Mullard
DOUBLE DIODE

2D13

The 2D13 is an indirectly heated double diode for use in D.C./A.C. operated receivers, and for car radio.

The valve consists of two diode anodes located on a common cathode assembly.

HEATER CHARACTERISTICS

Heater Voltage	... ...	Vf = 13·0 volts
Heater Current	... ...	If = 0·2 amp
Heating Time—100 seconds		

DIMENSIONS

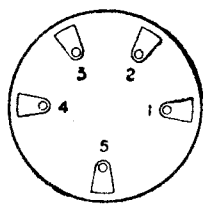
Overall Length ...	= 83 mm.
Overall Diameter	= 29 mm.
Bulb Finish—Metallised	

OPERATING CHARACTERISTICS

Maximum Diode Anode Voltage (Peak)	... Vd_{max}	= 200 volts
Maximum Diode Current	... Id_{max}	= 0·8 mA
Maximum Resistance Heater to Cathode	... Rfk_{max}	= 20,000 ohms
Maximum Voltage Heater to Cathode ...	... Vfk_{max}	= 125 volts

For characteristic curve see valve type 2D13C. Except for the base the 2D13 and 2D13C are identical.

CONNECTIONS



Viewed from underside of base.

Contact No. 1 Metallising
" 2 Heater
" 3 Heater
" 4 Cathode
" 5 Diode (1)
Top Cap—Diode (2)

Mullard
DOUBLE DIODE

2D13A

Heater

Vf = 13.0 V
If = 0.2 A

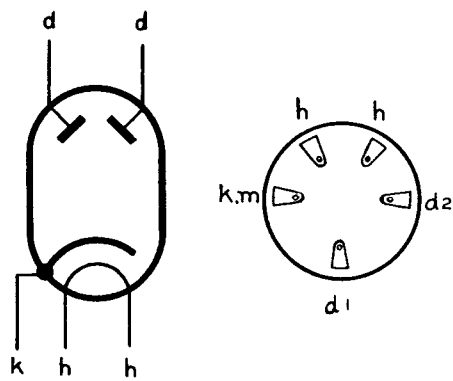
Heating Time = 20 secs

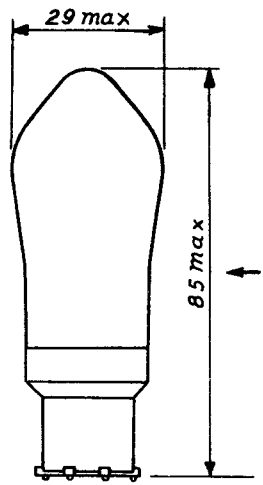
Operating Conditions

Vd max	200	V
Id max	0.8	mA
Vfk max	125	V
Rfk max	20,000	ohms

For characteristic curve see valve type 2D13C.
Except for the base, the 2D13A and 2D13C are identical.

Arrangement of electrodes and base connections.





2D13A

Mullard
DOUBLE-DIODE

2D13C

The 2D13C is an indirectly heated double-diode for use in D.C./A.C. operated receivers, and for Car Radio.

The valve consists of two diode anodes located on a common cathode assembly.

HEATER CHARACTERISTICS

Heater Voltage	... ...	Vf=13·0 volts
Heater Current	... ...	If=0·2 amp
Heating Time—15 secs.		

DIMENSIONS

Overall Length	...	= 93 mm.
Overall Diameter	...	= 29 mm.
Bulb Finish—Metallised		

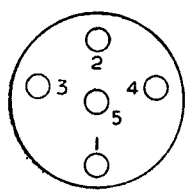
OPERATING CHARACTERISTICS

Maximum Diode Anode Voltage (peak)	...	Vd_{max}	= 200 volts
Maximum Diode Current	...	Id_{max}	= 0·8 mA
Maximum Resistance Heater/Cathode ...	...	Rfk_{max}	= 20,000 ohms
Maximum Voltage Heater/Cathode ...	...	Vfk_{max}	= 125 volts

