# CAMERA TUBE
# VIDICON

# 20PE11

**TENTATIVE DATA**

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

HEATER

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

| | | |
|---|---|---|
| $V_h$ | 6.3 ±10% | V |
| $I_h$ | 95 ±10% | mA |

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

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

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

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

CAPACITANCE

| | | |
|---|---|---|
| Target electrode to all other electrodes | 2.0 | pF |

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

## TYPICAL OPERATION

### Operating conditions

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

### 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)

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 | $\mu$A |
| Maximum peak dark current | 150 | nA |
| Maximum faceplate illumination | 10 000 | lux |
| Maximum faceplate temperature during storage and operation (see note 9) | 70 | $^oC$ |

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

MOUNTING POSITION

Any

WEIGHT

| | | |
|---|---|---|
| Tube alone (approx.) | 18 | g |

ACCESSORIES

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

NOTES

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

NOTES (contd.)

3. With 10 lux (colour temperature = 2854K) on the faceplate.
4. With a dark current of 20nA and an initial signal current of 200nA.
5. The deflection circuit must provide sufficiently linear scanning for good black-level reproduction. Since the output current is proportional to the velocity of scanning, any change in this velocity will produce non-uniformity.
6. Signal current is defined as the component of the output current after the dark current has been subtracted.
7. Conditions:

   Dark current 20nA and output current of 220nA.

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

   The scanning amplitudes of a rectangular monitor are adjusted to obtain a raster with an aspect ratio of 3:4. The monitor set-up and contrast control are adjusted for a faint raster when the lens of the camera is capped, and for a non-blooming bright raster when uncapped.

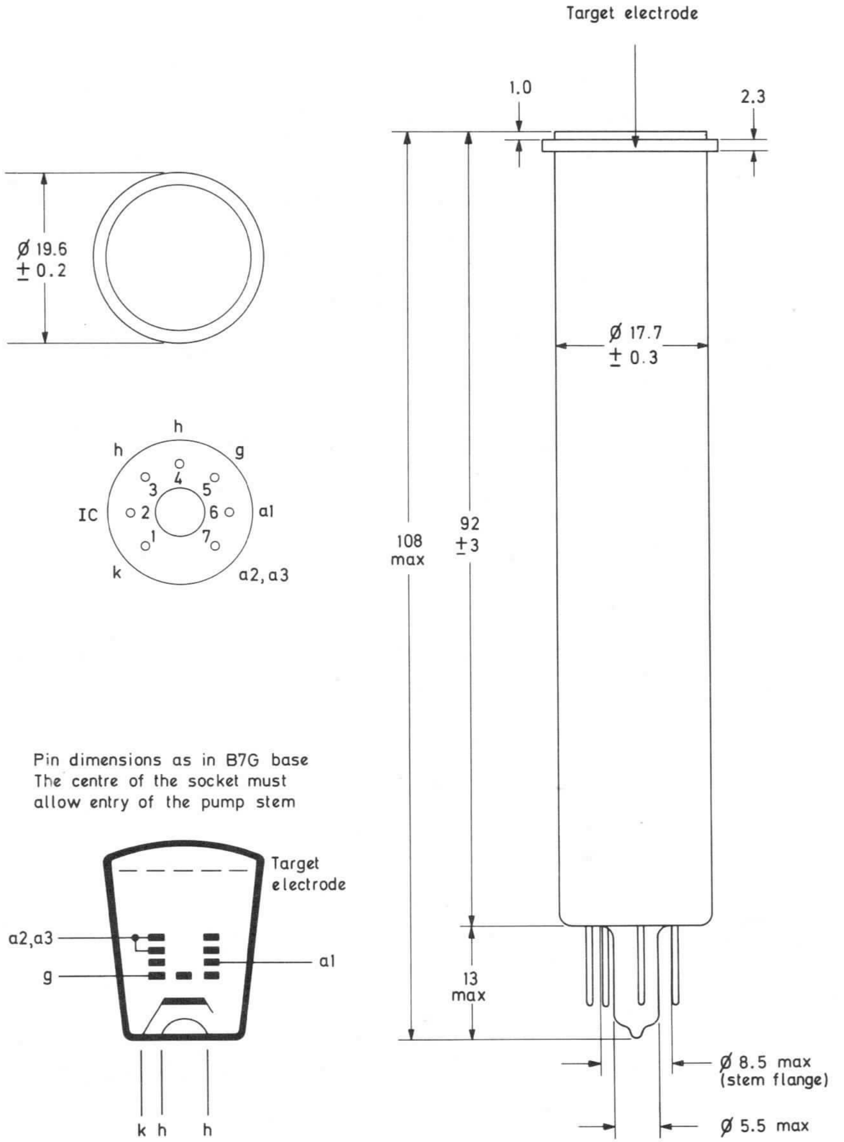
Under the above conditions the number and size of the spots visible in the monitor picture will not exceed the limits stated below. Both black and white spots are counted unless the amplitude is less than 50% of the peak white signal.

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

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

8. Video amplifiers should be capable of handling target-electrode currents of this magnitude without overloading the amplifier or distorting the picture.
9. Under difficult environmental conditions a flow of cooling air directed at the faceplate is recommended. When televising flames and furnaces appropriate infrared filters should be used.

OUTLINE DRAWING OF 20PE11




All dimensions in mm

D2503

**TENTATIVE DATA**

| QUICK REFERENCE DATA | | |
|---|---|---|
| 17.7mm diameter vidicon television camera tube with separate mesh, low heater consumption, magnetic focusing, and magnetic deflection. Intended for use in low-cost industrial cameras, home cameras and for amateur use. | | |
| Resolution capability | >550 | TV lines |

## HEATER

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

| | | |
|---|---|---|
| $V_h$ | 6.3 ±10% | V |
| $I_h$ | 95 ±10% | mA |

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

## FOCUSING

Magnetic

## DEFLECTION

Magnetic

## PHOTOCONDUCTIVE LAYER

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

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

## CAPACITANCE

| | | |
|---|---|---|
| Target electrode to all other electrodes | 2.0 | pF |

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

## TYPICAL OPERATION

### Operating conditions

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

### Typical performance

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

Spurious signals - shading

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

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

MOUNTING POSITION

Any

WEIGHT

| | | |
|---|---|---|
| Tube alone (approx.) | 20 | g |

ACCESSORIES

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

NOTES

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

NOTES (contd.)

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

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

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

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

7. Conditions:

   Dark current 20nA and output current of 220nA.

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

   The scanning amplitudes of a rectangular monitor are adjusted to obtain a raster with an aspect ratio of 3:4. The monitor set-up and contrast control are adjusted for a faint raster when the lens of the camera is capped, and for a non-blooming bright raster when uncapped.

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

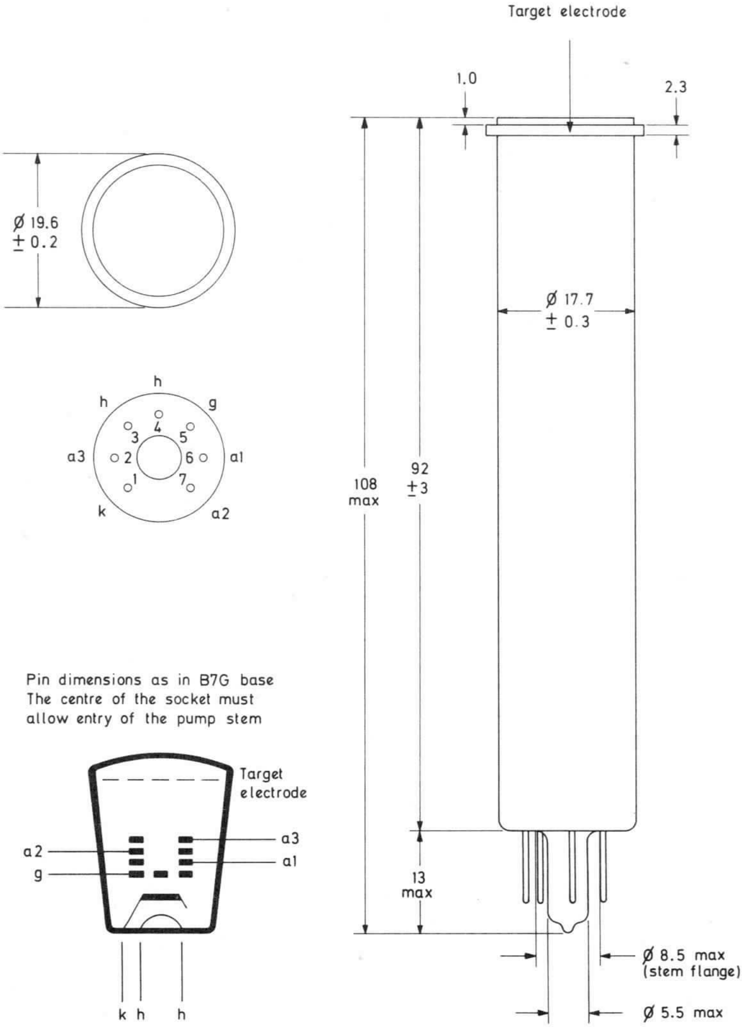
| Spot size in % of raster height | Maximum number of spots | |
|---|---|---|
| | Zone 1 | Zone 2 |
| >0.8 | none | 1 |
| 0.8 to 0.6 | 2 | 2 |
| 0.6 to 0.3 | 2 | 3 |
| <0.3 | * | * |

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

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

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

OUTLINE DRAWING OF 20PE13




All dimensions in mm

# CAMERA TUBE INTENSIFIER VIDICON (INTENSICON)

# 50MXQ (Dev. No.)

**DEVELOPMENT SAMPLE DATA**

QUICK REFERENCE DATA

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

| | | |
|---|---|---|
| Sensitivity | A signal current of 150nA is produced with a photocathode illumination of 0.1 lux at 20nA dark current | |
| Resolution | >500 | TV lines |
| Image format | $10 \times 13.3$ | 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.

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

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 |

# CAMERA TUBE
# INTENSIFIER VIDICON
# (INTENSICON)

# 50MXQ
## (Dev. No.)

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

MOUNTING POSITION

Any

WEIGHT

| | | |
|---|---|---|
| Tube alone (approx.) | 350 | g |

ACCESSORIES

| | |
|---|---|
| Socket | Cinch No. 54A 18088 or equivalent |

NOTES

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

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

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

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

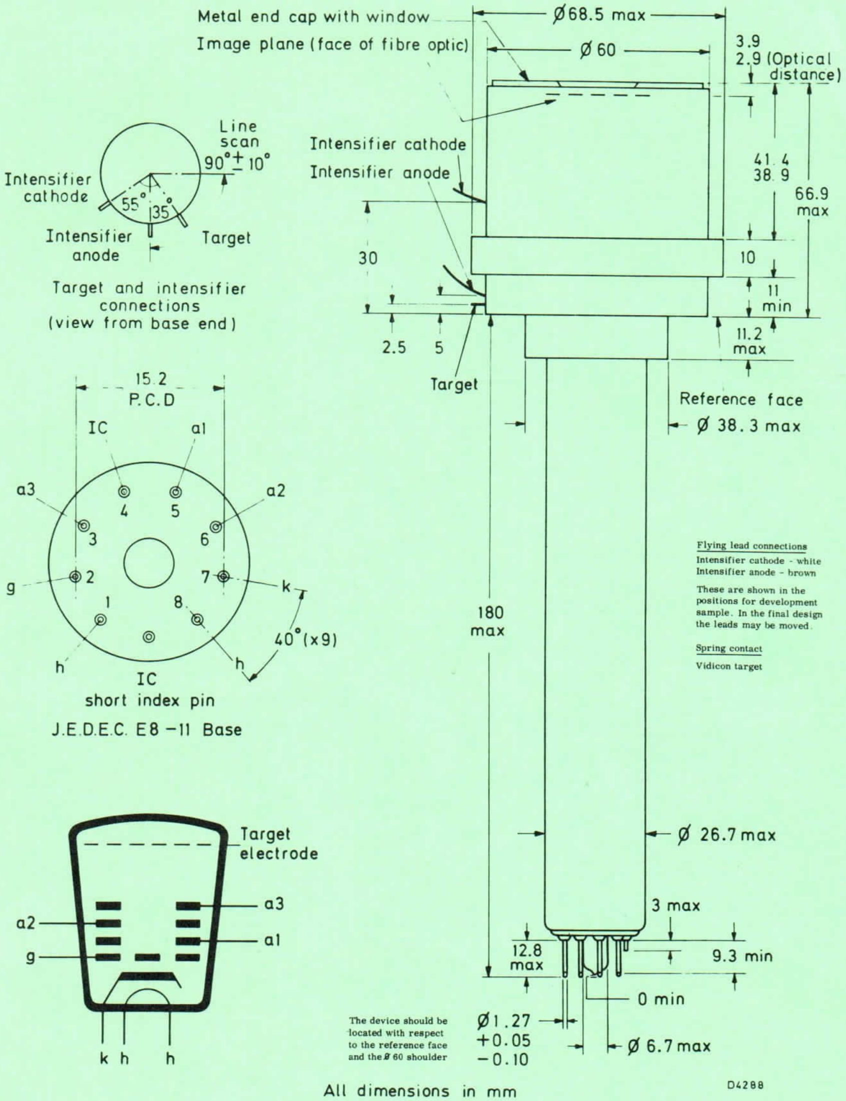
5. When the photocathode illumination rating is exceeded this may lead to permanent damage of the device.

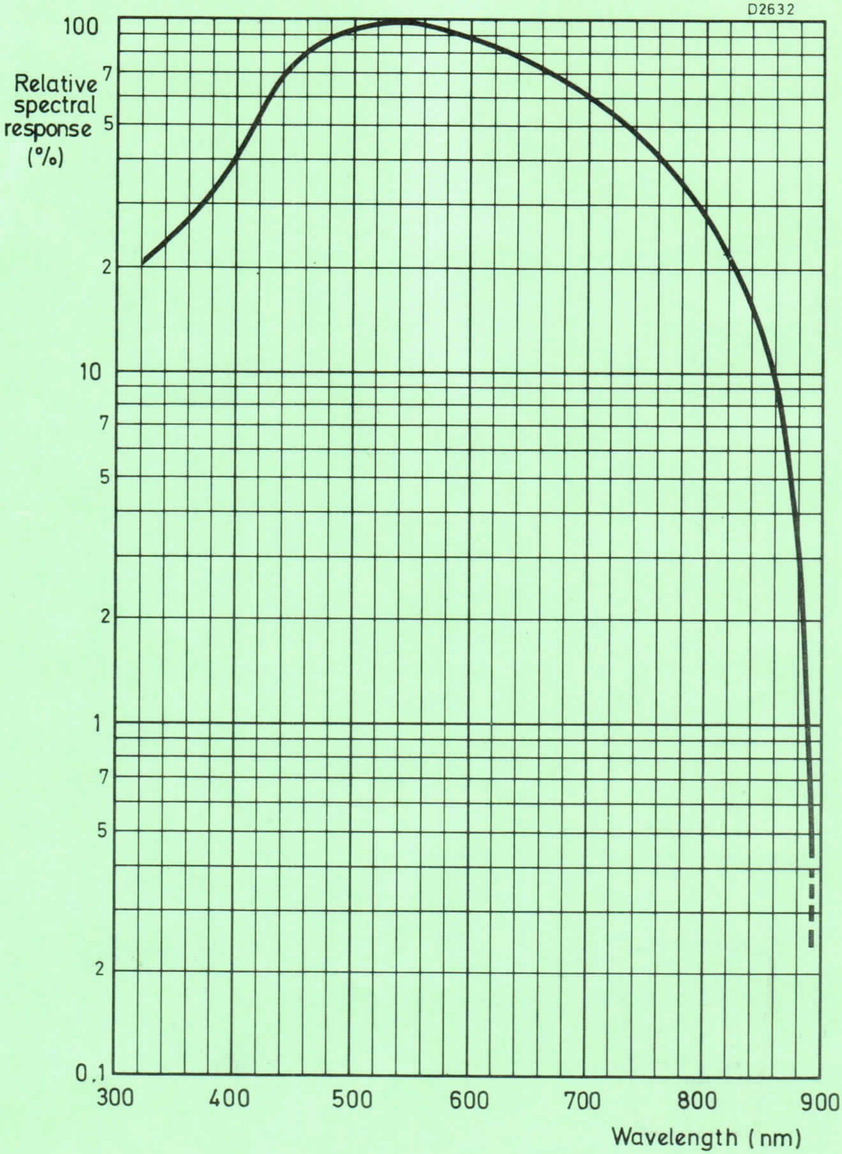
6. The metal end cap should be connected to chassis. ←

# CAMERA TUBE INTENSIFIER VIDICON (INTENSICON)

# 50MXQ (Dev. No.)

OUTLINE DRAWING OF 50MXQ ←






TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CURVE

# IMAGE INTENSIFIER ASSEMBLY

# 50MXX
## (Dev. No.)

**DEVELOPMENT SAMPLE DATA**

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.) | Ø70 × 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

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

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 $\lambda = 800$nm | 10 | mA/W |
| at $\lambda = 850$nm | 3.0 | mA/W |
| Centre magnification, $M_c$ (see note 2) | $0.91 \pm 0.09$ | |
| 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 | $\mu$lux |

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 | $^{o}C$ |

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: $\frac{\pi . L_o}{E_i}$

   where $L_o$ = luminance (cd/m$^2$) in a direction normal to the screen, measured with an eye-corrected photometer having an acceptance angle of less than 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 = $(\frac{M_d}{M_c} - 1) \times 100$, 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.

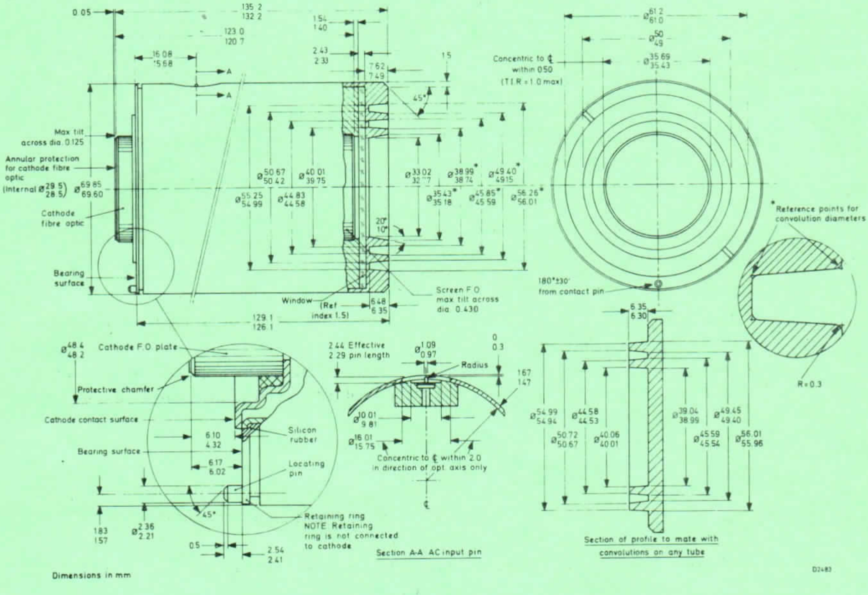
5. Measured at the photocathode at a distance of 7mm from the centre.

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.

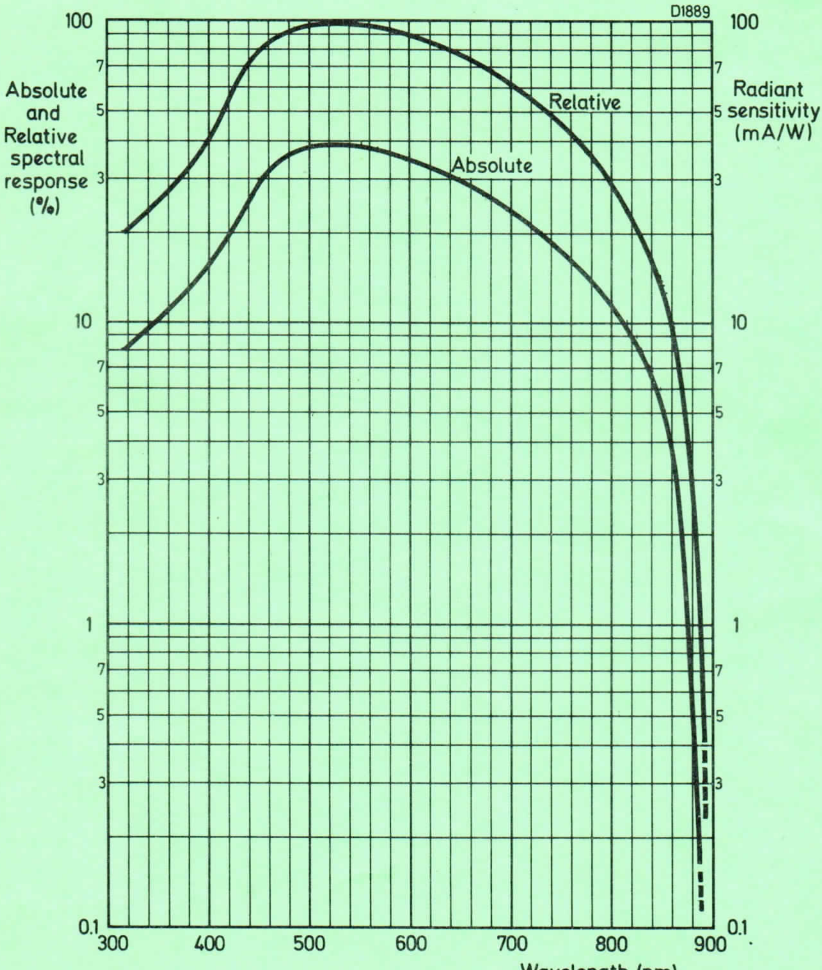
8. Intermittent flashes producing much higher cathode illuminations are allowed, but the tube must not be used in full daylight.

# OUTLINE DRAWING OF 50MXX



# IMAGE INTENSIFIER ASSEMBLY

**50MXX**
**(Dev. No.)**




TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CURVES

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 | |

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 | $\mu$A |
| 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.

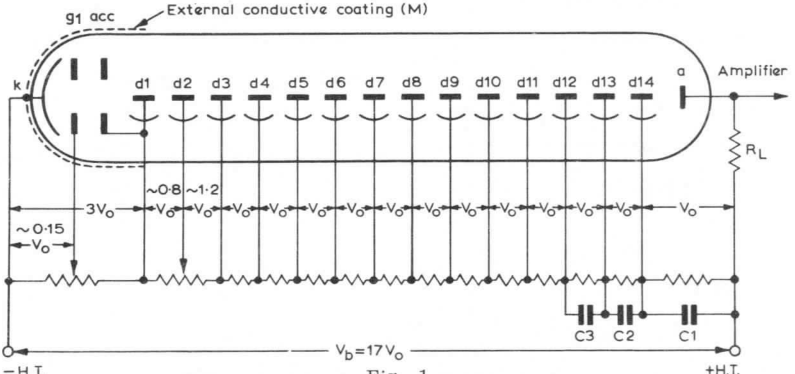



Fig. 1

The issue of the information contained in this publication does not imply any authority or licence for the utilisation of any patented feature.

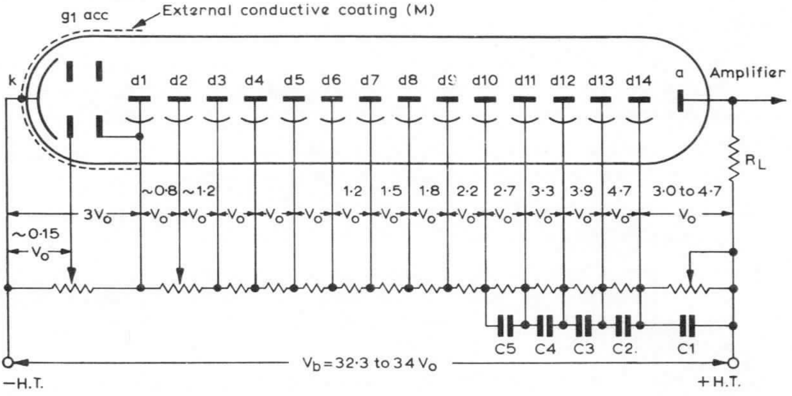



Fig. 2

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 |
| $V_{d1-d2 \cdots\cdots d13-d14}$ max. | 500 | V |
| $V_{d1-d2 \cdots\cdots d13-d14}$ 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.

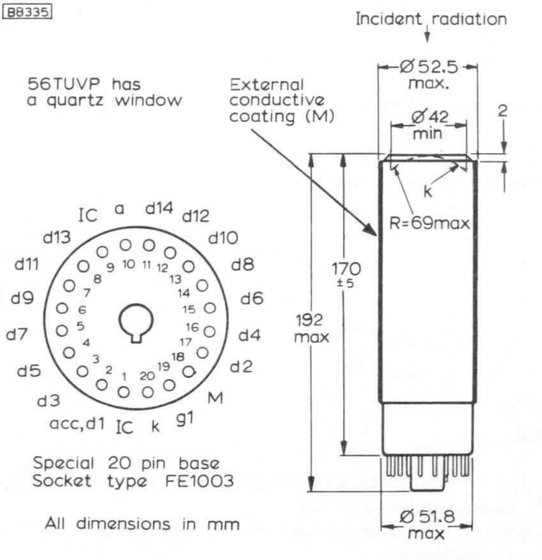
**When calculating the anode voltage, the voltage drop across the load resistance should not be overlooked.

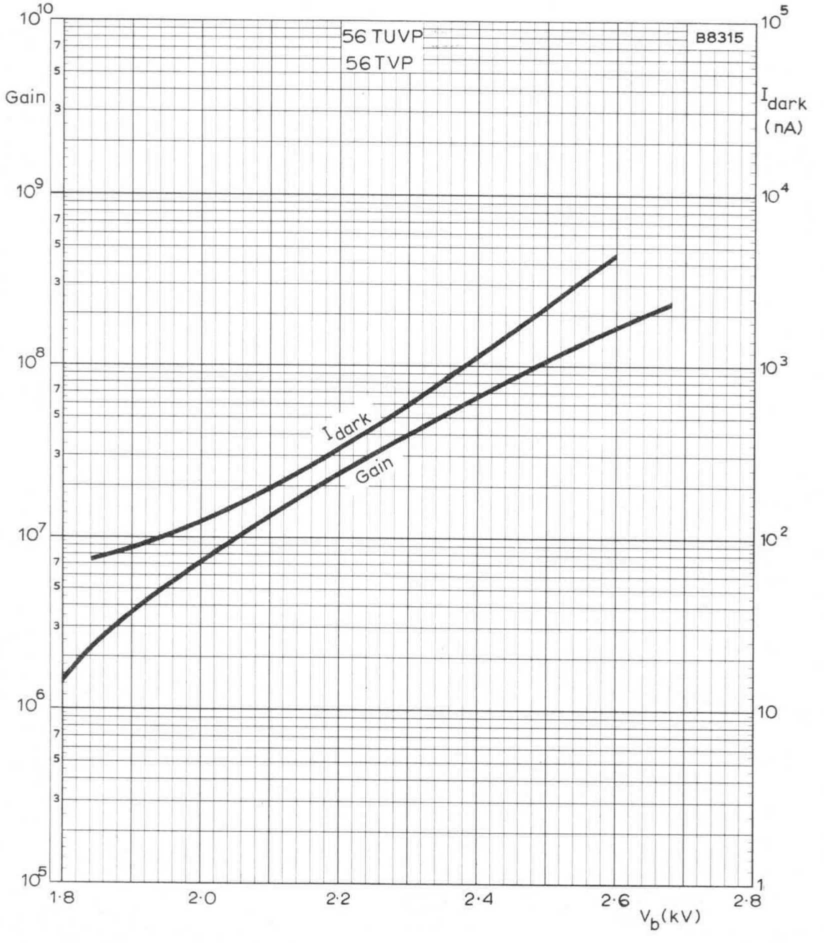
ACCESSORIES (supplied as additional items)

| | |
|---|---|
| Socket | FE1003 |
| Mu-metal shield | 56131 |

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.






