FERRANTI

# TECHNICAL HANDBOOK

# VALVES AND CATHODE RAY TUBES

Both vols checked Oct. 61

TPD

FERRANTI

Prefixes ✓

INDUSTRIAL VALVES.

# FERRANTI

## ARC DISCHARGE VALVE

A Cold Cathode gas filled arc discharge Diode which is capable of passing high peak currents of short duration ; suitable for use with magneto-striction oscillators, etc.

### PHYSICAL DETAILS.

| | |
|---|---|
| Max. Overall Length ... ... | 249 mm. (9¾in.). |
| Max. Overall diameter ... ... | 31 mm. (1¼in.). |
| Max. Dia. of glass tube ... | 28·5 mm. (1⅛in.). |
| End Caps ... ... ... | CT3. |
| Mounting Position ... ... | Any. |

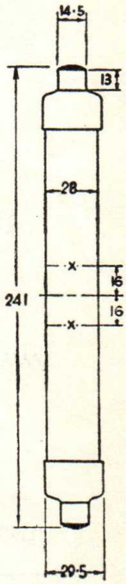
### RATINGS (Max. Ratings are "Absolute.")

| | |
|---|---|
| Max. Anode Voltage ... ... | 1800 volts. |
| Max. Mean Anode Current ... | 100 mA. |
| Max. Operating Frequency ... | 4 pps. |
| Max. Discharge Capacitor ... | 10 μF. |

### TYPICAL OPERATION and CHARACTERISTICS.

| | |
|---|---|
| Anode Voltage ... ... ... | 1650 volts. |
| Discharge Capacitor ... ... | 4 μF. |
| *Trigger Voltage ... ... ... | 20000 volts. |
| Load Resistance ... ... ... | 4 Ω |
| Operating Frequency ... ... | 4 pps. |
| †Peak Anode Current ... (approx.) | 250 Amps. |
| ‡Anode Current Duration (approx.) | 25 μsecs. |
| Delay Time ... ... ... | 50 μsecs. |

Typical circuits for operation are shown overleaf. These circuits employ a Ferranti Cold Cathode Tetrode Type NSP2 to discharge high peak current pulses through the primary of a Pulse Transformer or Ignition Coil to provide the high voltage trigger pulses for the AD30.




All dimensions shown are in millimetres. (max.).

*The trigger voltage may be supplied from an ignition coil giving a secondary voltage between 20 and 30 kilovolts. This voltage should be applied to the valve by means of a clip, or a few turns of bare wire wrapped round the envelope. The trigger clip should be located near the mid point of the tube in the area enclosed by lines X X on the outline drawing. The trigger pulses can be applied to the primary of the igniton coil by electronic or mechanical means.

†The peak anode current with zero discharge resistance is of the order of 550 Amps. when a 4 μF. capacitor is employed. Higher values of capacitor result in higher peak currents.

‡The duration of the current pulses varies with voltage, discharge capacitor and discharge circuit resistance. With Va = 1650, C = 4 μF. typical times are as follows :—

| Circuit Resistance. | Current Duration. |
|---|---|
| 0 ohms ... ... | 10 μsecs. |
| 4 ohms ... ... | 25 μsecs. |
| 10 ohms ... ... | 70 μsecs. |

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# AD30

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OPERATION CONTROLLED BY FREE RUNNING OSCILLATOR.

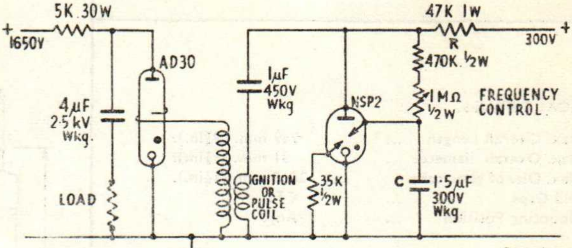


FIG. 1.

The frequency of operation is controlled by the values of R and C. The values shown in the diagram are suitable for a repetition rate of 4 pps.

ELECTRONICALLY SYNCHRONISED OPERATION.

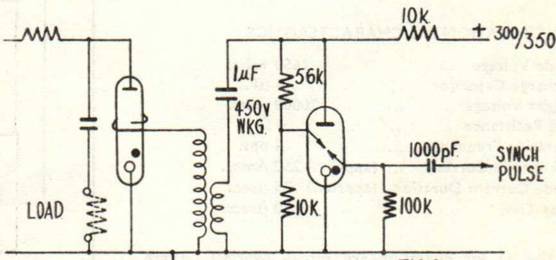


FIG 2.

Greater frequency stability can be attained if the NSP2 is triggered from a controlled frequency source as indicated in the above diagram. The synchronising pulses must be negative going and of about 150 volts minimum height.

MECHANICALLY SYNCHRONISED OPERATION.

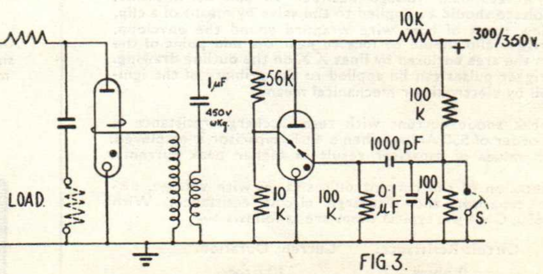


FIG 3.

Closing the switch S causes a single discharge. The switch may be operated by a motor or other mechanical means.

Further information regarding operation of the NSP2 as a trigger valve may be obtained from the Data Sheet for NSP2.

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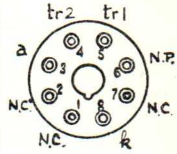
## COLD CATHODE TETRODE

**ASP2**

Ferranti "Argostron" Type ASP2 is an argon filled cold cathode tetrode valve. It is intended for use as a Stroboscopic Light Source in applications employing photographic recording. For visual observations Type NSP2 is recommended.




**Base Connections Underside View Base**

PHYSICAL SPECIFICATION.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Seated Height ... ... | 89 mm. ($3\frac{1}{2}$in.). |
| Max. Overall Length ... ... | 103 mm. ($4\frac{1}{16}$in.). |
| Max. Base Diameter ... ... | 32 mm. ($1\frac{1}{4}$in.). |
| Length of Arc ... ... ... | 24 mm. ($\frac{15}{16}$in.). |
| Mounting Position ... ... | Any. |

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 5—Trigger Electrode 1. |
| Pin 2—No Connection. | Pin 6—No Pin. |
| Pin 3—Anode. | Pin 7—No Connection. |
| Pin 4—Trigger Electrode 2. | Pin 8—Cathode. |

RATINGS (Absolute).

| | |
|---|---|
| Max. Anode Voltage (working) | 380 volts. |
| Min. Anode Voltage (working) | 270 volts. |
| Max. Peak Inverse Anode Voltage | 350 volts. |
| †Max. Average Anode Current ... | 80 µF. |
| Max. Discharge Capacitance ... | 16 mA. |
| Max. Average Trigger Current | 10 mA. |
| Min. Series Discharge Resistance | 0·3 ohms. |

CHARACTERISTICS.

| | |
|---|---|
| *Static Striking Voltage ($tr_2$ to $tr_1$) | 75-120 volts. |
| Max. Flashing Frequency ... | 250 per sec. |
| Min. Trigger Current required at $V_a$ 380 ... ... ... | 100 µA. |
| Min. Trigger Current required at $V_a$ 270 ... ... ... | 200 µA. |
| Peak Luminous Intensity / Flash Duration | The discharge of a 2 µF capacitor charged to 350V. gives a Peak Luminous Intensity of approx. 80 candelas with a flash duration of 20 microseconds at half the peak light output. |
| Delay Time ... ... | From 50 microseconds down to a few microseconds dependent on circuit conditions. Minimum delay times are achieved by using high values of trigger pulse energy and anode voltage. |

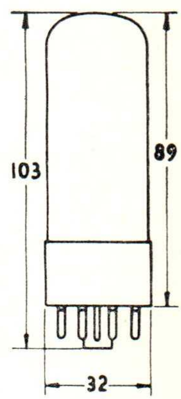
TYPICAL OPERATION as Stroboscopic Light Source :

| | |
|---|---|
| DC. Supply Voltage ... ... | 350 volts. |
| ‡$V_{tr2}$ at Triggering Instant ... | 70 volts. |
| §Trigger Pulse Amplitude ($V_{tr1}$) | 150 volts min. |
| Series Discharge Resistance ... | 0·5 ohms. |
| Charging Resistor ... ... | 3000 ohms. |

Discharge Capacitor for Operation at :—

| | |
|---|---|
| 6–35 c.p.s. ... ... | 4 µF. |
| 30–50 c.p.s. ... ... | 3 µF. |
| 45–80 c.p.s. ... ... | 2 µF. |
| 80–150 c.p.s. ... ... | 1 µF. |
| 140–250 c.p.s. ... ... | 0·5 µF. |

For typical circuits and further information refer to "Notes on Operation" on NSP2 Data Sheets.




All dimensions shown are in millimetres.

†A minimum peak current of 5 amp. is recommended. This ensures the formation of an arc discharge with an anode-cathode volt drop of approx. 20 volts. If the peak current is less than 5 amps. a glow discharge is likely to form with a volt drop of 75 volts which may result in permanent damage to the valve.

*The limits quoted refer to the trigger voltage for a low rate of change of electrode voltages with $tr_1$ negative to $tr_2$. For pulse operation a higher trigger voltage is generally necessary. See under "Typical Operation."

‡Positive with respect to cathode.

§Negative with respect to cathode.

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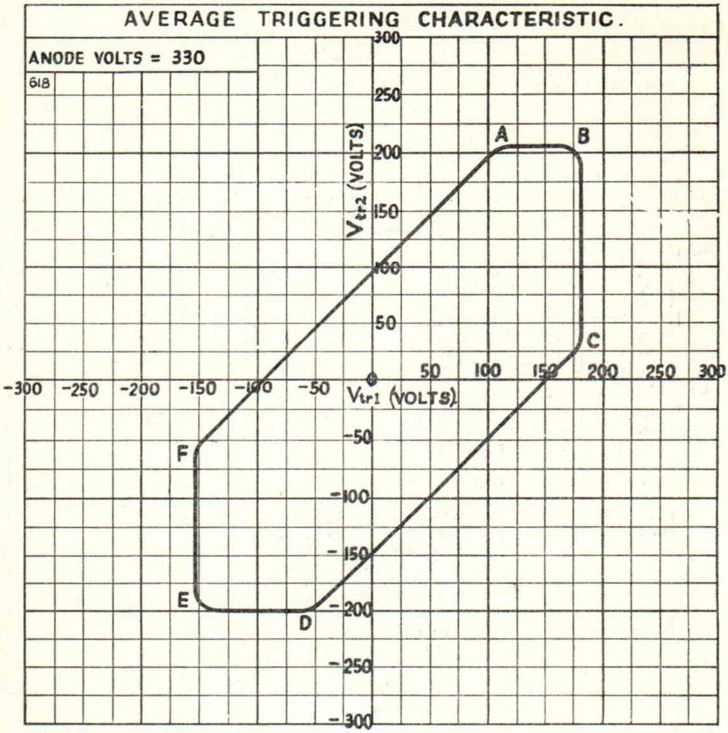
## ASP2




AVERAGE STATIC TRIGGERING CHARACTERISTIC

The area enclosed by the loops is an area of non-conduction. If the vector sum of the voltages on two electrodes lies within the loop the valve will not fire. Any change of either or both of these voltages which cause the vector sum to fall outside the loop will trigger the valve.

For pulse operation it is usually necessary to ensure that the pulse has a sufficient excess voltage (See "Typical Operation.")

As the triggering impulse carries the vector sum of the applied voltages outside the loop the point at which it crosses the loop indicates the manner in which the valve is triggered as follows :—

Between AB Trigger Electrode 2 to Cathode.
BC Trigger Electrode 1 to Cathode.
CD Trigger Electrode 1 to Trigger Electrode 2.
DE Cathode to Trigger Electrode 2.
EF Cathode to Trigger Electrode 1.
FA Trigger Electrode 2 to Trigger Electrode 1.

The most reliable operation is ensured by triggering between $tr_2$ and $tr_1$, i.e., between F and A.

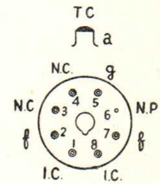
# FERRANTI

## LOW VOLTAGE X-RAY TUBE

**B110**

A low power X-ray tube with copper target, suitable for radiographic work on materials which are appreciably transparent to low voltage X-rays, e.g., plastics and thin metals. The electrical characteristics and focus properties of the tube may be varied by the application of suitable potentials to a control electrode which is positioned around the directly heated tungsten filament.

The B110 is not designed as a micro-focus type tube but is primarily intended for use in applications employing comparatively low power and where a fairly fine focus is required, and where the cost of a conventional high power X-ray tube is not justified.




**Base Connections Underside View of Base**

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Overall Length ... ... | 265 mm. |
| Max. Diameter ... ... ... | 40 mm. |
| Top Cap ... ... ... | CT3. |
| Mounting Position ... ... | Any. |
| Target ... ... ... ... | Copper. |

PIN CONNECTIONS.

*Pin 1, *Pin 2 —Filament.
Pin 3—No Connection.
Pin 4—No Connection.
Pin 5—Grid.
Pin 6—No Pin.
*Pin 7, *Pin 8 —Filament.
T.C.—Target.

RATINGS.

| | |
|---|---|
| Max. Target Voltage ... ... | 50 kV. D.C.<br>25 kV. A.C. |
| Max. Target Dissipation (continuous) ... ... | 25 watts. |
| †Max. Target Dissipation (intermittent) ... ... | 500 watts. |
| Max. Negative Grid Voltage ... | 1400 volts. |
| Max. Filament Current ... ... | 6 amps. |

CHARACTERISTICS OF TYPICAL TUBE.

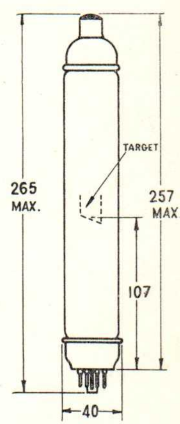
| | | | | |
|---|---|---|---|---|
| Filament Current ... | 5·8 | 5·8 | 5·8 | amps. |
| Target Voltage (D.C.) ... | 15 | 35 | 35 | kV. |
| Grid Bias ... ... | −150 | −550 | −650 | volts. |
| Target Current ... ... | 1·2 | 0·8 | 0·05 | mA. |

TYPICAL OPERATION (1). D.C. operation with Grid Bias.

| | |
|---|---|
| Filament Current ... ... | 5·5 amps. |
| Filament Voltage ... ... | 3·6 volts (approx.). |
| Target Voltage ... ... ... | 40 kV. D.C. |
| Grid Voltage ... ... | 0 to −1400 volts. |
| ‡Spot Size ... ... ... | 0·8 mm. |

TYPICAL OPERATION (2). D.C. operation with Auto Bias.

| | |
|---|---|
| Filament Current ... ... | 5·8 amps. |
| Filament Voltage ... ... | 3·9 volts. (approx.). |
| Target Voltage ... ... ... | 15 kV. D.C. |
| Auto Bias Resistor ... ... | 100 kΩ |
| Target Current (mean) ... | 1·5 mA. |




All dimensions shown are in millimetres. (max.)

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TYPICAL OPERATION (3). A.C. operation with Auto Bias.

| | | |
|---|---|---|
| Filament Current | ... ... | 5·8 amps. |
| Filament Voltage | ... ... | 3·9 volts (approx.). |
| Target Voltage ... | ... ... | 15 kV. A.C. |
| Auto Bias Resistor | ... ... | 100 kΩ |
| Target Current (mean) | ... | 0·7 mA. |

MODE OF OPERATION.

Adjust the filament current to 5·5 amps. and connect the grid to one side of the filament. Raise the target voltage steadily to the required figure, and as the target voltage is increasing adjust the filament current so that the target dissipation does not exceed 25 watts. If it is desired to operate with a smaller focal spot, it may be necessary to apply a negative potential of 400—900 volts to the grid and then increase the filament current slightly until sufficient beam current is available.

The tube may be operated at constant filament current, and target current adjusted by changing the grid bias voltage.

The target current may be compensated for variations of mains input voltage and tube characteristics by feedback circuits which adjust either the filament current or the grid bias voltage.

The target voltage should be increased gradually from zero to the required operating potential.

The filament current should be kept as low as possible, consistent with obtaining the required target current.

Care must be taken during transport and handling to avoid mechanical shocks to the tube.

Suitable shielding should be provided to protect the operator from radiation when the tube is working.

NOTES.

*One filament lead should be connected to both pins 1 and 2, and the other lead to both pins 7 and 8.

†The tube should never be operated at the maximum intermittent target dissipation for periods of more than 20 seconds. Between two periods of intermittent operation the target must be allowed to cool completely. If the tube has been operated at the maximum rating, the cooling time will be approximately 15 minutes.

‡At Target Voltage 40 kV. D.C. Target Current 100 micro-amperes.

**B120**

# FERRANTI

## LOW VOLTAGE X-RAY TUBE

A low power X-ray tube with copper target, suitable for radiographic work on materials which are appreciably transparent to low voltage X-rays, e.g., plastics and thin metals. The radiation is emitted through a thin glass window to reduce absorption of the softer rays.

The electrical characteristics and focus properties of the tube may be varied by the application of suitable potentials to a control electrode which is positioned around the directly heated tungsten filament.

Type B120 is not designed as a micro-focus type tube but is primarily intended for use in applications employing comparatively low power and where a fairly fine focus is required, and where the cost of a conventional high power X-ray tube is not justified.

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Overall Length ... ... | 265 mm. |
| Max. Diameter ... ... ... | 60 mm. |
| Top Cap ... ... ... | CT3. |
| Mounting Position ... ... | Any. |
| Target ... ... ... ... | Copper. |

### PIN CONNECTIONS.

| | |
|---|---|
| *Pin 1 } Filament. | Pin 5—Grid. |
| *Pin 2 } Filament. | Pin 6.—No Pin. |
| Pin 3.—No Connection. | *Pin 7 } Filament. |
| Pin 4.—No Connection. | *Pin 8 } Filament. |

### RATINGS.

| | |
|---|---|
| Max. Target Voltage ... ... | { 25 kV. DC. <br> 25 kV. AC. 50 c/s. |
| Max. Target Dissipation (cont.) | 25 watts. |
| †Max. Target Dissipation (intermittent) ... ... ... | 150 watts. |
| Max. Negative Grid Voltage ... | –1400 volts. |
| Max. Filament Current ... | 6 amps. |

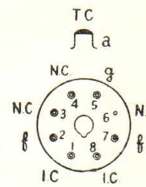
### CHARACTERISTICS.

| | |
|---|---|
| Filament Current ... ... | 5·8 amps. |
| Target Voltage (DC.) ... ... | 15 kV. |
| Grid Bias ... ... ... | –150 volts. |
| Target Current ... ... ... | 1·2 mA. |

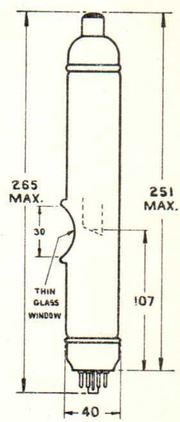
### NOTES.

*One filament lead should be connected to both pins 1 and 2, and the other lead to both pins 7 and 8.

†The tube should never be operated at the maximum intermittent target dissipation for periods of more than 20 seconds. Between two periods of intermittent operation the target must be allowed to cool completely. If the tube has been operated at the maximum rating, the cooling time will be approximately 15 minutes.




**Base Connections Underside View of Base**




All dimensions shown are in millimetres. (max.)

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TYPICAL OPERATION.

DC. Operation with Grid Bias.

| | |
|---|---|
| Filament Current ... ... | 5·5 amps. |
| Filament Voltage ... ... | 3·6 volts (approx.). |
| Target Voltage ... ... ... | 20 kV. DC. |
| Grid Voltage ... ... ... | –250 |

DC. Operation with Auto Bias.

| | |
|---|---|
| Filament Current ... ... | 5·8 amps. |
| Filament Voltage ... ... | 3·9 volts (approx.). |
| Target Voltage ... ... ... | 15 kV. DC. |
| Auto Bias Resistor . ... | 100 kΩ |
| Target Current (mean) ... | 1·5 mA. |

AC. Operation with Auto Bias.

| | |
|---|---|
| Filament Current ... ... | 5·8 amps. |
| Filament Voltage ... ... | 3·9 volts (approx.). |
| Target Voltage (50 c/s.) ... | 15 kV. AC. |
| Auto Bias Resistor ... ... | 100 kΩ |
| Target Current (mean) ... | 0·7 mA. |

NOTES ON OPERATION.

Adjust the filament current to 5·5 amps and connect the grid to one side of the filament. Raise the target voltage steadily to the required figure, and as the target voltage is increasing adjust the filament current so that the target dissipation does not exceed 25 watts. If it is desired to operate with a smaller focal spot, it may be necessary to apply a negative potential of 400–900 volts to the grid and then increase the filament current slightly until sufficient beam current is available.

The tube may be operated at constant filament current, and target current adjusted by changing the grid bias voltage.

The target current may be compensated for variations of mains input voltage and tube characteristics by feedback circuits which adjust either the filament current or the grid bias voltage.

The target voltage should be increased gradually from zero to the required operating potential.

The filament current should be kept as low as possible, consistent with obtaining the required target current.

The thin window opposite the target should not be handled as the glass in this area is very thin and easily fractured.

Suitable shielding should be provided to protect the operator from radiation when the tube is in operation.

Care must be taken during transport and handling to avoid mechanical shocks to the tube.

# FERRANTI
## DEMOUNTABLE LOW VOLTAGE X-RAY TUBE

A demountable X-Ray Tube with provision for rapid replacement of the filament.

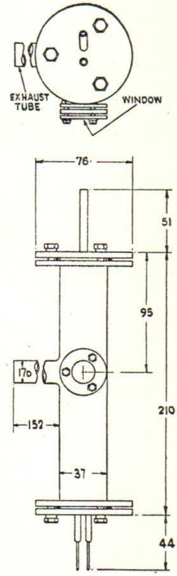
The tube has an inclined target which is water cooled and can be operated up to 10mA beam current at a target voltage of 40kV.

A special feature is the polythene window which can also be easily replaced if necessary.

As this polythene window is very transparent to soft X-Rays a very high intensity of X radiation can be obtained with target voltages as low as 5kV. The tube can therefore be operated under conditions which produce an X-Ray output which provides a much higher ratio of characteristic radiation to "white" radiation than is normally obtainable from conventional types of X-Ray tubes.

The electrical characteristics and focus of the tube can be controlled by application of suitable potentials to a screen which is positioned round the directly heated tungsten filament.

The tube is not of the micro-focus type but is primarily intended for use in applications requiring fairly fine focus at comparatively high power.




### PHYSICAL DETAILS.

| | |
|---|---|
| Max. Overall Length ... ... | 305 mm. |
| Max. Overall Diameter (excl. exhaust tube) ... | 78 mm. |
| Max. Tube Diameter ... ... | 38 mm. |
| For other dimensions see drawing. | |
| Mounting Position ... ... | Any. |
| Target ... ... ... ... | Copper. |

### RATINGS.

| | |
|---|---|
| Max. Target Voltage ... ... | 40 kV. |
| Max. Target Dissipation ... | 400 watts. |
| Max. Negative Screen Voltage | 1400 volts. |
| Max. Filament Current ... | 3·5 Amps. |

### TYPICAL OPERATION.

| | |
|---|---|
| Filament Current ... ... | 2·0 Amps. |
| Filament Voltage ... ... | 6·0 Volts approx. |
| Target Voltage ... ... ... | 40 kV. |
| Screen Voltage ... ... | 0 to –1400 Volts. |
| Spot Size (approx.) at 500 $\mu$A. | 0·5 mm. |
| Spot Size (approx.) at 10 mA. ... | 1·0 mm. |

All dimensions shown are in millimetres.

### MODE OF OPERATION.

Adjust the filament current to 1·5 amps and set the screen voltage at –800V. Increase the E.H.T. supply to the Target continuously from zero to the required operating potential. Adjust the screen voltage to bring the beam to a sharp focus on the target (as indicated by the usual photographic methods). Adjust the filament supply to give the required beam current. Repeat the last two adjustments in order to obtain optimum focus. In general it is desirable to operate the tube with the highest negative screen potential which will give sufficient beam current.

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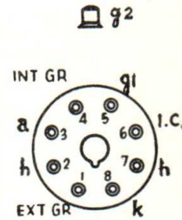
R.158

# FERRANTI

## TETRODE ELECTROMETER VALVE

**BM10**

A single tetrode electrometer valve, with an indirectly heated oxide-coated cathode, suitable for battery or mains operation. Internal and external guard rings are fitted and the envelope is silicone coated to render it moisture repellent.




**Base Connections**

**Underside View of Base**

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... | International Octal. |
| Top Cap ... .. ... | Type CT2. |
| Max. Overall Length ... ... | 140 mm. (5½in.). |
| Max. Seated Height ... ... | 125 mm. (5in.). |
| Max. Diameter ... ... ... | 45 mm. (1¾in.). |
| Mounting Position ... ... | Any. |
| Envelope ... ... ... ... | Clear glass, silicone coated. |

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Ext. Guard Ring. | Pin 5—Screen ($g_1$). |
| Pin 2—Heater (h) | Pin 6—Internal Connection. |
| Pin 3—Anode (a) | Pin 7—Heater (h) |
| Pin 4—Int. Guard Ring | Pin 8—Cathode (k) |

Top Cap—Control Grid ($g_2$)

HEATER.

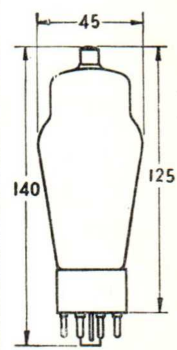
| | |
|---|---|
| Heater Voltage ... ... ... | 4·0 volts. |
| Heater Current ... ... ... | 0·25 amp. |

RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... | 8·0 volts. |
| Max. Screen Voltage ... ... | 6·0 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{in}$ ... ... ... ... | 2·9 pF. |
| $C_{out}$ ... ... ... ... | 6·9 pF. |
| $C_{a-g_2}$ ... ... ... ... | 5·0 pF. |
| $C_{a-g_1}$ (screen) ... ... ... | 1·9 pF. |




TYPICAL OPERATION.

| | | | | |
|---|---|---|---|---|
| Anode Voltage (Va) ... | 4·6 | 6·0 | 4·0 | volts. |
| Screen Voltage ($V_{g_1}$) ... | 6·0 | 4·0 | 3·0 | volts. |
| Control Grid Voltage ($V_{g_2}$) | −3·0 | −3·0 | −2·0 | volts. |
| Anode Current (Ia) ... | 275 | 190 | 100 | μA. |
| Screen Current ($I_{g_1}$) ... | 430 | 240 | 160 | μA. |
| Mutual Conductance (gm) | 160 | 100 | 90 | μA/V. |
| Amplification Factor (μ) | 2·0 | 1·8 | 2·0 | |
| Control Grid Current ($I_{g_2}$) | $<30\times10^{-14}$ | $<20\times10^{-14}$ | $<2\times10^{-14}$ | amp. |
| Control Grid Insulation ($r_{g_2}$) | $>10^{13}$ | $>3\times10^{13}$ | $>10^{14}$ | ohms. |

In order to achieve maximum stability and to reduce the control grid current to a minimum :—

1. Keep the glass envelope dry and free from contamination by fingerprints, etc.
2. Operate the valve in total darkness with adequate electrical and magnetic screening.
3. Ensure that the potential at any point of the heater is positive relative to that of the cathode.

e.g.—In DC. operation connect the heater negative terminal to the cathode or to a source of constant potential which is positive relative to the cathode.
In AC. operation maintain the centre-tap of the 4-volt heater supply 4 volts positive relative to the cathode.

4. The guard rings should be at a fixed potential equal to the mean operating potential of the control grid.

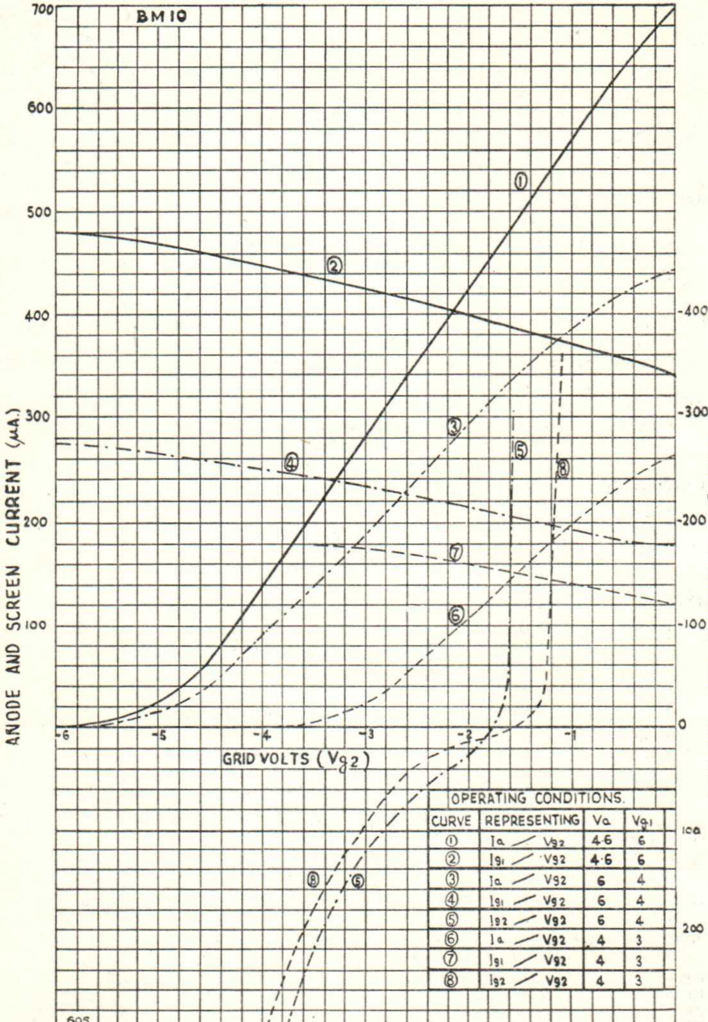
A steady operating condition of the valve will be more rapidly achieved if the heater voltage is applied at least 45 seconds before the anode and screen potentials.

All dimensions shown are in millimetres (max.).

FERRANTI

Issue 1
Dec., 1955
(Tentative)

# BM10




OPERATING CONDITIONS.

| CURVE | REPRESENTING | Va | $V_{g1}$ |
|---|---|---|---|
| ① | $I_a$ / $V_{g2}$ | 4·6 | 6 |
| ② | $I_{g1}$ / $V_{g2}$ | 4·6 | 6 |
| ③ | $I_a$ / $V_{g2}$ | 6 | 4 |
| ④ | $I_{g1}$ / $V_{g2}$ | 6 | 4 |
| ⑤ | $I_{g2}$ / $V_{g2}$ | 6 | 4 |
| ⑥ | $I_a$ / $V_{g2}$ | 4 | 3 |
| ⑦ | $I_{g1}$ / $V_{g2}$ | 4 | 3 |
| ⑧ | $I_{g2}$ / $V_{g2}$ | 4 | 3 |

**Ferranti**

# FLASH TUBE

Xenon filled flash tubes designed for use in Electronic Flash Equipment for Photographic or similar applications to operate from low voltages which can be supplied from a small power pack.

## PHYSICAL DETAILS.

### CD10

| | |
|---|---|
| Max. Length (excluding leads and pins) ... ... | 60 mm. (2·36″) |
| Max. Diameter of Glass ... | 8 mm. (·325″) |
| Max. Overall Width ... ... | 24 mm. (·955″) |
| Electrode Connections ... ... | Flexible Leads |
| Mounting Position ... ... | Any |

### CD11

| | |
|---|---|
| Max. Seated Height ... ... | 70 mm. (2·75″) |
| Max. Diameter of Glass ... | 8 mm. (0·32″) |
| Max. Overall Width ... ... | 35 mm. (1·38″) |
| Electrode Connections ... ... | Octal Base |
| Mounting Position ... ... | Any |

## ELECTRODE CONNECTIONS.

Type **CD10** has flexible leads. The twin twisted lead is the trigger lead. The device is non-polarised.

Type **CD11** is fitted on an Octal Base—see diagram in margin for connections.

The devices are non-polarised, the charging voltage and discharge capacitor may therefore be connected across the leads marked * in the marginal diagrams without regard to polarity.

## RATINGS. (Both types)

| | |
|---|---|
| Max. Discharge Energy ... ... | 50 Joules |
| Max. Operating Voltage... ... | 500 Volts |
| Min. Operating Voltage ... | 180 Volts |
| *Min. Interval between Flashes ... | 10 Secs |
| Max. Discharge Capacitor ... | 600 μF |

## TYPICAL OPERATION. (Both Types)

| | |
|---|---|
| Operating Voltage ... ... | 410 Volts |
| †Trigger Voltage ... ... | 2 to 3 kV |
| Discharge Capacitor ... ... | 600 μF |
| Charging Resistor ... ... | 3·3 kΩ (6 watt) |
| Flash Duration ... ... | ·002 Sec Approx. |

A typical circuit is shown overleaf

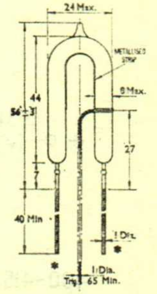
*At maximum dissipation.

†Ferranti Miniature Pulse Transformer Type PT56 is recommended.

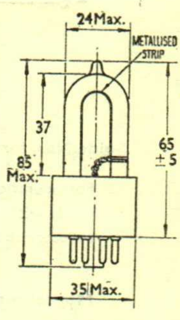
Tentative
Issue 3.
Nov., 1963

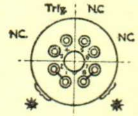
**CD10**

**CD11**




Type CD10



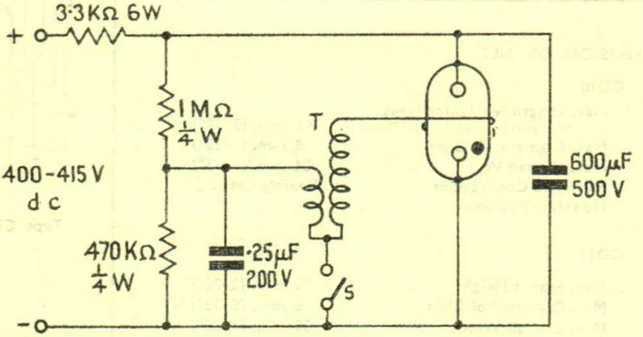

Type CD11

Dimensions in millimetres

**Ferranti**

| CD10 |
| --- |
| CD11 |

## CIRCUIT DIAGRAM




**Guide Nos. for Flash Photography**

For operation in a circuit similar to the above, i.e. with a discharge energy of 50 joules with the CD10 or CD11 mounted in a 3¾" diameter satin finish parabolic reflector the following guide numbers may be used.

**Monochrome Film**

| Film Speed A.S.A. | Guide No. |
| --- | --- |
| 25— 32 ... ... ... ... | 50 |
| 40— 50 ... ... ... ... | 65 |
| 64— 80 ... ... ... ... | 85 |
| 110—125 ... ... ... ... | 105 |
| 160—200 ... ... ... ... | 125 |
| 250—320 ... ... ... ... | 150 |

**Reversal Colour Film**

| Film Speed A.S.A. | |
| --- | --- |
| 25 ... ... ... ... | 30 |
| 50 ... ... ... ... | 40 |

The above figures are approximate and are intended to be used only as a guide for correct exposure.

Ferranti

# FLASH TUBE

A Xenon filled flash tube with integral reflector and pulse transformer designed for use in Electronic Flash Equipment for Photographic or similar applications operating at low voltage.

## PHYSICAL DETAILS

| | |
|---|---|
| Base ... ... ... ... | International Octal |
| Seated Height ... ... ... | 86 mm. ($3\frac{3}{8}$ in.) |
| Overall Length ... ... ... | 102 mm. ( 4 in.) |
| Diameter of Reflector ... ... | 105 mm. ($4\frac{1}{8}$ in.) |
| Diameter of Base ... ... | 35 mm. ($1\frac{3}{8}$ in.) |
| *Mounting Position ... ... | Any |

See outline drawing overleaf.

## PIN CONNECTIONS

| | |
|---|---|
| Pin 1—Not connected. | Pin 5—Trigger Input. |
| Pin 2—** | Pin 6—Not Connected. |
| Pin 3—Not Connected. | Pin 7—** |
| Pin 4—Trigger Earth. | Pin 8—Not Connected. |

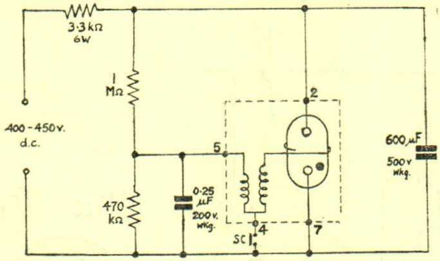
**The device is non-polarised, the charging voltage and discharge capacitor may therefore be connected across the pins 2 and 7 without regard to polarity.

## RATINGS

| | |
|---|---|
| Max. Discharge Energy ... ... | 50 Joules |
| Max. Operating Voltage ... | 500 Volts |
| Min. Operating Voltage ... | 180 Volts |
| †Min. Interval between Flashes ... | 10 Secs |
| Max. Discharge Capacitor ... | 600 $\mu$F |

## TYPICAL OPERATION

| | |
|---|---|
| Operating Voltage ... ... | 420 Volts |
| Trigger Pulse at Pin 5 ... ... | See Note ‡ |
| Discharge Capacitor ... ... | 600 $\mu$F |
| Charging Resistor ... ... | 3·3 k$\Omega$ (6 watt) |
| Flash Duration ... ... ... | ·002 Sec (approx) |




The figures outside the broken line indicate the pins in the CD 14 base. SC denotes the camera shutter contacts or other appropriate switch.

*The recommended method of mounting is by support at the flange of the reflector.

†At maximum dissipation.

‡A suitable trigger voltage may be obtained from the discharge of a Capacitor between pins 5 and 4 as indicated in the circuit diagram.

Max. values are :

| | |
|---|---|
| Capacitor ... ... ... | 0·25 $\mu$F |
| Charge ... ... ... | 350 volts. |

Tentative
Issue 2.
Feb., 1964

Ferranti

GUIDE NOS. FOR FLASH PHOTOGRAPHY

For operation in a circuit similar to that shown overleaf, i.e. with a discharge energy of 50 joules the following guide numbers may be used.

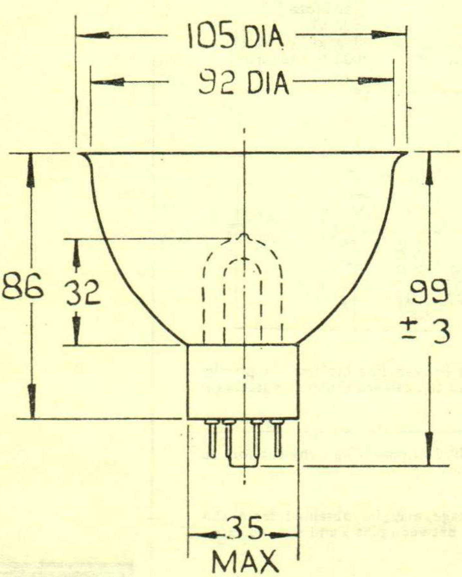
**Monochrome Film**

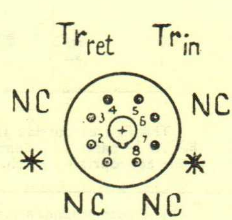
| Film Speed A.S.A. | Guide No. |
|---|---|
| 25— 32 | 50 |
| 40— 50 | 65 |
| 64— 80 | 85 |
| 110—125 | 105 |
| 160—200 | 125 |
| 250—320 | 150 |

**Reversal Colour Film**

| Film Speed A.S.A. | |
|---|---|
| 25 | 30 |
| 50 | 40 |

The above figures are approximate and are intended to be used only as a guide to correct exposure.




*—The tube is not polarised. The discharge capacitor is connected across these pins without regard to polarity.

# FERRANTI

## LINEAR LIGHT SOURCES

Mercury-Argon filled light sources in which the light output is proportional to the anode current. The many uses include phototelegraphic picture recording, sound film recording, time interval marking and stroboscopic applications.

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Overall Diameter ... ... | 33 mm. ($1\frac{5}{16}$in.). |
| Max. Seated Height ... ... | 85 mm. ($3\frac{11}{32}$in.). |
| Max. Overall Length ... ... | 100 mm. ($3\frac{15}{16}$in.). |
| Mounting Position ... ... | Should not be declined more than 45° below horizontal. |

### BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 5—Trigger. |
| Pin 2—Heater. | Pin 6—No Pin. |
| Pin 3—Anode. | Pin 7—Heater. |
| Pin 4—No Connection. | Pin 8—Cathode. |

### RATINGS.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 1·2 amp. |
| Max. Anode Voltage ... ... | 600 volts. |
| *Min. Trigger Supply Voltage ... | 350 volts. |
| Min. Cathode Current to maintain glow ... ... | 5 mA. |
| Volt Drop Across Tube (During Operation) ... | 30 (approx.). |
| Max. Modulation Frequency ... | 20 kc/s. |
| Max. Cathode Current ... | 100 mA. |
| Heating Time ... (see "Notes on Operation" overleaf). | |

### LIGHT SOURCE.

CL40. The End aperture is circular and approx. 3·2 mm. diameter.

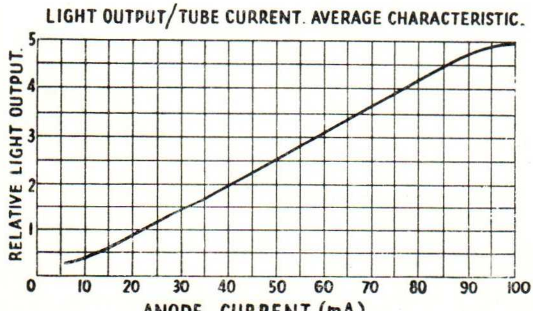
CL41. The End aperture is in the form of a slit of length 3·0 mm. and width 0·5 mm.

On both types the column of light viewed broadside presents an area approximately 24 × 5 mm.

### TYPICAL OPERATING CONDITIONS.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 |
| †Anode and Trigger Supply Voltage | 400 |
| Mean Anode Current ... ... | 50 mA. |
| Current Modulation ... ... | 50 % |

LIGHT OUTPUT/TUBE CURRENT. AVERAGE CHARACTERISTIC.

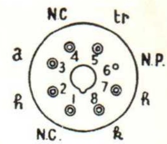



*See "Notes on Operation" overleaf.

†It is recommended that the Trigger is connected to the anode by an external resistance of 22,000 ohms.

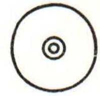
**CL40**

**CL41**

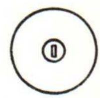



**Base Connections Underside View of Base**

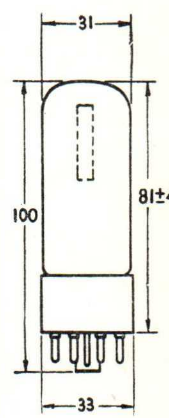
**Light Apertures**



**CL40**



**CL41**




All dimensions shown are in millimetres.

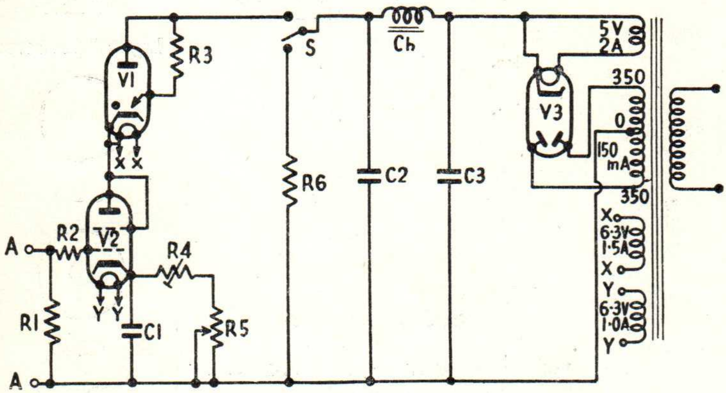
FERRANTI

Issue 1
Jan., 1955

NOTES ON OPERATION.

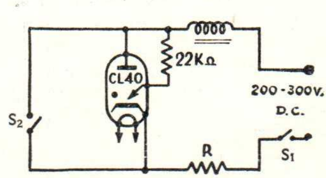
A recommended method of operation is to connect the CL40 in series with a hard valve which is capable of passing sufficient current to provide the required maximum modulation of the CL40.

The modulating signal is applied to the grid of this series valve at A.A. and the resultant changes in anode current of this valve produce corresponding variations in the CL40 anode current. In the typical circuit shewn below, the potentiometer R4 should be preset to limit the 807 cathode current to 100 mA. when R5 is at minimum resistance. R5 should then be adjusted so that the CL40 is operating at the required mean current.




| | | | | | |
|---|---|---|---|---|---|
| RI | 220kΩ | R5 | 2kΩ Pot. 3W. | C3 | 8μF. 500V Wkg. |
| R2 | 10kΩ | R6 | 47kΩ 5W. | VI | Ferranti CL40/1 |
| R3 | 22kΩ | Ch | 20 Henries. | V2 | Ferranti 807. |
| R4 | 300Ω Preset 3W. | CI | 50μF. 50V. Wkg. | V3 | Ferranti R52. |
| | | C2 | 16μF. 500V. Wkg. | | |

Under circumstances where only a limited DC. voltage is available it is possible to run the CL40 by utilising surge voltage to trigger the valve in a manner indicated in the following circuit diagram. The choke is not critical, a normal radio smoothing choke would be suitable but the resistor R should be chosen to limit the valve current to 100mA. Triggering is achieved by opening switch $S_2$.




IMPORTANT.

When the lamp is first installed or after a long period of rest, the heater should be operated at 6·3 volts for at least 5 mins. without the application of anode and striker voltages. Anode and striker potentials should then be applied and the lamp given a preliminary operating run for 15 mins. with anode current not greater than 50 mA.

On subsequent occasions before the lamp is put to normal use, it should have an initial run for 2 mins. at a heater voltage of 6·3 volts without the application of anode voltage, followed by a further period of 5 mins. during which the anode current is limited to 50 mA.

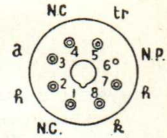
For applications where optimum stability of light output is required this second period should be extended to 10–15 mins.

Ferranti

# LINEAR LIGHT SOURCE

A Helium filled, end viewing, light source in which the light output is proportional to the anode current. The low noise content of this light source makes it particularly suitable for use in sound-on film recording, interferometers and many other applications.

CL42




**Base Connections Underside View of Base**

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal |
| Max. Overall Diameter ... ... | 29·5 mm. (1·16″) |
| Max. Seated Height ... ... | 75 mm. (2·95″) |
| Max. Overall Length ... ... | 90 mm. (3.55″) |
| Mounting Position ... ... | Any |

## BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection | Pin 5—Trigger |
| Pin 2—Heater | Pin 6—No Pin |
| Pin 3—Anode | Pin 7—Heater |
| Pin 4—No Connection | Pin 8—Cathode |

## LIGHT SOURCE.

The tube is designed for end viewing applications.
The end aperture is circular and approx. 4·0 mm. diameter

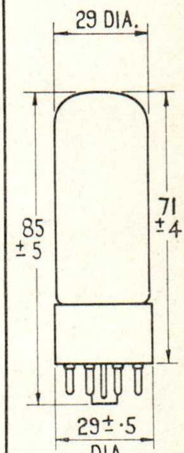
## HEATER.

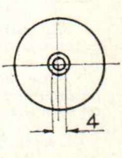
Suitable parallel operation only, a.c. or d.c.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts |
| Heater Current ... ... ... | 1·2 amps |

## RATINGS & CHARACTERISTICS.

| | |
|---|---|
| *Max. Trigger Voltage ... ... | 500 volts (d.c.) |
| Max. Mean Anode Current ... | 40 mA |
| Max. Peak Anode Current ... | 90 mA. |
| ‡Min. Cathode Current ... ... | 10 mA |
| Max. Anode/Cathode Volt Drop | 110 volts |
| §Min. Cathode Heating Time ... | 60 secs |




**Light Aperture**

Dimensions are in millimetres

## NOTES ON OPERATION.

(1). The trigger electrode should be connected to anode via a resistor—22 kΩ is the recommended value.

(2). Before the application of anode or trigger voltages, the tubes must be run with heater volts only applied for a period of at least one minute before application of H.T. voltage, followed by an unmodulated stabilising period of 5 minutes during which time the anode current should be near 40 mA.

(3). For optimum stability the anode supply should be derived from a stabilised D.C. power pack and the stabilising period mentioned in (2) increased to say 15 minutes.

*With trigger electrode connected to anode via a 22 kΩ resistor. If the supply voltage is below this value the valve may not trigger unless special circuitry is used as indicated on page 2.

‡In a circuit similar to that shown overleaf this is the lowest value of current to maintain the discharge. Operation at lower values can be achieved with special circuitry.

§Before application of the H.T. supply to anode or trigger. See 'Notes on Operation.

Issue 2.
May, 1962.

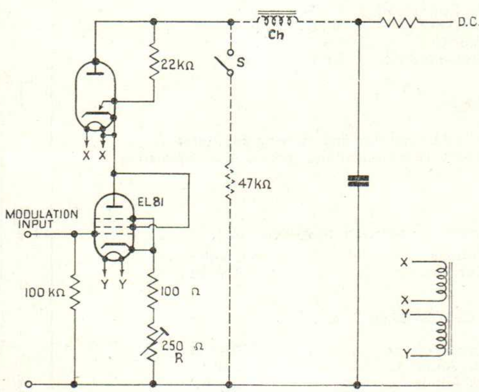
Ferranti

TYPICAL OPERATION.

A recommended simple method of operation is to connect the CL42 in series with a hard valve which is capable of passing sufficient current to provide the required maximum modulation.

The modulating signal is applied to the grid of this series valve and the resultant changes in anode current of this valve produce corresponding variations in the CL42 cathode current.

A diagram of a typical circuit of this type is shown below.




In the circuit above the cathode current of the EL81 is limited to the maximum rated peak current of the CL42 (i.e. 90 mA) by the pre-set resistance (R) in the cathode circuit.

This circuit is designed to operate from a supply voltage which is lower than the necessary trigger voltage. The method of operation is as follows:—

After the CL42 and EL81 have had the appropriate filament voltage applied for the necessary warm up time, (see 'Notes on Operation' below), the H.T. should be switched on with the switch 'S' closed.

Switch 'S' is then opened and the resultant surge will trigger the CL42.

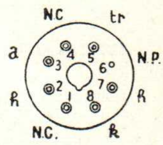
If the DC supply voltage is higher than the trigger voltage, the choke switch and resistor shown dotted may be omitted from the circuit.

CL44

Ferranti

# LINEAR LIGHT SOURCE

A Neon filled, end viewing, light source which can be modulated. The light output is proportional to the anode current.




**Base Connections Underside View of Base**

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal |
| Max. Overall Diameter ... ... | 29·5 mm. (1·16") |
| Max. Seated Height ... ... | 75 mm. (2·95") |
| Max. Overall Length ... ... | 90 mm. (3·55") |
| Mounting Position ... ... | Any |

## BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection | Pin 5—Trigger |
| Pin 2—Heater | Pin 6—No Pin |
| Pin 3—Anode | Pin 7—Heater |
| Pin 4—No Connection | Pin 8—Cathode |

## LIGHT SOURCE.

The end aperture is circular and approx. 4·0 mm. diameter. The tube is designed for end viewing applications, but the light may be viewed broadside if desired.

## HEATER.

Suitable parallel operation only, AC. or DC.

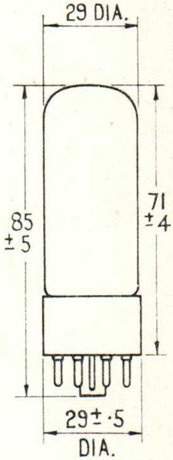
| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts |
| Heater Current ... ... ... | 1·5 amps |

## RATINGS.

| | |
|---|---|
| *Min. Supply Voltage ... ... | 400 volts (d.c.) |
| Max. Mean Anode Current ... | 40 mA |
| Max. Peak Anode Current ... | 90 mA |
| §Min. Cathode Heating Time ... | 60 secs |

## CHARACTERISTICS.

| | |
|---|---|
| †Max. Trigger Voltage ... ... | 400 volts (d.c.) |
| ‡Min. Cathode Current ... ... | 10 mA |
| Max. Modulation Frequency ... | 15 Kc/s |
| Max. Anode/Cathode Volt Drop | 55 volts |

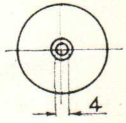



## NOTES ON OPERATION.

(1) The trigger electrode should be connected to anode via a resistor—20 kΩ is the minimum value.

(2) Before the application of anode or trigger voltages, the tubes must be run with heater volts only applied for a period of at least one minute before application of H.T. voltage. For use as a modulated light source this period should be followed by an unmodulated stabilising period of 5 minutes during which time the anode current should be near 40 mA.

(3) For optimum stability the anode supply should be derived from a stabilised DC. power pack and the stabilising period mentioned in (2) increased to say 15 minutes.




**Light Aperture**

Dimensions are in millimetres

*If the supply voltage is below this value the valve may not trigger unless special circuitry is used as indicated on the circuit diagram on Page 2.

§Before application of the H.T. supply to anode or trigger. See 'Notes on Operation (2)'

†With trigger electrode connected to anode via a 22 kΩ resistor.

‡In a circuit similar to that shown overleaf this is the lowest value of current to maintain the discharge. Operation at lower values can be achieved with special circuitry.


Issue 2.
Nov. 1962

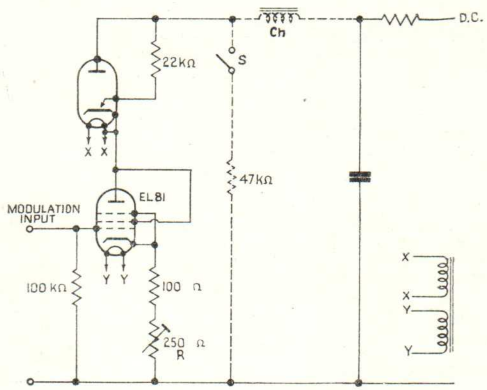

Ferranti

TYPICAL OPERATION.

A recommended simple method of operation as a modulated light source is to connect the CL44 in series with a hard valve which is capable of passing sufficient current to provide the required maximum modulation.

The modulating signal is applied to the grid of this series valve and the resultant changes in anode current of this valve produce corresponding variations in the CL44 cathode current.

A typical circuit of this type is shown below.




In this circuit the resistance (R) in the cathode circuit of the EL81 is pre-set to limit the cathode current of the EL81 to the maximum rated peak current of the CL44 (i.e. 90 mA).

This circuit is designed to operate from a d.c. supply voltage which is lower than the necessary trigger voltage. The method of operation is as follows:—

After the CL44 and EL81 have had the appropriate filament voltage applied for the necessary warm up time, (see 'Notes on Operation'), the H.T. should be switched on with the switch 'S' closed.

Switch 'S' is then opened and the resultant surge will trigger the CL44.

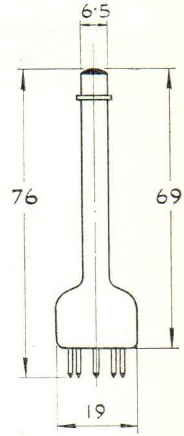
If the DC. supply voltage is higher than the trigger voltage, the choke, switch and resistor shown dotted may be omitted from the circuit.

Ferranti

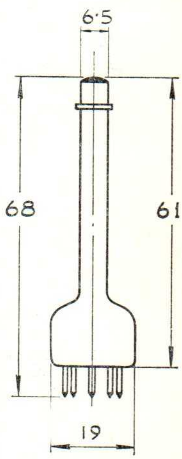
# LINEAR LIGHT SOURCES

Gas filled light sources in which the light output is proportional to the anode current. Used for phototelegraphic picture recording, sound film recording, time interval marking and stroboscopic and many other applications.

## CL50
## CL52




CL50




CL52

Dimensions are in millimetres (max.)

### PHYSICAL DETAILS.

| | | CL50 | CL52 |
|---|---|---|---|
| Max. Overall Length | ... | 68 | 76 mm. |
| Max. Seated Height | ... | 61 | 69 mm. |
| Base (both types) | ... | B7G. | |
| Top Cap (both types) | ... | CTI. | |

### GAS FILLING.

| | |
|---|---|
| CL50 ... ... ... ... | Mercury/Argon. |
| CL52 ... ... ... ... | Helium. |

### BASE CONNECTIONS.

CL50.

| | |
|---|---|
| Pin 1—I.C. | Pin 5—Trigger. |
| Pin 2—Cathode. | Pin 6, Pin 7 } Heater. * |
| Pin 3, Pin 4 } Heater. * | Top Cap—Anode |

CL52.

| | |
|---|---|
| Pin 1—Trigger. | Pin 5—Trigger. |
| Pin 2—Cathode. | Pin 6—No connection. |
| Pin 3—Heater. | Pin 7—Cathode. |
| Pin 4—Heater. | Top Cap—Anode. |

See diagrams overleaf.

### LIGHT SOURCE.

The source of light is cylindrical and extends downwards from the top cap. The effective broadside dimensions are approximately :—

| | |
|---|---|
| CL50 ... ... | 5×35 mm. |
| CL52 ... ... | 5×26 mm. |

### HEATER.

| | CL50 | CL52 | |
|---|---|---|---|
| Heater Voltage ... ... ... | 6·3 | 6·3 | volts. |
| Heater Current ... ... ... | 1·25 | 1·5 | amps. |

### RATINGS & CHARACTERISTICS.

| Type No. | CL50 | CL52 | |
|---|---|---|---|
| Gas | Hg/A | He | |
| †Min. Supply Voltage ... ... | 375 | 500 | volts(d.c.). |
| Max. Mean Anode Current ... | 50 | 40 | mA. |
| Max. Peak Cathode Current ... | 100 | 90 | mA. |
| ‡Min. Cathode Current ... ... | 8 | 10 | mA. |
| Anode/Cathode Volt Drop ... | 35 | 95 | volts (apx). |

§Min. Cathode Heating Time—See Notes on Operation.

### TYPICAL OPERATION.

A recommended simple method of operation is to connect the CL50/52 in series with a hard valve which is capable of passing sufficient current to provide the required maximum modulation of the CL50/52.

The modulating signal is applied to the grid of this series valve and the resultant changes in anode current of this valve produce corresponding variations in the CL50/52 cathode current.

A diagram of a typical circuit of this type is shown overleaf.

---

*Pins 3 & 4 are connected to one end of the heater and the other end is connected to both pins 6 & 7. (see diagrams overleaf).

†This is the maximum voltage required to trigger the lamp.

‡In a circuit as shown overleaf this is the lowest value of current to maintain the discharge. Operation at lower values can be achieved with special circuitry.

§Before application of the HT supply to anode or trigger.

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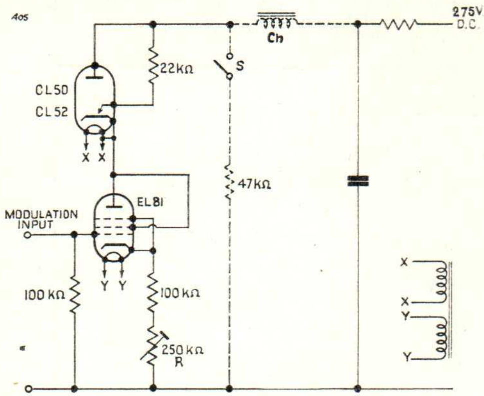
Aug. 1961

Ferranti

TYPICAL OPERATION (cont'd).




In the circuit above the cathode current of the EL81 is limited to 100 mA for CL50 or 90 mA for CL52 by the pre-set resistance (R) in the cathode circuit.

This circuit is designed to operate either tube from a supply voltage which is lower than the necessary trigger voltage. The method of operation is as follows:-

After the CL50 or CL52 and EL81 have had the appropriate filament voltage applied for the necessary warm up time, (see notes on operation (2) below), the H.T. should be switched on with the switch S closed.

Switch S is then opened and the resultant surge will trigger the CL50 or CL52.
If the DC supply voltage is higher than the appropriate trigger voltage, the choke switch and resistor shown dotted may be omitted from the circuit.

NOTES on OPERATION.

(1). The trigger electrode should be connected to anode via a resistor - 22Kohms is the recommended value.

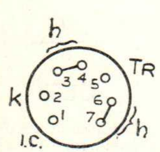
(2). Before the application of anode or trigger voltages, the tubes must be run with heater volts only applied as indicated below.

(a). Type CL50 - When first installed or after long inoperative periods the heater should be run at full voltage for at least 5 minutes - followed by a stabilising period after application of anode voltage of say 10 minutes without modulation and anode current not exceeding 50 mA.

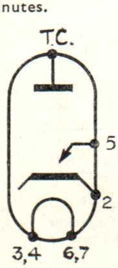
On subsequent occasions the heater warm up time can be reduced to 2 minutes and the stabilising period to say 5 minutes.

(b). Type CL52 - On all occasions the heater voltage should be applied at least one minute before H.T. voltage followed by an unmodulated stabilising period of 5 minutes during which time the anode current should be near 40 mA.

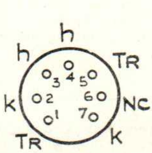
(3). For optimum stability the anode supply should be derived from a stabilised D.C. power pack and the stabilising period mentioned in (2) increased to say 15 minutes.



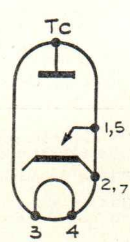

**Underside view of base**




**CL50**




**Underside view of base**



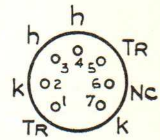

**CL52**

# Ferranti

## SPECTRAL LIGHT SCOURCES

| CL 55 |
|---|
| CL 56 |
| CL 57 |
| CL 58 |

Light Sources filled with spectrally pure gas. These spectral sources can be used in cases where a known line spectrum is required and the form of construction makes them particularly suitable for uses requiring a compact source or where a close approach to the actual source is necessary.
The light output is roughly proportional to the anode current.




**Underside view of base**

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B7G |
| Max. Overall Length ... ... | 68 mm. |
| Max. Seated Height ... ... | 61 mm. |
| Top Cap ... ... ... | CT1. |

### GAS FILLING.

| | |
|---|---|
| CL55 ... ... ... ... | Helium. |
| CL56 ... ... ... ... | Krypton. |
| CL57 ... ... ... ... | Neon. |
| CL58 ... ... ... ... | Xenon. |

### LIGHT SOURCE.

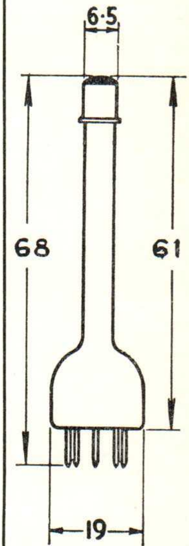
The source of light is cylindrical with an effective broadside dimension of 5×32 mm. approx. and extends downwards from the top cap.

### BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Trigger. | Pin 5—Trigger. |
| Pin 2—Cathode. | Pin 6—No connection. |
| Pin 3—Heater. | Pin 7—Cathode. |
| Pin 4—Heater. | Top Cap—Anode. |

### HEATER.

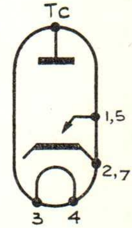
| | CL55 | CL56 | CL57 | CL58 | |
|---|---|---|---|---|---|
| Heater Voltage ... | 6·3 | 6·3 | 6·3 | 6·3 | volts. |
| Heater Current ... | 1·5 | 1·5 | 1·3 | 1·5 | amps. |




Dimensions are in millimetres (max.)

### RATINGS & CHARACTERISTICS.

| Type No. | CL55 | CL56 | CL57 | CL58 | |
|---|---|---|---|---|---|
| Gas | He. | Kr. | Ne. | Xe. | |
| *Min. Supply Voltage | 500 | 375 | 400 | 375 | volts(d.c.). |
| Max. Mean Anode Current ... | 40 | 50 | 40 | 50 | mA. |
| Min. Cathode Current | See Note * below. | | | | |
| Max. Peak Cathode Current ... | 90 | 90 | 90 | 90 | mA. |
| Anode/Cathode Volt Drop ... | 95 | 15 | 55 | 12 | volts.(Apx) |
| †Min. Cathode Heating Delay (all types) | — 60 — | | | | sec. |




*It is recommended that the trigger electrode is connected to the anode through a 22,000 ohm resistor. Under these conditions the minimum anode current to maintain the discharge is less than 10 mA.
*This is the maximum voltage required to trigger the lamp.
†Before application of the HT supply to anode or trigger.

Ferranti

Issue 2.
Apr., 1961

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

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| CL 55 |
|---|
| CL 56 |
| CL 57 |
| CL 58 |

## TYPICAL OPERATION

For most applications in which a light source of predetermined and relatively constant brightness is required the circuit of Fig. 1 is suitable. If it is desired to operate the lamp at various levels of brightness the series resistor R should be variable. The value of R should be chosen to limit the current to within the specified rating.

The lamp should first be allowed to stabilise at near maximum mean current for a few minutes after which the series resistance can be increased to reduce the current through the lamp.

If it is required to have a light source that can be continuously controlled, the circuit of Fig. 2 should be used. The control signal is applied to the pentode control grid at A.

When greater stability is required in either of the above circuits the HT supply to the lamp (and pentode) should be derived from a stabilised DC power pack.

In circumstances where the available DC voltage is limited and lower than the specified minimum supply voltage, it is possible to start the lamp by utilising a surge voltage in the manner indicated in Fig. 3. Triggering is achieved by opening S2 with S1 closed. The value of the choke is not critical but the resistance at R must limit the current through the lamp to 40 mA.

In all cases provision should be made for the cathode heating delay before application of HT voltage.

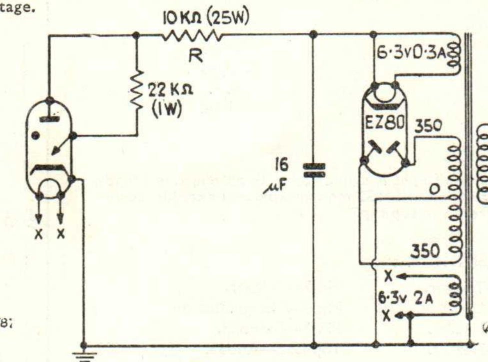



Fig. 1.

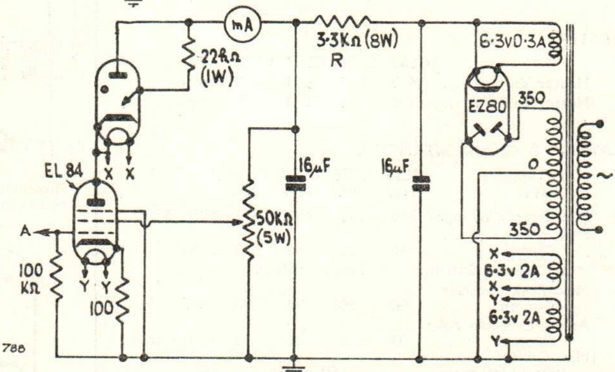



Fig. 2.

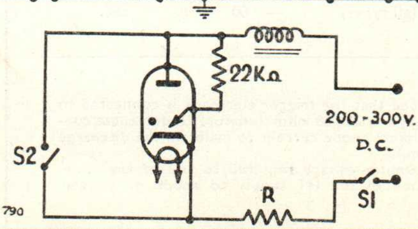



Fig. 3.

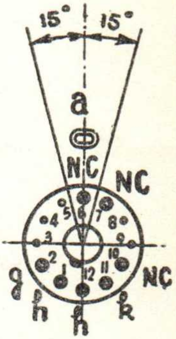
# FERRANTI

## VACUUM LIGHT SOURCES — HIGH SPEED STROBOSCOPIC LIGHT SOURCES

Small grid controlled Triode Tubes designed to produce single light flashes or trains of light flashes of high luminous intensity ; they are also suitable for continuous stroboscopic working at high repetition rates. The seven types differ only in the type of screen phosphor employed.

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Side Contact ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 221 mm. (8¾in.). |
| Max. Diameter ... ... ... | 95mm. (3¾in.). |
| Nom. Neck Diameter ... ... | 35 mm. |
| Mounting Position ... ... | Any. |




### SCREEN FLUORESCENCE.

| *Type* | *Phosphor* | *Luminescence* | *Decay Time** |
|---|---|---|---|
| CL60 | A type | Green | $<1\mu$sec. |
| CL61 | P type | Blue | $5\mu$secs. approx. |
| CL62 | Q type | Ultra-Violet | $0{\cdot}1\mu$sec. approx. |
| CL63 | C type | Yellow-Green | $6\mu$secs. approx. |
| CL64 | V type | Yellow | $5\mu$secs. approx. |
| CL65 | R type | Red | $2\mu$secs. approx. |
| CL66 | T type | White | $5\mu$secs. approx. |

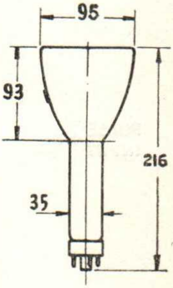
### BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No connection. |
| Pin 2—Grid. | Pin 8—No pin. |
| Pin 3—No pn. | Pin 9—No pin. |
| Pin 4—No pin. | Pin 10—No connection. |
| Pin 5—No pin. | Pin 11—Cathode. |
| Pin 6—No connection. | Pin 12—Heater. |

Side Contact—Anode.

### HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |




### RATINGS AND CHARACTERISTICS.

| | |
|---|---|
| ‡Max. Anode Voltage ... ... | 20 kV. |
| Max. Anode Current (Pulsed) ... | 100 mA. |
| **Max. Mean Anode Current ... | 200 $\mu$A. |
| Grid Volts for Cut off ... | –30 to –80 volts. |
| Grid drive for Max. Anode Current | 150 volts max. |

### LIGHT OUTPUT ($V_a$ = 20 kV—100 mA peak beam current, using eye corrected photometer).

| | |
|---|---|
| CL60 ... ... ... | 10,000 candelas approx. |
| CL61 ... ... ... | 16,000 candelas approx. |
| CL62 ... ... ... | 240 candelas approx.†† |
| CL63 ... ... ... | 24,000 candelas approx. |
| CL64 ... ... ... | 12,000 candelas approx. |
| CL65 ... ... ... | 14,000 candelas approx. |
| CL66 ... ... ... | 12,000 candelas approx. |

†See Phosphor Characteristic Curves on pages 2 and 3.
*To 1/e level.
‡The anode voltage may be raised to 25 kV. in applications where the presence of constant 'background illumination' of a low level can be tolerated. Alternatively the anode may be pulsed up to 35 kV. for applications where greatest light output is required for single flashes of short duration trains of flashes.
**Averaged over a period 1 min. For shorter periods mean anode currents of up to 400 $\mu$A. may be used. For periods of not more than 1 sec. mean currents up to 3 mA. may be used.
††Most of the output of the Q phosphor is in the extreme violet.

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Aug, 1958

FERRANTI

| |
|---|
| CL60 |
| CL61 |
| CL62 |
| CL63 |
| CL64 |
| CL65 |
| CL66 |

FERRANTI

## LUMINOUS AREA.

The unfocused luminous area is 5 cm. dia. minimum. The fluorescent area may be reduced to approx. ¼in. diameter by means of a suitable focus coil : under this condition care must be taken to avoid damaging the phosphor by overloading.

## FLASH DURATION.

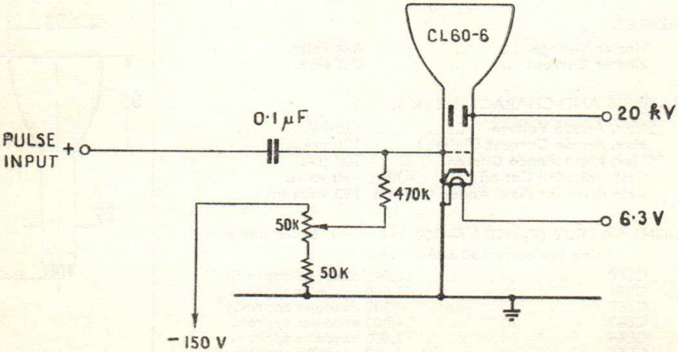
The minimum duration of the flash depends on the duration of the grid pulse and on the screen phosphor. With CL60 and CL62 the flash duration can be reduced to less than 1 microsecond.

## FLASH FREQUENCY.

Any repetition rate can be employed within the characteristics of the particular screen phosphor provided the maximum mean current rating is not exceeded.

## TYPICAL OPERATION.

The usual method of operation of these Flash Tubes is to apply positive going pulses to the negatively biased control grid. A typical circuit is shewn on the following diagram :—

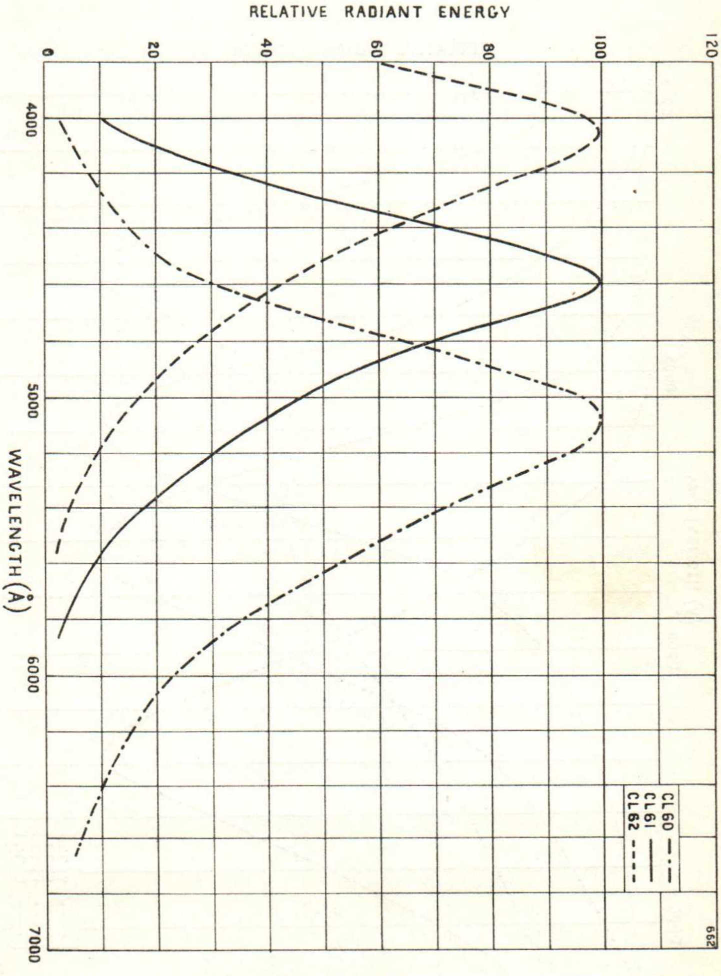



The negative bias on the control grid is set by means of the potentiometer so that when H.T. is applied to the anode there is no anode current flowing or that there is no illumination of the screen. When the positive pulses are applied to the grid the anode current flows and the screen fluoresces. The brightness duration and frequency of the flash are respectively controlled by the amplitude, duration and P.R.F. of the pulses as applied to the grid. These pulses should be derived from a low impedance source and should not have an amplitude in excess of 200 volts but the maximum anode current of the CL60-66 should not exceed 100 mA. in any case.

| |
|---|
| CL60 |
| CL61 |
| CL62 |
| CL63 |
| CL64 |
| CL65 |
| CL66 |

# TYPICAL PHOSPHOR CHARACTERISTICS IN THE VISIBLE SPECTRUM

(NOTE—The curves are not relative to each other)







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| |
|---|
| CL60 |
| CL61 |
| CL62 |
| CL63 |
| CL64 |
| CL65 |
| CL66 |

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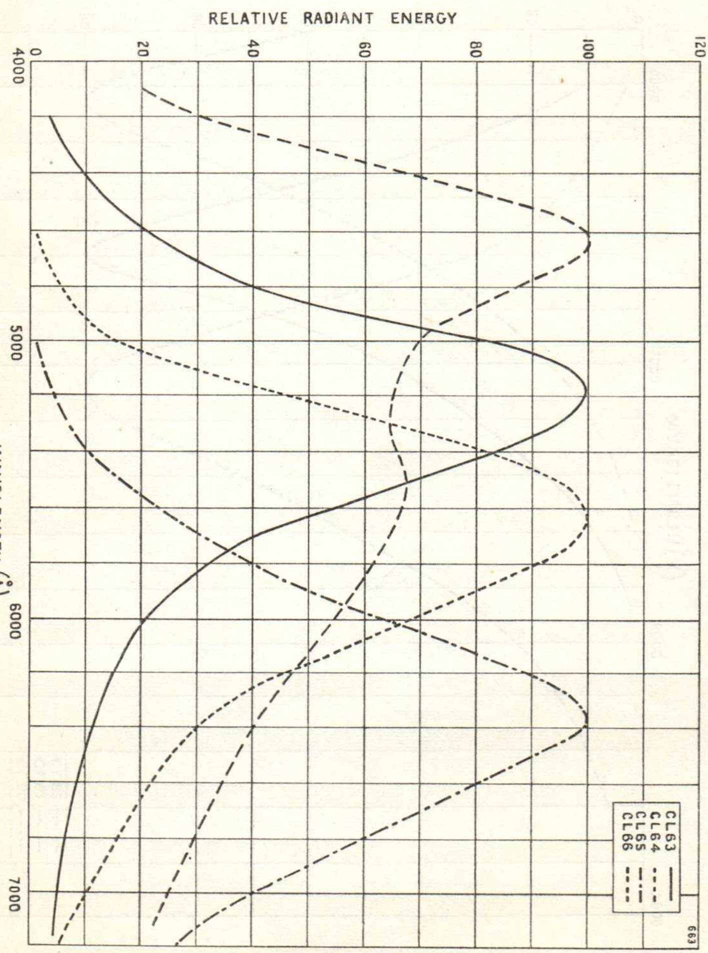
# TYPICAL PHOSPHOR CHARACTERISTICS IN THE VISIBLE SPECTRUM

(NOTE—The curves are not relative to each other)



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# STROBOSCOPIC LIGHT SOURCE

A Xenon filled arc discharge lamp intended primarily for use as a Stroboscopic Light Source for low repetition frequencies up to 30 per second. The reflector is an integral part of the design and the trigger pulse transformer is incorporated in the base.

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | UX6. |
| Max. Seated Height ... ... | 86 mm. ($3\frac{3}{8}$in.). |
| Overall Length ... ... ... | 102mm. ($4\frac{1}{64}$in.). |
| Diameter of Reflector ... ... | 105mm. ($4\frac{1}{8}$in.). |
| Diameter of base ... ... | 35mm. ($1\frac{3}{8}$in.). |
| *Mounting Position ... ... | Any. |

## PIN CONNECTIONS.

| | |
|---|---|
| Pin 1—Cathode. | Pin 5—I.C. |
| Pin 2—Trigger earth. | Pin 6—I.C. |
| Pin 3—Trigger input. | |
| Pin 4—Anode. | |

## RATINGS.

| | |
|---|---|
| Max. A.C. Supply Voltage ... | 240 volts (r.m.s.). |
| Max. Anode Voltage (Static) ... | 300 volts d.c. |
| Max. Anode Voltage (Working) | 240 volts d.c. |
| Min. Anode Voltage (Working) | 180 volts d.c. |
| Max. Dissipation ... ... | 12 watts. |
| Max. Energy per Flash ... ... | 1 joule. |
| Max. Discharge Capacitor ... | 16 μF. |
| Min. Value of Charging Resistor | 500 ohms. |

## CHARACTERISTICS.

| | |
|---|---|
| Max. Flashing Frequency ... | 30 per second. |
| Trigger Voltage ... ... ... | see Note 1 overleaf. |

## TYPICAL OPERATION.

as Stroboscopic Light Source.

| | |
|---|---|
| Anode Voltage ... ... | 230 volts. |
| Charging Resistor : | |
| 1—15 c/s. ... ... | 500 ohms. |
| 16—30 c/s. ... ... | 1000 ohms. |
| Discharge Capacitor | |
| 1—15 c/s. ... ... | 16 μF. |
| 16—30 c/s. ... ... | 4 μF. |

A simple circuit for operation from a.c. mains is shown overleaf.

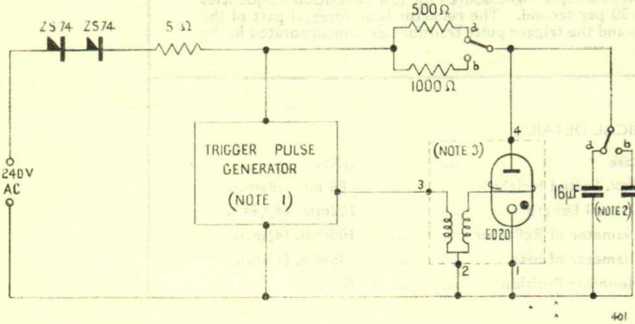
*The recommended method of mounting is by support at the flange of the reflector.

Tentative
Issue 1
Mar., 1961

Ferranti

TYPICAL OPERATION (Cont.).

**Circuit diagram for operation as a Stroboscopic Light Source from A.C. supplies with silicon rectifiers and 2 range frequency switching.**




Note 1.

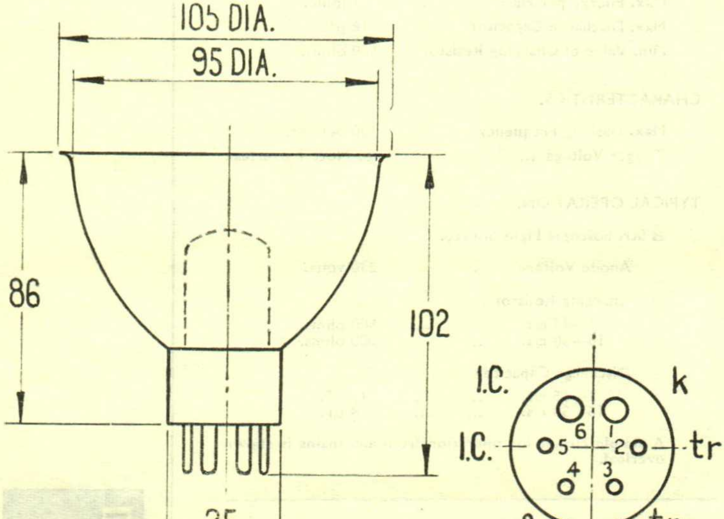
The trigger pulse generator circuit may use either valve or semi-conductor devices. It can conveniently consist of a means of controlling the frequency of a discharge through the primary of the built in transformer. A suitable discharge may be obtained from a capacitor of approx. 0·1 μF charged to 150 volts.

Note 2.

The capacitors should be good quality paper type—electrolytic capacitors are unsuitable.

Note 3.

The figures refer to the valve pin connections.

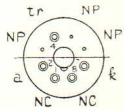


**ED25**

Ferranti

# STROBOSCOPIC LIGHT SOURCE

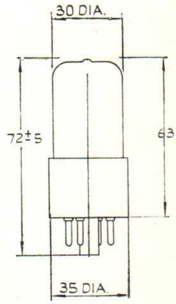
A gas filled cold cathode arc discharge tube designed for use in stroboscopic applications at frequencies up to 150 flashes per second. It emits a white light.




**Underside View of Base**

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Seated Height ... ... | 63 mm. (2·48") |
| Max. Overall Length ... ... | 77 mm. (2·86") |
| Max. Diameter ... ... ... | 35 mm. (1·38") |
| Mounting Position ... ... | Any (Vertical-base down preferred) |




PIN CONNECTIONS.

| | |
|---|---|
| Pin 1—Anode | Pin 5—Blank |
| Pin 2—Anode | Pin 6—Blank |
| Pin 3—Blank | Pin 7—Cathode |
| Pin 4—Trigger | Pin 8—Cathode |

RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... | 500 volts |
| Max. Flash repetition rate ... | 150 per sec. |
| Max. Discharge Capacitor ... | 8 $\mu$F |

TYPICAL OPERATION.

| | |
|---|---|
| D.C. Supply Voltage ... ... | 450 volts |
| *Trigger Voltage ... ... ... | 2 to 4 kV |
| Discharge Capacitor ... ... | 0·5 $\mu$F |
| Charging Resistance ... ... | 8000 ohms |
| Flash Repetition Rate ... ... | 150 per sec. |

Dimensions in Millimetres

See overleaf for a typical stroboscope circuit with suitable component values.

*A suitable trigger pulse transformer is Ferranti Type PT56.

Ferranti

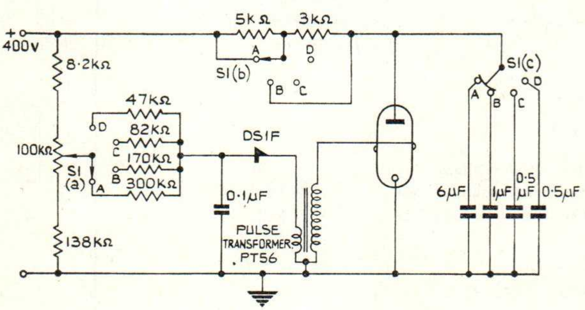
Issue 2.
Aug. 1962.

TYPICAL OPERATION (Continued).

The circuit of a Stroboscope offering repetition rates up to 150 flashes per second in 4 ranges is shown below.

The approximate frequency of the four ranges is as follows.

| | | | |
|---|---|---|---|
| Switch in position | A ... | 100–150 c/s | (6000–9000 r.p.m.) |
| | B ... | 30–100 c/s | (1800–6000 r.p.m.) |
| | C ... | 15– 30 c/s | ( 900–1800 r.p.m.) |
| | D ... | 1– 15 c/s | ( 60– 900 r.p.m.) |




The resistors R1 or R2 should be of the vitreous type with a dissipation rating of 14 watts.

The above range coverage is only applicable with an input voltage of 400 V D.C. and with resistors of close tolerance (5%).

Ferranti

# STROBOSCOPIC LIGHT SOURCE

A Xenon filled stroboscopic Flash Tube designed for low voltage operation for use in applications at frequencies up to 250 flashes per second. It emits a white light.

## PHYSICAL DETAILS.

| | |
|---|---|
| Electrode Connections ... | Flexible Leads |
| Max. Overall Length (excl. leads) | 45 mm. (1·772″) |
| Max. Width ... ... ... | 20 mm. (·787″) |
| Max. Diameter of Glass Tube | 7 mm. (·276″) |

## ELECTRODE CONNECTIONS.

The anode lead is marked red.

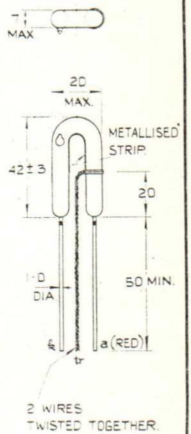
## RATINGS.

| | |
|---|---|
| Max. Anode Voltage (Static) | 600 volts |
| Max. Anode Voltage (Working) | 500 volts |
| Min. Anode Voltage (Working) | 350 volts |
| Max. Flash repetition rate ... | 250 per sec |
| Max. Dissipation ... ... | 6 watts |
| Min. Charging Resistor ... | 7·5 kΩ |

## TYPICAL OPERATION.

| | |
|---|---|
| DC. Supply Voltage ... ... | 450 volts |
| *Trigger Voltage ... ... | 4 to 6 kV |
| Charging Resistance ... ... | 7·5 kΩ |
| Discharge Capacitor:— | |
| 0—25 f.p.s. ... ... | 2·0 μF |
| 25— 50 f.p.s. ... ... | 1·0 μF |
| 50—150 f.p.s. ... ... | 0·5 μF |
| 150—250 f.p.s. ... ... | 0·25 μF |

See overleaf for a typical stroboscope circuit with suitable component values.




Dimensions in Millmetres

*A suitable trigger pulse transformer is Ferranti Type PT.56.

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Ferranti

TYPICAL OPERATION (Continued).

The circuit of a Stroboscope providing repetition rates up to 250 flashes per second in 4 ranges is shown below.

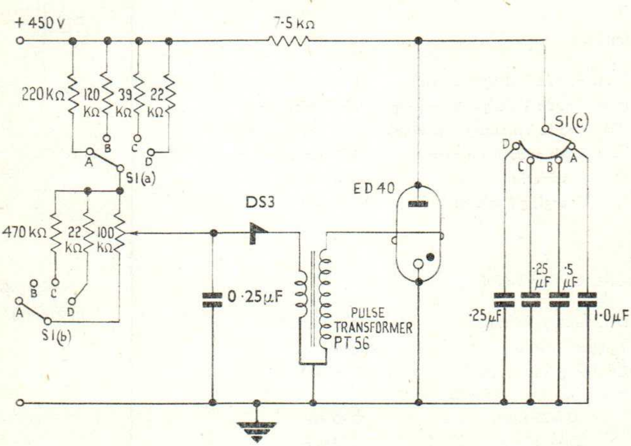
In this equipment a silicon p-n-p-n switch (Ferranti type DS.3) is used to provide a simplified trigger circuit.

The repetition rate is controlled by the 100kΩ potentiometer which may be calibrated.

Switches S1(a), S1(b) and S1(c) are ganged.

The approximate flashing frequency of the four ranges is as follows:

| | | | |
|---|---|---|---|
| Switch in position | A | ... | 15— 25 f.p.s. ( 900—1500 r.p.m.) |
| | B | ... | 25— 50 f.p.s. (1500—3000 r.p.m.) |
| | C | ... | 50—140 f.p.s. (3000—8000 r.p.m.) |
| | D | ... | 140—250 f.p.s. (8400—15000 r.p.m.) |




The 7·5 kΩ charging resistor should be preferably of the vitreous type with a dissipation rating of 14 watts.

As the frequency of operation of the p-n-p-n switch is dependent on voltage, the above range coverage is only applicable with an input voltage of 450 V D.C. and with resistors of close tolerance (5%).

Other types of controlled trigger circuits to produce the necessary triggering pulse for the ED.40 may of course be used.

**Ferranti**

# STROBOSCOPIC LIGHT SOURCE

A Xenon filled stroboscopic Flash Tube designed for low voltage operation in applications requiring a linear source at low repetition rates. It emits a white light.

## PHYSICAL DETAILS.

| | |
|---|---|
| Electrode Connections ... ... | Flexible Leads |
| Max. Overall Length (excl. leads) | 95 mm. (3·7″) |
| Min. Lead Length ... ... | 50 mm. (1·9″) |
| Max. Diameter of Glass Tube ... | 8 mm. (0·3″) |
| Effective Flash Length ... ... | 40 mm. (1·6″) |

For other dimensions see outline drawing.

## ELECTRODE CONNECTIONS.

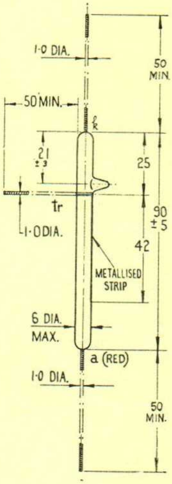
The anode lead is marked red.

## RATINGS.

| | |
|---|---|
| Max. Anode Voltage (Static) ... ... | 600 volts |
| Max. Anode Voltage (Working) ... | 550 volts |
| Min. Anode Voltage (Working) ... | 350 volts |
| Max. Flash repetition rate ... ... | 10 per sec |
| Max. Dissipation ... ... ... | 10 watts |
| Min. Charging Resistor ... ... ... | 7·5 kΩ |

## TYPICAL OPERATION.

| | | | |
|---|---|---|---|
| DC. Supply Voltage ... ... | 350 | 500 | volts |
| *Trigger Voltage ... ... ... | 4 to 6 | 4 to 6 | kV |
| Charging Resistor ... ... | 7·5 | 7·5 | kΩ |
| Discharge Capacitor:— | | | |
| 0—10 f.p.s. ... ... ... | 32 | 8·0 | μF |




Dimensions in Millmetres

*A suitable trigger pulse transformer is Ferranti Type PT.56.

Tentative
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Nov., 1962

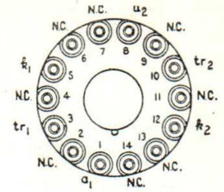
**Ferranti**

# Ferranti

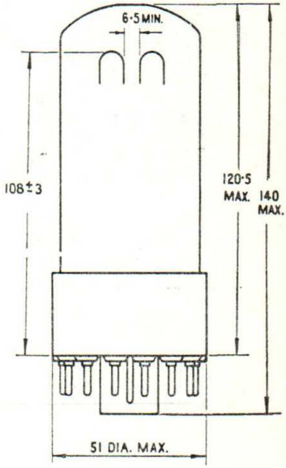
EDN10

## STROBOSCOPIC LIGHT SOURCE

A xenon filled cold cathode arc discharge tube incorporating two independent EN55 assemblies. The tube is designed for stroboscopic operation with interlaced trigger circuits to provide flash rates of up to 800 per second. (The tube can be operated at flash rates of 1000 per second in specially designed circuits.) It emits a white light.




Base Connections
Underside View of Base




All dimensions shown are in millimetres

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... | B14A (Diheptal) |
| Max. Seated Height | 120·5 mm. (4·74″) |
| Max. Overall Length | 140 mm. (5·51″) |
| Max. Dia. (over base) | 51 mm. (2·08″) |
| Mounting Position... | Any |

BASE CONNECTIONS.

Pin 1—Anode 1
Pin 2—No Connection
Pin 3—Trigger 1
Pin 4—No Connection
Pin 5—Cathode 1
Pin 6—No Connection
Pin 7—No Connection
Pin 8—Anode 2
Pin 9—No Connection
Pin 10—Trigger 2
Pin 11—No Connection
Pin 12—Cathode 2
Pin 13—No Connection
Pin 14—No Connection

RATINGS. (Each section)

(All maximum ratings are 'absolute')

| | |
|---|---|
| Max. Anode Voltage (DC. Static) ... | 1000 volts |
| Max. Anode Voltage (working) ... | 900 volts |
| Min. Anode Voltage (working) ... | 700 volts |
| *Max. Dissipation ... ... ... ... | 20 watts |
| Max. Discharge Capacitor ... ... | 6 μF |
| †Min. Charging Resistor (12–150 c/s) ... | 8 kΩ |
| (150–400 c/s) ... | 11 kΩ |
| Max. Operating Frequency ... ... | 400 c/s |

CHARACTERISTICS.

| | |
|---|---|
| ‡*Trigger Voltage ... ... ... | 2–4 kV |
| §Typical Peak Luminous Intensity ... | 140,000 Candelas |
| §Typical Flash Duration at $\frac{1}{3}$ peak ... | 25–30 μSec |

*See Notes on Operation—Page 2.
†For stroboscopic operation these resistors should be rated for 25W dissipation.
‡Peak pulse voltage.
§$V_a = 900$ $C = 6\mu F$.

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Nov., 1963

NOTES ON OPERATION.

**Discharge Capacitor.** Should be a good quality type with sufficient working voltage continuous rating, preferably non-inductive and designed for high current pulse operation.

**Discharge Energy.** It is important to ensure that the energy dissipated in the tube does not exceed the maximum rating given on Page 1. Over-running the tube even for very short periods may cause permanent damage, resulting in erratic operation particularly at the higher frequencies and/or shortened life.

**Trigger Voltage.** The trigger voltage is the peak pulse voltage.

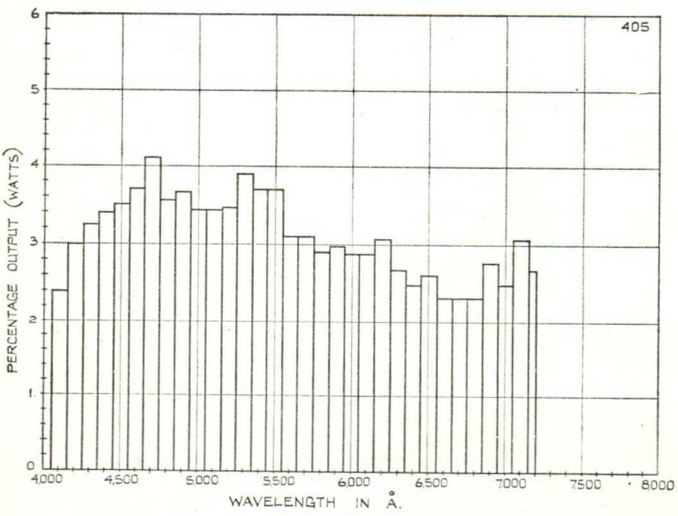
**Connecting Leads.** Because of the very high peak current of the discharge all the leads in the discharge path connecting the capacitor with anode and cathode should be of heavy gauge and as short as possible in order to ensure the maximum discharge energy.

**Flash Duration.** The duration of the light flash with a 4 μF. capacitor charged to 800 volts is approximately 15–20 microseconds at $\frac{1}{3}$ of the peak luminous intensity. Higher energy discharges will lengthen the duration of the discharge and lower energy discharges are shorter.

**WARNING.** The use of high voltages and capacitances constitutes a hazard and care should be taken in operating or repairing any equipment incorporating these tubes.

**SPECTRAL CHARACTERISTICS.**

DISTRIBUTION OF RATE OF EMISSION OF ENERGY OVER THE VISIBLE SPECTRUM.



**EN10**

# Ferranti

## "NEOSTRON" STROBOSCOPIC LIGHT SOURCE

Designed for use in Stroboscopic applications, the Ferranti 'Neostron' is a cold cathode tetrode gas discharge tube emitting a reddish light. Operating frequency can be controlled by low voltage, low energy pulses. Also suitable for operation as a relay valve providing high peak current pulses.

PHYSICAL SPECIFICATION.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Seated Height ... ... | 89 mm. ($3\frac{1}{2}$in.). |
| Max. Overall Length ... ... | 103 mm. ($4\frac{1}{16}$in.). |
| Max. Base Diameter ... ... | 32 mm. ($1\frac{1}{4}$in.). |
| Length of Arc ... ... ... | 24 mm. ($\frac{15}{16}$in.). |
| Mounting Position ... ... | Any. |

PIN CONNECTIONS.

Pin 1—No Connection.
Pin 2—No Connection.
Pin 3—Anode.
Pin 4—Trigger Electrode 2.
Pin 5—Trigger Electrode 1.
Pin 6—No Pin.
Pin 7—No Connection.
Pin 8—Cathode.

RATINGS (Maximum Ratings are 'Absolute' ratings).

| | |
|---|---|
| Max. Anode Voltage (static) ... ... | 440 volts. |
| Max. Anode Voltage (working) ... | 380 volts. |
| Min. Anode Voltage (working) ... | 240 volts. |
| Max. Peak Inverse Anode Voltage ... | 350 volts. |
| Max. Average Anode Current ... ... | 100 mA. |
| Max. Discharge Capacitance ... ... | 16 $\mu$F. |
| Max. Average Trigger Current... ... | 10 mA. |

CHARACTERISTICS.

| | |
|---|---|
| *Static striking voltage ($tr_2$ to $tr_1$) ... | 80–130 volts. |
| Max. flashing frequency ... ... | 250 per sec. |
| Min. trigger current required at $V_a$ 380 | 50 $\mu$A. |
| Min. trigger current required at $V_a$ 240 | 300 $\mu$A. |
| †Peak Luminous Intensity ... ... | 700 candelas. |
| †Flash Duration at $\frac{1}{3}$peak ... ... | 15 $\mu$Sec. |
| †Peak Anode Current ... ... ... | 400 amps. |
| §Triggering delay ... ... ... ... | < 40 $\mu$Sec. |

TYPICAL OPERATION as Stroboscopic Light Source:—

| | |
|---|---|
| DC. supply voltage ... ... | ...300–330 volts. |
| $Vtr_2$ at triggering instant ... ... | 70 volts. |
| Trigger pulse amplitude ($Vtr_1$) ... | −150 volts(min.). |
| Charging resistor ... ... ... | 3000 ohms. |

Discharge Capacitor for Operation at:—

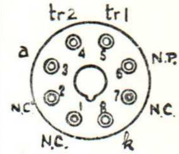
| | | |
|---|---|---|
| | 6–35 f.p.s. ... | 4 $\mu$F. |
| Up to | 50 f.p.s. ... | 3 $\mu$F. |
| to | 80 f.p.s. ... | 2 $\mu$F. |
| to | 150 f.p.s. ... | 1 $\mu$F. |
| to | 250 f.p.s. ... | 0·5 $\mu$F. |

The voltage applied to $tr_2$ should be positive with respect to the cathode and the trigger pulse applied to $tr_1$ should be negative.
The discharge capacitor should be a good quality type suitable for heavy current pulse operation.

*$tr_1$ negative to $tr_2$. This range of trigger voltage quoted is for single flash operation or for operation with long intervals between flashes. For repetitive flash operation as in stroboscopic applications a higher trigger voltage is necessary.

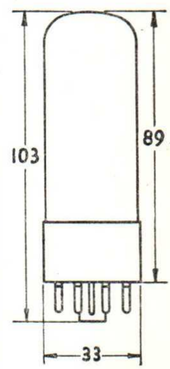
†Va = 380 volts. C = 4 $\mu$F.

§See 'Notes on Operation'.




**Base Connections**

**Underside View of Base**




All dimensions shown are in millimetres.

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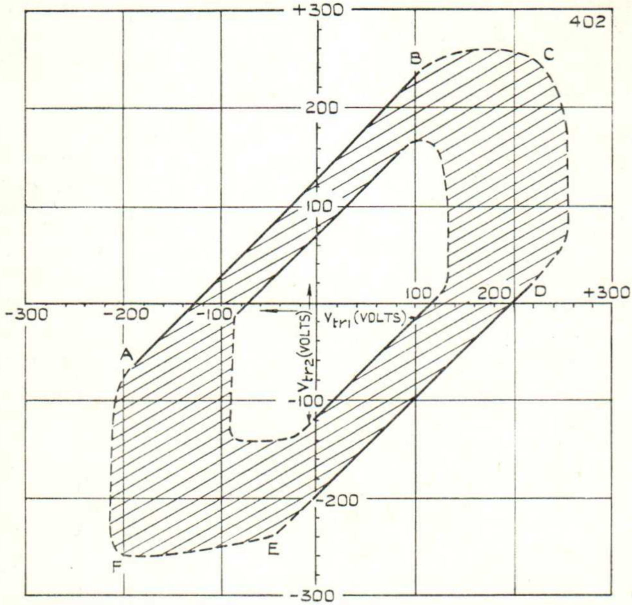
Dec., 1961

## AVERAGE STATIC TRIGGERING CHARACTERISTICS.




The unshaded area enclosed by the loops is an area of non-conduction. If the vector sum of the voltages on two trigger electrodes lies within the loop the valve will not fire. Any change of either or both of these voltages which causes the vector sum to fall outside the loop will trigger the valve.

The inner loop is applicable to tubes with trigger voltage at the lower limit and the outer loop applies to tubes on the upper trigger voltage limit.

To ensure reliable operation and interchangeability with any tube, the vector sum of the two trigger electrodes must fall outside the outer loop.

For repetitive pulse operation it is usually necessary to ensure that the pulse has a sufficient excess voltage (See 'Notes on Operation').

As the triggering impulse carries the vector sum of the applied voltages outside the loop the point at which it crosses the loop indicates the manner in which the valve is triggered as follows:—

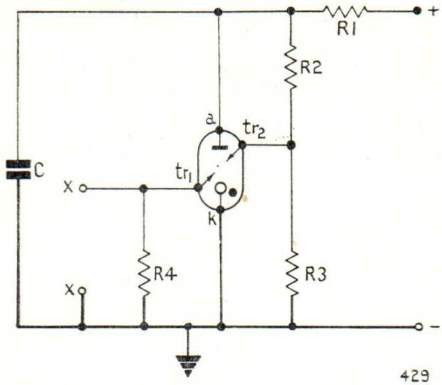
Between BC Trigger Electrode 2 to Cathode.
CD Trigger Electrode 1 to Cathode.
DE Trigger Electrode 1 to Trigger Electrode 2.
EF Cathode to Trigger Electrode 2.
FA Cathode to Trigger Electrode 1.
FB Trigger Electrode 2 to Trigger Electrode 1.

The portion of the loops shown broken indicate regions in which triggering is erratic and the limits are ill defined.

The most reliable operation is ensured by triggering between $tr_2$ and $tr_1$ with $tr_1$ negative to $tr_2$ i.e. between A and B on the diagram.

## NOTES ON OPERATION.

**Method of Operation.**




Operation of this type of flash tube is as follows:—

The capacitor C (Discharge capacitor), connected between anode and cathode is charged through a resistor R1 (Charging resistor). A voltage of sufficient amplitude applied between the two trigger electrodes $tr_1$ and $tr_2$ will initiate a glow discharge between these electrodes. This discharge will in turn cause breakdown of the main gap between anode and cathode, discharging the capacitor C and producing a bright flash of light. Operating with maximum rated anode voltage and a 4 $\mu$F capacitor the duration of the current discharge is approx. 4 to 5 microseconds at one third of peak light output. The light duration is longer, approx. 20 microseconds.

When the trigger voltage between $tr_1$ and $tr_2$ is obtained from a controlled pulse the frequency of flashing will be determined by the trigger pulse frequency.

**Trigger Pulse.** As noted on Page 2, the tube may be triggered in a variety of ways, some of these are however likely to prove erratic and unreliable. The recommended method of triggering is to apply a positive voltage to Trigger electrode No. 2 ($tr_2$) and a negative pulse to Trigger electrode No. 1 ($tr_1$).

The voltage applied to $tr_1$ is conveniently obtained by means of the potentiometer chain R2, R3, shown in the diagram above, but must always be lower than the minimum trigger voltage and should have a maximum value of about 70 volts.

To ensure reliable operation at all frequencies, the negative trigger pulse amplitude (applied to Trigger Electrode 1) should be at least 150 volts, with a width of 30 to 100 microseconds at half amplitude. A suitable pulse may be derived by differentiation of a pulse from a multivibrator. If a square pulse is used, the pulse width may be slightly less (down to 20 microseconds).

The minimum values of trigger current quoted on Page 1 are for pulses of long duration. For very short pulses high values of current may be necessary.

The duration of the trigger pulse is not critical, subject to the minimum quoted above. However, the duration of the pulse must not exceed the time required for the anode discharge capacitor to recharge to about 80 volts as, during deionization time, pulses of greater length are liable to cause a second discharge when the anode reaches 80 volts. This second spurious discharge may cause loss of control and the tube will flash at a repetition rate quite independent of the trigger pulse or the discharge may be a glow discharge in the main gap with consequent serious deterioration of the cathode (A glow discharge is characterised by a more diffused appearance and a less intense colour than the required arc discharge).

**Trigger Delay.** In conventional circuits the delay in triggering the main gap after the application of the trigger pulse is less than 40 microseconds. It is however dependent on circuit conditions and low energy trigger pulses may lengthen the delay time, whilst high energy pulses with normal circuitry can considerably reduce the delay time.

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(Cont.)

Ferranti

**Notes on Operation (Cont.)**

**Charging Resistor.** The minimum value of charging resistor should be approx. 3,000 ohms, and must be rated for at least 8 watts dissipation.

**Discharge Capacitor.** This capacitor should be a good quality foil type, preferably non-inductive. Electrolytic types are quite unsuitable.

The Discharge Capacitor value should be chosen in accordance with the recommendation on Page 1, dependent on the frequency range required.

In equipments required to operate over a wide frequency band, the complete range is preferably covered in steps by switching different capacitor values in accordance with the recommendations regarding the charging time in the last paragraph under the heading 'Trigger Pulse' and in the

For maximum light output, the time constant of the discharge capacitor and its charging resistance, must be such as to ensure a nearly complete recharge between flashes. This requires that the time constant is not greater than about one third of the flash interval (for a 96% recharge). At higher frequencies it may not be possible to ensure such a complete recharge as, if the charging rate is faster than the valve recovery (deionization) rate, a spurious discharge will occur. As noted under 'Trigger Pulse' this discharge may initiate a series of uncontrolled flashes quite independent of the trigger pulse and at a higher repetition rate.

**Anode Voltage.** The operating anode voltage should be preferably in the range 300—340 volts. In frequency controlled operation when it is required to operate over a wide range, a low impedance power supply is desirable to avoid large fluctuations of the anode voltage and the voltage applied to $tr_1$ if this is obtained from a potentiometer across the anode supply voltage.

**Peak Anode Current.** The peak anode current must be sufficient to ensure the formation of an arc discharge which gives an anode-cathode volt drop of approximately 20 volts. If the peak anode current is low a glow discharge is probable and the volt drop will then be around 70 volts which will result in permanent damage and serious deterioration. A recommended minimum value of peak anode current is 2 amperes.

**Mean Anode Current.** The mean anode current may be calculated as follows:—

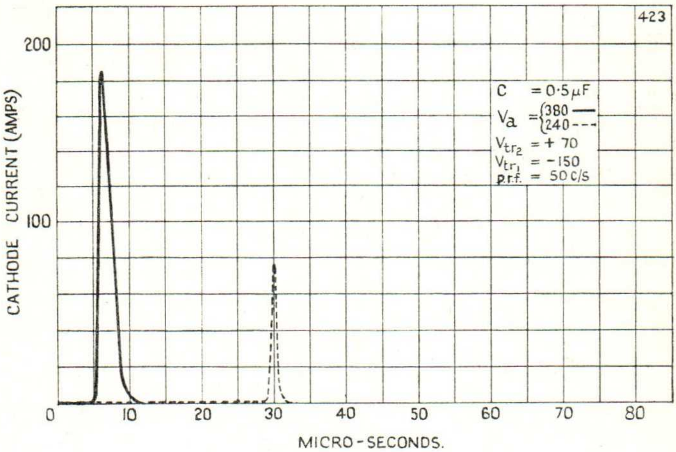
$$I_a(\text{mean}) = \frac{CVf}{1000} \quad \text{mA.}$$

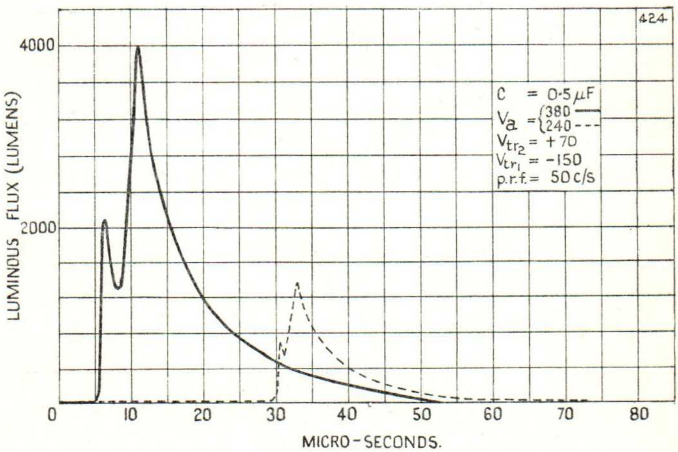
where C = discharge capacitor in $\mu$F.
V = voltage to which capacitor is charged at instant of triggering.
f = flash frequency per second.

**Trigger Electrode/Cathode Connections.** The tube must not be operated without a DC. connection between each trigger electrode and cathode.

The circuit resistance between cathode and $tr_1$ and between cathode and $tr_2$ must have a value of at least 1000 ohms in each instance. A resistance of the order of 100,000 ohms is recommended.

# TYPICAL DISCHARGE CHARACTERISTICS



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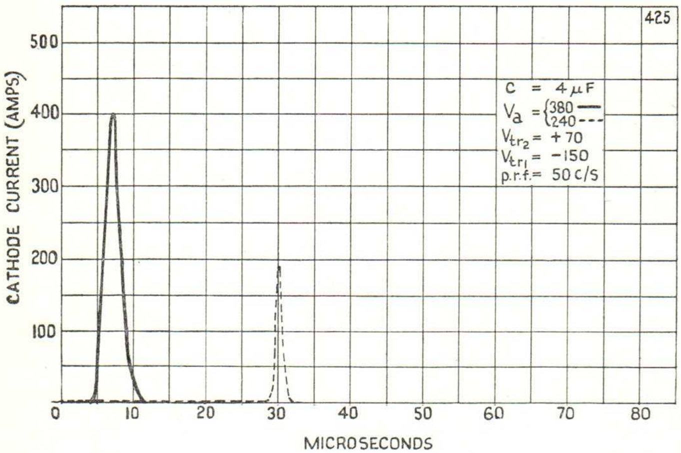
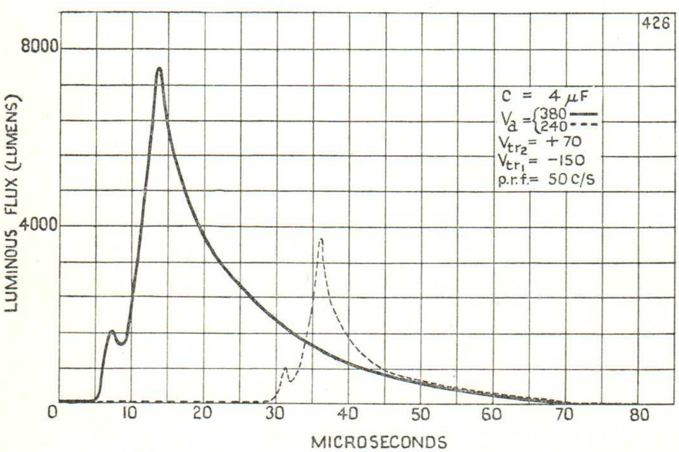
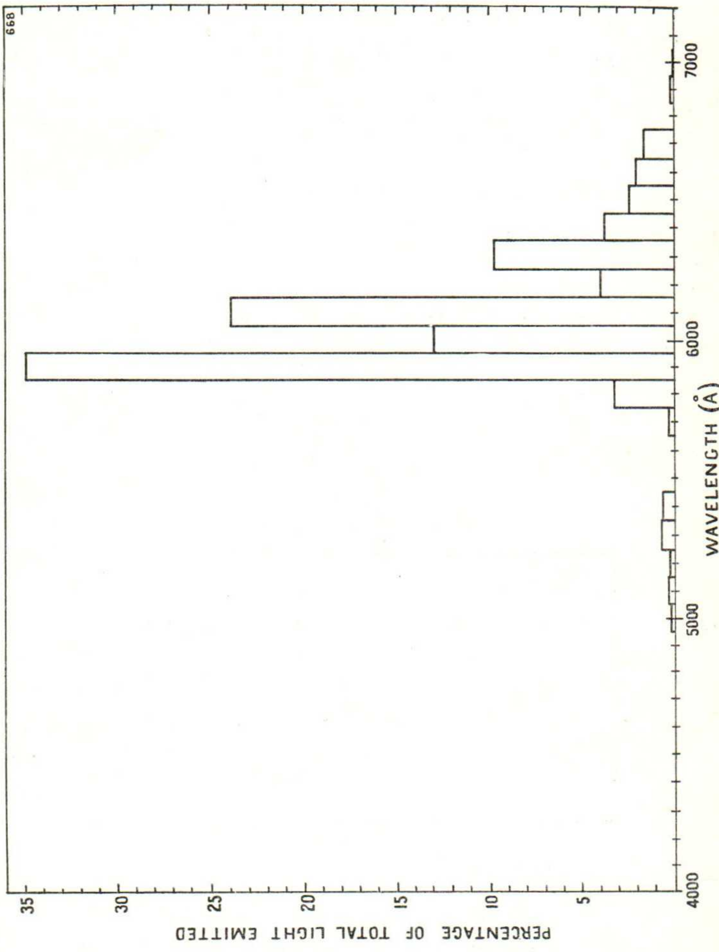
## TYPICAL DISCHARGE CHARACTERISTICS



## SPECTRAL DISTRIBUTION OF VISIBLE LIGHT

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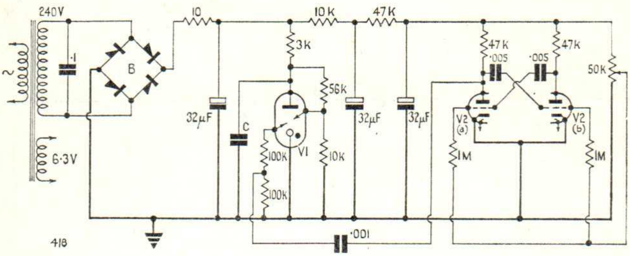
## NOTES ON OPERATION—RECOMMENDED CIRCUITS

### STROBOSCOPE.




C — Discharge Capacitor (see pages 1 and 4)

B — Single Phase Bridge (4 Ferranti Silicon Rectifiers ZS74)

V1 — Ferranti EN 10

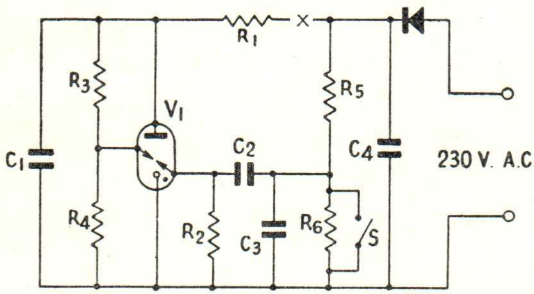
V2(a)
V2(b) — Ferranti ECC 81

A typical circuit using a multivibrator as frequency control is shown above The frequency of operation is determined by the suitable choice of component values as indicated. The square pulses are differentiated by using a 1000 pF. capacitor with 100,000 ohm resistor.