CAPACITIES

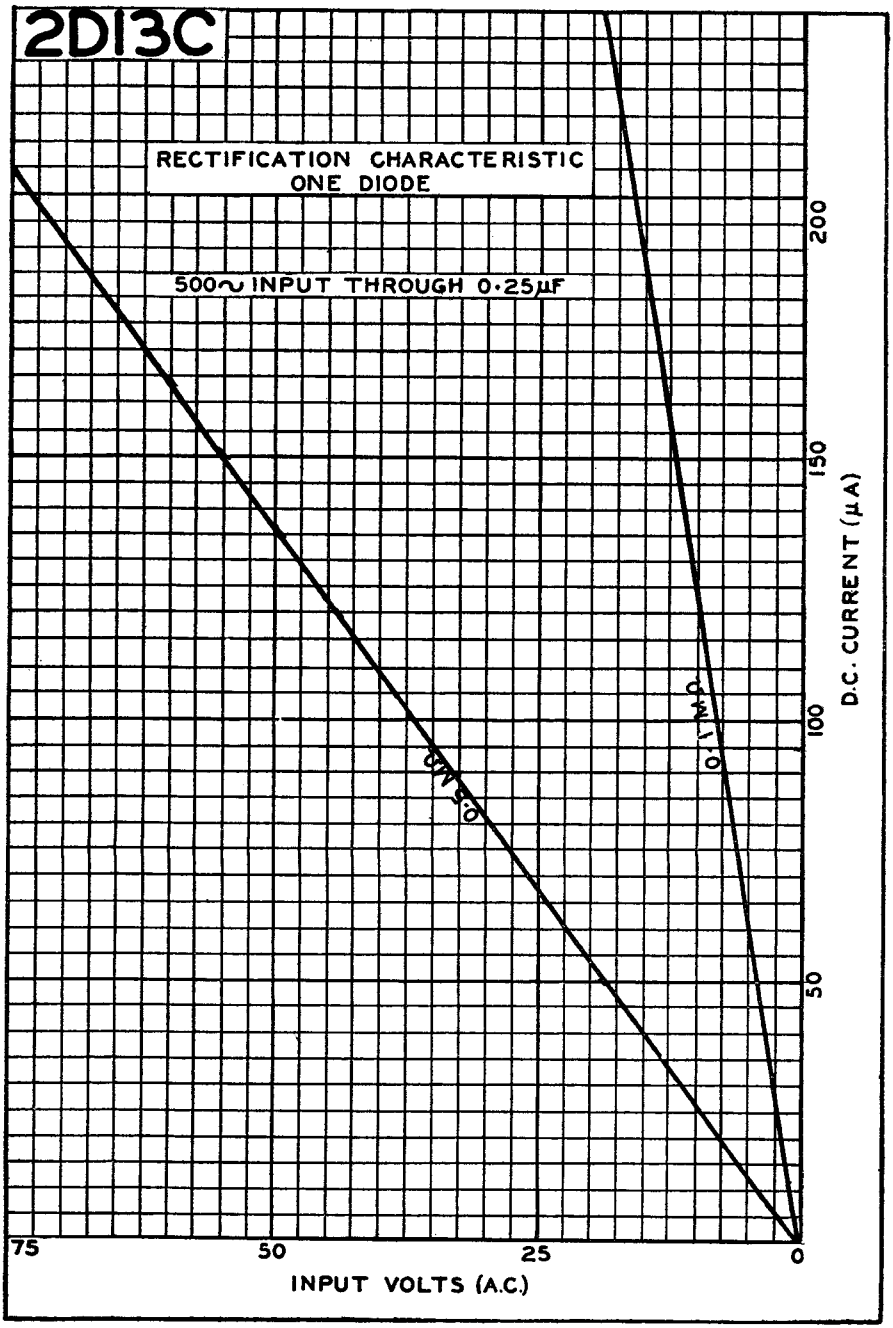
Diode No. 1 to Diode No. 2	...	Cd1d2	= 0·3 $\mu\mu$F
Cathode to Diode No. 1	...	Cd1	= 4·5 $\mu\mu$F
Cathode to Diode No. 2	...	Cd2	= 4·5 $\mu\mu$F

CONNECTIONS



Viewed from free end of pins.

Pin No. 1 Speech Diode (D2)
„ 2 A.V.C. Diode (D1)
„ 3 Heater
„ 4 Heater
„ 5 Cathode


2D13C
RECTIFICATION CHARACTERISTIC
ONE DIODE
500~ INPUT THROUGH 0·25μF
0·1 MΩ
0·5 MΩ
200
150
100
50
D.C. CURRENT (μA)
75
50
25
0
INPUT VOLTS (A.C.)

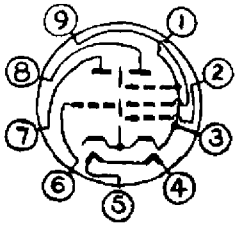
MULLARD LIMITED,
Mullard House
Torrington Place,
L O N D O N, W.C.1.
ENGLAND.

Combined triode and sharp cut-off frame grid r.f. pentode for use as frequency changer at frequencies up to 220 Mc/s.