GAIN AND DARK CURRENT
AS A FUNCTION OF TOTAL VOLTAGE

**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

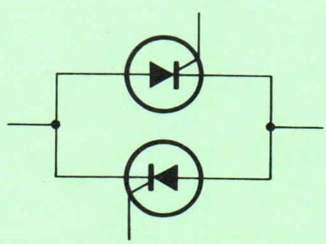
| | | OTH800 - 800 | 1000 | 1200 | 1400 | |
|---|---|---|---|---|---|---|
| $V_{DRM}$ | max. | 800 | 1000 | 1200 | 1400 | V |
| $V_{DWM}$ | max. | 600 | 700 | 800 | 1000 | V |
| $I_{T(RMS)}$ | max. ($T_{water} = 40^{o}C$, water flow = 4 $\ell$/min) | | 800 | | | A |
| $I_{TSM}$ | max. (t = 10ms, $T_j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

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

OUTLINE AND DIMENSIONS

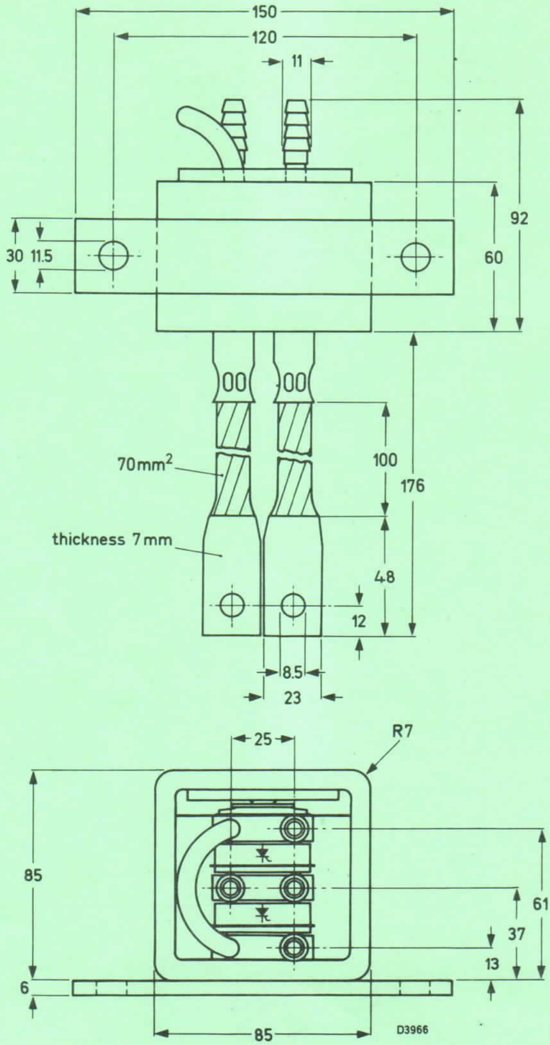
For details see page 2

CIRCUIT DIAGRAM



OUTLINE AND DIMENSIONS

All dimensions in millimetres



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 ($t \leq 10ms$) | 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 $T_{water} = 40^oC$, water flow = $4\ell$/min. | | 800 | | | A |
| $I_{TSM}$ max. | Non-repetitive peak on-state current ($t = 10ms$, half sine wave) $T_j = 125^oC$ prior to surge | | 5000 | | | A |
| $I^2t$ max. | $I^2t$ for fusing ($t = 10ms$) | | 125 000 | | | $A^2s$ |
| $\frac{dI_T}{dt}$ max. | Rate of rise of on-state current after triggering with $I_G = 1.0A$, $dI_G/dt = 1.0A/\mu s$ | | 100 | | | $A/\mu s$ |

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 | $^oC$ |

THERMAL CHARACTERISTIC

| | | | |
|---|---|---|---|
| $R_{th(j-w)}$ | Thermal resistance from junction to water at $4\ell$/min per cell | 0.13 | $^oC/W$ |

## ELECTRICAL CHARACTERISTICS

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

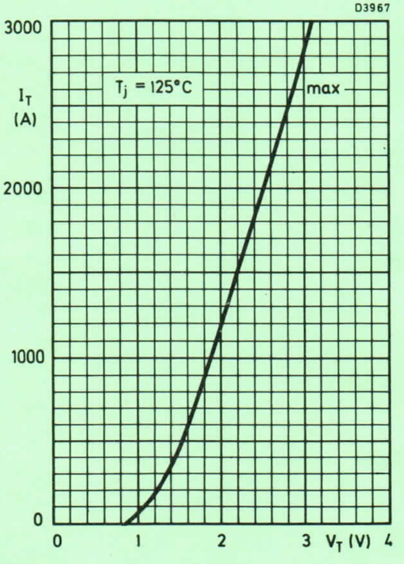
WATER TEMPERATURE RISE

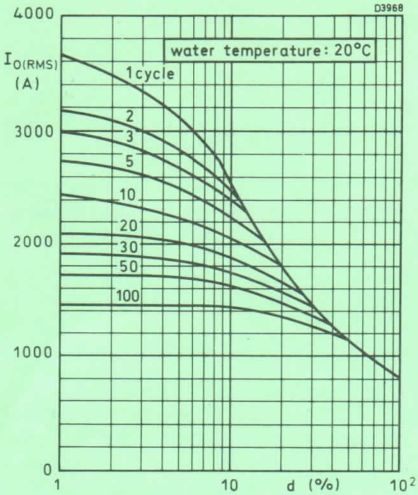
Max. rise of water temperature
4 ℓ/min (both heatsinks in series) $\Delta T = T_{out} - T_{in} < 6^{\circ}C$

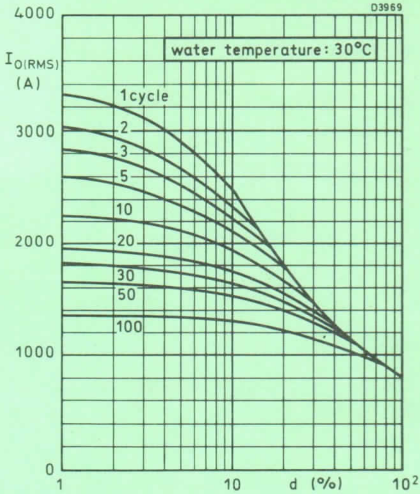
COOLING WATER

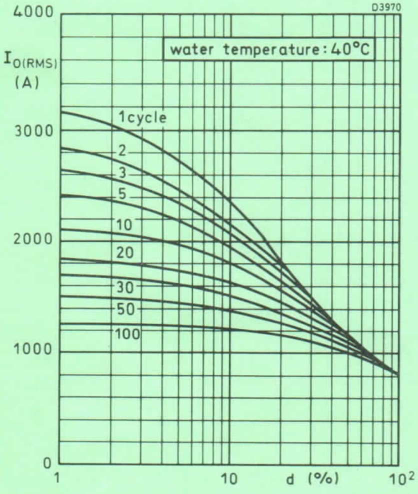
The cooling water must satisfy the following requirements as regards the content of solids and soluble chemicals:

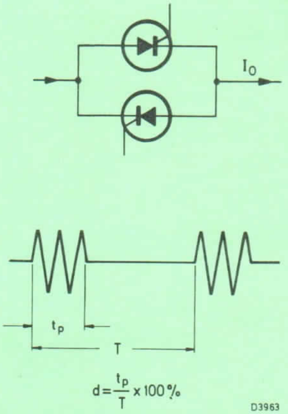
1. pH value: 7 to 9
2. Max. weight of chlorides per litre: 20mg
   Max. weight of nitrates per litre: 10mg
   Max. weight of sulphates per litre: 100mg
3. Max. weight of insolubles per litre: 250mg



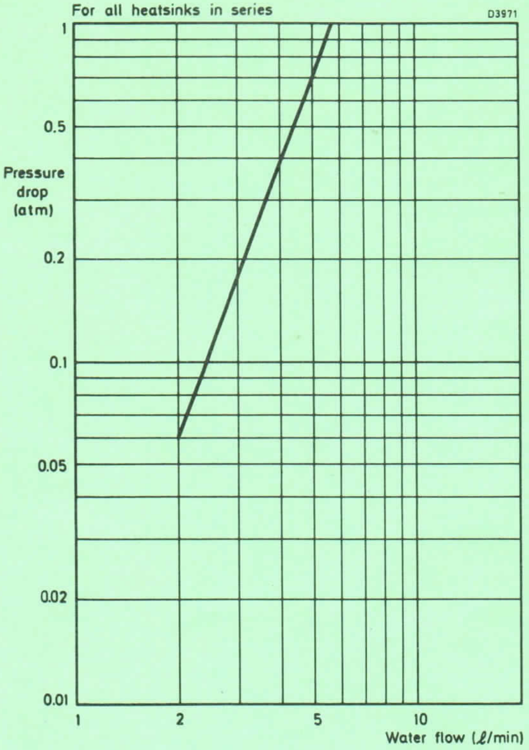


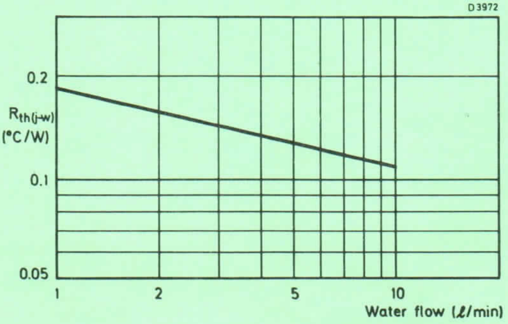




Conduction angle: 360°
water flow : 4 ℓ/min


For all heatsinks in series
D3971
Pressure drop (atm)
1
0.5
0.2
0.1
0.05
0.02
0.01
1
2
5
10
Water flow (ℓ/min)


D3972
$R_{th(j-w)}$ (°C/W)
0.2
0.1
0.05
1
2
5
10
Water flow (ℓ/min)

## DEVELOPMENT SAMPLE DATA

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

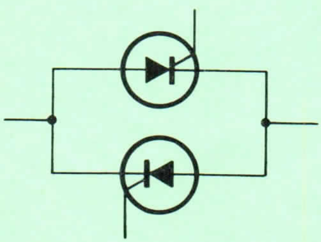
| | | OTH1200 - 800 | 1000 | 1200 | 1400 | |
|---|---|---|---|---|---|---|
| $V_{DRM}$ | max. | 800 | 1000 | 1200 | 1400 | V |
| $V_{DWM}$ | max. | 600 | 700 | 800 | 1000 | V |
| $I_{T(RMS)}$ | max. ($T_{water} = 40^{o}C$, water flow = 4 ℓ/min) | | 1200 | | | A |
| $I_{TSM}$ | max. (t = 10ms, $T_j = 125^{o}C$ prior to surge) | | 7000 | | | A |
| $T_j$ | max. | | 125 | | | $^{o}C$ |
| $\frac{dI_T}{dt}$ | max. | | 100 | | | A/μs |
| $\frac{dV_D}{dt}$ | max. | | 300 | | | V/μs |

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

OUTLINE AND DIMENSIONS

For details see page 2

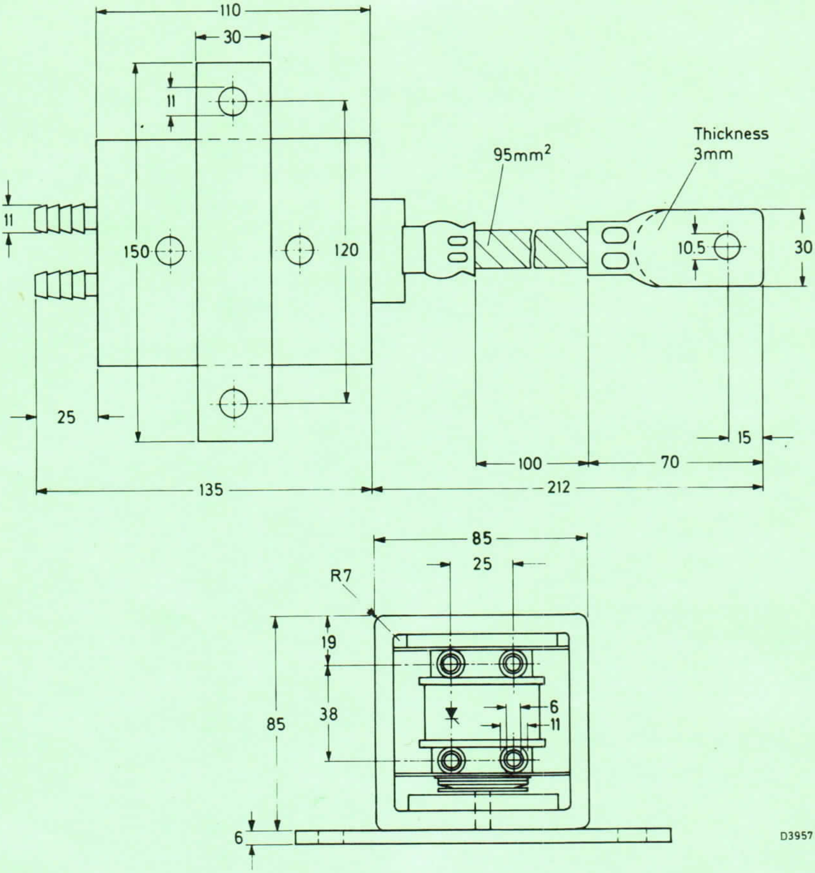
CIRCUIT DIAGRAM



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

OUTLINE AND DIMENSIONS

All dimensions in millimetres




All dimensions in mm

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 | $^{o}C/W$ |

## ELECTRICAL CHARACTERISTICS

### ANODE TO CATHODE

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

### GATE TO CATHODE

| | | Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $V_{GT}$ | Minimum voltage that will trigger all devices at $T_j = 125^oC$ | 4 0 | - | - | V |
| $V_{GD}$ | Maximum voltage that will not trigger any device, $V_D = V_{DRM}$ max $T_j = 125^oC$ | - | - | 0.15 | V |
| $I_{GT}$ | Minimum current that will trigger all devices at $T_j = 25^oC$ | 400 | - | - | mA |

### Switching characteristics

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

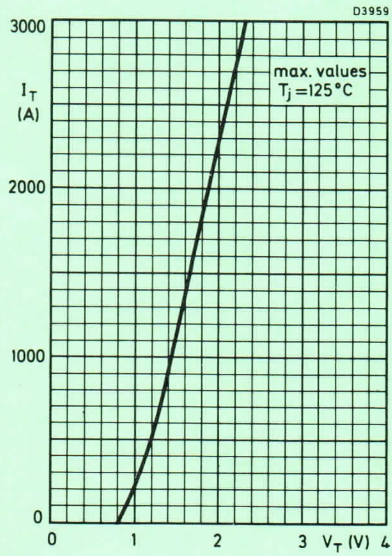
WATER TEMPERATURE RISE

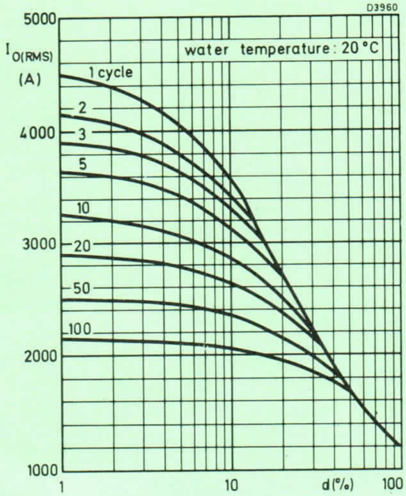
Max. rise of water temperature
at 4ℓ/min (both heatsinks in series) $\Delta T = T_{out} - T_{in} < 7.5^{o}C$

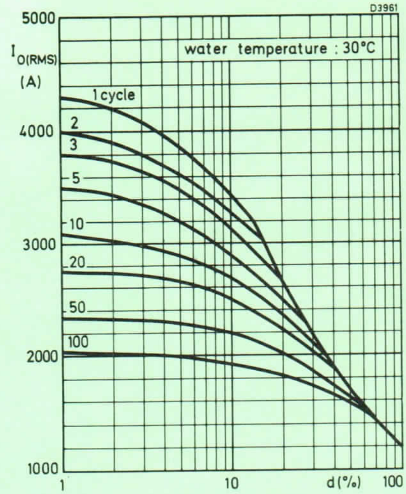
COOLING WATER

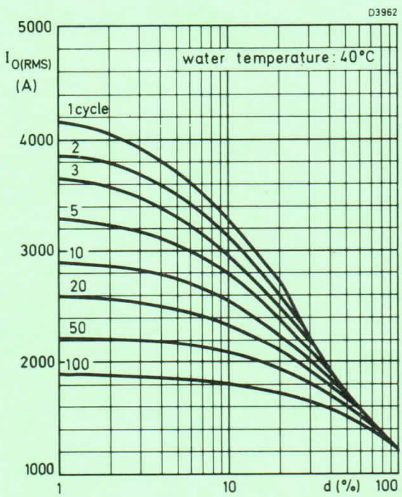
The cooling water must satisfy the following requirements as regards the content of solids and soluble chemicals:

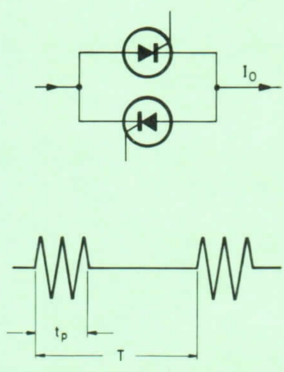
1. pH value: 7 to 9
2. Max. weight of chlorides per litre: 20mg
   Max. weight of nitrates per litre: 10mg
   Max. weight of sulphates per litre: 100mg
3. Max. weight of insolubles per litre: 250mg





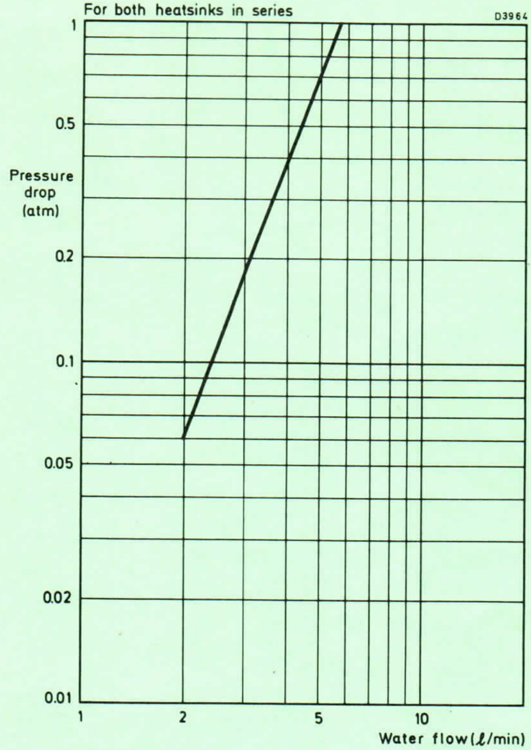



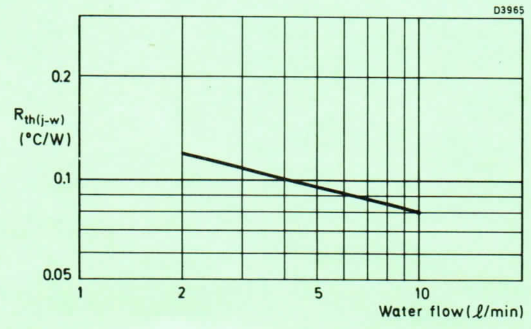




$$d = \frac{t_p}{T} \times 100\,\%$$

D3963

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


For both heatsinks in series
D3964
1
0.5
Pressure
drop
(atm)
0.2
0.1
0.05
0.02
0.01
1
2
5
10
Water flow(ℓ/min)


D3965
0.2
$R_{th(j-w)}$
(°C/W)
0.1
0.05
1
2
5
10
Water flow(ℓ/min)

# CAMERA TUBE

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

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

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

## QUICK REFERENCE DATA

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

## OPTICAL

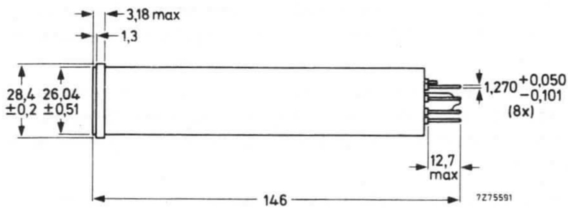
| | | |
|---|---|---|
| Dimension of useful area on photoconductive target | | circle of 18 mm Ø |
| Dimensions of scanned area (4 : 3 aspect ratio, 10% overscan) | | 26,5 x 20 mm |
| Average δ of transfer characteristic | | 1 |
| Spectral response | | 8 to 14 μm |
| Target reflectance | max. | 20 %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

**MECHANICAL DATA**

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

Outline drawing

Dimensions in mm



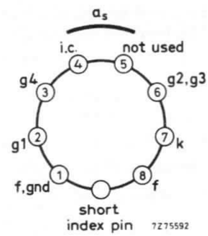




Fig. 1 The faceplate is typically 2 mm thick with a refractive index of 4,0 (germanium). The target is located max. 0,25 mm behind the inside of the faceplate.

Pin connections:

1. filament, common camera ground
2. grid 1
3. grid 4
4. internal connection
5.
6. grid 2, 3
7. cathode
8. filament

$a_s$. signal electrode (target)
S. short index pin

**ACCESSORIES**

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

## ELECTRICAL DATA

Heating

Indirect by a.c. or d.c.

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

## ELECTRON GUN CHARACTERISTICS

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

## CAPACITANCE

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

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

## LIMITING VALUES (Absolute maximum rating system)

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

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

DEVELOPMENT SAMPLE DATA

## OPERATING CONDITIONS AND PERFORMANCE

**Conditions**

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

Scan failure and blanking failure protection required.

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

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

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

## SPURIOUS SIGNALS

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

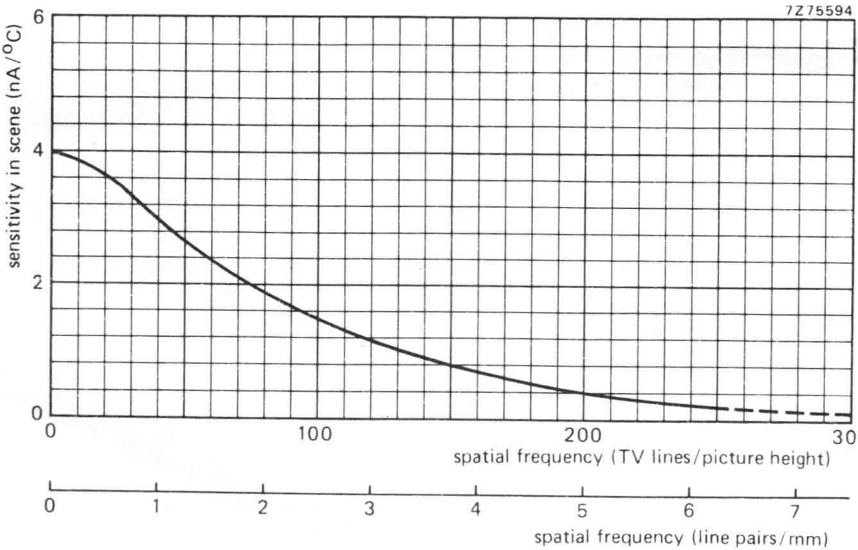



Fig. 2 Typical spatial sensitivity characteristics.

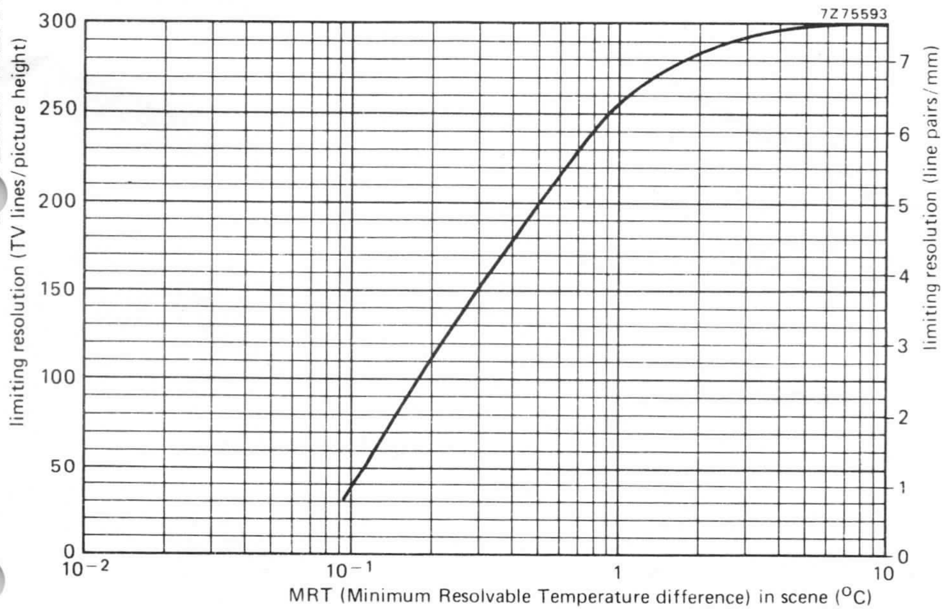



Fig. 3 Typical limiting resolution as a function of MRT.

# 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 | | $2.0 \times 10^8$ | |
| Typical resistance | | $6.0 \times 10^8$ | 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 | $\times 10^8$ Ω |
| Gain (note 1) | 1.0 | 2.0 | – | $\times 10^8$ |
| Background above an equivalent threshold of $2.0 \times 10^7$ electrons | – | 0.15 | 0.5 | pulse/s |
| Starting voltage with an equivalent threshold of $2.0 \times 10^7$ electrons | 1.4 | 1.6 | 1.8 | kV |
| Resolution (F.W.H.M.) at a modal gain of $2.0 \times 10^8$ | – | 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 | $mN/m^2$ |
| | | $3.7 \times 10^{-4}$ | torr |

## MASS

| | | |
|---|---|---|
| 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

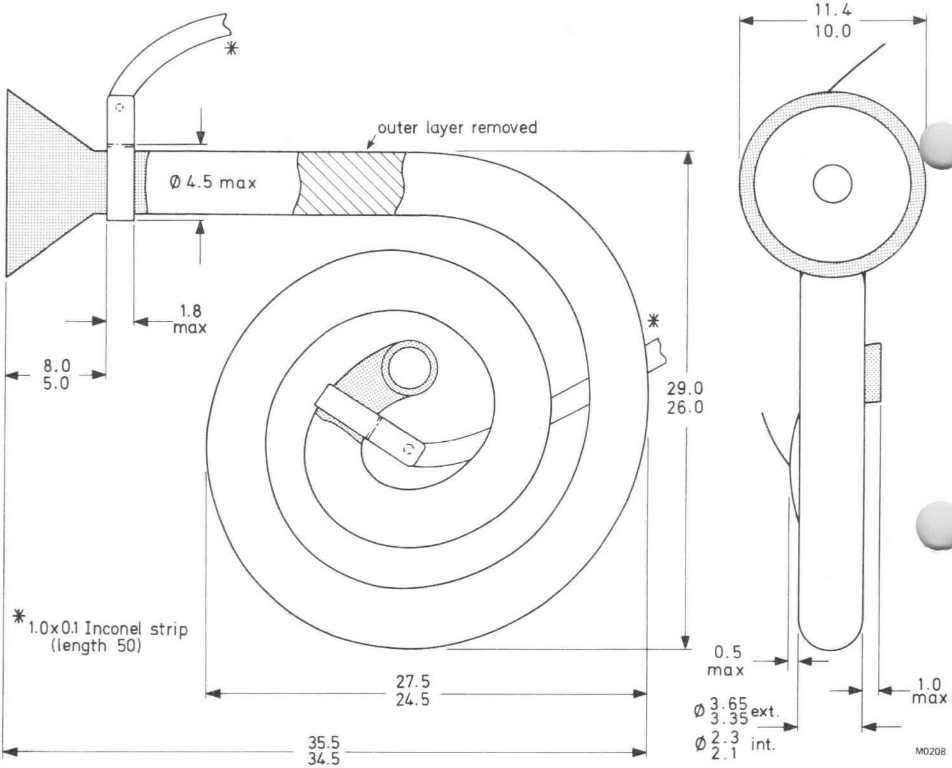
1. The gain of a typical multiplier will increase by a factor of approx. 2 for an increase of operating voltage of 500 V.
2. X919 AL only: to ensure efficient collection of electrons, a collector should be used, biased at 100 to 200 V positive with respect to the multiplier output.

orange binder, tab 10

NOTES (continued)

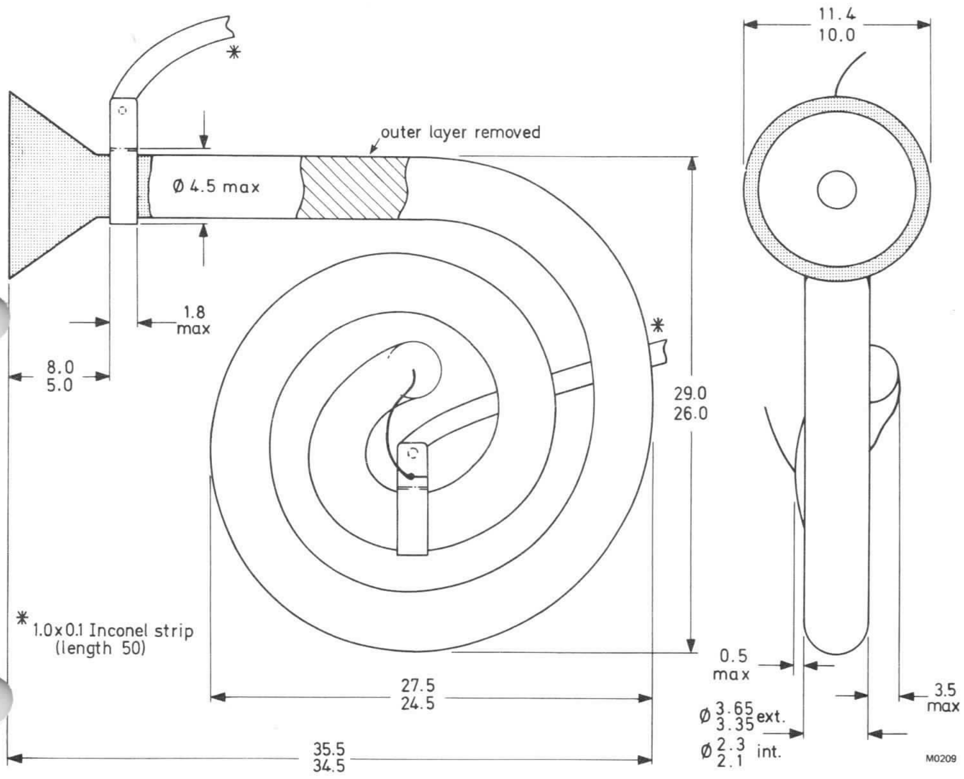
3. Baking will cause a permanent slight loss of gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 °C could reduce the gain by approximately a factor of 2.

