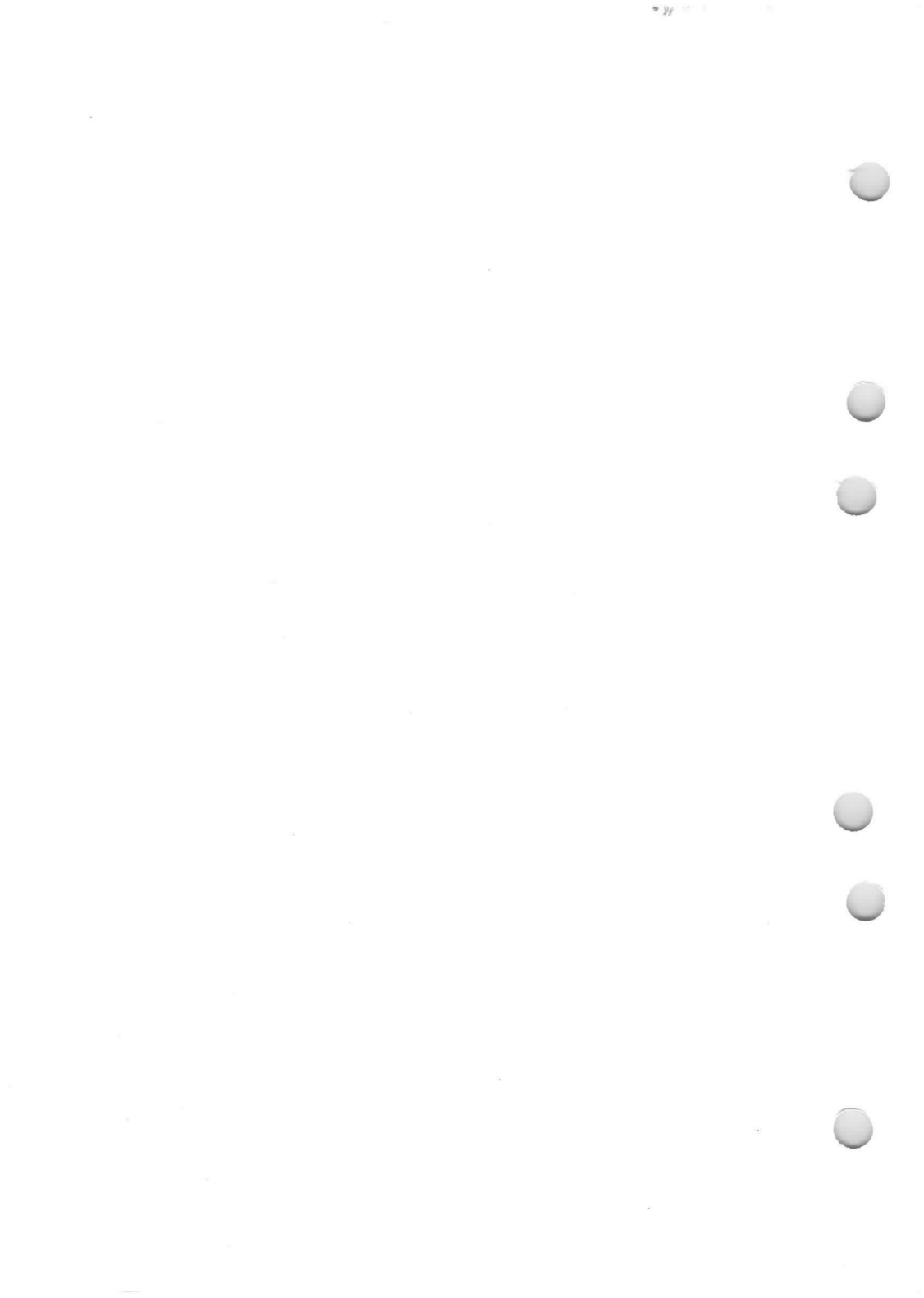DEVELOPMENT SAMPLE DATA

7Z89060.1

$V_{g2} = 600$ V; $V_f = 8$ V.

Mullard

M82-1078RO

DEVELOPMENT SAMPLE DATA
This information is derived from development samples
made available for evaluation. It does not necessarily
imply that the device will go into regular production.

YL1640

WATER COOLED 100 kW POWER TETRODE

Water cooled power tetrode in metal-ceramic coaxial construction for use as r.f. and a.f. amplifier in a.m. broadcast transmitters and scientific applications.

QUICK REFERENCE DATA

Class-C

Frequency	f	30	MHz
Anode voltage	V_a	11	kV
Output power	W_o	125	kW

Class B

Anode voltage	V_a	11	kV
Output power in load	W_ℓ	2 x 75	kW

HEATING: direct; thoriated tungsten filament, mesh type.

Filament voltage	V_f		10	V
Filament current	I_f		280	A
Filament peak starting current	I_{fp}	max.	1600	A
Cold filament resistance	R_{fo}		4,0	mΩ
Waiting time	T_w		10	s

The filament is designed to accept temporary fluctuations of ± 5%.

TYPICAL CHARACTERISTICS

Anode voltage	V_a	3	kV
Grid 2 voltage	V_{g2}	1	kV
Anode current	I_a	25	A
Transconductance	S	140	mA/V
Amplification factor	μ_{g2g1}	5	

CAPACITANCES

Cathode to grid 1	C_{kg1}	$\approx$	180	pF
Cathode to grid 2	C_{kg2}	$\approx$	13	pF
Cathode to anode	C_{ka}	$\approx$	0,3	pF
Grid 1 to grid 2	C_{g1g2}	$\approx$	300	pF
Grid 1 to anode	C_{g1a}	$\approx$	2,3	pF
Grid 2 to anode	C_{g2a}	$\approx$	47	pF

orange binder, tab 7

Mullard

TEMPERATURE LIMITS

Absolute maximum envelope temperature	T_{env}	max.	240	^oC
Recommended maximum seal temperature	T	max.	200	^oC

Low velocity air flow should be directed to the grid and filament seals in order to keep the temperature below 200 ^oC.

COOLING

Maximum anode dissipation	W_a	150	kW
Water cooling with 60 l/min			
Absolute maximum output temperature	T_o	100	^oC
Pressure drop in the anode cooler		20	kPa
Absolute maximum water pressure		500	kPa

MECHANICAL DATA

Net mass   approx. 35 kg

Mounting position   vertical with anode up

Fig. 1.

