FERRANTI

TELEVISION MONITOR TUBE

10FP4A

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.

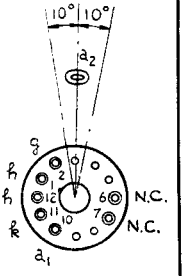
PHYSICAL DETAILS.

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 2—Grid.
Pin 3—No Pin.
Pin 4—No Pin.
Pin 5—No Pin.
Pin 6—No Connection.
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 Anode.



Base Connections
Underside View of Base

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.

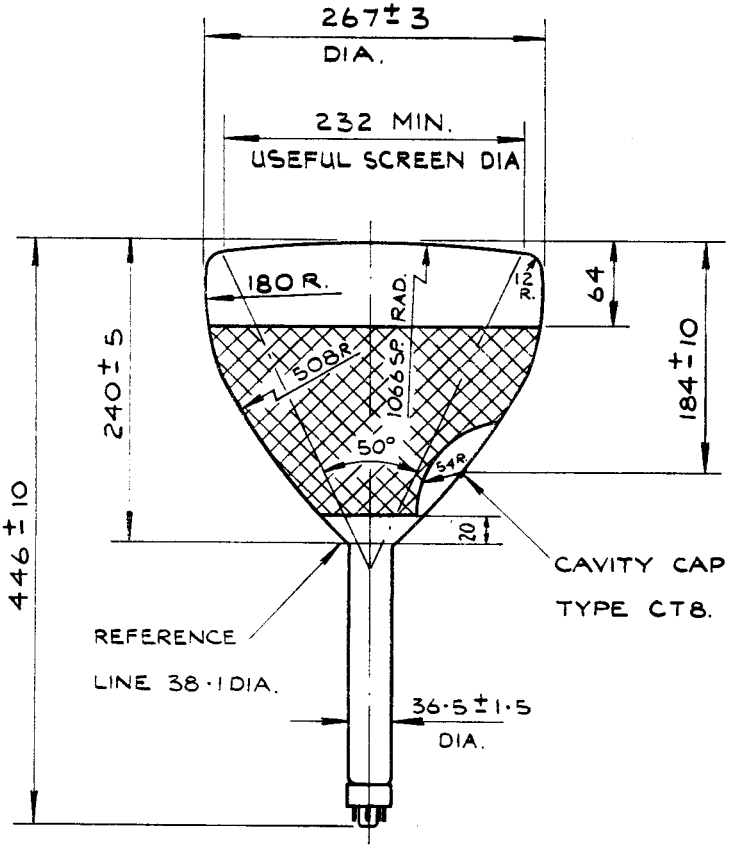
*This Tube is normally supplied with a 6·3 volt 0·3 amp. heater. For direct replacement of Tubes of American origin a Tube with 6·3 volt 0·6 amp. heater should be requested.

**The recommended centre of the magnetic length of the focus unit should be approx. 80 mm. from the Reference Line.

Issue 1
Aug., 1959

FERRANTI

10FP4A



DIMENSIONS IN MILLIMETERS

FERRANTI
RADAR TUBE

10WP7

A 10in. diameter Radar Display Tube with metal backed screen magnetic deflection, and low voltage electrostatic focus.

FOCUS	Low Voltage Electrostatic
DEFLECTION	Magnetic

SCREEN.

Phosphor Type	'J'
Fluorescence	Blue
Afterglow	Yellow
Persistence	Long

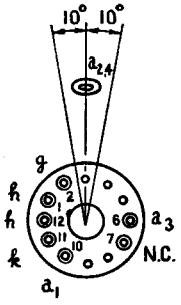
For further details, refer to the Type 'J' Phosphor characteristics at the front of this section of the handbook.

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.	



Base Connections
Underside View of Base

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.

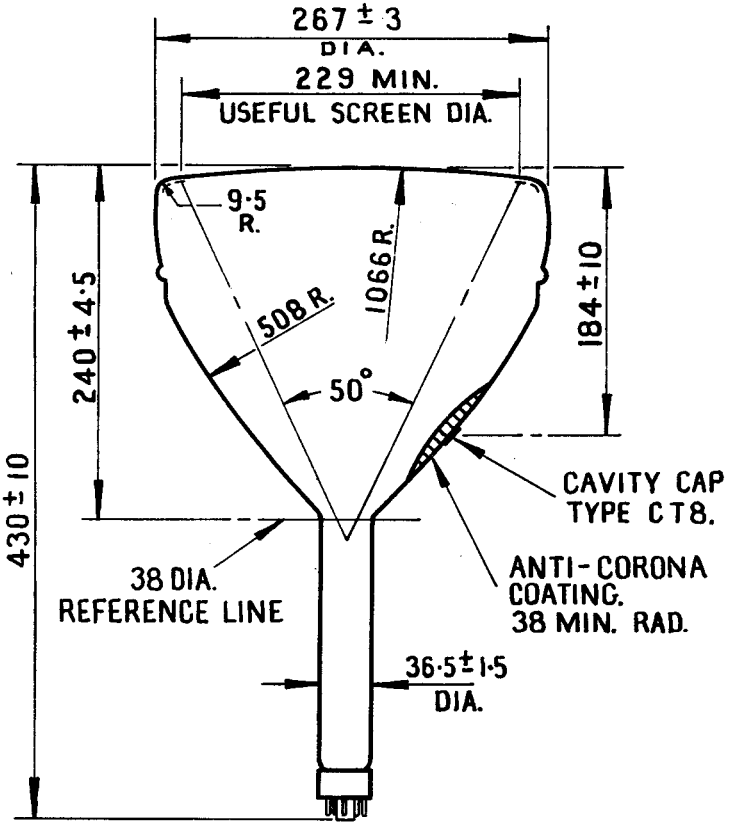
C_{k-all}	<8 pF.
C_{g-all}	<8 pF.

*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

10WP7



DIMENSIONS IN MILLIMETRES

= CV2162

12/02 HM

FERRANTI
RADAR TUBE

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.1.
Max. Overall Length	545 mm.
Max. Diameter	306·5 mm.
Neck Diameter	$35^{+\frac{0}{5}}$ 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.

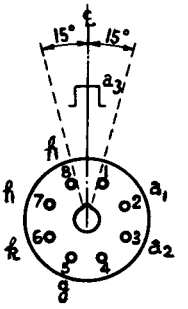
Max. 3rd Anode Voltage ...	13 kV.
Min. 3rd Anode Voltage ...	9 kV.
†Max. 1st Anode Voltage ...	2·2 kV.
†Min. 1st Anode Voltage ...	1·5 kV.
Max. V_{h-k}	150 Volts.

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.

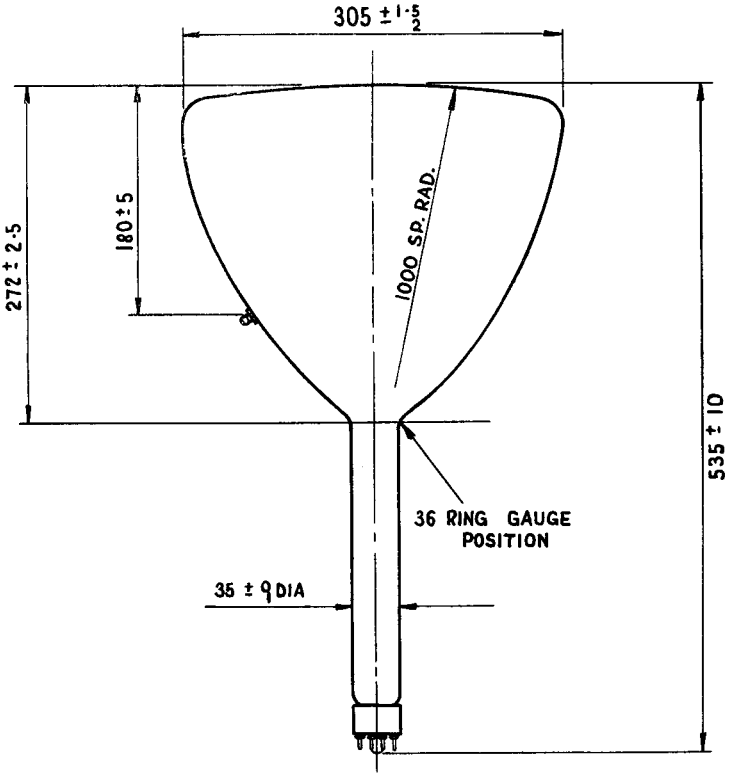
*The screen material is liable to burn if operated with a spot which is stationary or slow moving. The tube should not be operated under such conditions even at low beam current.

†The voltage applied to a_1 should always be at least 50 volts positive with respect to a_2.

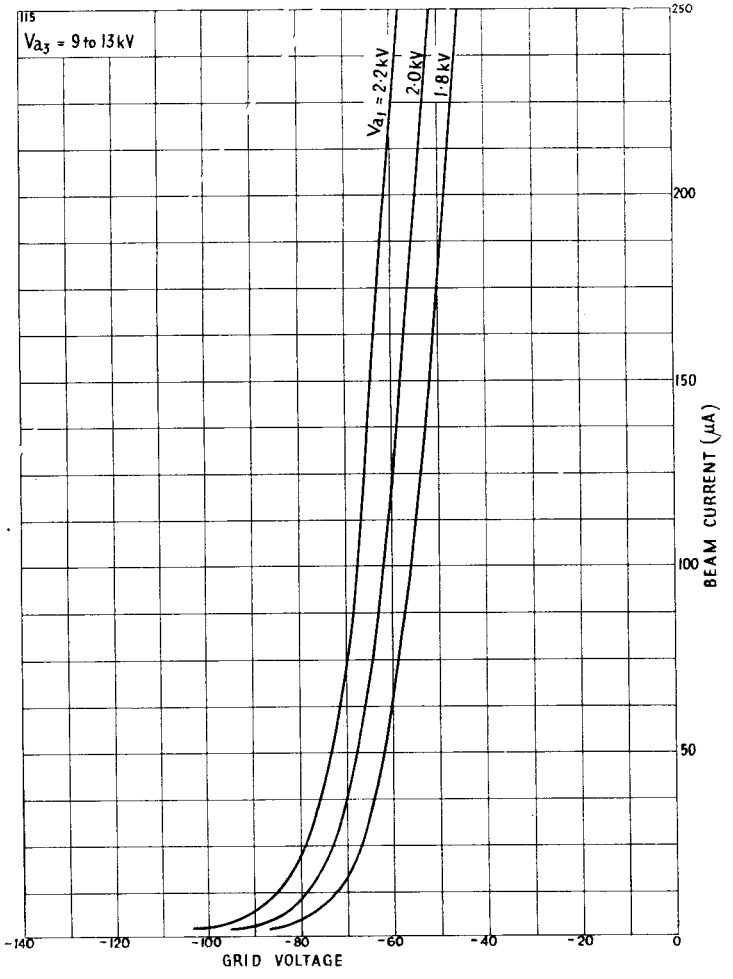
This tube was formerly designated A12/02.

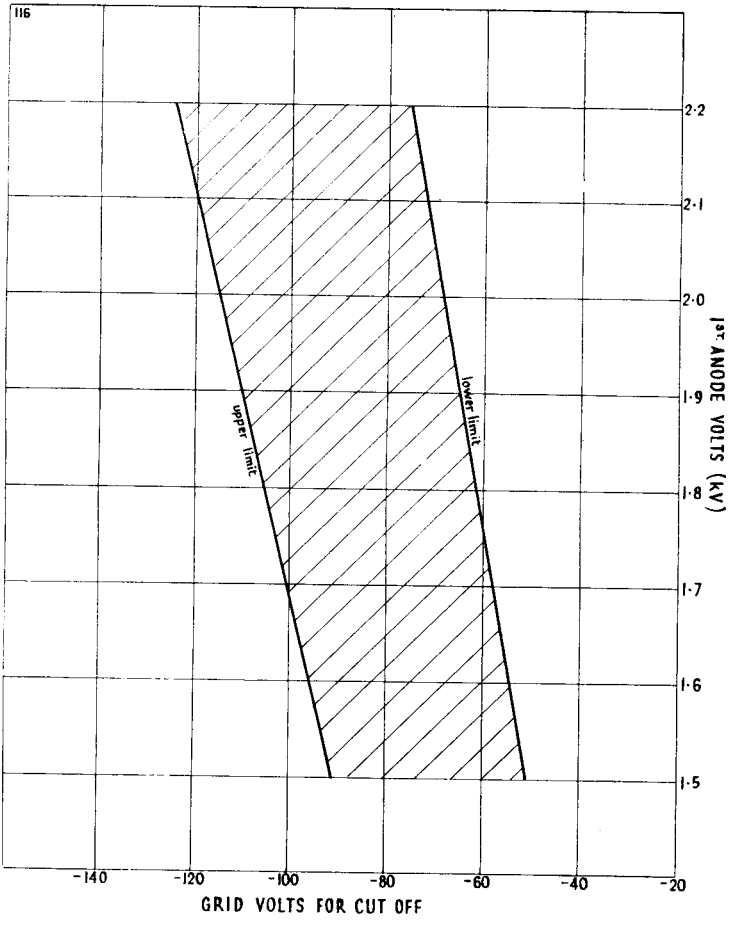
Issue 2
Mar., 1957

12/02 HM



All dimensions in millimetres.


115
V_{a3} = 9 to 13 kV
V_{a1} = 2·2 kV
2·0 kV
1·8 kV
250
200
150
100
50
BEAM CURRENT (μA)
-140
-120
-100
-80
-60
-40
-20
0
GRID VOLTAGE


116
2·2
2·1
2·0
1·9
1·8
1·7
1·6
1·5
ANODE VOLTS (kV)
upper limit
lower limit
-140
-120
-100
-80
-60
-40
-20
GRID VOLTS FOR CUT OFF

FERRANTI

RADAR TUBES

12in. diameter Radar Display Tubes with metal backed screens, magnetic deflection and low voltage electrostatic focus.

12/03 HB

12/03 JB

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.

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.

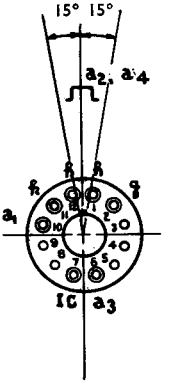
Max. A_1 Voltage	500 volts.
Max. $A_2 + A_4$ voltage	15 kV.
Max. Pos. A_3 Voltage	+500 volts.
Max. Neg. A_3 voltage	−500 volts.
Min. A_1 voltage	200 volts.
Min. $A_2 + A_4$ voltage.	8 kV.
Max. V_{h-k}	200 volts.
Max. R_{g-k}	1·5 MΩ
Max. R_{h-k}	1·0 MΩ

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.
$C_{a-ext.\ coating}$	1200 pF. approx.



Base Connections Underside View of Base

‡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.

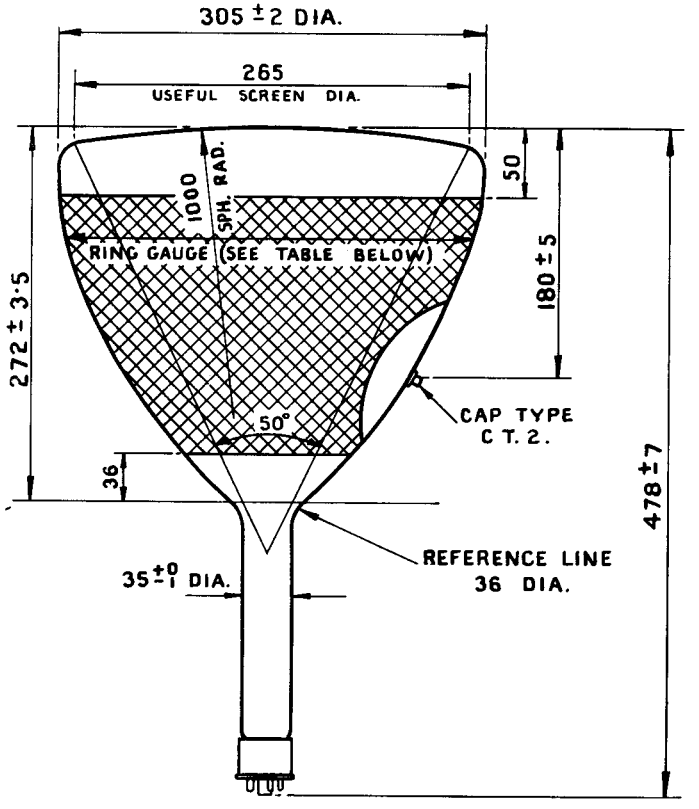
*When used for series operation, the surge heater voltage should not exceed 9·5 volts r.m.s. and a current limiting device should be incorporated in the circuit to limit switching surge.

†The point of optimum focus lies between these values.

Issue 1.
Aug., 1957.

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.

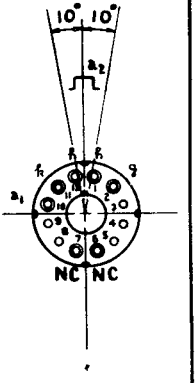
Max. 1st Anode Voltage ...	600 volts.
Max. 2nd Anode Voltage ...	15·0 kV.
Min. 1st Anode Voltage ...	250 volts.
Min. 2nd Anode Voltage ...	9·0 kV.
Max. Cathode Current ...	150 μA.
Max. V_{h-k}	200 volts.
Max. R_{h-k}	1·0 MΩ.
Max. R_{g-k}	1·5 MΩ.

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.)



Base Connections Underside View of Base

The anode cap can lie within 15° either side of the centre line as indicated in the diagram.

*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.

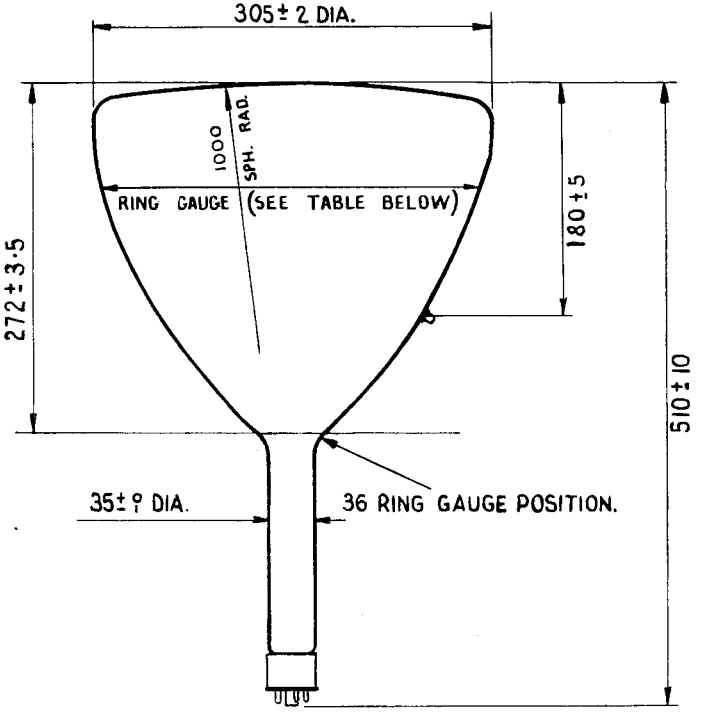
‡Positioned so that the centre of the gap is approx. 120mms. from the reference line (36mm. Ring Gauge Position).

This tube was formerly designated A12/04.

Issue 1.
Feb., 1957.

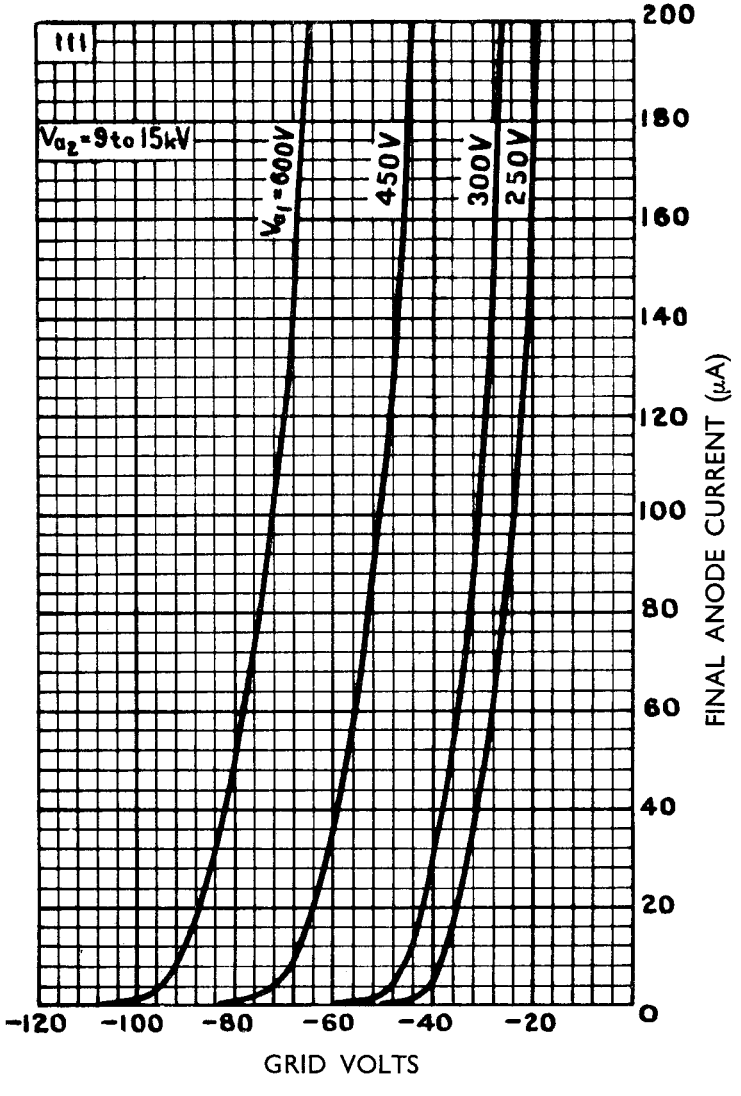
12/04 HM

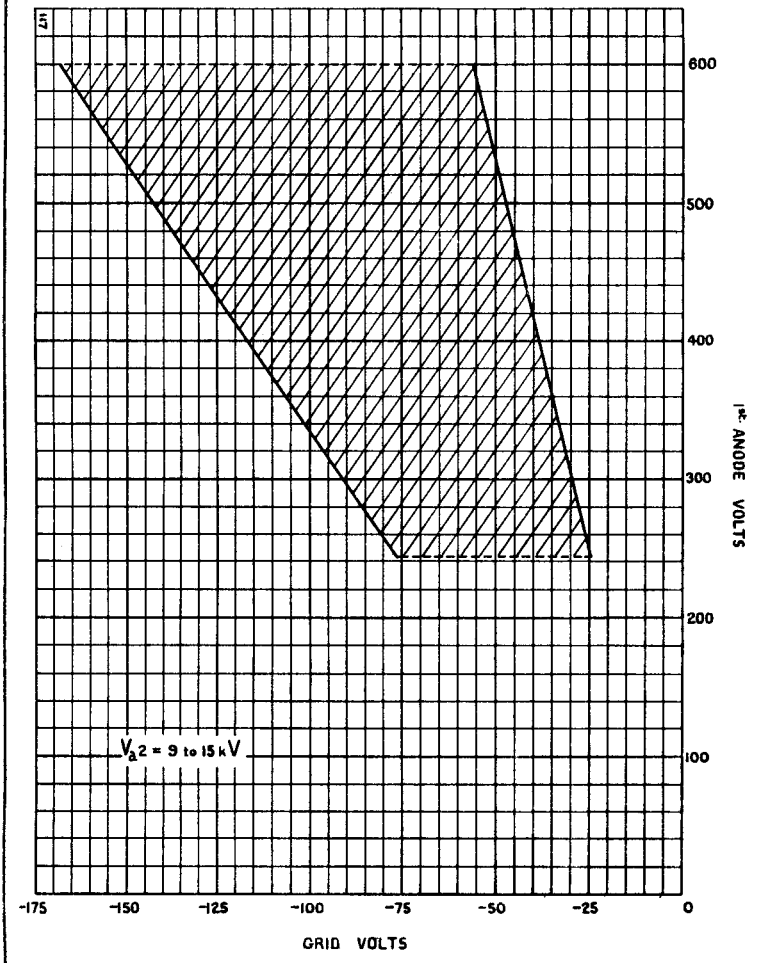
12/04 JM



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


111
V_{a_2}=9 to 15kV
V_{a_1}=600V
450V
300V
250V
200
180
160
140
120
100
80
60
40
20
0
FINAL ANODE CURRENT (μA)
−120
−100
−80
−60
−40
−20
GRID VOLTS


600
500
400
300
200
100
V_{a2} = 9 to 15 kV
-175
-150
-125
-100
-75
-50
-25
0
GRID VOLTS
ANODE VOLTS

FERRANTI

RADAR TUBE

12/05HM

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	CTI
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.

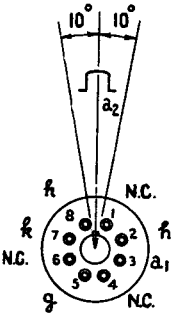
Max. 1st Anode Voltage ...	850 volts.
Max. 2nd Anode Voltage ...	15·0 kV.
Min. 1st Anode Voltage ...	600 volts.
Min. 2nd Anode Voltage ...	10·0 kV.
Max. Cathode Current ...	150 μA.
Max. V_{h-k}	200 volts.
Max. R_{h-k}	1·0 MΩ
Max. R_{g-k}	1·5 MΩ

CAPACITANCES.

C_{k-all}	<8 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 μA. Beam Current	20 volts
†Focus Coil	640 amp. turns (approx.).



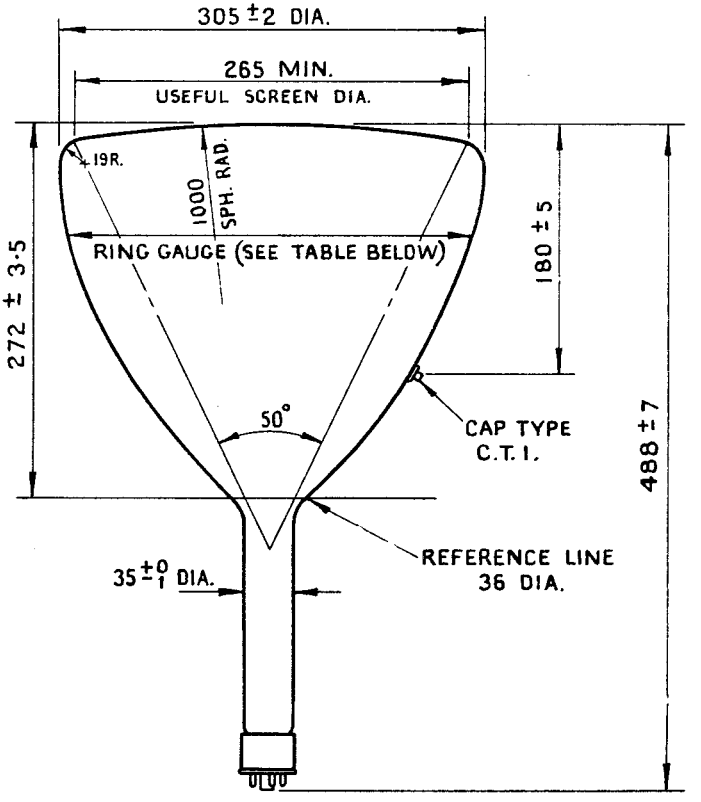
All dimensions in millimetres.

*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

12/05HM



RING GAUGE	DISTANCE FROM CENTRE OF SCREEN		
280	93	±	10
230	150	±	9
180	191	±	8
130	222	±	7
80	249	±	6

Ferranti

RADAR TUBES

12/08 HM

12/08 JM

12in. diameter flat faced Radar Display Tubes primarily designed for P.P.I. applications.

Improved version of CV.429. giving higher resolution.

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.

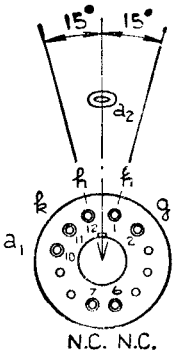
Max. 1st Anode Voltage ...	600 volts
Max. 2nd Anode Voltage ...	15·5 kV
Min. 1st Anode Voltage ...	250 volts
Min 2nd Anode Voltage ...	9·0 kV
Max. Cathode Current ...	150 μA
Max. V_{h-k}	200 volts
Max. R_{h-k}	1·0 MΩ
Max. R_{g-k}	1·5 MΩ

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. Grid Drive for 50μA beam current	20 volts
Line width at I_B=50 μA ...	0·25 mm.
‡Focus Coil	640 amp. turns (approx)



Base Connections

Underside View of Base

*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.

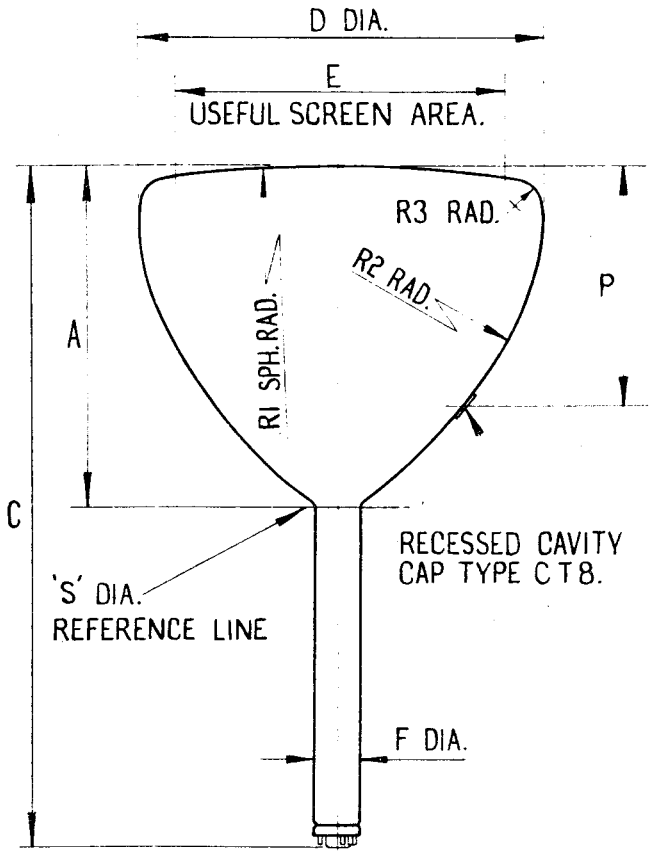
‡Positioned so that the centre of the gap is approx. 120 mms. from the reference line (36 mm. Ring Gauge Position).

Issue 2
Sept. 1962

Ferranti

12/08 HM

12/08 JM



DIM.	INS.	m m.	DIM.	INS.	m m.
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 $\pm^{\cdot 020}_{\cdot 039}$	35 $\pm^{\cdot 5}_{1}$	S	1·417	36

Ferranti

RADAR TUBES

12/48HM

12/48L3M

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.

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

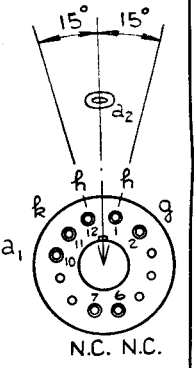
TYPICAL OPERATING CONDITIONS.

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



Base Connections Underside View of Base

*This phosphor is liable to burn even at low values of beam current, if operated with a spot which is stationary or slow moving.

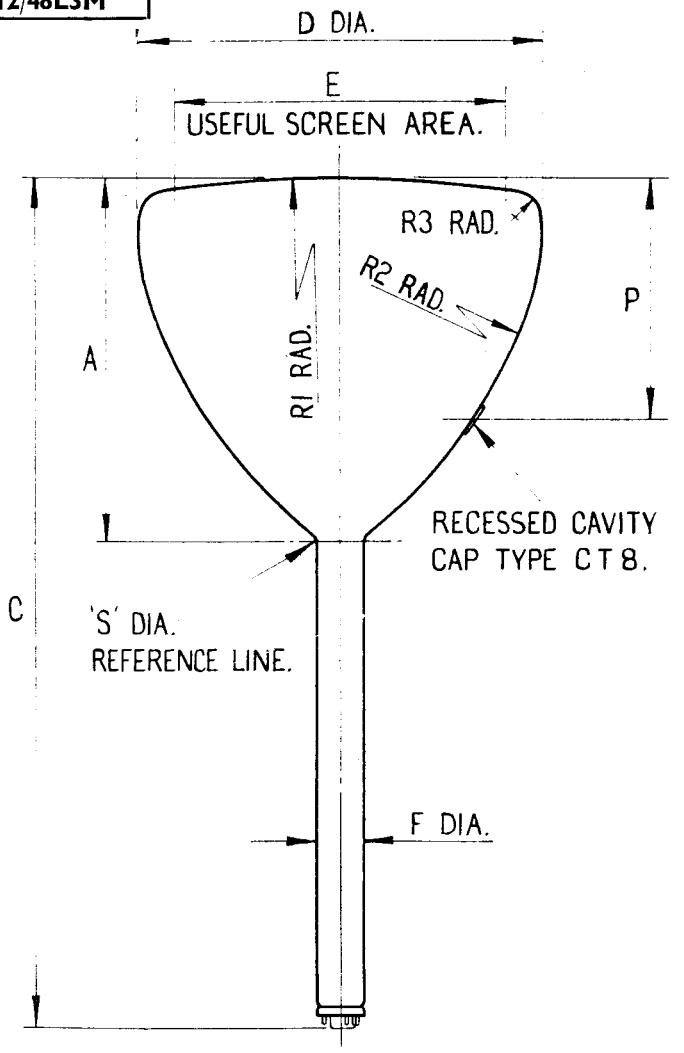
Issue 1.
Sept., 1962

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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	$1{\cdot}378^{+\cdot020}_{-\cdot039}$	$35^{+5}_{-1\cdot0}$	S	1·417	36

Ferranti

FLYING SPOT SCANNER TUBES

14/03AB
14/03QB
14/03Q2B

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.

HEATER.

†Heater Voltage	6·3 volts.
Heater Current	0·3 amp.

RATINGS.

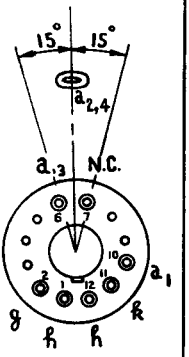
Max. A_1 Voltage	500 volts.
Max. A_2+A_4 voltage	15 kV.
Max. Pos. A_3 voltage	+500 volts.
Max. Neg. A_3 voltage	−500 volts.
Min. A_1 voltage	200 volts
Min. A_2+A_4 voltage	8 kV.
Max. V_{h-k}	200 volts.
Max. R_{g-k}	1·5 MΩ
Max. R_{h-k}	1·0 MΩ

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.).



Base Connections

Underside View of Base

*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.

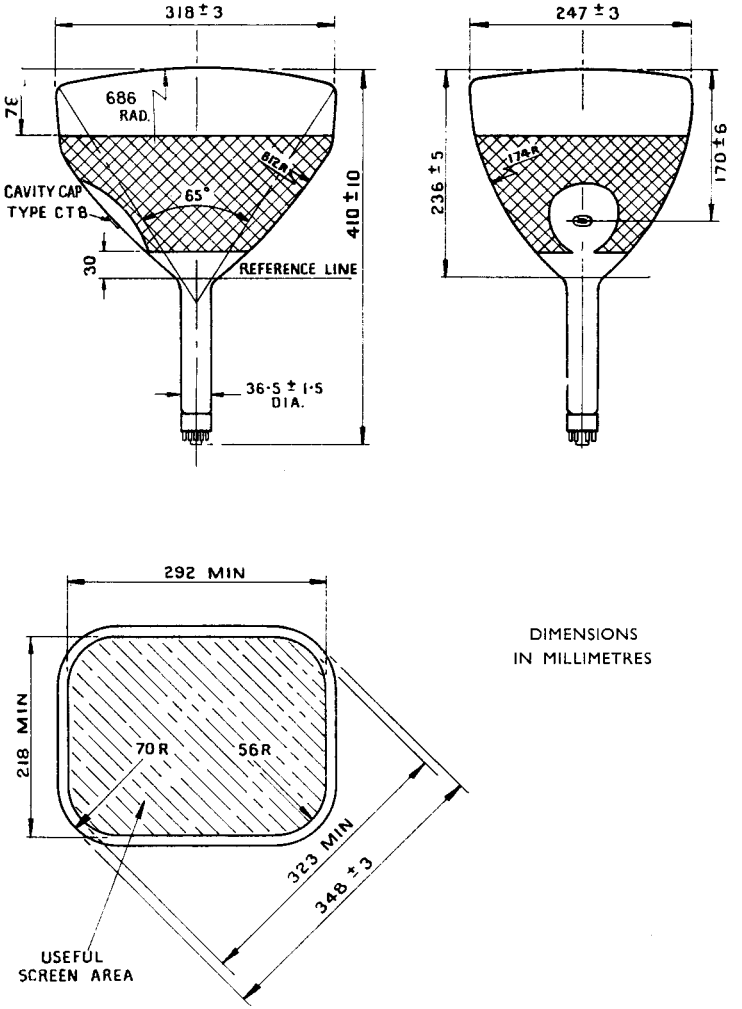
Issue 2
June, 1960

Ferranti

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14/03AB
14/03QB
14/03Q2B

THIRD ANGLE PROJECTION



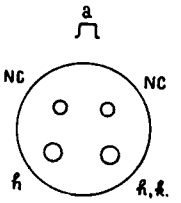
DIMENSIONS IN MILLIMETRES

FERRANTI

HALF WAVE RECTIFIER

2X2A

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



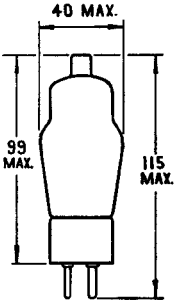
Base Connections
Underside View of Base

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.



All dimensions shown are in millimetres (max.).

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.

TYPICAL OPERATION.

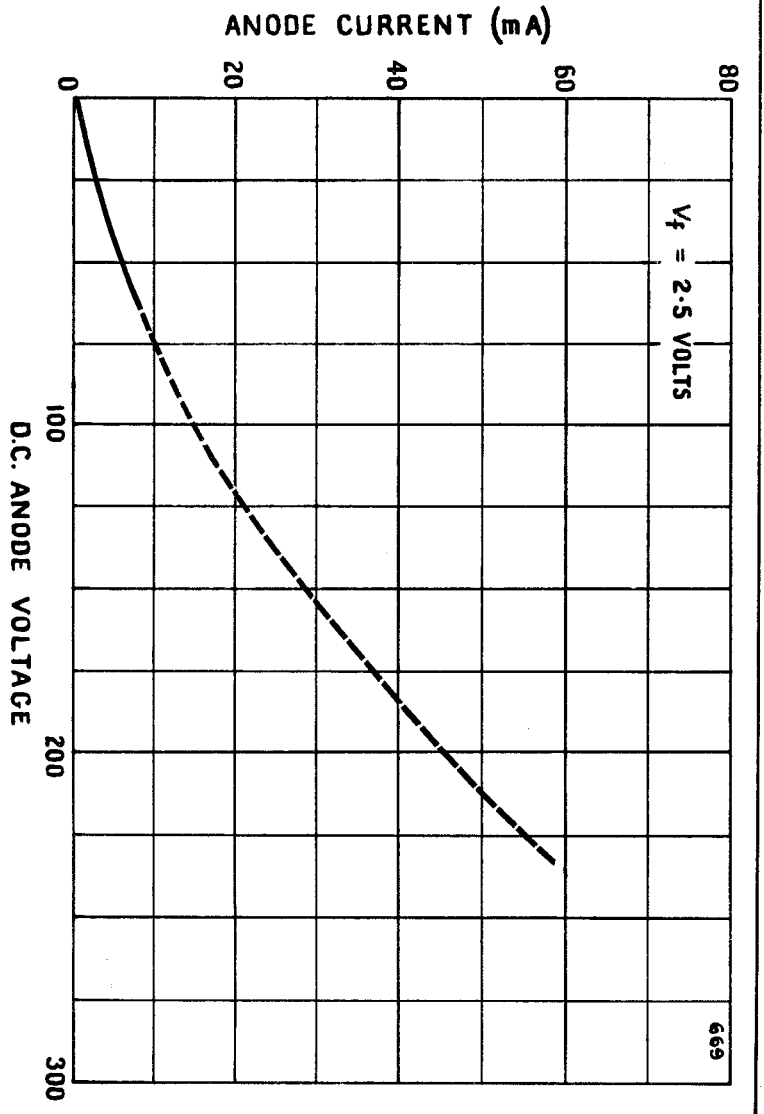
Capacitor Input Filter.

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.

Issue 1
Tentative
July, 1958

2X2A


ANODE CURRENT (mA)
0
20
40
60
80
D.C. ANODE VOLTAGE
100
200
300
V_f = 2·5 VOLTS
669

Ferranti

HIGH RESOLUTION CATHODE RAY TUBES

3/21 AM
3/21 PM
3/21 QM

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

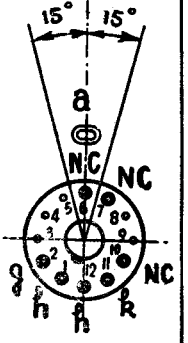
All types have metal-backed screens.

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.



Underside View of Base

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	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.

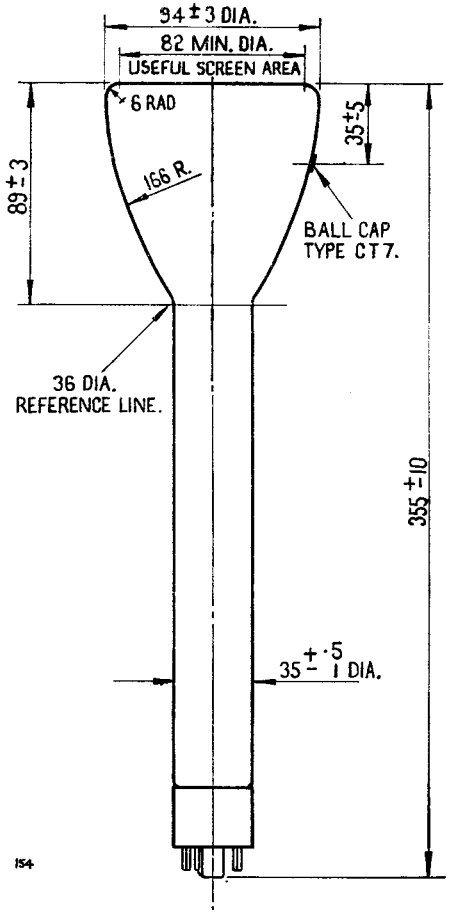
X-RAY WARNING

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.

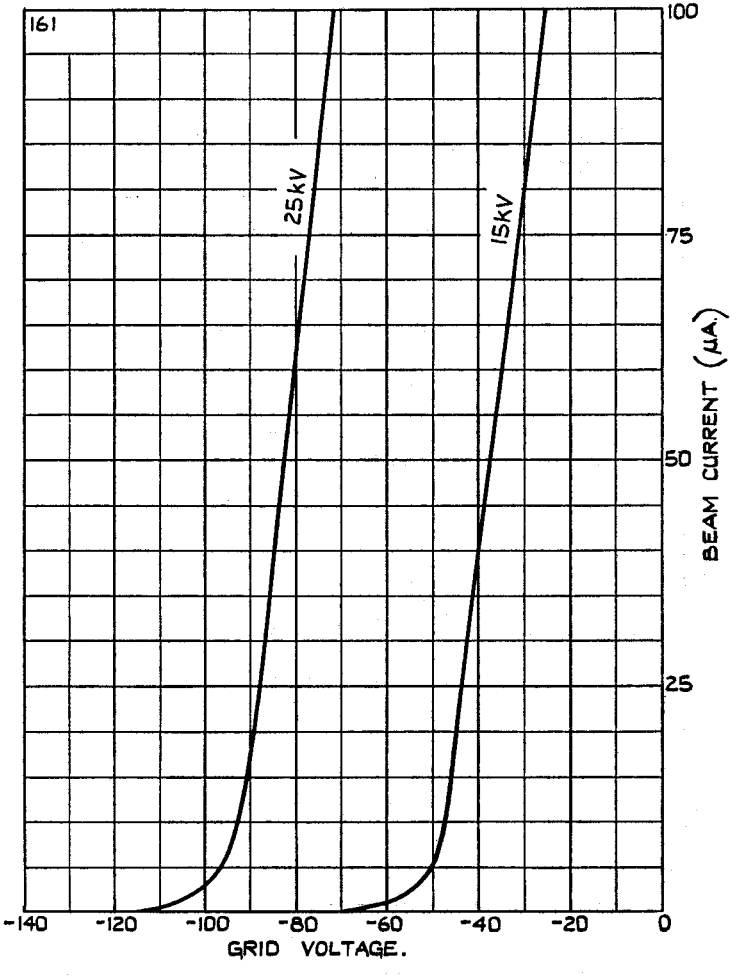
Tentative
Issue 2
July 1961

Ferranti



DIMENSIONS ARE IN MILLIMETRES.

TYPICAL BEAM CURRENT/GRID VOLTAGE CHARACTERISTIC

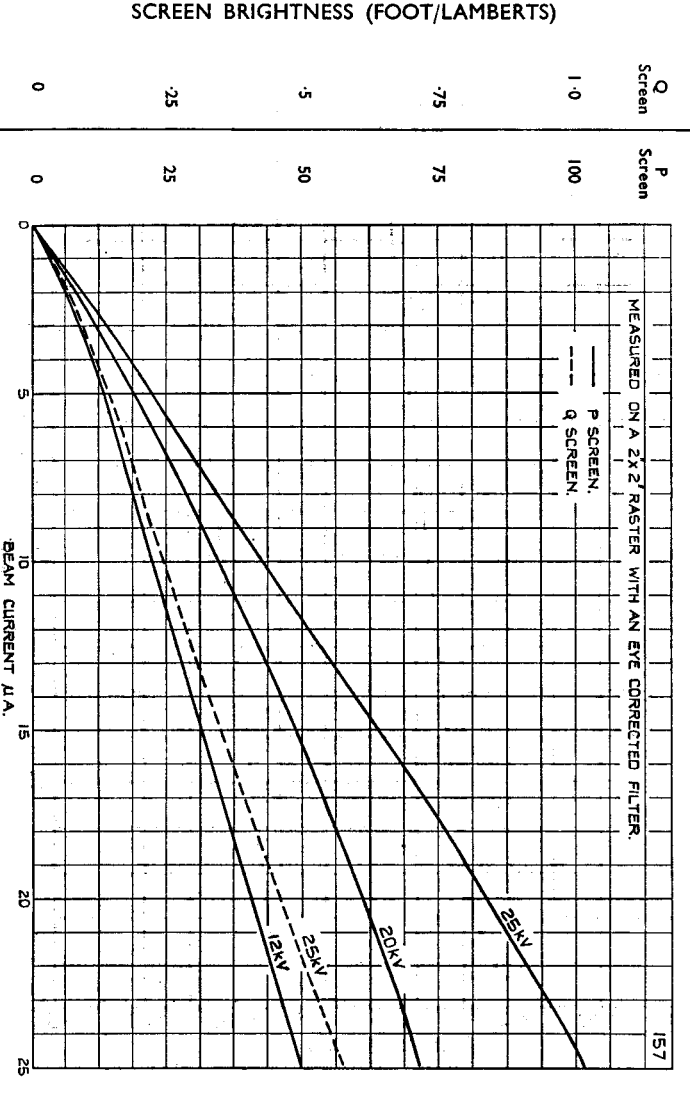


FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

Ferranti

3/21 AM
3/21 PM
3/21 QM

TYPICAL SCREEN BRIGHTNESS CHARACTERISTICS

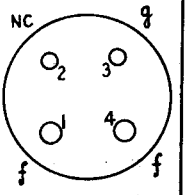


FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.

FERRANTI
THYRATRON

3C23

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



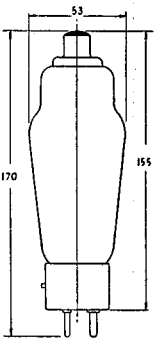
Base Connections
Underside View of Base

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.

CAPACITANCES.

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

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

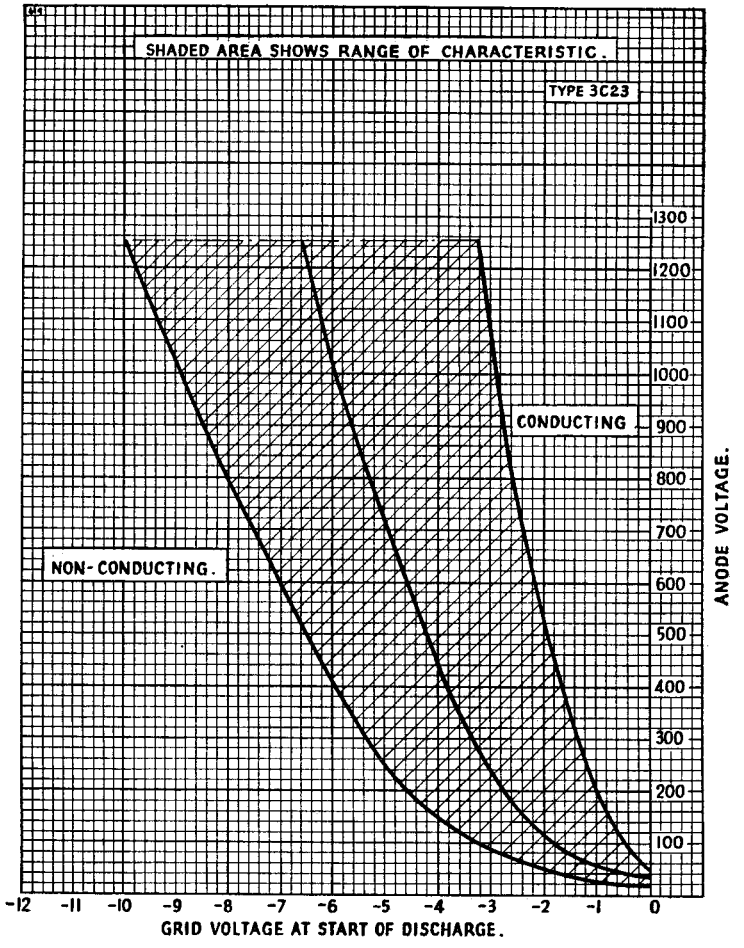
*Averaged over 5 seconds.

**Recommended condensed mercury temperature = 40°C.

Issue 1
April, 1956

FERRANTI

CONTROL CHARACTERISTIC



Ferranti

RADAR TUBES

5/03 HM
5/03 JM
5/03 LM

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 'H'	5/03JM 'J'	5/03LM 'L'
*Phosphor Type			
Fluorescence	Orange	Blue	Orange
Afterglow	Orange	Yellow	Orange
Persistence	Very long	long	long

All Types have metal backed screens.

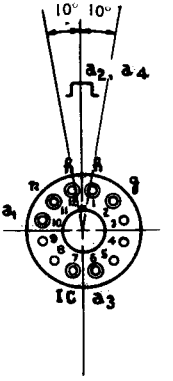
For further details, refer to the relevant phosphor characteristics at the front of this section of the handbook.

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

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 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.

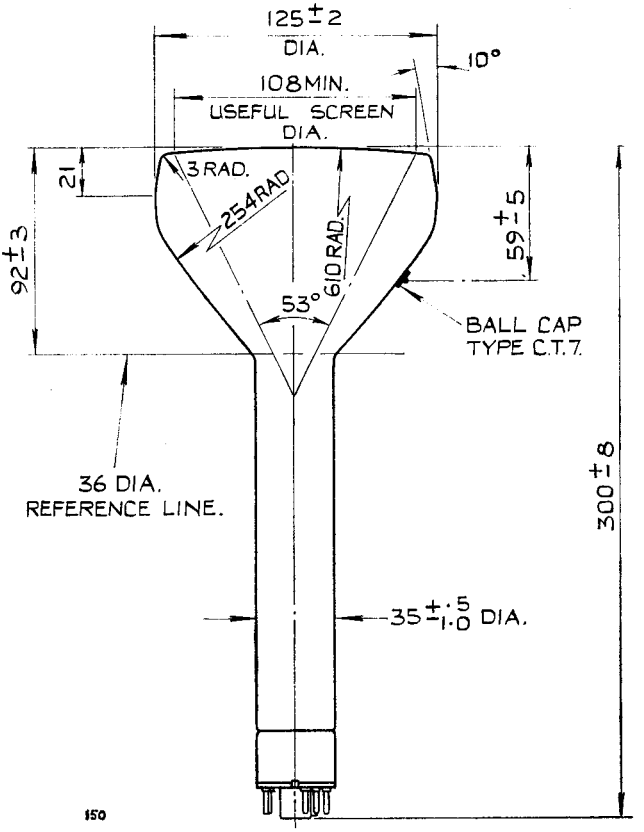
§The grid should never be positive with respect to the cathode except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

Issue 2
July, 1961

Ferranti

Ferranti

5/03 HM
5/03 JM
5/03 LM



Dimensions are in millimetres

Ferranti

TELEVISION MONITOR TUBE

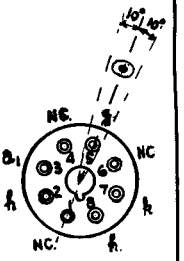
A 5 inch diameter tube with metal backed screen having good resolution. Designed as a camera viewfinder tube.

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.



Base Connections

Underside View of Base

*The grid should never be positive with respect to the cathode.

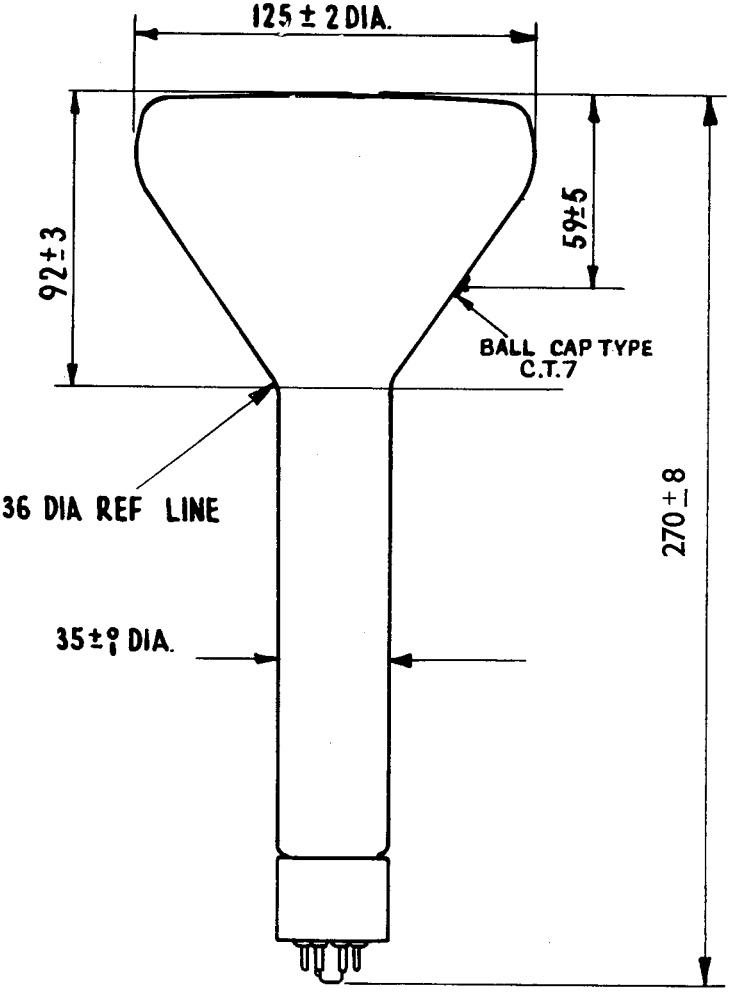
†Positioned so that the gap is 75 mm. from the reference line.

Ferranti

Issue 2
Mar.. 1961

Ferranti

5/04TM



DIMENSIONS IN MILLIMETRES.

5/21 AM

5/21 PM

5/21 QM

Ferranti

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

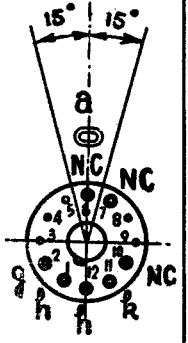
Base	B12A (Duodecal)
Anode Cap	CT8 (Cavity type) (JEDEC type J1-21)
Max. Overall Length	350 mm.
Max. Diameter	128 mm.
Nom. Neck Diameter	37 mm.
Min. Useful Screen Area ...	110 mm.

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.

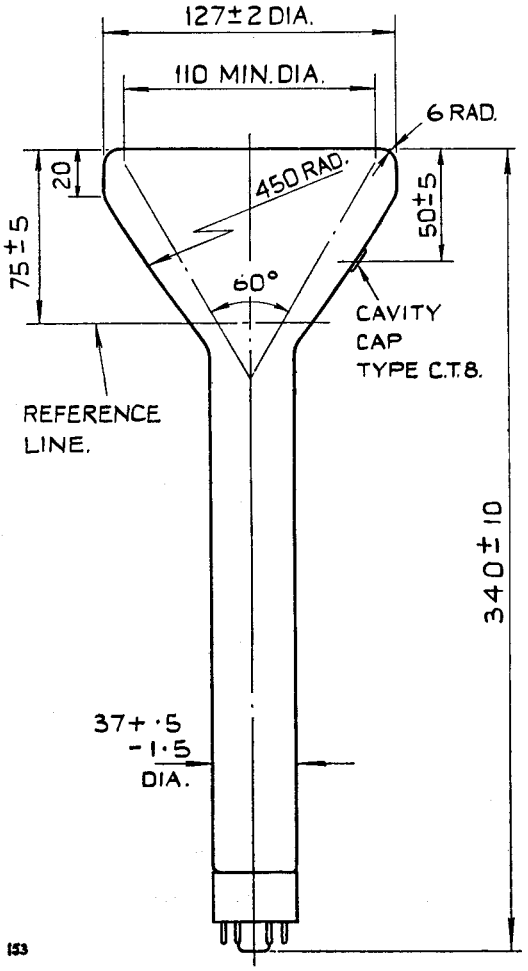
X-RAY WARNING

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.