The above circuit may require slight modification in practice to allow for such variations as impedance of power supply, tolerances of components, etc. High impedance power supplies result in large variations of the HT. line voltage as the frequency is varied, and consequent variations in $tr_2$ voltage and pulse height at $tr_1$.

The HT. voltage line during operation should preferably be in the range 300–330 volts.

### RELAY CIRCUIT.




| | | | |
|---|---|---|---|
| R1 | 3300 ohms. | C1 | 3 μF. |
| R2 | 100K ohms. | C2 | 1000 pF. |
| R3 | 56K ohms. | C3 | 0·1 μF. |
| R4 | 10K ohms. | C4 | 8 μF. |
| R5 | 100K ohms. | S | External switch. |
| R6 | 100K ohms. | V1 | EN10 |

The above circuit is for operation of an electro-magnetic relay in which triggering is effected by closure of external contacts.

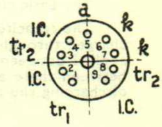
Closing of switch S causes a single flash, and operates an electro-magnetic relay which should be inserted at the point 'X'.

# Ferranti

**EN15**

## STROBOSCOPIC LIGHT SOURCE

**A neon filled cold cathode tetrode discharge tube designed for use as a Stroboscopic Light Source. Operating frequency is controlled by low voltage, low energy pulses. For some applications it may be operated as a free running oscillator with simple Resistance/Capacity control of frequency.**




**Base Connections**
**Underside View of Base**

PHYSICAL SPECIFICATION.

| | |
|---|---|
| Base ... ... ... ... ... | B9A/D. |
| Max. Seated Height ... ... | 54 mm. ($2\frac{1}{8}$in.). |
| Max. Overall Length ... ... | 65 mm. ($2\frac{9}{16}$in.). |
| Max. Diameter ... ... ... | 22·2 mm. ($\frac{7}{8}$in.). |
| Mounting Position ... ... | Any.* |

PIN CONNECTIONS.

| | |
|---|---|
| Pin 1—Trigger Electrode 1. | Pin 5—Anode. |
| Pin 2—Internal Connection. | Pin 6—Cathode. |
| Pin 3—Trigger Electrode 2. | Pin 7—Cathode. |
| Pin 4—Internal Connection. | Pin 8—Trigger Electrode 2. |

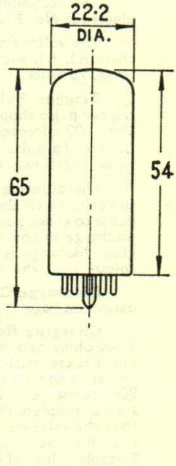
Pin 9—Internal Connection.

RATINGS (Absolute).

| | |
|---|---|
| Max. Anode Voltage (Static) ... ... | 440 volts. |
| Max. Anode Voltage (Operating) ... | 375 volts. |
| Min. Anode Voltage (Operating) ... | 230 volts. |
| ‡Max. Trigger Electrode No. 2 voltage | 75 volts. |
| Max. Average Anode Current ... ... | 80 mA. |
| Max. Discharge Capacitor ... ... | 8 μF. |
| Min. $R_{trig.\ 1-k}$ ... ... ... ... | 1000 ohms. |
| Min. $R_{trig.\ 2-k}$ ... ... ... ... | 1000 ohms. |

CHARACTERISTICS.

| | |
|---|---|
| §Trigger Voltage ($V_{trig.\ 1-trig.\ 2}$) ... (Single Flashes) ... | 80 to 130 volts. |
| †Trigger Electrode No. 1 Voltage (Stroboscopic Operation) | –150 volts (min.). |
| Max. Flashing frequency ... ... | 250 per sec. |




TYPICAL OPERATION (As Stroboscopic Light Source).

| | |
|---|---|
| DC supply Voltage ... ... ... | 300 volts. |
| †Trigger Pulse amplitude ($V_{trig.\ 1}$) ... | –150 volts. |
| ‡Trigger Electrode No. 2 voltage ($V_{trig.\ 2}$) | 70 volts. |
| **Charging Resistor ... ... ... | 3000 ohms. |

Discharge Capacitor.

| | |
|---|---|
| 6—40 f.p.s. ... ... ... ... ... | 4 μF. |
| 40—50 f.p.s. ... ... ... ... ... | 3 μF. |
| 50—75 f.p.s. ... ... ... ... ... | 2 μF. |
| 75—140 f.p.s. ... ... ... ... ... | 1 μF. |
| 140—200 f.p.s. ... ... ... ... ... | 0·75 μF. |
| 200—250 f.p.s. ... ... ... ... ... | 0·5 μF. |

***A position between horizontal or vertically base up is preferred.**

**‡Positive to Cathode.**

**§Trigger Electrode No. 1 negative to Trigger Electrode No. 2.**

**†Negative to Cathode.**

****Of suitable wattage. For most applications a readily available small vitreous enamel type rated at 14 watts is satisfactory.**

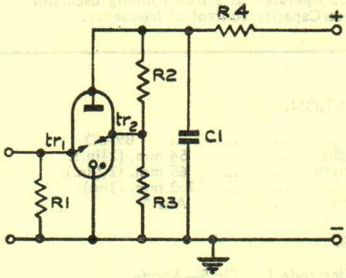
Tentative
Issue 1
Mar., 1961

Ferranti

## NOTES ON OPERATION.

The basic circuit for operation of this tube is shown in the diagram below.

The capacitor C1 (Discharge capacitor), connected between anode and cathode is charged through a resistor R4 (Charging resistor). A voltage of sufficient amplitude applied between the two trigger electrodes $tr_1$ and $tr_2$ will initiate a glow discharge between these electrodes, which will cause breakdown between anode and cathode, discharging the capacitor C1 and producing a bright flash of light.




The recommended method of triggering is to apply a positive voltage to trigger electrode No. 2 ($tr_2$) and a negative pulse to trigger electrode No. 1 ($tr_1$).

The voltage applied to $tr_2$ is conveniently obtained by means of the potentiometer chain R2, R3, shown in the diagram above, and should have a value of about 70 volts. (max. 75 volts).

**Trigger Pulse.** To ensure reliable operation at all frequencies, the negative trigger pulse should be steep fronted with amplitude of at least 150 volts, and a width of 30 to 100 microseconds at half amplitude. A suitable pulse may be derived by differentiation of a pulse from a multivibrator or Miller circuit. If a square pulse is used, the pulse width may be slightly less.

The duration of the pulse must be limited to the time required for the capacitor to recharge to about 80 volts, as during deionization time, pulses of greater length are liable to cause a second discharge when the anode reaches 80 volts, or to initiate a glow discharge in the main gap with consequent serious deterioration of the cathode. (A glow discharge is characterised by a more diffused appearance and is of a less intense colour than the required arc discharge).

**Discharge Capacitor.** This should be chosen in accordance with the recommendation on Page 1, dependent on the frequency range required.

**Charging Resistor.** The minimum value of charging resistor should be approx. 3,000 ohms, and must be rated for the appropriate dissipation. For maximum light output it is essential-to ensure a nearly complete recharge of the capacitor between flashes The time constant should be not greater than about one third of the flash interval (for a 96% recharge). At the higher operating frequencies it may not be possible to ensure such a complete recharge, as a spurious discharge will ocucr as the charging rate is faster than the valve de-ionisation time. This discharge may in turn initiate a series of uncontrolled flashes, quite independent of the trigger pulse and at a higher repetition rate. Suitable values of discharge capacitor and charging resistance are given on Page 1 of this data sheet.

**Anode Voltage.** The operating anode voltage should be preferably in the range 300—330 volts. A low impedance power supply is desirable to avoid large fluctuations of the anode voltage and $tr_2$ voltage over the frequency range.

**Mean Anode Current.** The mean anode current may be calculated as follows:—

$$I_a\,(\text{mean}) = \frac{CVf}{1000}\ \text{mA.}$$

where C = discharge capacitor in µF.

V = voltage on discharge capacitor at instant of triggering.

f = flash frequency per second.

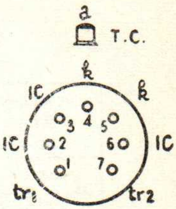
**Trigger Electrode/Cathode Connections.** The tube must not be operated without a D.C. connection between each trigger electrode and cathode. The circuit resistance between cathode and $tr_1$ and between cathode and $tr_2$ must have a value of at least 1000 ohms in each instance. A resistance of the order of 100.000 ohms is recommended.

# FERRANTI

## COLD CATHODE TETRODE

A miniature cold cathode gas filled tetrode. It is an arc discharge valve. The cathode is designed for pulse operation and is capable of passing up to 250 amperes peak. It is equally suitable as a stroboscopic light source or for relay applications where high peak current, short duration, pulses are required.

**EN30**




**Base Connections Underside View of Base**

PHYSICAL SPECIFICATION.

| | |
|---|---|
| Base ... ... ... ... | B7G. |
| Max. Seated Height ... ... | 70 mm. |
| Max. Overall Length ... ... | 77 mm. |
| Max. Diameter ... ... ... | 19 mm. |
| Length of arc ... ... ... | 22 mm. (approx.) |
| Mounting Position ... ... | Any.* |

PIN CONNECTIONS.

| | |
|---|---|
| Pin 1—Trigger Electrode 1. | Pin 5—Cathode† |
| Pin 2—I.C. | Pin 6—I.C. |
| Pin 3—I.C. | Pin 7—Trigger Electrode 2. |
| Pin 4—Cathode† | Top Cap—Anode. |

RATINGS.

| | |
|---|---|
| Maximum Anode Voltage (Static) ... | 440 volts. |
| Maximum Anode Voltage (working) ... | 400 volts. |
| Minimum Anode Voltage (working) ... | 250 volts. |
| Peak Inverse Anode Voltage ... ... | 350 volts. |
| Max. Mean Anode Current ... ... | 50 mA. |
| Maximum Average Current ... ... | 10 mA. |
| Minimum $R_{tr_1-k}$ ... ... ... | 1000 ohms. |
| Minimum $R_{tr_2-k}$ ... ... ... | 1000 ohms. |

CHARACTERISTICS.

| | |
|---|---|
| ‡Static Trigger Voltage ($tr_2$ to $tr_1$) | 80–130 volts.‡ |
| Max. Repetition Frequency ... ... | 250 per sec. |
| Min. Trigger Current required at $V_a$ 400 | 50 μA. |
| Min. Trigger Current required at $V_a$ 250 | 300 μA. |

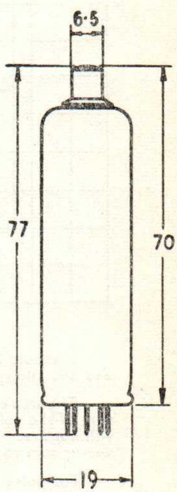
§Peak Anode Current, Peak Luminous Intensity, Flash Duration ... — The discharge of a 1 μF capacitor charged to 330V. gives a peak anode current of approx. 150 amp. and a Peak Luminous Intensity of approx. 270 candelas with a flash duration of 15 microseconds at half the peak light output.

Delay Time ... ... Less than 40 microseconds, dependent on circuit conditions. With higher energy pulses the delay time can be considerably reduced

TYPICAL OPERATION as Stroboscopic Light Source :

| | |
|---|---|
| Anode Supply Voltage ... ... | 300–330 volts DC. |
| **Trigger Electrode No. 2 Voltage | 70 volts. |
| ††Trigger Pulse Amplitude ($V_{tr_1}$) | 150 volts min. |
| Charging Resistor ... ... | 6000 ohms. |
| Discharge Capacitor for operation | |
| at 6–35 c.p.s. ... | 2 μF. |
| 30–50 c.p.s. ... | 1·5 μF. |
| 45–80 c.p.s. ... | 1 μF. |
| 80–150 c.p.s. ... | 0·5 μF. |
| 140–250 c.p.s. ... | 0·3 μF. |

For basic circuit and further information refer to "Notes on Operation" on Pages 3 and 4.




All dimensions shown are in millimetres (max.).

*Vertically base up or horizontally is preferred.

†The cathode circuit should be connected to both pins 4 and 5.

‡The limits quoted are to cover production variations, and refer to the triggering voltage for a low rate of change of electrode voltages, with $tr_1$ negative to $tr_2$. For pulse operation a higher trigger voltage is generally necessary. See under "Typical Operation."

§A minimum peak current of 5 amp. is recommended. This ensures the formation of an arc discharge with an anode-cathode volt drop of approx. 20 volts. If the peak current is less than 5 amps. a glow discharge is likely to form with a volt drop of 70 volts which may result in permanent damage to the valve.

**At instant of triggering.

††$V_{tr_1}$ negative with respect to cathode.

Issue 6.
Aug., 1959

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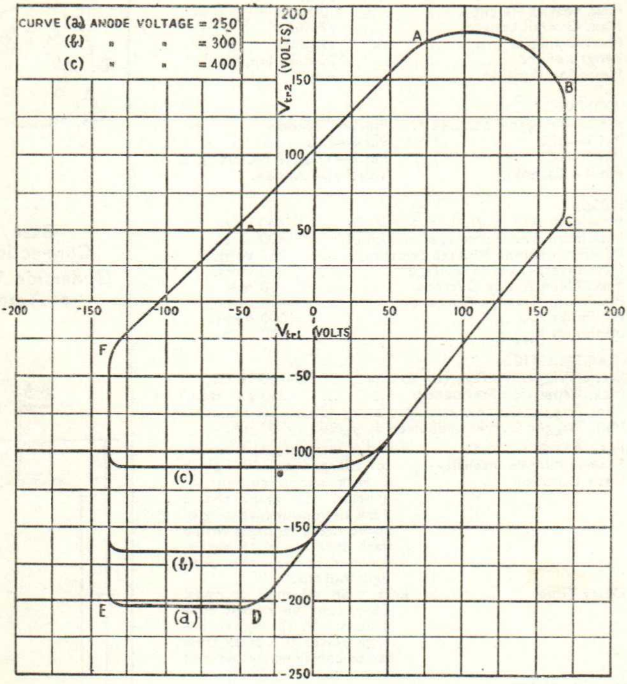
## AVERAGE STATIC TRIGGER CHARACTERISTICS




It should be noted that the above quadrant diagram is for an average EN30 and due allowance should be made for trigger voltage tolerance (see page 1).

The area enclosed by the loops is an area of non-conduction. If the vector sum of the voltages on the two trigger electrodes lies within the loop the valve will not fire. Any change of either or both of these voltages which causes the vector sum to fall outside the loop will trigger the valve.

For pulse operation it is usually necessary to ensure that the pulse has a sufficient excess voltage (See under "Trigger Pulse" on page 3.)

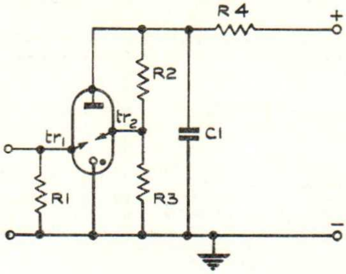
As the triggering impulse carries the vector sum of the applied voltages outside the loop the point at which it crosses the loop indicates the manner in which the valve is triggered as follows :—

Between AB Trigger Electrode 2 to Cathode Breakdown.
BC Trigger Electrode 1 to Cathode Breakdown.
CD Trigger Electrode 1 to Trigger Electrode 2. Breakdown.
DE Cathode to Trigger Electrode 2 Breakdown.
EF Cathode to Trigger Electrode 1 Breakdown.
FA Trigger Electrode 2 to Trigger Electrode 1 Breakdown.

The most reliable operation is ensured by triggering between $tr_2$ and $tr_1$, i.e., between F and A.

## NOTES ON OPERATION.

The basic circuit for operation of this tube is shown below :—




The capacitor C1 (Discharge capacitor), connected between anode and cathode is charged through a resistor R4 (Charging resistor). A voltage of sufficient amplitude applied between the two trigger electrodes $tr_1$ and $tr_2$ will initiate a glow discharge between these electrodes, which will cause breakdown between anode and cathode, discharging the capacitor C1 and producing a bright flash of light. The current duration of this discharge is of the order of 5 microseconds, with a peak current up to 250 amperes. The light duration is longer, approximately 20 microseconds at half peak light output, operating with maximum anode voltage.

When the trigger voltage between $tr_1$ and $tr_2$ is obtained from a controlled pulse the frequency of flashing will be determined by the trigger pulse frequency.

The following points should be noted in designing equipment incorporating EN30.

**Trigger Pulse.** Whilst as noted on page 2, the tube may be triggered in a variety of ways some of these are likely to be erratic and unreliable. The recommended method of triggering is to apply a positive voltage to trigger electrode No. 2 ($tr_2$) and a negative pulse to trigger electrode No. 1 ($tr_1$).

The voltage applied to $tr_2$ is conveniently obtained by means of the potentiometer chain R2, R3, shown in the diagram above, but must always be lower than the minimum trigger voltage and should have a maximum value of about 70 volts.

To ensure reliable operation at all frequencies, the trigger pulse amplitude should be at least 150 volts, with a width of 30 to 100 microseconds at half amplitude ; a suitable pulse may be derived by differentiation of a square pulse from a multivibrator. If a square pulse is used, the pulse width may be slightly less (down to 20 microseconds).

The minimum values of trigger current quoted on page 1 are for pulses of long duration. For short pulses higher values of current are necessary.

The duration of the triggering pulse is not critical, subject to the minimum quoted above, but certain factors should be noted. The duration of the pulse must be limited to the time required for the anode discharge capacitor to recharge to about 80 volts as, during deionization time. pulses of greater length are liable to cause a second discharge when the anode reaches 80 volts, or to initiate a glow discharge in the main gap with consequent serious deterioration of the cathode. (A glow discharge is characterised by a more diffused appearance and is of a less intense colour than the required arc discharge).

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**Discharge capacitor,** This should be chosen in accordance with the recommendation on Page 1, dependent on the frequency range required.

In equipments required to operate over a wide frequency band, the whole range of frequency is preferably covered in steps by switching different capacitor values.

**Charging resistor.** The minimum value of charging resistor should be approx. 6,000 ohms, and must be rated for 8 watts minimum dissipation.

For maximum light output, the time constant of the discharge capacitor and its charging resistance, must be such as to ensure a nearly complete recharge between flashes. This requires that the time constant is not greater than about one third of the flash interval (for a 96% recharge). At higher frequencies it may not be possible to ensure such a complete recharge as, if the charging rate is faster than the valve recovery rate, a spurious discharge will occur. This discharge may in turn initiate a series of uncontrolled flashes, quite independent of the trigger pulse and at a higher repetition rate. Suitable values of discharge capacitor and charging resistance are given on Page 1 of this data sheet.

**Anode voltage.** The operating anode voltage should be preferably in the range 300—330 volts. In frequency controlled operation when it is required to operate over a wide frequency range, a low impedance power supply is desirable to avoid large fluctuations of the anode voltage and also of course the $tr_2$ voltage in conventional circuit.

**Mean anode current.** The mean anode current may be calculated as follows :—

$$I_a \text{ (mean)} = \frac{CVf}{1000} \text{ mA}$$

where C = discharge capacitor in $\mu$F.

V = voltage on discharge capacitor at instant of triggering.

f = flash frequency per second.

**Trigger Electrode/Cathode Connections.** The tube must not be operated without a D.C. connection between each trigger electrode and cathode.

The circuit resistance between cathode and $tr_1$ and between cathode and $tr_2$ must have a value of at least 1000 ohms in each instance. A resistance of the order of 100,000 ohms is recommended.

---

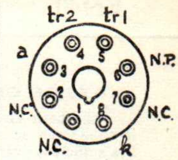
Additional circuits shown on NSP2 data sheets may be adapted to EN30 operation by modification of circuit values in accordance with the foregoing notes.

# FERRANTI
## COLD CATHODE TETRODE

Type EN40 is a cold cathode tetrode gas discharge valve intended for use as a stroboscopic light source, particularly in applications employing photographic recording.

The light emitted is "whitish" in colour and of high actinic value.

Operation can be controlled by pulses of low energy.




**Base Connections**

**Underside View of Base**

### PHYSICAL SPECIFICATION.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Seated Height ... ... | 89 mm. ($3\frac{1}{2}$in.). |
| Max. Overall Length ... ... | 103 mm. ($4\frac{1}{16}$in.). |
| Max. Diameter Base ... ... | 32 mm. ($1\frac{1}{4}$in.). |
| Length of Arc ... ... ... | 24 mm. ($\frac{15}{16}$in.). |
| Mounting Position ... ... | Any.* |

### PIN CONNECTIONS.

| | |
|---|---|
| Pin 1—No connection. | Pin 5—Trigger No. 1. |
| Pin 2—No connection. | Pin 6—No Pin. |
| Pin 3—Anode. | Pin 7—No connection. |
| Pin 4—Trigger No. 2. | Pin 8—Cathode. |

### RATINGS.

| | |
|---|---|
| Maximum Anode Voltage (Static) | 440 volts. |
| Maximum Anode Voltage (working) | 350 volts. |
| Minimum Anode Voltage (working) | 250 volts. |
| Peak Inverse Anode Voltage ... | 300 volts. |
| Maximum Mean Anode Current | 100 mA. |
| Maximum Average Grid Current | 10 mA. |

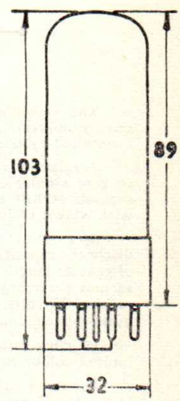
### CHARACTERISTICS.

| | |
|---|---|
| ††Static Trigger Voltage ($tr_2$ to $tr_1$) | 70–120 volts. |
| Maximum Flashing Frequency | 150 per sec. |
| †Peak Anode Current ... ... | 250 amps. |
| Minimum Trigger Current required :— | |
| $V_a = 350$ ... ... | 50 $\mu$A. |
| $V_a = 250$ ... ... | 300 $\mu$A. |

### TYPICAL OPERATION.

| | |
|---|---|
| DC Supply Voltage ... ... | 300–330 volts. |
| ‡Trigger Electrode No. 2 Voltage ($V_{tr_2}$) ... ... | 50 volts. |
| §Trigger Pulse Amplitude ($V_{tr_1}$) | 150 volts. |
| Charging Resistor ... ... | 3500 ohms. |
| Discharge Capacitor for operation | |
| at 6–35 c.p.s. ... ... | 4 $\mu$F. |
| 30–50 c.p.s. ... ... | 3 $\mu$F. |
| 45–80 c.p.s. ... ... | 2 $\mu$F. |
| 80–150 c.p.s. ... ... | 1 $\mu$F. |

For further information refer to "Notes on Operation" overleaf.




Dimensions shown are in millimetres (max.)

*Vertically base up or horizontally preferred.

†A minimum peak current of 5 amps. is recommended. This ensures the formation of an arc discharge with an anode-cathode volt drop of approx. 20 volts. If the peak current is less than 5 amps. a glow discharge is likely to form with a volt drop of 70 volts which may result in permanent damage to the valve.

††$tr_1$ negative with respect to $tr_2$. The limits quoted refer to operation with a trigger voltage having a low rate of change. For pulse operation a higher trigger voltage is generally necessary.

‡At instant of triggering.

§$V_{tr_1}$ negative with respect to cathode.

Issue 3
Mar., 1958

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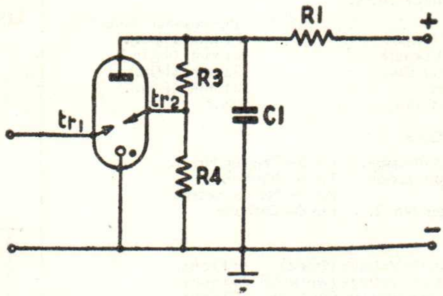
## NOTES ON OPERATION.

The basic circuit for the operation of this valve is shown below. A capacitor C1 is connected across anode and cathode and charged through a series resistance R1. If a sufficient voltage is now applied between electrodes $tr_1$ and $tr_2$ to initiate a glow discharge, this will cause breakdown of the main anode to cathode gap. The capacitor C1 discharges within a few microseconds, and the valve emits a bright flash of light of similar duration.




The recommended triggering method is to apply a positive voltage from the potentiometer R3–R4 to $tr_2$, and a negative pulse to $tr_1$, the flashing frequency being controlled by the pulses on $tr_1$.

A suitable triggering pulse for $tr_1$ may be derived by differentiating a square pulse to give a pulse of 150 volts or higher, with a width of approximately 30–100 microseconds at half amplitude. Alternatively, square pulses of approximately 200 volts, with widths of 20–400 microseconds may be used.

The duration of the pulse must be limited to the time required for the anode discharge capacitor to recharge to about 80 volts as, during de-ionization time, pulses of greater length are liable to cause a glow discharge in the main gap with consequent serious deterioration of the cathode, or to initiate a second discharge when the anode reaches 80 volts. This discharge may in turn initiate a series of uncontrolled flashes quite independent of the trigger pulse and at a higher repetition rate.

(A glow discharge is characterised by a more diffused appearance and is of a less intense colour than the required arc discharge.)

For short pulses, higher values of initiating currents are required than those quoted in the specification.

For maximum light output, the time constant of the discharge capacitor and its charging resistance must be such as to ensure a nearly complete recharge between flashes. This requires that the time constant is not greater than about one third of the flash interval (for a 96% recharge). At higher frequencies it may not be possible to ensure such a complete recharge as, if the charging rate is faster than the valve recovery rate, a spurious discharge will occur as indicated above.

Suitable values of discharge capacitor and charging resistance are given under "Typical Operation" overleaf.

The mean anode current may be calculated as follows :—

$$I_{a\ (mean)} = \frac{CVf}{1000}\ \text{mA.}$$

where C = discharge capacitor in $\mu$F.

V = voltage on discharge capacitor at instant of triggering.

f = flash frequency per second.

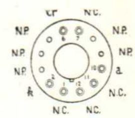
In equipments which operate over a wide frequency band, the whole range of frequency is preferably covered in steps by switching different capacitor values in accordance with the recommendations regarding charging time.

The circuit resistance connected between cathode and $tr_1$ and cathode and $tr_2$ must have a value of at least 1000 ohms.

**Ferranti**

# STROBOSCOPIC LIGHT SOURCE

A xenon filled cold cathode arc discharge tube designed for use in stroboscopic applications at frequencies up to 400 c/s. It emits a white light.



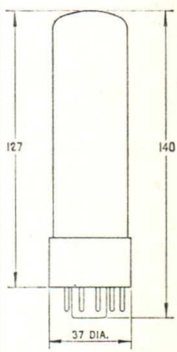

Underside View of base

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Max. Seated Height ... ... | 127 mm. (5 in.). |
| Max. Overall Length ... ... | 140 mm. ($5\frac{1}{2}$ in.). |
| Max. Diameter (over base) ... | 37 mm. ($1\frac{15}{32}$ in.). |
| Mounting Position ... ... | Any. |

## BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 7—No Connection. |
| Pin 2—Cathode. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—Anode. |
| Pin 5—No Pin. | Pin 11—No Connection. |
| Pin 6—Trigger. | Pin 12—No Connection. |




## RATINGS.

(All maximum ratings are 'absolute').

| | |
|---|---|
| Max. Anode Voltage (D.C. Static) ... | 1000 volts. |
| Max. Anode Voltage (working) ... | 900 volts. |
| Min. Anode Voltage (working) ... | 700 volts. |
| *Max. Dissipation ... ... ... ... | 20 watts. |
| Max. Discharge Capacitor ... ... | 6 µF. |
| †Min. Charging Resistor (12–150 c/s) ... | 8 kΩ |
| (150–400 c/s) ... | 11 kΩ |
| Max. Operating Frequency ... ... | 400 c/s. |

## CHARACTERISTICS.

| | |
|---|---|
| ‡*Trigger Voltage ... ... ... | ... 2 to 4 kV. |
| §Typical Peak Luminous Intensity | ... 140,000 Candelas. |
| §Typical Flash Duration at $\frac{1}{3}$ peak | ... 25 to 30 µsec. |

For Peak Luminous Intensity and Flash Duration for other operating conditions see graphs on Pages 4 and 5.

*See Notes on Operation—Page 6.

†For stroboscopic operation these resistors should be rated for 25W. dissipation.

‡Peak pulse voltage.

§Va = 900 C = 6µF.

**Ferranti**

Issue 2.
Jan., 1962.

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

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## TYPICAL OPERATION.

For repetitive flashing operation the following circuits are suitable for use in conjunction with a variable frequency pulse generator to control the flash frequency.

For stroboscopic equipment the initiating controlled frequency pulse applied to the trigger of the EN10 or fed to the control grid of the EL81 in the circuits below may be derived from a multivibrator circuit (as described in the EN10 data sheet) or other hard valve pulse generator circuit.

(1) For operation at frequencies from 5 to 250 c/s. The trigger pulse voltage may be satisfactorily derived from a trigger circuit using a 'NEOSTRON' type tube (EN10) as illustrated in Fig. 1. The controlled frequency pulse which is applied to the trigger electrode of the EN10 determines the flash frequency of the EN55. Further information on the operation of this circuit is contained in the EN10 data sheets.

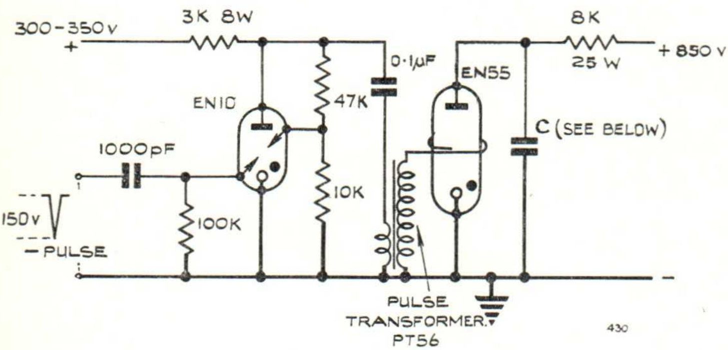


Fig. 1

Recommended values of C:—

| | |
|---|---|
| 5–25 c/s ... ... ... ... ... ... | 3 μF. |
| 25–50 c/s... ... ... ... ... ... | 1·5 μF. |
| 50–150 c/s ... ... ... ... ... | 0·75 μF. |
| 150–250 c/s ... ... ... ... ... | 0·5 μF. |

(2) For frequencies above 250 c/s it is desirable to use a hard value trigger circuit. A suitable circuit is shown below (Fig. 2).

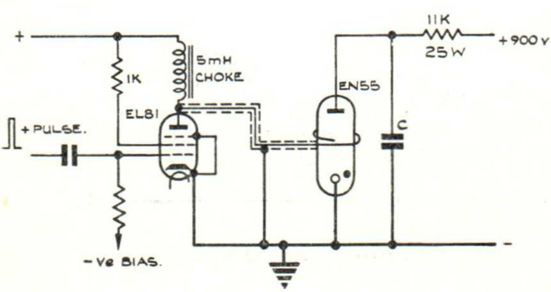


Fig. 2

Recommended values of C —

250–400 c/s ... ... ... ... ... 0·25 μF.

A simple air cored or "ferrox" cored choke with an inductance of approximately 5 mH and adequate insulation will be suitable.



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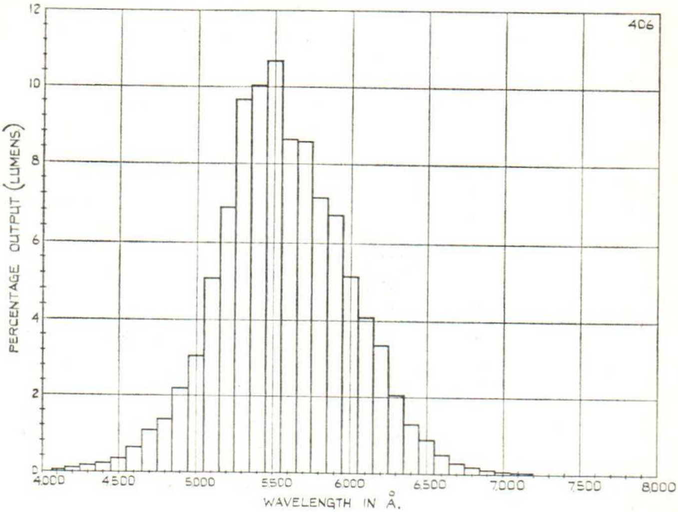
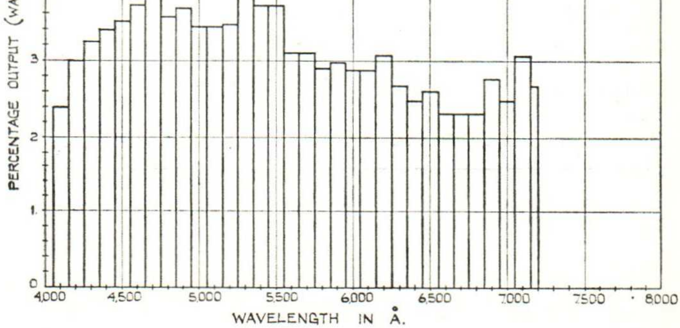
## SPECTRAL CHARACTERISTICS

DISTRIBUTION OF LIGHT OUTPUT OVER THE VISIBLE SPECTRUM




DISTRIBUTION OF RATE OF EMISSION OF ENERGY OVER THE VISIBLE SPECTRUM

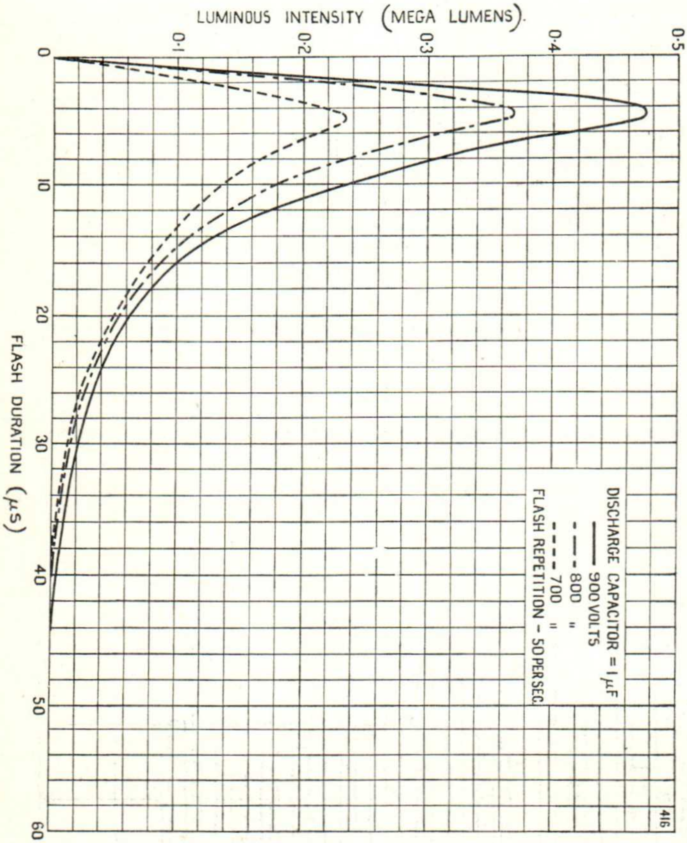



Issue 2.
Jan., 1962

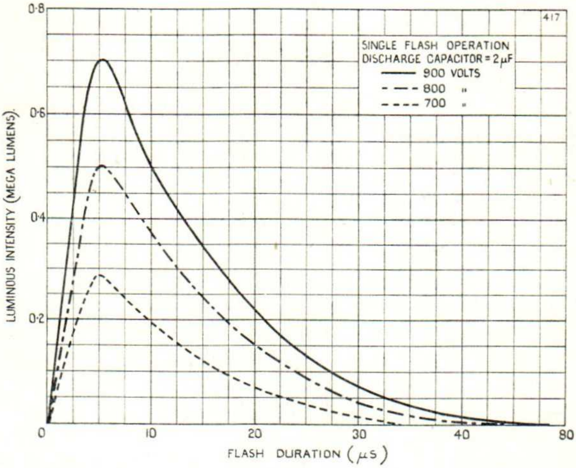


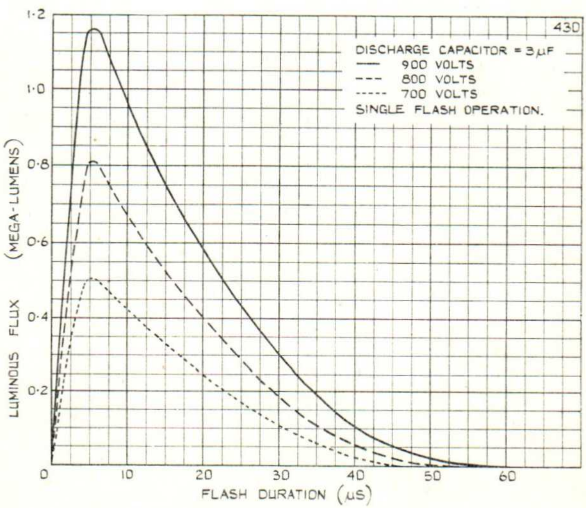
FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

**TYPICAL FLASH CHARACTERISTICS**
**at 50 flashes per sec.**



## TYPICAL FLASH CHARACTERISTICS
### Single Flash Operation



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## NOTES ON OPERATION.

**Discharge Capacitor.** Should be a good quality paper type with sufficient working voltage continuous rating preferably non-inductive and designed for high current pulse operation.

**Discharge Energy.** It is important to ensure that the energy dissipated in the tube does not exceed the maximum rating given on page 1. Over-running the tube even for very short periods may cause permanent damage, resulting in erratic operation particularly at the higher frequencies, and/or shortened life.

**Trigger Voltage.** The trigger voltage is the peak pulse voltage.

**Connecting Leads.** Because of the very high peak current of the discharge all the leads in the discharge path connecting the capacitor with anode and cathode should be of heavy gauge and as short as possible in order to ensure the maximum discharge energy.

**Flash Duration.** The duration of the light flash with a 4 μF. capacitor charged to 800 volts is approximately 15-20 microseconds at $\frac{1}{3}$ of the peak luminous intensity. Higher energy discharges will lengthen the duration of the discharge and lower energy discharges are shorter. (See graphs on Pages 4 and 5).

**WARNING.** The use of high voltages and capacitances constitutes a hazard and care should be taken in operating or repairing any equipment incorporating these tubes.



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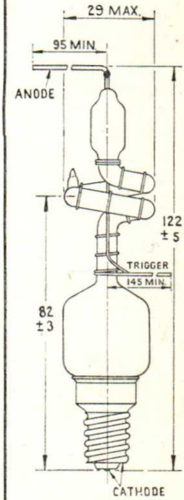
# STROBOSCOPIC LIGHT SOURCE

A gas filled cold cathode arc discharge lamp intended primarily for use as a stroboscopic light source for frequencies of up to 250 c/s. It emits a white light.




All dimensions shown are in Millimetres (max.).

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... | Small Edison Screw Type. |
| Max. Overall Height ... | 127 mm. (5 ins.). |
| Max. Diameter ... ... | 29 mm. ($1\frac{5}{32}$ ins.). |
| Mounting Position ... | Any. |

## RATINGS (Absolute).

| | |
|---|---|
| Max. Anode Voltage ... ... | 900 volts. |
| Min. Anode Voltage ... ... | 650 volts. |
| *Max. Dissipation ... ... ... | 25 watts. |
| Min. Charging Resistor ... ... | 3 kΩ |
| Max. Discharge Capacitor ... | 10 μF. |
| Max. Flashing Frequency ... | 250 c/s. |

## CHARACTERISTICS.

| | |
|---|---|
| †Trigger Voltage ... ... | 2 to 4 kV. |
| Peak Luminous Intensity | The discharge of a 10μF. capacitor charged to 800 volts produces a flash with peak luminous flux of approx. 900,000 lumens. |

## TYPICAL OPERATION.

| | |
|---|---|
| D.C. Supply Voltage ... ... | 750 volts. |
| Charging Resistor:— | |
| Up to 150 c/s. ... ... ... | 3·3 kΩ |
| 150 to 250 c/s. ... ... ... | 5·0 kΩ |
| Discharge Capacitor:— | |
| 0—25 c/s. ... ... ... | 6·0 μ.F |
| 25—50 c/s. ... ... ... | 3·0 μ.F |
| 50—150 c/s. ... ... ... | 1·5 μ.F |
| 150—250 c/s. ... ... ... | 0·5 μ.F |

A typical circuit of a Stroboscope for operation up to 250 c/s in four ranges is shown overleaf.

*See Notes on Operation overleaf.

†The Peak Pulse Voltage. A suitable Pulse Transformer is Ferranti type PT56.

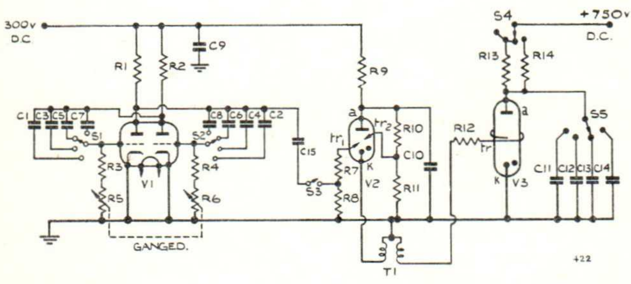
Issue 3.
Jan., 1962.

Ferranti

**Typical Operation (Cont.)**

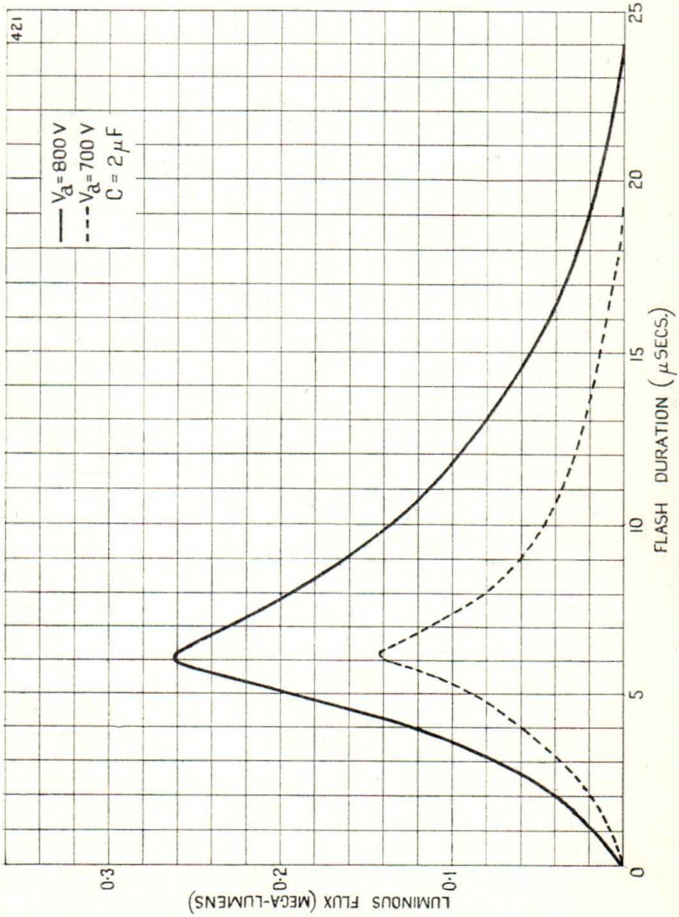
FOUR RANGE STROBOSCOPE.

The circuit below is for a Stroboscope covering frequencies from approx. 8 c/s. to 250 c/s in four ranges. Switches S1, S2, S4 and S5 are preferably ganged. Switch S3 is included to switch off the flash unit whilst keeping the multivibrator synchronising pulse generator running in order to avoid frequency drift during warming up periods.




| | | | | |
|---|---|---|---|---|
| V1 | Ferranti Valve Type ECC81. | | | |
| V2 | Ferranti Valve Type EN10. | | | |
| V3 | Ferranti Valve Type EN60. | | | |
| T1 | Ferranti Pulse Transformer Type PT56. | | | |
| R1 | 47 kΩ | | C1 | ·25 μF. |
| R2 | 47 kΩ | | C2 | ·25 μF. |
| R3 | 50 kΩ | | C3 | ·1 μF. |
| R4 | 50 kΩ | | C4 | ·1 μF. |
| R5 / R6 | 2 × 100 kΩ—Ganged | | C5 | ·03 μF. |
| | | | C6 | ·03 μF. |
| R7 | 100 kΩ | | C7 | ·01 μF. |
| R8 | 100 kΩ | | C8 | ·01 μF. |
| R9 | 5 kΩ 8W. | | C9 | 8 μF. |
| R10 | 56 kΩ 5W. | | C10 | 2 μF. |
| R11 | 10 kΩ 5W. | | C11 | 6 μF. |
| R12 | 100 kΩ | | C12 | 3 μF. |
| R13 | 3·3 kΩ 25W. | | C13 | 1·5 μF. |
| R14 | 5·0 kΩ 25W. | | C14 | 0·5 μF. |
| | | | C15 | 1000 pF. |

## TYPICAL FLASH CHARACTERISTIC






FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

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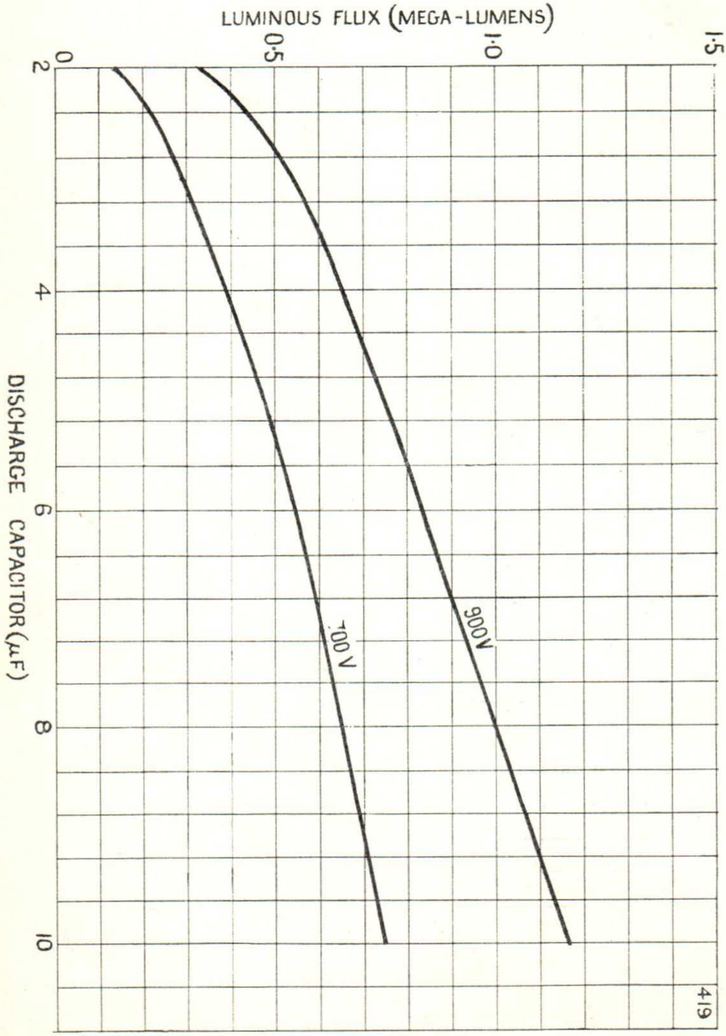
TYPICAL PEAK LUMINOUS FLUX



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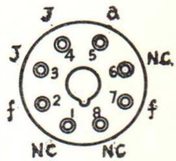
# FERRANTI

## SATURATED EMISSION DIODE



A directly heated tungsten filament diode, intended for operation with temperature limited emission. The large change in anode current resulting from a small change in filament voltage, and the stability of the valve, make it suitable for use as a control in stabiliser circuits.



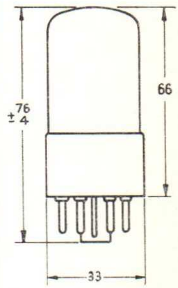

**Base Connections**
**Underside View of Base**

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Overall Length ... ... | 81 mm. ($3\frac{3}{16}$ in.). |
| Max. Seated Height ... ... | 65 mm. ($2\frac{9}{16}$ in.). |
| Max. Diameter ... ... ... | 33 mm. ($1\frac{5}{16}$ in.). |
| Mounting Position ... ... | Any. |

### BASE CONNECTIONS.

Pin 1—Not connected.
Pin 2—Filament.
*Pin 3—Jumper.
*Pin 4—Jumper.
Pin 5—Anode.
Pin 6—Not connected.
Pin 7—Filament.
Pin 8—Not connected.




### RATINGS.

| | |
|---|---|
| Max. Filament Voltage ... ... | 1·8 volts. |
| Max. Anode Voltage ... ... | 500 volts. |
| Min. Anode Voltage to ensure saturation ... ... ... | 100 volts. |

### CHARACTERISTICS.

| | |
|---|---|
| Filament Current (at 1·8 volts) | 330 mA. |
| Anode Current (at $V_f = 1{\cdot}8$, $V_a = 500$) ... | 0·65 mA. |

All dimensions shown are in millimetres (max.)

### TYPICAL OPERATION.

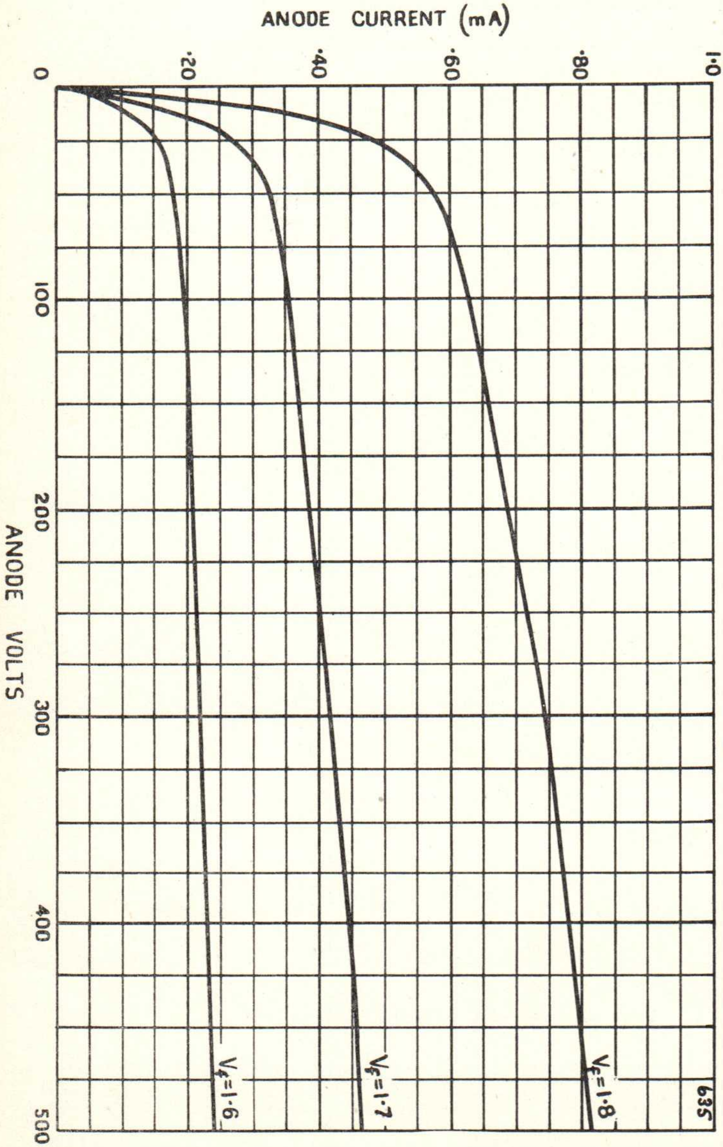
| | |
|---|---|
| Anode Current (saturated) ... | 0·3 mA. |
| Filament Voltage ... ... | 1·65 volts (approx.). |
| Filament Current ... ... | 320 mA. (approx.). |
| Minimum anode voltage ... | 100 volts. |
| Maximum anode voltage ... | 500 volts. |

*The "jumper" link in the base is a short circuit between pins 3 and 4 and with suitable circuit connections operates as a switch to render the equipment inoperative when the valve is removed from its holder.

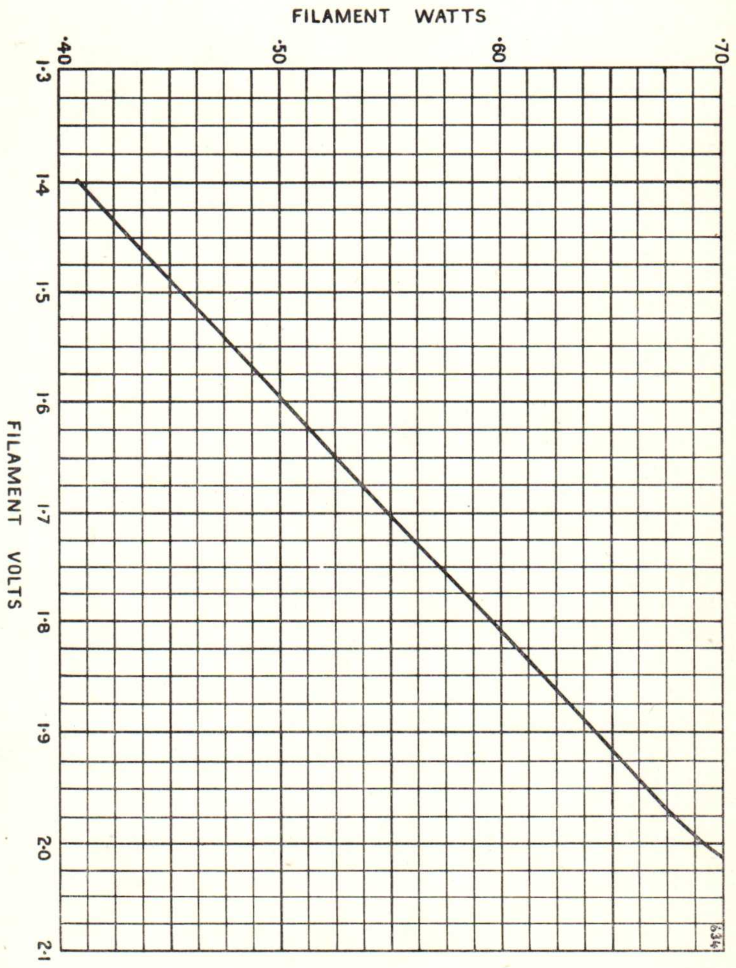
Issue 2.
Mar., 1957

FERRANTI

**GE10**



ANODE CURRENT (mA)
0
·20
·40
·60
·80
1·0
100
200
300
400
500
ANODE VOLTS
$V_f = 1·6$
$V_f = 1·7$
$V_f = 1·8$
635






FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS

R.857

**GK10**

# FERRANTI

## COLD CATHODE TRIODE

A gas-filled cold cathode Triode of miniature dimensions, designed for use as a Relay Valve.

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B7G. |
| Max. diameter (glass envelope) | 19 mm. ($\frac{3}{4}$in.). |
| Max. seated height ... ... | 48 mm. ($1\frac{7}{8}$in.). |
| Max. overall length ... ... | 54 mm. ($2\frac{1}{8}$in.). |
| Mounting position ... ... | Any. |

### BASE CONNECTIONS.

Pin 1—Anode.
Pin 2—Internal Connection.
Pin 3—Cathode.
Pin 4—Trigger.
Pin 5—Internal Connection.
Pin 6—Internal Connection.
Pin 7—Cathode.

### CHARACTERISTICS.

| | |
|---|---|
| Nominal Trigger Voltage ... | 80 volts. |
| Anode-Cathode Gap Volt Drop | 75 volts (approx.). |
| Trigger-Cathode Gap Volt Drop | 70 volts (approx.). |
| ‡§Min. Transfer Current ... ... | 10 $\mu$A. |
| Recovery Time ... ... ... | 800 $\mu$Secs. (approx.). |

### RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... | 150 volts DC. |
| Max. Peak Anode Current ... | 30 mA. |
| Max. Mean Anode Current ... | 7·5 mA. |
| Max. Trigger Current ... ... | 500 $\mu$A. |

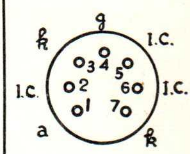
### TYPICAL OPERATING CONDITIONS.

| | |
|---|---|
| *Anode Voltage ... ... ... | 135 volts DC. |
| †Static Bias (positive) ... ... | 55 volts DC. |
| Transfer Current ... ... | 4 $\mu$A. |
| †Trigger Pulse Amplitude ... | 50 volts. |

‡At $V_a = 135$.

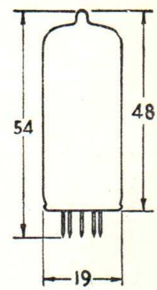
§10 microamperes is the minimum current to ensure interchangeability and reliable operation during life, but transfer currents on individual valves may be considerably lower.

*The anode supply switch should be shunted by a resistor of approximately 30 megohms to prevent surge effects which would cause the valve to fire on switching.




**Base Connections**

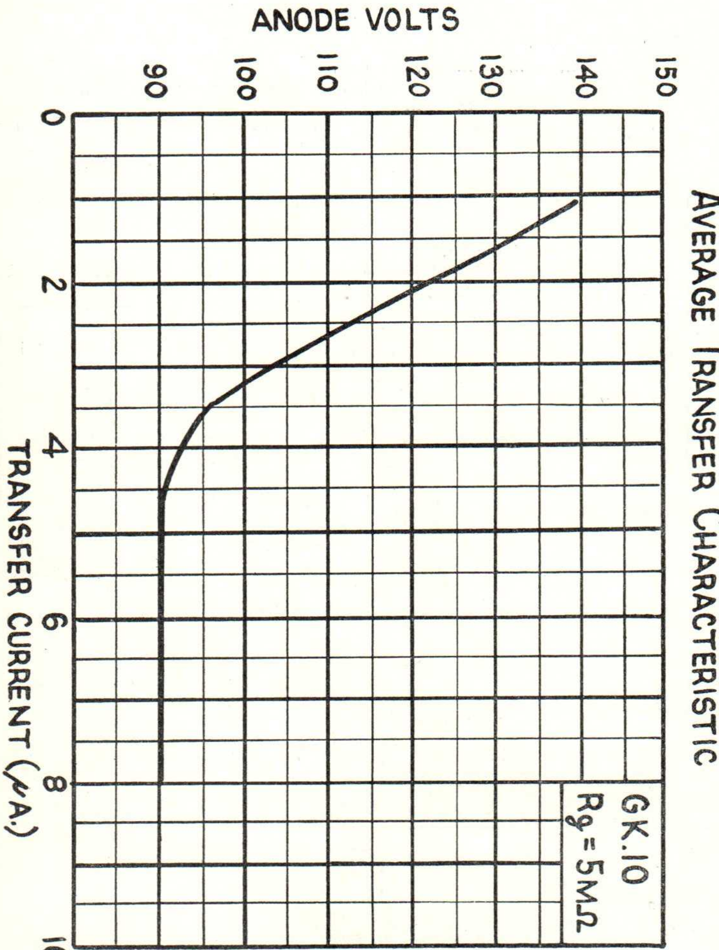
**Underside View of Base**




All dimensions shown are in millimetres (max.).

Issue 2
July, 1955

GK10

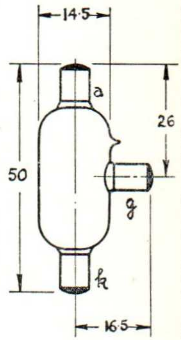

ANODE VOLTS
90
100
110
120
130
140
150
AVERAGE TRANSFER CHARACTERISTIC
TRANSFER CURRENT (μA.)
0
2
4
6
8
10
GK.10
Rg = 5MΩ

# FERRANTI



## COLD CATHODE TRIODES

Gas filled valves of miniature dimensions designed for use as Relay Tubes. These valves are intended for pulse operation with a low duty cycle.




### PHYSICAL DETAILS.

| | GK32 | GK33 |
|---|---|---|
| Base ... ... ... ... | None. | |
| Max. Diameter (glass envelope) | 15·5 mm. | 15·5 mm. |
| Max. Overall Diameter ... | 25·5 mm. | 21·5 mm. |
| Max. Overall Length ... | 51·5 mm. | 42 mm. |
| Mounting Position ... ... | Any. | |

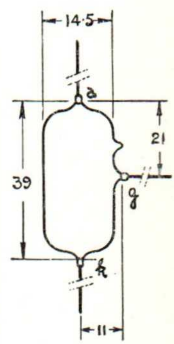
On Type GK32 the electrodes are brought out to CT.I caps in order to permit mounting in standard clips.

Type GK33 is fitted with flexible leads and is intended to be wired in to the equipment.

On both types the grid is brought out to a side connection and the anode is indicated by a red band.

### RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... | 140 volts DC. |
| Max. Peak Anode Current ... | 20 mA. |
| Max. Grid Current ... ... | 500 μA. |




### CHARACTERISTICS.

| | |
|---|---|
| *Trigger Voltage ... ... ... | 85–98 volts DC. |
| **Min. Transfer Current ... ... | 10 μA. |
| Average Recovery Time ... | 1 millisec. |

### TYPICAL OPERATION.

| | |
|---|---|
| †Anode Voltage ... ... ... | 135 volts DC. |
| ‡Static Bias (positive) ... ... | 80 volts DC. |
| Transfer Current ... ... | 2·2 μA. |
| Volt Drop across Valve ... ... | 80 volts (approx.). |
| §Trigger Pulse Amplitude ... | $\nless$20 volts. |

### CAPACITANCES.

| | |
|---|---|
| $C_{g-k}$ ... ... ... ... | 0·6 pF. |
| $C_{a-k}$ ... ... ... ... | 0·12 pF. |
| $C_{a-g}$ ... ... ... ... | 0·1 pF. |

*At Va = 135.

**10 microamperes is the minimum current to ensure interchangeability and reliable operation, but transfer currents on individual valves may be considerably lower.

†The anode supply switch should be shunted by a resistor of approximately 30 megohms to prevent surge effects which would cause the valve to fire on switching.

‡Alternatively the static bias may be obtained by connecting the grid to the anode supply voltage through a high resistance of the order of 1000 megohms. Under these conditions the valve will respond to trigger signals of very low amplitude and consistent operation by the same signal can be ensured from valve to valve.

§For operation by pulses of very short duration it is usually necessary to increase the pulse amplitude.

All dimensions shown are in millimetres (nom.).

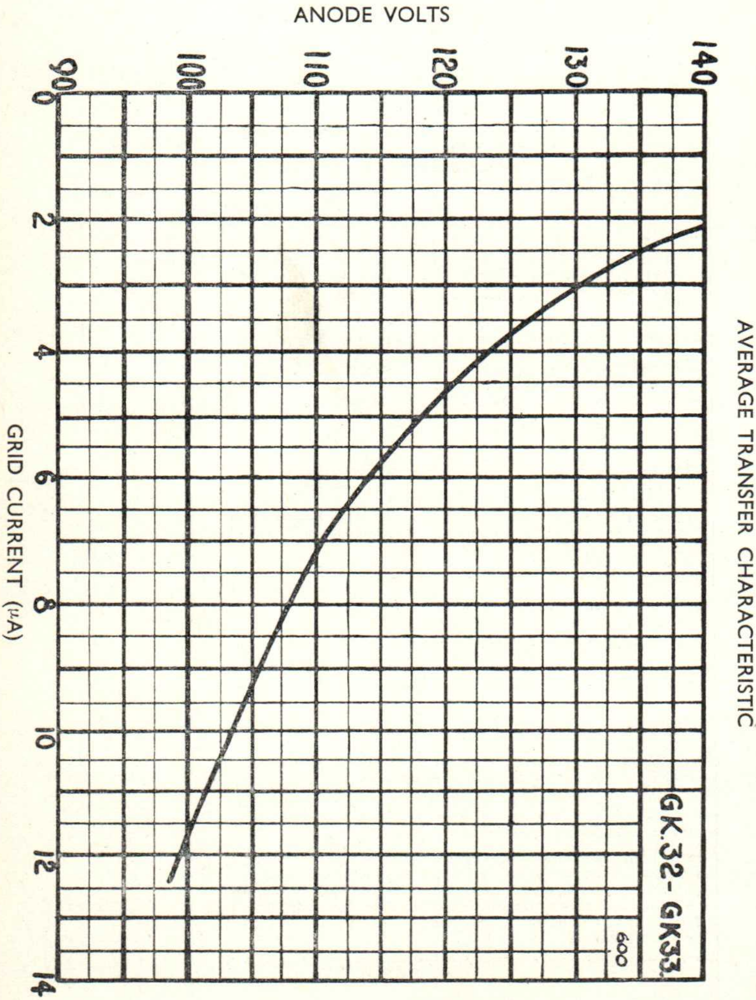
These valves were formerly designated K32 and K33.

FERRANTI

Issue 3
Dec., 1955

| GK32 |
| --- |
| GK33 |

FERRANTI



# FERRANTI

## COLD CATHODE TRIODES

**GK40**

**GK41**

Gas filled valves of miniature dimensions designed for use as Relay Tubes.

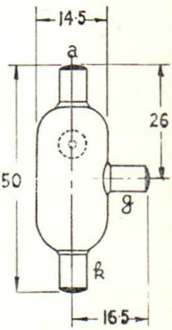
PHYSICAL DETAILS.

| | GK40 | GK41 |
|---|---|---|
| Base ... ... ... ... | None. | |
| Max. diameter (glass envelope) | 15·5 mm. | 15·5 mm. |
| Max. overall width ... | 25·5 mm. | 21·5 mm. |
| Max. overall length ... | 52 mm. | 42 mm. |
| Mounting position ... | Any. | |

On Type GK40 the electrodes are brought out to caps in order to permit mounting in standard clips.

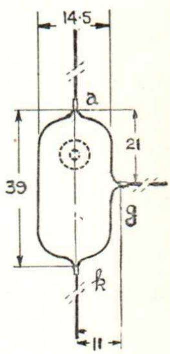
Type GK41 is fitted with flexible leads and is intended to be wired in to the equipment.

On both types the grid is brought out to a side connection and the anode is indicated by a red band.




RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... | 140 volts DC. |
| Max. Peak Anode Current ... | 20 mA. |
| Max. Grid Current ... ... | 500 μa. |




CHARACTERISTICS.

| | |
|---|---|
| *Trigger Voltage ... ... ... | 79–85 volts DC. |
| **Min. Transfer Current ... ... | 4μa. |
| Average Recovery Time ... | 1·5 milliseconds. |

TYPICAL OPERATION.

| | |
|---|---|
| †Anode Voltage ... ... ... | 135 volts DC. |
| ‡Static Bias (positive) ... ... | 70 volts DC. |
| Transfer Current ... ... | 1 μA. |
| Volt Drop across Valve ... | 73 volts approx. |
| §Trigger Pulse Amplitude ... | ≮20 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{g-k}$ ... ... ... ... | 0·7 pF. |
| $C_{a-k}$ ... ... ... ... | 0·12 pF. |
| $C_{a-g}$ ... ... ... ... | 0·1 pF. |

*At $V_a = 135$.

**4 microamperes is the minimum current to ensure interchangeability and reliable operation, but transfer currents on individual valves may be considerably lower.

†The anode supply switch should be shunted by a resistor of approximately 30 megohms to prevent surge effects which would cause the valve to fire on switching.

‡Alternatively the static bias may be obtained by connecting the grid to the anode supply voltage through a high resistance of the order of 1000 megohms. Under these conditions the valve will respond to trigger signals of very low amplitude and consistent operation by the same signal can be ensured from valve to valve.

§For operation by pulses of very short duration it is usually necessary to increase the pulse amplitude.

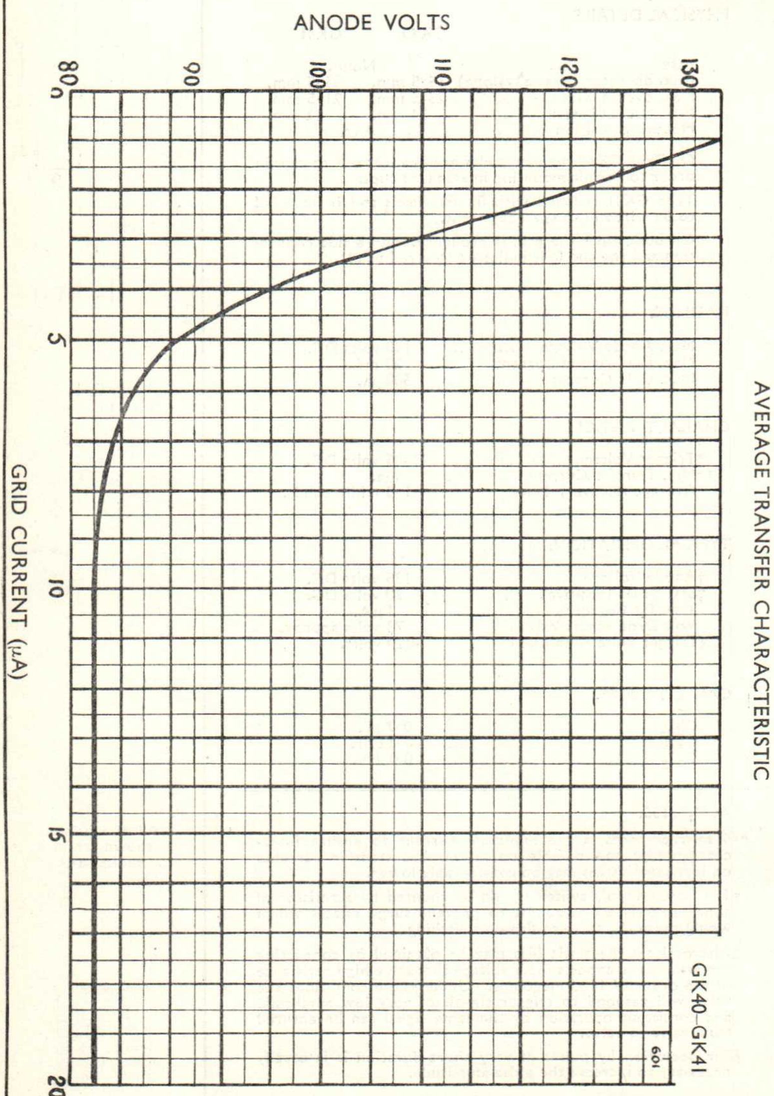
All dimensions shown are in millimetres

These valves were formerly designated K40 and K41.

Issue 3
Dec., 1955

**GK40**

**GK41**



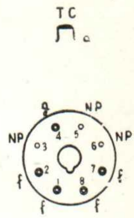

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

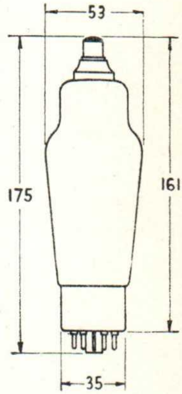
GL1

# FERRANTI

## TRIODE THYRATRON

Type GL1 is a Mercury-Argon Triode Thyratron with a directly heated oxide coated cathode.





All dimensions shown are in millimetres. (max.)

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Top Cap ... ... ... ... | Type CT2 with ceramic collar. |
| Max. Overall Length ... ... | 175 mm. ($6\frac{29}{32}$ins.). |
| Max. Seated Height ... ... | 161 mm. ($6\frac{11}{32}$ins.). |
| Max. Bulb Diameter ... ... | 53·0 mm. ($2\frac{3}{32}$ins.). |
| Mounting Position ... ... | Vertical Base Down. |

### BASE CONNECTIONS.

Pin 1 } Filament*
Pin 2 }
Pin 3—No Pin.
Pin 4—Control Grid.
Pin 5—No Pin.
Pin 6—No Pin.
Pin 7 } Filament*
Pin 8 }
Top Cap—Anode.

### RATINGS—Absolute Ratings.

| | |
|---|---|
| Filament Voltage ... ... | 2·5 volts. |
| Filament Current ... ... | 7·0 amps. |
| Max. Peak Anode Voltage : | |
| Forward ... | 1250 volts. |
| Inverse ... | 1250 volts. |
| Max. Peak Anode Current ... | 6·0 amps. |
| Max. Mean Anode Current ... | 1·5 amps. |
| Max. Instantaneous Grid Current | 50 mA. |
| Min. Heating Time ... ... | 15 secs. |
| Max. Power Supply Frequency | 400 c/s. |
| Temperature Range ... ... | –55°C to +80°C. |
| Max. Negative Control Grid Voltage : | |
| Before Conduction ... | 500 volts. |
| After Conduction ... | 12 volts. |

### ELECTRICAL CHARACTERISTICS.

| | | | |
|---|---|---|---|
| Peak Voltage Drop ... ... | | 16 volts. | |
| Control Characteristics : | | | |
| DC Anode Voltage | 26 | 500 | 1250 volts. |
| DC Grid Voltage | 0 | –4·0 | –6·8 volts. |
| Min. Grid Circuit Resistance ... | | 1000 ohms. | |

### INTERELECTRODE CAPACITANCES :

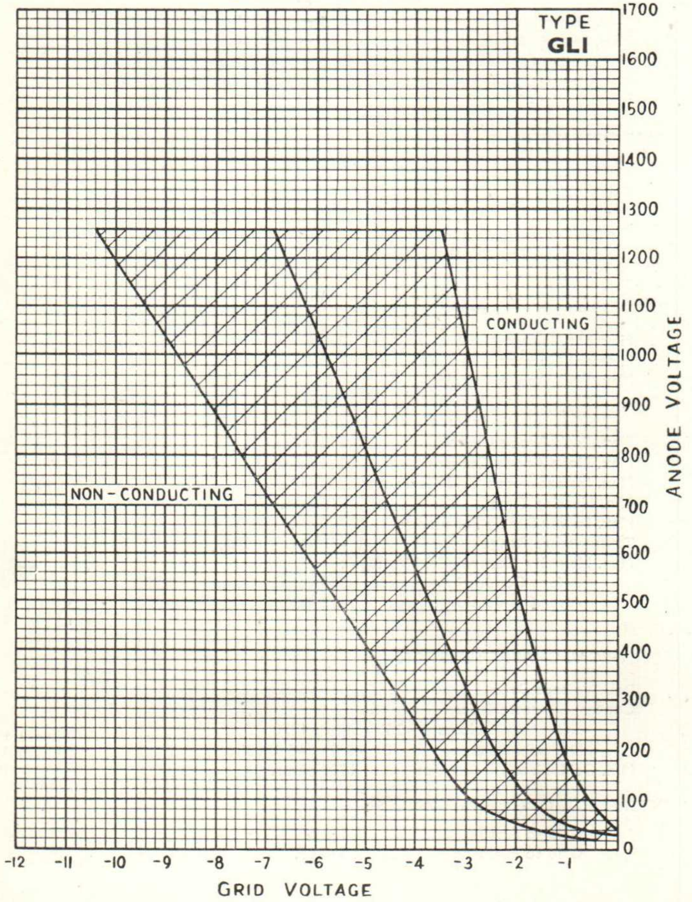
| | |
|---|---|
| Grid to Anode ... ... | 1·8 pF. |
| Grid to Filament ... | 5·8 pF. |

*It is essential to connect one side of the filament supply to both pins 1 and 2, and the other side to both pins 7 and 8.

Issue 4.
Sept., 1955

FERRANTI

CRITICAL CONTROL GRID VOLTAGE CHARACTERISTIC

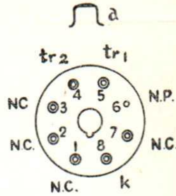


# FERRANTI

## COLD CATHODE TETRODE

**GN10**

A gas-filled cold cathode arc discharge valve, designed for pulse operation. It is capable of passing a discharge current of the order of 250 Amperes peak, and is particularly suitable for Electronic Relays and Controls when short duration high peak current pulses are required.




**Base Connections**

**Underside View of Base**

PHYSICAL SPECIFICATION.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Seated Height ... ... | 100 mm. ($3\frac{15}{16}$in.). |
| Max. Overall Length ... ... | 114 mm. ($4\frac{1}{2}$in.). |
| Max. Base Diameter ... ... | 33 mm. ($1\frac{5}{16}$in.). |
| Top Cap ... ... ... | Type CT1 ($\frac{1}{4}$in. dia.). |
| Mounting Position ... ... | Any. |

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No connection. | Pin 5—Trigger Electrode No. 1. |
| Pin 2—No connection. | Pin 6—No Pin. |
| Pin 3—No connection. | Pin 7—No connection. |
| Pin 4—Trigger Electrode No. 2. | Pin 8—Cathode. |
| | Top Cap—Anode. |

RATINGS.

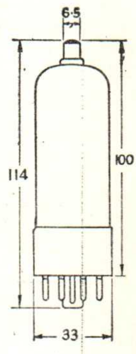
| | |
|---|---|
| Maximum Anode Voltage (Static) ... | 550 volts. |
| Maximum Anode Voltage (working) ... | 450 volts. |
| Minimum Anode Voltage (working) ... | 320 volts. |
| Peak Inverse Anode Voltage ... ... | 500 volts. |
| Max. Mean Anode Current ... ... | 90 mA. |
| Maximum Average Grid Current ... | 10 mA. |
| Max. Discharge Capacity ... ... | 16 $\mu$F. |

CHARACTERISTICS.

| | | |
|---|---|---|
| *Static Striking Voltage ($tr_2$ to $tr_1$) | 90–140 | volts. |
| Max. Repetition Frequency ... | 250 | per sec. |
| Min. Trigger Current required at $V_a$ 450 | 50 $\mu$A. | |
| Min. Trigger Current required at $V_a$ 320 | 100 $\mu$A. | |

†Peak Anode Limits Anode Current Duration: A peak anode current of approx. 300 amps. results from the discharge of a 2 $\mu$Fd. capacitor charged to 450 V. The discharge time is 5 $\mu$ secs. approx.

Luminous Intensity: Under discharge conditions noted above the peak luminous intensity is approx. 530 candelas.




All dimensions shown are in millimetres.

TYPICAL OPERATION.

| | |
|---|---|
| DC. Supply Voltage ... ... | 420 volts. |
| Trigger Electrode No. 2 Voltage ($V_{tr2}$) ... ... | 60 volts. |
| §Trigger Pulse Amplitude ($V_{tr_1}$) | 160 volts. |
| Charging Resistor ... ... | 3000 ohms. |
| Discharge Capacitor for operation at :— | |
| 50 c.p.s. ... ... ... | 2 $\mu$F. |
| 250 c.p.s. ... ... ... | 0·5 $\mu$F. |

For further information on operation please refer to data sheet for NSP2 under "Notes on Operation." However, because of the increased supply voltage used with GN10, the circuits shown on the NSP2 Sheet will require some modification of component valves to provide the correct trigger electrode voltages.

DELAY TIME.

From 50 microseconds down to a few microseconds dependent on circuit conditions. In normal operation shortest delay times are ensured by using high values of Anode Voltage and trigger pulse energy.

*The limits quoted are to cover production variations, and refer to the triggering voltage for a low rate of change of electrode voltages, with $tr_1$ negative to $tr_2$. For pulse operation a higher trigger voltage is generally necessary. See under "Typical Operation" and "Notes on Operation."

†A minimum of 5 amps. is necessary for the formation of an arc discharge with a tube drop of approx. 20 volts. If the main gap current is less than 5 amps. peak, a glow discharge is likely to form with a 70 volt drop and results in excessive cathode dissipation.

‡At instant of triggering.

§Negative in respect to cathode.

Issue 3
Jan., 1958

FERRANTI

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NOTES ON OPERATION.

On the quadrant diagram shown below the area enclosed by the loops is an area of non-conduction. If the vector sum of the voltages on two electrodes lies within the loop the valve will not fire. Any change of either or both of these voltages which causes the vector sum to fall outside the loop will trigger the valve by producing a glow discharge between one of the trigger electrodes and cathode or between the two trigger electrodes. This discharge will then initiate the arc discharge in the main anode—cathode gap. However to ensure reliable triggering and interchangeability, the valve should be triggered by a discharge between the two Trigger Electrodes, with a positive voltage on $tr_2$ and a negative going voltage on $tr_1$.

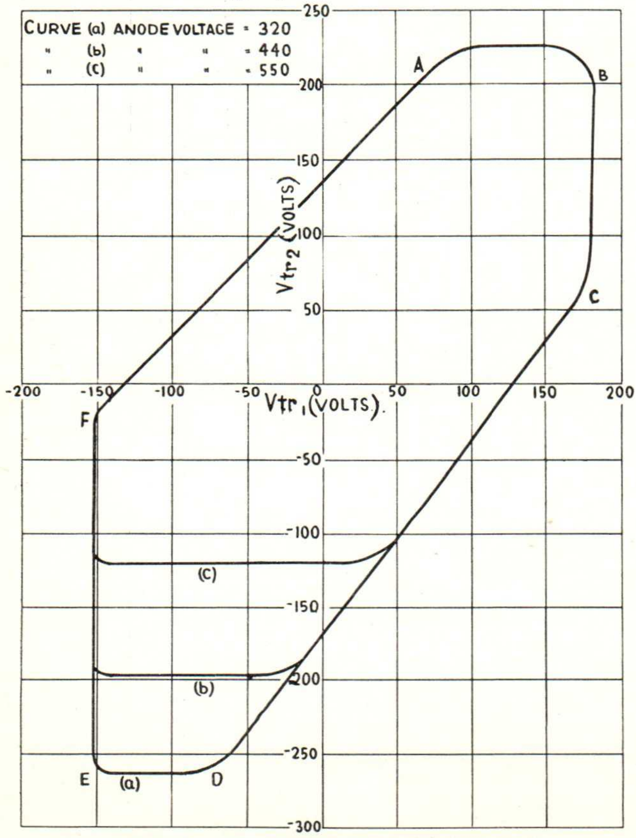
As the triggering impulse carries the vector sum of the applied voltages outside the loop, the point at which it crosses the loop indicates the manner in which the valve is triggered as follows :—

A—B Trigger Elec. 2 to Cathode.
B—C Trigger Elec. 1 to Cathode.
C—D Trigger Elec. 1 to Trigger Elec. 2.
D—E Cathode to Trigger Elec. 2.
E—F Cathode to Trigger Elec. 2.
F—A Trigger Elec. 2 to Trigger Elec. 1.

As noted above the most reliable operation is ensured by triggering between F and A, i.e., between $tr_2$ and $tr_1$.

For pulse operation it is necessary to apply a negative pulse of sufficient height and width, to trigger Electrode No. 1. A suitable trigger pulse is one about 150—200 volts which has a width of 30—100 microseconds at half the pulse amplitude.

The voltage on Trigger Electrode 2 should be approximately 60 volts positive at the instant of triggering.



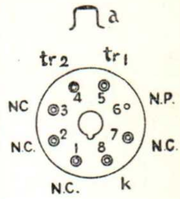

AVERAGE STATIC TRIGGERING CHARACTERISTIC

# FERRANTI

## COLD CATHODE TETRODE



Type GN20 is a gas-filled cold cathode arc discharge valve. It is designed for pulse operation, and is particularly suitable for such applications as Electronic Relays where short duration pulses of up to 250 Amperes peak are required. The gas filling is argon.




**Base Connections**

**Underside View of Base**

### PHYSICAL SPECIFICATION.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Seated Height ... ... | 100 mm. ($3\frac{15}{16}$in.). |
| Max. Overall Length ... ... | 114 mm. ($4\frac{1}{2}$in.). |
| Max. Base Diameter ... ... | 33 mm. ($1\frac{5}{16}$in.). |
| Top Cap ... ... ... | Type CTI ($\frac{1}{4}$in. dia.). |
| Mounting Position ... ... | Any. |

### BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No connection. | Pin 5—Trigger Electrode No. 1 |
| Pin 2—No connection. | Pin 6—No Pin. |
| Pin 3—No connection. | Pin 7—No connection. |
| Pin 4—Trigger Electrode No. 2 | Pin 8—Cathode. |
| | Top Cap—Anode. |

### RATINGS.

| | |
|---|---|
| Maximum Anode Voltage ... | 420 volts DC. |
| Minimum Anode Voltage ... | 350 volts DC. |
| Peak Inverse Anode Voltage ... | 400 volts. |
| *Maximum Mean Anode Current | 80 mA. |
| Maximum Average Trigger Current | 10 mA. |
| Minimum Series Discharge Resistance ... ... ... | 0·3 ohms. |

### CHARACTERISTICS.

| | |
|---|---|
| †Static Trigger Voltage ($tr_1$ to $tr_2$) | 75 to 125 volts. |
| Max. Repetition Frequency ... | 250 per sec. |
| Min. Trigger Current :— | |
| $V_a = 420$ ... ... ... | 50 $\mu$A. |
| $V_a = 350$ ... ... ... | 100 $\mu$A. |

### TYPICAL OPERATION.

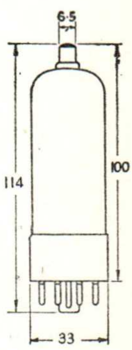
| | |
|---|---|
| DC. Supply Voltage ... ... | 360 volts. |
| Trigger Electrode No. 2 Voltage ($V_{tr_2}$) ... ... | 60 volts. |
| §Trigger Pulse Amplitude ($V_{tr_1}$) | 150 volts. |
| Charging Resistor ... ... | 4000 ohms. |
| Discharge Capacitor for operation at :— | |
| 50 c.p.s. ... ... ... | 2 $\mu$F. |
| 250 c.p.s. ... ... ... | 0·5 $\mu$F. |

For pulse operation to ensure interchangeability and reliable triggering it is necessary to employ a pulse of sufficient height and width. A suitable pulse may be derived by differentiating a square pulse of about 150—200 volts (e.g., from a multivibrator circuit) to produce a pulse which has a width of 30—100 microseconds at half the pulse height. The voltage on Trigger Electrode No. 2 should be approx. 60 volts at the instant of triggering.

For further information on operation please refer to data sheet for NSP2 under "Notes on Operation."

### DELAY TIME.

From 50 microseconds down to a few microseconds dependent on circuit conditions. Minimum delay times can be achieved by using high values of trigger pulse energy and anode voltage.




All dimensions shown are in millimetres.

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*A minimum of 5 amps. is recommended. This ensures the formation of an arc discharge with a tube drop of approx. 20 volts. If the peak current is less than 5 amps. a glow discharge is likely to form with a 75 volt drop.

†The limits quoted are to cover production variation and refer to the trigger voltage for single triggering with $tr_1$ negative to $tr_2$. For pulse operation a higher trigger voltage is generally necessary. See under "Typical Operation."

§Negative with respect to cathode.

Issue 1
Aug., 1955

FERRANTI

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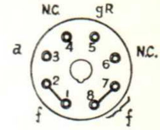
# GUARD RING DIODE

Type GRD7 is a directly heated diode with cylindrical co-axial electrodes and a tungsten filament. The guard rings ensure a homogeneous anode-cathode field and eliminate 'fringe' effect.
Although primarily designed for educational deomnstration purposes it is equally suitable in applicatons requiring a saturated diode of high stability, such as in stabilised AC. supply circuits.




**Base Connections**

**Underside View of Base**

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Max. Overall Length ... ... | 109 mm. ($4\frac{1}{4}$in.). |
| Max. Seated Height ... ... | 94 mm. ($3\frac{11}{16}$in.). |
| Max. Diameter ... ... ... | 33 mm. ($1\frac{5}{16}$in.). |
| Mounting Position ... ... | Vertical, base down. |

The Anode and Guard Rings are of non-magnetic material.

A hole in the anode alows the filament to be sighted for the approximate assessment of temperature by optical method.*

## BASE CONNECTIONS.

†Pin 1, †Pin 2 — Filament.
Pin 3—Anode.
Pin 4—No connection.
Pin 5—Guard Rings.
Pin 6—No connection.
†Pin 7, †Pin 8 — Filament.

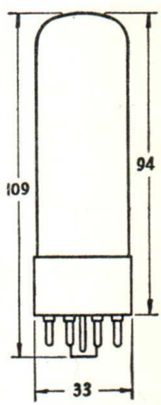
## RATINGS.

Continuous Operation:

| | |
|---|---|
| Max. Filament Voltage ... ... | 6 volts. |
| Max. Anode Voltage ... ... | 300 volts. |
| Max. Anode Dissipation... ... | 2 watts. |

‡Intermittent Operation:

| | |
|---|---|
| Max. Filament Voltage ... ... | 7 volts. |
| Max. Anode Voltage ... ... | 300 volts. |
| Max. Anode Dissipation... ... | 5 watts. |




Dimensions shown are in millimetres (max.).

## CHARACTERISTICS.

Electrical.

| | |
|---|---|
| Filament Voltage (for $I_f = 2{\cdot}2$ amps.) ... | 6·3 volts approx. |
| Filament Current ... ... | Variable. (See $I_f$/Temp. graph on Page 3). |

Physical.

| | |
|---|---|
| Anode Length ... ... ... | 14·5 mm. |
| Anode Internal Diameter ... | 6·5 mm. |
| Filament Diameter ... ... | 0·125 mm. |
| Effective Filament Length ... | 14·5 mm. |

*Due allowance should be made for transmission losses due to the glass envelope. There may also be losses due to film deposited on the glass.

†It is advisable that one filament lead shall be connected to both Pins 1 and 2 and the other lead to both Pins 7 and 8.

‡Short period operation, for example, as required for demonstration purposes.

Issue 4.
Oct., 1961.

Ferranti

# BRIEF NOTES
# ON EDUCATIONAL DEMONSTRATIONS

**Richardson's Law.**

Total Electron Emission $= aAT^2 \exp. (-11600\varnothing/T.)$

Where a is the effective area of electron emission

T is the absolute temperature of the Electron emitting surface of the cathode.

A and $\varnothing$ are thermionic constants determined by the chemical nature of the cathode.

The GRD7 cathode is a tungsten filament with diameter (d) $= 0 \cdot 125$ mm. and an effective length $(l) = 14 \cdot 5$ mm.

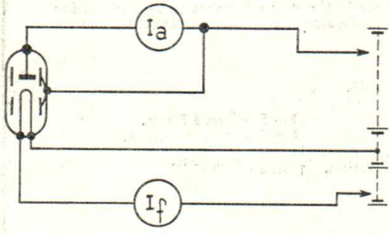
For Tungsten the generally accepted value of A is approximately 600 and the value of $\varnothing$ is $4 \cdot 52$.

The expression above therefore becomes

$$= \pi dl \times 600 \times T^2 \text{ Exp. } (-11600 \times 4 \cdot 52/T).$$

$$= 3400 \times T^2 \text{ Exp. } (-52500/T) \text{ approximately.}$$

A typical circuit for demonstration is shown below:

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**Child-Langmuir Three-halves Power Law.**

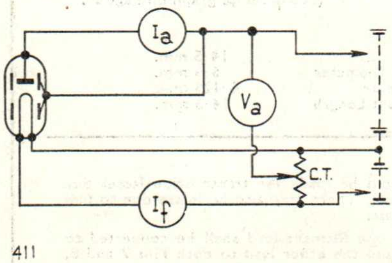
For a vacuum diode:—

$$I_a \text{ (mA)} = 14 \cdot 65 \frac{l}{R} 10^{-3} V_a{}^{1 \cdot 5}$$

Where $l$ is the length of the anode

R is the inside radius of the anode.

A circuit for experimental verification:—

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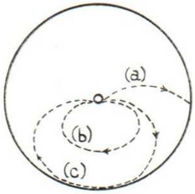
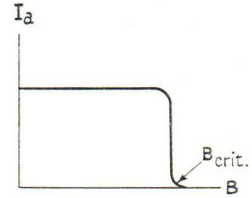
**Hull's Law** (Basic Magnetron Effect).

Experimental verification of this law can be effected by surrounding the GRD7 with a solenoid to produce a homogeneous magnetic field parallel to the electrode axis.

It is useful only as a device to conveniently demonstrate the principle of current cut-off in a vacuum diode.

The magnetic field affects the electron path as illustrated below. At a low value of flux density (B) the electrons reach the anode along a slightly curved path (a) whilst at a high value of flux density the curvature of the electron path (b) is such that the electrons return to the cathode. Therefore by varying the flux density it is possible to let anode current (I) pass, or to cut it off. The point at which I is cut off is $B_{crit}$, a condition corresponding to the electron path (c). The cut off is somewhat gradual because the initial electron velocity is non-uniform and for other reasons.




For a vacuum diode:—

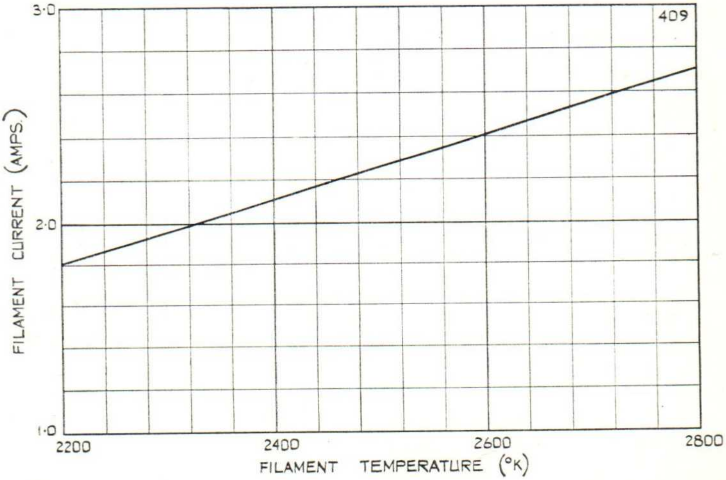
$B_{crit} = k\sqrt{V_a}$

where Bcrit = the flux density of the magnetic field for current cut-off.

$V_a$ = Anode Voltage.

k = a constant with a value dependent on the dimensions of the diode and the configuration of the magnetic field.

FILAMENT TEMPERATURE/FILAMENT CURRENT




Issue 4.
Oct., 1961.



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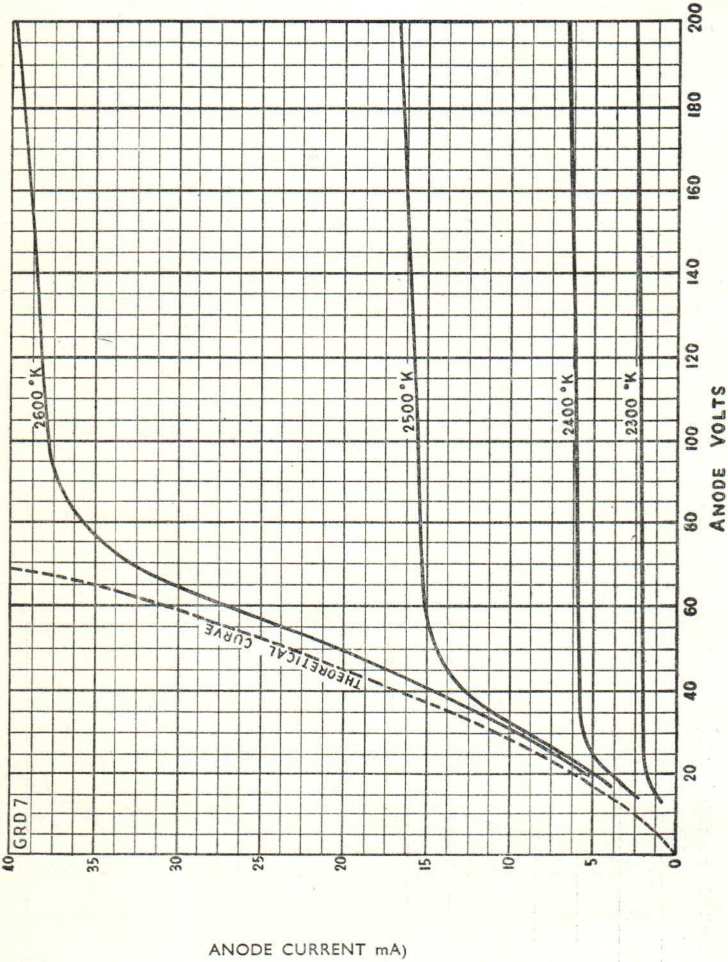




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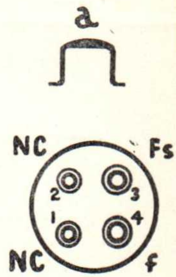
# HG25

# FERRANTI

## MERCURY VAPOUR RECTIFIER

A Mercury Vapour Rectifier with an oxide coated filament.




**Base Connections**
**Underside View of Base**

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | UX—4-pin (Bayonet). |
| Max. Overall Length ... ... | 170 mm. ($6\frac{11}{16}$in.). |
| Max. Seated Height ... ... | 155 mm. ($6\frac{1}{8}$in.) |
| Max. Bulb Diameter ... ... | 66 mm. ($2\frac{19}{32}$in.). |
| Anode Cap ... ... ... | Type CT3. |
| Mounting Position ... ... | Vertical—Base down. |

### CATHODE.

| | |
|---|---|
| Fil. Voltage ... ... ... | 2·5 volts. |
| Fil. Current ... ... ... | 5·0 amps. |

### RATINGS. (Maximum ratings are "absolute" values.)

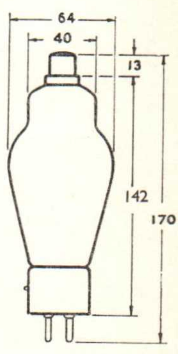
| Natural Ventilation<br>Forced Ventilation | 20°C—40°C<br>20°C—60°C | 25°C—55°C<br>25°C—65°C |
|---|---|---|
| Max. P.I.V. ... ...<br>(See Note 2 below) | 5kV—10kV | up to 5kV |

| | | |
|---|---|---|
| Max. Peak Anode Current ... | 1·0 | Amp. |
| Max. Av. Anode Current ... | 0·25 | Amp. |
| Ambient Temperature Range : | | |
| Natural Ventilation ... | 20°—55°C. | |
| Forced Ventilation ... ... | 20°—65°C. | |
| Min. Cathode Heating Delay ...<br>(See Note 1 below.) | 30 | secs. |

The above ratings apply to operation in circuits using a choke input filter and a supply frequency of 50 c/s.

### TYPICAL OPERATION.

| *CIRCUIT. | | D.C. Output Kilovolts. | Amps. |
|---|---|---|---|
| No. 1. | Bi-Phase Half Wave (2 valves) ... | 3·2 | 0·5 |
| No. 2. | 3-Phase Half Wave (3 valves) ... | 4·5 | 0·75 |
| No. 3. | Single Phase Full Wave (4 valves) ... | 6·5 | 0·5 |
| No. 4. | 3-Phase Full Wave (6 valves) ... | 9·5 | 0·75 |
| No. 5. | 3-Phase Half Wave Double Y (6 valves) | 4·5 | 1·5 |




All dimensions shown are in millimetres (max.)

### INSTALLATION NOTES.

1. When first installed or after a long period of rest the valve should be run for at least 5 minutes before the application of any anode voltage.
2. The rated value of P.I.V. is applicable only over the temperature ranges noted above. Care should be taken in selecting a suitable position in the layout to ensure free circulation of air around the bulb.
3. Valves should be shielded from radio frequency fields.
4. Surges due to H.T. switching or other causes should be avoided.
5. This rectifier is directly heated and it is therefore recommended that the output circuit should be returned to the mid point of the filament transformer secondary.
6. If valves are used in parallel to increase current output balancing inductances must be placed in the anode leads.

*For Circuit Diagrams see overleaf.

This Valve is a direct equivalent to U.S.A. type 866A.

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Mar., 1957

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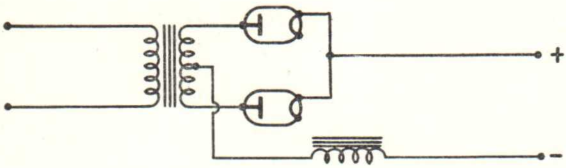
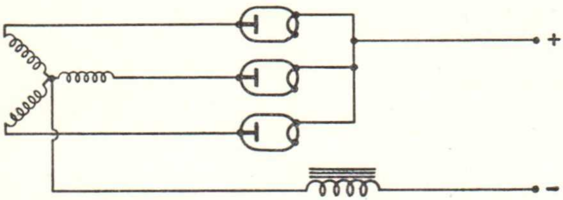
# HG25

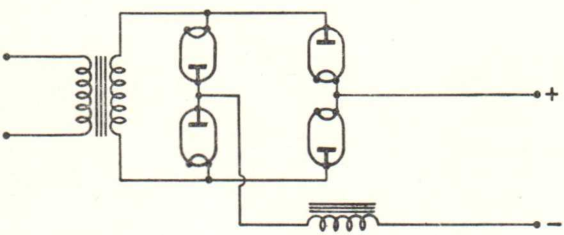
Circuits referred to under "TYPICAL OPERATION" overleaf.



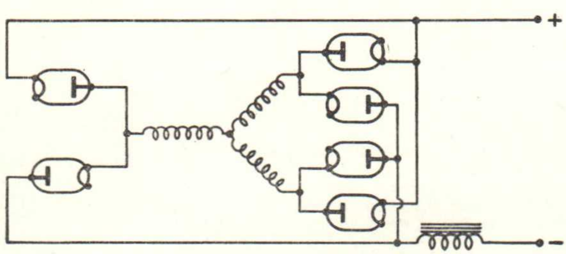

1




2




3

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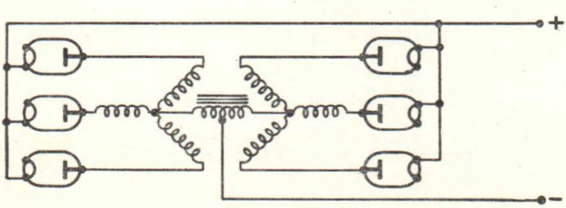



5

Ferranti

**HL10**

# HIGH VOLTAGE VACUUM TRIODE

A high voltage vacuum triode with an indirectly heated oxide coated cathode. Applications include its use as a control valve or regulator for high voltage d.c. power supplies and as a variable resistor for use at high d.c. voltages.

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Top Cap ... ... ... | Skirted Medium CT3. (14.5 mm. dia.) |
| Max. Overall Length ... ... | 234 mm. |
| Max. Seated Height ... ... | 220 mm. |
| Max. Diameter ... ... ... | 64 mm. |
| Mounting Position ... ... | Any. |

## BASE CONNECTIONS.

Pin 1—Not connected.
Pin 2—Heater.
Pin 3—Not connected.
Pin 4—Grid.
Pin 5—Not connected.
Pin 6—No Pin.
Pin 7—Heater.
Pin 8—Cathode.
Top Cap—Anode.

## HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 4·0 volts. |
| Heater Current ... ... ... | 1·5 amps. |

## RATINGS (Absolute).

| | |
|---|---|
| Max. Anode Voltage ... ... | 20 kV. |
| Max. Peak Anode Current ... | 30 mA. |
| Max. Mean Anode Dissipation ... | 30 watts. |
| Max. Mean Anode Current ... | 10 mA. |
| Max. Negative Grid Voltage ... | –250 volts. |
| Max. Grid Circuit Resistance ... | 2 megohms. |
| *Max. Peak Heater/Cathode Voltage | 150 volts. |
| Min. Cathode Heating Period prior to application of anode potential | 30 secs. |

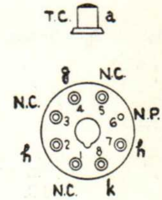
## CHARACTERISTICS.

| | | | | | |
|---|---|---|---|---|---|
| D.C. Anode Voltage | 5 | 10 | 15 | 20 | kV. |
| D.C. Grid Volts for cut off ... | –24 | –40 | –59 | –80 | volts. |
| D.C. Grid Volts for $I_a = 100\mu A$ | –18 | –35 | –52 | –73 | volts. |
| Amplification Factor | 300 | 300 | 300 | 300 | (approx.) |

## CAPACITANCES.

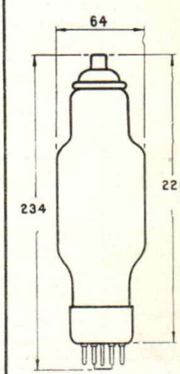
| | |
|---|---|
| $C_{g-k}$ (input) ... ... ... | 4·0 pF. |
| $C_{a-g}$ (output) ... ... | 2·0 pF. |

*Heater negative with respect to cathode.




**Base Connections**

**Underside View of Base**




All dimensions shown are in millimetres (max.).

## WARNING.

Operation of the HL10 at high anode voltage may result in the production of X-rays which could cause possible injury from prolonged exposure at close range unless adequate shielding is provided. Relatively simple shielding should prove adequate.

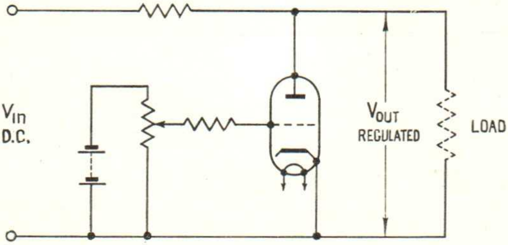
The high voltages normally applied to this valve can be very dangerous and particular care should be taken when making any circuit adjustments. It is recommended that before any part of the circuit is touched the supply voltage should be switched off and the terminals of any capacitor grounded.

Ferranti

Issue 3
Mar., 1961

Ferranti

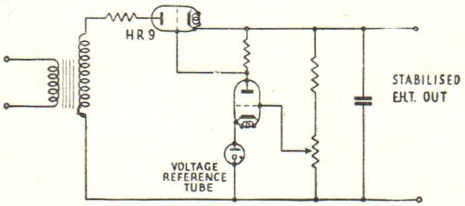
→ **As a Shunt Regulator.**




(*Fig* 1)

Fig. (1) shows a simple circuit using the HL10 as a shunt regulator.

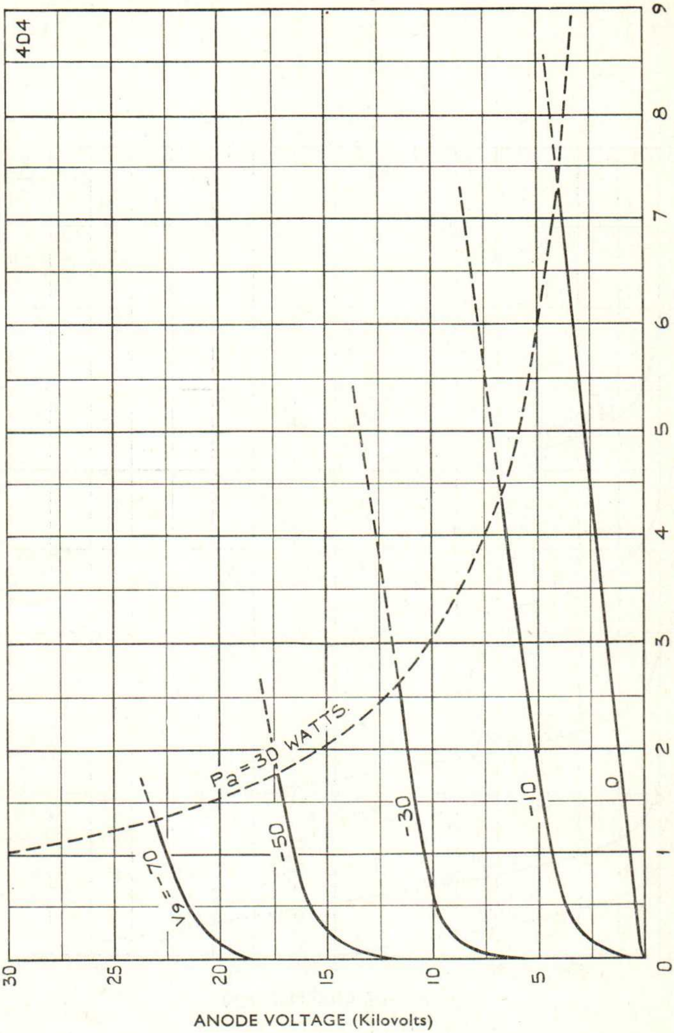
**As a Voltage Controller in a Grid Controlled Rectifier Circuit with Automatic Stabilisation.**




(*Fig*. 2)

→ In this application the HL10 is used in conjunction with a gas filled cold cathode diode type KD21. The function of the KD21 is to provide a stabilised cathode bias, and the HL10 supplies automatic grid control to the Rectifier HR9. The resultant stabilised E.H.T. output voltage can be varied by adjustment of the HL10 grid potentiometer.

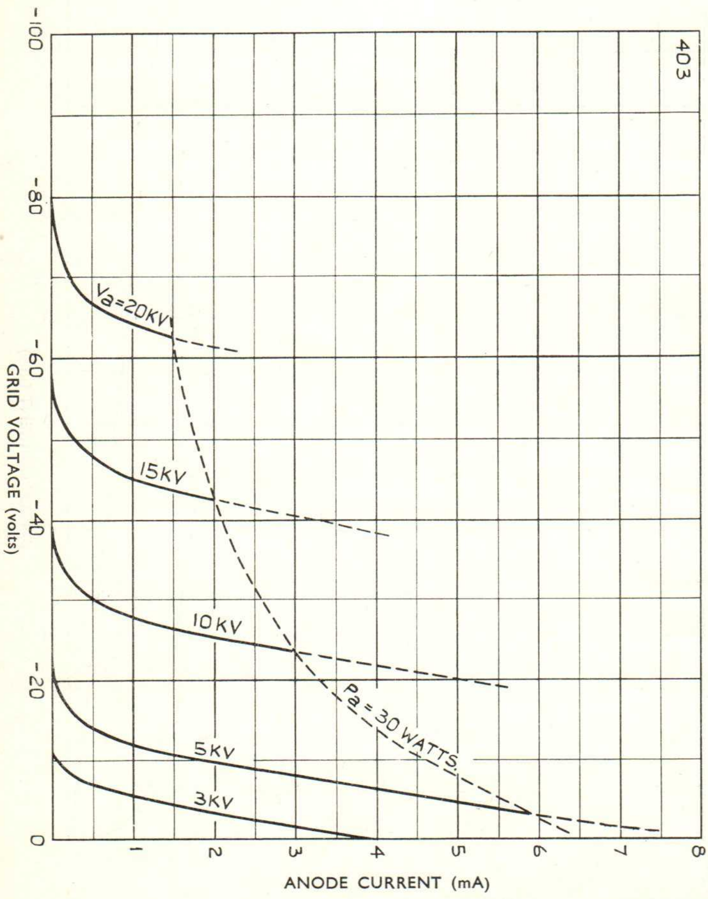
Typical Anode Voltage/Anode Current Characteristics



**HL10**

Ferranti

Typical Anode Current/Grid Voltage Characteristics



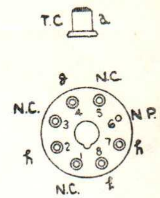
R657

# FERRANTI

## HIGH VOLTAGE REGULAR CONTROL TRIODE

**HL22**

A low current triode with an indirectly heated cathode. It has been specially designed for use as a control valve in voltage regulators for high voltage, low current, DC. power supplies. The envelope is silicone coated to render it moisture repellent.




**Base Connections Underside View of Base**

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Top Cap ... ... ... | Skirted Miniature. |
| Max. Overall Length ... ... | 129 mm. |
| Max. Seated Height ... ... | 115 mm. |
| Max. Diameter ... ... ... | 33 mm. |
| Mounting Position ... ... | Any. |
| Envelope ... ... ... ... | Silicone coated clear glass. |

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 4·0 volts. |
| Heater Current ... ... ... | 0·9 amp. |

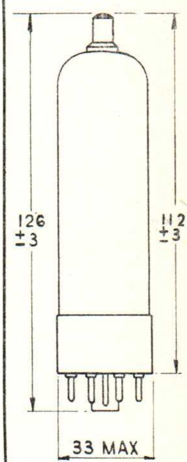
RATINGS (Absolute).

| | |
|---|---|
| Max. Anode Voltage ... ... | 25 kV. |
| Max. Peak Anode Current ... | 5 mA. |
| Max. Mean Anode Dissipation ... | 4 watts. |
| Max. Anode Direct Current ... | 0·75 mA. |
| *Max. Peak Heater Cathode Voltage | 150 volts. |
| Max. Negative Grid Voltage ... | 200 volts. |
| Max. Grid Circuit Resistance ... | 10 megohms. |
| Minimum Cathode Heating Time | 45 secs. |

CHARACTERISTICS.