Mullard
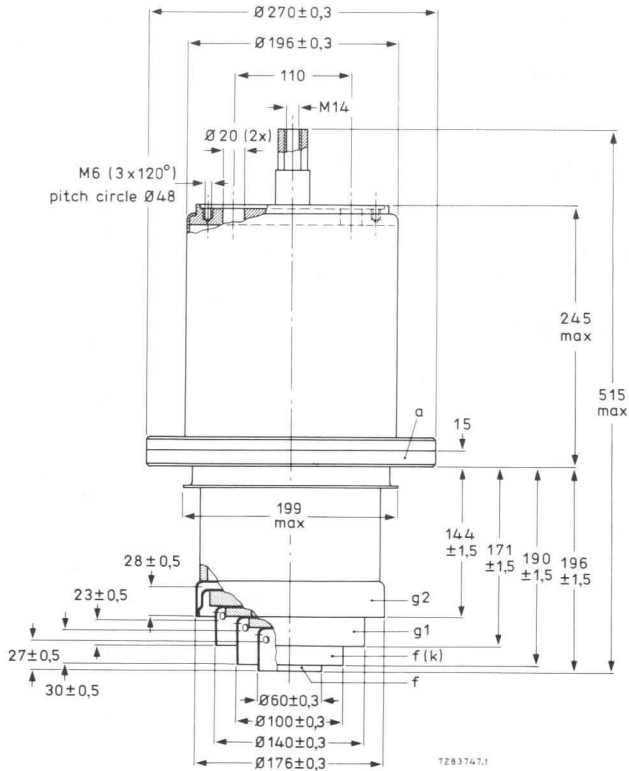
R.F. CLASS-C ANODE AND SCREEN GRID MODULATION (CARRIER CONDITIONS)

LIMITING VALUES (Absolute maximum rating system)

Frequency	f		30	MHz
Anode voltage	V_a	max.	13	kV
Grid 2 voltage	V_{g2}	max.	1200	V
Grid 1 voltage	V_{g1}	max.	−800	V
Cathode current	I_k		17	A
Cathode current (peak)	I_k		160	A
Anode input power	W_{ia}	max.	200	kW
Anode dissipation	W_a	max.	150	kW
Grid 2 dissipation	W_{g2}	max.	2,2	kW
Grid 1 dissipation	W_{g1}	max.	1	kW

OPERATING CONDITIONS

Frequency	f		30	MHz
Anode voltage	V_a	≈	11	kV
Grid 2 voltage (modulation 80%)	V_{g2}	≈	1	kV
Grid 1 voltage	V_{g1}	≈	−550	V
Grid driving voltage peak	V_p		700	V
Anode current	I_a	≈	15	A
Grid 2 current	I_{g2}	≈	0,5	A
Grid 1 current	I_{g1}	≈	0,8	A
Driving power	W_{dr}		1	kW
Grid 2 dissipation	W_{g2}		500	W
Grid 1 dissipation	W_{g1}		120	W
Anode input power	W_{ia}		165	kW
Anode output power	W_{oa}		125	kW
Anode dissipation	W_a		40	kW
Efficiency	η		76	%

A.F. CLASS-B POWER AMPLIFIER AND MODULATOR

LIMITING VALUES, per tube (Absolute maximum rating system)

Anode voltage	V_a	15	kV
Grid 2 voltage	V_{g2}	1,6	kV
Grid 1 voltage	V_{g1}	−800	V
Anode input power	W_{ia}	200	kW
Anode dissipation	W_a	150	kW
Cathode current (peak)	I_k	160	A
Cathode current	I_k	20	A
Grid 2 dissipation	W_{g2}	2,2	kW
Grid 1 dissipation	W_{g1}	1	kW

OPERATING CONDITIONS, two tubes in push-pull

Anode voltage	V_a	≈	11	kV
Grid 2 voltage	V_{g2}	≈	1,6	kV
Grid 1 voltage, $I_{ao} = 1$ A	V_{g1}	≈	−350	V
Anode current	I_a		2 x 10	A
Grid 2 current	I_{g2}		2 x 0,3	A
Grid 1 current	I_{g1}	≈	0	mA
Anode input power	W_{ia}		2 x 110	kW
Anode output power	W_{oa}		2 x 75	kW
Anode dissipation	W_a		2 x 35	kW
Efficiency	η		68	%

Mullard

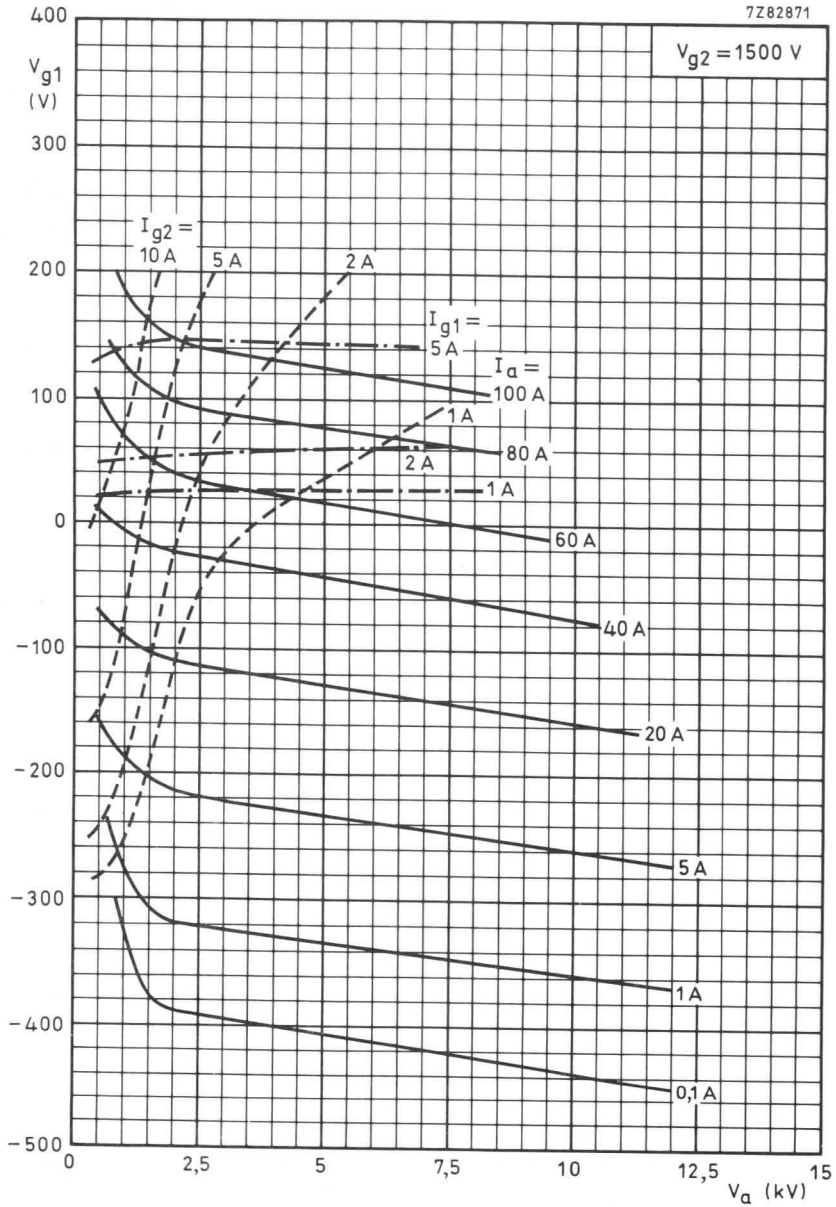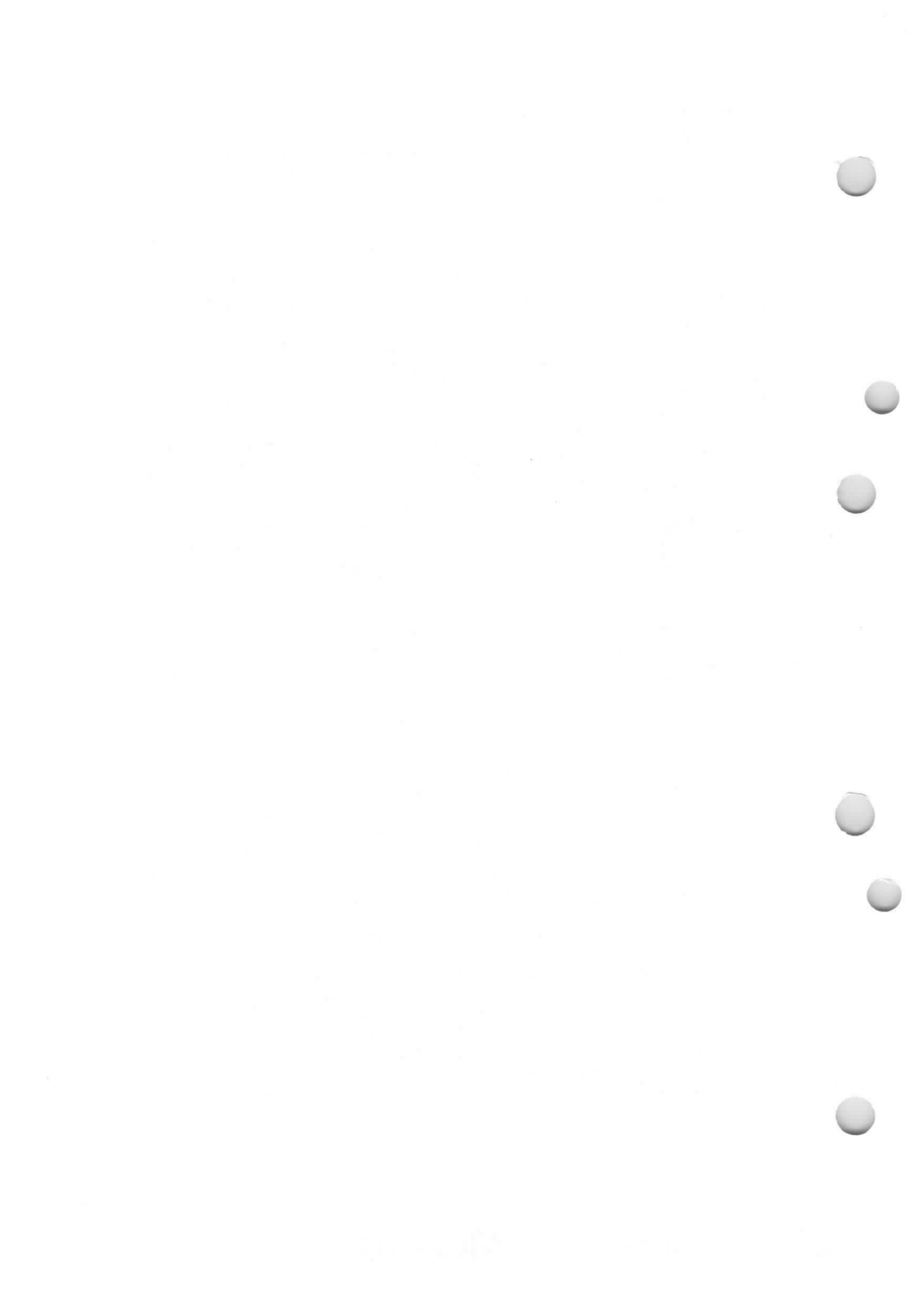Fig. 2.