**MECHANICAL DATA X919AL** Dimensions in mm



## MECHANICAL DATA X919BL

Dimensions in mm



# 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 | | $1.5 \times 10^8$ | |
| Typical resistance | | $7.5 \times 10^8$ | 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 | $\times 10^8$ Ω |
| Gain (note 1) | 0.8 | 1.5 | – | $\times 10^8$ |
| Background above an equivalent threshold of $2.0 \times 10^7$ electrons | – | 0.15 | 0.5 | pulse/s |
| Starting voltage with an equivalent threshold of $2.0 \times 10^7$ electrons | 1.3 | 1.5 | 1.7 | kV |
| Resolution (F.W.H.M.) at a modal gain of $2.0 \times 10^8$ | – | 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 | $mN/m^2$ |
| | | $3.7 \times 10^{-4}$ | 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

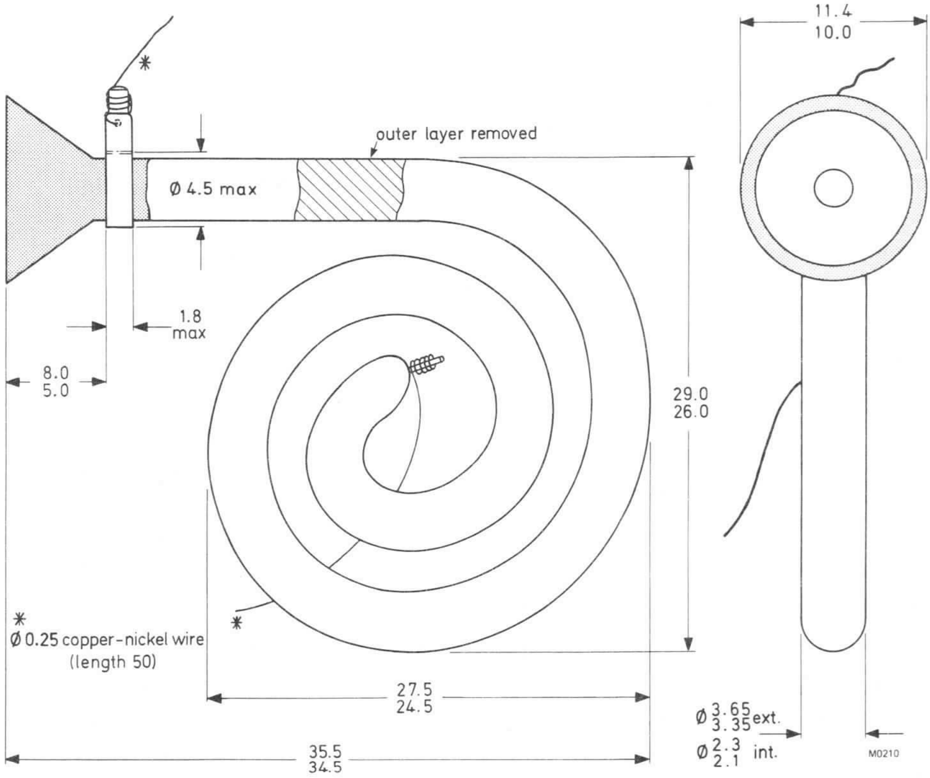
1. The gain of a typical multiplier will increase by a factor of approx. 2 for an increase of operating voltage of 500 V.

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 °C could reduce the gain by approximately a factor of 2.

**OUTLINE DRAWING**

Dimensions in mm



QUICK REFERENCE DATA

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

XQ1020 - for use in monochrome television cameras

XQ1020L - provides the luminance component of a colour picture

XQ1020R - provides the red component of a colour picture

XQ1020G - provides the green component of a colour picture

XQ1020B - provides the blue component of a colour picture

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

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

HEATER

Suitable for parallel operation only

| | | |
|---|---|---|
| $V_h$ | 6.3 ± 5% | V |
| $I_h$ | 300 | mA |

FOCUSING

Magnetic

DEFLECTION

Magnetic

PHOTOCONDUCTIVE LAYER

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

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

CAPACITANCE

Target electrode to all other electrodes 3 to 6 pF

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

*Registered trade mark for television camera tubes

## TYPICAL OPERATION

### Operating conditions

| | | | |
|---|---|---|---|
| $V_k$ | | 0 | V |
| $V_{target}$ | | 45 | V |
| $V_{a3}$ | | 675 | V |
| $V_{a2}$ | | 600 | V |
| $V_{a1}$ | | 300 | V |
| $V_g$ adjusted to give the required beam current | | | |
| Scanned area | | 12.8 × 17.1 | mm |
| Faceplate illumination | | See note 2 | |
| Faceplate temperature | | 20 to 45 | °C |
| | XQ1020, XQ1020L, G | XQ1020R, B | |
| Highlight signal current | 300 | 150 | nA |

### Typical performance

| | | | |
|---|---|---|---|
| Dark current | | <3 | nA |

Resolution

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

| | | | |
|---|---|---|---|
| XQ1020, XQ1020L | | 40 | % |
| XQ1020R | | 35 | % |
| XQ1020G | | 40 | % |
| XQ1020B | | 50 | % |
| Resolution capability | | >600 | TV lines |
| Signal-to-noise ratio | | See note 3 | |
| Gamma of transfer characteristic (see note 4) | | 0.95 ± 0.05 | |
| Wavelength at maximum response (approx.) | | 500 | nm |
| Lag (see note 5) | | | |
| | XQ1020, XQ1020L, R, G | XQ1020B | |
| Max. residual signal after dark pulse of 60ms | 5 | 6 | % |
| Max. residual signal after dark pulse of 200ms | 2 | 3 | % |
| Sensitivity (see note 6) | | | |
| XQ1020, XQ1020L | | >275 | μA/lm |
| XQ1020R | | >60 | μA/lm |
| XQ1020G | | >125 | μA/lm |
| XQ1020B | | >32 | μA/lm |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

EQUIPMENT DESIGN RECOMMENDATIONS

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

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

MOUNTING POSITION

Any

WEIGHT

| | | |
|---|---|---|
| Tube alone (approx.) | 100 | g |

ACCESSORIES (see separate data sheets)

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

NOTES

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

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

   for XQ1020R Schott OG2 thickness 3mm
   XQ1020G Schott VG9 thickness 1mm
   XQ1020B Schott BG12 thickness 1mm

   Transmission curves for these filters are given on page 10.

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

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

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

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

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

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

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

6. As measured under the following conditions:

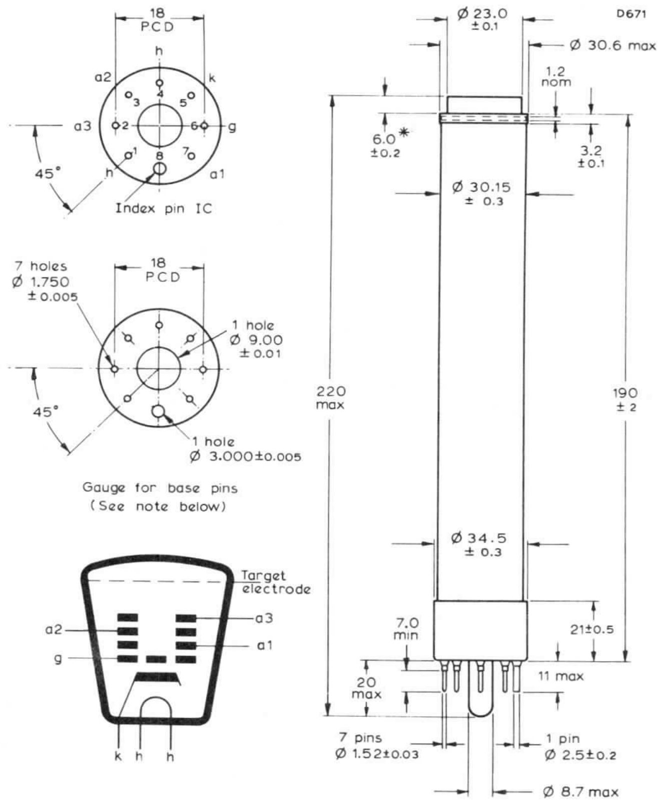
   Tubes are exposed to an illumination of 4.54 lux at a colour temperature of 2854K. The appropriate filter is inserted in the light path. The current obtained is a measure of the colour sensitivity, and is expressed in micro-amperes per lumen of white light before the filter.

   Filters used:
   for XQ1020R Schott OG2 thickness 3mm
   XQ1020G Schott VG9 thickness 1mm
   XQ1020B Schott BG12 thickness 3mm

   Transmission curves for these filters are given on page 10.

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

OUTLINE DRAWING OF XQ1020 SERIES




All dimensions in mm

* Total glass thickness = 7.2 ± 0.2

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

GENERAL OPERATIONAL RECOMMENDATIONS

**Transport, handling and storage**

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

**Base pins**

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

**Target electrode**

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

**Photoconductive layer**

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

**Light transfer**

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

**Signal-to-noise ratio**

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

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

OPERATING INSTRUCTIONS

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

2. Carefully mate the socket with the base pins.

3. Cap the lens and close the iris.

OPERATING INSTRUCTIONS (contd.)

4. Adjust the operating conditions as follows:

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

   (b) Target electrode voltage to 45V

   (c) Scanning amplitudes to maximum (overscanning)

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

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

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

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

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

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

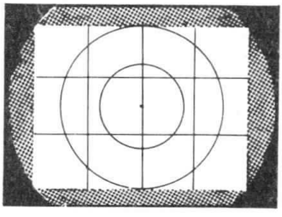
    (a) Adjust the alignment fields in such a way that the centre of the picture on the monitor does not move when $V_{a2}$ and $V_{a3}$ (beam focus) is varied. This is catered for automatically in some cameras.

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

11. Adjust the scanning amplitudes as follows:

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

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



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

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

13. Check alignment, beam focus and optical focus.

14. **Procedure for standby operation**

    From operation to standby -

    (a) Cap lens

    (b) Set $V_g$ for beam cut-off

    (c) Reduce heater voltage to 4V or less

    From standby to normal operation -

    (a) Restore heater voltage to 6.3V

    (b) Wait 1 minute

    (c) Increase beam current to normal value

    (d) Uncap lens

**ALWAYS**

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

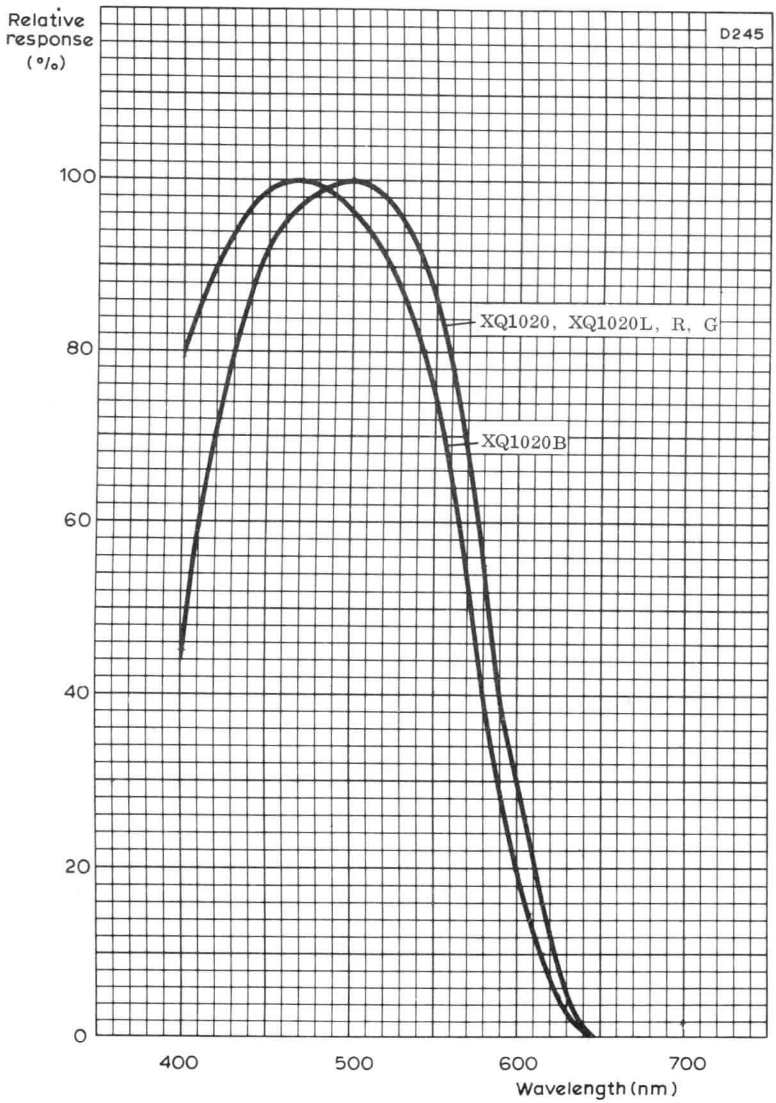
Adjust sufficient beam current to stabilise the picture highlights.

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

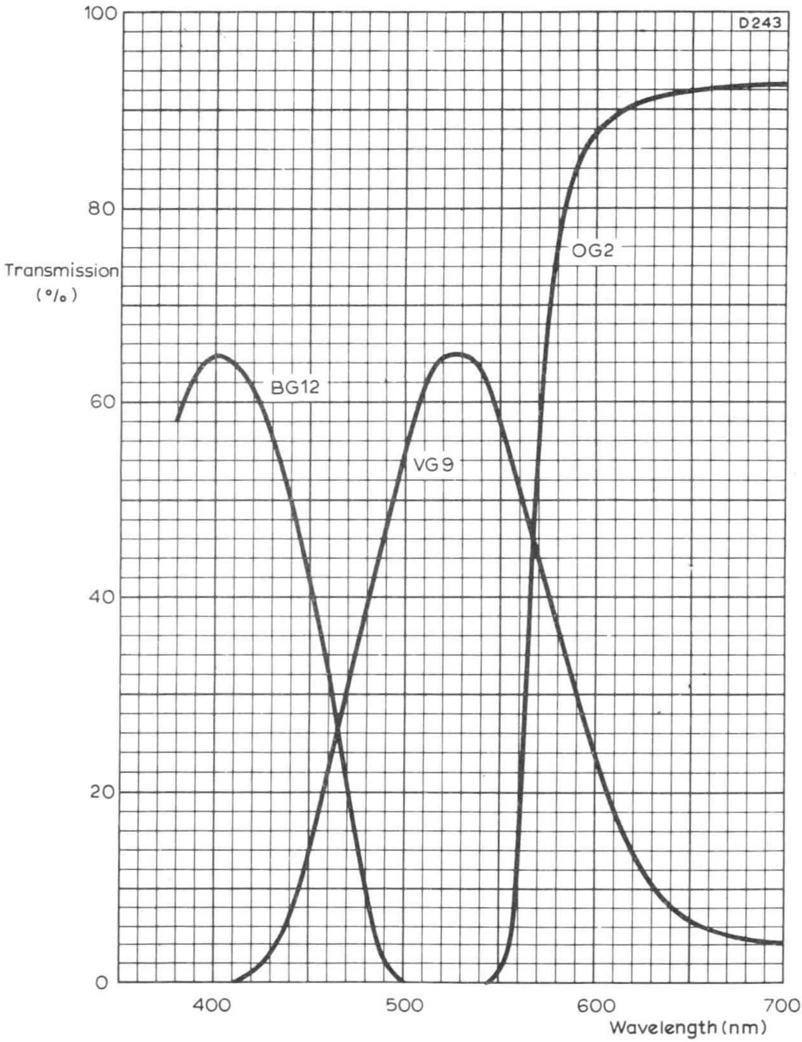
Operate a3 at a voltage equal to or more positive than a2.

Avoid pointing the camera directly into the sun.

Keep the lens capped when transporting the camera.




TYPICAL SPECTRAL RESPONSE CURVES




TRANSMISSION CURVES FOR SCHOTT FILTERS

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

## TYPICAL OPERATION

### Operating conditions

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

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

### Typical performance

| | | |
|---|---|---|
| Dark current | <3 | nA |

Resolution

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

| | | |
|---|---|---|
| XQ1070 and /01, XQ1070L and /01L | 30 | % |
| XQ1070R, XQ1070/01R | 25 | % |
| XQ1070G, XQ1070/01G | 30 | % |
| XQ1070B, XQ1070/01B | 35 | % |

| | | |
|---|---|---|
| Resolution capability | >600 | TV lines |
| Gamma of transfer characteristic (see note 4) | 0.95 ± 0.05 | |
| Wavelength (approx.) (see page 9) | | |
| at maximum response | 500 | nm |
| at cut-off | 650 | nm |

Lag (see note 5)

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

Sensitivity (see note 6)

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|---|---|
| $V_{target}$ max. (see note 7) | 50 | V |
| $V_{a3}$ max. | 1100 | V |
| $V_{a2}$ max. | 800 | V |
| $V_{a3-a2}$ max. | 450 | V |
| $V_{a1}$ max. | 350 | V |
| $-V_g$ max. | 125 | V |
| $+V_g$ max. | 0 | V |
| $I_k$ max. | 3.0 | mA |
| $v_{h-k(pk)}$ max. | | |
| Cathode positive | 125 | V |
| Cathode negative | 50 | V |
| Maximum faceplate illumination (see note 8) | 500 | lux |
| Maximum faceplate temperature (operation and storage) | 50 | $^{o}C$ |
| 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

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:

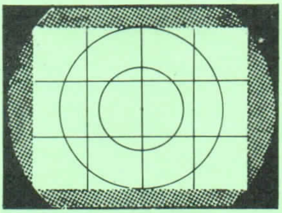
    (a) Adjust the alignment fields in such a way that the centre of the picture on the monitor does not move when $V_{a2}$ (beam focus) is varied. This is catered for automatically in some cameras.

    (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 $9.6 \times 12.8$mm mask which is in contact with and centred on the faceplate. Decrease the horizontal and vertical scanning amplitudes until the periphery of the mask is just outside the raster on the monitor. This may be facilitated by small adjustments of the centring controls.

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



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

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

13. Check alignment, beam focus and optical focus.

14. Procedure for standby operation

From operation to standby -

(a) Cap lens

(b) Set $V_g$ for beam cut-off

(c) Switch off heater

From standby to normal operation -

(a) Restore heater voltage to 6.3V

(b) Wait 1 minute

(c) Increase beam current to normal value

(d) Uncap lens

ALWAYS -

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

Adjust sufficient beam current to stabilise the picture highlights.

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

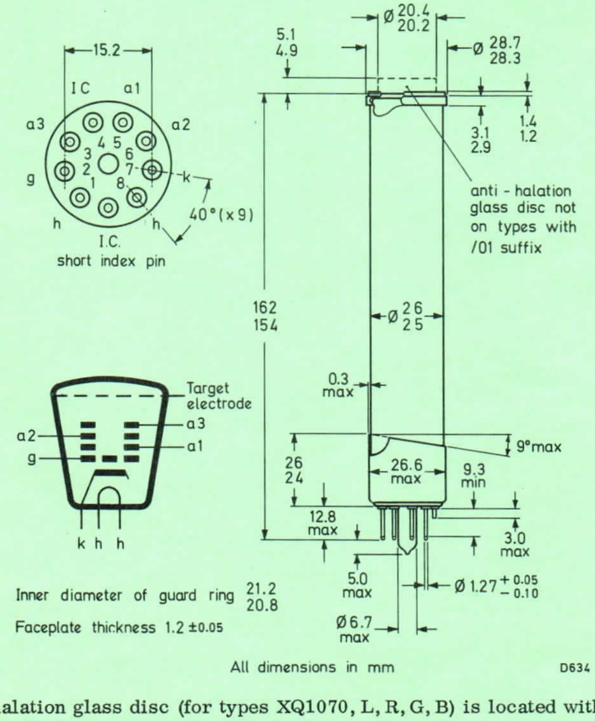
Operate a3 at a voltage equal to or more positive than a2.

Avoid pointing the camera directly into the sun.

Keep the lens capped when transporting the camera.

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

OUTLINE DRAWING OF XQ1070 SERIES




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

## GENERAL OPERATIONAL RECOMMENDATIONS

### Transport, handling and storage

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

### Base pins

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

### Light transfer

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

### Signal-to-noise ratio

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

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

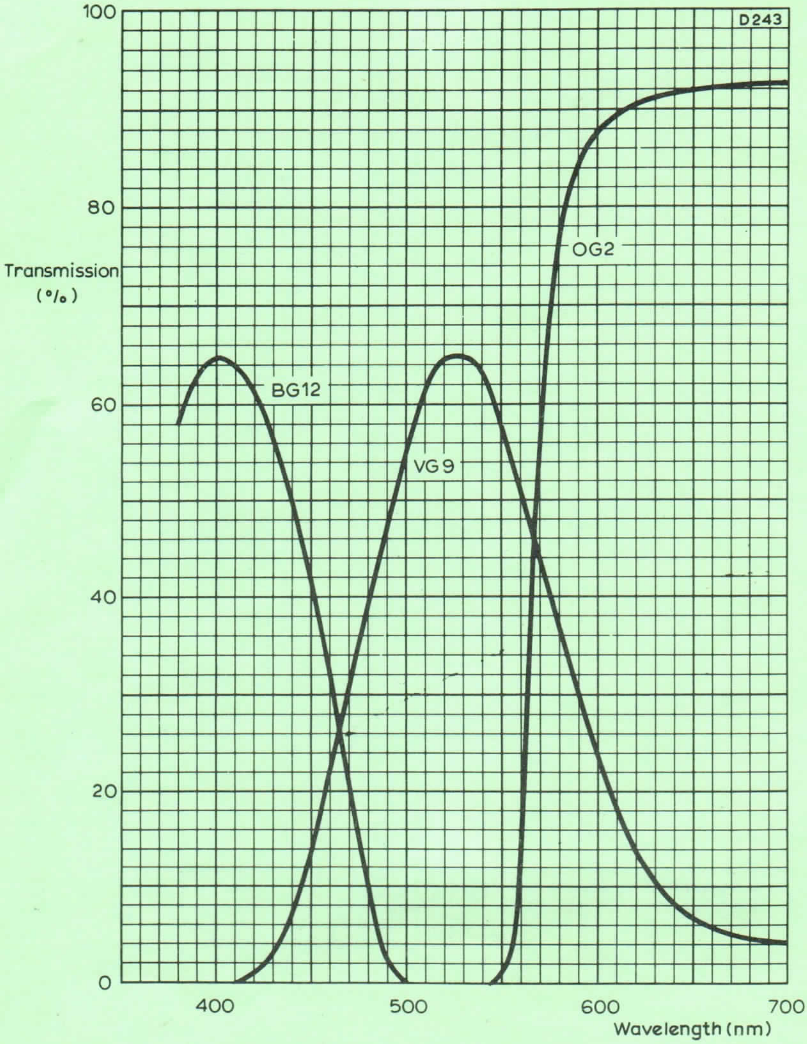
## OPERATING INSTRUCTIONS

1. Clean the faceplate of the tube and insert in the coil assembly in such a way that the plane defined by the tube axis and the mark on the base is essentially parallel to the direction of the vertical scan.

2. Carefully mate the socket with the base pins.

3. Cap the lens and close the iris.


TYPICAL SPECTRAL RESPONSE CURVES




TRANSMISSION CURVES FOR SCHOTT FILTERS

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

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

# IMAGE INTENSIFIER ASSEMBLY XX1063

DEVELOPMENT SAMPLE DATA

| 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

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

CHARACTERISTICS (measured at $V_{supply}$ = 6.75V, $T_{amb}$ = -50 to +30°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 | $\mu$lux |

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 | °C |
| Cathode illumination | 1 to 1000 | mlux |

The cathode must be connected to the instrument housing.

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: $\frac{\pi . L_o}{E_i}$

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

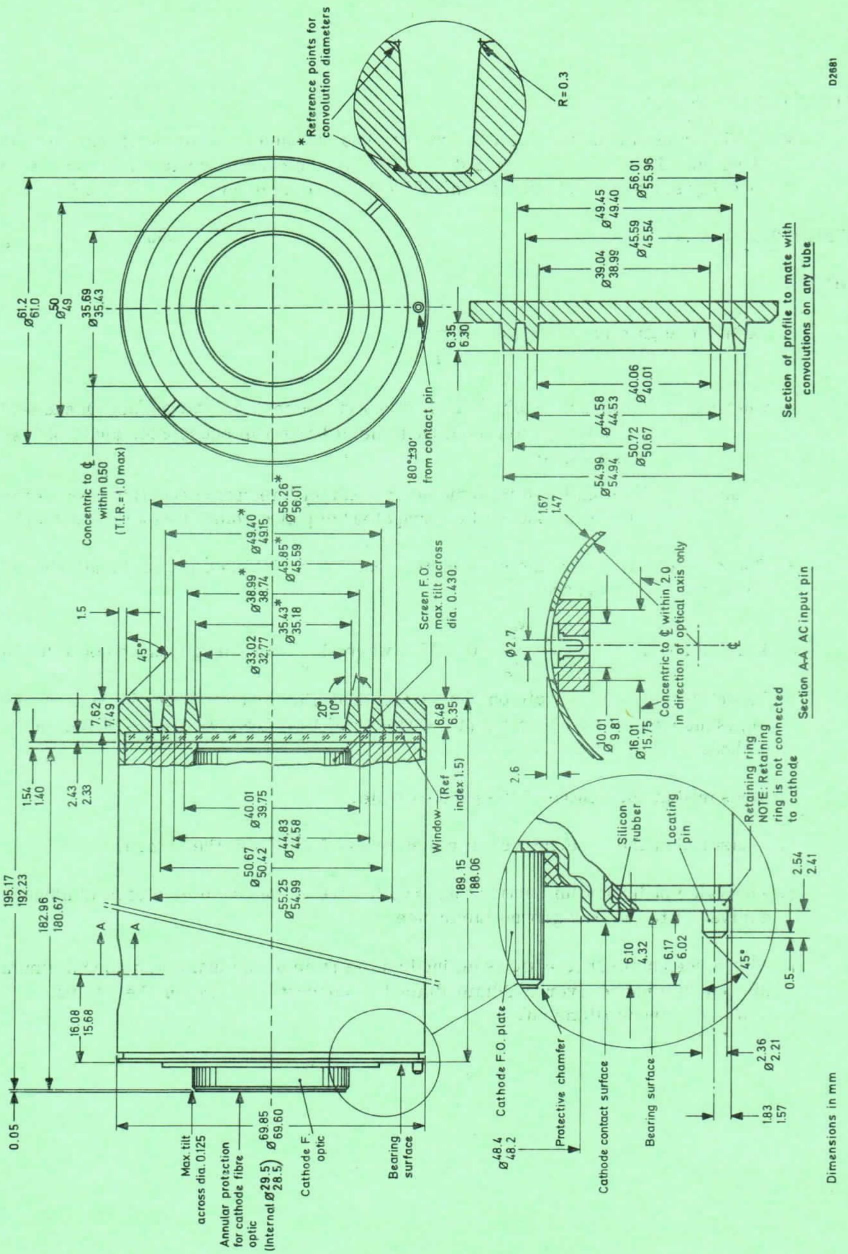
3. Percentage distortion = $(\frac{M_d}{M_c} - 1) \times 100$, where $M_d$ is the magnification of a 20mm diameter concentric circle on the photocathode, as measured on the screen and $M_c$ is the centre magnification at a distance of 1mm from the centre of the photocathode.

4. Measured at the centre of the photocathode.

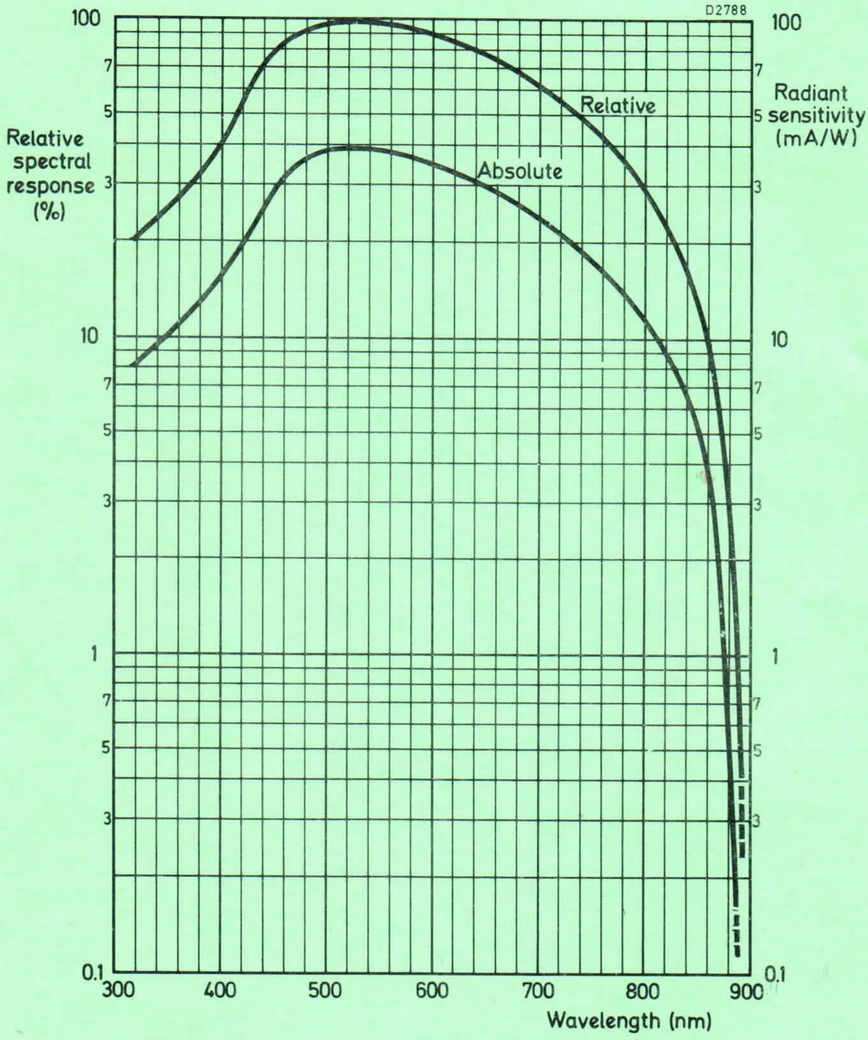
5. Measured at the photocathode at a distance of 7mm from the centre.