Control Characteristics :

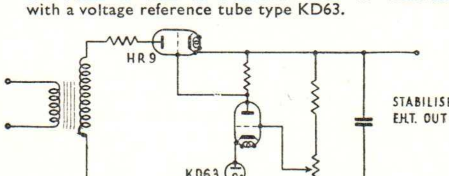
| | | | |
|---|---|---|---|
| DC. Anode Voltage (kV) | 15 | 20 | 25 |
| DC. Grid Voltage for cut off (Volts) ... | –26 | –34 | –42 |
| DC. Grid Voltage for $I_a = 5\mu A$ ... ... | –21·5 | –29 | –36 |
| Amplification Factor ... | 900 | 900 | 900 |




All dimensions shown are in millimetres (max.)

TYPICAL OPERATION.

The valve is usually employed in a High Voltage Stabiliser Circuit. A typical circuit incorporating a type HR9 grid controlled rectifier is shown below. In this arrangement the HL22 is used as a control valve in association with a voltage reference tube type KD63.




The high voltages normally applied to this valve can be very dangerous and particular care should be taken when making any circuit adjustments. It is recommended that before any part of the circuit is touched the supply should be switched off and the terminals of any capacitor grounded.

Operation of the HL22 at high anode voltage may result in the production of X-rays which could cause possible injury from prolonged exposure at close range unless adequate shielding is provided. Relatively simple shielding should prove adequate.

CAPACITANCES.

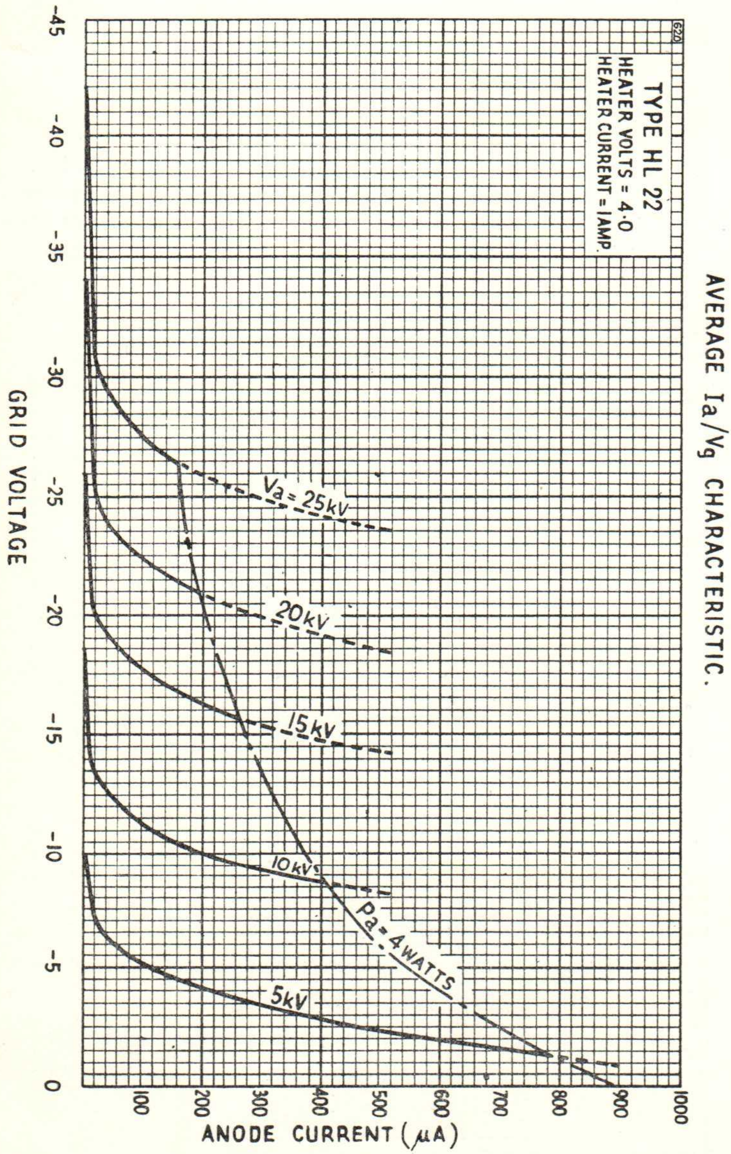
| | |
|---|---|
| $C_{a-k}$ ... ... ... ... | <0·1 pF. |
| $C_{g-k}$ ... ... ... ... | 1·0 pF. |
| $C_{a-g}$ ... ... ... ... | 0·6 pF. |

*The heater may be either positive or negative with respect to cathode.

Tentative Issue 1 April, 1956

FERRANTI

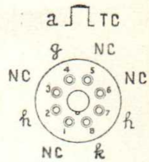
**HL22**


AVERAGE Ia/Vg CHARACTERISTIC.
TYPE HL 22
HEATER VOLTS = 4.0
HEATER CURRENT = 1AMP.
Va = 25kV
20kV
15kV
10kV
5kV
Pa = 4 WATTS
GRID VOLTAGE
-45 -40 -35 -30 -25 -20 -15 -10 -5 0
ANODE CURRENT (μA)
100 200 300 400 500 600 700 800 900 1000
620

Ferranti

# HIGH VOLTAGE CONTROL TRIODE

A triode with an indirectly heated cathode designed for use as a control valve in voltage regulators in high voltage, low current, DC. power supplies.




**Base Connections**

**Underside View of Base**

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... | International Octal |
| Top Cap ... ... ... | TC. 1 (flanged) |
| Max. Overall Length ... | 132 mm |
| Max. Seated Height ... | 118 mm |
| Max. Diameter ... ... | 33 mm |
| Mounting Position ... | Any |
| Envelope ... ... ... | Silicone coated clear glass |

## HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 4·0 volts |
| Heater Current ... ... ... ... | 1·0 amp |

## RATINGS (Absolute).

| | |
|---|---|
| Max. Anode Voltage ... ... ... | 15 kV |
| Max. Mean Anode Current ... ... | 1·0 mA |
| Max. Peak Anode Current ... ... | 5 mA |
| Max. Mean Anode Dissipation ... ... | 4 watts |
| *Max. Peak Heater Cathode Voltage ... | 150 volts |
| Max. Negative Grid Voltage ... ... | 150 volts |
| Max. Grid Circuit Resistance ... ... | 5 megohms |
| Minimum Cathode Heating Time ... | 45 secs |

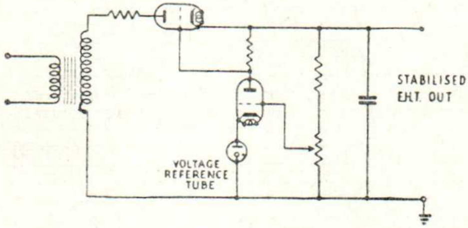
## CHARACTERISTICS.

Control Characteristics:

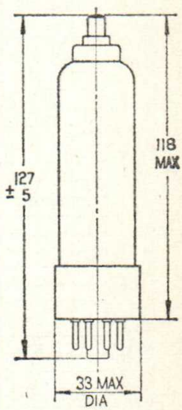
| | |
|---|---|
| Anode Voltage ... ... ... ... | 15 kV |
| Grid Voltage for cut-off... ... ... | −32 volts |
| Grid Voltage for $I_a = 5\mu A$ ... ... | −25 volts |
| Amplification Factor ... ... ... | 800 |

## TYPICAL OPERATION.

A typical circuit for a stabilised High Voltage Supply is shown below.




The voltage reference tube supplies stabilised bias to the HL25 which provides automatic control of the grid controlled rectifier. Variation of the stabilised output voltage is achieved by adjustment of the HL25 grid supply.




All dimensions shown are in millimetres

## CAPACITANCES.

| | |
|---|---|
| $C_{a-k}$ ... ... ... ... ... | <0·1 pF |
| $C_{g-k}$ ... ... ... ... ... | 1·0 pF |
| $C_{a-g}$ ... ... ... ... ... | 0·6 pF |

## WARNING

The high voltages normally applied to this valve can be very dangerous and particular care should be taken when making any circuit adjustments. It is recommended that before any part of the circuit is touched the supply should be switched off and the terminals of any capacitor grounded

*The heater may be either positive or negative with respect to cathode.

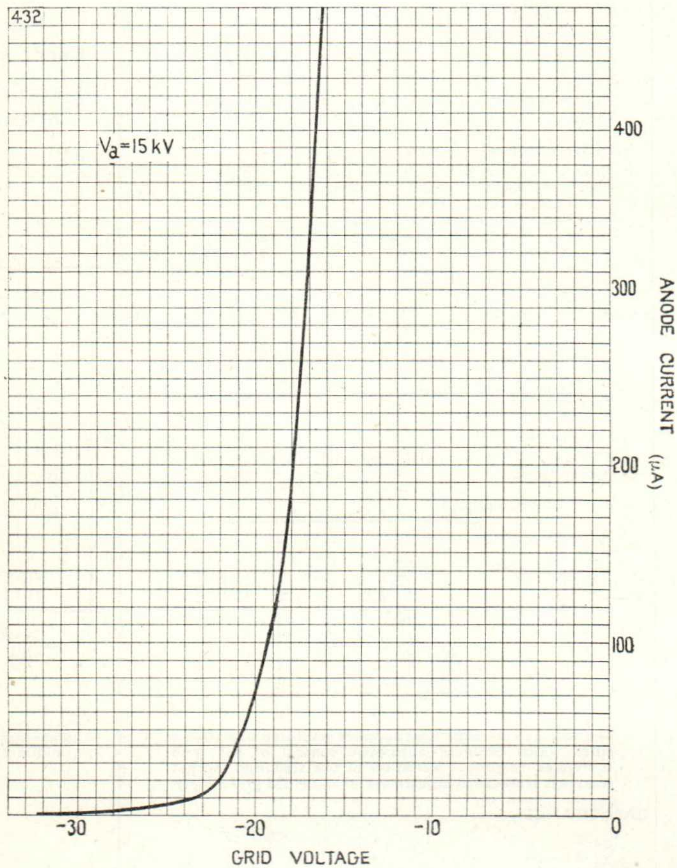
Ferranti

Issue 1
April, 1963

HL25

Ferranti

## AVERAGE Ia/Vg CHARACTERISTIC

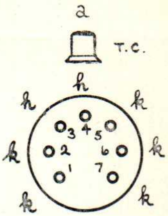


# FERRANTI

## VACUUM HIGH VOLTAGE RECTIFIER

**HR2**

A miniature indirectly heated Half-Wave High Voltage Rectifier, suitable for use for E.H.T. supplies for Oscilloscopes, Television Receivers, etc.



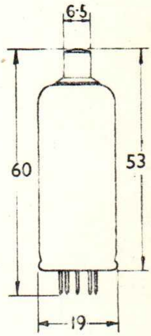

**Base Connections Underside View of Base**

### PHYSICAL DETAILS

| | |
|---|---|
| Base ... ... ... | B7G |
| Top Cap... ... ... | Skirted Miniature |
| Max. Overall Length ... | 60 mm. ($2\frac{5}{16}''$) |
| Max. Seated Height ... | 53 mm. ($2\frac{1}{16}''$) |
| Max. Diameter ... ... | 19 mm. ($\frac{3}{4}''$) |
| Mounting Position ... | Any |

### BASE CONNECTIONS

| | |
|---|---|
| Pin 1.—Cathode. | Pin 5.—Cathode. |
| Pin 2.—Cathode. | Pin 6.—Cathode. |
| Pin 3.—Heater. | Pin 7.—Cathode. |
| Pin 4.—Heater. | Top Cap—Anode. |




### HEATER

| | |
|---|---|
| Heater Voltage ... ... ... | 4·0 volts. |
| Heater Current ... ... ... | 0·5 Amp. |

### RATINGS

The following Ratings are "Absolute" and apply to operation at 50 c/s with a capacitor input filter and delayed switching.

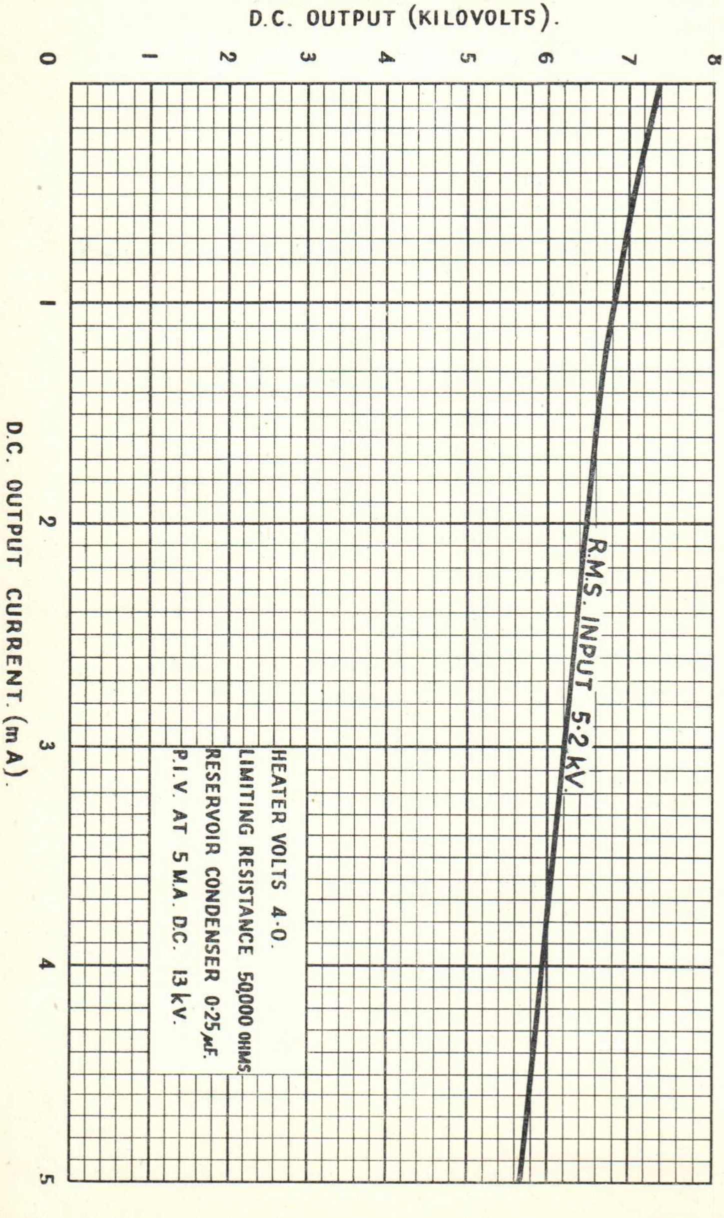
| | |
|---|---|
| Max. P.I.V. (no load) ... | 15·5 kV. |
| Max. P.I.V. (working) ... | 13·0 kV. |
| Max. R.M.S. Input Voltage ... | 5·5 kV. |
| Max. Peak Anode Current ... | 40 mA. |
| Max. Rectified Current ... | 5 mA. |
| Max. Reservoir Condenser ... | 0·25 $\mu$F. |
| Min. Supply Impedance ... | 50,000 ohms. |
| Min. delay for H.T. switching | 30 secs. |
| Max. Operating Frequency ... | 100 kc/s. |

All dimensions shown are in millimetres. (max.)

This valve may be used with simultaneous switching providing the RMS input voltage is not more than 3·5 kV and the rectified current does not exceed 1·5 mA.

FERRANTI

Issue 3
Feb., 1954


D.C. OUTPUT (KILOVOLTS).
0
1
2
3
4
5
6
7
8
D.C. OUTPUT CURRENT. (mA).
1
2
3
4
5
R.M.S. INPUT 5·2 kV.
HEATER VOLTS 4·0.
LIMITING RESISTANCE 50,000 OHMS.
RESERVOIR CONDENSER 0·25 μF.
P.I.V. AT 5 M.A. D.C. 13 kV.

# FERRANTI

## VACUUM HIGH VOLTAGE RECTIFIER

A miniature indirectly heated Half-Wave High Voltage Rectifier.

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B7G. |
| Top Cap ... ... ... | Skirted Miniature. |
| Max. Overall Length ... ... | 60 mm. ($2\frac{5}{16}$in.). |
| Max. Seated Height ... ... | 53 mm. ($2\frac{1}{16}$in.). |
| Max. Diameter ... ... ... | 19 mm. ($\frac{3}{4}$in.). |
| Mounting Position ... ... | Any. |

### BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Cathode. | Pin 5—Cathode. |
| Pin 2—Cathode. | Pin 6—Cathode. |
| Pin 3—Heater. | Pin 7—Cathode. |
| Pin 4—Heater. | Top Cap—Anode. |

### HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 4·0 volts. |
| Heater Current ... ... ... | 0·5 amp. |

### RATINGS*

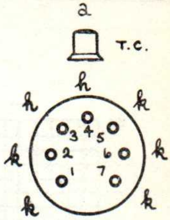
| | |
|---|---|
| Max. P.I.V. (no load) ... ... | 14·0 kV. |
| Max. P.I.V. (working) ... ... | 11·5 kV. |
| Max. R.M.S. Input Voltage ... | 5·0 kV. |
| Max. Peak Anode Current ... | 80 mA. |
| Max. Rectified Current ... | 15 mA. |
| Max. Reservoir Condenser ... | 1·0 μF. |
| Min. Supply Impedance ... ... | 30,000 ohms. |
| †Min. Delay for H.T. switching ... | 30 secs. |
| Max. Operating Frequency ... | 100 kc/s. |

*The above Ratings are "Absolute" and apply to operation at 50 c/s. with a capacitor input filter and delayed switching.

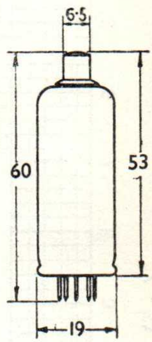
†This valve may be used with simultaneous switching providing the R.M.S. input voltage is not more than 3·5 kV. and the rectified current does not exceed 3·0 mA.

Issue 3
Feb., 1954

# HR3



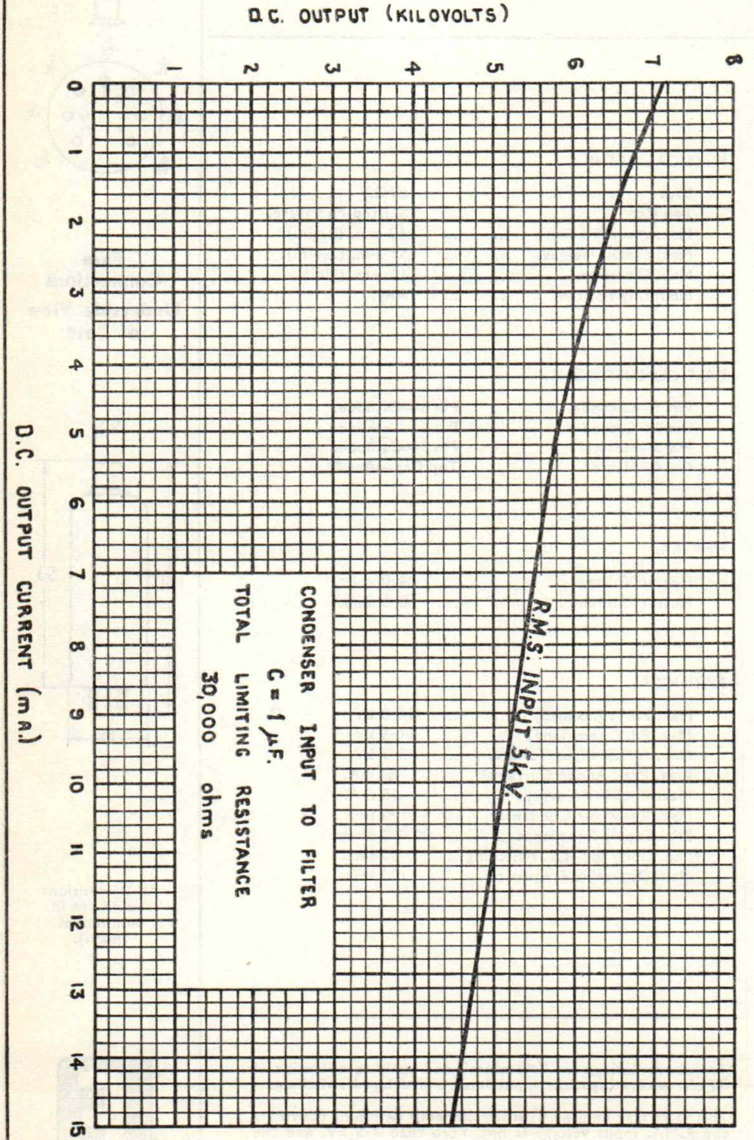

**Base Connections Underside View of Base**




All Dimensions shown are in millimetres (max.).

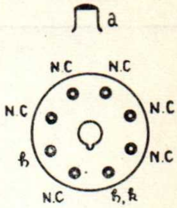
FERRANTI

HR3



# FERRANTI
## VACUUM HIGH VOLTAGE RECTIFIER

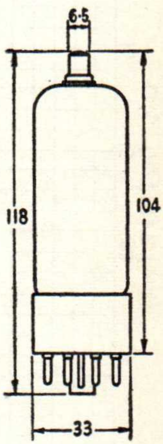
An indirectly heated Half-Wave High Voltage Rectifier.




**Base Connections Underside View of Base**

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Top Cap ... ... ... | Skirted Miniature—CT1 |
| Max. Overall Length ... ... | 118 mm. ($4\frac{21}{32}$in.). |
| Max. Seated Height ... ... | 104 mm. ($4\frac{3}{32}$in.). |
| Max. Diameter (Base) ... ... | 33 mm. ($1\frac{5}{16}$in.). |
| Mounting Position ... ... | Any. |




BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 5—No Connection. |
| Pin 2—Heater. | Pin 6—No Connection. |
| Pin 3—No Connection. | Pin 7—No Connection. |
| Pin 4—No Connection. | Pin 8—Heater, Cathode. |

Top Cap—Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 4·0 volts. |
| Heater Current ... ... ... | 1·25 amp. |

RATINGS*

| | |
|---|---|
| Max. P.I.V. (no load) ... ... | 13·0 kV. |
| Max. P.I.V. (working) ... ... | 11·5 kV. |
| Max. R.M.S. Input Voltage ... | 4·5 kV. |
| Max. Peak Anode Current ... | 280 mA. |
| Max. Rectified Current ... | 40 mA. |
| Max. Reservoir Capacitor ... | 1·0 μF. |
| Min. Supply Impedance ... ... | 4500 ohms. |
| Min. Switching Delay Time ... | 60 secs. |

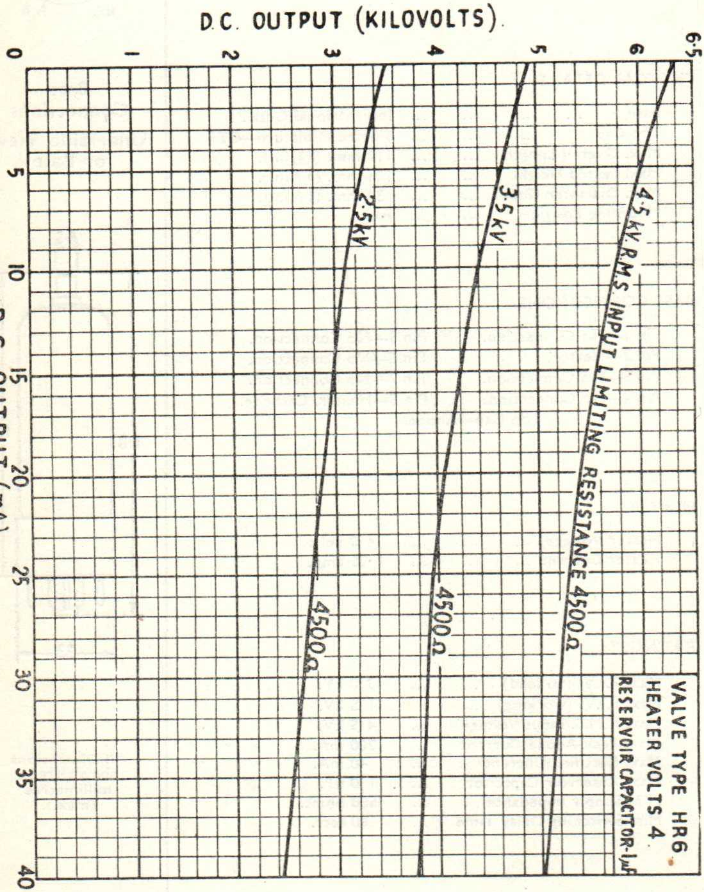
All Dimensions shown are in millimetres (max.).

*The above ratings are "Absolute" and apply to operation at 50 c/s. with a capacitor input and delayed switching.

FERRANTI

Issue 3
Dec., 1955

FERRANTI


D.C. OUTPUT (KILOVOLTS)
0
1
2
3
4
5
6
6.5
D.C. OUTPUT (mA)
0
5
10
15
20
25
30
35
40
2.5kV
4500Ω
3.5kV
4500Ω
4.5 kV R.M.S. INPUT LIMITING RESISTANCE 4500Ω
VALVE TYPE HR6
HEATER VOLTS 4
RESERVOIR CAPACITOR-1μF

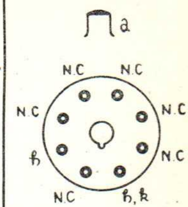
R0256

HR8

# FERRANTI

## VACUUM HIGH VOLTAGE RECTIFIER

An indirectly heated Half-Wave High Voltage Rectifier.




**Base Connections Underside View of Base**

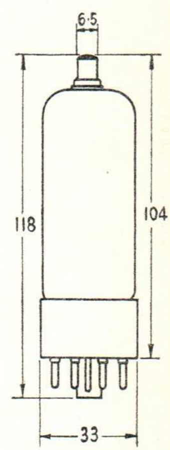
### PHYSICAL DETAILS

| | |
|---|---|
| Base ... ... ... | International Octal. |
| Top Cap ... ... | Skirted Miniature. |
| Max. Overall Length... | 118 mm. ($4\frac{21}{32}''$) |
| Max. Seated Height ... | 104 mm. ($4\frac{3}{32}''$) |
| Max. Diameter (Base) | 33 mm. ($1\frac{5}{16}''$) |
| Mounting Position ... | Any. |

### BASE CONNECTIONS

| | |
|---|---|
| Pin 1.—No Connection. | Pin 5.—No Connection. |
| Pin 2.—Heater. | Pin 6.—No Connection. |
| Pin 3.—No Connection. | Pin 7.—No Connection. |
| Pin 4.—No Connection. | Pin 8.—Heater, cathode. |

Top Cap—Anode.




All dimensions shown are in millimetres. (max.).

### HEATER

| | |
|---|---|
| Heater Voltage ... ... | 4·0 volts. |
| Heater Current ... ... | 1·25 amps. |

### RATINGS

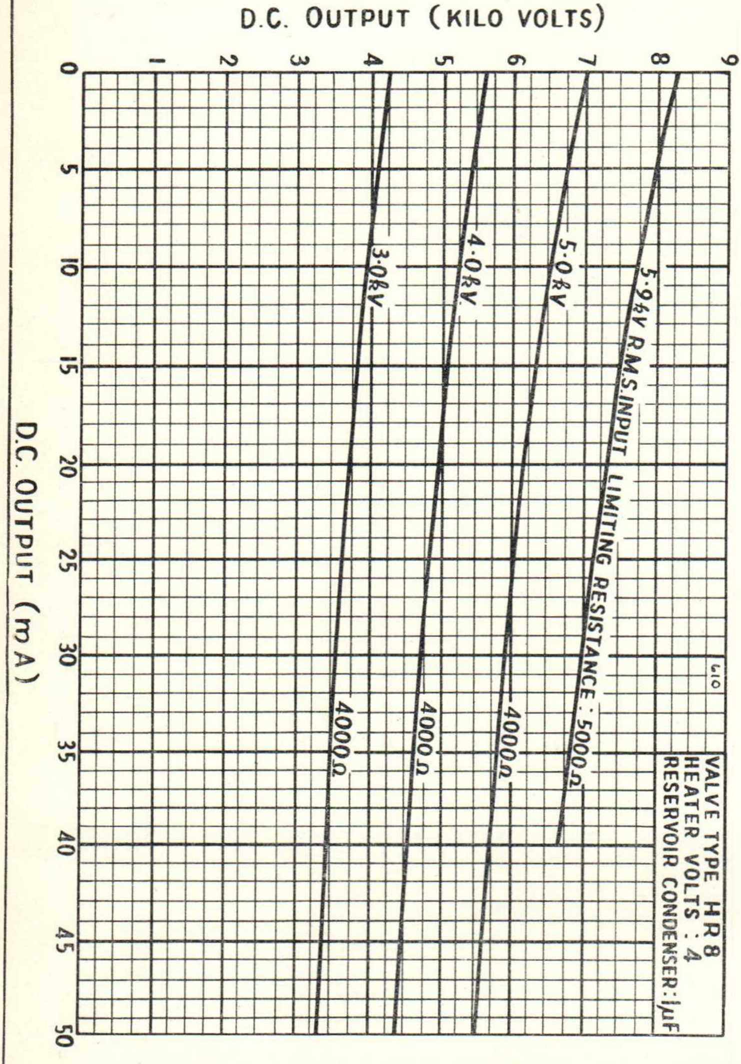
The following ratings are "Absolute" and apply to operation at 50 c/s with a capacitor input and delayed switching.

| | |
|---|---|
| Max. P.I.V. (no load) ... ... | 14·0 kV. |
| *Max. P.I.V. (working) ... | 12·5 kV. |
| Max. R.M.S. Input Voltage ... | 5·0 kV. |
| Max. Peak Anode Current ... | 350 mA. |
| Max. Rectified Current ... | 50 mA. |
| Max. Reservoir Capacitor ... | 1·0 $\mu$F. |
| Min. Supply Impedance ... | 4000 ohms |
| Min. Switching Delay Time ... | 60 secs. |

*The Valve may be operated at a P.I.V. (working) of 15 kV. [P.I.V. (no load) 16·5 kV.] provided that the maximum Rectified Current load is reduced to 40 mA., and the maximum Peak Anode Current is restricted to 300 mA. Under these conditions the supply impedance should be increased to a minimum of 5000 ohms.

Issue 1.
Feb., 1954

FERRANTI

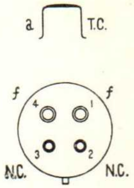

D.C. OUTPUT (KILO VOLTS)
D.C. OUTPUT (mA)
3·0kV
4000Ω
4·0kV
4000Ω
5·0kV
4000Ω
5·9kV R.M.S. INPUT LIMITING RESISTANCE: 5000Ω
VALVE TYPE HR8
HEATER VOLTS: 4
RESERVOIR CONDENSER: 1μF
L10

HR12

Ferranti

# VACUUM HIGH VOLTAGE RECTIFIER

A directly heated Half-Wave High Voltage Rectifier, with thoriated tungsten filament.




**Base Connections**

**Underside View of Base**

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... | Medium UX–4. |
| Top Cap ... ... | Skirted Medium CT3. |
| Max. Overall Length ... | 154 mm. ($6\frac{1}{16}$in.). |
| Max. Seated Height ... | 140 mm. ($5\frac{1}{2}$in.). |
| Max. Diameter ... ... | 45 mm. ($1\frac{3}{4}$in.). |
| Mounting Position ... | Any. |

## BASE CONNECTIONS.

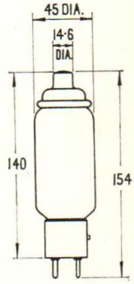
Pin 1.—Filament. Pin 3.—No Connection.
Pin 2.—No Connection. Pin 4.—Filament.
TC.—Anode.

## HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 2·5 volts. |
| Heater Current ... ... ... ... | 5·0 amp. |

## RATINGS* (Absolute).

| | |
|---|---|
| Max. P.I.V. (no load) ... ... ... | 40 kV. |
| Max. P.I.V. (working) ... ... ... | 36 kV. |
| Max. R.M.S. Input Voltage ... ... | 15 kV. |
| Max. Peak Anode Current ... ... | 175 mA. |
| Max. Peak Rectified Current ... ... | 25 mA. |
| Max. Reservoir Capacitor ... ... | 0·1 μF. |
| Min. Supply Impedance ... ... ... | 27 kΩ |
| Min. Switching Delay Time ... ... | 5 secs. |




All Dimensions shown are in millimetres (max.).

## OPERATING NOTES.

It is advisable to clean the bulb at regular intervals as accumulation of dust or dirt on the bulb may cause leakage paths and lead to failure of the valve.

## X-RAY WARNING.

Operation at high anode voltage may result in the production of X-rays which could cause possible injury from prolonged exposure at close range unless adequate shielding is provided. Relatively simple shielding should prove adequate.

*The above ratings are "Absolute Maximum Ratings" and apply to operation at 50 c/s. with a capacitor input and delayed switching.

Issue 1
Nov. 1960

Ferranti

# FERRANTI

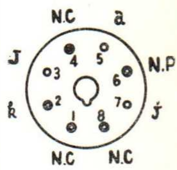
## VOLTAGE STABILISERS

Types KD21 (VR75/30), KD24 (VR105/30) and KD25 (VR150/30) are cold cathode glow discharge voltage stabiliser valves.

**KD21**
(VR 75/30)

**KD24**
(VR 105/30)

**KD25**
(VR 150/30)




**Base Connections Underside View of Base**

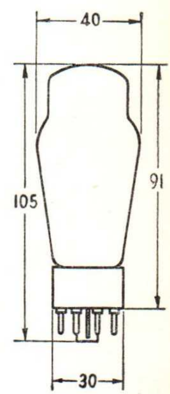
PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Bulb ... ... ... ... | Clear. |
| Max. Overall Length ... ... | 105 mm. ($4\frac{1}{8}$in.). |
| Max. Seated Height ... ... | 91 mm. ($3\frac{9}{16}$in.). |
| Max. Diameter (Bulb) ... ... | 40 mm. ($1\frac{9}{16}$in.). |
| Mounting Position ... ... | Any. |

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 5—Anode. |
| Pin 2—Cathode. | Pin 6—No Pin. |
| Pin 3—Jumper* | Pin 7—Jumper* |
| Pin 4—No Connection. | Pin 8—No Connection. |

*With suitable circuit connections the 'jumper' link in the base operates as a switch to render the equipment inoperative when the stabiliser valve is removed from its holder. A suggested arrangement is shown overleaf.




All dimensions shown are in millimetres. (max.).

RATINGS AND CHARACTERISTICS.

KD21

| | |
|---|---|
| †Min. Anode Supply Voltage ... | 105 volts DC. |
| Nom. Striking Voltage ... ... | 100 volts DC. |
| Nom. Operating Voltage ... | 75 volts DC. |
| Max. Operating Current ... | 40 mA. |
| Min. Operating Current ... | 5 mA. |
| ‡Max. Peak Current ... ... | 100 mA. |
| Regulation (5 to 40 mA.) ... | 6 volts. |

KD24

| | |
|---|---|
| †Min. Anode Supply Voltage ... | 135 volts DC. |
| Nom. Striking Voltage ... ... | 115 volts DC. |
| Nom. Operating Voltage ... | 105 volts DC. |
| Max. Operating Current ... | 40 mA. |
| Min. Operating Current ... | 5 mA. |
| ‡Max. Peak Current ... ... | 100 mA. |
| Regulation (5 to 40 mA.) ... | 4 volts. |

KD25

| | |
|---|---|
| †Min. Anode Supply Voltage ... | 180 volts DC. |
| Nom. Striking Voltage ... ... | 160 volts DC. |
| Nom. Operating Voltage ... | 150 volts DC. |
| Max. Operating Current ... | 40 mA. |
| Min. Operating Current ... | 5 mA. |
| ‡Max. Peak Current ... ... | 100 mA. |
| Regulation (5 to 40 mA.) ... | 5·5 volts. |

†See note overleaf.
‡See note overleaf.

FERRANTI

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Feb., 1954

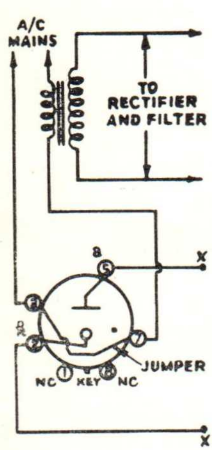
| **KD21** (VR 75/30) |
|---|
| **KD24** (VR 105/30) |
| **KD25** (VR 150/30) |

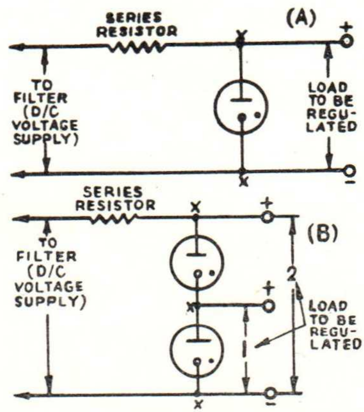
NOTES.

†To ensure 'striking' throughout life.

‡Sufficient resistance must always be included in series with these valves to limit the current through the valve to 40 milliamperes under steady operating conditions. However during the warming up period of approximately 10 seconds, before the valves in the associated equipment draw anode current, the maximum current can be permitted to rise to 100 mA providing that each such starting period is followed by at least several minutes of operation under normal conditions. Unless this precaution is observed the performance of the stabiliser will be impaired.

TYPICAL CIRCUIT CONNECTIONS.




| VALVE TYPE | REGULATED SUPPLY VOLTAGE TO LOAD (APPROX. VOLTS) | | |
|---|---|---|---|
| | CIRCUIT A | CIRCUIT B 1 | CIRCUIT B 2 |
| VR75/30 | 75 | 75 | 150 |
| VR105/30 | 105 | 105 | 210 |
| VR150/30 | 150 | 150 | 300 |

# FERRANTI

## VOLTAGE STABILISERS



Small sized neon filled Cold-cathode Diodes, designed to fulfil the requirement of a high order of stability of running voltage at low currents. The valves are constructed in such a manner that they can also be used as visual indicators.

### PHYSICAL DETAILS.

| | KD60 | KD61 |
|---|---|---|
| Base ... ... ... | None | Flexible leads. |
| Max. Overall Length ... | 51 | 44 mm. |
| Max. Width ... ... | 23 | 19·5 mm. |
| Max. Dia. of glass envelope | 12·5 | 12·5 mm. |
| End Caps ... ... | Skirted Miniature | — |

The anode is indicated by a red band.

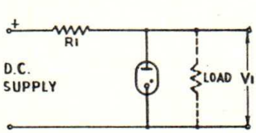
### RATINGS.

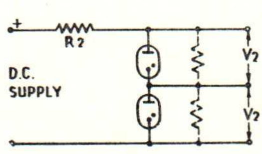
Max. Ignition Voltage (DC) ... 85 volts.
Max. Operating Current ... 2·5 mA.
Min. Current to maintain Ionisation 20 μA.

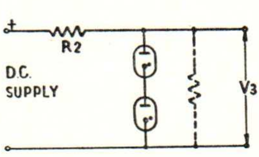
### CHARACTERISTICS.

| | | |
|---|---|---|
| Max. Voltage Drop across tube over operating range ... | | 64 volts. |
| Min. Voltage Drop across tube over operating range ... ... | | 60 volts. |
| †Regulation | 1·0 mA to 1·2 mA | ±0·15 volts. |
| | 0·5 mA to 1·0 mA | ± 0·2 volts. |
| | 125 μA to 2·5 mA | ± 0·4 volts. |
| *Min. operating current ... ... | | 125 μA. |
| Preferred operating current ... | | 1·0 mA. |

### TYPICAL OPERATION.



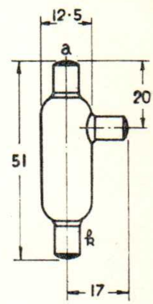

| | |
|---|---|
| DC Supply ... | 300 V. |
| $I_L$ ... ... | 1 mA. |
| V1 ... ... | 62 B. |
| V2 ... ... | 62 V. |
| V3 ... ... | 124 V. |
| R1 ... ... | 100 kΩ |
| R2 ... ... | 56 kΩ |

For other operating conditions refer to chart overleaf.

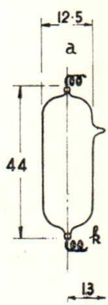
†The initial drift is very small but for maximum stability the valve should be given a preliminary run of 15 minutes.

*At current below 125 μA the potential drop across the tube rises.

KD 60




KD 61




All Dimensions shown are in Millimetres (max.)

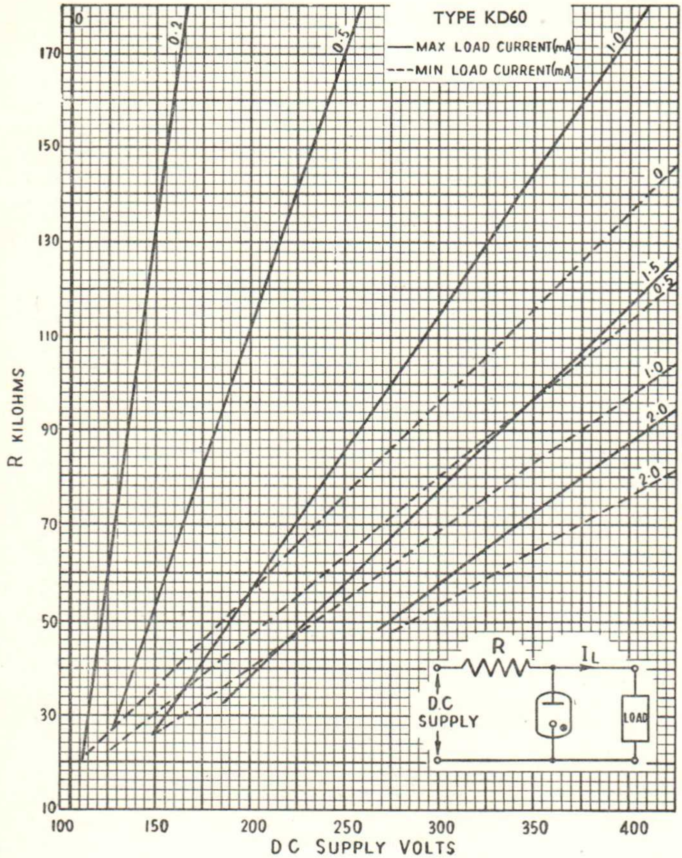
FERRANTI

Issue 5
Mar., 1956

# KD60

# KD61

FERRANTI




This graph facilitates the determination of the permissible values of supply voltage and series resistance for operation with various loads permanently connected in parallel with the Stabiliser Valve.

On this graph Load current ($I_L$) refers to the DC. current flowing through the load at 62v.

The operating point of the valves must lie—

(a) below and to the right of the full line corresponding to the maximum load current.

(b) above and to the left of the dotted line corresponding to the minimum load current.

To determine the value of series resistor required in applications which employ several valves in series in order to get a higher stabilised voltage (e.g., $R_2$ overleaf) the method is as follows :—

For a circuit employing n valves in series the value of Series Resistor (Rs) is determined from the formula

$$R_s = R \times n$$

R is the value of resistor on the graph appropriate to a supply Voltage $\frac{V}{n}$ when V is the actual supply Voltage.

The largest convenient value of Resistor should be employed to obtain the best stability and longest life.

Due allowance should be made for the tolerance of the resistor and variation of the DC. supply voltage.

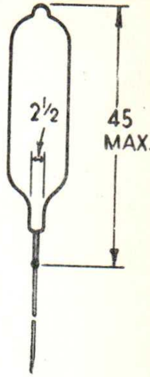
If the load is removed, or its resistance increased at the instant of switching on the supply voltage, much lower supply voltages and higher load currents may be employed.

# FERRANTI



## VOLTAGE REFERENCE TUBE

A subminiature neon filled Cold-cathode Diode. The running voltage is of a high order of stability and the valve is suitable for use as a Voltage Reference Tube. It is of rugged design suitable for use under conditions where shock or vibration is encountered.




PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B3B/A—Flexible Leads. |
| Max. Overall Length (excluding leads) ... ... | 45 mm. (1 $\frac{25}{32}$ in.). |
| Max. Length of glass bulb ... | 38 mm. (1 $\frac{1}{2}$ in.). |
| Max. Diam. of glass envelope | 10·16 mm. ($\frac{13}{32}$ in.). |

The anode lead is indicated by a red spot.

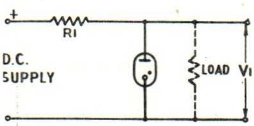
RATINGS.

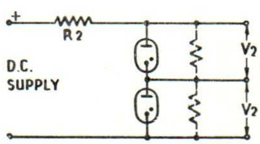
| | |
|---|---|
| Max. Operating Current ... | 2·5 mA. |
| *Min. Operating Current ... | 200 μA. |

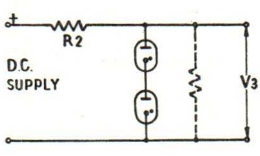
CHARACTERISTICS.

| | | |
|---|---|---|
| Min. Voltage to ensure ignition | | 105 volts. |
| Max. Voltage Drop across tube over operating range ... | | 64 volts. |
| Min. Voltage Drop across tube over operating range ... ... | | 60 volts. |
| †Regulation 1·0 mA to 1·2 mA | ± | 0·1 volts. |
| 0·5 mA to 2·2 mA | ± | 0·4 volts. |
| 200 μA to 2·5 mA | ± | 0·75 volts. |
| *Min. current to maintain ionisation ... ... ... | | 20 μA. |
| Preferred operating current range | | 1·0 to 1·2 volts. |

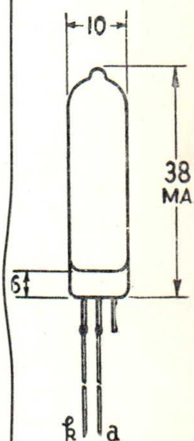
TYPICAL OPERATION.




| | | |
|---|---|---|
| DC. Supply ... | } See graph | |
| $I_L$ ... ... | } overleaf | |
| V1 ... ... | 62 B. | |
| V2 ... ... | 62 V. | |
| V3 ... ... | 124 V. | |
| R1 ... ... | } See graph | |
| R2 ... ... | } overleaf. | |




Dimensions shown are in millimetres (nominal) unless otherwise stated.

Because of the constancy of ignition voltage this valve can readily be employed in voltage overload protection devices for instruments, etc.

*At current below 200 μA the potential drop across the tube rises and performance may be erratic.

†This stabiliser will operate immediately an adequate ignition voltage is applied but for maximum stability the valve should be given a preliminary run of 15 minutes. The initial drift of Type KD63 is very small.

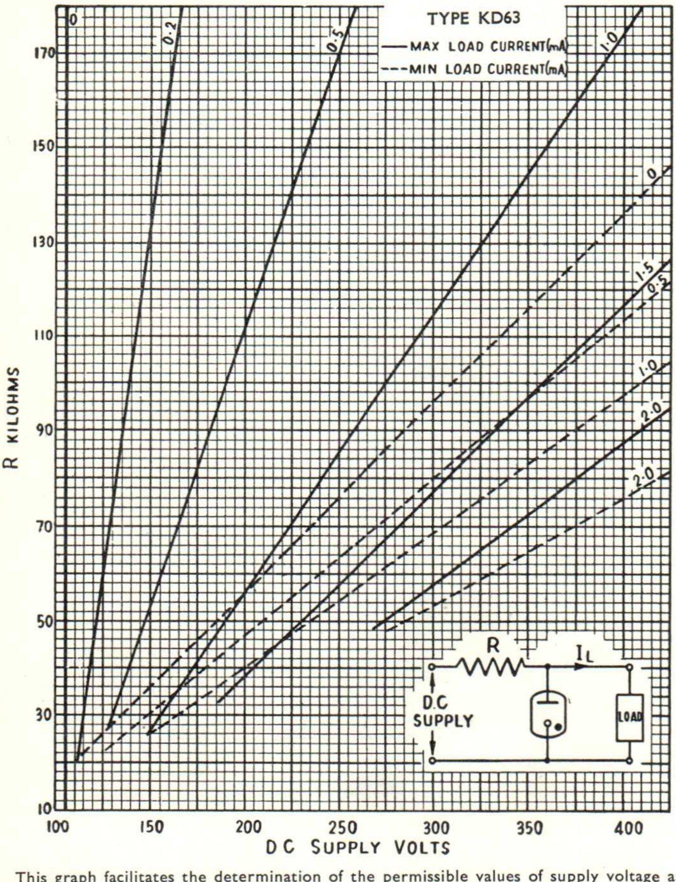
‡Regulation approximating to that quoted for the range 1·0–1·2 mA. can be obtained by limiting the operation to any similar narrow current range within the limits 0·5–2·2 mA.

Issue 4
July, 1957

FERRANTI

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

## KD63




This graph facilitates the determination of the permissible values of supply voltage and series resistance for operation with various loads permanently connected in parallel with the KD63.

On this graph Load current ($I_L$) refers to the DC. current flowing through the load at 62v.

The operating point of the KD63 must lie-–

(a) below and to the right of the full line corresponding to the maximum load current.
(b) above and to the left of the dotted line corresponding to the minimum load current.

In applications which employ several valves in series in order to get a higher stabilised voltage, the method to determine the value of series resistor required (i.e., $R_2$ overleaf), is as follows :—

For a circuit employing n valves in series the value of Series Resistor ($R_s$) is determined from the formula

$$R_s = R \times n$$

R is the value of resistor on the graph appropriate to a supply Voltage $\frac{V}{n}$ when V is the actual supply Voltage.

The largest convenient value of Resistor should be employed to obtain the best stability and longest life.

Due allowance should be made for the tolerance of the resistor and variation of the DC. supply voltage.

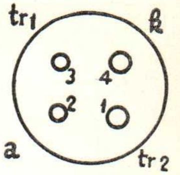
If the load is removed, or its resistance increased at the instant of switching on the supply voltage, much lower supply voltages and higher load currents may be employed.

# FERRANTI

## COLD CATHODE TETRODE

The Ferranti "Neostron" type NSPI is a cold cathode tetrode gas discharge valve. Developed primarily as a stroboscopic light source emitting a neon-red light, it is equally suitable for other uses where pulses of very high peak current are required.

NSPI




**Base Connections**
**Underside View of Base**

PHYSICAL SPECIFICATION.

| | |
|---|---|
| Base ... ... ... ... | UX 4 pin. |
| Max. Seated Height ... ... | 96 mm. ($3\frac{3}{4}$in.). |
| Max. Overall Length ... ... | 110 mm. ($4\frac{11}{32}$in.). |
| Max. Base Diameter ... ... | 33 mm. ($1\frac{5}{16}$in.). |
| Length of arc ... ... ... | 24 mm ($\frac{15}{16}$in.). |
| Mounting Position ... ... | Any. |

BASE CONNECTIONS.

Pin 1—Trigger Electrode 2. Pin 3—Trigger Electrode 1.
Pin 2—Anode. Pin 4—Cathode.

RATINGS (Absolute).

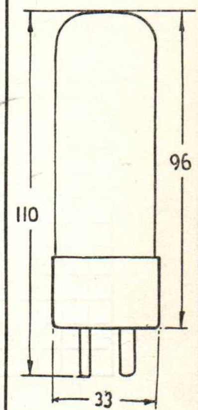
| | |
|---|---|
| Max. Anode Voltage (static) ... ... ... | 440 volts. |
| Max. Anode Voltage (working) ... ... | 380 volts. |
| Min. Anode Voltage (working) ... ... | 220 volts. |
| Max. Peak Inverse Anode Voltage ... ... | 350 volts. |
| Max. Average Anode Current ... ... ... | 100 mA. |
| Max. Discharge Capacitance ... ... ... | 16 μF. |
| Max. Average Trigger Current ... ... | 10 mA. |

CHARACTERISTICS.

| | |
|---|---|
| *Static striking voltage ($tr_2$ to $tr_1$) ... | 80–130 volts. |
| Max. flashing frequency ... ... | 250 per sec. |
| Min. trigger current required at $V_a$ 380 | 50 μA. |
| Min. trigger current required at $V_a$ 220 | 300 μA. |

†Peak Anode Current, Peak Luminous Intensity, Flash Duration: The discharge of a 2μF capacitor charged to 380V. gives a peak anode current of approx. 230 amps. and a Peak Luminous Intensity of approx. 460 candelas with a flash duration of 10 microseconds at half the peak light output.

Delay Time ... ... Less than 40 microseconds, dependent on circuit conditions. With higher energy pulses the delay time can be considerably reduced.




TYPICAL OPERATION as Stroboscopic Light Source :

| | |
|---|---|
| DC. supply voltage ... ... | 300–330 volts. |
| ‡$Vtr_2$ at triggering instant ... ... | 70 volts. |
| §Trigger pulse amplitude ($Vtr_1$) ... | 150 volts min. |
| Charging resistor ... ... ... | 3000 ohms. |
| Discharge Capacitor for Operation at:— | |
| 6–35 c.p.s. ... ... ... | 4 μF. |
| 30–50 c.p.s. ... ... ... | 3 μF. |
| 45–80 c.p.s. ... ... ... | 2 μF. |
| 80–150 c.p.s. ... ... ... | 1 μF. |
| 140–250 c.p.s. ... ... ... | 0·5 μF. |

For typical circuits and further information refer to NSP2 Data Sheet under "Notes on Operation."

All dimensions shown are in millimetres.

*$tr_1$ negative to $tr_2$.
†A minimum peak current of 5 amps. is recommended. This ensures the formation of an arc discharge with an anode–cathode volt drop of approx. 20 volts. If the peak current is less than 5 amps. a glow discharge is likely to form with a volt drop of 70 volts which may result in permanent damage to the valve.
‡Positive with respect to cathode.
§Negative with respect to cathode.

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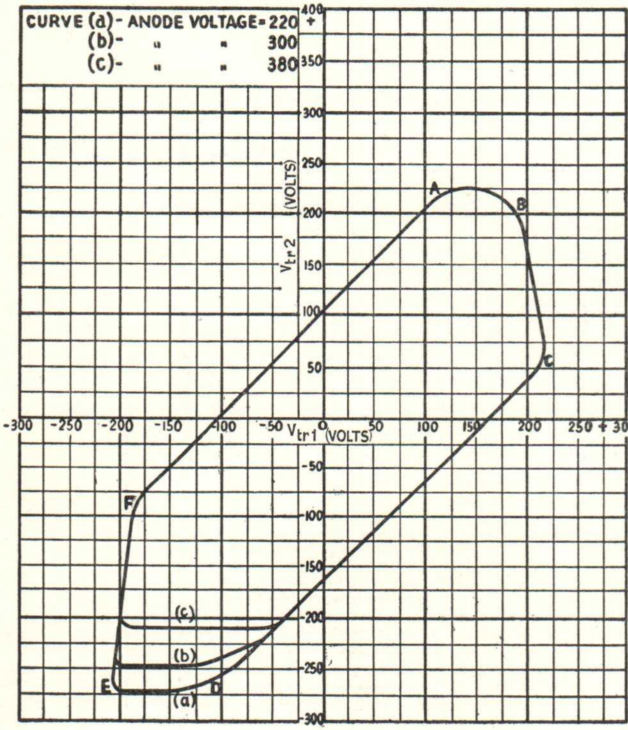
July, 1957

FERRANTI




AVERAGE STATIC TRIGGERING CHARACTERISTICS

The area enclosed by the loops is an area of non-conduction. If the vector sum of the voltages on two electrodes lies within the loop the valve will not fire. Any change of either or both of these voltages which causes the vector sum to fall outside the loop will trigger the valve.

For pulse operation it is usually necessary to ensure that the pulse has a sufficient excess voltage (see "Notes on Operation" on NSP2 data sheet).

As the triggering impulse carries the vector sum of the applied voltages outside the loop the point at which it crosses the loop indicates the manner in which the valve is triggered as follows :—

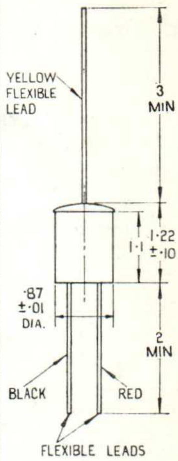
Between AB Trigger Electrode 2 to Cathode Breakdown.
BC Trigger Electrode 1 to Cathode Breakdown.
CD Trigger Electrode 1 to Trigger Electrode 2 Breakdown.
DE Cathode to Trigger Electrode 2 Breakdown.
EF Cathode to Trigger Electrode 1 Breakdown.
FA Trigger Electrode 2 to Trigger Electrode 1 Breakdown.

The most reliable operation is ensured by triggering between $Tr_2$ and $Tr_1$, i.e., between F and A on the diagram.

Ferranti

# PULSE TRANSFORMER

A compact, resin encapsulated pulse transformer designed to supply the trigger voltage for photographic and stroboscopic flash tubes.




Dimensions in inches

## PHYSICAL DETAILS.

| | |
|---|---|
| Max. Overall Length ... ... | 1·32″ (33·5 mm.) |
| Diameter ... ... ... ... | 0·87″ (22·1 mm.) |
| Length of Flexible Leads | |
| Output Lead (Yellow) ... | 3·0″ (76·2 mm.) |
| Other Leads... ... ... | 2·0″ (50·8 mm.) |

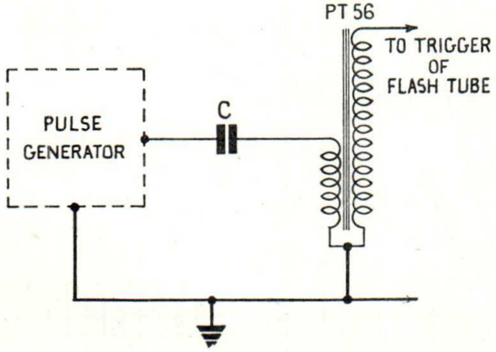
## LEAD CONNECTIONS.

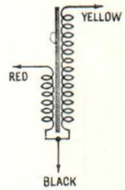
| | |
|---|---|
| Pulse Input ... ... ... | Red |
| Pulse Output ... ... ... | Yellow |
| Common Negative ... ... | Black |

## RATINGS & CHARACTERISTICS.

| | |
|---|---|
| Max. Input Pulse Voltage ... | 350 volts |
| Max. Input Discharge Capacitor | 0·25 $\mu$F |
| Output Voltage ... ... ... | See graph overleaf |

## TYPICAL OPERATION.



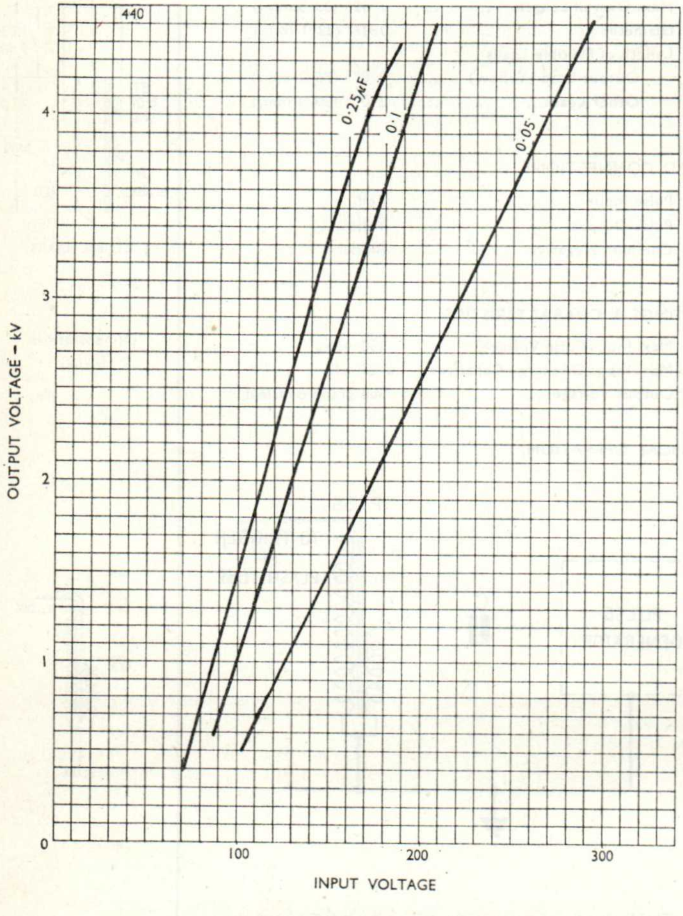

The discharge voltage pulse from the capacitor C must have a ouick rate of current change.

Connections to the red (primary) lead and black (earth) lead should be as short as possible.

Ferranti

Issue 2
Aug., 1963

## TYPICAL INPUT/OUTPUT CHARACTERISTICS

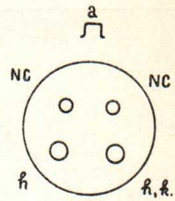


## 2X2A

# FERRANTI

## HALF WAVE RECTIFIER

An indirectly heated, high vacuum half wave rectifier. It is designed for use in applications where shock and vibration are encountered.




**Base Connections Underside View of Base**

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | UX–4 Pin. |
| Bulb ... ... ... ... | Clear. |
| Max. Overall Length ... ... | 115 mm. ($4\frac{17}{32}$in.). |
| Max. Seated Height ... ... | 99 mm. ($3\frac{29}{32}$in.). |
| Max. Diameter (Bulb) ... ... | 40 mm. ($1\frac{9}{16}$in.). |
| Anode Cap ... ... ... | $CT_2$. |
| Mounting Position ... ... | Any. |

BASE CONNECTIONS.

Pin 1—Heater. Pin 3—No Connection

Pin 2—No Connection Pin 4—Heater, Cathode.

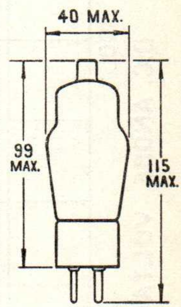
Top Cap—Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 2·5 volts. |
| Heater Current ... ... ... | 1·75 amps. |

RATINGS.

| | |
|---|---|
| Max. P.I.V. ... ... ... | 12·5 kV. |
| Max. Peak Anode Current ... | 60 mA. |
| Max. Rectified Current ... ... | 7·5 mA. |
| †Max. Hot Switching Transient Current ... ... ... | 100 mA. |
| Max. Ambient Temperature ... | 70 °C. |




All dimensions shown are in millimetres (max.).

TYPICAL OPERATION.

Capacitor Input Filter.

| | |
|---|---|
| R.M.S. Input Voltage ... ... | 5·5 kV. |
| Min. Supply Impedance ... ... | 300,000 ohms. |
| Filter Input Capacitor ... ... | 0·1 µF. |
| Rectified Current ... ... | 2·0 mA. |
| *DC. Output Voltage ... ... | 4·5 kV. |

*At input to filter.

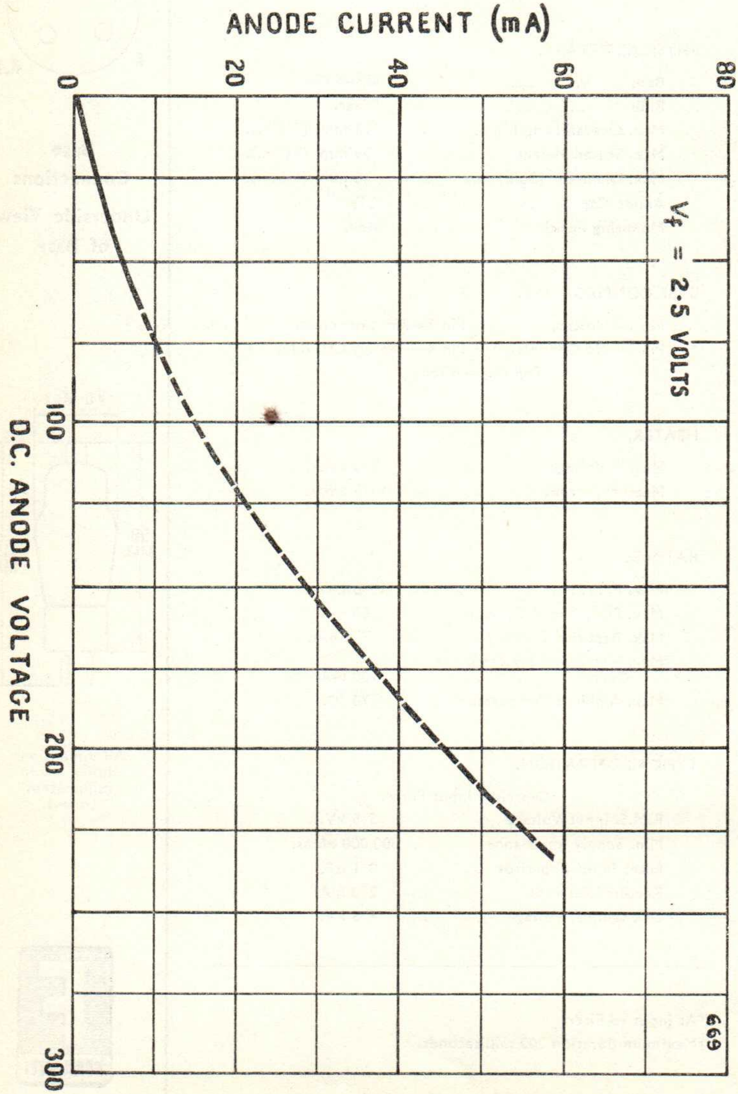
†Maximum duration 200 milliseconds.

FERRANTI

Issue 1
Tentative
July, 1958

FERRANTI

2X2A

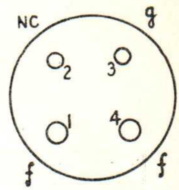


R.0158

# FERRANTI
## THYRATRON

A gas and mercury vapour triode thyratron with a directly heated oxide coated cathode.

**3C23**




**Base Connections**

**Underside View of Base**

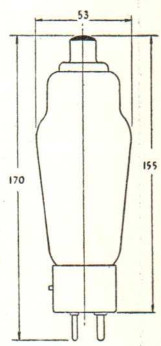
### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | Medium UX 4-pin Bayonet. |
| Top Cap ... ... ... | CT3. |
| Max. Overall Length ... ... | 170 mm. ($6\frac{11}{16}$in.). |
| Max. Seated Height ... ... | 155 mm. ($6\frac{3}{32}$in.). |
| Max. Diameter (Bulb) ... ... | 53 mm. ($2\frac{3}{32}$in.). |
| Mounting Position ... ... | Vertical, base down. |

### BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Filament. ... ... | Pin 3—Grid. |
| Pin 2—No Connection.... ... | Pin 4—Filament. |

Top Cap—Anode.




### FILAMENT.

| | |
|---|---|
| Filament Voltage ... ... ... | ... 2·5 volts. |
| Filament Current (nominal) ... ... | ... 7·0 amps. |
| Min. Filament Heating Time ... ... | ... 15 seconds. |

### RATINGS (Absolute).

| | |
|---|---|
| Max. Peak Anode Voltage : | |
| Forward ... ... ... ... | 1250 volts. |
| Inverse ... ... ... ... | 1250 volts. |
| Max. Peak Anode Current : | |
| Below 25 c/s. ... ... ... ... | 3 amps. |
| 25 c/s. and higher ... ... ... ... | 6 amps. |
| Max. Mean Anode Current : | |
| Below 210 c/s. ... ... ... | ... 1·5 amps. |
| 210 to 400 c/s. ... ... ... | ... 1·0 amp. |
| Max. Peak Grid Current ... ... | ... 50 mA. |
| *Max. Mean Grid Current ... ... | ... 10 mA. |
| Max. Negative Control Grid Voltage : | |
| Before Conduction ... ... | ... 500 volts. |
| During Conduction ... ... | ... 10 volts. |
| Max. Power Supply Frequency ... | ... 400 c/s. |
| **Condensed Mercury Temperature Range | –40 to +80°C. |
| Min. Grid Circuit Resistance ... ... | 1000 ohms. |

### ELECTRICAL CHARACTERISTICS.

| | | | | |
|---|---|---|---|---|
| Peak Voltage Drop ... ... | 16 | | | volts. |
| Approximate Control Characteristics : | | | | |
| DC. Anode Voltage ... | 25 | 500 | 1250 | volts. |
| DC. Grid Voltage ... | 0 | –4 | –6·5 | volts. |
| Ionisation Time (approx.) ... | | 10 | | µsecs. |
| De-ionisation Time (approx.) ... | | 1000 | | µsecs. |

All dimensions shown are in millimetres. (max.).

### CAPACITANCES.

| | |
|---|---|
| Grid to Anode ... ... ... ... | 1·8 pF. (approx.) |
| Grid to Filament ... ... ... | 5·8 pF. (approx.) |

FERRANTI

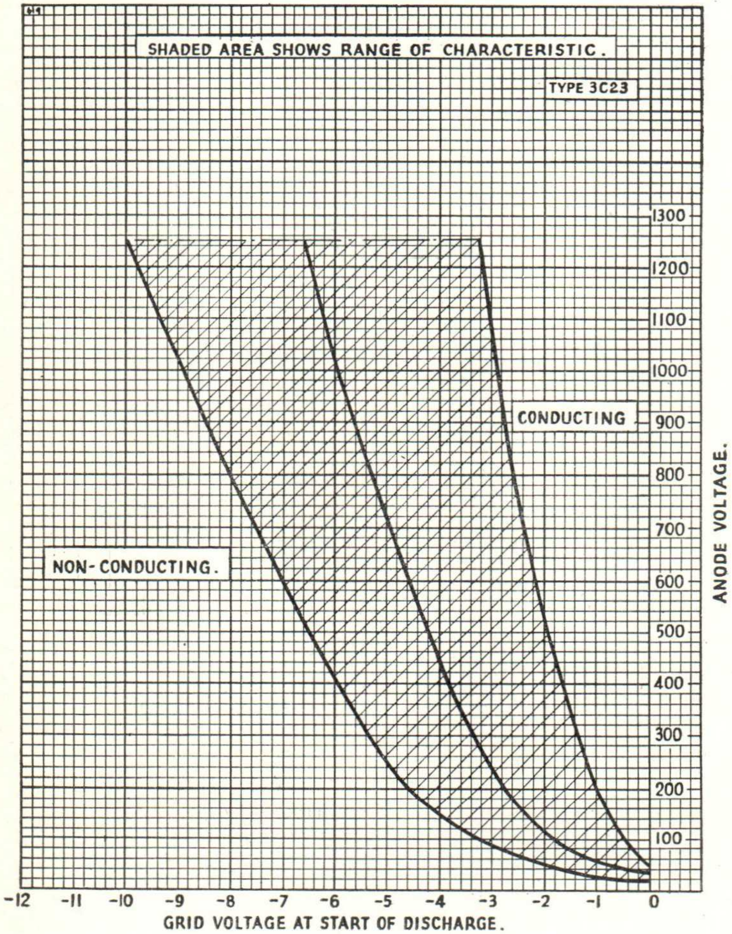
*Averaged over 5 seconds.

**Recommended condensed mercury temperature = 40°C.

Issue 1
April, 1956

FERRANTI

## CONTROL CHARACTERISTIC

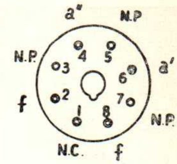


R0256

# FERRANTI
## FULL WAVE RECTIFIER

**5R4GY**

A directly heated, high vacuum full wave rectifier, designed for use in equipments where a large output is required.




**Base Connections Underside View of Base**

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Bulb ... ... ... ... | Clear. |
| Max. Overall Length ... ... | 135 mm. ($5\frac{5}{16}$ in.) |
| Max. Seated Height ... ... | 121 mm. ($4\frac{3}{4}$ in.) |
| Max. Diameter (Bulb) ... ... | 52 mm. ($2\frac{1}{16}$ in.) |
| Mounting Position ... ... | Vertical, base down ; or horizontal with pins 1 and 4 in vertical plane. |

### BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 5—No Pin. |
| Pin 2—Filament. | Pin 6—Anode 1. |
| Pin 3—No Pin. | Pin 7—No Pin. |
| Pin 4—Anode 2. | Pin 8—Filament. |

### FILAMENT.

| | |
|---|---|
| Filament Voltage ... | 5·0 volts. |
| Filament Current ... | 2·0 amps. |

### RATINGS.

| | | | | |
|---|---|---|---|---|
| Max. Peak Anode Current per anode | | 650 | | mA. |
| Max. P.I.V. (no load) ... | 2100 | 2400 | 2800 | volts. |
| Max. Rectified Current (Capacitor Input) ... | 250 | 175 | 150 | mA. |
| Max. Rectified Current (Choke Input) ... | 250 | 250 | 175 | mA. |
| Min. Choke Inductance ... | 5 | 5 | 10 | Henries |
| Delay for H.T. Switching | | see Note * | | |

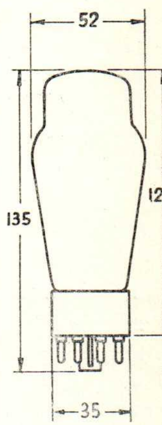
### TYPICAL OPERATION.

CAPACITOR INPUT.

| | | | | |
|---|---|---|---|---|
| ‡R.M.S. Input voltage ... | 750 | 850 | 1000 | volts. |
| †‡Min. Supply Impedance ... | 250 | 500 | 575 | ohms. |
| Rectified Current ... | 250 | 150 | 150 | mA. |
| Reservoir Capacitor ... | 4 | 4 | 4 | μF. |

CHOKE INPUT.

| | | | |
|---|---|---|---|
| ‡R.M.S. Input Voltage ... | 850 | 1000 | volts. |
| Rectified Current ... | 250 | 175 | mA. |
| Min. Input Choke Inductance | 5 | 10 | Henries |




All Dimensions shown are in Millimetres (max.).

*Under certain operating conditions which are shown on the graph overleaf it is necessary to delay application of the Anode Voltage until the filament has reached the required temperature. Neglect of this precaution will lead to early failure.

†If an input capacitor larger than 4 μF is employed the anode supply impedance should be increased to limit the peak anode current to the maximum specified under "Ratings."

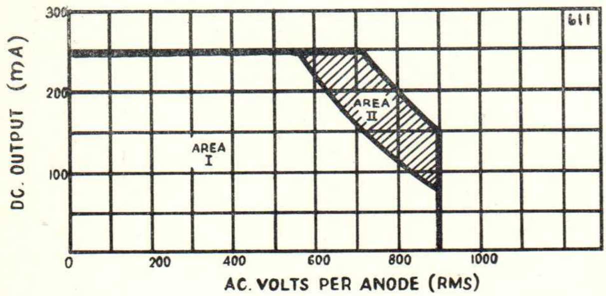
‡Each Anode.

Issue 1.
Feb., 1954.

## 5R4GY

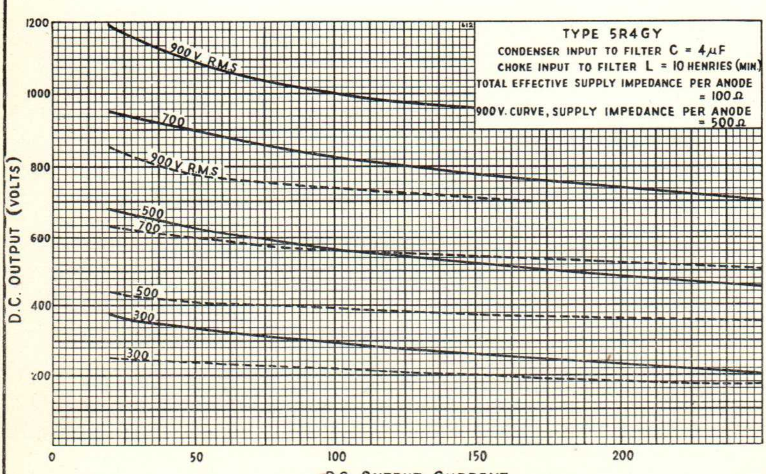
### OPERATION CHARACTERISTICS

CAPACITOR INPUT TO FILTER




AREA I: FILAMENT & ANODE VOLTAGE MAY BE APPLIEED SIMULTANEOUSLY.

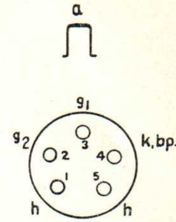
AREA II: FILAMENT SHOULD BE ALLOWED TO REACH OPERATING TEMPERATURE BEFORE ANODE VOLTAGE IS APPLIED, FOR AVERAGE CONDITIONS, THE DELAY IS APPROXIMATELY 10 SECONDS.



# FERRANTI

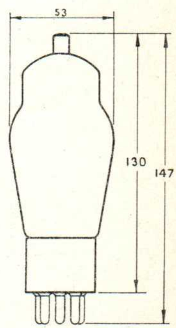
## OUTPUT BEAM TETRODE

Indirectly heated beam tetrode designed for use as a Low Frequency Amplifier or Modulator, or as a Radio Frequency Power Amplifier or Oscillator.




**Base Connections**

**Underside View of Base**




All dimensions shown are in millimetres (max.).

### PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | UX–5 pin bayonet. |
| Max. Overall Length ... ... | 147 mm. |
| Max. Seated Height ... ... | 130 mm. |
| Max. Diameter (Bulb) ... ... | 53 mm. |
| Mounting Position ... ... | Any. |

### BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 4—Cathode, Beam Plates. |
| Pin 2—Screen Grid | Pin 5—Heater. |
| Pin 3—Control Grid. | Top Cap—Anode. |

### HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·9 amp. |

### RATINGS.

| | | |
|---|---|---|
| Max. Anode Voltage ... ... ... | 600 | volts. |
| Max. Peak Anode Voltage ... ... | 2000 | volts. |
| Max. Screen Grid Voltage ... ... | 300 | volts. |
| Max. Negative Control Grid Voltage ... | 200 | volts. |
| Max. Cathode Current ... ... | 150 | mA. |
| Max. Peak Cathode Current ... ... | 400 | mA. |
| Max. Screen Grid Current ... ... | 10 | mA. |
| Max. Control Grid Current ... ... | 5 | mA. |
| Max. Peak Control Grid Current ... | 25 | mA. |
| Max. Anode Dissipation ... ... | 25 | watts. |
| Max. Screen Grid Dissipation ... ... | 3·5 | watts. |
| Max. $V_{h-k}$ ... ... ... ... | 100 | volts. |
| Max. $R_{g-k}$ ... ... ... ... | 25 | kΩ |

### TYPICAL OPERATION.

Single Valve Class A Amplifier.

| | | | |
|---|---|---|---|
| Anode Voltage ... ... | 300 | 500 | volts. |
| Screen Voltage ... ... | 250 | 200 | volts. |
| Control Grid Voltage ... | −12.5 | −14·5 | volts. |
| Anode Current ... | 83 | 50 | mA. |
| Screen Current ... ... | 8.0 | 1·6 | mA. |
| Anode Impedance ... | 24 | 39 | kΩ |
| Mutual Conductance ... | 6.5 | 5·7 | mA/volts. |
| Cathode Bias Resistor ... | 140 | 280 | ohms. |
| Anode Load ... ... | 3 | 6 | kΩ |
| Power Output ... ... | 6.4 | 11·5 | watts. |
| Total Harmonic Distortion | 6 | 12 | % |

2 Valves Push Pull Amplifier.

| | Class AB1 | | Class AB2† | |
|---|---|---|---|---|
| Anode Voltage ... ... | 500 | 600 | 600 | volts. |
| Screen Voltage ... ... | 300 | 300 | 300 | volts. |
| Control Grid Voltage ... | – | −27·5 | −30 | volts. |
| Cathode Bias Resistor ... | 270 | – | – | ohms. |
| Peak AF. Input Voltag. Grid to Grid ... | 72 | 59 | 78 | volts. |
| Anode Current (Zero Signal) | 100 | 80 | 60 | mA. |
| Anode Current (Max. Signal) | 119 | 150 | 200 | mA. |
| Screen Current (Zero Signal) | 2·5 | 1·5 | 1·5 | mA. |
| Screen Current (Max. Signal) | 16·5 | 17·5 | 21 | mA. |
| Optimum Load Resistance Anode to Anode ... | 9 | 10 | 6·4 | kΩ |
| Power Output ... ... | 32·5 | 47·5 | 80 | watts. |
| Total Harmonic Distortion | 2·7 | 2·2 | 3·5 | % |

### CAPACITANCES.

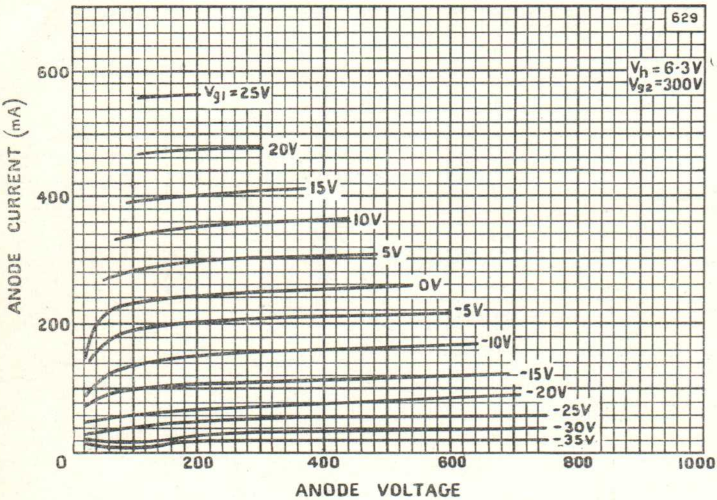
| | |
|---|---|
| $C_{in}$ ... ... ... ... | 11 pF. |
| *$C_{out}$ ... ... ... ... | 7 pF. |
| $C_{a-g1}$ ... ... ... ... | <0·2 pF. |

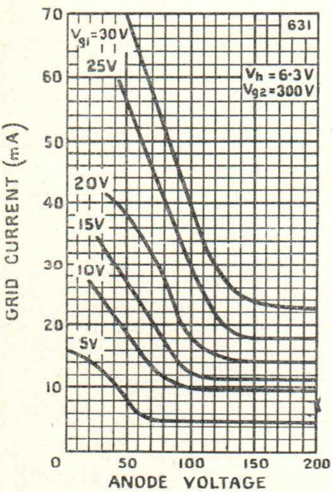
*Measured with external shield.

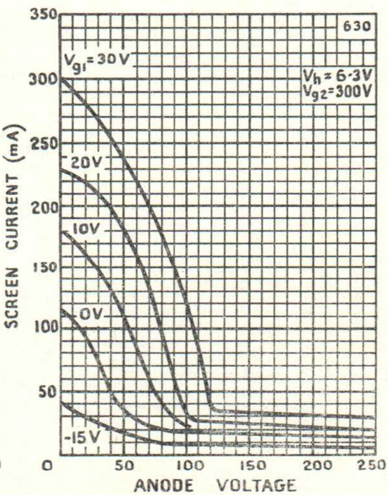
†Anode and Screen supply voltages must not vary by more than 5% and grid bias voltage by not more than 3% between no signal and peak signal conditions to obtain the maximum output at low distortion.

Issue 1
Aug., 1957

FERRANTI


629
$V_h$ = 6·3V
$V_{g2}$=300V
$V_{g1}$ = 25V
20V
15V
10V
5V
0V
-5V
-10V
-15V
-20V
-25V
-30V
-35V
ANODE CURRENT (mA)
0
200
400
600
800
1000
ANODE VOLTAGE


631
$V_h$ = 6·3V
$V_{g2}$=300V
$V_{g1}$=30V
25V
20V
15V
10V
5V
GRID CURRENT (mA)
0
50
100
150
200
ANODE VOLTAGE

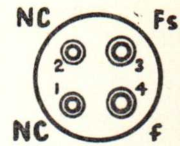

630
$V_h$ = 6·3V
$V_{g2}$=300V
$V_{g1}$= 30V
20V
10V
0V
-15V
SCREEN CURRENT (mA)
0
50
100
150
200
250
ANODE VOLTAGE

# FERRANTI
## MERCURY VAPOUR RECTIFIER

A Mercury Vapour Rectifier with an oxide coated filament.


PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | UX—4-pin (Bayonet). |
| Max. Overall Length ... ... | 170 mm. ($6\frac{11}{16}$in.). |
| Max. Seated Height ... ... | 155 mm. ($6\frac{1}{8}$in.) |
| Max. Bulb Diameter ... ... | 66 mm. ($2\frac{19}{32}$in.). |
| Anode Cap ... ... ... | Type CT3. |
| Mounting Position ... ... | Vertical—Base down. |




Base Connections Underside View of Base

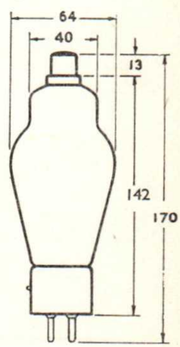
CATHODE.

| | |
|---|---|
| Fil. Voltage ... ... ... | 2·5 volts. |
| Fil. Current ... ... ... | 5·0 amps. |

RATINGS. (Maximum ratings are "absolute" values.)

| | | |
|---|---|---|
| Natural Ventilation<br>Forced Ventilation | 20°C—40°C<br>20°C—60°C | 25°C—55°C<br>25°C—65°C |
| Max. P.I.V. ... ...<br>(See Note 2 below) | 5kV—10kV | up to 5kV |

| | | |
|---|---|---|
| Max. Peak Anode Current ... | 1·0 | Amp. |
| Max. Av. Anode Current ... | 0·25 | Amp. |
| Ambient Temperature Range : | | |
| Natural Ventilation ... | 20°—55°C. | |
| Forced Ventilation ... ... | 20°—65°C. | |
| Min. Cathode Heating Delay ...<br>(See Note 1 below.) | 30 | secs. |




The above ratings apply to operation in circuits using a choke input filter and a supply frequency of 50 c/s.

TYPICAL OPERATION.

| *CIRCUIT. | | D.C. Output Kilovolts. | D.C. Output Amps. |
|---|---|---|---|
| No. 1. | Bi-Phase Half Wave (2 valves) ... | 3·2 | 0·5 |
| No. 2. | 3-Phase Half Wave (3 valves) ... | 4·5 | 0·75 |
| No. 3. | Single Phase Full Wave (4 valves) ... | 6·5 | 0·5 |
| No. 4. | 3-Phase Full Wave (6 valves) ... | 9·5 | 0·75 |
| No. 5. | 3-Phase Half Wave Double Y (6 valves) | 4·5 | 1·5 |

All dimensions shown are in millimetres (max.)

INSTALLATION NOTES.

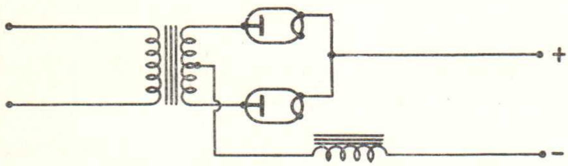
1. When first installed or after a long period of rest the valve should be run for at least 5 minutes before the application of any anode voltage.
2. The rated value of P.I.V. is applicable only over the temperature ranges noted above. Care should be taken in selecting a suitable position in the layout to ensure free circulation of air around the bulb.
3. Valves should be shielded from radio frequency fields.
4. Surges due to H.T. switching or other causes should be avoided.
5. This rectifier is directly heated and it is therefore recommended that the output circuit should be returned to the mid point of the filament transformer secondary.
6. If valves are used in parallel to increase current output balancing inductances must be placed in the anode leads.

*For Circuit Diagrams see overleaf.

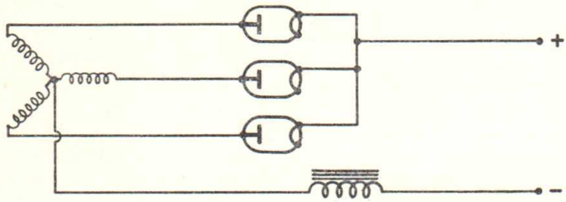
FERRANTI

Issue 1.
Mar., 1957

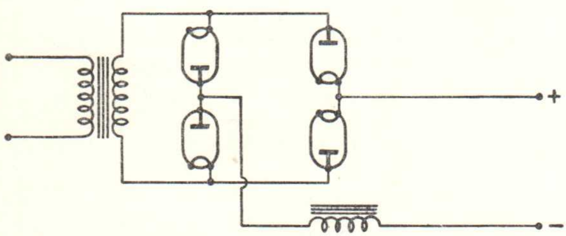
Circuits referred to under "TYPICAL OPERATION" overleaf.



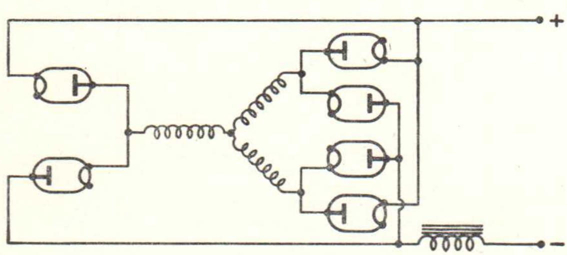

1



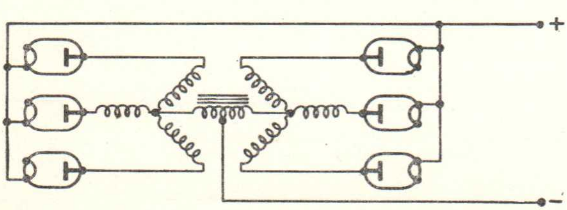

2




3




4




5

FERRANTI

MICROWAVE DEVICES.

Ferranti

# T. R. CELL

A broad band passive protection cell normally used in conjunction with pulsed attenuators or in radar systems where protection against random signals is not available.

The cell should be mounted in the receiver arm, between rectangular flanges for W.G.16.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... | See outline drawing overleaf. |
| Waveguide ... ... | W.G.16 (0·4″ × 0·9″). |
| Primer Terminal ... | CT.1. |
| Mounting Position ... | Any. |

## FREQUENCY RANGE ... 8950 to 9600 Mc/s.

## RATINGS.

| | |
|---|---|
| Max. Line Power level ... ... | 10 kW. |
| *Max. Primer Supply Voltage ... | −1500 volts. |
| Min. Primer Supply Voltage ... | −950 volts. |
| *Max. Primer Current ... ... | 150 μA. |
| *Min. Primer Current ... ... | 100 μA. |
| Ambient Temperature Range (non-operating) ... | −40 to +100 °C. |

## CHARACTERISTICS.

| | Average. | Limit. | |
|---|---|---|---|
| **Low Power Level.** | | | |
| Insertion Loss :— 8950 to 9600 Mc/s. ... | 0·6 | 1·0 | dB. |
| V.S.W.R. ... ... ... | 1·15 | 1·25 | dB. |
| **High Power Level.** | | | |
| Breakdown Power ... ... | 120 | 200 | mW. |
| Leakage at 40kW. peak :— Total Leakage Power ... | 12 | 20 | mW. |
| Spike Leakage Energy ... | 0·12 | 0·2 | ergs/pulse. |
| †Recovery Time (to 6dB. loss) ... | — | 50 | μSec. |
| **Primer Characteristics.** | | | |
| Primer Operating Voltage ... | 200 | 180 to 280 | volts. |

*A suitable resistor should be connected in series with the electrode to limit the current to between 100 and 150 microamperes. At least 1 megohm should be connected directly to the primer electrode terminal.

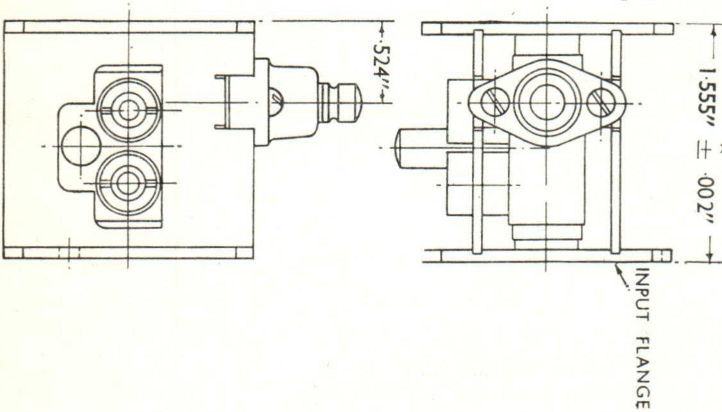
†Measured at 10 kW.

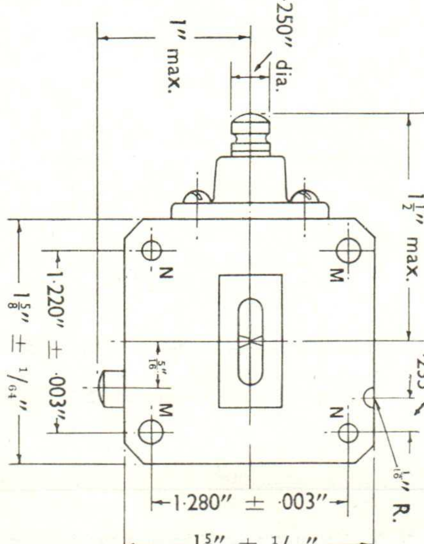
Issue 2.
Sept., 1960

Ferranti

# NF40

★ Flanges are flat and parallel within these limits




**M**—2 holes in each flange:—·170″ dia. ±·002″ coaxial to each other
**N**—2 holes in each flange:—·150″ dia. ±·002″ coaxial to each other
The holes are positioned as shown and are on a 1·768″ ±·004″ P.C.D.

Ferranti

# T. R. CELL

A very broad band power limiting cell for use in Radar systems as a unit to provide protection for crystals against random signals.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... | See outline drawing overleaf. |
| Waveguide ... ... | W.G.16 (0·4″ × 0·9″). |
| Primer Terminal ... | CT.1. |
| Mounting Position ... | Any. |

## FREQUENCY RANGE ... 7000 to 11500 Mc/s.

## RATINGS.

| | |
|---|---|
| Max. Line Power level ... ... | 100 watts. |
| *Max. Primer Supply Voltage ... | –1500 volts. |
| Min. Primer Supply Voltage ... | –950 volts. |
| *Max. Primer Current ... ... | 150 μA. |
| *Min. Primer Current ... ... | 100 μA. |
| Ambient Temperature Range (non-operating) ... | –40 to + 100 °C. |

## CHARACTERISTICS.

| | Average. | Limit. | |
|---|---|---|---|
| Low Power Level. | | | |
| Insertion Loss :— | | | |
| 7400– 7900 Mc/s. ... | 0·6 | 1·2 | dB. |
| 8000– 9900 Mc/s. ... | 0·4 | 0·9 | dB. |
| 10000–10600 Mc/s. ... | 0·3 | 0·8 | dB. |
| 7000–11500 Mc/s. ... | — | 4 | dB. |
| High Power Level. | | | |
| Breakdown Power ... ... | 150 | 300 | mW. |
| Leakage at 40kW. peak :— | | | |
| Total Leakage Power ... | 60 | — | mW. |
| Spike Leakage Energy ... | 0·13 | — | ergs/pulse. |
| †Recovery Time (to 6dB. loss) ... | — | 50 | μSec. |
| Primer Characteristics. | | | |
| Primer Operating Voltage ... | 190 | 170 to 240 | volts. |

*A suitable resistor should be connected in series with the electrode to limit the current to between 100 and 150 microamperes. At least 1 megohm should be connected directly to the primer electrode terminal.

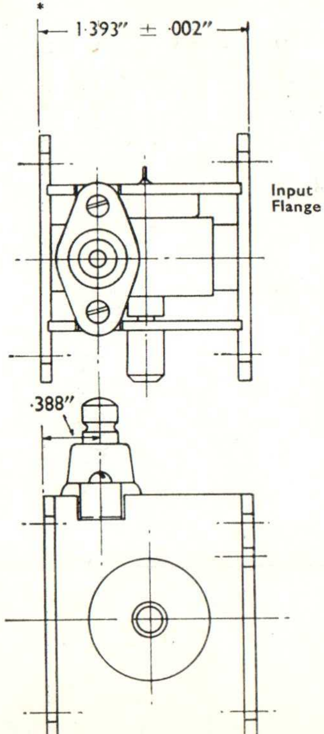
†Measured at 10 watts.

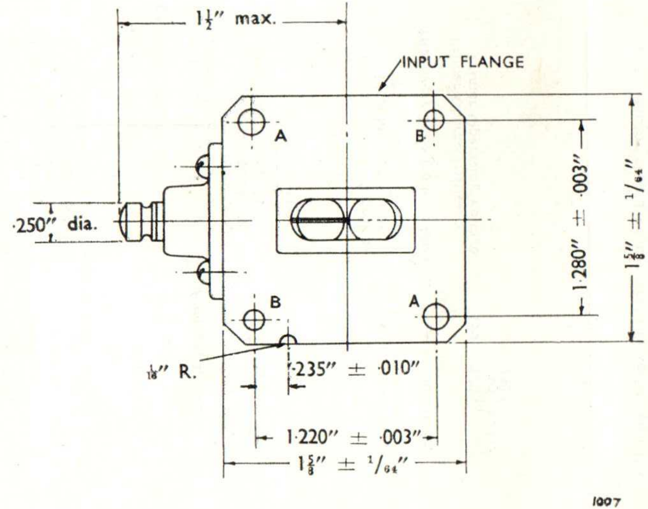
Issue 2.
May, 1960

Ferranti

Ferranti

*Flanges are flat and parallel within these limits




1007

A —2 holes in each flange: ·170″ dia. ±·002″ coaxial to each other

B—2 holes in each flange: ·150″ dia. ±·002″ coaxial to each other

The holes are positioned as shown and are on a 1·768″ ±·004″ P.C. D.

Ferranti

# T. R. CELL

A separate cavity T.R. Cell designed for use in 'L' Band.
It is equivalent to the American Type 1B23.

PHYSICAL DATA.

| | |
|---|---|
| Max. overall length ... ... | 3" (76 mm.). |
| Max. dia. over diaphragm flange | $1\frac{9}{64}$" (29 mm.). |

For other dimensions see drawing overleaf.

FREQUENCY RANGE ... ... 400 to 1500 Mc/s. Dependent on the cavity design.*

RATINGS.

| | |
|---|---|
| Max. Transmitter Power ... | 20 kW. |
| Max. Primer Supply Voltage ... | –1500 volts. |
| Min. Primer Supply Voltage ... | –800 volts. |
| Max. Primer Current ... ... | 200 µA. |
| Min. Primer Current ... ... | 100 µA. |

CHARACTERISTICS.

| | |
|---|---|
| Low Power Level | |
| †Insertion Loss ... ... ... | 1·6 dB max. |
| Interaction Loss ... ... | 0·2 dB max. |
| Primer Electrode Characteristic | |
| Primer Operating Voltage ... | 375 to 525 volts. |

OPERATING NOTES.

(1) The performance of this T.R. Cell is to a large extent determined by the cavity into which the tube is fitted. It will work satisfactorily over a large portion of the 'L' Band depending on the cavity design.

(2) The primer electrode should be supplied from a negative potential DC source of at least 800 volts. Suitable resistors should be used to limit the primer electrode current to between 100 and 200 micro-amperes.

*When tested in a cavity as drawing 162-JAN the valves will tune in the range 949 to 951 Mc/s.

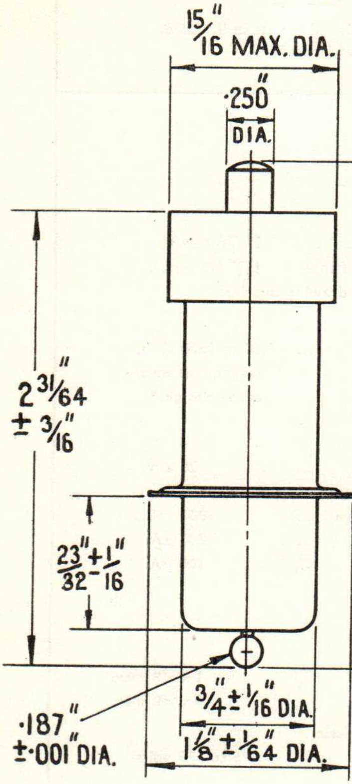
†In test cavity as drawing 162-JAN.

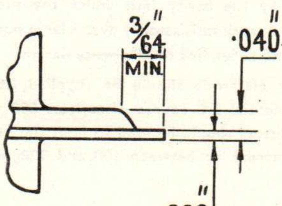
Issue 2.
Nov. 1959

Ferranti

Ferranti

# QF10




ENLARGED VIEW OF DIAPHRAGM FLANGE

Ferranti

# T. R. CELL

A separate cavity T.R. Cell designed for use in 'L' Band.

PHYSICAL DATA.

| | |
|---|---|
| Max. overall length ... ... | 3″ (76 mm.). |
| Max. dia. over diaphragm flange | $1\frac{9}{64}$″ (29 mm.). |

For other dimensions see drawing overleaf.

| | |
|---|---|
| *FREQUENCY RANGE ... ... | 400 to 1500 Mc/s. Dependent on the cavity design. |

RATINGS.

| | |
|---|---|
| Max. Transmitter Power ... | 20 kW. |
| Max. Primer Supply Voltage ... | −1500 volts. |
| Min. Primer Supply Voltage ... | −800 volts. |
| Max. Primer Current ... ... | 200 μA. |
| Min. Primer Current ... ... | 100 μA. |

CHARACTERISTICS.

| | |
|---|---|
| Low Power Level | |
| †Insertion Loss ... ... ... | 1·6 dB max. |
| Interaction Loss ... ... | 0·2 dB max. |
| Primer Electrode Characteristic | |
| Primer Operating Voltage ... | 300 to 425 volts. |

OPERATING NOTES.

(1) The performance of this T.R. Cell is to a large extent determined by the cavity into which the tube is fitted. It will work satisfactorily over a large portion of the 'L' Band depending on the cavity design.

(2) The primer electrode should be supplied from a negative potential DC source of at least 800 volts. Suitable resistors should be used to limit the primer electrode current to between 100 and 200 micro-amperes.

*When tested in a cavity as drawing 162-JAN the valves will tune in the range 949 to 951 Mc/s.

†In test cavity as drawing 162-JAN.

Issue 2.
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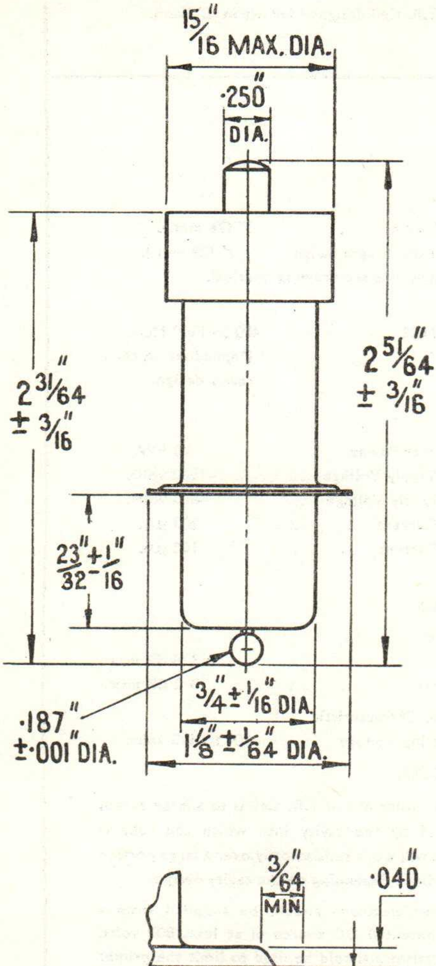
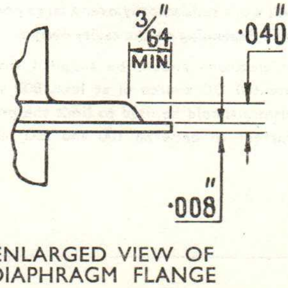



ENLARGED VIEW OF DIAPHRAGM FLANGE

# FERRANTI

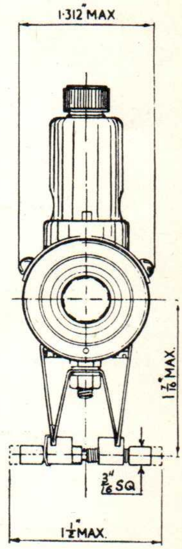
## T.R. CELL

**QF40**

Type QF40 is an integral cavity, high 'Q'. T-R Cell for operation in the 3 cm. band. It is designed for coupling to $\frac{7}{8}$in. I.D. circular waveguide.

PHYSICAL DIMENSIONS.

Max. overall height ... ... $3\frac{15}{16}$ins. (100 mm.)
Max. overall width ... ... 2·065ins. (52·4 mm.)
For other dimensions see drawings in margin and overleaf.
The Keep-alive electrode is connected to a 5 BA terminal at the top of the cell.




All dimensions shewn are in inches.

RATINGS.

| | |
|---|---|
| Max. Transmitter Power level | 50 kW. Peak. |
| Tuning Range ... ... ... | 9,500 Mc/s. ± 5% |
| Voltage Standing Wave Ratio | 2·0 |
| Max. Insertion loss ... ... | 1·5 db. |
| *Max. Leakage at 40 kW. Peak— spike | 0·04 ergs/pulse. |
| flat | 15 mW. |
| †Min. Breakdown Power ... | > 100 mW. |
| ‡Effective R.F. short circuit | (a) 0·72in. ± 0·03in. |
| | (b) 0·67in. ± 0·03in. |
| Max. Recovery time (to 6 db. loss) | 4 μsecs. |
| Max. Keep-alive Breakdown voltage ... ... ... | 1000 volts. |

TYPICAL PERFORMANCE DATA.

Low Level Characteristics.

| | |
|---|---|
| $Q_L$ ... ... ... ... | 400 (approx.) |
| Voltage Standing Wave Ratio | 1·4 approx. |
| Insertion Loss ... ... | 1·2 db. |

High Power Characteristics.

| | |
|---|---|
| *Leakage at 40 kW.— spike | 0·02 ergs/pulse. |
| — flat ... | 10 mW. |
| †Breakdown Power ... ... | 40 mW. |
| Recovery time (to 6 db. loss) | 2·5 μsecs. |

Keep Alive Characteristics.

| | |
|---|---|
| Breakdown Voltage ... ... | 700 volts. |
| Potential Drop ... ... | 350 volts. |

* 1 μsec. pulses.

† For protection from external transmitters.

‡ The position of the R.F. short has two alternative values depending on whether a window discharge occurs or not, but in either case the crystal protection is not affected.

(a) At peak powers below approximately 15 kW. or with 0·1 μsec. pulse lengths at all power levels, discharge is confined to the cones, and the effective short is at 0·72in. ±0·03in.

(b) At peak powers above approximately 15 kW. with pulse lengths greater than 0·1 μsec., a window discharge occurs as well and the effective short is at 0·67in. ± 0·03in.

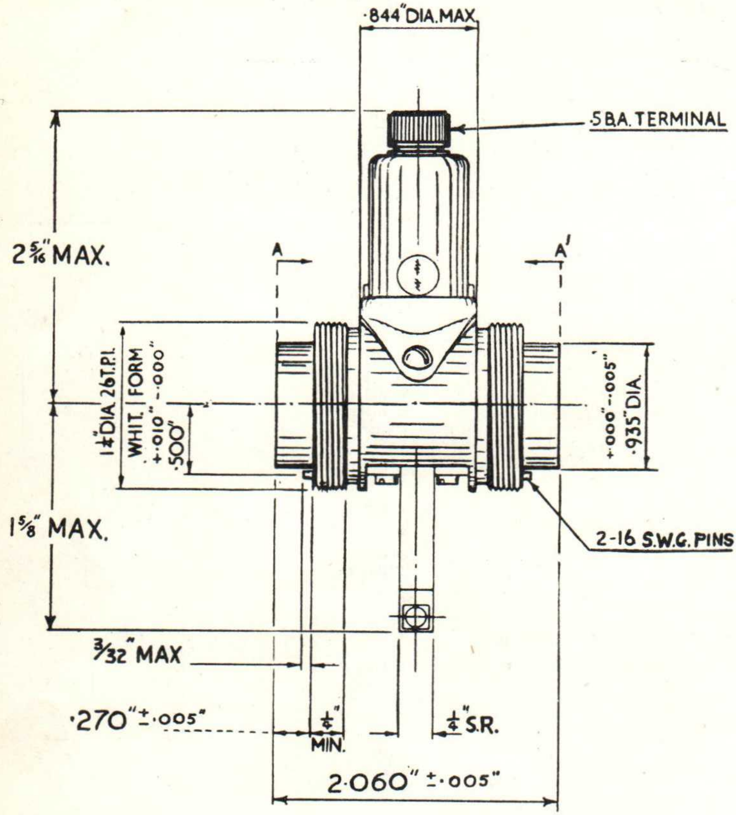
These distances are measured from the input edge of the cell, i.e., from either of the positions indicated by the broken lines A or A' on the drawing.

Formerly known as Type TTR31.

Issue 3.
Jan., 1955.

FERRANTI

## QF40




OPERATING NOTES.

This T.R. Cell in a simple duplexer, gives complete protection to all types of crystals both from the local and neighbouring transmitters, with an appreciable margin of safety and long life.

To ensure rapid breakdown a negative voltage of 1000V. D.C. should be applied to the keep-alive electrode. The keep-alive current should be restricted to between 100 $\mu$A and 150 $\mu$A by means of a suitable limiting resistance. Some of this resistance may be located in the power supply but at least 1 megohm should be connected directly on to the keep-alive terminal to prevent relaxation oscillations at the keep-alive. It is advisable to arrange that the keep-alive current is passing for a few seconds before the transmitter begins to operate.

The cell is provided with a tuner free from backlash which gives a sensitive adjustment of frequency over the specified tuning ranges.

To give protection from neighbouring transmitters when the set is not operating and the keep-alive unenergised a suitable gate or crystal shutter must be fitted.

# FERRANTI
## T.R. CELL

Type QF41 is a tuneable T-R Cell for operation in the 3 cm. band. It is designed for coupling to rectangular waveguide 0·9in. x 0·4in. internal dimensions (Waveguide No. 16 in RCL351) and is fitted with an engraved tuner. It is similar to Type QF40 but its effective bandwidth when tuned has been increased to about 25 M/cs. for a V.S.W.R. of 2·0, or 15 M/cs. if the limit of V.S.W.R. is 1·5.

### PHYSICAL DIMENSIONS.

| | |
|---|---|
| Max. overall height ... ... | $3\frac{11}{16}$ins. (94 mm.) |
| Max. overall width ... ... | 1·0in. (25·4 mm.) |

For other dimensions see drawings in margin and overleaf.
The Keep-alive electrode is connected to a 5 BA terminal at the top of the cell.

### RATINGS.

| | |
|---|---|
| Max. Transmitter Power level | 50 kW. peak. |
| *Tuning Range ... ... ... | 9,500 Mc/s. ± 5% |
| Preset Tuning Range ... | Centre Frequency ± 100 Mc/s. |
| V.S.W.R. ... ... ... ... | 1·4. |
| Max. Insertion Loss at Resonant Frequency ... | 1·2 db. |
| Max. Insertion Loss at ± 15 Mc/s. off Resonant Frequency | 1·5 db. |
| †Max. Leakage at 40 kW. Peak— spike | 0·10 ergs/pulse. |
| flat | 30 mW. |
| ‡Min. Breakdown Power ... | 250 mW. |
| §Effective R.F. short circuit | (a) 0·25 ± 0·03 inches. |
| | (b) 0·20 ± 0·03 inches. |
| Max. Recovery Time (to 6 db. loss) at 40 kW. | 4 µsecs. |
| Max. Keep-alive Breakdown voltage ... ... ... | 1000 volts. |

### TYPICAL PERFORMANCE DATA.

Low Level Characteristics.

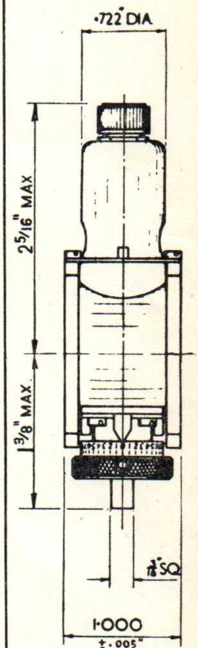
| | |
|---|---|
| QL ... ... ... ... | 130 approx. |
| V.S.W.R. at Resonance ... | 1·1 approx. |
| Insertion Loss at Resonance ... | 0·8 db. |

High Power Characteristics.

| | |
|---|---|
| Leakage at 40 kW.— spike | 0·06 ergs/pulse. |
| —flat ... | 20 mW. |
| Breakdown Power ... ... | 100 mW. |
| Recovery Time (to 6 db. loss) | 1·5 µsec. |

Keep-Alive Characteristics.

| | |
|---|---|
| Breakdown Voltage ... ... | 700 volts. |
| Potential Drop at 150 µA. ... | 350 volts. |




All dimensions shewn are in inches.

* The engraved tuner provides a covergae of ± 100 Mc/s. about the centre frequency. Each division of the tuner scale corresponds to an alteration in frequency of approx. 10 Mc/s. The cell is normally supplied with the tuner centred on 9375 Mc/s. but on request it may be set at other points within the range 9075 Mc/s. to 9925 Mc/s.

† 1 µsec. pulses.

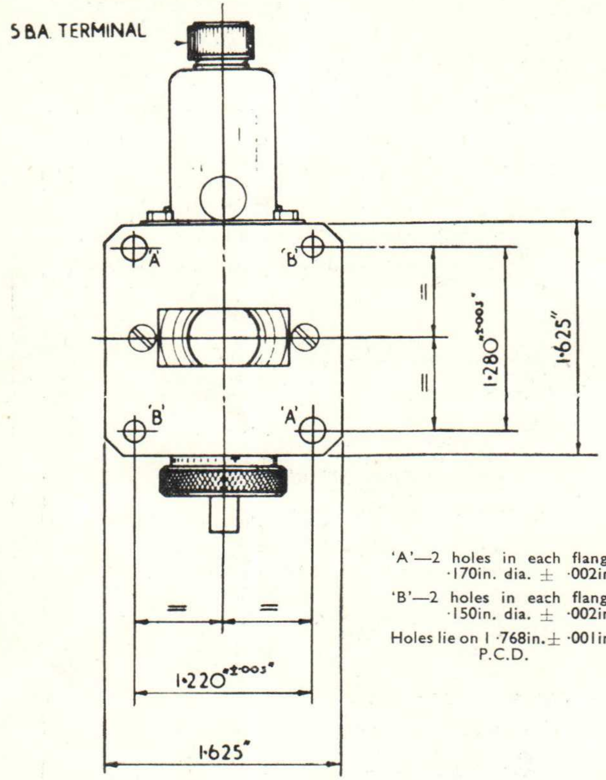
‡ For protection against external transmitters.