Fig. 3.

Mullard
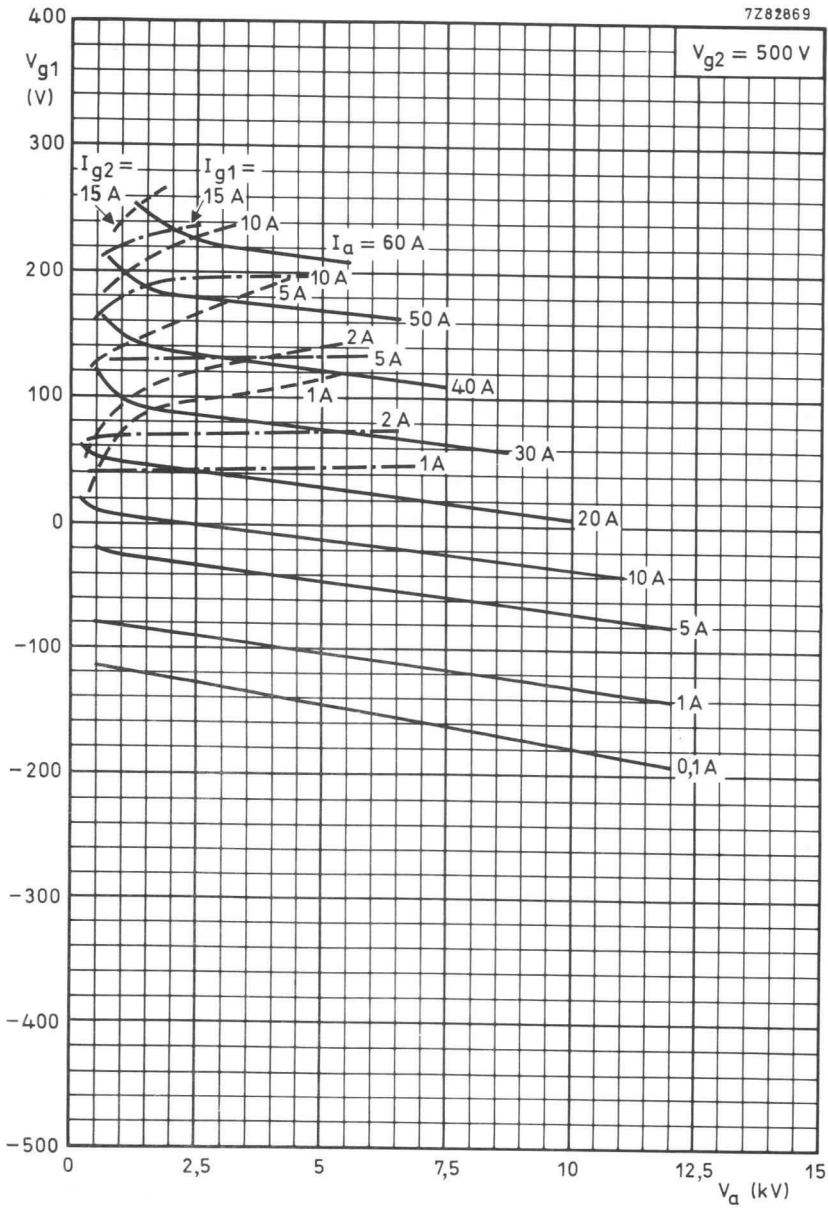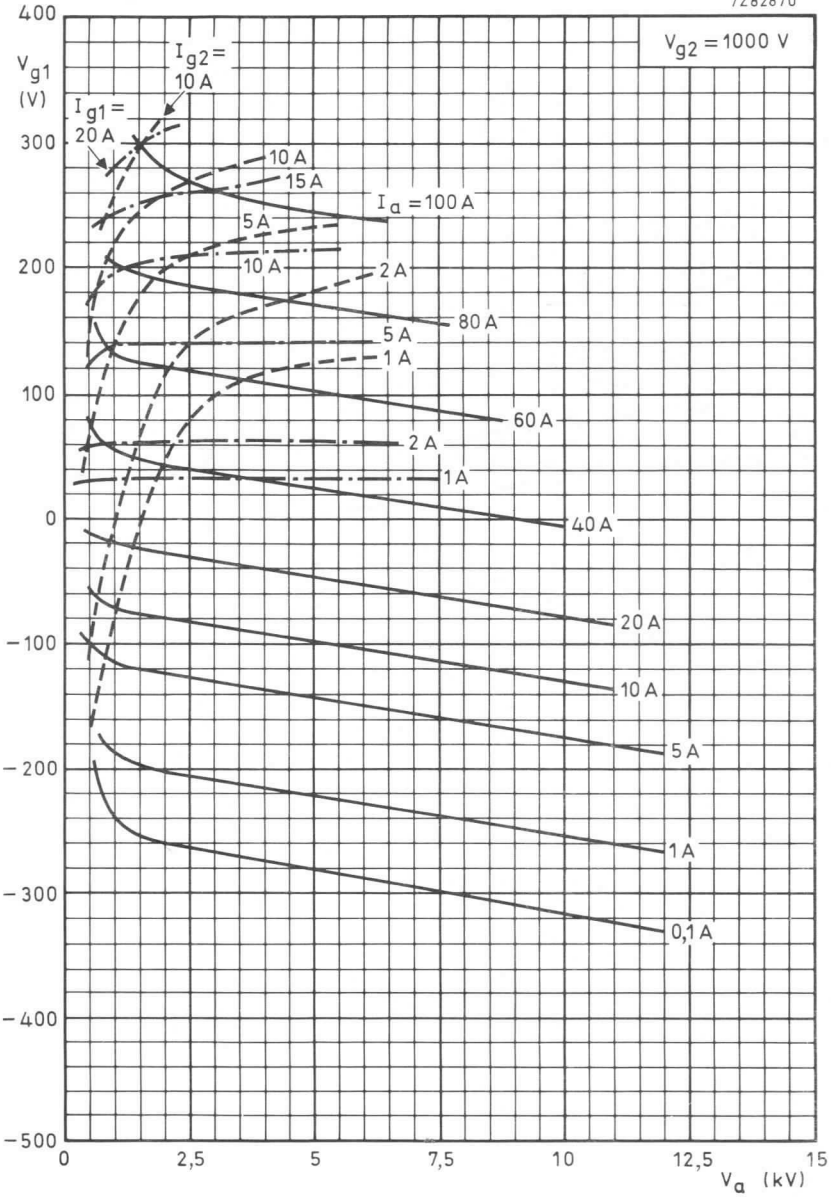
Fig. 4.