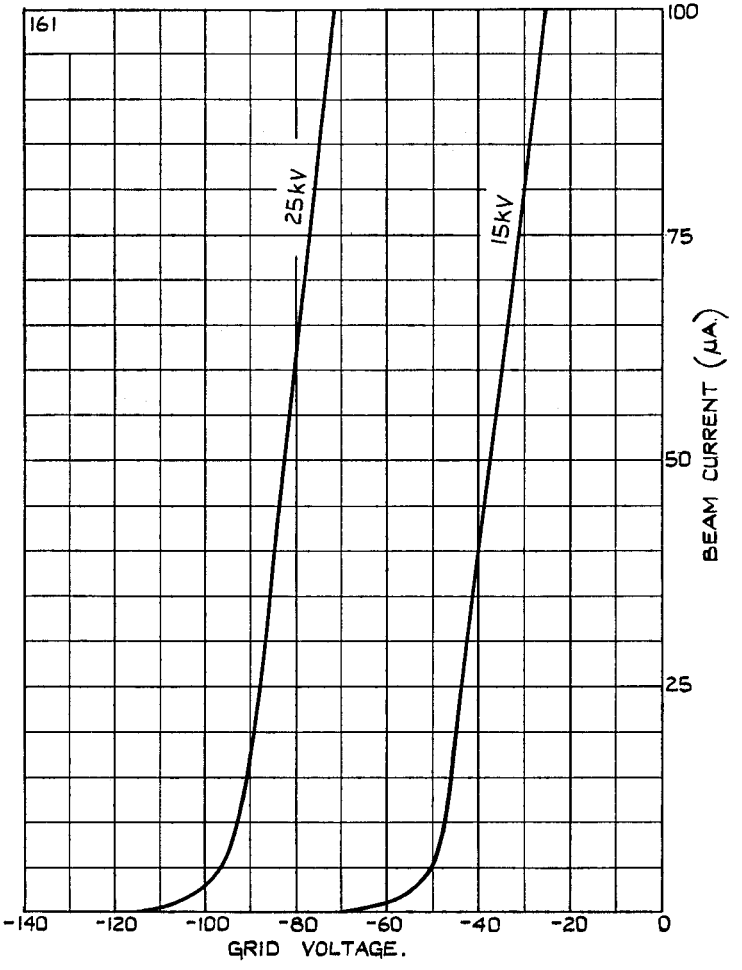
Tentative
Issue 2
July 1961

Ferranti



DIMENSIONS ARE IN MILLIMETRES.

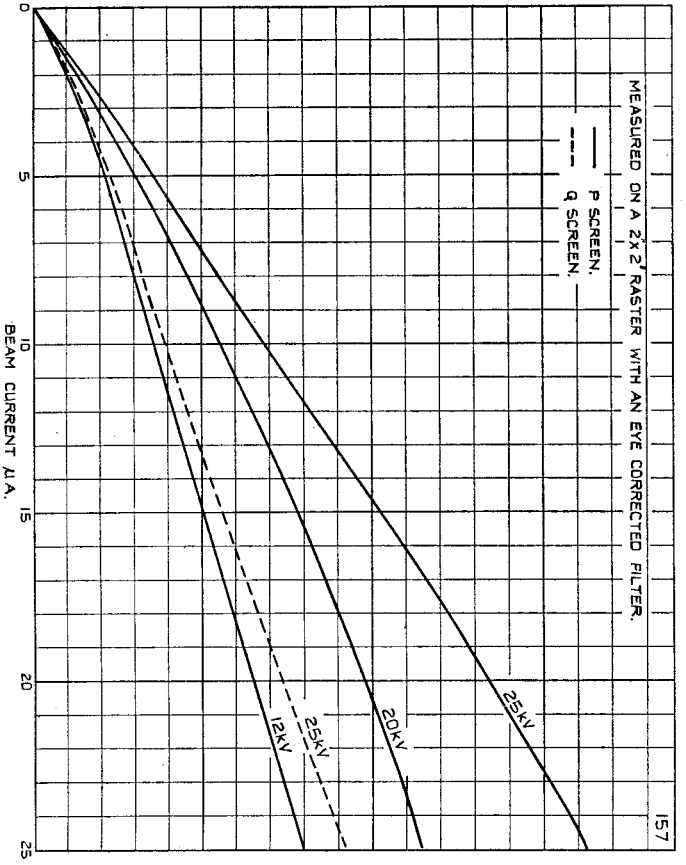
TYPICAL BEAM CURRENT/GRID VOLTAGE CHARACTERISTIC



Ferranti

5/21 AM
5/21 PM
5/21 QM

TYPICAL SCREEN BRIGHTNESS CHARACTERISTICS



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

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.

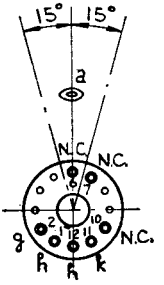
	5/28AM	5/28PM	5/28QM
Phosphor Type	'A'	'P'	'Q'
Fluorescence	Green	Blue	Blue/Violet
Persistence	Ultra Short	Ultra Short	Killed

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 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	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.

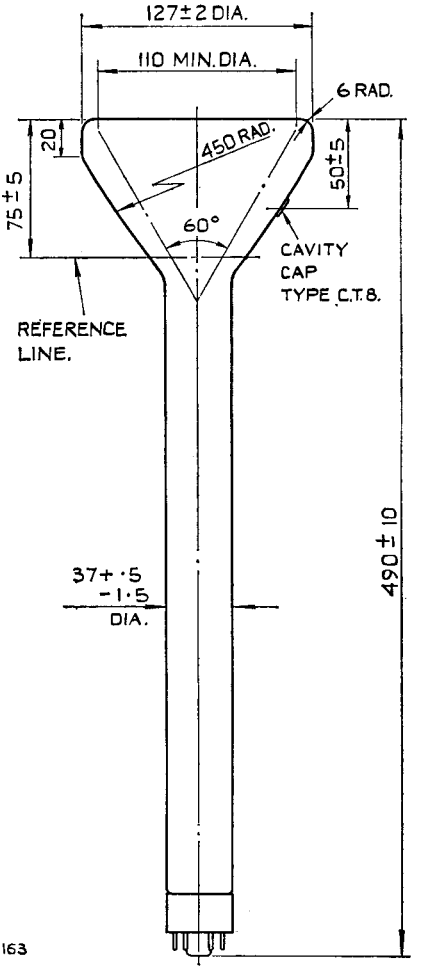
X-RAY WARNING: When operated at an anode voltage in excess of 16 kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

*Minimum diameter of internal ground surface

†At screen centre, measured by shrinking raster method.

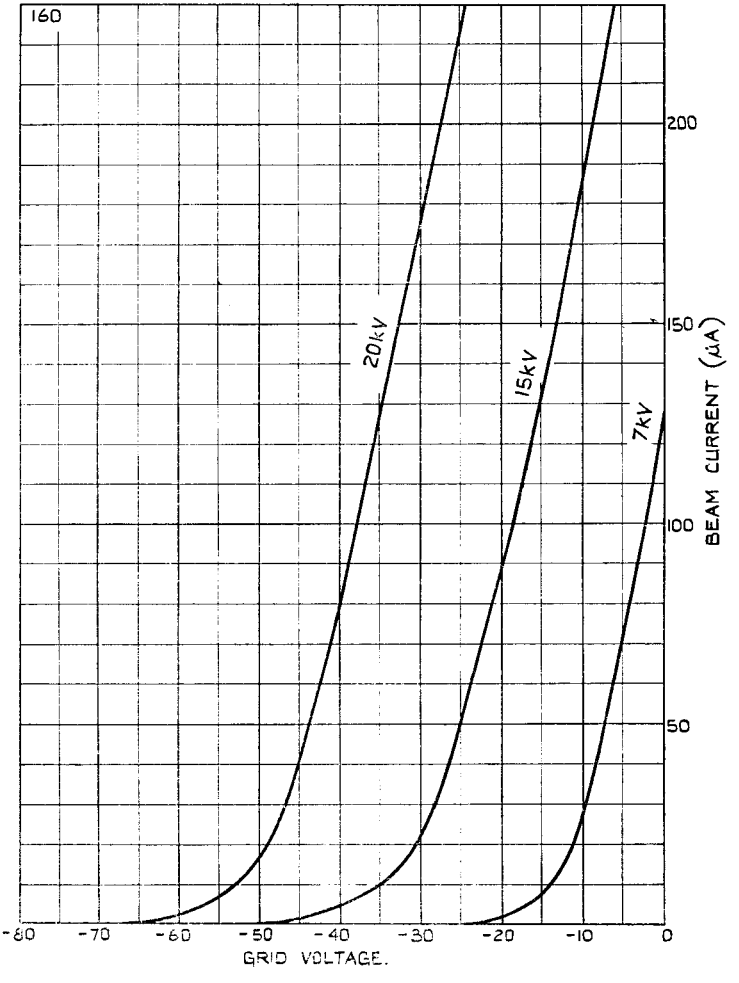
Tentative
Issue 2
Nov. 1961

Ferranti



ALL DIMENSIONS IN MILLIMETERS

TYPICAL ANODE CURRENT/GRID VOLTAGE CHARACTERISTIC



Tentative
Issue 2,
Nov. 1961

Ferranti

MICRO SPOT RADAR TUBES

5/71AM
5/71PM
5/71QM

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 1/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.

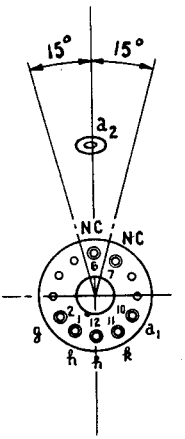
Final Anode Voltage	25	kV
First Anode Voltage	2	kV
Vg for visual cut-off	−120	volts
→ Resolution	>8000	lines

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.



Base Conections

Viewed from spigot end of tube

*Other phosphors available to special order, but resolution may suffer with other type phosphors and our recommendation for specific applications should be sought.

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 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.

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".

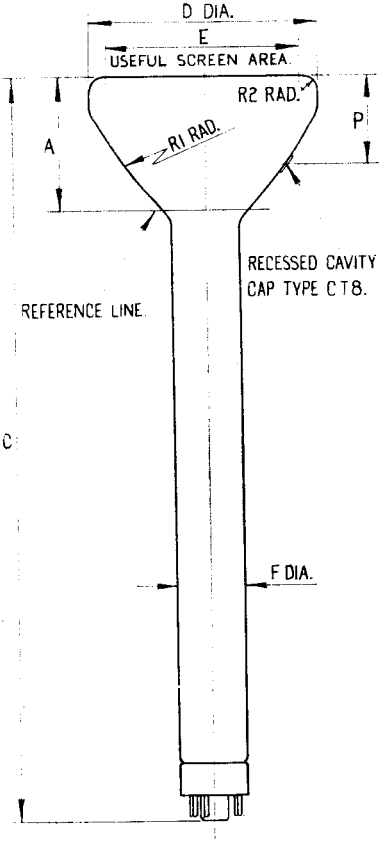
SETTING UP.

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.

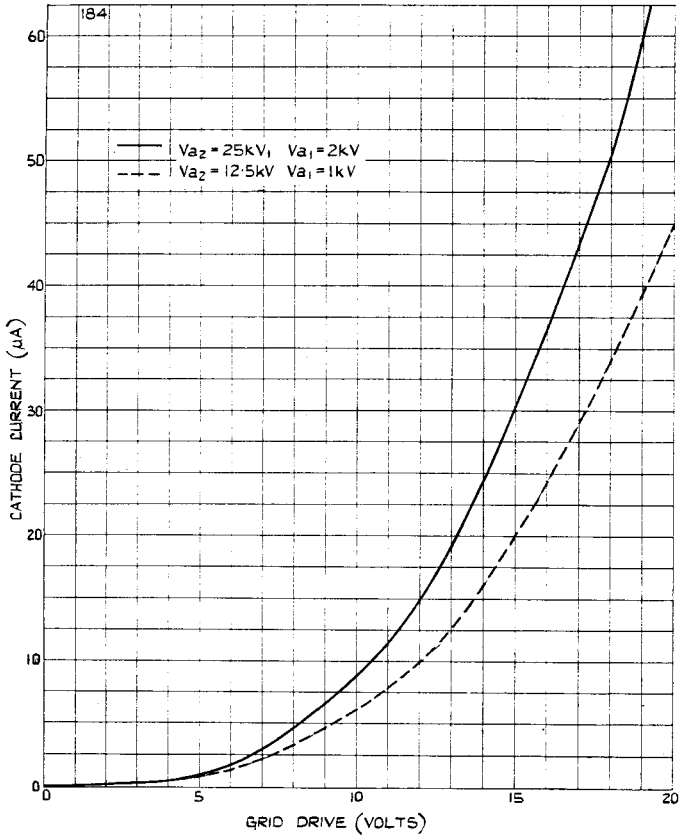
Neither ferrous nor non-ferrous metals should be placed close to the scan coil.

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	1·457 $^{+.029}_{-.059}$	37 $^{+1}_{-1.5}$
C	18·307 ± ·197	465 ± 5	P	1·968 ± ·197	50 ± 5
D	4·960 ± ·078	126 ± 2	R1	17·716	450
E	4·330	110 MIN.	R2	·250	6·35

TYPICAL GRID DRIVE CHARACTERISTICS.



Ferranti

MICRO SPOT RADAR TUBES

5/71AP
5/71PP
5/71QP

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 1/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

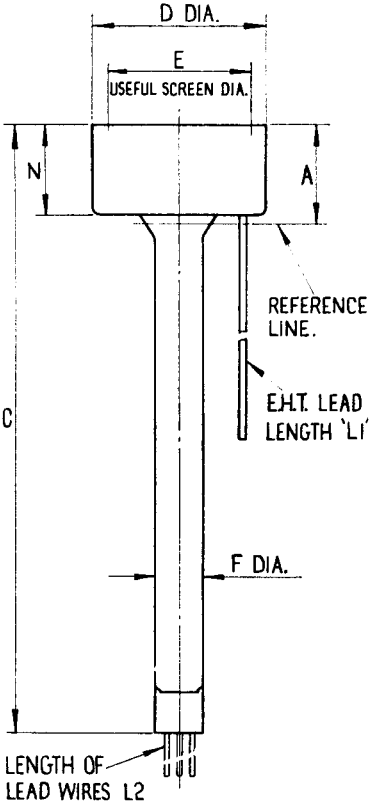
X-RAY WARNING.

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.

Issue 3.
Aug., 1962

Ferranti



DIM.	INS.	m m.	DIM.	INS.	m m.
A	2·953 ± ·118	75 ± 3	F	1·457 $\pm^{\cdot 020}_{\cdot 035}$	37 $\pm^{0.5}_{1.5}$
C	18·228 ± ·394	463 ± 10	L1	36	914
D	5·118 ± ·079	130 ± 2	L2	36	914
E	4·330	110 MIN.	N	2·756 ± ·118	70 ± 3

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.

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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 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.

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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.

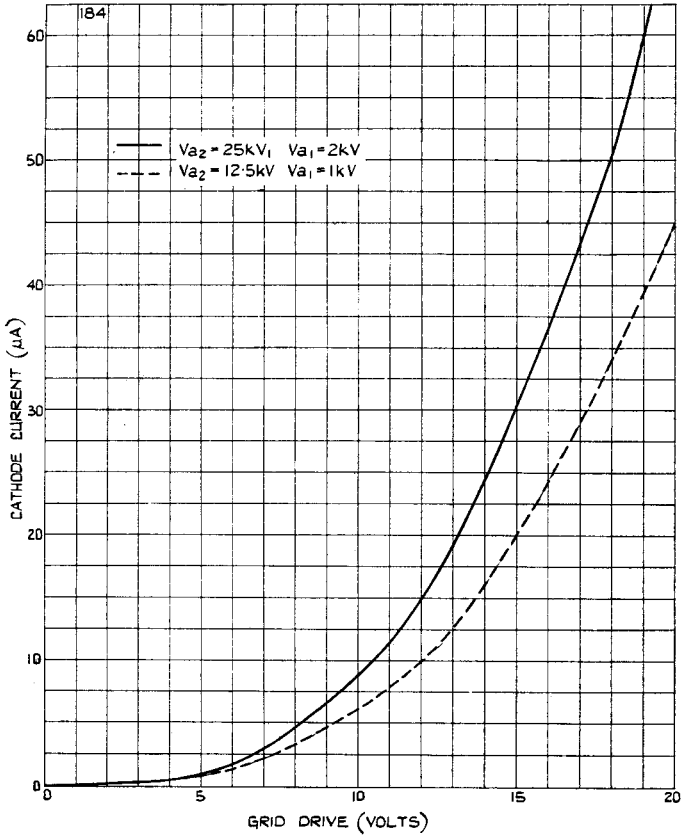
Great care must be taken in considering the quality of EHT, scanning and focus supplies, since multiple effects due to EHT ripple, imperfect focusing and poor scanning fields can cause such enlargement of the spot that no advantage is apparent when using these tubes.

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".

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

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TYPICAL GRID DRIVE CHARACTERISTICS.



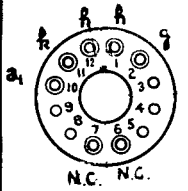
Ferranti

MICRO SPOT RADAR TUBES

5/74QM

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.

FOCUS	Magnetic and Electrostatic.
DEFLECTION	Magnetic, 60° angle.
SCREEN	Metal Backed.
*Phosphor	Type 'Q'
Fluorescence	Blue/Violet.
Persistence	Ultra Short.



Base Connections

View from spigot end of tube

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 V_{a_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.

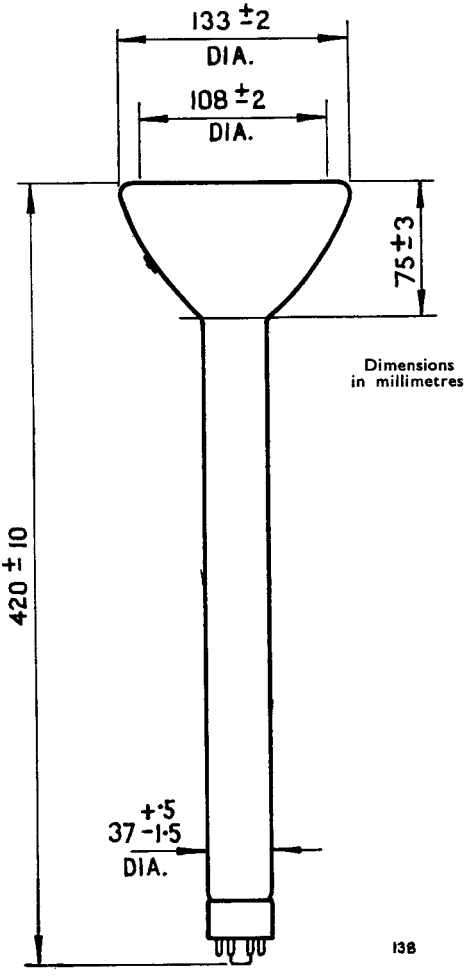
*Other phosphors available to special order.

†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 5/74QP.

§Measured by microscope at screen centre.

Ferranti

Issue 2
Oct., 1960


133 ±2
DIA.
108 ±2
DIA.
75 ±3
420 ± 10
+·5
37 -1·5
DIA.
Dimensions
in millimetres
138

Ferranti

5G/14 AJ	5G/14 QJ
5G/14 PJ	5G/14 Q4J

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 μSec.
5G/14PJ	P	Blue	2 μSec.
5G/14QJ	Q	Blue/Violet	0·1 μSec.
5G/14Q_4J	Q_4	Blue/Violet	0·1 μSec.

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=50μA) 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=1μA). Equivalent to 35 microns. 30 cycles c/m spatial frequency response at 60% modulation (I_B=50 μA). Equivalent to 100 microns.

Q and Q_4 Phosphors

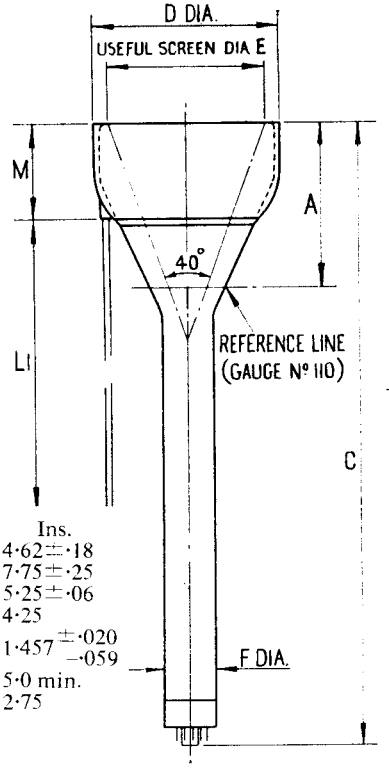
85 cycles/cm spatial frequency response at 60% modulation (I_B=1μA). Equivalent to 37 microns. 25 cycles/cm spatial frequency response at 60% modulation (I_B=50 μA). Equivalent to 130 microns.

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.



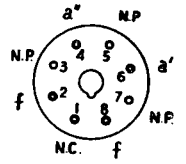
Dim.	mm.	Ins.
A	117·5±4·5	4·62±·18
C	451±6·3	17·75±·25
D	133·4±1·5	5·25±·06
E	108 min.	4·25
F	37 $^{+\cdot5}_{-1\cdot5}$	1·457 $^{\pm\cdot020}_{-\cdot059}$
L1	380 min.	15·0 min.
M	70	2·75

FERRANTI

FULL WAVE RECTIFIER

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

5R4GY



Base Connections

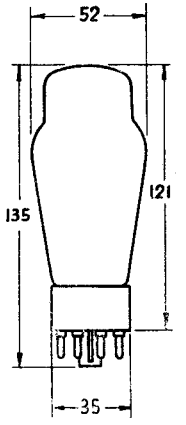
Underside View of Base

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 2—Filament.
Pin 3—No Pin.
Pin 4—Anode 2.
Pin 5—No Pin.
Pin 6—Anode 1.
Pin 7—No Pin.
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."

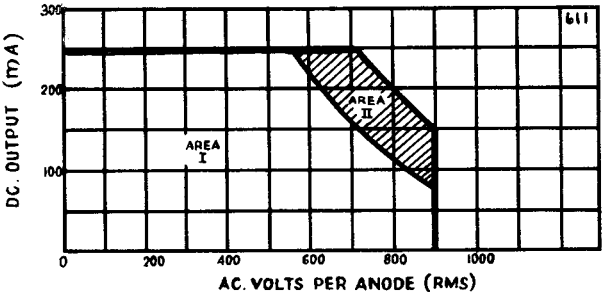
‡Each Anode.

Issue 1.
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FERRANTI

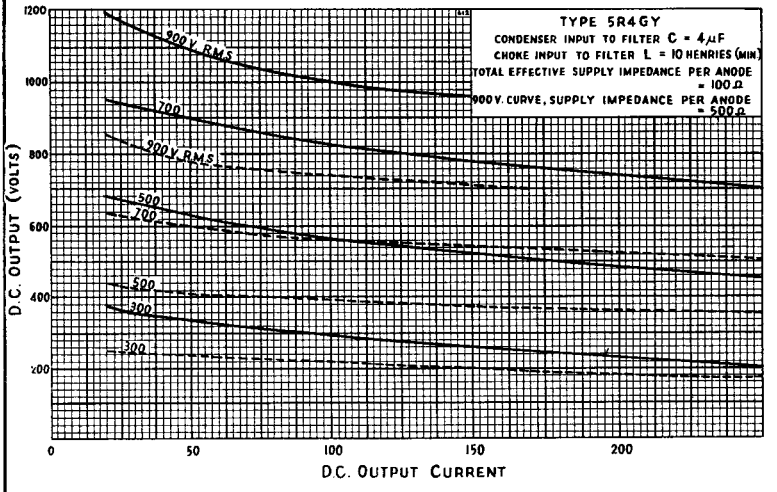
OPERATION CHARACTERISTICS

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

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.
'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
Pin 5—Heater.	'Y_2' Deflector Plate.

Side Contact : 1st and 3rd Anodes and 'Y_2' Deflector Plate.

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

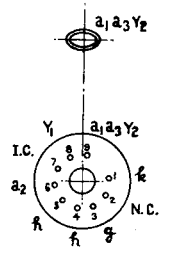
TYPICAL OPERATION.

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.).



Base Connections

Underside View of Base

*This Type of Tube can also be supplied with potted base and flying leads—see Data Sheet for Type 5×3/53DE.

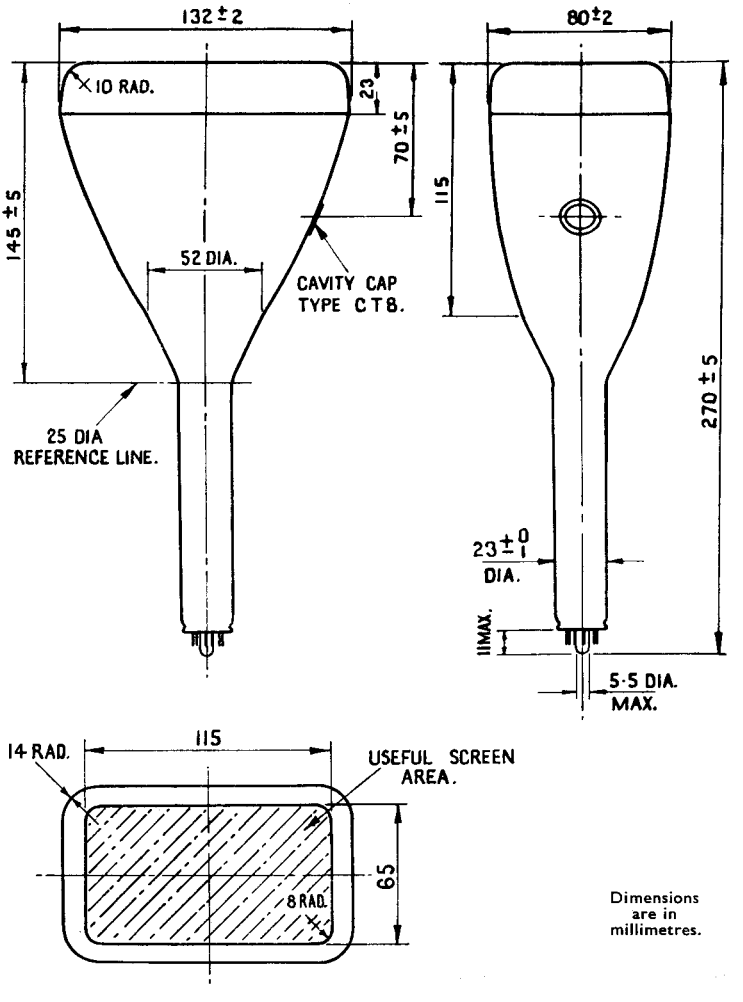
†A suitable shield is Type 11467 manufactured by Magnetic and Electrical Alloys Ltd.

Tentative
Issue 3
June 1960.

Ferranti

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5×3/53D



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.

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

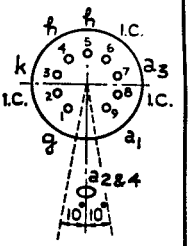
Max. A_1 voltage	70 volts.
Max. A_2+A_4 voltage	18 kV.
Min. A_2+A_4 voltage	8 kV.
Max. Neg. A_1 voltage	–500 volts.
Max. V_{h-k}	200 volts.
A_3 voltage for focus ...	0 to –300 volts.

†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.



Underside view of base

*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.

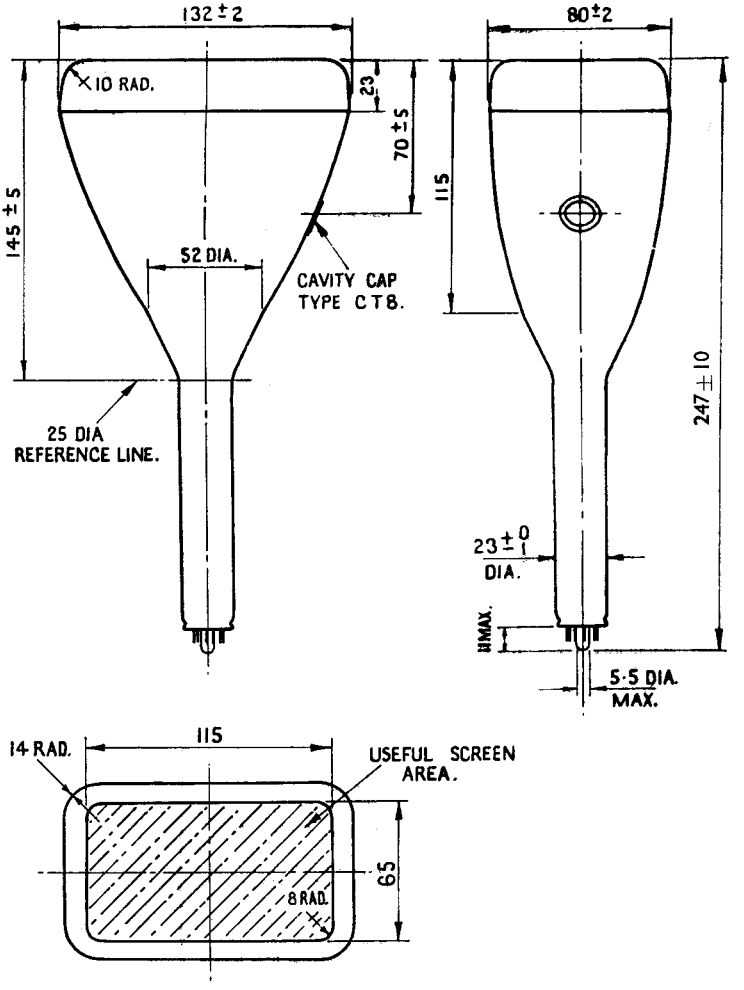
Tentative Issue 2 Mar., 1961

Ferranti

Ferranti

5X3/94LM

5X3/95LM



DIMENSIONS ARE IN MILLIMETRES.

Ferranti

CATHODE RAY TUBES

6/22AM

6/22PM

6/22QM

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. Vhk (Heater Negative) ...	200 volts.
Max. Vhk (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.).

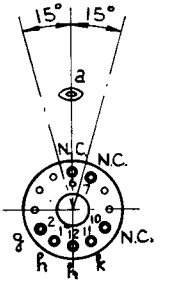
CAPACITANCE.

C_{k-all}	<8 pF.
C_{g-all}	<8 pF.

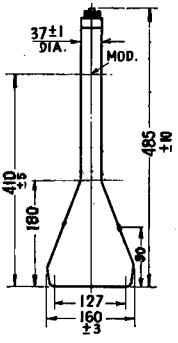
*Recommended operating range—17 to 25 kV.
†The grid should never be positive with respect to the cathode.
‡At Beam Current of 100μA with a 10 x 10 cm. raster.
§A suitable coil is a soleniod of approx. 16,000 turns of 38 s.w.g. wire, positioned with the gap approx. 150 mm. in front of the modulator. Ferranti 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



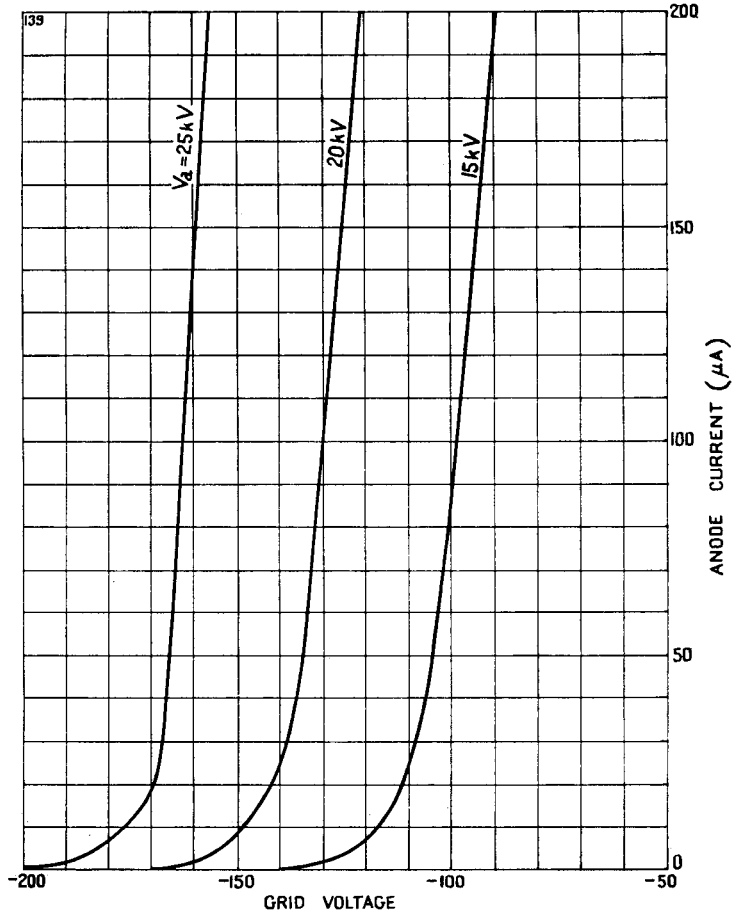
All dimensions shown are in millimetres.

Ferranti

Issue 3
Nov. 1960

Ferranti

TYPICAL ANODE CURRENT GRID/VOLTAGE CHARACTERISTICS



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

FERRANTI

VOLTAGE TRANSIENT OSCILLOGRAPH TUBE

6/32PM

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±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 μA.

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.

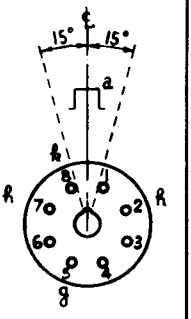
TYPICAL OPERATION.

Anode Voltage	20 kV.
Beam Current	75 μA.
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.

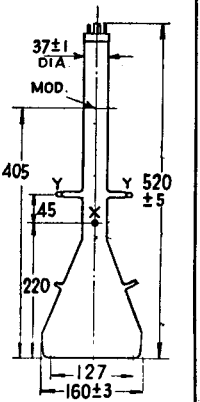
CAPACITANCES.

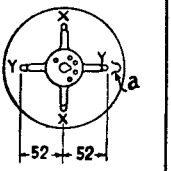
C_{k-all}	6.0 pF.
C_{g-all}	6.2 pF.
$C_{x_1-x_2}$	1.0 pF.
$C_{y_1-y_2}$	0.9 pF.
C_{x_1-all}	4.8 pF.
C_{x_2-all}	4.8 pF.
C_{y_1-all}	4.3 pF.
C_{y_2-all}	4.3 pF.
$C_{x_1x_2-y_1y_2}$	1.0 pF.

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.

Issue 1
Aug.,1957

FERRANTI

FLYING SPOT SCANNER TUBE

6/33AM

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.

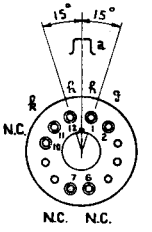
Heater Voltage	6.3 volts.
Anode Voltage	20 kV.
V_g for visual cut off	−170 volts.
‡Focus Coil	900 ampere turns (approx.).
Screen Resolution	> 100 lines per cm.
Normal Peak Beam Current ...	150 μA.

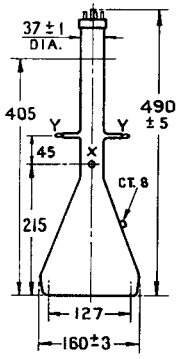
X-RAY WARNING.

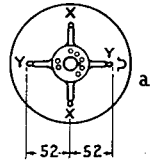
When operated at high anode voltage shielding may be required to protect against harmful X-Ray radiation, which could cause possible injury from prolonged exposure.

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.







Dimensions shown are in millimetres.

*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

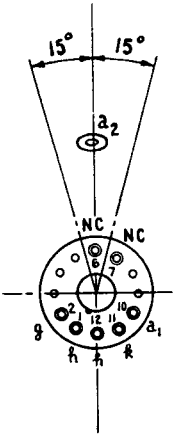
Ferranti

CATHODE RAY TUBES

6/44DM

6/44PM

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.



Base Connections Underside View of Base

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.

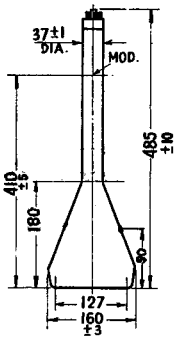
TYPICAL OPERATION.

1st Anode Voltage	600 volts.
2nd Anode Voltage	25 kV.
Vg for visual cut off	-85 volts.
Grid Drive for I_B=100 μA ...	35 volts.
Screen Resolution at 50 f.p.s. ...	1000 lines.
Focus Coil...	See Note § Below.

CAPACITANCE.

C_{k-all}	<8 pF.
C_{g-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.



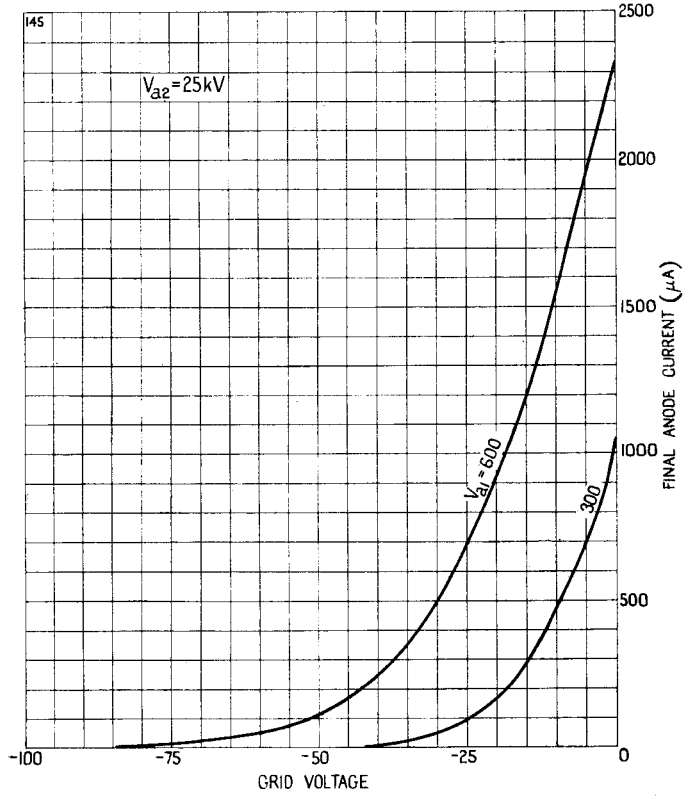
All dimensions shown are in millimetres.

*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.

Ferranti

Issue 2.
Dec.. 1961

TYPICAL BEAM CURRENT/GRID VOLTAGE CHARACTERISTICS



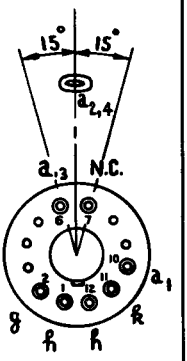
Ferranti

FLYING SPOT SCANNER TUBES

High Resolution Rectangular Flying Spot Scanner Tubes with Electrostatic Focus.

8/03AM

8/03QM



Base Connections Underside View of Base

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.

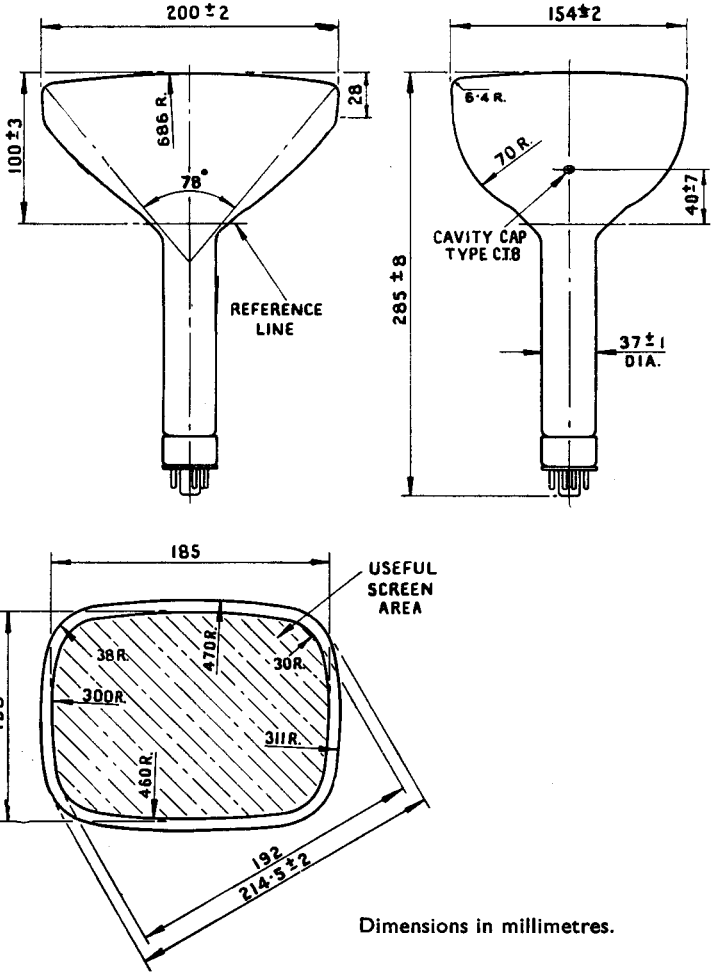
†The grid should never be positive with respect to the cathode.

Issue 3.
May, 1960

Ferranti

8/03AM

8/03QM



Dimensions in millimetres.

FERRANTI

TELEVISION MONITOR TUBE

8/03TM

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.

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 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 Anode + 4th Anode.

HEATER.

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

RATINGS.

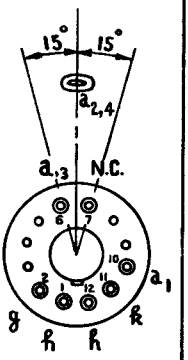
Max. A_1 Voltage	500 volts.
Max. A_2+A_4 voltage	15 kV.
Max. Pos. A_3 voltage	+500 volts.
Max. Neg. A_3 voltage	-500 volts.
Min. A_1 voltage	200 volts.
Min. A_2+A_4 voltage	8 kV.
Max. V_{h-k} (Heater positive)	150 volts.
Max. V_{h-k} (Heater negative)	200 volts.
Max. R_{g-k}	1·5 MΩ
Max. R_{h-k}	1·0 MΩ

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_a=100 μA	25 volts.

CAPACITANCES.

C_{k-all}	<8 pF.
C_{g-all}	<8 pF.

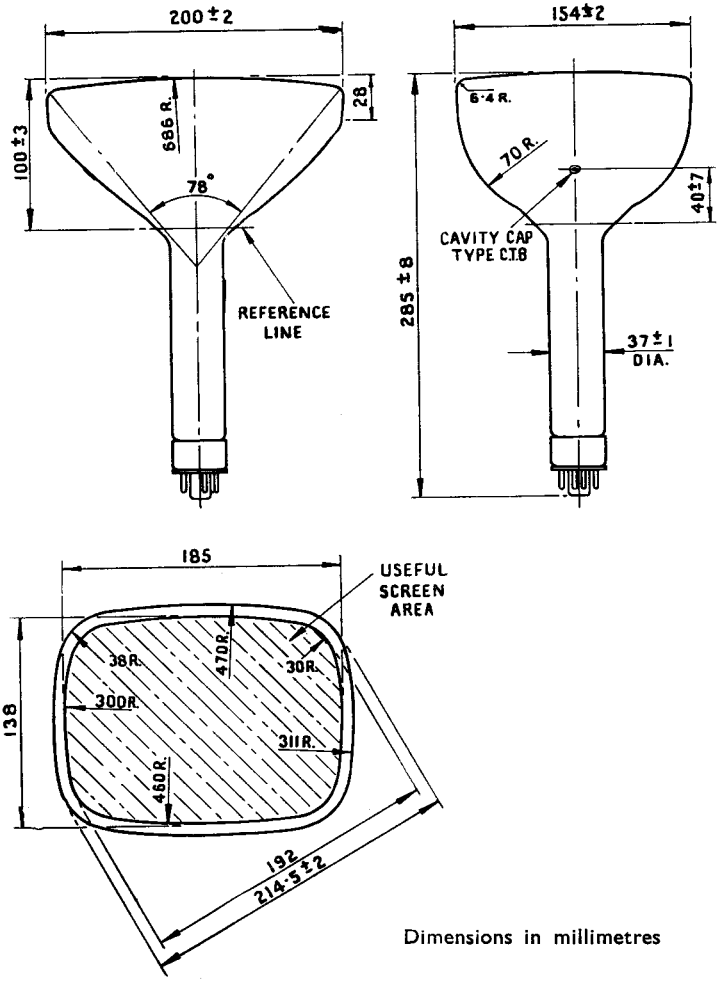


Base Connections Underside View of Base

†The grid should never be positive with respect to the cathode.

Issue 2
May, 1958

8/03TM



Dimensions in millimetres

FERRANTI

TELEVISION MONITOR TUBE

An 8in. diagonal Rectangular Tube with metal backed screen having very high definition.

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.

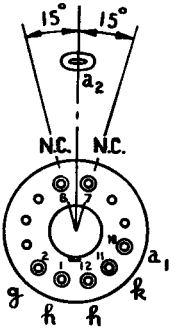
Max. 1st Anode Voltage ...	600 volts.
Max. 2nd Anode Voltage ...	15·0 kV.
Min. 1st Anode Voltage ...	250 volts.
Min. 2nd Anode Voltage ...	8·0 kV.
Max. V_{h-k} Heater Negative ...	200 volts.
Max. V_{h-k} Heater Positive ...	150 volts.
Max. R_{h-k}	1·0 MΩ
Max. R_{g-k}	1·5 MΩ

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.



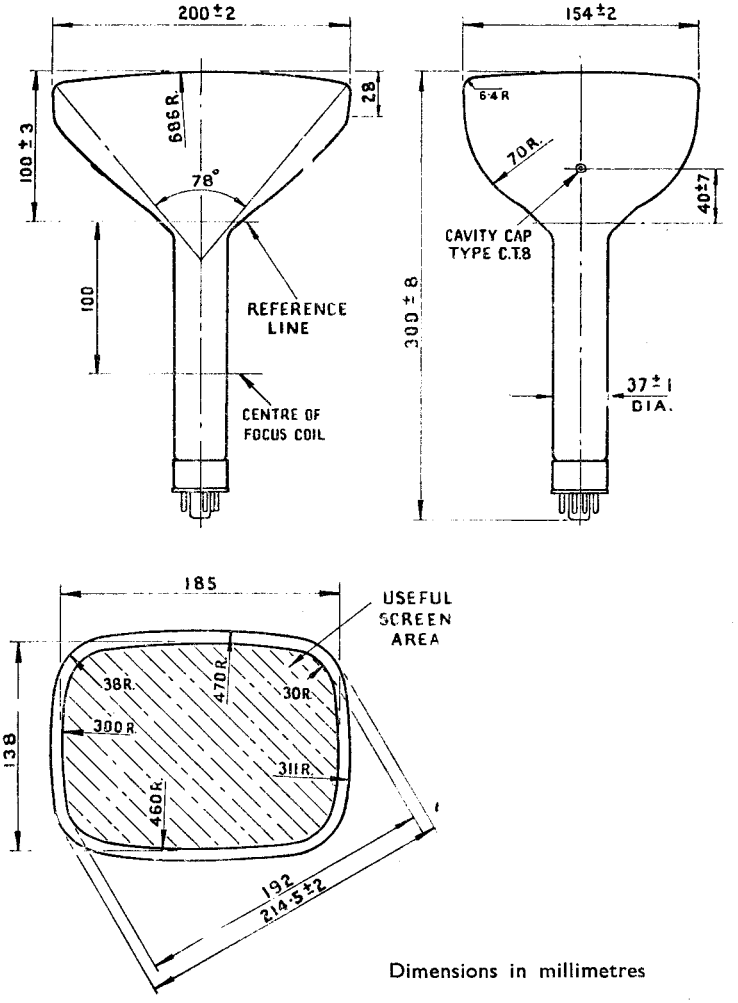
Base Connections Underside View of Base

*The grid should never be positive with respect to the cathode.

Issue 2
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8/04TM

FERRANTI



Dimensions in millimetres

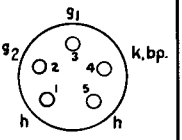
FERRANTI

OUTPUT BEAM TETRODE

807

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

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.

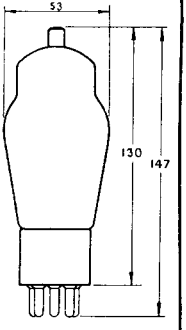
Pin 1—Heater. Pin 4—Cathode, Beam Plates.
Pin 2—Screen Grid Pin 5—Heater.
Pin 3—Control Grid. Top Cap—Anode.

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.

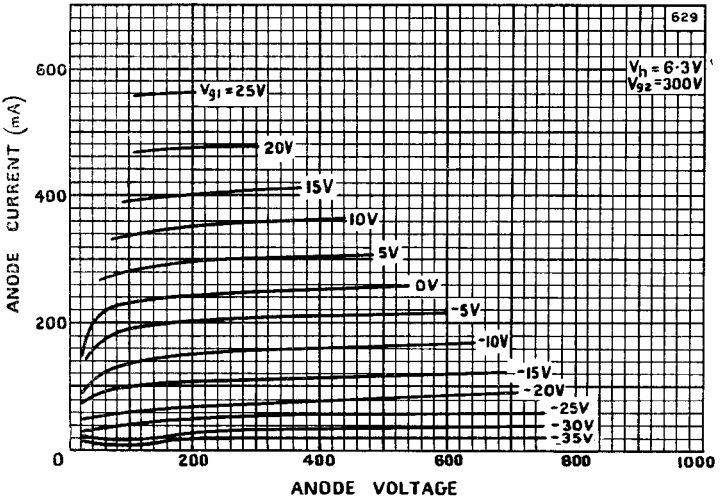
C_{in}	11 pF.
*C_{out}	7 pF.
C_{a-g1}	<0·2 pF.

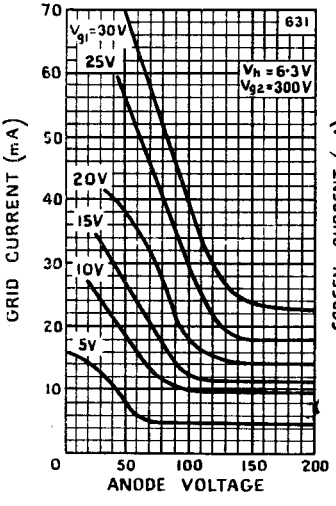
All dimensions shown are in millimetres (max.).

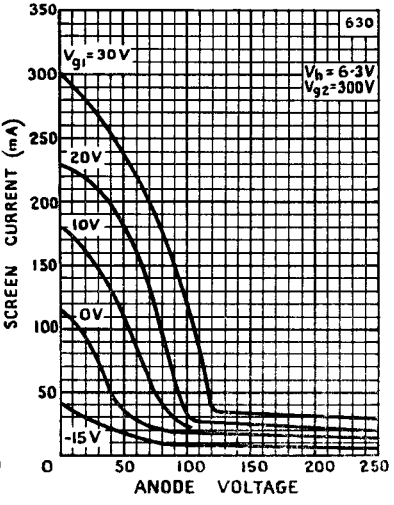
*Measured with external shield.

†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.

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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)
600
400
200
0
200
400
600
800
1000
ANODE VOLTAGE


631
V_{g1} = 30V
25V
V_h = 6·3V
V_{g2} = 300V
20V
15V
10V
5V
GRID CURRENT (mA)
70
60
50
40
30
20
10
0
50
100
150
200
ANODE VOLTAGE


630
V_{g1} = 30V
V_h = 6·3V
V_{g2} = 300V
20V
10V
0V
-15V
SCREEN CURRENT (mA)
350
300
250
200
150
100
50
0
50
100
150
200
250
ANODE VOLTAGE

FERRANTI

RADAR TUBE

8/52 HM

8/52 LM

A miniaturised Radar Display Tube with a 8½in. 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

HEATER.

Heater Voltage	6·3 volts.
Heater Current	0·3 amps.

RATING.

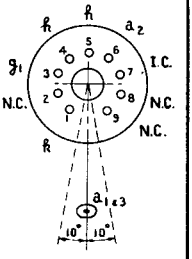
Max. $A_1 + A_3$ voltage	15 kV.
Max. Pos. A_2 voltage	+400 volts.
Max. Neg. A_2 voltage	−200 volts.
Min. $A_1 + A_3$ voltage	8 kV.
Max. V_{h-k}	200 volts.
Max. R_{g-k}	0·5 MΩ
Max. R_{h-k}	1·0 MΩ

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.



Base Connections

Underside View of Base

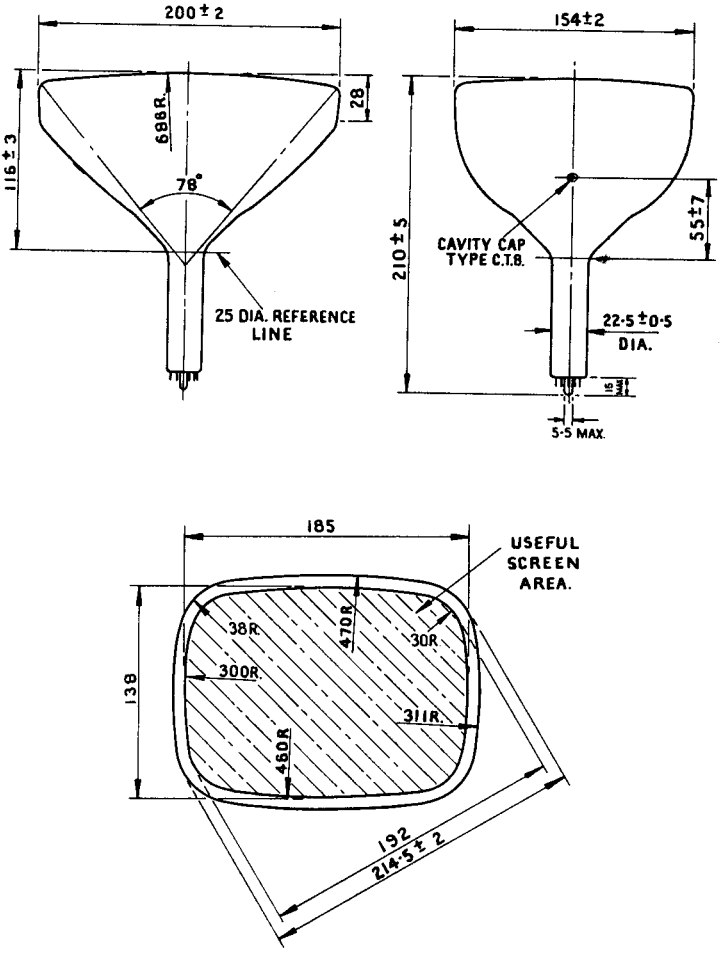
*These phosphors are liable to burn if operated with a spot which is stationary or slow moving. The tube should not be operated under such conditions, even at low beam current. See list of alternative phosphors for this application.

†Note that the centre of the valve holder should be drilled out to ¼inch to accommodate the protruding pumping stem.

Issue 2
May., 1958

8/52 HM

8/52 LM



Dimensions in mm.

Ferranti

RADAR TUBES

8A/54HM

8A/54LM

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.

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.

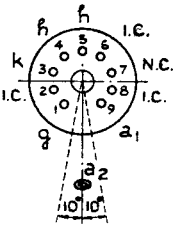
With Valve Drive.

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.

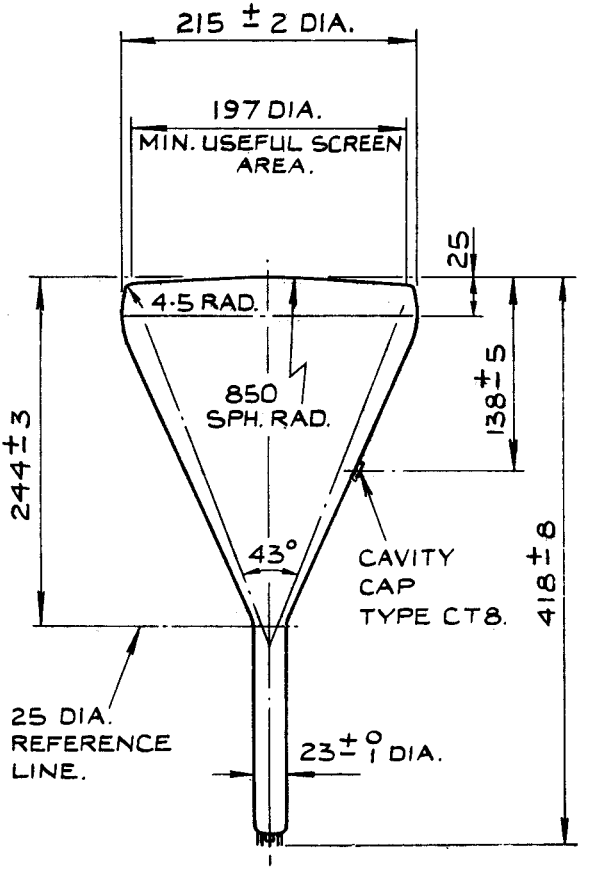


Base Connections Underside View of Base

*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



DIMENSIONS ARE IN MILLIMETRES.

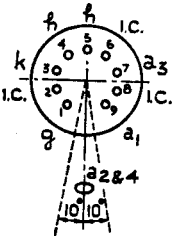
Ferranti

RADAR TUBE

8A/56HM

8A/56LM

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.



Underside view of base

FOCUS	Low Voltage Electrostatic.
DEFLECTION	Magnetic. 43° angle.

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	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.

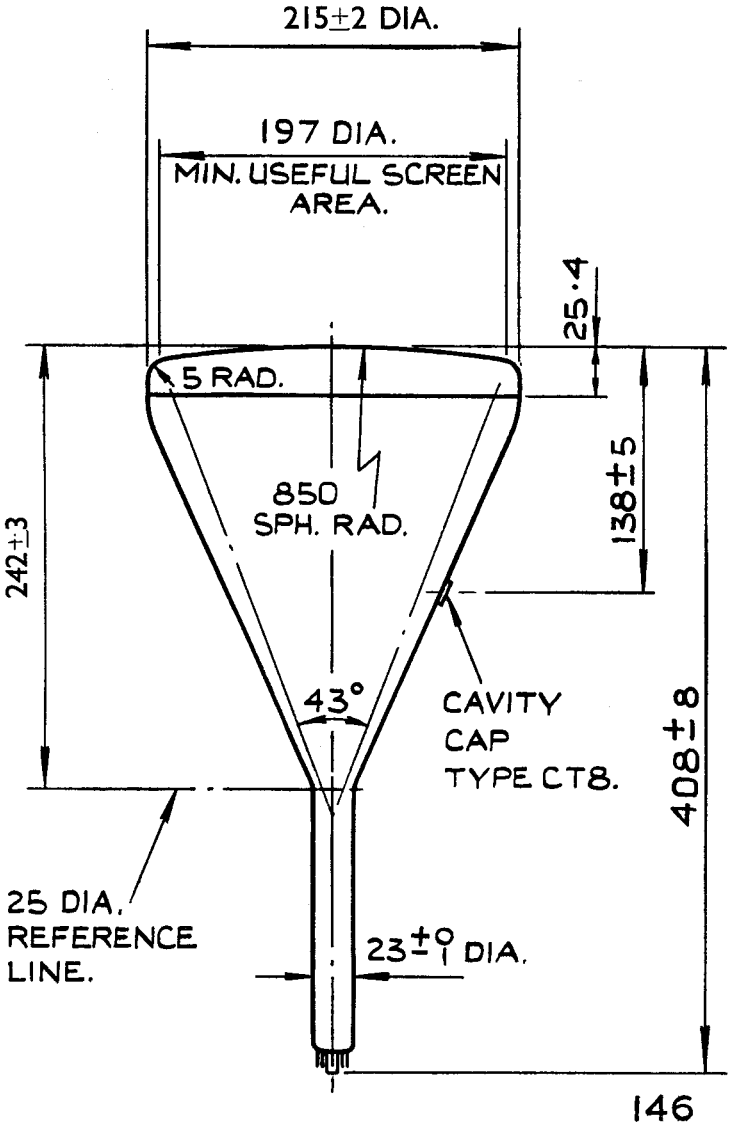
Transistor Drive.