§ See note overleaf.

Formerly known as Type TTR31MR.

Issue 4.
Jan., 1955

## QF41




'A'—2 holes in each flange ·170in. dia. ± ·002in.

'B'—2 holes in each flange ·150in. dia. ± ·002in.

Holes lie on 1·768in. ± ·001in. P.C.D.

OPERATING NOTES.

This T.R. Cell in a simple duplexer, gives complete protection to all types of crystals both from the local and neighbouring transmitters, with an appreciable margin of safety and long life.

To ensure rapid breakdown a negative voltage of 1000V. D.C. should be applied to the keep-alive electrode. The keep-alive current should be restricted to between 100 $\mu$A and 150 $\mu$A by means of a suitable limiting resistance. Some of this resistance may be located in the power supply but at least 1 megohm should be connected directly on to the keep-alive terminal to prevent relaxation oscillations at the keep-alive. It is advisable to arrange that the keep-alive current is passing for a few seconds before the transmitter begins to operate.

To give protection from neighbouring transmitters when the set is not operating and the keep-alive unenergised a suitable gate or crystal shutter must be fitted.

---

* The position of the R.F. short has two alternative values, depending on whether a window discharge occurs or not, but in either case the crystal protection is not affected.

(a) At peak powers below approximately 15 kW. or with 0·1 $\mu$sec. pulse lengths at all power levels, discharge is confined to the cones, and the effective short is at 0·25in. ± 0·03in.

(b) At peak powers above approximately 15 kW. with pulse lengths greater than 0·1 $\mu$sec., a window discharge occurs as well and the effective short is at 0·20in. ± 0·03in.

These distances are measured from the face of the input flange of the cell.

QF41A
to
QF41K

Ferranti

# T.R. CELL

The QF41 series are tuneable integral cavity T-R cells for operation in the 'X' (3 cm.) band. These cells are designed for use in branched duplexers in WG16 (Rectangular 0·9″×0·4″ internal dimensions).

## PHYSICAL DIMENSIONS.

| | |
|---|---|
| Max. overall height ... ... | 3¾ins. (95·3 mm.) |
| Max. width between flanges | 1·0in. (25·4 mm.) |
| Top Cap (Primer electrode) | CT6 (5BA thread). |
| Mounting Position | Any. |
| Waveguide ... ... ... | WG16. |

For other dimensions see drawings overleaf.

## FREQUENCY RANGE.

The preset tuner provides tuning over a range of approx. ±75 Mc/s.

The operating centre frequency and actual range is indicated by the suffix letter:—

| | |
|---|---|
| QF41A ... ... ... | 9005 to 9155 Mc/s. |
| QF41B ... ... ... | 9100 to 9250 Mc/s. |
| QF41C ... ... ... | 9200 to 9350 Mc/s. |
| QF41D ... ... ... | 9300 to 9450 Mc/s. |
| QF41E ... ... ... | 9400 to 9550 Mc/s. |
| QF41F ... ... ... | 9500 to 9650 Mc/s. |
| QF41G ... ... ... | 9600 to 9750 Mc/s. |
| QF41H ... ... ... | 9700 to 9850 Mc/s. |
| QF41J ... ... ... | 9800 to 9950 Mc/s. |
| QF41K ... ... ... | 9900 to 10050 Mc/s. |

## RATINGS.

| | |
|---|---|
| Max. Transmitter Power level ... | 50 kW. Peak. |
| *Max. Primer Supply Voltage ... | –1500 volts. |
| *Min. Primer Supply Voltage ... | –700 volts. |
| *Max. Primer Current ... ... | 200 μA. |
| *Min. Primer Current ... ... | 100 μA. |

## CHARACTERISTICS.

| | Average. | Limit. |
|---|---|---|
| Low Power Level | | |
| $Q_L$ ... ... ... ... | 130 | 125 to 160 |
| V.S.W.R. (at Resonance) ... | 1·1 | 1·4 |
| †Insertion Loss ... ... | 0·8 | 1·2 dB. |
| High Power Level. | | |
| ‡Leakage at 40 kW.:— | | |
| Flat Leakage Power ... | 20 | 30 mW. |
| Spike Leakage Energy ... | 0·06 | 0·1 ergs/pulse |
| Breakdown Power ... ... | 100 | 250 mW. |
| Recovery Time (to –6dB.)... | 1·5 | 4 μSec. |
| §Position of V.S.W. minimum:— | | |
| Gap discharge ... ... | | 0·24″±0·02″. |
| Window discharge ... | | 0·22″±0·02″. |
| Primer Operating Voltage ... | 350 | 250 to 450 volts. |

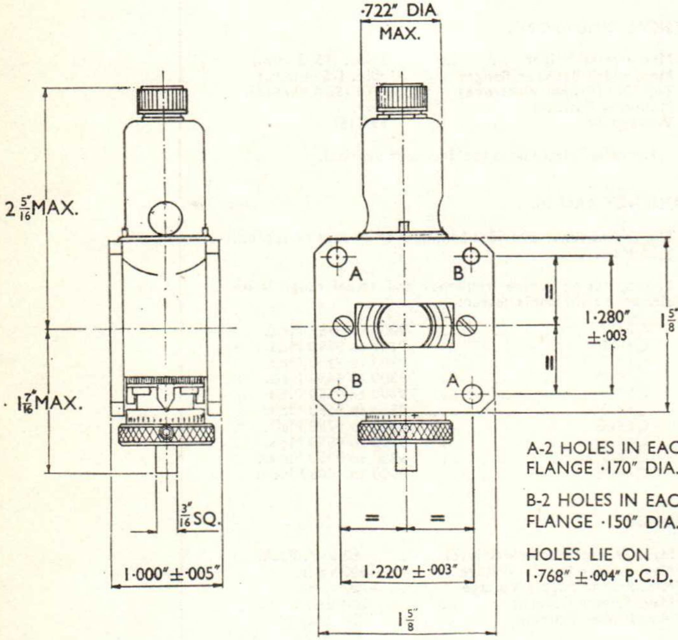
*See note (4) under 'Operating Notes' overleaf.
†Primer energised.
‡1 μsec. pulses.
§Measured from the input flange.
See note (5) under 'Operating Notes' overleaf.

Issue 5.
Nov., 1959.

Ferranti

Ferranti

# QF41A to QF41K




A-2 HOLES IN EACH FLANGE ·170" DIA. ± ·002"

B-2 HOLES IN EACH FLANGE ·150" DIA. ± ·002"

HOLES LIE ON 1·768" ± ·004" P.C.D.

OPERATING NOTES.

(1) This T.R. Cell in a simple duplexer, gives complete protection to all types of crystals both from the local and neighbouring transmitters, with an appreciable margin of safety and long life.

(2) A balanced mixer is an advantage.

(3) To give protection from neighbouring transmitters when the set is not operating and the primer unenergised a suitable gate or crystal shutter must be fitted.

(4) To ensure rapid breakdown a negative voltage of 1000V. D.C. should be applied to the primer electrode. The primer current should be restricted to between 100 μA and 200 μA by means of a suitable limiting resistance. Some of this resistance may be located in the power supply but at least 1 megohm should be connected directly on to the primer terminal to prevent relaxation oscillations. It is advisable to arrange that the keep-alive current is passing for a few seconds before the transmitter begins to operate.

(5) The position of the V.S.W. minimum has two alternative values, depending on whether a window discharge occurs or not, but in either case the crystal protection is not affected. Transition of the V.S.W. minimum from the cones to the window takes place under the following conditions:—

At 8·7 kW. approx. with a pulse width of 1 μsec. and a P.R.F. of 1000.
At 10·4 kW. approx. with a pulse width of 1 μsec. and a P.R.F. of 500.
At 17 kW. approx with a pulse width of 0·1 μsec. and a P.R.F. of 1000.

Ferranti

# T.R. CELL

A series of medium 'Q', integral cavity T.R. cells for operation in the 'X'-Band. They are designed for coupling to ⅞" i.d. circular waveguide and a preset tuner is incorporated.

## PHYSICAL DIMENSIONS.

| | |
|---|---|
| Max. overall height ... ... | 3·675ins. (93·35 mm.) |
| Max. width | 2·065in. (52·4 mm.) |
| Top Cap (Primer electrode) | CT6 (5BA thread). |
| Mounting Position | Any. |
| Waveguide ... ... ... | Circular ⅞" i.d. |

For other dimensions see drawings overleaf.

## FREQUENCY RANGE.

The preset tuner provides tuning over a range of approx. ±75 Mc/s.

The operating centre frequency and range is indicated by the suffix letter:—

| | |
|---|---|
| QF41A ... ... ... | 9005 to 9155 Mc/s. |
| QF41B ... ... ... | 9100 to 9250 Mc/s. |
| QF41C ... ... ... | 9200 to 9350 Mc/s. |
| QF41D ... ... ... | 9300 to 9450 Mc/s. |
| QF41E ... ... ... | 9400 to 9550 Mc/s. |
| QF41F ... ... ... | 9500 to 9650 Mc/s. |
| QF41G ... ... ... | 9600 to 9750 Mc/s. |
| QF41H ... ... ... | 9700 to 9850 Mc/s. |
| QF41J ... ... ... | 9800 to 9950 Mc/s. |
| QF41K ... ... ... | 9900 to 10050 Mc/s. |

## RATINGS.

| | |
|---|---|
| Max. Transmitter Power level ... | 50 kW. Peak. |
| *Max. Primer Supply Voltage ... | −1500 volts. |
| *Min. Primer Supply Voltage ... | −700 volts. |
| *Max. Primer Current ... ... | 200 μA. |
| *Min. Primer Current ... ... | 100 μA. |

## CHARACTERISTICS.

| | Average. | Limit. |
|---|---|---|
| **Low Power Level** | | |
| $Q_L$ ... ... ... ... | | 160 approx. |
| V.S.W.R. (at Resonance) ... | 1·1 | 1·4 |
| †Insertion Loss ... ... | 0·8 | 1·2 dB. |
| **High Power Level.** | | |
| ‡Leakage at 40 kW.:— | | |
| Flat Leakage Power ... | 20 | 30 mW. |
| Spike Leakage Energy ... | 0·06 | 0·1 ergs/pulse |
| Breakdown Power ... ... | 100 | 250 mW. |
| Recovery Time (to −6dB.)... | 1·5 | 4 μSec. |
| §Position of V.S.W. minimum:— | | |
| Gap discharge ... ... | | 0·69"±0·03". |
| Window discharge ... | | 0·67"±0·03". |
| Primer Operating Voltage ... | 350 | 250 to 450 volts. |

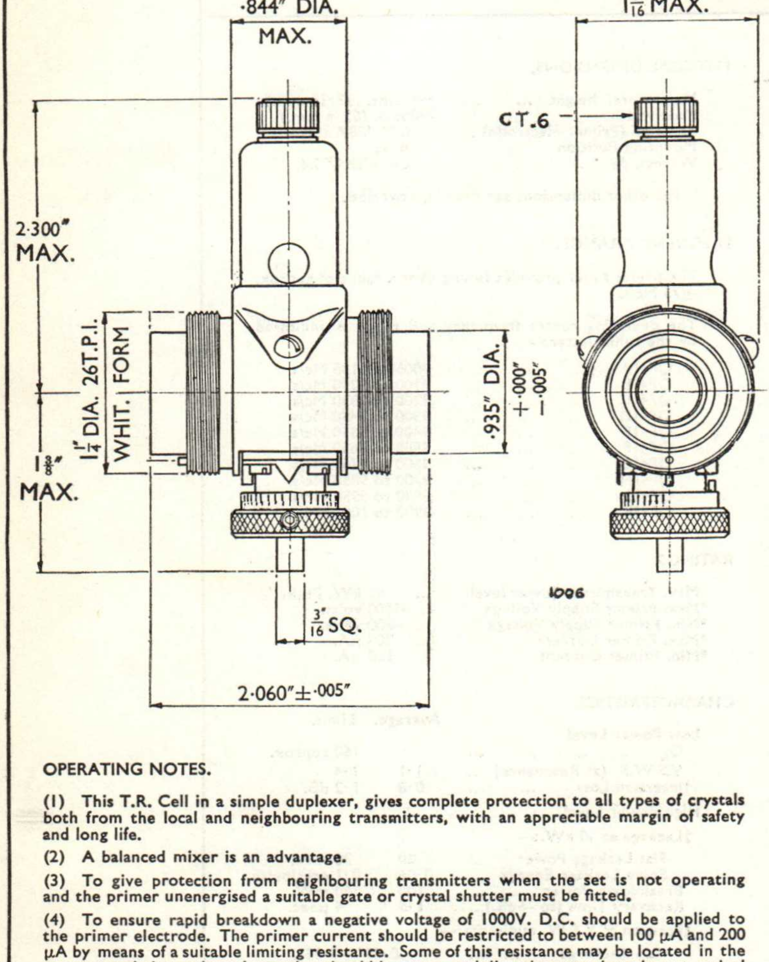
*See note (4) under 'Operating Notes' overleaf.
†Primer energised.
‡1 μsec. pulses.
§Measured from the input edge of the cell. See note (5) under 'Operating Notes' overleaf.

Issue 5.
Nov., 1959.

Ferranti

**QF42A to QF42K**

Ferranti




**OPERATING NOTES.**

(1) This T.R. Cell in a simple duplexer, gives complete protection to all types of crystals both from the local and neighbouring transmitters, with an appreciable margin of safety and long life.

(2) A balanced mixer is an advantage.

(3) To give protection from neighbouring transmitters when the set is not operating and the primer unenergised a suitable gate or crystal shutter must be fitted.

(4) To ensure rapid breakdown a negative voltage of 1000V. D.C. should be applied to the primer electrode. The primer current should be restricted to between 100 μA and 200 μA by means of a suitable limiting resistance. Some of this resistance may be located in the power supply but at least 1 megohm should be connected directly on to the primer terminal to prevent relaxation oscillations. It is advisable to arrange that the keep-alive current is passing for a few seconds before the transmitter begins to operate.

(5) The position of the V.S.W. minimum has two alternative values, depending on whether a window discharge occurs or not, but in either case the crystal protection is not affected. Transition of the V.S.W. minimum from the cones to the window takes place under the following conditions:—

At 8·7 kW. approx. with a pulse width of 1 μsec. and a P.R.F. of 1000.
At 10·4 kW. approx. with a pulse width of 1 μsec. and a P.R.F. of 500.
At 17 kW. approx with a pulse width of 0·1 μsec. and a P.R.F. of 1000.

# FERRANTI

QF50

## T.R. CELL

Type QF50 is a tuneable T-R Cell for operation in the Q band.

PHYSICAL DIMENSIONS.

| | | |
|---|---|---|
| Max. Overall Height ... | ... | 92 mm. (3·625in.). |
| Max. Width over Tuner | ... | 31 mm. (1·220in.). |
| Primer Connection Caps | ... | Type C.T.I. (0.25in. dia.). |

For other dimensions see drawings overleaf.

CHARACTERISTICS.

**Low Level Characteristics.**

| | |
|---|---|
| Loaded 'Q' ... ... ... | 150 max. |
| V.S.W.R. ... ... ... ... | 2 max. |
| Tuning Range ... ... | 8·4 to 8·8 mm. |
| Insertion Loss ... ... ... | 2 db. max. |

**High Power Characteristics.**

| | |
|---|---|
| Nominal Peak Power ... ... | 20 kW. |
| Nominal Mean Power ... ... | 8 watts. |
| Leakage { Spike ... ... ... | 0·045 e/p. max. |
| Leakage { Flat ... ... ... | 25 mW. max. |
| Recovery Time to 3 db. ... ... | 2 μsecs. max* |
| Recovery Time to 1 db. ... ... | 4 μsecs. max. |

**Primer Characteristics.**

| | |
|---|---|
| Primer Supply Voltage ... ... | –2 kV. |
| *Primer Current ...... ...... | 50 to 75 μamps. |

*The primer electrodes should be fed from a source maintained at a negative potential of 2,000 volts DC. The primer current should be restricted to a value between 50 and 75 μA. by employing suitable limiting resistors. Some of this resistance may be located in the power supply but at least 2 megohms must be connected directly on to each primer terminal to prevent relaxation oscillations.

Issue 2
Dec. 1958

FERRANTI

QF50

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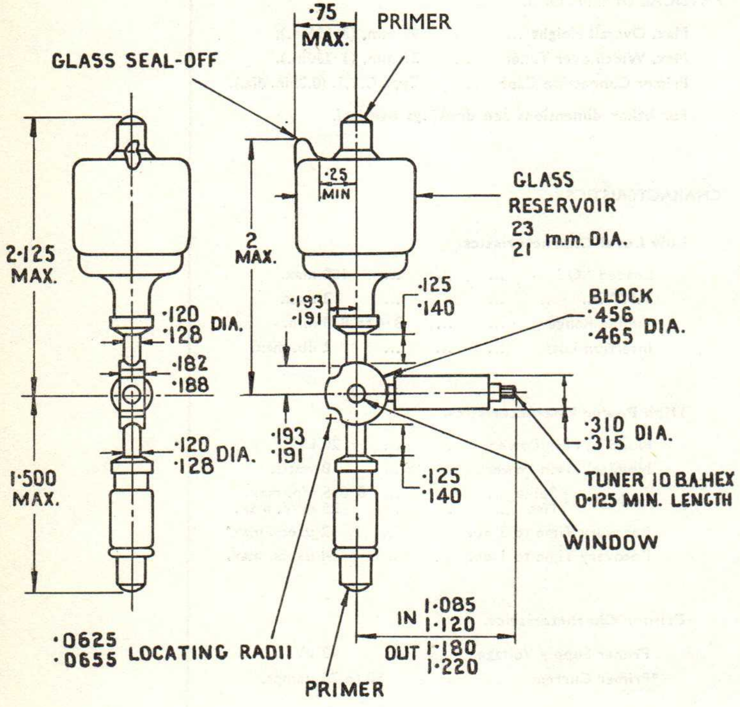


Note:

Maximum displacement of tuning mechanism is 2° with cell held against either face and held on locating radii.

Ferranti

# KLYSTRON

A High Power Amplifier Klystron designed for CW operation in the 3 cm. waveband.

## PHYSICAL DETAILS.

| | |
|---|---|
| Electrode Connections | See Drawing. |
| Overall Length ... ... | 296 mm. (11 21/32 in.). |
| For other dimensions see outline drawing on Page 3. | |
| Output Waveguide ... | Rect. 1in. × ½in. I.D. |
| Input Waveguide ... | Rect. 1in. × ½in. I.D. |
| Water Connections : | |
| Block ... ... | To B.S.S. 659 for ¼" bore. |
| Collector ... ... | To B.S.S. 659 for ½" bore. |
| Mounting Position ... | Vertical with Cathode uppermost. |

## HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 4·5 to 6·0 volts. |
| Heater Current ... ... ... | 10 to 10·5 Amps. |
| *Minimum Heating Delay Time ... | 5 minutes. |

## RATINGS.

| | |
|---|---|
| Max. Beam Voltage ... ... ... | 14 kV. |
| Max. Beam Current ... ... ... | 850 mA. |
| †Min. Power Output ... ... ... | 1800 watts. |

## FREQUENCY.

| | |
|---|---|
| ‡Operating Frequency ... | 8700 – 10,000 Mc/s. |
| Tuning Range ... ... | 45 Mc/s. ± 10 Mc/s. |

## WATER COOLING for operation at :—

| | 1 kw. | 2 kw. | |
|---|---|---|---|
| Minimum Water flow through Block at 20°C. ... ... | 1·0 | 2·0 | litres/min. |
| Pressure drop through Block at above flow ... ... | 0·6 | 1·2 | lbs./sq.in. |
| Minimum Water flow through Collector at 20°C. ... | 2·5 | 5·0 | litres/min. |
| Pressure Drop through Collector at above flow ... ... | 0·1 | 0·4 | lbs./sq.in. |

## §AIR COOLING of Output Window

| | | | |
|---|---|---|---|
| Min. Air Flow at 20°C. ... | 0·5 | 1·0 | litres/sec. |

## TYPICAL OPERATION AND CHARACTERISTICS.

| | | | |
|---|---|---|---|
| Beam Voltage | 9·4 to 10·6 | 12·8 to 13·6 | kV. |
| Beam Current | 450 to 550 | 720 to 790 | mA. |
| Focus Voltage | –200 to –450 | –300 to –700 | volts. |
| Focus Current | <0·5 | <0·5 | mA. |
| Output Power | 1000 | 2000 | watts. |
| Efficiency | 19 to 22 | 19 to 22 | % |
| R.F. Gain : | | | |
| High Level | 10·5 to 12·5 | 12 to 14 | dB. |
| Low Level | 12 to 14 | 17 to 18·5 | dB. |
| Phase Variation of Output with Beam Voltage | 1·3 | 1·5 | radians/kV. |
| Loss Current : | | | |
| No. R.F. | ≯10 | ≯10 | % of beam current. |
| Optimum R.F. Drive | <150 | <200 | mA. |

*See Notes on Operation (2) overleaf.

†At Beam Voltage = 14 kV.

‡Valves can be supplied tuned to any frequency within this range.

§Drawings of the necessary wave guide cooling section will be supplied on request.

Issue 2.
May, 1960

Ferranti

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NOTES ON OPERATION.

1. The heater voltage should be gradually increased until a steady current within the specified range is obtained.

2. The valve has no getter and therefore when first installed or after more than two or three weeks shelf life it is advisable to run the heater for about half an hour before applying H.T. which should then be raised slowly (approx. 4 kV/min.) checking that reasonable focus is obtained. On other occasions when this procedure is unnecessary the warm up time from switching on of heaters to full power is about 5 minutes. During this heating period the heater current should not exceed 13 Amps.

3. The cavity block and collector are insulated from each other, therefore current taken by the block can be measured separately. This current should not exceed 200 mA. and an H.T. trip set to operate at 200mA. is a useful safeguard against H.T. flashover.

4. It is recommended that a pressure type water flow relay should be fitted in the collector drain pipe, in order to break the H.T. supply in the event of cooling water supply failure, otherwise the beam will rapidly puncture the collector if such a failure occurs.

5. Care should be taken not to exceed 2 : 1 V.S.W.R. in the output circuit, otherwise the output window may puncture.

6. The following precautions should be taken to avoid internal damage to the cathode or focus electrode in the event of flashover when the valve is first run :—

   (a) Connect a resistor of not less than 75 ohms in series with the mains H.T. feed to the cathode.

   (b) Limit the focus electrode to cathode potential in the event of breakdown to less than 1000 volts. This can be readily achieved by series connected neon discharge tubes across the focus electrode supply.

   (c) It is also advisable to connect a series resistor (approx. $10k\Omega$) between the focus electrode and its supply potentiometer and to decouple the latter to cathode with a capacitor of $1\mu F$.



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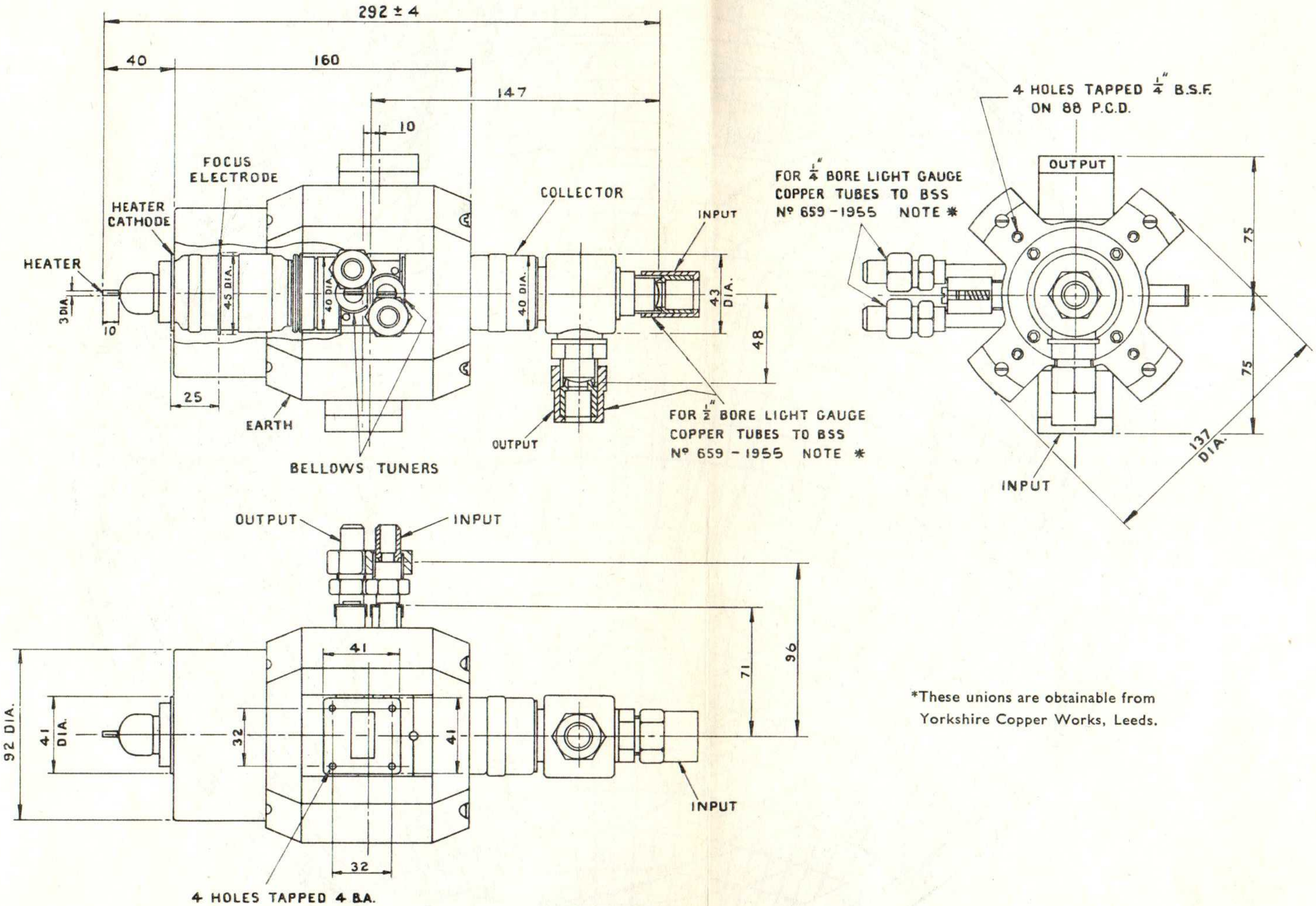


*These unions are obtainable from Yorkshire Copper Works, Leeds.

Dimensions shown are in millimetres

Issue 2.
May, 1960

Ferranti



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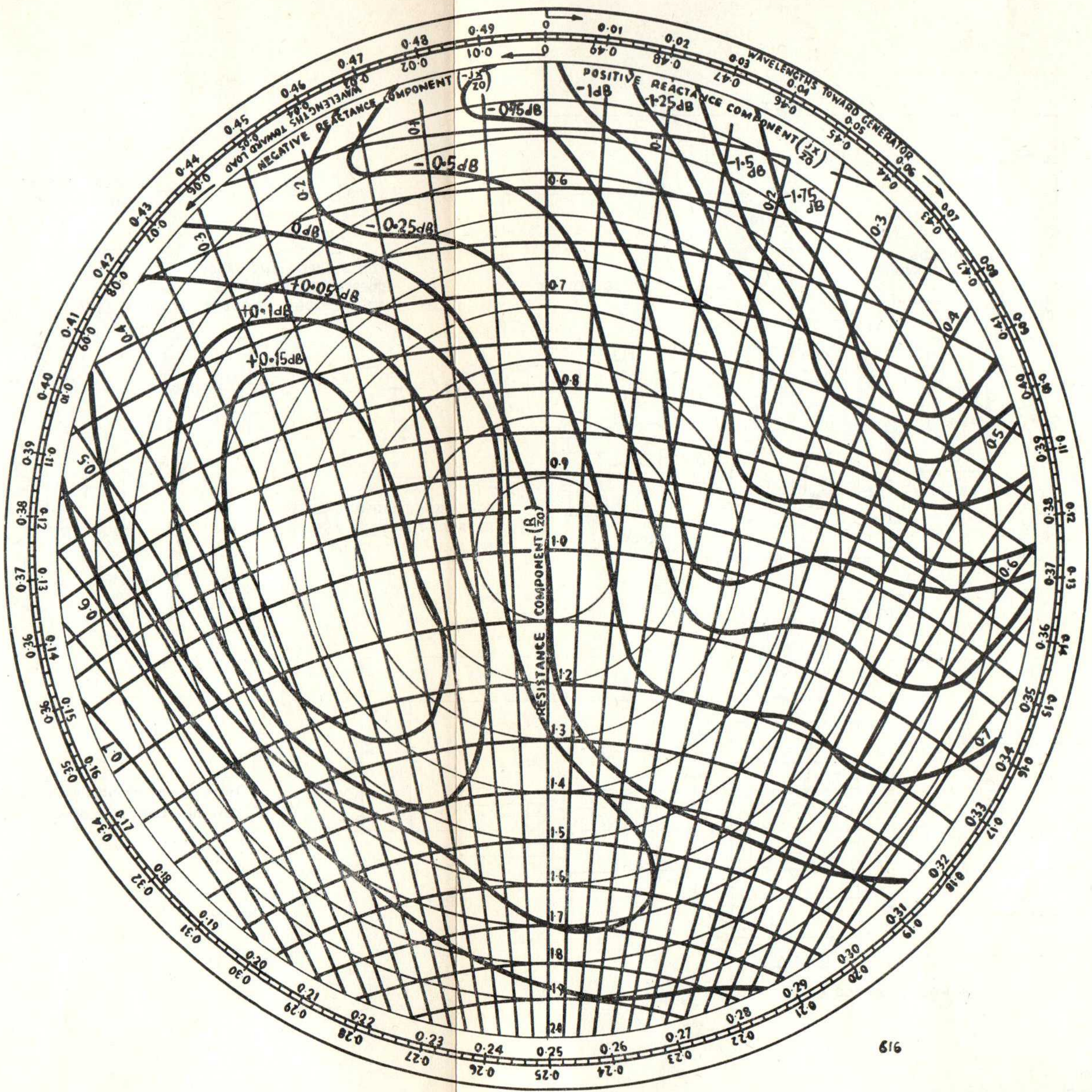
RIEKE DIAGRAM




Beam Voltage = 10kV
Beam Current = 500mA
OdB = 1kW

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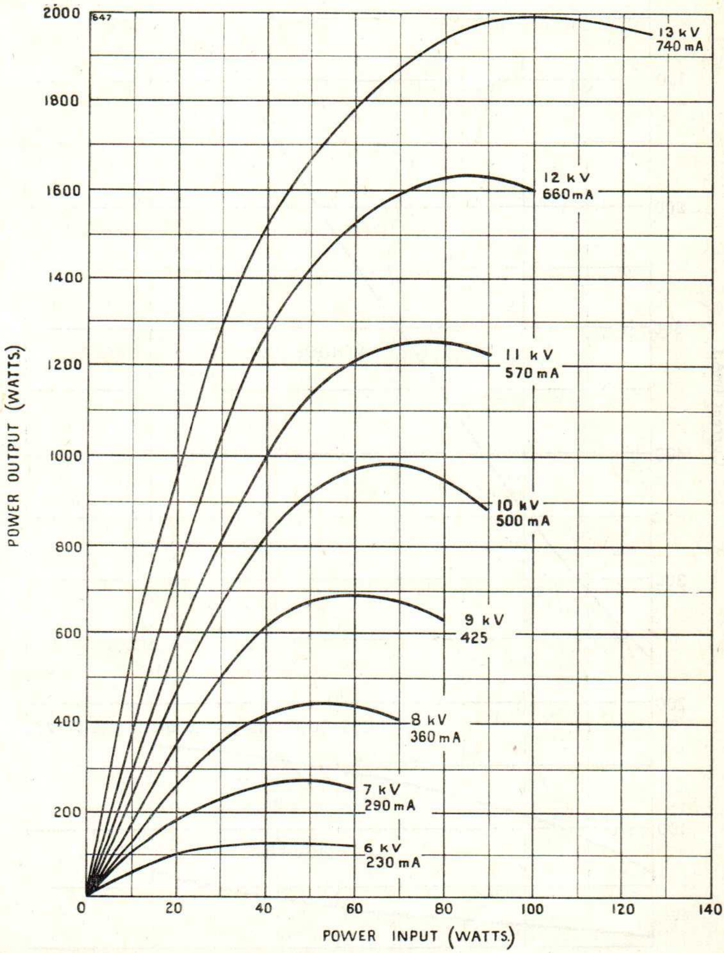
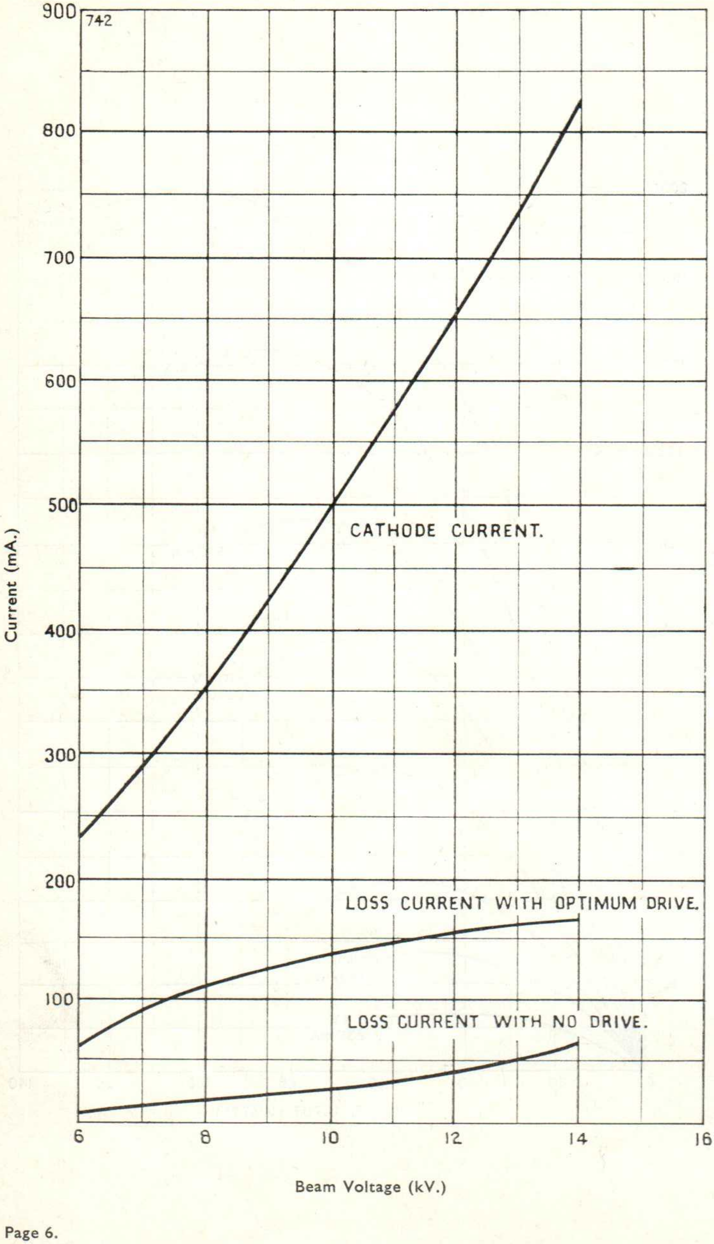



Issue 2
May, 1960

Ferranti






FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

# FERRANTI
## KLYSTRON

SY30

A water-cooled two resonator low noise rugged Klystron Power Amplifier with a gain of 10dB intended for C.W. operation. It is designed to be driven by an oscillator type SZ21, under which condition the power output will be in the range 150-200W. The valve has rugged tuners capable of $\pm$ 20 Mc/s. tuning range which are intended to be used for tuning the cavities up to any one SZ21.

Tentative Data.

PHYSICAL DETAILS.

| | |
|---|---|
| Overall Length ... ... ... | 185 mm. ($11\frac{1}{4}$in.). |
| For other dimensions see outline drawing. | |
| Output Waveguide ... ... | WG16 coupling to |
| Input Waveguide ... ... | I.S.S. choke flanges. |
| Water Connections ... ... | $\frac{1}{8}$in. gas thread. |

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 5 to 7·0 volts. |
| Heater Wattage ... ... ... | 19–21 watts. |

RATINGS.

| | |
|---|---|
| Max. Beam Voltage ... ... | 10·0 kV. |
| Max. Beam Current ... ... | 260 mA. |
| Max. Focus Voltage ... ... | 50 volts. |

FREQUENCY.

| | |
|---|---|
| *Operating Frequency ... ... | 9500 Mc/s. |
| Tuning Range ... ... ... | $\pm$20 Mc/s. |

WATER COOLING.

| | |
|---|---|
| †Minimum Water flow at 20°C. | 1·0 Litre/min. |

TYPICAL OPERATION AND CHARACTERISTICS.

| | | | | | |
|---|---|---|---|---|---|
| Beam Voltage | ... ... ... | | 8 | kV. |
| Beam Current | ... ... ... | | 150 | mA. |
| Focus Voltage | ... ... ... | | –25 | volts. |
| Efficiency | ... ... ... | | 17 | % |
| R.F. Gain ... | High Level ... | | 10 | dB. |
| | Low Level ... | | 14 | dB. |
| Input Power | ... ... ... | 15 | 25 | watts. |
| ‡Output Power | ... ... ... | 175 | 200 | watts. |

NOTES ON OPERATION.

1. The heater voltage should be gradually increased until a steady current within the specified range is obtained.
2. It is recommended that a pressure type water flow relay should be fitted in the drain pipe, in order to break the H.T. supply in the event of cooling water supply failure, otherwise the beam will rapidly puncture the colletor if such a failure occurs.
3. Care should be taken not to exceed 2 : 1 V.S.W.R. in the output circuit, otherwise the output window may puncture.
4. The following precautions should be taken to avoid internal damage to the cathode or focus electrode in the event of flashover when the valve is first run : the focus electrode to cathode potentials should be limited in the event of breakdown to less than 500 volts. This can be readily achieved by series connected neon discharge tubes across the focus electrode supply.

*Valves can be supplied tuned to any "X" band frequency by arrangement.

†Water input must be to collector end union.

‡At 9500 Mc/s.—F.
Bandwidth : to 3 dB points—18·5 Mc/s.
to 1 dB points— 10 Mc/s.

Issue 1
Dec., 1957
(Tentaive)

FERRANTI

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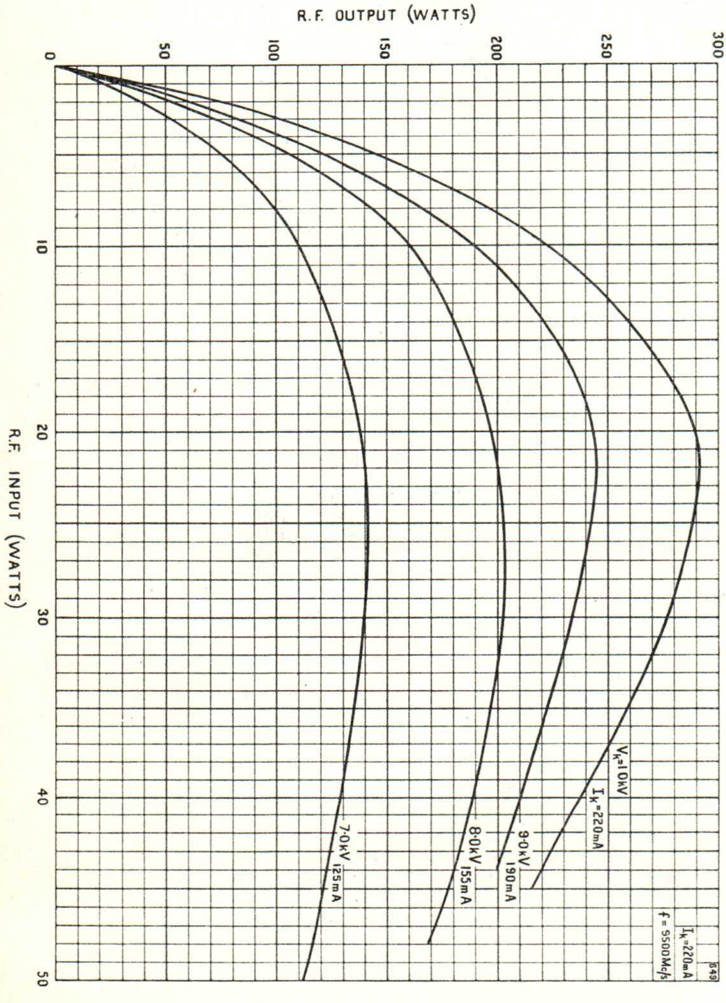
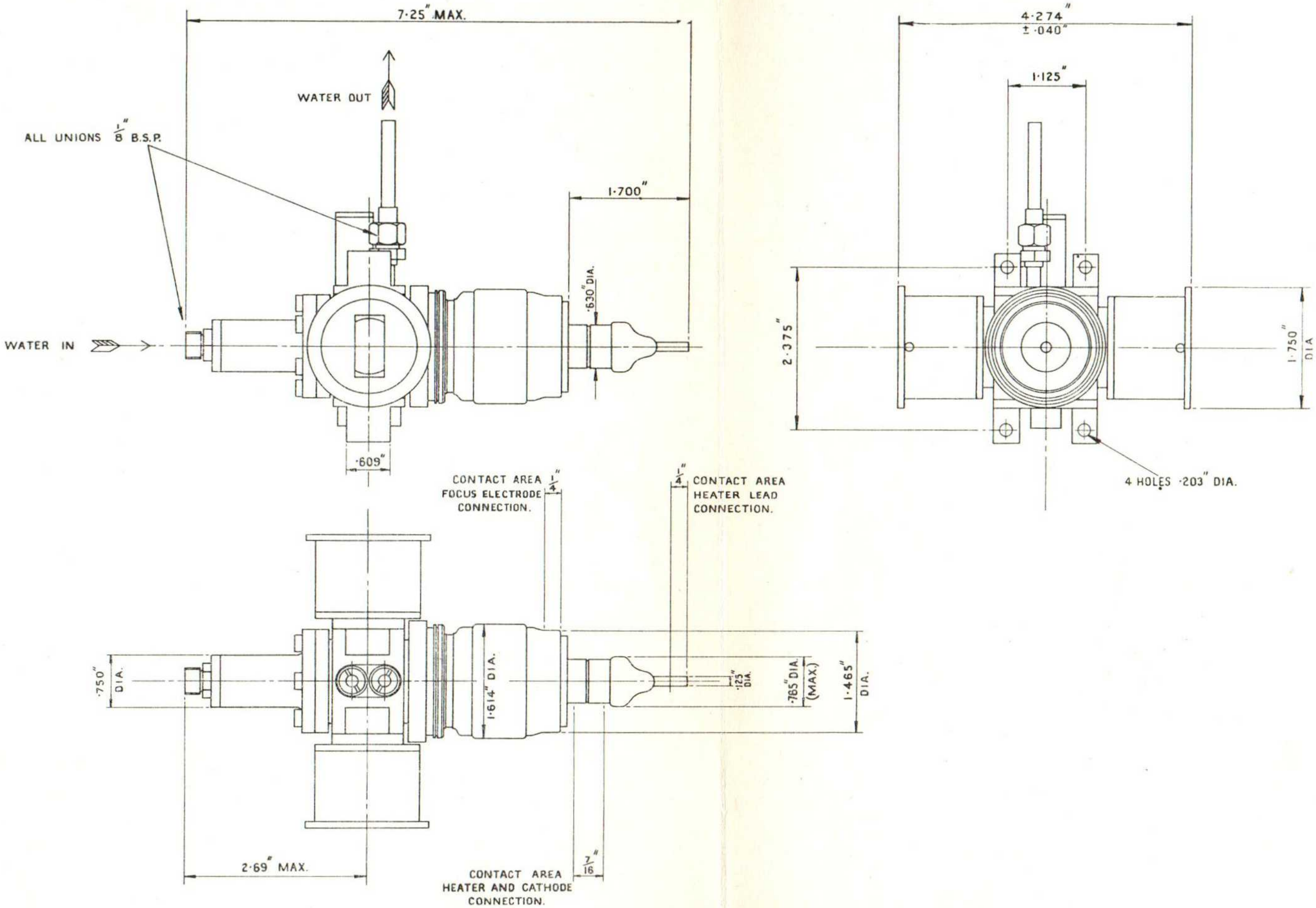

R.F. OUTPUT (WATTS)
0
50
100
150
200
250
300
R.F. INPUT (WATTS)
10
20
30
40
50
7·0kV 125mA
8·0kV 155mA
9·0kV 190mA
$V_K$=10kV
$I_K$=220mA
$I_K$=220mA
f = 9500Mc/s
849



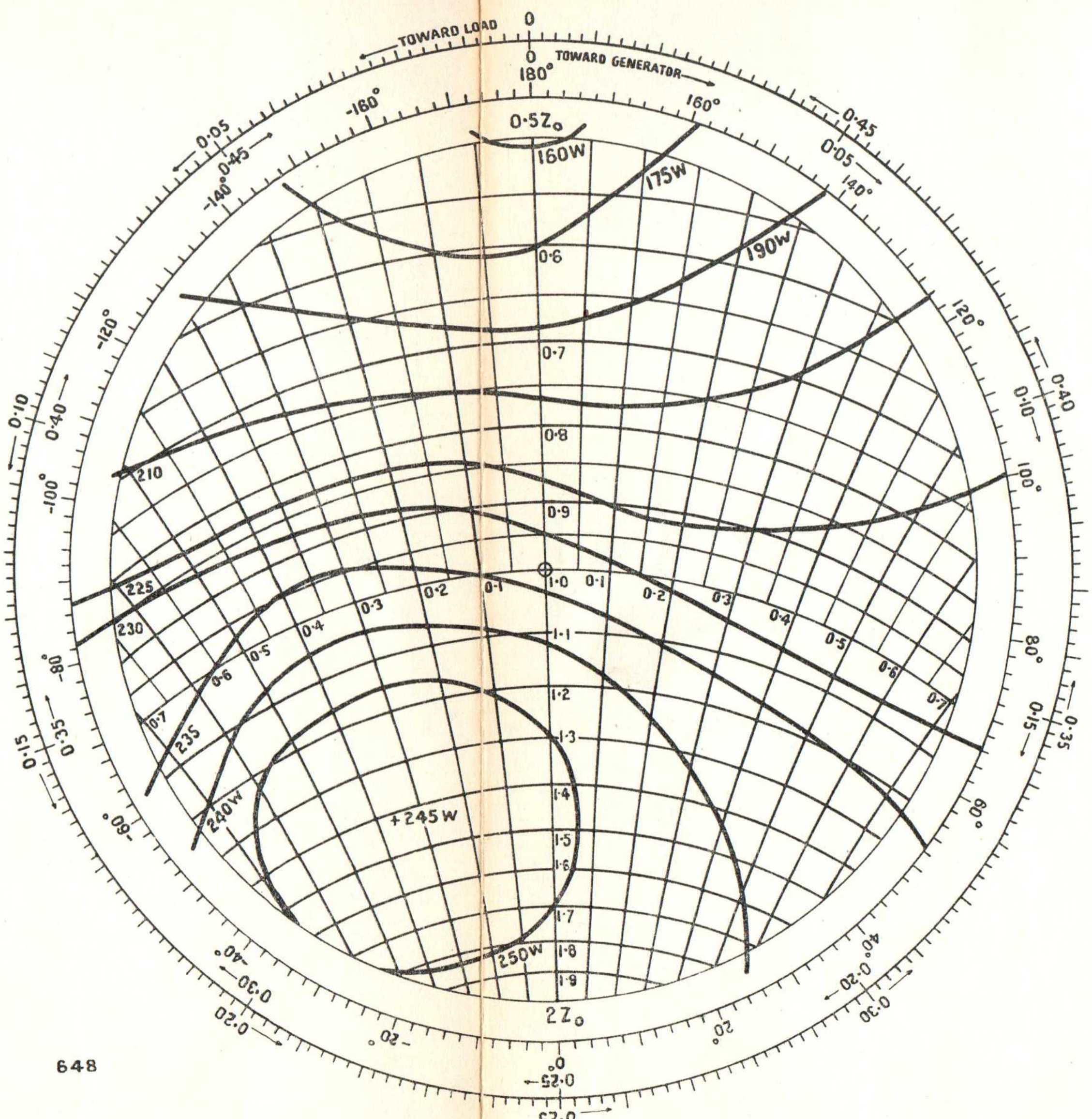

All dimensions shown are in millimetres (max.).

Issue 1
Dec., 1957
(Tentative)



FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

RIEKE DIAGRAM

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FERRANTI

Beam Voltage = 8 kV.
Beam Current 150 mA.
Drive Power for max. power output in matched conditions.
180° corresponds to the plane of output flange.

Ferranti

# KLYSTRON

A water-cooled two resonator low noise rugged Klystron Power Amplifier with a gain of 10dB intended for C.W. operation. It is designed to be driven by an oscillator type SZ22, under which condition the power output will be in the range 150-200 W. The valve has rugged tuners with a ±20 Mc/s. tuning range which is intended to be used for tuning the cavities to match any SZ22.

## PHYSICAL DETAILS.

| | |
|---|---|
| Max. Overall Length ... ... | 7·25″ (184·5 mm.). |
| Max. Overall Width ... ... | 4·314″ (109·5 mm.). |

For other dimensions see outline drawing on Page 3.

| | |
|---|---|
| Output Waveguide ... ... | WG16 coupling to I.S.S. choke flanges |
| Input Waveguide ... ... | WG16 coupling to I.S.S. choke flanges |
| Water Connections ... ... | ⅛″ B.S.P. Unions. |

## HEATER.

| | |
|---|---|
| Heater Power ... ... | 20 to 27 Watts. |
| Heater Resistance at 23·5 watts. ... | 2·35 to 2·65 Ohms. |
| Cold Heater Resistance ... | 0·2 Ohms. |
| Max. switch-on surge current ... | 9 Amps. |

## RATINGS.

| | |
|---|---|
| Max. Beam Voltage ... ... | 10·0 kV. |
| Max. Beam Current ... ... | 260 mA. |
| Max. Focus Voltage ... ... | 50 volts. |

## FREQUENCY.

| | |
|---|---|
| †Operating Frequency ... ... | 9500 Mc/s. |
| Tuning Range ... ... ... | ±20 Mc/s. |

## WATER COOLING.

‡Minimum Water flow at 20°C.... 1·0 Litre/min.

## TYPICAL OPERATION AND CHARACTERISTICS.

| | | | | |
|---|---|---|---|---|
| Beam Voltage ... ... ... | | 8 | | kV. |
| Beam Current ... ... ... | | 150 | | mA. |
| Focus Voltage ... ... ... | | −25 | | volts. |
| Efficiency ... ... ... ... | | 17 | | % |
| R.F. Gain ... High Level ... | | 10 | | dB. |
| Low level ... | | 14 | | dB. |
| Input Power ... ... ... | 15 | | 25 | watts. |
| §Output Power ... ... ... | 175 | | 200 | watts. |

## NOTES ON OPERATION.

1. It is recommended that a pressure type water flow relay should be fitted in the drain pipe, in order to break the H.T. supply in the event of cooling water supply failure, otherwise the beam will rapidly puncture the collector if such a failure occurs.
2. Care should be taken not to exceed 2:1 V.S.W.R. in the output circuit, otherwise the output window may puncture.
3. To avoid internal damage to the cathode or focus electrode in the event of flashover when the valve is first run, the focus electrode to cathode potential should be limited in the event of breakdown to less than 500 volts. This can be readily achieved by series connected neon discharge tubes across the focus electrode supply.

*Over the operating heater power range the heater resistance R series with the heater power W according to the law $R \propto \sqrt{W}$.

†Valves can be supplied tuned to any "X" band frequency by arrangement.

‡Water input must be to collector end union.

§At 9500 Mc/s.
Bandwidth: to 3 dB points—18·5 Mc/s.
to 1 dB points—10 Mc/s.

Issue 1.
Mar., 1962

Ferranti

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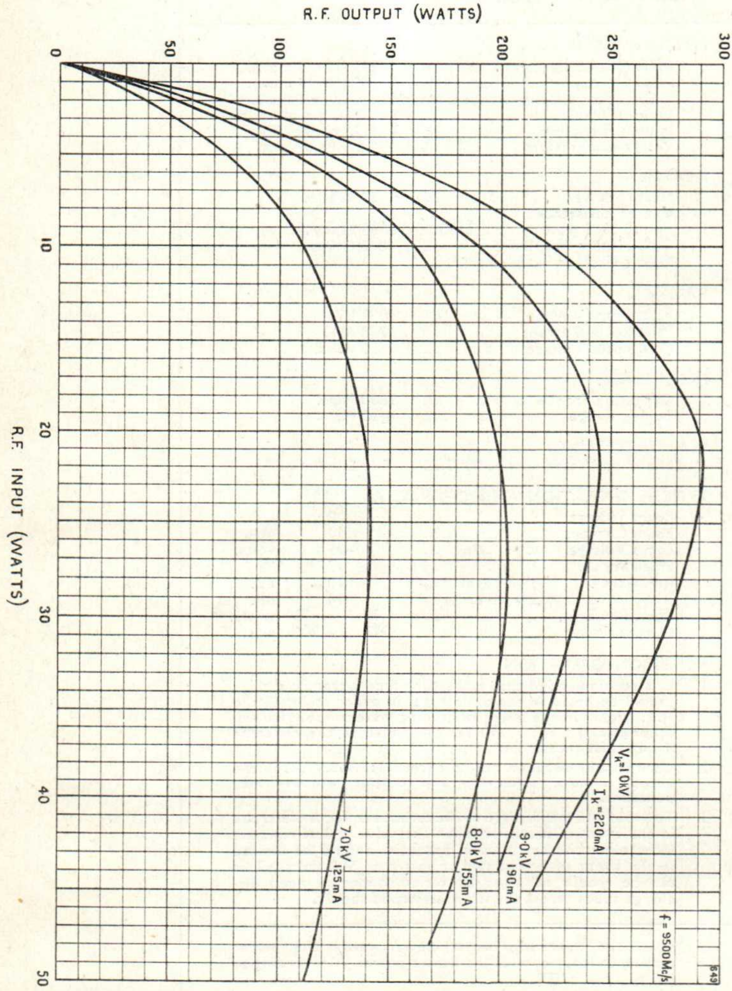
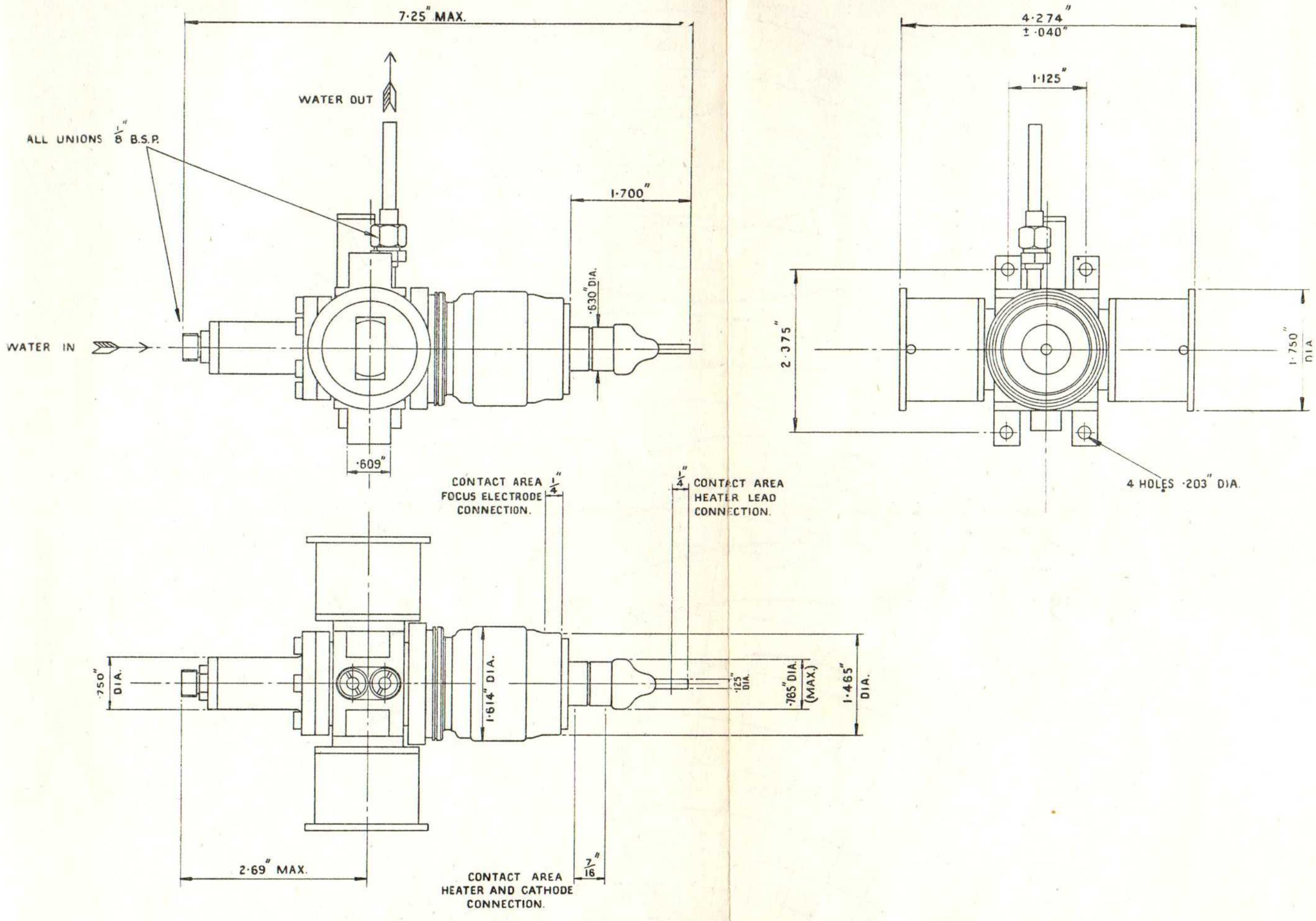
## TYPICAL RF INPUT/OUTPUT CHARACTERISTICS.

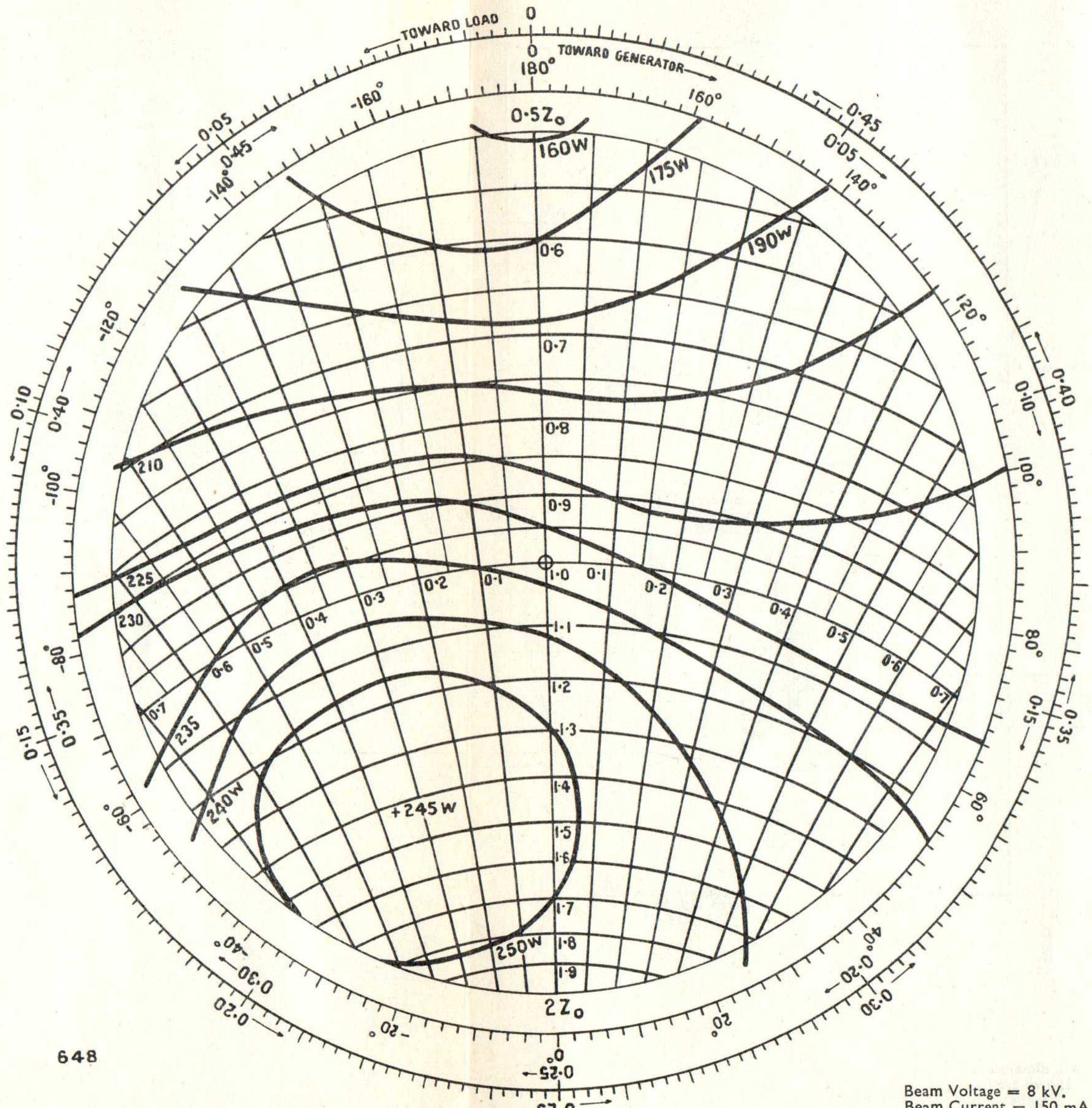





All dimensions shown are in inches

Issue 1.
Mar. 1962.

RIEKE DIAGRAM




Beam Voltage = 8 kV.
Beam Current = 150 mA.
Drive Power for max. power output in matched conditions.
180° corresponds to the plane of the output flange.

Ferranti

# KLYSTRON

A High Power 4 Cavity Broad Band Amplifier Klystron for CW operation at 'X' Band frequency.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | None. |
| Overall Length (valve) ... | 14″ (356 mm.) |
| Overall Length (Magnet Assembly) ... ... | 17⅜″ (442 mm.) |
| *Output Waveguide... ... | Rect. 1·122″×0·497″ I.D. |
| *Input Waveguide ... ... | Rect. 1·122″×0·497″ I.D. |

For other dimensions see drawing on Page 3.

| | |
|---|---|
| Water Connections ... | ½ B.S.P. Unions. |
| Mounting Position ... ... | Vertical—Cathode end down |
| Weight (in permanent magnet assembly) ... ... | 90 lbs. |

HEATER.

| | |
|---|---|
| Heater Power ... | 27·6 to 37·2 Watts |
| Heater Resistance at 32 watts ... | 3·1 to 3·4 Ohms |
| Cold Heater resistance ... | 0·2 Ohms |
| †Max. switch-on surge current | 9 Amps |
| ‡Min. heating delay time ... | 3 Mins |

RATINGS.

| | |
|---|---|
| Maximum Beam Volts ... | 13 kV |
| Maximum Beam Current ... | 700 mA |
| Maximum Power Output ... | 3 kW |

FREQUENCY.

| | |
|---|---|
| **Operating Frequency | 8000—9000 Mc/s |
| ††Valve Bandwidth ... ... | 16 Mc/s |

WATER COOLING.

| | |
|---|---|
| Minimum water flow through block at 20°C. ... ... | 1·5 litre/min |
| Minimum water flow through collector at 20°C. ... | 6 litres/min |
| Pressure drop through block at 1·5 litre/min. ... | 0·5 lbs./sq. in. |
| Pressure drop through collector at 6 litres/min.... | 4 lbs./sq. in. |

Note: The block and collector may be run in series with a 6 litres/min. water flow. The water must enter the block first.

| | |
|---|---|
| Pressure drop through block at 6 litres/min.... ... | 4 lbs./sq. in. |

TYPICAL OPERATION.

| | |
|---|---|
| Beam Voltage ... ... | 13 kV |
| Beam Current ... | 530 to 600 mA |
| §Magnetic Field ... | 1500 to 1700 Gauss. |
| Output Power ... ... | ≮2000 watts |
| Efficiency ... ... | 33 to 38 % |
| R.F. Gain ... ... | 32 to 47 dB |
| Loss current: | |
| No R.F. at 13 kV. ... | ≯3% of beam current. |
| 2 kW. at 13 kV. ... | ≯100 mA |

*Pressure joint to dowelled plate-further details will be sent on request.

†See 'Notes on Operation' (1) overleaf.

‡The time which must elapse after application of full heater volts before the E.H.T. can be run up.

**Valves can be supplied tuned to any frequency in this band.

††See graph on page 4.

§This field can either be supplied by a permanent magnet system or by electromagnet. Details of the electromagnet can be supplied on request.

Issue 1.
April, 1962.

Ferranti

NOTES ON OPERATION.

(1) The heater should either be increased slowly from zero to satisfy the surge current specification, or a resistance should be inserted in series with the supply voltage so that application of this voltage will not produce a surge current greater than the specified figure.

(2) The cavity block and collector are insulated from each other, and, current taken by the block can be therefore measured separately. This current should not exceed 200 mA. An H.T. trip set to operate at 200 mA. is a safeguard against H.T. Flash-over.

(3) Care should be taken not to exceed 2:1 VSWR in the output circuit, otherwise the output window may puncture. A VSWR higher than 2:1 may also make it impossible to obtain the stated output.

(4) A 200 ohms resistor of suitable wattage should be connected in series with the cathode H.T. supply to limit the current drawn in the event of flash-over.

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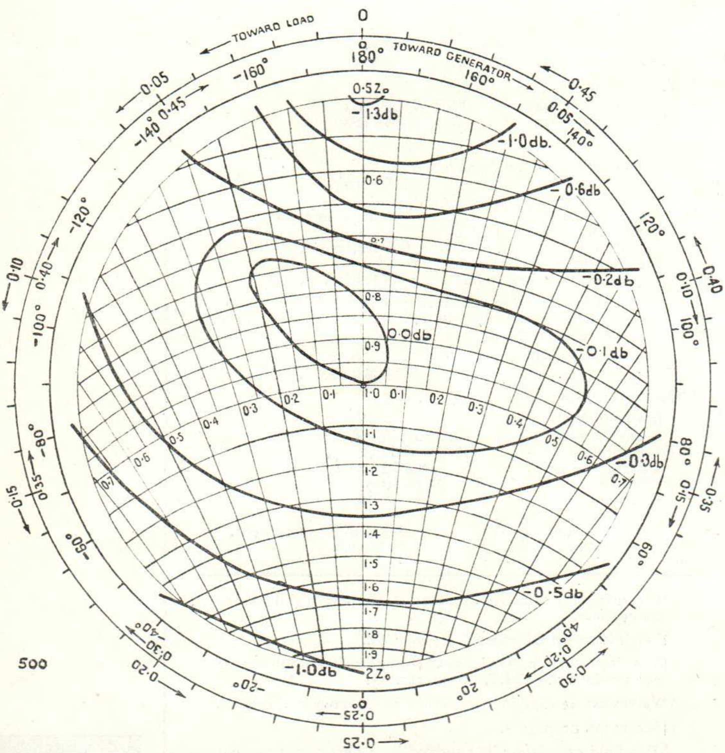
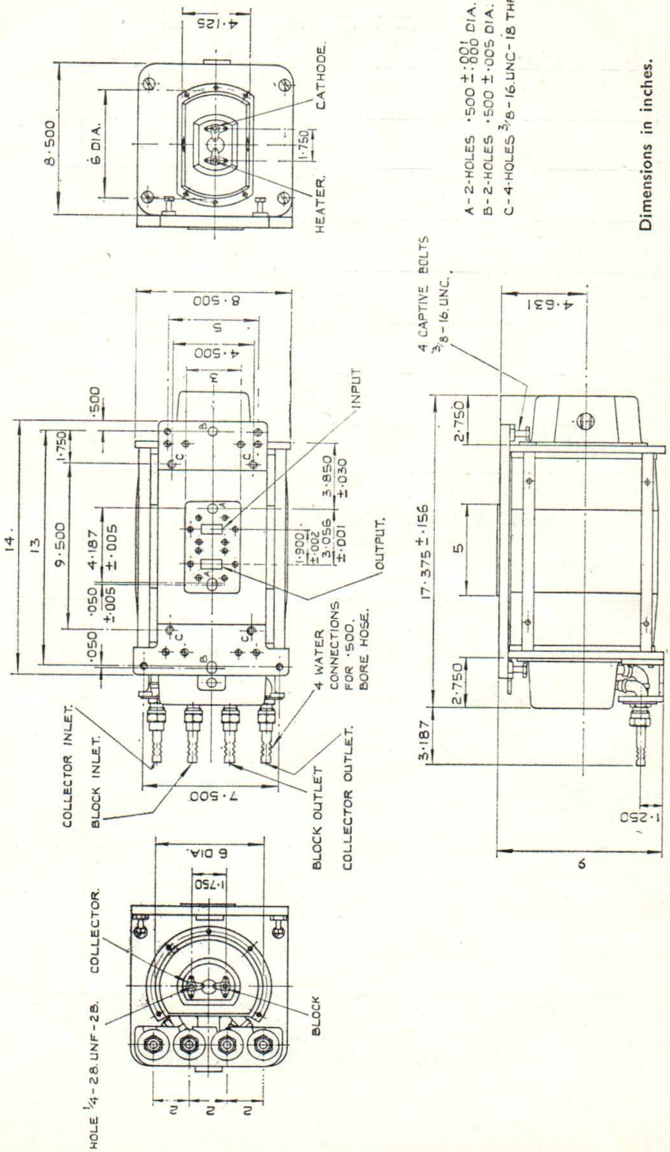
RIEKE DIAGRAM.




500

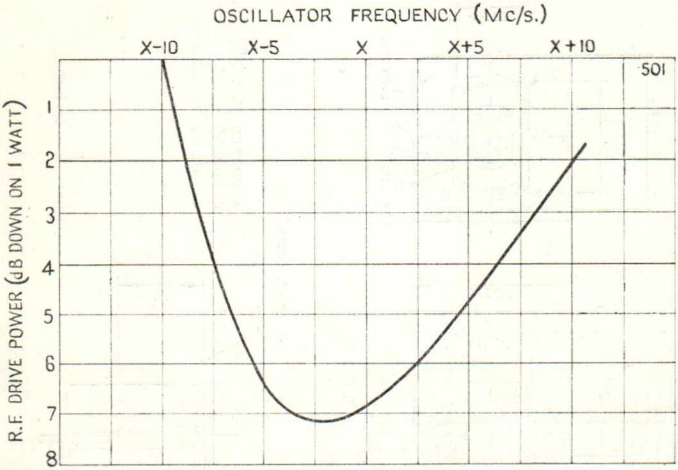


FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

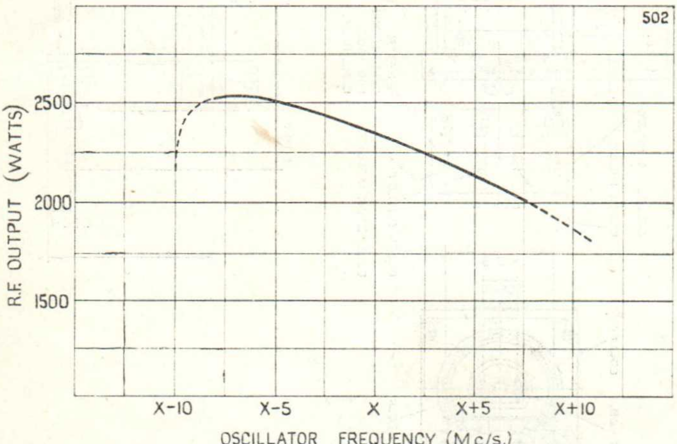



A - 2-HOLES ·500 $^{+\cdot 001}_{-\cdot 000}$ DIA.
B - 2-HOLES ·500 ± ·005 DIA.
C - 4-HOLES 3/8 - 16. UNC - 18 THREAD.

Dimensions in inches.




'X' IS THE TUNED FREQUENCY OF THE SY 41.




'X' IS THE SET FREQUENCY OF THE SY41 IN Mc/s.

Ferranti

# KLYSTRON

A two cavity fixed Tuned Klystron Oscillator for Transmitter operation in the 'X' Band. This valve is designed to minimise the effects of vibration and to withstand heavy acceleration.

PHYSICAL DETAILS.

| | |
|---|---|
| Overall Length ... ... ... | 170 mm. |
| For other dimensions see outline drawings on Page 3. | |
| *Output Waveguide ... ... | W.G. 16–American Type UG39/U. |
| Water Connections ... ... | ⅛in. B.S.P. |
| Mounting Position (Preferred) | Vertical with Cathode down. |
| Weight ... ... ... ... | 1 lb. 10 ozs. 0·73 kg. |

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 7 to 8·5 volts. |
| Heater Input Power ... ... | 15·5 to 21 watts. |
| Heater Resistance at 18w. Input Power ... ... ... | 1·9 to 2·1 ohms. |
| Cold Heater Resistance ... | 0·2 ohms. |
| Max. Heater Switching Surge ... | 8 amps. |

RATINGS.

| | |
|---|---|
| Max. Beam Voltage ... ... | 8·0 kV. |
| Max. Beam Current ... ... | 40 mA. |

FREQUENCY.

| | |
|---|---|
| †Operating Frequency ... ... | 9500±25 Mc/s. |
| Tuning Range ... ... ... | Fixed Tuned. |

WATER COOLING.

The valve is provided with water cooling circuits on both block and collector. With these connected in series a flow of not less than 0·5 litre/min. of water at 25°C. is necessary.

TYPICAL OPERATION AND CHARACTERISTICS.

| | |
|---|---|
| Beam Voltage ... ... ... | 7·2 to 7·8 kV. |
| Beam Current ... ... ... | 30—40 mA. |
| Output Power ... ... ... | 10—20 watts. |
| Beam Voltage at low end of mode | 5·6 to 6·2 kV. |
| §Electronic Tuning Range ... | 2 Mc/s. for 600 volts. ±100 volts. |
| **Frequency Pushing with Beam Voltage ... ... ... | 4·2 kc/s/V. |
| Frequency Pushing with Heater Current ... ... ... | 150 c/s/Amp. |
| ††Frequency Pulling ... ... | 1·1 Mc/s. |
| §§Frequency Drift ... ... ... | <2 kc/s/hour. |
| Temp. Coefficient Frequency ... | 150 kc/s/°C. |
| Microphony ... ... ... | Less than 500 c/s/g. up to 10g. in the range 20—5000 c/s. |
| Shock ... ... ... ... | Shocks up to 150g of 7 milliseconds duration produce no detectable frequency variation. |

*Bolts to UG 40A/U. Choke Flange.

†This is the frequency to which these Klystrons are normally tuned.

†Tubes for operation at other frequencies in the range 8500 to 10,000 Mc/s. can be supplied to special order.

§For a power variation of less than 1dB.

**At optimum power output.

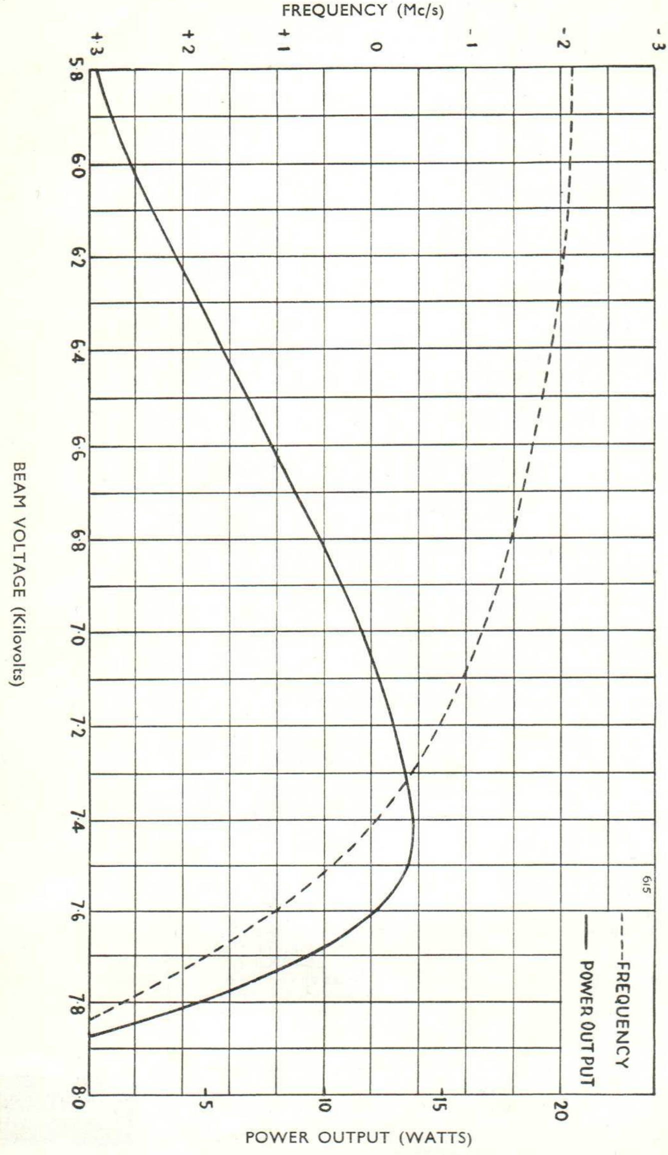
††All phases of V.S.W.R. 1·5:1.

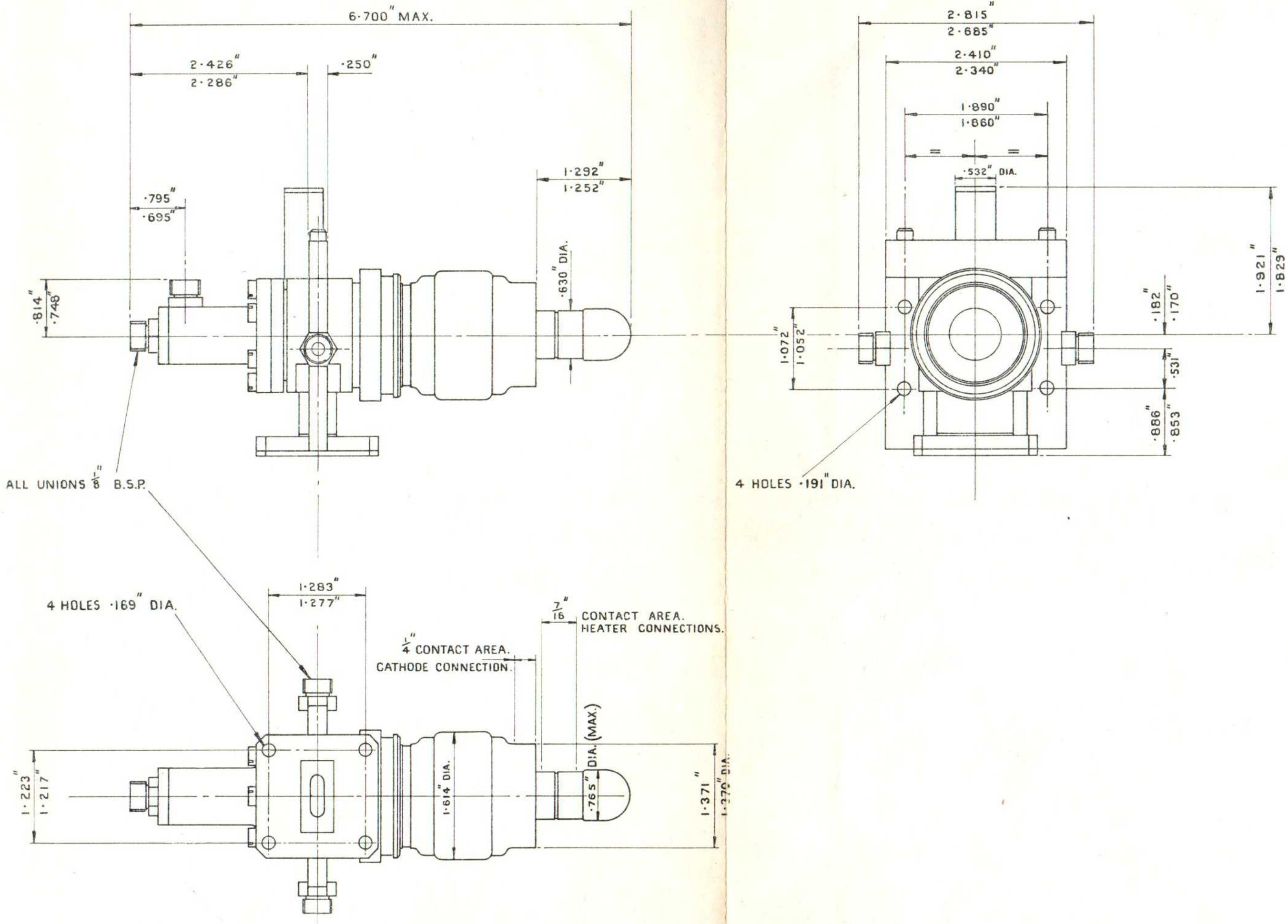
§§At constant temperature.

Ferranti

Issue 1.
Nov., 1961.

Ferranti

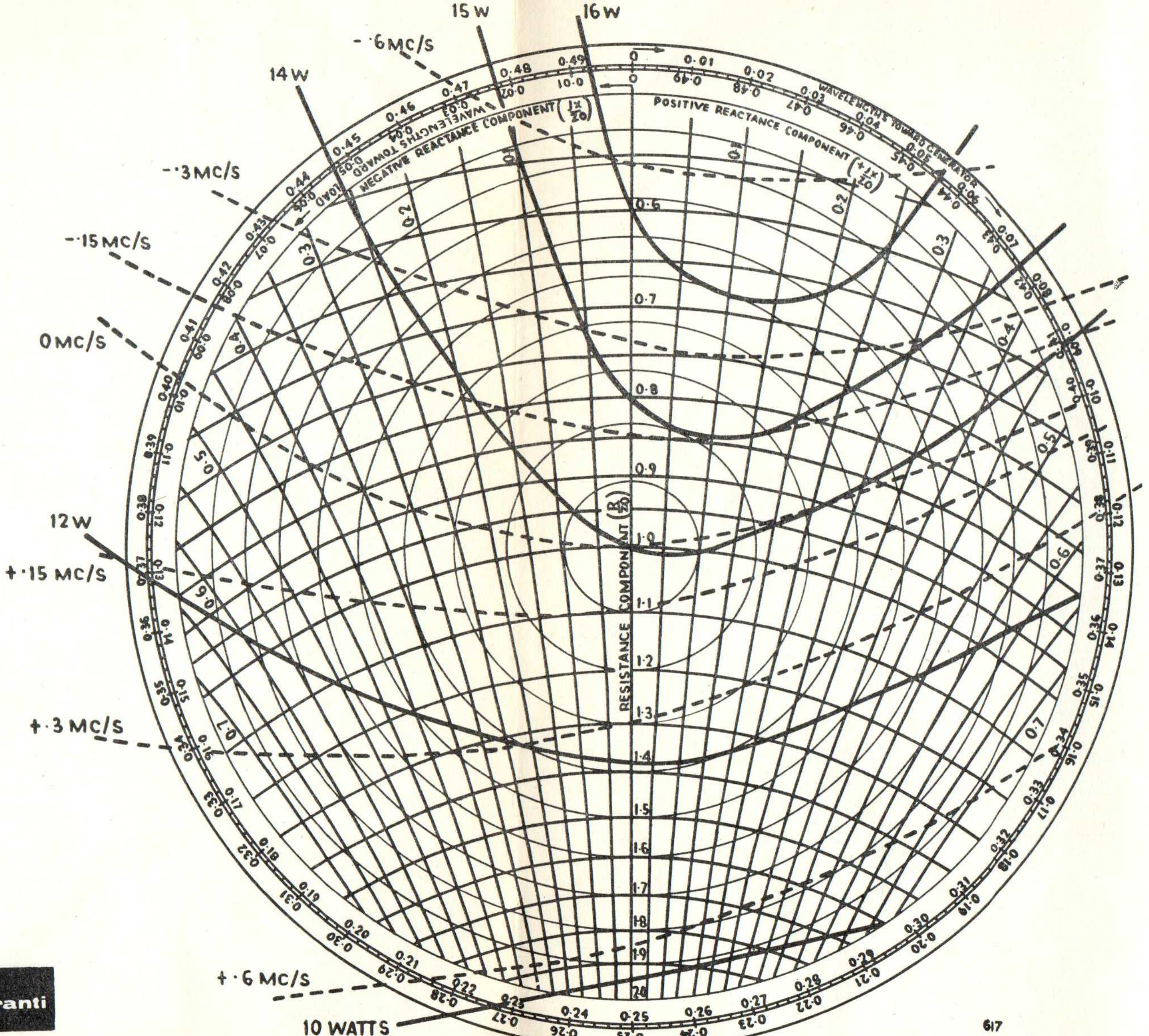

FREQUENCY (Mc/s)
+3
+2
+1
0
-1
-2
-3
BEAM VOLTAGE (Kilovolts)
5·8
6·0
6·2
6·4
6·6
6·8
7·0
7·2
7·4
7·6
7·8
8·0
POWER OUTPUT (WATTS)
5
10
15
20
---FREQUENCY
— POWER OUTPUT




Issue I
Nov., 1961

# SZ22

RIEKE DIAGRAM



Ferranti

## KLYSTRON

A two cavity Tunable Klystron Oscillator for Transmitter operation in the 'X' Band. This valve is designed to minimise the effects of vibration and to withstand heavy acceleration.

### PHYSICAL DETAILS.

| | |
|---|---|
| Max. Overall length ... ... | 8·48ins. (216 mm.) |
| For other dimensions, see outline drawing on page 3. | |
| *Output waveguide ... ... ... | W.G. 15 |
| Water connections thread ... | No. 10–32U.N.F.–2A |
| Mounting position ... ... ... | Any. |
| Weight ... ... ... ... | 1·66 Kg. (3lb. 10oz.) |

### HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 7 to 8·5 volts. |
| Heater Input Power ... ... | 15·5 to 21 watts. |
| Heater Resistance at 18w. Input Power ... ... ... ... | 1·9 to 2·1 ohms. |
| Cold Heater Resistance ... ... | 0·2 ohms. |
| Max. Heater Switching Surge ... | 8 amps. |

### RATINGS.

| | |
|---|---|
| Max. Beam Voltage... ... ... | 8·0 kV. |
| Max. Beam Current ... ... | 40 mA. |

### FREQUENCY.

| | |
|---|---|
| ‡Operating frequency Range ... | 8000—9000 Mc/s. |
| Tuning Range ... ... ... | ± 20 Mc/s. |

### WATER COOLING.

| | |
|---|---|
| Minimum water flow ... ... | 0·3 litre/min. |
| §Maximum water flow ... ... | 3·0 litre/min. |
| Maximum temperature of coolant | 50 °C. |
| Coolant pressure drop at 0·6 litres/min. flow at 10°C. ... ... ... | 0·1 lb./sq. in. |

### TYPICAL OPERATION AND CHARACTERISTICS.

| | |
|---|---|
| Beam Voltage ... ... ... | 6·8—7·4 kV. |
| Beam Current ... ... ... | 28—30 mA. |
| Output Power ... ... ... | 10—20 watts. |
| Electronic tuning range ... ... | |
| Frequency pushing with Beam volts | 3 kc/s./V. |
| Frequency pushing with heater current | 200 c/s./A. |
| Frequency pulling ... ... ... | 4·5 Mc/s. |
| Temperature coefficient of frequency | 150 kc/s./°C. |
| Microphony ... ... ... ... | less than 4000 c/s/g up to 10g in the range 20—200 cycles |
| Shock ... ... ... ... | Up to 150g of 7 millisecs. duration produces no detectable frequency variation. |

---

*Bolts to UG40A/U Choke flange.
‡The operating frequency required should be specified when ordering.
§To avoid microphony due to turbulence in water channels.

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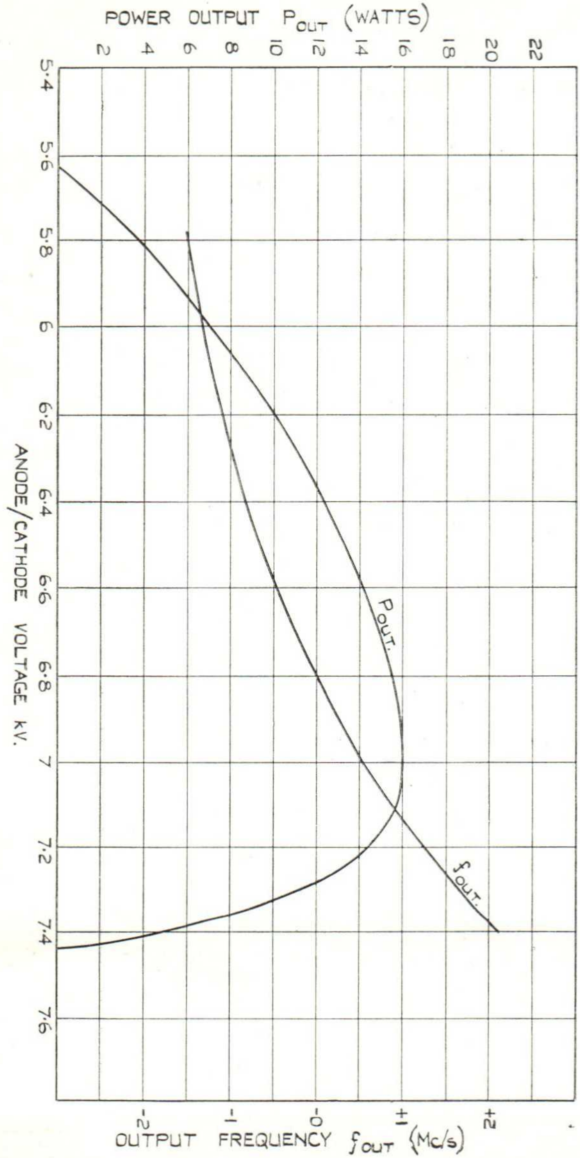
Typical Power Output and Frequency/Anode Voltage Characteristics.



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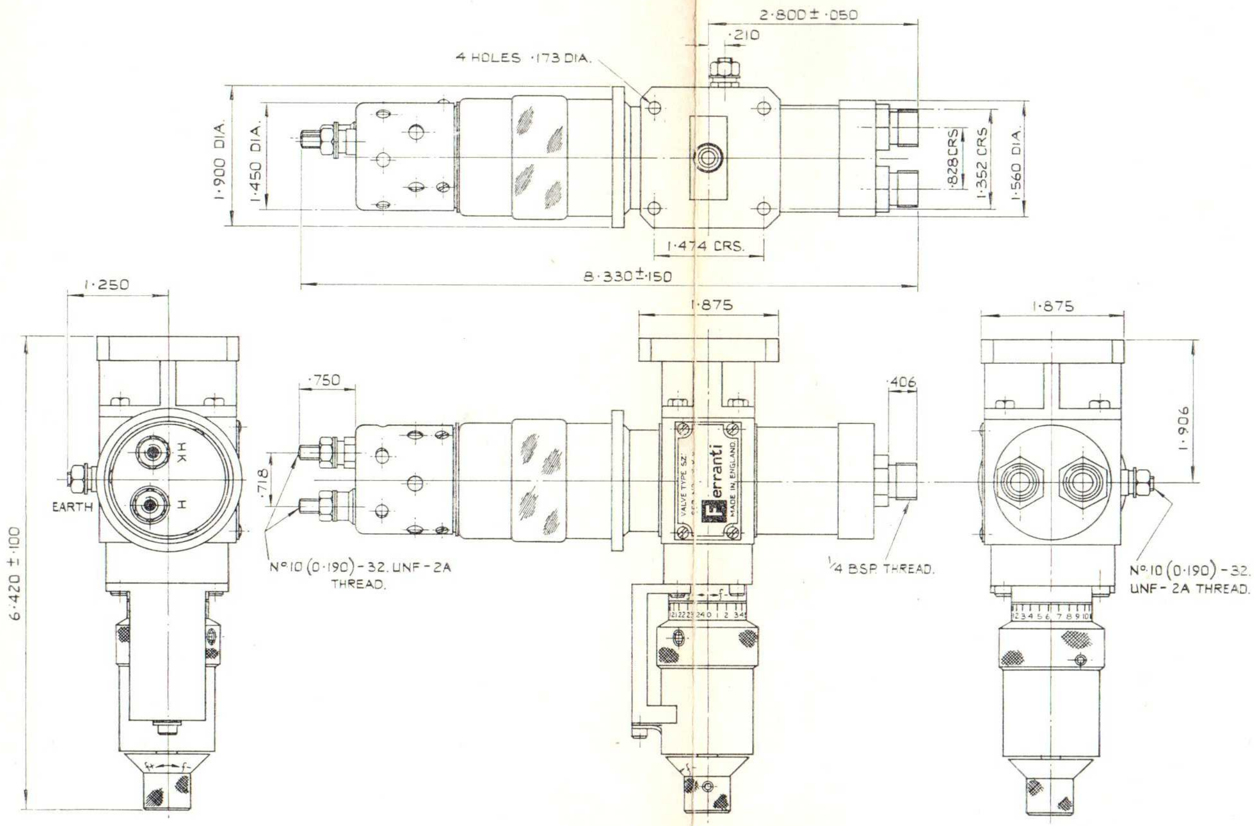


Dimensions in inches.
(Nominal unless otherwise stated.)

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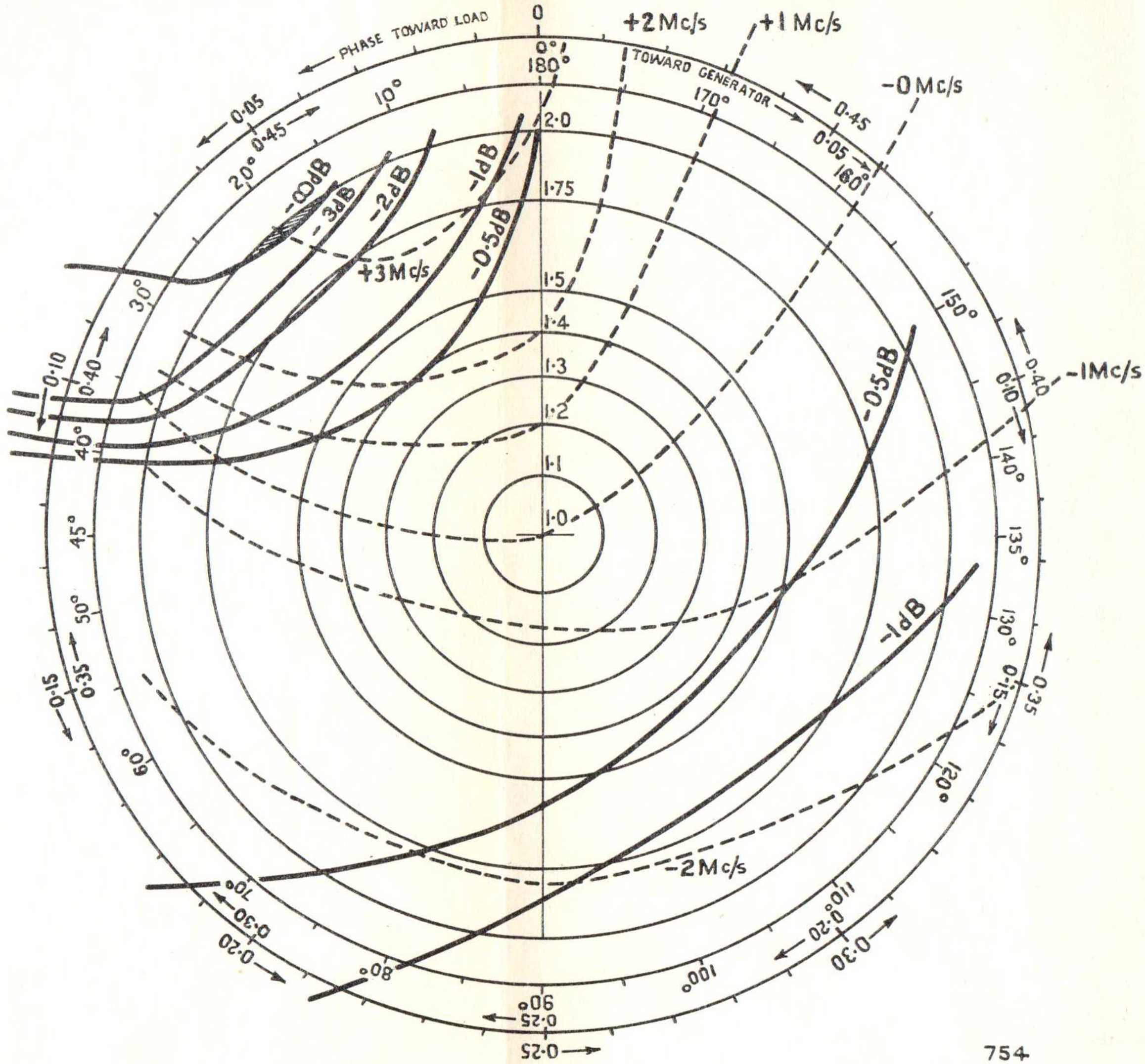
RIEKE DIAGRAM

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Ferranti

# KLYSTRON

A very rugged Reflex Klystron for use as a Local Oscillator. It has been designed to provide extreme stability and reliability in operation under the most severe environmental conditions. It is intended for convection cooling with free air circulation.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... | See Drawings on Page 3. |
| Output Connection ... | Bolts to UG–39/U flange or UG–40A/U choke for W.G.16 |
| Mounting Position ... | Any |
| Weight ... | 6 oz. (180 gm.) approx. |
| Electrode Connections ... | Moulded flying leads. |

## FREQUENCY.

| | |
|---|---|
| Operating Range ... | 9300±300 Mc/s |

## TUNING.

A single screw tuner covers the tuning frequency range in approximately 2¼ turns. For tuner screw settings see the graph on page 5. The average tuner torque is 35 in./oz. (max. 50 in./oz.).

## HEATER.

| | |
|---|---|
| Heater Voltage ... | 6·3 volts |
| Heater Current ... | 1·2±10% amps |

## RATINGS. (All ratings are 'Absolute')

| | |
|---|---|
| Max. Heater Voltage ... | 6·9 volts |
| Min. Heater Voltage ... | 5·7 volts |
| Max. Resonator Voltage ... | 350 volts |
| Max. Resonator Current ... | 60 mA |
| Max. Neg. Reflector Voltage... | 500 volts |
| Max. Vibration... | 20 g |
| Max. Shock (short duration)... | 150 g |
| Max. Altitude for operation ... | 60,000 ft |
| *Max. Body Temperature ... | 200 °C |
| Max. $V_{h-k}$ ... | 55 volts |

## CHARACTERISTICS AND TYPICAL OPERATION.

| | |
|---|---|
| Frequency Range ... | 9300±300 Mc/s |
| Heater Voltage ... | 6·3 volts |
| Load ... | Matched-V.S.W.R. <1·1 |
| Resonator Voltage ... | 250 volts |

| | Min. | Max. | |
|---|---|---|---|
| †Reflector Voltage ... | −75 | −120 | volts |
| Resonator Current ... | 20 | 40 | mA |
| Reflector Current ... | – | 5 | μA |
| Power Output ... | 29 | 66 | mW |
| ‡Electronic Tuning Range ... | ±15 | – | Mc/s |
| Electronic Tuning Tracking Error ... | – | 5 | Mc/s |
| §Electronic Tuning Rate ... | 1·3 | 4·3 | Mc/s / volt |
| Temperature Coefficient ... | +50 | −100 | kc/s / °C |
| Warm-up Frequency Drift ... | – | 10 | Mc/s |
| Heater Voltage Coefficient ... | – | 1·5 | Mc/s / volt |
| Hysteresis ... | – | 50 | % |

*Reliability will be seriously impaired if this temperature is exceeded.

†See Graph on Page 4.

‡Measured at half power point.

§At mode peak.

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## CHARACTERISTICS AND TYPICAL OPERATION (cont.)

| | |
|---|---|
| *Tuner Resetting Accuracy (max. $\Delta$F.) ... ... ... ... | 2 Mc/s |
| †Pressure Coefficient (Max. $\Delta$F.) ... ... ... ... ... | $\pm\frac{9}{2}$ Mc/s |

Vibration.

The max. peak to peak frequency variation from vibration of 100 c/s to 4 kc/s at 10g peak to peak is 0·2 Mc/s. ‡

Shock.

The maximum frequency deviation due to shock of 100g. is 2·0 Mc/s.

## NOTES ON OPERATION.

Mounting.

The klystron should be securely bolted to the mating waveguide flange. Normally the anode (tube body) is operated at earth potential; when operated with the anode above earth potential suitable insulation should be provided between the tube and waveguide flanges. §

Installation.

It is important that the circuit in which a new klystron is being installed is thoroughly checked before the application of any voltages.

Applied Voltages.

The applied voltages should not exceed the maximum published ratings under any circumstances. All quoted voltages are relative to the cathode.

Tuning.

Anti-clockwise rotation of the tuner screw increases frequency.

Heater Voltage.

Life and reliability are directly related to the deviation of the heater voltage from its centre rated frequency. Under no circumstances should it deviate by more than $\pm 10\%$.

Reflector Voltage.

The Reflector must always be operated at a potential which is negative with respect to that of the cathode, and its power supply should not be disconnected during the time the resonator voltage is applied. When the reflector voltage is modulated, the magnitude of the modulating voltage must be limited to the extent necessary to prevent positive excursions of the reflector voltage. When there is any possibility of the reflector voltage becoming equal to or more positive than the cathode a protective diode should be connected between the reflector and cathode. The performance of this diode should be checked regularly as it will normally be operated at zero current drain, an operating condition which materially reduces the life.

Load.

For correct functioning over the specified frequency band and also from 8500 Mc/s. to 9000 Mc/s., the load should present a V.S.W.R. of not more than 1·2 to the valve. Outside the range 8500 to 9600 Mc/s but within the frequency range of 7800 to 10500 Mc/s the load should present a V.S.W.R. of less than 1·5.

Life.

The guaranteed life under normal operating conditions is 500 hours. An average life of 1000 hours is a 95% expectancy. The life expectancy will be appreciably reduced if the valve is operated under conditions where specified maximum ratings are exceeded. See also the note on 'Heater Voltage' above.

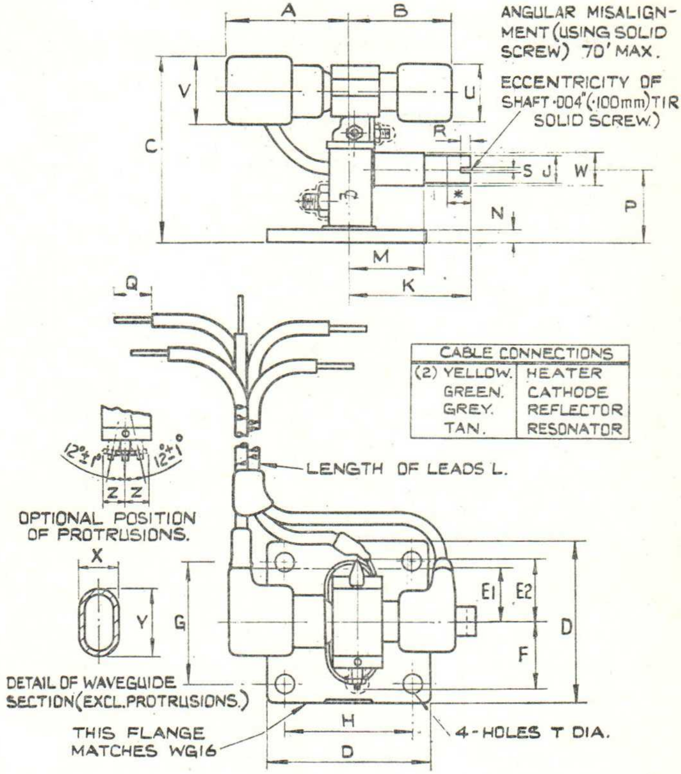
---

*Resetting accuracy defines the frequency deviation which can result from turning the tuner screw through approximately half a turn in either direction, then returning it to its original position.

†The frequency deviation measured when the atmosphere pressure surrounding the valve and inside the set and cavity is increased from 1/10th atmosphere to 1 atmophere in 1 minute (max.).

‡The valve is design tested to 20g.

§To facilitate insulated mounting the eyelets in the fixing bolt holes are removable.




| CABLE CONNECTIONS | |
|---|---|
| (2) YELLOW. | HEATER |
| GREEN. | CATHODE |
| GREY. | REFLECTOR |
| TAN. | RESONATOR |

| DIM | INCHES | m.m. | NOTES. | DIM | INCHES | m.m. | NOTES. |
|---|---|---|---|---|---|---|---|
| A | 1·260 MAX. | 32 | | N | $\cdot125^{+\cdot025}_{-\cdot020}$ | $3\cdot17^{+\cdot63}_{-\cdot50}$ | |
| B | 1·026 MAX. | 25·56 | | P | ·720±·002 | 18·29±·05 | |
| C | 1·900 MAX. | 48·25 | | Q | ·375±·125 | 9·52±3·18 | |
| D | 1·625±·015 | 41·25±·40 | | R | ·100 | 2·54 | |
| E1 | ·680 MAX. | 17·27 | | S | ·040 | 1·02 | |
| E2 | ·725 | 18·42 | } MAX. BODY WIDTH | T | ·219±·003 | 5·55±·08 | EXCLUDING ·195 INSERTS. |
| F | ·625 MAX. | 15·87 | } EXCL. GROUND TAG | U | ·600 MAX. | 15·25 | |
| G | 1·220±·004 | 31 ±·10 | | V | ·750 MAX. | 19·05 | |
| H | 1·280±·004 | 32·51±·10 | | W | ·360 MAX. | 9·13 | |
| J | $\cdot281^{+\cdot000}_{-\cdot002}$ | $7\cdot14^{+\cdot00}_{-\cdot05}$ | * DIA. OVER ·200" (5mm) LENGTH | X | ·435 MAX. | 11·06 | |
| K | 1·240±·060 | 31·50±1·52 | AT 9·6 Gc/s (32-34 TPI) | Y | 1·100 MAX. | 27·94 | |
| L | 18 | 457 | | Z | ·240 MAX. | 6·10 | |
| M | ·812 | 20·64 | | | | | |

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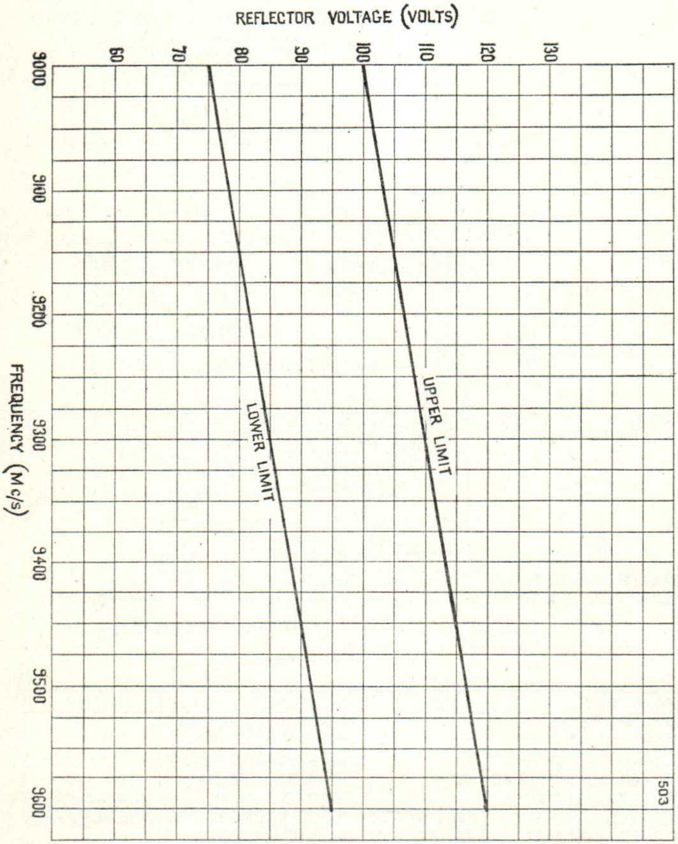
## REFLECTOR VOLTAGE/FREQUENCY CHARACTERISTIC



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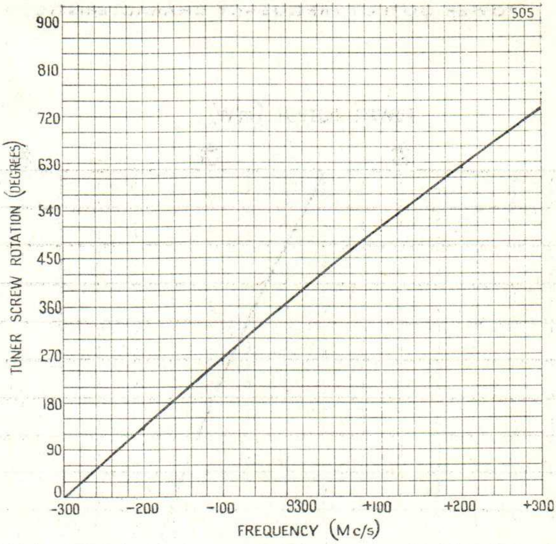
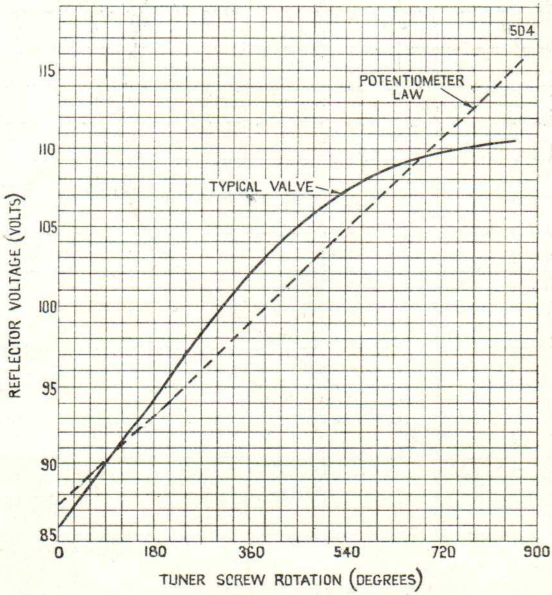
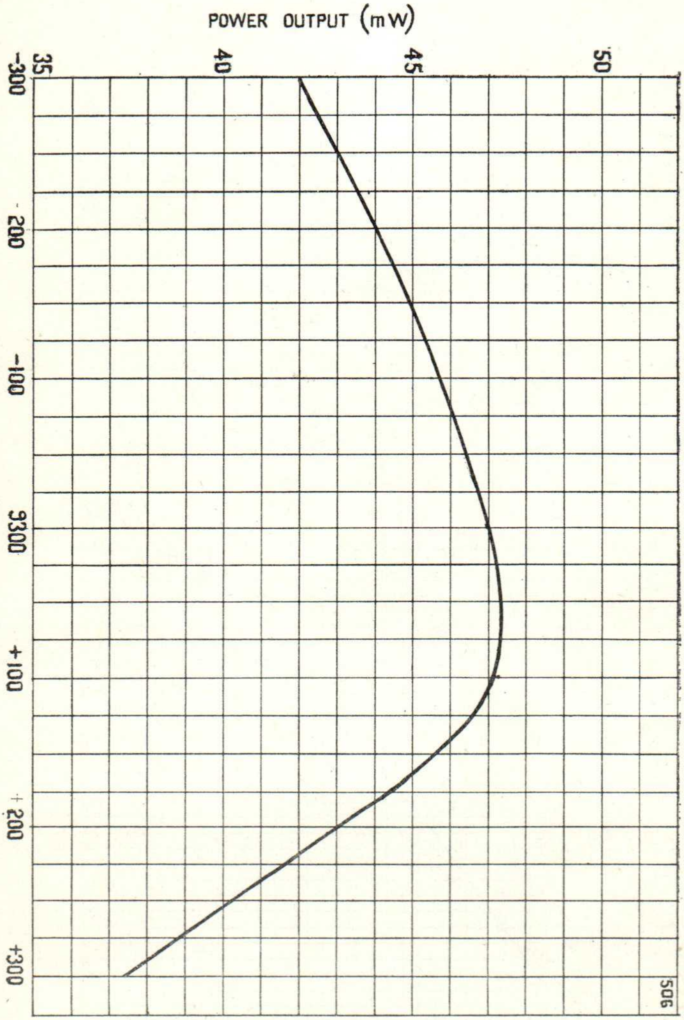
## TUNER SCREW SETTING



## POWER OUTPUT/FREQUENCY CHARACTERISTIC



Ferranti

# KLYSTRONS

Reflex Klystrons of rugged construction for use as a local oscillator. They have been designed for use in the most severe environmental conditions where extreme frequency stability and reliability are required. The two types are identical except for Tuner Screw turns to cover the tuning range.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... | See Drawings on Page 3. |
| Output Connection ... | Bolts to UG–39/U flange or UG-40A/U choke for 1in. x 0·5in. x 0·05in. waveguide. |
| Mounting Position ... | Any. |
| Weight ... ... ... | 6 oz. (180gm.) approx. |
| Base ... ... ... | Moulded with flying leads. |
| Top Cap ... ... ... | Moulded with flying lead. |

## FREQUENCY.

| | |
|---|---|
| Operating Range ... ... ... | 8450 ± 400 Mc/s. |

## TUNING.

A single screw tuner covers the tuning frequency range in approximately 1¾in. turns. For tuner screw settings see the graphs on page 7 (SZ51) & page 8 (SZ51A). The average tuner torque is 30 in./oz. (max. 35in./oz.).

## HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 1·2 ±10% amps. |

## RATINGS.

| | |
|---|---|
| Max. Heater Voltage ... ... ... ... | 6·9 volts. |
| Min. Heater Voltage ... ... ... ... | 5·7 volts. |
| Max. Resonator Voltage ... ... ... | 350 volts. |
| Max. Resonator Current ... ... ... | 60 mA. |
| Max. $V_{h-k}$ ... ... ... ... ... | 45 volts. |
| Max. Body Temperature ... ... ... | 200 °C. |
| Reflector Voltage (negative) ... ... | 0–500 volts. |

## COOLING.

Designed for cooling by conduction and free air circulation. Forced air cooling is not usually required but the Klystron body temperature should not be allowed to exceed 200°C.

## CHARACTERISTICS AND TYPICAL OPERATION

| | | | | |
|---|---|---|---|---|
| Frequency Range ... | 8450 ± 400 | | | Mc/s. |
| Heater Voltage ... ... | 6·3 | | | volts. |
| Load ... ... ... | Matched | | | |
| Resonator Voltage ... | 350 | | | volts. |

| | Min. | Av. | Max. | |
|---|---|---|---|---|
| *Reflector Voltage ... | −90 | — | −185 | volts. |
| Resonator Current ... | — | 50 | 60 | mA. |
| Reflector Current ... | — | — | 10 | μA. |
| Power Output ... ... | 40 | 120 | — | mW. |
| Electronic Tuning Range ... ... | 30 | — | 80 | Mc/s. |
| Modulation Sensitivity ... ... | 0·6 | — | 2·7 | Mc/s / volt. |
| Temperature Coefficient ... | −100 | −30 | +50 | kc/s / °C. |
| Heater Voltage Coefficient ... | — | — | 1·5 | Mc/s / volt. |

*See Graph on page 5

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CHARACTERISTICS AND TYPICAL OPERATION. (cont.)

| | |
|---|---|
| †Noise ... ... ... ... ... ... | $<3 \times 10^{-14}$ W/ Mc/s/ mW |
| ‡Tuner Resetting Accuracy (max. $\Delta$ F.) ... ... ... | 1 Mc/s. |
| §Tuner Side Thrust (max. $\Delta$ F.) ... ... ... ... | 0·5 Mc/s. |
| ¶Pressure Coefficient (Max. $\Delta$F). ... ... ... ... | 2 Mc/s. |

Vibration.

The max. peak to peak frequency variation from vibration of 40 c/s to 4 kc/s at 10g peak to peak is 0.2 Mc/s.

Shock.

The maximum frequency deviation due to shock of 150g. is 1·5 Mc/s.

NOTES ON OPERATION.

Mounting.

The klystron should be securely bolted to the mating waveguide flange. Normally the anode (tube body) is operated at earth potential ; when operated with the anode above earth potential suitable insulation should be provided between the tube and waveguide flanges.**

Application of Voltages.

It is important that the circuit in which a new klystron is being installed is thoroughly checked before the application of any voltages. The applied voltages should not exceed the maximum published ratings under any circumstances.

Reflector Voltage.

The Reflector must never be operated at a potential positive with respect to that of the cathode, nor should its power supply be disconnected during the time the resonator voltage is applied. When the reflector voltage is modulated the magnitude of the modulating voltage must be limited to the extent necessary to prevent positive excursions of the reflector voltage. A protective diode connected directly between the reflector and the cathode can be used to prevent the reflector from becoming positive. The performance of this diode should be checked regularly as it will normally be operated at zero current drain, an operating condition which materially reduces the life.

Load.

For correct functioning the load should present a VSWR of less than 1·4 to the tube at the operating frequency.

---

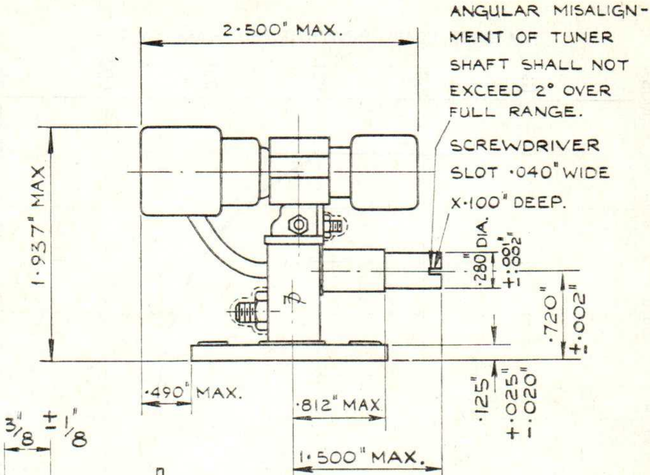
†The R.F. noise is the sum of the R.F. noise power in two channels 40 Mc/s. above and below the frequency of oscillation, compared to normal noise at 290°K. in the same channels.
The noise standard used in these measurements is a CV1881 discharge tube. The noise power is expressed as Watts per Mc/s. of I.F. band width per milliwatt of R.F. output power.

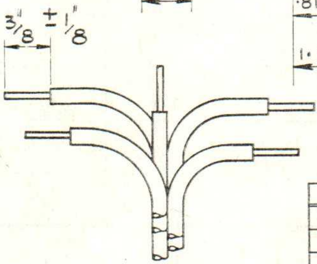
‡Resetting accuracy defines the frequency deviation which can result from turning the tuner screw through approximately half a turn in either direction, then returning it to its original position.

§The frequency deviation, caused by side thrust due to the application a ¼lb. weight to the top of the tuner spindle in each of two mutually perpendicular axes both of which are perpendicular to the spindle axis.

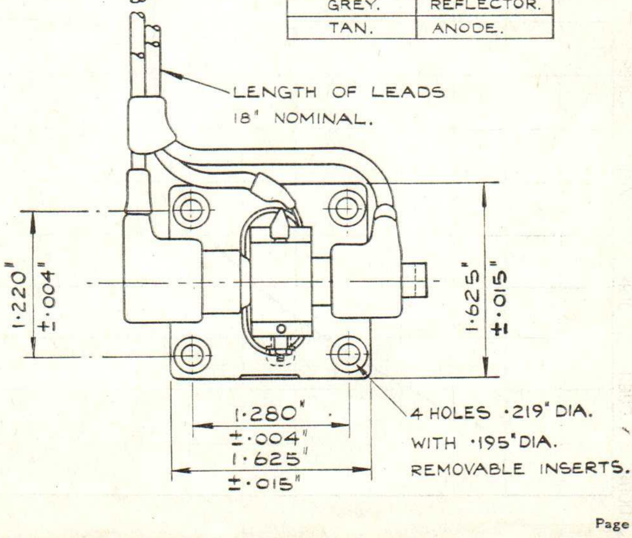
¶The frequency deviation measured when the atmosphere pressure surrounding the valve and inside the set and cavity is increased from 1/10th atmosphere to 1 atmosphere in 1 minute (max.).

**To facilitate insulated mounting the eyelets in the fixing bolt holes are removable




| CABLE CONNECTIONS. | |
|---|---|
| (2) YELLOW. | HEATER. |
| GREEN. | CATHODE. |
| GREY. | REFLECTOR. |
| TAN. | ANODE. |

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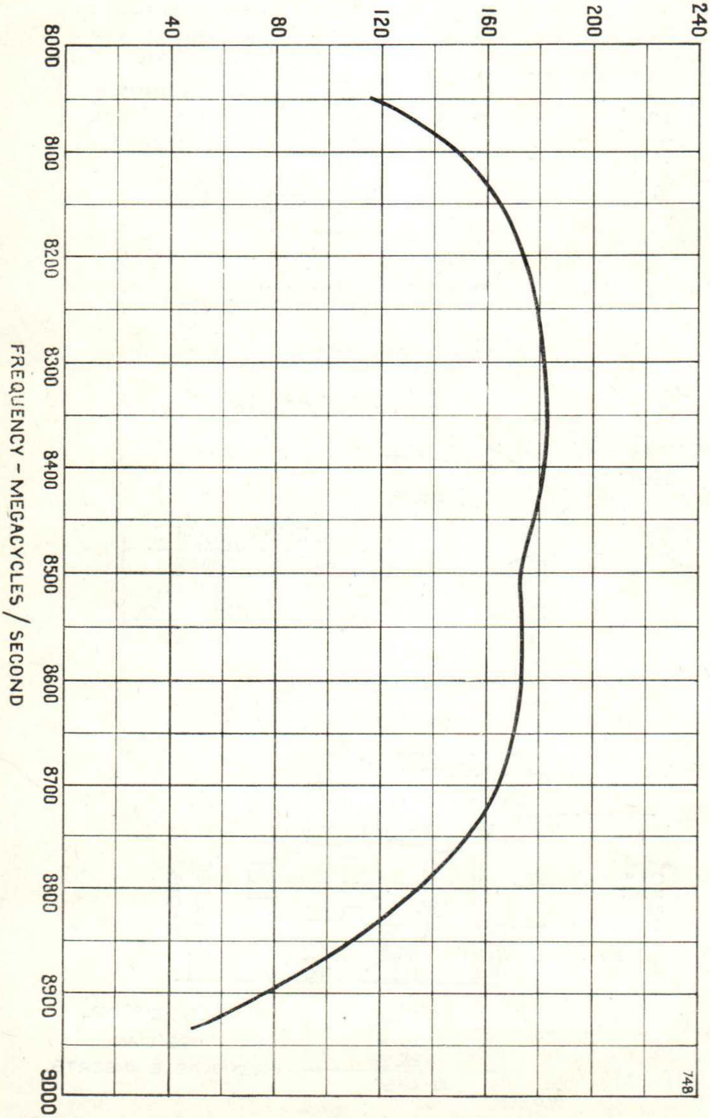
| SZ51 |
|---|
| SZ51A |

POWER OUTPUT/FREQUENCY CHARACTERISTIC

MATCHED LOAD



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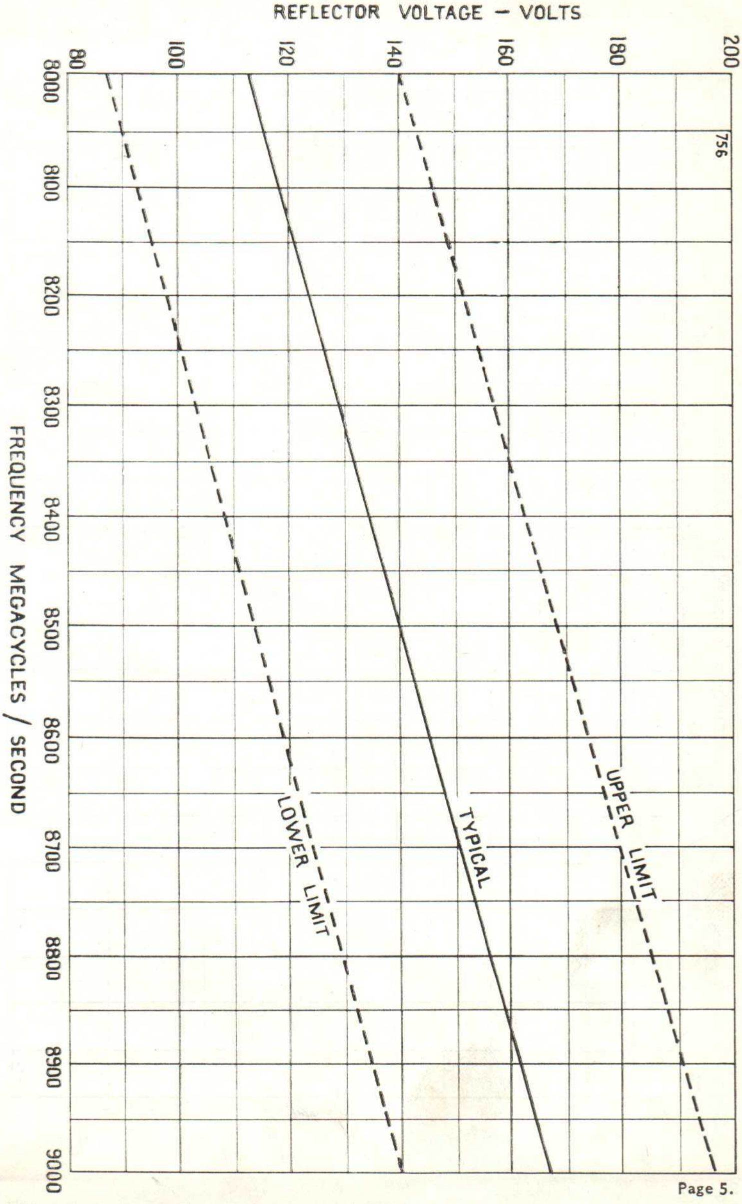
REFLECTOR VOLTS/FREQUENCY CHARACTERISTICS.

Reflector Voltage at Maximum Power Point.

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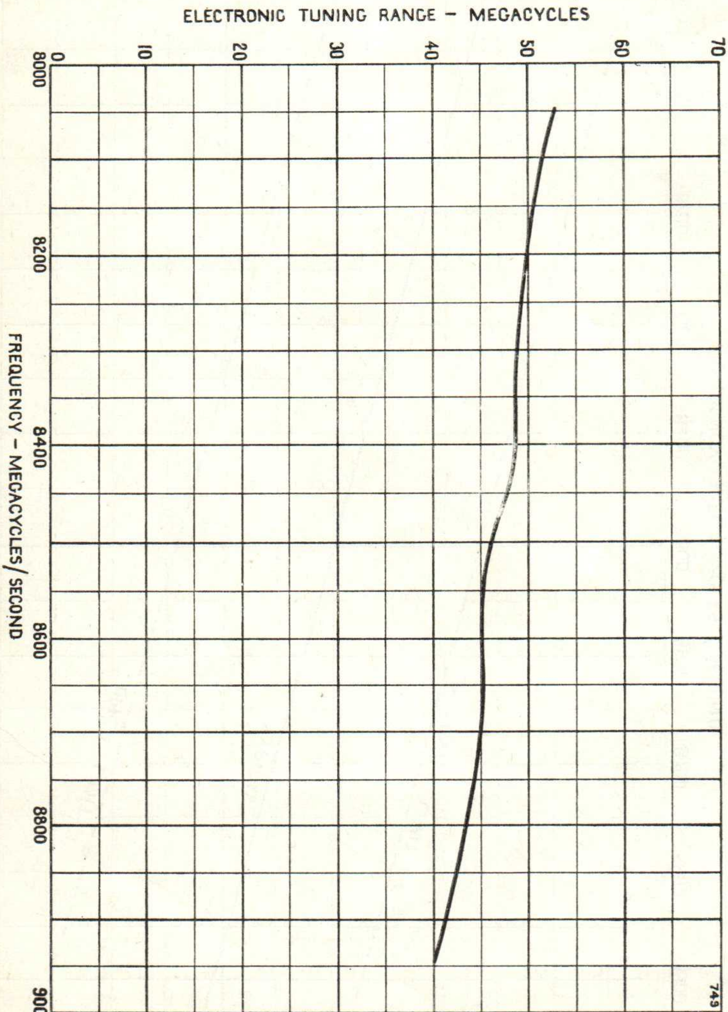
ELECTRONIC TUNING RANGE



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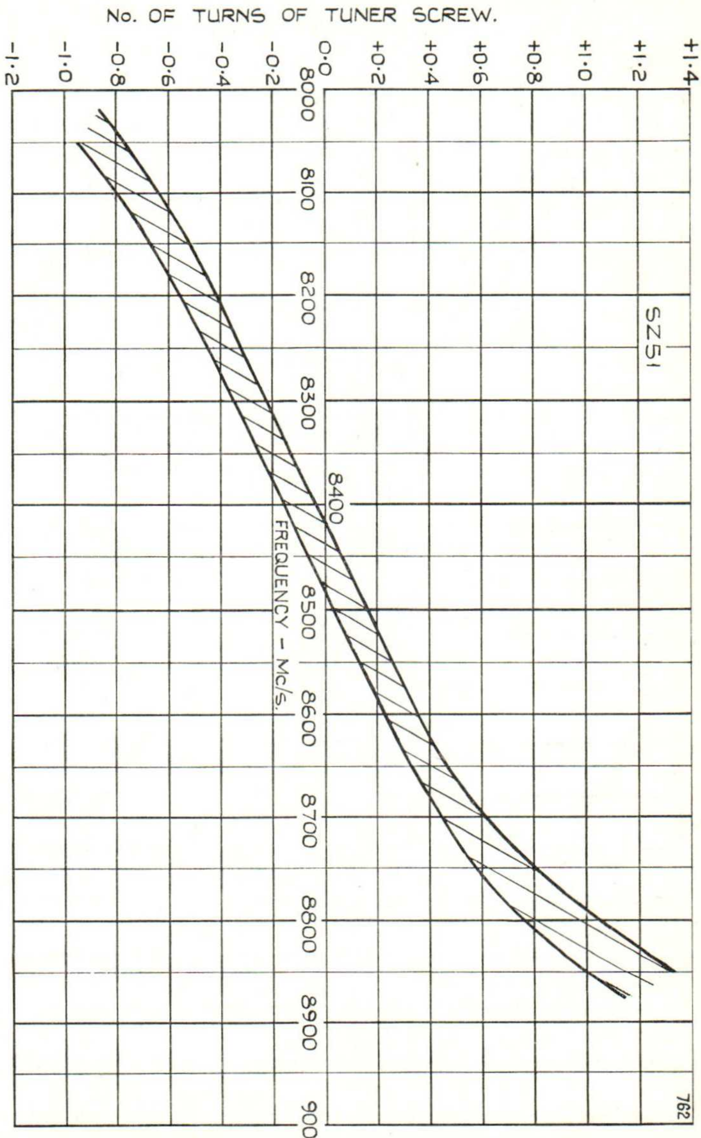
TUNER SCREW SETTING.

(The tuner screw setting for any frequency should lie within the area enclosed by the two lines,)



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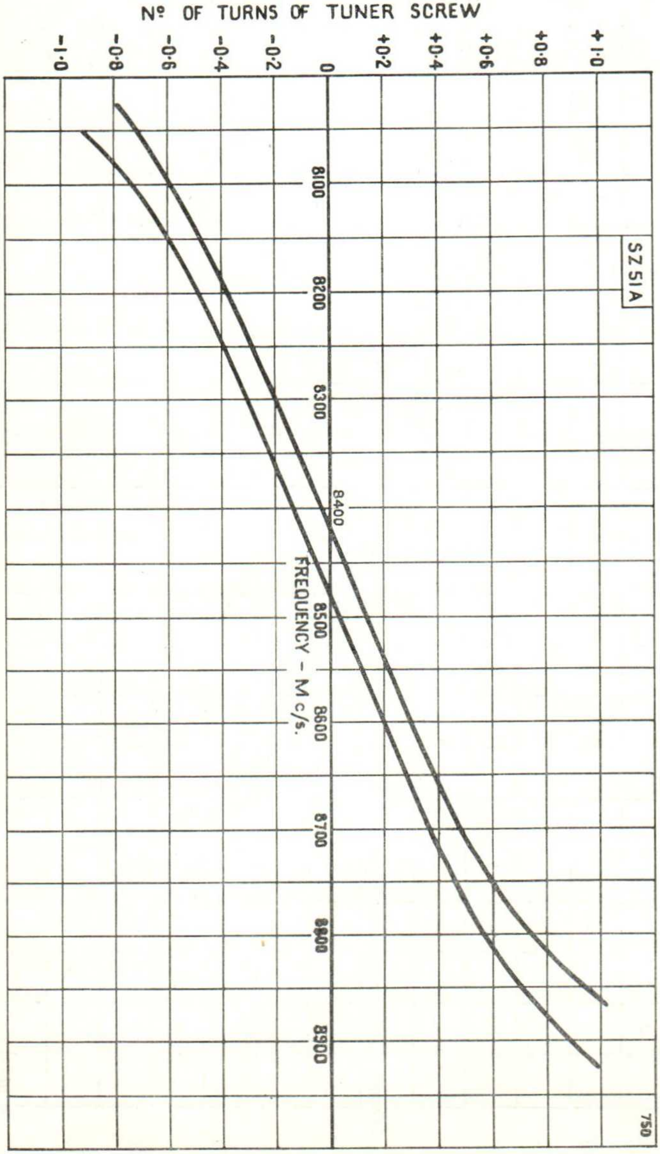
TUNER SCREW SETTING

(The tuner screw setting for any frequency should lie within the area enclosed by the two lines.)



Ferranti

# KLYSTRON

A rugged wide band Reflex Klystron for use as a Local Oscillator Designed for low voltage operation and to provide extreme stability and reliability under the most severe environmental conditions. Other features are low noise and small 'warm up' frequency drift. Intended for convection cooling with free air circulation. It is a direct replacement for American Type VA201B

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... ... ... ... | See Drawings on Page 3. |
| Output Connection ... ... ... ... | Bolts to UG–39/U flange or UG–40A/U choke for W.G.16 |
| Mounting Position ... ... ... ... | Any |
| Weight ... ... ... ... ... ... | 6 oz. (170 gm.) approx. |
| Electrode Connections ... ... ... ... | Moulded flying leads. |

## FREQUENCY RANGE.

Mechanical Tuning Range ... ... ... ... ... 8500–9655 Mc/s

A single screw tuner covers the tuning frequency range in approximately 4½ turns. For tuner screw settings see the graph on Page 6. The average tuner torque is 30 oz./in. (max. 50 oz./in.).
Clockwise rotation reduces the frequency.

## HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... ... ... ... | 6·3 volts |
| Heater Current ... ... ... ... ... ... ... | 1·2±10% amps |

## RATINGS. (All ratings are 'Absolute')

| | |
|---|---|
| Max. Heater Voltage ... ... ... ... ... ... | 6·9 volts |
| Min. Heater Voltage ... ... ... ... ... ... | 5·7 volts |
| Max. Resonator Voltage... ... ... ... ... ... | 350 volts |
| Max. Resonator Current ... ... ... ... ... | 60 mA |
| Max. Neg. Reflector Voltage ... ... ... ... ... | –500 volts |
| Max. Reflector Current ... ... ... ... ... | 10 μA |
| Max. $V_{h-k}$ ... ... ... ... ... ... ... | 45 volts |
| Max. Vibration ... ... ... ... ... ... ... | 20 g |
| Max. Shock (short duration) ... ... ... ... ... | 150 g |
| Max. Altitude for operation ... ... ... ... ... | 60,000 ft |
| *Max. Body Temperature ... ... ... ... ... | 200 °C |

## CHARACTERISTICS AND TYPICAL OPERATION.

| | | | | | |
|---|---|---|---|---|---|
| Frequency Range ... | 8500–9655 | | | | Mc/s |
| Heater Voltage ... ... | 6·3 | | | | volts |
| Load ... ... ... | Matched | | | | |
| Resonator Voltage ... | 250 | | 300 | | volts |
| Mode ... ... ... | 6¾ | | 5¾ | | |
| | Min. | Max. | Min. | Max. | |
| †Reflector Voltage ... ... | –40 | –120 | –80 | –200 | volts |
| Resonator Current ... ... | — | 45 | — | 60 | mA |
| Reflector Current ... ... | — | 10 | — | 10 | μA |
| Power Output ... ... ... | 12 | 66 | 40 | 120 | mW |
| ‡Electronic Tuning Range ... | 30 | — | 20 | — | Mc/s |
| §Electronic Tuning Rate ... ... | 1·0 | — | ·5 | — | Mc/s / volt |
| Temperature Coefficient ... | –100 | +50 | –100 | +50 | kc/s / °C |
| Heater Voltage Coefficient ... | — | 1·5 | — | 1·5 | Mc/s / volt |

*Reliability will be seriously impaired if this temperature is exceeded.
†See Graph on Page 4.
‡Measured at half power point.
§At mode peak.

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Nov., 1963

CHARACTERISTICS AND TYPICAL OPERATION (Cont.)

| | |
|---|---|
| *Noise ... ... ... ... ... ... ... | $<3 \times 10^{-14}$ W / Mc/s / mW |
| †Tuner Resetting Accuracy (max. $\Delta$F.) ... ... ... | 1 Mc/s |
| ‡Tuner Side Thrust (max. $\Delta$F.) ... ... ... ... | 0·5 Mc/s |

Vibration.

The max. peak to peak frequency variation from vibration of 20–1000 c.p.s. at 10g. is 0·2 Mc/s.

Shock.

The maximum frequency deviation due to shock of 150g. is 1·5 Mc/s.

NOTES ON OPERATION.

Mounting.

The klystron should be securely bolted to the mating waveguide flange. Normally the resonator (tube body) is operated at earth potential; when operated with the resonator above earth potential suitable insulation should be provided between the tube and waveguide flanges.

Applied Voltages.

It is important that the circuit in which a new klystron is being installed is thoroughly checked before the application of any voltages.

All quoted voltages are relative to the cathode.

The applied voltages should not exceed the maximum published ratings under any circumstances.

Voltage surges due to switching must be limited within the maximum ratings.

Heater Voltage.

Life and reliability are directly related to the deviation of the heater voltage from its centre rated voltage. Under no circumstances should it deviate by more than $\pm 10\%$.

Reflector Voltage.

The Reflector must always be operated at a potential which is negative with respect to that of the cathode, and its power supply should not be disconnected during the time the resonator voltage is applied. When the reflector voltage is modulated, the magnitude of the modulating voltage must be limited to the extent necessary to prevent positive excursions of the reflector voltage. When there is any possibility of the reflector voltage becoming equal to or more positive than the cathode a protective diode should be connected between the reflector and cathode. The performance of this diode should be checked regularly.

Load.

For correct functioning of the tube the load should meet the following conditions:

(a) Over the specified operating frequency range the load should present a VSWR of less than 1·2 to the tube.

(b) Over the frequency ranges: 7,800 to 8,500 Mc. and 9,655 to 10,500 Mc. the load should present a VSWR of less than 1·5 to the tube.
Failure to meet condition (b) may result in the occurrence of spurious modes.

Life.

The guaranteed life under normal operating conditions is 500 hours. An average life of 1000 hours is a 95% expectancy. The life expectancy will be appreciably reduced if the valve is operated under conditions where specified maximum ratings are exceeded. See also the note on 'Heater Voltage' above.

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*The R.F. noise is the sum of the R.F. noise power in two channels 40 Mc/s. above and below the frequency of oscillation, compared to normal noise at 290°K. in the same channels.
The noise standard used in these measurements is a CV1881 discharge tube. The noise power is expressed as Watts per Mc/s. of I.F. band width per milliwatt of R.F. output power.

†Resetting accuracy defines the frequency deviation which can result from turning the tuner screw through approximately half a turn in either direction, then returning it to its original position.

‡The frequency deviation, caused by side thrust due to the application of a ¼lb. weight to the top of the tuner spindle in each of two mutually perpendicular axes both of which are perpendicular to the spindle axis.



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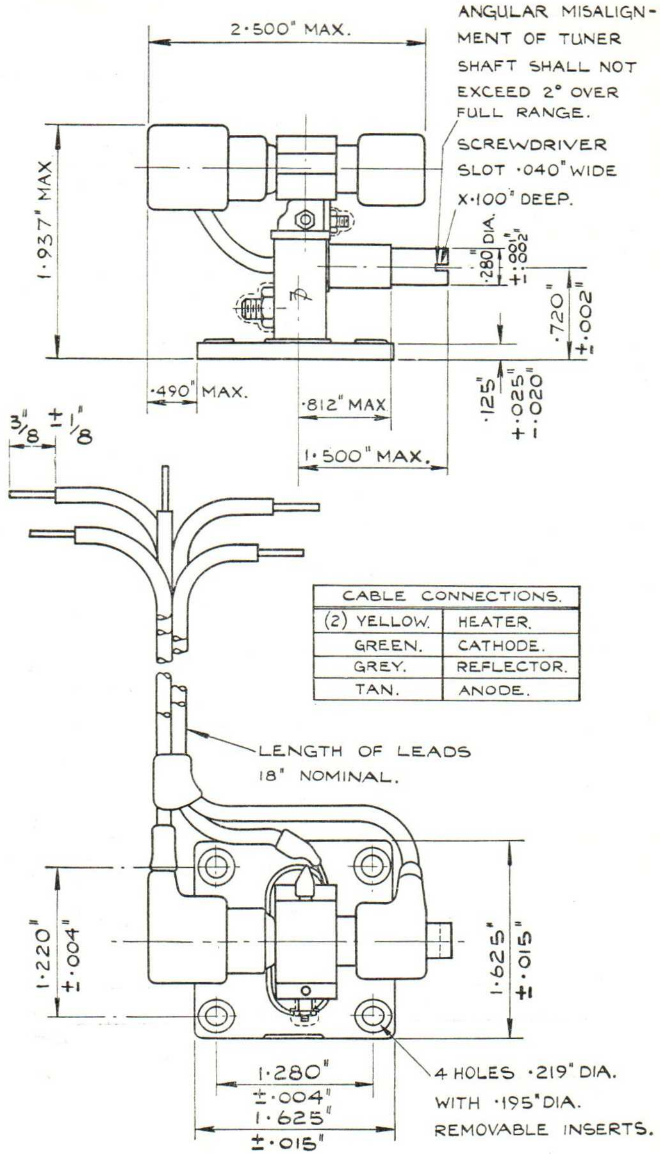
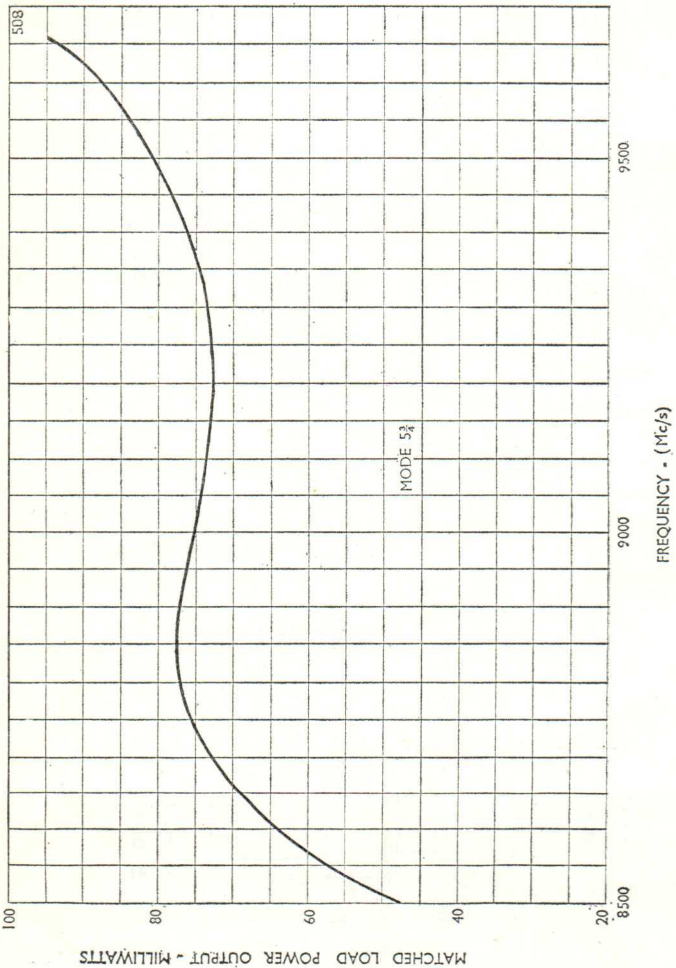


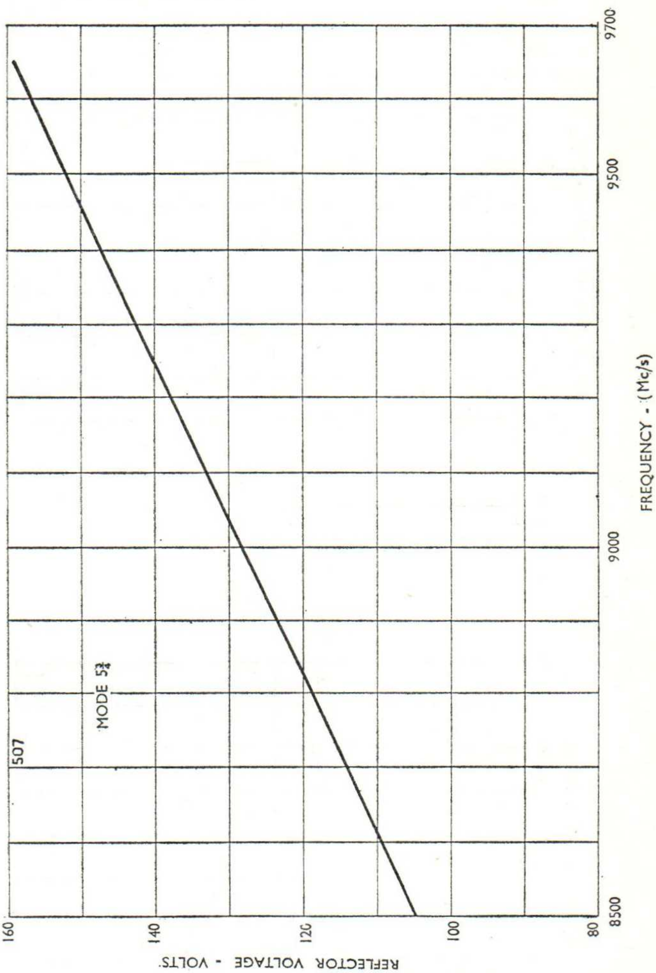

| CABLE CONNECTIONS. | |
|---|---|
| (2) YELLOW. | HEATER. |
| GREEN. | CATHODE. |
| GREY. | REFLECTOR. |
| TAN. | ANODE. |

## TYPICAL POWER OUTPUT/FREQUENCY CHARACTERISTIC



## TYPICAL REFLECTOR VOLTS/FREQUENCY CHARACTERISTICS

Reflector Voltage at Maximum Power Point.



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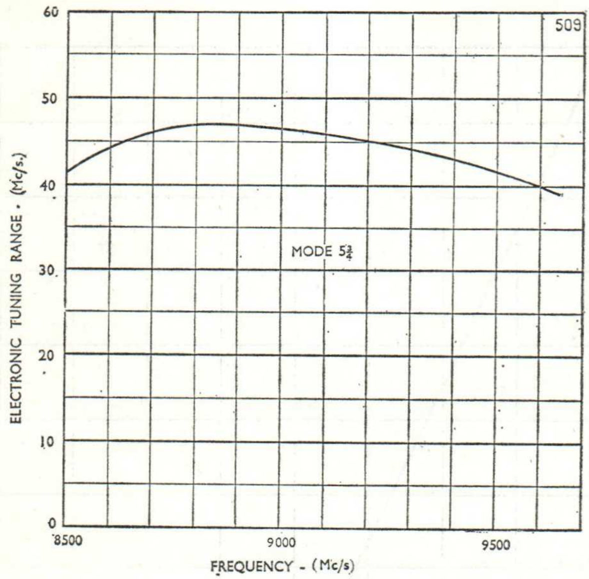
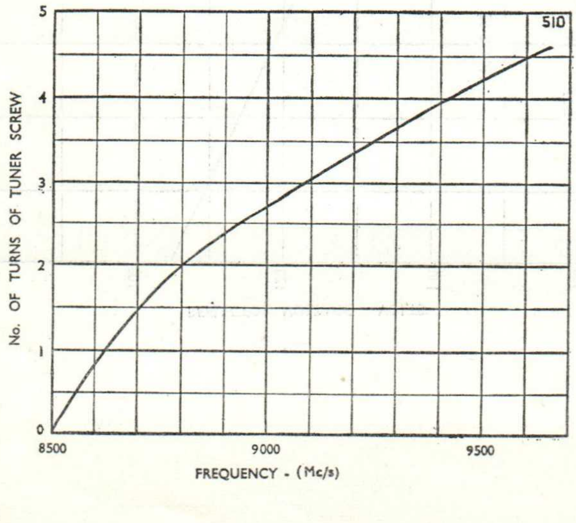
## TYPICAL ELECTRONIC TUNING RANGE




## TUNER SCREW SETTING



# FERRANTI

## "X" BAND NOISE TUBE

A tube specifically designed for noise measurement at "X" Band frequencies. The small size and low current drain, coupled with stable noise output make this tube particularly suitable for applications where a built in noise monitoring facility is required.

### PHYSICAL DETAILS.

The tube is normally supplied in a waveguide mount. The dimensions of this mount and of the tube are shown on the drawing overleaf. The tube can be supplied without the mount if desired.

### HEATER.

| | |
|---|---|
| Heater Voltage ...... ...... ...... | 6·3 volts. |
| Heater Current ...... ...... ...... | 0·95 amp. (nom.) |

### RATINGS AND CHARACTERISTICS.

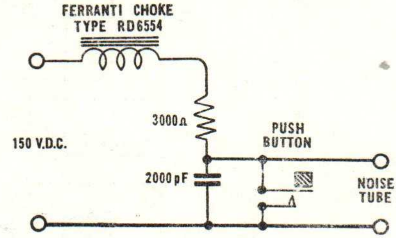
| | |
|---|---|
| Striking Voltage ...... ...... ...... | 1150 volts. |
| *Normal Operating Voltage ...... | 50 volts. |
| Normal Operating Current ...... | 35 mA. |
| Max. Operating Current ...... | 50 mA. |
| Min. Series Resistance ...... ...... | 3000 ohms. |
| †Available Noise Power | 15·25±0·25 dB. |
| ‡V.S.W.R. over band 9·375±350 Mc/s.– | <1·25 |
| Insertion loss of 'unstruck' tube on mount ...... | <0·2 dB. |

§Bandwidth : The wave guide mount is normally fitted with a three screw matching section which is tuned and locked to a centre frequency of 9375 Mc/s. at a V.S.W.R. of 1·01.

Waveguide Mount : The mount can be supplied with or without a built in dummy load as required.

### OPERATION.

The striking voltage is 1,150 and the diagram below gives details of a circuit which enables the high striking voltage to be obtained from a low voltage supply. The push button which is normally open is depressed for a second or two and then released and the resulting high voltage transient is sufficient to strike the tube.




The noise output remains stable over long periods, but to ensure stability a resistor having a value of at least 3,000 ohms must be connected in series with the tube.

---

*at Ia=35 mA.

†The available noise power is referred to thermal noise at 17°C and does not include the image frequency contribution.

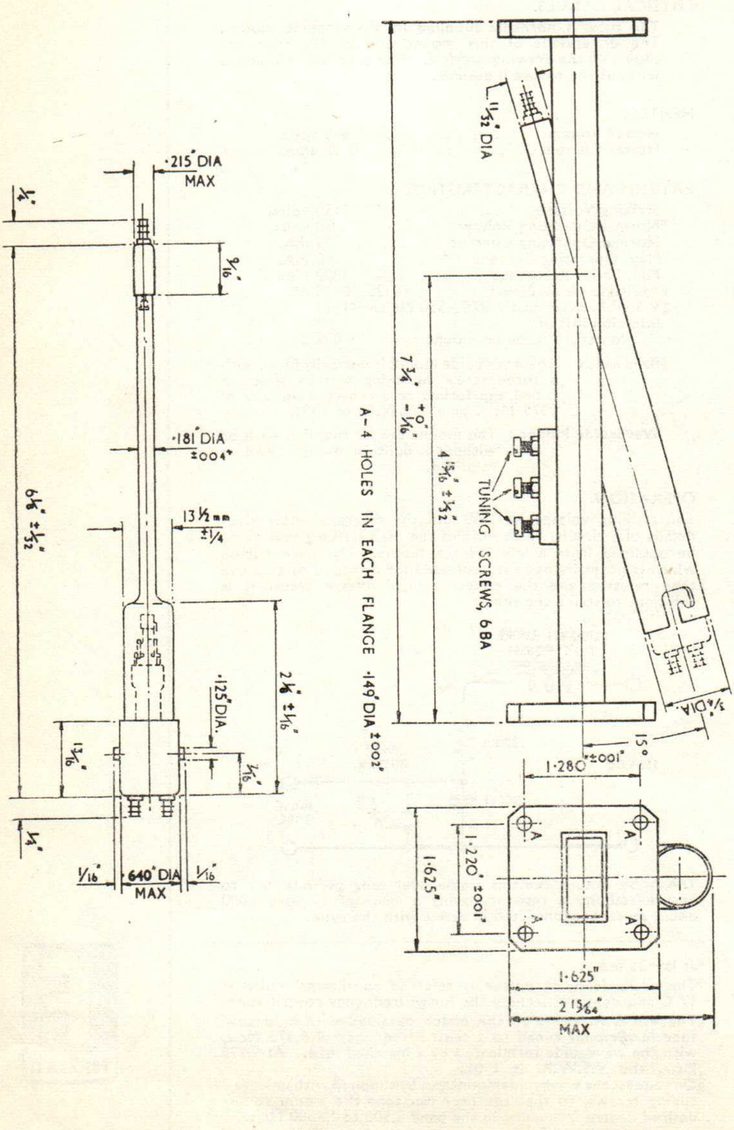
‡The V.S.W.R. refers to the match obtained with a 'struck' tube in a mount tuned to a centre frequency of 9,375 Mc/s. with the waveguide terminated by a matched load. At 9,375 Mc/s. the V.S.W.R. is 1·01.

§On request the waveguidemount can be supplied with unlocked tuning screws, so that the user can tune the mount to any desired centre frequency in the band 8,500 to 10,500 Mc/s.

Issue 2
July, 1958

FERRANTI

# TE10



Ferranti

# KLYSTRON

A reflex Klystron designed for use as local oscillator in airborne applications. The very rugged construction and extreme frequency stability ensure reliability under the most severe environmental conditions.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... | See Drawings on Page 2. |
| Output Connection ... | Bolts to UG–39/U flange or UG4OA/U chokes for 1in. x 0·5in. x 0·05in. waveguide. |
| Mounting Position ... | Any. |
| Weight ... ... ... | 6 oz. (180gm.) approx. |
| Base ... ... ... | Moulded with flying leads. |
| Top Cap ... ... ... | Moulded with flying lead. |

## COOLING.

Designed for cooling by conduction and free air circulation. Forced air cooling is not usually required but the Klystron body temperature should not be allowed to exceed 200°C.

## HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 1·2 ±10% amps. |

## FREQUENCY.

| | |
|---|---|
| Operating Range ... ... ... | 8500–9600 Mc/s. |

## TUNING.

The single screw tuner covers the frequency range in approximately 4½ turns. Clockwise rotation reduces the frequency. The average tuner torque is 35in./oz. (maximum –50in./oz.).

## RATINGS.

| | |
|---|---|
| Max. Heater Voltage ... ... ... ... | 6·9 volts. |
| Min. Heater Voltage ... ... ... ... | 5·7 volts. |
| Max. Resonator Voltage ... ... ... | 350 volts. |
| Max. Resonator Current ... ... ... | 55 mA. |
| Max. $V_{h-k}$ ... ... ... ... ... | 45 volts. |
| Max. Body Temperature ... ... ... | 200°C. |
| Reflector Voltage (negative) ... ... | 0–500 volts. |

Ferranti

Issue 2.
Oct., 1959

**VA201B**

Ferranti

## CHARACTERISTICS AND TYPICAL OPERATION.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Frequency Range | | | 8500–9600 | | | | Mc/s. |
| Heater Voltage | | | 6·3 | | | | volts. |
| Load | | | Matched | | | | |
| Resonator Voltage | | 250 | | | 300 | | volts. |
| Mode ... ... | | $6\frac{3}{4}$ | | | $5\frac{3}{4}$ | | |

| | Min. | Av. | Max. | Min. | Av. | Max. | |
|---|---|---|---|---|---|---|---|
| Reflector Voltage | –40 | — | –120 | –80 | — | –200 | volts. |
| Resonator Current | — | 33 | — | — | 41 | 45 | mA. |
| Reflector Current | — | — | 5 | — | — | 5 | µA. |
| Power Output ... | 12 | 30 | 66 | 40 | 90 | 120 | mW. |
| Electronic Tuning Range ... | 30 | 45 | — | 20 | 40 | — | Mc/s. |
| Modulation Sensitivity ... | 1·0 | 3·0 | — | ·5 | 2·0 | — | Mc/s / volt. |
| Temperature Coefficient | –100 | –30 | +50 | –100 | –30 | +50 | kc/s / °C. |
| Heater Voltage Coefficient ... | — | — | 1·5 | — | — | 1·5 | Mc/s / volt. |

*Noise ... ... ... ... ... ... $<3\times10^{-14}$ W / Mc/s / mW

†Tuner Resetting Accuracy (max. $\Delta$F.) ... ... ... 1 Mc/s.

‡Tuner Side Thrust (max. $\Delta$F.) ... ... ... ... 0·5 Mc/s.

Vibration.

The max. peak to peak frequency variation from vibration of 20–1000 c.p.s. at 10g is 0.2 Mc/s.

Shock.

The maximum frequency deviation due to shock of 150g. is 1·5 Mc/s.

## NOTES ON OPERATION.

Mounting.

The klystron should be securely bolted to the mating waveguide flange. Normally the anode (tube body) is operated at earth potential ; when operated with the anode above earth potential suitable insulation should be provided between the tube and waveguide flanges.**

Application of Voltages.

It is important that the circuit in which a new klystron is being installed be thoroughly checked before the application of any voltages. Under no circumstances should the applied voltages exceed the maximum published ratings.

Reflector Voltage.

The Reflector must never be operated at a potential positive with respect to that of the cathode nor should its power supply be disconnected during the time the resonator voltage is applied. When the reflector voltage is modulated the magnitude of the modulating voltage must be limited to the extent necessary to prevent positive excursions of the reflector voltage. A protective diode connected directly between the reflector and the cathode can be used to prevent the reflector from becoming positive. The performance of this diode should be checked regularly as it will normally be operated at zero current drain, an operating condition which materially reduces the life.

Load.

For correct functioning of the tube the load should meet the following conditions.

(a) At the frequency of operation the load should present a VSWR of less than 1·2 to the tube.

(b) Over the frequency ranges : 7,800 to 8,500 Mc. and 9,600 to 10,500 Mc. the load should present a VSWR of less than 1·5 to the tube. Failure to meet condition (b) may result in the occurrence of spurious modes.

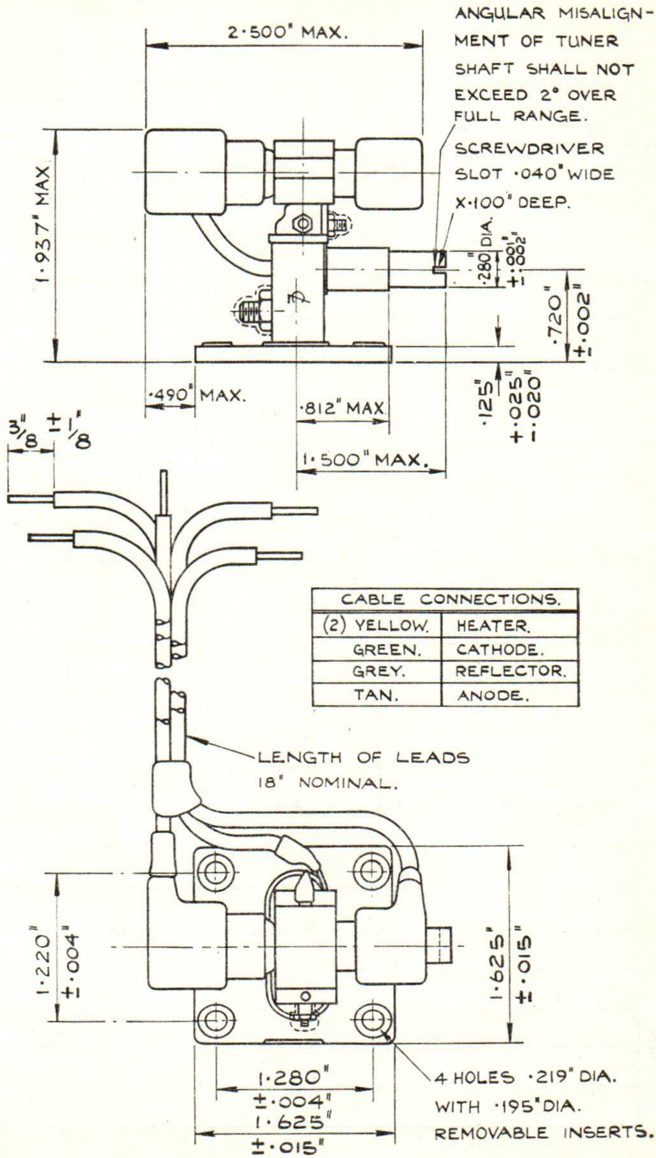
---

*The R.F. noise is the sum of the R.F. noise power in two channels 40 Mc/s. above and below the frequency of oscillation, compared to normal noise at 290°K. in the same channels.
The noise standard used in these measurements is a CV1881 discharge tube. The noise power is expressed as Watts per Mc/s. of I.F. band width per milliwatt of R.F. output power.

†Resetting accuracy defines the frequency deviation which can result from turning the tuner screw through approximately half a turn in either direction, then returning it to its original position.

‡The frequency deviation, caused by side thrust due to the application a ¼lb. weight to the top of the tuner spindle in each of two mutually perpendicular axes both of which are perpendicular to the spindle axis.

**To facilitate this the eyelets in the fixing bolt holes are removable.




| CABLE CONNECTIONS. | |
|---|---|
| (2) YELLOW. | HEATER. |
| GREEN. | CATHODE. |
| GREY. | REFLECTOR. |
| TAN. | ANODE. |



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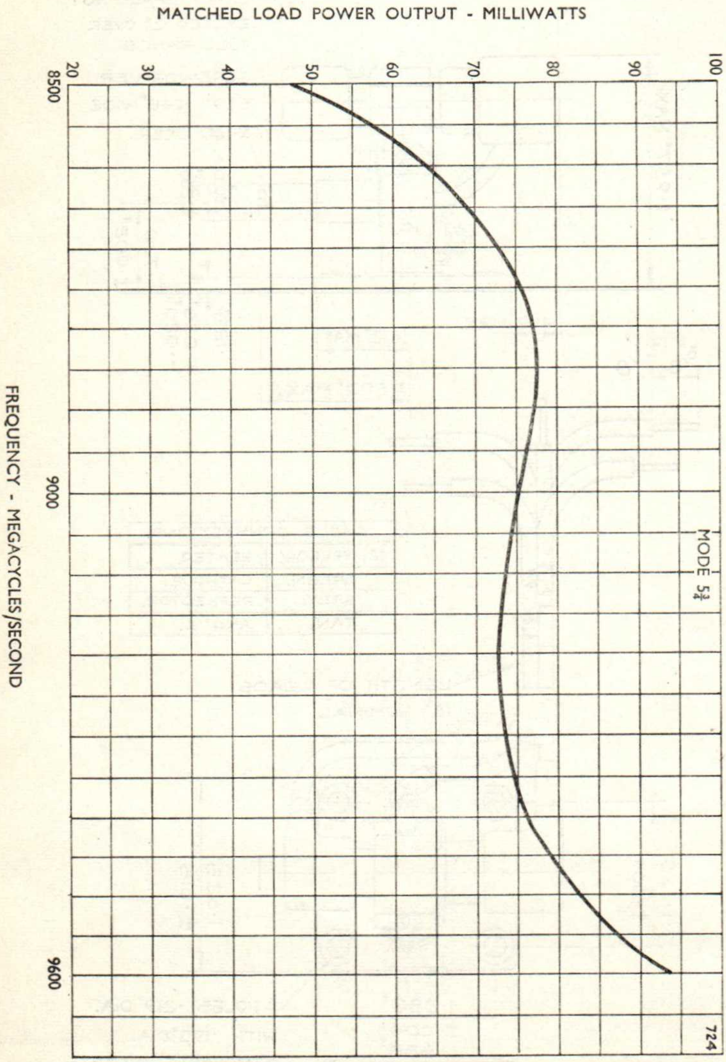
POWER OUTPUT/FREQUENCY CHARACTERISTIC

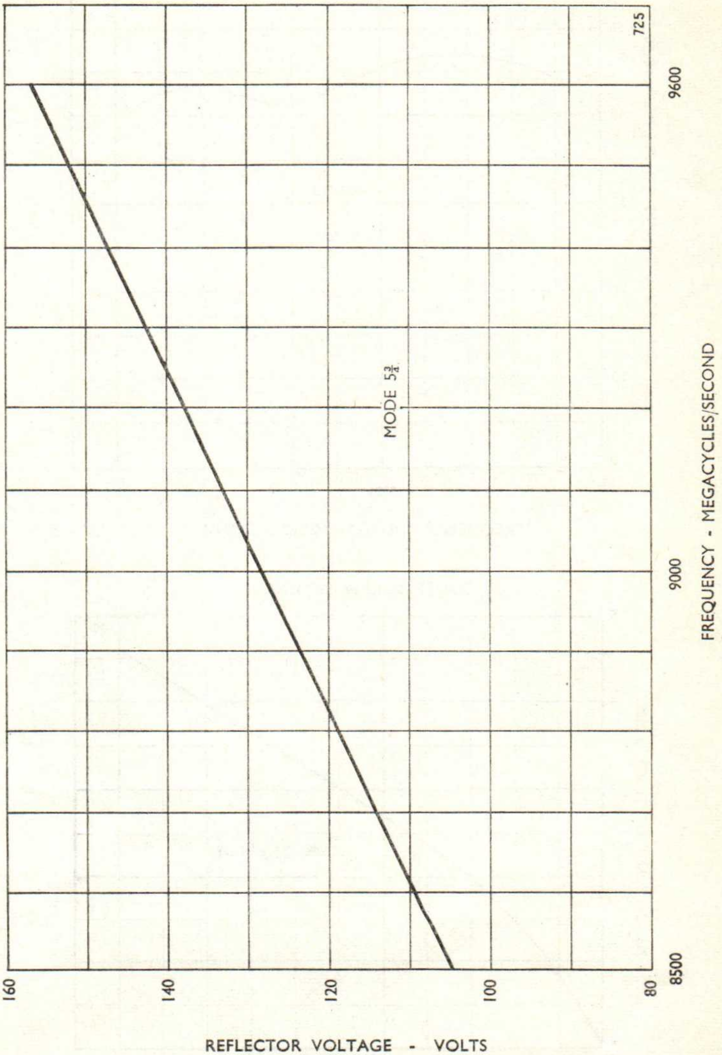





FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

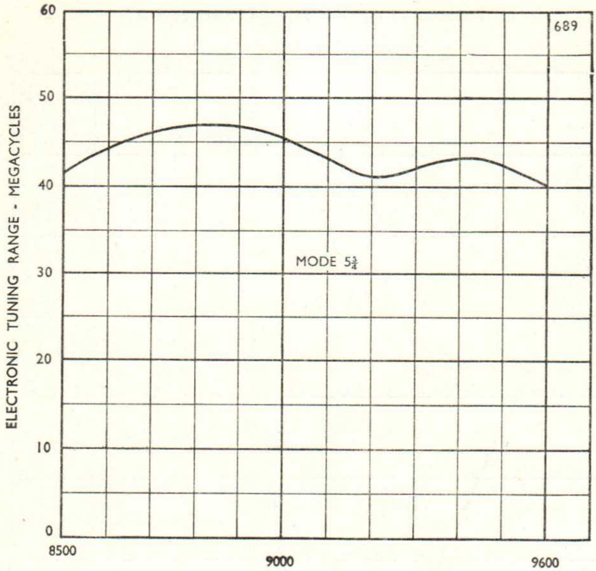
REFLECTOR VOLTS/FREQUENCY CHARACTERISTICS.

Reflector Voltage at Maximum Power Point.



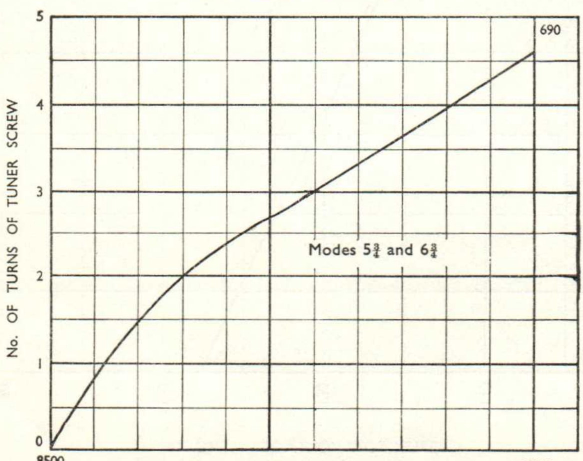
Ferranti

ELECTRONIC TUNING RANGES.




FREQUENCY - MEGACYCLES/SECOND

TUNER SCREW SETTING.




FREQUENCY - MEGACYCLES/SECOND

Ferranti

# T.R. CELL

A broad band T.R. for operation in the frequency range 9180 Mc/s. to 10,000 Mc/s. May be used in branched duplexer or balanced duplexer systems. Specially developed for high reliability and long life.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... | See outline drawing overleaf. |
| Waveguide ... ... | W.G.16 (0·4″×0·9″). |
| Primer Terminals ... | CT1. |
| Mounting Position ... | Any. |
| Max. Waveguide Pressure | 30 lbs./Sq. in. |

## FREQUENCY RANGE ... ... 9180 to 10,000 Mc/s.

## RATINGS.

| | |
|---|---|
| Max. Transmitter Line Power ... | 200 kW. |
| Min. Transmitter Line Power ... ... | 4 kW. |
| *Max. Primer Supply Voltage (Main & Aux.) | –1500 volts. |
| *Min Primer Supply Voltage (Main & Aux.) | –950 volts. |
| †Max. Main Primer Current ... ... | 185 µA. |
| †Min. Main Primer Current ... ... | 100 µA. |
| †Max. Aux. Primer Current ... ... | 80 µA. |
| †Min. Aux. Primer Current ... ... | 50 µA. |
| Ambient Temperature Range (Storage) ... ... | –40 to +100°C. |

## CHARACTERISTICS.

| | Average | Limit. | |
|---|---|---|---|
| Low Power Level. | | | |
| V.S.W.R. (9400–9800 Mc/s.) | 1·14 | 1·2 | |
| V.S.W.R. (9100–10,000 Mc/s.) | 1·2 | 1·3 | |
| ‡Insertion Loss ... ... | 0·5 | 0·8 | dB. |
| High Power Level. | | | |
| Leakage at 200 kW. Peak:– | | | |
| Total Leakage Power ... | 45 | 100 | mW. |
| Spike Leakage Energy | 0·16 | 0·3 | ergs/pulse. |
| Primer Breakdown Power | 150 | 250 | mW. |
| Recovery Time (to –6dB Loss) | 1 | 3 | µSec |
| Arc Loss (at 4 kW.) ... | | 0·8 | dB. |
| §Position of Min. V.S.W. | 0·020 | 0·014 to 0·028 | inches |
| Primer Characteristics. | | | |
| Primer Operating Voltage | 210 | 180 to 280 | volts. |

## OPERATING NOTES.

(1) For operation at a line power above 50 kW. a pre T.R. cell is recommended.

(2) A balanced mixer should be used wherever possible.

(3) To ensure rapid primer breakdown, the primer electrodes should be supplied from a negative voltage of at least 1,000 volts D.C.

(4) Suitable resistors should be connected in series with the electrodes to limit the current to between 100 and 185 microamperes for the main primer electrode and between 50 and 80 microamperes for the aux. primer. At least 1 megohm should be connected directly to each primer electrode terminal to prevent relaxation oscillations at the "keep alive".

(5) The maximum difference in electrical length between cells is 40 degrees.

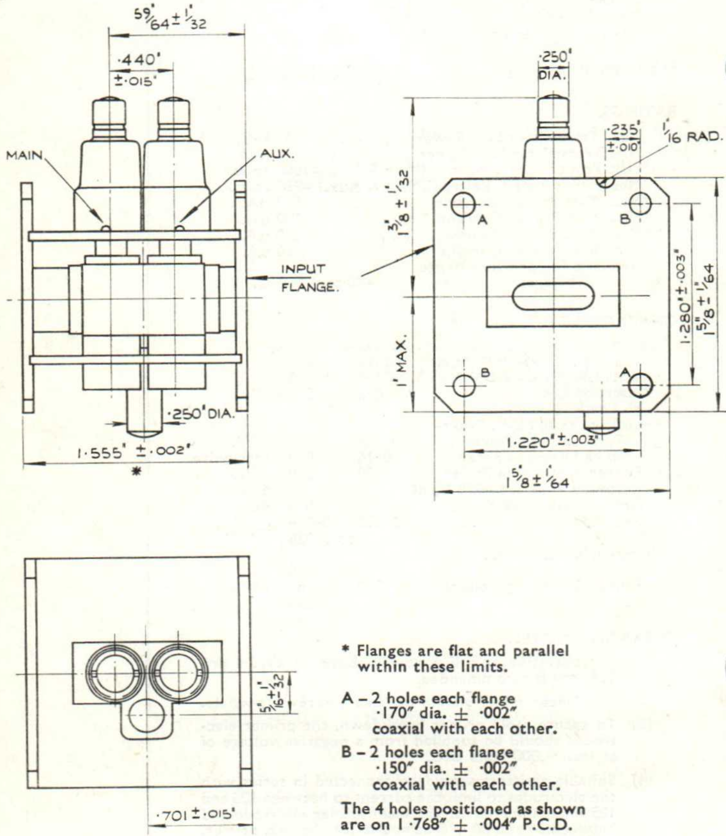
*See "Operating Notes" (3).
†See "Operating Notes" (4).
‡With primer energised.
§Measured from input flange face.

Issue 2.
June, 1960

Ferranti

Ferranti

1012




* Flanges are flat and parallel within these limits.

A – 2 holes each flange ·170" dia. ± ·002" coaxial with each other.

B – 2 holes each flange ·150" dia. ± ·002" coaxial with each other.

The 4 holes positioned as shown are on 1·768" ± ·004" P.C.D.

Ferranti

# TR. CELL

A broad band T. R. Cell specially developed for high reliability and long life. Suitable for use in branched or balanced duplexer systems.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... | See outline drawing overleaf |
| Waveguide ... ... | W.G.16 (0·4″×0·9″). |
| Mounting Position ... | Any. |
| Max. Waveguide Pressure | 30 lbs./sq. in. |

FREQUENCY RANGE ... ... 8500 to 9300 Mc/s.

## RATINGS.

| | |
|---|---|
| Max. Transmitter Line Power ... | 200 kW. |
| Min. Transmitter Line Power ... ... | 4 kW. |
| *Max. Primer Supply Voltage (Main & Aux.) | –1500 volts. |
| *Min. Primer Supply Voltage (Main & Aux.) | –950 volts. |
| Max. Main Primer Current ... ... | 185 μA. |
| Min. Main Primer Current ... ... | 100 μA. |
| Max. Aux. Primer Current ... ... | 80 μA. |
| Min. Aux. Primer Current ... ... | 50 μA. |
| Ambient Temperature Range (Storage) ... ... | –40 to + 100°C. |

## CHARACTERISTICS.

| | Average | Limit. | |
|---|---|---|---|
| †Low Power Level. | | | |
| V.S.W.R. (8500–9300 Mc/s.) | 1·2 | 1·3 | |
| ‡Insertion Loss ... ... | 0·5 | 0·8 | dB. |
| §High Power Level. | | | |
| Leakage at 200 kW. Peak :– | | | |
| Total Leakage Power ... | 45 | 100 | mW. |
| Spike Leakage Energy ... | 0·16 | 0·3 | ergs/pulse |
| Primer Breakdown Power | 150 | 250 | mW. |
| Recovery Time (to –6dB loss) | 1 | 3 | μS. |
| Arc Loss (at 4 kW.) ... | — | 0·8 | dB. |
| **Position of Min. V.S.W. | 0·020 | 0·021 ± ·007 | ins. |
| Primer Operating Voltage... | 210 | 180 to 280 | volts. |

## OPERATING NOTES.

(1) For operation at a line power above 50 kW. a pre-TR. cell is recommended.

(2) A balanced mixer should be used wherever possible.

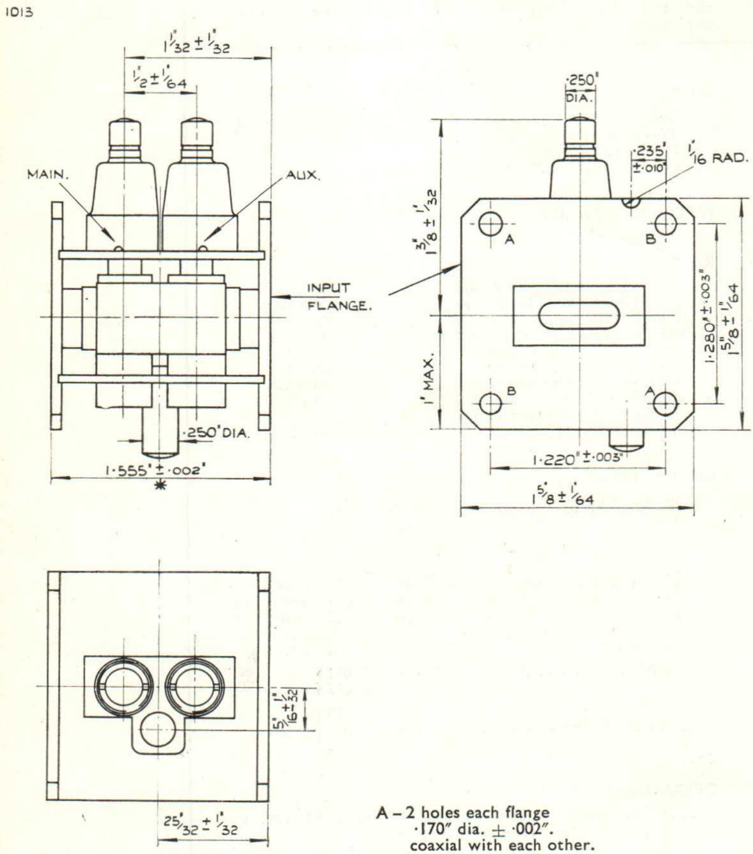
(3) The maximum difference in electrical length between cells is 40 degrees.

(4) To ensure rapid primer breakdown, the primer electrodes should be supplied from a negative voltage of 1000 volts D.C. Suitable resistors should be connected in series with the electrodes to limit the current to between 100 and 185 microamperes for the main primer electrode and between 50 and 80 microamperes for the aux. primer. At least 1 megohm should be connected directly to each primer electrode terminal to prevent relaxation oscillations at the "keep alive".

*See note (4) under "Operating Notes".
†Unfired Characteristics.
‡With primer energised.
§Fired Characteristics.
**Measured from input flange face.

Issue 3
Jan., 1961

Ferranti




A – 2 holes each flange
·170″ dia. ± ·002″.
coaxial with each other.

B – 2 holes each flange
·150″ dia. ± ·002″
coaxial with each other.

The 4 holes positioned as shown are on 1·768″ ± ·004″ P.C.D.

Ferranti

# T.R. CELL

A broad band T.R. Cell with two keep-alive electrodes and suitable for pre-pulsing. May be used in branched duplexer or balanced duplexer systems.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... | See outline drawing overleaf |
| Waveguide ... ... | W.G.16 (0·4" × 0·9"). |
| Primer Terminals ... | C.T.I. |
| Mounting Position ... | Any. |
| Max. Waveguide Pressure | 30 lbs./Sq. in. |

FREQUENCY RANGE ... ... 8500 to 10000 Mc/s.

## RATINGS.

| | |
|---|---|
| Max. Transmitter Line Power ... | 200 kW. |
| Min. Transmitter Line Power ... ... | 4 kW. |
| *Max. D.C. Primer Supply Voltage ... | −1500 volts. |
| *Min. D.C. Primer Supply Voltage ... | −950 volts. |
| *Max. D.C. Primer Current ... ... | 185 μA. |
| *Min. D.C. Primer Current ... ... | 100 μA. |
| †Max. Peak P.P. Primer Supply Voltage | −650 volts ± 10%. |
| †Max. P.P. Primer Current ... ... | 10 mA. |
| Ambient Temperature Range (not operating) ... ... | −40 to + 100°C. |

## CHARACTERISTICS.

| | Limit. |
|---|---|
| Low Power Level | |
| V.S.W.R. (8500–8850 Mc/s.) ... ... | 1·4 |
| V.S.W.R. (8850–9850 Mc/s.) ... ... | 1·25 |
| V.S.W.R. (9850–10000 Mc/s.) ... | 1·3 |
| §Insertion Loss ... ... ... ... | 1·0 dB. |
| High Power Level. | |
| Leakage at 200 kW. peak :– | |
| Total Leakage Power (unpulsed) ... | 100 mW. |
| Spike Leakage Energy (unpulsed) ... | 0·3 ergs/pulse. |
| Spike Leakage Energy (pulsed) ... | 0·1 ergs/pulse. |
| Primer Breakdown Power ... ... | 250 mW. |
| Recovery Time (to −6dB) ... ... | 3 μsec. |
| Arc Loss (at 4 kW.) ... ... ... | 0·8 dB. |
| ‡Position of Min. V.S.W. ... | 0·014 to 0·028 ins. |
| Primer Characteristics. | |
| D.C. Primer Operating Voltage | 180 to 280 volts. |

## OPERATING NOTES.

(1) For operation at a line power above 50 kW. a pre T.R. cell is recommended.

(2) A balanced mixer should be used wherever possible.

(3) There are two primer electrodes, one of which is designed to operate as a pulsed electrode and is marked P.P. The other is D.C. primed and is marked D.C.

(4) The leading edge of the pre-pulse must precede the main R.F. pulse by 0·2/μsecs. and should be applied to the pre-pulse electrode through a 50 KΩ resistor which must be immediately adjacent to the pre-pulse terminal.
Pre-pulse Characteristics.
Peak amplitude : 650 V. ± 10%. Duration : 2/μsecs.

(5) The D.C. Primer Electrode should be supplied from a negative potential Source of 1000 volts D.C. minimum. Suitable resistors should be used to limit the electrode current to between 100 and 185 microamperes At least one megohm must be placed immediately adjacent to the electrode terminal to prevent relaxation oscillations.

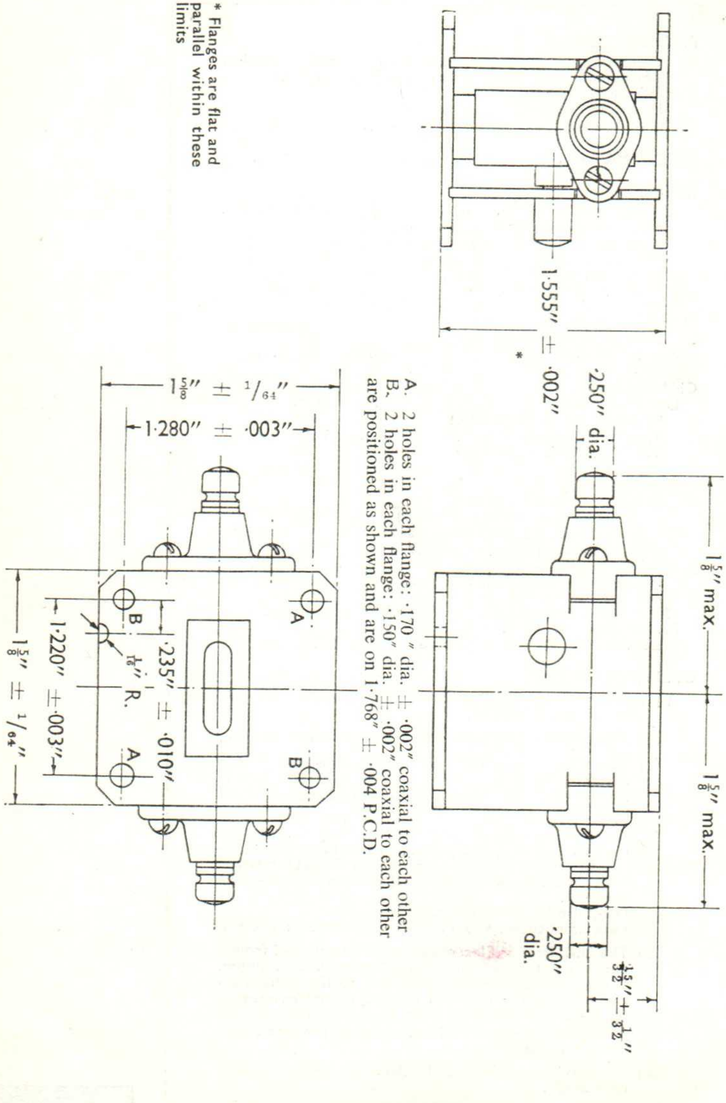
(6) The maximum difference in electrical length between cells is 40°.

*See "Operating Notes" (3) and (5).
†See "Operating Notes" (3) and (4).
§With Primer energised.
‡Measured from input flange face.

Issue 2
June, 1960

Ferranti

# WF44


1·555″ ± ·002″
*
·250″ dia.
1 5/8″ max.
1 5/8″ max.
·250″ dia.
15/32″ ± 1/32″
A. 2 holes in each flange: ·170″ dia. ± ·002″ coaxial to each other
B. 2 holes in each flange: ·150″ dia. ± ·002″ coaxial to each other
are positioned as shown and are on 1·768″ ± ·004 P.C.D.
1 5/8″ ± 1/64″
1·280″ ± ·003″
A
B
B
A
·235″ ± ·010″
1/16″ R.
1·220″ ± ·003″
1 5/8″ ± 1/64″
* Flanges are flat and parallel within these limits

Ferranti

# T.R. CELL

A broad band T.R. self-operating in the frequency range 8490 Mc/s. to 9578 Mc/s. May be used in branched duplexer or balanced duplexer systems.
It is equivalent to the American type 1B63A.

## PHYSICAL DATA.

| | |
|---|---|
| Dimensions ... ... | See outline drawing overleaf. |
| Waveguide ... ... | W.G.16 (0·4″ × 0·9″). |
| Mounting Position ... | Any. |
| Max. Waveguide Pressure | 30 lbs./Sq. in. |

## FREQUENCY RANGE ... 8490 to 9578 Mc/s.

## RATINGS.

| | |
|---|---|
| Max. Transmitter Line Power ... | 200 kW. |
| Min. Transmitter Line Power ... ... | 4 kW. |
| *Max. Primer Supply Voltage ... ... | −1500 volts. |
| *Min. Primer Supply Voltage ... ... | −650 volts. |
| †Max. Primer Current ... ... ... | 180 μA. |
| †Min. Primer Current ... ... ... | 100 μA. |
| Ambient Temperature Range (Storage) ... ... | −40 to +100 °C. |

## ‡CHARACTERISTICS.

Low Power Level.

| | |
|---|---|
| V.S.W.R. (8565–9487 Mc/s.) ... ... | 1·4 |
| V.S.W.R. (8490–9578 Mc/s.) ... ... | 1·9 |
| §Insertion Loss ... ... ... ... | 0·9 dB. |

High Power Level.

| | |
|---|---|
| Leakage at 200 kW. peak :– | |
| Total Leakage Power ... ... ... | 70 mW. |
| Spike Leakage Energy ... ... | 0·2 ergs/pulse |
| Primer Breakdown Power ... ... | 250 mW. |
| Recovery Time (to −6dB. loss) ... | 4 μsec. |
| Arc Loss (at 4 kW.) ... ... ... | 0·8 dB. |
| **Position of Min. V.S.W. | 0·058″ to 0·072″ |

Primer Characteristics.

| | |
|---|---|
| Primer Operating Voltage ... | 200 to 375 volts. |

## OPERATING NOTES.

(1) For operation at a line power above 50 kW. a pre T.R. cell is recommended.

(2) To ensure rapid primer breakdown, the electrode should be supplied from a negative voltage of 1000 volts D.C.

(3) A suitable resistor should be connected in series with the electrode to limit the current to between 100 and 180 microamperes. At least 1 megohm should be connected directly to the primer electrode terminal to prevent relaxation oscillations at the "keep alive".

(4) A balanced mixer should be used wherever possible.

---

*See "Operating Notes" (above) Note (2).

†See "Operating Notes" (above) Note (3).

‡The figures quoted are "limit" figures.

§With primer energised.

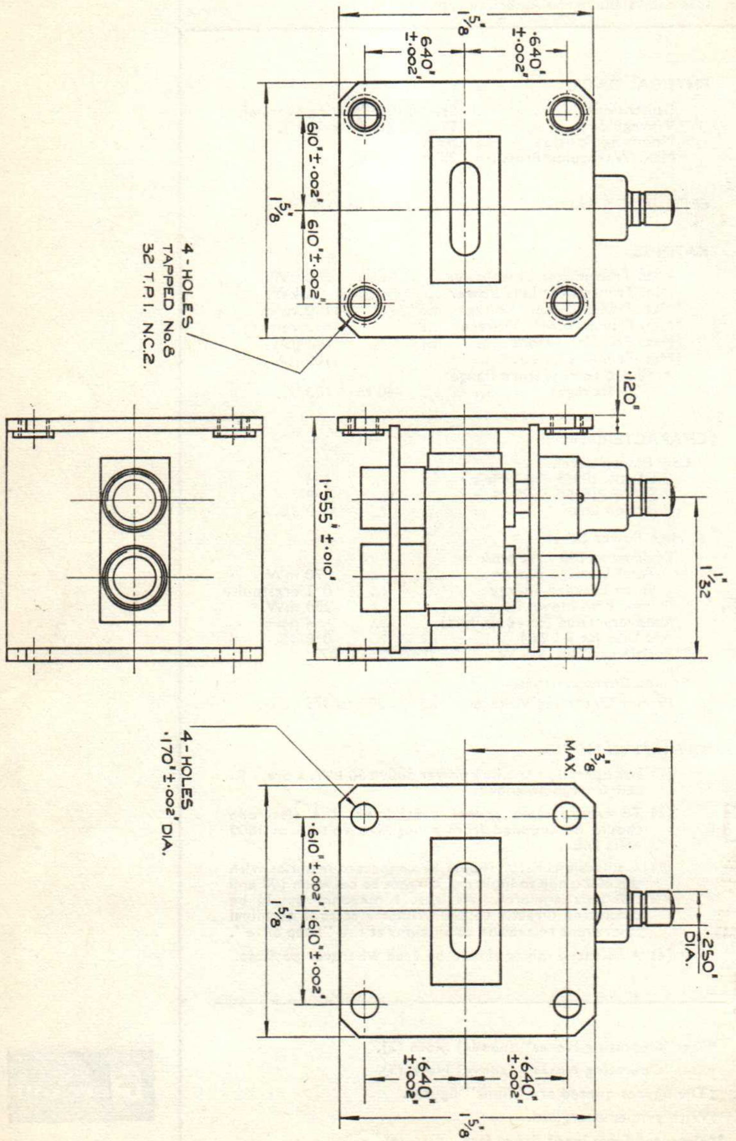
**Measured from input flange face.

Ferranti

Issue 2.
Nov. 1959

Ferranti

# WF45



FERRANTI

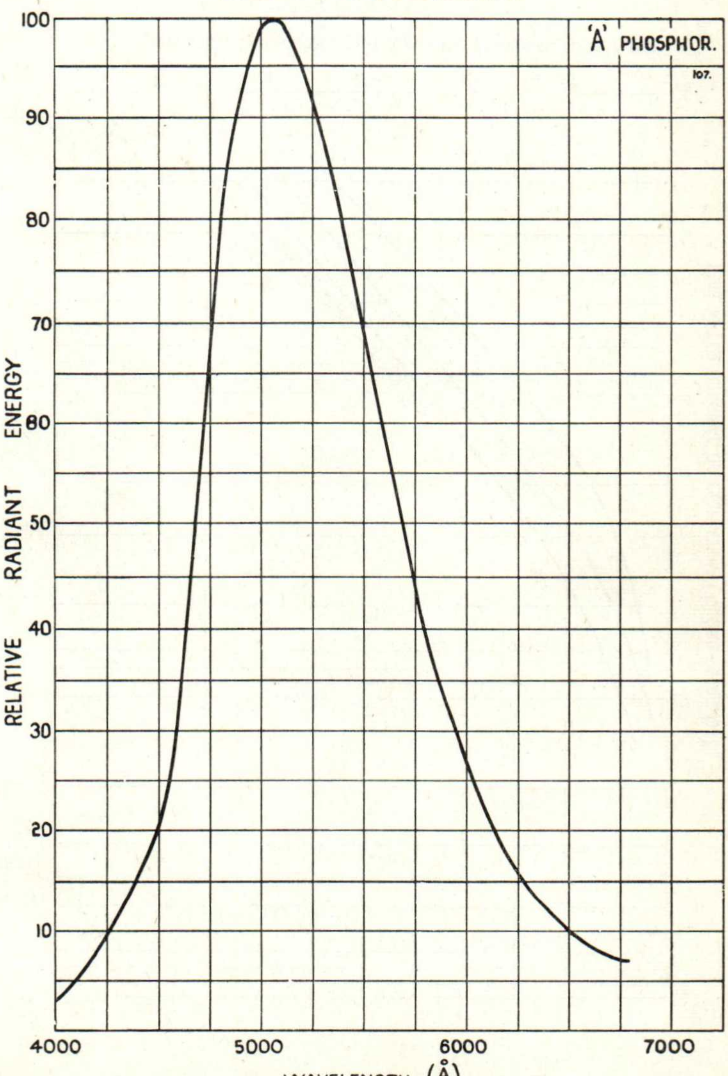
CATHODE RAY TUBES.

**Ferranti**

CATHODE RAY TUBE

# SCREEN TYPE "A"

RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC



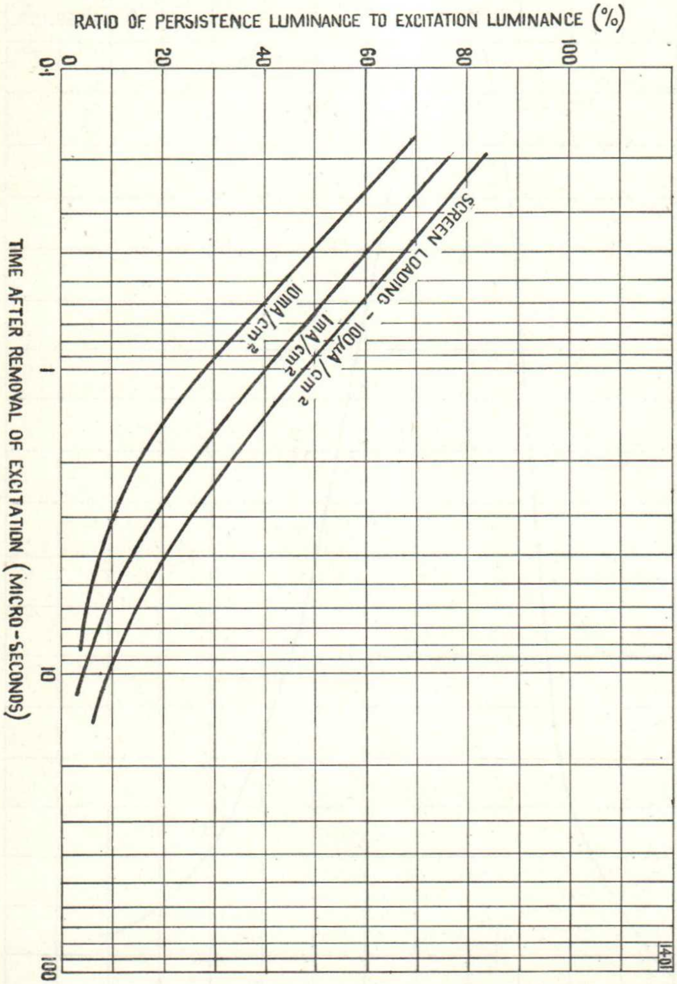

Issue 3.
Apr., 1963

THIS PHOSPHOR IS EQUIVALENT TO U.S.A. PHOSPHOR TYPE P24

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

## SCREEN TYPE "A"

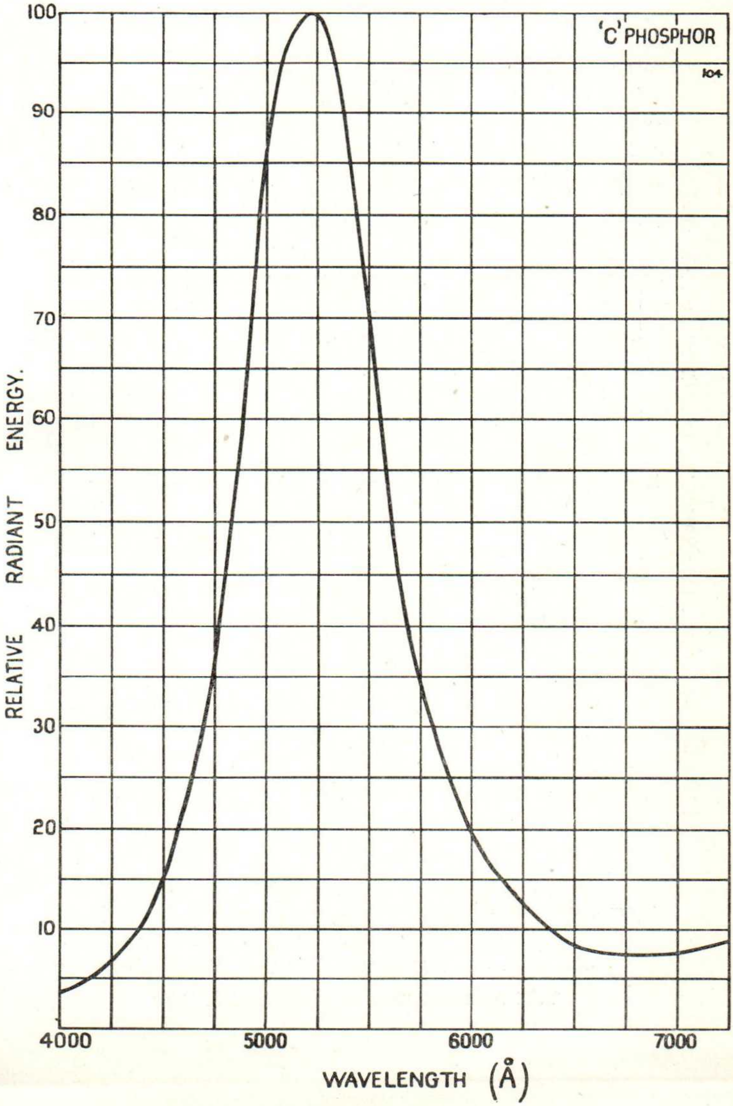
### PERSISTENCE CHARACTERISTIC



Ferranti

## CATHODE RAY TUBE
# SCREEN TYPE "C"

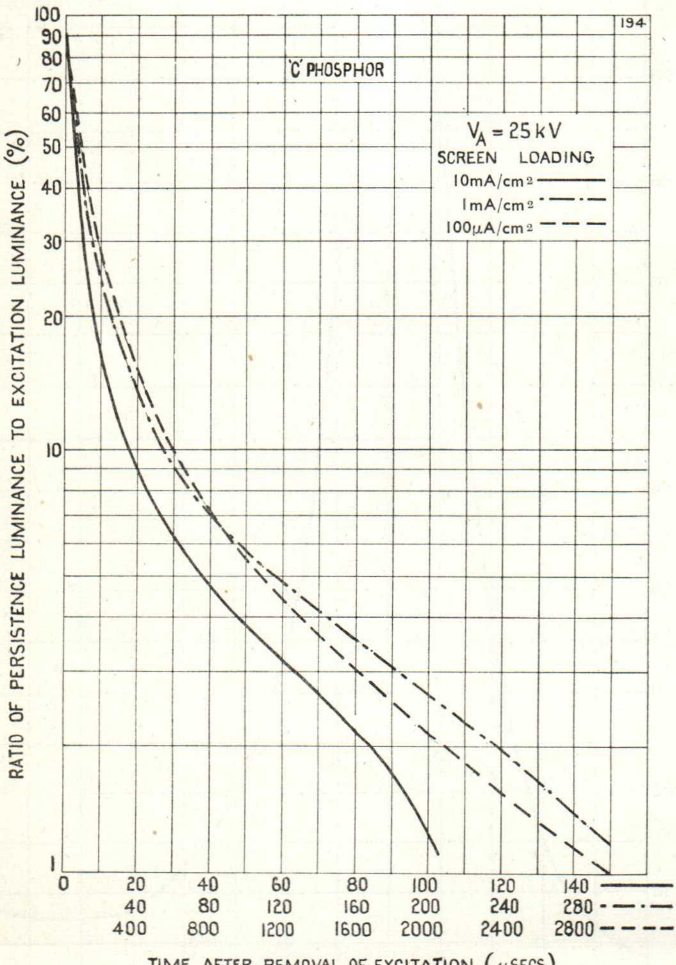
RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC




Issue 3.
Aug., 1962

# SCREEN TYPE "C"

## PERSISTENCE CHARACTERISTIC

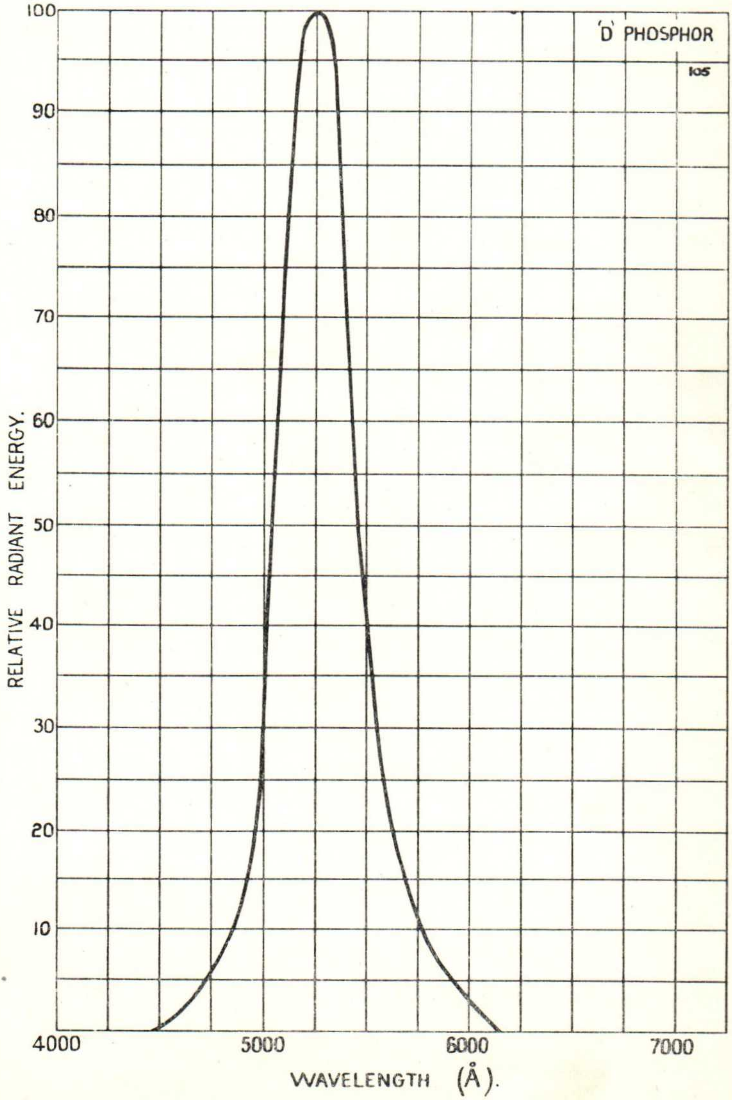


# FERRANTI

## CATHODE RAY TUBE

## SCREEN TYPE "D"

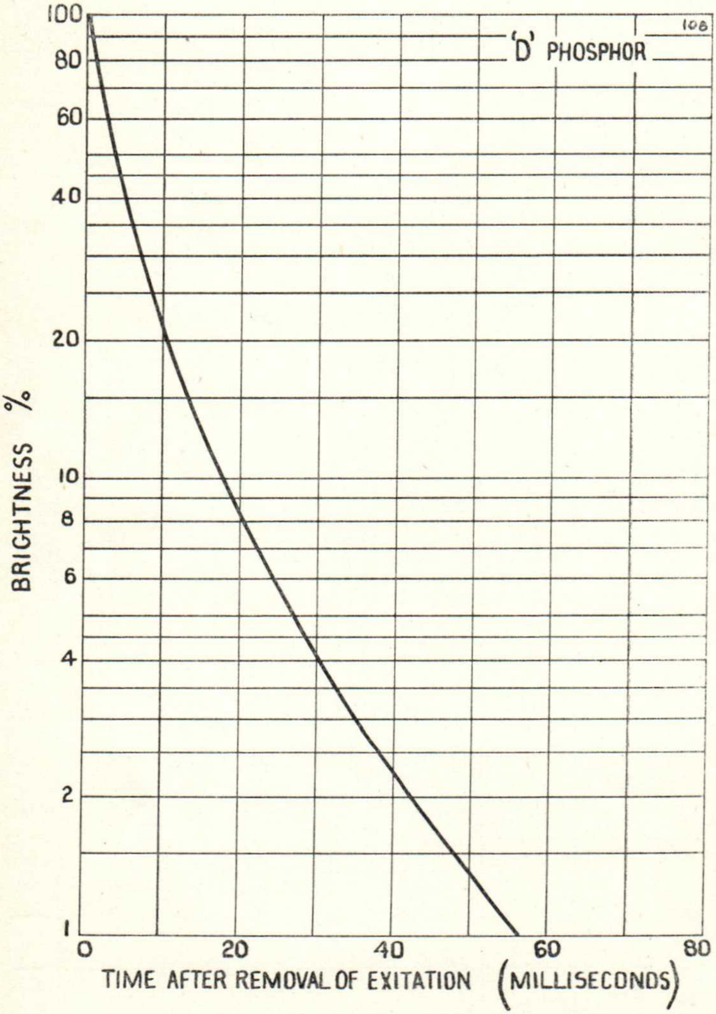
RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC




Issue I
Oct. 1956

## SCREEN TYPE "D"

PERSISTENCE CHARACTERISTIC



# Ferranti

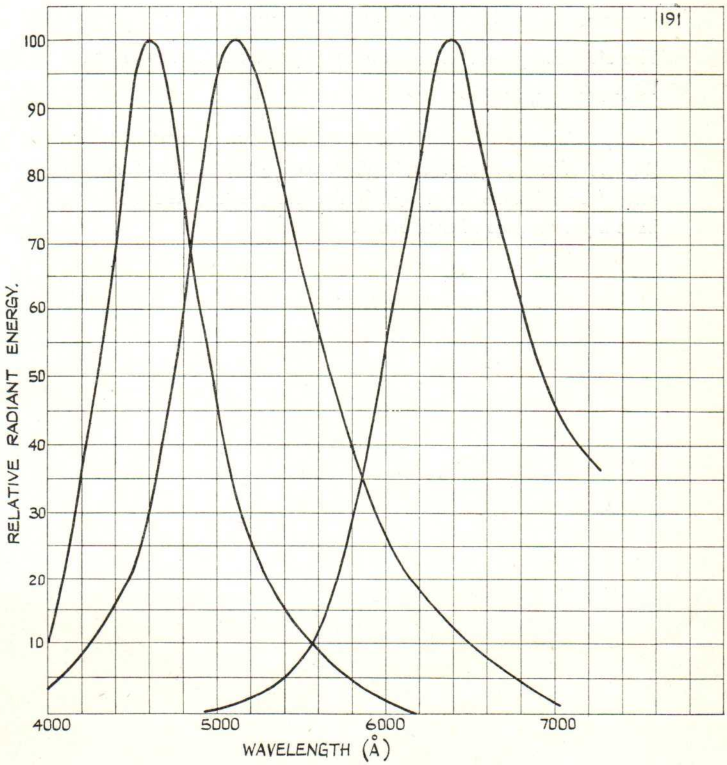
## CATHODE RAY TUBES

# SCREEN TYPE "E"

### SPECTRAL ENERGY EMISSION CHARACTERISTIC

This is a three component screen. The relative spectral emission for each component phosphor is shown. The three curves show the relative radiant energy as a percentage of the total energy for each individual phosphor, but they are not related quantitatively.

The ratios of the three components can be varied to suit customer requirement, (for some applications the blue component can be omitted).




Issue 1.
July, 1962

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

Ferranti

## SCREEN TYPE "E"

### PERSISTENCE CHARACTERISTIC

The persistence characteristic depends on the relative amounts of the three component phosphors present.

The blue component has the longest persistence (of the order 10 $\mu$Sec. to $1/_E$ level).

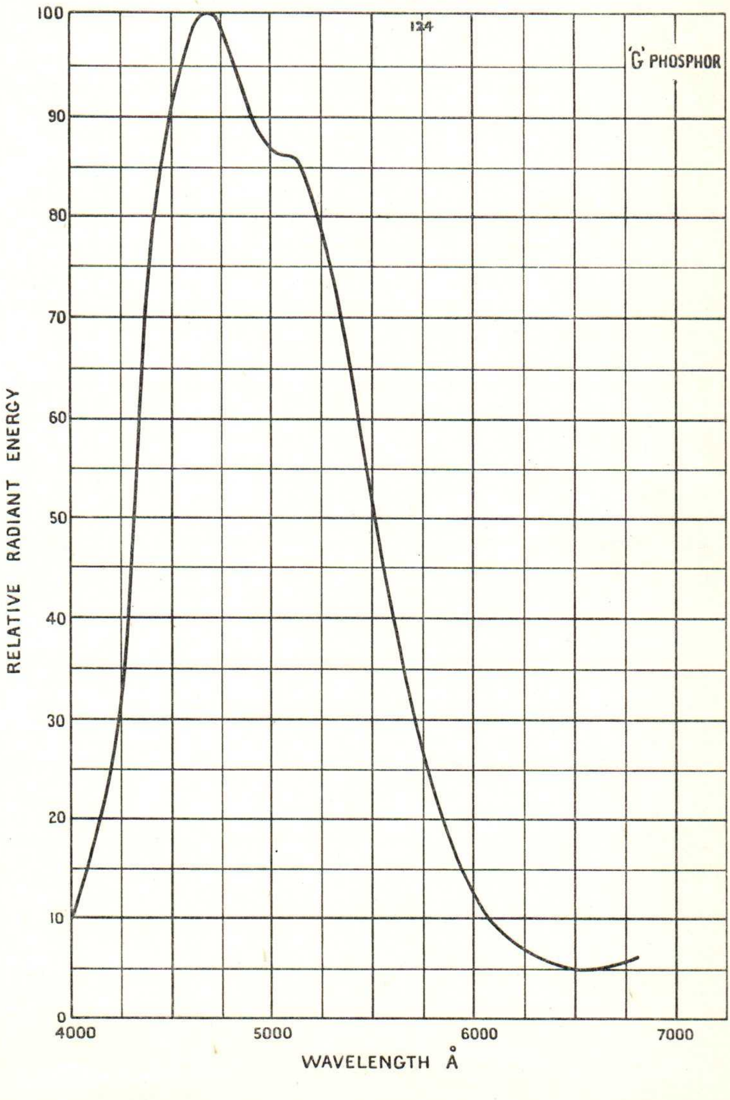
The persistence times of the red and green components are similar, of the order 1 or 2 $\mu$Sec. to $1/_E$ level; therefore any phosphor mixture from which the blue is omitted will also have a persistence of that order.

# FERRANTI

## CATHODE RAY TUBE

## SCREEN TYPE "G"

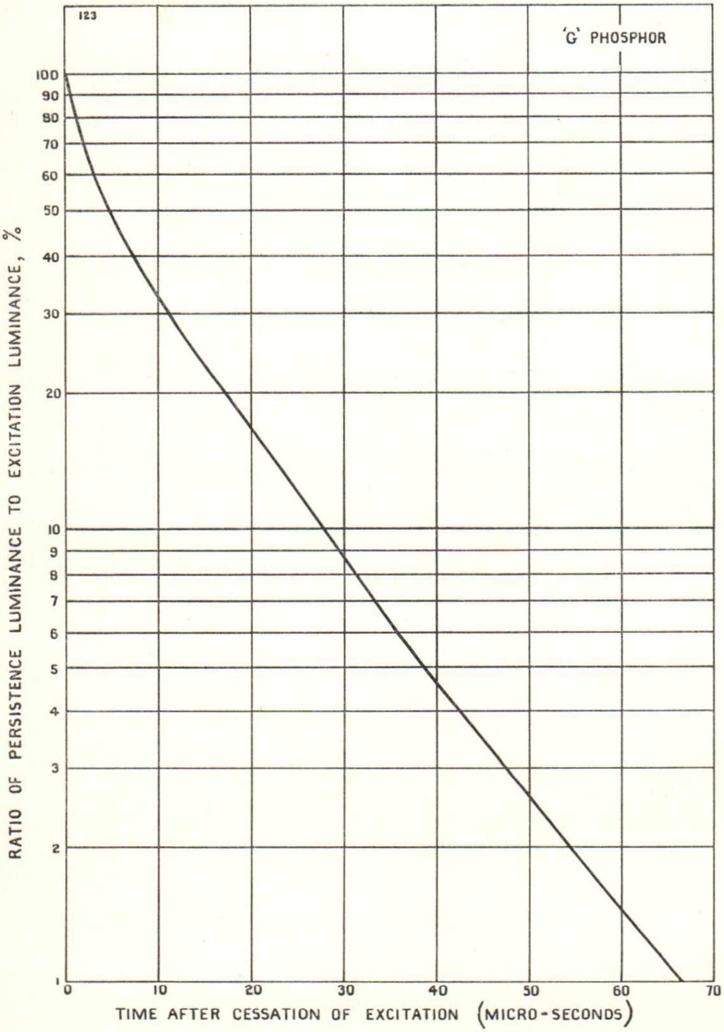
RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC




Issue 1.
Aug. 1957

## SCREEN TYPE "G"

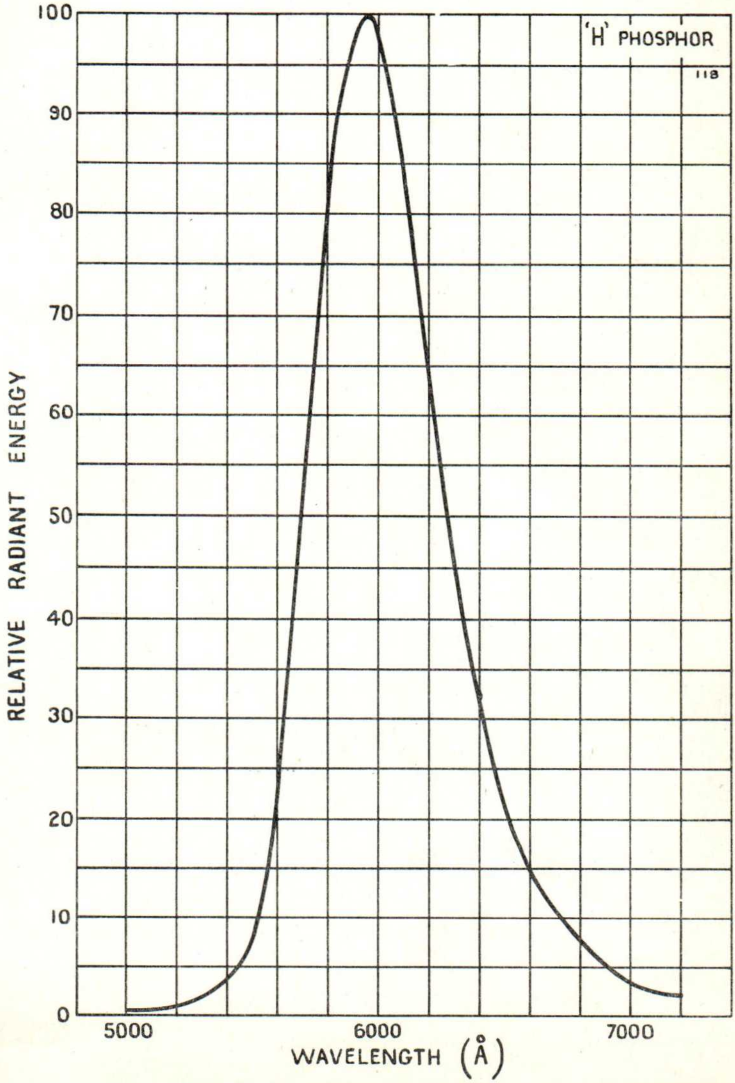
PERSISTENCE CHARACTERISTIC



Ferranti

## CATHODE RAY TUBE
# SCREEN TYPE "H"

RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC



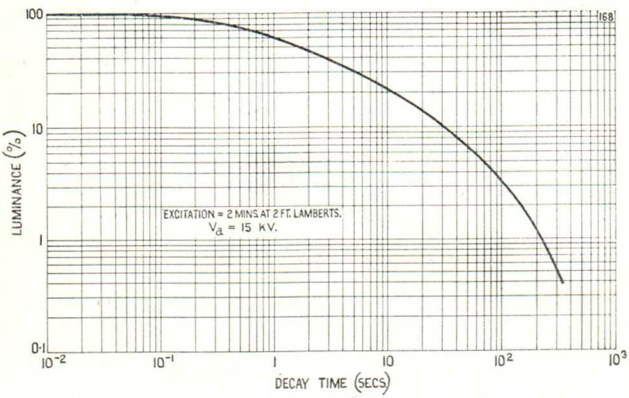

Issue 2
Feb., 1962.