DEVELOPMENT SAMPLE DATA

This information is derived from development samples
made available for evaluation. It does not necessarily
imply that the device will go into regular production.

YL1690

AIR-COOLED R.F. POWER TETRODE

Forced air-cooled coaxial power tetrode in metal-ceramic construction primarily intended for use as grid-driven linear amplifier for single sideband, suppressed carrier service.

QUICK REFERENCE DATA

Class-AB1 linear SSB amplifier

Frequency	f	1,5 to 30	MHz
Anode voltage	V_a	8	kV
Output power in load	W_l	10	kW
Power gain	G	23	dB

HEATING: direct; thoriated tungsten filament, mesh type

Filament voltage	V_f	10,4	V
Filament current	I_f	120	A
Filament peak starting current	I_{f_p} max	700	A
Cold filament resistance	R_{f_o}	10,5	mΩ
Waiting time	t_w min	1	s

The filament is designed to accept temporary fluctuations of +5%

TYPICAL CHARACTERISTICS

Anode voltage	V_a	8	kV
Grid 2 voltage	V_{g2}	700	V
Anode current	I_a	2,4	A
Transconductance	S	60	mA/V
Amplification factor	μ_{g2g1}	8,5	

CAPACITANCES, grounded cathode

Input	C_i	135	pF
Output	C_o	23	pF
Anode to grid 1	C_{ag1}	0,85	pF

orange binder, tab 7

Mullard

TEMPERATURE LIMITS

Absolute maximum envelope temperature	T_{env}	max.	240 °C
Recommended maximum seal temperature	T	max.	200 °C

COOLING

Direction of air flow: see cooling curves. The air should be ducted so that sufficient air is directed to the seals.
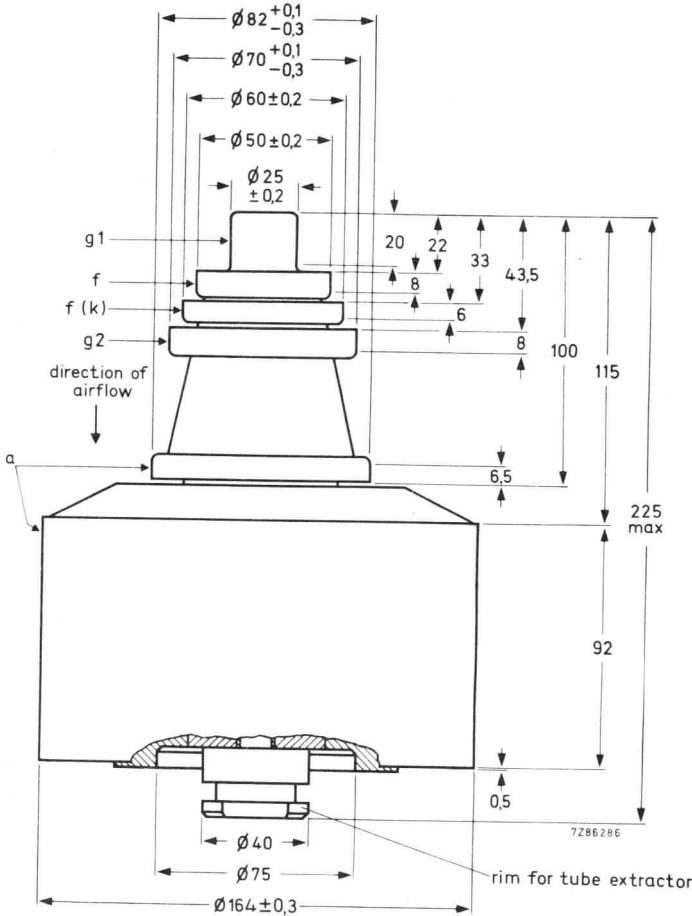
Mullard
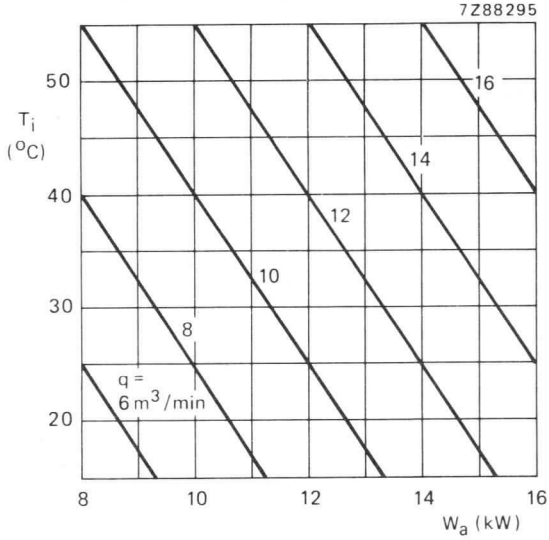
MECHANICAL DATA

Dimensions in mm

Net weight: approx. 11 kg

Mounting position: vertical with anode up or down

DEVELOPMENT SAMPLE DATA

direction of airflow

rim for tube extractor

7Z86286

The electrode connection arrangement allows full isolation of input and output resonant circuits, and provides optimal screen grid/cathode bypass when operated as a grid-driven amplifier. No neutralization required.