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.

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DIMENSIONS ARE IN MILLIMETRES.

8B/08L2B

8B/08VB

8B/08ZB

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RADAR TUBES

High Resolution 8½in. Rectangular Radar Display Tubes.

FOCUS ... ... Magnetic.

DEFLECTION ... ... Magnetic.

Phosphor ...	8B/08L2B*	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.

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

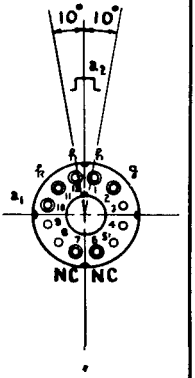
CAPACITANCES.

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.



Base Connections Underside View of Base

*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.

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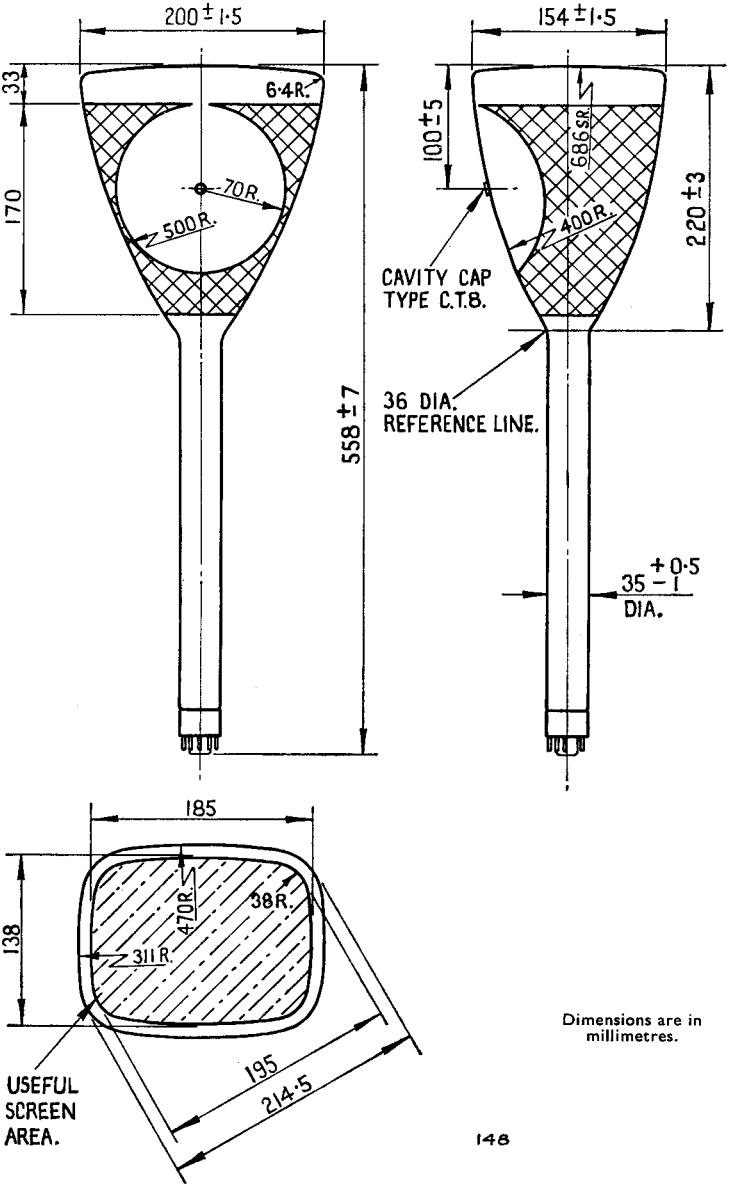
Ferranti

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.

9/03HB

9/03JB

9/03LB

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.

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.

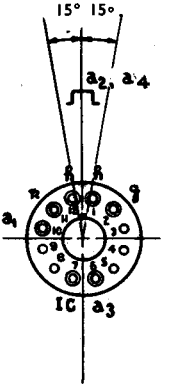
*These screens are liable to burn if operated with a spot which is stationary or slow moving. The tube should not be operated under such conditions, even at low beam current.

†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.



Base Connections View from spigot end of tube

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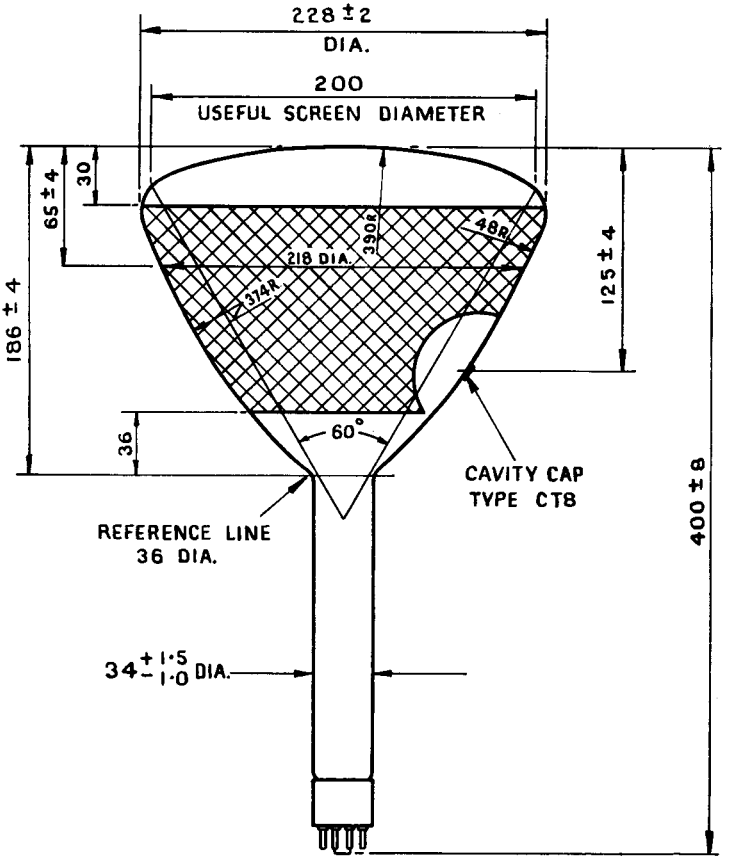
9/03HB

9/03JB

9/03LB

CAPACITANCES.

C_{k-all}	...	...	...	...	<8 pF.
C_{g-all}	...	...	...	...	<8 pF.
C_{a_2-M}	...	...	...	...	750 pF. approx.



9/22AM

9/22PM

9/22QM

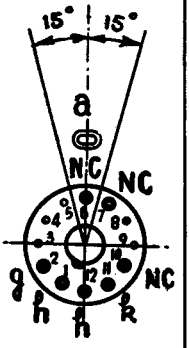
Ferranti

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 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/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-all}	<8 pF.
C_{g-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.

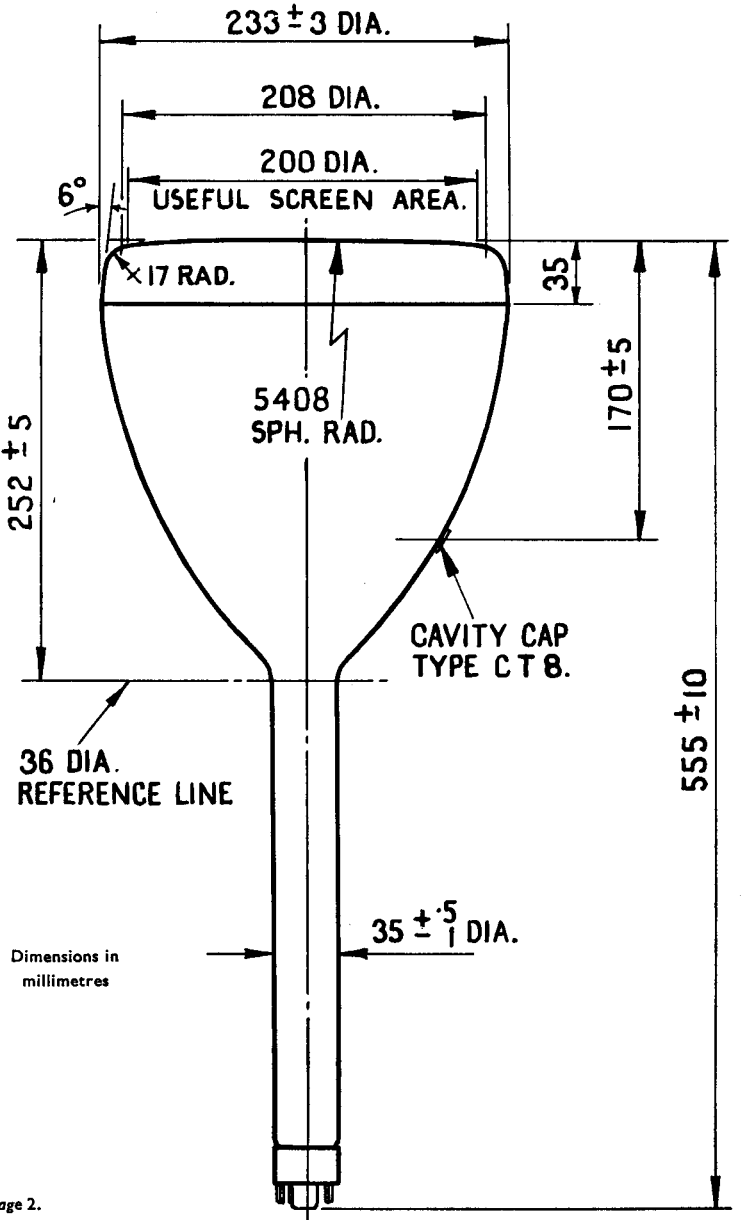
When operated at an anode voltage in excess of 16 kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

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Ferranti

9/22AM
9/22PM
922QM



Dimensions in millimetres

Ferranti

CATHODE RAY TUBE

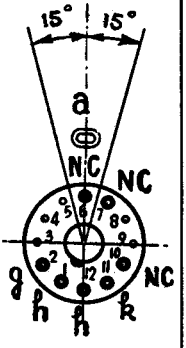
A 9-inch diameter Triode Tube which has a high quality flat face with ground internal and external surfaces.

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.

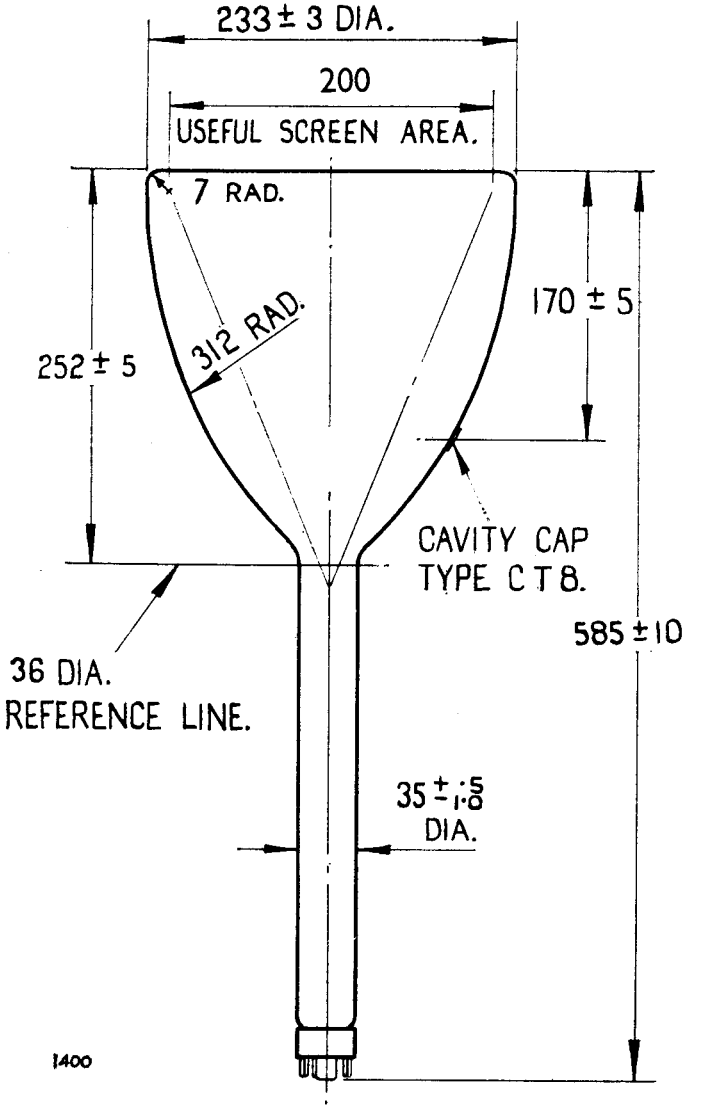
CAPACITANCE.

C_k–all	<8 pF
C_g–all	<8 pF

†Ferranti Focus Coil units Type FC.4 or FC.5 are available.

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Ferranti



Dimensions in millimetres

Ferranti

HIGH RESOLUTION DISPLAY TUBES

9/25AM
9/25PM
9/25QM

9 inch diameter Display Tubes with an optically flat face which has ground internal and external surfaces.

FOCUS. ... ... Magnetic

DEFLECTION. ... ... Magnetic

SCREEN.

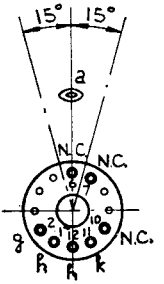
	9/25AM	9/25PM	9/25QM
Phosphor Type	'A'	'P'	'Q'
Fluorescence	Green	Blue	Blue/Violet
Persistence	Ultra Short	Ultra Short	Killed

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 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/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.

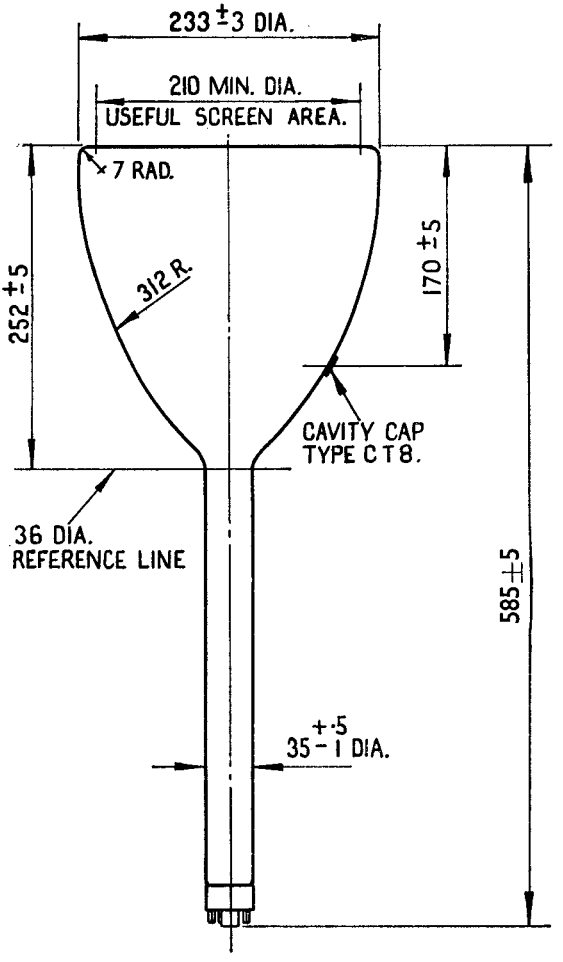
X-RAY WARNING: When operated at an anode voltage in excess of 16 kV. shielding may be required to protect against harmful X-ray radiation which could cause possible injury from prolonged exposure.

*Minimum diameter of internal ground surface

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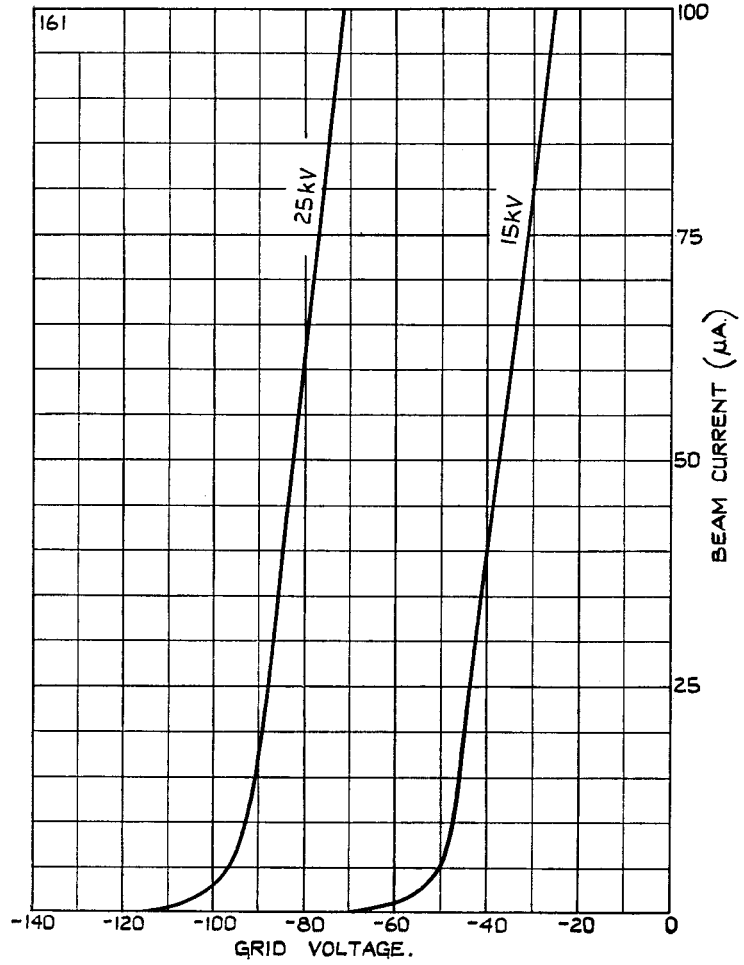
Ferranti

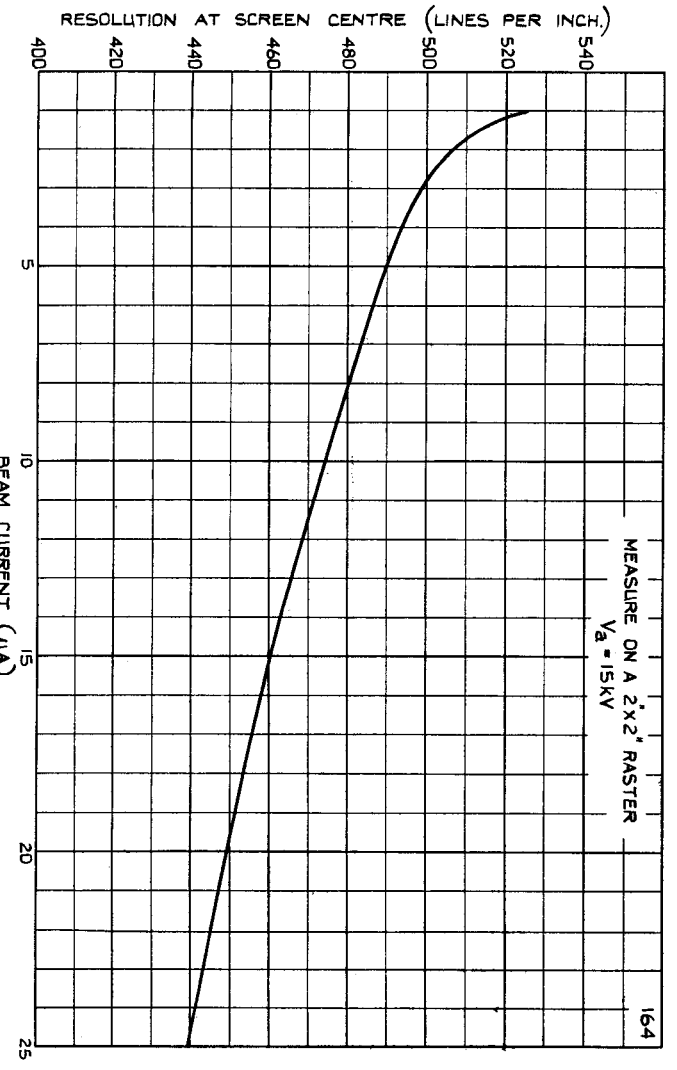
Ferranti



ALL DIMENSIONS IN MILLIMETERS

TYPICAL BEAM CURRENT/GRID VOLTAGE CHARACTERISTIC





TYPICAL RESOLUTION OF "P" SCREEN.
(Measured by shrinking raster method).

Ferranti

HIGH RESOLUTION DISPLAY TUBE

A 9 inch diameter Display Tube with an optically flat face with ground internal and external surfaces.

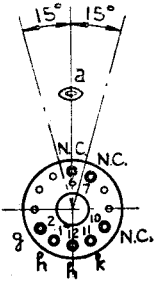
FOCUS. ... ... Magnetic

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 Ω

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.

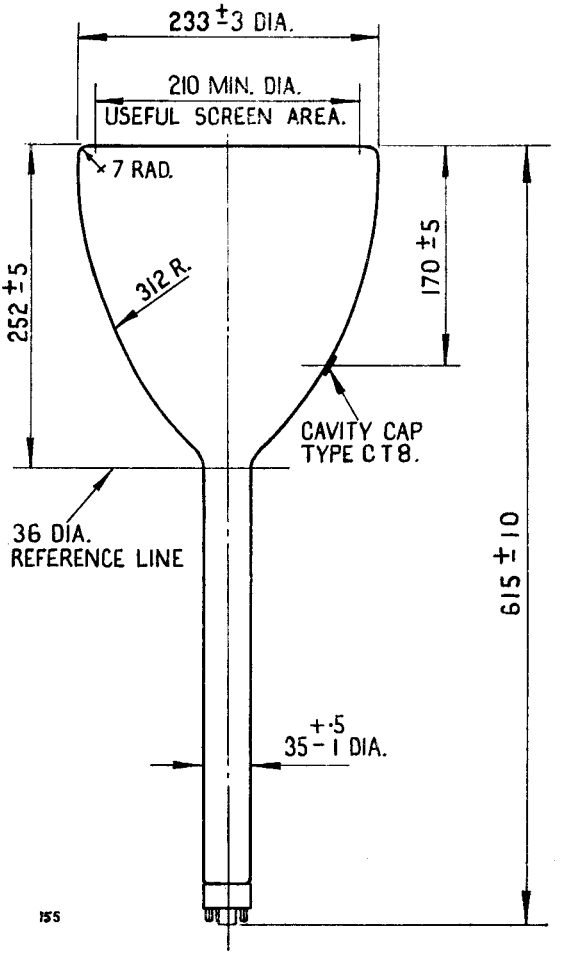
$C_{k—all}$	<8pF.
$C_{g—all}$	<8pF.

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.

*Minimum diameter of internal ground surface

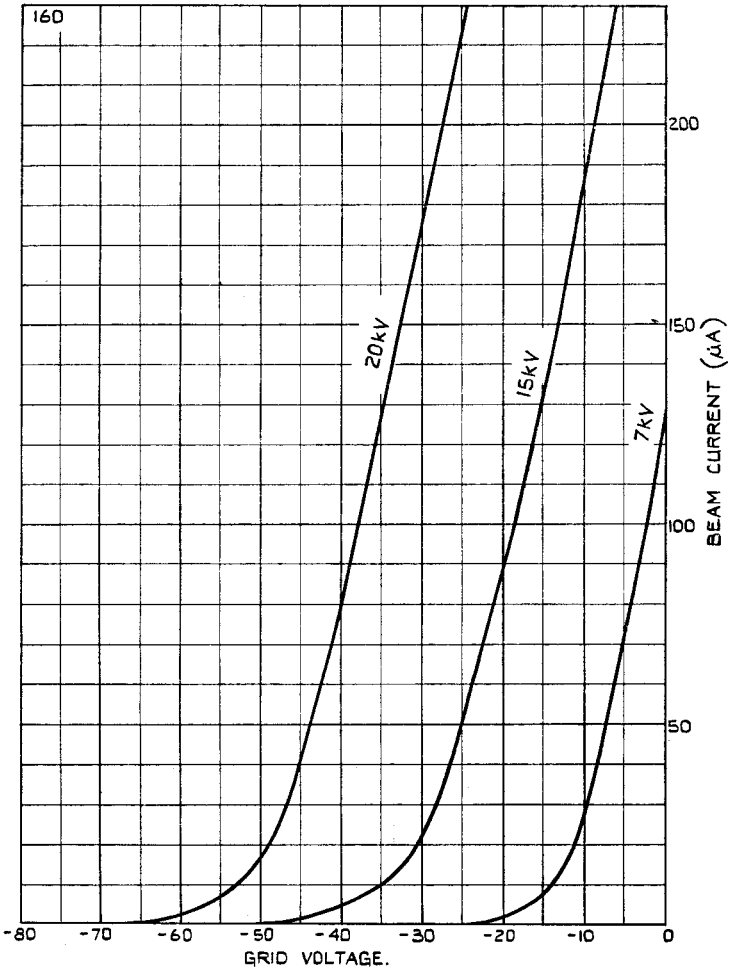
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Issue 2
July, 1961

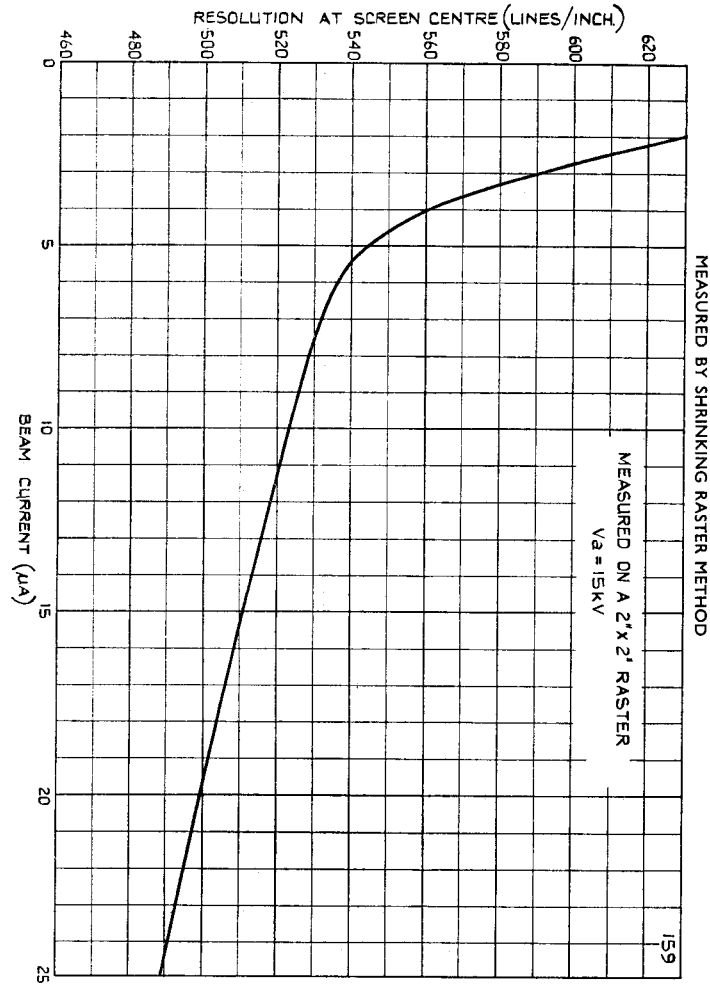
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ALL DIMENSIONS IN MILLIMETERS

TYPICAL ANODE CURRENT/GRID VOLTAGE CHARACTERISTIC





TYPICAL RESOLUTION WITH 'P' SCREEN
MEASURED BY SHRINKING RASTER METHOD

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.

1240/54HM

1240/54L3M

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

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.

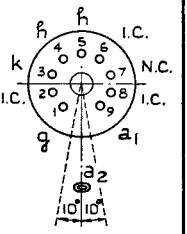
With Valve Drive.

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.



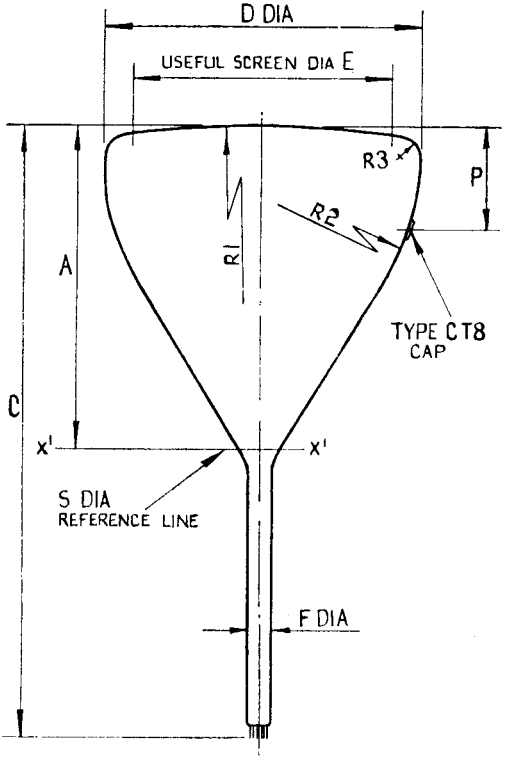
Base Connections Underside View of Base

*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.

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Ferranti



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 ± 1°	·906 +·000 −·039	S	25	·984

ORIGINAL DIMENSIONS IN MILLIMETERS

FERRANTI

MONITOR TUBE

14/03TB

A 14in. 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.
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.

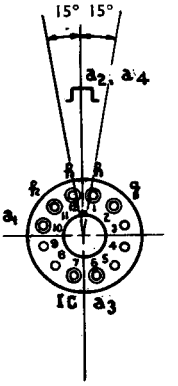
PHYSICAL DETAILS.

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.	



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	... ...	−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.

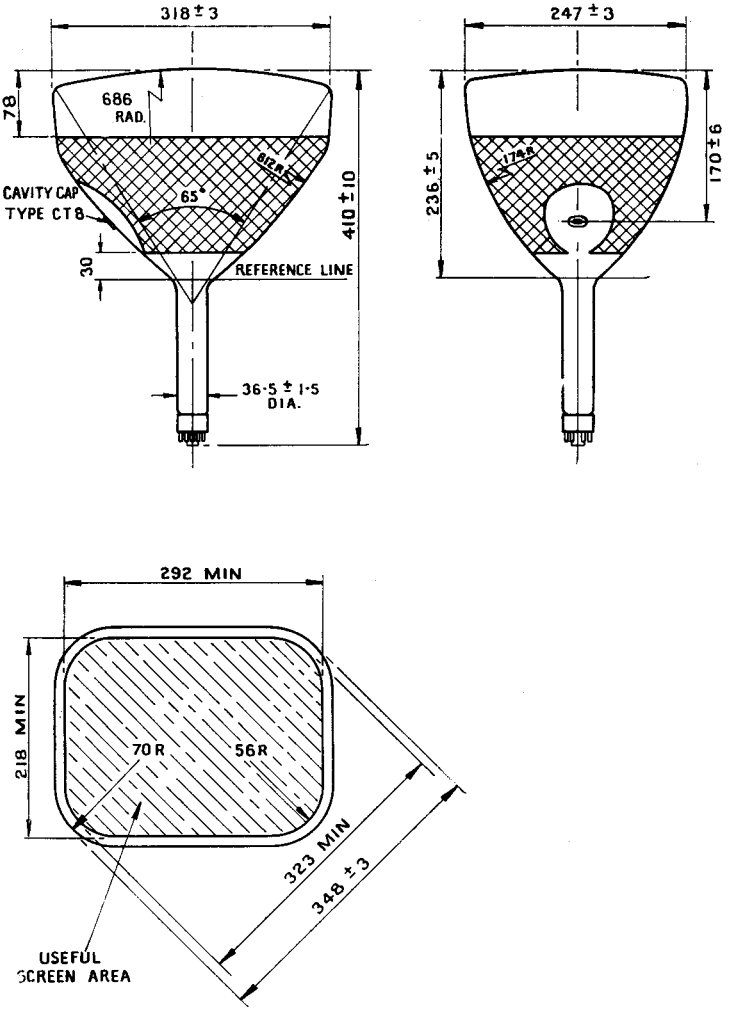
†The grid should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

Issue 1
Aug., 1957

14/03TB

FERRANTI

THIRD ANGLE PROJECTION



FERRANTI

TELEVISION MONITOR TUBE

14/04TB

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.

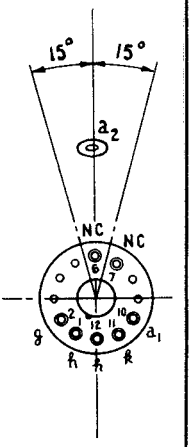
Max. A_1 Voltage	500 volts.
†Max. A_2 Voltage	16 kV.
Min. A_1 Voltage	200 volts.
Min. A_2 Voltage	8 kV.
Max. V_{h-k}	200 volts.
Max. R_{g-k}	1·5 MΩ
‡Max. R_{h-k}	1·0 MΩ
Max. A_1 Supply Impedance ...	1·5 MΩ

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.).



Base Connections

Underside View of Base

*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 V_{a2} and I_{a2} must not exceed 6 watts average value for the whole screen.

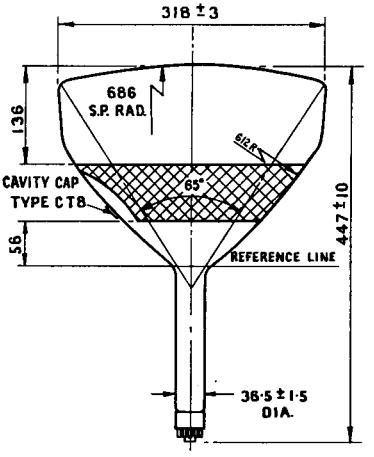
‡When the heater supply is from a separate transformer. When the heater is in a series chain or earthed the 50 c/s. impedance between earth and cathode (Z_k) is 100kΩ (max).

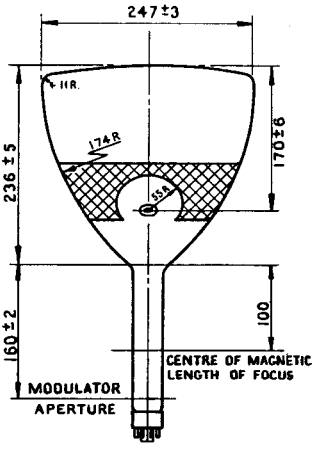
**The recommended centre of the magnetic length of the focus unit should be approx. 100 mm. from the Reference Line.

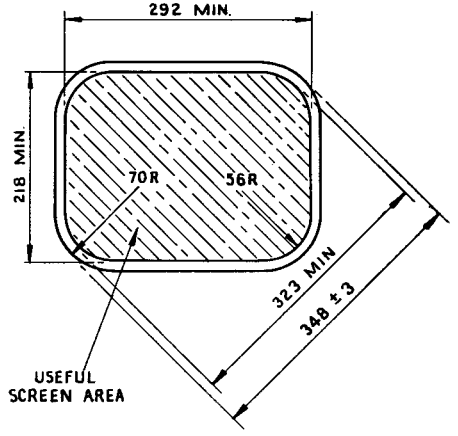
§The grid should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

Issue 1
Jan., 1958

14/04TB







All dimensions are in millimetres

FERRANTI

TELEVISION MONITOR TUBE

14/04TB

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.

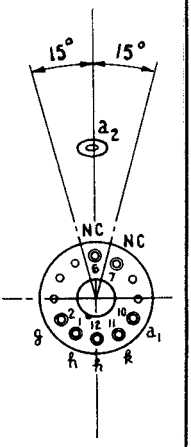
Max. A_1 Voltage	500 volts.
†Max. A_2 Voltage	16 kV.
Min. A_1 Voltage	200 volts.
Min. A_2 Voltage	8 kV.
Max. V_{h-k}	200 volts.
Max. R_{g-k}	1·5 MΩ
‡Max. R_{h-k}	1·0 MΩ
Max. A_1 Supply Impedance ...	1·5 MΩ

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.).



Base Connections

Underside View of Base

*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 V_{a2} and I_{a2} must not exceed 6 watts average value for the whole screen.

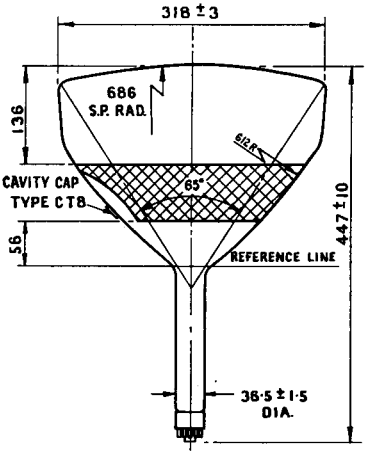
‡When the heater supply is from a separate transformer. When the heater is in a series chain or earthed the 50 c/s. impedance between earth and cathode (Z_k) is 100kΩ (max).

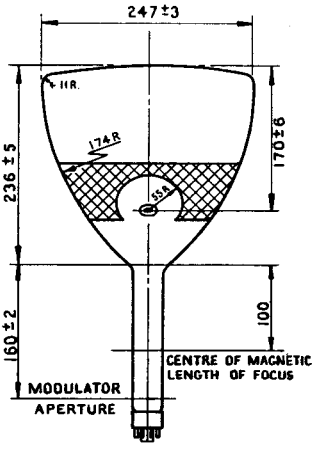
**The recommended centre of the magnetic length of the focus unit should be approx. 100 mm. from the Reference Line.

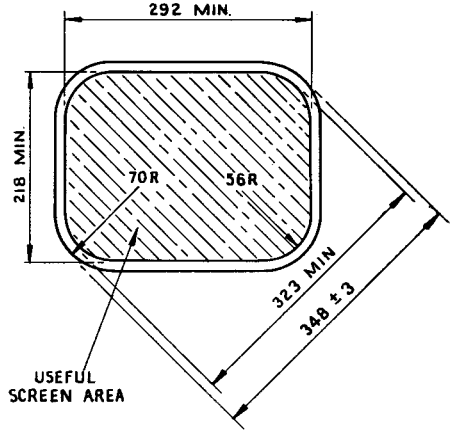
§The grid should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

Issue 1
Jan., 1958

14/04TB







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.

HEATER.

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

RATINGS.

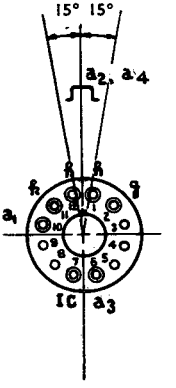
Max. A_1 Voltage	500 volts.
Max. $A_2 + A_4$ Voltage ...	15 kV.
Max. Pos. A_3 Voltage ...	+500 volts.
Max. Neg. A_3 Voltage ...	−500 volts.
Min. A_1 Voltage	200 volts.
Min. $A_2 + A_4$ Voltage ...	8 kV.
Max. V_{h-k}	200 volts.
Max. R_{g-k}	1·5 MΩ
Max. R_{h-k}	1·0 MΩ

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.
†Vg 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.



Base Connections Underside View of Base

*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.

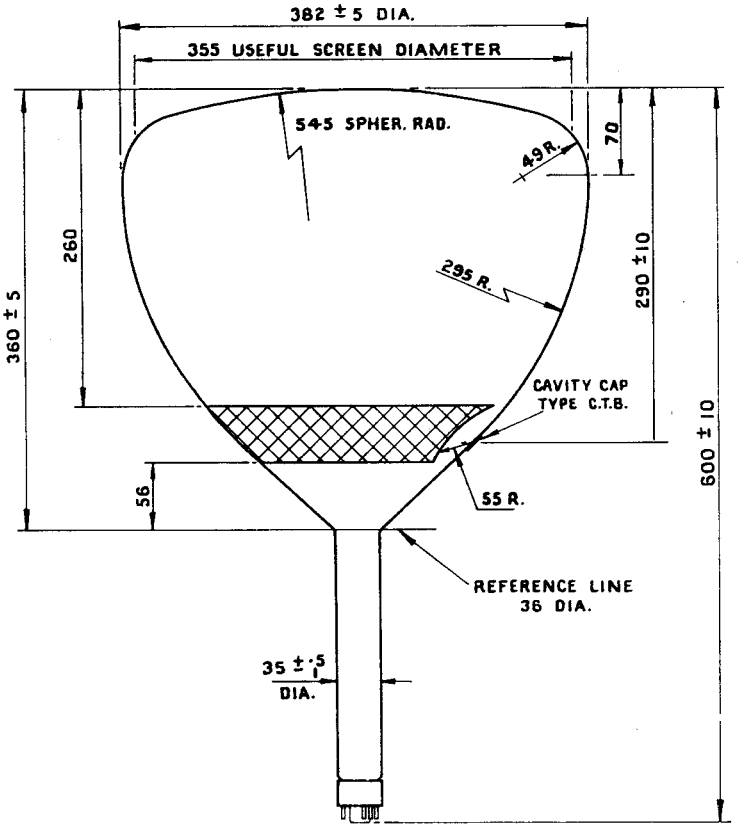
†The modulator should never be positive with respect to the cathode, except during the period immediatly after switching off, when it may be allowed to rise to + 1 volt.

Issue 1.
Dec., 1957

15/03 HB

15/03 JB

15/03 LB



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.	

HEATER.

*Heater Voltage	6·3 volts.
Heater Current	0·3 amp.

RATINGS.

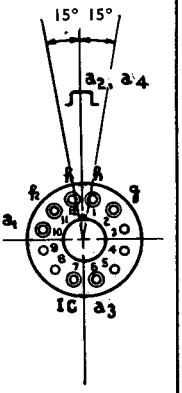
Max. A_1 Voltage	500 volts.
Max. A_2 + A_4 Voltage	15 kV.
Max. Pos. A_3 Voltage	+500 volts.
Max. Neg. A_3 Voltage	–500 volts.
Min. A_1 Voltage	200 volts.
Min. A_2 + A_4 Voltage	8 kV.
Max. V_{h-k}	200 volts.
Max. R_{g-k}	1·5 MΩ
Max. R_{h-k}	1·0 MΩ

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.



Base Connections

Underside View of Base

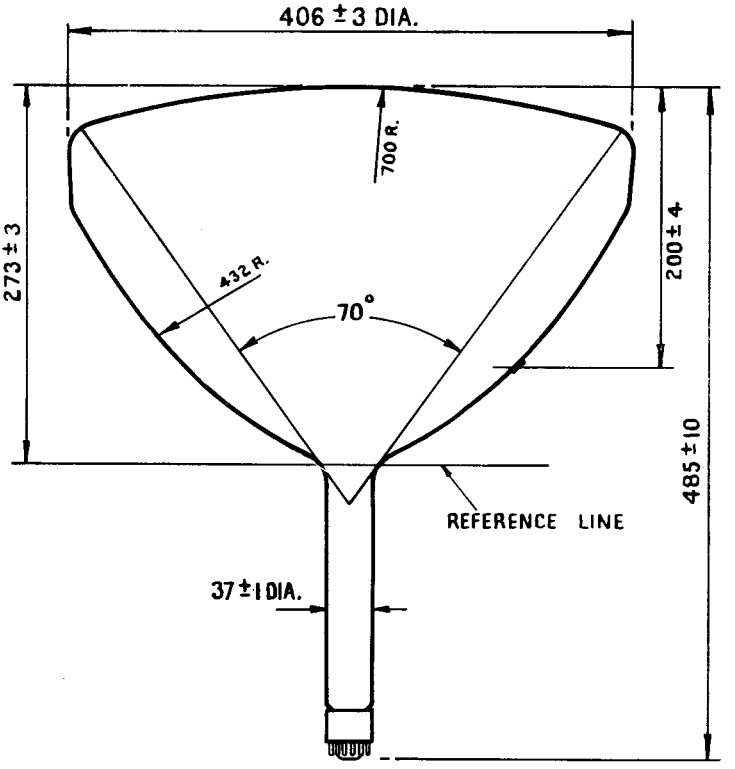
*The screen material of Type 16/03HB is liable to burn if operated with a stationary or slow moving spot, even at low values of beam current.

†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

16/03HB

16/03 JB



ALL DIMENSIONS ARE IN MILLIMETRES

FERRANTI
RADAR TUBES

1650/03HB

1650/03JB

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

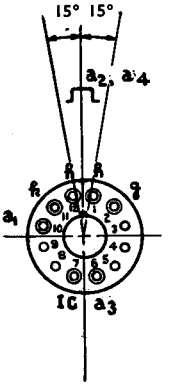
TYPICAL OPERATION.

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.



Base Connections Underside View of Base

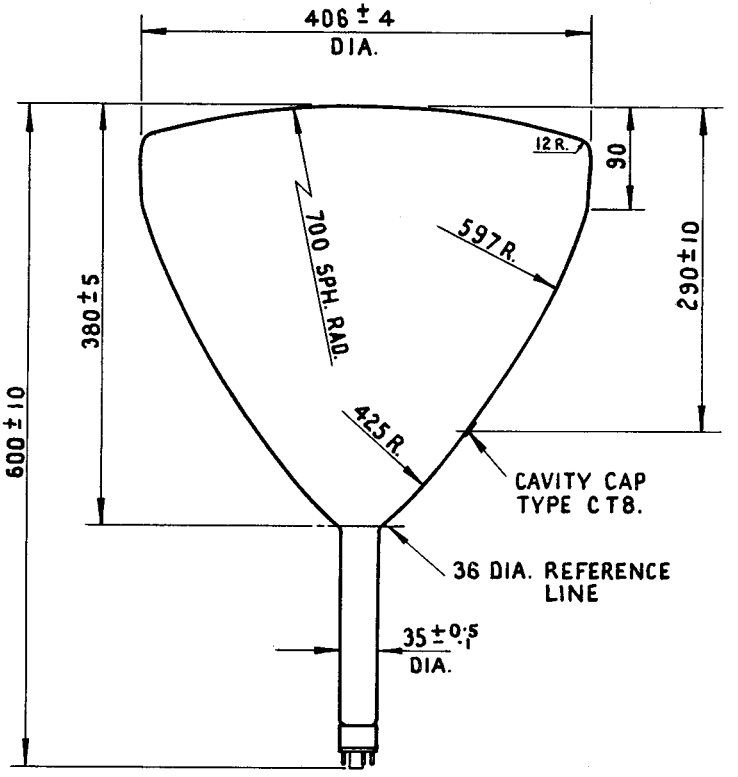
*The screen material of type 1650/03HB is liable to burn if operated with a stationary or slow moving spot, even at low values of beam current.

†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.

Issue 1
Nov.,1958

1650/03HB

1650/03JB



ALL DIMENSIONS ARE IN MM.

FERRANTI

MONITOR TUBE

17/03TB

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.

HEATER.

*Heater Voltage	... ...	6·3 volts.
Heater Current	... ...	0·3 amp.

RATINGS.

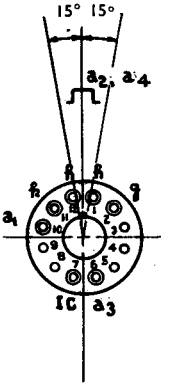
Max. A_1 Voltage	... ... 500 volts.
Max. $A_2 + A_4$ Voltage	... ... 18 kV.
Max. Pos. A_3 Voltage	... ... +500 volts.
Max. Neg. A_3 Voltage	... ... -500 volts.
Min. A_1 Voltage	... ... 200 volts.
Min. $A_2 + A_4$ Voltage	... ... 12 kV.
Max. V_{h-k}	... ... 200 volts.
Max. R_{g-k}	... ... 1·5 MΩ
Max. 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.



Base Connections

Underside View of Base

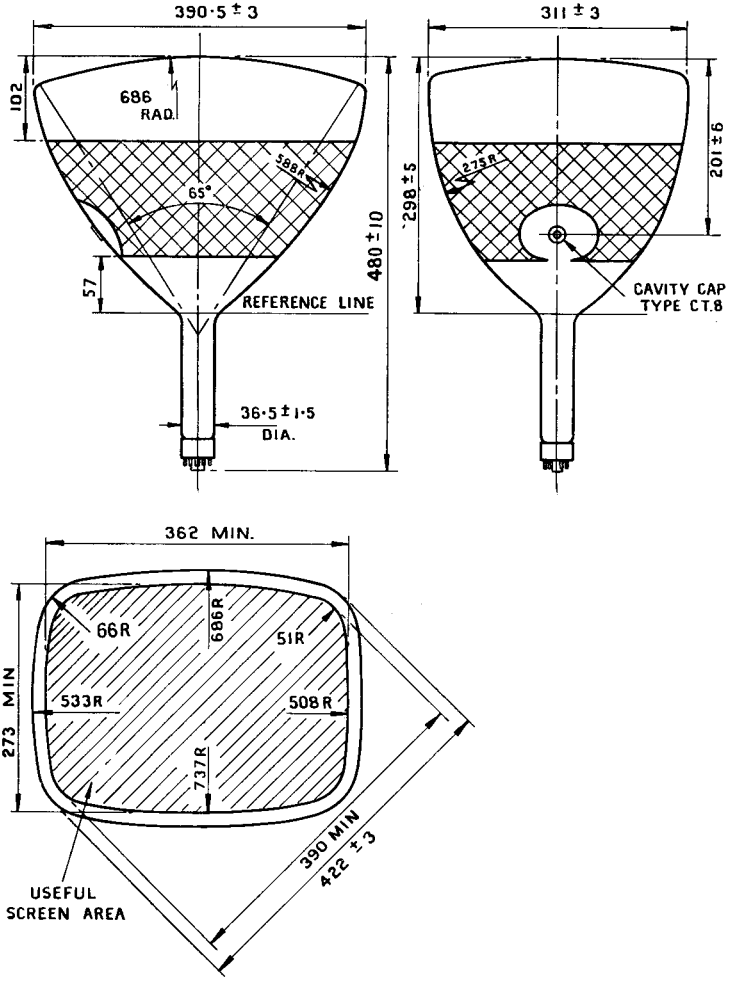
*When used for series operation, the surge heater voltage should not exceed 9·5 volts r.m.s. and a current limiting device should be incorporated in the circuit to limit switching surge.

†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


390·5 ± 3
102
686
RAD.
588R
65°
57
REFERENCE LINE
480 ± 10
36·5 ± 1·5
DIA.
311 ± 3
298 ± 5
275R
201 ± 6
CAVITY CAP
TYPE CT.8
362 MIN.
273 MIN
66R
686R
51R
533R
508R
737R
USEFUL
SCREEN AREA
390 MIN
422 ± 3

FERRANTI

PICTURE MONITOR TUBE

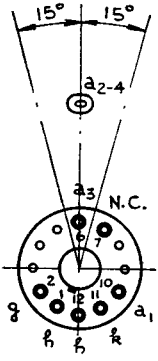
1790/03TB

A rectangular tube with 17" diagonal screen and 90° deflection angle. Designed primarily for use in Television Monitoring Equipment.

FOCUS	Low Voltage Electrostatic.
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 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 & 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.

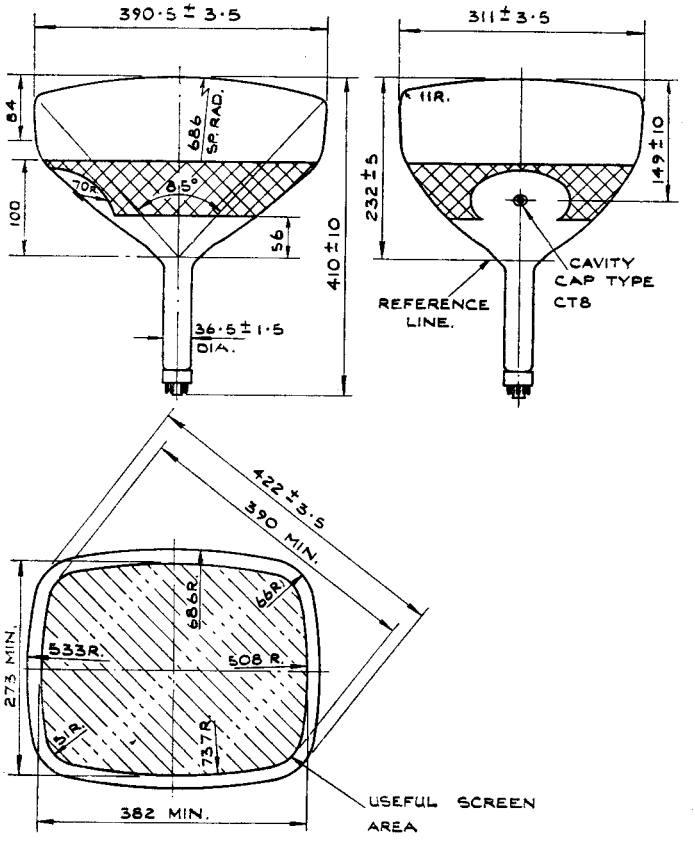
C_{k-all}	<8 pF.
C_{g-all}	<8 pF
$C_{a-ext.\ coating}$	1500 pF approx.

*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.

Issue 1, Apl., 1959

1790/03TB


390·5 ± 3·5
311 ± 3·5
84
686 SP. RAD.
70°
85°
100
56
410 ± 10
36·5 ± 1·5 DIA.
11R.
232 ± 5
149 ± 10
CAVITY CAP TYPE CT8
REFERENCE LINE.
422 ± 3·5
390 MIN.
273 MIN.
686R.
66R.
533R.
508 R.
13R.
737R.
382 MIN.
USEFUL SCREEN AREA

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.

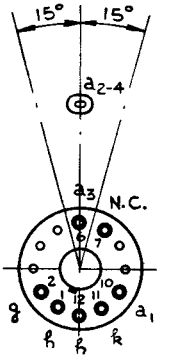
FOCUS	Low Voltage Electrostatic.
DEFLECTION	Magnetic.
Deflection Angle	90°.
SCREEN	Metal backed.
Phosphor	Type 'T'—Silver activated.
Fluorescence	White.
Persistence	Short.

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
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	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.

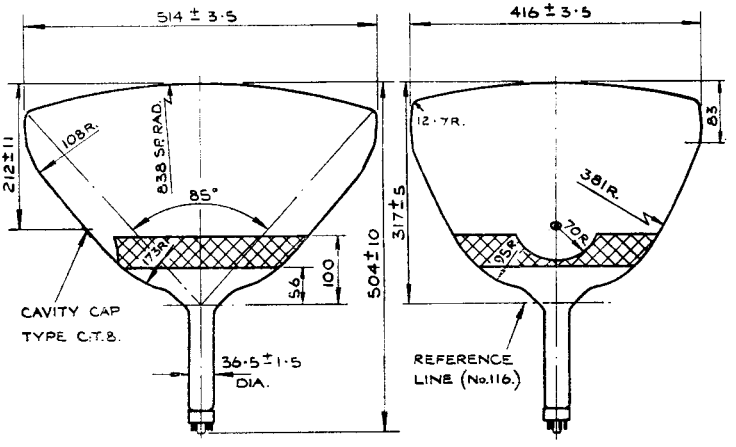
C_{k-all}	<8 pF.
C_{g-all}	<8 pF.
$C_{a-ext.\ coating}$	1500 pF. (approx.).

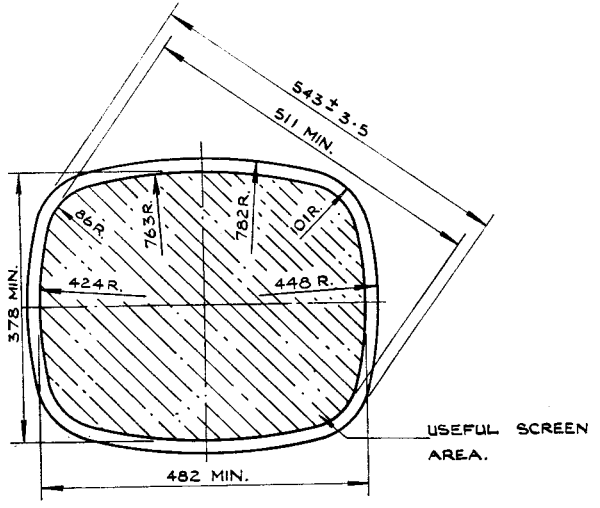
**The point of optimum focus lies between these values.

†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





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.	

HEATER.

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

RATINGS.

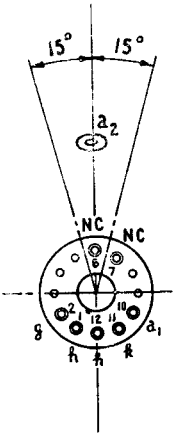
Max. A_1 Voltage	500 volts.
Max. A_2 Voltage	18 kV.
Min. A_1 Voltage	200 volts.
Min. A_2 Voltage	12 kV.
Max. V_{h-k}	200 volts.
Max. R_{g-k}	1·5 MΩ
Max. R_{h-k}	1·0 MΩ
Max. A_1 Supply Impedance ...	1·5 MΩ

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.).