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.



D2681
* Reference points for convolution diameters
R=0.3
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
6.35 6.30
Ø56.01 55.96
Ø49.45 49.40
Ø45.59 45.54
Ø39.04 38.99
Ø40.06 40.01
Ø44.58 44.53
Ø50.72 50.67
Ø54.99 54.94
Section of profile to mate with convolutions on any tube
Ø56.26* 56.01
Ø49.40* 49.15
Ø45.85* 45.59
Ø38.99* 38.74
Ø35.43* 35.18
Ø33.02 32.77
1.5
45°
20° 10°
Screen F.O. max. tilt across dia. 0.430.
7.62 7.49
6.48 6.35
1.54 1.40
2.43 2.33
Ø40.01 39.75
Ø44.83 44.58
Ø50.67 50.42
Ø55.25 54.99
Window (Ref index 1.5)
195.17 192.23
182.96 180.67
189.15 188.06
A
A
16.08 15.68
0.05
Max. tilt across dia. 0.125
Annular protection for cathode fibre optic (Internal Ø29.5 28.5)
Ø69.85 69.60
Cathode F. optic
Bearing surface
1.67 1.47
Ø2.7
Concentric to ℄ within 2.0 in direction of optical axis only
Ø10.01 9.81
Ø16.01 15.75
2.6
Section A-A AC input pin
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
Ø48.4 48.2
Dimensions in mm




TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CURVES

# 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 | $C_{as}$ | $\approx$ 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.

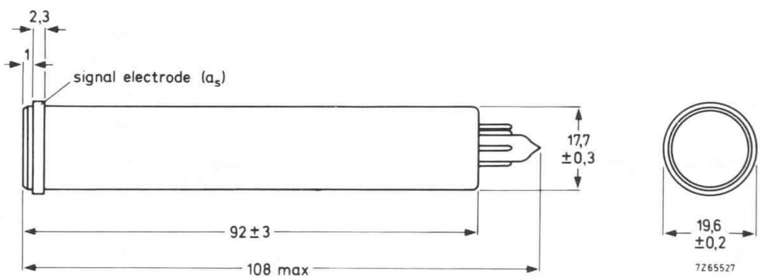
## MECHANICAL DATA

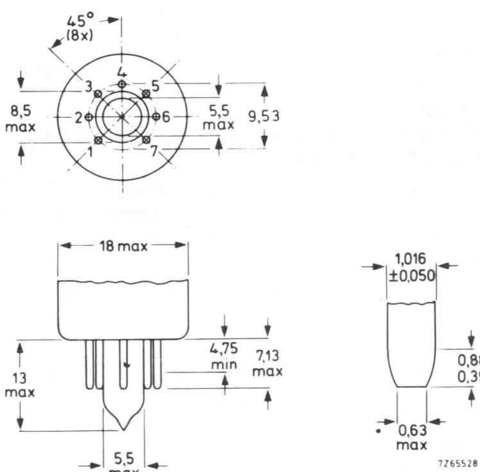
Dimensions in mm

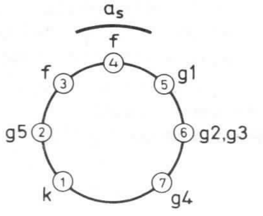
**Base :** Small button miniature 7-pin (IEC 67–I–10a) with pumping stem (JEDEC E7–91)

**Mounting position:** any

**Net mass :** approx. 23 g



## 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 | $V_{kf\,p}$ | max | 125 | V |
| Cathode-to-heater voltage peak negative | $-V_{kf\,p}$ | max | 10 | V |
| Output current, peak | $I_{as\,p}$ | max | 0,8 | μA ** |
| Faceplate illumination | E | max | 10 000 | lx † |
| Faceplate temperature, storage and operation | t | max | 60 | °C |
| Cathode heating time before drawing cathode current | $T_h$ | min | 1 | min |

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

**Conditions**

| | | | | | | note |
|---|---|---|---|---|---|---|
| Signal electrode voltage | $V_{as}$ | 10 | to | 25 | V | 1 |
| Grid 4 (decelerator) voltage | $V_{g4}$ | | | 400 | V | 2 |
| Grid 3 (beam focus electrode) voltage | $V_{g3}$ | | | 300 | V | 3 |
| Grid 2 (accelerator) voltage | $V_{g2}$ | | | 300 | V | |
| Blanking voltage, peak to peak | | | | | | |
| when applied to grid 1 | | | | 50 | V | |
| when applied to cathode | | | | 20 | V | |
| Flux density at centre of focusing coil | | | | 5,0 | mT | |
| Flux density of adjustable alignment coil or magnet | | 0 | to | 0,4 | mT | |

**Performance**

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

Notes see page 5.

**Notes to page 4.**

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

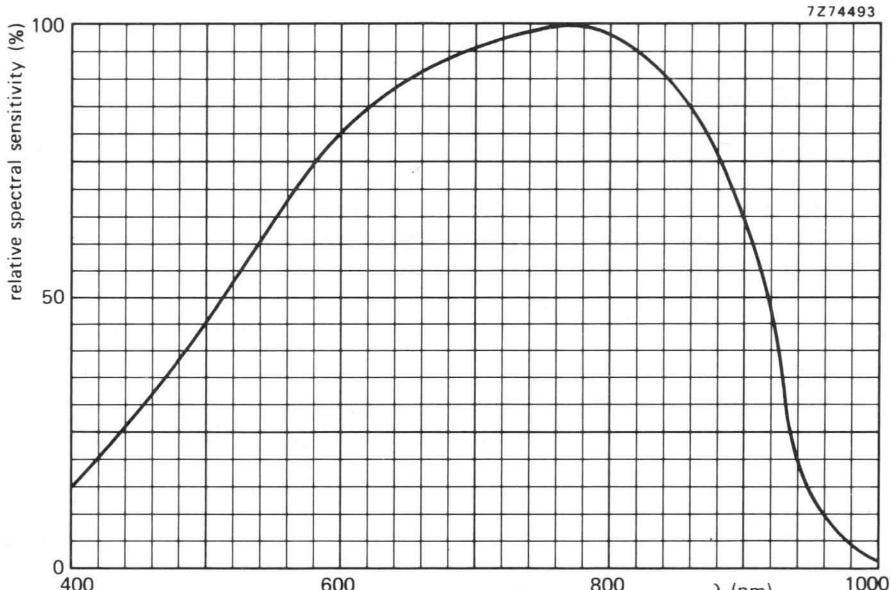



Fig.1 Typical spectral response curve.

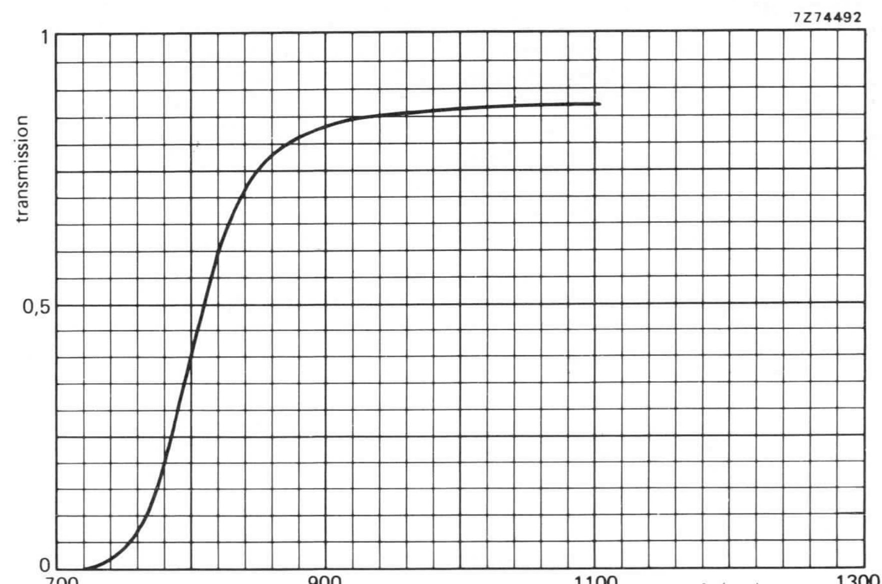



Fig.2 Transmission curve of infrared filter.

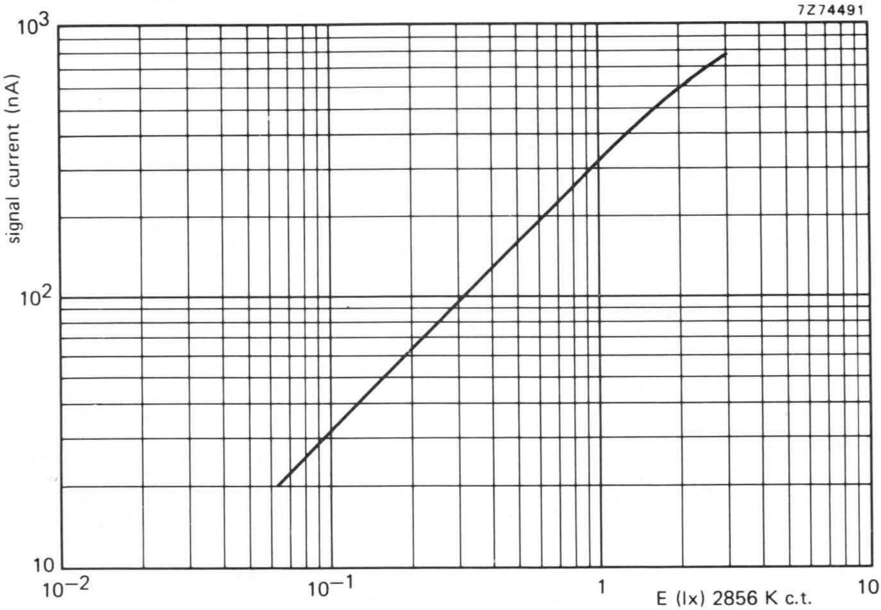



Fig.3 Typical light transfer characteristic.

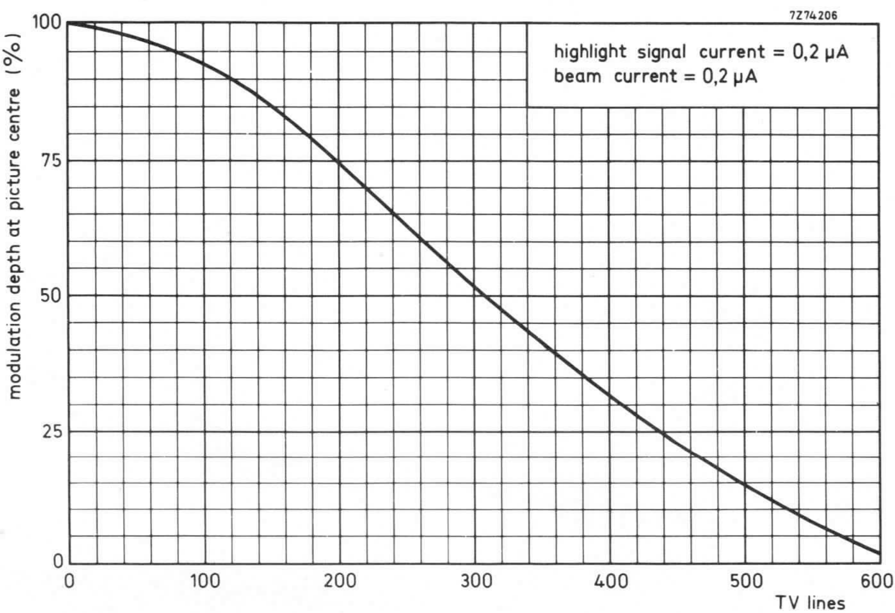



Fig.4 Typical uncompensated square wave response curve.

# CAMERA TUBE

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

The 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.

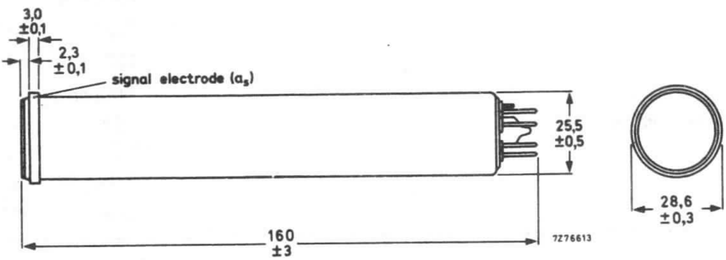
## MECHANICAL DATA

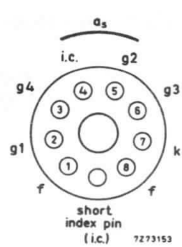
Dimensions in mm

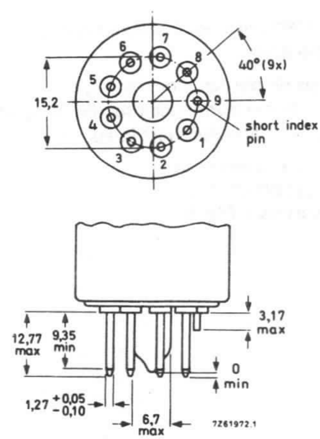
**Base:** IEC67-1-33a, JEDEC E8-11 except for pumping stem

**Mounting position:** any

**Net mass:** approx. 60 g



## 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 $^{o}$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 $^{o}$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 $\mu$A | | | 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 $\gamma$ of transfer characteristic | | | ≈ 1 | | |
| Spurious signals (spots and blemishes) | | | see note 5 | | |

Notes see page 5.

**Notes to page 4.**

1. The signal electrode voltage adjusted to the value indicated by the tube manufacturer on the test sheet accompanying each tube.
   To minimize picture sticking effects the signal electrode voltage should be adjusted with an inaccuracy of <±5%. In the case of cathode blanking, the voltage drop across the cathode resistor during read-out should be taken into account.
2. Grid 4 voltage must always be higher than grid 3 voltage. The recommended ratio of grid 4 voltage to grid 3 voltage both for best geometry and most uniform signal output depends upon the type of coil unit used and will be 5:3 for the recommended types (see 'Accessories').
3. Beam focus is obtained by the combined effect of grid 3 and the focus coil.
4. On RETMA resolution test chart; faceplate illuminance adjusted for a peak output current of 0,2 μA.
5. **Conditions**

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

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

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

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

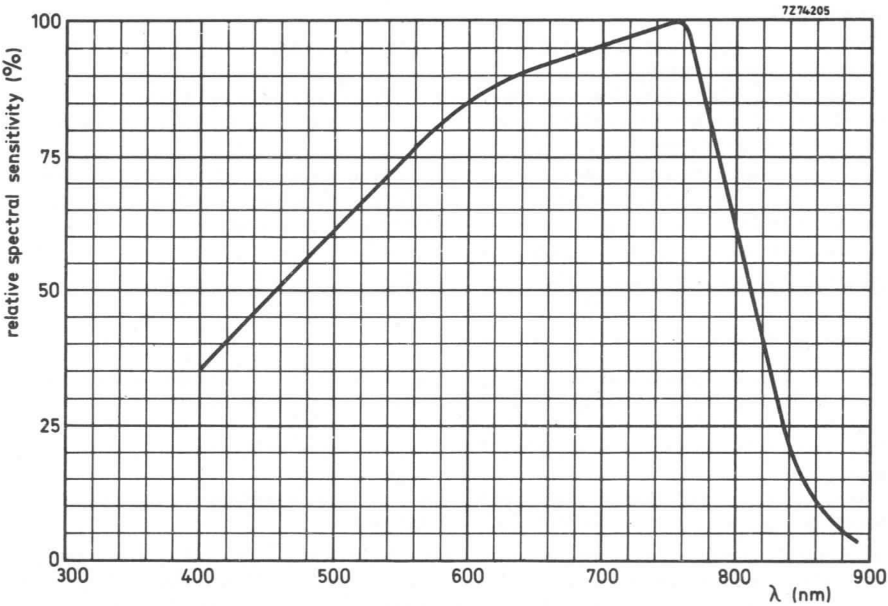



Fig.1 Typical spectral response curve.

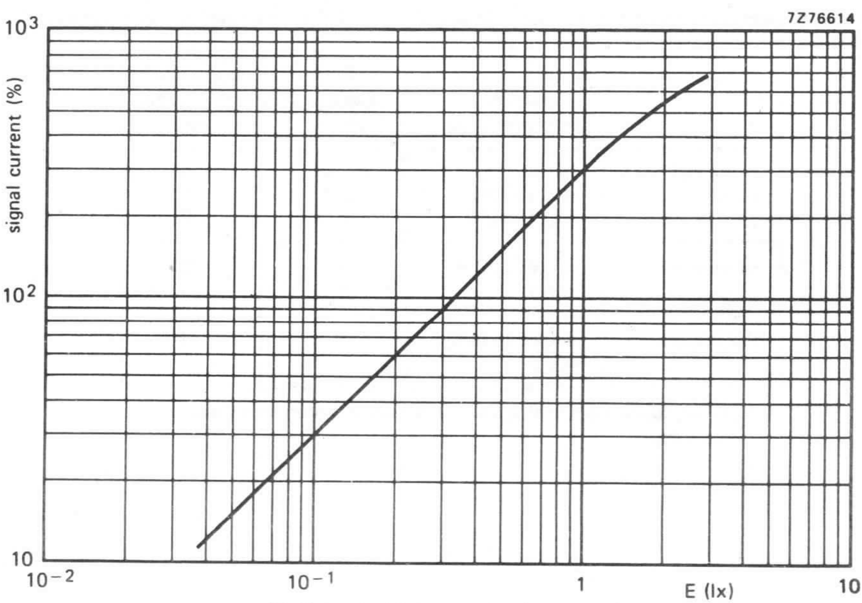



Fig.2 Typical light transfer characteristic.

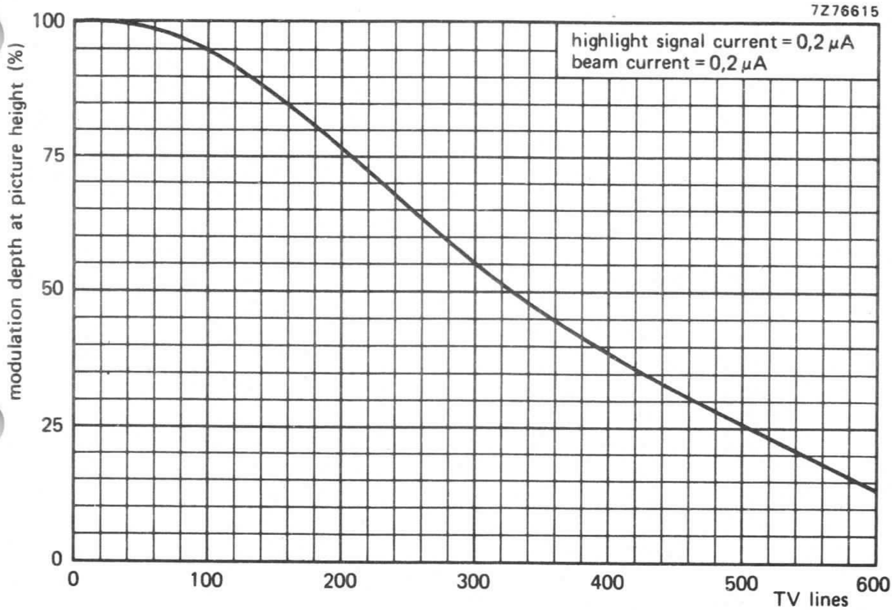



Fig.3 Typical uncompensated square-wave response curve.

# 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.

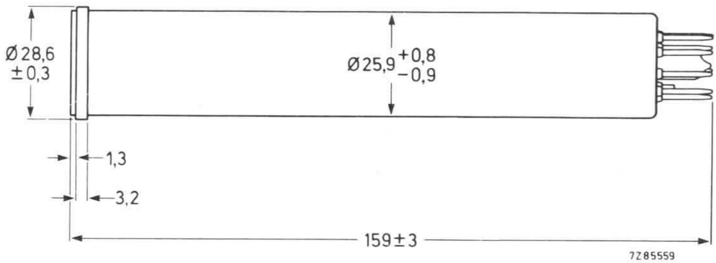
## CAPACITANCES

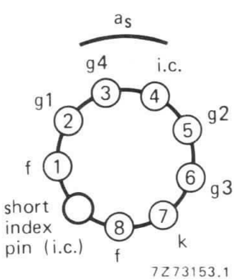
Signal electrode to all $\quad C_{as} \approx 4,6$ pF

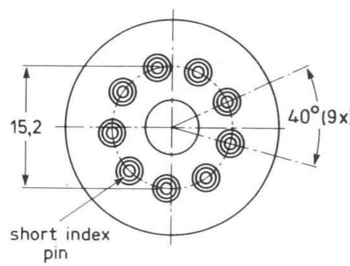
This capacitance, which is effectively the output impedance of the tube, increases when the tube is inserted in the deflection and focusing coil unit.

## MECHANICAL DATA

Dimensions in mm

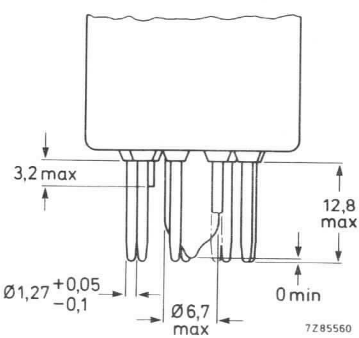



### BASE PIN CONNECTIONS (Bottom view)

| | |
|---|---|
| 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) |




**Mounting position**: any

**Net mass:** ≈ 70 g

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

## 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 | $V_{kf\,p}$ | max. | 125 | V |
| Cathode-to-heater voltage | $-V_{kf\,p}$ | max. | 10 | V |
| Output current, peak | $I_{as\,p}$ | max. | 0,8 | $\mu$A** |
| Faceplate illumination | E | max. | 10 000 | lx ▲ |
| Faceplate temperature, storage and operation | T | max. | 70 | °C |
| Cathode heating time before drawing cathode current | $t_h$ | min. | 1 | min |

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

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

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

## OPERATING CONDITIONS AND PERFORMANCE

for a scanned area of 9,6 mm x 12,8 mm 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. | unit | notes |
|---|---|---|---|---|---|---|
| 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 $\mu$A | | | 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 $\gamma$ 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 ⩾ 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 | maximum number of spots zone 2 |
|---|---|---|
| > 1,2 | none | none |
| ⩽ 1,2 to 0,8 | none | 1 |
| ⩽ 0,8 to 0,4 | 4 | 5 |
| ⩽ 0,4 to 0,2 | 5 | 5 |
| ⩽ 0,2 | * | * |

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

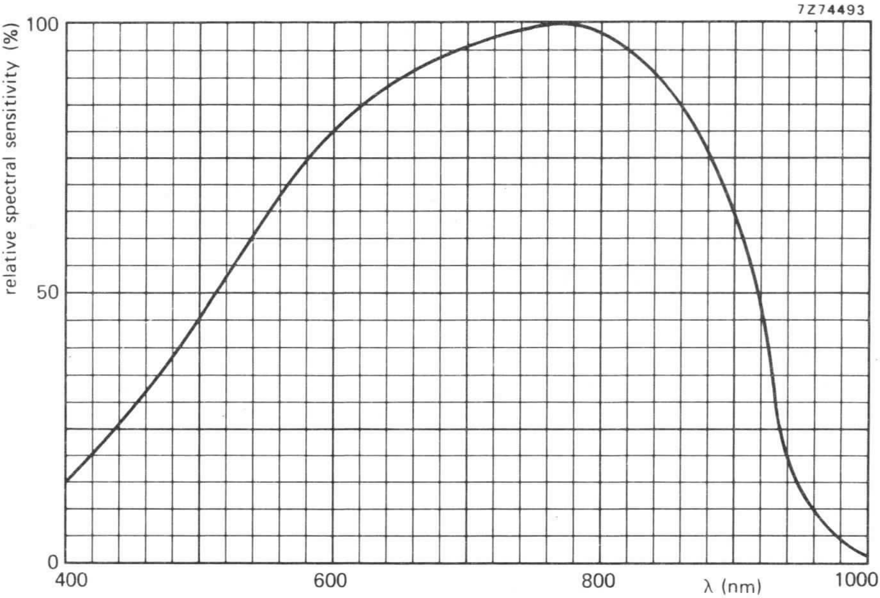



Fig. 1 Typical spectral response curve, C2.

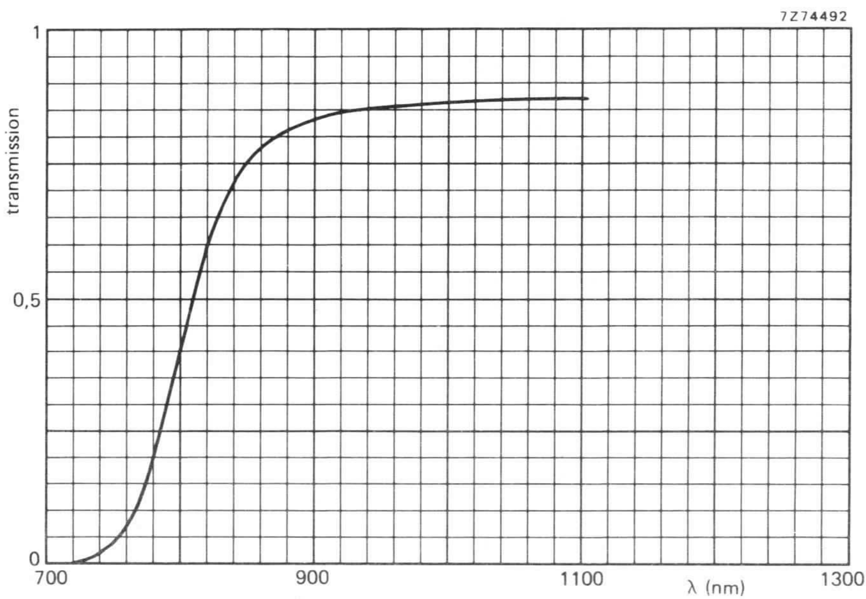



Fig. 2 Transmission curve of infrared filter. (Hoya IR80).

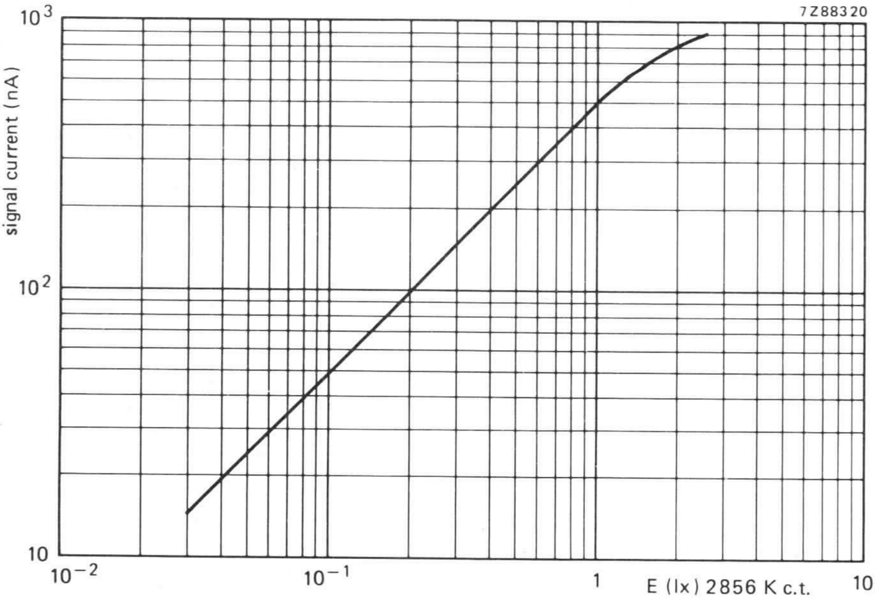



Fig. 3 Typical light transfer characteristic.

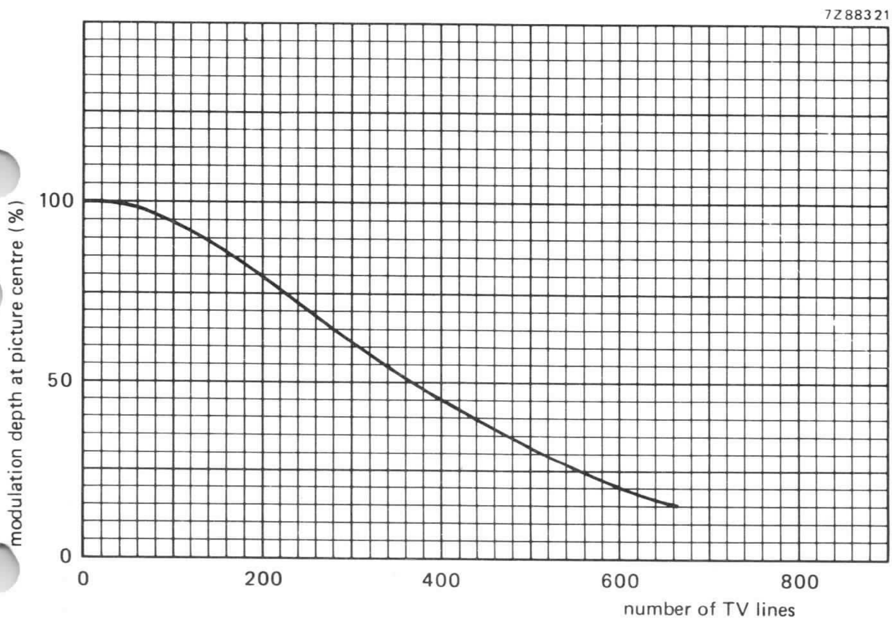



Fig. 4 Typical uncompensated square wave response curve.