Mullard

R.F. CLASS-AB LINEAR AMPLIFIER, SINGLE SIDEBAND, SUPPRESSED CARRIER

Unless otherwise specified the voltages are given with respect to the cathode.

LIMITING VALUES (Absolute maximum rating system)   notes

Frequency	f		up to 120	MHz
Anode voltage	V_a	max.	9	kV
Grid 2 voltage	V_{g2}	max.	1	kV
Grid 1 voltage	$-V_{g1}$	max.	500	V
Anode current	I_a	max.	7	A
Anode input power	W_{ia}	max.	40	kW
Anode dissipation	W_a	max.	18	kW
Grid 2 dissipation	W_{g2}	max.	100	W

OPERATING CONDITIONS

Frequency	f	30	MHz	
Anode voltage	V_a	8	kV	
Grid 2 voltage	V_{g2}	900	V	
Grid 1 voltage	V_{g1}	−100	V	1

		zero signal	single tone signal	double tone signal		
Grid 1 driving voltage, peak	V_{g1p}	0	< 100	< 100	V	
Anode current	I_a	1,2	2,5	1,9	A	
Grid 2 current	I_{g2}	10	50	15	mA	
Grid 1 current	I_{g1}	0	0	0	mA	
Anode input power	W_{ia}	9,6	20	15,2	kW	
Anode dissipation	W_a	9,6	9,8	10	kW	
Output power in load (PEP)	W_ℓ	—	> 10	10	kW	
Total efficiency	η	—	50	33	%	
Intermodulation distortion						
3rd order	d_3	—	—	< −42	dB	2
5th order	d_5	—	—	< −60	dB	2

Notes

1. To be adjusted to zero signal current.
2. With reference to zero dB level.

Mullard

DEVELOPMENT SAMPLE DATA

Mullard

M82-1079RO

DOT MATRIX TUBE

ZM1250
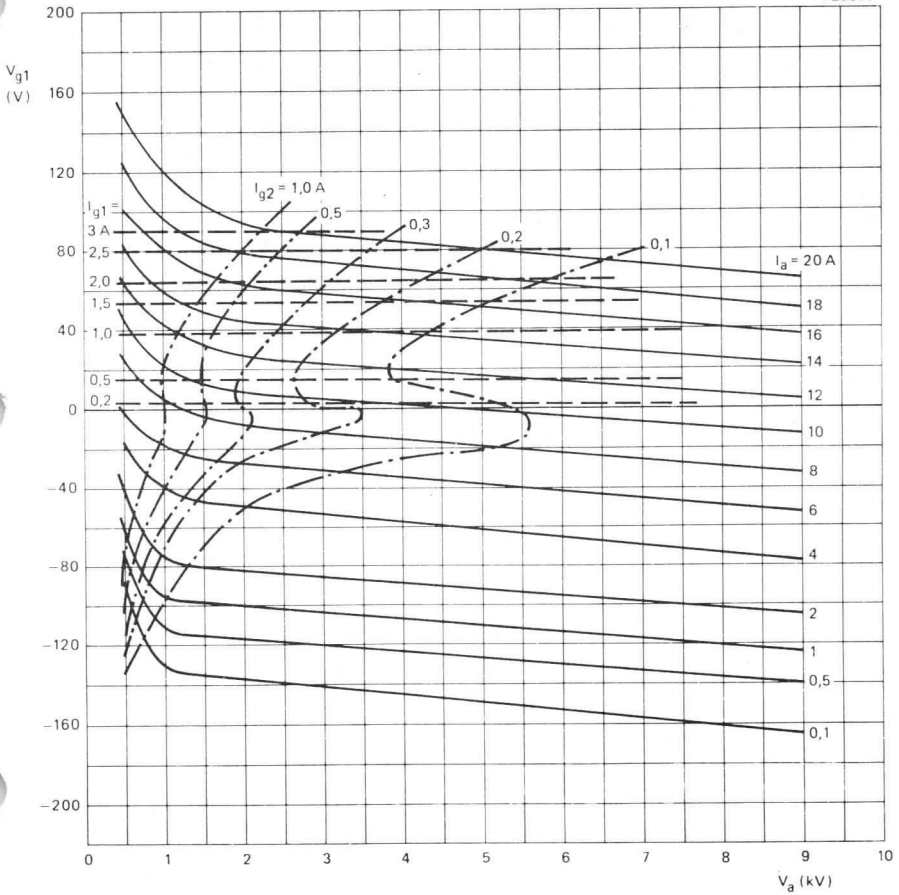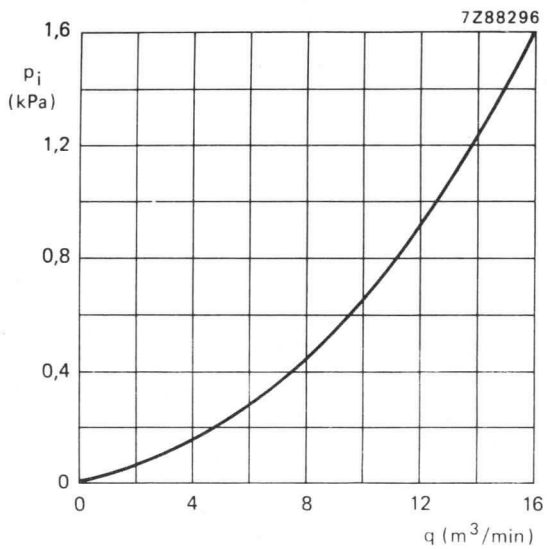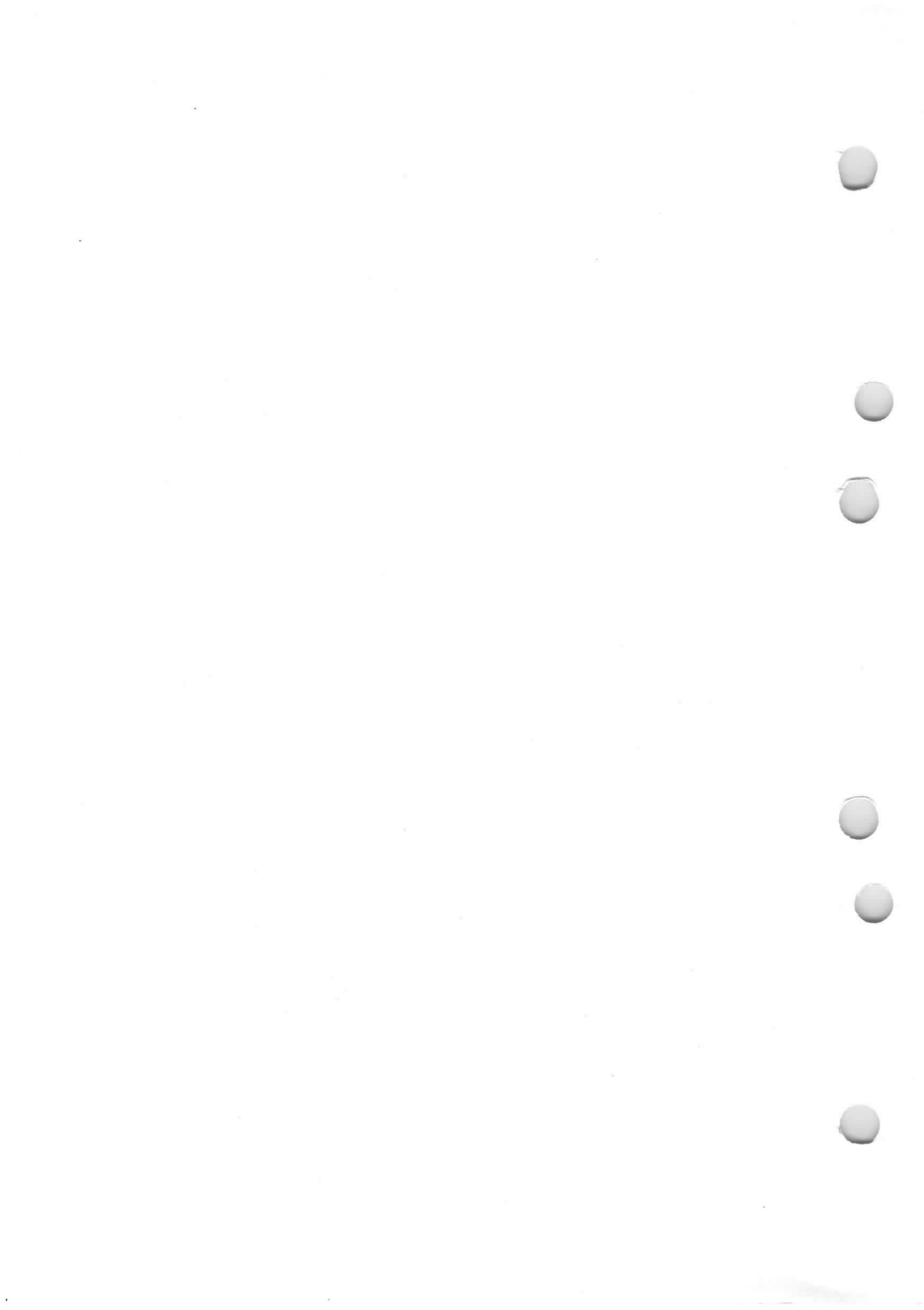
QUICK REFERENCE DATA