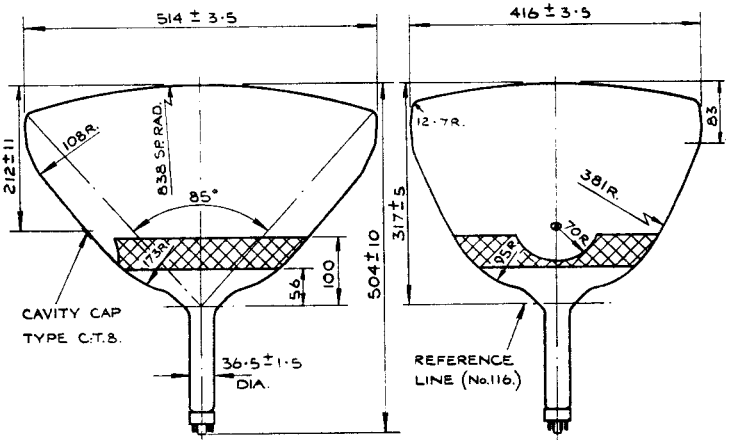
Base Connections Underside View of Base

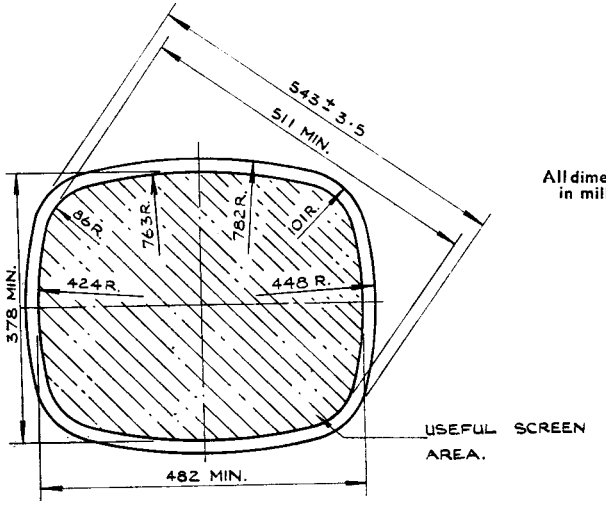
*The grid should never be positive with respect to the cathode, except during the period immediately after switching off, when it may be allowed to rise to + 1 volt.

†The recommended centre of the magnetic length of the focus unit should be approx. 100 mm. from the Reference Line.

Tentative, Issue 1 Aug. 1959.

21/04HB





All dimensions are in millimetres

FERRANTI

ARC DISCHARGE VALVE

AD30

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.

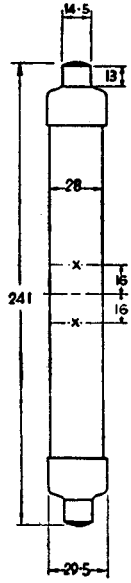
RATINGS (Max. Ratings are "Absolute.")

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 ignition 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.

Issue 3
Mar.,1956

FERRANTI

OPERATION CONTROLLED BY FREE RUNNING OSCILLATOR.

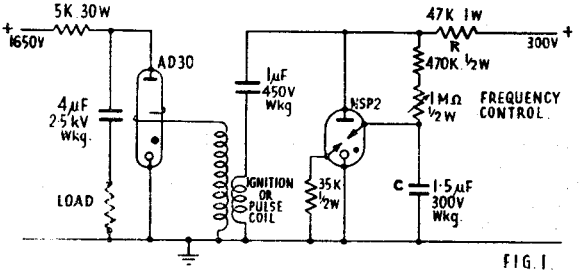


FIG. 1.

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.

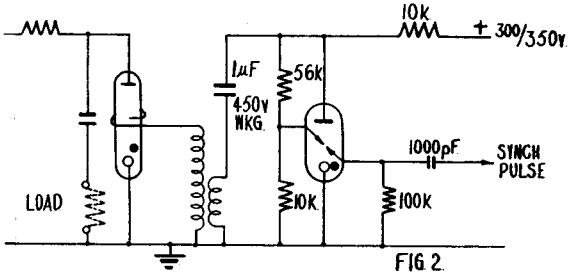


FIG. 2.

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.

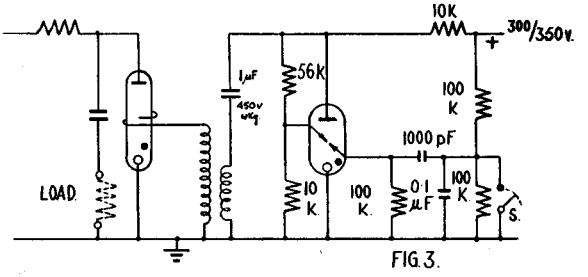


FIG. 3.

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

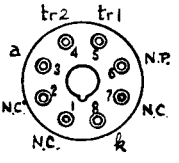
Further information regarding operation of the NSP2 as a trigger valve may be obtained from the Data Sheet for NSP2.

FERRANTI

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.

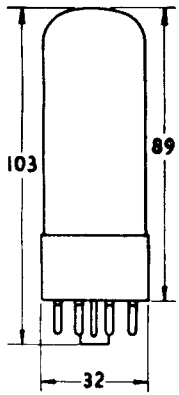
Pin 1—No Connection.	Pin 5—Trigger Electrode 1.
Pin 2—No Connection.	Pin 6—No Pin.
Pin 3—Anode.	Pin 7—No Connection.
Pin 4—Trigger Electrode 2.	Pin 8—Cathode.

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.
‡Vtr_2 at Triggering Instant ...	70 volts.
§Trigger Pulse Amplitude (Vtr_1)	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.

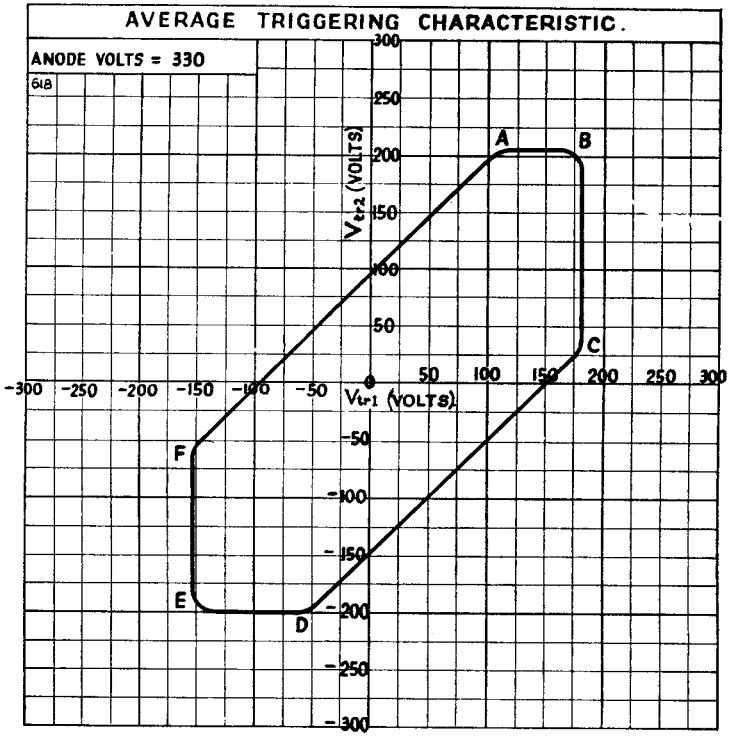
*The limits quoted refer to the trigger voltage for a low rate of change of electrode voltages with tr_1 negative to tr_2. For pulse operation a higher trigger voltage is generally necessary. See under "Typical Operation."

‡Positive with respect to cathode.

§Negative with respect to cathode.

Issue 5
Jan., 1958

FERRANTI



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

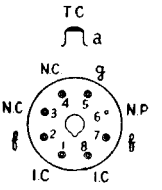
LOW VOLTAGE X-RAY TUBE

B120

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.



Base Connections Underside View of Base

PHYSICAL DETAILS.

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

PIN CONNECTIONS.

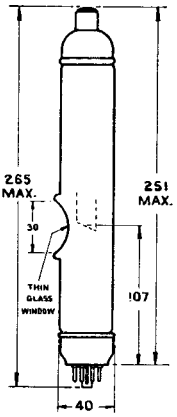
*Pin 1, *Pin 2	Filament.
Pin 3.—No Connection.	
Pin 4.—No Connection.	
Pin 5—Grid.	
Pin 6.—No Pin.	
*Pin 7, *Pin 8	Filament.

RATINGS.

Max. Target Voltage	25 kV. DC. 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.



All dimensions shown are in millimetres. (max.)

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.

Tentative.
Issue 1.
Mar.,1957

FERRANTI

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

B210D

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

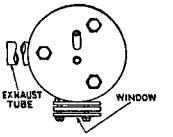
The tube has an inclined target which is water cooled and can be operated up to 10mA beam current at a target voltage of 40kV.

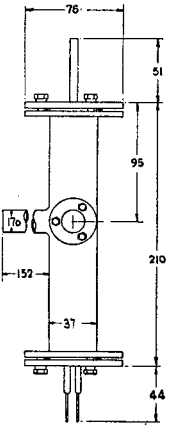
A special feature is the polythene window which can also be easily replaced if necessary.

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.





All dimensions shown are in millimetres.

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 μA.	0·5 mm.
Spot Size (approx.) at 10 mA. ...	1·0 mm.

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.

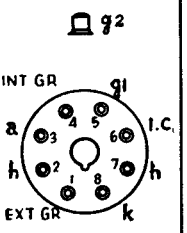
Issue 2
Aug.,1957

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 (Vg_1)	...	6·0	4·0	3·0 volts.
Control Grid Voltage (Vg_2)		−3·0	−3·0	−2·0 volts.
Anode Current (Ia)	...	275	190	100 μA.
Screen Current (Ig_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 (Ig_2)		$<30\times10^{-14}$	$<20\times10^{-14}$	$<2\times10^{-14}$ amp.
Control Grid Insulation (rg_2)		$>10^{13}$	$>3\times10^{13}$	$>10^{14}$ ohms.

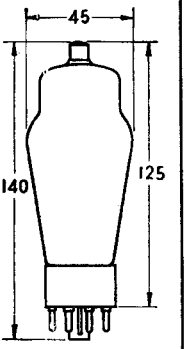
In order to achieve maximum stability and to reduce the control grid current to a minimum :—

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.

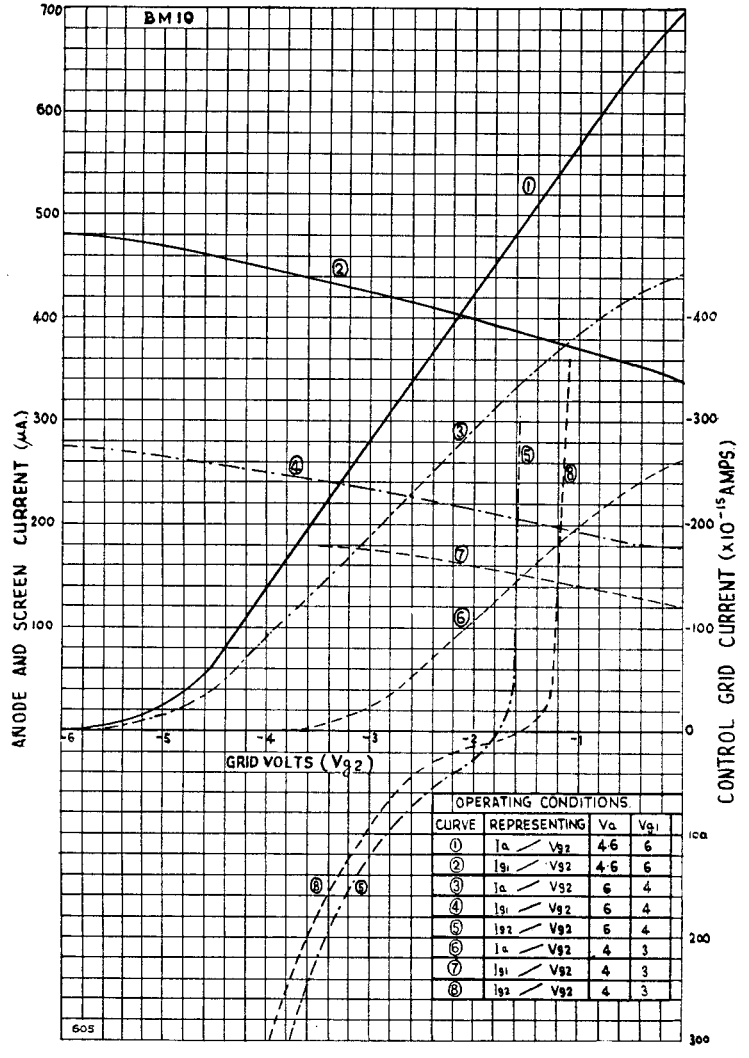
A steady operating condition of the valve will be more rapidly achieved if the heater voltage is applied at least 45 seconds before the anode and screen potentials.



All dimensions shown are in millimetres (max.).

Issue 1
Dec., 1955
(Tentative)

BM10



OPERATING CONDITIONS			
CURVE	REPRESENTING	Va	Vg1
①	Ia / Vg2	4·6	6
②	Ig1 / Vg2	4·6	6
③	Ia / Vg2	6	4
④	Ig1 / Vg2	6	4
⑤	Ig2 / Vg2	6	4
⑥	Ia / Vg2	4	3
⑦	Ig1 / Vg2	4	3
⑧	Ig2 / Vg2	4	3

Ferranti

FLASH TUBE

CD10

CD11

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.

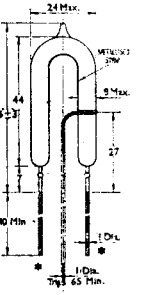
RATINGS. (Both types)

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

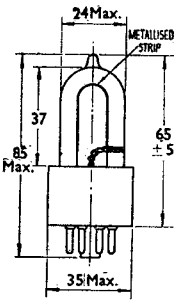
TYPICAL OPERATION. (Both Types)

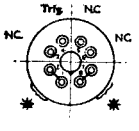
Operating Voltage	410 Volts
†Trigger Voltage	2 to 3 kV
Discharge Capacitor	600 μF
Charging Resistor	3·3 kΩ (6 watt)
Flash Duration	·002 Sec Approx.

A typical circuit is shown overleaf



Type CD10





Type CD11

Dimensions in millimetres

*At maximum dissipation.

†Ferranti Miniature Pulse Transformer Type PT56 is recommended.

Tentative Issue 3. Nov., 1963

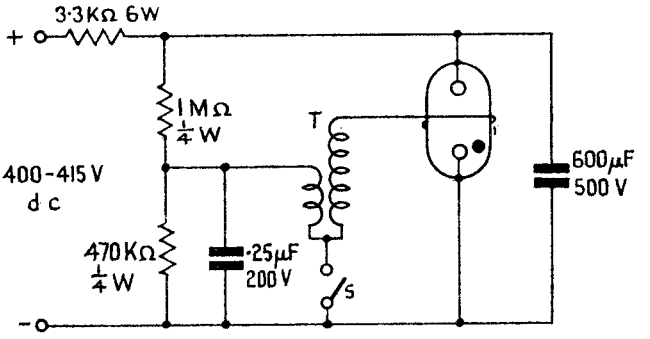
Ferranti

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.

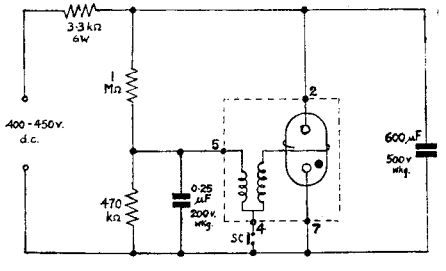
**The device is non-polarised, the charging voltage and discharge capacitor may therefore be connected across the pins 2 and 7 without regard to polarity.

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 μF

TYPICAL OPERATION

Operating Voltage	420 Volts
Trigger Pulse at Pin 5	See Note ‡
Discharge Capacitor	600 μF
Charging Resistor	3·3 kΩ (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 μF
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.

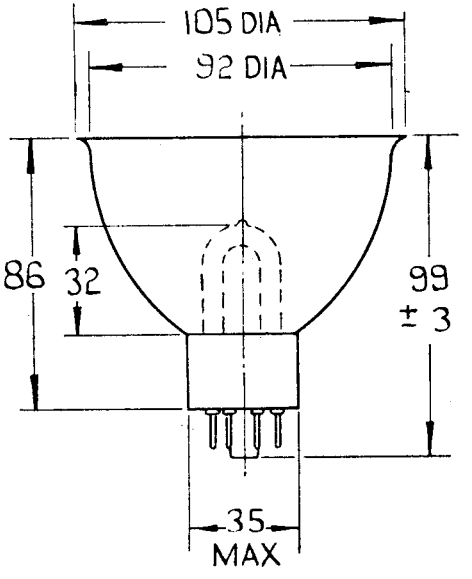
Monochrome Film

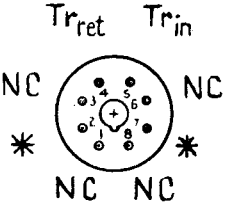
Film Speed A.S.A.	Guide No.
25— 32	50
40— 50	65
64— 80	85
110—125	105
160—200	125
250—320	150

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.

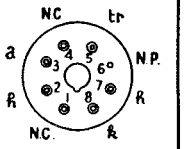
FERRANTI

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.

CL40

CL41



Base Connections
Underside View of Base

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

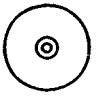
RATINGS.

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).	

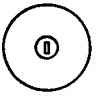
LIGHT SOURCE.

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.

Light Apertures



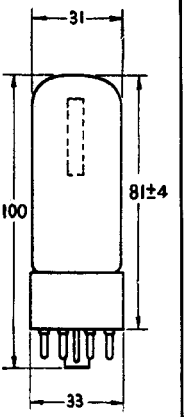
CL40



CL41

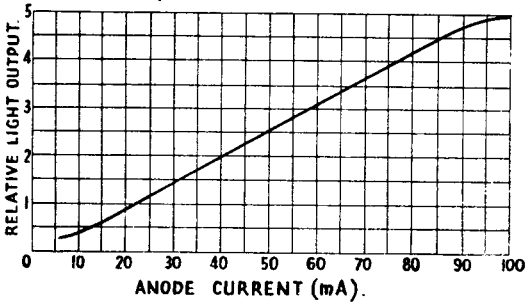
TYPICAL OPERATING CONDITIONS.

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



All dimensions shown are in millimetres.

LIGHT OUTPUT/TUBE CURRENT. AVERAGE CHARACTERISTIC.



*See "Notes on Operation" overleaf.

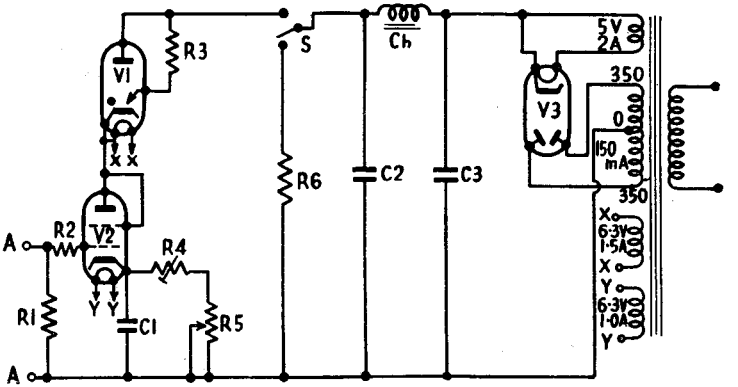
†It is recommended that the Trigger is connected to the anode by an external resistance of 22,000 ohms.

Issue 1
Jan.,1955

NOTES ON OPERATION.

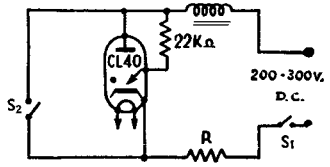
A recommended method of operation is to connect the CL40 in series with a hard valve which is capable of passing sufficient current to provide the required maximum modulation of the CL40.

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.



R1	220kΩ	R5	2kΩ Pot. 3W.	C3	8μF. 500V Wkg.
R2	10kΩ	R6	47kΩ 5W.	V1	Ferranti CL40/1
R3	22kΩ	Ch	20 Henries.	V2	Ferranti 807.
R4	300Ω Preset 3W.	C1	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.

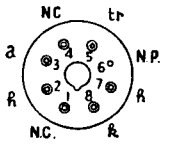
For applications where optimum stability of light output is required this second period should be extended to 10–15 mins.

Ferranti

CL42

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.



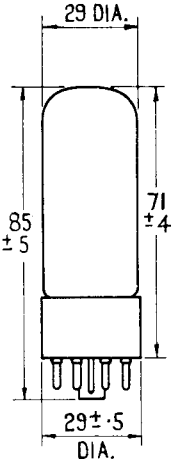
Base Connections Underside View of Base

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

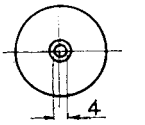
BASE CONNECTIONS.

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



Light Aperture

Dimensions are in millimetres

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

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.

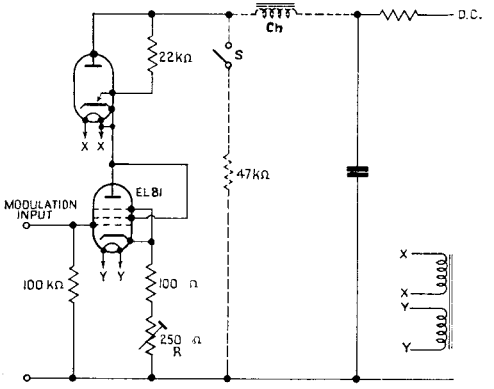
Ferranti

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.

Ferranti

LINEAR LIGHT SOURCE

CL44

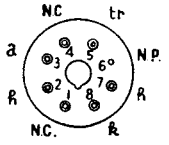
A Neon filled, end viewing, light source which can be modulated. The light output is proportional to the anode current.

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.

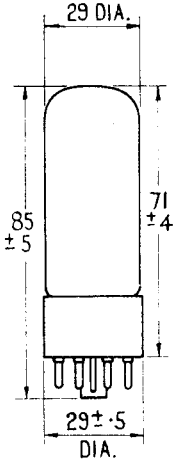
Pin 1—No Connection	Pin 5—Trigger
Pin 2—Heater	Pin 6—No Pin
Pin 3—Anode	Pin 7—Heater
Pin 4—No Connection	Pin 8—Cathode



Base Connections Underside View of Base

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.

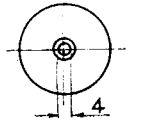
†Max. Trigger Voltage	400 volts (d.c.)
‡Min. Cathode Current	10 mA
Max. Modulation Frequency ...	15 Kc/s
Max. Anode/Cathode Volt Drop	55 volts

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.

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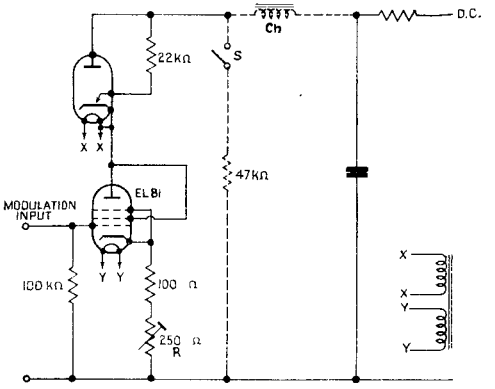
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TYPICAL OPERATION.

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.

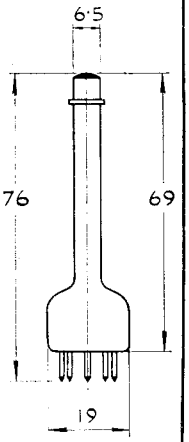
Ferranti

LINEAR LIGHT SOURCES

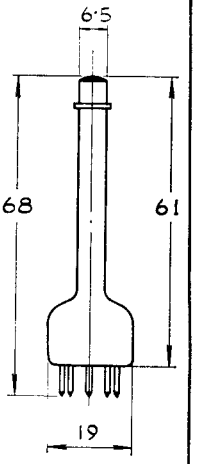
Gas filled light sources in which the light output is proportional to the anode current. Used for phototelegraphic picture recording, sound film recording, time interval marking and stroboscopic and many other applications.

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 } Heater. *
Pin 3 } Heater. *	Pin 7 }
Pin 4 }	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.

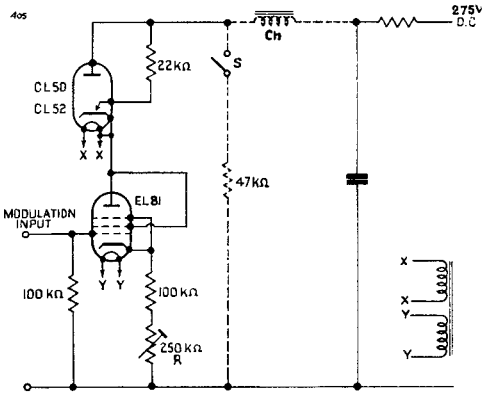
‡In a circuit as shown overleaf this is the lowest value of current to maintain the discharge. Operation at lower values can be achieved with special circuitry.

§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.

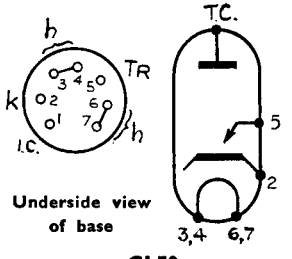
(2). Before the application of anode or trigger voltages, the tubes must be run with heater volts only applied as indicated below.

(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.

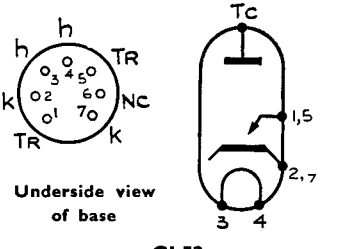
(b). Type CL52 - On all occasions the heater voltage should be applied at least one minute before H.T. voltage followed by an unmodulated stabilising period of 5 minutes during which time the anode current should be near 40 mA.

(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

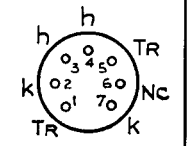
CL52

Ferranti

SPECTRAL LIGHT SCOURCES

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.

CL 55
CL 56
CL 57
CL 58



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.

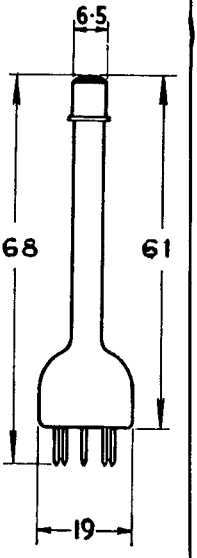
Pin 1—Trigger.	Pin 5—Trigger.
Pin 2—Cathode.	Pin 6—No connection.
Pin 3—Heater.	Pin 7—Cathode.
Pin 4—Heater.	Top Cap—Anode.

HEATER.

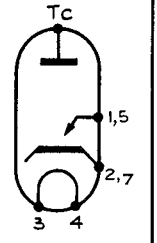
	CL55	CL56	CL57	CL58	
Heater Voltage ...	6·3	6·3	6·3	6·3	volts.
Heater Current ...	1·5	1·5	1·3	1·5	amps.

RATINGS & CHARACTERISTICS.

Type No. / Gas	CL55 He.	CL56 Kr.	CL57 Ne.	CL58 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.



Dimensions are in millimetres (max.)



*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.

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Apr., 1961

Ferranti

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.

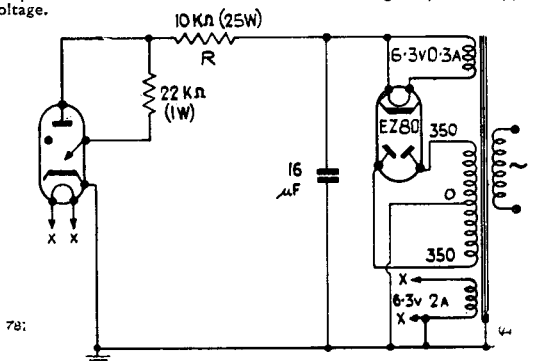


Fig. 1.

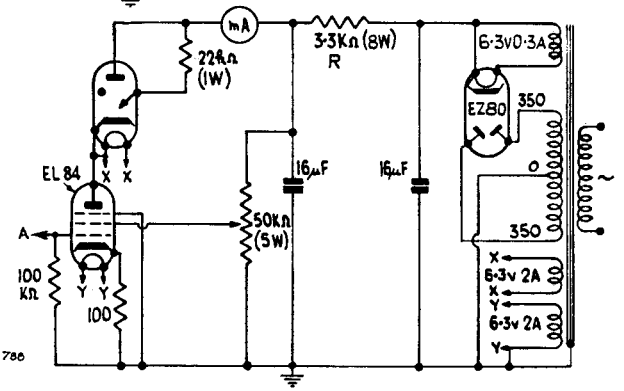


Fig. 2.

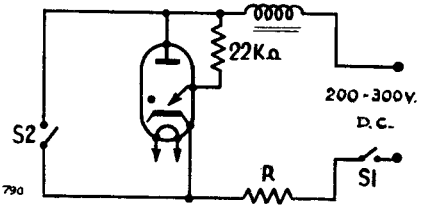


Fig. 3.

FERRANTI

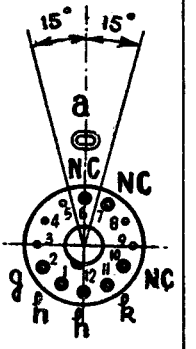
VACUUM LIGHT SOURCES — HIGH SPEED STROBOSCOPIC LIGHT SOURCES

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.

CL60
CL61
CL62
CL63
CL64
CL65
CL66

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.

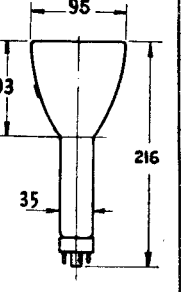
Type	*Phosphor*	*Luminescence*	*Decay Time**
CL60	A type	Green	<1μsec.
CL61	P type	Blue	5μsecs. approx.
CL62	Q type	Ultra-Violet	0·1μsec. approx.
CL63	C type	Yellow-Green	6μsecs. approx.
CL64	V type	Yellow	5μsecs. approx.
CL65	R type	Red	2μsecs. approx.
CL66	T type	White	5μsecs. approx.

BASE CONNECTIONS.

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

CL60
CL61
CL62
CL63
CL64
CL65
CL66

LUMINOUS AREA.

The unfocused luminous area is 5 cm. dia. minimum. The fluorescent area may be reduced to approx. ½in. diameter by means of a suitable focus coil : under this condition care must be taken to avoid damaging the phosphor by overloading.

FLASH DURATION.

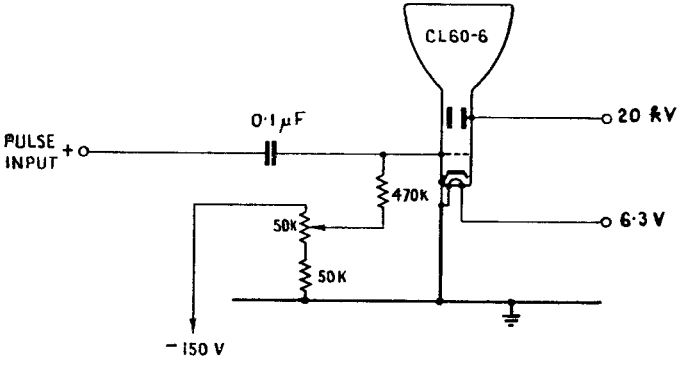
The minimum duration of the flash depends on the duration of the grid pulse and on the screen phosphor. With CL60 and CL62 the flash duration can be reduced to less than 1 microsecond.

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.

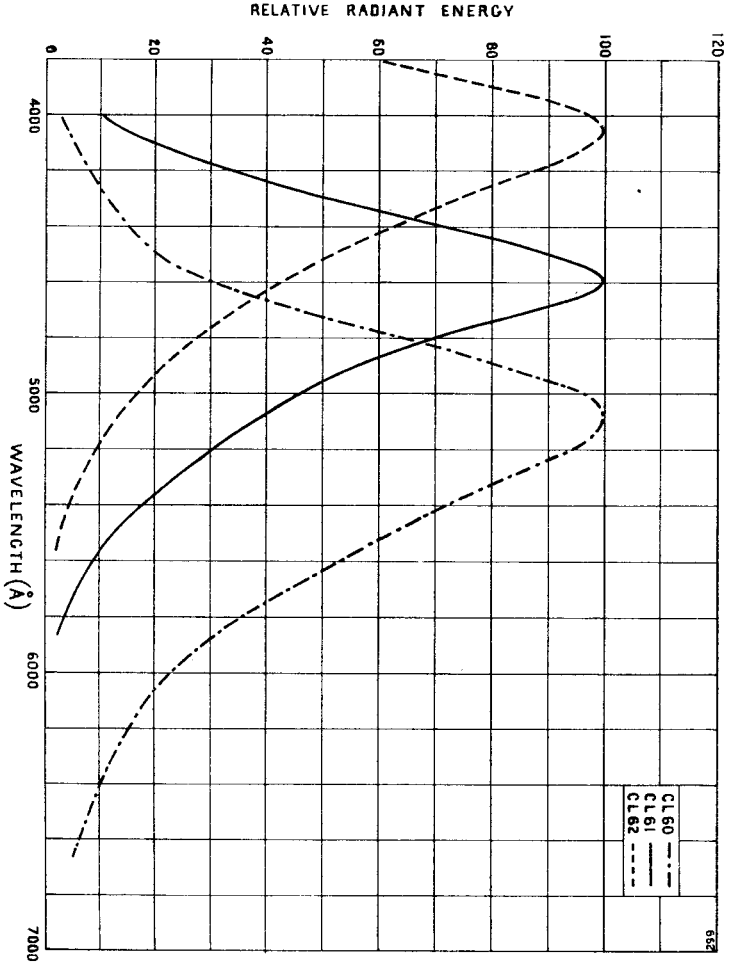
The usual method of operation of these Flash Tubes is to apply positive going pulses to the negatively biased control grid. A typical circuit is shewn on the following diagram :—



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.

TYPICAL PHOSPHOR CHARACTERISTICS IN THE VISIBLE SPECTRUM

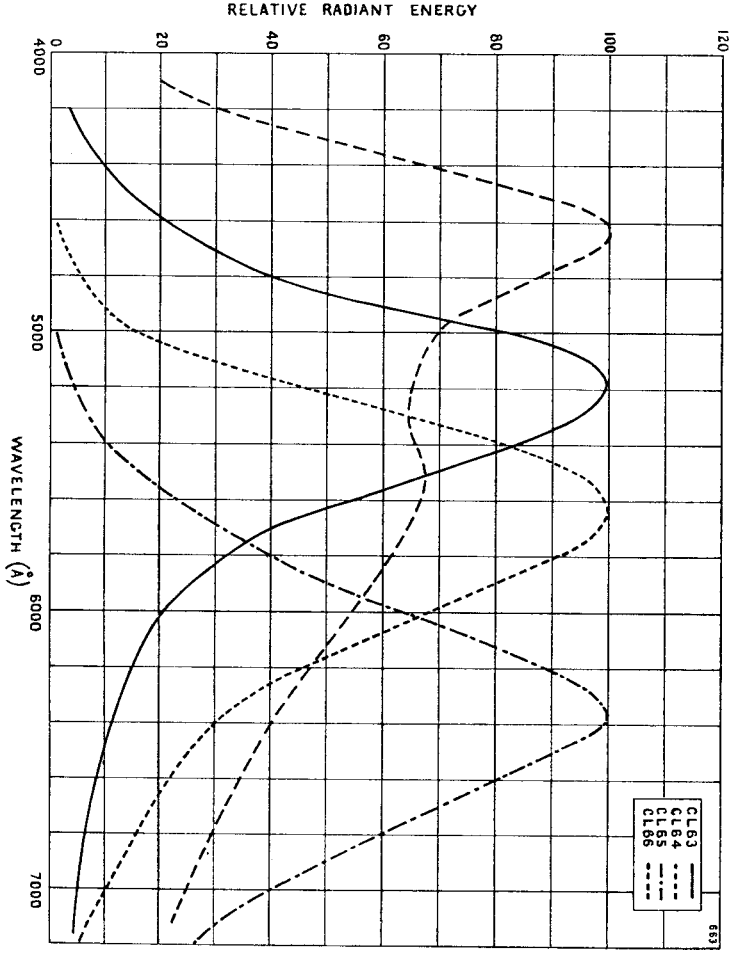
(NOTE—The curves are not relative to each other)



CL60
CL61
CL62
CL63
CL64
CL65
CL66

TYPICAL PHOSPHOR CHARACTERISTICS IN THE VISIBLE SPECTRUM

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



Ferranti

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. (3⅜in.).
Overall Length	102mm. (4 1/16 in.).
Diameter of Reflector	105mm. (4⅛in.).
Diameter of base	35mm. (1⅜in.).
*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.

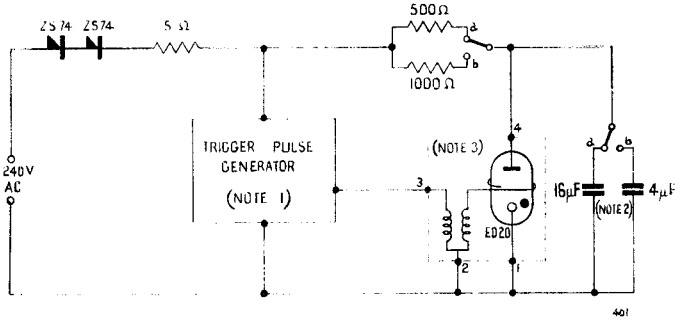
*The recommended method of mounting is by support at the flange of the reflector.

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.

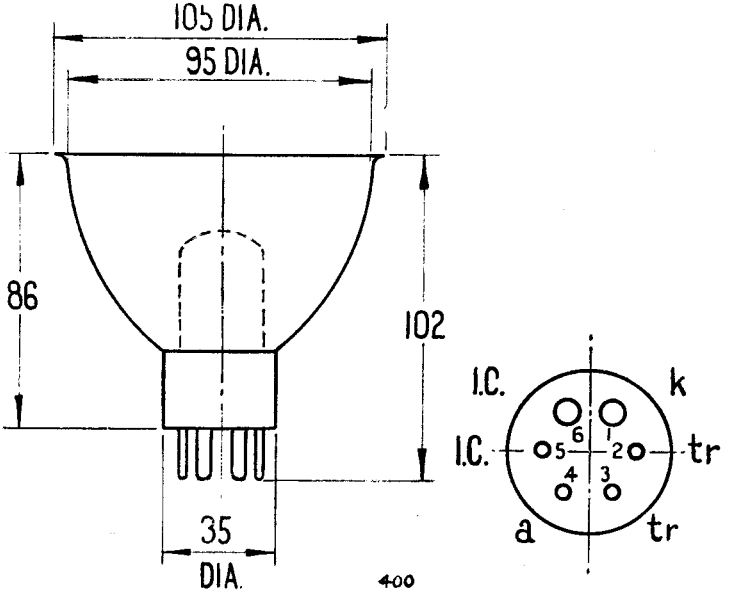
The trigger pulse generator circuit may use either valve or semi-conductor devices. It can conveniently consist of a means of controlling the frequency of a discharge through the primary of the built in transformer. A suitable discharge may be obtained from a capacitor of approx. 0·1 μF charged to 150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

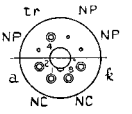


Ferranti

ED25

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.



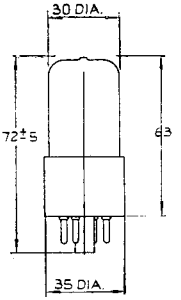
Underside View of Base

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 μF

TYPICAL OPERATION.

D.C. Supply Voltage	450 volts
*Trigger Voltage	2 to 4 kV
Discharge Capacitor	0·5 μF
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.

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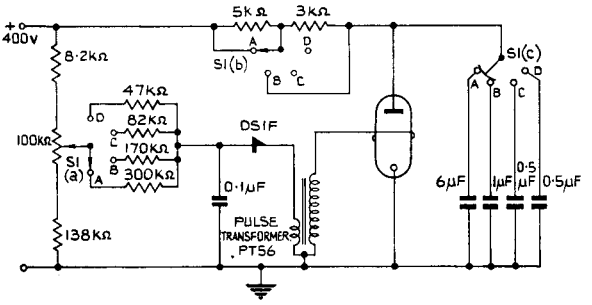
Ferranti

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%).

ED40

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.

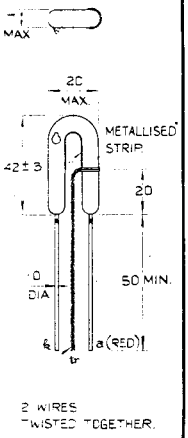
RATINGS.

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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TYPICAL OPERATION (Continued).

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

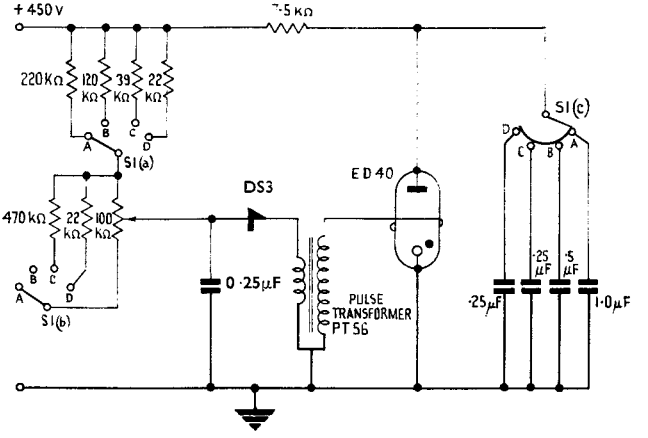
In this equipment a silicon p-n-p-n switch (Ferranti type DS.3) is used to provide a simplified trigger circuit.

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.

ED50

Ferranti

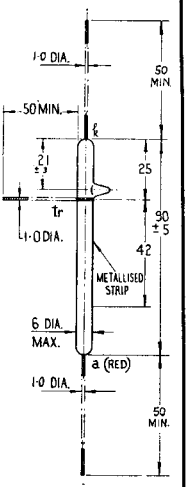
STROBOSCOPIC LIGHT SOURCE

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.



Dimensions in Millmetres

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

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

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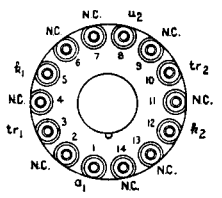
Ferranti

Ferranti

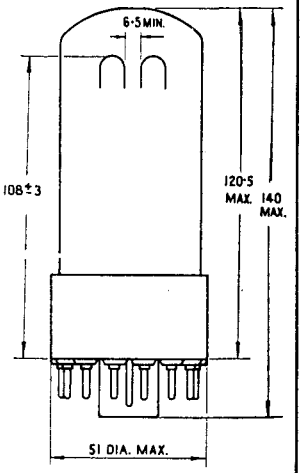
EDN10

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=6μF.

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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.

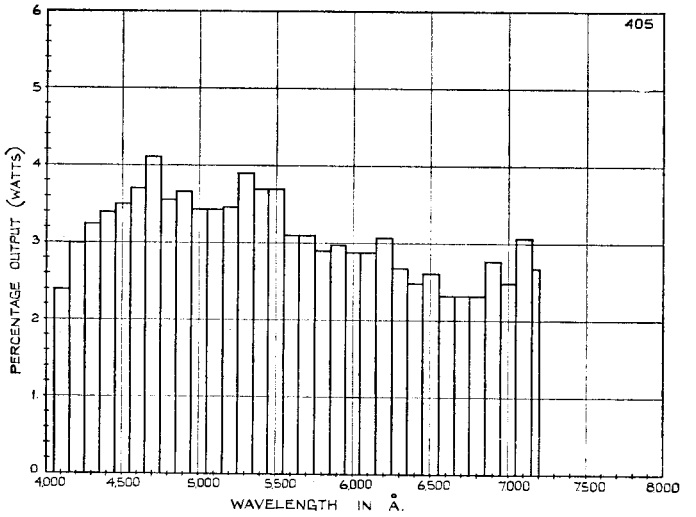
Connecting Leads. Because of the very high peak current of the discharge all the leads in the discharge path connecting the capacitor with anode and cathode should be of heavy gauge and as short as possible in order to ensure the maximum discharge energy.

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.

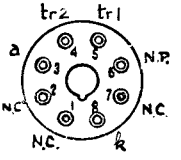


Ferranti

"NEOSTRON"
STROBOSCOPIC LIGHT SOURCE

EN10

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.



Base Connections

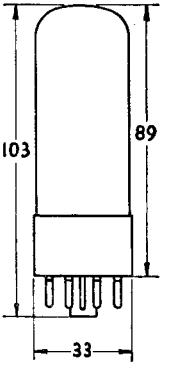
Underside View of Base

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. Base Diameter	32 mm. ($1\frac{1}{4}$in.).
Length of Arc	24 mm. ($1\frac{15}{16}$in.).
Mounting Position	Any.

PIN 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 (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 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 240	300 μA.
†Peak Luminous Intensity	700 candelas.
†Flash Duration at $\frac{1}{2}$peak	15 μSec.
†Peak Anode Current	400 amps.
§Triggering delay	< 40 μSec.

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 μF.
Up to 50 f.p.s. ...	3 μF.
to 80 f.p.s. ...	2 μF.
to 150 f.p.s. ...	1 μF.
to 250 f.p.s. ...	0·5 μF.

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.

All dimensions shown are in millimetres.

*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 μF.

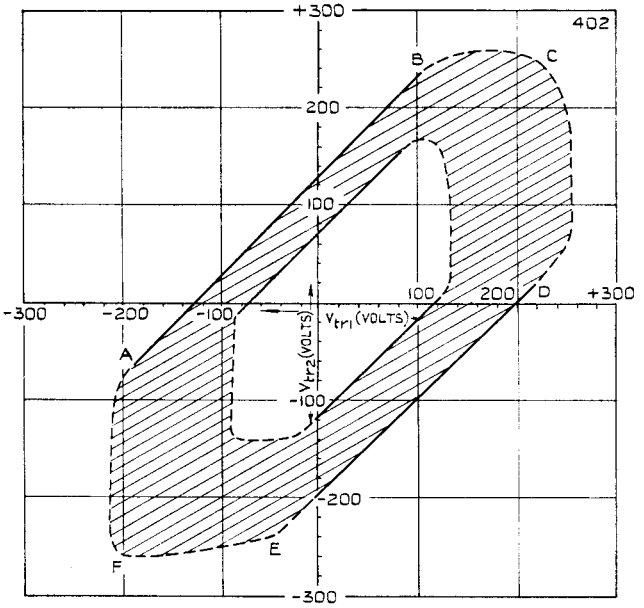
§See 'Notes on Operation'.

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Ferranti

Ferranti

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:—

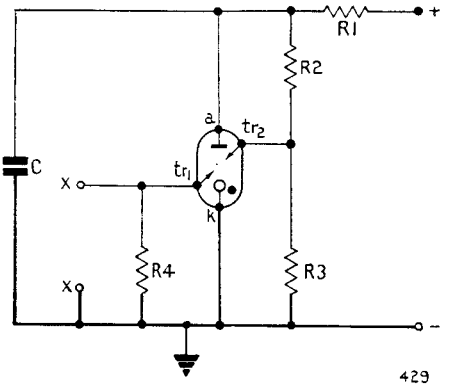
Between BC Trigger Electrode 2 to Cathode.
CD Trigger Electrode 1 to Cathode.
DE Trigger Electrode 1 to Trigger Electrode 2.
EF Cathode to Trigger Electrode 2.
FA Cathode to Trigger Electrode 1.
FB Trigger Electrode 2 to Trigger Electrode 1.

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 μF 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.

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:—

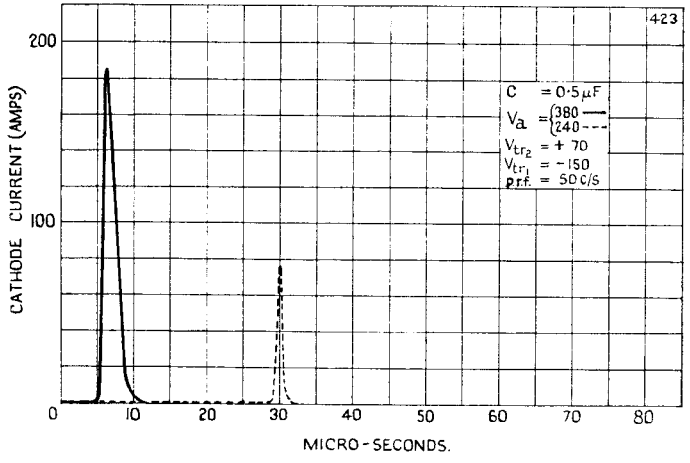
$$I_a(\text{mean}) = \frac{CVf}{1000} \quad \text{mA.}$$

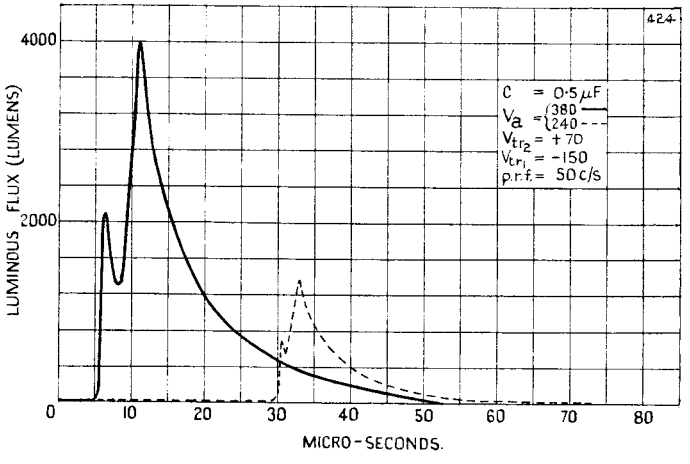
where C = discharge capacitor in μF.
V = voltage to which capacitor is charged at instant of triggering.
f = flash frequency per second.

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

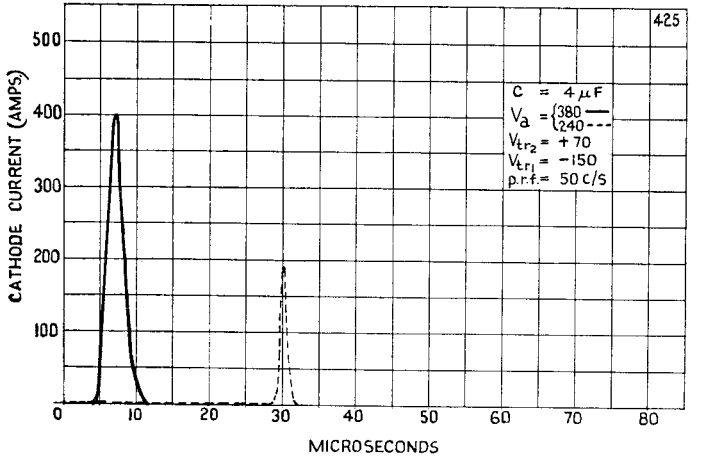
The circuit resistance between cathode and tr_1 and between cathode and tr_2 must have a value of at least 1000 ohms in each instance. A resistance of the order of 100,000 ohms is recommended.

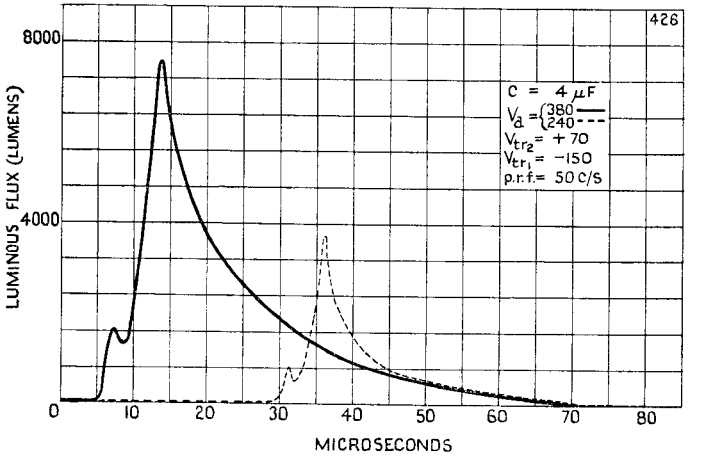
TYPICAL DISCHARGE CHARACTERISTICS



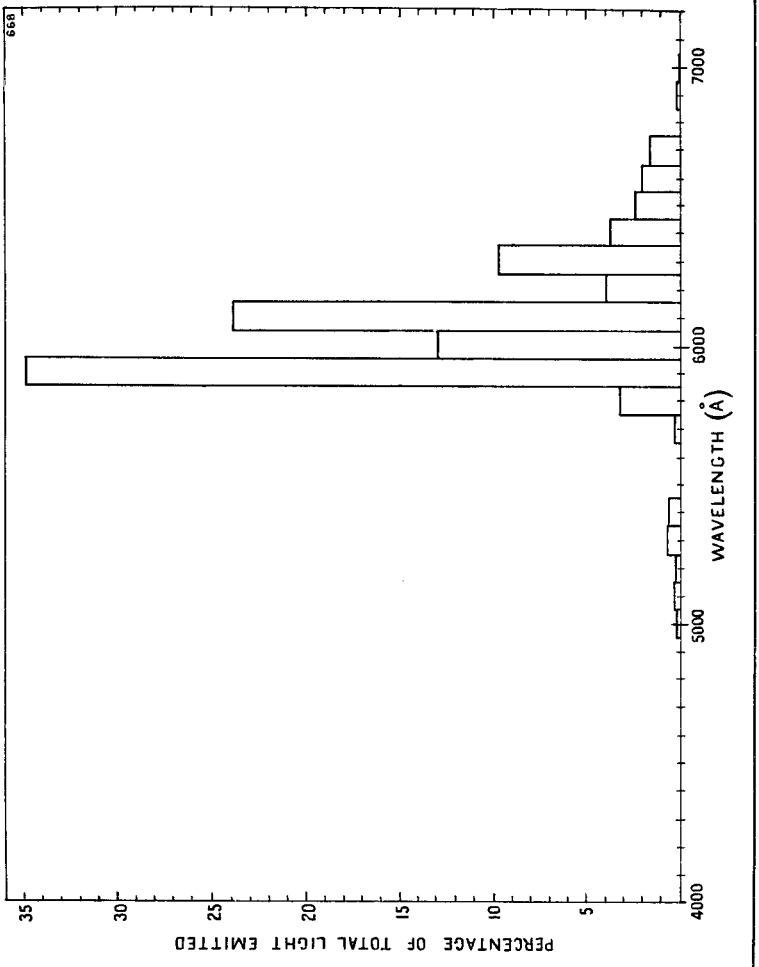


TYPICAL DISCHARGE CHARACTERISTICS





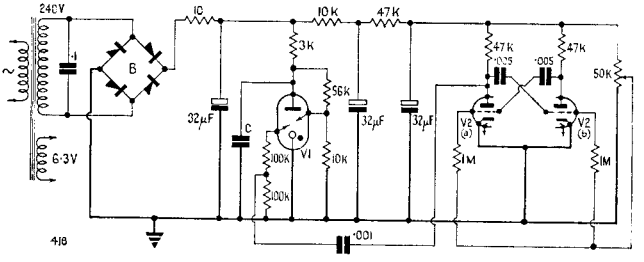
SPECTRAL DISTRIBUTION OF VISIBLE LIGHT



Ferranti

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

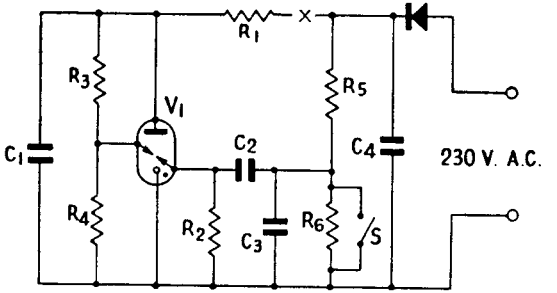
V2(a) }
V2(b) } — Ferranti ECC 81

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.

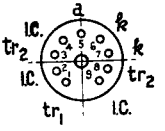
Closing of switch S causes a single flash, and operates an electro-magnetic relay which should be inserted at the point 'X'.

Ferranti

STROBOSCOPIC LIGHT SOURCE

EN15

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.



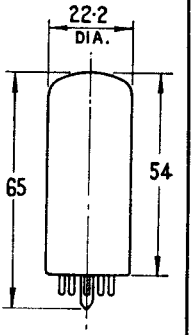
Base Connections
Underside View of Base

PHYSICAL SPECIFICATION.

Base	B9A/D.
Max. Seated Height	54 mm. (2⅛in.).
Max. Overall Length	65 mm. (2⅝in.).
Max. Diameter	22·2 mm. (⅞in.).
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.

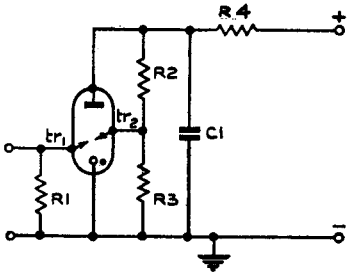
Tentative
Issue 1
Mar., 1961

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.

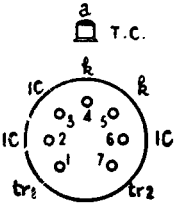
f = flash frequency per second.

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.

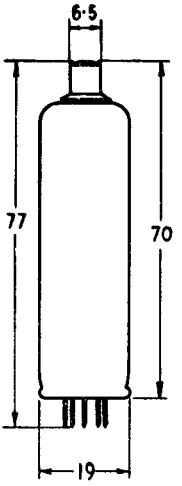
CHARACTERISTICS.

‡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 1μF 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.

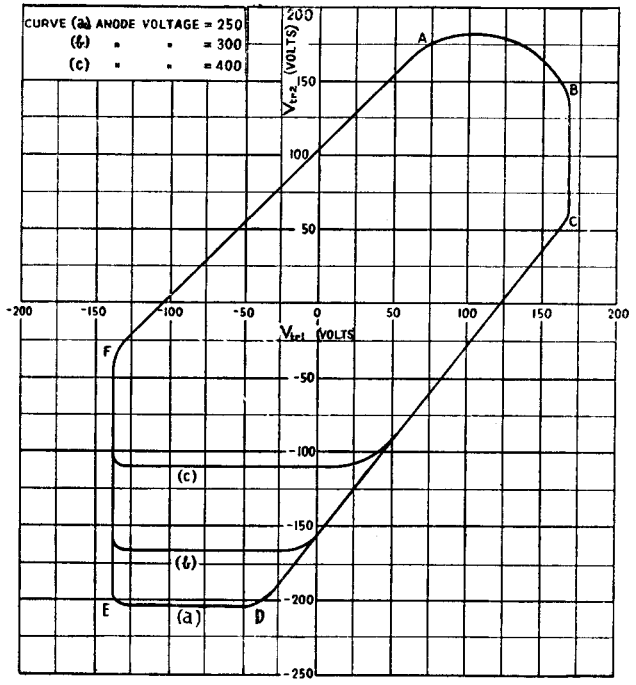
**At instant of triggering.

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

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Aug., 1959

FERRANTI

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 page1).

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.)