# 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 |
| $\lambda$ = 800 nm | | 20 mA/W |
| $\lambda$ = 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 $\phi_G$ = 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 $\phi_D$ = 14 mm | min. | 0,995 | |
| | max. | 1,005 | |
| Centre resolution | min. | 25 | line pairs/mm |
| Edge resolution $\phi_E$ = 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 | $\mu lx$ |
| 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 | $\mu lx$ |
| $T_{amb}$ | | 22 ± 3 | $^oC$ |

WARNING

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

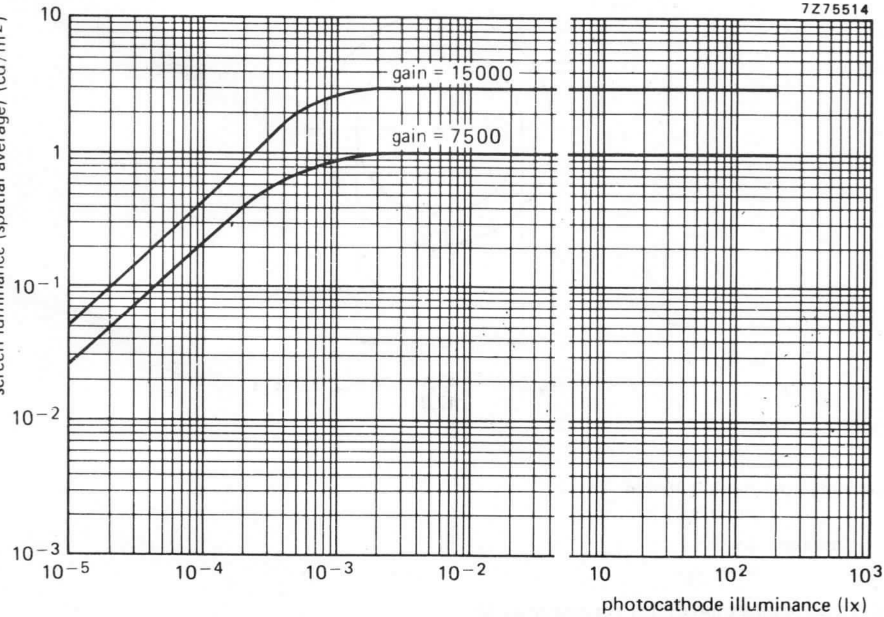
* Measured before the power supply is fitted.

## RATINGS

Limiting values in accordance with the Absolute Maximum System IEC 134

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

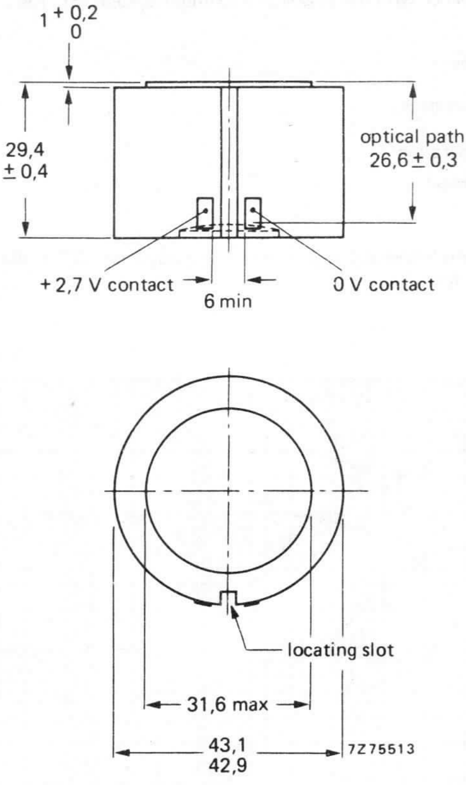
* If the supply voltage falls below 2,0 V, but remains greater than −2,7 V the intensifier will not be damaged, but may not function.




Typical automatic gain control characteristic.

OUTLINE DRAWING

Dimensions in mm




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

**contact**: length 5,6
width 3,2

Maximum contact force must not exceed 10 N.

# R.F. INDUSTRIAL TRIODES

# YD1195
# YD1197

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 |
| $\eta_a$ | 73.6 | 76 | 78.8 | % |
| $\eta_{osc}$ | 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 |

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.

CAPACITANCES

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

CHARACTERISTICS

| | | |
|---|---|---|
| $g_m$ | 80 | mA/V |
| $\mu$ | 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 |

YD1197 COOLING CHARACTERISTICS

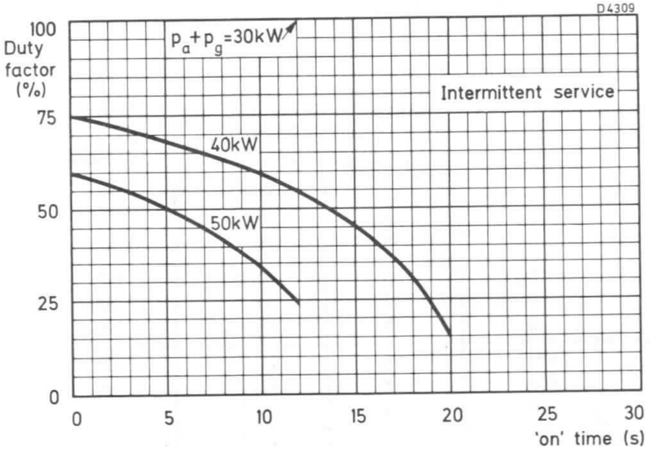
| Anode and grid dissipation (kW) | Inlet water temperature ($^oC$) | Outlet water temperature ($^oC$) | Minimum rate of water flow (ℓ/min) | Pressure drop (atm) |
|---|---|---|---|---|
| 40 | 20 | 51 | 20.0 | 0.5 |
| | 50 | 70 | 30.0 | 1.0 |
| 30 | 20 | 53 | 14.0 | 0.27 |
| | 50 | 72 | 21.0 | 0.55 |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

PHYSICAL DATA

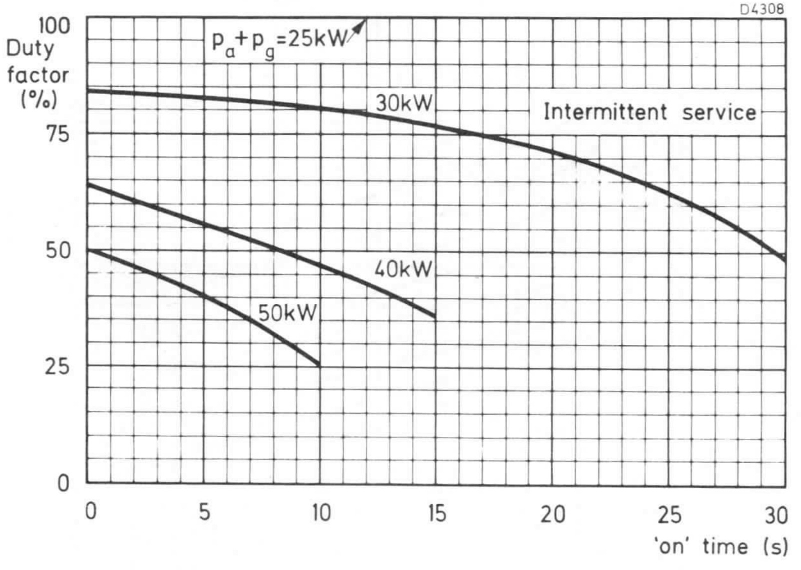
| | YD1195 | YD1197 | |
|---|---|---|---|
| Weight of tube (approx.) | 20 | 6.5 | kg |
| Weight of insulating pedestal | 8.2 | - | kg |

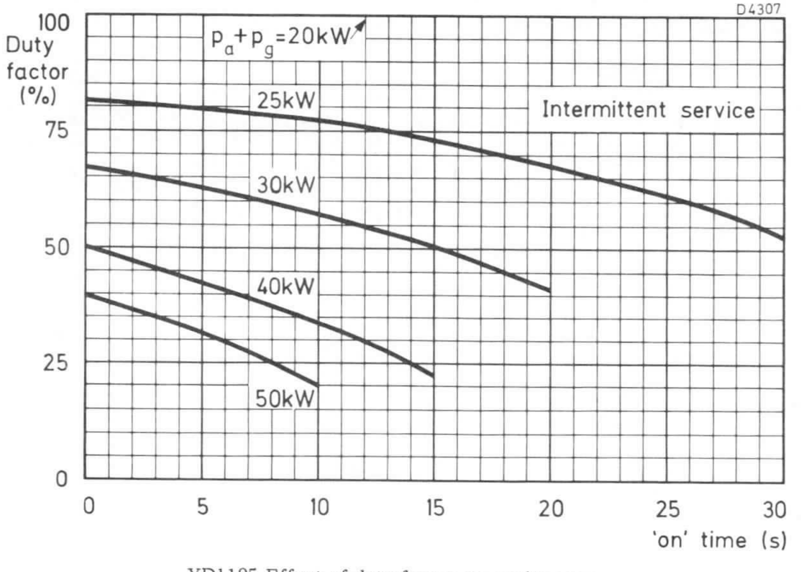
ACCESSORIES

| | |
|---|---|
| Filament connector | 40705 |
| Filament/cathode connector | 40706 |
| Grid connector | 40736 |
| Filament cables (both required) | 40718<br>40719 |
| Insulating pedestal (YD1195) | 40729 |

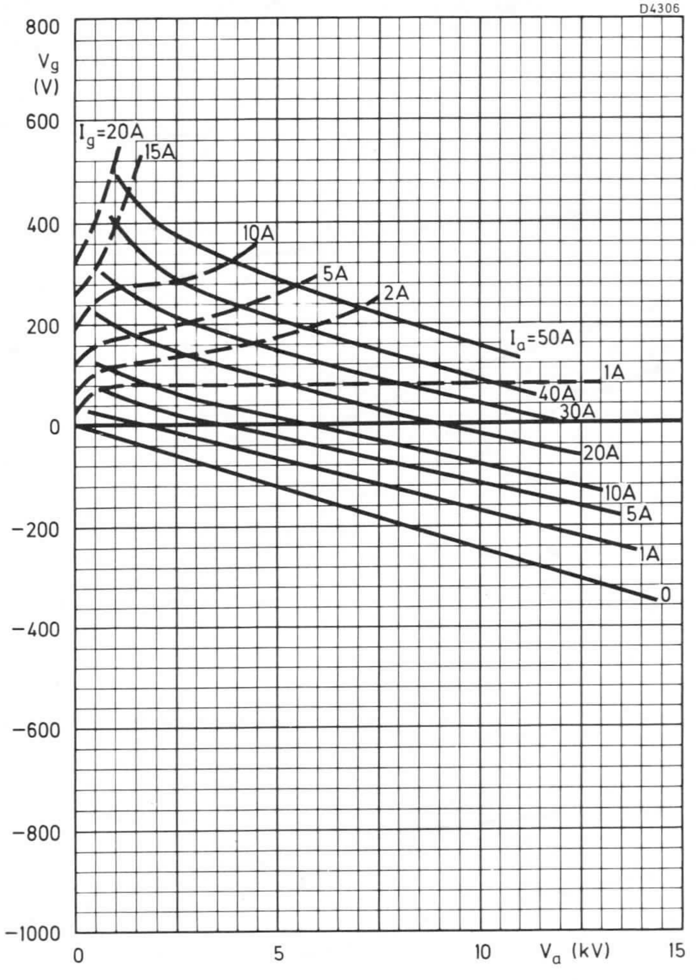



YD1195 Effect of duty factor on cooling for
30kW continuous service conditions



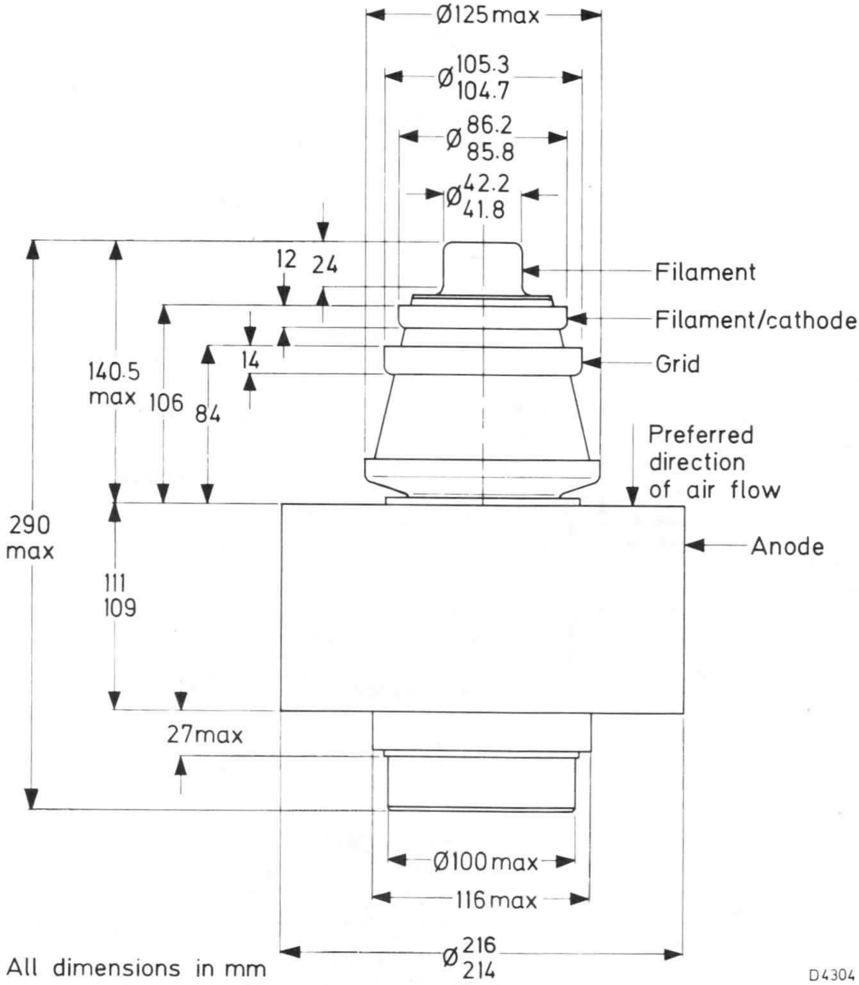




YD1195 Effect of duty factor on cooling for
25 and 20kW continuous service conditions

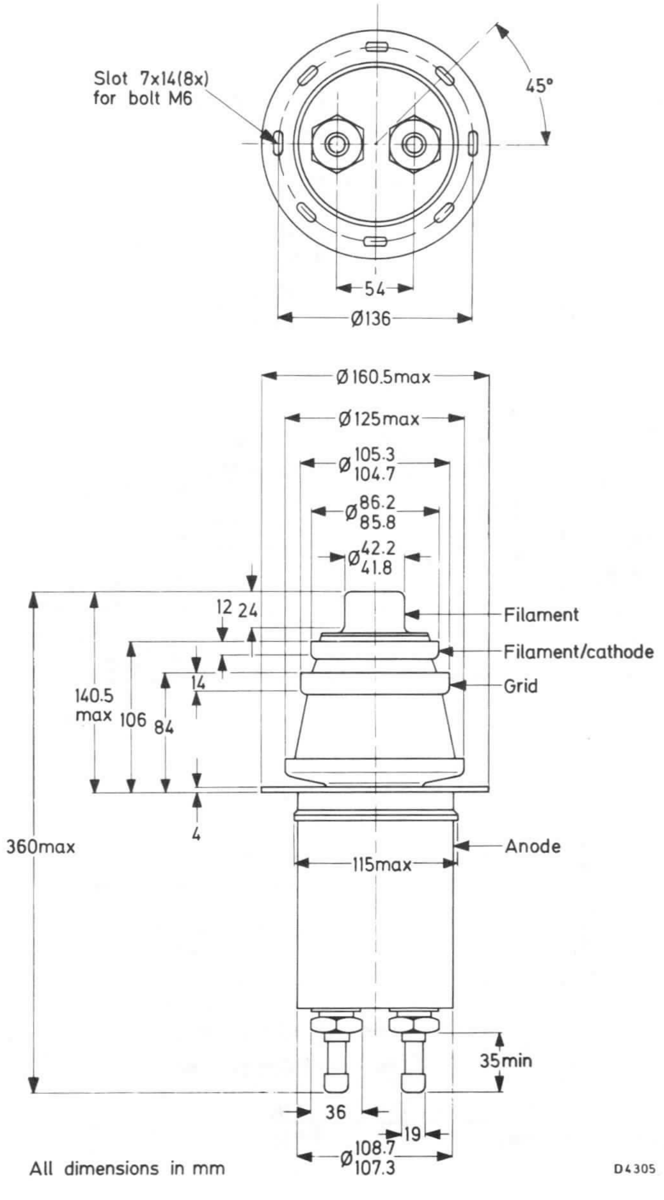



Constant current characteristics

OUTLINE DRAWING OF YD1195



OUTLINE DRAWING OF YD1197




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

# COMMUNICATIONS TRAVELLING-WAVE TUBE

# YH1210

**TENTATIVE DATA**

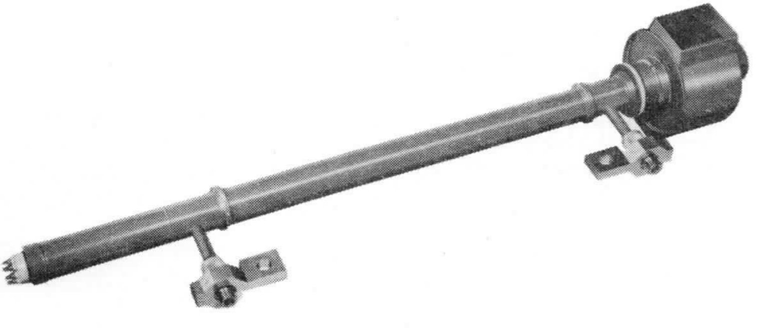
QUICK REFERENCE DATA

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) | $\geq$95 | $\geq$95 | $\geq$95 | % |
| Differential gain (see note 4) | $\geq$95 | $\geq$95 | $\geq$95 | % |
| Differential phase of colour subcarrier | $\leq$3.0 | $\leq$3.0 | $\leq$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.

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°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 | °C |

AMBIENT TEMPERATURE

| | Min. | Max. | |
|---|---|---|---|
| Operation to full specification | -20 | +50 | °C |
| Storage for tube and mount | -40 | - | °C |

PHYSICAL DATA

Tube

| | kg | lb |
|---|---|---|
| Weight (approx.) | 3.5 | 7.7 |

Mount

| | | |
|---|---|---|
| Weight (approx.) | 53 | 117 |

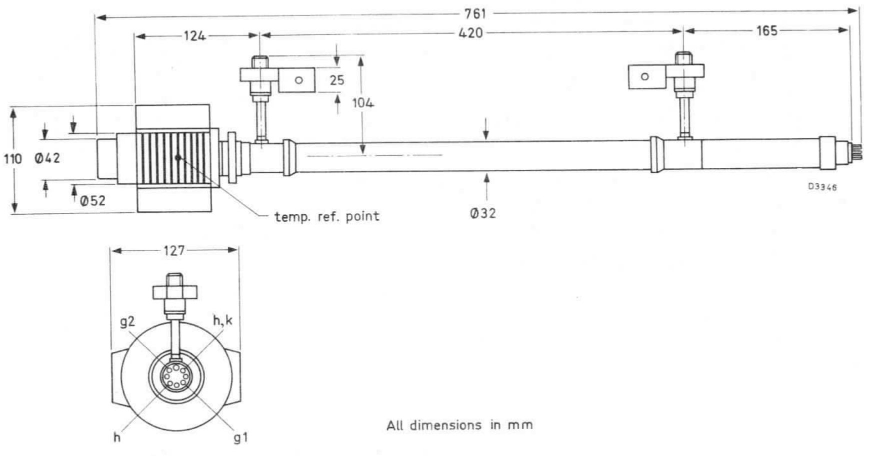
ACCESSORIES

| | |
|---|---|
| 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

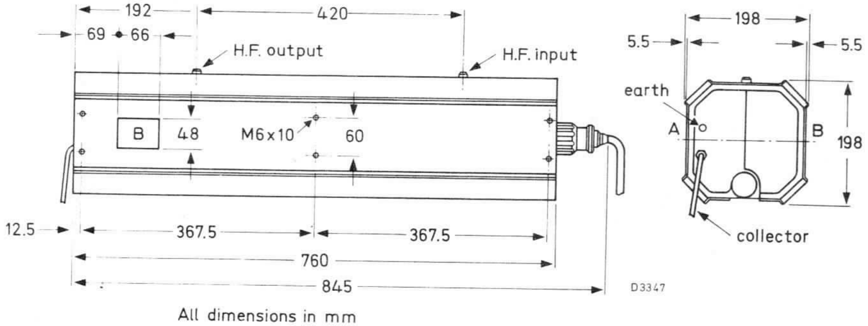



All dimensions in mm

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 | | |

OUTLINE DRAWING OF MOUNT



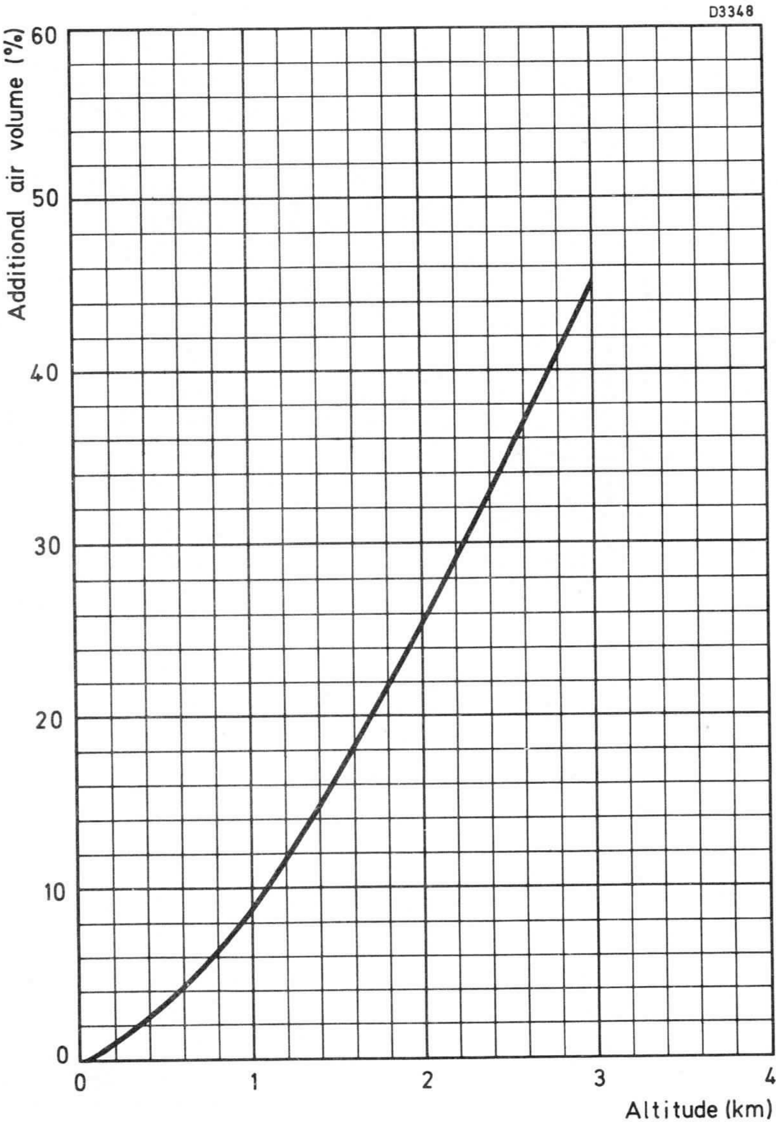

| Plug connections to mount | |
|---|---|
| Heater | Brown |
| Heater/Cathode | Brown/Yellow |
| Cathode | Yellow |
| Grid 1 | Green |
| Grid 2 | Blue |
| Earth via mount | Black |

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

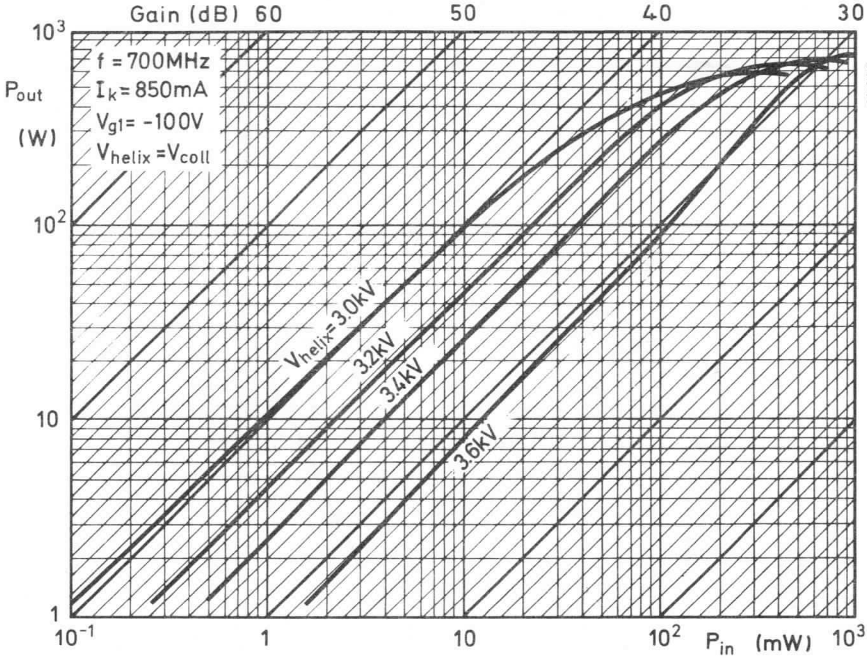
The collector is electrically isolated from the tube body and is connected to its power supply via the flying lead.