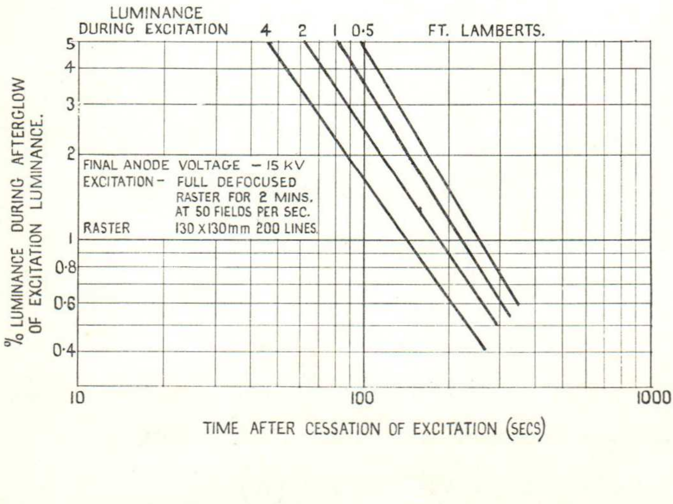
Ferranti

# SCREEN TYPE "H"

## PERSISTENCE CHARACTERISTIC

AFTERGLOW CHARACTERISTICS OF TYPE H (ALUMINISED) AT 20°C



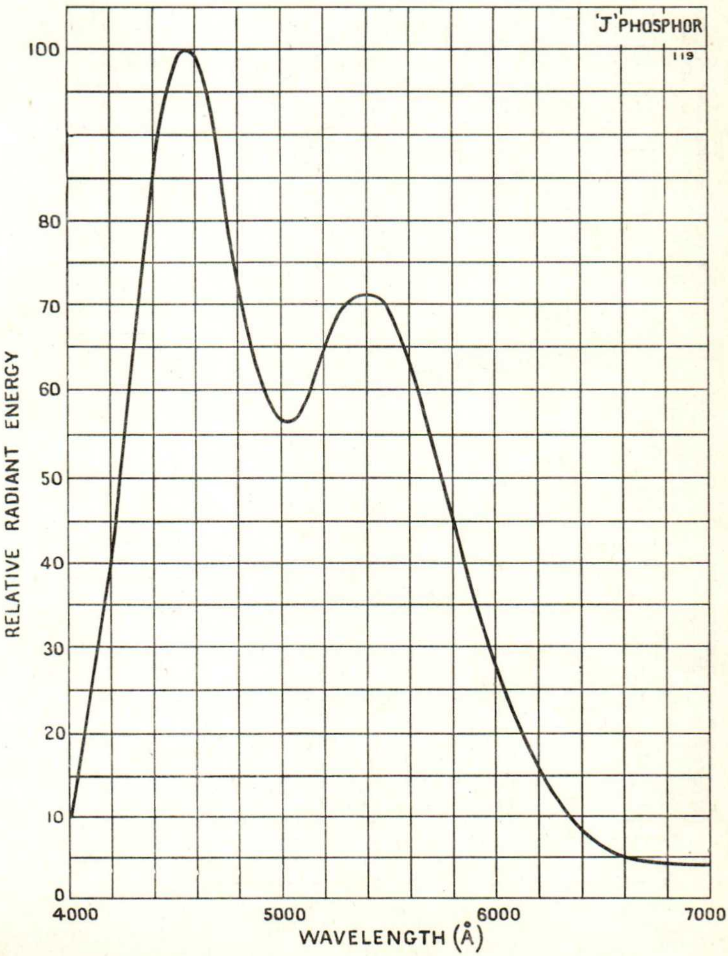



Ferranti

**CATHODE RAY TUBE**

# SCREEN TYPE "J"

## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC

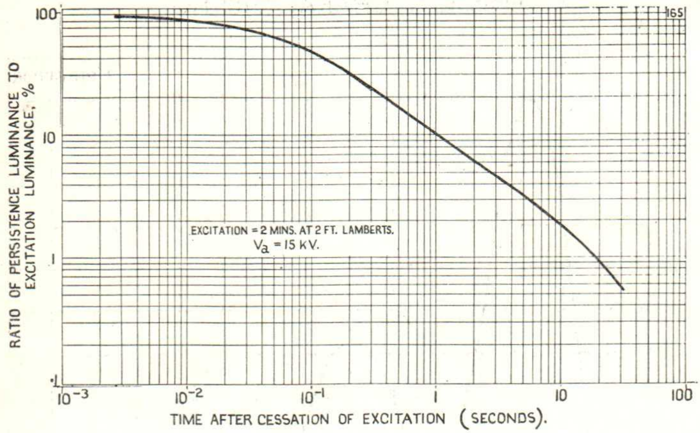


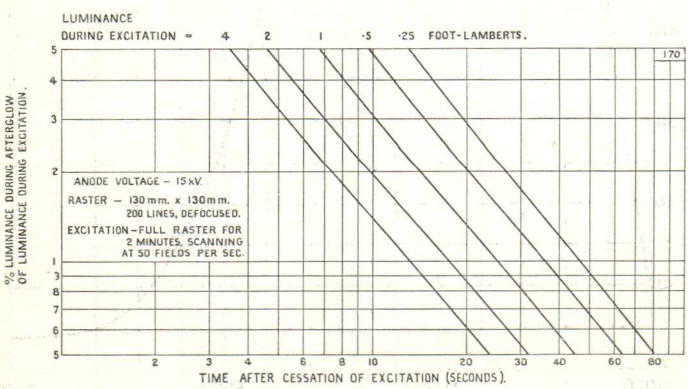

Issue 2
Jan. 1962

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

# SCREEN TYPE "J"

## PERSISTENCE CHARACTERISTICS



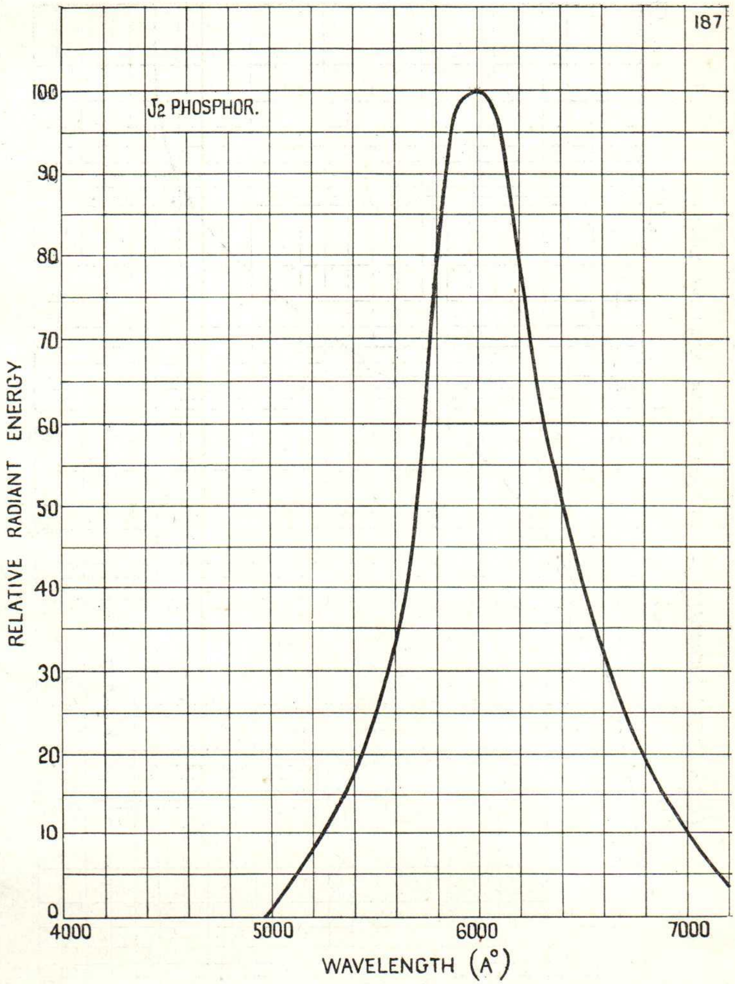



# Ferranti

## CATHODE RAY TUBES

# SCREEN TYPE "$J_2$"

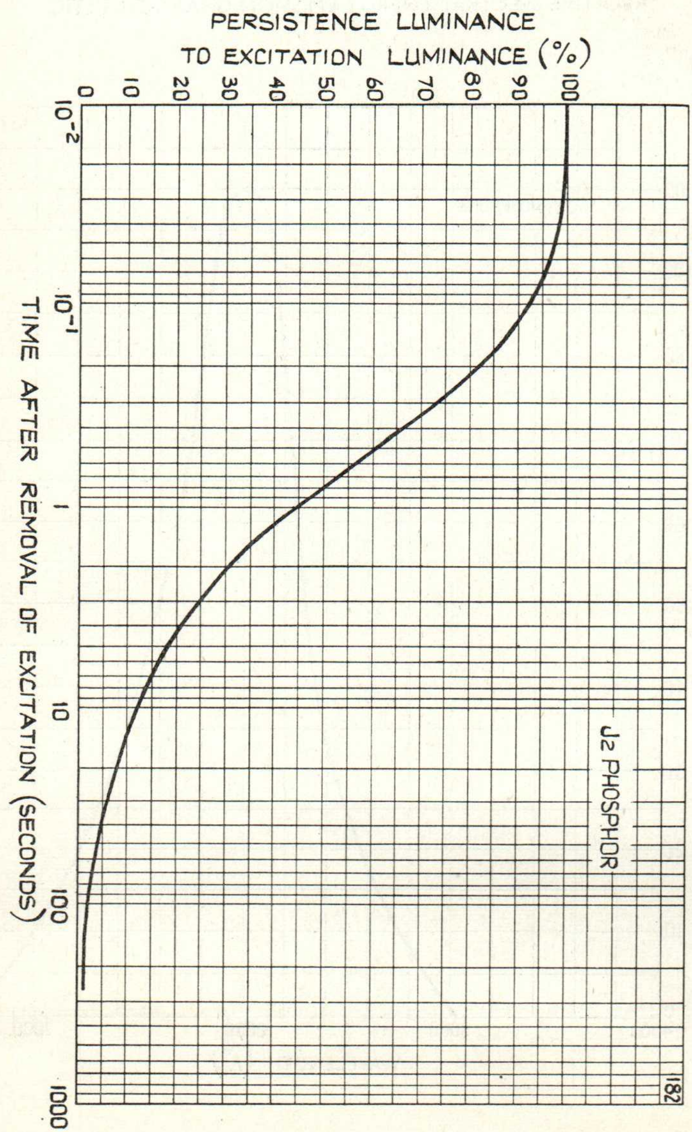
RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC




Issue I
June, 1962

## SCREEN TYPE "$J_2$"

PERSISTENCE CHARACTERISTIC

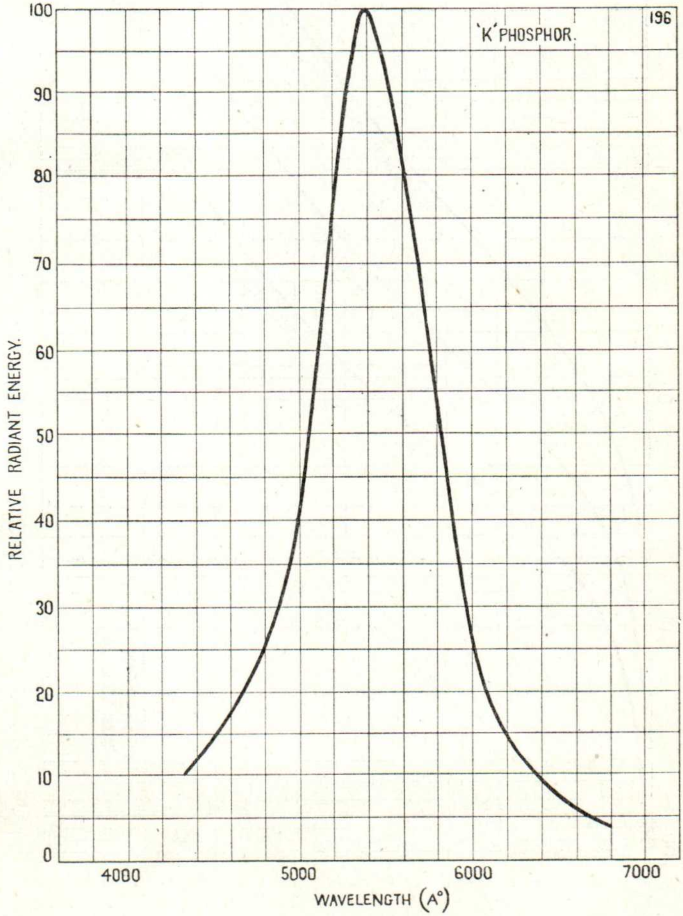


**Ferranti**

CATHODE RAY TUBE

# SCREEN TYPE "K"

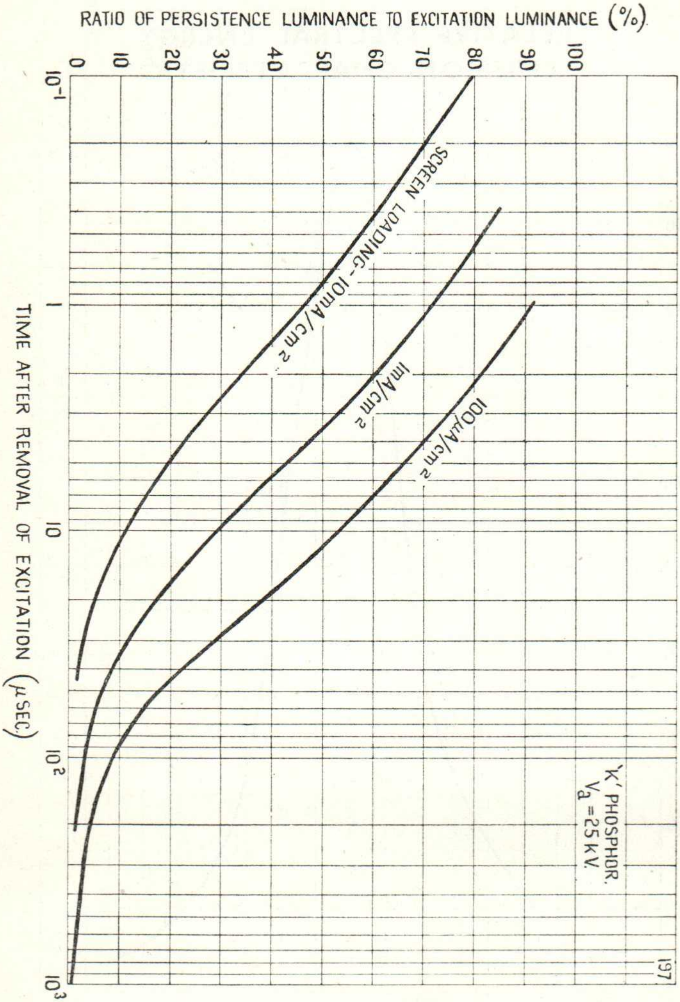
## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC




Issue 2.
Feb. 1963

# SCREEN TYPE "K"

## PERSISTENCE CHARACTERISTIC



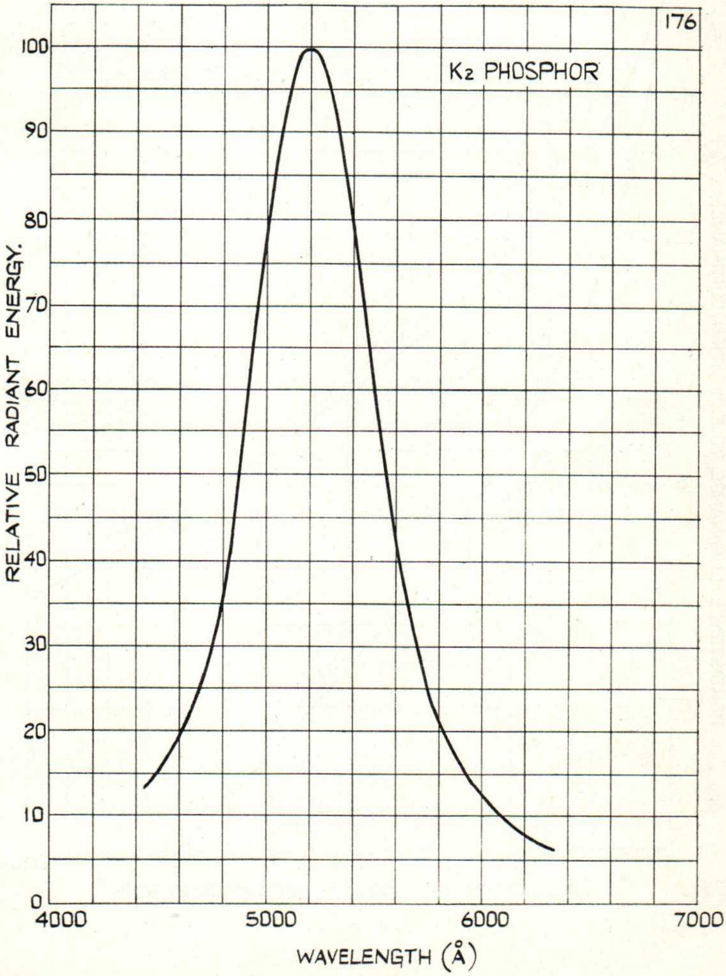

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

Ferranti

CATHODE RAY TUBE

# SCREEN TYPE "K2"

## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC

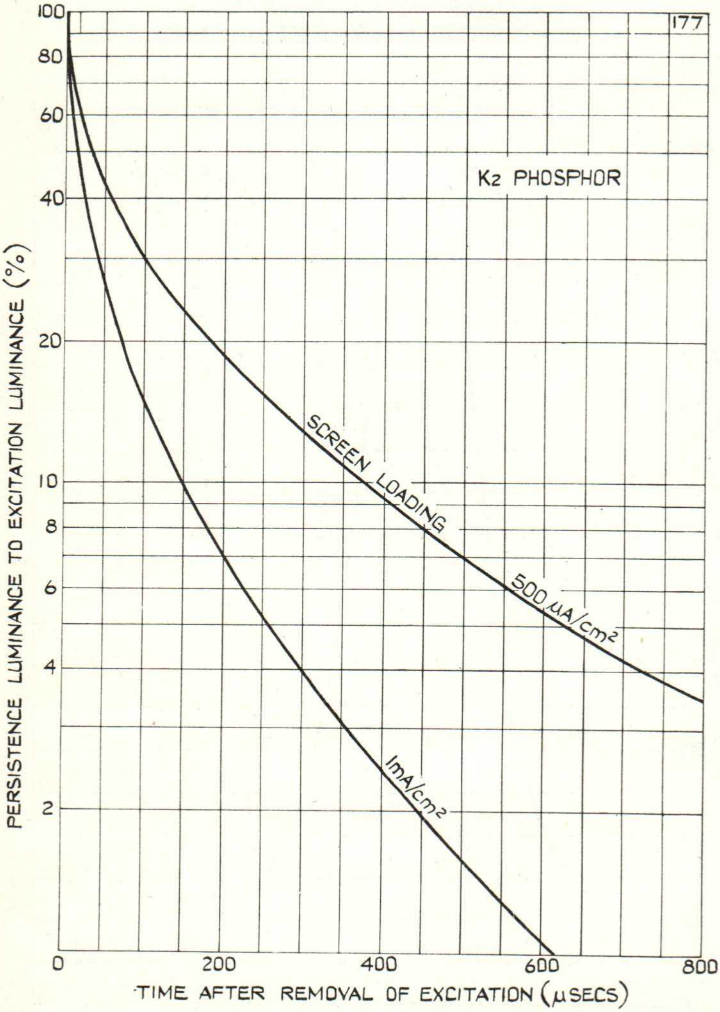



Issue 2
May, 1962

Ferranti

# SCREEN TYPE "K2"

## PERSISTENCE CHARACTERISTIC

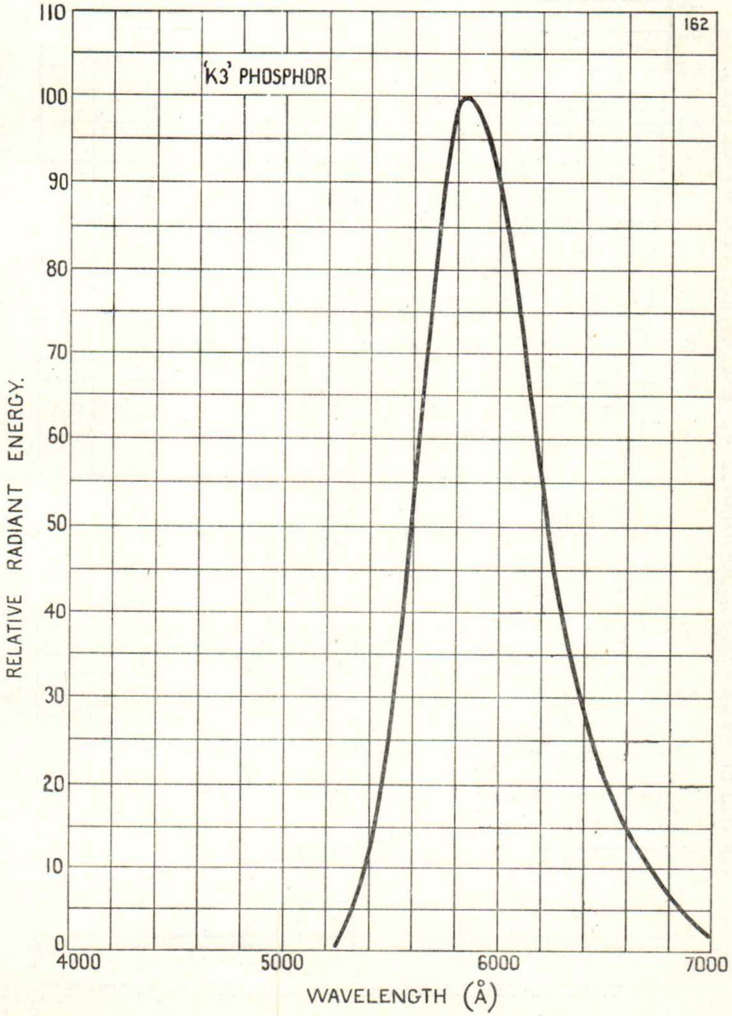



FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

**CATHODE RAY TUBE**

# SCREEN TYPE "K3"

RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC

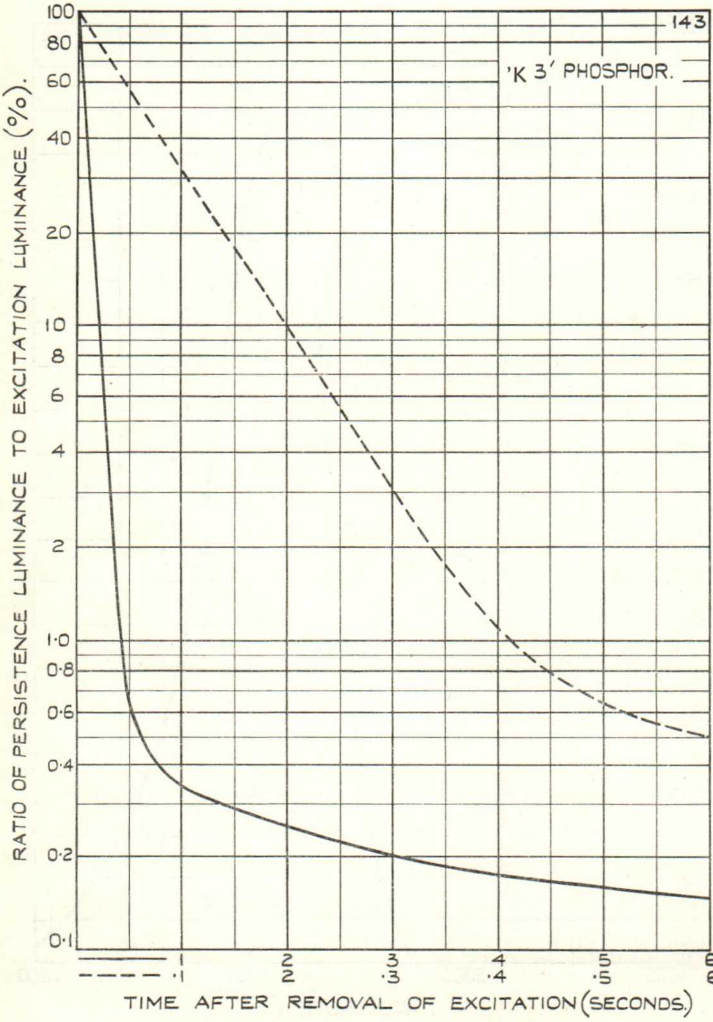



THIS PHOSPHOR IS EQUIVALENT TO U.S.A. PHOSPHOR TYPE P12.


Issue 2
Aug. 1961

# SCREEN TYPE "K3"

PERSISTENCE CHARACTERISTIC

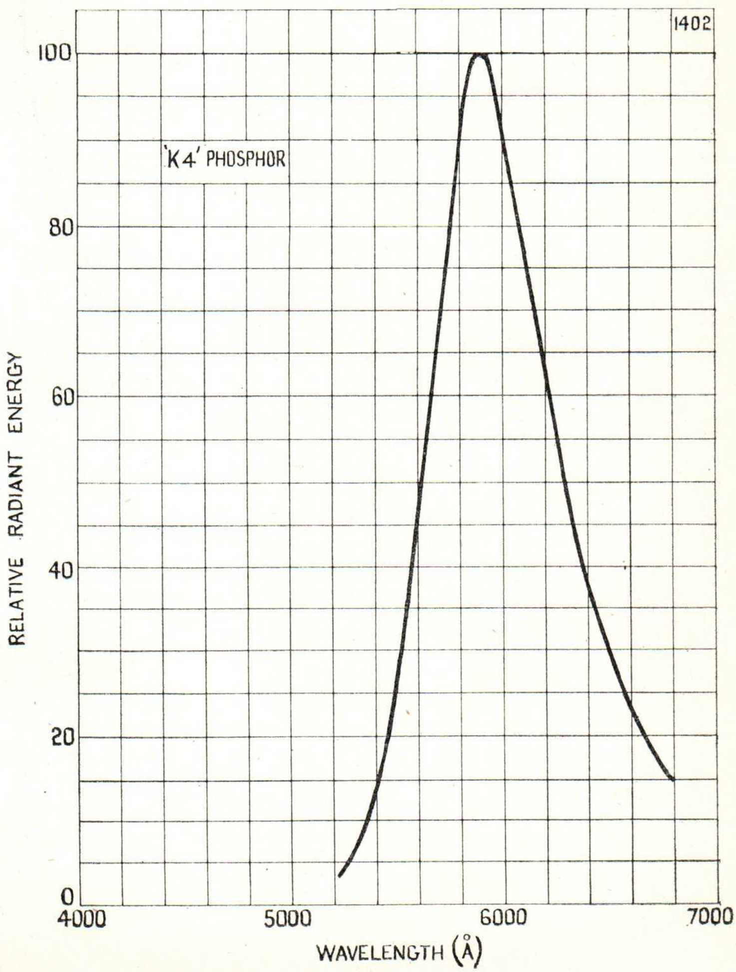


Ferranti

CATHODE RAY TUBE

# SCREEN TYPE "K4"

## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC

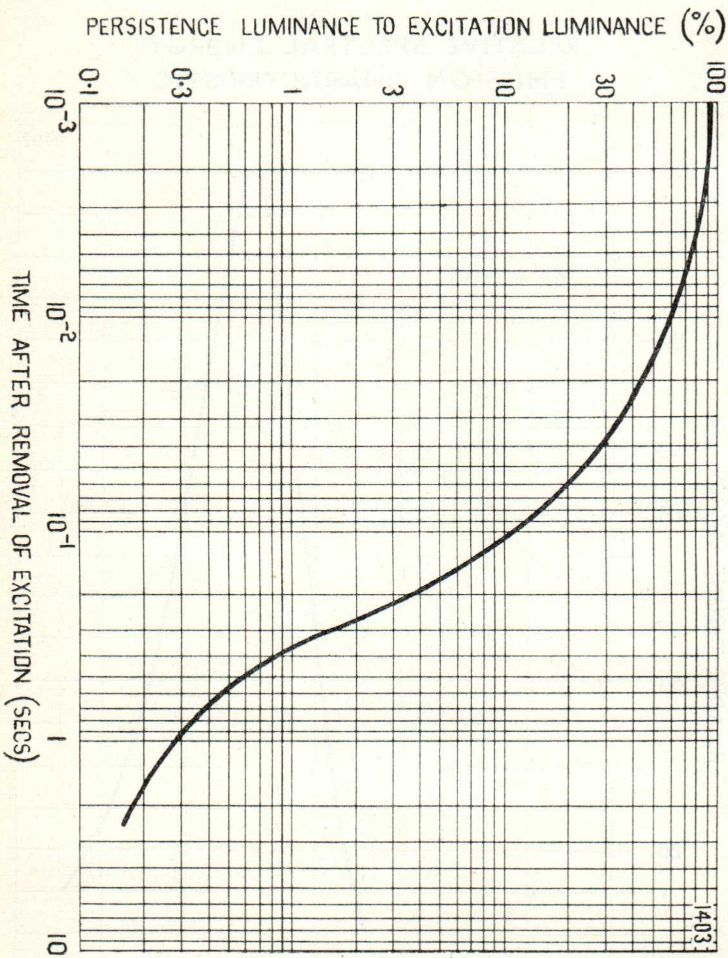



Issue 1.
May, 1963

Ferranti

## SCREEN TYPE "K4"

### PERSISTENCE CHARACTERISTIC

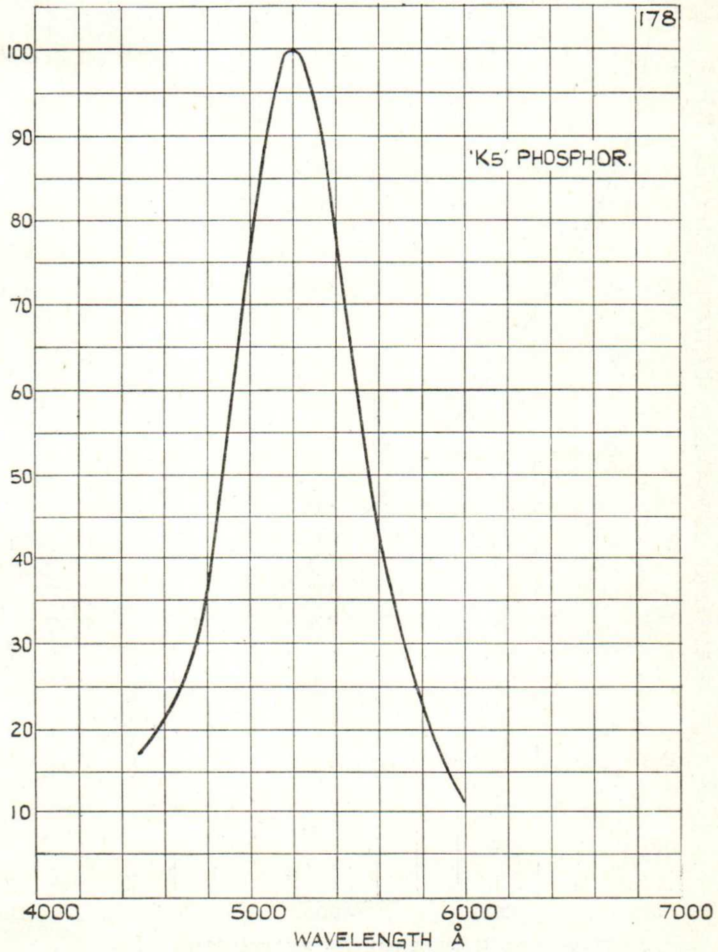



FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

**Ferranti**

## CATHODE RAY TUBE
# SCREEN TYPE 'K5'

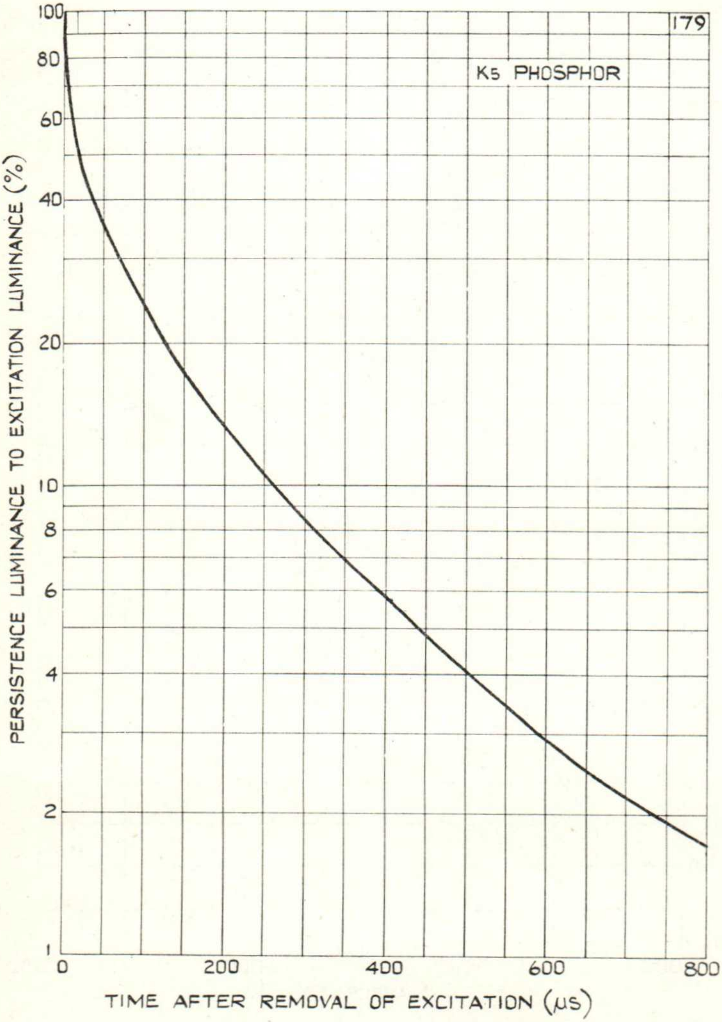
## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC




Issue 1
June 1962

Ferranti

# SCREEN TYPE 'K5'
## PERSISTENCE CHARACTERISTIC

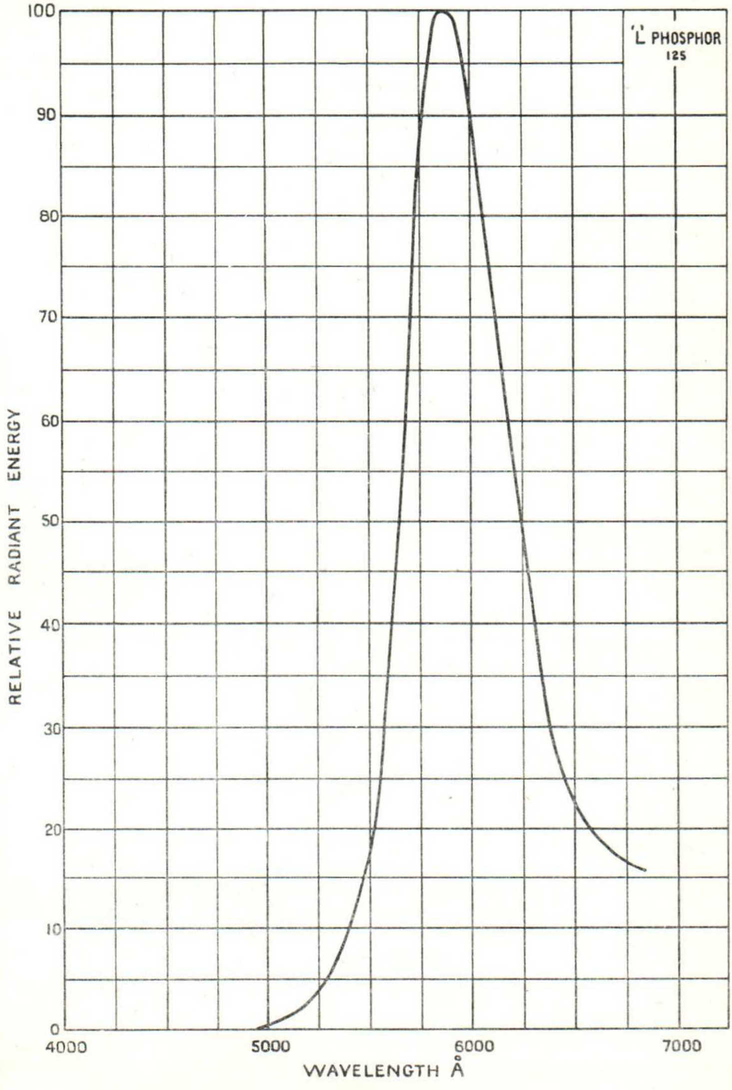


**Ferranti**

## CATHODE RAY TUBE

# SCREEN TYPE "L"

RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC



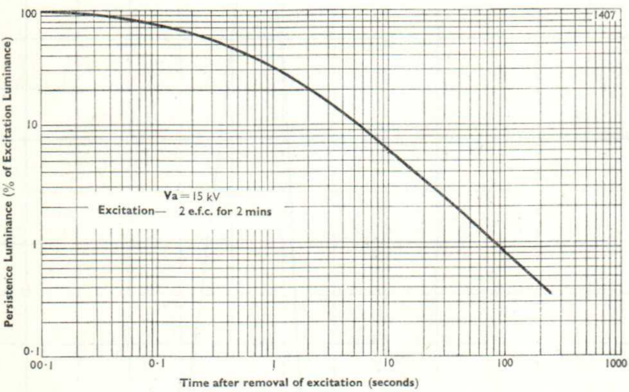

Issue 3.
Aug., 1963

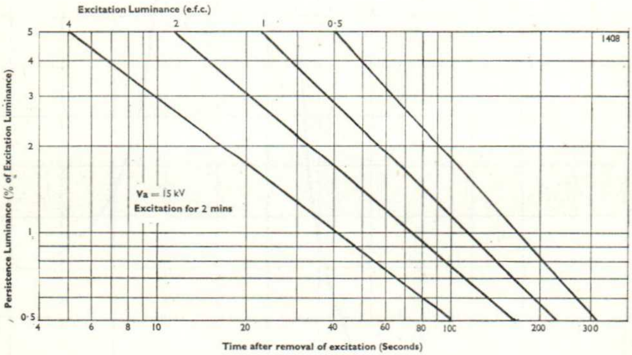
FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

Ferranti

# SCREEN TYPE "L"

AFTERGLOW CHARACTERISTICS of TYPE "L" PHOSPHOR AT 20°C

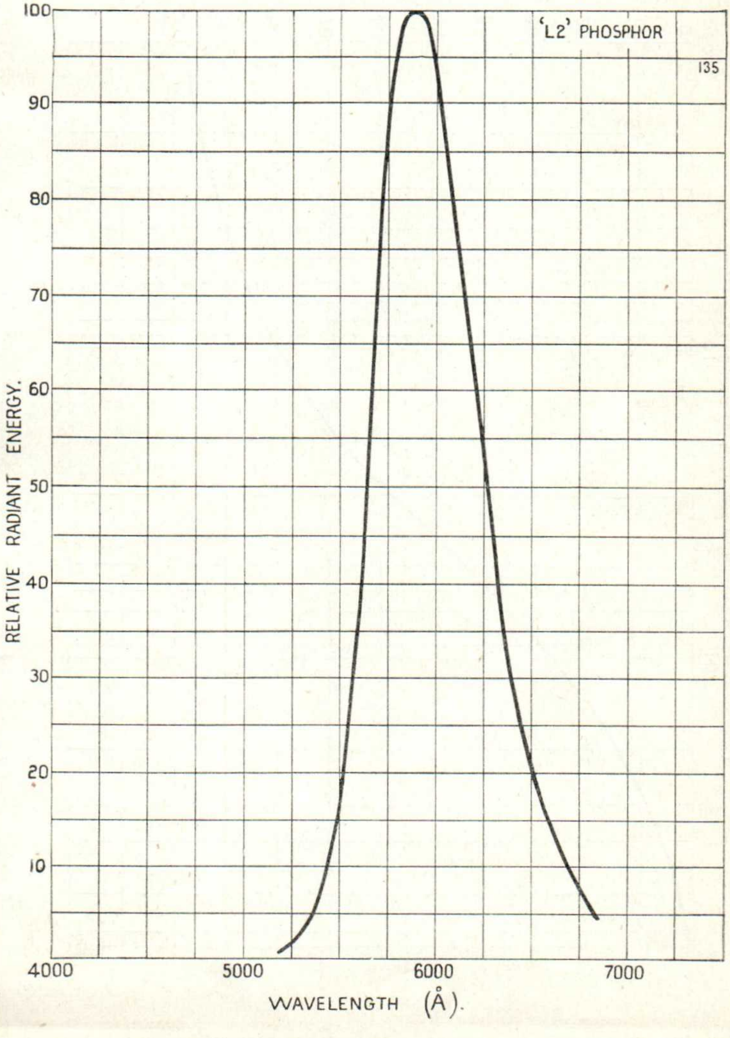


**Ferranti**

## CATHODE RAY TUBES
# SCREEN TYPE "L2"

### RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC

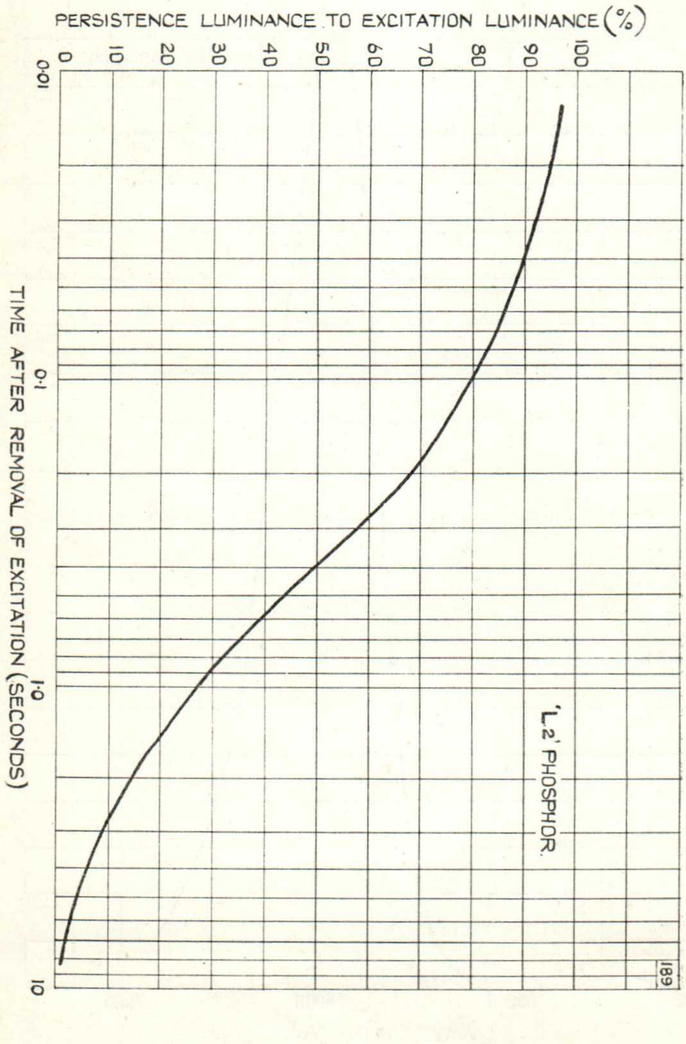



Issue 2.
Oct., 1962

Ferranti

# SCREEN TYPE "L2"

## PERSISTENCE CHARACTERISTIC

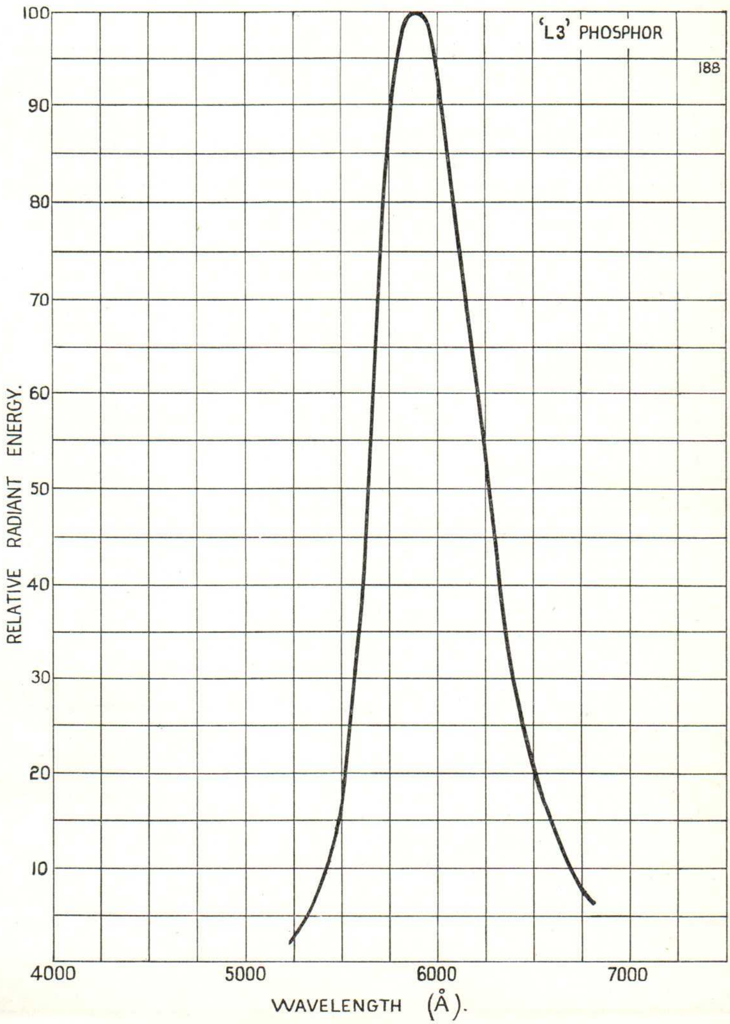


# Ferranti

## CATHODE RAY TUBES

# SCREEN TYPE "L3"

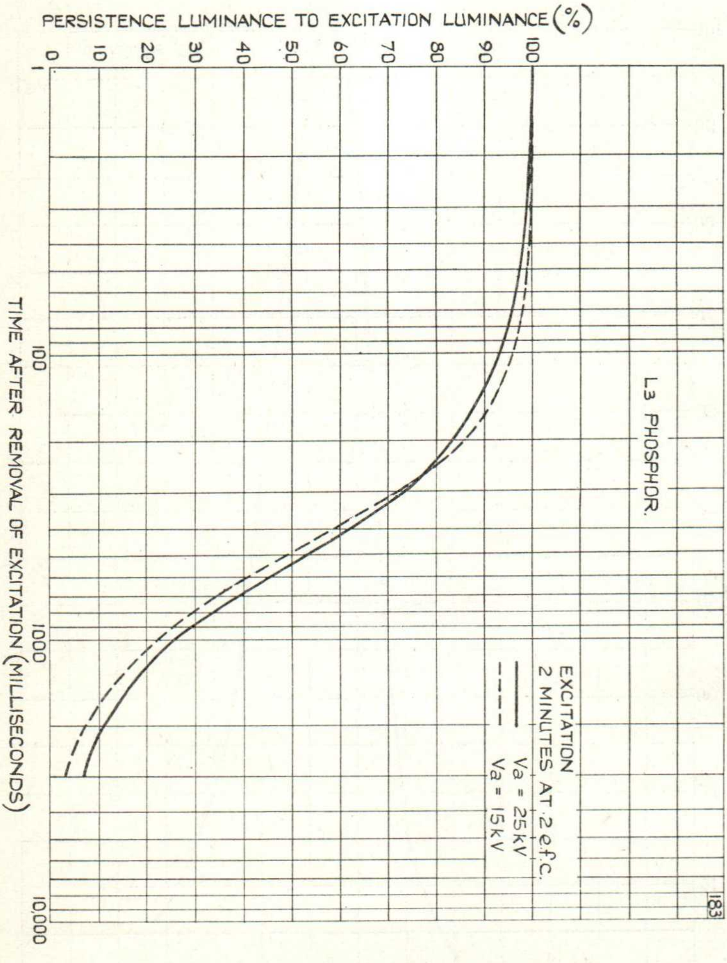
RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC




Issue 1.
June, 1962

# SCREEN TYPE "L3"

PERSISTENCE CHARACTERISTIC

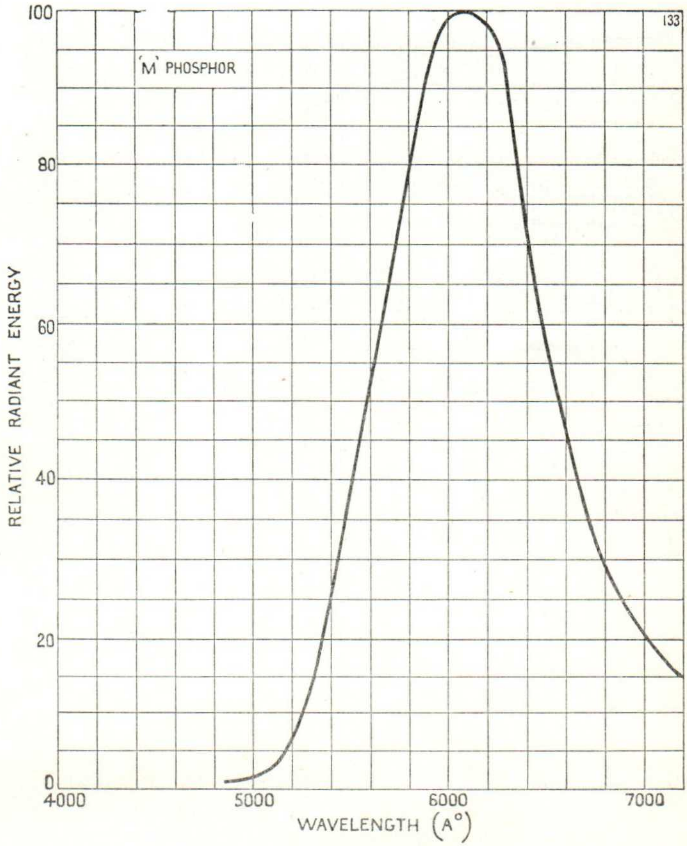


Ferranti

CATHODE RAY TUBES

# SCREEN TYPE "M"

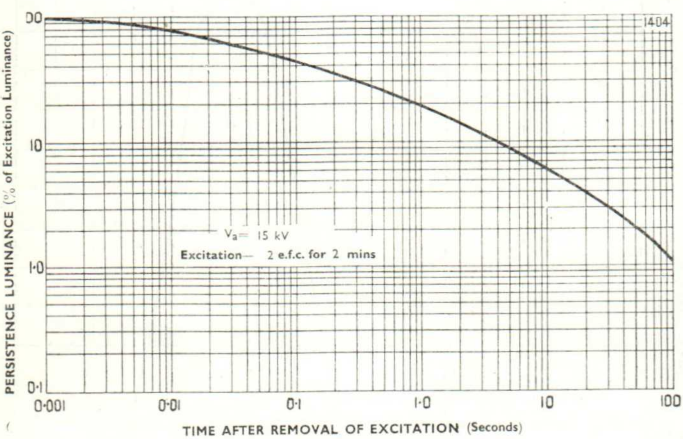
## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC




Issue 2.
Sept., 1963

# SCREEN TYPE "M"

PERSISTENCE CHARACTERISTIC

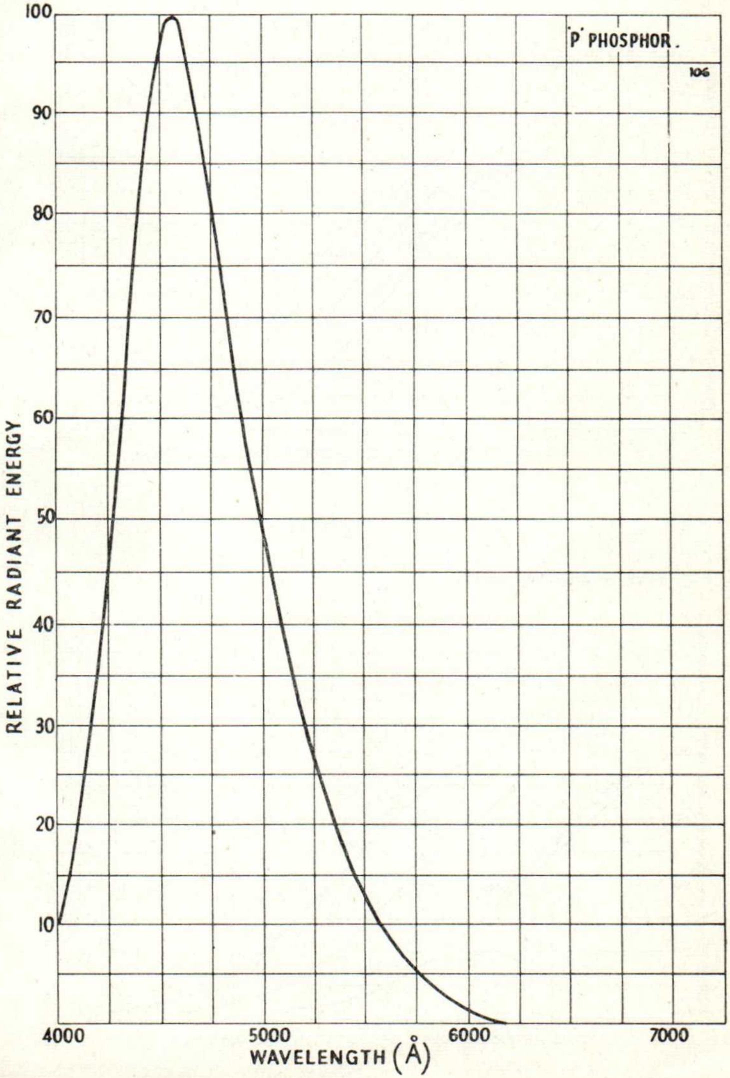


Ferranti

## CATHODE RAY TUBE

# SCREEN TYPE "P"

### RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC




Issue 3.
Dec., 1962

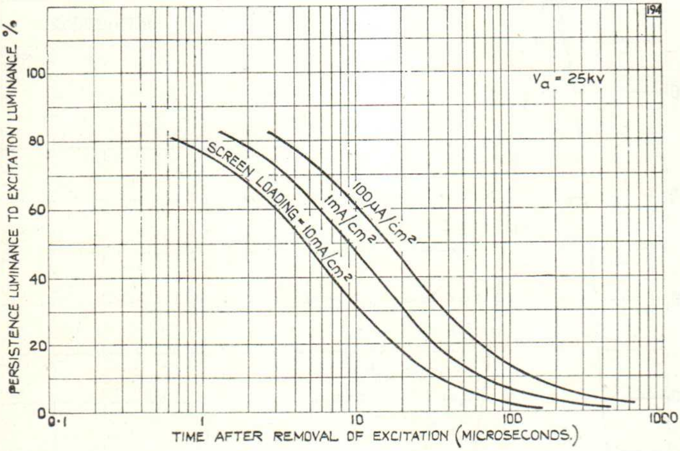
THE PHOSPHOR IS EQUIVALENT TO U.S.A. PHOSPHOR TYPE P11.

Ferranti

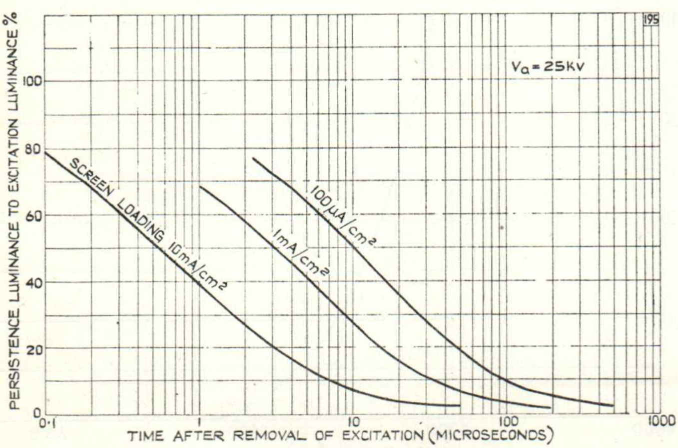
# SCREEN TYPE "P"

## PERSISTENCE CHARACTERISTIC

NORMAL PHOSPHOR




FINE GRAIN PHOSPHOR

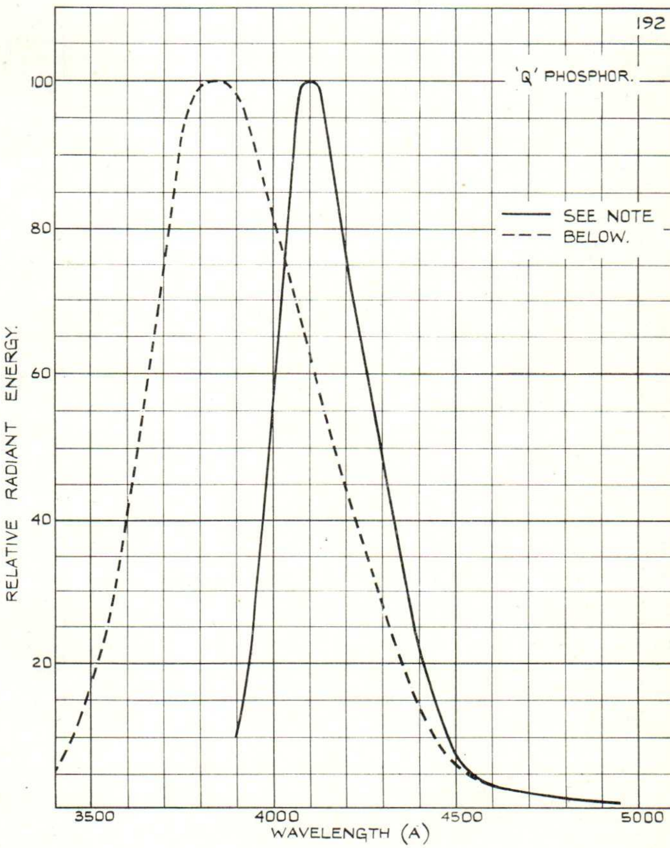


Ferranti

**CATHODE RAY TUBE**

# SCREEN TYPE "Q"

**RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC**




NOTE:

The actual emission from the screen of a glass faced Cathode Ray Tube screened with 'Q' phosphor is shown by the solid line.

The broken line shows the emission characteristic of the phosphor itself when it is not modified by the glass.

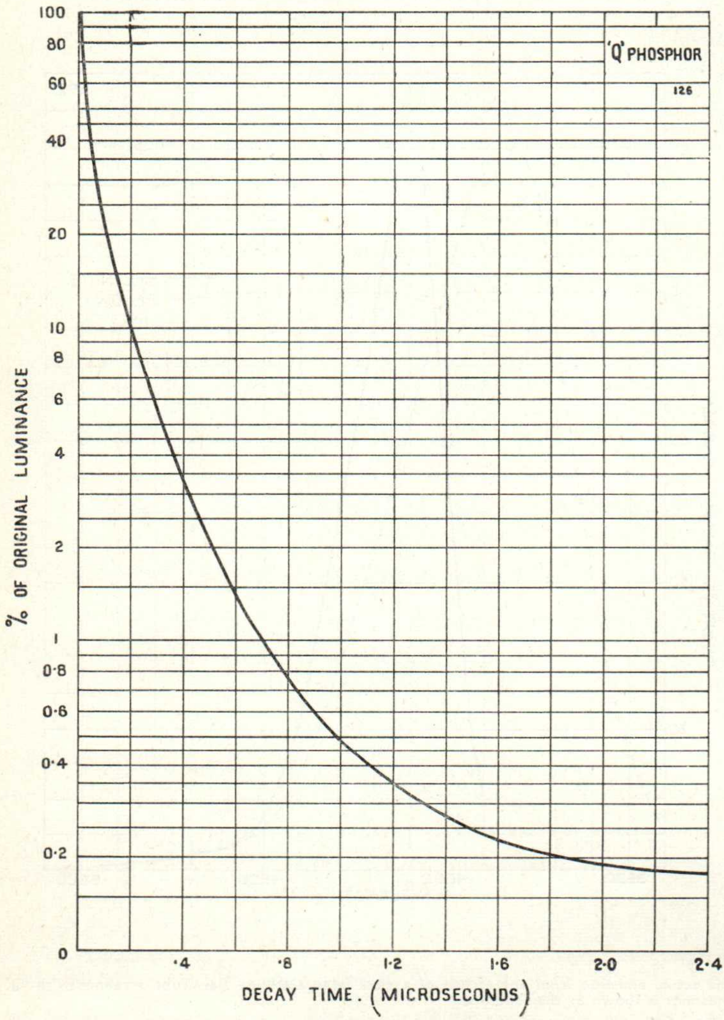

Issue 3
Aug., 1962


THIS PHOSPHOR IS EQUIVALENT TO U.S.A. PHOSPHOR TYPE P16.

Ferranti

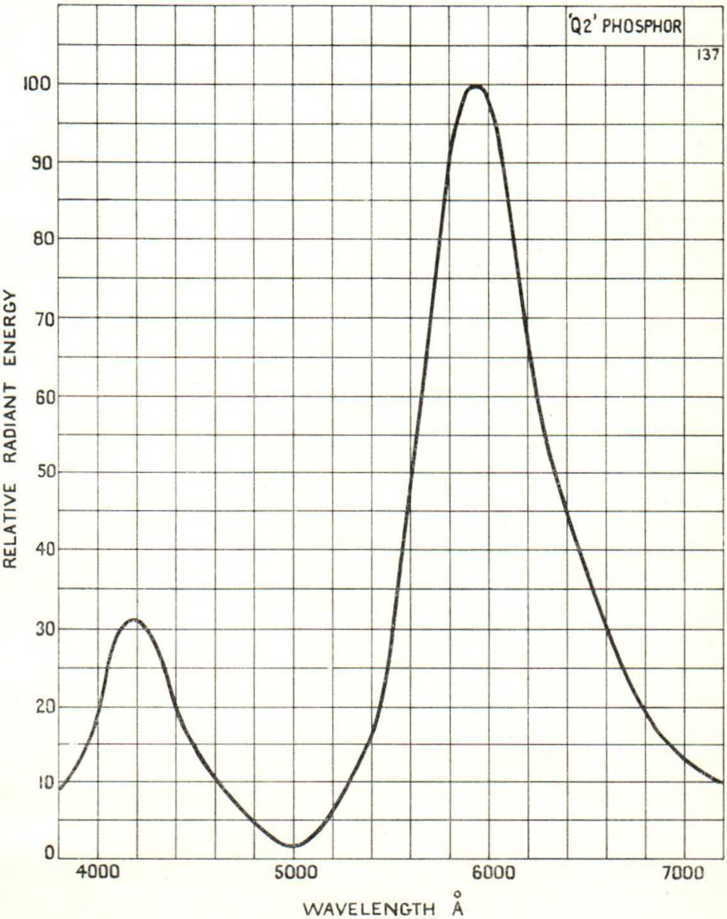
# SCREEN TYPE "Q"

## PERSISTENCE CHARACTERISTIC



# CATHODE RAY TUBE
## SCREEN TYPE "Q2"

RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC

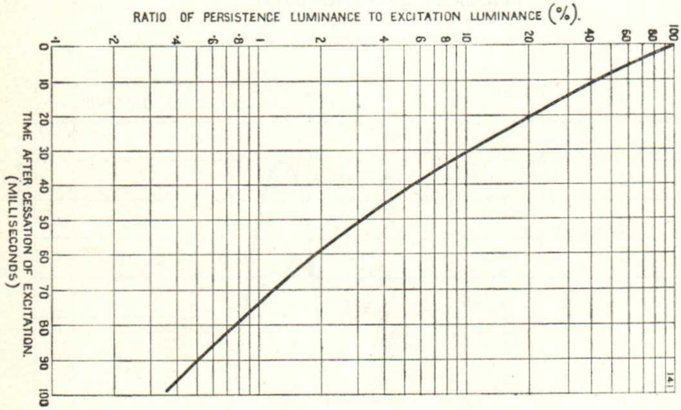



Issue I
Sept, 1960

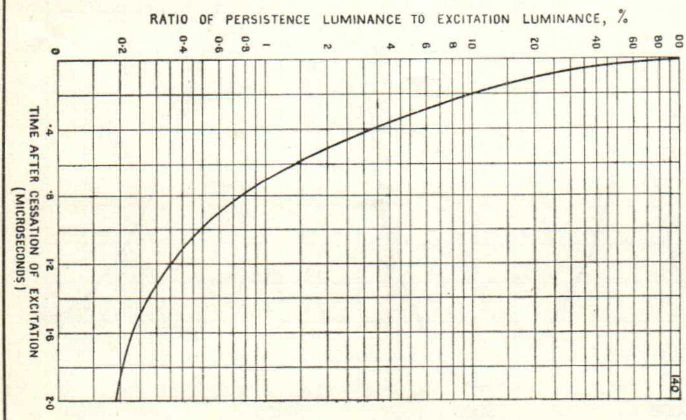
Ferranti

# SCREEN TYPE "Q2"

## PERSISTENCE CHARACTERISTICS




Normal Persistence Characteristic.



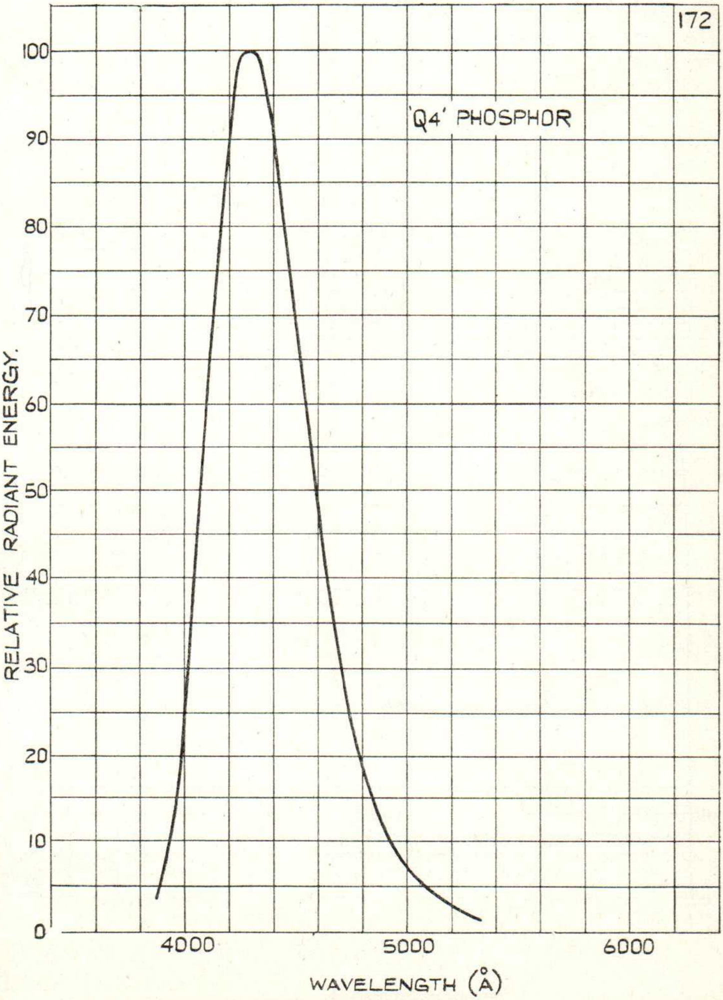

Persistence Characteristic with Chance OB8 (Blue) Filter.

Ferranti

CATHODE RAY TUBE

# SCREEN TYPE 'Q4'

## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC

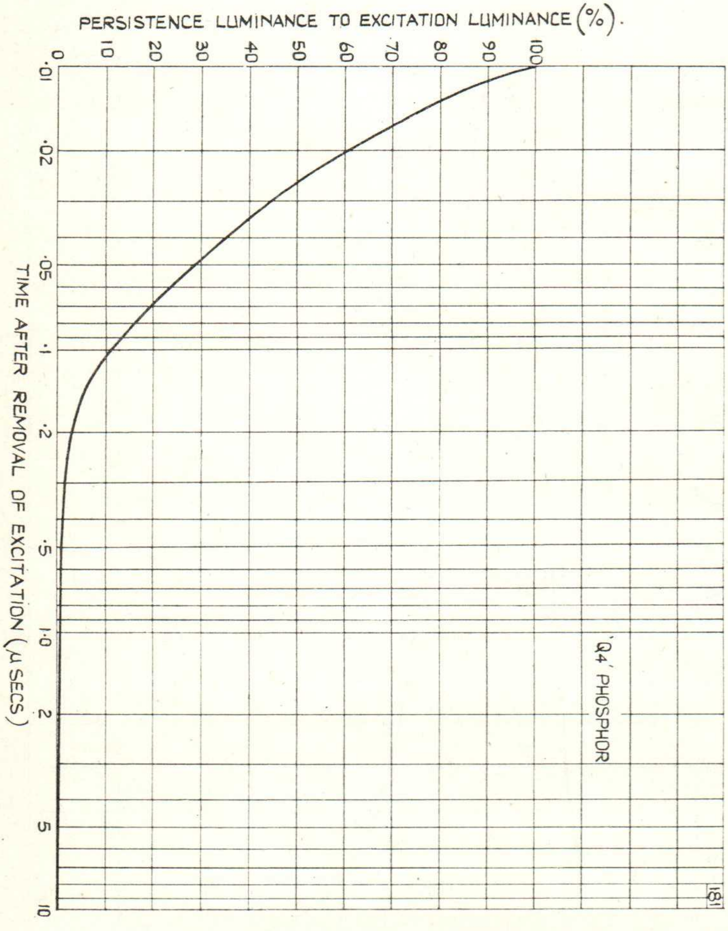



Issue 1
May, 1962.

Ferranti

# SCREEN TYPE 'Q4'

## PERSISTENCE CHARACTERISTIC

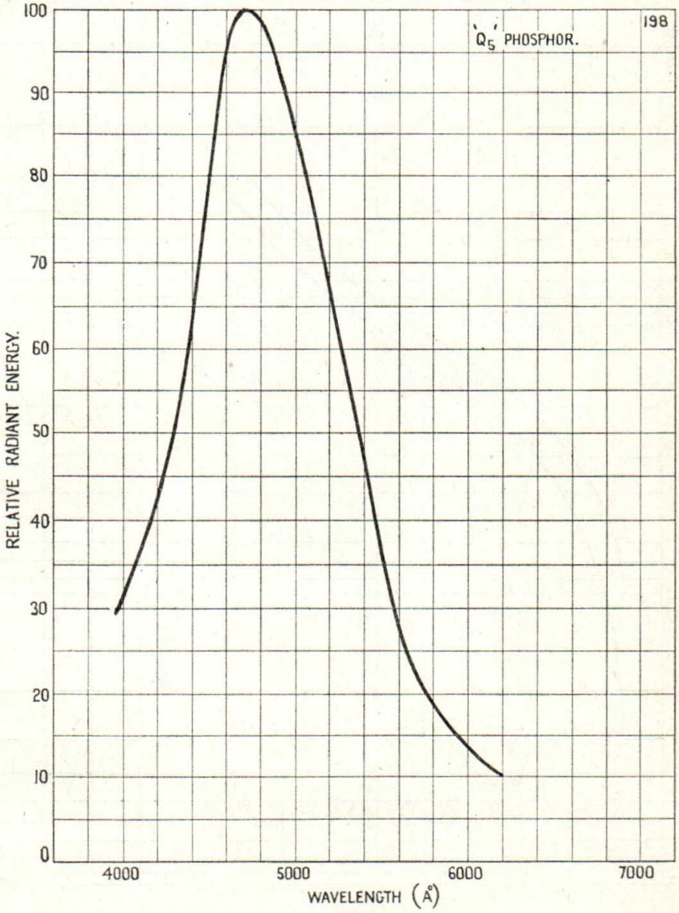


**Ferranti**

CATHODE RAY TUBE

# SCREEN TYPE 'Q5'

## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC

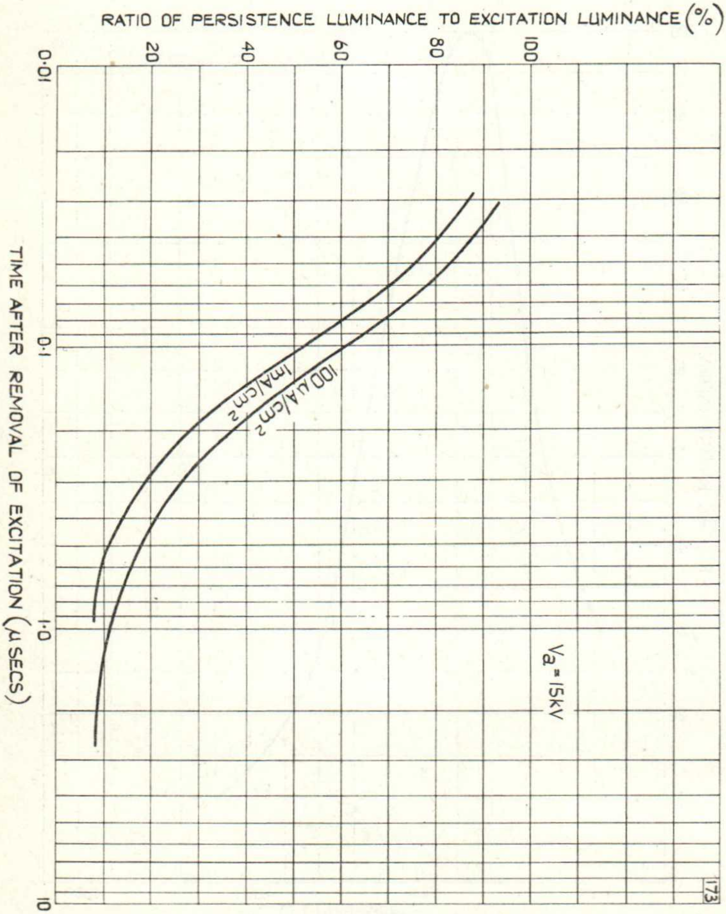



Issue 1.
Feb., 1963

## Ferranti

# SCREEN TYPE 'Q5'

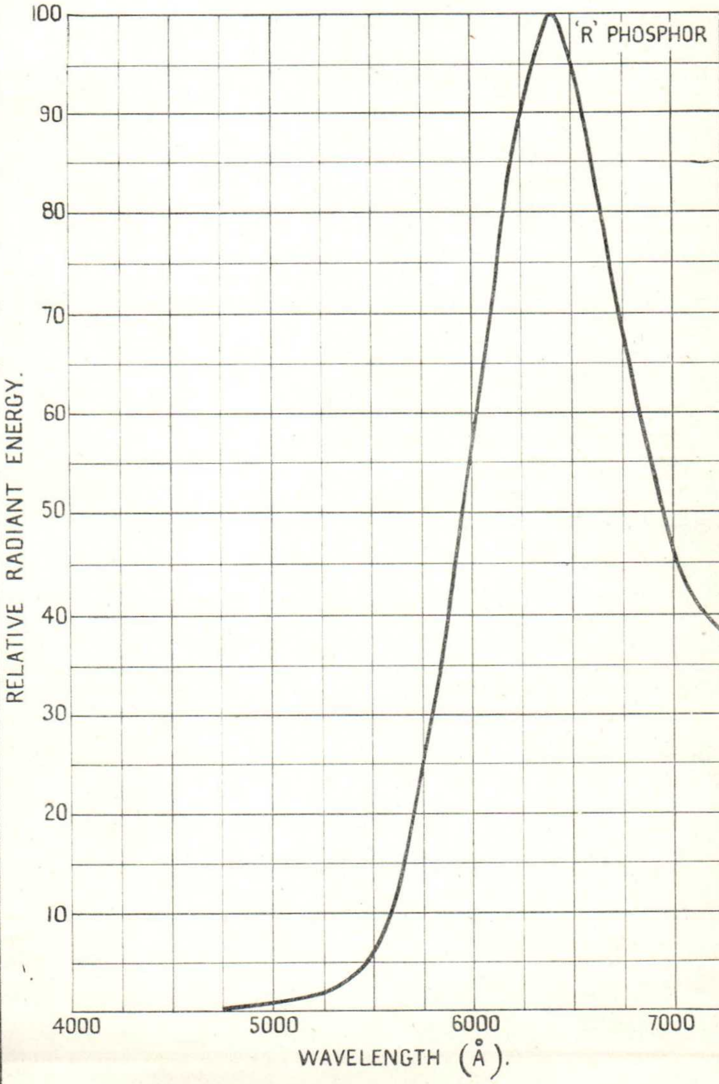
## PERSISTENCE CHARACTERISTIC



**Ferranti**

## CATHODE RAY TUBE
# SCREEN TYPE "R"

RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC



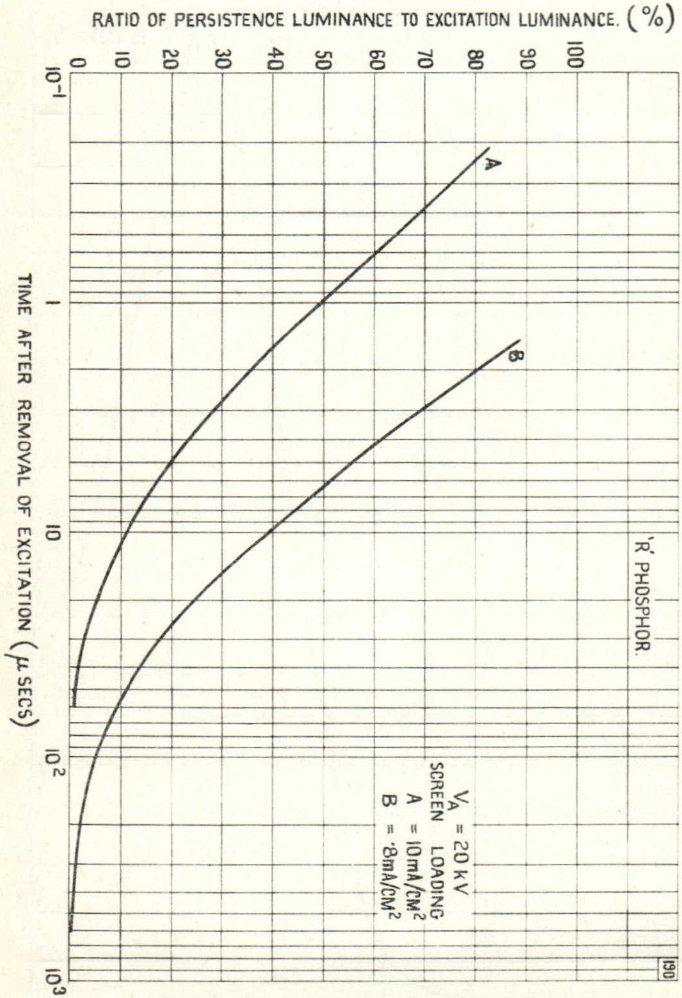

Issue 2.
Oct., 1962

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

Ferranti

# SCREEN TYPE "R"

PERSISTENCE CHARACTERISTIC

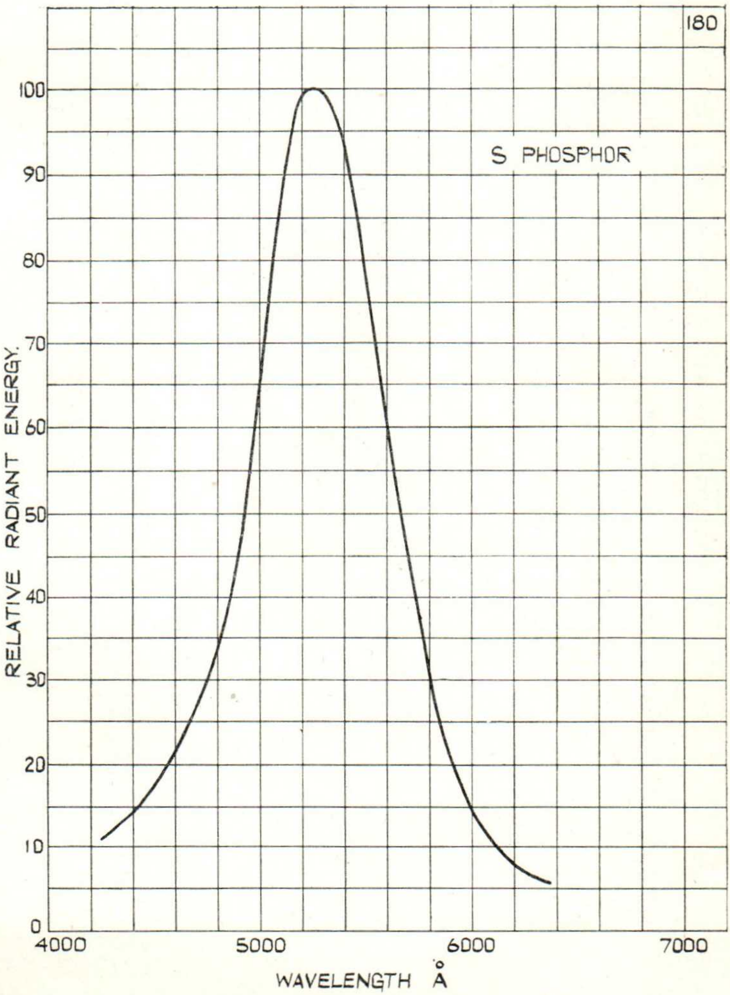


**Ferranti**

## CATHODE RAY TUBE

# SCREEN TYPE "S"

## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC

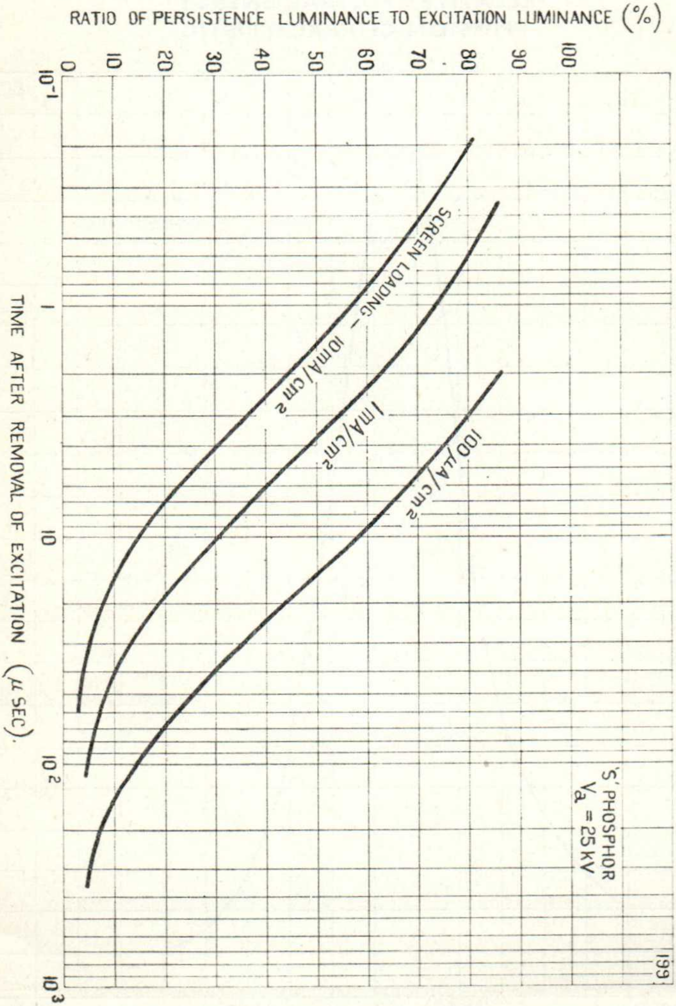



Issue I.
Dec. 1962

Ferranti

# SCREEN TYPE "S"

## PERSISTENCE CHARACTERISTIC

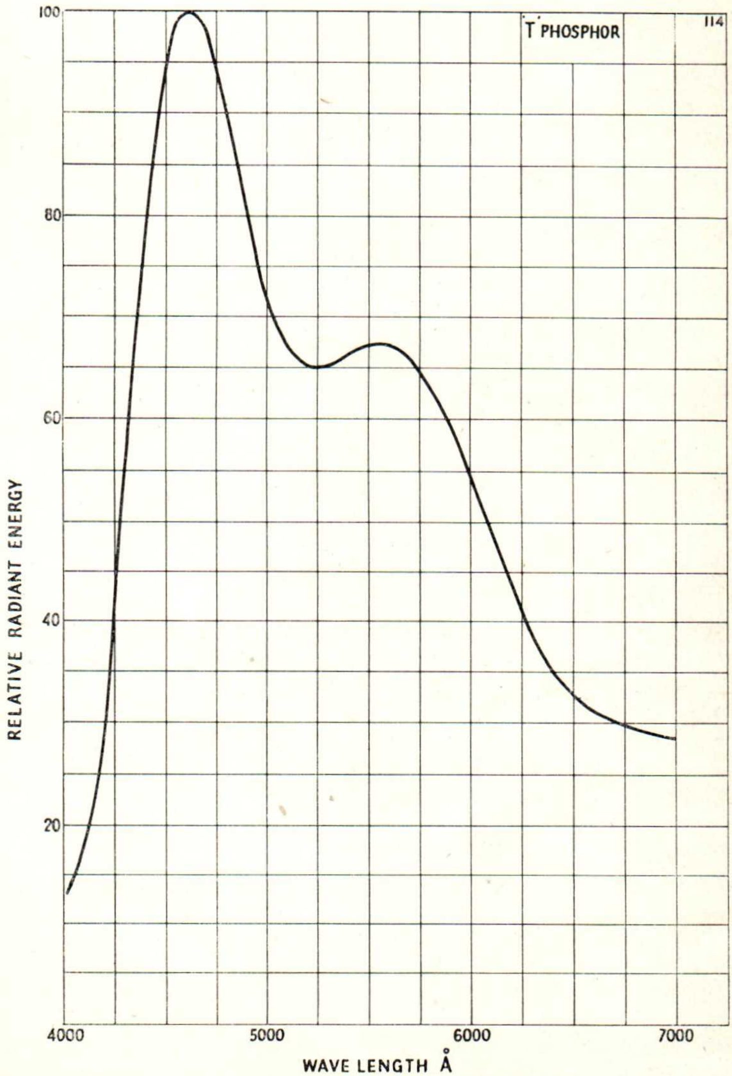


# FERRANTI

## CATHODE RAY TUBE

## SCREEN TYPE "T"

RELATIVE SPECTRAL ENERGY
EMISSION CHARACTERISTIC

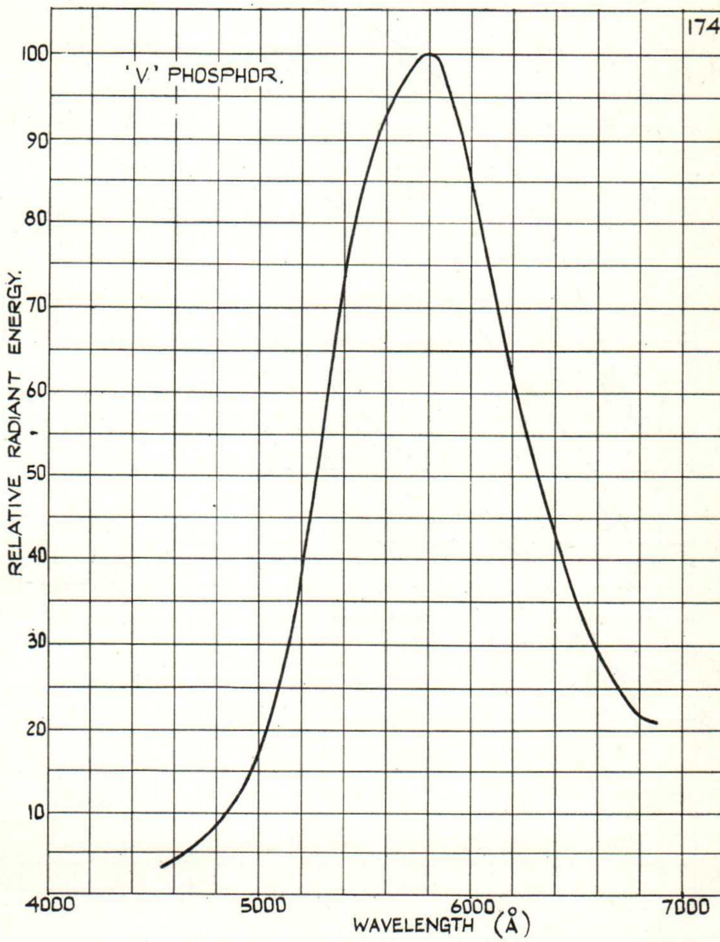



Issue 1.
Mar., 1957

Ferranti

CATHODE RAY TUBE
## SCREEN TYPE "V"

## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC




Issue I
May, 1962.

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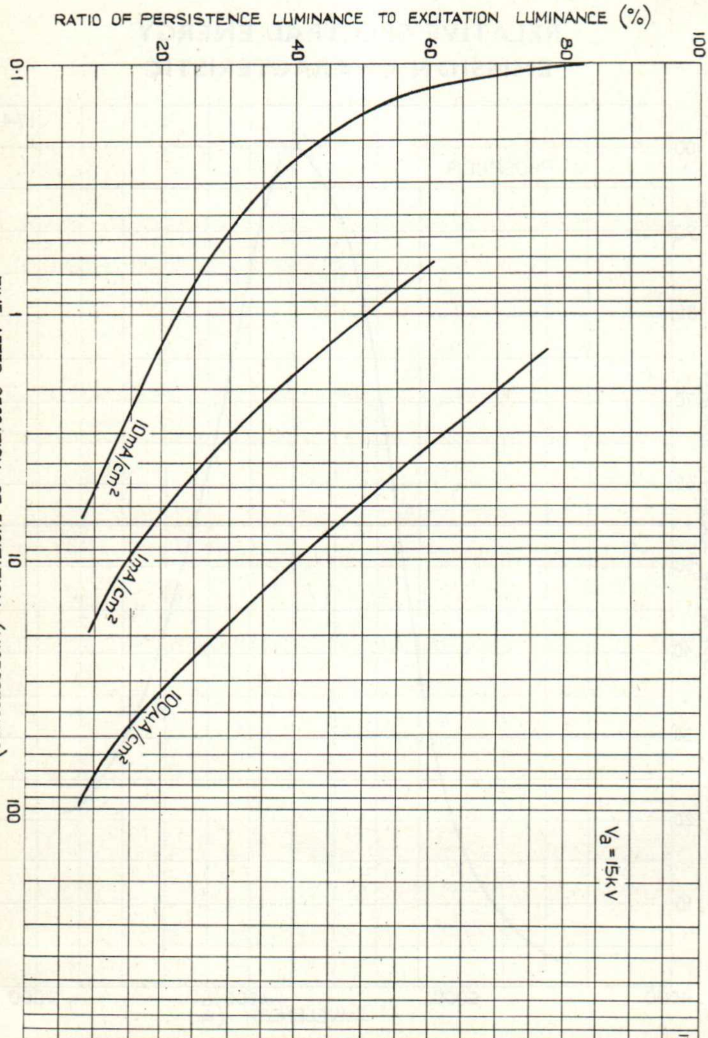
# SCREEN TYPE "V"

## PERSISTENCE CHARACTERISTIC



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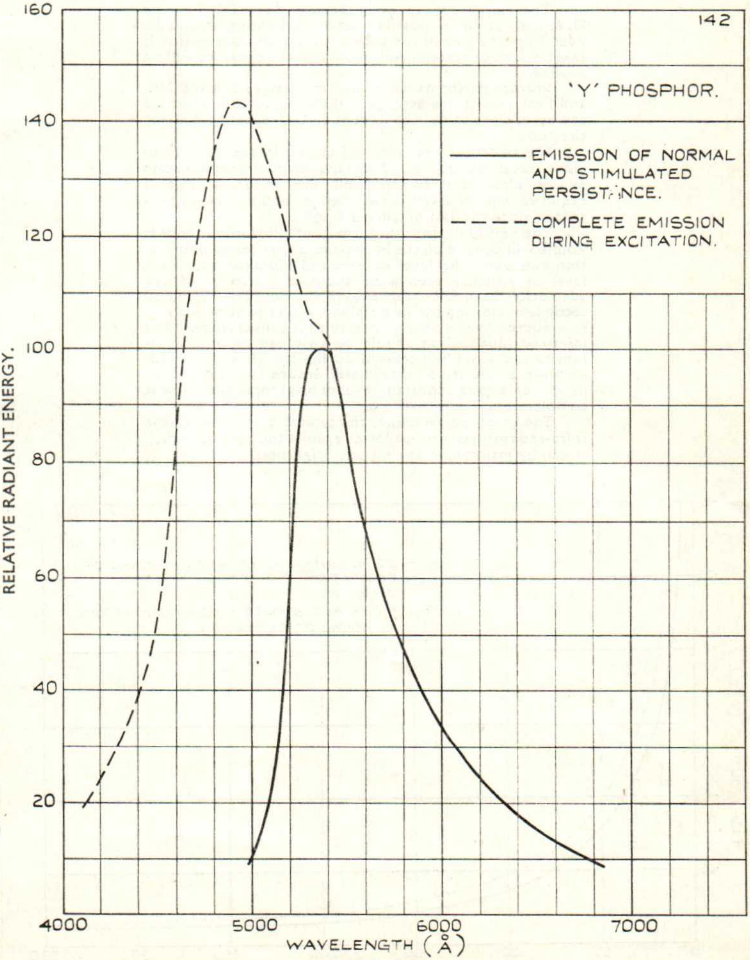
**CATHODE RAY TUBES**

# SCREEN TYPE "Y"

## RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC




Issue 1
Oct., 1960

Ferranti

# SCREEN TYPE "Y"

VISUAL INFORMATION STORAGE.

The Ferranti 'Y' phosphor is intended to provide visual information storage. The afterglow is under the control of the operator who may delay the revelation of a trace until a time convenient for observation.

Use of the 'Y' phosphor requires provision of an infra-red source (of about 1 micron wavelength) arranged to illuminate the whole screen of the tube uniformly when switched on, and with provision for its intensity to be varied. A convenient method is to use a small car head-lamp, or a number of small filament lamps. Each lamp should be carefully screened by means of a filter to eliminate the visible illumination whilst passing the short and medium infra-red. Gelatine material such as Ilford No. 207 is suitable for this purpose.

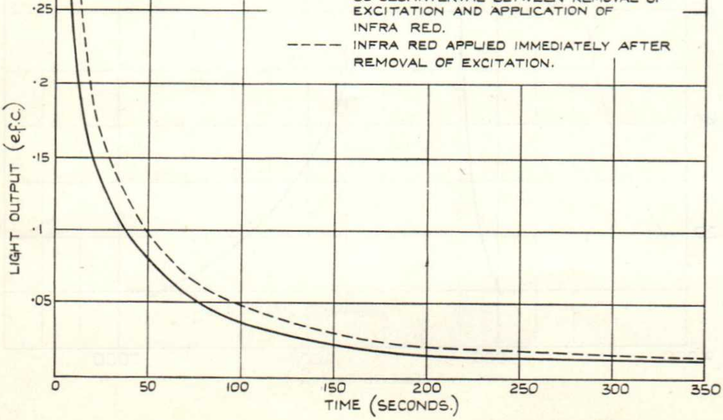
The storage phosphor is sensitive to visible light or U.V. and, as far as possible, ambient lighting should be kept from the face of the tube. Unless this precaution is taken spurious storage will occur and the contrast will be spoiled.

Storage performance is poor at voltages below 8 kV., and best results are achieved when the tube is operated at a point close to the top limit of E.H.T. recommended for the tube.

On switching the infra-red to full intensity, all previous traces are erased and storage can commence as soon as the infra-red is switched off. When observation is required, the infra-red is switched on and all images presented since the last erasure are seen.

The period during which the controlled persistence is visible will depend on the intensities of written-in information and upon the level of infra-red illumination. At a level of visibility seen after about ten seconds of eye adaptation from full external daylight, between 15 and 60 seconds of viewing can be obtained, either continuously or interrupted by the observer to suit his convenience. The infra-red illumination should be switched on at low intensity and steadily increased during the viewing period; increase of the lamp voltage will ensure that the stored image remains at a constant level of brightness until almost complete erasure is reached.

The graph below shows the typical brightness of the infra-red restored image plotted against the time for which it can be maintained at constant brightness.



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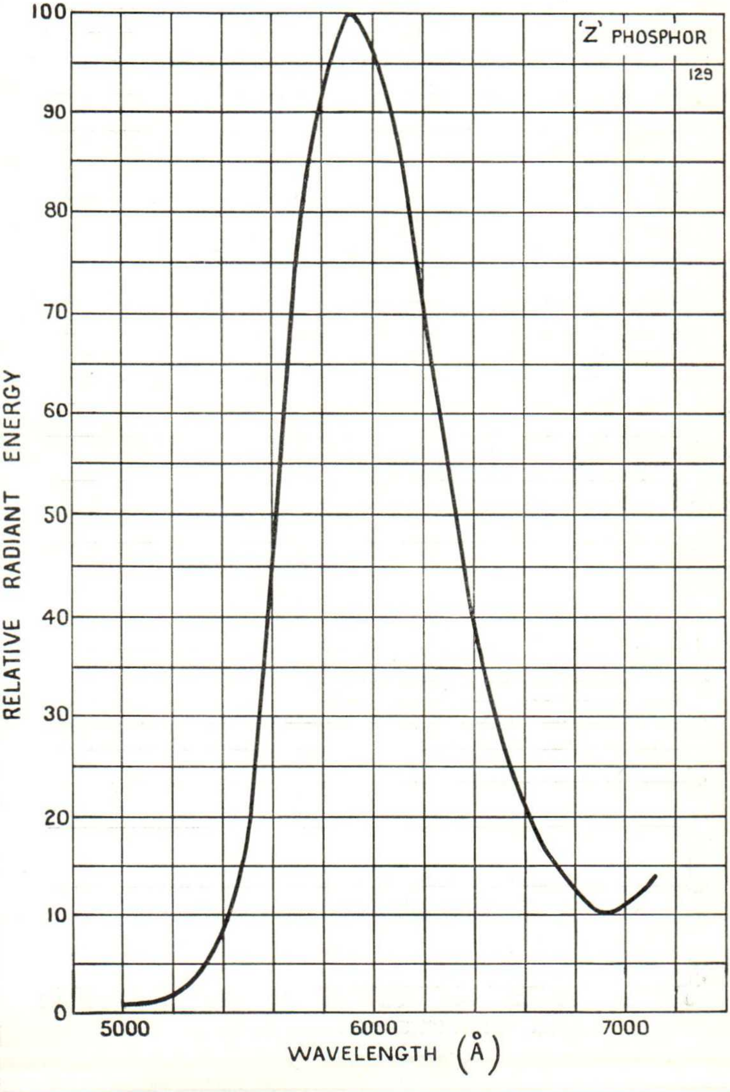
## CATHODE RAY TUBES

# SCREEN TYPE "Z"

RELATIVE SPECTRAL ENERGY EMISSION CHARACTERISTIC

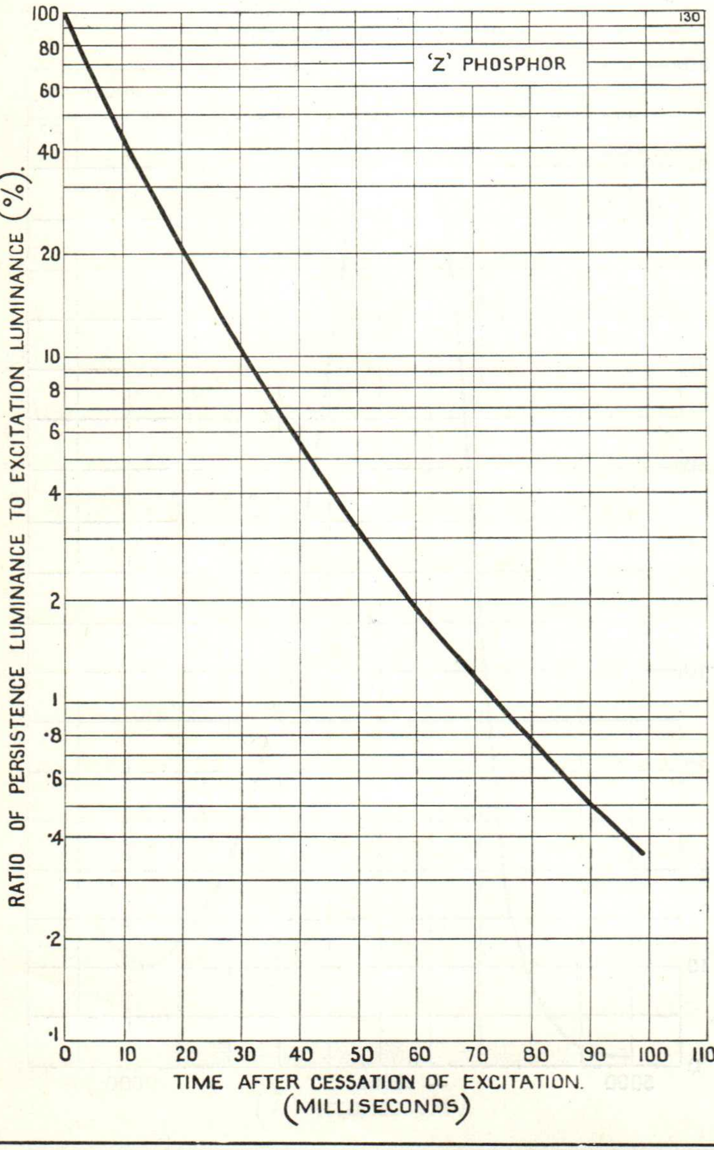



Issue I
June 1960

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

# SCREEN TYPE "Z"

PERSISTENCE CHARACTERISTIC



# Ferranti



## HIGH RESOLUTION CATHODE RAY TUBES

3″ diameter high resolution triode tubes having optically flat faces with ground internal and external surfaces.

FOCUS ... ... ... ... Magnetic

DEFLECTION ... ... ... ... Magnetic—Angle 60°

| SCREEN | 3/21AM | 3/21PM | 3/21QM |
|---|---|---|---|
| Phosphor Type | 'A' | 'P' | 'Q' |
| Fluorescence | Green | Blue | Blue/Violet |
| Persistence | Ultra Short | Ultra Short | Killed |

All types have metal-backed screens.

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS

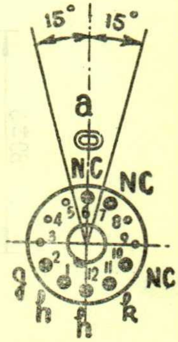
| | |
|---|---|
| Base ... | B12A (Duodecal) |
| Anode Cap ... | CT7 (Recessed Ball type) (JEDEC type J1-22) |
| Max. Overall Length ... | 365 mm. |
| Max. Diameter ... | 97 mm. |
| Nom. Neck Diameter ... | 35 mm. |
| Min. Useful Screen Area ... | 85 mm. dia. |

For other dimensions see drawing overleaf.

BASE CONNECTIONS

| | |
|---|---|
| Pin 1—Heater | Pin 7—Not connected |
| Pin 2—Grid | Pin 8—No pin |
| Pin 3—No pin | Pin 9—No pin |
| Pin 4—No pin | Pin 10—Not connected |
| Pin 5—No pin | Pin 11—Cathode |
| Pin 6—Not connected | Pin 12—Heater |

Side contact—Anode




Underside View of Base

HEATER

| | |
|---|---|
| Heater Voltage ... | 6·3 volts |
| Heater Current ... | 0·3 amp. |

RATINGS

| | |
|---|---|
| Max. Anode Voltage ... | 25 kV. |
| Nom. $V_g$ for visual cut-off ... | Va/210 |
| Max. $V_{hk}$ (heater negative) ... | 200 volts |
| Max. $V_{hk}$ (heater positive) ... | 200 volts |
| Max. $R_{gk}$ ... | 1·5 MΩ |

TYPICAL OPERATION

| | |
|---|---|
| Heater Voltage ... | 6·3 volts |
| Anode Voltage ... | 20 kV. |
| Vg for visual cut-off ... | –90v. |
| *Screen resolution ... | 1000 lines per inch. |

CAPACITANCE

| | |
|---|---|
| $C_{k\text{-all}}$ ... | <8 pF. |
| $C_{g\text{-all}}$ ... | <8 pF. |

X-RAY WARNING

When operated at an anode voltage in excess of 16kVd. X-ray shielding may be required to give protection against the possible danger of injury from prolonged exposure at close range.

*At screen centre. Measured by shrinking raster method.

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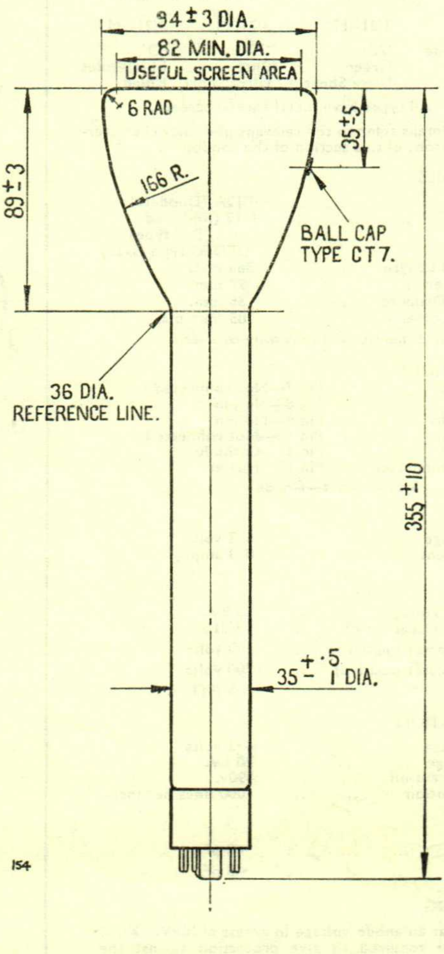
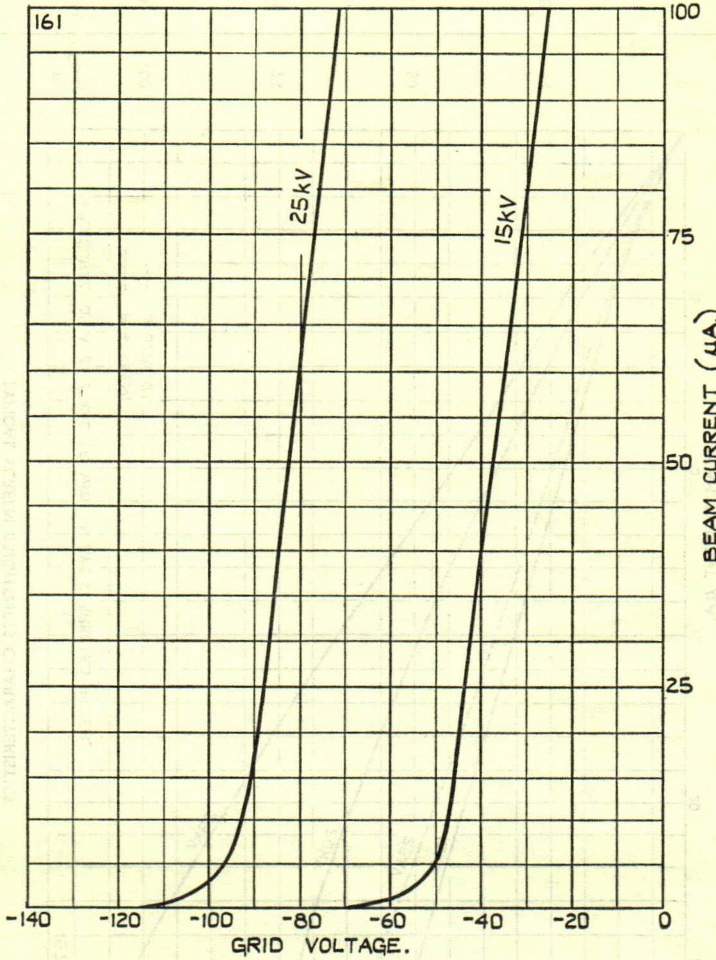



DIMENSIONS ARE IN MILLIMETRES.

## TYPICAL BEAM CURRENT/GRID VOLTAGE CHARACTERISTIC

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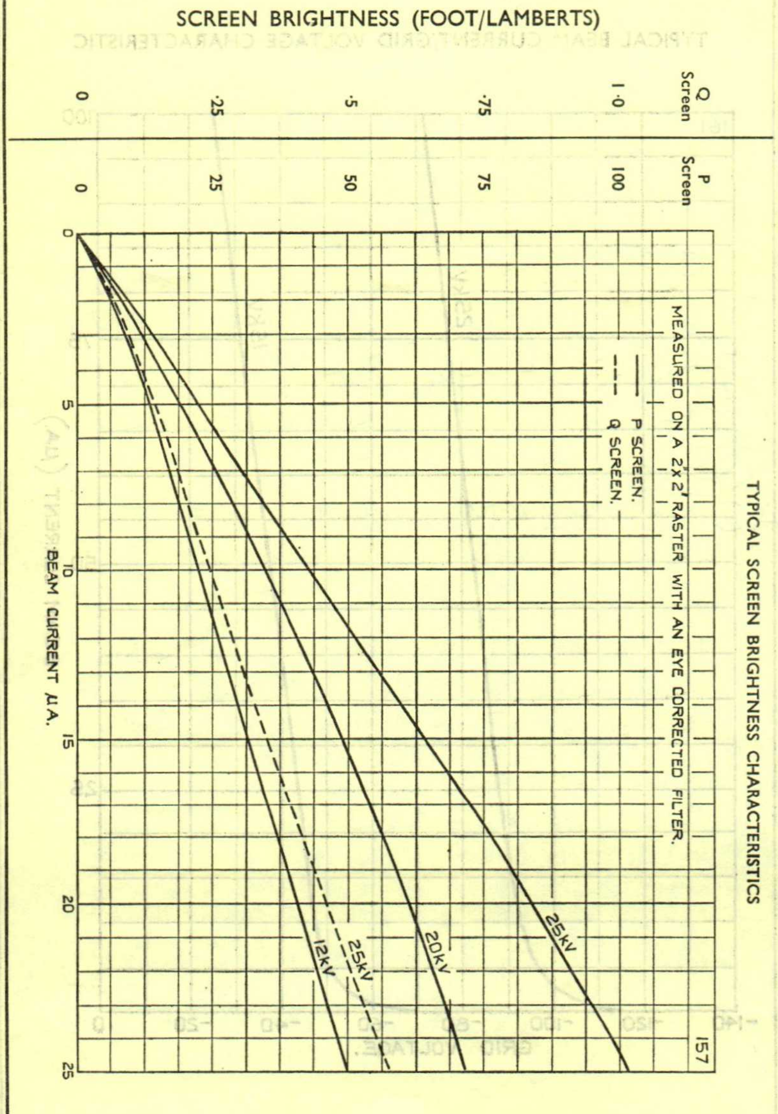
| |
|---|
| **3/21 AM** |
| **3/21 PM** |
| **3/21 QM** |




TYPICAL SCREEN BRIGHTNESS CHARACTERISTICS

# 5/03 HM
# 5/03 JM
# 5/03 LM

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## RADAR TUBES

5in. diameter Display Tubes with metal backed screens, magnetic deflection and Low Voltage Electrostatic focus, suitable for small radar installations.

FOCUS ... ... ... ... Low Voltage Electrostatic

DEFLECTION ... ... ... Magnetic—Angle 53°

SCREENS

| | 5/03HM | 5/03JM | 5/03LM |
|---|---|---|---|
| *Phosphor Type ... ... | 'H' | 'J' | 'L' |
| Fluorescence ... ... ... | Orange | Blue | Orange |
| Afterglow ... ... | Orange | Yellow | Orange |
| Persistence ... ... ... | Very long | long | long |

All Types have metal backed screens.

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT7. Recessed Ball Type. |
| Max. Overall Length ... ... | 308 mm. |
| Min. Useful Screen Area ... | 108 mm. dia. |
| Mounting Position ... ... | Any except vertical screen down. |

For other dimensions see drawing.

These tubes can also be supplied with an external conductive coating in which case the Type Nos. are respectively 5/03HB, 5/03JB and 5/03LB.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater | Pin 7—No Connection. |
| Pin 2—Grid | Pin 8—No Pin. |
| Pin 3—No Pin | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Conatct—2nd Anode, 4th Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 6·3 volts. |
| Heater Current ... ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... ... | 500 volts. |
| Min. $A_1$ Voltage ... ... ... ... | 200 volts. |
| Max. $A_2 + A_4$ voltage ... ... ... | 15 kV. |
| Min. $A_2 + A_4$ Voltage ... ... ... | 8 kV. |
| Max. Pos. $A_3$ Voltage ... ... ... ... | +500 volts. |
| Max. Neg. $A_3$ Voltage... ... ... ... | —500 volts. |
| Max. $V_{h-k}$ (Heater positive) ... ... ... | 200 volts. |
| Max. $V_{h-k}$ (Heater negative)... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... ... ... | 1·0 MΩ |

TYPICAL OPERATION

| | |
|---|---|
| 1st Anode Voltage ... ... ... ... | 300 volts. |
| 2nd + 4th Anode Voltage ... ... ... | 12 kV. |
| †3rd Anode Voltage for focus... | —300 to + 300 volts. |
| §Vg for visual cut off ... ... ... | —30 to —70 volts. |

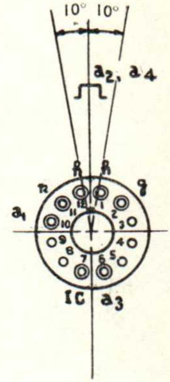
CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... ... ... | <8 pF. |

*Phosphors Type 'H' and 'L' are liable to burn if operated with a stationary or slow moving spot, even at low values of beam current.

†Optimum focus lies between these values.

§The grid should never be positive with respect to the cathode except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.




**Base Connections**

**Underside View of Base**

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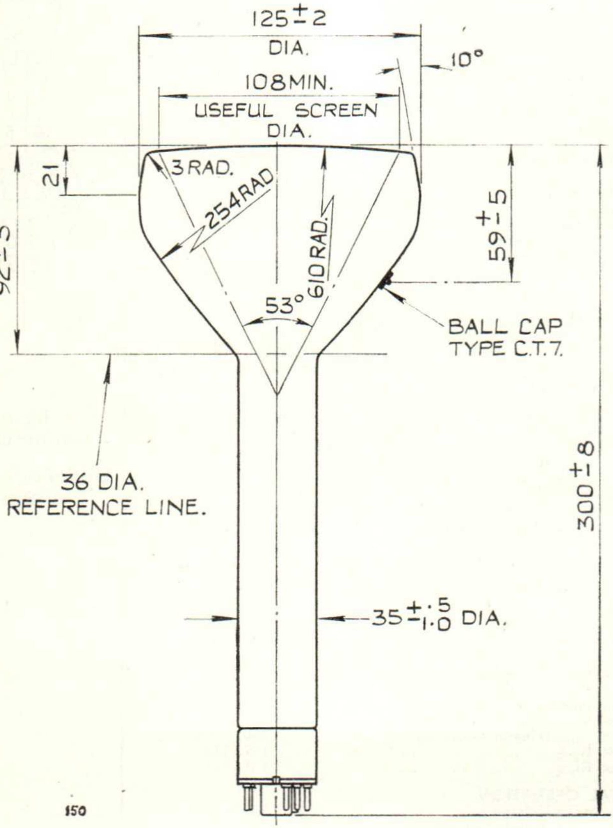


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Dimensions are in millimetres

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# TELEVISION MONITOR TUBE

A 5 inch diameter tube with metal backed screen having good resolution. Designed as a camera viewfinder tube.

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic. |
| DEFLECTION ... ... ... ... | Magnetic. |

SCREEN.

| | |
|---|---|
| Phosphor ... ... ... ... | Type 'T' (Metal backed). |
| Fluorescence ... ... ... | White. |
| Persistence ... ... ... | Short. |

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Anode Cap ... ... ... | CT7 (Recessed Ball Type). |
| Max. Overall Length ... ... | 287 mm. |
| Max. Diameter ... ... ... | 127 mm. |
| Neck Diameter ... ... ... | $35\pm^{0}_{1}$ mm. |
| Min. Useful Screen Diameter ... | 108 mm. |
| Weight (Tube alone) ... ... | 500 gms. (1lb. 2oz.). |

For other dimensions see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 5—Grid. |
| Pin 2—Heater. | Pin 6—No Connection. |
| Pin 3—1st Anode. | Pin 7—Cathode. |
| Pin 4—No Connection. | Pin 8—Heater. |

Side Cap—2nd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. 1st Anode Voltage ... | 500 volts. |
| Max. 2nd Anode Voltage ... | 11·0 kV. |
| Min. 1st Anode Voltage ... | 200 volts. |
| Min. 2nd Anode Voltage ... | 5·5 kV. |
| Max. $V_{h-k}$ (Heater positive) ... | 150 volts. |
| Max. $V_{h-k}$ (Heater negative) ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. 1st Anode Supply Impedance | 1·5 MΩ |

TYPICAL OPERATION.

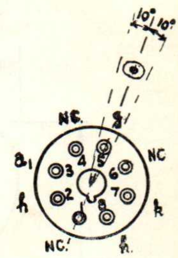
| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd Anode Voltage ... ... | 7·0 kV. |
| *Vg for visual cutoff ... | –30 to –70 volts. |
| Av. Mod. Drive for 50 μA. Beam Current ... | 20 volts. |
| †Focus Coil ... ... ... | 570 ampere turns (approx.). |
| Recommended distance of Focus Unit from Ref. Line ... | 73 mm. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <10·0 pF. |
| $C_{g-all}$ ... ... ... ... | <10·0 pF. |

*The grid should never be positive with respect to the cathode.

†Positioned so that the gap is 75 mm. from the reference line.




**Base Connections**

**Underside View of Base**

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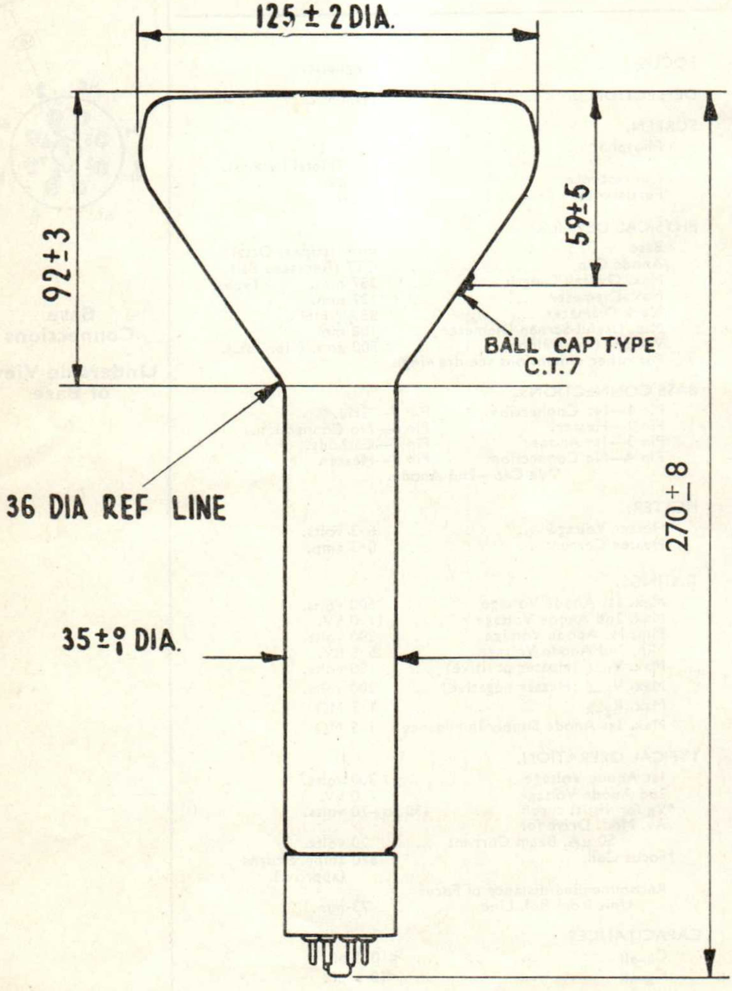
5/04TM




DIMENSIONS IN MILLIMETRES.

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**5/21 AM**

**5/21 PM**

**5/21 QM**

# HIGH RESOLUTION CATHODE RAY TUBES

5″ diameter high resolution triode tubes having optically flat faces with ground internal and external surfaces.

FOCUS ... ... ... ... Magnetic

DEFLECTION ... ... ... ... Magnetic—Angle 60°

| SCREEN | 5/21AM | 5/21PM | 5/21QM |
|---|---|---|---|
| Phosphor Type | 'A' | 'P' | 'Q' |
| Fluorescence | Green | Blue | Blue/Violet |
| Persistence | Ultra Short | Ultra Short | Killed |

All types have metal-backed screens.

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

## PHYSICAL DETAILS

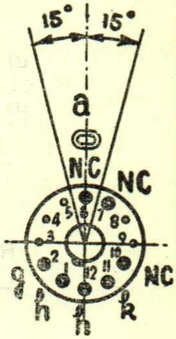
| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal) |
| Anode Cap ... ... ... | CT8 (Cavity type) (JEDEC type J1-21) |
| Max. Overall Length ... ... | 350 mm. |
| Max. Diameter ... ... ... | 128 mm. |
| Nom. Neck Diameter ... ... | 37 mm. |
| Min. Useful Screen Area ... | 110 mm. |

For other dimensions see drawing overleaf.

## BASE CONNECTIONS

| | |
|---|---|
| Pin 1—Heater | Pin 7—Not connected |
| Pin 2—Grid | Pin 8—No pin |
| Pin 3—No pin | Pin 9—No pin |
| Pin 4—No pin | Pin 10—Not connected |
| Pin 5—No pin | Pin 11—Cathode |
| Pin 6—Not connected | Pin 12—Heater |

Side contact—Anode




**Underside View of Base**

## HEATER

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts |
| Heater Current ... ... ... | 0·3 amp. |

## RATINGS

| | |
|---|---|
| Max. Anode Voltage ... ... | 25 kV. |
| Nom. $V_g$ for visual cut-off ... | Va/210 |
| Max. $V_{hk}$ (heater negative) ... | 200 volts |
| Max. $V_{hk}$ (heater positive) ... | 200 volts |
| Max. $R_{gk}$ ... ... ... ... | 1·5 MΩ |

## TYPICAL OPERATION

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts |
| Anode Voltage ... ... ... | 20 kV. |
| Vg for visual cut-off ... ... | –90v. |
| *Screen resolution ... ... | 1000 lines per inch. |

## CAPACITANCE

| | |
|---|---|
| $C_{k\text{-}all}$ ... ... ... ... | <8 pF. |
| $C_{g\text{-}all}$ ... ... ... ... | <8 pF. |

## X-RAY WARNING

When operated at an anode voltage in excess of 16kV. X-ray shielding may be required to give protection against the possible danger of injury from prolonged exposure at close range.

*At screen centre. Measured by shrinking raster method.