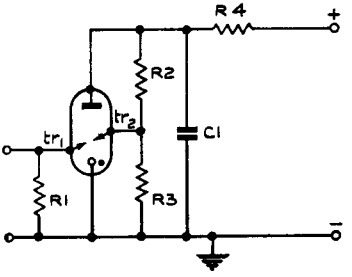
As the triggering impulse carries the vector sum of the applied voltages outside the loop the point at which it crosses the loop indicates the manner in which the valve is triggered as follows :—

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).

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 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.

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

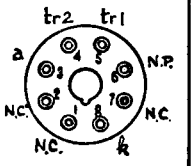
COLD CATHODE TETRODE

EN40

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.

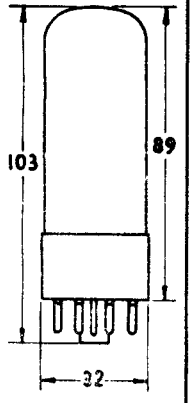
CHARACTERISTICS.

††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 μA.
V_a = 250	300 μA.

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 μF.
30–50 c.p.s.	3 μF.
45–80 c.p.s.	2 μF.
80–150 c.p.s.	1 μF.

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.

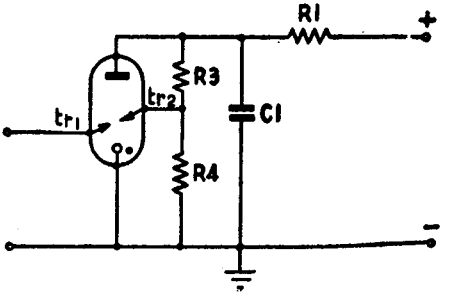
‡At instant of triggering.

§V_{tr_1} negative with respect to cathode.

Issue 3
Mar., 1958

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 :—

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

where C = discharge capacitor in μF.

V = voltage on discharge capacitor at instant of triggering.

f = flash frequency per second.

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.

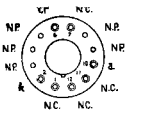
The circuit resistance connected between cathode and tr_1 and cathode and tr_2 must have a value of at least 1000 ohms.

Ferranti

EN55

STROBOSCOPIC LIGHT SOURCE

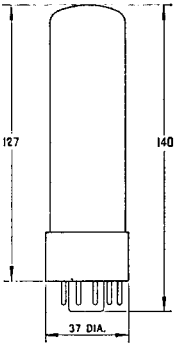
A xenon filled cold cathode arc discharge tube designed for use in stroboscopic applications at frequencies up to 400 c/s. It emits a white light.



Underside View of base

PHYSICAL DETAILS.

Base	B12A (Duodecal).
Max. Seated Height	127 mm. (5 in.).
Max. Overall Length	140 mm. (5½ in.).
Max. Diameter (over base) ...	37 mm. (1 13/32 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 ⅓ 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

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.

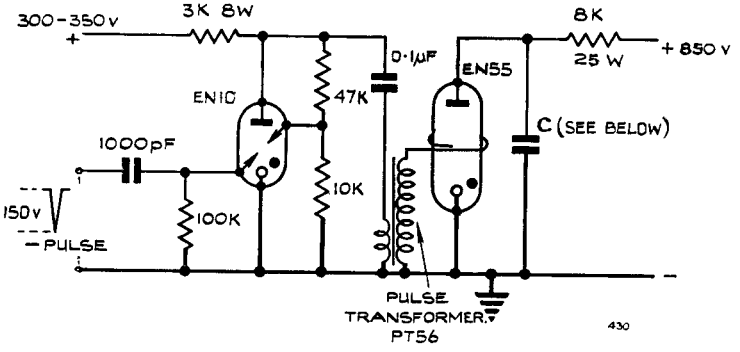


Fig. 1

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).

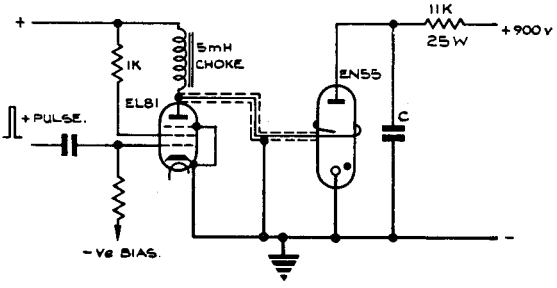


Fig. 2

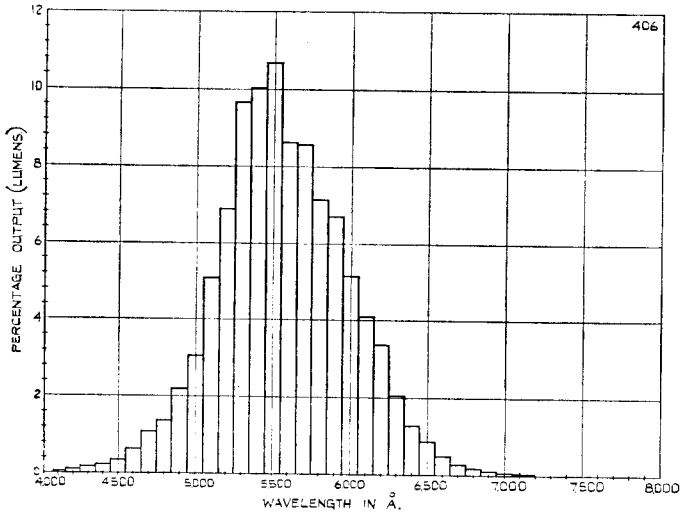
Recommended values of C —

250–400 c/s ... ... 0·25 μF.

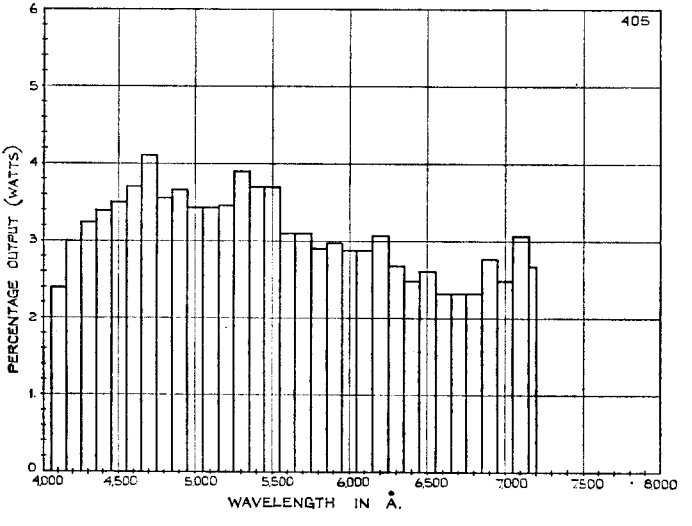
A simple air cored or "ferrox" cored choke with an inductance of approximately 5 mH and adequate insulation will be suitable.

SPECTRAL CHARACTERISTICS

DISTRIBUTION OF LIGHT OUTPUT OVER THE VISIBLE SPECTRUM

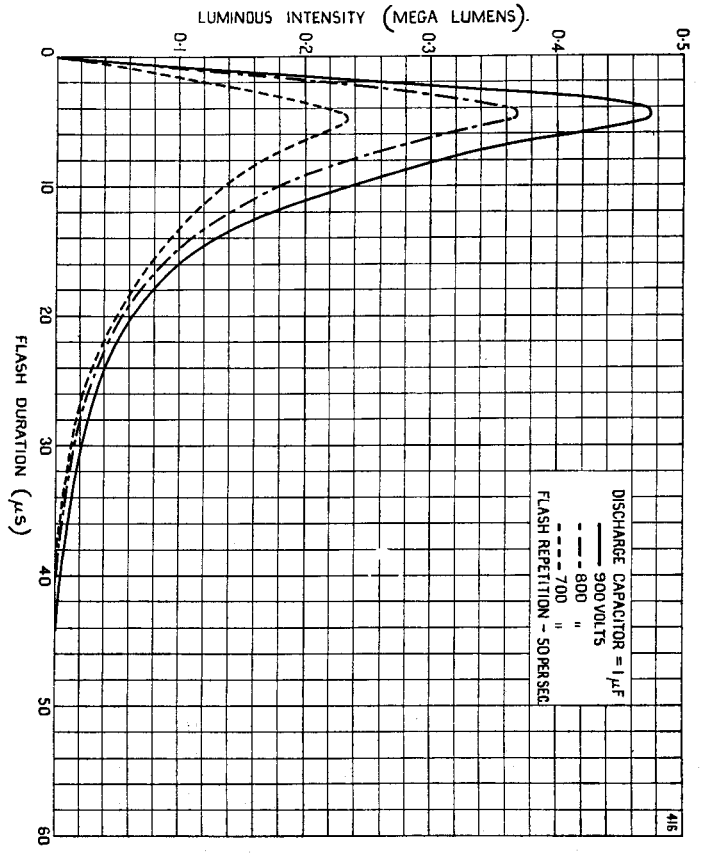


DISTRIBUTION OF RATE OF EMISSION OF ENERGY OVER THE VISIBLE SPECTRUM

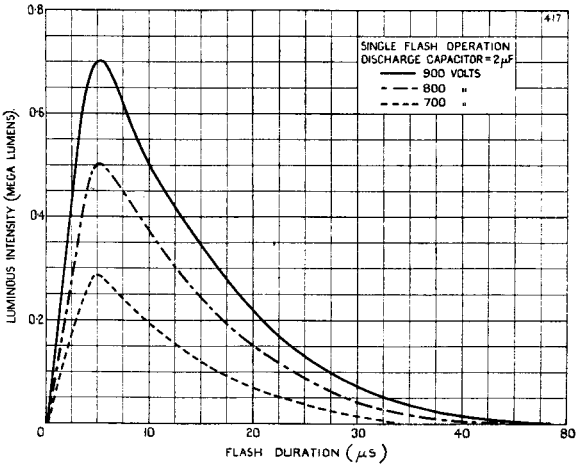


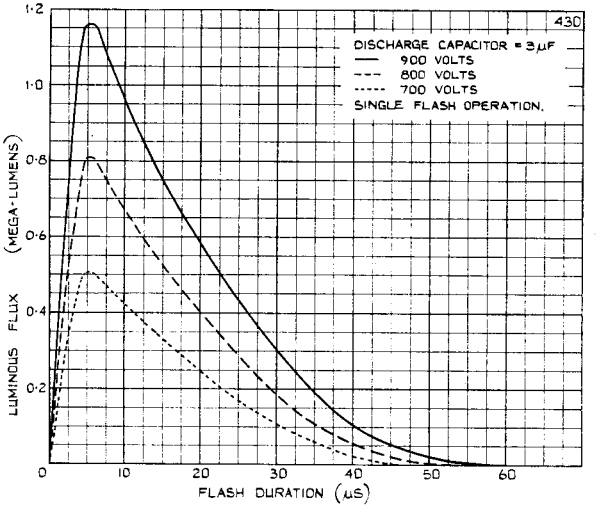
Ferranti

TYPICAL FLASH CHARACTERISTICS
at 50 flashes per sec.



TYPICAL FLASH CHARACTERISTICS
Single Flash Operation





Ferranti

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 $\frac{1}{8}$ 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.

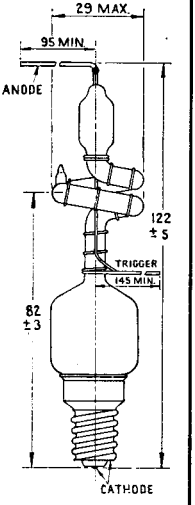
FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS

EN60

Ferranti

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. ($1\frac{1}{32}$ 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.

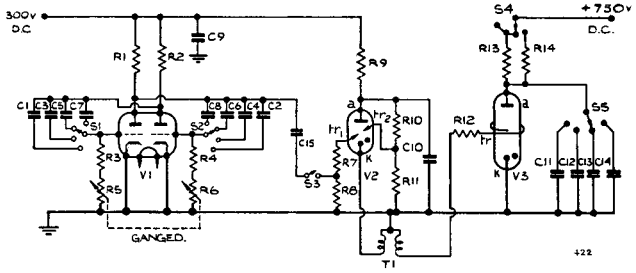
Issue 3.
Jan., 1962.

Ferranti

Typical Operation (Cont.)

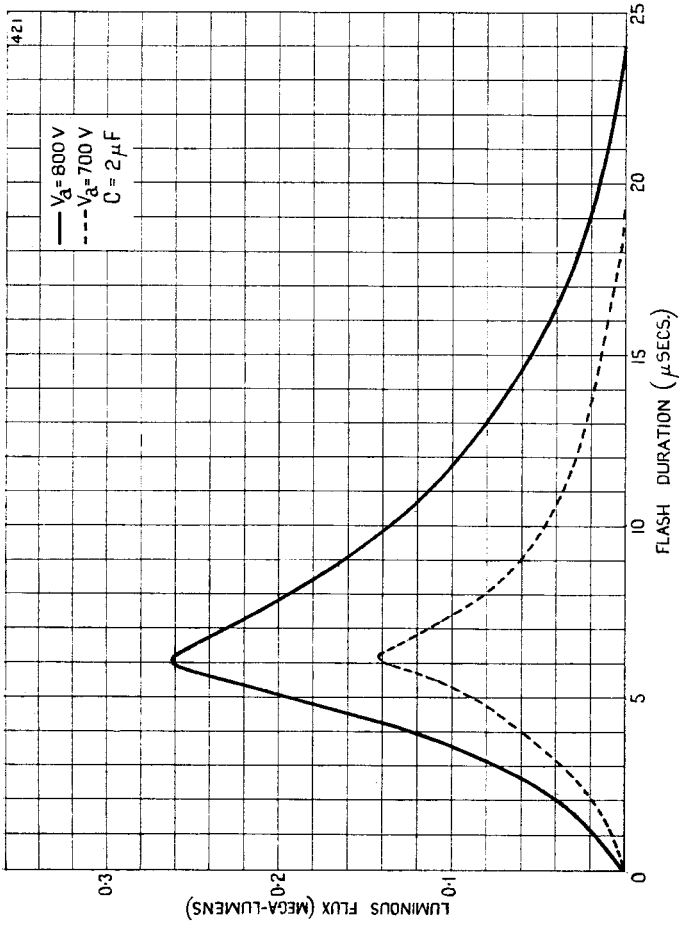
FOUR RANGE STROBOSCOPE.

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.

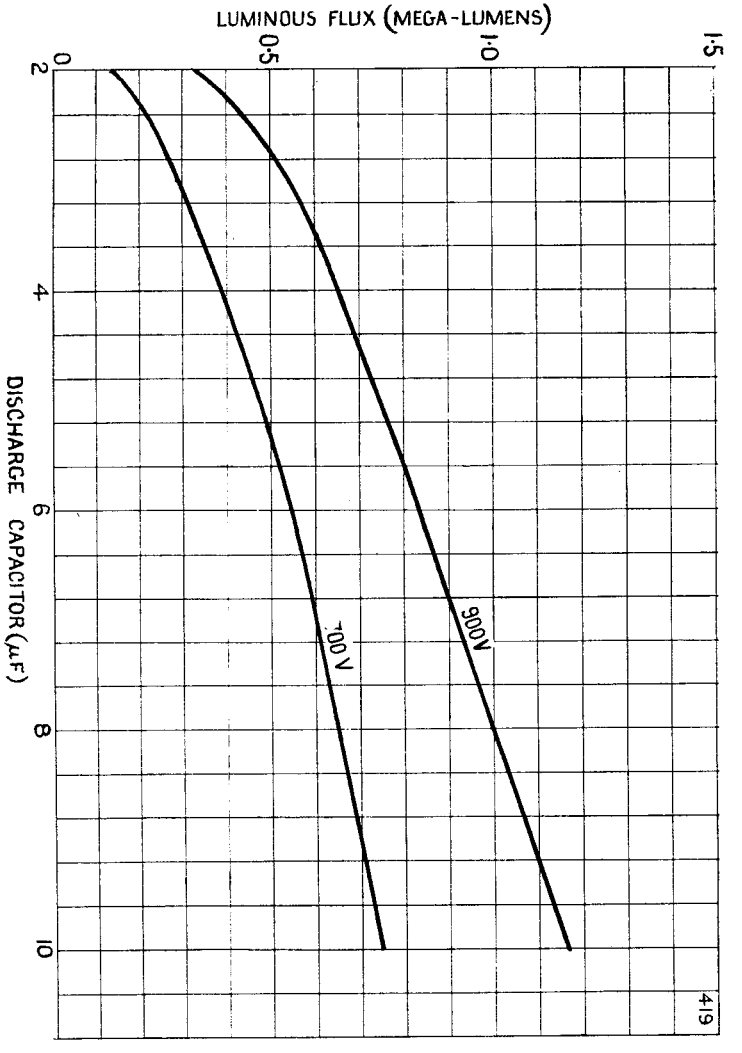


V1	Ferranti Valve Type ECC81.		
V2	Ferranti Valve Type EN10.		
V3	Ferranti Valve Type EN60.		
T1	Ferranti Pulse Transformer Type PT56.		
R1	47 kΩ	C1	·25 μF.
R2	47 kΩ	C2	·25 μF.
R3	50 kΩ	C3	·1 μF.
R4	50 kΩ	C4	·1 μF.
R5, R6	2 × 100 kΩ—Ganged	C5	·03 μF.
		C6	·03 μF.
R7	100 kΩ	C7	·01 μF.
R8	100 kΩ	C8	·01 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



TYPICAL PEAK LUMINOUS FLUX

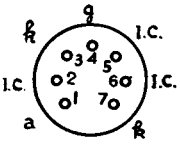


FERRANTI

COLD CATHODE TRIODE

GK10

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



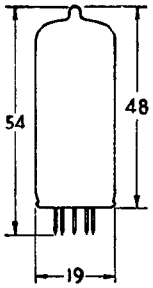
Base Connections Underside View of Base

PHYSICAL DETAILS.

Base	B7G.
Max. diameter (glass envelope)	19 mm. (¾in.).
Max. seated height	48 mm. (1⅞in.).
Max. overall length	54 mm. (2⅛in.).
Mounting position	Any.

BASE CONNECTIONS.

Pin 1—Anode.	Pin 4—Trigger.
Pin 2—Internal Connection.	Pin 5—Internal Connection.
Pin 3—Cathode.	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 μA.
Recovery Time	800 μSecs. (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 μA.

TYPICAL OPERATING CONDITIONS.

*Anode Voltage	135 volts DC.
†Static Bias (positive)	55 volts DC.
Transfer Current	4 μA.
†Trigger Pulse Amplitude ...	50 volts.

All dimensions shown are in millimetres (max.).

‡At $V_a = 135$.

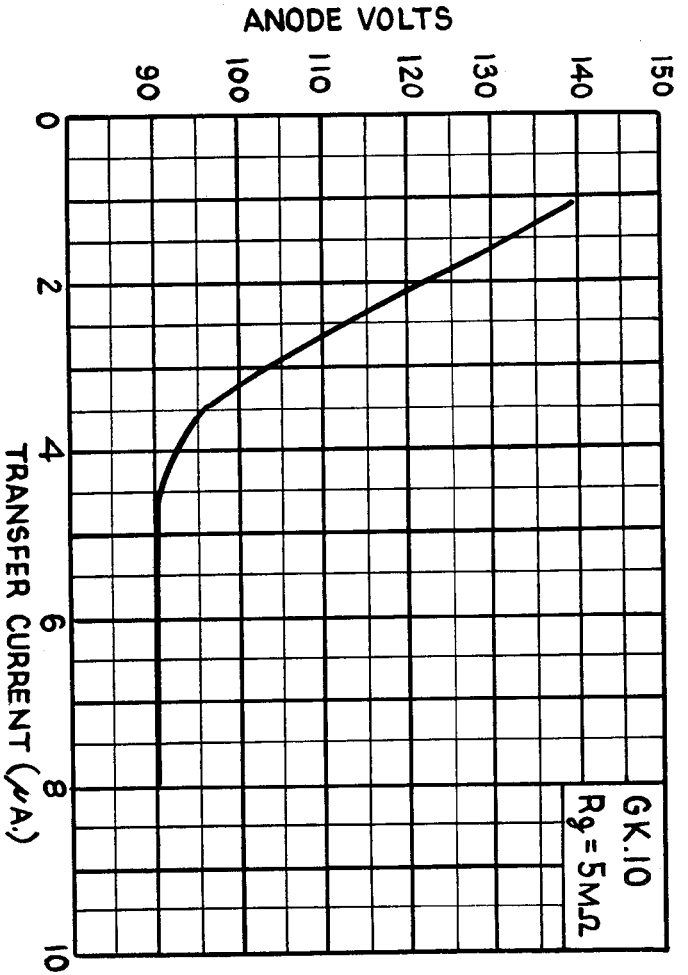
§10 microamperes is the minimum current to ensure interchangeability and reliable operation during life, but transfer currents on individual valves may be considerably lower.

*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.

Issue 2
July, 1955

GK10

FERRANTI



AVERAGE TRANSFER CHARACTERISTIC

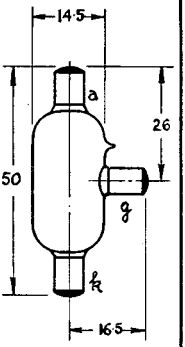
FERRANTI

COLD CATHODE TRIODES

GK32

GK33

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.	

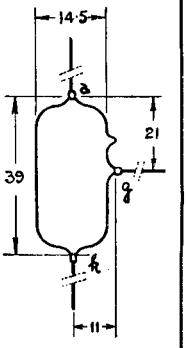
On Type GK32 the electrodes are brought out to CT.1 caps in order to permit mounting in standard clips.

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 ...	≮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.

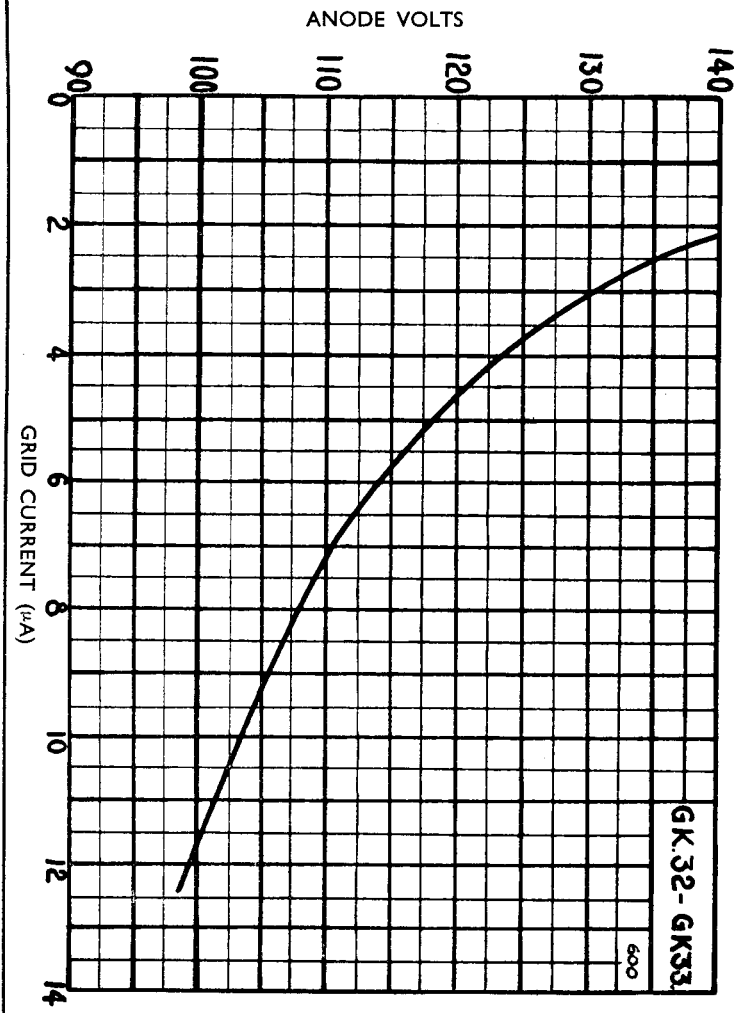
These valves were formerly designated K32 and K33.

All dimensions shown are in millimetres (nom.).

Issue 3
Dec., 1955

GK32

GK33



AVERAGE TRANSFER CHARACTERISTIC

FERRANTI

COLD CATHODE TRIODES

GK40

GK41

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

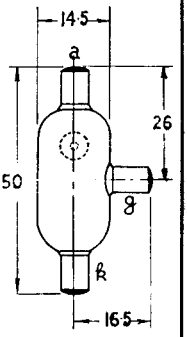
PHYSICAL DETAILS.

	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.

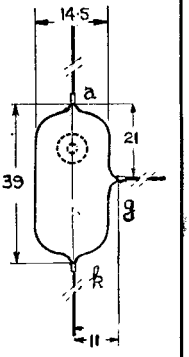
Type GK41 is fitted with flexible leads and is intended to be wired in to the equipment.

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.

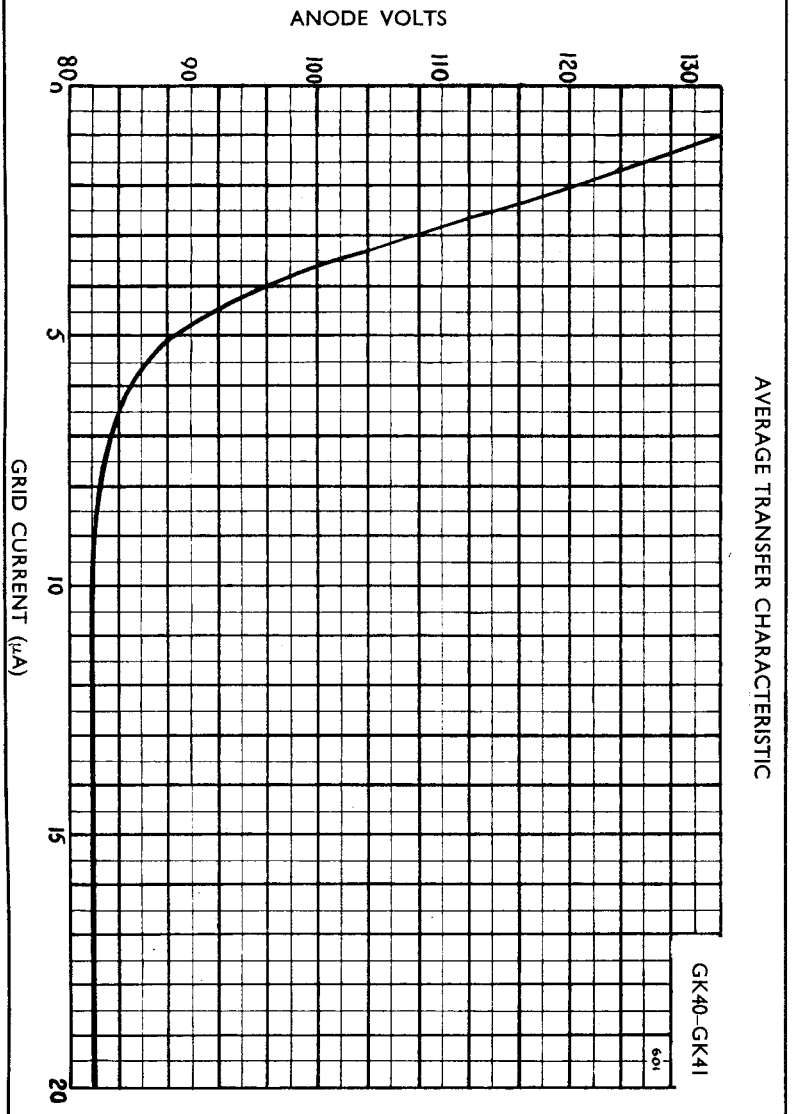
These valves were formerly designated K40 and K41.

All dimensions shown are in millimetres

Issue 3
Dec.,1955

GK40

GK41


ANODE VOLTS
80
90
100
110
120
130
5
10
15
20
GRID CURRENT (μA)
AVERAGE TRANSFER CHARACTERISTIC
GK40–GK41
601

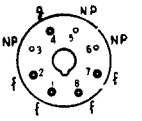
FERRANTI

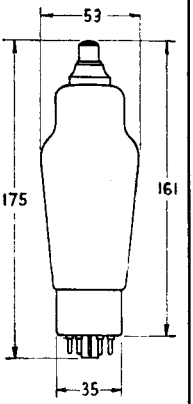
TRIODE THYRATRON

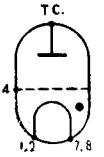
GL1

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

TC







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 :

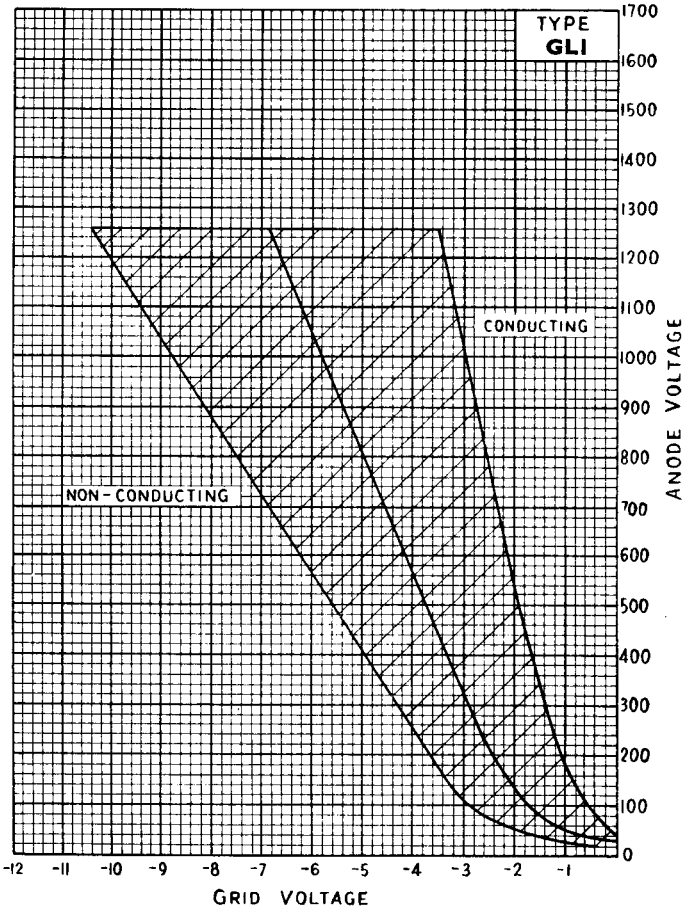
Grid to Anode	1·8 pF.
Grid to Filament ...	5·8 pF.

*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

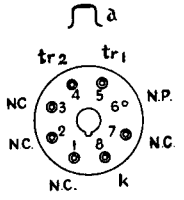


FERRANTI

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 ($\frac{1}{2}$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 μF.

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	μA.
Min. Trigger Current required at V_a 320	100	μA.

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

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

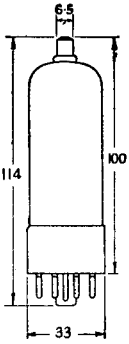
TYPICAL OPERATION.

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 μF.
250 c.p.s.	0·5 μF.

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.



All dimensions shown are in millimetres.

*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

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.

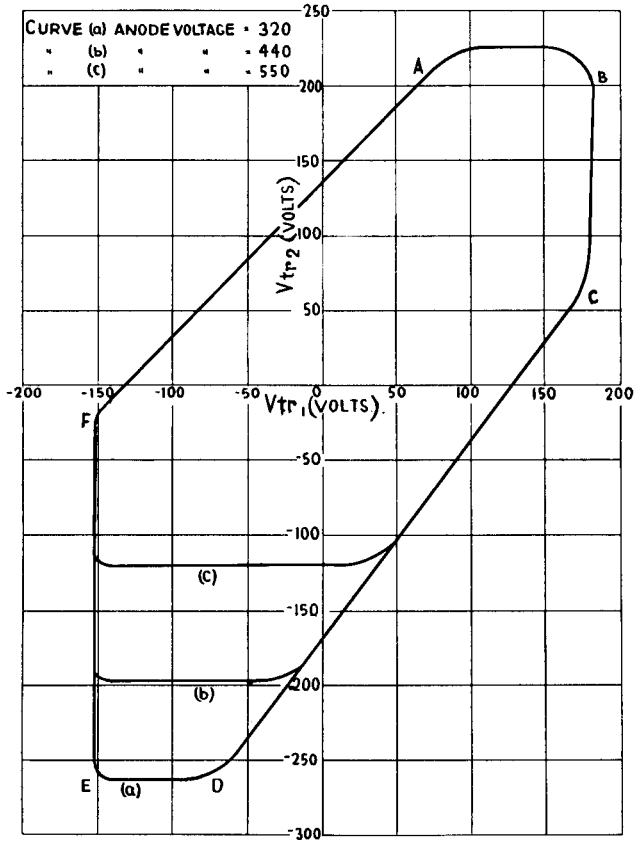
As the triggering impulse carries the vector sum of the applied voltages outside the loop, the point at which it crosses the loop indicates the manner in which the valve is triggered as follows :—

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

GN20

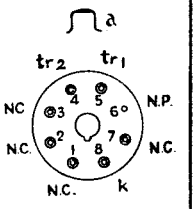
Type GN20 is a gas-filled cold cathode arc discharge valve. It is designed for pulse operation, and is particularly suitable for such applications as Electronic Relays where short duration pulses of up to 250 Amperes peak are required. The gas filling is argon.

PHYSICAL SPECIFICATION.

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

BASE CONNECTIONS.

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



Base Connections

Underside View of Base

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 :—	
Va = 420	50 μA.
Va = 350	100 μA.

TYPICAL OPERATION.

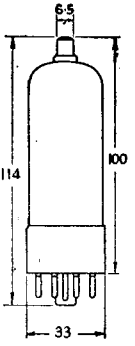
DC. Supply Voltage	360 volts.
Trigger Electrode No. 2 Voltage (V_{tr_2})	60 volts.
§Trigger Pulse Amplitude (V_{tr_1})	150 volts.
Charging Resistor	4000 ohms.
Discharge Capacitor for operation at :—	
50 c.p.s.	2 μF.
250 c.p.s.	0·5 μF.

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.

*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.

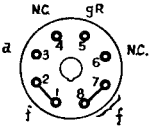
Issue 1
Aug.,1955

Ferranti

GRD7

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.

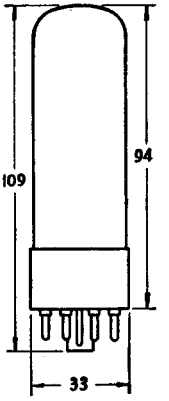
Base	... ...	International Octal.
Max. Overall Length	... ...	109 mm. (4$\frac{1}{4}$in.).
Max. Seated Height	... ...	94 mm. (3$\frac{11}{16}$in.).
Max. Diameter	... ...	33 mm. (1$\frac{5}{16}$in.).
Mounting Position	... ...	Vertical, base down.

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



Dimensions shown are in millimetres (max.).

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.

CHARACTERISTICS.

Electrical.

Filament Voltage (for I_f=2·2 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. $(-11600\phi/T.)$

Where a is the effective area of electron emission

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

A and ϕ are thermionic constants determined by the chemical nature of the cathode.

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

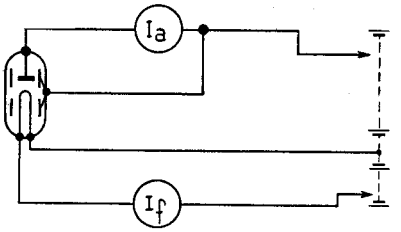
For Tungsten the generally accepted value of A is approximately 600 and the value of ϕ is 4·52.

The expression above therefore becomes

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

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

A typical circuit for demonstration is shown below:



410

Child-Langmuir Three-halves Power Law.

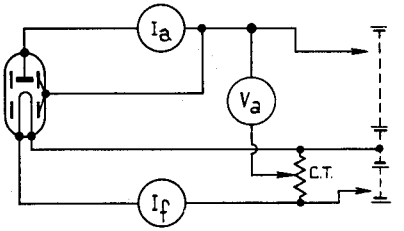
For a vacuum diode:—

I_a (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:—



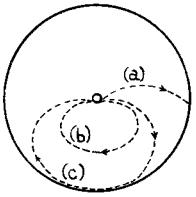
411

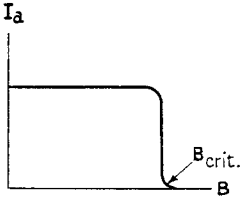
Hull's Law (Basic Magnetron Effect).

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:—

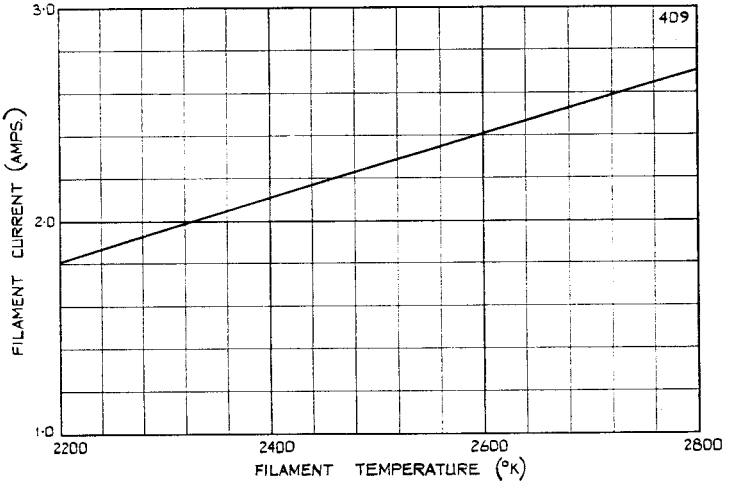
$B_{crit} = k\sqrt{V_a}$

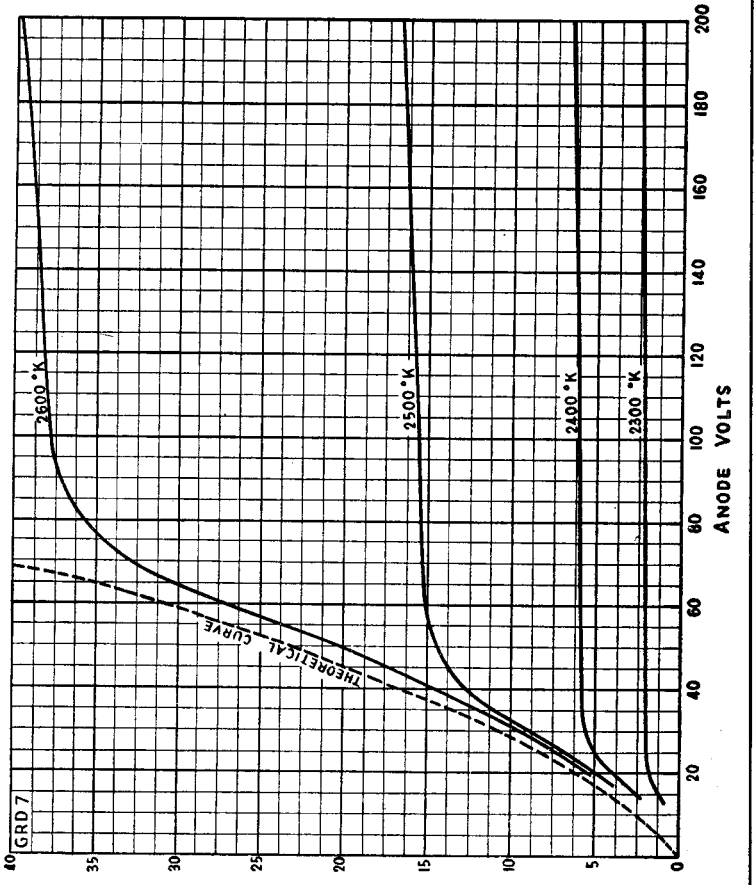
where Bcrit = the flux density of the magnetic field for current cut-off.

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





ANODE CURRENT mA)

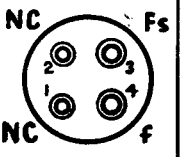
FERRANTI

MERCURY VAPOUR RECTIFIER

A Mercury Vapour Rectifier with an oxide coated filament.

HG25





Base Connections
Underside View of Base

PHYSICAL DETAILS.

Base	UX—4-pin (Bayonet).
Max. Overall Length	170 mm. (6¼in.).
Max. Seated Height	155 mm. (6⅛in.)
Max. Bulb Diameter	66 mm. (2⅝in.).
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.)

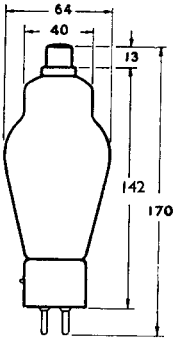
Natural Ventilation Forced Ventilation	20°C—40°C 20°C—60°C	25°C—55°C 25°C—65°C
Max. P.I.V. ... ... (See Note 2 below)	5kV—10kV	up to 5kV

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 ... (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.

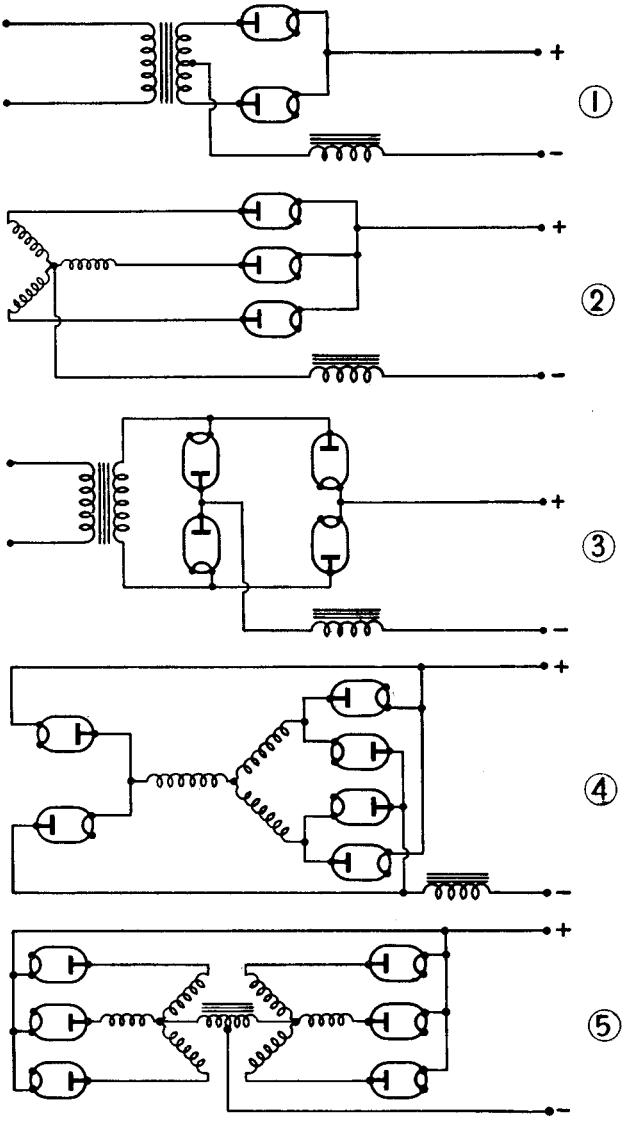
1. When first installed or after a long period of rest the valve should be run for at least 5 minutes before the application of any anode voltage.
2. The rated value of P.I.V. is applicable only over the temperature ranges noted above. Care should be taken in selecting a suitable position in the layout 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.

Issue 1.
Mar., 1957

Circuits referred to under "TYPICAL OPERATION" overleaf.

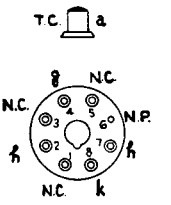


Ferranti

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.



Base Connections
Underside View of Base

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

HEATER.

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

RATINGS (Absolute).

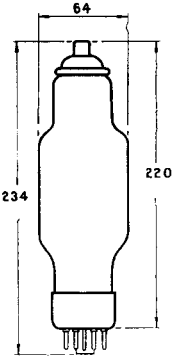
Max. Anode Voltage	20 kV.
Max. Peak Anode Current ...	30 mA.
Max. Mean Anode Dissipation ...	30 watts.
Max. Mean Anode Current ...	10 mA.
Max. Negative Grid Voltage ...	−250 volts.
Max. Grid Circuit Resistance ...	2 megohms.
*Max. Peak Heater/Cathode Voltage	150 volts.
Min. Cathode Heating Period prior 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=100μA	−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.



All dimensions shown are in millimetres (max.).

*Heater negative with respect to cathode.

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.

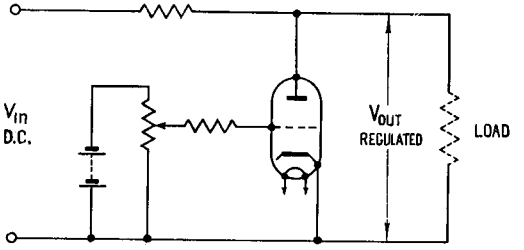
The high voltages normally applied to this valve can be very dangerous and particular care should be taken when making any circuit adjustments. It is recommended that before any part of the circuit is touched the supply voltage should be switched off and the terminals of any capacitor grounded.

Issue 3
Mar., 1961

Ferranti

Ferranti

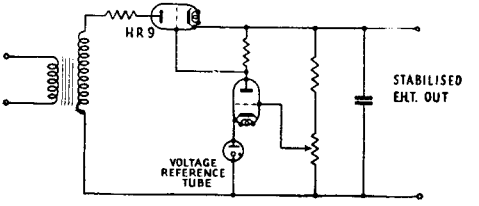
As a Shunt Regulator.



(*Fig* 1)

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

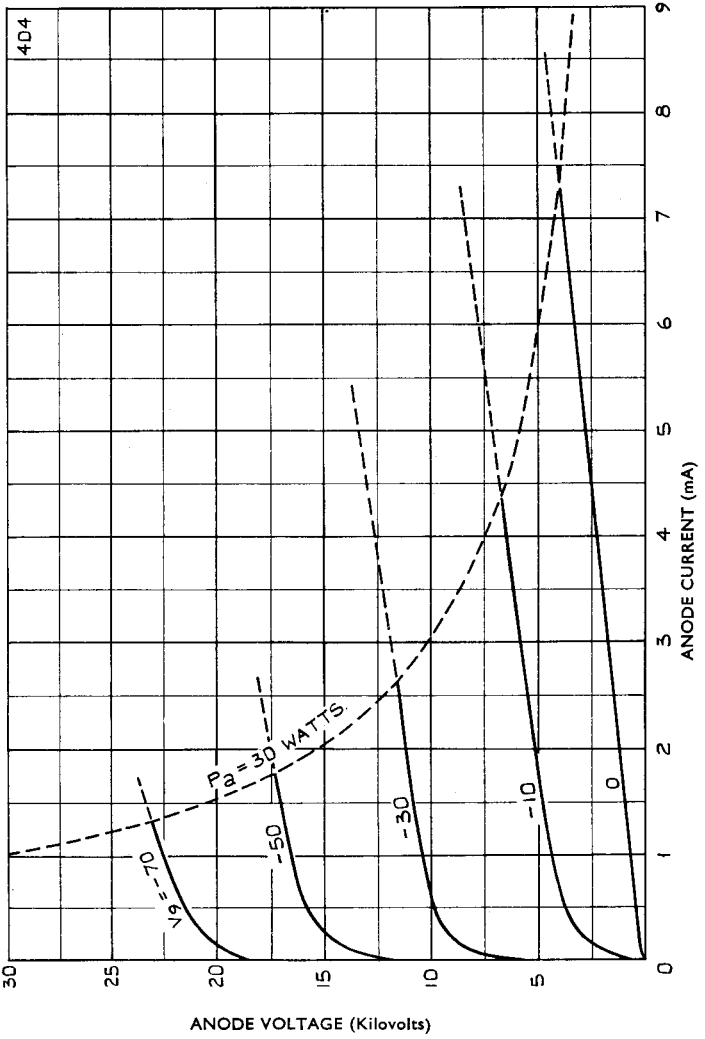
As a Voltage Controller in a Grid Controlled Rectifier Circuit with Automatic Stabilisation.



(*Fig*. 2)

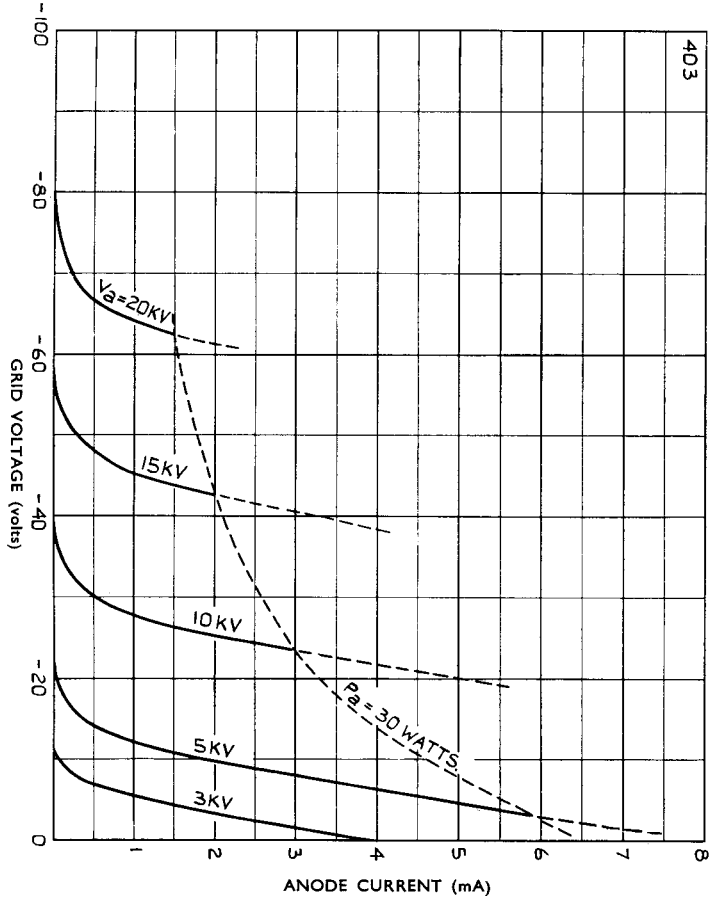
In this application the HL10 is used in conjunction with a gas filled cold cathode diode type KD21. The function of the KD21 is to provide a stabilised cathode bias, and the HL10 supplies automatic grid control to the Rectifier HR9. The resultant stabilised E.H.T. output voltage can be varied by adjustment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

Typical Anode Voltage/Anode Current Characteristics



Ferranti

Typical Anode Current/Grid Voltage Characteristics



R657

FERRANTI

HIGH VOLTAGE REGULAR CONTROL TRIODE

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.

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).

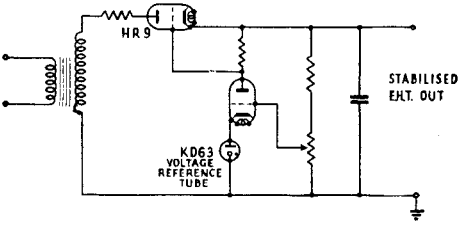
Max. Anode Voltage	25 kV.
Max. Peak Anode Current ...	5 mA.
Max. Mean Anode Dissipation ...	4 watts.
Max. Anode Direct Current ...	0·75 mA.
*Max. Peak Heater Cathode Voltage	150 volts.
Max. Negative Grid Voltage ...	200 volts.
Max. Grid Circuit Resistance ...	10 megohms.
Minimum Cathode Heating Time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

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.

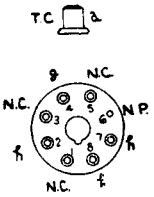
CAPACITANCES.

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

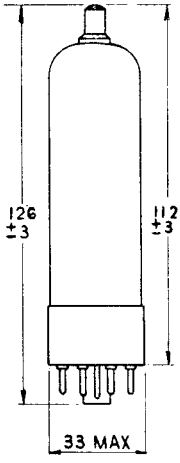
*The heater may be either positive or negative with respect to cathode.

Tentative
Issue 1
April, 1956

HL22



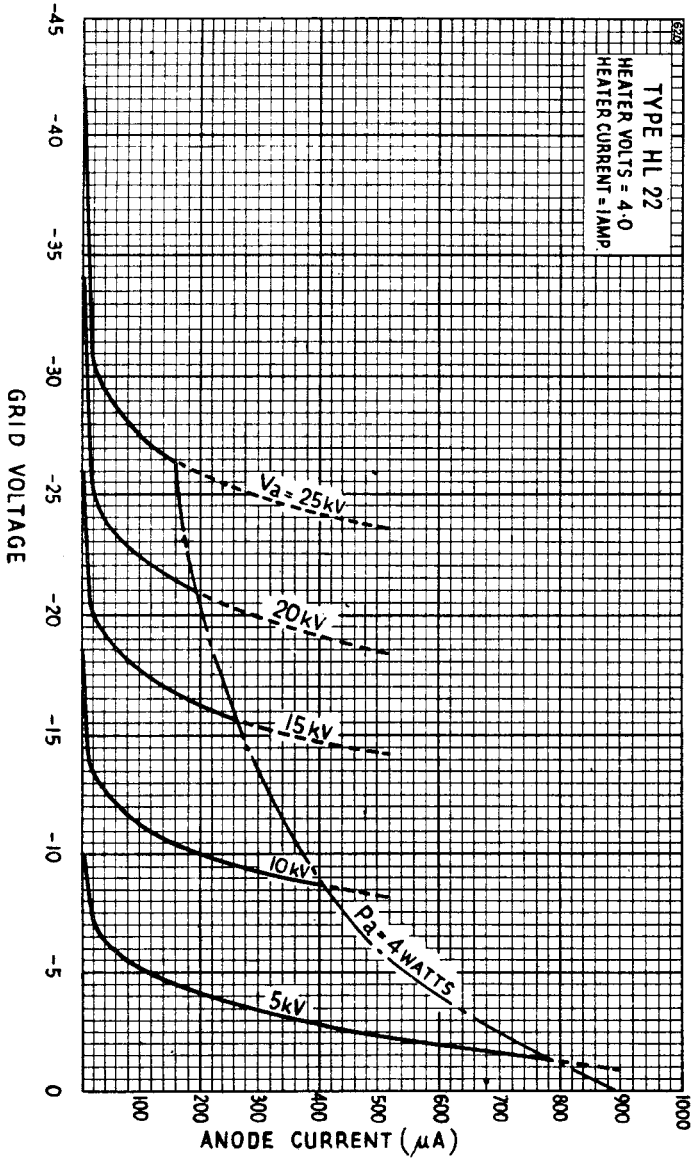
Base Connections Underside View of Base



All dimensions shown are in millimetres (max.)

FERRANTI

HL22


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

Ferranti

HIGH VOLTAGE CONTROL TRIODE

HL25

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.

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

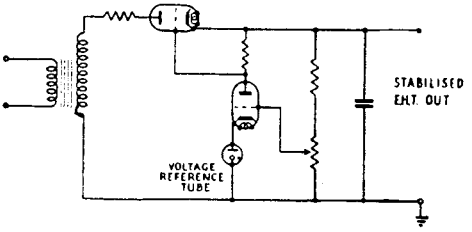
CHARACTERISTICS.

Control Characteristics:

Anode Voltage	15 kV
Grid Voltage for cut-off...	−32 volts
Grid Voltage for Ia=5μA	−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.

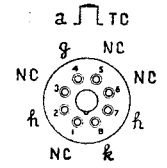
CAPACITANCES.

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

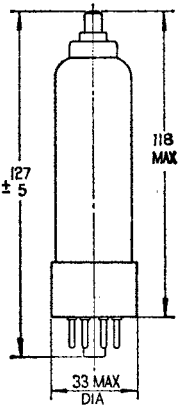
WARNING

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.



Base Connections Underside View of Base



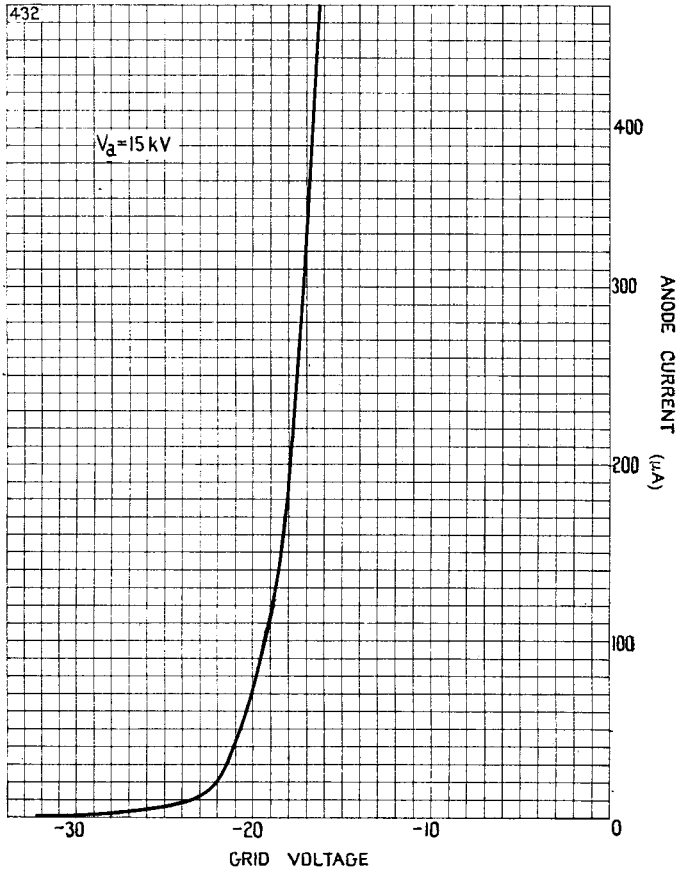
All dimensions shown are in millimetres

Ferranti

Issue 1
April, 1963

Ferranti

AVERAGE Ia/Vg CHARACTERISTIC

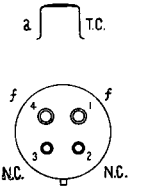


Ferranti

VACUUM HIGH VOLTAGE RECTIFIER

HR12

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.

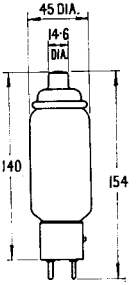
Pin 1.—Filament. Pin 3.—No Connection.
Pin 2.—No Connection. Pin 4.—Filament.
TC.—Anode.

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

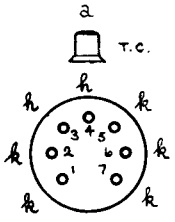
Ferranti

FERRANTI

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.

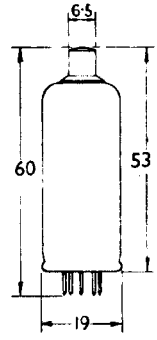
HEATER

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 μF.
Min. Supply Impedance ...	50,000 ohms.
Min. delay for H.T. switching	30 secs.
Max. Operating Frequency ...	100 kc/s.