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 |




ADDITIONAL AIR VOLUME PLOTTED
AGAINST ALTITUDE




OUTPUT POWER PLOTTED AGAINST
INPUT POWER

| 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°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 | $\mu s$ |
| 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:

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

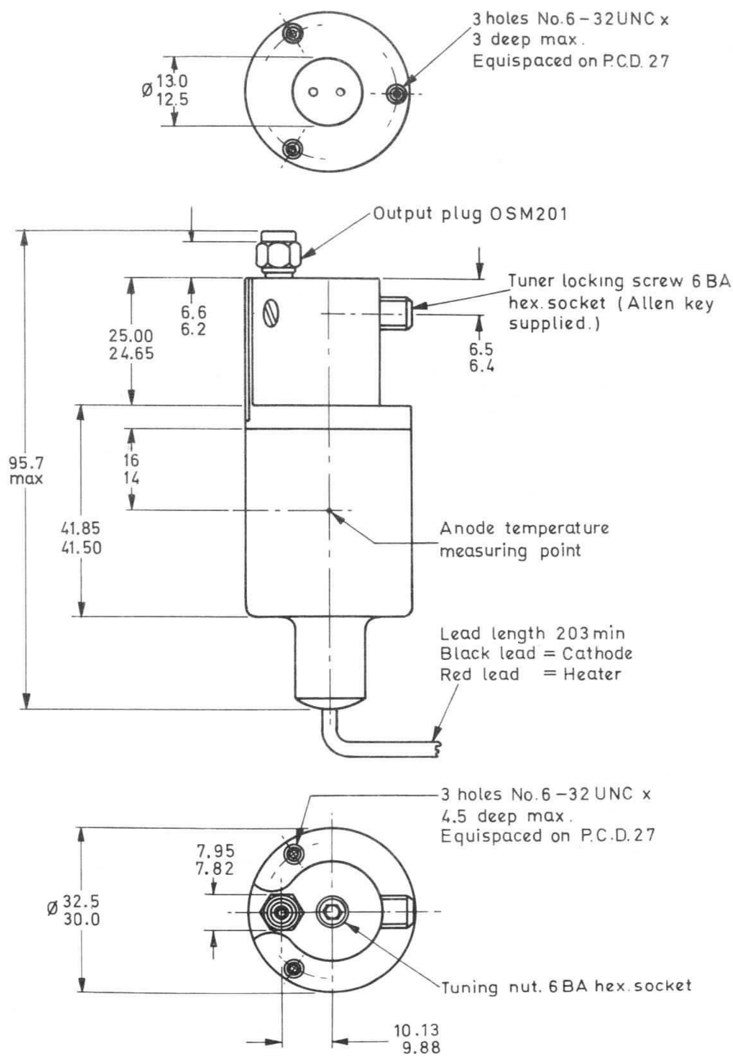
OPERATING NOTE

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 ←




All dimensions in mm

D648

For conversion table see Page 4

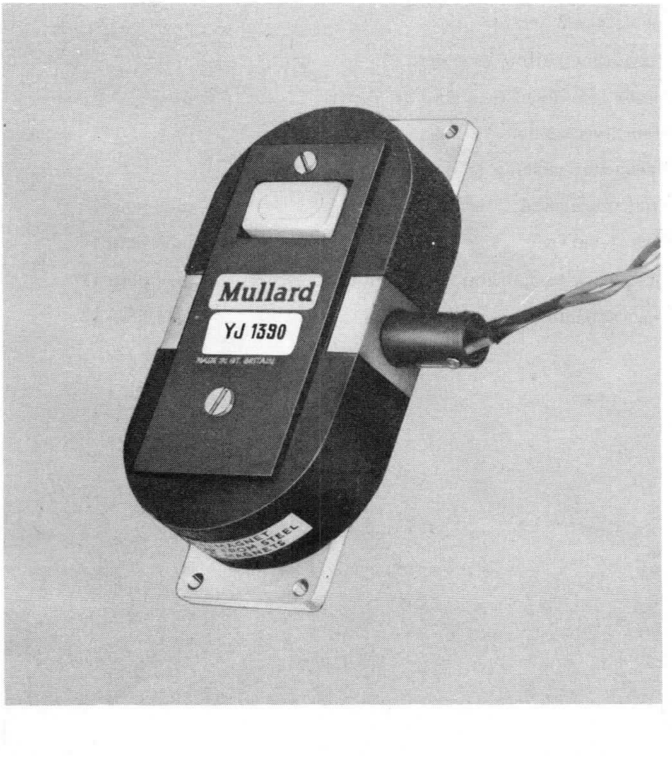
CONVERSION TABLE
(Rounded outwards)

| 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 |

**TENTATIVE DATA**

| 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



## 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) | - | $\frac{2.5}{t_p}$ | 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 | | |

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 | $^oC$ |
| v.s.w.r. at output connection | - | 1.5:1 | |

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 | - | $\frac{3.5}{t_p}$ | 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 | 190×190×280 | 7.5×7.5×11 |

VIBRATION

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

NOTES

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

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

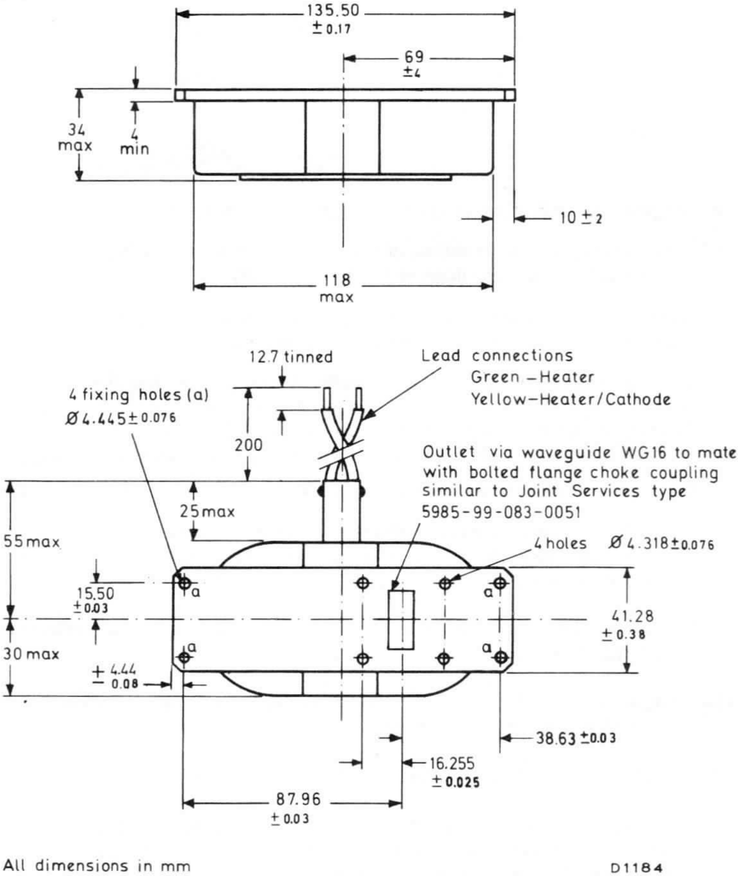
3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

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 mismatch 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




| 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. | | |

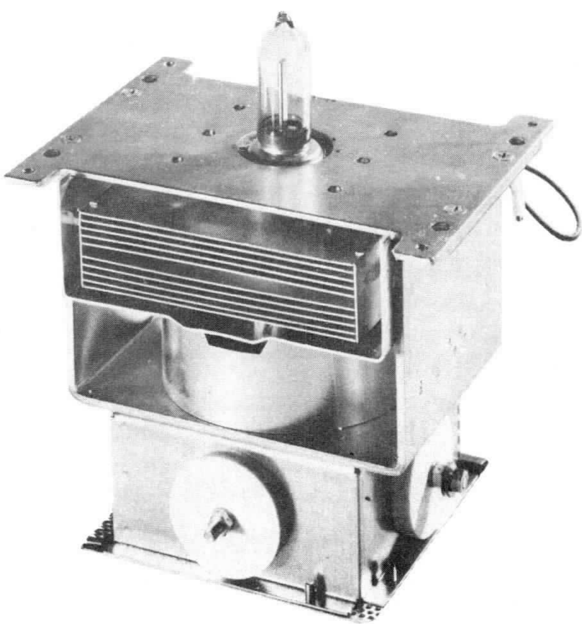
**TENTATIVE DATA**

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 |

## 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.

## 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 information 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.

HANDLING, STORAGE AND MOUNTING (contd.)

Handling and storage (contd.)

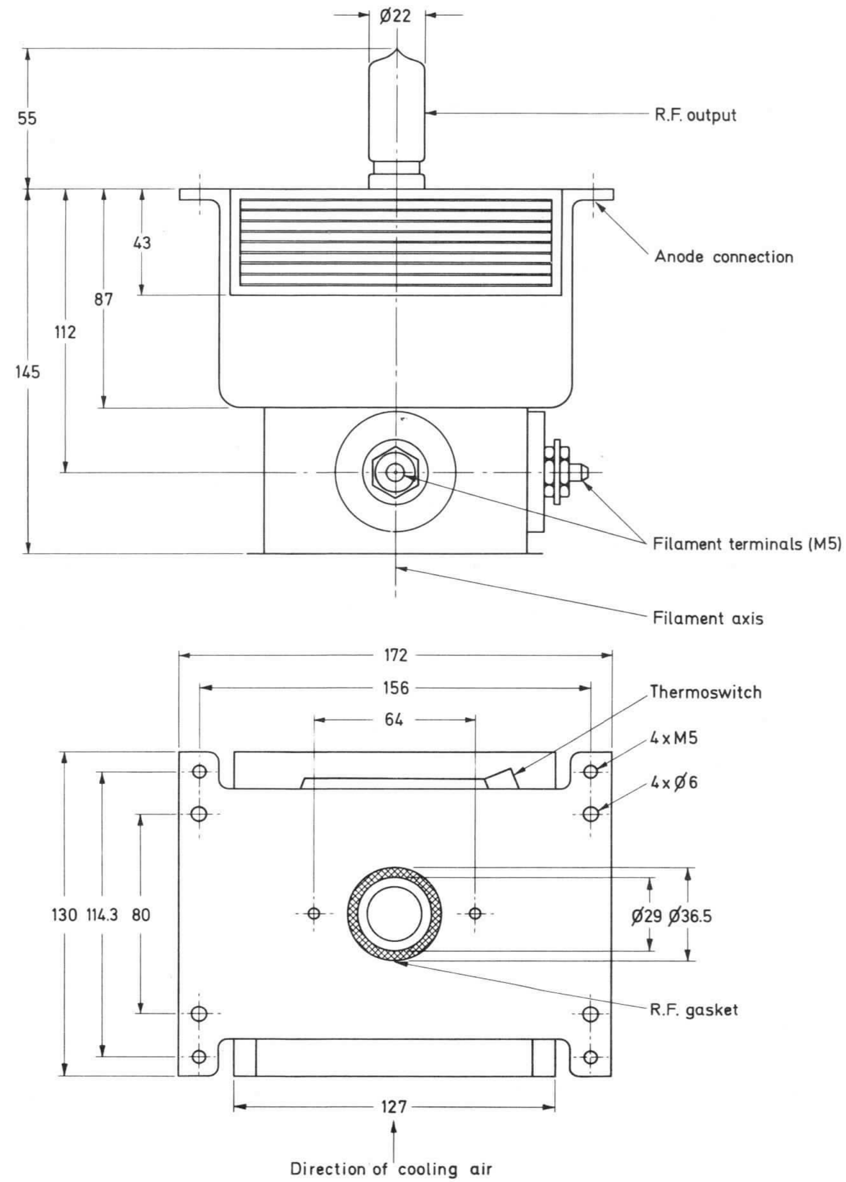
The user should be aware of the strong magnetic fields around the magnetron. When handling the tube, non-magnetic tools must be used and care should be taken to avoid damage to watches and other precision instruments.

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.

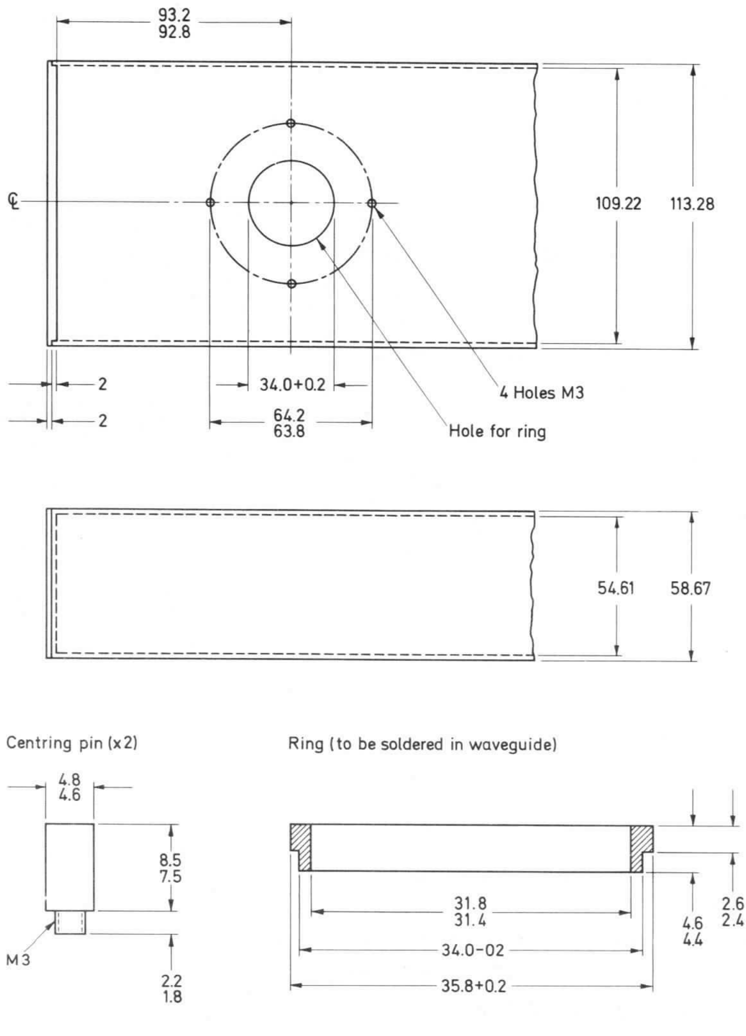
The magnetron should be mounted in a position which ensures that a minimum distance of 130mm (5 in) is maintained between the magnet and any magnetic materials (for example, transformers, inductors, etc.).




All dimensions in mm

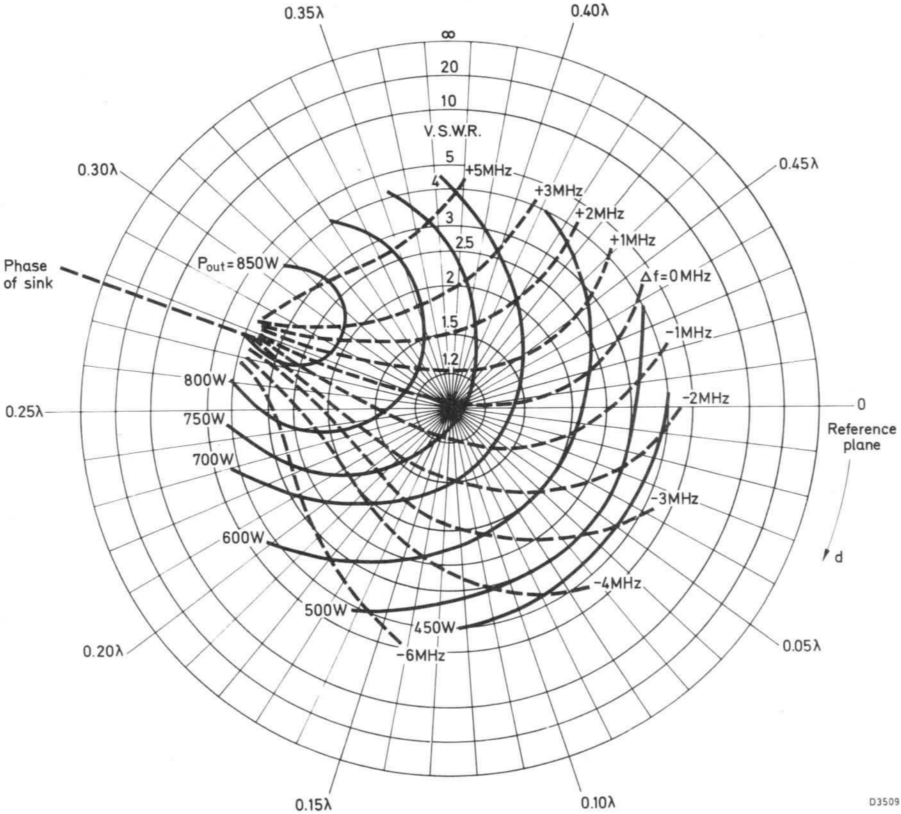
D3507

WAVEGUIDE LAUNCHING SECTION




All dimensions in mm

D3508




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 |

# 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 | $I_f$ | ≈ | 22 to 27 | A | note 1 |
| Cold heater resistance | $R_{fo}$ | ≈ | 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 | ⩽ | 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.

**MECHANICAL DATA YK1190**

Dimensions in mm

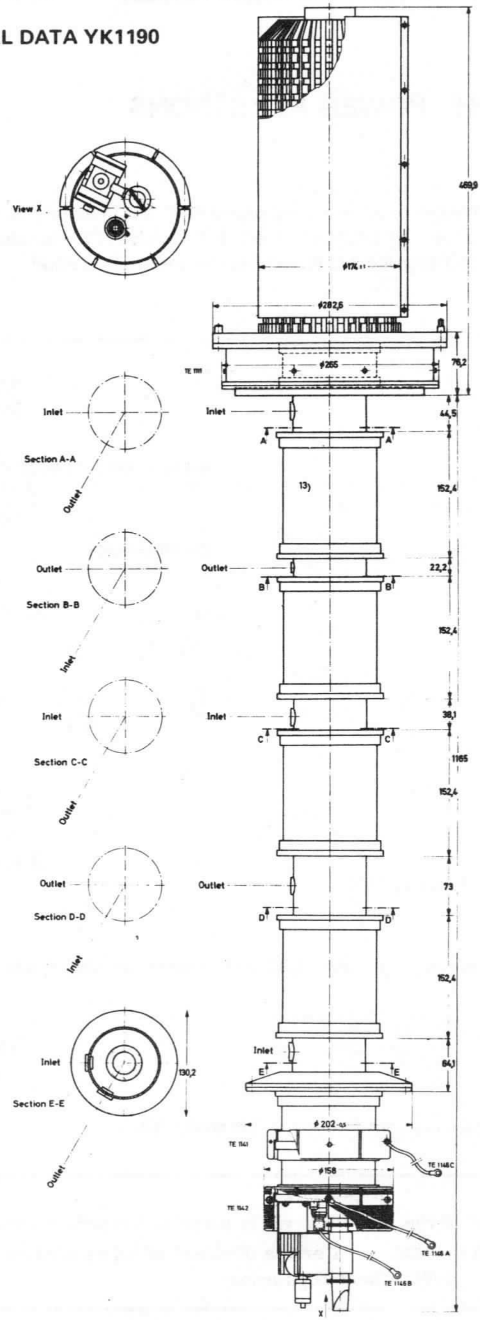



Fig. 1

YK1191, YK1192

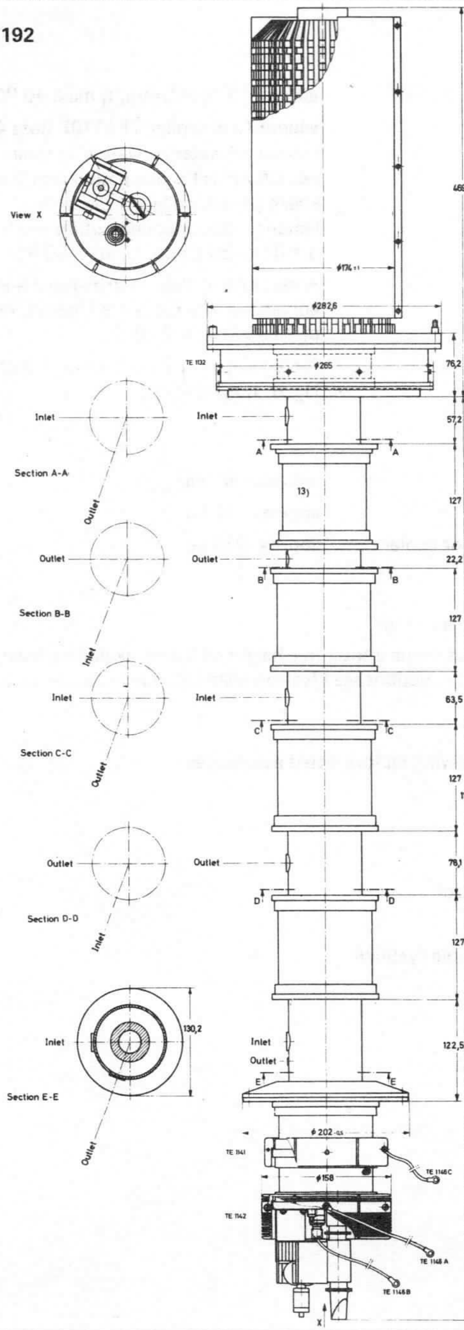



Fig. 2

**COOLING**

| | |
|---|---|
| Cathode socket and accelerator electrode | air ; q ≈ 0,15 m³/min, $t_i$ max. 40 °C |
| Collector | vapour (with boiler TE1110), note 4<br>volume of water converted to steam: 27 cm³/min per kW collector dissipation resulting in 43 ℓ/min steam per kW collector dissipation<br>water or vapour condensation (with cooler TE1194)<br>q = 35 to 60 ℓ/min, $t_o$ max. 80 °C |
| Drift tubes | water; rate of flow to drift tubes and collector connected in series q = 9 ℓ/min, $t_i$ max. 80 °C, $p_i$ = 200 kPa (≈ 2 at) |
| Cavities 3 and 4 | forced air; q = 1,5 m³/min, $p_i$ = 250 Pa (≈ 25 mm $H_2O$), $t_i$ max. 45 °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

| 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 for drift tubes | 6x TE1133A<br>2x TE1133B | 6x TE1133A<br>2x TE1133B | 6x TE1133A<br>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<br>1x TE1121D | 3x TE1098A<br>1x TE1098D | 3x TE1191A<br>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 | |

## 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.

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.

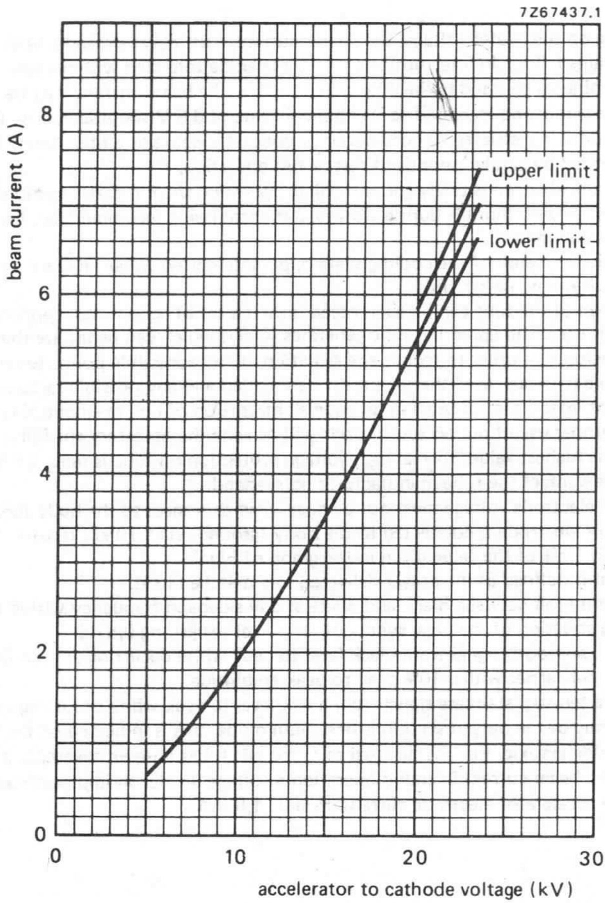

7Z67437.1
beam current (A)
8
6
4
2
0
upper limit
lower limit
0
10
20
30
accelerator to cathode voltage (kV)

Fig. 3.

# 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 | $I_f$ | ≈ | 22 to 27 A | note 1 |
| Cold heater resistance | $R_{fo}$ | ≈ | 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 | ⩽ | 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 |

**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

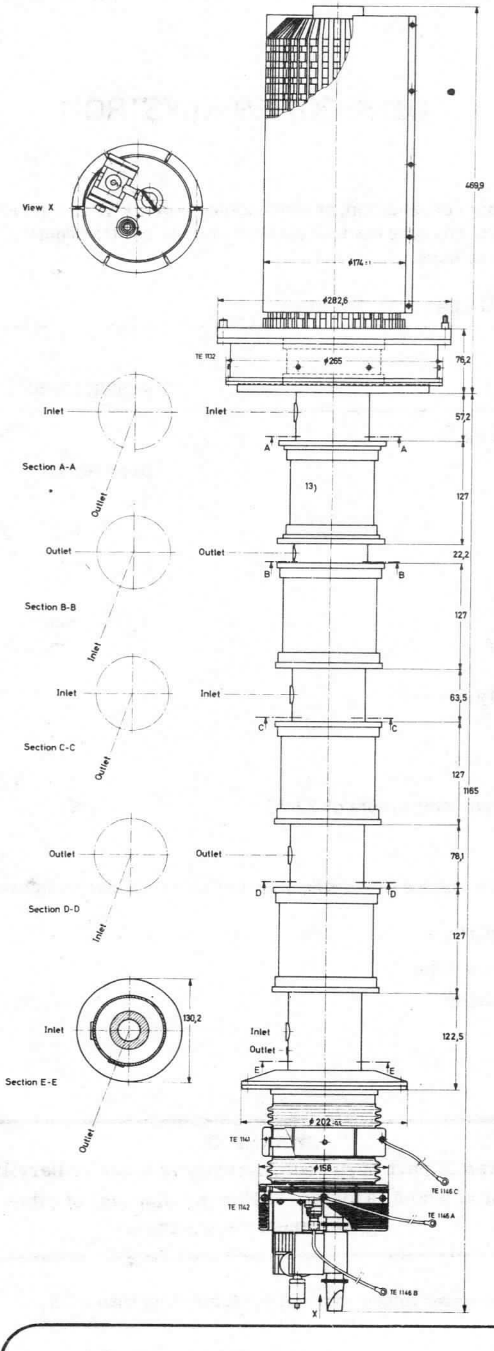



Fig. 1.

## COOLING

| | |
|---|---|
| Cathode socket and accelerator electrode | air; $q \approx 0,15\ m^3/min$, $t_i$ max. 45 °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<br>water or vapour condensation (with cooler TE1194) $q$ = 35 to 60 ℓ/min, $t_o$ max. 80 °C |
| Drift tubes | water; rate of flow to drift tubes and collector connected in series $q \approx 9$ ℓ/min, $t_i$ max. 80 °C, $p_i$ = 200 kPa ($\approx$ 2 at) |
| Cavities 3 and 4 | forced air; $q = 1,5\ m^3/min$, $p_i$ = 250 Pa ($\approx$ 25 mm $H_2O$), $t_i$ max. 45 °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.

## 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 for drift tubes | 6 x TE1133A<br>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<br>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) | |

**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 | % | |

DEVELOPMENT SAMPLE DATA

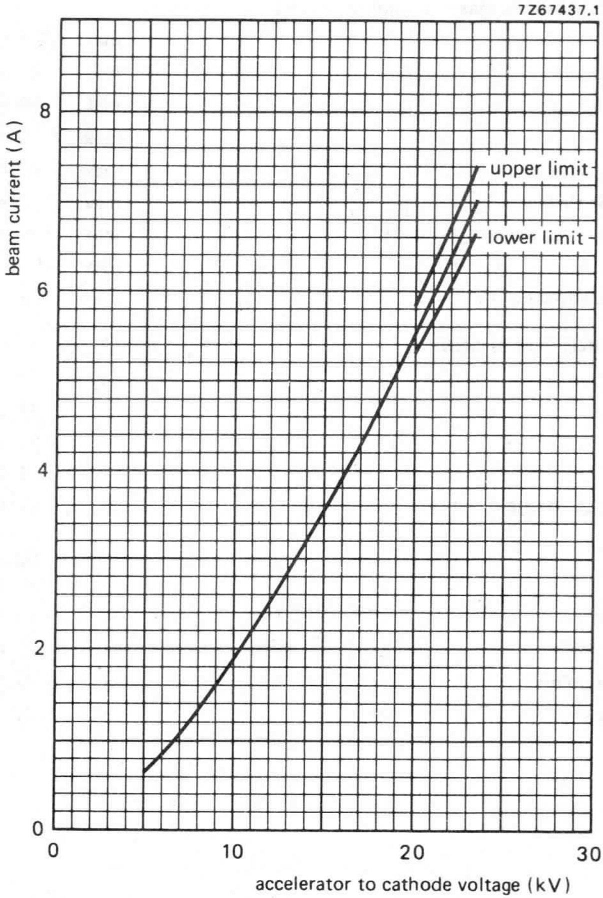

7Z67437.1
beam current (A)
8
6
4
2
0
0
10
20
30
accelerator to cathode voltage (kV)
upper limit
lower limit

Fig. 2.

*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.

# 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 | $I_f$ | ≈ | 20 to 27 | A note 1 |
| Cold heater resistance | $R_{fo}$ | ≈ | 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 | ⩽ | 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

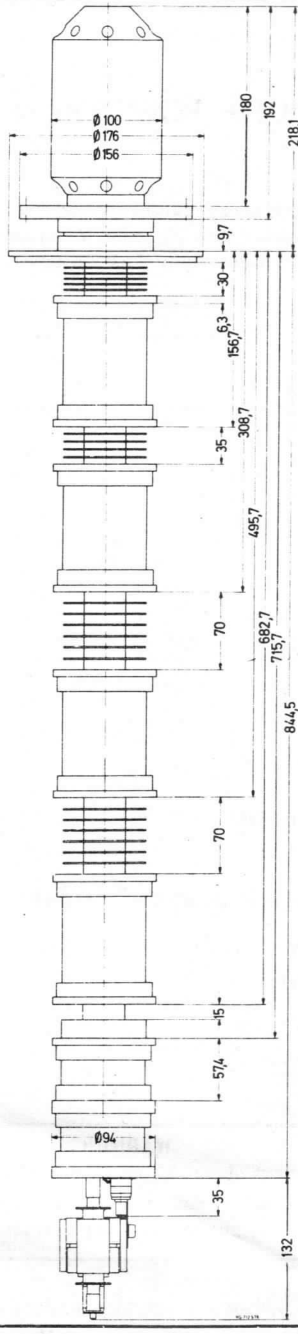



Fig. 1.

DEVELOPMENT SAMPLE DATA

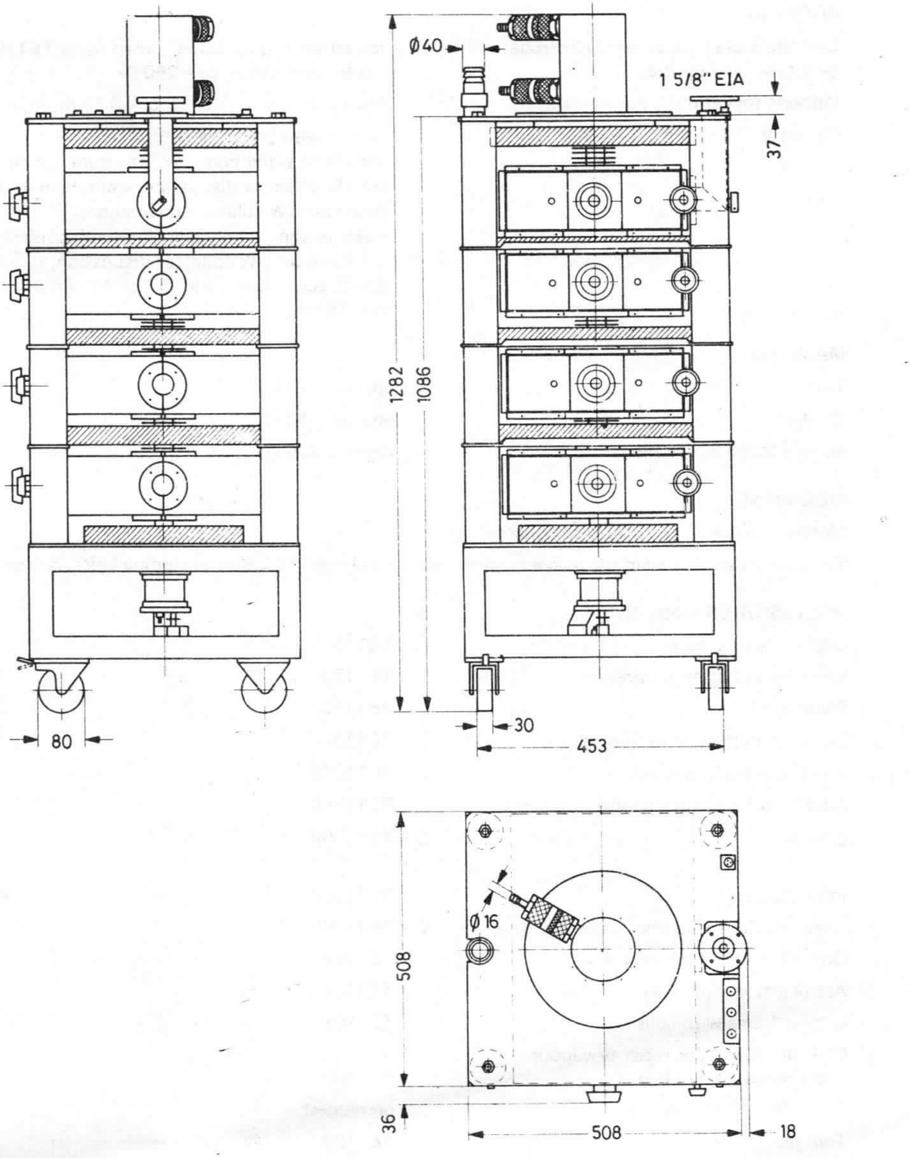



Fig. 2.