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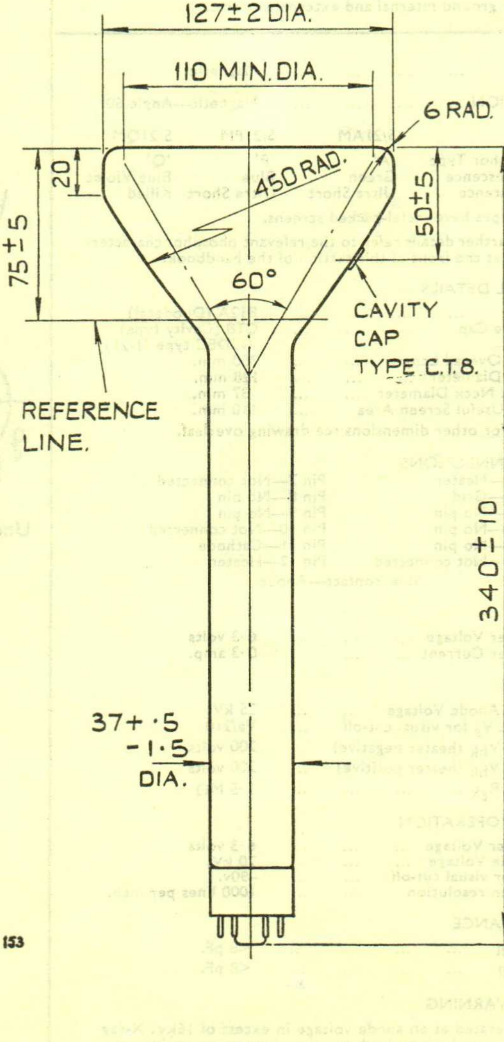


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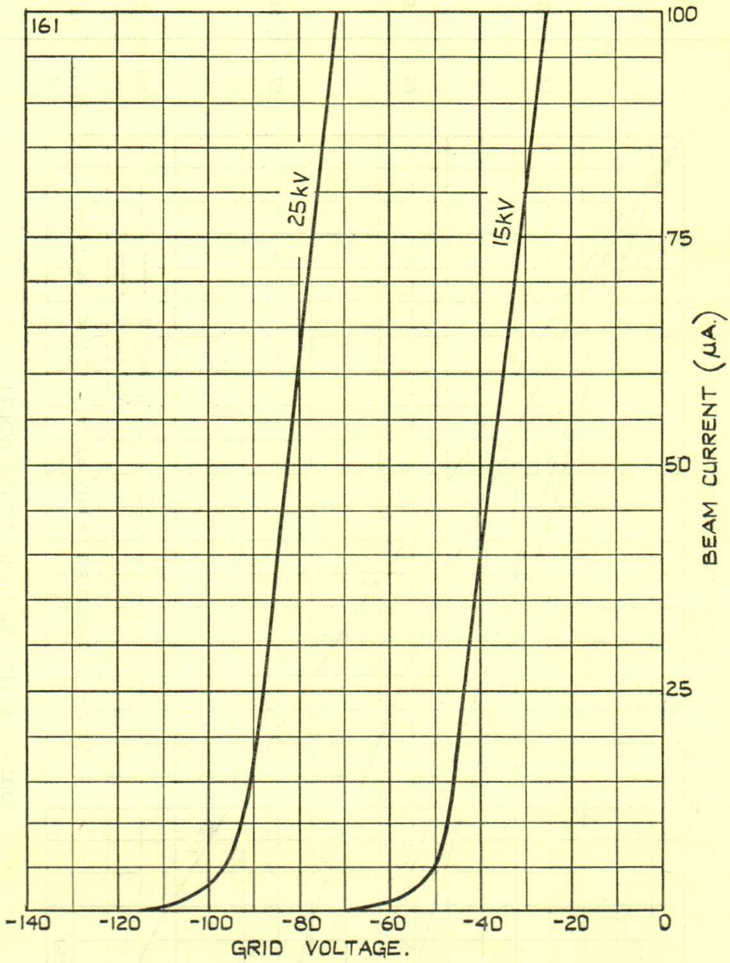
DIMENSIONS ARE IN MILLIMETRES.

TYPICAL BEAM CURRENT/GRID VOLTAGE CHARACTERISTIC

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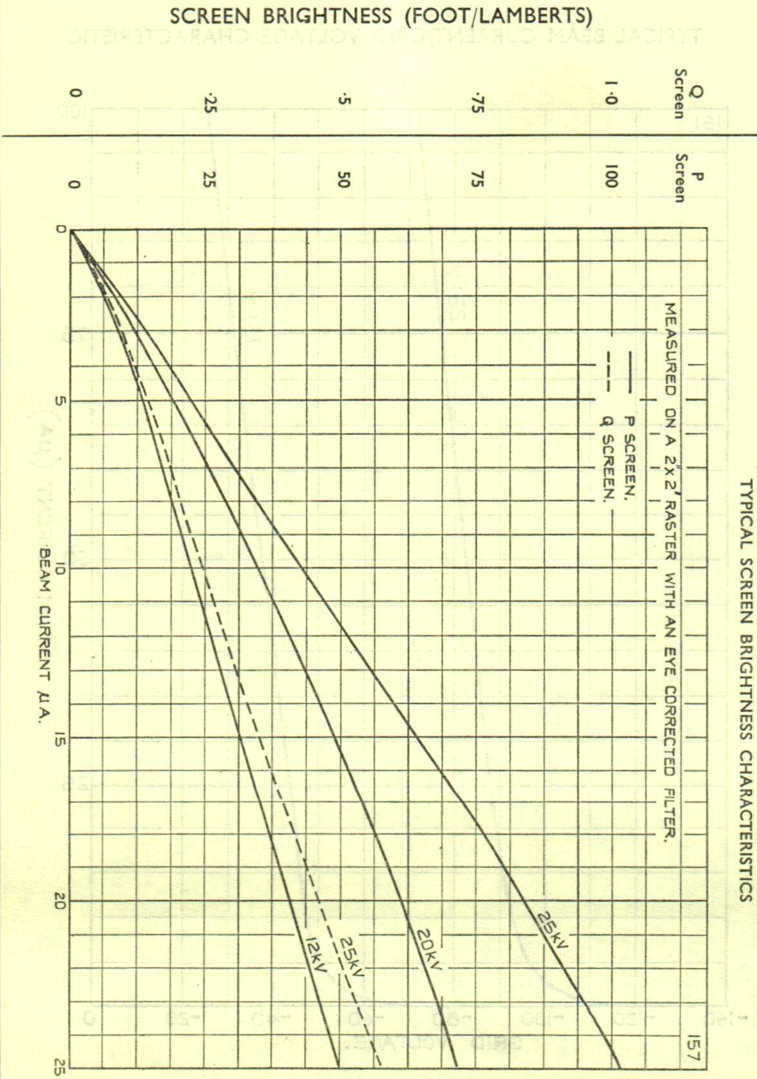




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# Ferranti

5/28AM

5/28PM

5/28QM

## HIGH RESOLUTION DISPLAY TUBES

A 5 inch diameter Ultra High Resolution Display Tube with an optically flat face with ground internal and external surfaces.

FOCUS. ... ... ... Magnetic

DEFLECTION. ... ... ... Magnetic—Angle 60°

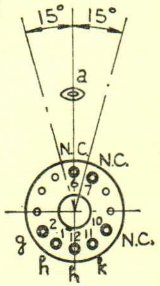
| SCREEN. | 5/28AM | 5/28PM | 5/28QM |
|---|---|---|---|
| Phosphor Type | 'A' | 'P' | 'Q' |
| Fluorescence | Green | Blue | Blue/Violet |
| Persistence | Ultra Short | Ultra Short | Killed |

All types have fine particle size metal-backed screens.

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

Base ... ... ... ... ... B12A (Duodecal)
Anode Cap ... ... ... ... CT8 Cavity Type (JEDEC Type J1-21)
Max. Overall Length ... ... ... 500 mm.
Max. Diameter ... ... ... ... 129 mm.
Nom. Neck Diameter ... ... ... 37 mm.
*Useful Screen Area Diameter... ... 110 mm. min.




BASE CONNECTIONS.

Pin 1—Heater
Pin 2—Grid.
Pin 3—No Pin.
Pin 4—No Pin.
Pin 5—No Pin.
Pin 6—Not Connected.
Pin 7—Not Connected
Pin 8—No Pin
Pin 9—No Pin.
Pin 10—Not Connected
Pin 11—Cathode.
Pin 12—Heater.
Side contact—Anode.

HEATER.

Heater Voltage ... ... ... ... 6·3 V.
Heater Current... ... ... ... 0·3 A.

RATINGS.

Max. Anode Voltage ... ... ... 25 kV.
Nom. $V_g$ for visual cut-off ... ... Va/300
Max. $V_{h-k}$ (heater negative) ... 200 V.
Max. $V_{h-k}$ (heater positive) ... 200 V.
Max. $R_{g-k}$ ... ... ... ... 1·5 M Ω

TYPICAL OPERATION.

Heater Voltage ... ... ... ... 6·3 V.
Anode Voltage ... ... ... ... 15 kV.
$V_g$ for visual cut-off ... ... ... —50 V.
†Screen Resolution ... ... ... 2000 lines per inch

CAPACITANCE.

$C_{k-all}$ ... ... ... ... ... <8pF.
$C_{g-all}$ ... ... ... ... ... <8pF.

**X-RAY WARNING:** When operated at an anode voltage in excess of 16 kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

*Minimum diameter of internal ground surface

†At screen centre, measured by shrinking raster method.

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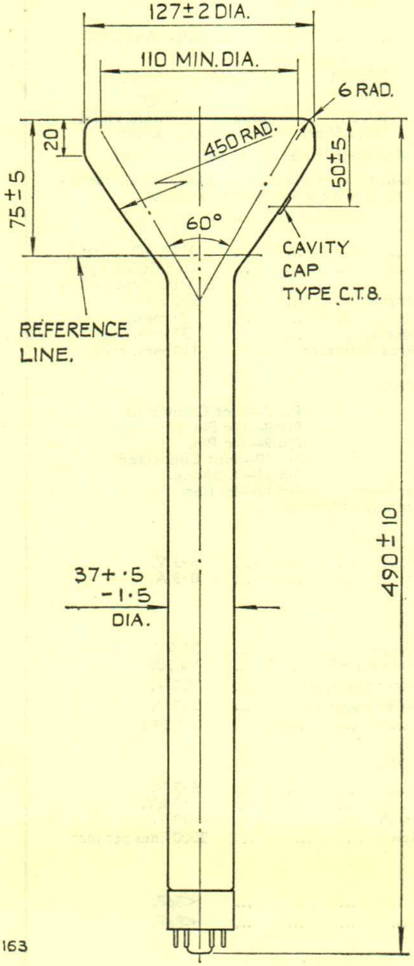
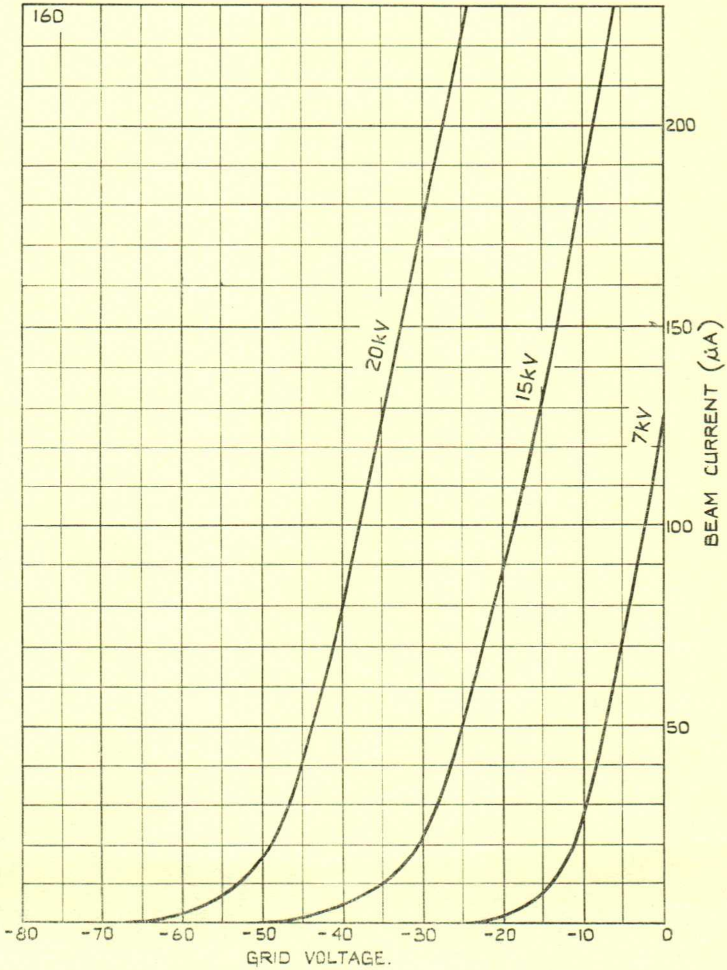



ALL DIMENSIONS IN MILLIMETERS

TYPICAL ANODE CURRENT/GRID VOLTAGE CHARACTERISTIC




Tentative
Issue 2,
Nov. 1961

| 5/71AM |
|---|
| 5/71PM |
| 5/71QM |

**Ferranti**

# MICRO SPOT RADAR TUBES

5″ diameter optically flat faced Cathode Ray Tubes with a short bulb. The spot size is very small, being less than 0·0005″ at the screen centre and the screen can be accurately scanned over an area greater than four inches in diameter.

The high resolution has been made possible in this series of cathode ray tubes by the use of an entirely novel design of electron gun involving two focusing elements, one only of which is electromagnetic and external to the tube in the usual way; the other is electrostatic and of fixed focal length.

FOCUS ... ... ... ... ... Magnetic and Electrostatic

DEFLECTION ... ... ... ... Magnetic, 60° angle.

SCREEN ... ... ... ... ... Metal Backed.

| *Phosphor | Type 'A' | Type 'P' | Type 'Q' |
|---|---|---|---|
| Fluorescence | Green | Blue | Blue Violet |
| Persistence to I/e | 1–2 μsecs. | 5–10 μsecs. | <0·1 μsecs. |

PHYSICAL DETAILS.

| | |
|---|---|
| Max. Overall Length ... ... ... | 470 mm. |
| Max. Diameter ... ... ... ... | 128 mm |
| Nom. Neck Diameter ... ... ... | 37 mm |
| Min. Useful Screen Diameter ... ... | 110 mm |

For other dimensions see outline drawing on Page 3.

BASE CONNECTIONS.†

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection |
| Pin 2—Grid | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater |

Side Cap—2nd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 6·3 volts |
| Heater Current ... ... ... ... | 0·3 amps |

RATINGS.

| | |
|---|---|
| Max. Final Anode Voltage ... ... | 30 kV |
| Min. Final Anode Voltage ... ... ... | 12 kV |
| Max. First Anode Voltage ... ... | 2·5 kV |
| Min. First Anode Voltage ... ... ... | 1 kV |
| $V_g$ for visual cut-off (at $Va_1$=2kV) | −80 to −160 volts |
| Max. $V_{h-k}$ (heater negative) ... ... | 200 volts |
| Max. $V_{h-k}$ (heater positive) ... ... | 200 volts |

TYPICAL OPERATION.

| | |
|---|---|
| Final Anode Voltage ... ... ... | 25 kV |
| First Anode Voltage ... ... ... | 2 kV |
| Vg for visual cut-off ... ... ... | −120 volts |
| Resolution ... ... ... ... | >8000 lines |

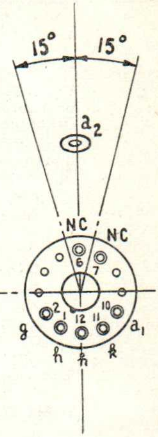
CAPACITANCES.

| | |
|---|---|
| $C_k$–all ... ... ... ... ... | <8 pF |
| $C_g$–all ... ... ... ... ... | <8 pF |

X-RAY WARNING.

When operated at an anode voltage in excess of 16kV, X-ray shielding may be required to give protection against the possible danger of injury from prolonged exposure at close range.

*Other phosphors available to special order, but resolution may suffer with other type phosphors and our recommendation for specific applications should be sought.




**Base Conections**

**Viewed from spigot end of tube**

**Ferranti**

Issue 3.
Sept, 1962

Ferranti

## NOTES ON OPERATION

### FOCUS COILS.

The tube is intended for use with an air cored electromagnetic focus coil or a suitable astignatism-free coil, supplemented by a dynamic focus coil (focus modulation coil).

Ferranti Focus Coil Assembly Type FC5 has been designed as a thin magnetic lens to provide the highest resolution of which the tube is capable.
This Focus Coil Assembly incorporat es:—

**Main Focus Coil.**

**Alignment Coils** for electrical alignment—no mechanical adjustment required.

**Astigmatism Coils** to produce a non astigmatic round spot

**Dynamic Focus Coil** to ensure highest resolution over whole scan area

This dynamic focus coil is supplied with a signal, the current of which is proportional to the distance of the spot from the screen centre, by this means the focal length of the combined lens decreases as the spot approaches the centre.

Further information regarding this coil will be supplied on request.

### SCAN COILS.

The design of deflector coils should be aimed at producing a uniform field consistent with linear angular deflection and with minimum spot size. The best design for scan coils is toroidally wound coils on a ferrite core with the connections for each winding brought out separately to permit push pull or single ended operation. The coils should be wound in segments to keep the self capacity as low as possible. Damping resistors should be provided.

Any pin-cushion distortion which may result from coil design is best corrected by small shaping magnets placed around the tube bulb between the scan coils and face

Suitable scan coils for most applications can be supplied by Ferranti Ltd. Details on request.

### BEAM CENTRING MAGNET.

A weak permanent magnet, clamped to the base or neck of the tube a little behind the cathode can be adjusted to provide the correction necessary to allow for reasonable tolerances in the gun design and the presence of a small external field.

### EHT AND HT SUPPLIES

The quality of EHT, scanning and focus is very important since multiple effcts due to EHT ripple, imperfect focusing and poor scanning fields can cause such enlargement of the spot that no advantage is apparent when using these tubes.

High Frequency ripple on the EHT supply can cause considerable performance loss in this type of tube. This fault can usually be recognised by a "crawl" visible on the line as seen under a microscope, more commonly observed when the EHT supply is driven by a free-running oscillator. Even locked ripple at a harmonic of the sweep speed may upset both focus and linearity. In decoupling to cure this trouble, excessive smoothing capacity should be avoided to prevent "flashover".

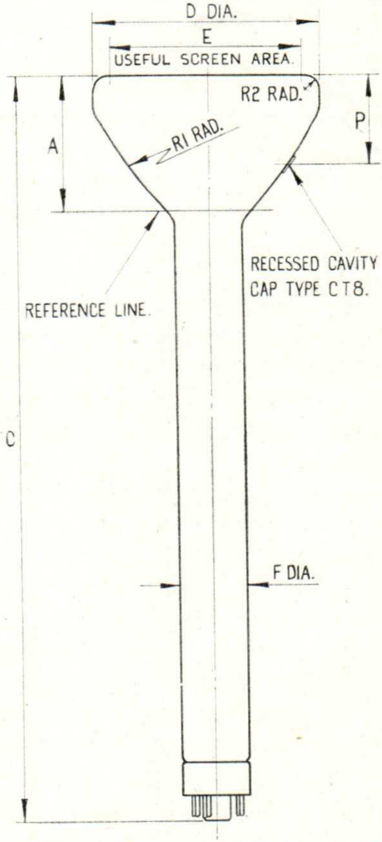
### SETTING UP.

The centring magnet should be clipped loosely at the gun end of the neck Bias and H.T. voltages should be applied and a raster obtained. Without applying focus current, the centring magnet should be now adjusted and clamped or exact symmetry of the raster on the face of the tube. The strength of the centring magnet may be adjusted by rotation.

Ferrous metal should not be used in the construction of the mount.

Neither ferrous nor non-ferrous metals should be placed close to the scan coil.

It is essential that the mumetal sleeve provided should be fitted to the neck.




| DIM. | INS | m m. | DIM. | INS. | m m. |
|---|---|---|---|---|---|
| A | 2·953 ± ·118 | 75 ± 3 | F | $1{\cdot}457^{+\cdot020}_{-\cdot059}$ | $37^{+\cdot5}_{-1\cdot5}$ |
| C | 18·307 ± ·197 | 465 ± 5 | P | 1·968 ± ·197 | 50 ± 5 |
| D | 4·960 ± ·079 | 126 ± 2 | R1 | 17·716 | 450 |
| E | 4·330 | 110 MIN. | R2 | ·250 | 6·35 |



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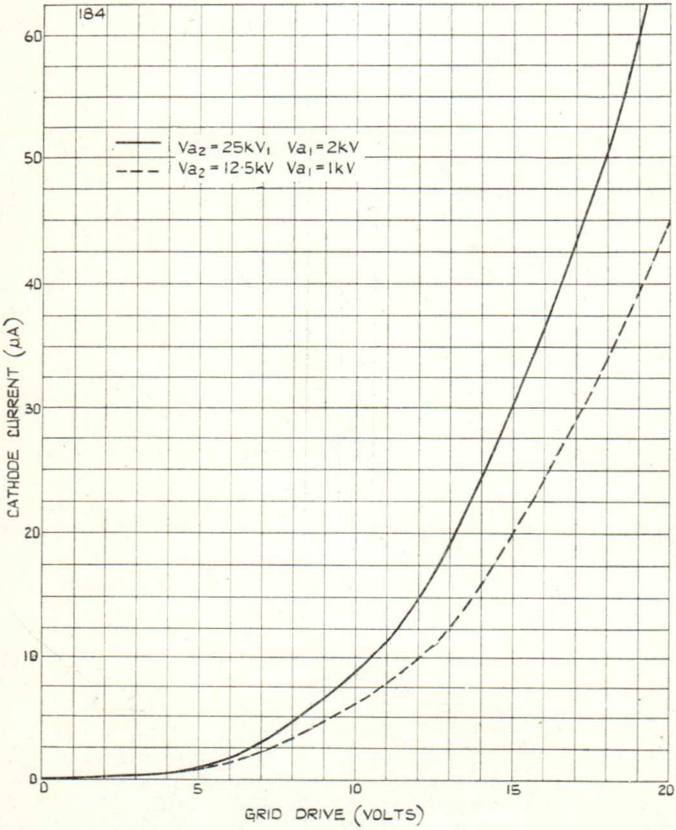
| 5/71AM |
|---|
| 5/71PM |
| 5/71QM |

## TYPICAL GRID DRIVE CHARACTERISTICS.






FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

Ferranti

# MICRO SPOT RADAR TUBES

5″ diameter optically flat faced Cathode Ray Tubes with a short bulb. The spot size is very small, being less than 0·0005″ at the screen centre and the screen can be accurately scanned over an area greater than four inches in diameter.

The high resolution has been made possible in this series of cathode ray tubes by the use of an entirely novel design of electron gun involving two focusing elements, one only of which is electromagnetic and external to the tube in the usual way; the other is electrostatic and of fixed focal length.

FOCUS ... ... ... ... ... Magnetic and Electrostatic

DEFLECTION ... ... ... ... Magnetic 60° angle.

SCREEN ... ... ... ... ... Metal Backed.

| *Phosphor | Type 'A' | Type 'P' | Type 'Q' |
|---|---|---|---|
| Fluorescence | Green | Blue | Blue Violet |
| Persistence to I/e | 1–2 μsecs. | 5–10 μsecs. | <0·1 μsecs. |

## PHYSICAL DETAILS.

| | |
|---|---|
| Max. Overall Length | 473 mm. |
| Max. Diameter | 135 mm |
| Nom. Neck Diameter | 37 mm |
| Min. Useful Screen Diameter | 110 mm |

For other dimensions see outline drawing on Page 2.

Electrode Connections ... ... ... Flying Leads

## ELECTRODE CONNECTIONS.

Colour Code:

| | |
|---|---|
| Heater | Brown |
| Cathode | Yellow |
| Modulator | Green |
| First Anode | Orange |
| Final Anode | White |

## HEATER.

| | |
|---|---|
| Heater Voltage | 6·3 volts |
| Heater Current | 0·3 amps |

## RATINGS.

| | |
|---|---|
| Max. Final Anode Voltage | 30 kV |
| Min. Final Anode Voltage | 12 kV |
| Max. First Anode Voltage | 2·5 kV |
| Min. First Anode Voltage | 1 kV |
| $V_g$ for visual cut-off (at $Va_1 = 2kV$) | –80 to –160 volts |
| Max. $V_{h-k}$ (heater negative) | 200 volts |
| Max. $V_{h-k}$ (heater positive) | 200 volts |

## TYPICAL OPERATION.

| | |
|---|---|
| Final Anode Voltage | 25 kV |
| First Anode Voltage | 2 kV |
| Vg for visual cut-off | –120 volts |
| Resolution | >8000 lines |

## CAPACITANCES.

| | |
|---|---|
| $C_k$–all | <8 pF |
| $C_g$–all | <8 pF |

## X-RAY WARNING.

When operated at an anode voltage in excess of 16kV, X-ray shielding may be required to give protection against the possible danger of injury from prolonged exposure at close range.

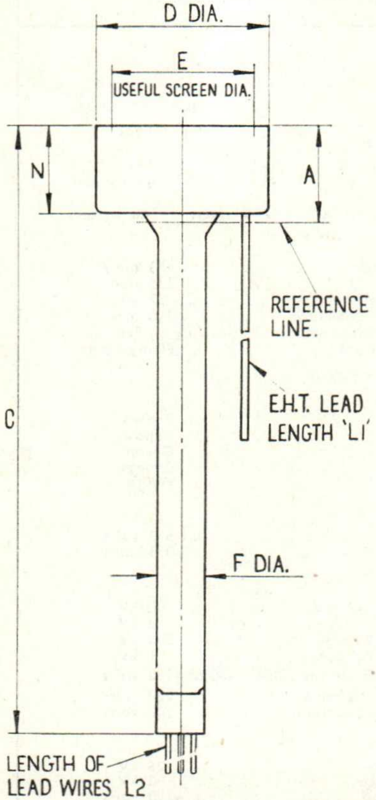
*Other phosphors available to special order, but resolution may suffer with other type phosphors and our recommendation for specific applications should be sought.

Ferranti

Issue 3.
Aug., 1962

Ferranti

# 5/71AP
# 5/71PP
# 5/71QP




| DIM. | INS. | m.m. | DIM. | INS. | m.m. |
|---|---|---|---|---|---|
| A | $2 \cdot 953 \pm \cdot 118$ | $75 \pm 3$ | F | $1 \cdot 457 \pm^{\cdot 020}_{\cdot 039}$ | $37 \pm^{\cdot 5}_{1 \cdot 5}$ |
| C | $18 \cdot 228 \pm \cdot 394$ | $463 \pm 10$ | L1 | 36 | 914 |
| D | $5 \cdot 118 \pm \cdot 079$ | $130 \pm 2$ | L2 | 36 | 914 |
| E | 4·330 | 110 MIN. | N | $2 \cdot 756 \pm \cdot 118$ | $70 \pm 3$ |



FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

## NOTES ON OPERATION

SCAN COILS.

The design of deflector coils should be aimed at producing a uniform field consistent with linear angular deflection and with minimum spot size. The best design for scan coils is toroidally wound coils on a ferrite core with the connections for each winding brought out separately to permit push pull or single ended operation. The coils should be wound in segments to keep the self capacity as low as possible. Damping resistors should be provided.

Any pin-cushion distortion which may result from coil design is best corrected by small shaping magnets placed around the tube bulb between the scan coils and face.

FOCUS COILS.

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Ferranti Focus Coil Assembly Type FC5 has been designed as a thin magnetic lens to provide the highest resolution of which the tube is capable.
This Focus Coil Assembly incorporates:—

**Main Focus Coil.**

**Alignment Coils** for electrical alignment—no mechanical adjustment required.

**Astigmatism Coils** to produce a non astigmatic round spot.

**Dynamic Focus Coil** to ensure highest resolution over whole scan area.

This dynamic focus coil is supplied with a signal, the current of which is proportional to the distance of the spot from the screen centre, by this means the focal length of the combined lens decreases as the spot approaches the centre.

Further information regarding this coil will be supplied on request.

BEAM CENTRING MAGNET.

A weak permanent magnet, clamped to the base or neck of the tube a little behind the cathode can be adjusted to provide the correction necessary to allow for reasonable tolerances in the gun design and the presence of a small external field.

SETTING UP.

The centring magnet should be clipped loosely at the gun end of the neck Bias and H.T. voltages should be applied and a raster obtained. Without applying focus current, the centring magnet should be now adjusted and clamped or exact symmetry of the raster on the face of the tube. The strength of the centring magnet may be adjusted by rotation.

It is advisable to use no ferrous metal in the construction of the mount. Neither ferrous nor non-ferrous metals should be placed close to the scan coil.

It is essential that the mumetal sleeve provided should be fitted to the neck.

GENERAL.

The tube is coated, except over the screen and neck surface, with a thick layer of plastic resin. The final anode lead, insulated with a coating of irradiated polythene emerges from the rear surface of the resin, enabling the tube to be operated under adverse atmospheric conditions without danger of EHT breakdown.

The leads to the gun electrodes are also encapsulated in a manner which does not hinder the easy fitting of the scan and focus coils.

The cylindrical shape of the resin coating facilitates firm clamping of the tube in its mount.

Great care must be taken in considering the quality of EHT, scanning and focus supplies, since multiple effects due to EHT ripple, imperfect focusing and poor scanning fields can cause such enlargement of the spot that no advantage is apparent when using these tubes.

High Frequency ripple on the EHT supply can cause considerable performance loss in this type of tube. This fault can usually be recognised by a "crawl" visible on the line as seen under a microscope, more commonly observed when the EHT supply is driven by a free-running oscillator, Even locked ripple at a harmonic of the sweep speed may upset both focus and linearity. In decoupling to cure this trouble, excessive smoothing capacity should be avoided to prevent "flashover".

5/71AP
5/71PP
5/71QP

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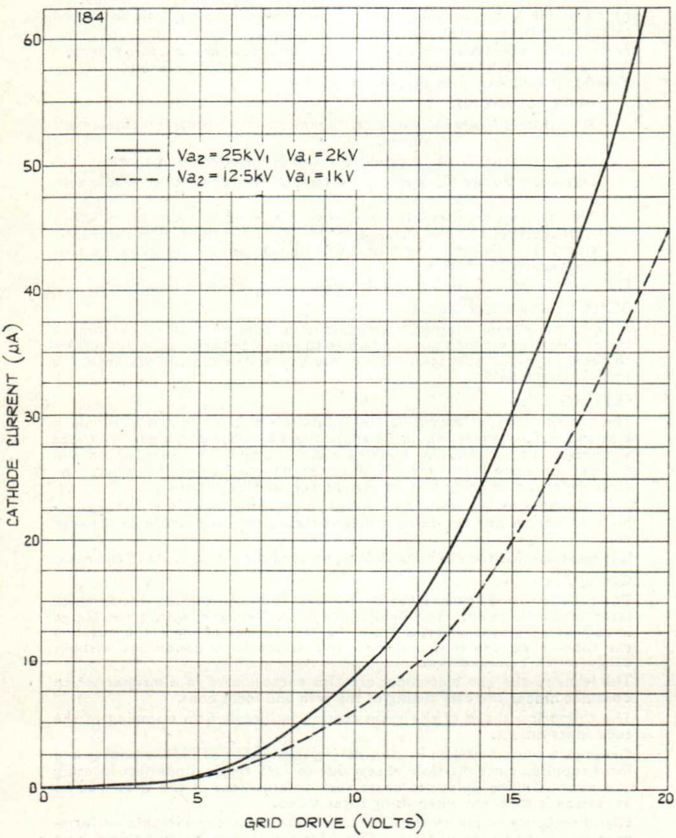
## TYPICAL GRID DRIVE CHARACTERISTICS.



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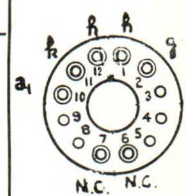
# MICRO SPOT RADAR TUBES

A very high definition Cathode Ray Tube with a 5in. diameter optically flat face and fine grain metal backed screen.
This Tube is designed for use in applications where it is not necessary to have the very high resolution of a Type 5/71 micro-spot tube or for high definition applications requiring a higher light output than that provided by Type 5/71QM.




**Base Connections**

**View from spigot end of tube**

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic and Electrostatic. |
| DEFLECTION ... ... ... ... | Magnetic, 60° angle. |
| SCREEN ... ... ... ... | Metal Backed. |
| *Phosphor ... ... ... ... | Type 'Q' |
| Fluorescence ... ... ... | Blue/Violet. |
| Persistence ... ... ... | Ultra Short. |

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal) |
| Final Anode Connector ... | CT8 (Cavity type). |
| Max. Overall Length ... ... | 430 mm. |
| Max. Diameter ... ... ... | 135 mm. |
| Nom. Neck Diameter ... ... | 37 mm. |
| Max. Useful Screen Diameter... | 110 mm. |

For other dimensions see outline drawing overleaf.

BASE CONNECTIONS.†

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater. |

Side Cap—2nd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amps. |

RATINGS.

| | |
|---|---|
| Max. Final Anode Voltage ... | 30 kV. |
| Max. First Anode Voltage ... | 2·5 kV. |
| Min. First Anode Voltage ... | 1 kV. |
| $V_g$ for visual cut-off (at $Va_1$ = 2kV.) | −80 to −160 volts. |
| Max. $V_{h-k}$ (heater negative) ... | 200 volts. |
| Max. $V_{h-k}$ (heater positive) ... | 200 volts. |

TYPICAL OPERATION.

| | |
|---|---|
| Final Anode Voltage ... ... | 25 kV. |
| First Anode Voltage ... ... | 2 kV. |
| $V_g$ for visual cut-off ... ... | −120 volts. |
| §Line Width ... ... ... | 0·001 ins. (approx.). |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |

*Other phosphors available to special order.
†This tube can also be supplied with potted anode and flying lead connector—Type 5/74QO
or with both potted anode and base with flying lead connections to all electrodes—Type 5/74 QP.
§Measured by microscope at screen centre.

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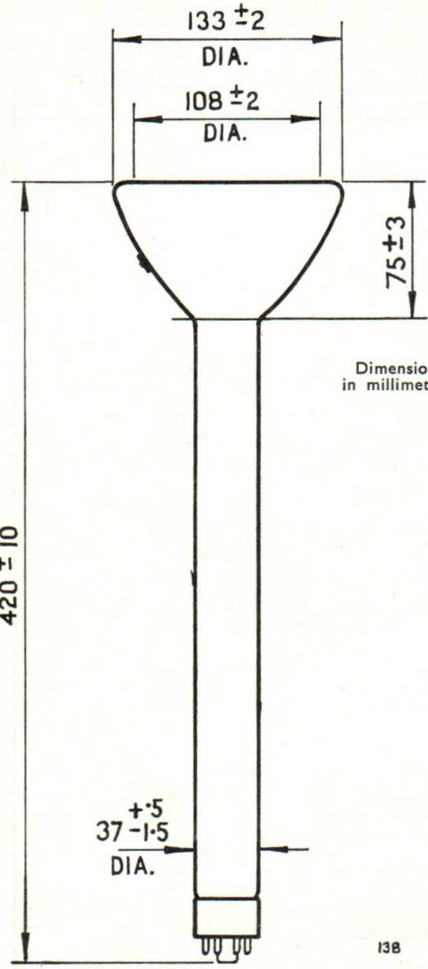
Issue 2
Oct., 1960

Ferranti




Dimensions
in millimetres

138

# HIGH RESOLUTION DISPLAY TUBES

High Resolution, High Light Output Display Tubes. The 5″ diameter face is optically flat and is of non-browning glass.

**FOCUS** ............................................ Magnetic
**DEFLECTION** .................................. Magnetic

**SCREENS:**

| Type No. | Phosphor | Fluorescence | Approx. Persistence |
|---|---|---|---|
| 5G/14AJ | A | Green | 1 $\mu$Sec. |
| 5G/14PJ | P | Blue | 2 $\mu$Sec. |
| 5G/14QJ | Q | Blue/Violet | 0·1 $\mu$Sec. |
| 5G/14Q$_4$J | Q$_4$ | Blue/Violet | 0·1 $\mu$Sec. |

Refer to phosphor characteristics at the front of this section of this handbook.

*All types have metal backed screens.*

**PHYSICAL DETAILS:**

Base ........................................ B12A (Duodecal)
Max. overall length..................... 458 mm. (18·0 in.)
Min. useful screen area.................. 108 mm. (4·25 in.)
Neck diameter .......................... 37 mm. nominal
Min. length—Anode lead.............. 380 mm. (15·0 in.)

*For other dimensions see outline drawing overleaf.*

The final anode lead is potted on to the tube and the neck has an external conductive coating.

**BASE CONNECTIONS:**

| | | |
|---|---|---|
| Pin 1—Heater | Pin 5—No pin | Pin 9—No pin |
| Pin 2—Grid | Pin 6—Not connected | Pin 10—Not connected |
| Pin 3—No pin | Pin 7—1st anode | Pin 11—Cathode |
| Pin 4—No pin | Pin 8—No pin | Pin 12—Heater |

Flying Lead 2nd anode.

**HEATER:**

Heater Voltage .......................... 6·3 volts
Heater Current .......................... 0·3 amp.

**RATINGS:**

Max. 1st Anode voltage .............. 600 volts
Max. 2nd Anode voltage .............. 30 kV
Min. 1st Anode voltage .............. 300 volts
Min. 2nd Anode voltage .............. 15 kV
Max. $V_{h\text{-}k}$ (Heater Positive).......... 250 volts
Max. $V_{h\text{-}k}$ (Heater Negative)......... 150 volts
Max. $R_{h\text{-}k}$................................ 1·0 MΩ
Max. $R_{g\text{-}k}$................................ 1·5 MΩ

**CAPACITANCES:**

$C_k$ - all....................................... $<$15·0 pF.
$C_g$ - all....................................... $<$15·0 pF.

**TYPICAL OPERATING CONDITIONS:**

1st Anode voltage........................ 500 volts
2nd Anode voltage........................ 25 kV
$V_g$ for visual cut off.................... −105 volts

**Resolution at Screen Centre:**

Microscope Measurement—A and P Phosphors:

Line width measured by microscope to visual extinction ($I_B$=50$\mu$A) 125 microns.

Issue 2
July, 1963

**Resolution at Screen Centre (cont.):**

Spatial Frequency Measurement:

A and P Phosphors

95 cycles/cm spatial frequency response at 60% modulation ($I_B$=1$\mu$A). Equivalent to 35 microns. 30 cycles c/m spatial frequency response at 60% modulation ($I_B$=50 $\mu$A). Equivalent to 100 microns.

Q and $Q_4$ Phosphors

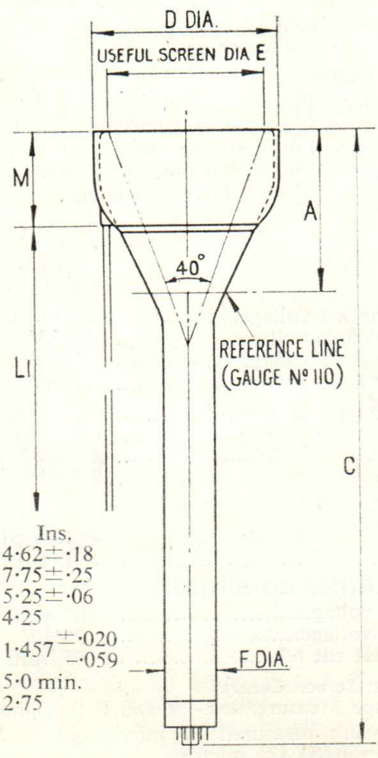
85 cycles/cm spatial frequency response at 60% modulation ($I_B$=1$\mu$A). Equivalent to 37 microns. 25 cycles/cm spatial frequency response at 60% modulation ($I_B$=50 $\mu$A). Equivalent to 130 microns.

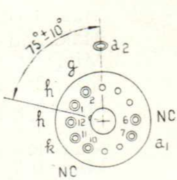
The position of the centre of the air gap in the focus-coil should be approximately 210 mm. from the tube face.

**X-RAY WARNING:**

When operated at an anode voltage in excess of 16kV. X-ray shielding may be required to give protection against the possible danger of injury from prolonged exposure at close range.

This type of tube is also available with the core coated with a thick layer of plastic resin.




| Dim. | mm. | Ins. |
|---|---|---|
| A | 117·5±4·5 | 4·62±·18 |
| C | 451±6·3 | 17·75±·25 |
| D | 133·4±1·5 | 5·25±·06 |
| E | 108 min. | 4·25 |
| F | $37 {}^{+\cdot 5}_{-1\cdot 5}$ | $1\cdot 457 {}^{\pm\cdot 020}_{-\cdot 059}$ |
| L1 | 380 min. | 15·0 min. |
| M | 70 | 2·75 |

Ferranti

# OSCILLOGRAPH TUBE

A miniaturised instrument tube with a rectangular flat face. 'Y' deflection is Electrostatic and 'X' deflection Magnetic.

| | |
|---|---|
| FOCUS ... ... ... ... | Low voltage Electrostatic |
| DEFLECTION ... ... ... ... | 'X' ... Magnetic.<br>'Y' ... Electrostatic (single end input) |

**SCREEN.**

| | |
|---|---|
| Phosphor † ... ... ... | Type 'D'. |
| Fluorescence ... ... ... | Green. |
| Persistence ... ... ... | Short. |

For further details refer to Type 'D' phosphor characteristics at the front of this section of the handbook.
This tube can be supplied with other screen phosphors.

**PHYSICAL DETAILS.**

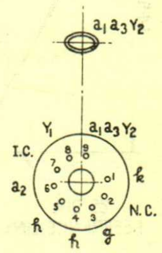
| | |
|---|---|
| Base ... ... ... ... | B9A/D. |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 275 mm. |
| Nom. Neck Diameter ... ... | 22·5 mm. |
| Min. 'Y' Deflection ... ... | 42 mm. |

For other dimensions see outline drawing overleaf.

**BASE CONNECTIONS. ***

| | |
|---|---|
| Pin 1—Cathode. | Pin 6—2nd Anode (focus). |
| Pin 2—No Connection | Pin 7—Internal Connection. |
| Pin 3—Grid. | Pin 8—'$Y_1$' Deflector Plate. |
| Pin 4—Heater. | Pin 9—1st & 3rd Anodes and '$Y_2$' Deflector Plate. |
| Pin 5—Heater. | |

Side Contact : 1st and 3rd Anodes and '$Y_2$' Deflector Plate.




**Base Connections**

**Underside View of Base**

**HEATER.**

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amps. |

**RATING.**

| | |
|---|---|
| Max. $A_1 + A_3$ voltage ... ... | 4 kV. |
| Min. $A_1 + A_3$ voltage ... ... | 1 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 0·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

**TYPICAL OPERATION.**

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| 1st and 3rd Anode Voltage ... | 2 kV. |
| 2nd Anode Voltage for focus ... ... ... | –50 to +100 volts. |
| Vg for visual cut-off ... | –20 to –50 volts. |
| 'Y' Plate Sensitivity ... ... | 11 v/cm. |

†This tube should be fitted with a magnetic shield which must be earthed.

**CAPACITANCES.**

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{y_1-all}$ ... ... ... ... | 2 pF (approx.). |

*This Type of Tube can also be supplied with potted base and flying leads—see Data Sheet for Type 5 × 3/53DE.

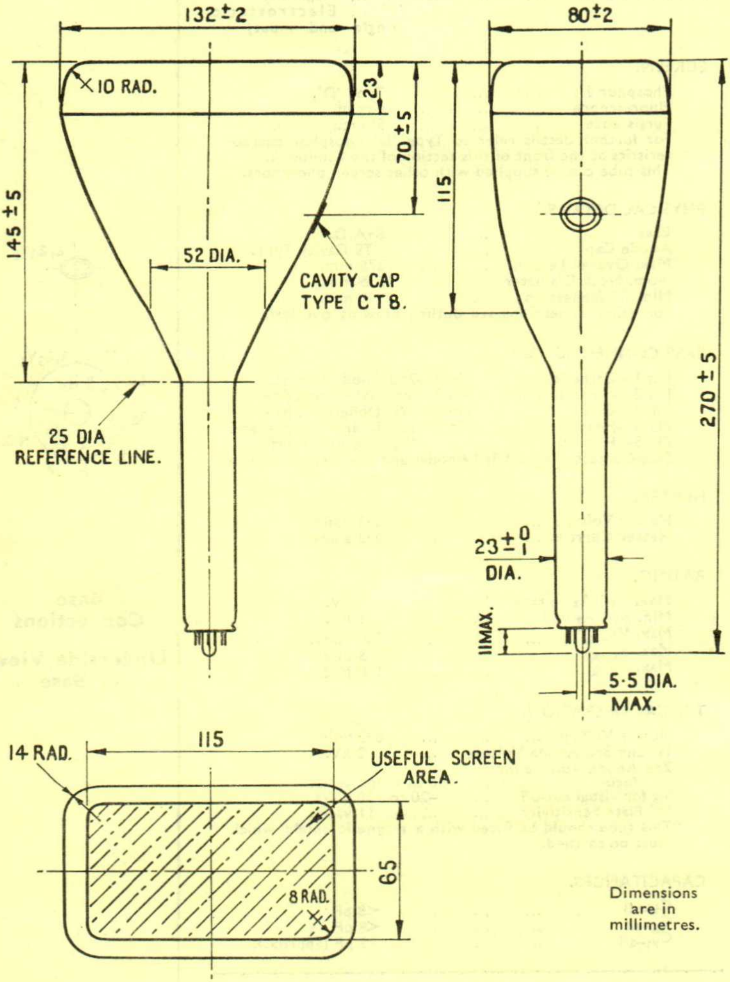
†A suitable shield is Type 11467 manufactured by Magnetic and Electrical Alloys Ltd.

Tentative
Issue 3
June 1960.

Ferranti

# 5×3/53D

Ferranti




Dimensions are in millimetres.

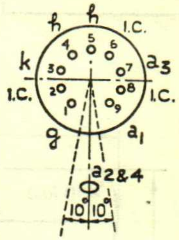
# Ferranti

## RADAR TUBES

**5X3/94LM**

**5X3/95LM**

Miniaturised rectangular faced Display Tube designed for use in airborne radar equipments with transistor circuitry. The narrow neck diameter and narrow scan angle ensure full deflection with low scan power. The high modulation slope and the phospor permit displays of conventional brightness with drive of the order of a few volts. With higher drive voltage, the high slope feature provides displays of high intensity for use in conditions of high ambient lighting.




**Underside view of base**

| | |
|---|---|
| FOCUS ... ... ... ... | Low Voltage Electrostatic. |
| DEFLECTION ... ... ... ... | Magnetic. |
| **SCREEN.** | |
| *Phosphor ... ... ... ... | Type 'L'. |
| Fluorescence ... ... ... | Orange. |
| Afterglow ... ... ... | Orange. |
| Persistence ... ... ... | Long. |
| **PHYSICAL DETAILS.** | |
| Base ... ... ... ... | B9A/D |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 257 mm. |
| Neck Diameter ... ... | 23 mm. (nom.) |
| Mounting Position ... ... | Any. |

**BASE CONNECTION.**

| | |
|---|---|
| Pin 1—Grid | Pin 6—I.C. |
| Pin 2—I.C. | Pin 7—3rd Anode. |
| Pin 3—Cathode. | Pin 8—I.C. |
| Pin 4—Heater. | Pin 9—1st Anode. |
| Pin 5—Heater. | Side Contact—2nd & 4th Anodes. |

**HEATER.**

| | 5 x 3/94 LM. | 5 x 3/95 LM. |
|---|---|---|
| Heater Voltage ... ... | 6·3 | 19·0 volts |
| Heater Current ... ... | 0·3 | 0·1 amp, |

**†RATINGS & CHARACTERISTICS**

| | |
|---|---|
| Max. $A_1$ voltage ... ... ... | 70 volts. |
| Max. $A_2+A_4$ voltage ... ... | 18 kV. |
| Min. $A_2+A_4$ voltage ... ... | 8 kV. |
| Max. Neg. $A_1$ voltage ... ... | –500 volts. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| $A_3$ voltage for focus ... | 0 to –300 volts. |

**†TYPICAL OPERATION.**

It is essential to employ cathode modulation, i.e., the grid should be operated at earth or some other fixed potential and all other voltages applied with reference to this point. This type of tube is inefficient under grid modulation conditions unless drive is also applied to $A_1$ in the same sense as that applied to the grid.

1. Short grid base conditions, where $V_k$ is approx. +10v. for visual cut-off.

| | |
|---|---|
| Final Anode Voltage $V_{a2+a4}$ | 15 kV. |
| $V_{A1}$ ... ... ... | –40 volts. |
| $V_{A3}$ for focus ... ... | –150 volts. |

Under these conditions the zero bias beam current is approx. 150 microamperes.

2. For high brightness applications with a conventional drive range, where $V_k$ is approximately +60 volts for visual cut off.

| | |
|---|---|
| Final Anode Voltage $V_{A2+4}$ | 15 kV. |
| $V_{A1}$ ... ... ... ... | 0 volts. |

Under these conditions the beam current at zero bias is approx. 2·5 mA.

Versions with flying leads and encapsulated base and anode contact are also available.

---

*This phosphor is liable to burn if operated with a spot which is stationary or slow moving, and tubes should not be operated under such conditions, even at low beam current. Alternative phosphors for this application can be supplied on request.

†All potentials are referred to grid.

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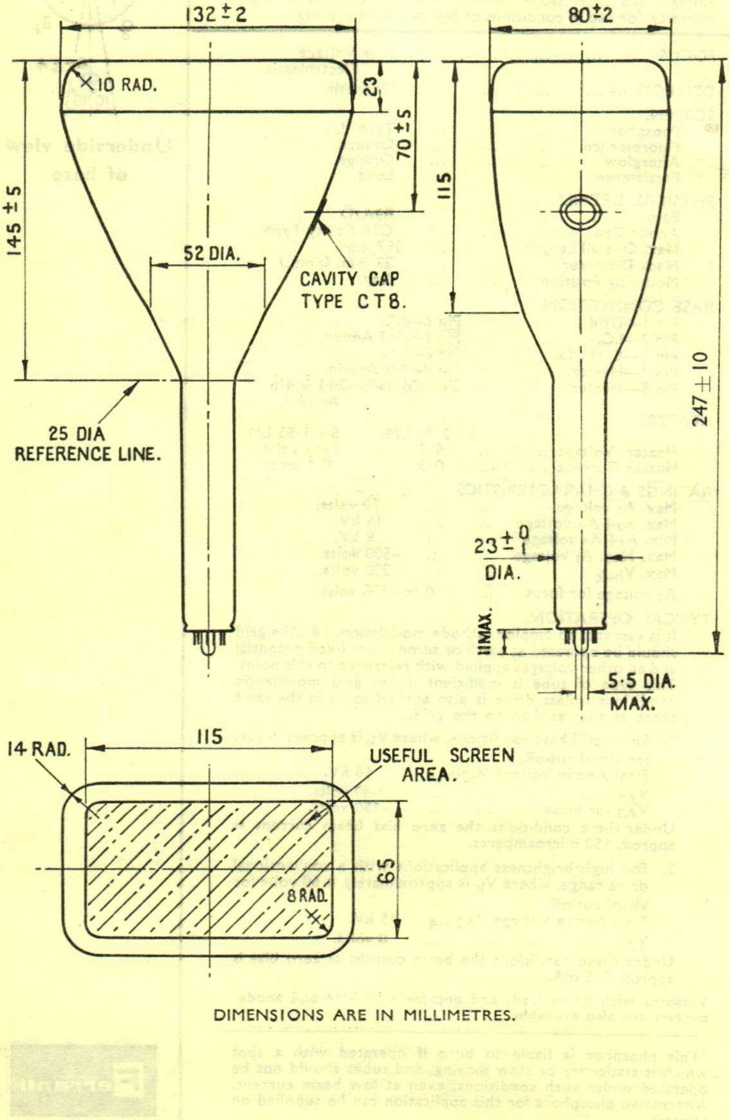
Issue 2
Mar., 1961

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

**5X3/94LM**

**5X3/95LM**




DIMENSIONS ARE IN MILLIMETRES.

FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

# 6/22AM
# 6/22PM
# 6/22QM

**Ferranti**

## CATHODE RAY TUBES

6-inch diameter Triode Tubes for Magnetic deflection and focus.
Types 6/22AM and 6/22QM are designed for use in general Flying Spot Scanner applications.
Type 6/22PM is for use in recording high resolution images on blue sensitive film stock.
All Types have optically flat faces with ground internal and external surfaces.
The tube face is of non-solarising glass.

FOCUS ... ... ... ... Magnetic.

DEFLECTION ... ... ... ... Magnetic.

SCREENS.

| | 6/22AM | 6/22PM | 6/22QM |
|---|---|---|---|
| Phosphor ... | Type 'A' | Type 'P' | Type 'Q' |
| Fluorescence | Green | Blue | Blue/Violet |
| Persistence | Ultra-short | Ultra-short | Killed |

All types have metal backed screens.

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT.8 (Cavity Type). |
| Max. Overall Length ... ... | 495 mm. |
| Max. Diameter ... ... ... | 163 mm. |
| Nom. Neck Diameter ... ... | 37 mm. |
| Useful Screen Area ... ... | 127 mm. dia. |

For other dimensions see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—Not connected. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No pin. | Pin 9—No pin. |
| Pin 4—No pin. | Pin 10—Not connected. |
| Pin 5—No pin. | Pin 11—Cathode. |
| Pin 6—Not connected. | Pin 12—Heater. |

Side Contact—Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| *Max. Anode Voltage ... ... | 30 kV. |
| †Nom. Vg for visual cut off ... | Va/125 |
| Max. $V_{hk}$ (Heater Negative) ... | 200 volts. |
| Max. $V_{hk}$ (Heater Positive) ... | 200 volts. |

TYPICAL OPERATION.

| | |
|---|---|
| Anode Voltage ... ... ... | 25 kV. |
| Vg for visual cut off ... ... | –200 volts. |
| Grid Drive for $I_a$ = 100μA ... | 37 volts. |
| Screen Resolution at 50 f.p.s. ... | 1000 lines. |
| ‡Light Output ('P' Screen) ... | 300 e.f.c. |
| §Focus Coil ... ... ... | 570 ampere turns (approx.). |

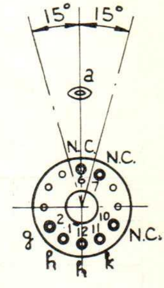
CAPACITANCE.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |

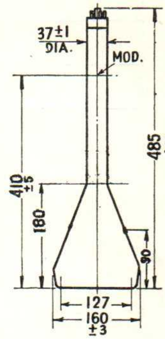
*Recommended operating range—17 to 25 kV.
†The grid should never be positive with respect to the cathode.
‡At Beam Current of 100μA with a 10 x 10 cm. raster.
§A suitable coil is a soleniod of approx. 16,000 turns of 38 s.w.g. wire, positioned with the gap approx. 150 mm. in front of the modulator. Ferranti Type FC.1 (Pt. No. 38/13300) is available.

X-RAY WARNING.

When operated at an anode voltage in excess of 16kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.




**Underside View of Base**



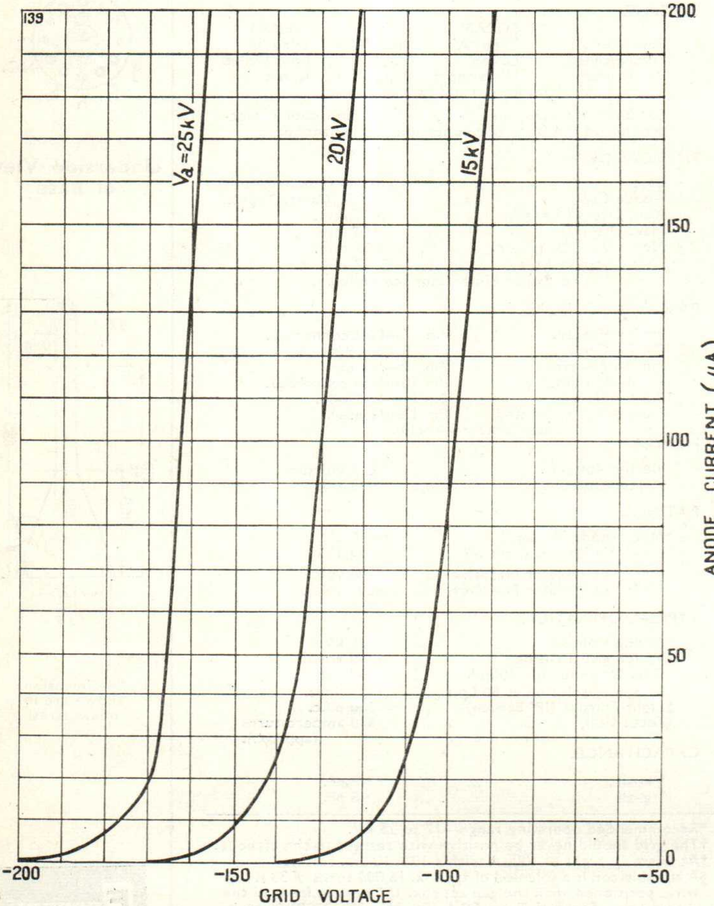

All dimensions shown are in millimetres.

**Ferranti**

Issue 3
Nov. 1960

Ferranti

TYPICAL ANODE CURRENT GRID/VOLTAGE CHARACTERISTICS



**6/32PM**

# FERRANTI

## VOLTAGE TRANSIENT OSCILLOGRAPH TUBE

An indirectly heated Triode Tube specially designed for Transient Oscillography. The Fluorescent spot of high actinic value and exceptional brightness makes the tube particularly suitable for photographic recording. The useful screen area is flat and approx. 5 inches in diameter.

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic. |
| DEFLECTION ... ... ... ... | Electrostatic. |
| SCREEN ... ... ... ... | Metal Backed. |
| Phosphor ... ... ... | Type 'P'. |
| Fluorescence ... ... ... | Blue. |
| Persistence ... ... ... | Ultra Short. |

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Anode Cap ... ... ... | Type CT8 (Cavity |
| Deflector Plate Caps ... ... | Type CT2 Type.) |
| Max. Overall Length ... ... | 525 mm. |
| Useful Screen Area ... ... | 127 mm. dia. (flat face). |
| Neck Diameter ... ... | $37 \pm 1$ mm. |
| Mounting Position ... ... | Any. |

For other dimensions see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 5—Grid. |
| Pin 2—Heater. | Pin 6—No Pin. |
| Pin 3—No Pin. | Pin 7—Heater. |
| Pin 4—No Pin. | Pin 8—Cathode. |

Anode and deflector plates connected to side caps.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 4.0 volts AC. or DC. |
| Heater Current ... ... ... | 1.0 amp. |

RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... | 25 kV. |
| Max. $V_{h-k}$ ... ... ... | 100 volts. |
| Max. Pulsed Beam Current ... | 500 $\mu$A. |

CHARACTERISTICS.

| | |
|---|---|
| *Nom. Vg for visual cut off ... | $V_a/120$ |
| Deflection Sensitivity :— | |
| 'Y' plates ... ... ... | $450/V_a$ mm./V. |
| 'X' plates ... ... ... | $500/V_a$ mm./V. |

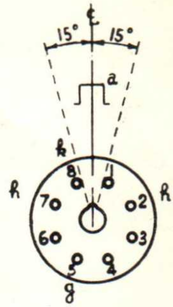
TYPICAL OPERATION.

| | |
|---|---|
| Anode Voltage ... ... ... | 20 kV. |
| Beam Current ... ... ... | 75 $\mu$A. |
| Vg for Cut-off ... ... ... | 165 volts. |
| †Focus Coil ... ... ... | 900 ampere turns. |
| Writing Speeds for Single Sweep Photography using Standard X-ray Film : | |
| Image Ratio ... ... | 1 : 3. |
| Lens Aperture ... ... | f1. |
| Writing Speed ... ... | $>$ 500,000 spot diameters per microsecond. |

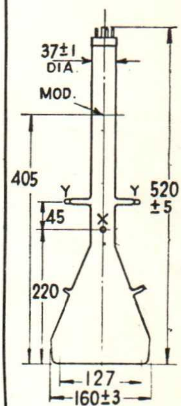
CAPACITANCES.

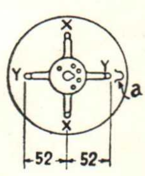
| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | 6.0 pF. |
| $C_{g-all}$ ... ... ... ... | 6.2 pF. |
| $C_{x_1-x_2}$ ... ... ... ... | 1.0 pF. |
| $C_{y_1-y_2}$ ... ... ... ... | 0.9 pF. |
| $C_{x_1-all}$ ... ... ... ... | 4.8 pF. |
| $C_{x_2-all}$ ... ... ... ... | 4.8 pF. |
| $C_{y_1-all}$ ... ... ... ... | 4.3 pF. |
| $C_{y_2-all}$ ... ... ... ... | 4.3 pF. |
| $C_{x_1x_2-y_1y_2}$ ... ... ... | 1.0 pF. |

This tube was formerly designated Type 06/3P.
*The grid should never be allowed to become positive with respect to the Cathode.
†The recommended focus coil is a shrouded solenoid of approx. 16,000 turns of 38 S.W.G. wire. The power unit required for energising this coil should be capable of supplying 40–60 mA. at 150–200 volts.




**Base Connections Underside View of Base**




All dimensions shown are in millimetres.

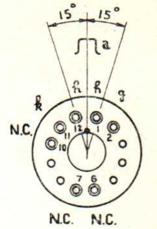
FERRANTI

Issue 1
Aug., 1957

# FERRANTI

## FLYING SPOT SCANNER TUBE

An indirectly heated Triode Tube with a 6in. diameter metal backed screen and electrostatic deflection. This tube is suitable as a replacement for earlier types S6/30A or 6/3A.



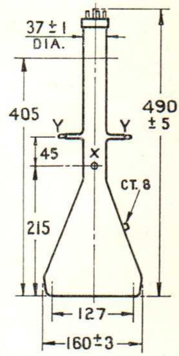

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic. |
| DEFLECTION ... ... ... ... | Electrostatic. |
| SCREEN ... ... ... ... | Metal Backed. |
| Phosphor ... ... ... | Type 'A'. |
| Fluorescence ... ... ... | Green. |
| Persistence ... ... ... | Ultra-short. |

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 Cavity Type.* |
| Deflector Plate Caps ... ... | Type CT2 (9.7 mm. dia.). |
| Max. Overall Length ... ... | 495 mm. |
| Useful Screen Area ... ... | 127 mm. dia. (flat face). |
| Neck Diameter ... ... | 37±1 mm. |
| Mounting Position ... ... | Any. |

For other dimensions see drawing.




BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—No Connection. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater. |

Side Contact—Anode.

HEATER.

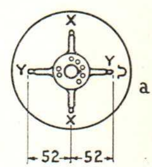
| | |
|---|---|
| Heater Voltage ... ... ... | 6.3 volts. |
| Heater Current ... ... ... | 0.3 amp. |

RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... | 25 kV. |
| Max. $V_{h-k}$ ... ... ... | 100 volts. |
| Max. Beam Current ... ... | 200 μA. |

CHARACTERISTICS.

| | |
|---|---|
| †Nom. Vg for visual cut off ... | $V_a/120$ |
| Av. Mod. Drive for 50 μA Beam Current ... ... ... | 33 volts. |
| Deflection Sensitivity :— | |
| 'X' plates ... ... ... | $500/V_a$ mm./V. |
| 'Y' plates ... ... ... | $450/V_a$ mm./V. |




TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... | 6.3 volts. |
| Anode Voltage ... ... ... | 20 kV. |
| $V_g$ for visual cut off ... ... | −170 volts. |
| ‡Focus Coil ... ... ... | 900 ampere turns (approx.). |
| Screen Resolution ... ... | > 100 lines per cm. |
| Normal Peak Beam Current ... | 150 μA. |

Dimensions shown are in millimetres.

X-RAY WARNING.

When operated at high anode voltage shielding may be required to protect against harmful X-Ray radiation, which could cause possible injury from prolonged exposure.

CAPACITANCES.

| | |
|---|---|
| $C_{x\,x_2-y\,y_2}$ ... ... ... | 1.0 pF. |
| $C_{g-all}$ ... ... ... ... | 5.8 pF. |
| $C_{x_1-x_2}$ ... ... ... ... | 1.0 pF. |
| $C_{y_1-y_2}$ ... ... ... ... | 0.9 pF. |
| $C_{x_1-all} = C_{x_2-all}$ ... ... ... | 4.8 pF. |
| $C_{y_1-all} = C_{y_2-all}$ ... ... | 4.3 pF. |

*A suitable adaptor to CT2 can be supplied where the tube is required to replace an earlier type.
†The grid should never be positive with respect to the cathode.
‡Positioned so that the gap is 100 mm. in front of the modulator.

Issue 1
Aug., 1957

# 6/44DM

# 6/44PM

Ferranti

## CATHODE RAY TUBES

6-inch diameter Tetrode Tubes having optically flat faces with ground internal and external surfaces.
Type 6/44 DM is designed for use in Telerecording and in Television Transmission Systems Converters.
Type 6/44 PM is for use in recording high resolution images on blue sensitive film stock.

FOCUS ... ... ... ... ... Magnetic.

DEFLECTION ... ... ... ... Magnetic.

SCREEN.

| | 6/44 DM | 6/44 PM |
|---|---|---|
| Phosphor ... | Type 'D' | Type 'P' |
| Fluorescence | Green | Blue |
| Persistence | Short | Ultra-short |

Both types have metal backed screens.
For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT.8 (Cavity Type). |
| Max. Overall Length ... ... | 495 mm. |
| Max. Diameter ... ... ... | 163 mm. |
| Nom. Neck Diameter ... ... | 37 mm. |
| Useful Screen Area ... ... | 127 mm. dia. |

For other dimensions see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater. |

Side Contact—2nd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 850 volts. |
| *Max. $A_2$ Voltage ... ... ... | 30 kV. |
| †Nom. Vgf or visual cut off ... | $V_{a_1}/7$ volts |
| Max. $V_{hk}$ (Heater Negative) ... | 200 volts. |
| Max. $V_{hk}$ (Heater Positive) ... | 200 volts. |

TYPICAL OPERATION.

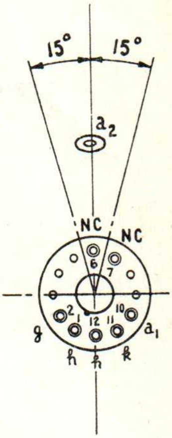
| | |
|---|---|
| 1st Anode Voltage ... ... | 600 volts. |
| 2nd Anode Voltage ... ... | 25 kV. |
| Vg for visual cut off ... ... | –85 volts. |
| Grid Drive for $I_B = 100\ \mu A$ ... | 35 volts. |
| Screen Resolution at 50 f.p.s. ... | 1000 lines. |
| Focus Coil... ... ... ... | See Note § Below. |

CAPACITANCE.

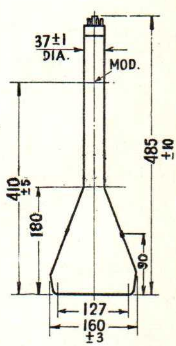
| | |
|---|---|
| $C_{k\text{-all}}$ ... ... ... ... | <8 pF. |
| $C_{g\text{-all}}$ ... ... ... ... | <8 pF. |

X-RAY WARNING.
When operated at an anode voltage in excess of 16 kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

*Recommended operating range—17 to 25 kV.
†The grid should never be positive with respect to the cathode.
§A suitable coil is a solenoid of approx. 16,000 turns of 38 s.w.g. wire, positioned with the gap approx. 150 mm. in front of the modulator.




**Base Connections Underside View of Base**



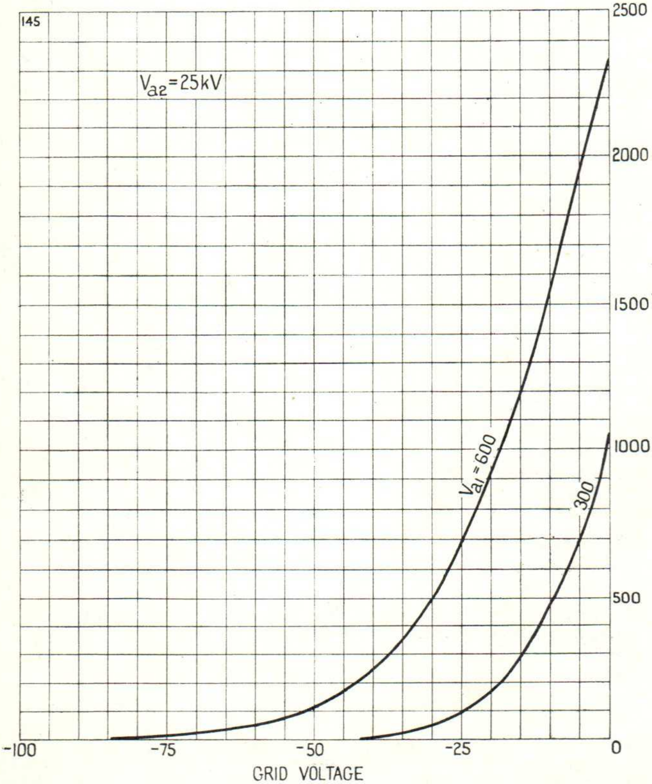

All dimensions shown are in millimetres.

Ferranti

Issue 2.
Dec.. 1961

Ferranti

## TYPICAL BEAM CURRENT/GRID VOLTAGE CHARACTERISTICS



Ferranti

# FLYING SPOT SCANNER TUBES

High Resolution Rectangular Flying Spot Scanner Tubes with Electrostatic Focus.

**8/03AM**

**8/03QM**

| | | |
|---|---|---|
| FOCUS ... ... ... ... | Low Voltage Electrostatic. | |
| DEFLECTION ... ... ... | Magnetic—90° | |
| SCREENS ... ... ... | Metal Backed. | |
| | 8/03AM | 8/03QM |
| Phosphor ... | Type 'A' | Type 'Q' |
| Fluorescence | Green | Magenta. |

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... | 293 mm. |
| Neck Diameter ... ... | 37 mm. (nominal). |
| Mounting Position ... | Any. |

For other dimensions see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. ($A_1$). |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. ($A_3$). | Pin 12—Heater. |

Side Contact—2nd Anode+4th Anode. ($A_2+A_4$).

HEATER.

| | |
|---|---|
| Heater Voltage ... ... | 6·3 volts. |
| Heater Current ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... | 500 volts. |
| Min $A_1$ voltage ... ... | 200 volts. |
| Max. $A_2+A_4$ voltage ... | 15 kV. |
| Min. $A_2+A_4$ voltage ... | 10 kV. |
| Max. Pos. $A_3$ voltage ... | +500 volts. |
| Max. Neg. $A_3$ voltage ... | –500 volts. |
| Max. $V_{h-k}$ (Heater positive) | 150 volts. |
| Max. $V_{h-k}$ (Heater negative) | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

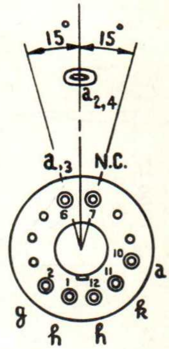
TYPICAL OPERATION AND CHARACTERISTICS.

| | |
|---|---|
| Heater Voltage ... ... | 6·3 volts. |
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode voltage | 12 kV. |
| 3rd Anode voltage for focus ... | –300 to +300 volts. |
| Vg for visual cut off | –30 to –70 volts. |
| †Av. Grid Drive for $I_B$= 100 μA. | 25 volts. |
| Screen Resolution ... ... | 600 lines. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... | <8 pF. |

†The grid should never be positive with respect to the cathode.



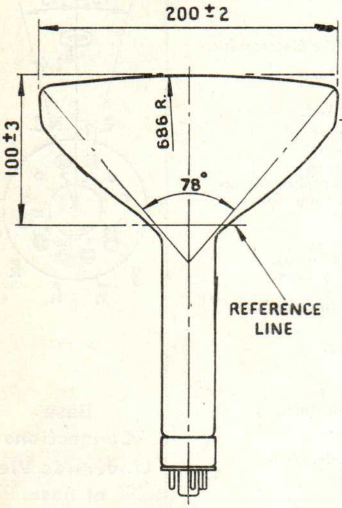

**Base Connections Underside View of Base**

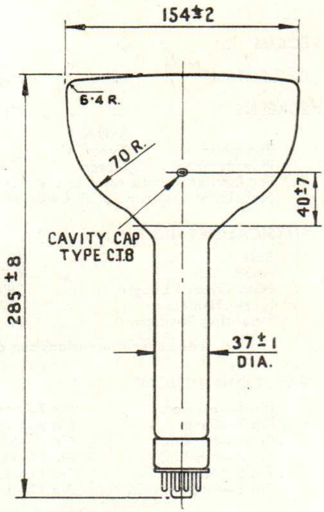
Ferranti

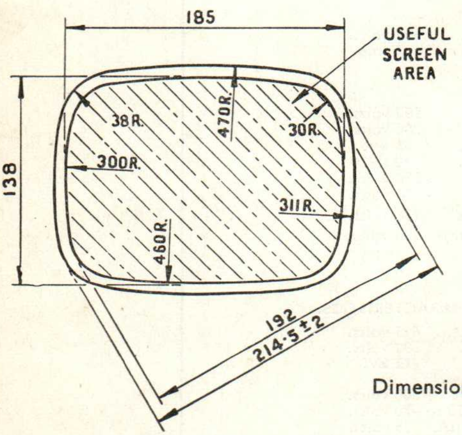
Issue 3.
May, 1960

**8/03AM**

**8/03QM**



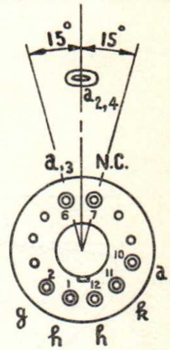




Dimensions in millimetres.

# FERRANTI

## TELEVISION MONITOR TUBE

A high resolution Television Studio Monitor Tube wth an 8½in. diagonal Rectangular Screen. The screen is metal backed and low voltage electrostatic focus is provided.




Base Connections Underside View of Base

| | |
|---|---|
| FOCUS ... ... ... ... | Low Voltage Electrostatic. |
| DEFLECTION ... ... ... ... | Magnetic—90° |
| SCREEN ... ... ... ... | Metal Backed. |
| Phosphor ... ... ... ... | Type 'T'. |
| Fluorescence ... ... ... | White. |
| Persistence ... ... ... | Short. |

For further details, refer to Screen Type 'T' phosphor characteristics at the front of this section of the handbook. This tube can also be supplied with other screen phosphors.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 293 mm. |
| Neck Diameter ... ... ... | 37 mm. (nominal). |
| Mounting Position ... ... | Any. |

For other dimensions see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode + 4th Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 500 volts. |
| Max. $A_2+A_4$ voltage ... ... | 15 kV. |
| Max. Pos. $A_3$ voltage ... ... | +500 volts. |
| Max. Neg. $A_3$ voltage ... ... | −500 volts. |
| Min. $A_1$ voltage ... ... | 200 volts. |
| Min. $A_2+A_4$ voltage ... ... | 8 kV. |
| Max. $V_{h-k}$ (Heater positive) | 150 volts. |
| Max. $V_{h-k}$ (Heater negative) | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION AND CHARACTERISTICS.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode voltage ... | 12 kV. |
| 3rd Anode voltage for focus ... | −300 to + 300 volts. |
| $V_g$ for visual cut off ... | −30 to −70 volts. |
| †Av. Grid Drive for $I_B$ = 100 μA | 25 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |

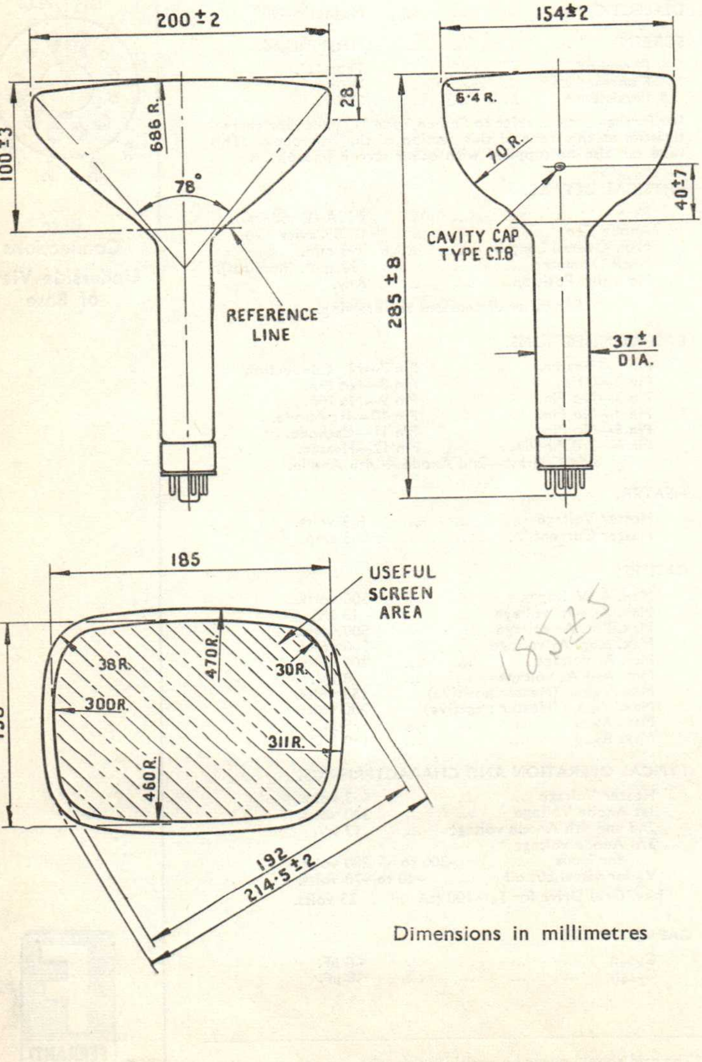
Issue 2
May, 1958

†The grid should never be positive with respect to the cathode.

FERRANTI

# 8/03TM

FERRANTI



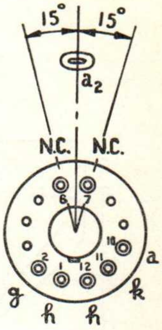

Dimensions in millimetres

8/04TM

# FERRANTI

## TELEVISION MONITOR TUBE

**An 8in. diagonal Rectangular Tube with metal backed screen having very high definition.**




**Base Connections**
**Underside View of Base**

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic. |
| DEFLECTION ... ... ... ... | Magnetic—90° |
| SCREEN ... ... ... ... | Metal Backed. |
| Phosphor ... ... ... ... | Type 'T' |
| Fluorescence ... ... ... | White. |
| Persistence ... ... ... | Short. |

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A—Duodecal. |
| Anode Cap ... ... ... | CT8 (Cavity Type). |
| Max. Overall Length ... ... | 308 mm. |
| Neck Diameter ... ... ... | 37 mm. (nominal). |

For other dimensions see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater. |

Side Cap—2nd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. 1st Anode Voltage ... | 600 volts. |
| Max. 2nd Anode Voltage ... | 15·0 kV. |
| Min. 1st Anode Voltage ... | 250 volts. |
| Min. 2nd Anode Voltage ... | 8·0 kV. |
| Max. $V_{h-k}$ Heater Negative ... | 200 volts. |
| Max. $V_{h-k}$ Heater Positive ... | 150 volts. |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8·0 pF. |
| $C_{g-all}$ ... ... ... ... | <8·0 pF. |

TYPICAL OPERATING CONDITIONS.

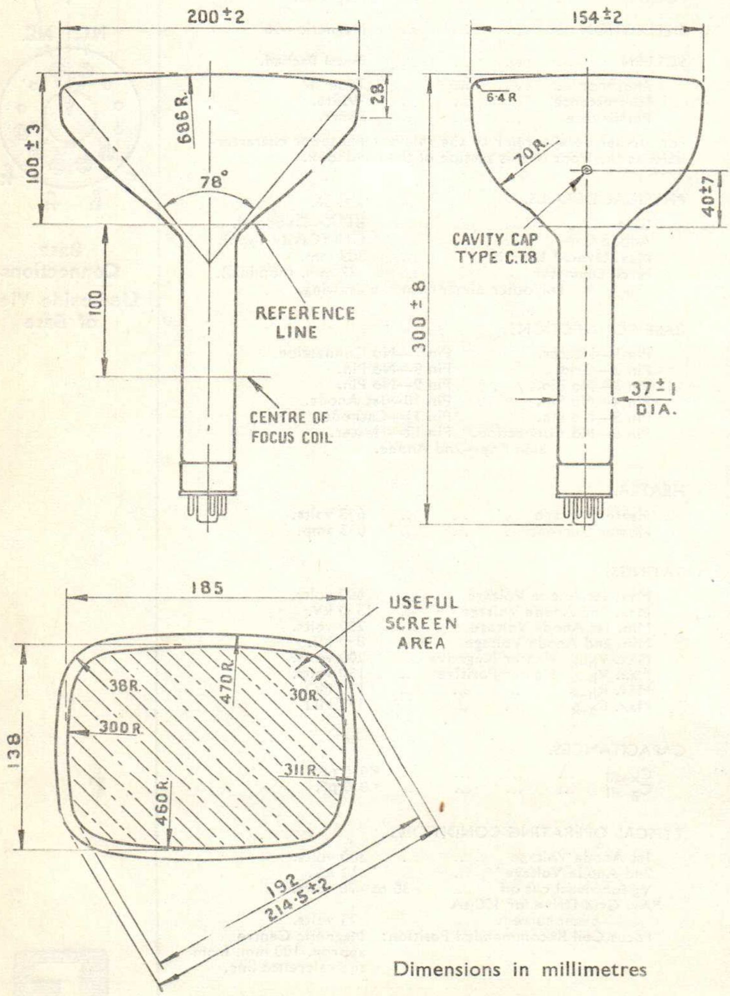
| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd Anode Voltage ... ... | 12 kV. |
| Vg for visual cut off ... | −30 to −70 volts. |
| *Av. Grid Drive for 100μA beam current ... ... | 25 volts. |
| Focus Coil Recommended Position: | Magnetic Centre approx. 100 mm. from the reference line. |

*The grid should never be positive with respect to the cathode.

Issue 2
May, 1958

8/04TM

FERRANTI




Dimensions in millimetres

# 8/52 HM

# 8/52 LM

# FERRANTI

## RADAR TUBE

A miniaturised Radar Display Tube with a $8\frac{1}{2}$in. diagonal rectangular Screen which is metal backed. The deflection angle is 90° and electrostatic focus is at low voltage.

FOCUS ... ... ... ... ... Low voltage Electrostatic.

DEFLECTION ... ... ... ... Magnetic.

SCREEN.

| | | |
|---|---|---|
| Phosphor* | Type H. | Type L. |
| Fluorescence ... ... ... | Orange. | Orange. |
| Afterglow ... ... ... | Orange. | Orange. |
| Persistence ... ... ... | Very long. | Long. |

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

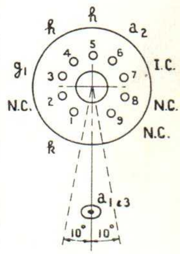
PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | Noval (B9A)† |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 215 mm. |
| Mounting Position ... ... | Any. |

For other dimensions see outline drawing overleaf.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Cathode. | Pin 6—2nd Anode (focus). |
| Pin 2—N.C. | Pin 7—I.C. |
| Pin 3—Grid. | Pin 8—N.C. |
| Pin 4—Heater. | Pin 9—N.C. |
| Pin 5—Heater. | Side Contact—1st & 3rd Anodes |




**Base Connections**

**Underside View of Base**

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amps. |

RATING.

| | |
|---|---|
| Max. $A_1 + A_3$ voltage ... ... | 15 kV. |
| Max. Pos. $A_2$ voltage ... ... | +400 volts. |
| Max. Neg. $A_2$ voltage ... ... | –200 volts. |
| Min. $A_1 + A_3$ voltage ... ... | 8 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 0·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| 1st and 3rd Anode Voltage ... | 12 kV. |
| 2nd anode voltage for focus ... | –100 to +200 volts. |
| Vg for visual cut-off ... ... | –50 to –100. |

CAPACITANCE.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |

*These phosphors are liable to burn if operated with a spot which is stationary or slow moving. The tube should not be operated under such conditions, even at low beam current. See list of alternative phosphors for this application.

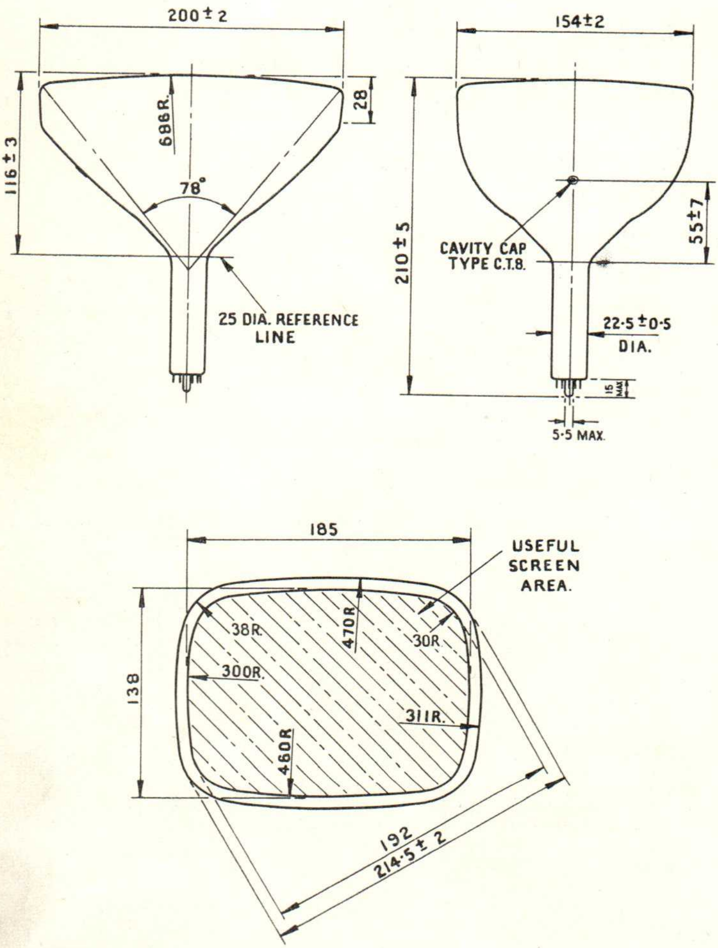
†Note that the centre of the valve holder should be drilled out to $\frac{1}{4}$inch to accommodate the protruding pumping stem.

Issue 2
May., 1958

FERRANTI

# 8/52 HM

# 8/52 LM




Dimensions in mm.

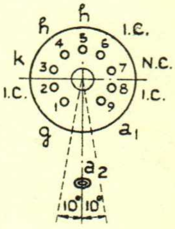
**8A/54HM**

**8A/54LM**

# Ferranti

## RADAR TUBES

Miniaturised 8in. diameter Radar Tubes with narrow neck and small deflection angle. Suitable for use with either Transistor or Valve circuits. Long persistence, metal backed screens.




**Base Connections Underside View of Base**

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic |
| DEFLECTION ... ... ... ... | Magnetic—43°. |

SCREEN.

| | | |
|---|---|---|
| *Phosphor | Type 'H'. | Type 'L'. |
| Fluorescence ... ... | Orange. | Orange. |
| Afterglow ... ... | Orange. | Orange. |
| Persistence ... ... | Very Long. | Long. |

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B9A/D. |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 426 mm. |
| Neck Diameter ... ... ... | 23 mm. (nom.) |
| Mounting Position ... ... | Any. |

For other dimensions see outline drawing overleaf.

BASE CONNECTION

| | |
|---|---|
| Pin 1—Grid. | Pin 6—I.C. |
| Pin 2—I.C. | Pin 7—N.C. |
| Pin 3—Cathode. | Pin 8—I.C. |
| Pin 4—Heater. | Pin 9—1st Anode. |
| Pin 5—Heater. | Side Contact—2nd Anode. |

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amps. |

RATING.

| | |
|---|---|
| Max. $A_1$ voltage ... ... | 600 volts. |
| Max. $A_2$ voltage ... ... | 15 kV. |
| Min $A_2$ voltage ... ... | 8 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

With Valve Drive.

| | |
|---|---|
| 1st Anode voltage ... ... | 300 volts. |
| 2nd Anode voltage ... ... | 12 kV. |
| $V_g$ for visual cut-off ... ... | –60 volts. |

With Transistor Drive

| | |
|---|---|
| 1st Anode voltage ... ... | 100 volts. |
| 2nd Anode voltage ... ... | 12 kV. |
| $V_g$ for visual cut-off ... ... | –25 volts. |

Recommended position of focus coil is 60 mm. in front of the grid.

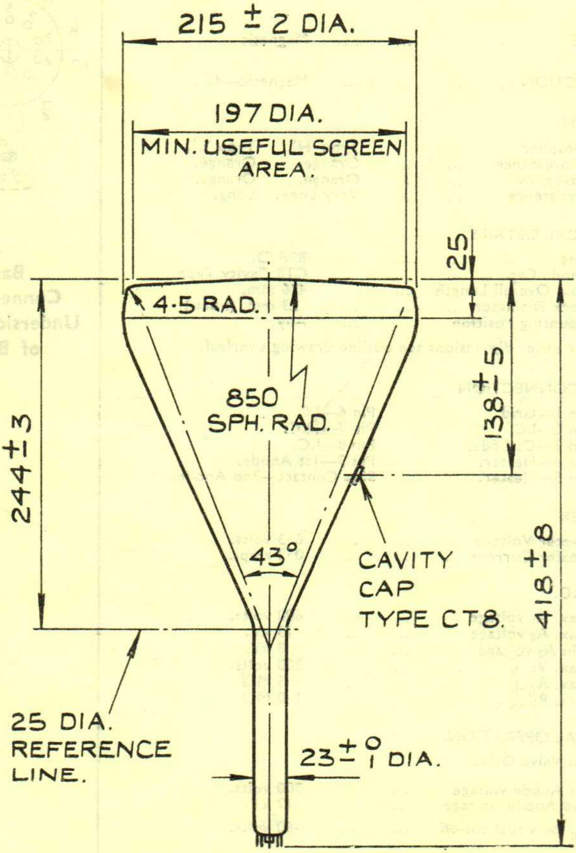
*These phosphors are liable to burn if operated with a spot which is stationary or slow moving, and tubes should not be operated under such conditions, even at low beam current. Alternative phosphors for this application can be supplied on request.

Tentative
Issue 1
Apl., 1961

Ferranti

8A/54HM

8A/54LM




DIMENSIONS ARE IN MILLIMETRES.



FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

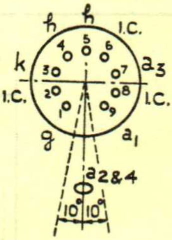
![Ferranti]

# RADAR TUBE

Miniaturised Radar Display Tubes with an 8in. diameter screen, narrow angle deflection and low voltage electrostatic focus. Suitable for use with either Valve or Transistor circuits.

**8A/56HM**

**8A/56LM**




**Underside view of base**

| | |
|---|---|
| FOCUS ... ... ... ... | Low Voltage Electrostatic. |
| DEFLECTION ... ... ... ... | Magnetic. 43° angle. |

SCREEN.

| | Type 'H'. | Type 'L'. |
|---|---|---|
| *Phosphor ... ... | Type 'H'. | Type 'L'. |
| Fluorescence ... ... | Orange. | Orange. |
| Afterglow ... ... | Orange. | Orange. |
| Persistence ... ... | Very Long. | Long. |

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B9A/D |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 416 mm. |
| Neck Diameter ... ... ... | 23 mm. (nom.) |
| Mounting Position ... ... | Any. |

BASE CONNECTION.

| | |
|---|---|
| Pin 1—Grid. | Pin 6—I.C. |
| Pin 2—I.C. | Pin 7—3rd Anode. |
| Pin 3—Cathode. | Pin 8—I.C. |
| Pin 4—Heater. | Pin 9—1st Anode. |
| Pin 5—Heater. | Side Contact—2nd & 4th Anodes. |

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amps. |

RATING.

| | |
|---|---|
| Max. $A_1$ voltage ... ... | 600 volts. |
| Max. $A_2+A_4$ voltage ... ... | 15 kV. |
| Min. $A_2+A_4$ voltage ... ... | 8 kV. |
| Max. Pos. $A_3$ voltage ... ... | +500 volts. |
| Max. Neg. $A_3$ voltage ... ... | –500 volts. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

Valve Drive.

| | |
|---|---|
| 1st Anode voltage ... ... | 300 volts. |
| 2nd & 4th Anode voltage ... | 12 kV. |
| 3rd Anode voltage for focus ... ... | –300 to +300 volts. |
| $V_g$ for visual cut-off ... ... | –60 volts. |

Transistor Drive.

| | |
|---|---|
| 1st Anode voltage ... ... | 100 volts. |
| 2nd & 4th Anode voltage ... | 12 kV. |
| $V_g$ for visual cut-off ... ... | –25 volts. |
| 3rd Anode voltage for focus ... ... | –300 to +300 volts. |

*These phosphors are liable to burn if operated with a spot which is stationary or slow moving, and tubes should not be operated under such conditions, even at low beam current. Alternative phosphors for this application can be supplied on request.

Tentative
Issue 2
Mar., 1961

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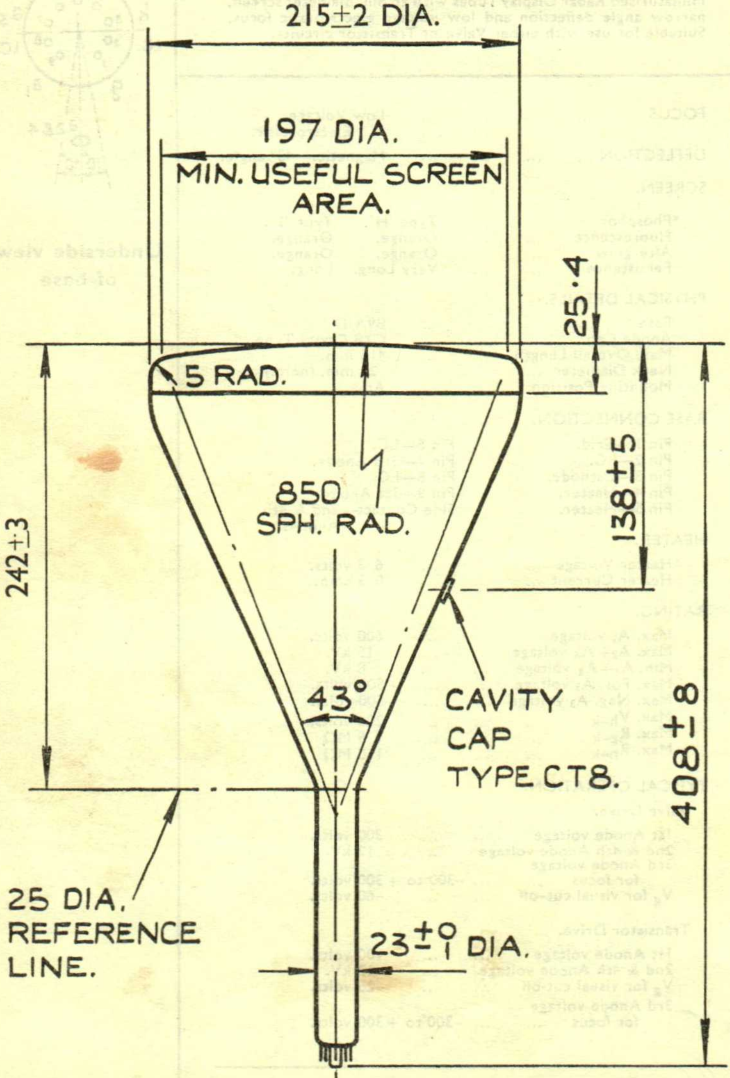
Ferranti

8A/56HM

8A/56LM

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DIMENSIONS ARE IN MILLIMETRES.

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# RADAR TUBES

High Resolution 8½in. Rectangular Radar Display Tubes.

FOCUS ... ... ... ... Magnetic.

DEFLECTION ... ... ... ... Magnetic.

| Phosphor ... | 8B/08L$_2$B* | 8B/08VB | 8B/08ZB |
|---|---|---|---|
| Fluorescence ... | Orange | Yellow | Orange |
| Afterglow ... | Orange | Yellow | Orange |
| Persistence ... | Long | Short | Short |

Refer to phosphor characteristics at the front of this section of the Handbook.

All types have metal backed screens.

## PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT.2 (9.25 mm. dia.). |
| Max. overall length ... ... | 588±7 mm. |
| Neck diameter ... ... ... | 35 mm. nominal. |

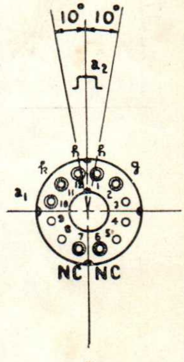
For other dimensions see outline drawing overleaf.

These tubes have an external conductive coating which may be used for E.H.T. smoothing.

## BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—Not Connected. |
| Pin 2—Grid. | Pin 8—No pin. |
| Pin 3—No pin. | Pin 9—No pin. |
| Pin 4—No pin. | Pin 10—1st anode. |
| Pin 5—No pin. | Pin 11—Cathode. |
| Pin 6—Not connected. | Pin 12—Heater. |

Side cap—2nd anode.




**Base Connections Underside View of Base**

## HEATER.

| | |
|---|---|
| Heater Voltage. ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

## RATINGS.

| | |
|---|---|
| Max. 1st Anode voltage ... | 600 volts. |
| Max. 2nd Anode voltage ... | 15·0 kV. |
| Min. 1st Anode voltage ... | 250 volts. |
| Min. 2nd Anode voltage ... | 9·0 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |

## CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8·0 pF. |
| $C_{g-all}$ ... ... ... ... | <8·0 pF. |

## TYPICAL OPERATING CONDITIONS.

| | |
|---|---|
| 1st Anode voltage ... ... | 300 volts. |
| 2nd Anode voltage ... ... | 15·0 kV. |
| $V_g$ for visual cut off ... | −30 to −90 volts. |
| Av. mod. drive for 50 μA. beam current ... ... ... | 20 volts. |

The position of the centre of the air gap in the focus coil is approximately 70 mm's. from the plane of the modulator face.

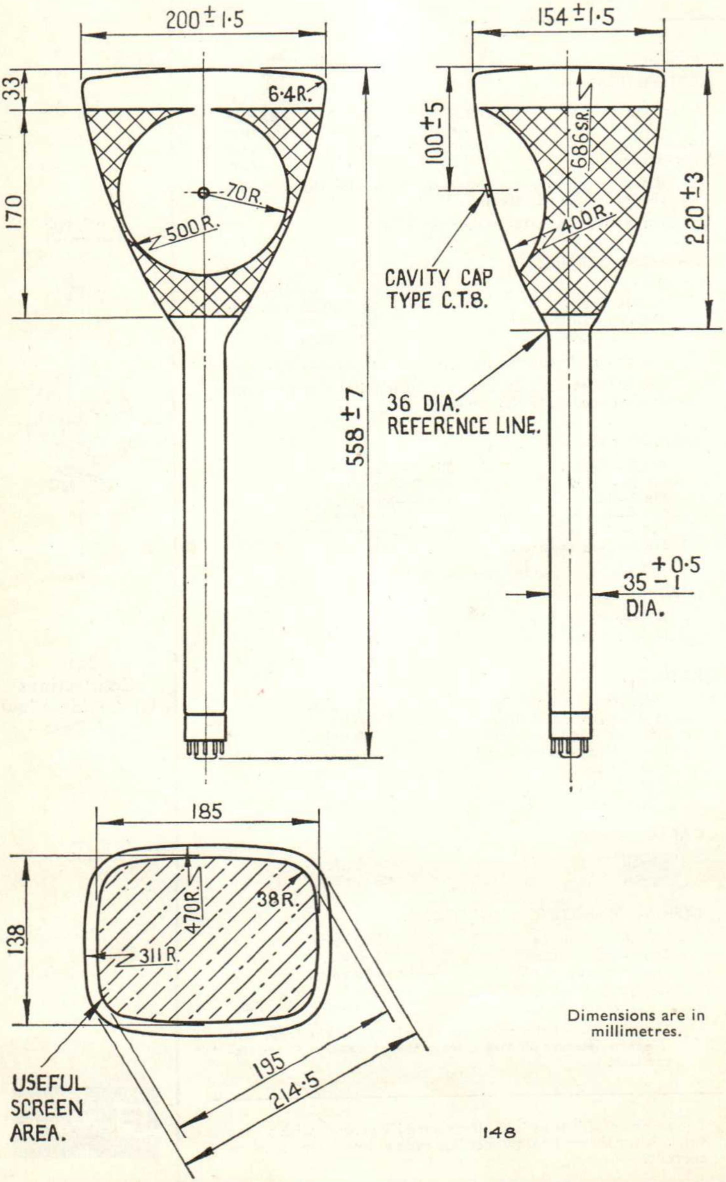
*The screen of this tube is liable to burn if operated with a spot which is stationary or slow moving, even at low values of beam current.

Tentative
Issue 1.
May, 1961

Ferranti

Ferranti

| |
|---|
| **8B/08L2B** |
| **8B/08VB** |
| **8B/08ZB** |




Dimensions are in millimetres.

Ferranti

# RADAR TUBES

9in. diameter Radar Display Tubes with metal backed screens, magnetic deflection and low voltage electrostatic focus.

FOCUS ... ... ... Low Voltage Electrostatic.
DEFLECTION ... ... ... Magnetic.
→ SCREENS ... ... ... Metal Backed.

| | 9/03HB | 9/03JB | 9/03LB |
|---|---|---|---|
| Phosphor ... ... | Type 'H'* | Type 'J' | Type 'L'.* |
| Fluorescence ... | Orange | Blue | Orange. |
| Afterglow ... | Orange | Yellow | Orange. |
| Persistence ... | very long | long | long. |

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 (Cavity Type.) |
| Max. Overall Length ... ... | 408 mm. |
| Nom. neck diameter ... ... | 35 mm. |

For other dimensions see drawing overleaf.

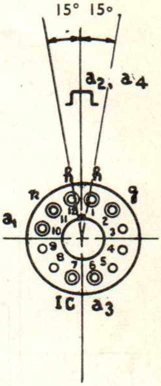
Mounting Position ... ... Any.

These tubes have an external conductive coating which may be used for E.H.T. smoothing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contacts—2nd Anode, 4th Anode.




Base Connections View from spigot end of tube

HEATER.

| | |
|---|---|
| †Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $a_1$ Voltage ... ... ... | 500 volts. |
| Min. $a_1$ voltage ... ... ... | 200 volts. |
| Max. $a_2+a_4$ voltage ... ... | 15 kV. |
| Min. $a_2+a_4$ voltage ... ... | 8 kV. |
| Max. Pos. $a_3$ voltage ... ... | +500 volts. |
| Max. Neg. $a_3$ voltage ... ... | –500 volts. |
| §Max. Neg. grid voltage ... ... | –200 volts. |
| → Max. $Z_{g-k}$ ... ... ... | 0·5 MΩ |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| → ‡Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |
| → Max. $V_{h-k}$ (heater negative) ... | 200 volts. |
| (heater positive) ... | 150 volts. |

TYPICAL OPERATION.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode voltage ... | 12 kV. |
| **3rd Anode voltage for focus ... | –300 to + 300 volts. |
| $V_g$ for visual cut off ... ... | –30 to –70 volts. |

*These screens are liable to burn if operated with a spot which is stationary or slow moving. The tube should not be operated under such conditions, even at low beam current.

†When used for series operation, a current limiting device should be incorporated in the circuit to ensure that the surge heater voltage does not exceed 9·5 volts r.m.s.

§The grid should never be positive with respect to the cathode.

‡This value of Rh–k is applicable only when the heater has a separate transformer. In series heater chains, the impedance between cathode and earth should not exceed 100kΩ

**The point of optimum focus lies between these values.

Issue 2
Nov. 1960

Ferranti

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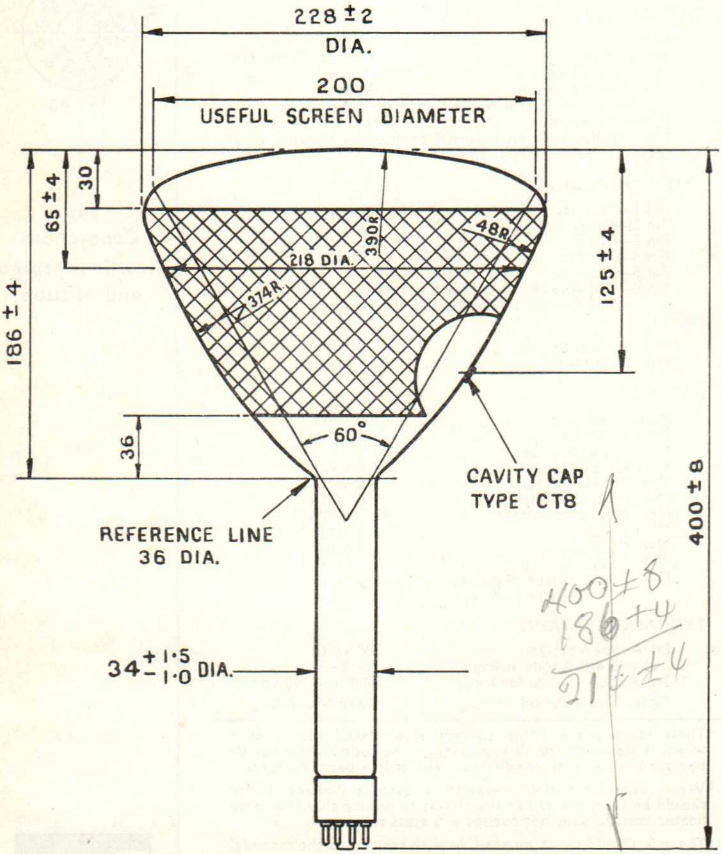
| |
|---|
| **9/03HB** |
| **9/03JB** |
| **9/03LB** |

CAPACITANCES.

| | |
|---|---|
| $C_{k\text{-}all}$ ... ... ... ... | <8 pF. |
| $C_{g\text{-}all}$ ... ... ... ... | <8 pF. |
| $C_{a_2\text{-}M}$ ... ... ... ... | 750 pF. approx. |

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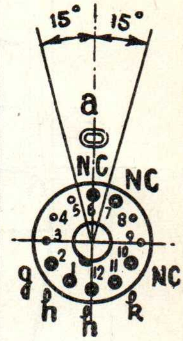
# CATHODE RAY TUBES

9-inch diameter Triode Tubes having high quality flat faces with ground internal and external surfaces

Types 9/22AM and 9/22QM are designed for use in Flying Spot Scanner applications

Type 9/22PM is for use in recording high resolution images on blue sensitive film stock




FOCUS ... ... ... ... Magnetic

DEFLECTION ... ... ... Magnetic

SCREEN ... ... ... ... Metal Backed (All Types)

| | 9/22AM | 9/22PM | 9/22QM |
|---|---|---|---|
| Phosphor ... ... | Type 'A' | Type 'P' | Type 'Q' |
| Fluorescence ... | Green | Blue | Blue/Violet |
| Persistence ... | Ultra-short | Ultra-short | Killed |

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook

## PHYSICAL DETAILS

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal) |
| Anode Cap ... ... ... | CT 8 (Cavity Type) |
| Max. Overall Length ... ... | 565 mm. |
| Max. Diameter ... ... ... | 236 mm. |
| Useful Screen Area ... ... | 200 mm. dia. |
| Nom. Neck Diameter ... ... | 37 mm. |

For other dimensions see drawing overleaf.

## BASE CONNECTIONS.

Pin 1—Heater.
Pin 2—Grid.
Pin 3—No pin.
Pin 4—No pin.
Pin 5—No pin.
Pin 6—Not connected.
Pin 7—Not connected.
Pin 8—No pin.
Pin 9—No pin.
Pin 10—Not connected.
Pin 11—Cathode.
Pin 12—Heater.
Side Contact—Anode.

## HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

## RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... | 30 kV. |
| Nom. Vg for visual cut off ... | Va/120 |
| Max. $V_{hk}$ (Heater Negative) ... | 200 volts. |
| Max. $V_{hk}$ (Heater Positive) ... | 200 volts. |

## TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Anode Voltage ... ... ... | 25 kV. |
| Vg for visual cut off ... ... | –210 volts. |
| Grid Drive for $I_B = 100\mu A$. ... | 35 volts. |
| Screen Resolution at 50 f.p.s. ... | 1000 lines. |
| §Focus Coil ... ... ... | 570 ampere turns (approx). |

## CAPACITANCE.

| | |
|---|---|
| $C_{k\text{–all}}$ ... ... ... ... | <8 pF. |
| $C_{g\text{–all}}$ ... ... ... ... | <8 pF. |

*A suitable coil is a solenoid of approx 16,000 turns of 38 s.w.g. wire, positioned with the gap approx 150 mm, in front of the modulator. Ferranti Type 38/13300 is available.

## X-RAY WARNING.

When operated at an anode voltage in excess of 16 kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

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June, 1960

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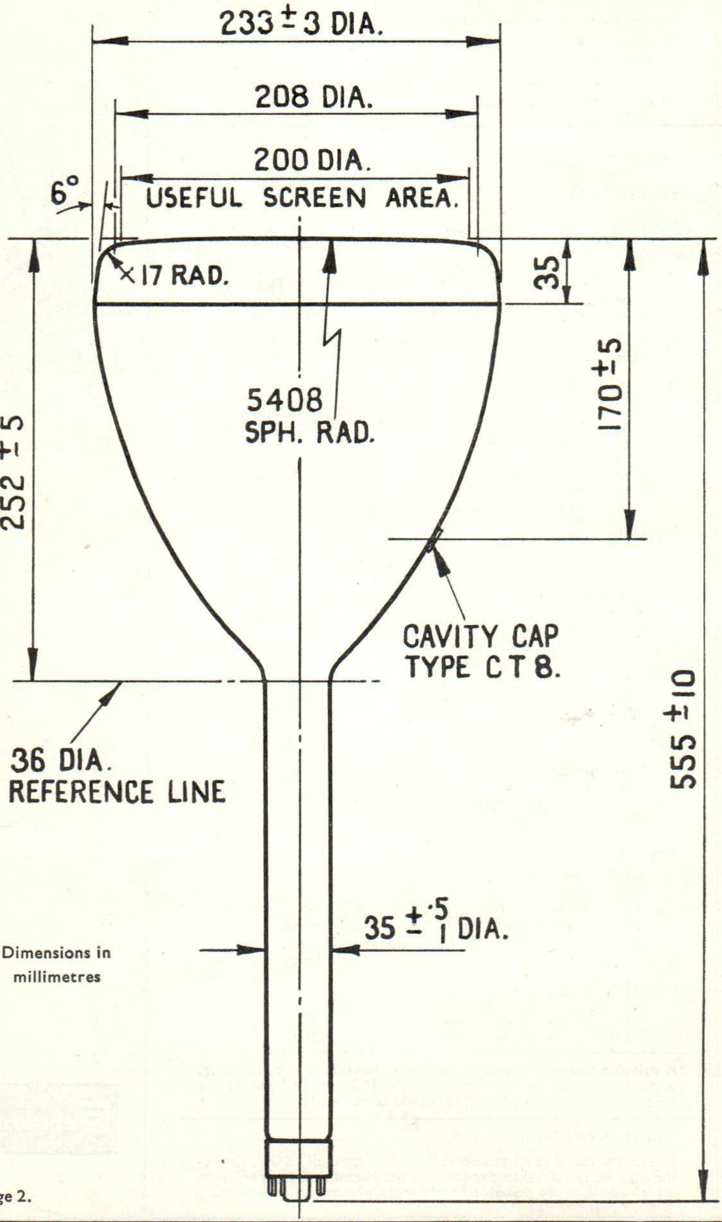


Dimensions in millimetres



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Ferranti

# CATHODE RAY TUBE

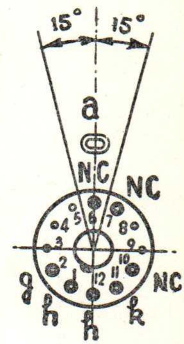
A 9-inch diameter Triode Tube which has a high quality flat face with ground internal and external surfaces.

Primarily designed for use in Telerecording and in Television Transmission Systems Converters.

| | |
|---|---|
| FOCUS | Magnetic |
| DEFLECTION | Magneti |
| SCREEN | Metal Backed |
| Phosphor | Type 'D' |
| Fluorescence | Green |
| Persistence | Short |

Other phosphors are available such as Type 'A' (Green) or 'Q' (Violet) for Flying Spot Scanner applications or Type 'P' (Blue) for Photographic Recording.

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.




PHYSICAL DETAILS.

| | |
|---|---|
| Base | B12A (Duodecal) |
| Anode Cap | CT8 (Cavity Type) |
| Max. Overall Length | 595 mm |
| Max. Diameter | 236 mm |
| Useful Screen Area | 200 mm dia |
| Nom. Neck Diameter | 35 mm |

For other dimensions see drawing overleaf.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater | Pin 7—Not connected |
| Pin 2—Grid | Pin 8—No pin |
| Pin 3—No pin | Pin 9—No pin |
| Pin 4—No pin | Pin 10—Not connected |
| Pin 5—No pin | Pin 11—Cathode |
| Pin 6—Not connected | Pin 12—Heater |

Side Contact—Anode

HEATER.

| | |
|---|---|
| Heater Voltage | 6·3 volts |
| Heater Current | 0·3 amp |

RATINGS.

| | |
|---|---|
| Max. Anode Voltage | 30 kV |
| Nom. $V_g$ for visual cut-off | Va/120 |
| Max. $V_{hk}$ (Heater Negative) | 200 volts |
| Max. $V_{hk}$ (Heater Positive) | 200 volts |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage | 6·3 volts |
| Anode Voltage | 25 kV |
| Vg for visual cut-off | –210 volts |
| Grid Drive for $I_B = 100\mu A$ | 35 volts |
| Screen Resolution at 50 f.p.s. | 1000 lines |
| †Focus Coil | 570 amp turns (aprox) |

X-RAY WARNING.

When operated at an anode voltage in excess of 16 kV shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

CAPACITANCE.

| | |
|---|---|
| $C_k$–all | <8 pF |
| $C_g$–all | <8 pF |

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Nov., 1962

†Ferranti Focus Coil units Type FC.4 or FC.5 are available.