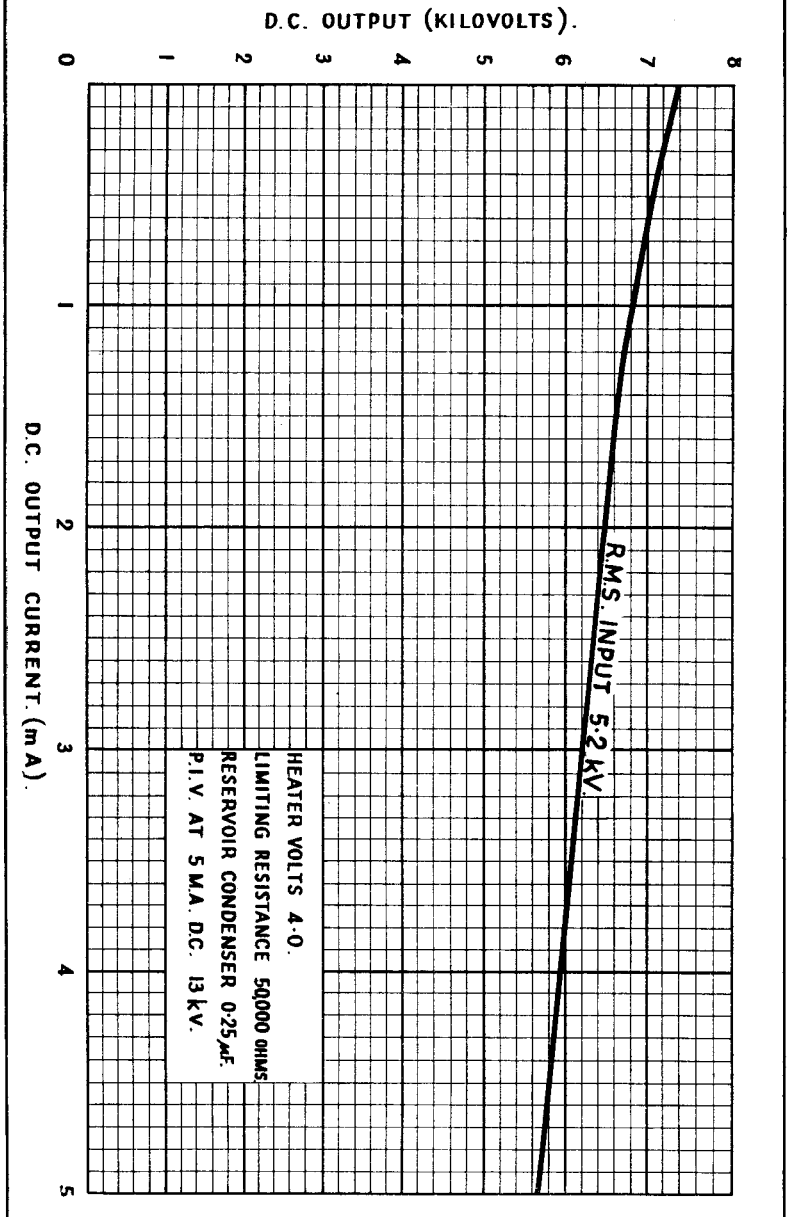


All dimensions shown are in millimetres. (max.)

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.

Issue 3
Feb., 1954

HR2

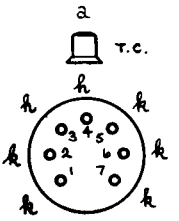

D.C. OUTPUT (KILOVOLTS).
0
1
2
3
4
5
6
7
8
R.M.S. INPUT 5·2 kV.
HEATER VOLTS 4·0.
LIMITING RESISTANCE 50,000 OHMS.
RESERVOIR CONDENSER 0·25 μF.
P.I.V. AT 5 M.A. D.C. 13 kV.
D.C. OUTPUT CURRENT (mA).
0
1
2
3
4
5

FERRANTI

VACUUM HIGH VOLTAGE RECTIFIER

A miniature indirectly heated Half-Wave High Voltage Rectifier.

HR3



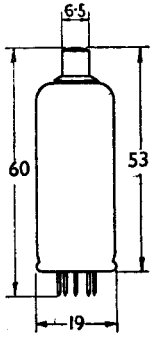
Base Connections Underside View of Base

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.

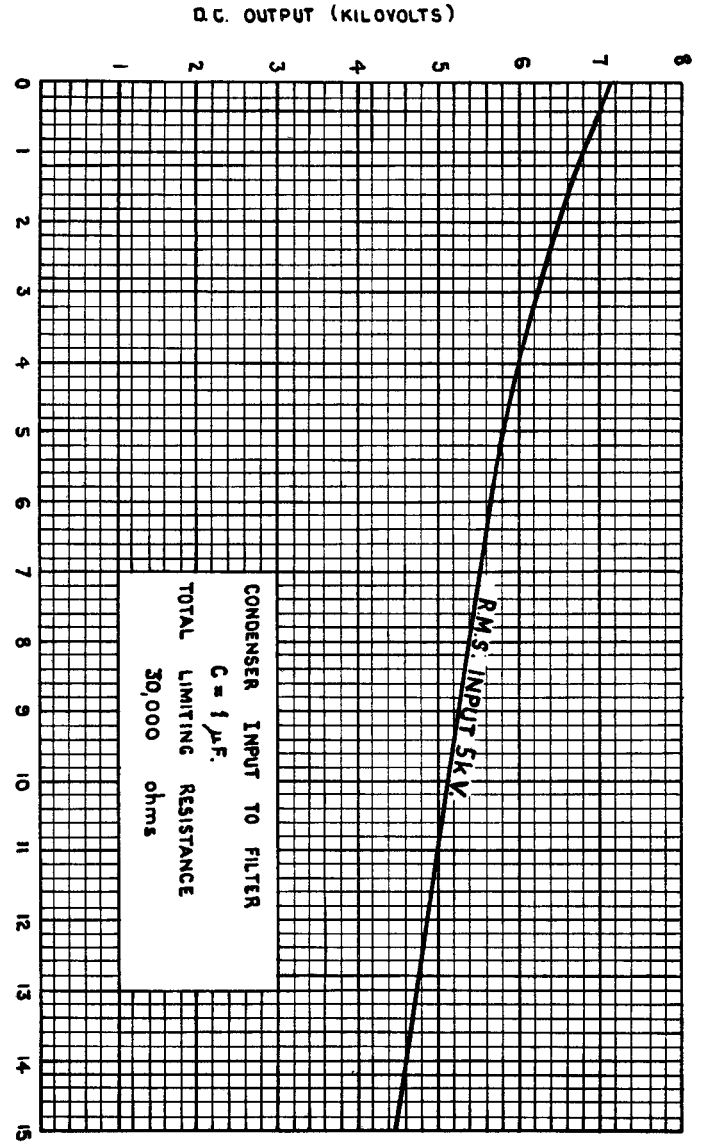
All Dimensions shown are in millimetres (max.).

*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


D.C. OUTPUT (KILOVOLTS)
1
2
3
4
5
6
7
8
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
D.C. OUTPUT CURRENT (m.a.)
R.M.S. INPUT 5 kV.
CONDENSER INPUT TO FILTER
C = 1 μF.
TOTAL LIMITING RESISTANCE
30,000 ohms

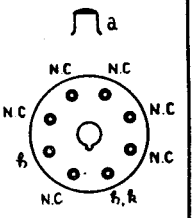
R0558.

FERRANTI

VACUUM HIGH VOLTAGE RECTIFIER

An indirectly heated Half-Wave High Voltage Rectifier.

HR6



Base Connections
Underside View of Base

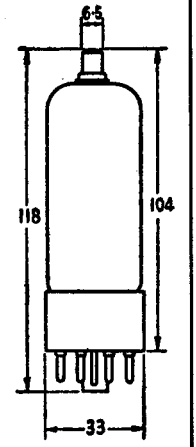
PHYSICAL DETAILS.

Base	International Octal.
Top Cap	Skirted Miniature—CT1
Max. Overall Length	118 mm. ($4\frac{41}{64}$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.



All Dimensions shown are in millimetres (max.).

HEATER.

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

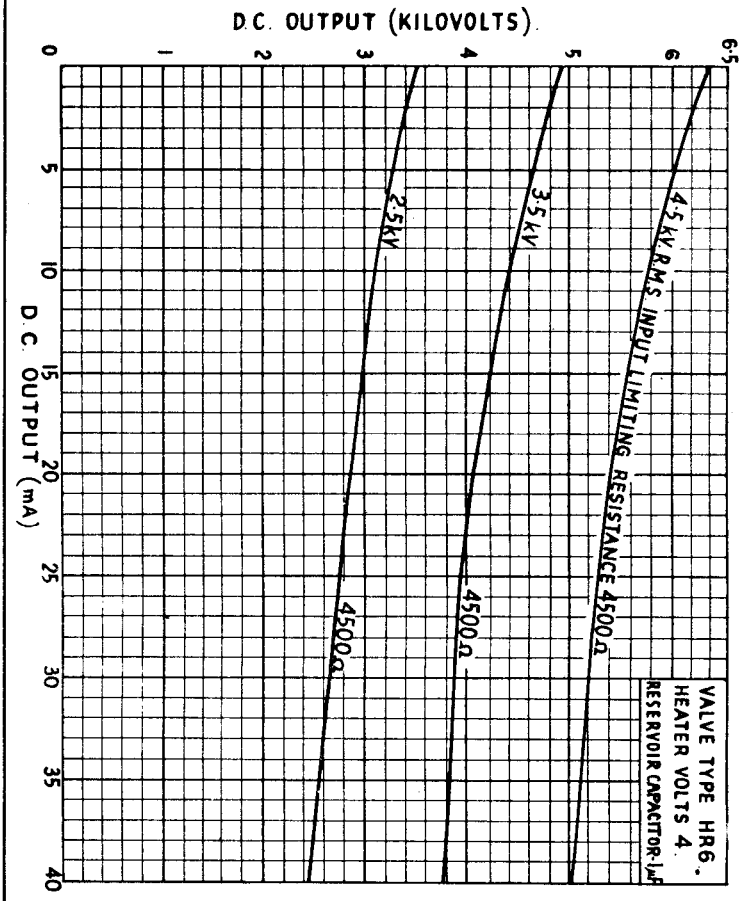
RATINGS*

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.

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

Issue 3
Dec., 1955

HR6

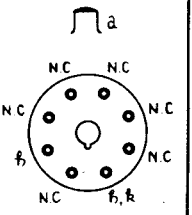

D.C. OUTPUT (KILOVOLTS)
0
1
2
3
4
5
6
6·5
D.C. OUTPUT (mA)
0
5
10
15
20
25
30
35
40
4·5 kV R.M.S. INPUT LIMITING RESISTANCE 4500Ω
3·5 kV
2·5 kV
4500Ω
4500Ω
VALVE TYPE HR6.
HEATER VOLTS 4.
RESERVOIR CAPACITOR 1μF

FERRANTI

VACUUM HIGH VOLTAGE RECTIFIER

HR8

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.

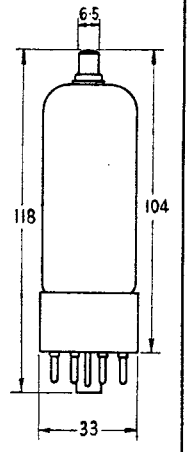
HEATER

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 μF.
Min. Supply Impedance ...	4000 ohms
Min. Switching Delay Time ...	60 secs.

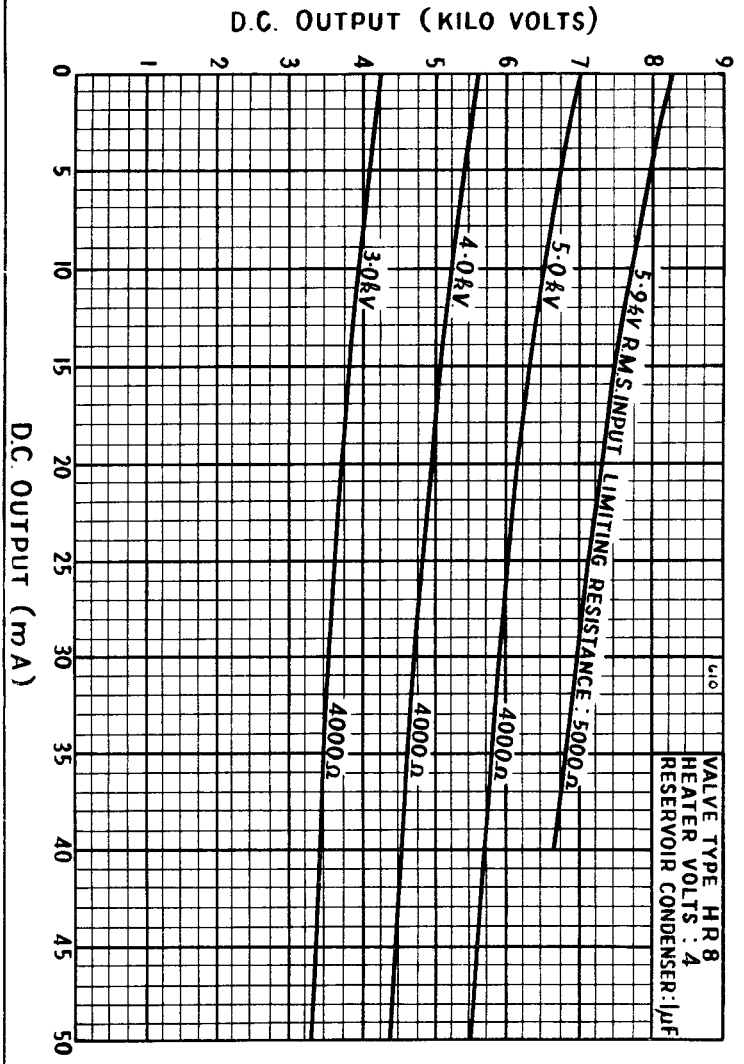


All dimensions shown are in millimetres. (max.).

*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

HR8


D.C. OUTPUT (KILO VOLTS)
0
1
2
3
4
5
6
7
8
9
D.C. OUTPUT (mA)
0
5
10
15
20
25
30
35
40
45
50
5·9kV R.M.S. INPUT LIMITING RESISTANCE : 5000Ω
5·0kV
4·0kV
3·0kV
4000Ω
4000Ω
4000Ω
4000Ω
VALVE TYPE HR8
HEATER VOLTS : 4
RESERVOIR CONDENSER: μF

FERRANTI

VOLTAGE STABILISERS

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

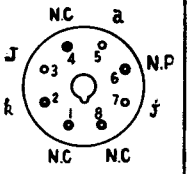
KD21 (VR 75/30)

KD24 (VR 105/30)

KD25 (VR 150/30)

PHYSICAL DETAILS.

Base	International Octal.
Bulb	Clear.
Max. Overall Length	105 mm. (4⅛in.).
Max. Seated Height	91 mm. (3 5/16in.).
Max. Diameter (Bulb)	40 mm. (1 9/16in.).
Mounting Position	Any.

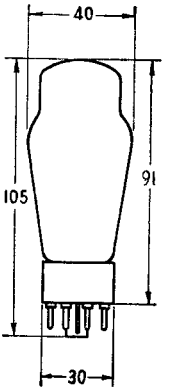


Base Connections Underside View of Base

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.

Issue 1.
Feb., 1954

KD21
(VR 75/30)

KD24
(VR 105/30)

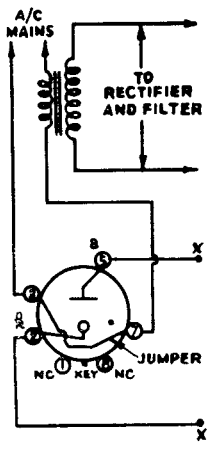
KD25
(VR 150/30)

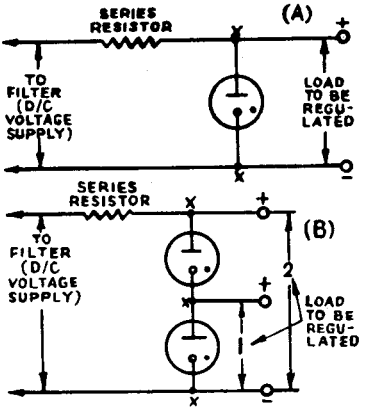
NOTES.

†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	2
VR 75/30	75	75	150
VR 105/30	105	105	210
VR 150/30	150	150	300

FERRANTI

VOLTAGE STABILISERS

KD60

KD61

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.

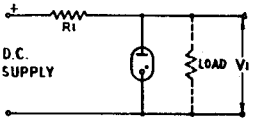
RATINGS.

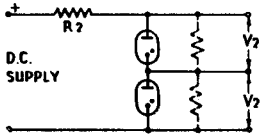
Max. Ignition Voltage (DC) ...	85 volts.
Max. Operating Current ...	2·5 mA.
Min. Current to maintain Ionisation	20 μA.

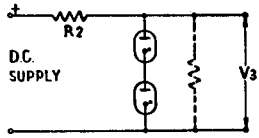
CHARACTERISTICS.

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.







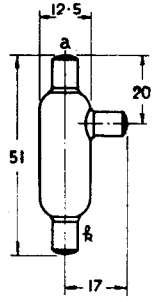
DC Supply	...	300 V.
I_L	... ...	1 mA.
V1	... ...	62 B.
V2	... ...	62 V.
V3	... ...	124 V.
R1	... ...	100 kΩ
R2	... ...	56 kΩ

For other operating conditions refer to chart overleaf.

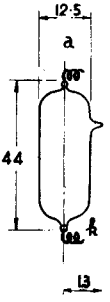
†The initial drift is very small but for maximum stability the valve should be given a preliminary run of 15 minutes.

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

KD 60



KD 61



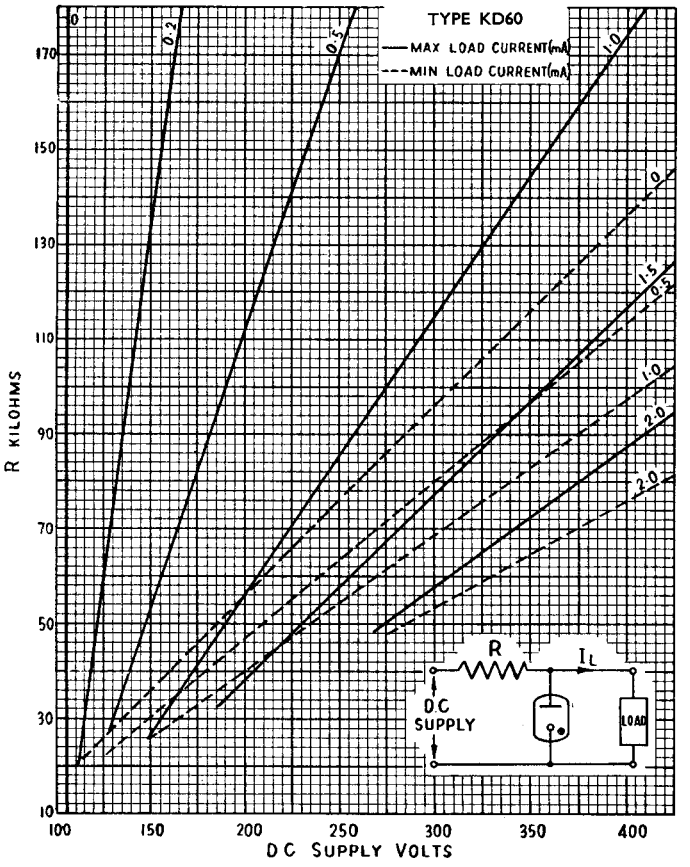
All Dimensions shown are in Millimetres (max.)

FERRANTI

Issue 5
Mar., 1956

KD60

KD61



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.

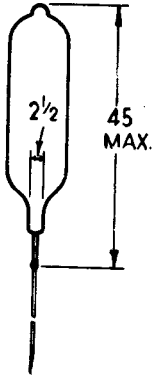
If the load is removed, or its resistance increased at the instant of switching on the supply voltage, much lower supply voltages and higher load currents may be employed.

FERRANTI

VOLTAGE REFERENCE TUBE

KD63

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. ($\frac{1}{2}$ in.).

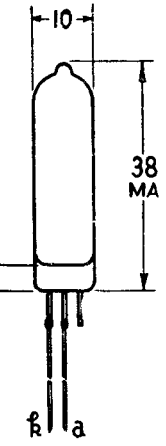
The anode lead is indicated by a red spot.

RATINGS.

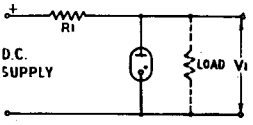
Max. Operating Current ...	2·5 mA.
*Min. Operating Current ...	200 μA.

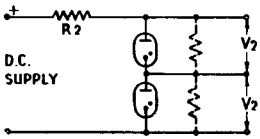
CHARACTERISTICS.

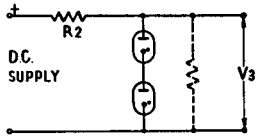
Min. Voltage to ensure ignition	105 volts.
Max. Voltage Drop across tube over operating range ...	64 volts.
Min. Voltage Drop across tube over operating range	60 volts.
†Regulation 1·0 mA to 1·2 mA ±	0·1 volts.
0·5 mA to 2·2 mA ±	0·4 volts.
200 μA to 2·5 mA ±	0·75 volts.
*Min. current to maintain ionisation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



TYPICAL OPERATION.







DC. Supply ...	See graph
IL	overleaf
V1	62 B.
V2	62 V.
V3	124 V.
R1	See graph
R2	overleaf.

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

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

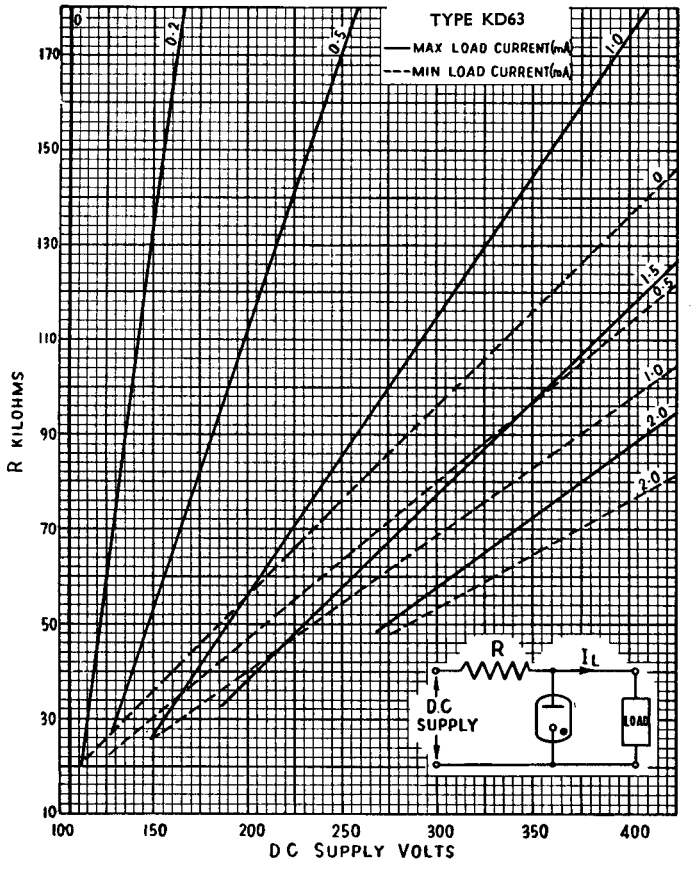
*At current below 200 μA the potential drop across the tube rises and performance may be erratic.

†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

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

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.

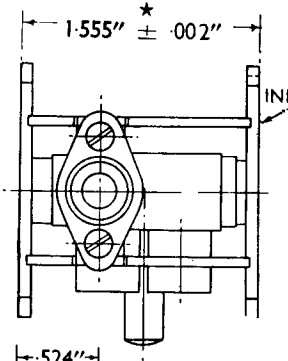
	Average.	Limit.	
Low Power Level.			
Insertion Loss :—			
8950 to 9600 Mc/s. ...	0·6	1·0	dB.
V.S.W.R.	1·15	1·25	dB.
High Power Level.			
Breakdown Power	120	200	mW.
Leakage at 40kW. peak :—			
Total Leakage Power ...	12	20	mW.
Spike Leakage Energy ...	0·12	0·2	ergs/pulse.
†Recovery Time (to 6dB. loss) ...	—	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 micro-amperes. At least 1 megohm should be connected directly to the primer electrode terminal.

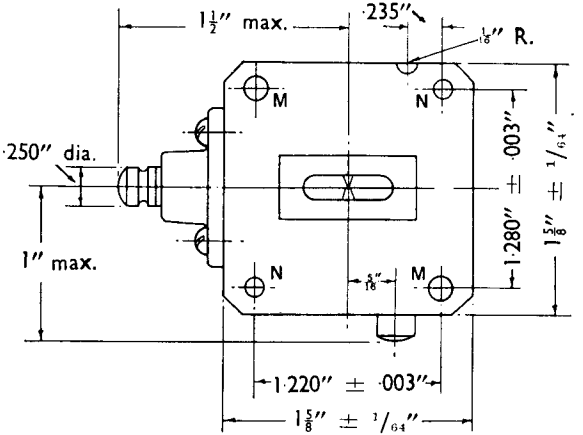
†Measured at 10 kW.

Ferranti

Issue 2.
Sept., 1960



★ 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.

1011

NF40

FERRANTI LTD., KINGS CROSS ROAD, DUNDEE.

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.

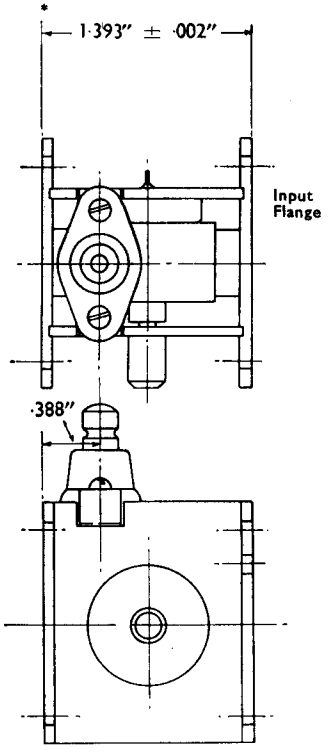
*A suitable resistor should be connected in series with the electrode to limit the current to between 100 and 150 micro-amperes. At least 1 megohm should be connected directly to the primer electrode terminal.

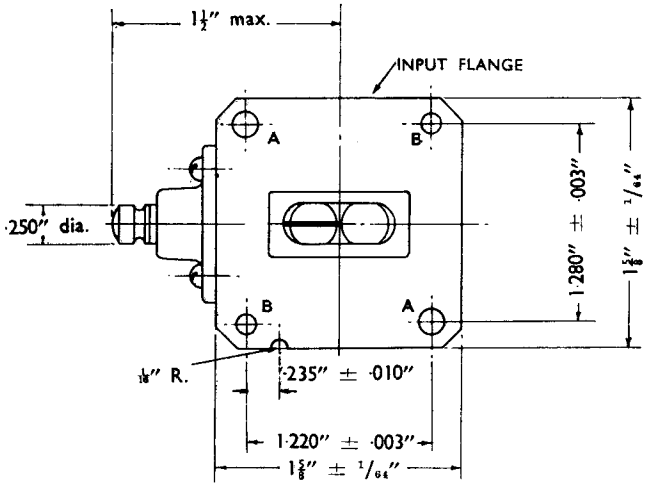
†Measured at 10 watts.

Ferranti

Issue 2.
May, 1960

*Flanges are flat and parallel within these limits





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

NF41

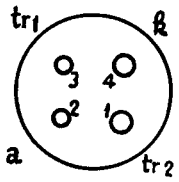
FERRANTI LTD., KINGS CROSS ROAD, DUNDEE.

FERRANTI

COLD CATHODE TETRODE

The Ferranti "Neostron" type NSP1 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.

NSP1



Base Connections
Underside View of Base

PHYSICAL SPECIFICATION.

Base	UX 4 pin.
Max. Seated Height	96 mm. (3⅞in.).
Max. Overall Length	110 mm. (4 11/32in.).
Max. Base Diameter	33 mm. (1 5/16in.).
Length of arc	24 mm (15/16in.).
Mounting Position	Any.

BASE CONNECTIONS.

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

RATINGS (Absolute).

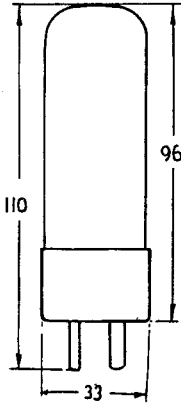
Max. Anode Voltage (static)	440 volts.
Max. Anode Voltage (working)	380 volts.
Min. Anode Voltage (working)	220 volts.
Max. Peak Inverse Anode Voltage	350 volts.
Max. Average Anode Current	100 mA.
→ Max. Discharge Capacitance	16 μF.
Max. Average Trigger Current	10 mA.

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 2 μF 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 :

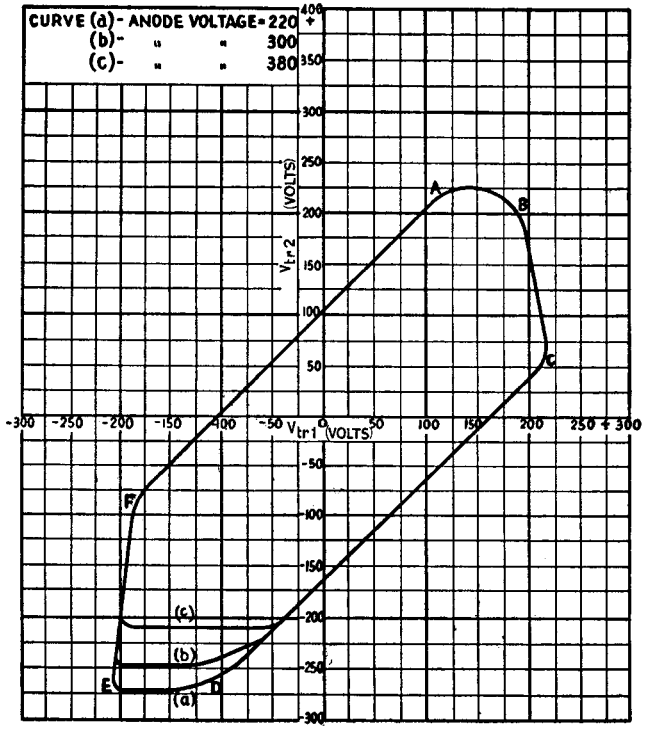
DC. supply voltage	300–330 volts.
‡Vtr_2 at triggering instant ...	... 70 volts.
§Trigger pulse amplitude (Vtr_1)	... 150 volts min.
Charging resistor	... 3000 ohms.
Discharge Capacitor for Operation at:—	
6–35 c.p.s.	4 μF.
30–50 c.p.s.	3 μF.
45–80 c.p.s.	2 μF.
80–150 c.p.s.	1 μF.
140–250 c.p.s.	0·5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

Issue 7
July, 1957



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

UNIVERSAL OUTPUT PENTODE

TYPE PTA

PRICE 18/6

BVA

MADE BY

FERRANTI LTD.

RADIO WORKS,

MOSTON, MANCHESTER 10

This valve has been thoroughly tested before leaving the works, and no responsibility can be accepted if it is used under conditions other than those stated.

If it is found necessary to have the valve tested or replaced it should be returned through your dealer or supplier, quoting type of valve and date of purchase. If returned direct to makers it will be accepted only on the following conditions.

1. That it is forwarded at sender's risk and expense.

2. If for inspection, it becomes necessary to break up the valve, FERRANTI LTD. are at liberty to do so, without obligation to return or replace it.

JANUARY 1936

THE FERRANTI TYPE PTA UNIVERSAL OUTPUT PENTODE VALVE is one of the range of high-grade valves developed as a result of much research and close collaboration between the FERRANTI Valve and Radio Laboratories, thus ensuring that its practical application to modern Radio has had the utmost consideration.

The use of the most modern methods and plant in the FERRANTI Valve Works has resulted in valves whose robustness of construction and uniformity of characteristics are not surpassed, whilst their size is as small as present-day conditions require and is less than that of most other makes of corresponding type.

NOTICE

THIS VALVE MUST NOT BE RESOLD OR OFFERED FOR SALE AT ANY PRICE LOWER THAN THAT STATED IN THIS LIST, AND ITS SALE IS SUBJECT TO THE STANDARD B.V.A. CONDITIONS.

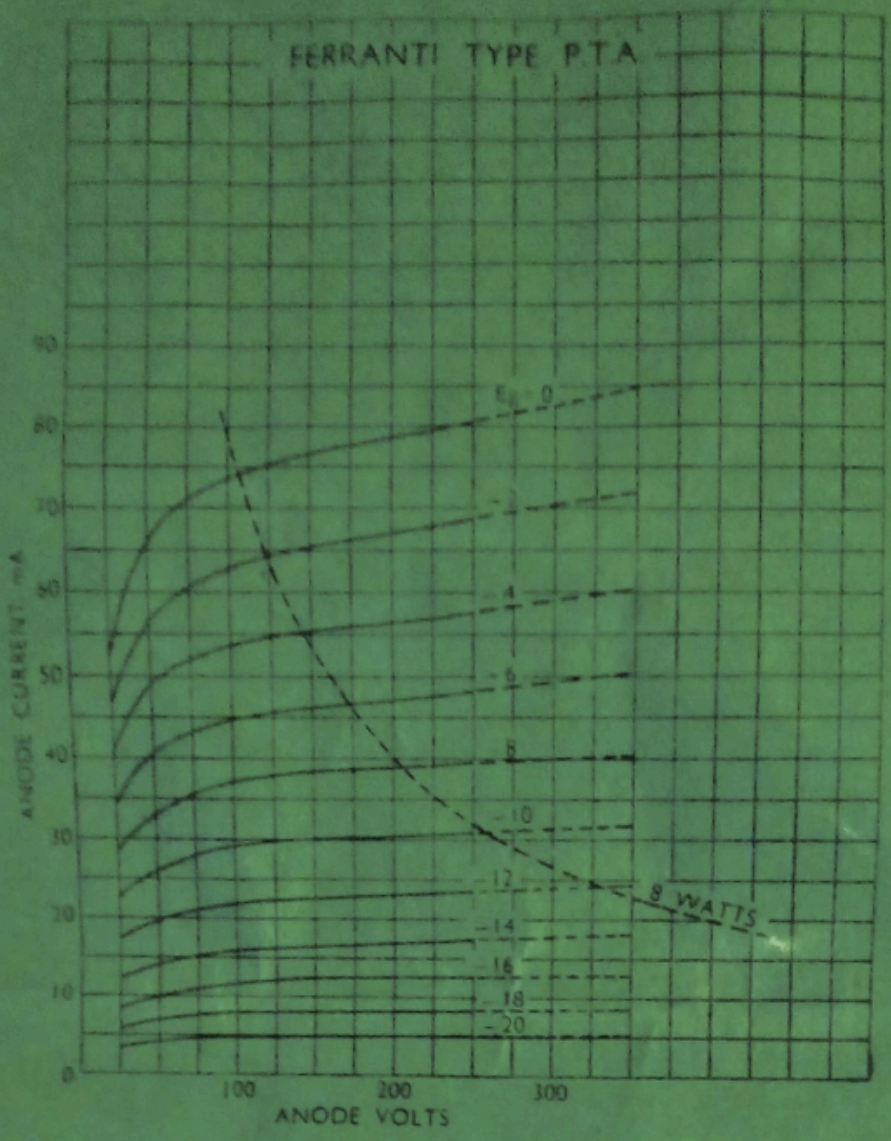
CHARACTERISTICS OF THE UNIVERSAL TYPE PTA OUTPUT PENTODE

Heater Volts	13·0
Heater Amps.	0·3
Max. Anode Volts	250
Max. screen Volts...	250
Mutual Conductance	4·0 mA./volt
At Ea = 100 Es = 100 Eg = 0	
Max. Anode Dissipation	8·0 watts
Optimum Load	6,500 ohms

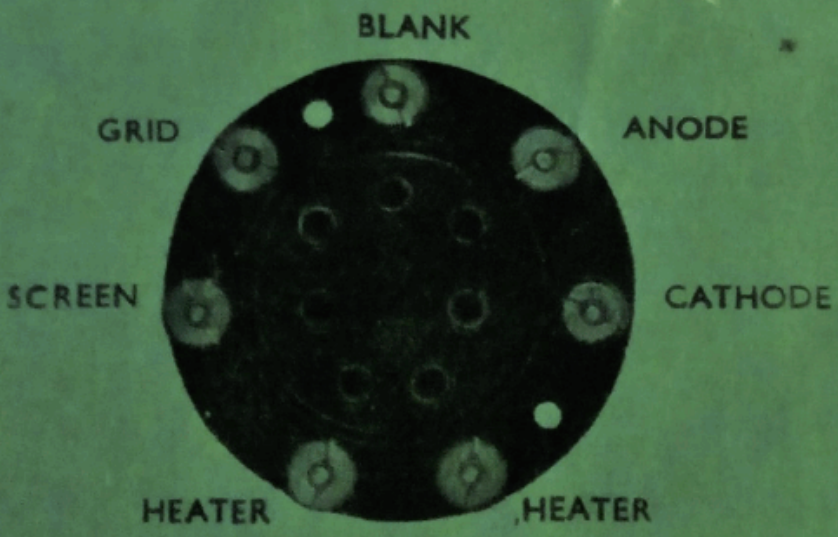
The FERRANTI Universal Output pentode type PTA is especially suitable for car receivers but can be used in universal A.C./D.C. sets utilising 0·3 amp. valves.

It has a high order of sensitivity but for full loading should be preceded by a valve such as the FERRANTI type HAD double-diode-triode and to which it may be coupled by means of resistance coupling.

It is recommended that the usual resistance condenser filter be connected across the primary winding of the output transformer or across the output choke utilised in the anode circuit, in order to prevent increase of load impedance with increase in frequency. Suitable values are 10,000 ohms and 0·01 mfd.



BASE CONNECTIONS OF PTA



Looking on top of a FERRANTI 7-pin Valve Holder (2/9).

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.

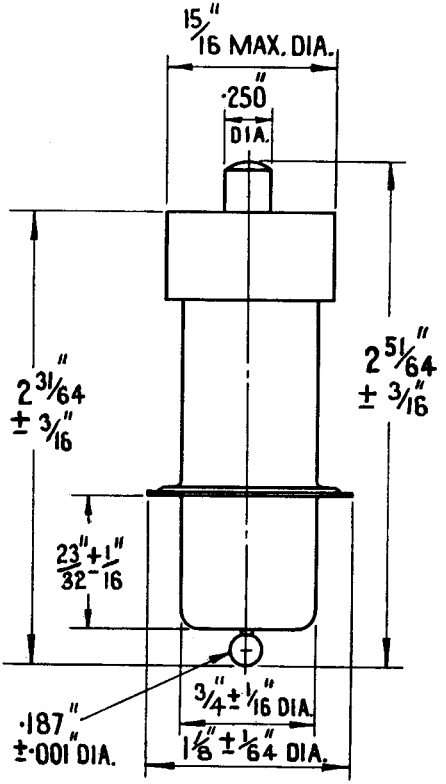
(2) The primer electrode should be supplied from a negative potential DC source of at least 800 volts. Suitable resistors should be used to limit the primer electrode current to between 100 and 200 micro-amperes.

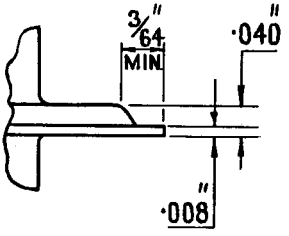
*When tested in a cavity as drawing 162-JAN the valves will tune in the range 949 to 951 Mc/s.

†In test cavity as drawing 162-JAN.

Issue 2.
Nov. 1959

Ferranti





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.

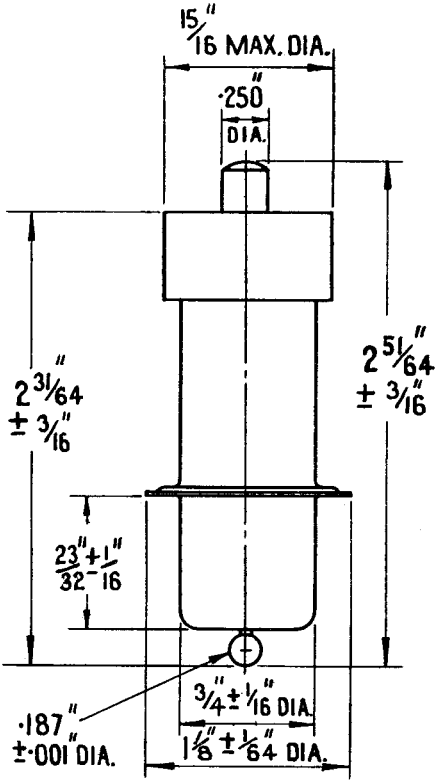
(2) The primer electrode should be supplied from a negative potential DC source of at least 800 volts. Suitable resistors should be used to limit the primer electrode current to between 100 and 200 micro-amperes.

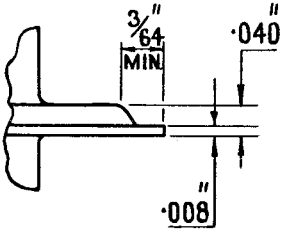
*When tested in a cavity as drawing 162-JAN the valves will tune in the range 949 to 951 Mc/s.

†In test cavity as drawing 162-JAN.

Issue 2.
Nov. 1959

Ferranti





ENLARGED VIEW OF
DIAPHRAGM FLANGE

FERRANTI

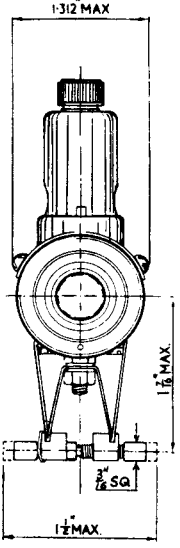
T.R. CELL

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$\frac{11}{16}$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.



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 A¹ on the drawing.

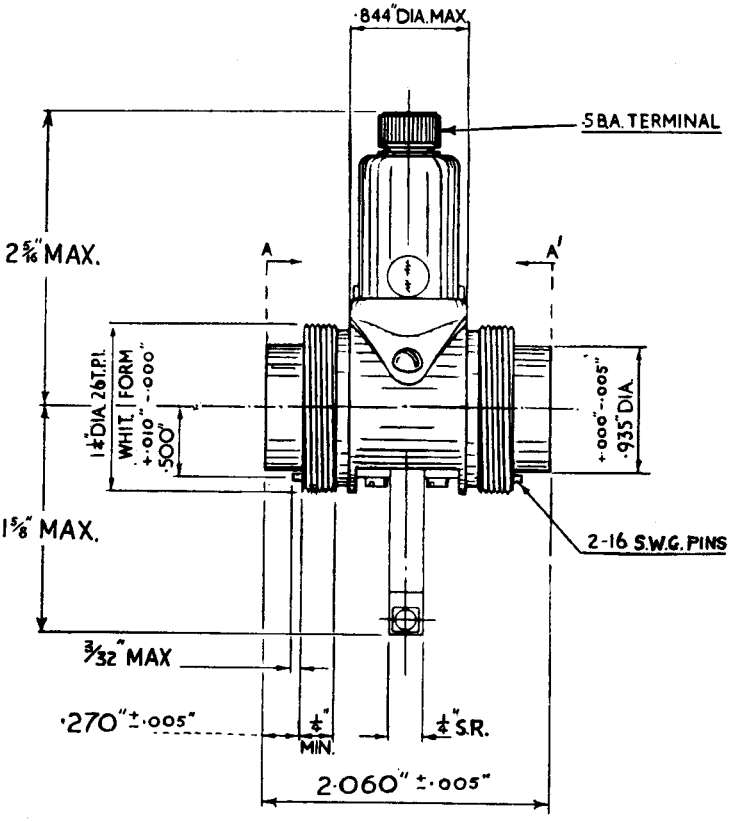
All dimensions shewn are in inches.

Issue 3.
Jan., 1955.

Formerly known as Type TTR31.

FERRANTI LIMITED, Crewe Toll, Ferry Road, EDINBURGH, 5.

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 μA and 150 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 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

QF41

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 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.

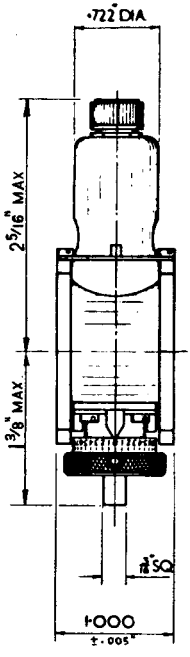
Q_L	130 approx.
V.S.W.R. at Resonance ...	1·1 approx.
Insertion Loss at Resonance ...	0·8 db.

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.

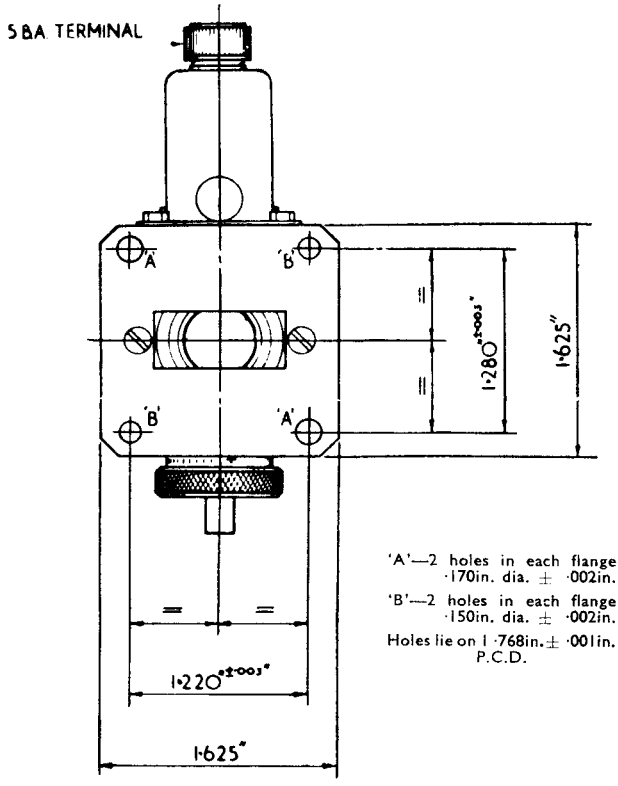
‡ For protection against external transmitters.

§ 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 μA and 150 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 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.

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* 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 0·25in. ± 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 0·20in. ± 0·03in.

These distances are measured from the face of the input flange of the cell.

Ferranti

T.R. CELL

QF41A to QF41K

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.

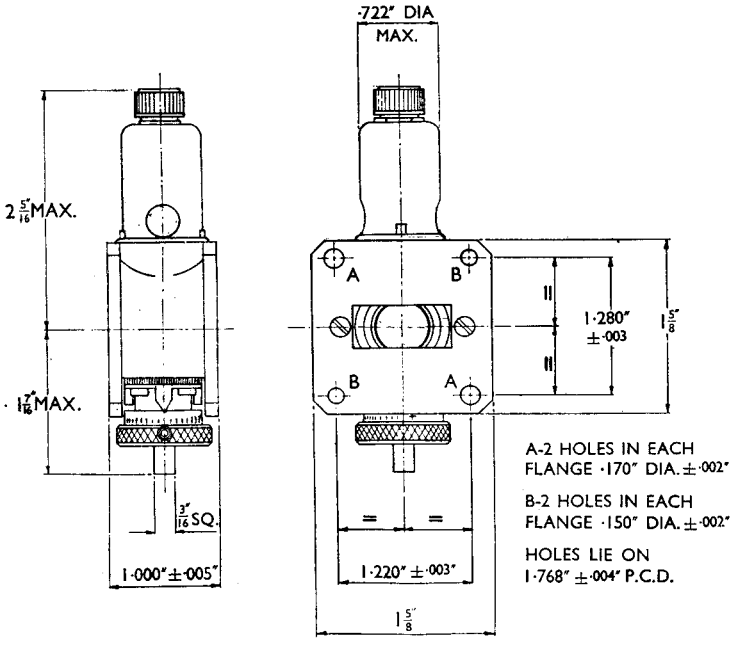
	Average.	Limit.
Low Power Level		
Q_L	130	125 to 160
V.S.W.R. (at Resonance) ...	1·1	1·4
†Insertion Loss	0·8	1·2 dB.
High Power Level.		
‡Leakage at 40 kW.:—		
Flat Leakage Power ...	20	30 mW.
Spike Leakage Energy ...	0·06	0·1 ergs/pulse
Breakdown Power	100	250 mW.
Recovery Time (to −6dB.)...	1·5	4 μSec.
§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.

Ferranti

Issue 5.
Nov., 1959.

QF41A to QF41K



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

QF42A to QF42K

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 $\frac{1}{4}$" 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 $\frac{1}{4}$" 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.

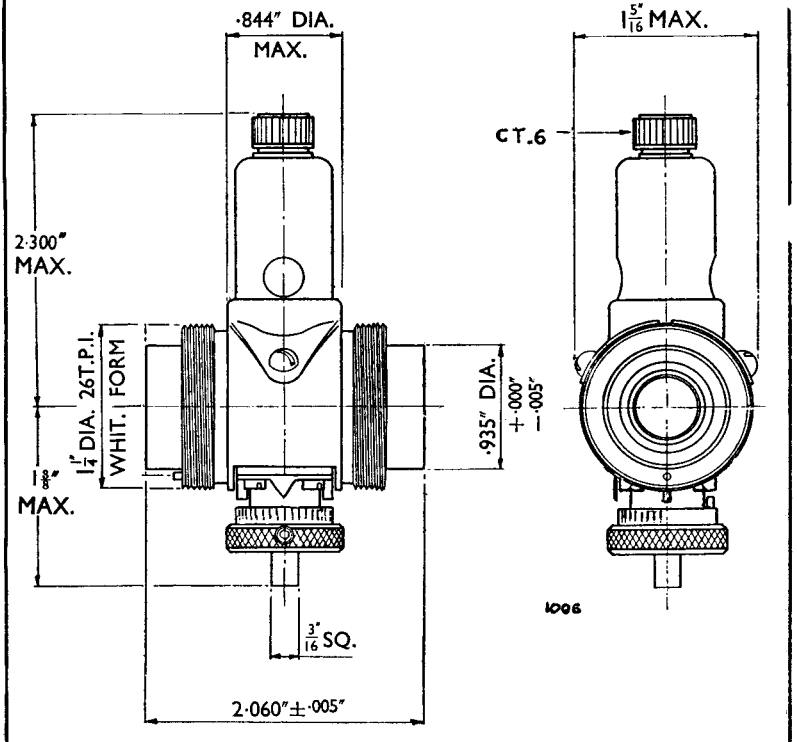
*See note (4) under 'Operating Notes' overleaf.
†Primer energised.
‡1μsec. pulses.
§Measured from the input edge of the cell.
See note (5) under 'Operating Notes' overleaf.

Issue 5.
Nov., 1959.

Ferranti

Ferranti

QF42A to QF42K



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

QF50

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.

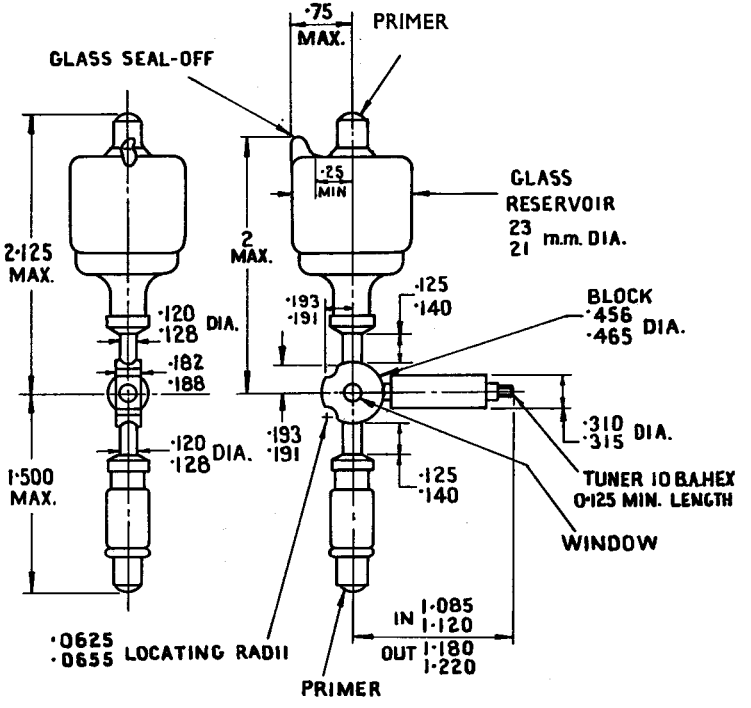
Primer Characteristics.

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

QF50



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 $\frac{5}{8}$in.).
For other dimensions see outline drawing on Page 3.	
Output Waveguide ...	Rect. 1in. × $\frac{1}{2}$in. I.D.
Input Waveguide ...	Rect. 1in. × $\frac{1}{2}$in. I.D.
Water Connections :	
Block	To B.S.S. 659 for $\frac{1}{4}$" bore.
Collector	To B.S.S. 659 for $\frac{1}{2}$" 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.

Ferranti

Issue 2.
May, 1960

Ferranti

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.

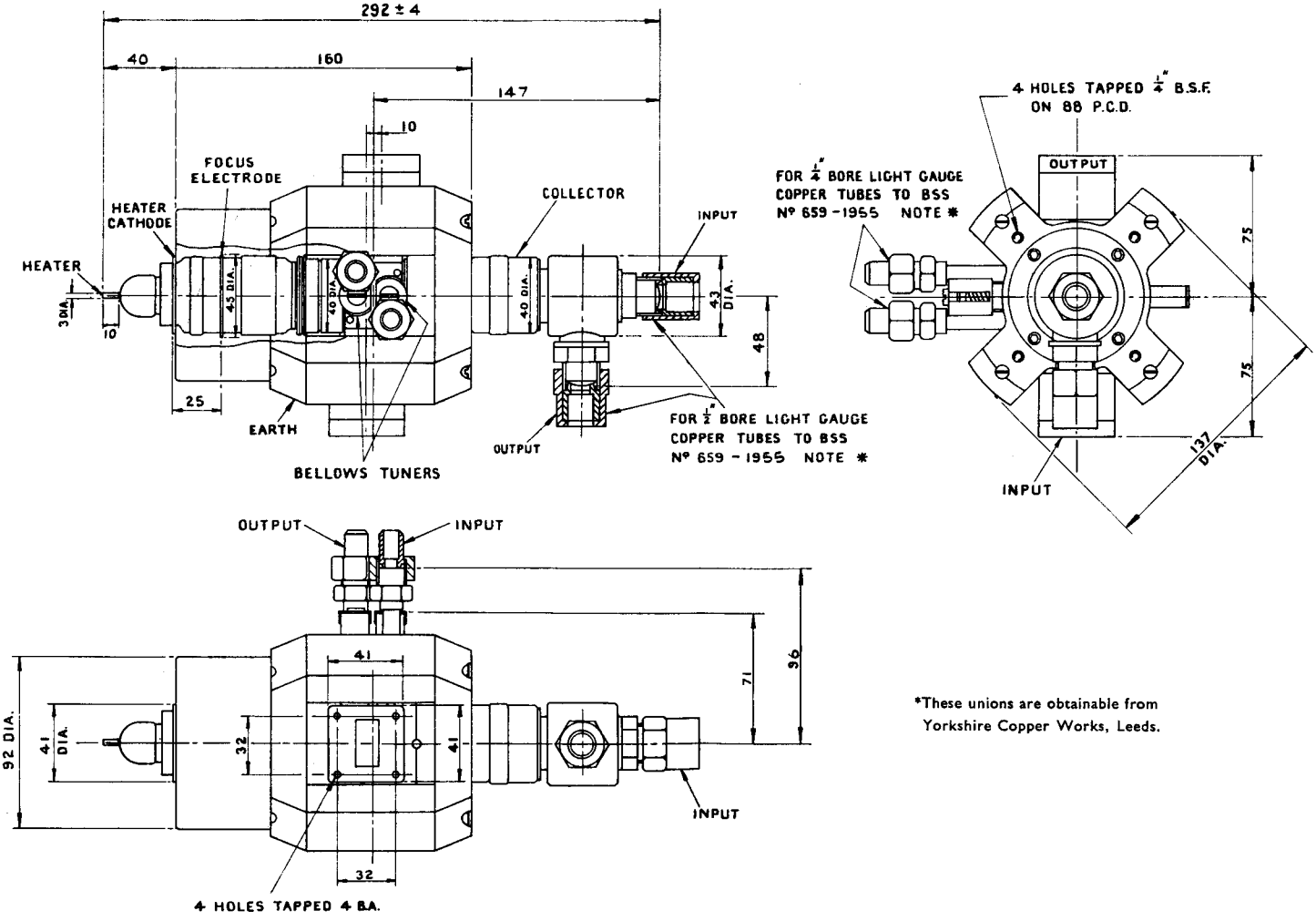
5. Care should be taken not to exceed 2 : 1 V.S.W.R. in the output circuit, otherwise the output window may puncture.

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. 10kΩ) between the focus electrode and its supply potentiometer and to decouple the latter to cathode with a capacitor of 1μF.