**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 stand-by | forced air, $t_i$ max. 50 °C, $q \approx 0{,}15$ m³/min |
| Collector | vapour with boiler, note 4<br>volume of water converted to steam: 27 cm³/min per kW collector dissipation resulting in 43 ℓ/min steam per kW collector dissipation;<br>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<br>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 | |

**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 | $^oC$ | |
| Static pressure in the cooling system | max. | 400 | kPa | (≈ 4 at) |



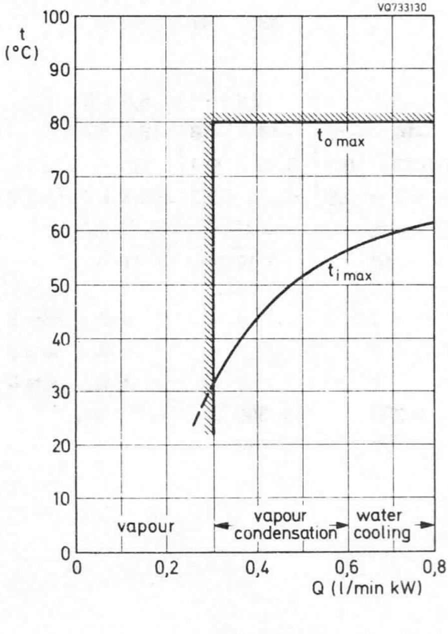



Fig. 3.

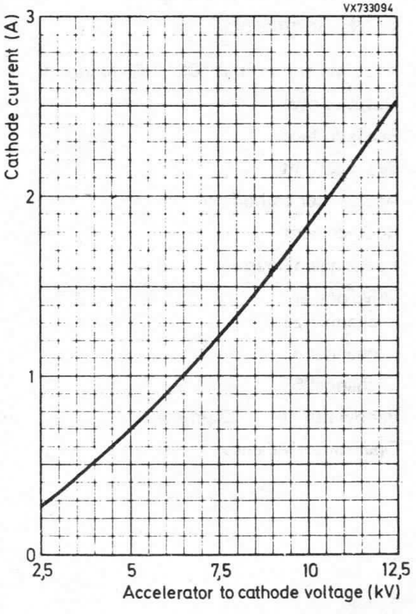



Fig. 4.

## 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 | % | |

**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 | | % | |

*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.

# U.H.F. POWER KLYSTRON

Optionally water, vapour condensation, or vapour-cooled power klystron, in metal-ceramic construction 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

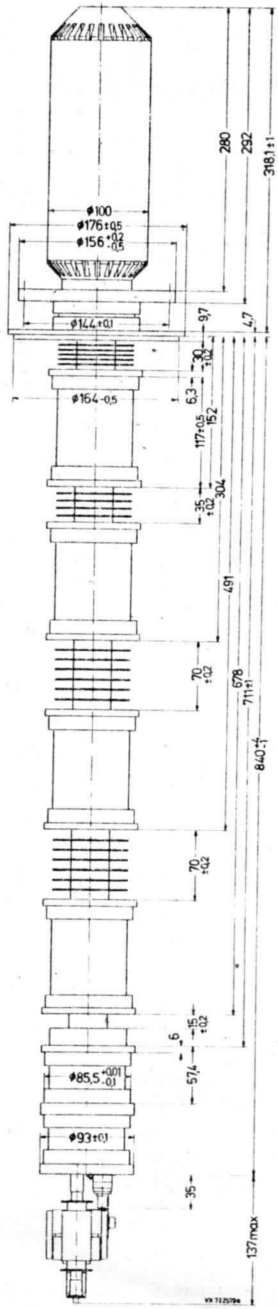


Fig. 1.

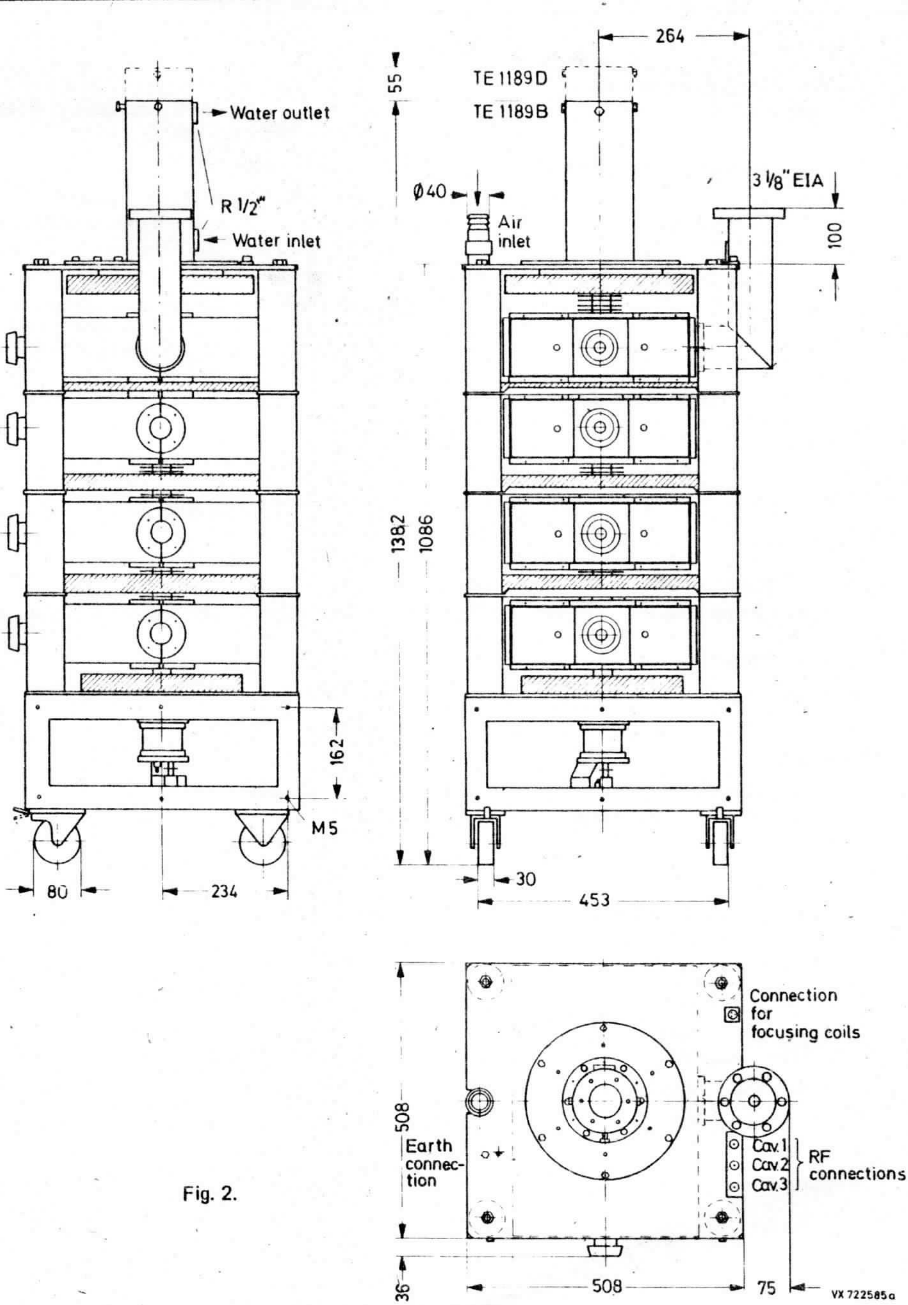

Water outlet
R 1/2"
Water inlet
M5
162
80
234
264
55
TE 1189D
TE 1189B
Ø40
Air
inlet
3 1/8" EIA
100
1382
1086
30
453
Connection
for
focusing coils
508
Earth
connec-
tion
Cav.1
Cav.2
Cav.3
RF
connections
36
508
75
VX 722585a

Fig. 2.

## COOLING

| | |
|---|---|
| Cathode socket, accelerator electrode, drift tubes and cavities | forced air, $t_i$ max. 50 °C; when using TE1188: $q \approx 1{,}5\ m^3/min$, $p_i = 250\ Pa$ |
| Cathode socket only, during black heat | forced air, $t_i$ max. 50 °C, $q \approx 0{,}15\ m^3/min$ |
| Collector | vapour with boiler TE1189D, note 4<br>volume of water converted to steam: 27 $cm^3$/min per kW collector dissipation resulting in 43 ℓ/min steam per kW collector dissipation;<br>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) |



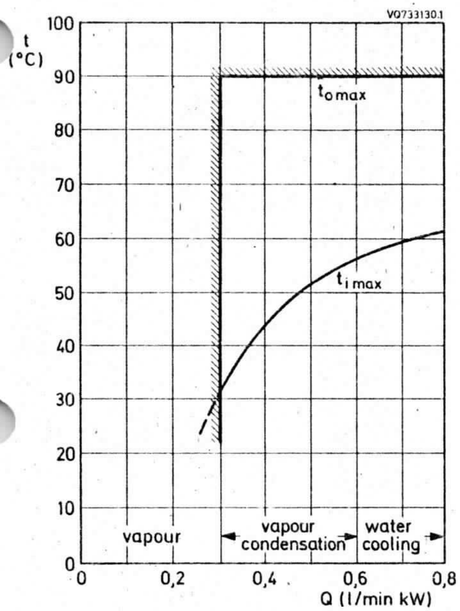



Fig. 3.

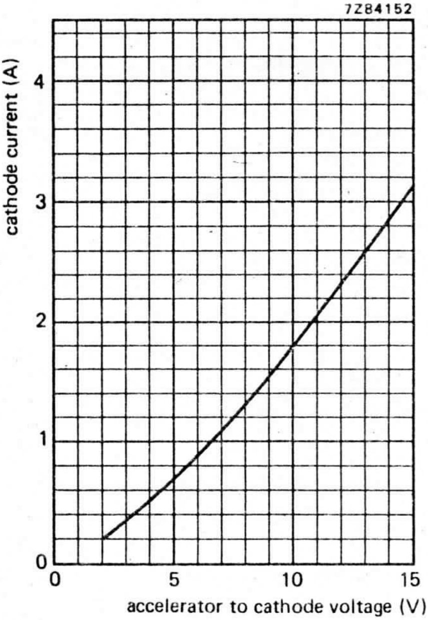



Fig. 4.

## 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 | | % | |

DEVELOPMENT SAMPLE DATA

## 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 | | % | |

*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.

# 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 | $W_\ell$ | 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 | $\mu_{g2g1}$ | 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)

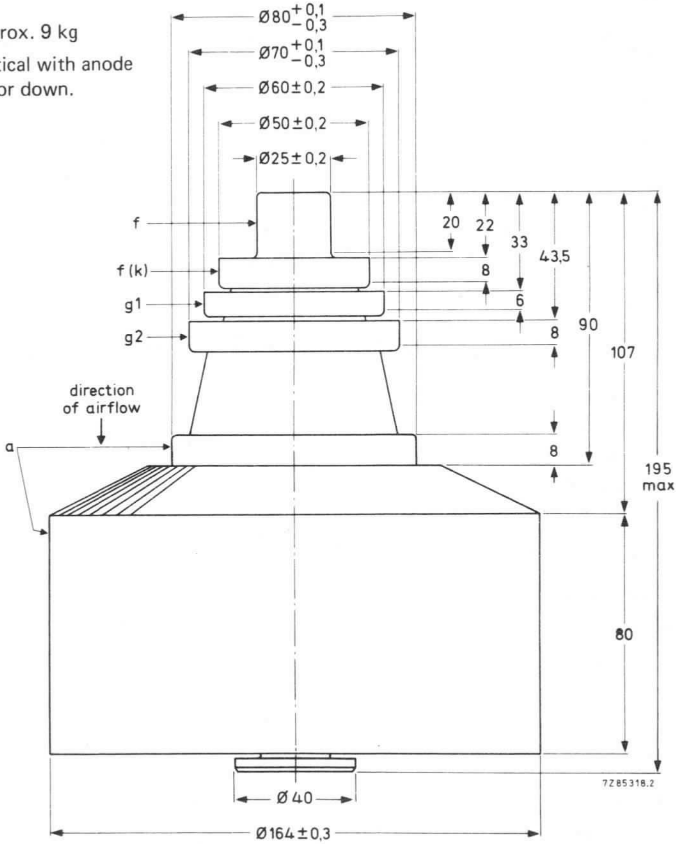
| $W_a$ kW | h m | $T_i$ °C | q $m^3/min$ | $P_i$ $P_a$ |
|---|---|---|---|---|
| 14 | 0 | 25 | 12 | 1050 |
| 10 | 0 | 25 | 8 | 500 |

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.



DEVELOPMENT SAMPLE DATA

## LIMITING VALUES (Absolute maximum rating system)

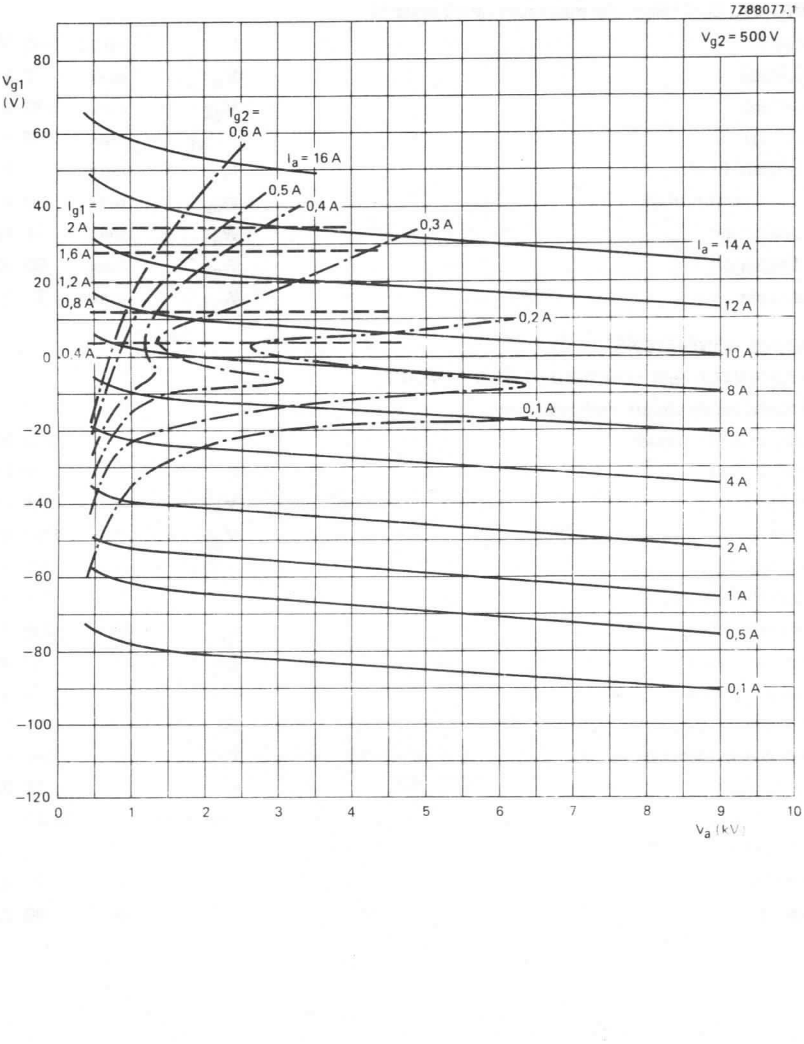
| | | | | |
|---|---|---|---|---|
| Frequency | f | up to | 250 | MHz |
| Anode voltage | $V_a$ | max. | 7 | kV |
| Grid 2 voltage | $V_{g2}$ | max. | 800 | V |
| Grid 1 voltage | $-V_{g1}$ | max. | 250 | V |
| Anode current, black | $I_a$ | max. | 4 | A |
| Anode input power, black | $W_{ia}$ | max.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

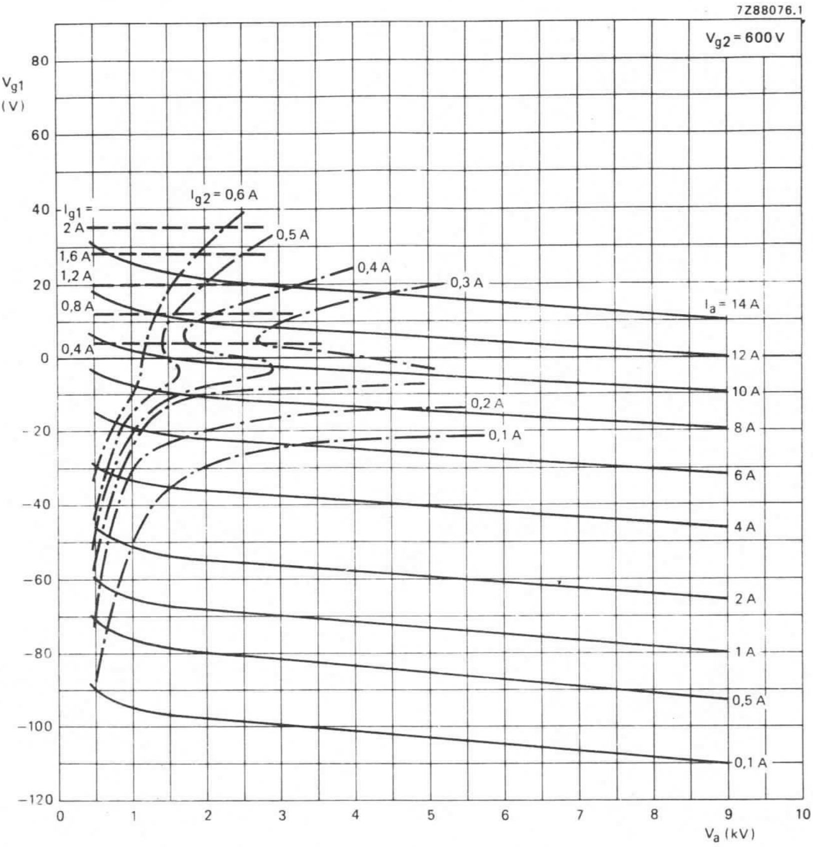
**Double tuned anode circuit, cathode driven**

| | | | | |
|---|---|---|---|---|
| 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 | $W_\ell$ | | 11 | kW |
| Output power in load, black | $W_\ell$ | | 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
$V_{g1}$ (V)
80
60
40
20
0
−20
−40
−60
−80
−100
−120
$I_{g2}$ = 0,6 A
0,5 A
0,4 A
0,3 A
0,2 A
0,1 A
$I_a$ = 16 A
$I_a$ = 14 A
12 A
10 A
8 A
6 A
4 A
2 A
1 A
0,5 A
0,1 A
$I_{g1}$ = 2 A
1,6 A
1,2 A
0,8 A
0,4 A
0
1
2
3
4
5
6
7
8
9
10
$V_a$ (kV)



Mullard




DEVELOPMENT SAMPLE DATA

**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) | $W_\ell$ | | 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 | $W_\ell$ | | 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 ± 5%

## TYPICAL CHARACTERISTICS

| | | | |
|---|---|---|---|
| Transconductance | S | ≈ | 130 mA/V |
| Amplification factor | $\mu_{g2g1}$ | ≈ | 8 |

**CAPACITANCES**, grounded grid

| | | | |
|---|---|---|---|
| Input | $C_i$ | ≈ | 125 pF |
| Output | $C_o$ | ≈ | 28 pF |

## TEMPERATURE LIMITS

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

## COOLING

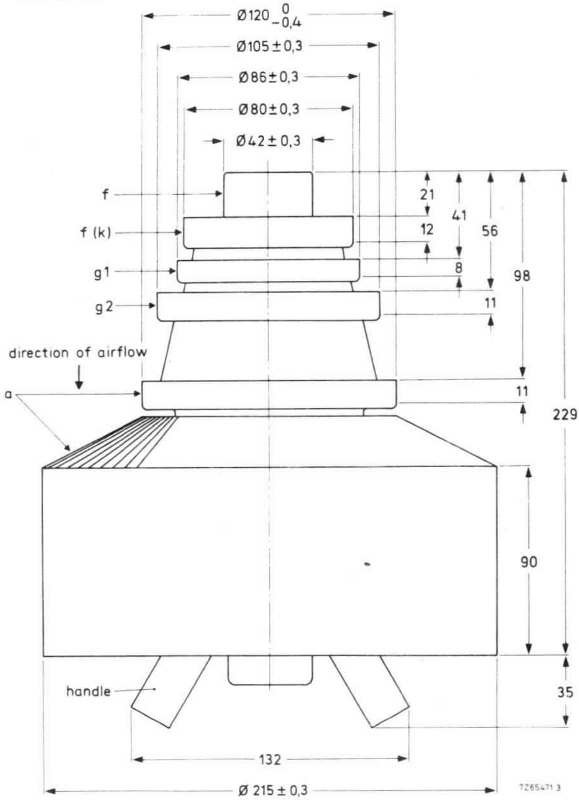
| $W_a$ kW | h m | $T_i$ °C | q $m^3$/min | $P_i$ tube only Pa | $T_o$ max. °C |
|---|---|---|---|---|---|
| 20 | 500 | 40 | 20 | 1000 | 105 |

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.



## 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 | $V_a$ | ≈ | 7 | kV |
| Grid 2 voltage | $V_{g2}$ | ≈ | 500 | V |
| Grid 1 voltage | $V_{g1}$ | ≈ | −70 | V |
| Anode current (zero signal) | $I_a$ | ≈ | 1,5 | A |
| Anode current (black) | $I_a$ | ≈ | 6 | A |
| Grid 2 current | $I_{g2}$ | ≈ | 100 | mA |
| Grid 1 current | $I_{g1}$ | ≈ | 100 | mA |
| Output power in load, sync | $W_\ell$ | | 37,5 | kW |
| Output power in load, black | $W_\ell$ | | 22,5 | kW |
| Gain | G | | 17 | dB |
| Sync compression | sync in/out | | 30/25 | |
| Differential phase | $R_a$ | < | 3 | deg |
| Differential gain | | ⩾ | 90 | % |
| L.F. linearity | | ⩾ | 90 | % |

DEVELOPMENT SAMPLE DATA

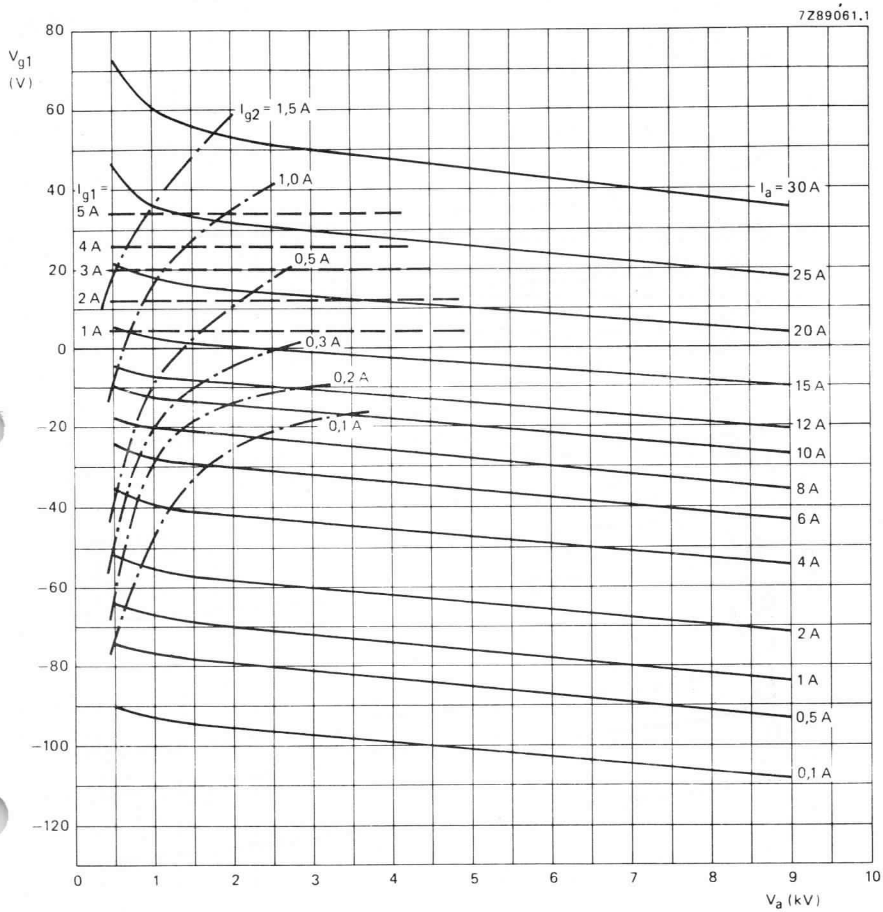
## CLASS-AB R.F. AMPLIFIER FOR TELEVISION SERVICE VISION AND SOUND COMBINED(10:1)

**Cathode driven**

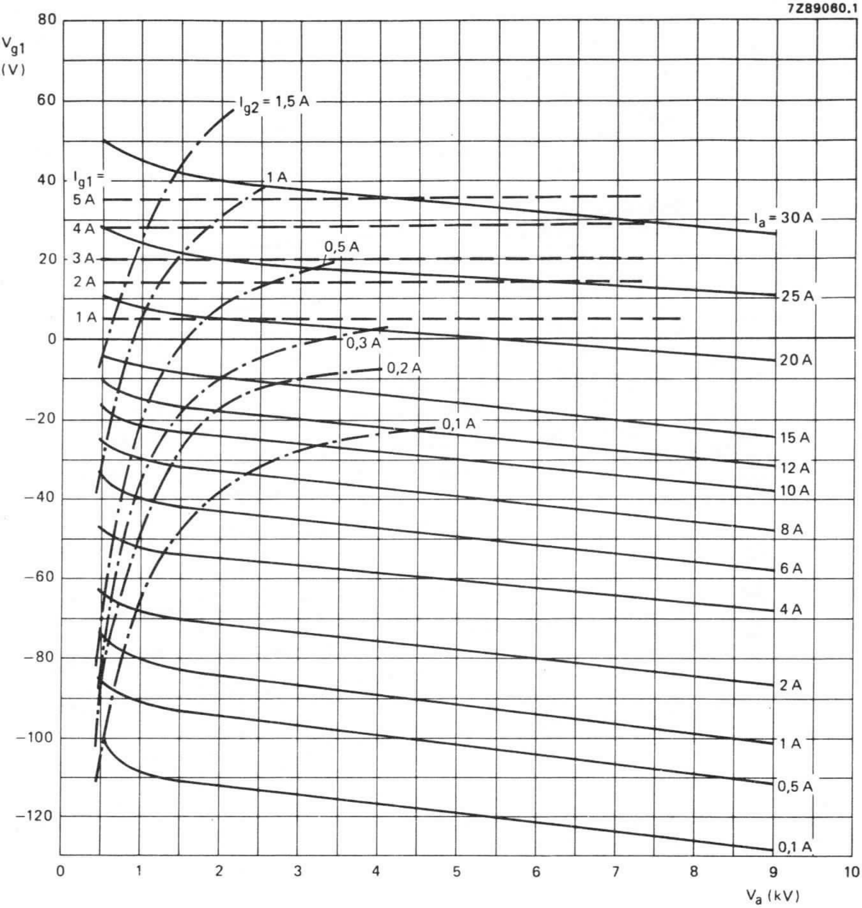
| | | | | |
|---|---|---|---|---|
| Frequency | f | | 250 | MHz |
| Bandwidth (−1 dB) | B | | 9 | MHz |
| Anode voltage | $V_a$ | ≈ | 5,5 | kV |
| Grid 2 voltage | $V_{g2}$ | ≈ | 500 | V |
| Grid 1 voltage | $V_{g1}$ | ≈ | 50 | V |
| Anode current (zero signal) | $I_a$ | ≈ | 2,5 | A |
| Anode current, 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) | $W_\ell$ | | 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.

DEVELOPMENT SAMPLE DATA




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




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

# 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 | $W_\ell$ | 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 | $\mu_{g2g1}$ | 5 | |

## CAPACITANCES

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

orange binder, tab 7

## TEMPERATURE LIMITS

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

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

## COOLING

| | | |
|---|---|---|
| Maximum anode dissipation | $W_a$ | 150 kW |
| Water cooling with 60 l/min | | |
| Absolute maximum output temperature | $T_o$ | 100 °C |
| 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 |

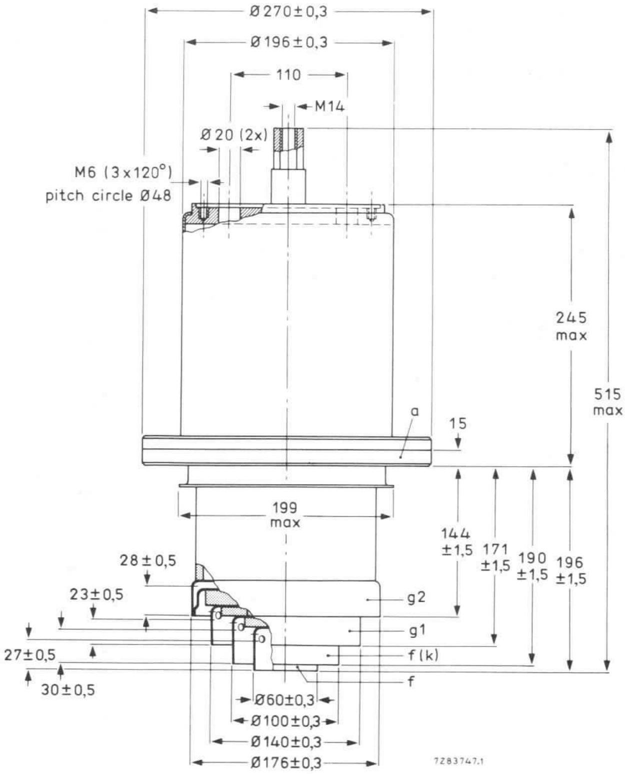



Fig. 1.