Gas discharge device, flat pack construction consisting of 7×5 dot matrix capable of displaying alpha numeric and symbolic information. The tube also incorporates a separate left hand decimal point. Suitable for both d.c. and dynamic drive. It gives a bright clear wide–angle display which can easily be read in unfavourable lighting conditions.

Character size		9.8×6.8	mm
Minimum distance between mounting centres		16	mm
Minimum supply voltage		220	V
*Tube dissipation	nom.	400	mW

*Supply power 800mW per tube, including dissipation in the current sharing resistors.

CHARACTERISTICS AND OPERATING CONDITIONS (measured at 20 to 50°C)

Minimum anode-to-cathode voltage necessary for ignition		220	V
Anode-to-cathode maintaining voltage at 1.5mA peak	min.	120	V
	nom.	140	V
Anode–to–cathode voltage below which a cathode will extinguish		115	V
Matrix cathode current (each cathode)			
peak	min.	1.0	mA
peak	max.	3.0	mA
average (averaged over any 10ms)	max.	0.3	mA

Mullard

CHARACTERISTICS AND OPERATING CONDITIONS (contd.)

Decimal point cathode current

peak	min.	3.0	mA
peak	max.	6.0	mA
average (averaged over any 10ms)	max.	0.6	mA
Pulsed frequency	min.	800	Hz
Pulse width	min.	100	μs

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Matrix cathode current (each cathode)

peak	max.	3.0	mA
average (averaged over any 10ms)	max.	0.3	mA
Decimal point cathode current			
peak	max.	6.0	mA
average (averaged over any 10ms)	max.	0.6	mA
Envelope temperature (see note 1)	max.	+70	^{o}C
	min.	–50	^{o}C

MOUNTING POSITION

Any

OPERATING NOTES

1. For envelope temperatures below +10°C the life expectancy of the tube is substantially reduced together with changes in characteristics.

2. The tube may be soldered directly into a printed circuit board.

3. The leads are tinned and may be dip-soldered to a minimum of 3mm from the envelope at a solder temperature of 240°C for a maximum of 10 seconds.

4. Care should be taken when bending leads.

5. It is recommended that a red (blue-light absorbing) filter be used preferably of circularly polarised type.
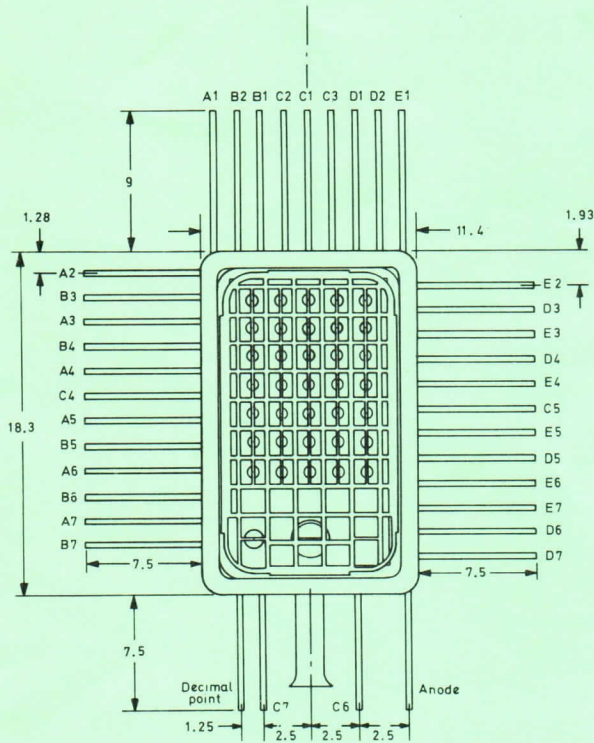
OUTLINE AND DIMENSIONS NOTES

Depth	max.	6.0	mm
Spacing between – top cathode leads		1.25 ±0.03	mm
– side cathode leads		1.30 ±0.03	mm
Cathode leads – width		0.30 ±0.03	mm
– thickness	nom.	0.1	mm
Anode lead – width	max.	0.5	mm
– thickness	nom.	0.1	mm