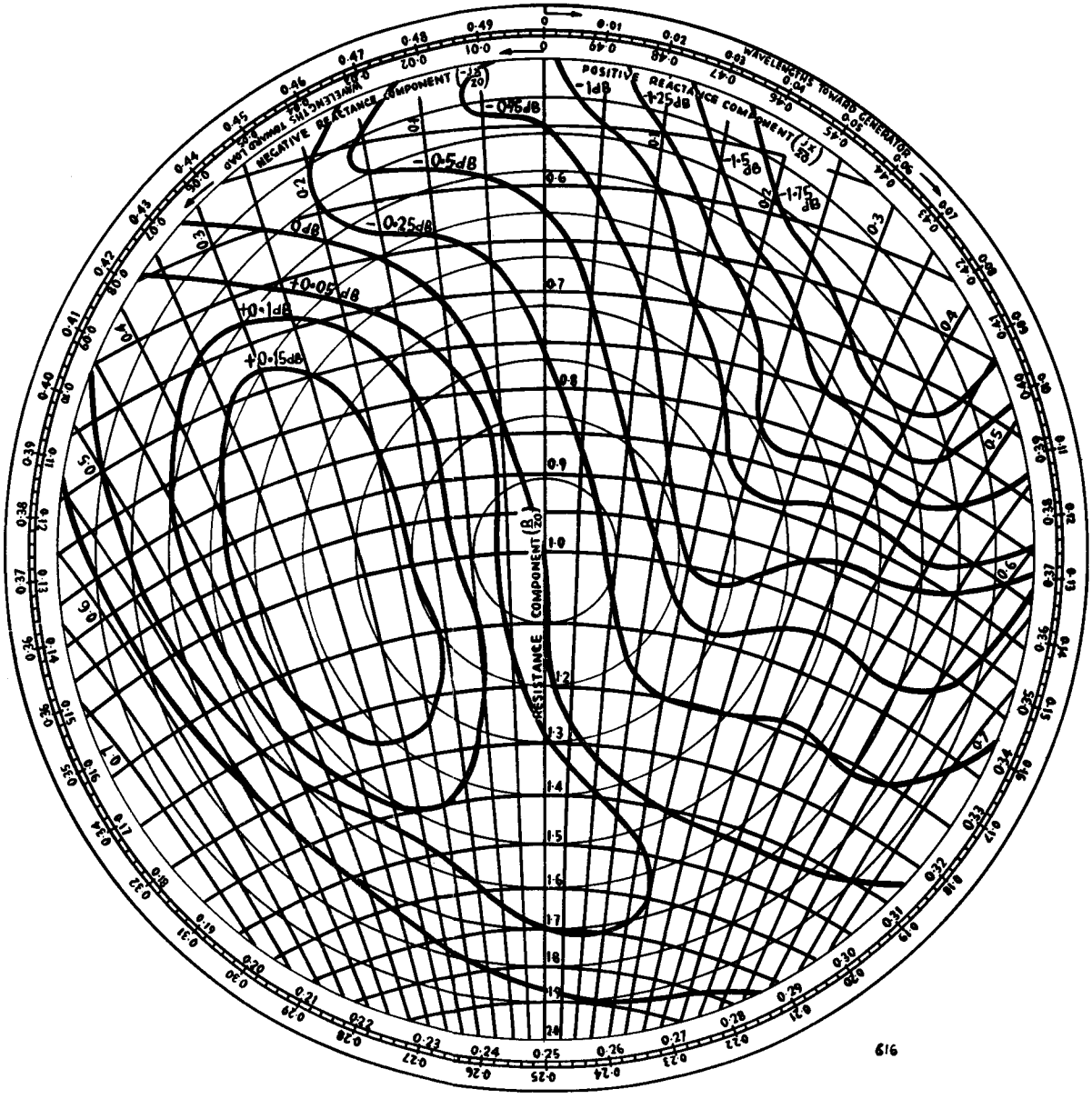


*These unions are obtainable from Yorkshire Copper Works, Leeds.

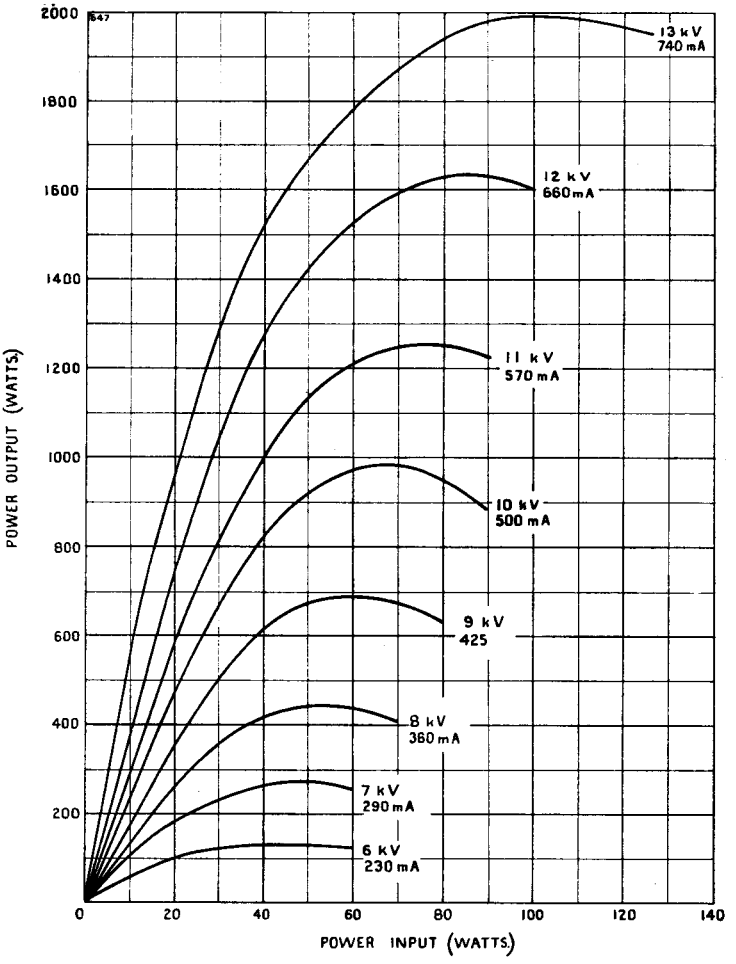
Dimensions shown are in millimetres

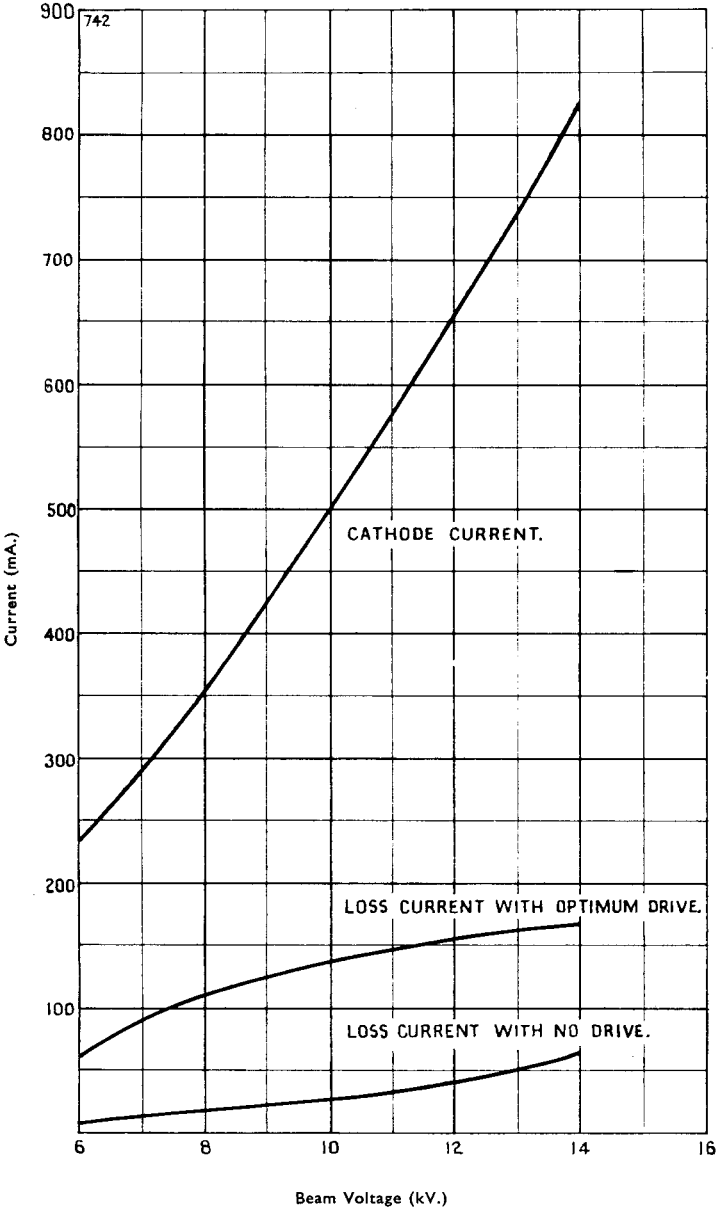
Ferranti

RIEKE DIAGRAM



Beam Voltage = 10kV
Beam Current = 500mA
OdB = 1kW


647
2000
1800
1600
1400
1200
1000
800
600
400
200
0
20
40
60
80
100
120
140
POWER OUTPUT (WATTS)
POWER INPUT (WATTS)
13 kV
740 mA
12 kV
660 mA
11 kV
570 mA
10 kV
500 mA
9 kV
425
8 kV
360 mA
7 kV
290 mA
6 kV
230 mA


742
900
800
700
600
500
400
300
200
100
Current (mA.)
CATHODE CURRENT.
LOSS CURRENT WITH OPTIMUM DRIVE.
LOSS CURRENT WITH NO DRIVE.
6
8
10
12
14
16
Beam Voltage (kV.)

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 ± 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. (11¼in.).
For other dimensions see outline drawing.	
Output Waveguide	WG16 coupling to
Input Waveguide	I.S.S. choke flanges.
Water Connections	⅛in. 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	±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.

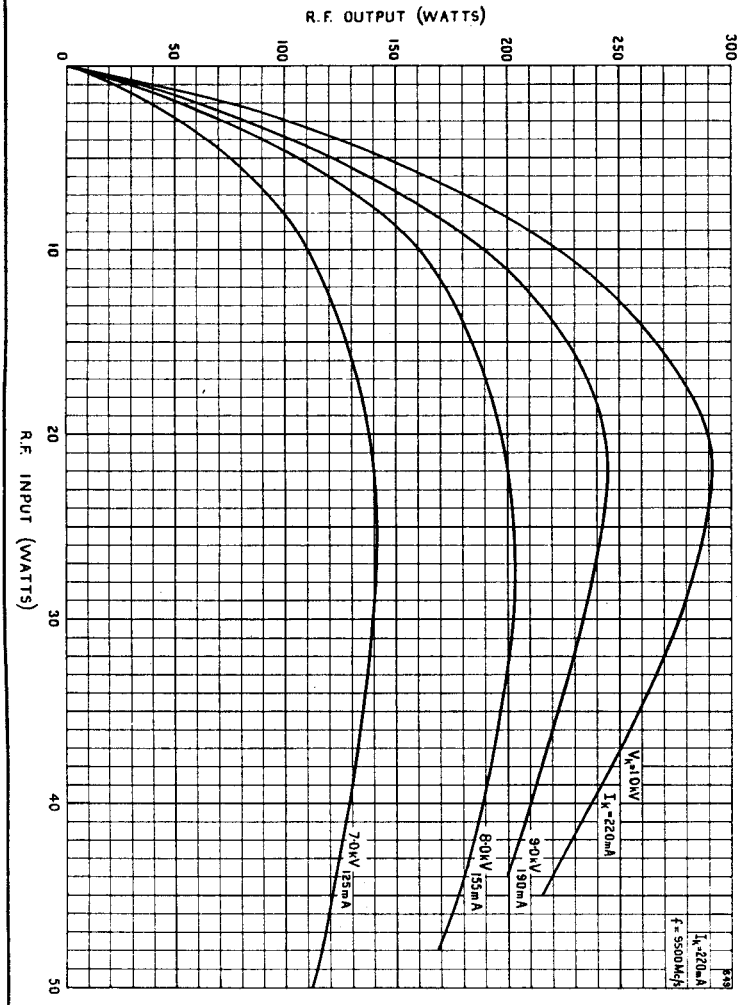
1. The heater voltage should be gradually increased until a steady current within the specified range is obtained.
2. It is recommended that a pressure type water flow relay should be fitted in the drain pipe, in order to break the H.T. supply in the event of cooling water supply failure, otherwise the 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.

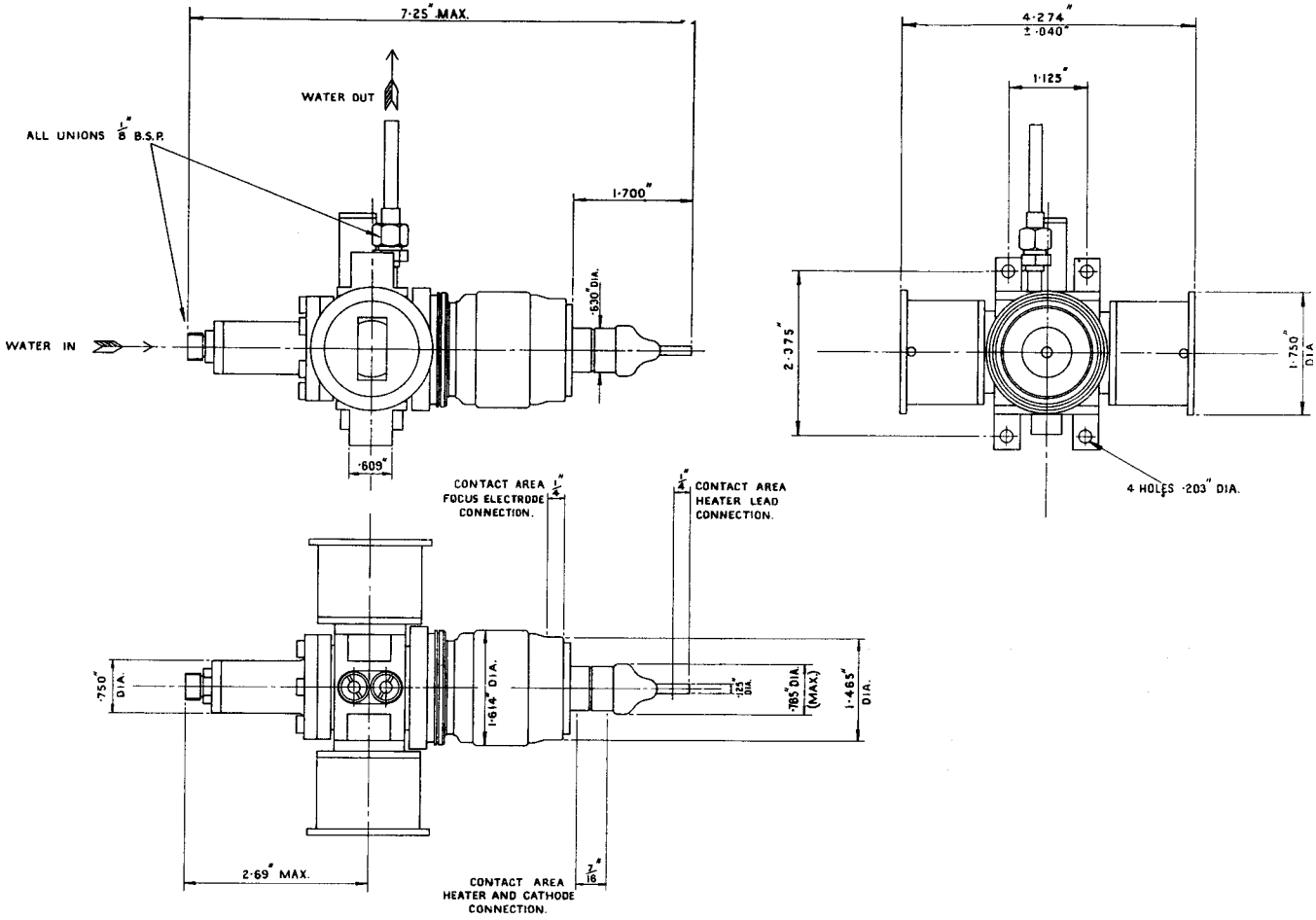
*Valves can be supplied tuned to any "X" band frequency by arrangement.

†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
(Tentative)

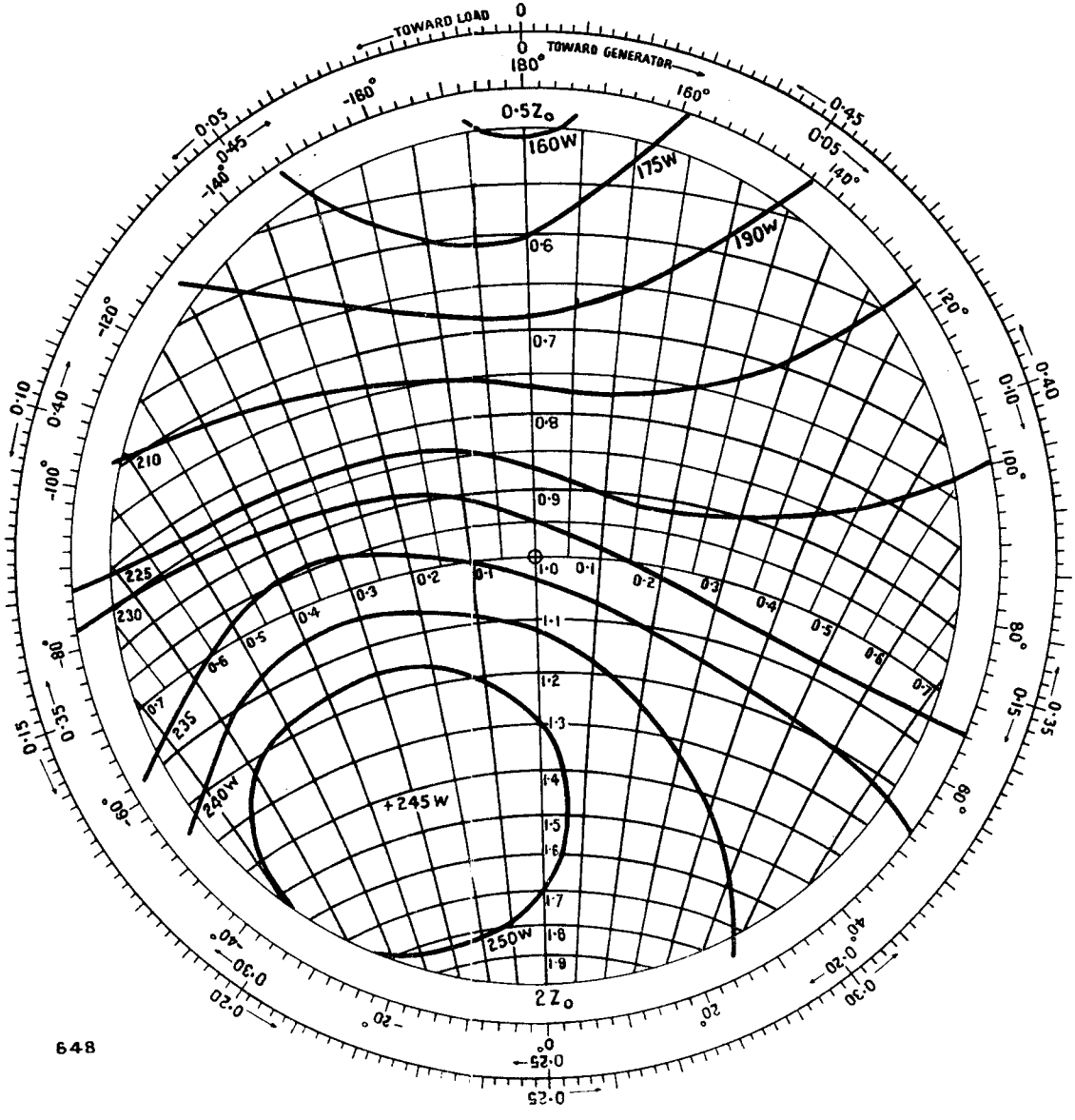

R.F. OUTPUT (WATTS)
0
50
100
150
200
250
300
R.F. INPUT (WATTS)
10
20
30
40
50
V_K=10kV
I_K=220mA
9·0kV
190mA
8·0kV
155mA
7·0kV
125mA
I_K=220mA
f = 9500Mc/s
849



All dimensions shown are in millimetres (max.).

Issue 1
Dec., 1957
(Tentative)

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 output flange.

FERRANTI

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
Input Waveguide	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.

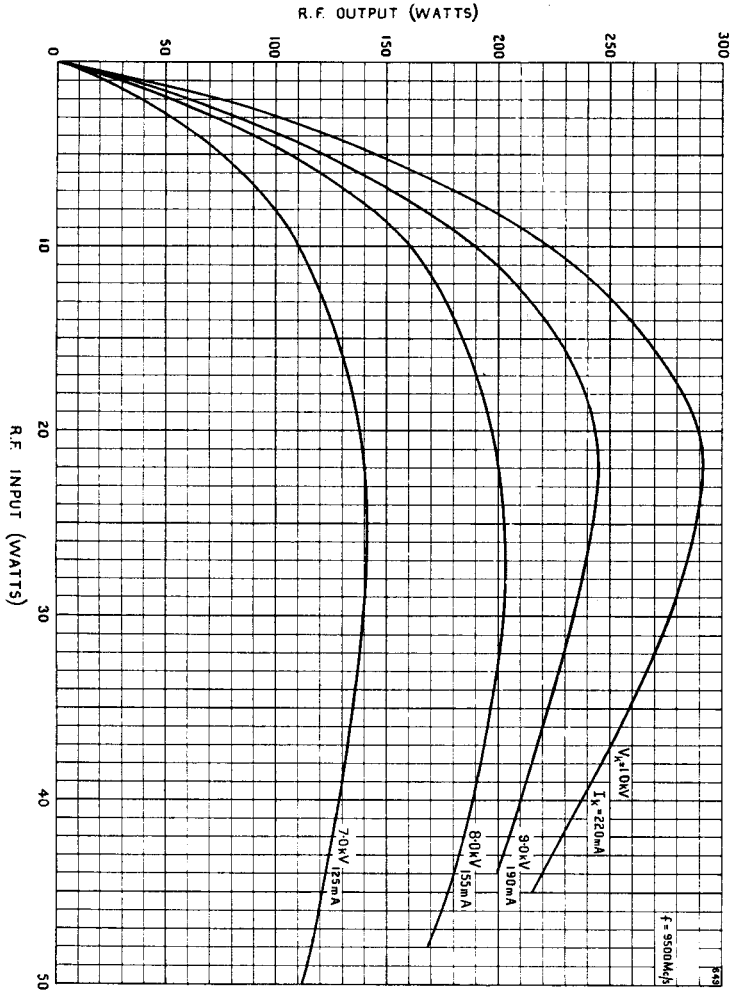
§At 9500 Mc/s.
Bandwidth: to 3 dB points—18·5 Mc/s.
to 1 dB points—10 Mc/s.

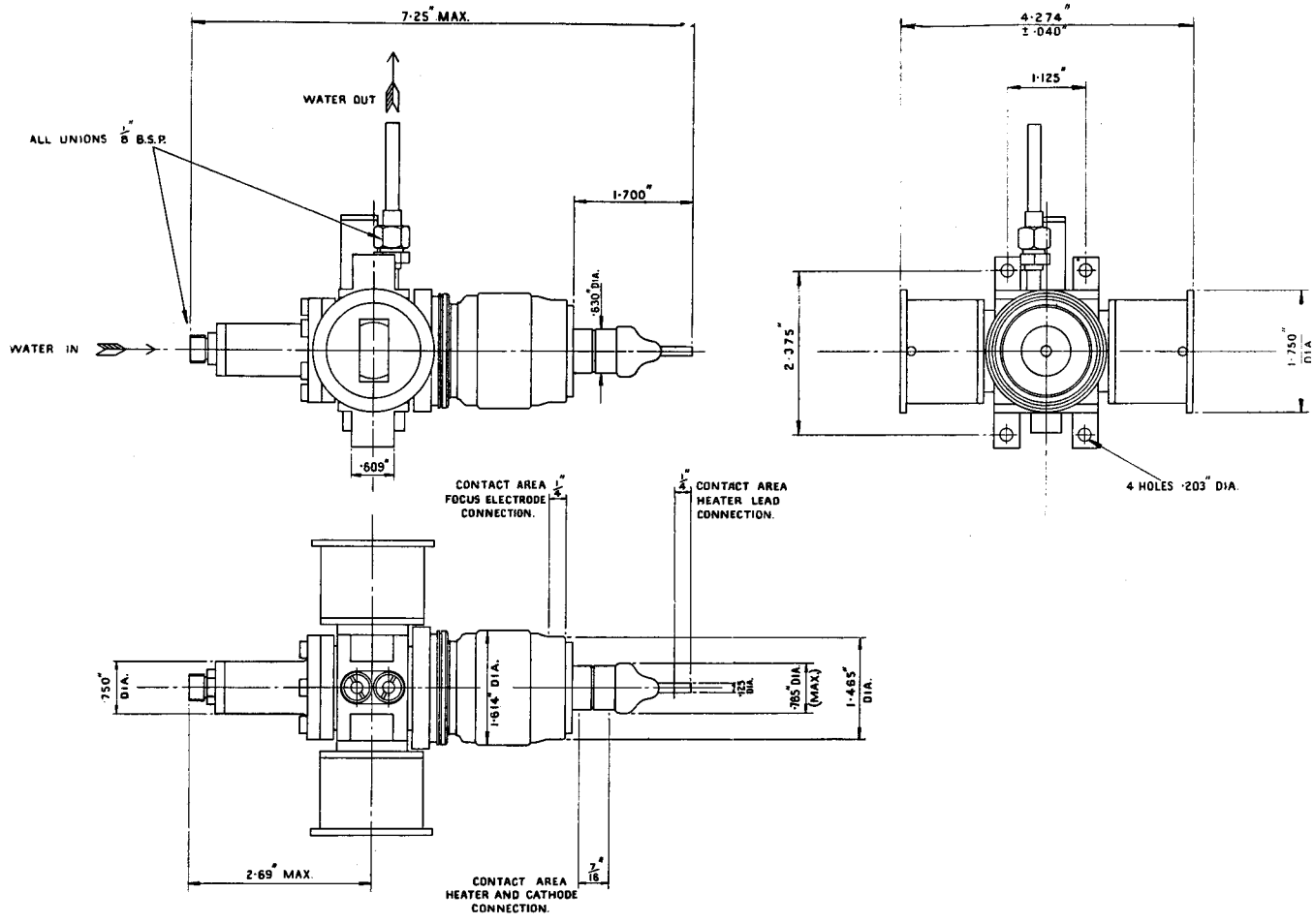
Issue 1.
Mar., 1962

Ferranti

Ferranti

TYPICAL RF INPUT/OUTPUT CHARACTERISTICS.

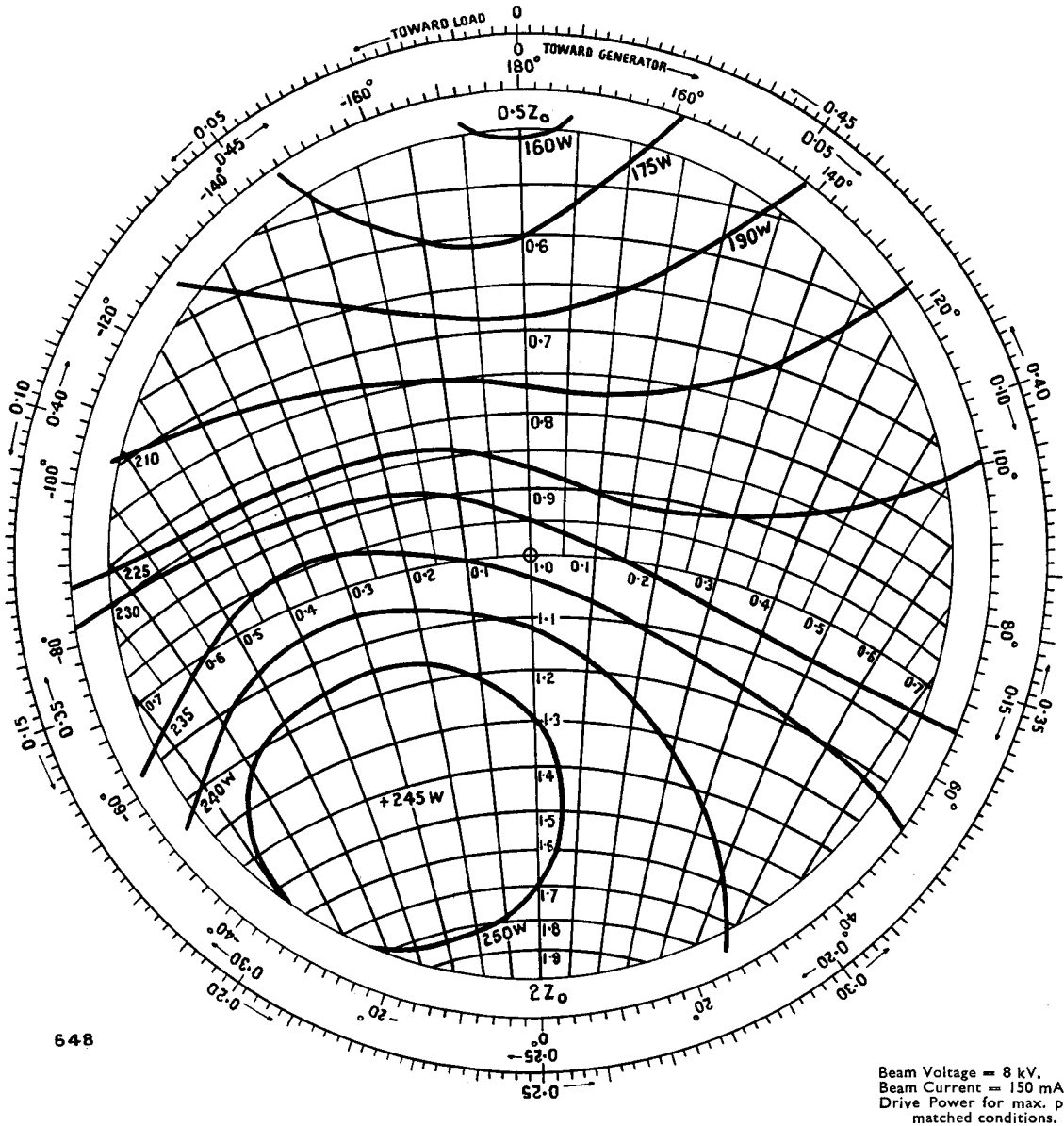




All dimensions shown are in inches

Ferranti

RIEKE DIAGRAM



648

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 ...	⅛ 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.

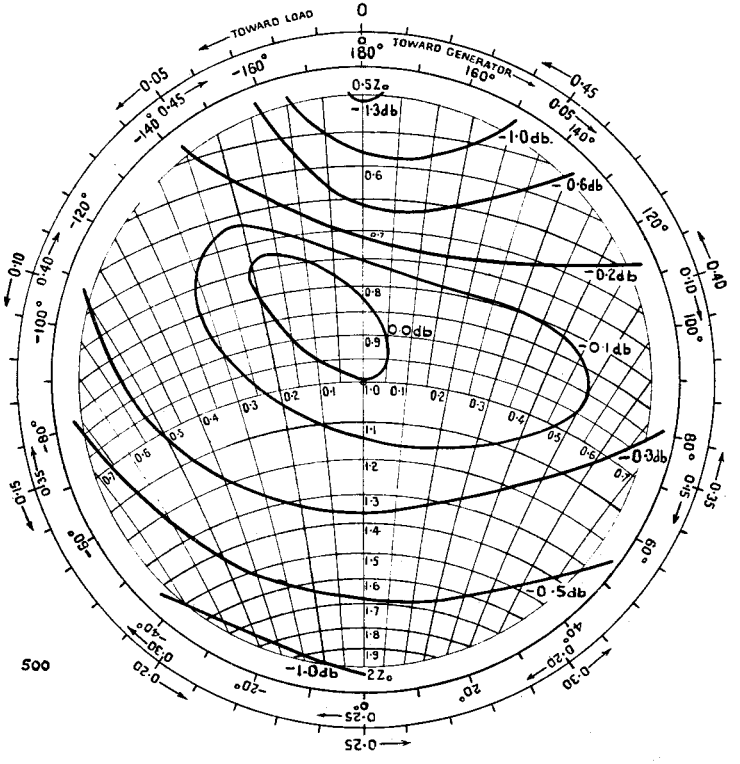
(1) The heater should either be increased slowly from zero to satisfy the surge current specification, or a resistance should be inserted in series with the supply voltage so that application of this voltage will not produce a surge current greater than the specified figure.

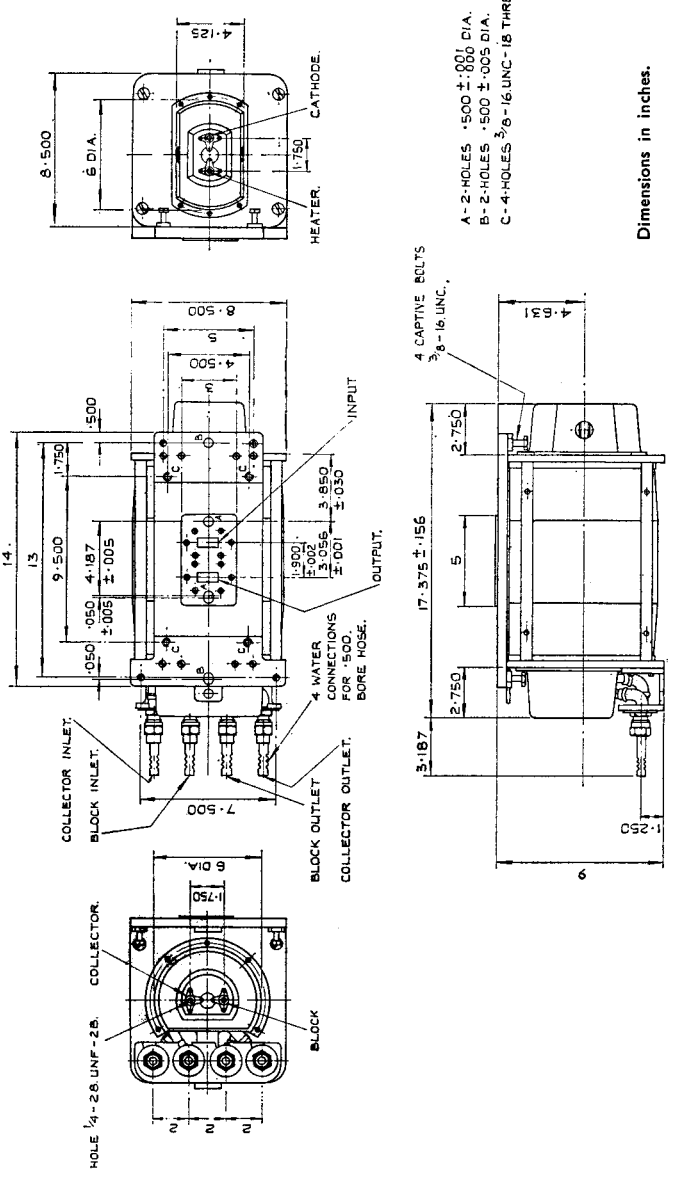
(2) The cavity block and collector are insulated from each other, and, current taken by the block can be therefore measured separately. This current should not exceed 200 mA. An H.T. trip set to operate at 200 mA. is a safeguard against H.T. Flash-over.

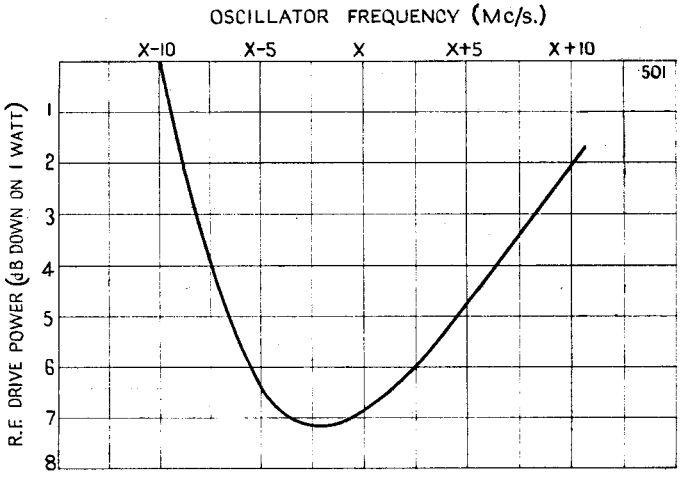
(3) Care should be taken not to exceed 2:1 VSWR in the output circuit, otherwise the output window may puncture. A VSWR higher than 2:1 may also make it impossible to obtain the stated output.

(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.

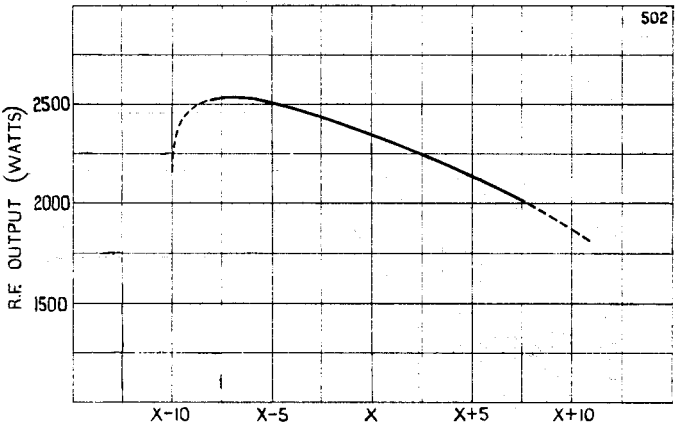
RIEKE DIAGRAM.




8·500
6 DIA.
4·125
1·750
CATHODE.
HEATER.
A - 2 HOLES ·500 +·001 -·000 DIA.
B - 2 HOLES ·500 ±·005 DIA.
C - 4 HOLES 3/8 - 16 UNC - 1B THREAD.
Dimensions in inches.
8·500
5
4·500
1·750
·500
14·
13
9·500
4·187 ±·005
·050 ±·005
·050
3·850 ±·030
1·900 +·002 -·001 3·056
INPUT
OUTPUT.
4 WATER CONNECTIONS FOR ·500. BORE HOSE.
COLLECTOR INLET.
BLOCK INLET.
BLOCK OUTLET
COLLECTOR OUTLET.
7·500
4 CAPTIVE BOLTS 3/8 - 16 UNC.,
4·631
2·750
17·375 ±·156
5
2·750
3·187
1·250
6
6 DIA
1·750
COLLECTOR.
BLOCK
HOLE 1/4 - 28 UNF - 2B.
2
2
2



'X' IS THE TUNED FREQUENCY OF THE SY41.



'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	¼in. 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.

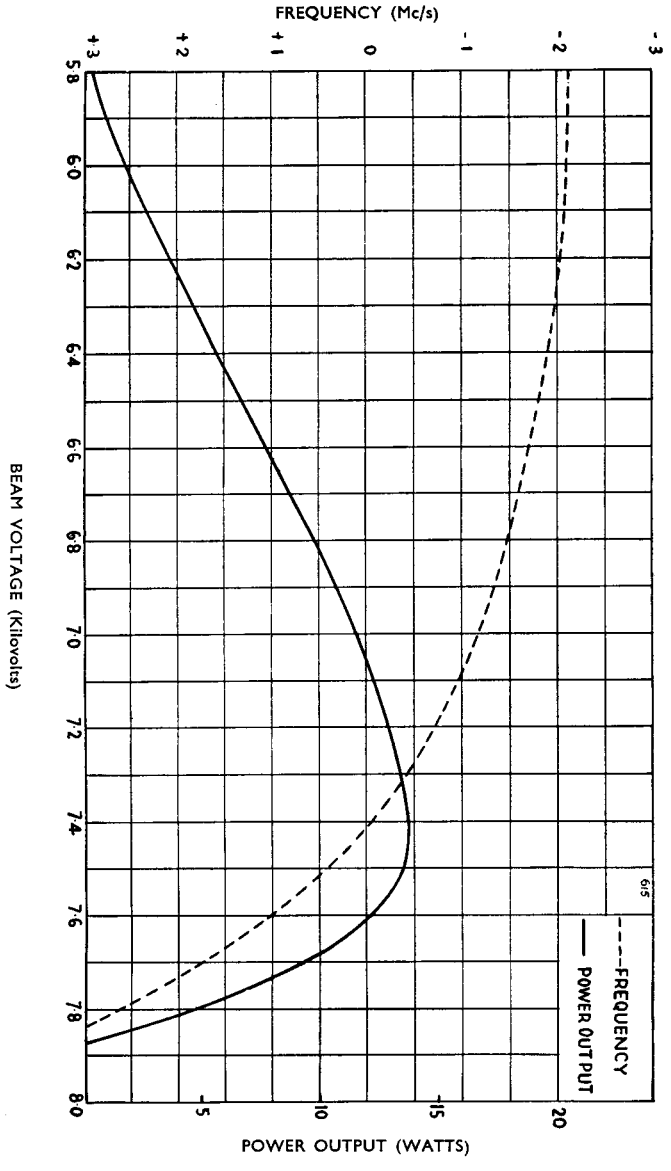
Beam Voltage	7·2 to 7·8 kV.
Beam Current	30—40 mA.
Output Power	10—20 watts.
Beam Voltage at low end of mode	5·6 to 6·2 kV.
§Electronic Tuning Range ...	2 Mc/s. for 600 volts. ±100 volts.
**Frequency Pushing with Beam Voltage	4·2 kc/s/V.
Frequency Pushing with Heater Current	150 c/s/Amp.
††Frequency 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.

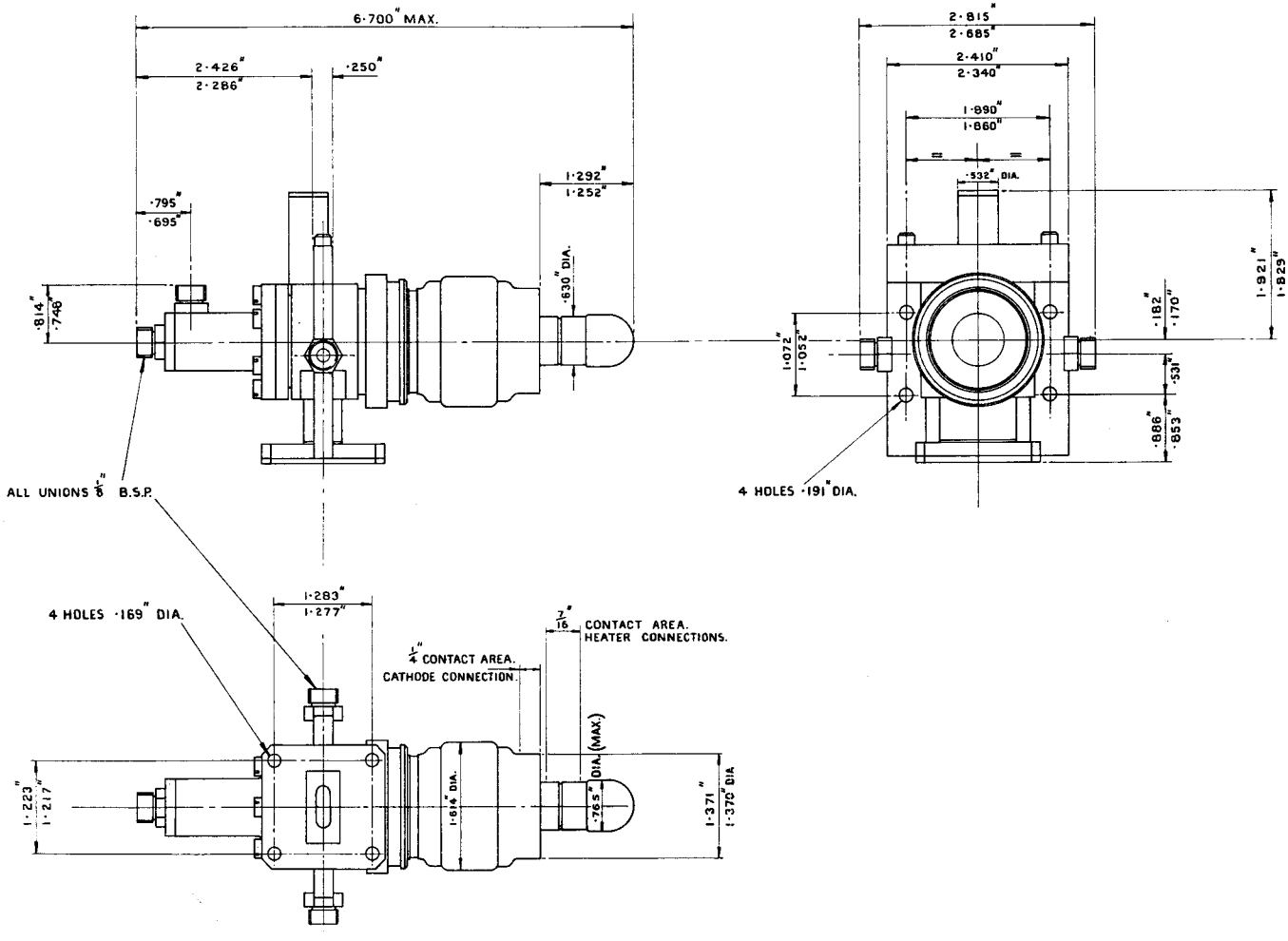
*Bolts to UG 40A/U. Choke Flange.
†This is the frequency to which these Klystrons are normally tuned.
†Tubes for operation at other frequencies in the range 8500 to 10,000 Mc/s. can be supplied to special order.
§For a power variation of less than 1dB.
**At optimum power output.
††All phases of V.S.W.R. 1·5:1.
§§At constant temperature.

Ferranti

Issue 1.
Nov., 1961.

Ferranti

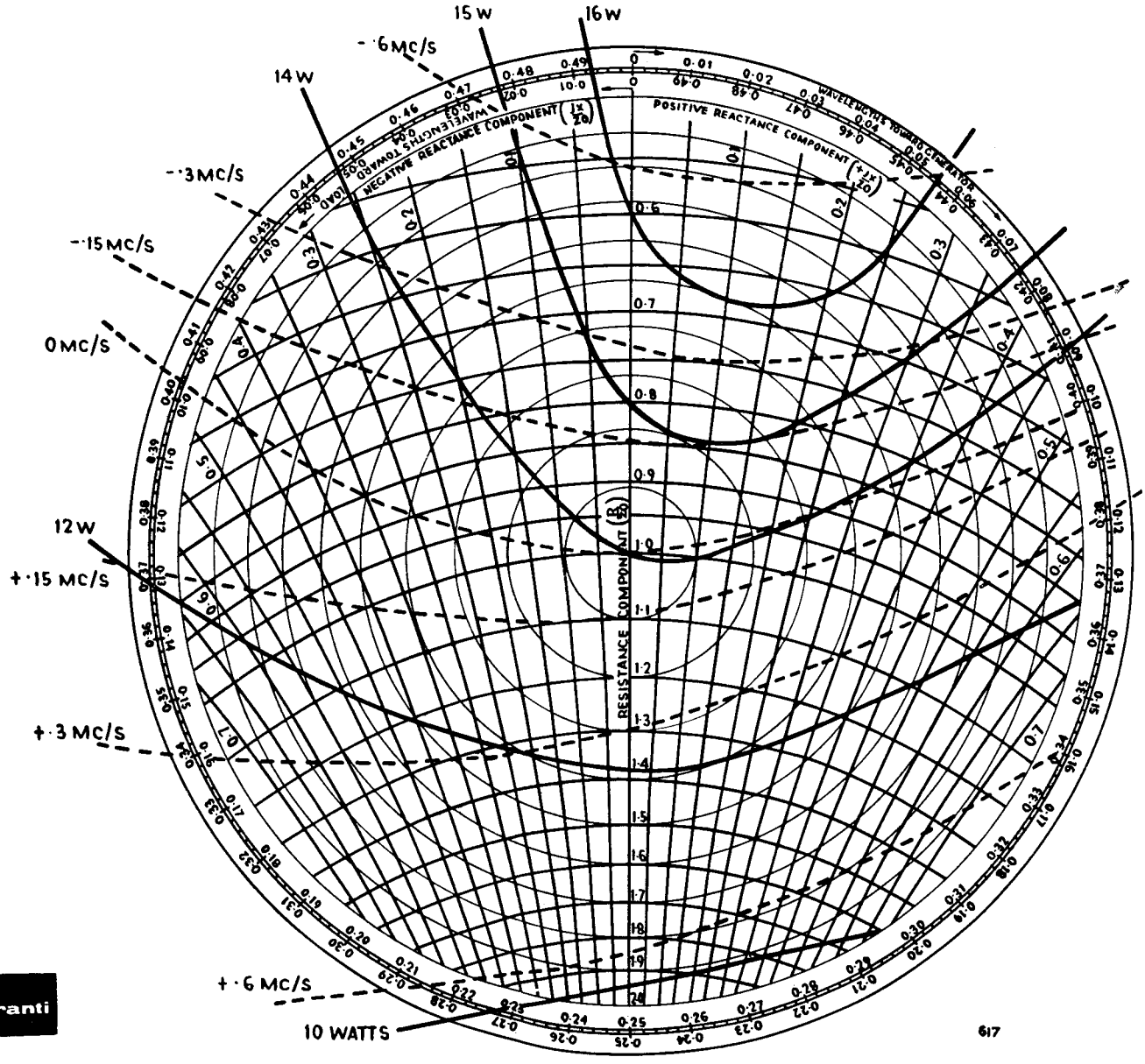

FREQUENCY (Mc/s)
+3
+2
+1
0
-1
-2
-3
58
60
62
64
66
68
70
72
74
76
78
80
BEAM VOLTAGE (Kilovolts)
5
10
15
20
POWER OUTPUT (WATTS)
6/5
FREQUENCY
POWER OUTPUT


6·700" MAX.
2·426"
2·286"
·250"
1·292"
1·252"
·795"
·695"
·814"
·746"
·630" DIA.
ALL UNIONS 1/8" B.S.P.
2·815"
2·685"
2·410"
2·340"
1·890"
1·860"
·532" DIA.
1·921"
1·829"
·182"
·170"
1·072"
1·052"
·531"
·886"
·853"
4 HOLES ·191" DIA.
4 HOLES ·169" DIA.
1·283"
1·277"
7/16" CONTACT AREA.
HEATER CONNECTIONS.
1/4" CONTACT AREA.
CATHODE CONNECTION.
·765" DIA. (MAX.)
1·614" DIA.
1·223"
1·217"
1·371"
1·370" DIA.

Ferranti

SZ22

RIEKE DIAGRAM



Ferranti

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.

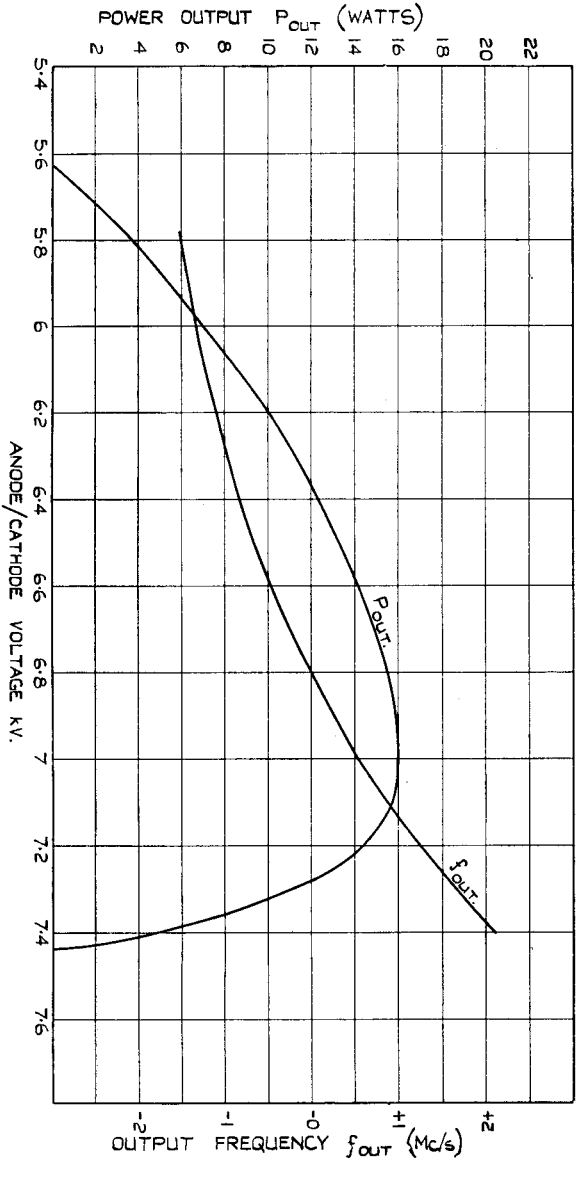
Beam Voltage	6·8—7·4 kV.
Beam Current	28—30 mA.
Output Power	10—20 watts.
Electronic tuning range	
Frequency pushing with Beam volts	3 kc/s./V.
Frequency pushing with heater current	200 c/s./A.
Frequency pulling	4·5 Mc/s.
Temperature coefficient of frequency	150 kc/s./°C.
Microphony	less than 4000 c/s/g up to 10g in the range 20—200 cycles
Shock	Up to 150g of 7 millisecs. duration produces no detectable frequency variation.

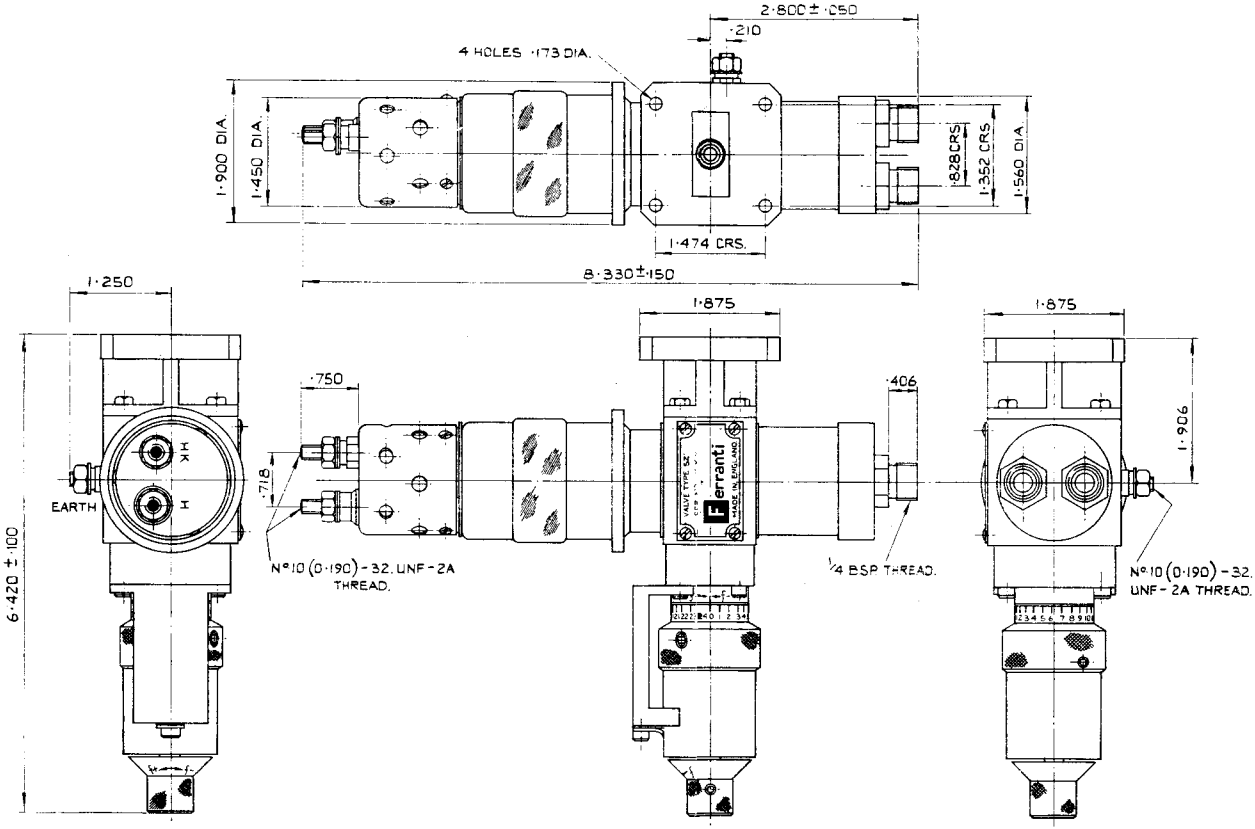
*Bolts to UG40A/U Choke flange.
‡The operating frequency required should be specified when ordering.
§To avoid microphony due to turbulence in water channels.

Ferranti

Issue 1.
Sept., 1961

Typical Power Output and Frequency/Anode Voltage Characteristics.



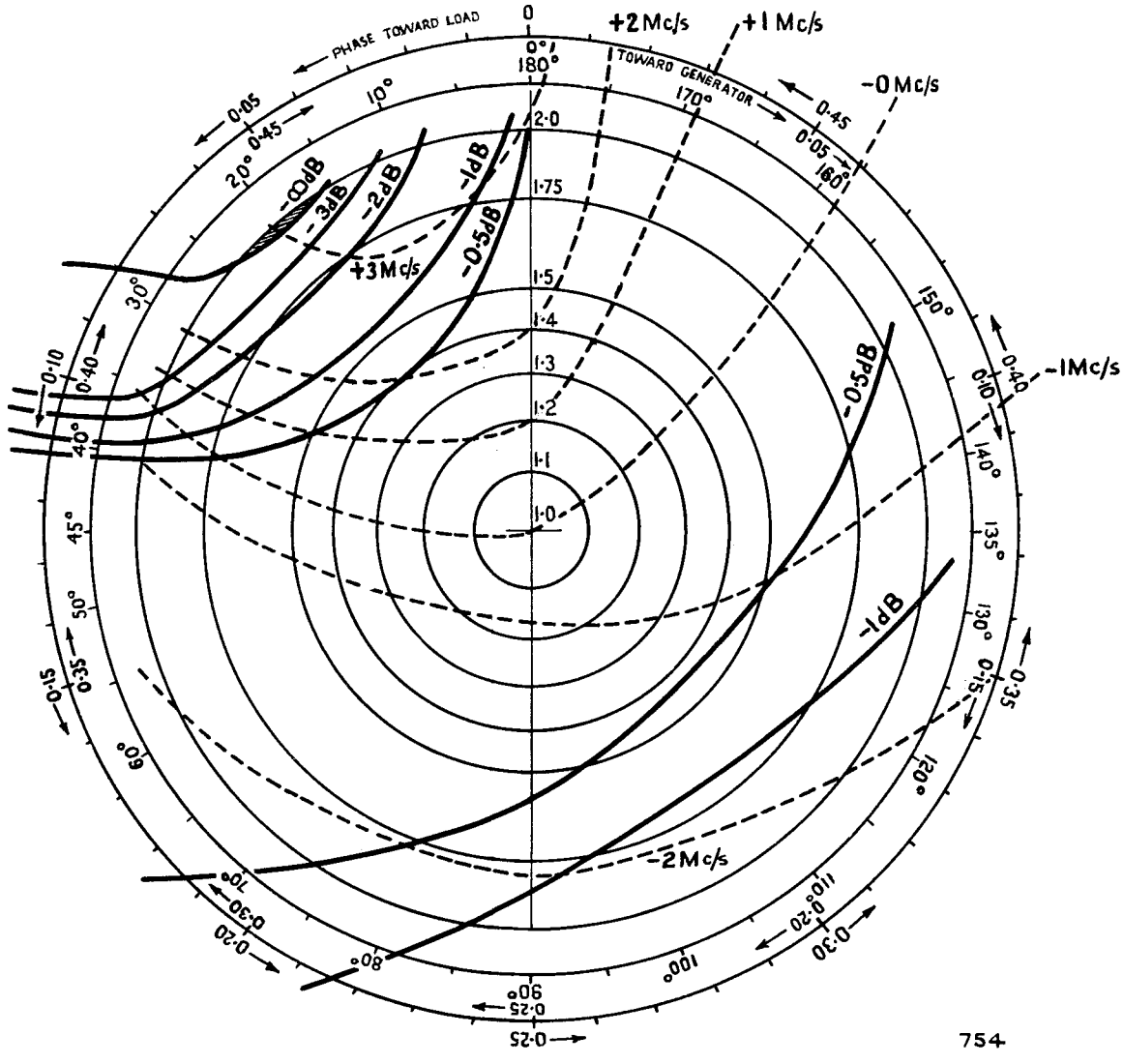


Dimensions in inches.
(Nominal unless otherwise stated.)