## 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 | $\eta$ | | 76 | % |

DEVELOPMENT SAMPLE DATA

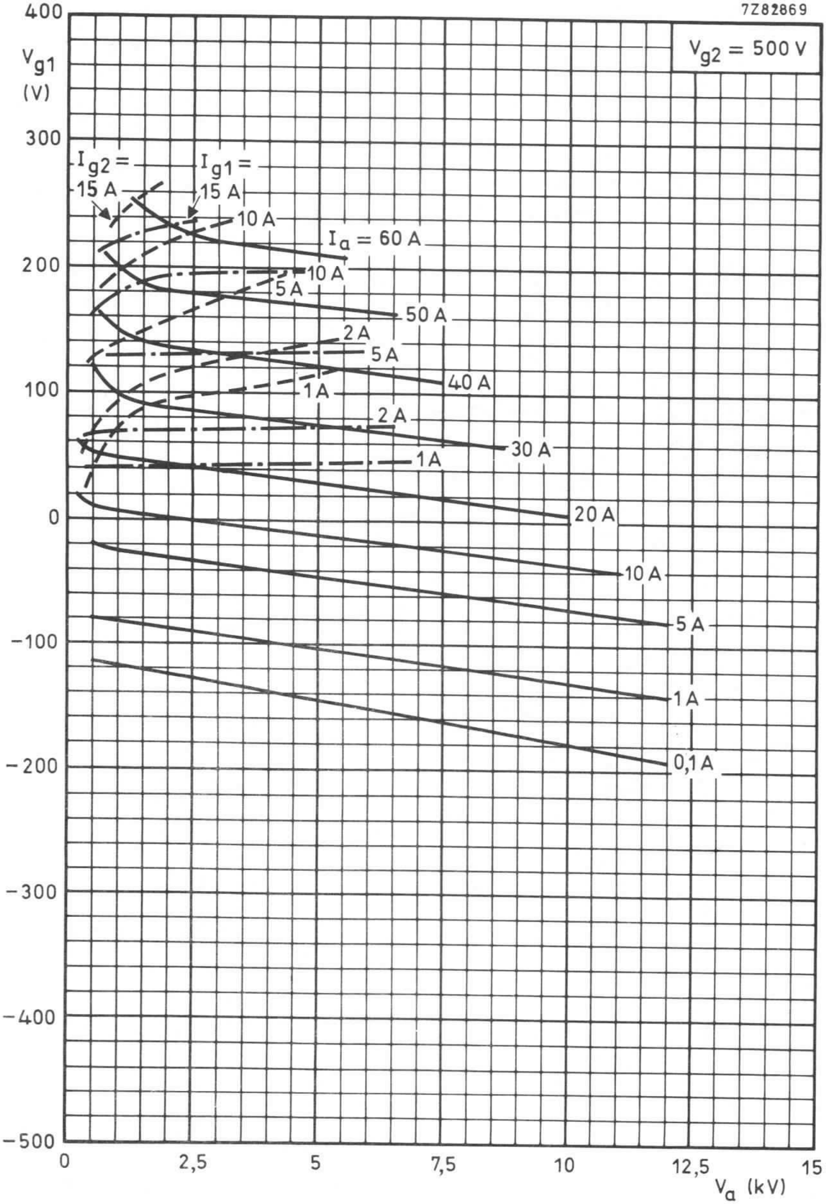
## A.F. CLASS-B POWER AMPLIFIER AND MODULATOR

**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 | $\eta$ | | 68 | % |




DEVELOPMENT SAMPLE DATA

Fig. 2.

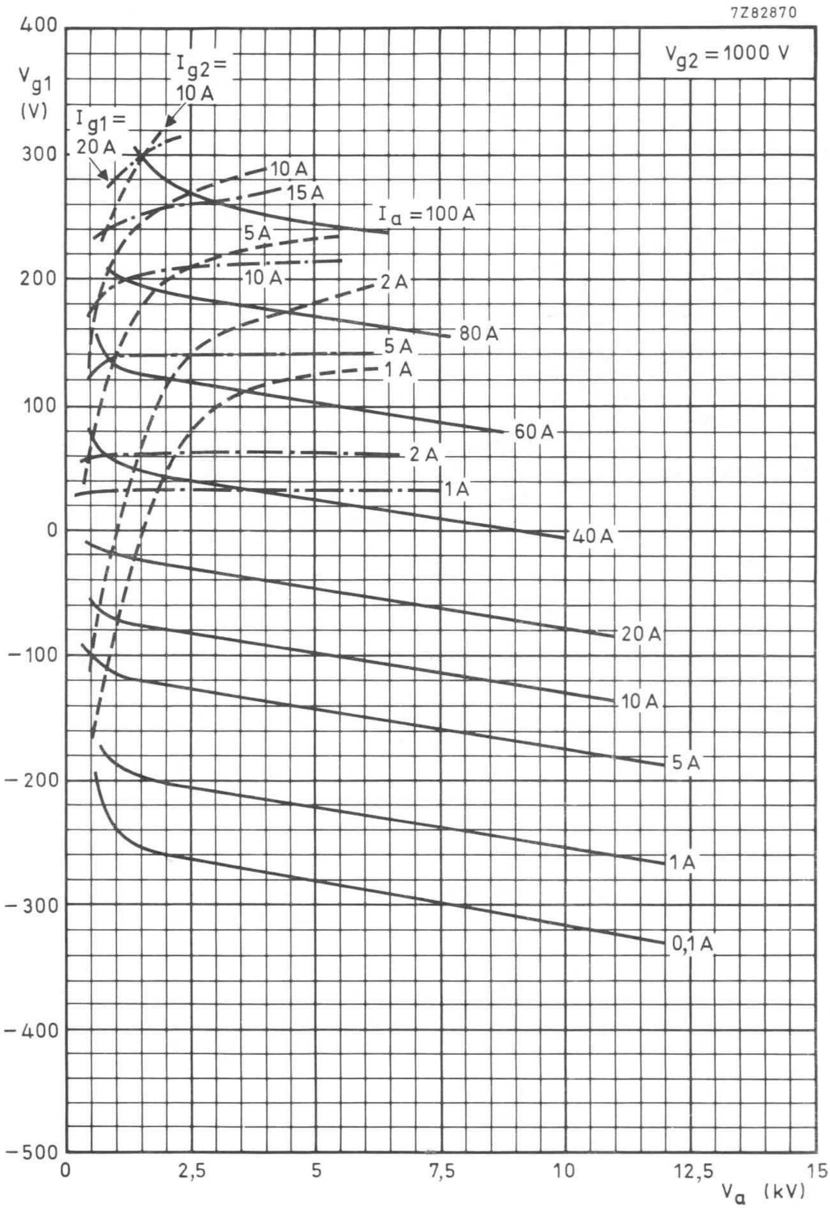

7Z82870
$V_{g2}$ = 1000 V
$V_{g1}$ (V)
$I_{g2}$ = 10 A
$I_{g1}$ = 20 A
10 A
15 A
$I_a$ = 100 A
5 A
10 A
2 A
80 A
5 A
1 A
60 A
2 A
1 A
40 A
20 A
10 A
5 A
1 A
0,1 A
400
300
200
100
0
−100
−200
−300
−400
−500
0
2,5
5
7,5
10
12,5
15
$V_a$ (kV)

Fig. 3.

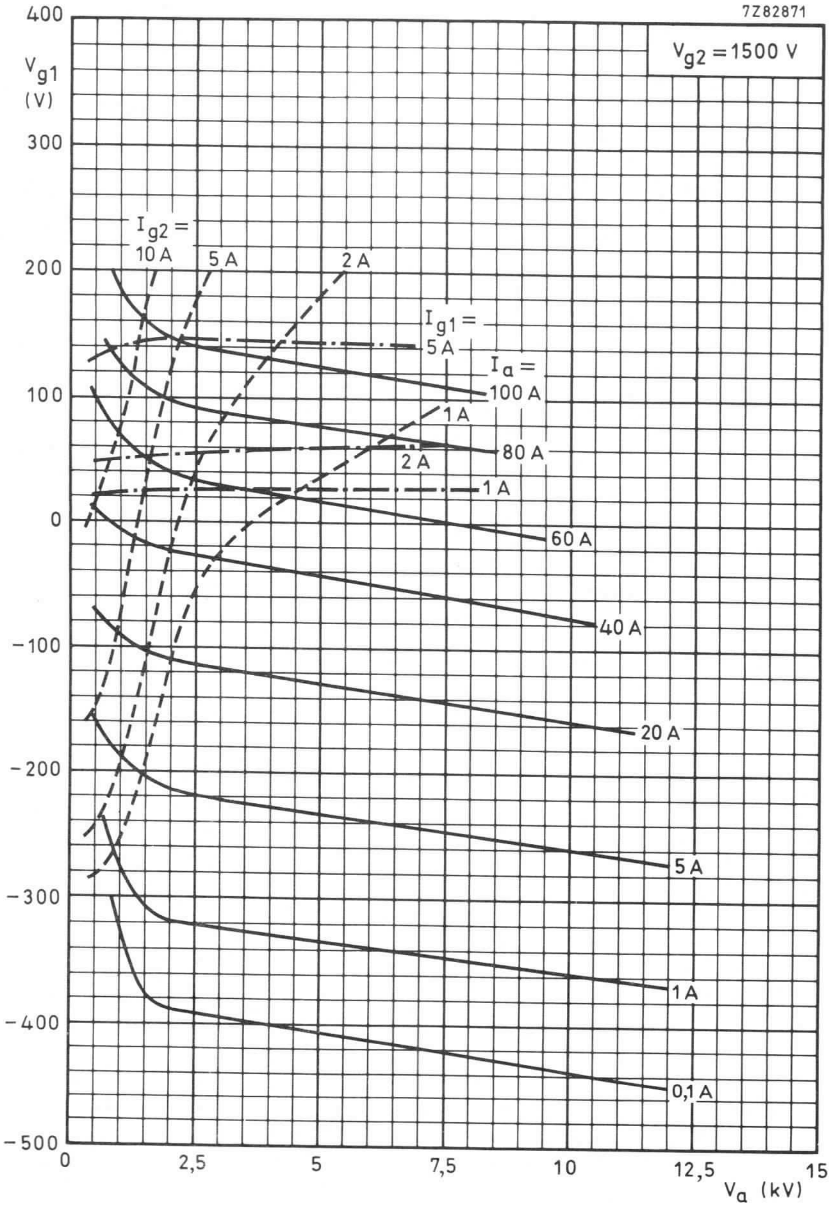



Fig. 4.

DEVELOPMENT SAMPLE DATA

# 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 | $I_{fp}$ 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 | $\mu_{g2g1}$ | 8,5 |

**CAPACITANCES**, grounded cathode

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

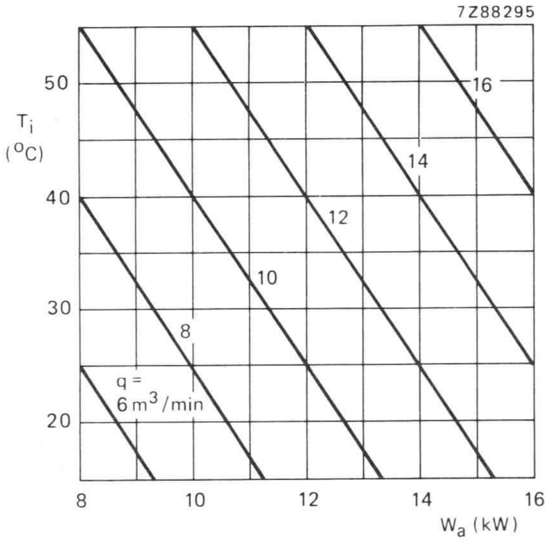
orange binder, tab 7

## TEMPERATURE LIMITS

| | | | |
|---|---|---|---|
| Absolute maximum envelope temperature | $T_{env}$ | max. | 240 $^{o}C$ |
| Recommended maximum seal temperature | T | max. | 200 $^{o}C$ |

## COOLING

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

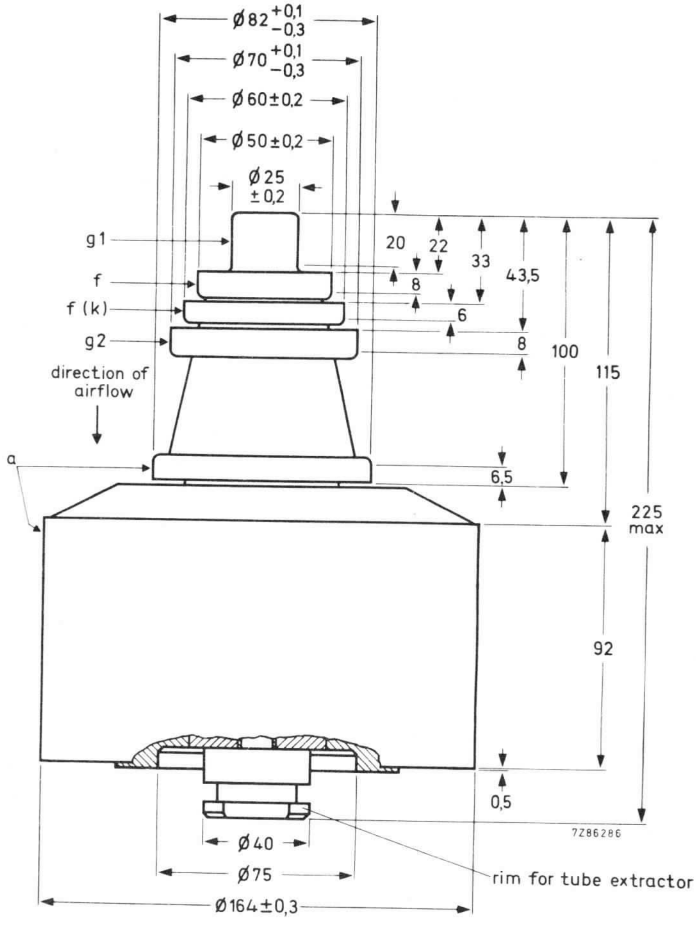


## MECHANICAL DATA

Dimensions in mm

Net weight: approx. 11 kg

Mounting position: vertical with anode up or down




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.

DEVELOPMENT SAMPLE DATA

## 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

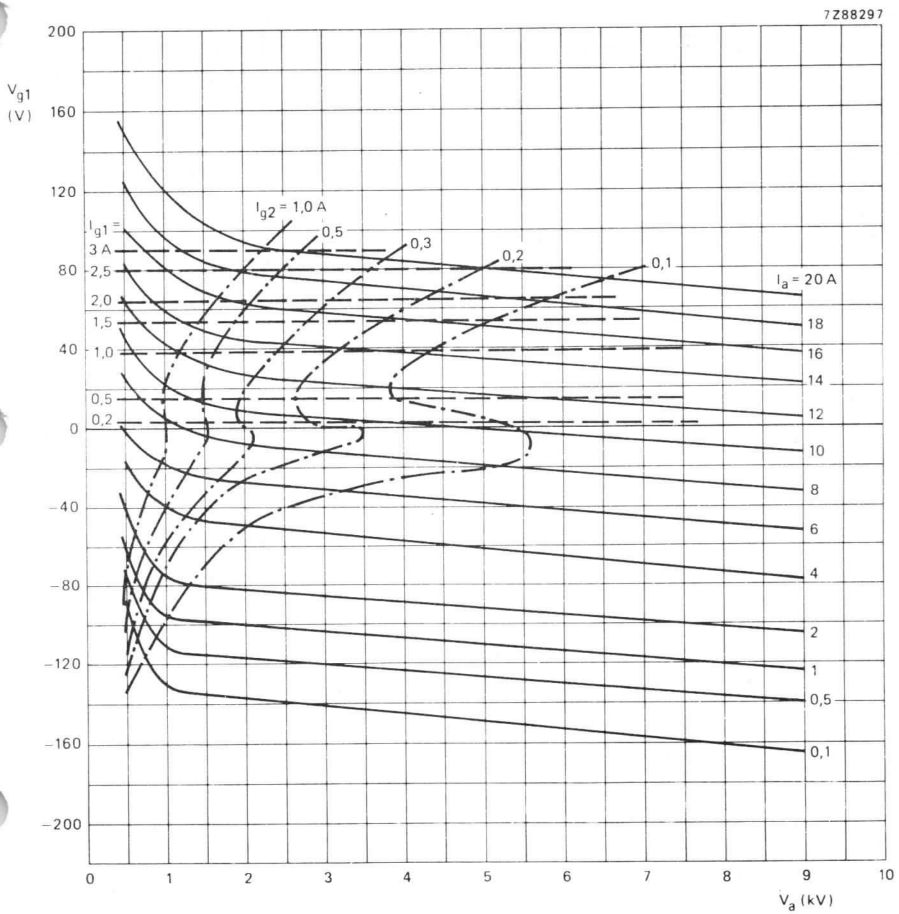
| | | | | |
|---|---|---|---|---|
| Frequency | f | 30 | MHz | |
| Anode voltage | $V_a$ | 8 | kV | |
| Grid 2 voltage | $V_{g2}$ | 900 | V | |
| Grid 1 voltage | $V_{g1}$ | −100 | V | 1 |

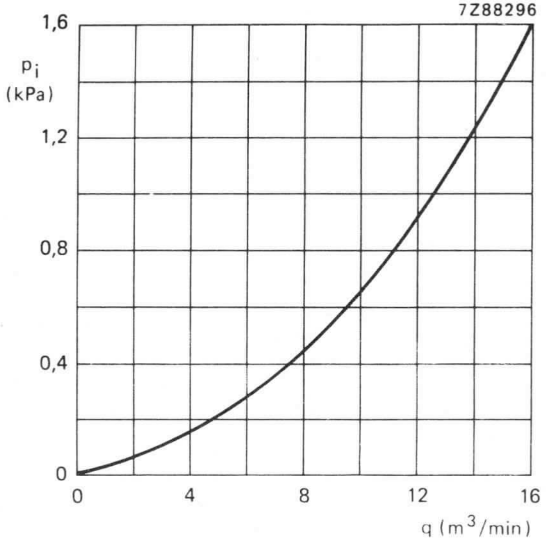
| | | zero signal | single tone signal | double tone signal | | notes |
|---|---|---|---|---|---|---|
| Grid 1 driving voltage, peak | $V_{g1p}$ | 0 | < 100 | < 100 | V | |
| Anode current | $I_a$ | 1,2 | 2,5 | 1,9 | A | |
| Grid 2 current | $I_{g2}$ | 10 | 50 | 15 | mA | |
| Grid 1 current | $I_{g1}$ | 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) | $W_\ell$ | – | > 10 | 10 | kW | |
| Total efficiency | $\eta$ | – | 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.

DEVELOPMENT SAMPLE DATA




7Z88296
1,6
$p_i$
(kPa)
1,2
0,8
0,4
0
0
4
8
12
16
q ($m^3$/min)

# DOT MATRIX TUBE

# ZM1250

**DEVELOPMENT SAMPLE DATA**

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 |

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

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

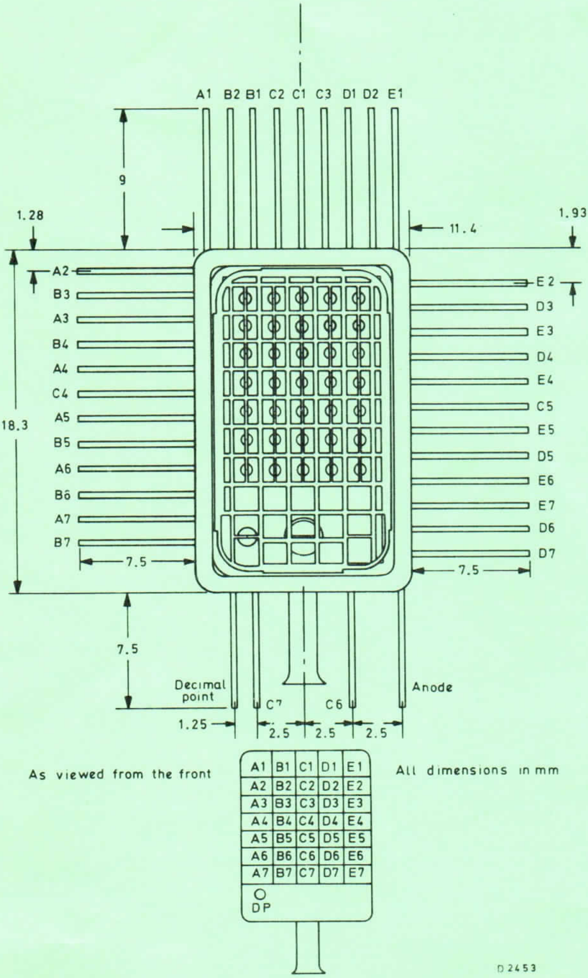
OPERATING NOTES

1. For envelope temperatures below $+10^{o}C$ 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 $240^{o}C$ 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

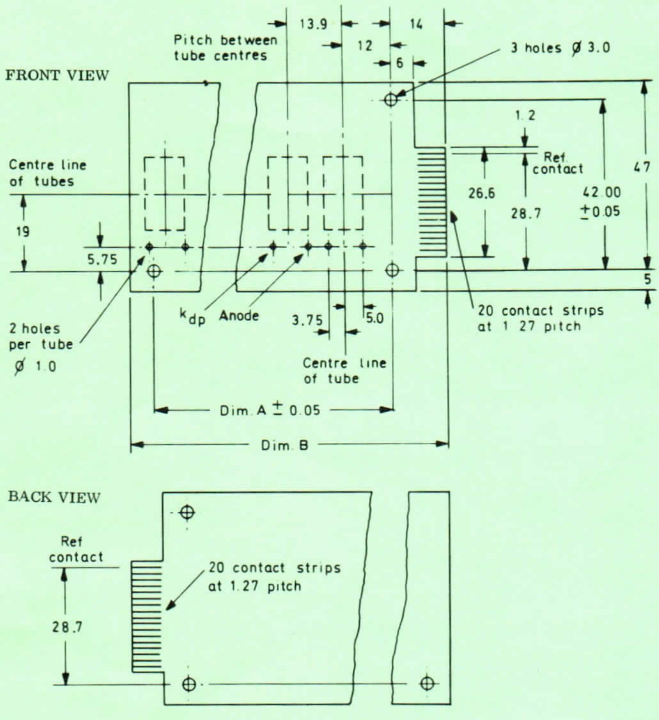
| | | | |
|---|---|---|---|
| Depth | max. | 6.0 | mm |
| Spacing between - top cathode leads | | 1.25 ±0.03 | mm |
| - side cathode leads | | 1.30 ±0.03 | mm |
| Cathode leads - width | | 0.30 ±0.03 | mm |
| - thickness | nom. | 0.1 | mm |
| Anode lead - width | max. | 0.5 | mm |
| - thickness | nom.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

OUTLINE AND DIMENSIONS



# DOT MATRIX TUBE ASSEMBLIES

## DEVELOPMENT SAMPLE DATA




All dimensions in mm

D2923

| | | | | |
|---|---|---|---|---|
| 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 |

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 |

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

# GEIGER-MÜLLER TUBE

End window halogen quenched $\alpha$, $\beta$ and $\gamma$ radiation counter tube.

## QUICK REFERENCE DATA

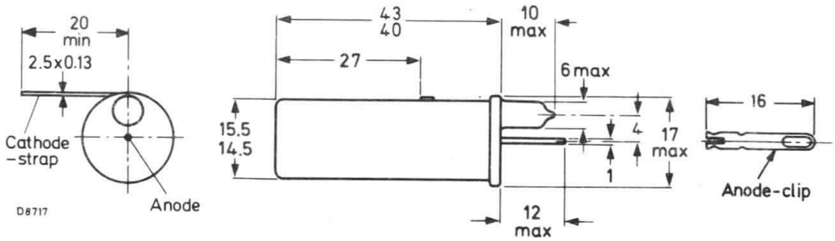
| | | |
|---|---|---|
| Dose rate range | $10^{-4}$ to 1 | R/h |
| Plateau threshold voltage | 400 | V |
| Plateau length | 200 | V |
| Recommended supply voltage | 500 | V |
| Chrome-iron cathode | 250 | $mg/cm^2$ |
| Mica window (9 mm diameter) | 1.5 to 2.0 | $mg/cm^2$ |

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

## MECHANICAL DATA

Dimensions in mm

Fig. 1




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

## 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 | $5 \times 10^{10}$ | count |

## MEASURING CIRCUIT

$R_1 = 10\ M\Omega$

$R_2 = 220\ k\Omega$

$C_1 = 1\ pF$

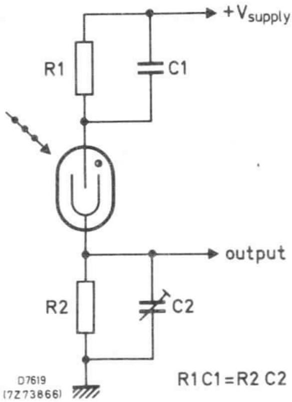
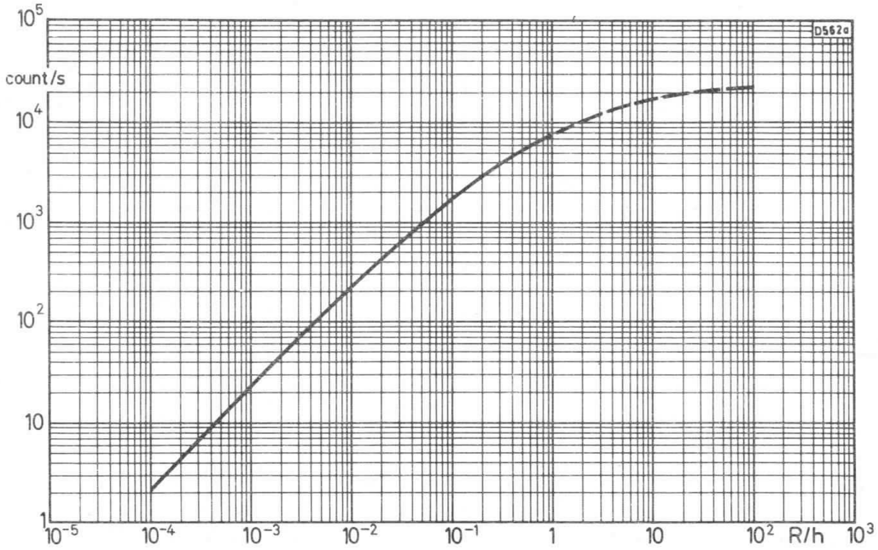
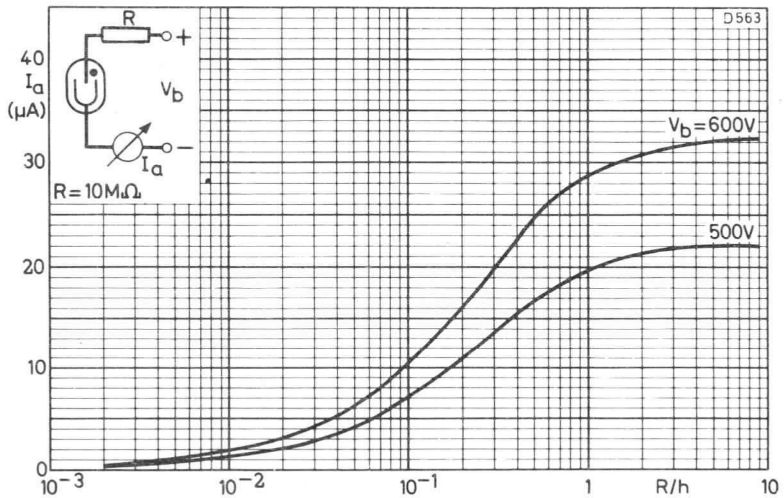


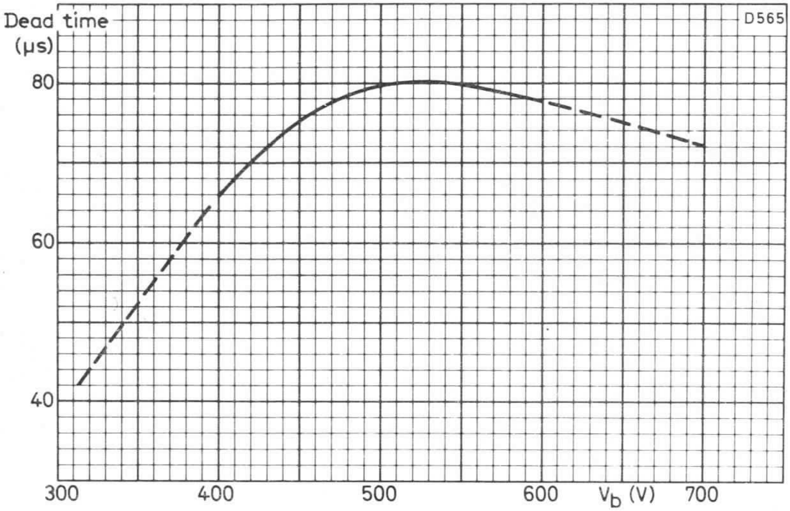

Fig.2




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