Mullard

OUTLINE AND DIMENSIONS

As viewed from the front

A1	B1	C1	D1	E1
A2	B2	C2	D2	E2
A3	B3	C3	D3	E3
A4	B4	C4	D4	E4
A5	B5	C5	D5	E5
A6	B6	C6	D6	E6
A7	B7	C7	D7	E7

O
DP

All dimensions in mm

D 2453
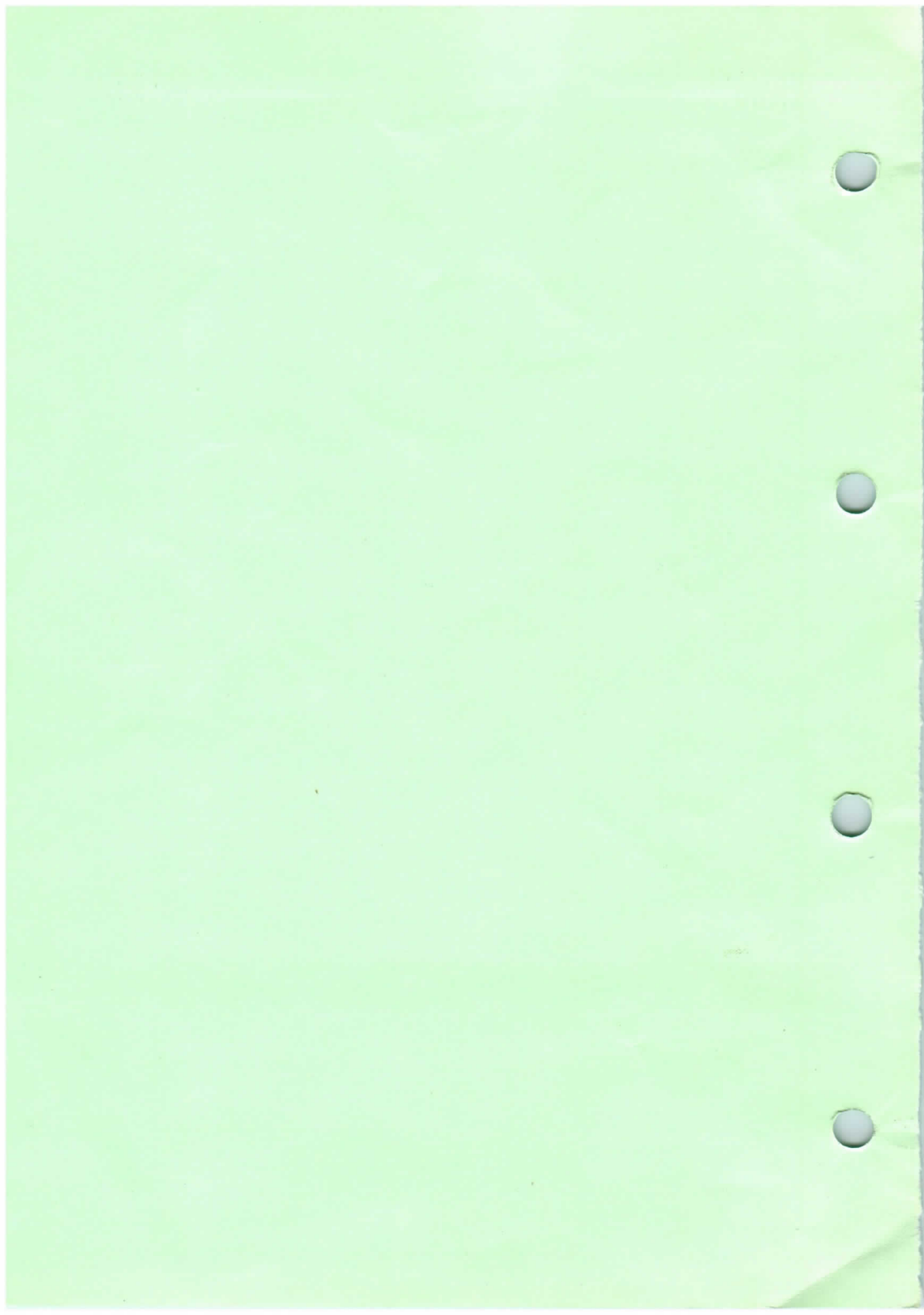
DOT MATRIX TUBE ASSEMBLIES

Z1250-A
Series

DEVELOPMENT SAMPLE DATA

FRONT VIEW

Pitch between tube centres

13.9   14
12
6

3 holes ⌀ 3.0

1.2

Ref contact

47

Centre line of tubes

26.6   42.00 ±0.05
28.7

19

5.75

2 holes per tube ⌀ 1.0

k_{dp} Anode   3.75   5.0

Centre line of tube

20 contact strips at 1.27 pitch

5

Dim. A ± 0.05

Dim. B

BACK VIEW

Ref contact

20 contact strips at 1.27 pitch

28.7
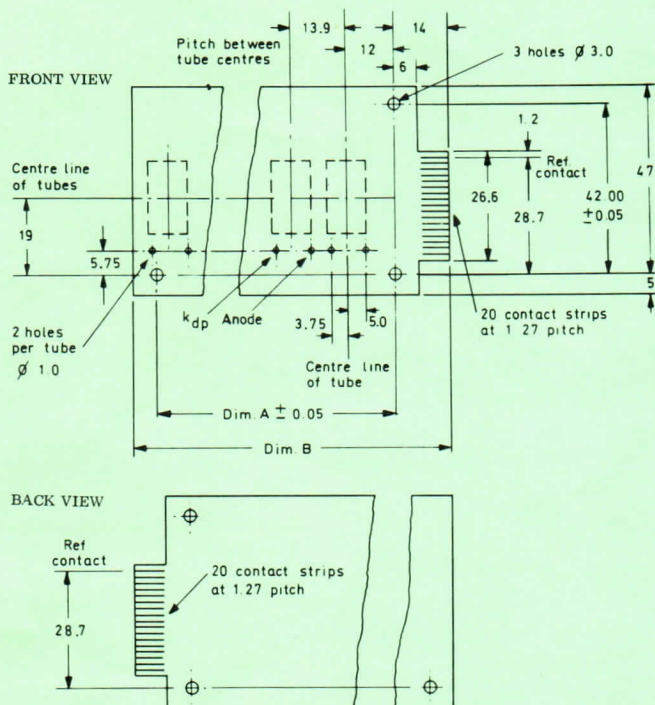
All dimensions in mm   D2923

A suitable edge connector is Cannon PB15–40T–52.

Material of mounting board is epoxy glass fibre laminate 1.6mm thickness, copper clad both sides.

Type No.	No. of tubes	Dim. A	Dim. B
Z1250–A4	4	57.2	76
Z1250–A8	8	112.8	132.8
Z1250–A10	10	140.6	160.6

A1	B1	C1	D1	E1
A2	B2	C2	D2	E2
A3	B3	C3	D3	E3
A4	B4	C4	D4	E4
A5	B5	C5	D5	E5
A6	B6	C6	D6	E6
A7	B7	C7	D7	E7
DP				

FACE OF TUBE

Connections to cathodes listed in order with Reference Contact at top

Front	Back
E1	D2
D1	C3
C1	C2
B1	B2
A1	E2
A2	D3
B3	E3
A3	D4
B4	E4
A4	C5
C4	E5
A5	D5
B5	E6
A6	E7
B6	D6
A7	D7
blank	blank
B7	blank
C7	blank
C6	blank

Mullard

GEIGER-MÜLLER TUBE

End window halogen quenched α, β and γ radiation counter tube.