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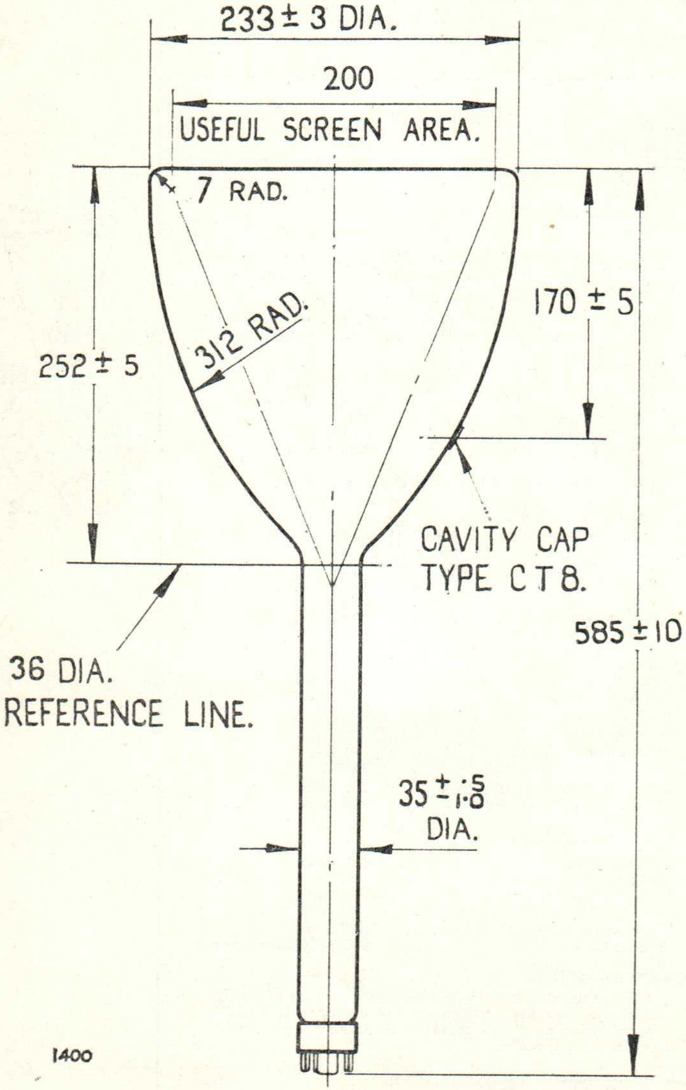



Dimensions in millimetres



FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

Ferranti

# HIGH RESOLUTION DISPLAY TUBES

9 inch diameter Display Tubes with an optically flat face which has ground internal and external surfaces.

FOCUS. ... ... ... Magnetic

DEFLECTION. ... ... ... Magnetic

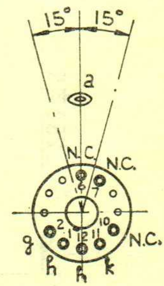
| SCREEN. | 9/25AM | 9/25PM | 9/25QM |
|---|---|---|---|
| Phosphor Type | 'A' | 'P' | 'Q' |
| Fluorescence | Green | Blue | Blue/Violet |
| Persistence | Ultra Short | Ultra Short | Killed |

All types have metal-backed screens.

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... ... | B12A (Duodecal) |
| Anode Cap ... ... ... ... | CT8 Cavity Type (JEDEC Type J1–21) |
| Max. Overall Length ... ... ... | 590 mm. |
| Max. Diameter ... ... ... ... | 236 mm. |
| Nom. Neck Diameter ... ... ... | 35 mm. |
| *Useful Screen Area Diameter... ... | 210 mm. min. |




BASE CONNECTIONS.

Pin 1—Heater
Pin 2—Grid.
Pin 3—No Pin.
Pin 4—No Pin.
Pin 5—No Pin.
Pin 6—Not Connected.
Pin 7—Not Connected
Pin 8—No Pin
Pin 9—No Pin.
Pin 10—Not Connected
Pin 11—Cathode.
Pin 12—Heater.
Side contact—Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 6·3 V. |
| Heater Current... ... ... ... | 0·3 A. |

RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... ... | 30 kV. |
| Nom. $V_g$ for visual cut-off ... ... | Va/210 |
| Max. $V_{h-k}$ (heater negative) ... | 200 V. |
| Max. $V_{h-k}$ (heater positive) ... | 200 V. |
| Max. $R_{g-k}$ ... ... ... ... | 1·5 M Ω |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 6·3 V. |
| Anode Voltage ... ... ... ... | 20 kV. |
| $V_g$ for visual cut-off ... ... ... | —90 V. |

Line width at screen centre ... See graph on page 4.

CAPACITANCE.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... ... | <8pF. |
| $C_{g-all}$ ... ... ... ... ... | <8pF. |

**X-RAY WARNING:** When operated at an anode voltage in excess of 16 kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

*Minimum diameter of internal ground surface

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| |
|---|
| 9/25AM |
| 9/25PM |
| 9/25QM |

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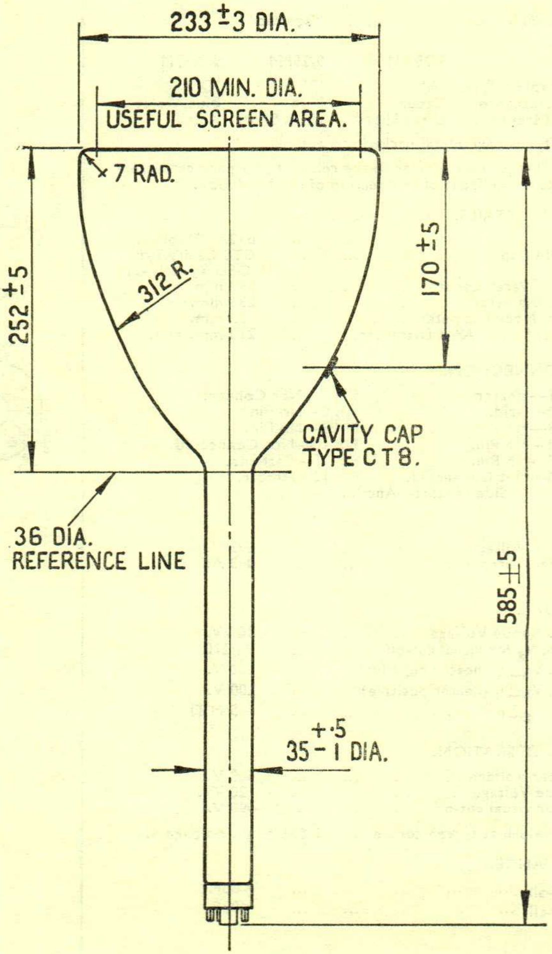
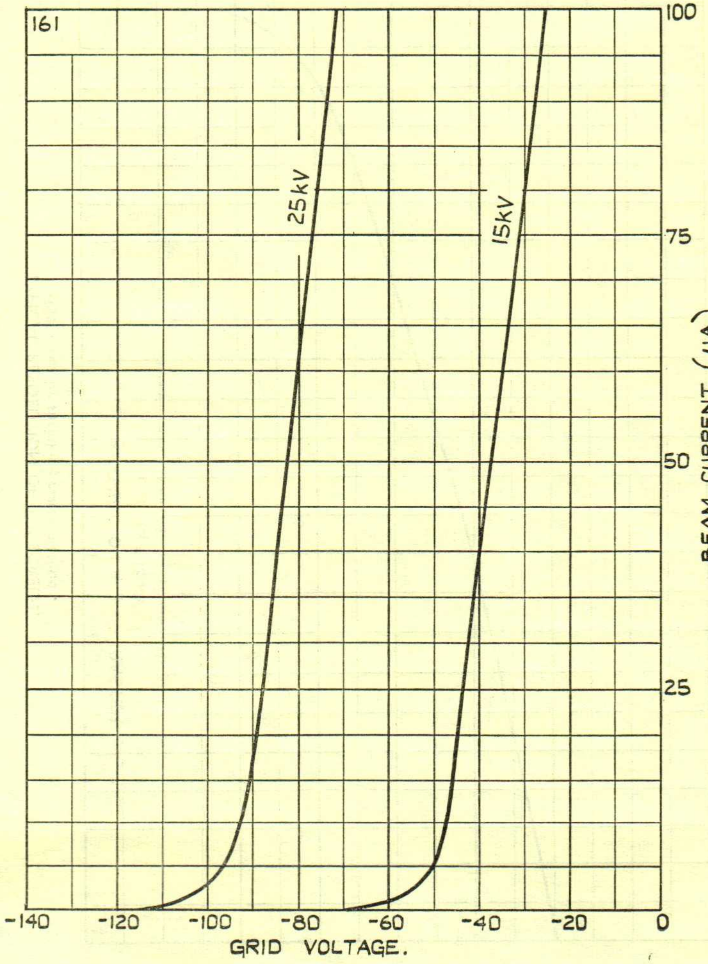



ALL DIMENSIONS IN MILLIMETERS



FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

TYPICAL BEAM CURRENT/GRID VOLTAGE CHARACTERISTIC



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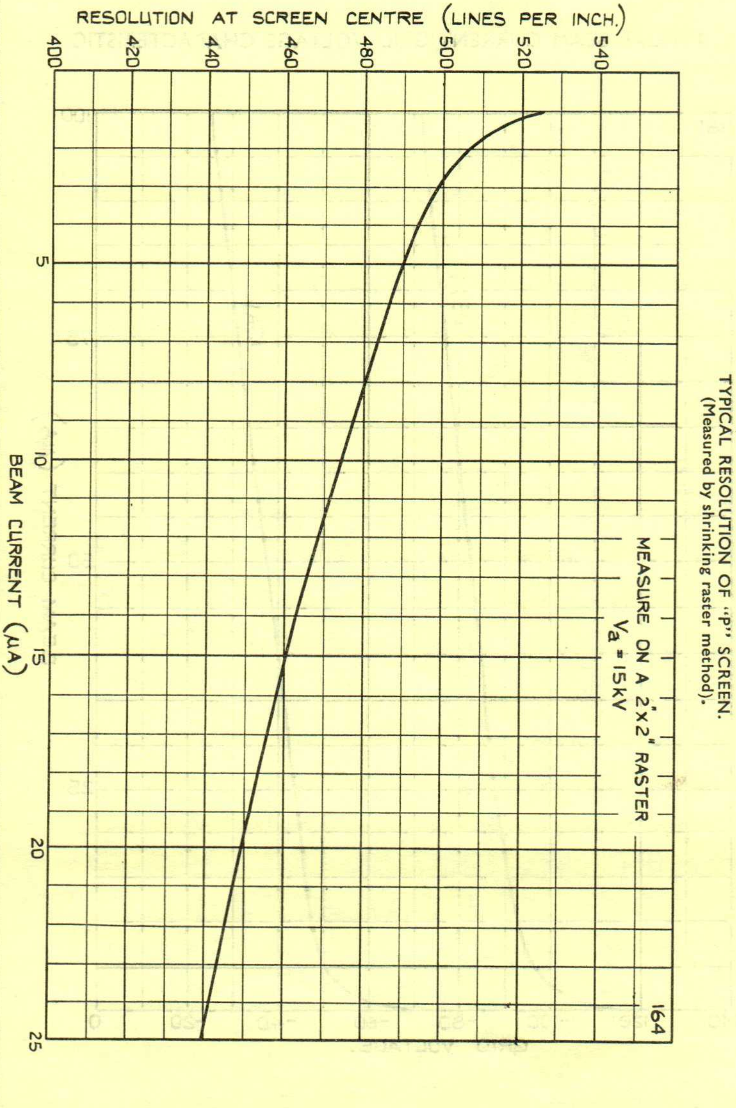

RESOLUTION AT SCREEN CENTRE (LINES PER INCH.)
400
420
440
460
480
500
520
540
BEAM CURRENT (μA)
5
10
15
20
25
TYPICAL RESOLUTION OF "P" SCREEN.
(Measured by shrinking raster method).
MEASURE ON A 2"x2" RASTER
Va = 15kV
164

**Ferranti**

# HIGH RESOLUTION DISPLAY TUBE

A 9 inch diameter Display Tube with an optically flat face with ground internal and external surfaces.

FOCUS. ... ... ... Magnetic

DEFLECTION. ... ... ... Magnetic

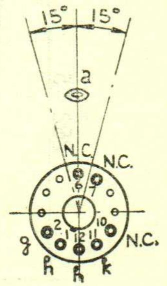
SCREEN.

Phosphor ... ... ... Type 'P' (Fine particle size).
Fluorescence ... ... ... Blue.
Persistence ... ... ... Ultra short.

For further details refer to Screen Phosphor characteristics at the front of this section of the handbook. This tube can also be supplied with other screen phosphors.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... ... | B12A (duodecal) |
| Anode Cap ... ... ... ... | CT8 Cavity Type |
| Max. Overall Length ... ... ... | 625 mm. |
| Max. Diameter ... ... ... ... | 236 mm. |
| Nom. Neck Diameter ... ... ... | 35 mm. |
| *Useful Screen Area ... ... ... | 195 mm. min. dia. |




BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater | Pin 7—Not Connected |
| Pin 2—Grid. | Pin 8—No Pin |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—Not Connected |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—Not Connected. | Pin 12—Heater. |

Side contact—Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 6·3 v. |
| Heater Current... ... ... ... | 0·3 A. |

RATINGS.

| | |
|---|---|
| Max. Anode Voltage ... ... ... | 30 kV. |
| Nom. $V_g$ for visual cut-off ... ... | Va/300 |
| Max. $V_{h-k}$ (heater negative) ... | 200 v. |
| Max. $V_{h-k}$ (heater positive) ... | 200 v. |
| Max. $R_{g-k}$ ... ... ... ... | 1·5 M $\Omega$ |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... ... | 6·3 v. |
| Anode ... ... ... ... ... | 15 kV. |
| $V_g$ for visual cut-off ... ... ... | —50 v. |

Line width at screen centre (see page 4.)

CAPACITANCE.

| | |
|---|---|
| $C_{k—all}$ ... ... ... ... ... | <8pF. |
| $C_{g—all}$ ... ... ... ... ... | <8pF. |

**X-RAY WARNING:** When operated at an anode voltage in excess of 16 kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

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*Minimum diameter of internal ground surface

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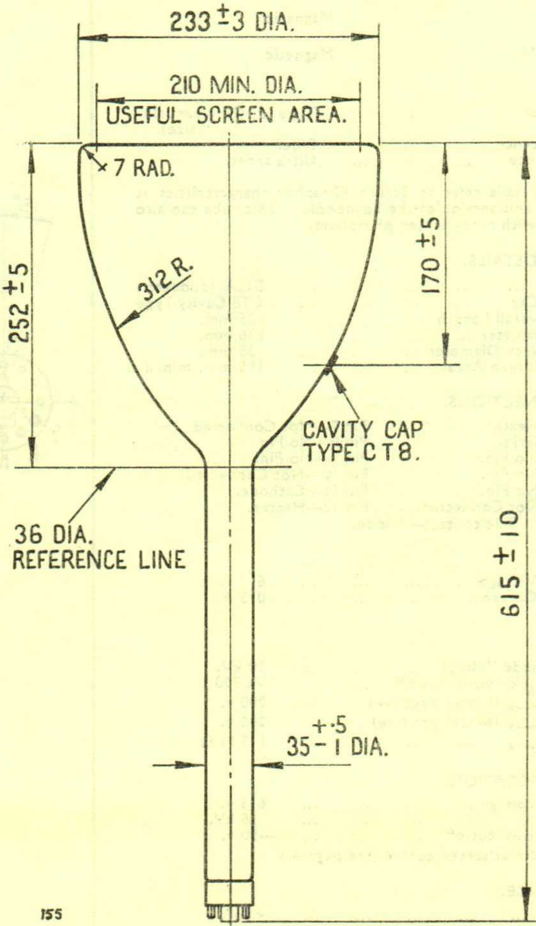


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ALL DIMENSIONS IN MILLIMETERS



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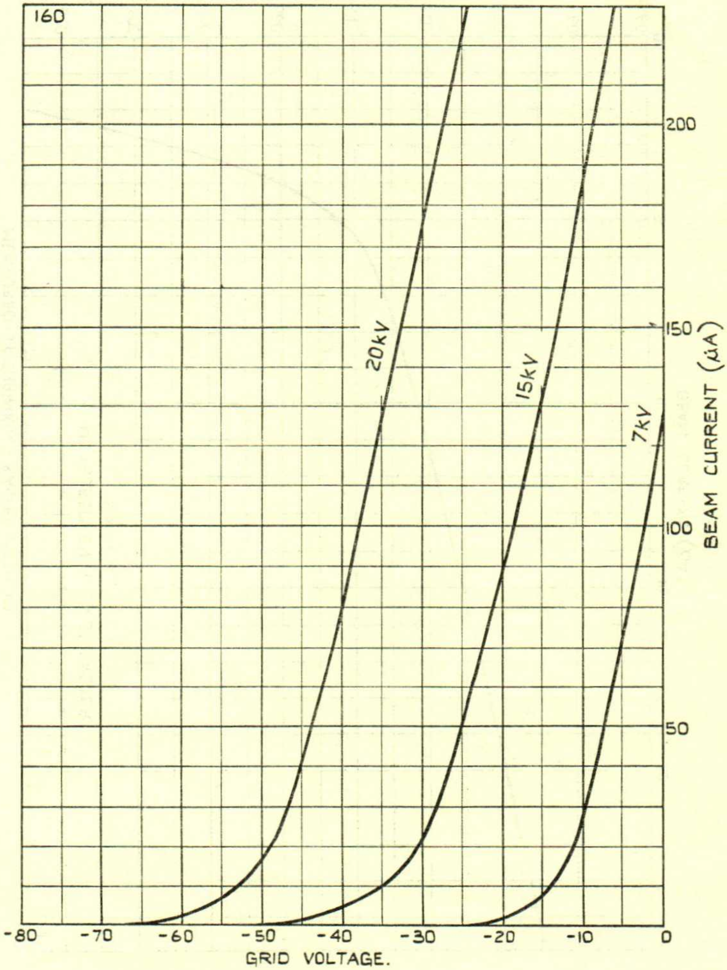
## TYPICAL ANODE CURRENT/GRID VOLTAGE CHARACTERISTIC

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Issue 2,
July 1961



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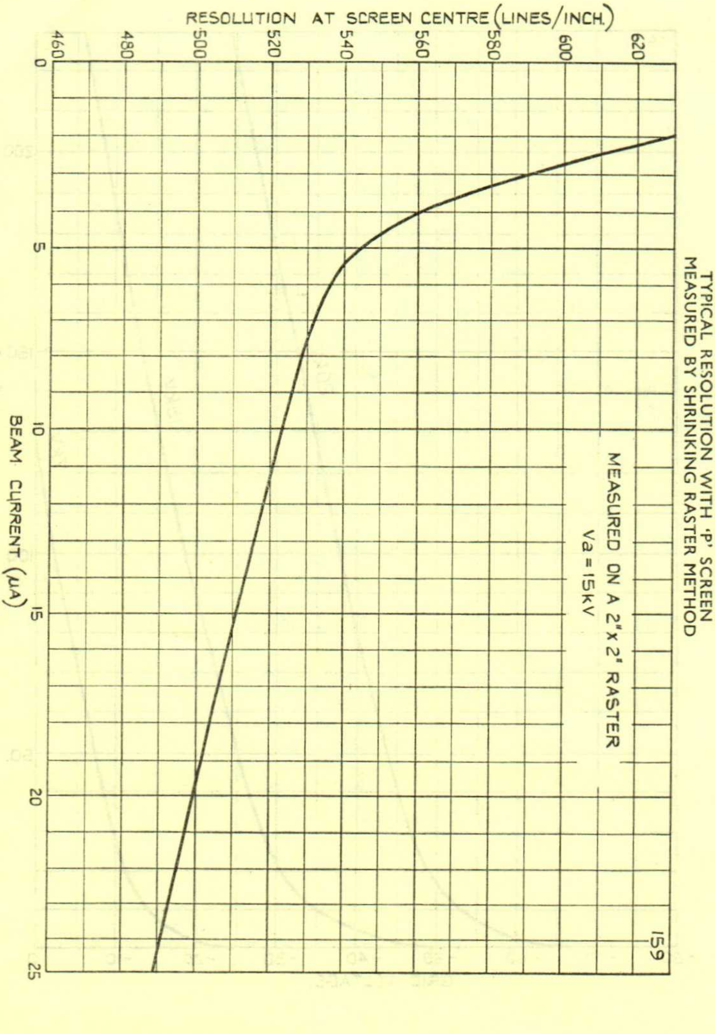




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# FERRANTI

## TELEVISION MONITOR TUBE

A 10in. diameter Tube with a metal backed screen and External conductive coating. Designed for use in Television Monitoring Equipment.

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic. |
| DEFLECTION ... ... ... ... | Magnetic. |
| Deflection Angle ... ... | 50°. |
| SCREEN ... ... ... ... | Metal Backed. |
| Phosphor ... ... ... ... | Type 'T'. —Silver activated. |
| Fluorescence ... ... ... | White. |
| Persistence ... ... ... | Short. |

For further details, refer to Screen Type 'T' phosphor characteristics at the front of this section of the handbook. This tube can also be supplied with other screen phosphors.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 (Cavity Type). |
| Max. Overall Length ... ... | 456 mm. |
| Nom. Neck Diameter ... ... | 37 mm. |

For other dimensions see drawing.

| | |
|---|---|
| Mounting Position ... ... | Any. |

This tube has an external conductive coating which may be used for E.H.T. smoothing

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater. |

Side Contact—2nd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| *Heater Current ... ... ... | 0·3 or 0·6 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... | 410 volts. |
| Max. $A_2$ Voltage ... ... | 12 kV. |
| Min. $A_1$ Voltage ... ... ... | 150 volts. |
| Min. $A_2$ Voltage ... ... ... | 8 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |
| Max. $A_1$ Supply Impedance ... | 1·5 MΩ |

TYPICAL OPERATION.

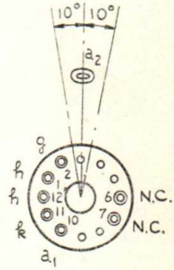
| | |
|---|---|
| 1st Anode Voltage ... ... | 250 volts. |
| 2nd and 4th Anode Voltage ... | 10 kV. |
| Vg for visual cut off ... ... | –27 to –63 volts. |
| Focus ... ... ... ... | See Note ** |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{a-ext. coating}$ ... ... ... | 2500 pF. max. / 500 pF. min. |

*This Tube is normally supplied with a 6·3 volt 0·3 amp. heater. For direct replacement of Tubes of American origin a Tube with 6·3 volt 0·6 amp. heater should be requested.

**The recommended centre of the magnetic length of the focus unit should be approx. 80 mm. from the Reference Line.




**Base Connections Underside View of Base**

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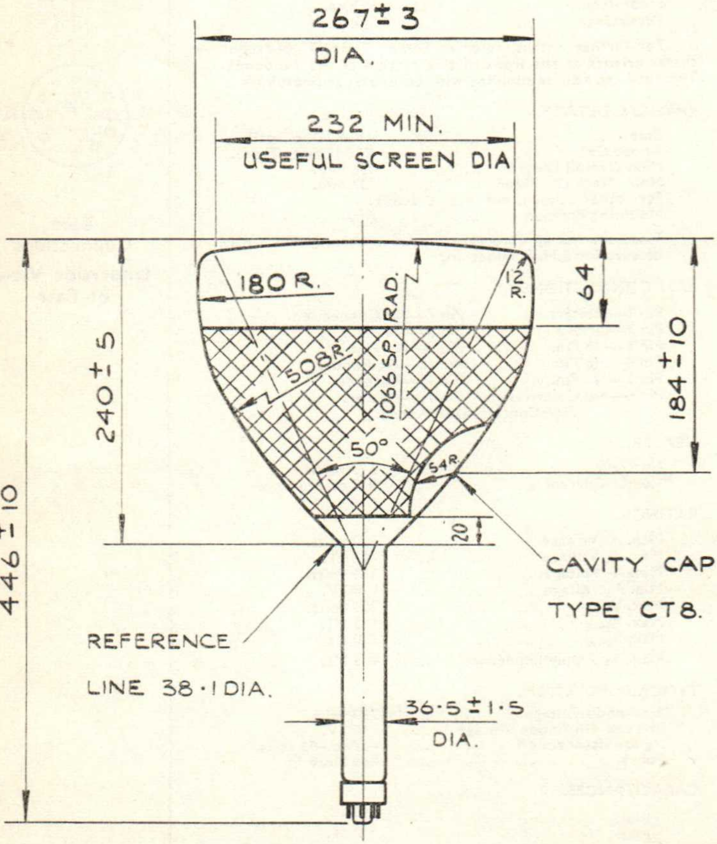
Aug., 1959

**10FP4A**

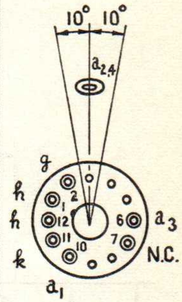
FERRANTI




DIMENSIONS IN MILLIMETERS

# FERRANTI
## RADAR TUBE

A 10in. diameter Radar Display Tube with metal backed screen magnetic deflection, and low voltage electrostatic focus.




**Base Connections**
**Underside View of Base**

FOCUS ... ... ... Low Voltage Electrostatic

DEFLECTION ... ... ... Magnetic

SCREEN.

| | |
|---|---|
| Phosphor Type ... ... | 'J' |
| Fluorescence ... ... | Blue |
| Afterglow ... ... | Yellow |
| Persistence ... ... | Long |

For further details, refer to the Type 'J' Phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... | CT8 Cavity Type. |
| Max. Overall Length ... | 440 mm. |
| Nom. Neck Diameter ... | 37mm. |

For other dimensions, see drawing.

Mounting Position ... Any.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode, 4th Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| *Heater Current ... ... | 0·3 or 0·6 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 600 volts |
| Max. $A_2 + A_4$ Voltage ... ... | 13·2 kV. |
| Max. Pos. $A_3$ Voltage ... ... | +1000 volts. |
| Max. Neg. $A_3$ Voltage ... ... | –500 volts. |
| Min. $A_1$ Voltage ... ... ... | 200 volts. |
| Min. $A_2 + A_4$ Voltage ... ... | 7 kV. |
| Max. $V_{h-k}$ ... ... ... ... | ±200 volts. |
| Max. $R_{g-k}$ ... ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| 1st Anode Voltage ... ... ... | 300 volts. |
| 2nd+4th Anode Voltage ... ... | 10 kV. |
| †3rd Anode Voltage for focus | 0 to +300 volts. |
| Vg for visual cut off | –33 to –77 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |

*This tube is normally supplied with a 6·3 volt 0·3 amp. heater. On request a tube with a 0·6 amp. heater will be supplied (direct replacement for tubes of American manufacture).

†The point of optimum focus lies between these values.

Issue 1.
Aug., 1959

FERRANTI

10WP7

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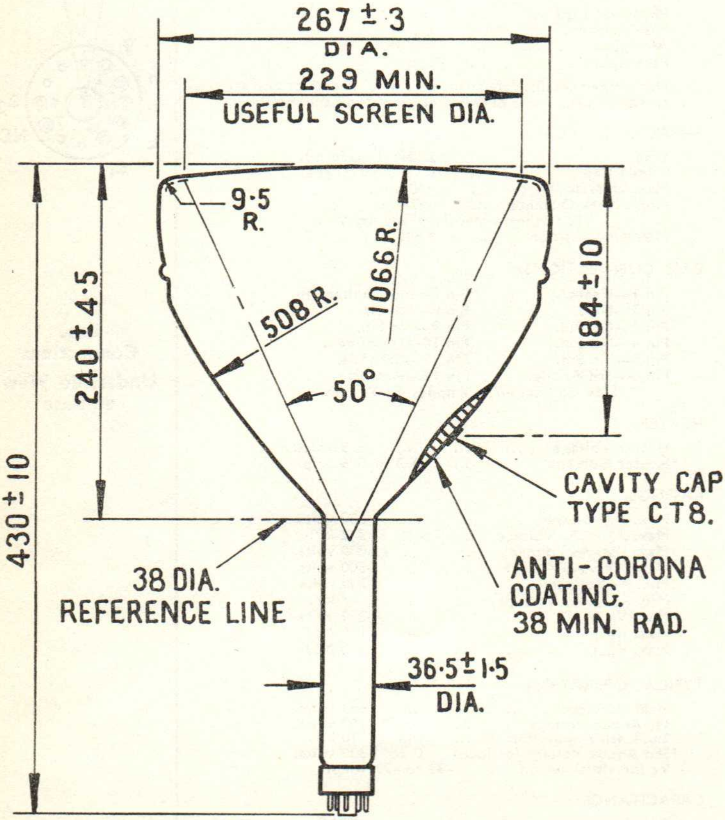



DIMENSIONS IN MILLIMETRES

= CV2162

# FERRANTI

## RADAR TUBE

**12/02 HM**

A 12in. diameter flat faced Radar Display Tube with Electrostatic Focus. It has a long persistence fluoride screen which is metal backed.

| | | |
|---|---|---|
| FOCUS ... ... ... ... | | Electrostatic. |
| DEFLECTION ... ... ... ... | | Magnetic. |
| *SCREEN :— | Fluorescence ... | Orange. |
| | Afterglow ... | Orange. |
| | Persistence ... | Long. |

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Anode Cap ... ... ... | CT.I. |
| Max. Overall Length ... ... | 545 mm. |
| Max. Diameter ... ... ... | 306·5 mm. |
| Neck Diameter ... ... ... | $35^{+0}_{-1}$ mm. |

For other dimensions see drawing overleaf.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—No Connection. | Pin 5—Grid. |
| Pin 2—1st Anode. | Pin 6—Cathode. |
| Pin 3—2nd Anode. | Pin 7—Heater. |
| Pin 4—No Connection. | Pin 8—Heater. |

Side Cap—3rd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 4·0 volts. |
| Heater Current ... ... ... | 0·9 amp. |

RATINGS.

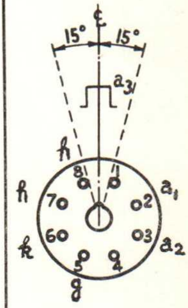
| | |
|---|---|
| Max. 3rd Anode Voltage ... | 13 kV. |
| Min. 3rd Anode Voltage ... | 9 kV. |
| †Max. 1st Anode Voltage ... | 2·2 kV. |
| †Min. 1st Anode Voltage ... | 1·5 kV. |
| Max. $V_{h-k}$ ... ... ... | 150 Volts. |

CHARACTERISTICS AND TYPICAL OPERATION.

| | |
|---|---|
| 3rd Anode Voltage ... ... | 12 kV. |
| 2nd Anode Voltage for focus ... | 1·85 to 2·05 kV. |
| 1st Anode Voltage ... ... | 2·1 kV. |
| Vg for visual cut-off ... | –70 to –120 Volts. |
| Av. Grid Drive for $I_b = 50\mu A$. | 22 Volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | < 10·0 pF. |
| $C_{g-k}$ ... ... ... ... | < 10·0 pF. |




**Base Connections**

**Underside View of Base**

The anode cap can lie within 15° either side of the centre line as indicated in the diagram.

*The screen material is liable to burn if operated with a spot which is stationary or slow moving. The tube should not be operated under such conditions even at low beam current.

†The voltage applied to $a_1$ should always be at least 50 volts positive with respect to $a_2$.

This tube was formerly designated A12/02.

Issue 2
Mar., 1957

12/02 HM

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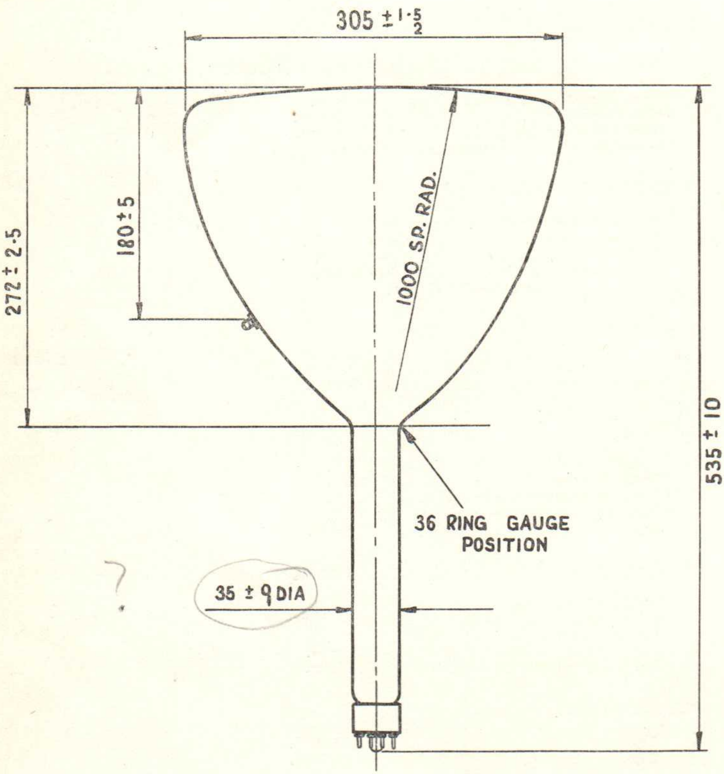
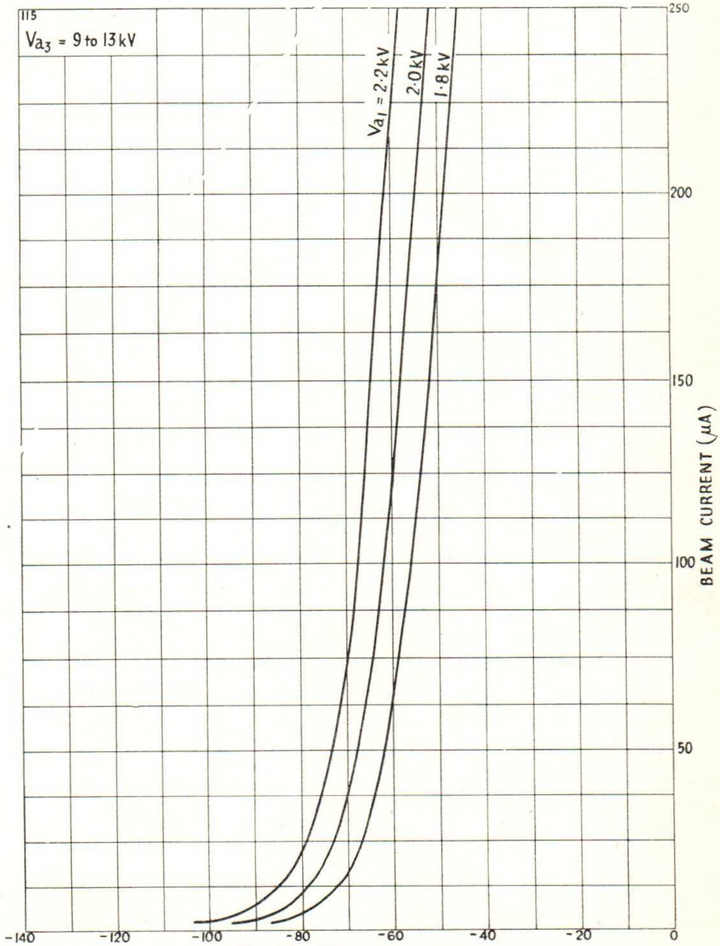



All dimensions in millimetres.




Issue 2.
Mar., 1957



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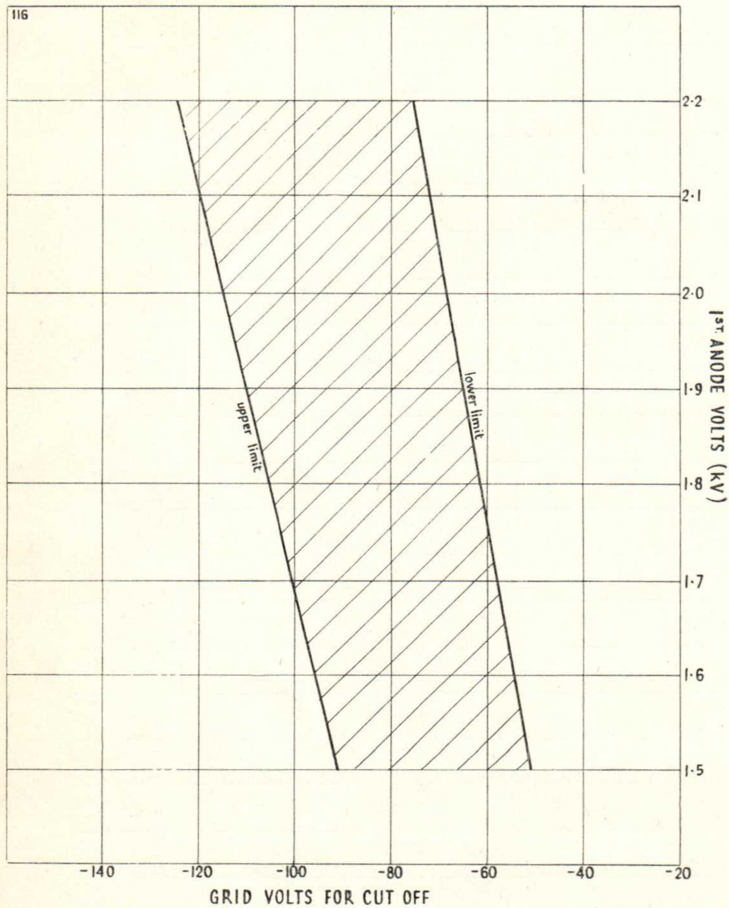
FERRANTI



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# FERRANTI

## RADAR TUBES

**12/03 HB**

**12/03 JB**

12in. diameter Radar Display Tubes with metal backed screens, magnetic deflection and low voltage electrostatic focus.

| | |
|---|---|
| FOCUS ... ... ... | Low Voltage. Electrostatic. |
| DEFLECTION ... ... ... ... | Magnetic. |

SCREEN.

| | 12/03HB | 12/03JB |
|---|---|---|
| Phosphor ... ... ... | ‡Type 'H' | Type 'J' |
| Fluorescence ... ... ... | Orange | Blue |
| Afterglow ... ... ... | Orange | Yellow |
| Persistence ... ... ... | very long | long. |

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

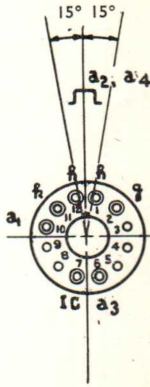
Both Types have metal backed screens.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 485 mm. |
| Mounting Position ... ... | Any |

For other dimensions see drawing overleaf.

These tubes have an external conductive coating which may be used for E.H.T. smoothing.




**Base Connections Underside View of Base**

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode, 4th Anode.

HEATER.

| | |
|---|---|
| *Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 500 volts. |
| Max. $A_2 + A_4$ voltage ... ... | 15 kV. |
| Max. Pos. $A_3$ Voltage ... ... | +500 volts. |
| Max. Neg. $A_3$ voltage ... ... | –500 volts. |
| Min. $A_1$ voltage ... ... ... | 200 volts. |
| Min. $A_2 + A_4$ voltage. ... ... | 8 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode voltage ... | 12 kV. |
| †3rd Anode voltage for focus ... | –300 to + 300 volts. |
| Vg for visual cut off ... ... | –30 to –70 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{a\text{-ext. coating}}$ ... ... ... | 1200 pF. approx. |

‡This screen material is liable to burn if operated with a spot which is stationary or slow moving. The tube should not be operated under such conditions, even at low beam current.

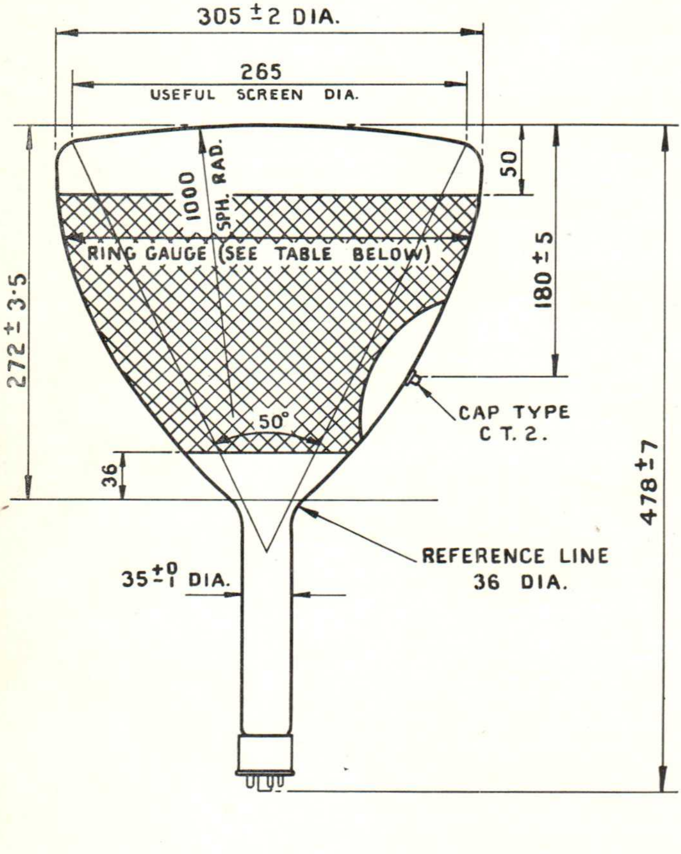
*When used for series operation, the surge heater voltage should not exceed 9·5 volts r.m.s. and a current limiting device should be incorporated in the circuit to limit switching surge.

†The point of optimum focus lies between these values.

Issue 1.
Aug., 1957.

FERRANTI

| 12/03 HB |
|---|
| 12/03 JB |




| RING GAUGE | DISTANCE FROM CENTRE OF SCREEN | | |
|---|---|---|---|
| 280 | 96 | ± | 10 |
| 230 | 150 | ± | 9 |
| 180 | 191 | ± | 8 |
| 130 | 222 | ± | 7 |
| 80 | 249 | ± | 6 |

# FERRANTI
## RADAR TUBE

**12/04 HM**

**12/04 JM**

12in. diameter flat faced Radar Display Tubes primarily designed for P.P.I. applications.

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic. |
| DEFLECTION ... ... ... | Magnetic. |

SCREEN.

| | 12/04HM* | 12/04JM |
|---|---|---|
| Phosphor ... ... | Type 'H' | Type 'J' |
| Fluorescence ... ... | Orange | Blue. |
| Afterglow ... ... | Orange | Yellow. |
| Persistence ... ... | long | long. |

Both types have metal backed screens.

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT.2. (9·25mm. dia.) |
| Max. Overall Length ... ... | 520mms. |
| Neck diameter ... ... ... | 35mms. nominal |

For other dimensions, see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater. |

Side Cap—2nd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. 1st Anode Voltage ... | 600 volts. |
| Max. 2nd Anode Voltage ... | 15·0 kV. |
| Min. 1st Anode Voltage ... | 250 volts. |
| Min. 2nd Anode Voltage ... | 9·0 kV. |
| Max. Cathode Current ... | 150 μA. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8·0 pF. |
| $C_{g-all}$ ... ... ... ... | <8·0 pF. |

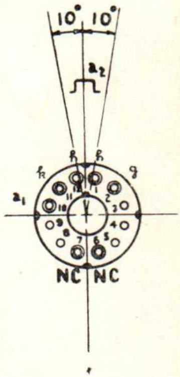
TYPICAL OPERATING CONDITIONS.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd Anode Voltage ... ... | 15 kV. |
| Vg for visual cut off ... ... | –60 volts. |
| Av. Mod. Drive for 50μA beam current ... ... | 20 volts. |
| ‡Focus Coil ... ... ... | 640 amp. turns (approx.) |

*This tube has a magnesium fluoride screen which is liable to burn even at low values of beam current, if operated with a spot which is stationary or slow moving.

‡Positioned so that the centre of the gap is approx. 120mms. from the reference line (36mm. Ring Gauge Position).

This tube was formerly designated A12/04.

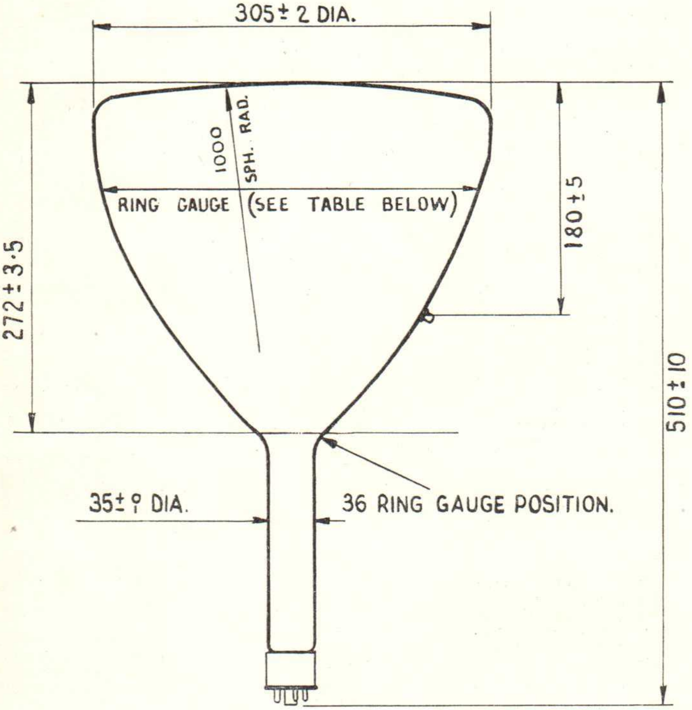



**Base Connections Underside View of Base**

The anode cap can lie within 15° either side of the centre line as indicated in the diagram.

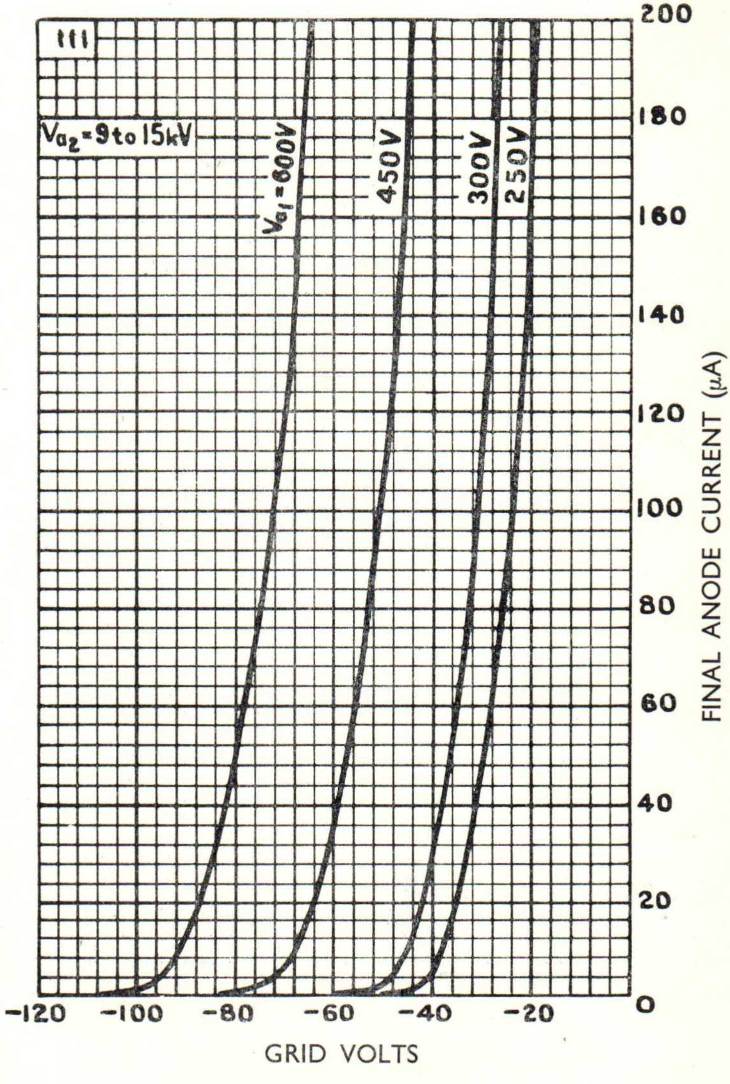
Issue 1.
Feb., 1957.

| 12/04 HM |
|---|
| 12/04 JM |




| RING GAUGE (mm) | DISTANCE FROM CENTRE OF SCREEN. (mm) |
|---|---|
| 280 | 96 ± 10 |
| 230 | 150 ± 9 |
| 180 | 191 ± 8 |
| 130 | 222 ± 7 |
| 80 | 249 ± 6 |
| 36·1 | 272 ± 3·5 |

ALL DIMENSIONS IN MILLIMETRES




Issue 1.
Feb., 1957

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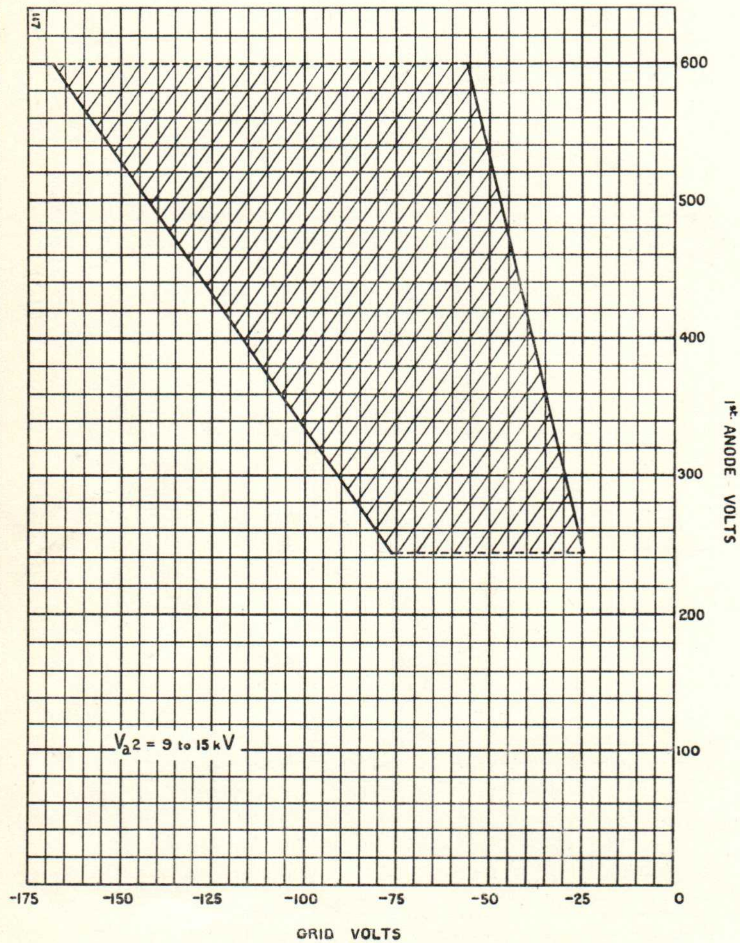

157
600
500
400
300
200
100
0
1st. ANODE VOLTS
$V_a2$ = 9 to 15 kV
-175
-150
-125
-100
-75
-50
-25
GRID VOLTS

12/05HM

# FERRANTI
## RADAR TUBE

A 12in. diameter flat faced Radar Display Tube primarily designed for P.P.I. applications. Replacement type.*

FOCUS ... ... ... ... Magnetic.

DEFLECTION ... ... ... ... Magnetic.

SCREEN.

| | |
|---|---|
| Phosphor ... ... ... ... | Type H. |
| Fluorescence ... ... ... | Orange. |
| Afterglow ... ... ... | Orange. |
| Persistence ... ... ... | Very Long. |

PHYSICAL DETAILS.

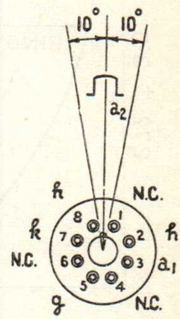
| | |
|---|---|
| Base ... ... ... ... | International Octal. |
| Anode Cap ... ... ... | CT1 |
| Max. Overall Length ... ... | 495 mm. |
| Neck Diameter ... ... ... | 35 mm. nominal. |

For other dimensions see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Not Connected. | Pin 5—Grid. |
| Pin 2—Heater. | Pin 6—Not Connected. |
| Pin 3—1st Anode. | Pin 7—Cathode. |
| Pin 4—Not Connected. | Pin 8—Heater. |

Side Contact—2nd Anode.




HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. 1st Anode Voltage ... | 850 volts. |
| Max. 2nd Anode Voltage ... | 15·0 kV. |
| Min. 1st Anode Voltage ... | 600 volts. |
| Min. 2nd Anode Voltage ... | 10·0 kV. |
| Max. Cathode Current ... | 150 $\mu$A. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{h-k}$ ... ... ... | 1·0 M$\Omega$ |
| Max. $R_{g-k}$ ... ... ... | 1·5 M$\Omega$ |

All dimensions in millimetres.

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |

TYPICAL OPERATING CONDITIONS.

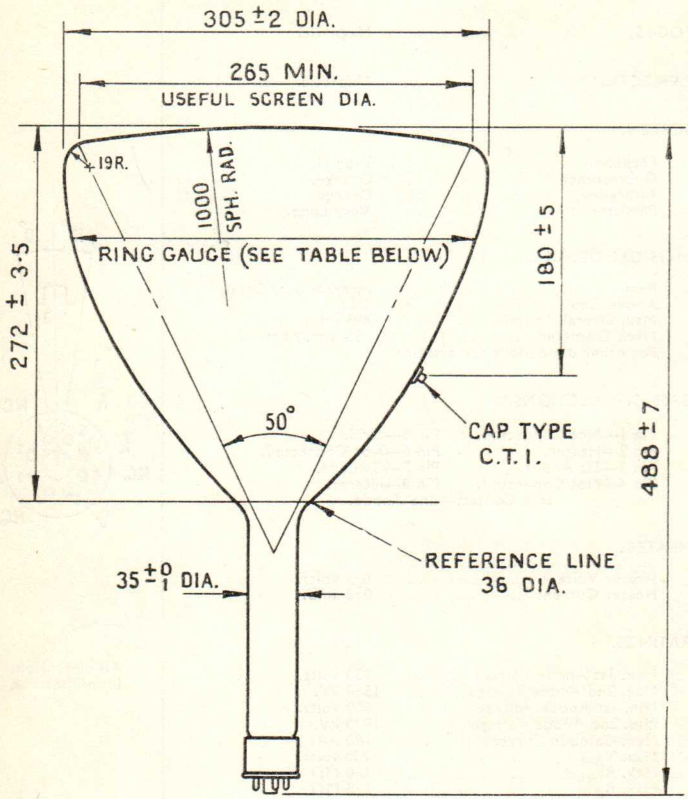
| | |
|---|---|
| 1st Anode Voltage ... ... | 800 volts. |
| 2nd Anode Voltage ... ... | 10 kV. |
| Vg for visual cut off ... ... | –80 volts. |
| Av. Mod. Drive for 50 $\mu$A. Beam Current ... ... | 20 volts |
| †Focus Coil ... ... ... | 640 amp. turns (approx.). |

*This tube is equivalent to CV1869 or CV2328.

†Positioned so that the centre of the gap is approx. 98 mms. from the reference line (36mm. Ring Gauge Position).

Issue 3
May 1959

FERRANTI




| RING GAUGE | DISTANCE FROM CENTRE OF SCREEN |
|---|---|
| 280 | 93 ± 10 |
| 230 | 150 ± 9 |
| 180 | 191 ± 8 |
| 130 | 222 ± 7 |
| 80 | 249 ± 6 |

## 12/08 HM

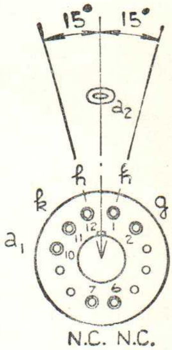
## 12/08 JM

Ferranti

# RADAR TUBES

12in. diameter flat faced Radar Display Tubes primarily designed for P.P.I. applications.

Improved version of CV.429. giving higher resolution.




**Base Connections**

**Underside View of Base**

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic |
| DEFLECTION ... ... ... | Magnetic |

SCREEN.

| | 12/08HM* | 12/08JM |
|---|---|---|
| Phosphor ... ... ... | Type 'H' | Type 'J' |
| Fluorescence ... ... ... | Orange | Blue |
| Afterglow ... ... ... | Orange | Yellow |
| Persistence ... ... ... | Long | Long |

Both types have metal backed screens

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal) |
| Anode Cap ... ... ... | CT8. (Cavity Type) |
| Max. Overall Length ... ... | 520 mm |
| Neck Diameter ... ... | 35 mm nominal |

For other dimensions, see drawing

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater | Pin 7—No Connection |
| Pin 2—Grid | Pin 8—No Pin |
| Pin 3—No Pin | Pin 9—No Pin |
| Pin 4—No Pin | Pin 10—1st Anode |
| Pin 5—No Pin | Pin 11—Cathode |
| Pin 6—No Connection | Pin 12—Heater |

Side Cap—2nd Anode

HEATER.

| | |
|---|---|
| Heater Voltage ... ... | 6·3 volts |
| Heater Current ... ... | 0·3 amps |

RATINGS.

| | |
|---|---|
| Max. 1st Anode Voltage ... | 600 volts |
| Max. 2nd Anode Voltage ... | 15·5 kV |
| Min. 1st Anode Voltage ... | 250 volts |
| Min 2nd Anode Voltage ... | 9·0 kV |
| Max. Cathode Current ... | 150 $\mu$A |
| Max. $V_{h-k}$ ... ... ... | 200 volts |
| Max. $R_{h-k}$ ... ... ... | 1·0 M$\Omega$ |
| Max. $R_{g-k}$ ... ... ... | 1·5 M$\Omega$ |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8·0 pF |
| $C_{g-all}$ ... ... ... ... | <8·0 pF |

TYPICAL OPERATING CONDITIONS.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts |
| 2nd Anode Voltage ... ... | 15 kV |
| Vg for visual cut-off ... ... | –60 volts |
| Av. Grid Drive for 50$\mu$A beam current ... ... | 20 volts |
| Line width at $I_B$=50 $\mu$A ... | 0·25 mm. |
| ‡Focus Coil ... ... ... | 640 amp. turns (approx) |

*This tube has a magnesium fluoride screen which is liable to burn even at low values of beam current, if operated with a spot which is stationary or slow moving.

‡Positioned so that the centre of the gap is approx. 120 mms. from the reference line (36 mm. Ring Gauge Position).

Issue 2
Sept. 1962

Ferranti

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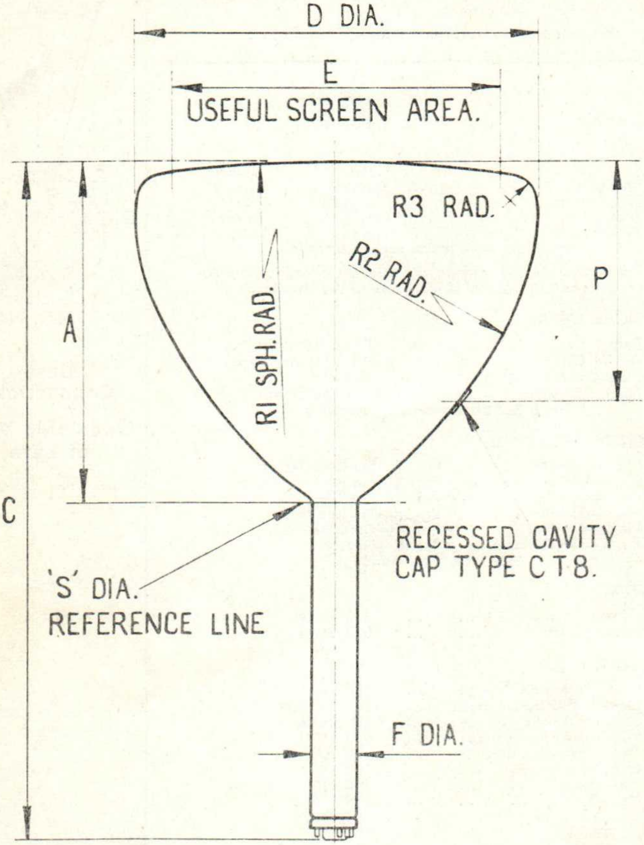
**12/08 HM**

**12/08 JM**




| DIM. | INS. | mm. | DIM. | INS. | mm. |
|---|---|---|---|---|---|
| A | 10·710 ± ·138 | 272 ± 3·5 | P | 7·087 ± ·197 | 180 ± 5 |
| C | 20·197 ± ·276 | 513 ± 7 | R1 | 39·370 | 1000 |
| D | 12·000 ± ·079 | 305 ± 2 | R2 | 16·772 | 426 |
| E | 9·842 | 250 MIN. | R3 | ·748 ± ·079 | 19 ± 2 |
| F | 1·378 $^{+\cdot 020}_{-\cdot 039}$ | 35 $^{+\cdot 5}_{-1}$ | S | 1·417 | 36 |

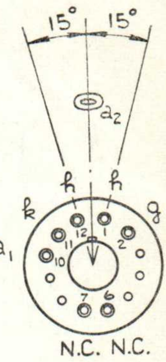
**12/48HM**

**12/48L3M**

Ferranti

# RADAR TUBES

12in. diameter flat faced Radar Tubes designed for fine symbol presentation, where high resolution is of primary importance. Phosphor Type 'L3' enables flicker free images to be produced at repetition frequencies down to 10 cycles per second, but the persistence of moving targets is curtailed in comparison with Type 'H' or 'L' Phosphor.




**Base Connections Underside View of Base**

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic |
| DEFLECTION ... ... ... | Magnetic |

SCREEN.

| | 12/48HM | 12/48L3M |
|---|---|---|
| Phosphor ... ... | *Type 'H' | *Type 'L3' |
| Fluorescence ... ... | Orange | Orange |
| Afterglow ... ... | Orange | Orange |
| Persistence ... ... | very long | long |

Both types have metal backed screens.

For further details refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal) |
| Anode Cap ... ... ... | CT8 (Cavity Type) |
| Max. Overall Length ... ... | 640 mm. (25·20") |
| Min Useful Screen Area ... | 250 mm. (9·84") dia. |
| Nom. Neck diameter ... | 35 mm .(1·378") |

For other dimensions, see drawing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater | Pin 7—No Connection |
| Pin 2—Grid | Pin 8—No Pin |
| Pin 3—No Pin | Pin 9—No Pin |
| Pin 4—No Pin | Pin 10—1st Anode |
| Pin 5—No Pin | Pin 11—Cathode |
| Pin 6—No Connection | Pin 12—Heater |

Side Cap—2nd Anode.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... | 6·3 volts |
| Heater Current ... ... | 0·3 amp |

RATINGS.

| | |
|---|---|
| Max. 1st Anode Voltage ... | 600 volts |
| Min 1st Anode Voltage ... | 250 volts |
| Max. 2nd Anode Voltage ... | 15·5 kV |
| Min. 2nd Anode Voltage ... | 9·0 kV |
| Max. Cathode Current ... | 150 µA |
| Max. $V_{h-k}$ ... ... ... | 200 volts |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |

TYPICAL OPERATING CONDITIONS.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts |
| 2nd Anode Voltage ... ... | 15 kV |
| Vg for visual cut-off ... ... | −90 volts |
| Av. Grid Drive for $I_B$=50 µA. | 30 volts |
| Line width at $I_B$=50 µA. ... | 0·25 mm |

The Focus coil should be positioned so that the centre of the gap is approx. 220 mm from the reference line (36 mm Ring Gauge Position).

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8·0 pF |
| $C_{g-all}$ ... ... ... ... | <8·0 pF |

Ferranti

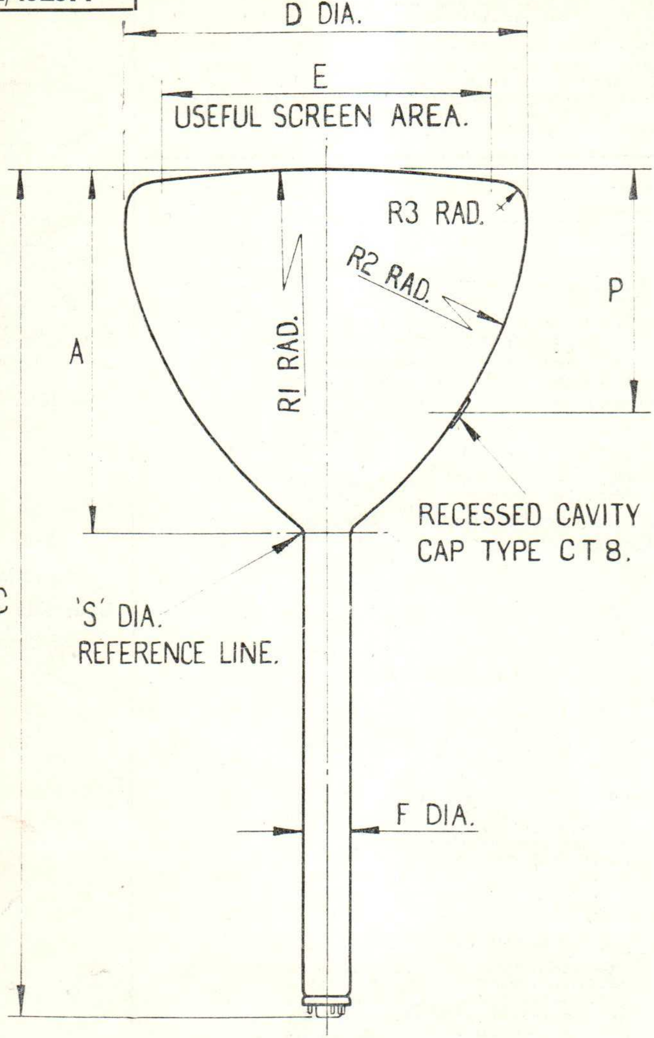
Issue 1.
Sept., 1962

*This phosphor is liable to burn even at low values of beam current, if operated with a spot which is stationary or slow moving.

Ferranti

12/48HM

12/48L3M




| DIM. | INS. | mm. | DIM. | INS. | mm. |
|---|---|---|---|---|---|
| A | 10·710 ± ·138 | 272 ± 3·5 | P | 7·087 ± ·197 | 180 ± 5 |
| C | 25·040 ± ·157 | 636 ± 4 | R1 | 39·370 | 1000 |
| D | 12·000 ± ·079 | 305 ± 2 | R2 | 16·772 | 426 |
| E | 9·842 | 250 MIN. | R3 | ·748 ± ·079 | 19 ± 2 |
| F | 1·378 $^{+·020}_{-·039}$ | 35 $^{+·5}_{-1·0}$ | S | 1·417 | 36 |

| 14/03AB |
|---|
| 14/03QB |
| 14/03Q2B |

Ferranti

# FLYING SPOT SCANNER TUBES

14in. diagonal Rectangular Tubes with metal backed screen and external conductive coating. Primarily designed for general Flying Spot Scanner applications.

FOCUS ... ... ... Low Voltage Electrostatic.

DEFLECTION ... ... ... Magnetic.

SCREEN

| | | | |
|---|---|---|---|
| Phosphor ... | Type 'A' | Type 'Q' | Type 'Q2' |
| Fluorescence ... | Green | Blue/Violet | Magenta |
| Persistence ... | Ultra short | Killed | * |

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

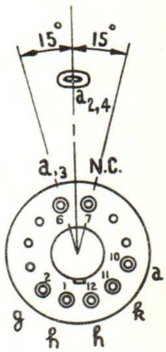
PHYSICAL DETAILS.

Base ... ... ... ... B12A (Duodecal).
Anode Cap ... ... ... CT8 (Cavity Type).
Max. Overall Length ... ... 420 mm.
Nom. neck diameter ... ... 37 mm.
For other dimensions see drawing overleaf.
Mounting Position ... ... Any.
These tubes have an external conductive coating which may be used for E.H.T. smoothing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode, 4th Anode.




**Base Connections**

**Underside View of Base**

HEATER.

†Heater Voltage ... ... ... 6·3 volts.
Heater Current ... ... ... 0·3 amp.

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... | 500 volts. |
| Max. $A_2+A_4$ voltage | 15 kV. |
| Max. Pos. $A_3$ voltage | +500 volts. |
| Max. Neg. $A_3$ voltage | –500 volts. |
| Min. $A_1$ voltage ... | 200 volts |
| Min. $A_2+A_4$ voltage | 8 kV. |
| Max. $V_{h-k}$ | 200 volts. |
| Max. $R_{g-k}$ | 1·5 MΩ |
| Max. $R_{h-k}$ | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| 1st Anode Voltage | 300 volts. |
| 2nd and 4th Anode voltage | 12 kV. |
| §3rd Anode voltage for focus | –300 to +300 volts. |
| ‡$V_g$ for visual cut off | –40 to –80 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ | <8 pF. |
| $C_{g-all}$ | <8 pF. |
| $C_{a-ext.\ coating}$ | 1100 pF. (approx.). |

*A blue filter should be provided for the photocell to separate the two colour peaks which have different persistence times.

†When used for series operation, the surge heater voltage should not exceed 9·5 volts r.m.s. and a current limiting device should be incorporated in the circuit to limit switching surge.

§The point of optimum focus lies between these values.

‡The grid should never be positive with respect to the cathode. except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

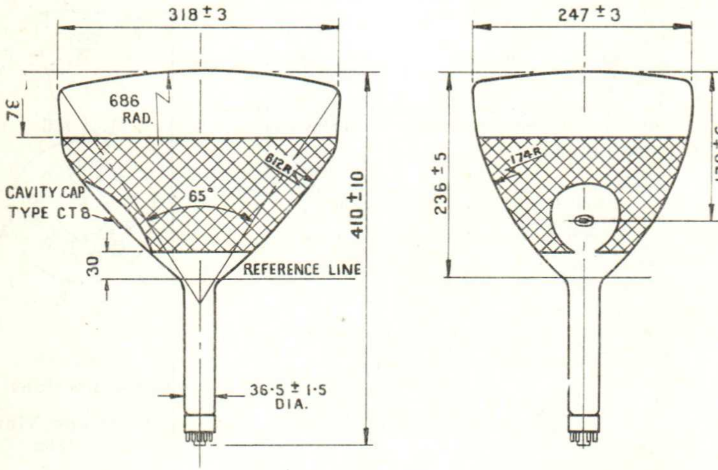
Issue 2
June, 1960

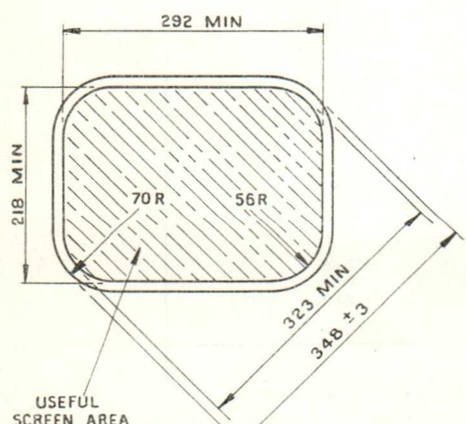
Ferranti

| |
|---|
| **14/03AB** |
| **14/03QB** |
| **14/03Q2B** |

Ferranti

## THIRD ANGLE PROJECTION

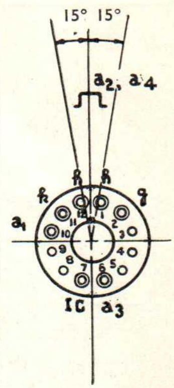



DIMENSIONS
IN MILLIMETRES

# FERRANTI
## MONITOR TUBE

A 14in. diagonal Rectangular Tube with a metal backed screen and external conductive coating. Designed for use in Television Monitoring Equipment.




**Base Connections Underside View of Base**

| | |
|---|---|
| FOCUS ... ... ... | Low Voltage Electrostatic. |
| DEFLECTION ... ... ... | Magnetic. |
| SCREEN ... ... ... | Metal backed. |
| Phosphor ... ... | Type 'T' |
| Fluorescence ... ... | White. |
| Persistence ... ... | Short. |

For further details, refer to Screen Type 'T' phosphor characteristics at the front of this section of the handbook. This tube can be supplied with other screen phosphors.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 (Cavity Type.) |
| Max. Overall Length ... ... | 420 mm. |
| Nom. neck diameter ... ... | 37 mm. |
| For other dimensions see drawing. | |
| Mounting Position ... ... | Any |

These tubes have an external conductive coating which may be used for E.H.T. smoothing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode, 4th Anode.

HEATER.

| | |
|---|---|
| *Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... | 500 volts. |
| Max. $A_2+A_4$ voltage ... ... | 15 kV. |
| Max. Pos. $A_3$ voltage ... ... | +500 volts. |
| Max. Neg. $A_3$ voltage ... ... | –500 volts. |
| Min. $A_1$ voltage ... ... | 200 volts. |
| Min. $A_2+A_4$ voltage ... ... | 8 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode voltage ... | 12 kV. |
| **3rd Anode voltage for focus ... | –300 to +300 volts. |
| †$V_g$ for visual cut off ... ... | –30 to –70 volts. |

VAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{a-ext.\ coating}$ ... ... | 1100 pF. (approx.). |

*When used for series operation, the surge heater voltage should not exceed 9·5 volts r.m.s. and a current limiting device should be incorporated in the circuit to limit switching surge.

**The point of optimum focus lies between these values.

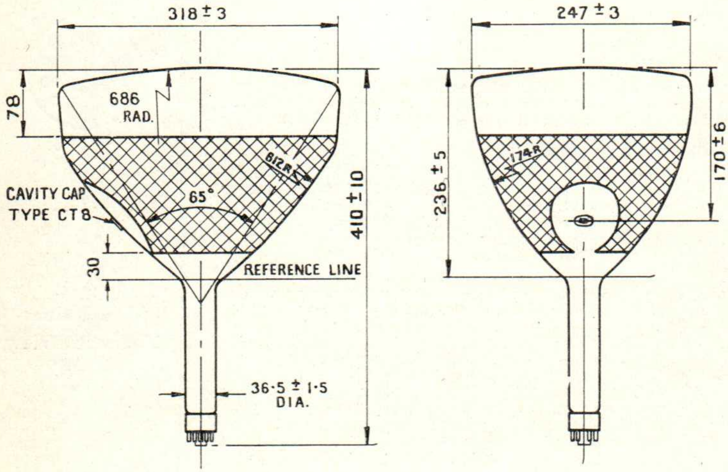
†The grid should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

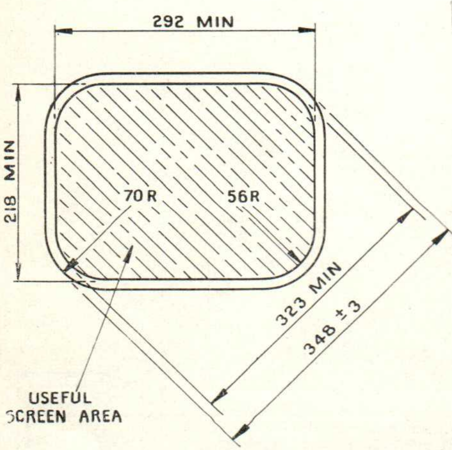
Issue 1
Aug., 1957

14/03TB

FERRANTI

THIRD ANGLE PROJECTION




410
236
174 ± 5

# FERRANTI

## TELEVISION MONITOR TUBE

A 14in. diagonal Rectangular Tube with a metal backed screen and external conductive coating. Designed for use in Television Monitoring Equipment.

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic. |
| DEFLECTION ... ... ... ... | Magnetic. |
| SCREEN ... ... ... ... | Metal Backed. |
| Phosphor ... ... ... ... | Type 'T'. |
| Fluorescence ... ... ... | White. |
| Persistence ... ... ... | Short. |

For further details, refer to Screen Type 'T' phosphor characteristics at the front of this section of the handbook. This tube can also be supplied with other screen phosphors.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 (Cavity Type). |
| Max. Overall Length ... ... | 457 mm. |
| Nom. Neck Diameter ... ... | 37 mm. |

For other dimensions see drawing.

| | |
|---|---|
| Mounting Position ... ... | Any. |

This tube has an external conductive coating which may be used for E.H.T. smoothing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater. |

Side Contact—2nd Anode.

HEATER.

| | |
|---|---|
| *Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 500 volts. |
| †Max. $A_2$ Voltage ... ... ... | 16 kV. |
| Min. $A_1$ Voltage ... ... | 200 volts. |
| Min. $A_2$ Voltage ... ... | 8 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| ‡Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |
| Max. $A_1$ Supply Impedance ... | 1·5 MΩ |

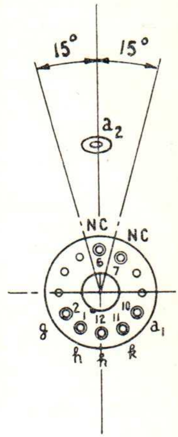
TYPICAL OPERATION.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode Voltage ... | 14 kV. |
| → §Vg for visual cut off ... ... | –30 to –70 volts. |
| Focus ... ... ... ... | See Note ** ← |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{a-ext.\ coating}$ ... ... ... | 1100 pF. (approx.). |

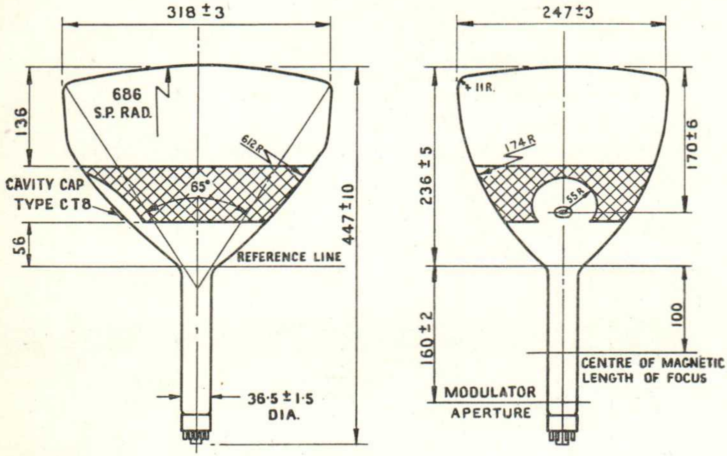
*When used for series operation, the surge heater voltage should not exceed 9·5 volts r.m.s. and a current limiting device should be incorporated in the circuit to limit switching surge.
†The product of $Va_2$ and $Ia_2$ must not exceed 6 watts average value for the whole screen.
‡When the heater supply is from a separate transformer. When the heater is in a series chain or earthed the 50 c/s. impedance between earth and cathode ($Z_k$) is 100kΩ (max).
**The recommended centre of the magnetic length of the focus unit should be approx. 100 mm. from the Reference Line.
§The grid should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

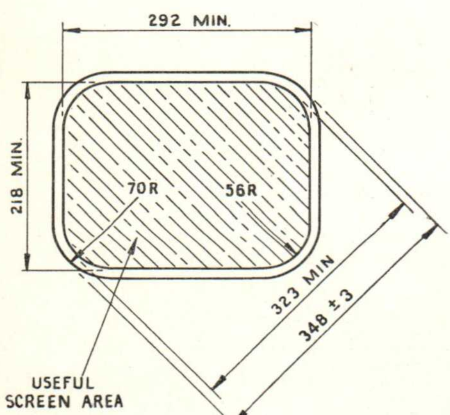



**Base Connections**
**Underside View of Base**

Issue 1
Jan., 1958

FERRANTI




All dimensions are
in millimetres

# FERRANTI

## RADAR TUBES

15in. diameter Radar Display Tubes with metal backed screens magnetic deflection, and low voltage electrostatic focus.

**15/03 HB**

**15/03 JB**

**15/03 LB**

FOCUS ... ... ... Low Voltage Electrostatic

DEFLECTION ... ... ... Magnetic

SCREEN.

| | 15/03HB | 15/03JB | 15/03LB |
|---|---|---|---|
| *Phosphor Type | 'H'* | 'J' | 'L' |
| Fluorescence | Orange | Blue | Orange |
| Afterglow ... | Orange | Yellow | Orange |
| Persistence | Very long | Long | Long |

All types have metal backed screens.

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

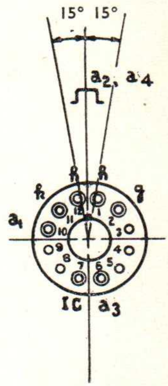
Base ... ... ... B12A (Duodecal).
Anode Cap ... ... CT8 Cavity Type.
Max. Overall Length ... 610 mm.
Nom. Neck Diameter ... 37 mm.
For other dimensions, see drawing.
Mounting Position ... Any except vertical screen down.

All types have an external conductive coating which can be used for E.H.T. smoothing.

A E CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode + 4th Anode.




**Base Connections Underside View of Base**

**HEATER.**

Heater Voltage ... ... 6·3 volts.
Heater Current ... ... 0·3 amp.

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... | 500 volts. |
| Max. $A_2 + A_4$ Voltage ... | 15 kV. |
| Max. Pos. $A_3$ Voltage ... | +500 volts. |
| Max. Neg. $A_3$ Voltage ... | –500 volts. |
| Min. $A_1$ Voltage ... ... | 200 volts. |
| Min. $A_2 + A_4$ Voltage ... | 8 kV. |
| Max. $V_{h\text{-}k}$ ... ... | 200 volts. |
| Max. $R_{g\text{-}k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h\text{-}k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... | 6·3 volts. |
| 1st Anode Voltage ... | 300 volts. |
| 2nd+4th Anode Voltage | 12 kV. |
| 3rd Anode Voltage for focus | –300 to + 300 volts. |
| †Vg for visual cut off ... | –30 to –90 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k\text{-}all}$ ... ... ... | <8 pF. |
| $C_{g\text{-}all}$ ... ... ... | <8 pF. |
| $C_{a\text{-}ext. coating}$ ... ... | 1500 pF. approx. |

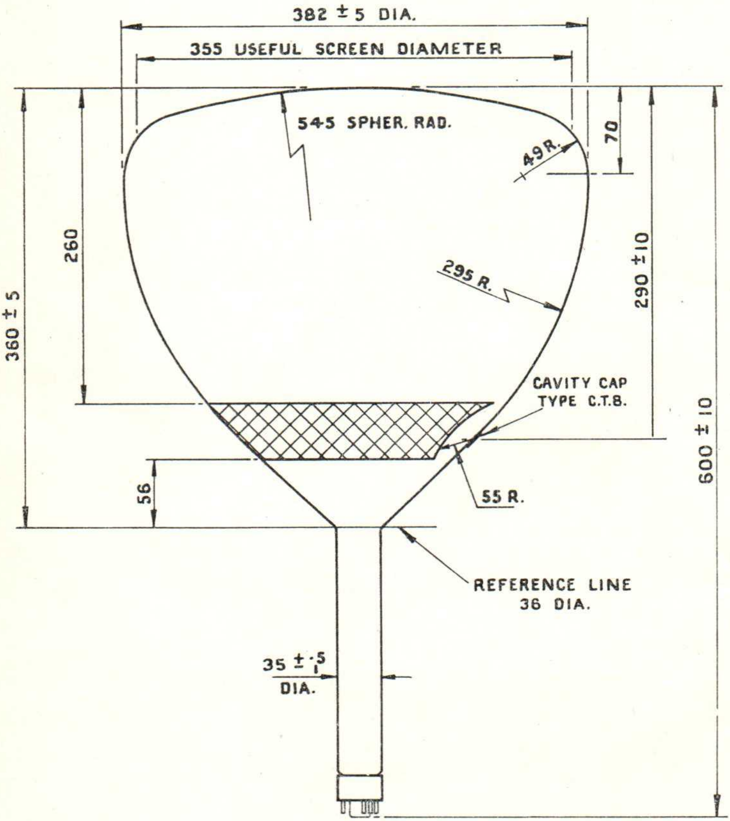
*The screen phosphor of Type 15/03HB is liable to burn if operated with a stationary or slow moving spot, even at low values of beam current.

†The modulator should never be positive with respect to the cathode, except during the period immediatly after switching off, when it may be allowed to rise to + 1 volt.

FERRANTI

Issue 1.
Dec., 1957

| |
|---|
| 15/03 HB |
| 15/03 JB |
| 15/03 LB |




FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

# FERRANTI RADAR TUBES

# 16/03HB
# 16/03 JB

16in. diameter Radar Display Tubes with metal backed screens magnetic deflection and Low Voltage Electrostatic focus.

| | |
|---|---|
| FOCUS ... ... ... ... | Low Voltage. Electrostatic. |
| DEFLECTION ... ... ... ... | Megnetic. |

SCREEN.

| | 16/03HB | 16/03JB. |
|---|---|---|
| Phosphor ... ... ... ... | Type 'H'* | Type 'J' |
| Fluorescence ... ... ... | Orange | Blue. |
| Afterglow ... ... ... | Orange | Yellow. |
| Persistence ... ... ... | Very long | long. |

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 485 mm. |

For other dimensions, see drawing.

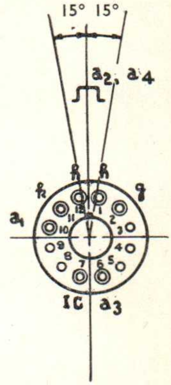
| | |
|---|---|
| Mounting Position ... ... | Any except vertical screen down. |

Both types have an external conductive coating which can be used for E.H.T. smoothing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode + 4th Anode.




Base Connections

Underside View of Base

HEATER.

| | |
|---|---|
| *Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 500 volts. |
| Max. $A_2 + A_4$ Voltage ... ... | 15 kV. |
| Max. Pos. $A_3$ Voltage ... ... | +500 volts. |
| Max. Neg. $A_3$ Voltage ... ... | –500 volts. |
| Min. $A_1$ Voltage ... ... ... | 200 volts. |
| Min. $A_2 + A_4$ Voltage ... ... | 8 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd + 4th Anode Voltage ... | 12 kV. |
| 3rd Anode Voltage for focus ... | –300 to + 300 volts. |
| †$V_g$ for visual cut off ... ... | –30 to –90 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{a-ext. coating}$ ... ... ... | 1500 pF. approx. |

*The screen material of Type 16/03HB is liable to burn if operated with a stationary or slow moving spot, even at low values of beam current.

†The modulator should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

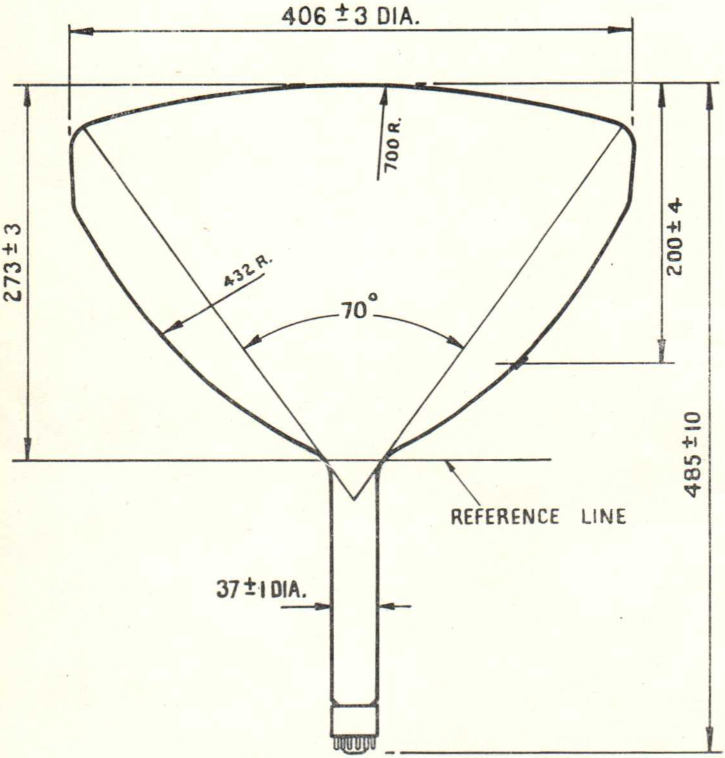
Issue 1.
Mar., 1957

FERRANTI

16/03HB

16/03 JB

FERRANTI




ALL DIMENSIONS ARE IN MILLIMETRES

# FERRANTI

## 17/03TB

## MONITOR TUBE

A rectangular Tube with 17in. diagonal screen which is metal backed.
Designed primarily for use in Television Monitoring Epuipment.

| | |
|---|---|
| FOCUS ... ... ... | Low Voltage Electrostatic. |
| DEFLECTION ... ... ... | Magnetic. |
| SCREEN.... ... ... ... | Metal backed. |
| Phosphor ... ... ... | Type 'T' |
| Fluorescence ... ... | White |

For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.
This tube can also be supplied with other screen phosphors.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 490 mm. |
| Nom. Neck diameter ... ... | 37mm. |

For other dimensions, see drawing.

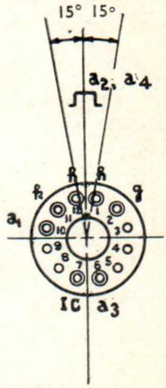
| | |
|---|---|
| Mounting Position ... ... | Any |

Both types have an external conductive coating which can be used for E.H.T. smoothing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode, 4th Anode.




**Base Connections**

**Underside View of Base**

HEATER.

| | |
|---|---|
| *Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 500 volts. |
| Max. $A_2 + A_4$ Voltage ... ... | 18 kV. |
| Max. Pos. $A_3$ Voltage ... ... | +500 volts. |
| Max. Neg. $A_3$ Voltage ... ... | –500 volts. |
| Min. $A_1$ Voltage ... ... ... | 200 volts. |
| Min. $A_2 + A_4$ Voltage ... ... | 12 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd + 4th Anode Voltage ... | 15 kV. |
| ‡3rd Anode Voltage for focus ... | –300 to + 300 volts. |
| †$V_g$ for visual cut off ... ... | –30 to –90 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{a-ext.\ coating}$ ... ... ... | 1500 pF. approx. |

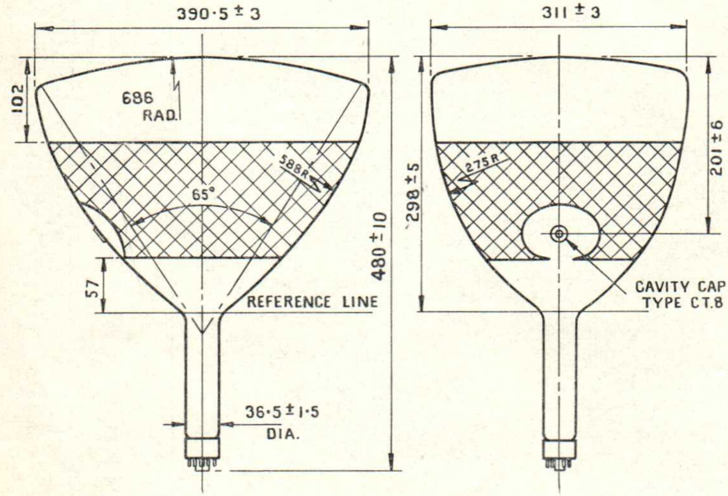
*When used for series operation, the surge heater voltage should not exceed 9·5 volts r.m.s. and a current limiting device should be incorporated in the circuit to limit switching surge.

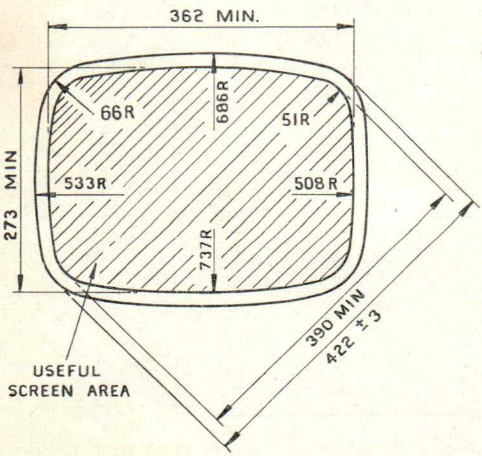
†The modulator should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

‡Optimum focus lies between these values.

Issue 1.
Aug., 1957

**17/03TB**




480
298
182

# FERRANTI
## MONITOR TUBE

**21/03TB**

A 21in. diagonal Rectangular Tube with a metal backed screen and external conductive coating. Designed for use in Television Monitoring Equipment.

| | |
|---|---|
| FOCUS ... ... ... ... | Low Voltage Electrostatic. |
| DEFLECTION ... ... ... ... | Magnetic. |
| Deflection Angle ... ... | 90°. |
| SCREEN ... ... ... ... | Metal backed. |
| Phosphor ... ... ... ... | Type 'T'—Silver activated. |
| Fluorescence ... ... ... | White. |
| Persistence ... ... ... | Short. |

For further details, refer to Screen Type 'T' phosphor characteristics at the front of this section of the handbook. This tube can be supplied with other screen phosphors.

PHYSICAL DETAILS.

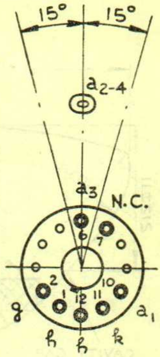
| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 (Cavity Type.) |
| Max. Overall Length ... ... | 514 mm. |
| Nom. neck diameter ... ... | 37 mm. |
| For other dimensions see drawing. | |
| Mounting Position ... ... | Any |

These tubes have an external conductive coating which may be used for E.H.T. smoothing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side Contact—2nd Anode, 4th Anode.




**Base Connections**

**Underside View of Base**

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 500 volts. |
| Max. $A_2+A_4$ voltage ... ... | 18 kV. |
| Max. Pos. $A_3$ voltage ... ... | +500 volts. |
| Max. Neg. $A_3$ voltage ... ... | −500 volts. |
| Min. $A_1$ voltage ... ... ... | 200 volts. |
| Min. $A_2+A_4$ voltage ... ... | 12 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode voltage ... | 16 kV. |
| **3rd Anode voltage for focus ... | −200 to +200 volts. |
| †$V_g$ for visual cut off ... ... | −30 to −90 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{a-ext.\ coating}$ ... ... ... | 1500 pF. (approx.). |

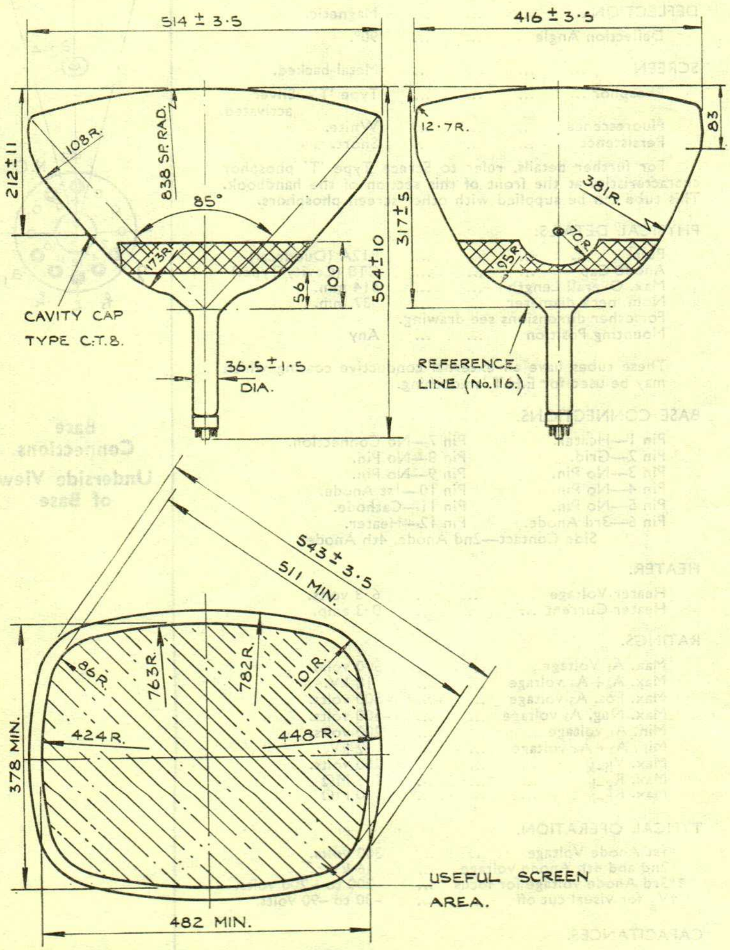
**The point of optimum focus lies between these values.

†The grid should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

Tentative
Issue 2
May, 1959

## 21/03TB

FERRANTI




DIMENSIONS IN MILLIMETRES

# FERRANTI

## RADAR TUBE

**21/04HB**

A 21in. diagonal Rectangular Tube with a metal backed screen and external conductive coating. Designed primarily for use as a Radar Display Tube.

| | |
|---|---|
| FOCUS ... ... ... ... | Magnetic. |
| DEFLECTION ... ... ... ... | Magnetic. |
| Deflection Angle... ... ... | 90°. |
| SCREEN ... ... ... ... | Metal Backed. |
| Phosphor ... ... ... ... | Type 'H' |
| Fluorescence ... ... ... | Orange. |
| Afterglow... ... ... ... | Orange. |
| Persistence ... ... ... | Very Long. |

For further details, refer to Screen Type 'T' phosphor characteristics at the front of this section of the handbook. This tube can also be supplied with other screen phosphors.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 (Cavity Type). |
| Max. Overall Length ... ... | 514 mm. |
| Nom. Neck Diameter ... ... | 37 mm. |

For other dimensions see drawing.

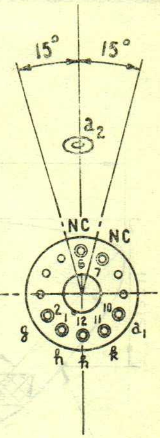
| | |
|---|---|
| Mounting Position ... ... | Any. |

This tube has an external conductive coating which may be used for E.H.T. smoothing.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No Connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—No Connection. | Pin 12—Heater. |

Side Contact—2nd Anode.




**Base Connections Underside View of Base**

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 500 volts. |
| Max. $A_2$ Voltage ... ... ... | 18 kV. |
| Min. $A_1$ Voltage ... ... | 200 volts. |
| Min. $A_2$ Voltage ... ... | 12 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |
| Max. $A_1$ Supply Impedance ... | 1·5 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode Voltage ... | 16 kV. |
| *Vg for visual cut off ... ... | –40 to –80 volts. |
| Focus ... ... ... ... | See Note † |

An ion trap magnet is not required.

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | <8 pF. |
| $C_{g-all}$ ... ... ... ... | <8 pF. |
| $C_{a-ext. coating}$ ... ... ... | 1500 pF. (approx.). |

*The grid should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

†The recommended centre of the magnetic length of the focus unit should be approx. 100 mm. from the Reference Line.

Tentative,
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Aug. 1959.

FERRANTI

# 21/04HB

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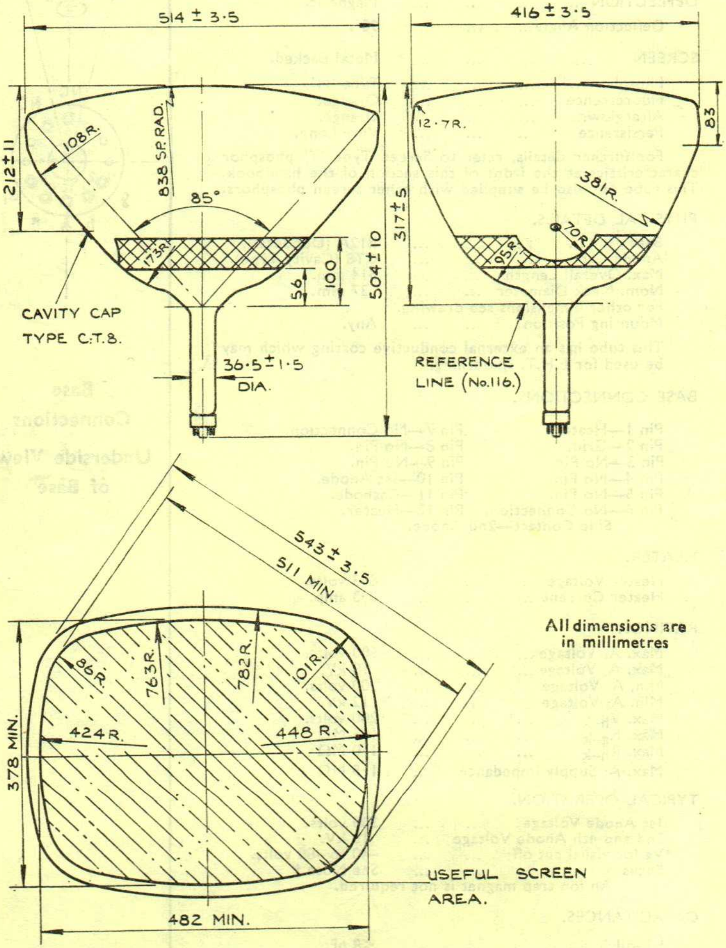


**1240/54HM**

**1240/54L3M**

**Ferranti**

# RADAR TUBES

12in. diameter tubes with narrow neck and small deflection angle. Suitable for use with either Transistor or Valve circuits in Raw or Synthetic Radar and symbol presentation.

FOCUS ... ... ... ... ... Magnetic

DEFLECTION ... ... ... ... Magnetic–45°(approx)

SCREEN.

| | 1240/54HM | 1240/54L3M |
|---|---|---|
| Phosphor ... ... ... | Type 'H'* | Type 'L3'* † |
| Fluorescence ... ... | Orange | Orange |
| Afterglow ... ... | Orange | Orange |
| Persistence ... ... | Very Long | Long |

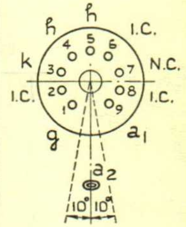
PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B9A/D |
| Anode Cap ... ... ... | CT8 Cavity Type |
| Max. Overall Length ... ... | 653 mm. |
| Neck Diameter ... ... ... | 23 mm. (nom.) |
| Mounting Position ... ... | Any |

For other dimensions see outline drawing overleaf.

BASE CONNECTIONS.

| | |
|---|---|
| Pin 1—Grid | Pin 6—I.C. |
| Pin 2—I.C. | Pin 7—N.C. |
| Pin 3—Cathode | Pin 8—I.C. |
| Pin 4—Heater | Pin 9—1st Anode |
| Pin 5—Heater | Side Contact—2nd Anode |




**Base Connections Underside View of Base**

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts |
| Heater Current ... ... ... | 0·3 amps |

RATING.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 600 volts |
| Max. $A_2$ Voltage ... ... ... | 15 kV |
| Min. $A_2$ Voltage ... ... ... | 8 kV |
| Max. $V_{h-k}$ ... ... ... | 200 volts |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

With Valve Drive.

| | |
|---|---|
| 1st Anode Voltage ... ... | 300 volts |
| 2nd Anode Voltage ... ... | 12 kV |
| $V_g$ for visual cut-off ... | –30 to —90 volts |

With Transistor Drive.

| | |
|---|---|
| 1st Anode Voltage ... ... | 100 volts |
| 2nd Anode Voltage ... ... | 12 kV |
| $V_g$ for visual cut-off ... ... | –25 volts |

Recommended position of focus coil is 170 mm in front of the grid.

*These phosphors are liable to burn if operated with a spot which is stationary or slow moving, and tubes should not be operated under such conditions, even at low beam current. Alternative phosphors for this application can be supplied on request.

†Phosphor Type L3 is flicker free at 10 c/s.

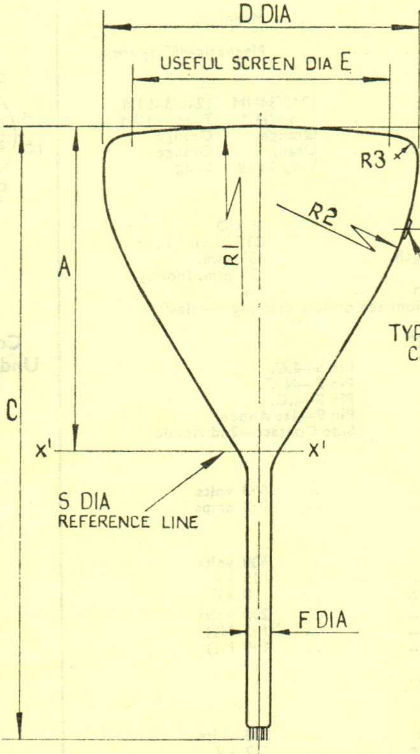
Tentative
Issue 1.
Dec., 1963

**Ferranti**

Ferranti

# 1240/54HM

# 1240/54L3M




| DIM. | mm. | IN. | DIM. | mm. | IN. |
|---|---|---|---|---|---|
| A | 322 ± 3 | 12·67 ±·12 | P | 90 ± 5 | 3·54 ±·20 |
| C | 645 ± 8 | 25·39 ±·31 | R1 | 1000 | 39·37 |
| D | 305 ± 2 | 12·00 ±·08 | R2 | 426 | 16·77 |
| E | 250 MIN. | 9·84 | R3 | 19 | ·75 |
| F | $23 \pm {}^{0}_{1}$ | $·906 {}^{+·000}_{-·039}$ | S | 25 | ·984 |

ORIGINAL DIMENSIONS IN MILLIMETERS



FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS

| 1650/03HB |
|---|
| 1650/03JB |

# FERRANTI
# RADAR TUBES

16in. diameter Radar Display Tube with metal backed screen, magnetic deflection and low voltage electrostatic focus. The deflection angle is approximately 50°.

| | |
|---|---|
| FOCUS ... ... ... ... | Low Voltage. Electrostatic. |
| DEFLECTION ... ... ... | Magnetic. |

SCREEN.

| | 1650/03HB | 1650/03JB |
|---|---|---|
| Phosphor ... ... ... | *Type "H" | Type "J" |
| Fluorescence ... ... | Orange | Blue |
| Afterglow ... ... | Orange | Yellow |
| Persistence ... ... | Very Long | Long |

For further details refer to the revelant phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base ... ... ... ... | B12A (Duodecal). |
| Anode Cap ... ... ... | CT8 Cavity Type. |
| Max. Overall Length ... ... | 600 mm. |
| Deflection Angle ... ... | 50° |

For other dimensions, see drawing.

| | |
|---|---|
| Mounting Position ... ... | Any except vertical screen down. |

Both types have an external conductive coating which can be used for E.H.T. smoothing.

CONNECTIONS.

| | |
|---|---|
| Pin 1—Heater. | Pin 7—No connection. |
| Pin 2—Grid. | Pin 8—No Pin. |
| Pin 3—No Pin. | Pin 9—No Pin. |
| Pin 4—No Pin. | Pin 10—1st Anode. |
| Pin 5—No Pin. | Pin 11—Cathode. |
| Pin 6—3rd Anode. | Pin 12—Heater. |

Side contact—2nd and 4th anodes.

HEATER.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| Heater Current ... ... ... | 0·3 amps. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ Voltage ... ... ... | 500 volts. |
| Max. $A_2+A_4$ Voltage ... ... | 18 kV. |
| Max. Pos. $A_3$ Voltage ... ... | +500 volts. |
| Max. Neg. $A_3$ Voltage ... ... | –500 volts. |
| Min. $A_1$ Voltage ... ... | 200 volts. |
| Min. $A_2+A_4$ Voltage ... ... | 8 kV. |
| Max. $V_{h-k}$ ... ... ... | 200 volts. |
| Max. $R_{g-k}$ ... ... ... | 1·5 MΩ |
| Max. $R_{h-k}$ ... ... ... | 1·0 MΩ |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage ... ... ... | 6·3 volts. |
| 1st Anode Voltage ... ... | 300 volts. |
| 2nd and 4th Anode Voltage ... | 15 kV. |
| 3rd Anode Voltage for focus ... ... | –300 to +300 volts. |
| †Vg for visual cut-off ... | –40 to –100 volts. |

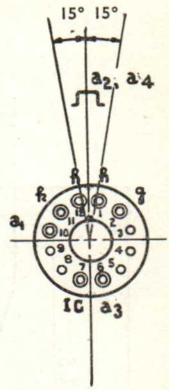
NOTE.— When using static shift coils external to the main deflecting system, care must be taken to shield both neck and lens regions of the tube from fringe fields, otherwise deflection defocusing conditions will result.

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ ... ... ... ... | 8 pF. |
| $C_{g-all}$ ... ... ... ... | 8 pF. |
| $C_{a-ext. coating}$ ... ... ... | 1500 pF. approx. |

*The screen material of type 1650/03HB is liable to burn if operated with a stationary or slow moving spot, even at low values of beam current.

†The modulator should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to +1 volt.




Base Connections Underside View of Base

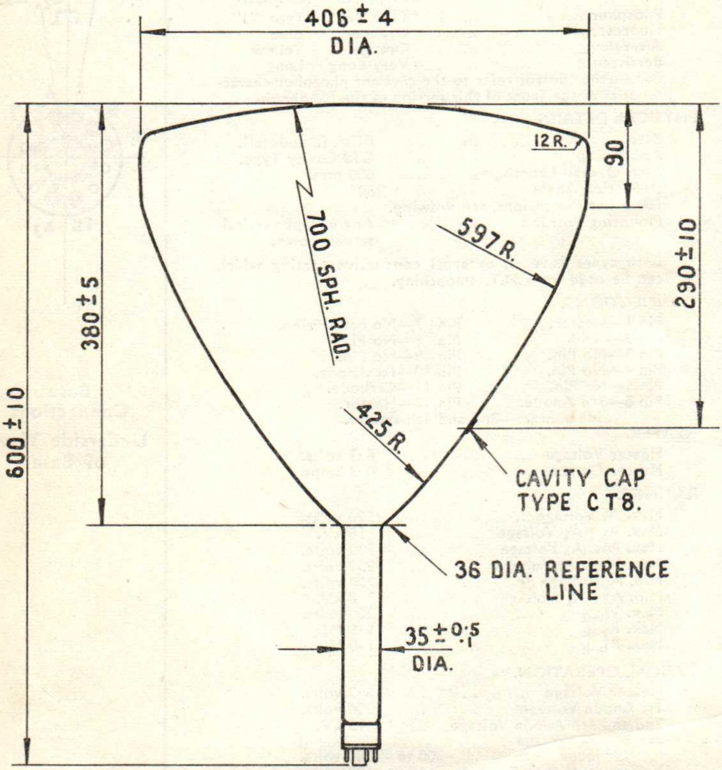
FERRANTI

Issue 1
Nov., 1958

FERRANTI

1650/03HB

1650/03JB




ALL DIMENSIONS ARE IN MM.

# FERRANTI

1790/03TB

## PICTURE MONITOR TUBE

A rectangular tube with 17″ diagonal screen and 90° deflection angle. Designed primarily for use in Television Monitoring Equipment.

| | |
|---|---|
| FOCUS | Low Voltage Electro-static. |
| DEFLECTION | Magnetic |
| SCREEN | Metal backed |
| Phosphor | Type 'T'— Silver Activated. |
| Fluorescence | White. |

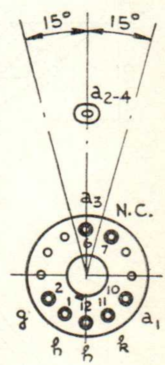
This tube can be supplied with other screen phosphors.

For further details refer to the phosphor characteristics at the front of this section of the handbook.

PHYSICAL DETAILS.

| | |
|---|---|
| Base | B12A (Duodecal). |
| Anode Cap | CT8 Cavity type. |
| Max. Overall Length | 420 mm. |
| Nom. Neck diameter | 37 mm. |
| Mounting Position | Any. |

For other dimensions see drawing on page 2.
The external conductive coating may be used for E.H.T. smoothing.




BASE CONNECTIONS.

Pin 1—Heater.
Pin 2—Grid.
Pin 3—No Pin.
Pin 4—No pin.
Pin 5—No pin.
Pin 6—3rd Anode.
Pin 7—No connection.
Pin 8—No pin.
Pin 9—No pin.
Pin 10—1st Anode.
Pin 11—Cathode.
Pin 12—Heater.
Side contact—2nd & 4th Anodes.

HEATER.

| | |
|---|---|
| Heater Voltage | 6·3 volts. |
| Heater Current | 0·3 amp. |

RATINGS.

| | |
|---|---|
| Max. $A_1$ voltage | 500 volts. |
| Max. $A_2+A_4$ voltage | 18 kV. |
| Max. Pos. $A_3$ voltage | +500 volts. |
| Max. Neg. $A_3$ voltage | -500 volts. |
| Min. $A_1$ voltage | 200 volts. |
| Min. $A_2+A_4$ voltage | 12 kV. |
| Max. $V_{h-k}$ | 200 volts. |
| Max. $R_{g-k}$ | 1·5 MΩ. |
| Max. $R_{h-k}$ | 1·0 MΩ. |

TYPICAL OPERATION.

| | |
|---|---|
| Heater Voltage | 6·3 volts. |
| 1st Anode Voltage | 300 volts. |
| 2nd + 4th Anode Voltage | 15 kV. |
| *3rd Anode Voltage for focus | -300 to +300 volts. |
| †$V_g$ for visual cut-off | -30 to -90 volts. |

CAPACITANCES.

| | |
|---|---|
| $C_{k-all}$ | <8 pF. |
| $C_{g-all}$ | <8 pF |
| $C_{a-ext. coating}$ | 1500 pF approx. |

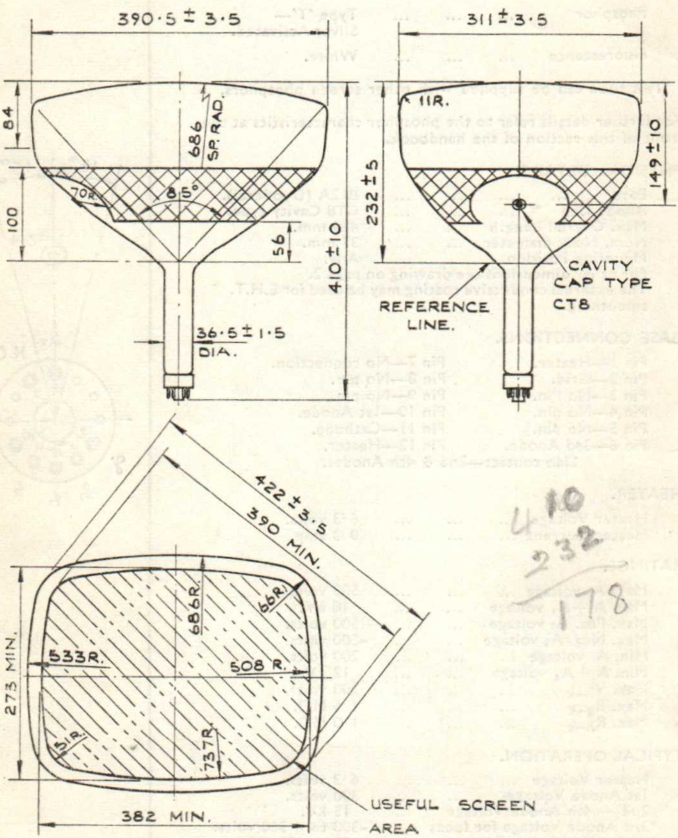
*Optimum focus lies between these values.

†The modulator should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

FERRANTI

Issue 1,
Apl., 1959

# 1790/03TB




410
232
178