Issue 1
Sept., 1961

SZ31

RIEKE DIAGRAM



Ferranti

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

Ferranti

SZ50

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.

Issue 1.
April, 1963

CHARACTERISTICS AND TYPICAL OPERATION (cont.)

*Tuner Resetting Accuracy (max. ΔF.)	...	...	...	...	2	Mc/s
†Pressure Coefficient (Max. ΔF.)	...	...	...	...	±$\frac{3}{4}$	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 ±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.

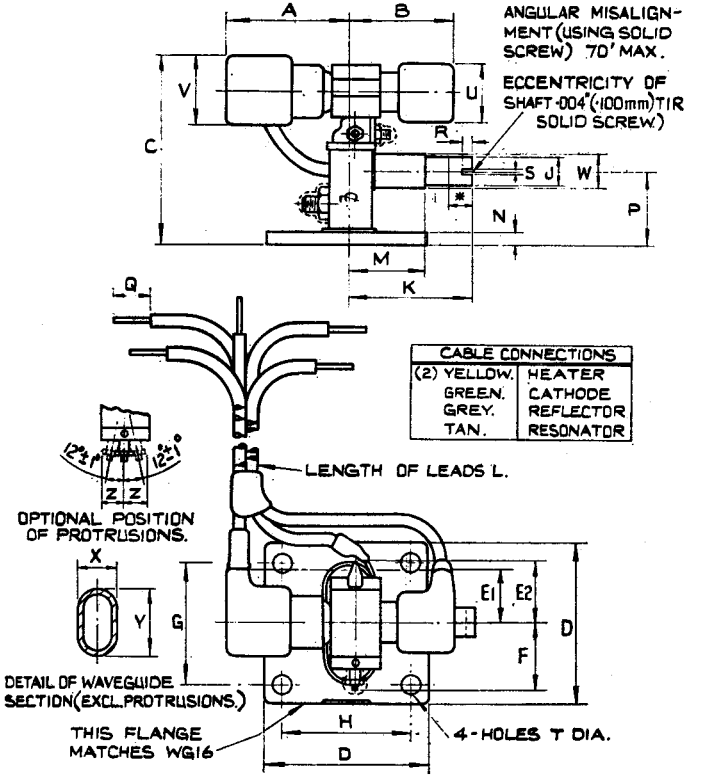
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*Resetting accuracy defines the frequency deviation which can result from turning the tuner screw through approximately half a turn in either direction, then returning it to its original position.

†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 atmosphere in 1 minute (max.).

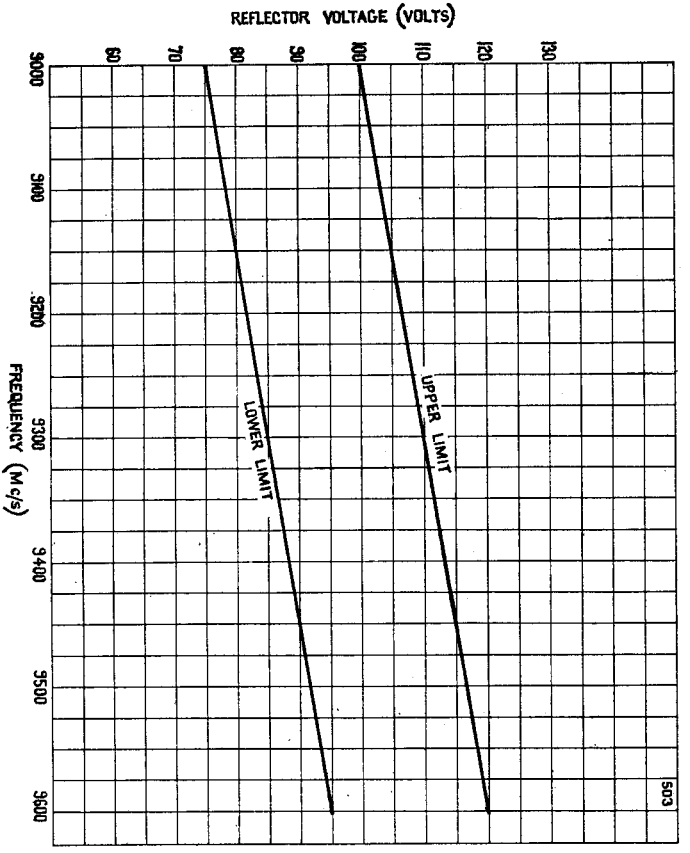
‡The valve is design tested to 20g.

§To facilitate insulated mounting the eyelets in the fixing bolt holes are removable.

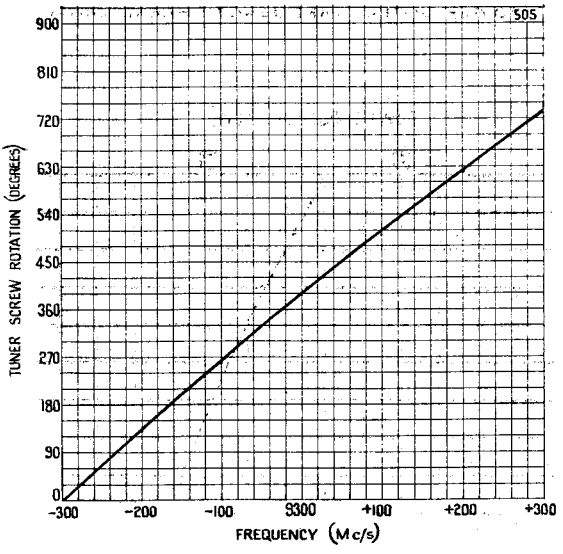


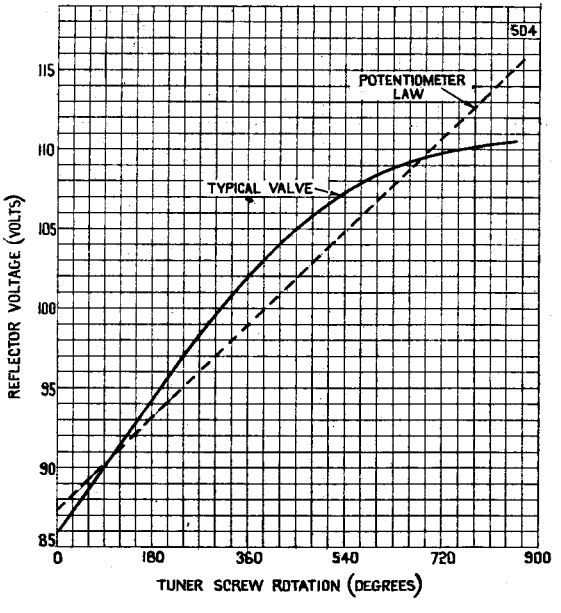
DIM	INCHES	m.m.	NOTES.	DIM	INCHES	m.m.	NOTES.
A	1·260 MAX.	32		N	·125 +·025 −·000	3·17 +·63 −·00	
B	1·026 MAX.	25·56		P	·720 ± ·002	18·29 ± ·05	
C	1·900 MAX.	48·25		Q	·375 ± ·125	9·52 ± 3·18	
D	1·625 ± ·015	41·25 ± ·40		R	·100	2·54	
E1	·680 MAX.	17·27		S	·040	1·02	
E2	·725	18·42	MAX. BODY WIDTH	T	·219 ± ·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	·281 +·002 −·002	7·14 +·00 −·05	* DIA. OVER ·200" (5mm) LENGTH AT 9·6 G/s (32-34 TPI)	X	·435 MAX.	11·06	
K	1·240 ± ·060	31·50 ± 1·52		Y	1·100 MAX.	27·94	
L	18	457		Z	·240 MAX.	6·10	
M	·812	20·64					

REFLECTOR VOLTAGE/FREQUENCY CHARACTERISTIC

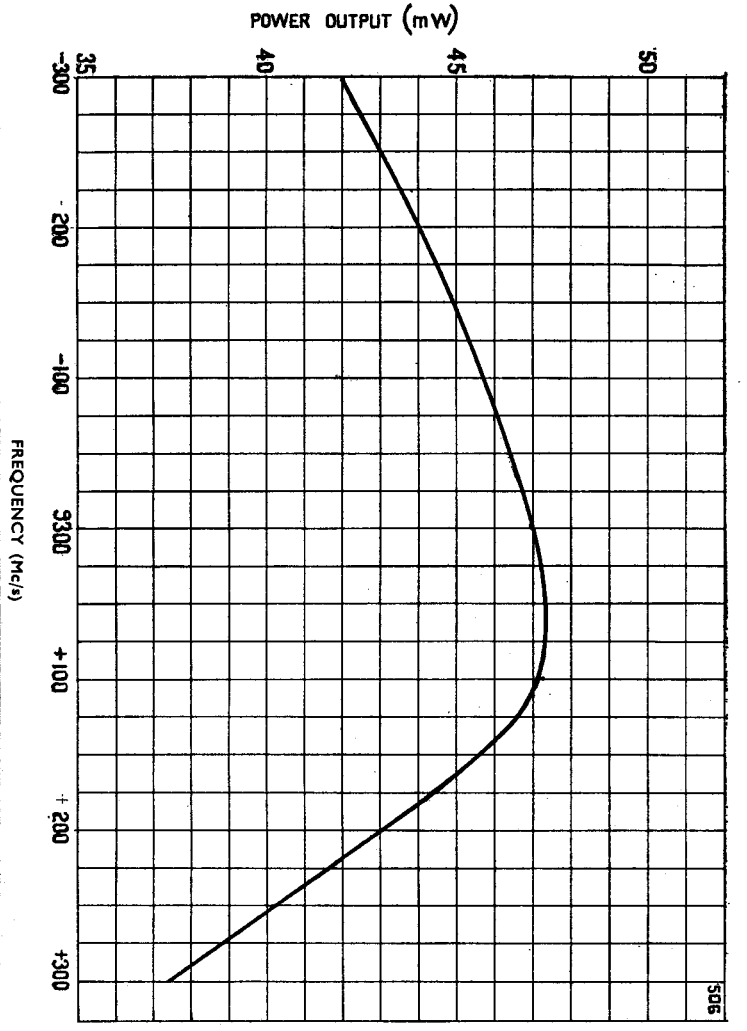


TUNER SCREW SETTING





POWER OUTPUT/FREQUENCY CHARACTERISTIC



Ferranti

KLYSTRONS

SZ51

SZ51A

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 1⅞in. 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

Ferranti

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May, 1960

CHARACTERISTICS AND TYPICAL OPERATION. (cont.)

†Noise	$<3 \times 10^{-14}$ W/ Mc/s/ mW
‡Tuner Resetting Accuracy (max. ΔF.)	1 Mc/s.
§Tuner Side Thrust (max. ΔF.)	0·5 Mc/s.
¶Pressure Coefficient (Max. ΔF).	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.

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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.

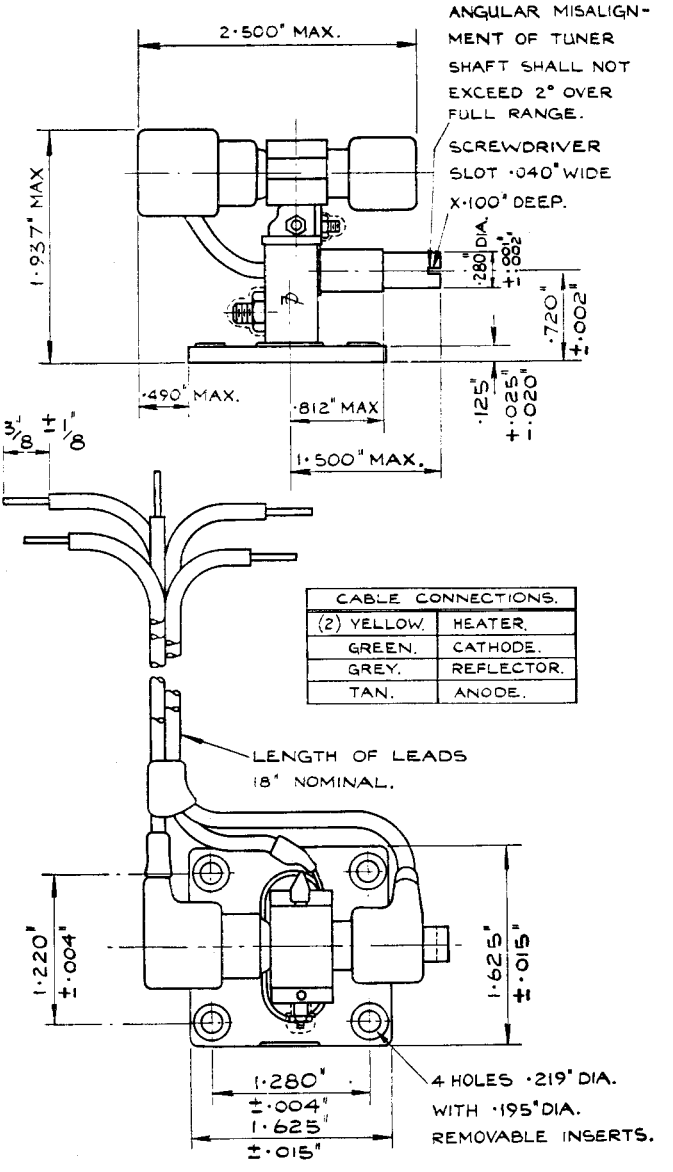
‡Resetting accuracy defines the frequency deviation which can result from turning the tuner screw through approximately half a turn in either direction, then returning it to its original position.

§The frequency deviation, caused by side thrust due to the application 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.

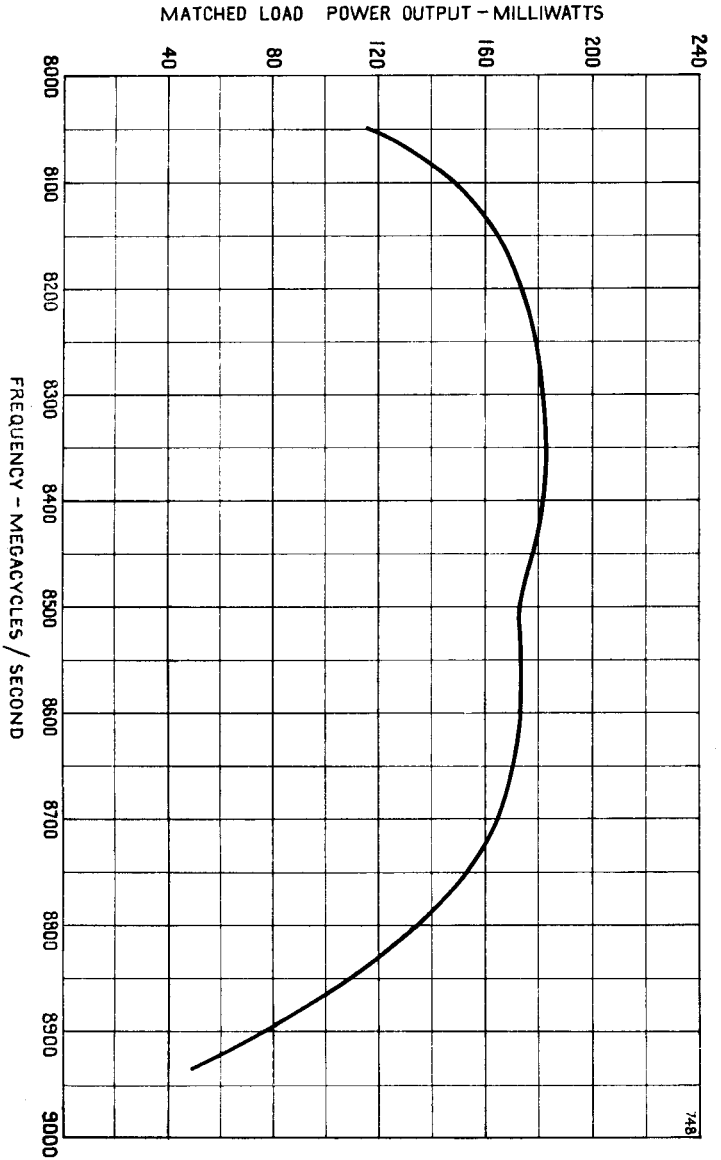
¶The frequency deviation measured when the atmosphere pressure surrounding the valve and inside the set and cavity is increased from 1/10th atmosphere to 1 atmosphere in 1 minute (max.).

**To facilitate insulated mounting the eyelets in the fixing bolt holes are removable

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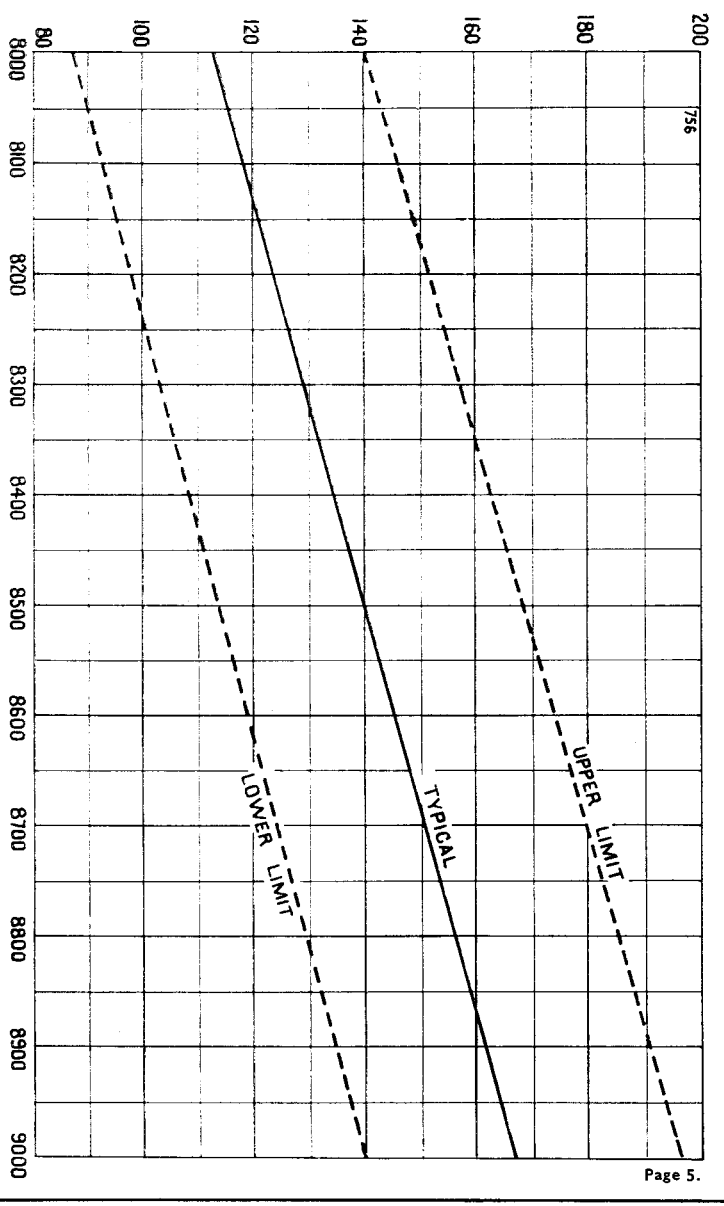

ANGULAR MISALIGNMENT OF TUNER SHAFT SHALL NOT EXCEED 2° OVER FULL RANGE.
2·500" MAX.
SCREWDRIVER SLOT ·040" WIDE X·100" DEEP.
1·937" MAX
·280" +·002" -·001" DIA.
·720" +·002"
·490" MAX.
·812" MAX
·125" +·025" -·020"
3/8" ± 1/8"
1·500" MAX.
CABLE CONNECTIONS.
(2) YELLOW. HEATER.
GREEN. CATHODE.
GREY. REFLECTOR.
TAN. ANODE.
LENGTH OF LEADS 18" NOMINAL.
1·220" ±·004"
1·625" ±·015"
1·280" ±·004"
1·625" ±·015"
4 HOLES ·219" DIA. WITH ·195" DIA. REMOVABLE INSERTS.

POWER OUTPUT/FREQUENCY CHARACTERISTIC

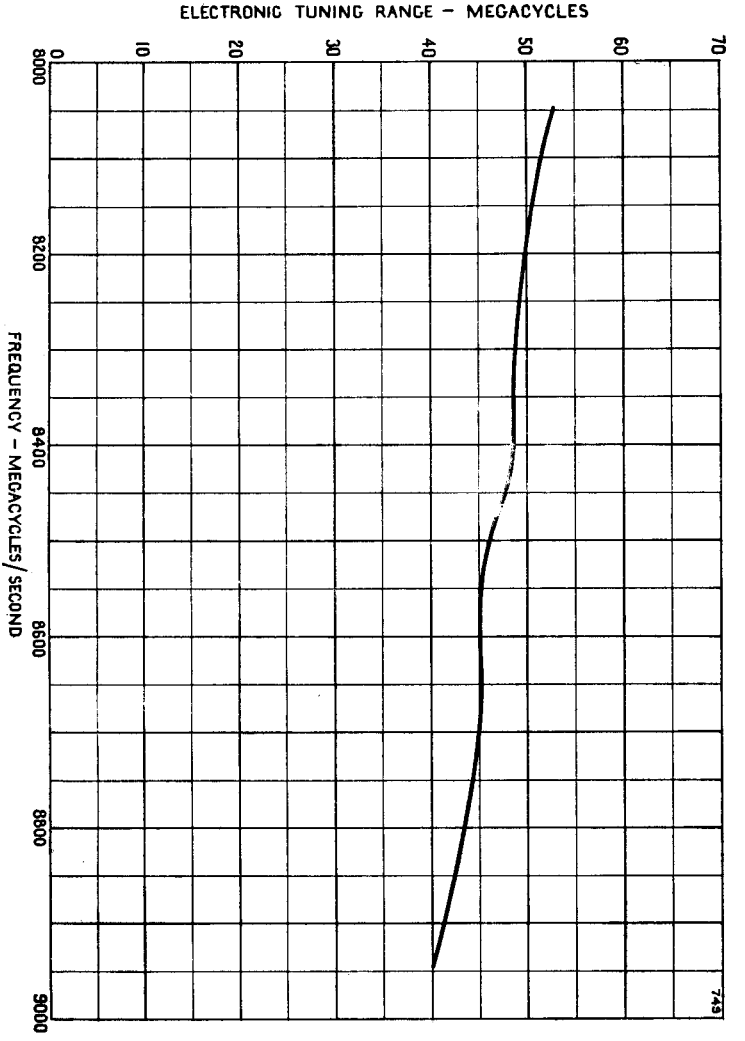


REFLECTOR VOLTS/FREQUENCY CHARACTERISTICS.

Reflector Voltage at Maximum Power Point.

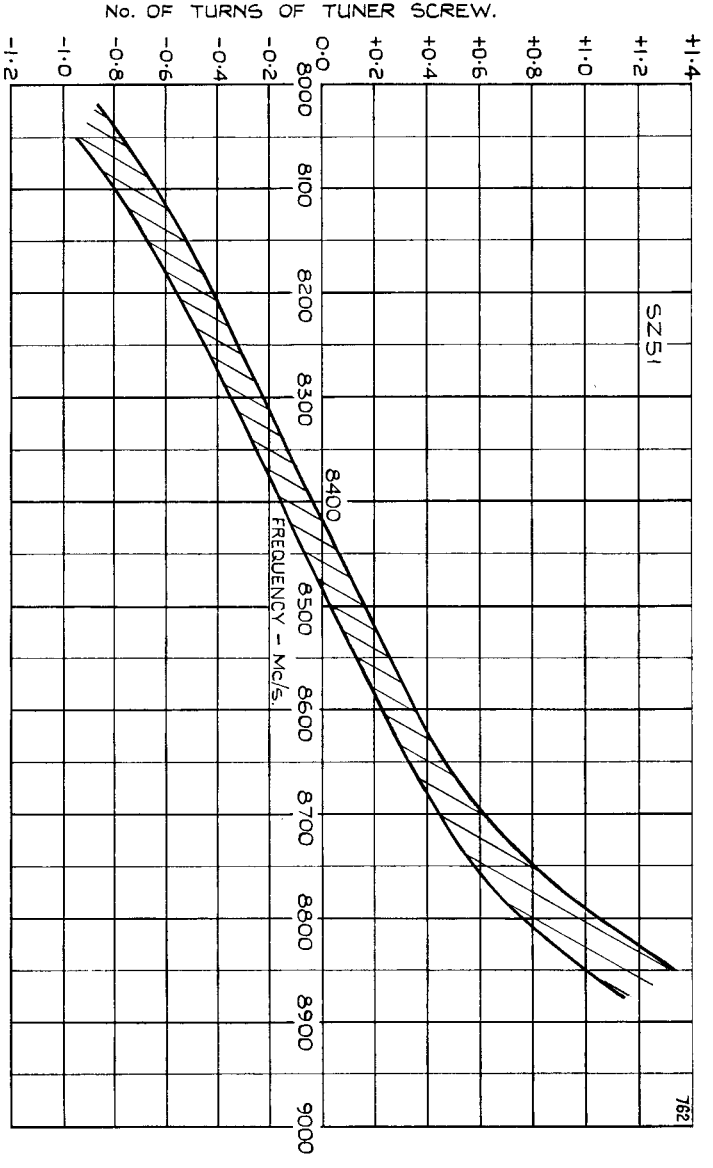


ELECTRONIC TUNING RANGE



TUNER SCREW SETTING.

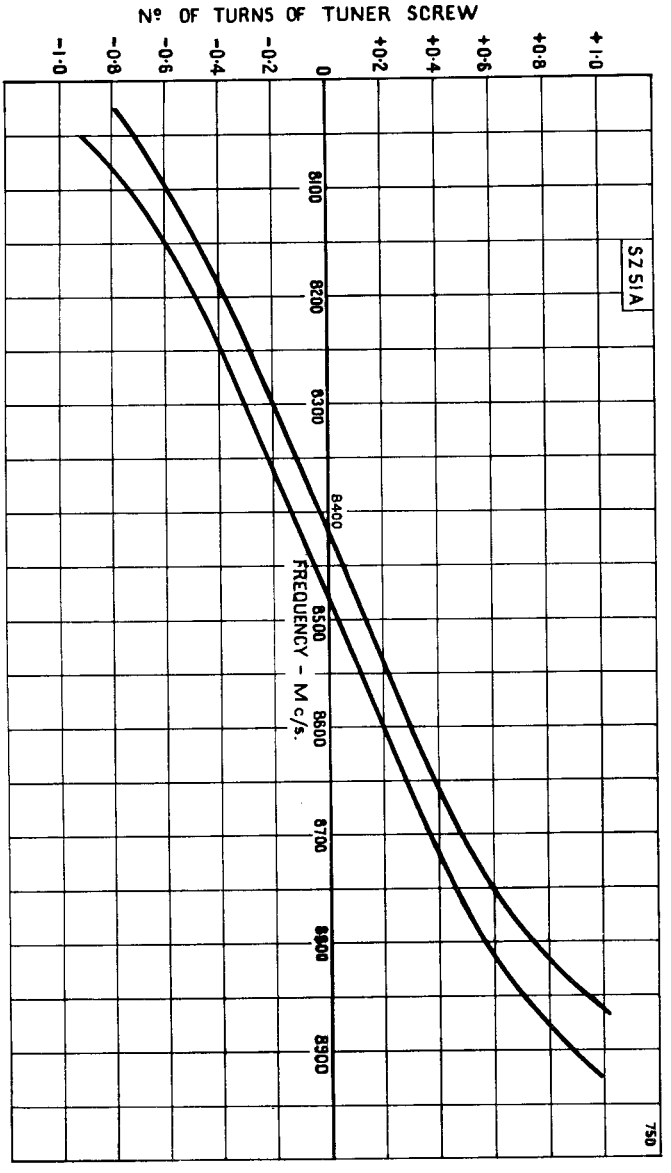
(The tuner screw setting for any frequency should lie within the area enclosed by the two lines,)



Ferranti

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 4¼ 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		$6\frac{3}{4}$		$5\frac{3}{4}$		
		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.

Issue 1.
Nov., 1963

CHARACTERISTICS AND TYPICAL OPERATION (Cont.)

*Noise	$<3\times10^{-14}$ W / Mc/s / mW
†Tuner Resetting Accuracy (max. ΔF.)	1 Mc/s
‡Tuner Side Thrust (max. ΔF.)	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 $\pm10\%$.

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.

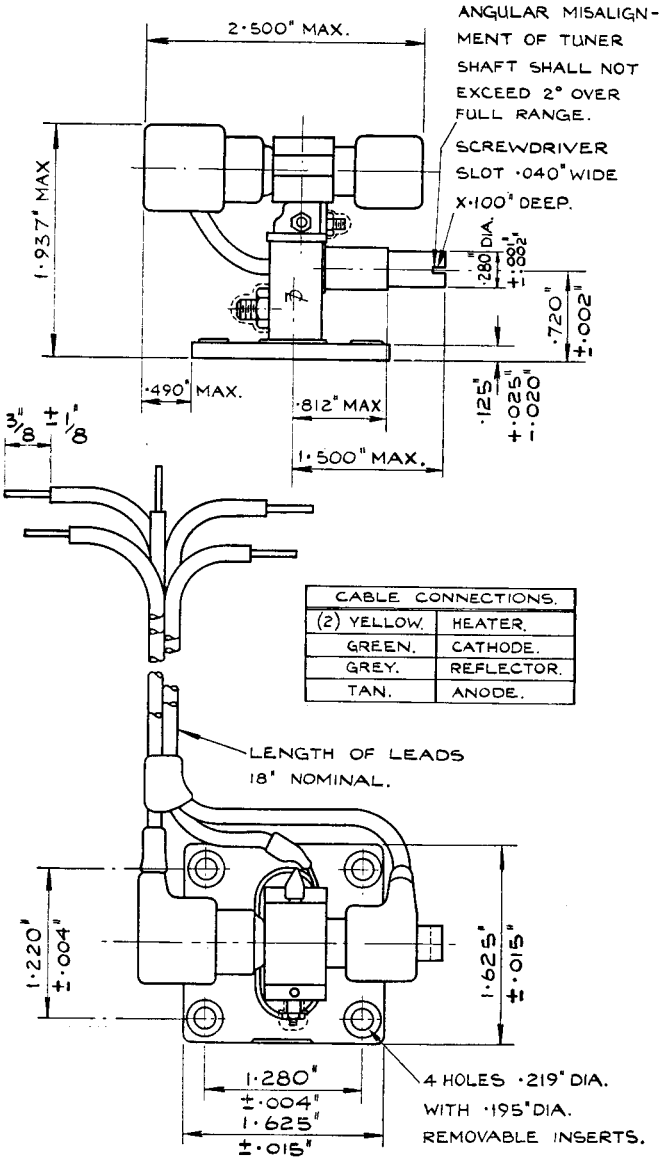
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*The R.F. noise is the sum of the R.F. noise power in two channels 40 Mc/s. above and below the frequency of oscillation, compared to normal noise at 290°K. in the same channels.
The noise standard used in these measurements is a CV1881 discharge tube. 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 ½lb. weight to the top of the tuner spindle in each of two mutually perpendicular axes both of which are perpendicular to the spindle axis.

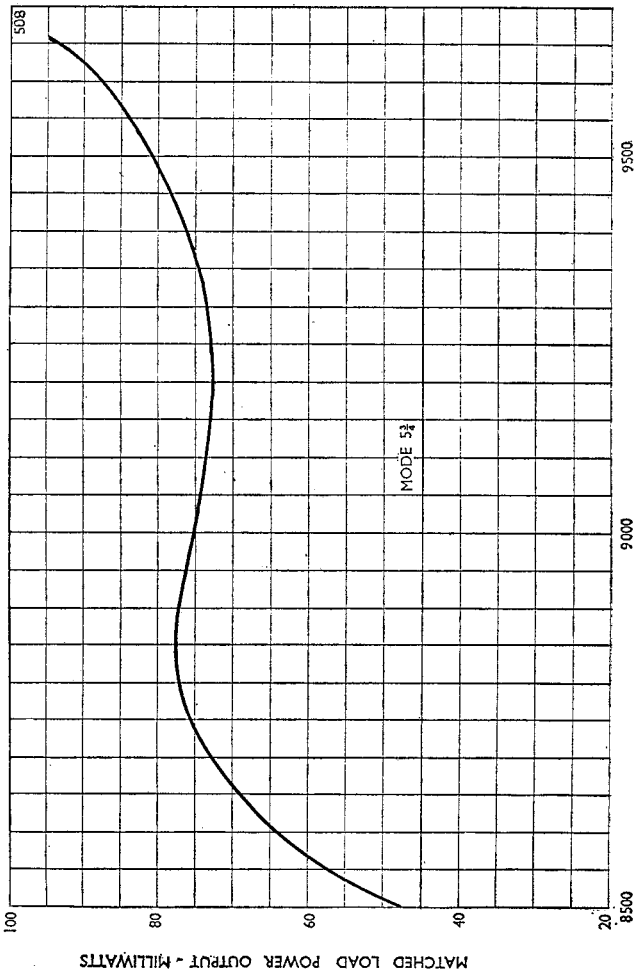
FERRANTI LIMITED, GEM MILL, CHADDERTON, OLDHAM, LANCS.



CABLE CONNECTIONS.	
(2) YELLOW.	HEATER.
GREEN.	CATHODE.
GREY.	REFLECTOR.
TAN.	ANODE.

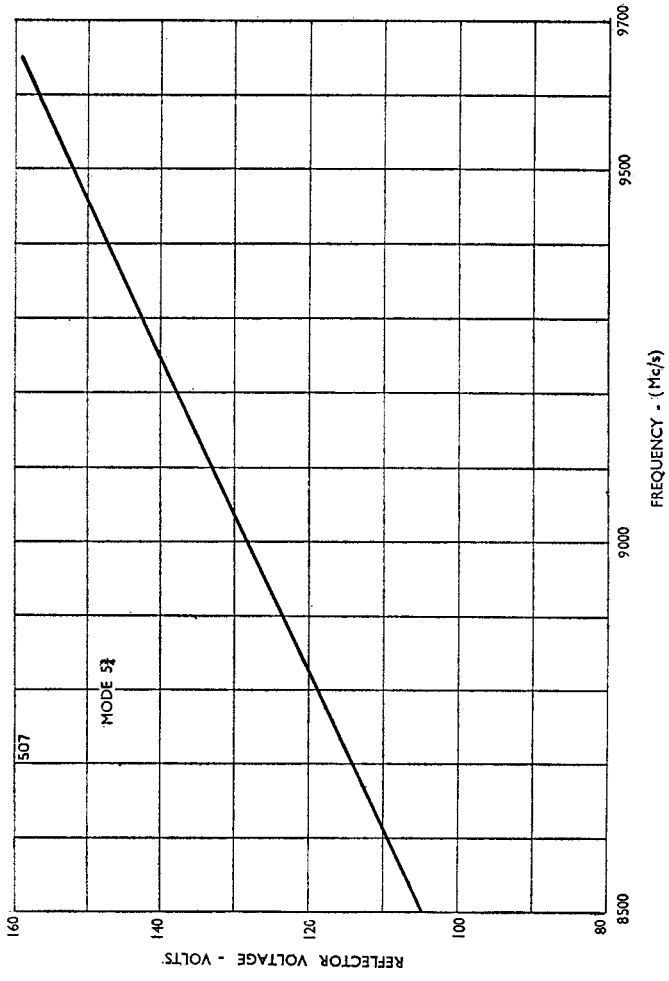
Ferranti

TYPICAL POWER OUTPUT/FREQUENCY CHARACTERISTIC

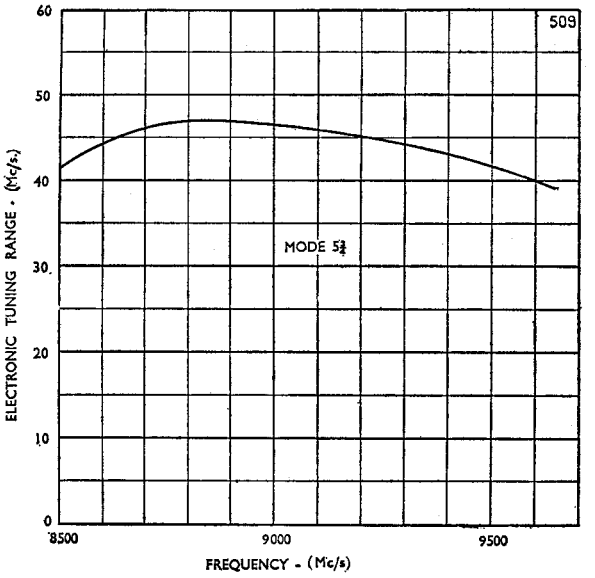


TYPICAL REFLECTOR VOLTS/FREQUENCY CHARACTERISTICS

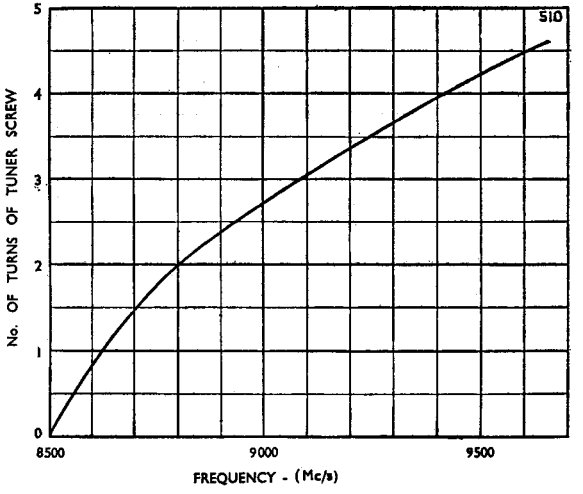
Reflector Voltage at Maximum Power Point.



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.

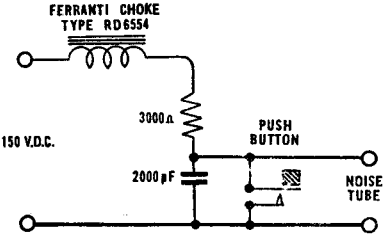
Striking Voltage	1150 volts.
*Normal Operating Voltage	50 volts.
Normal Operating Current	35 mA.
Max. Operating Current	50 mA.
Min. Series Resistance	3000 ohms.
†Available Noise Power	15·25±0·25 dB.
‡V.S.W.R. over band 9·375±350 Mc/s.	<1·25
Insertion loss of 'unstruck' tube on mount	<0·2 dB.

§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.

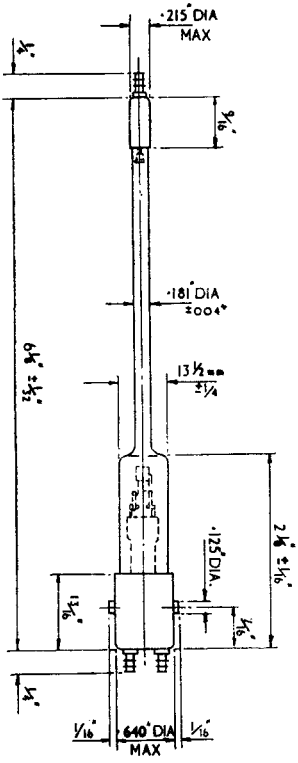
†The available noise power is referred to thermal noise at 17°C and does not include the image frequency contribution.

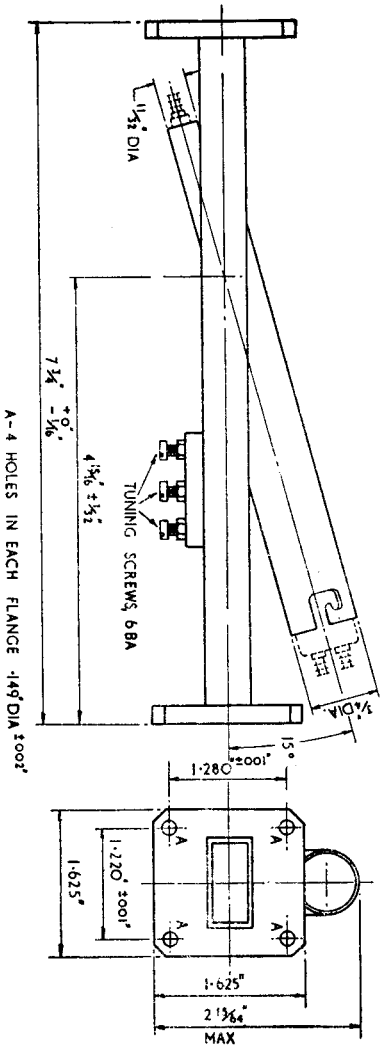
‡The V.S.W.R. refers to the match obtained with a 'struck' tube in a mount tuned to a centre frequency of 9,375 Mc/s. with the waveguide terminated by a matched load. At 9,375 Mc/s. the V.S.W.R. is 1·01.

§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

TE10





FERRANTI LIMITED, KINGS CROSS ROAD, DUNDEE.

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 UG40A/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.

Issue 2.
Oct., 1959

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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	$<3 \times 10^{-14}$ W / Mc/s / mW
†Tuner Resetting Accuracy (max. Δ F.)	1 Mc/s.
‡Tuner Side Thrust (max. Δ 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.

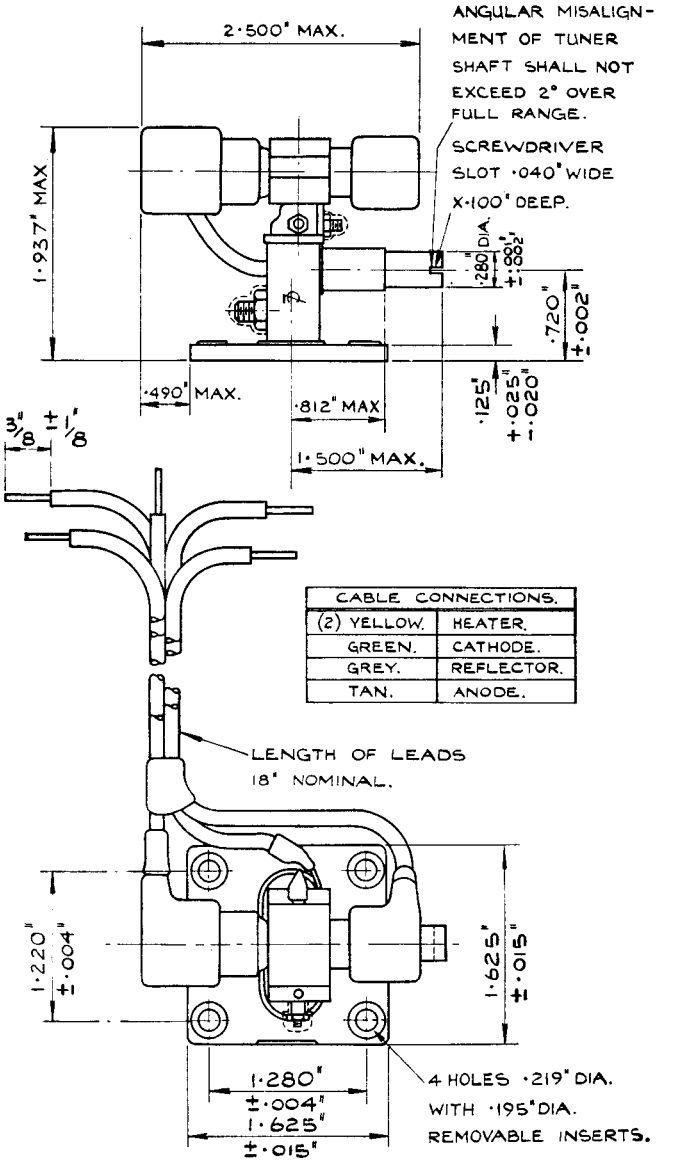
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*The R.F. noise is the sum of the R.F. noise power in two channels 40 Mc/s. above and below the frequency of oscillation, compared to normal noise at 290°K. in the same channels.
The noise standard used in these measurements is a CV1881 discharge tube. 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 a $\frac{1}{4}$lb. 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.

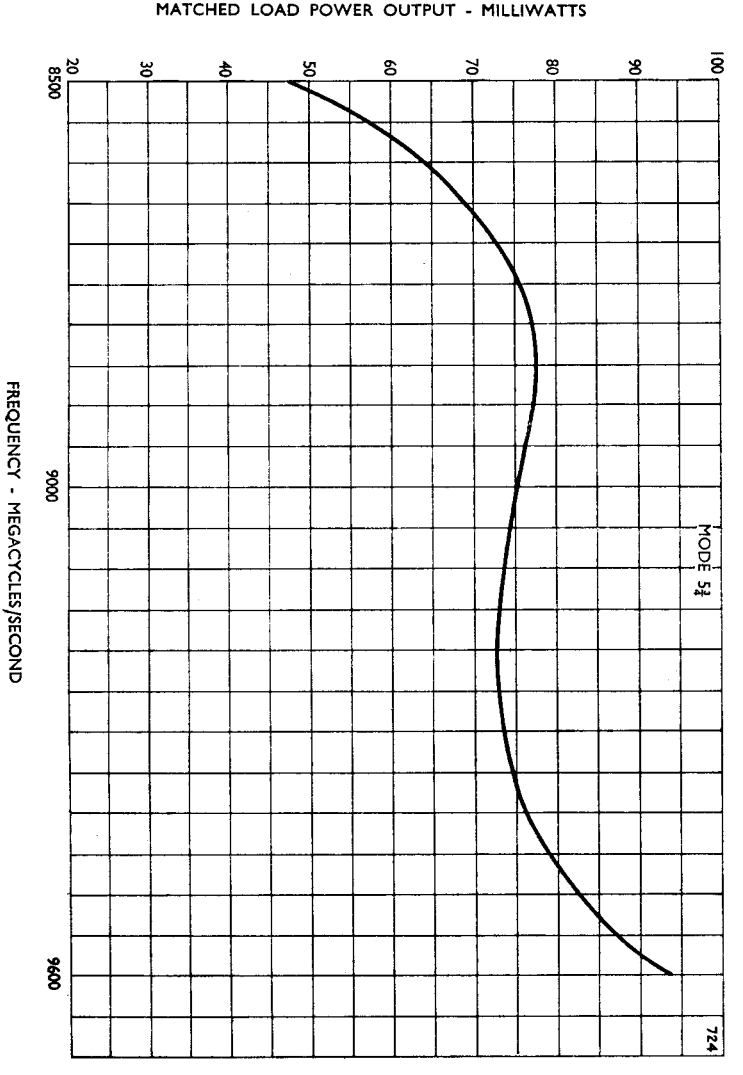


CABLE CONNECTIONS.	
(2) YELLOW.	HEATER.
GREEN.	CATHODE.
GREY.	REFLECTOR.
TAN.	ANODE.

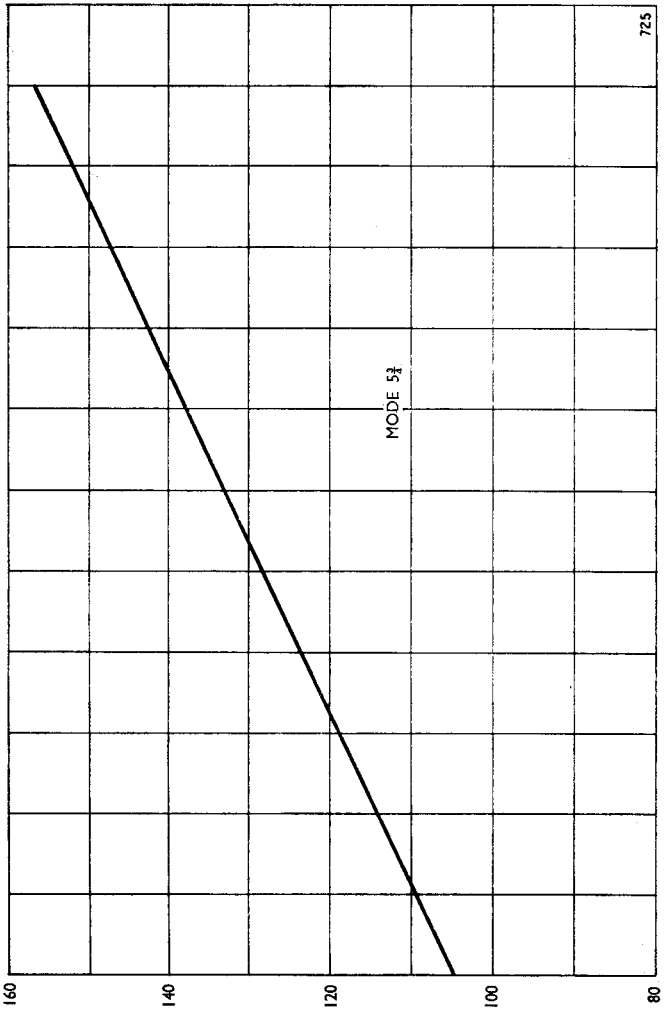
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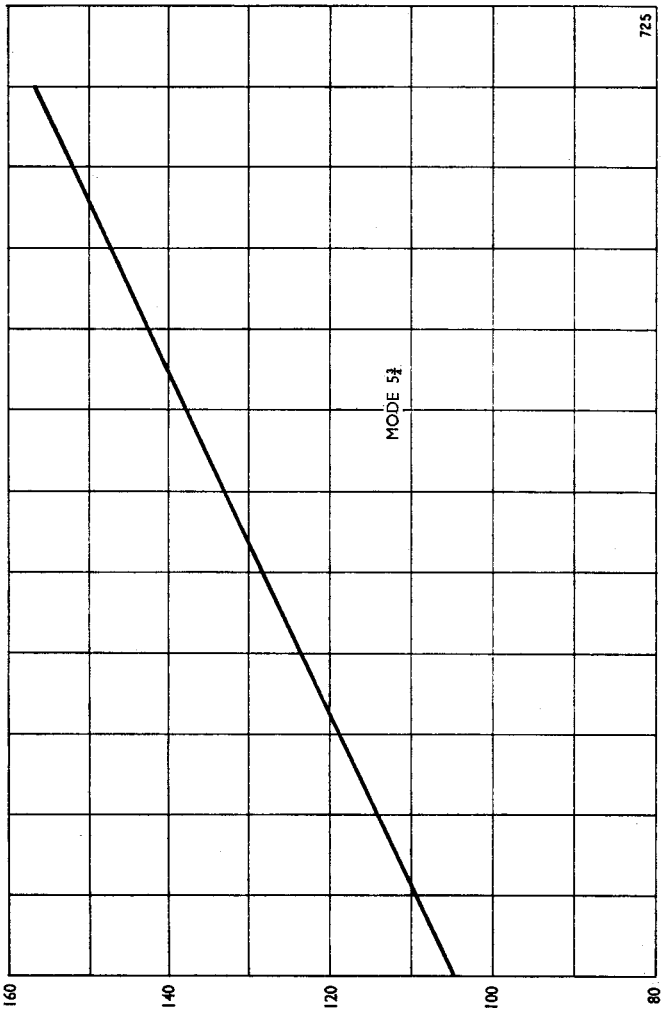
POWER OUTPUT/FREQUENCY CHARACTERISTIC



REFLECTOR VOLTS/FREQUENCY CHARACTERISTICS.
Reflector Voltage at Maximum Power Point.



REFLECTOR VOLTS/FREQUENCY CHARACTERISTICS.
Reflector Voltage at Maximum Power Point.



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.

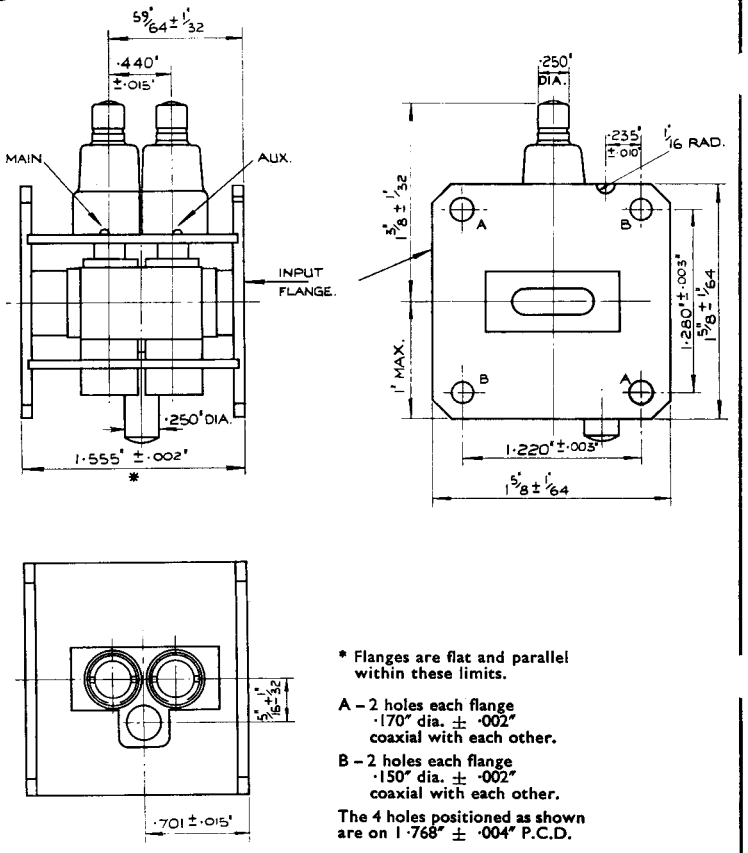
*See "Operating Notes" (3).
†See "Operating Notes" (4).
‡With primer energised.
§Measured from input flange face.

Issue 2.
June, 1960

Ferranti

Ferranti

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* 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.

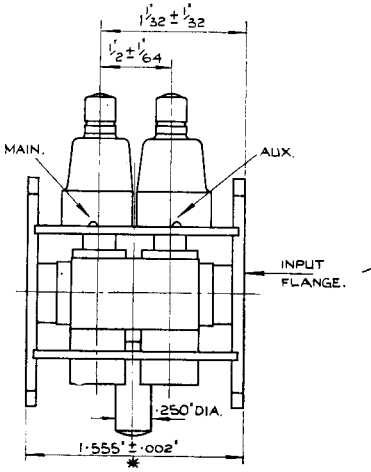
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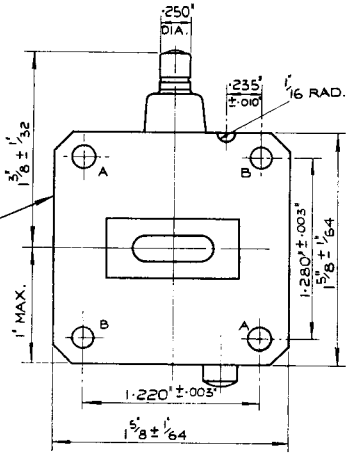
Issue 3
Jan., 1961

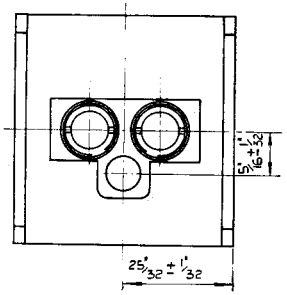
WF43

Ferranti

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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.

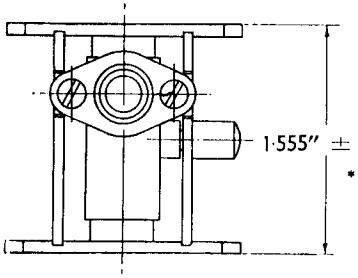
(5) The D.C. Primer Electrode should be supplied from a negative potential Source of 1000 volts D.C. minimum. Suitable resistors should be used to limit the electrode current to between 100 and 185 microamperes At least one megohm must be placed immediately adjacent to the electrode terminal to prevent relaxation oscillations.

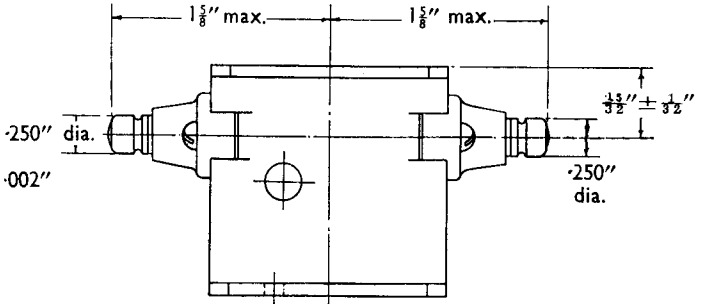
(6) The maximum difference in electrical length between cells is 40°.

*See "Operating Notes" (3) and (5).
†See "Operating Notes" (3) and (4).
§With Primer energised.
‡Measured from input flange face.

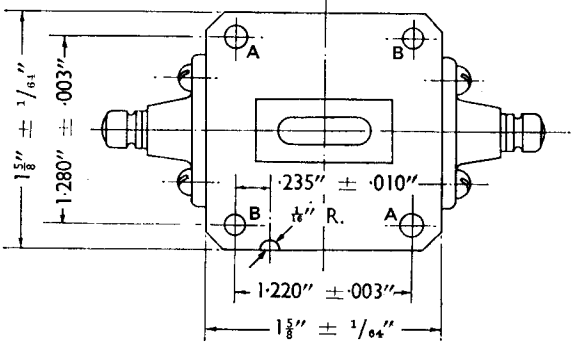
Issue 2
June, 1960

Ferranti





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.



* Flanges are flat and parallel within these limits

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WF44

FERRANTI LTD., KINGS CROSS ROAD, DUNDEE.

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.

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Issue 2,
Nov. 1959

Ferranti

WF45