QUICK REFERENCE DATA

Dose rate range	10^{-4} to 1	R/h
Plateau threshold voltage	400	V
Plateau length	200	V
Recommended supply voltage	500	V
Chrome-iron cathode	250	mg/cm^2
Mica window (9 mm diameter)	1.5 to 2.0	mg/cm^2

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1

D8717
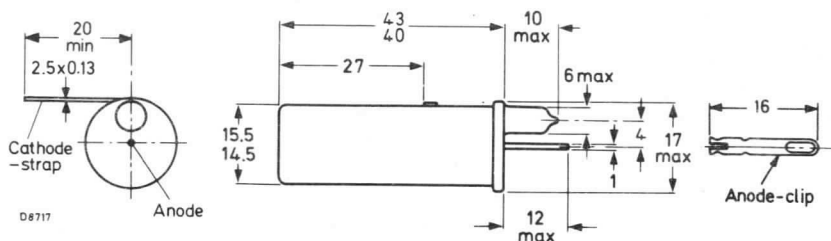
Use only anode connector supplied with tube.

WINDOW

Thickness	1.5 to 2.0	mg/cm^2
Useful diameter	9	mm
Material	mica	

CATHODE

Thickness	250	mg/cm^2
Sensitive length	39	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	2.0	pF

orange binder, tab 10

Mullard

November 1981   1

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	325	V
Plateau threshold voltage	max.	400	V
Plateau length		200	V
Recommended supply voltage		500	V
Plateau slope	max.	0.04	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	10	count/min
Dead time, at recommended supply voltage	max.	90	μs

LIMITING VALUES (Absolute max. rating system).

Anode resistor	min.	4.7	MΩ
Anode voltage	max.	600	V
Ambient temperature continuous operating	max.	+70	°C
	min.	−40	°C
storage	max.	+75	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C 5×10^{10} count

MEASURING CIRCUIT

R_1 = 10 MΩ
R_2 = 220 kΩ
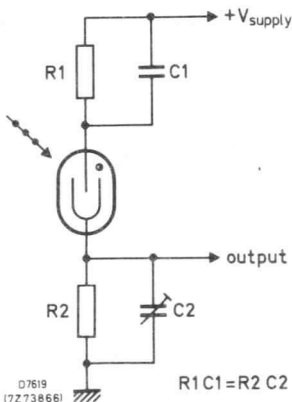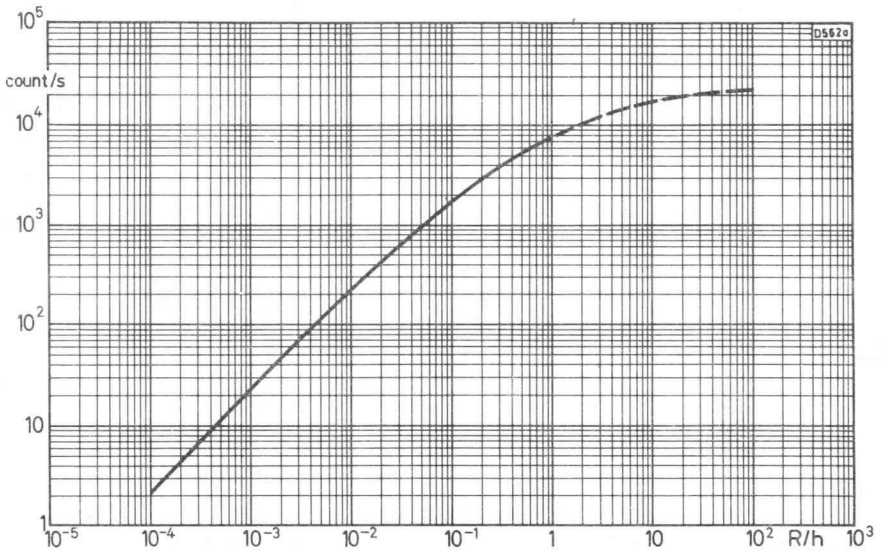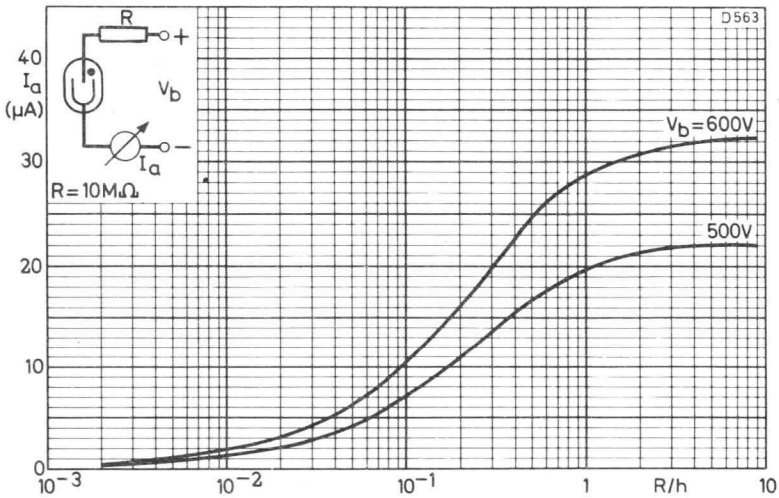C_1 = 1 pF

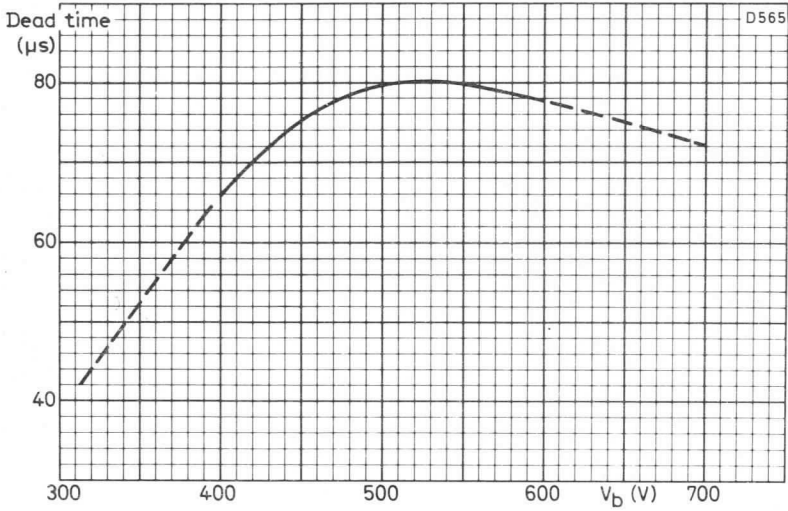$R_1 C_1 = R_2 C_2$

Fig.2

Mullard

Typical count rate as a function of dose rate (^{60}Co)
(through the side wall)

Typical current as a function of dose rate (^{60}Co)

Typical dead time as a function of supply voltage

Mullard