PHYSICAL SPECIFICATION

Base	E9-1
Bulb	Glass
Maximum overall height	$2^{7}/32$" (56mm)
Maximum seated height	$1^{15}/16$" (49mm)
Maximum diameter	7/8" (22.2mm)

BASING DIAGRAM



9MP

BASING CONNECTIONS

Pin No. 1 Cathode, pentode grid 3, shield
2 Pentode grid 1
3 Cathode, pentode grid 3, shield
4 Heater
5 Heater
6 Triode grid
7 Triode plate
8 Pentode plate
9 Pentode grid 2

GENERAL ELECTRICAL DATA

Heater voltage	4.6	volts
Heater current	600	m.Amps

ELECTRODE CAPACITANCES (measured without external shield)

Pentode plate to triode plate	0.14	µµF
Pentode plate to triode grid	0.014	µµF
Pentode grid 1 to triode plate	0.01	µµF max.
Pentode grid 1 to triode grid	0.01	µµF max.

Pentode Section

Plate to grid 1	0.012	μμF
Input	6.0	μμF
Output	3.5	μμF
Grid 1 to Grid 2	1.7	μμF

Triode Section

Grid to cathode and heater	2.4	μμF
Plate to cathode and heater	1.1	μμF
Plate to grid	2.0	μμF

MAXIMUM RATINGS (Design centre)

Pentode Section

Plate voltage	250	volts max.
Plate dissipation	2.0	watts max.
Grid 2 voltage	150	volts max.
Grid 2 dissipation	500	m.Watts max.
Cathode current	18	m.Amps max.
Grid circuit resistance (cathode bias)	500	k.ohms max.
Grid 1 circuit resistance (fixed bias)	250	k.ohms max.

Triode Section

Plate voltage	125	volts max.
Plate dissipation	1.5	watts max.
Cathode current	15	m.Amps max.
*Grid circuit resistance	500	k.ohms max.
Heater to cathode voltage	100	volts max.

*To fulfil hum requirements on a.m. sound, it will be necessary for heater to cathode voltage to be less than 50 volts r.m.s.

CHARACTERISTICS

Pentode Section

Plate voltage	170	volts
Grid 2 voltage	150	volts
Plate current	10	m.Amps
Grid 2 current	3.3	m.Amps
Mutual conductance	12000	μmhos
Plate impedance	>350	k.ohms
Inner amplification (g1 to g2)	70	
Grid 1 voltage	-1.2	volts

Triode Section

Plate voltage	100	volts
Plate current	14	m.Amps
Mutual conductance	5500	μmhos
Amplification factor	17	
Grid voltage	-3.0	volts

TYPICAL OPERATION AS A FREQUENCY CHANGER

Pentode Section

Plate voltage	190	volts
Grid 2 supply voltage	190	volts
Grid 2 resistor	18	k.ohms
Grid 1 resistor	100	k.ohms
Plate current	8.5	m.Amps
Grid 2 current	2.7	m.Amps
Oscillator voltage (r.m.s.)	2.3	volts
Conversion conductance	4500	μmhos

from JEDEC release #3253, May 1, 1961

DATA FOR E.I.A. REGISTRATIONS

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON.W.C.1.,
England.

CATHODE RAY TUBES TYPE MG13-10, MM13-10 JEDEC TYPES 5DHP1, 5DHP32

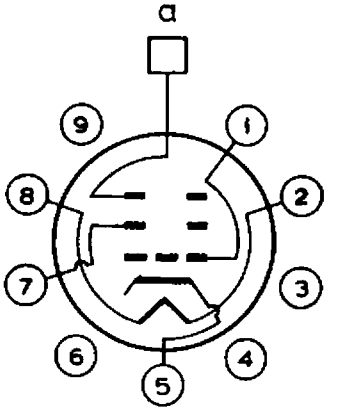
The MG13-10 and MM13-10 are magnetically focused and deflected high brightness cathode ray tubes for radar applications, having an aluminisised screen of 5in. diameter. The two types are identical with the exception of the phosphor characteristics.

PHYSICAL SPECIFICATIONS

Base	Noval with base seal-off pip JETECE9-37
Cap	J1-22
Bulb	Glass
Maximum overall length	$12^{21}/32$" (322mm)
Maximum overall diameter	5" (127mm)
Screen diameter	$3^{15}/16$" (100mm)

BASING CONNECTIONS

Pin 1 Grid No.1	6 Internally connected
2 Heater	7 Spark trap
3 Internally connected	8 Heater
4 No connection	9 Internally connected
5 Cathode	Cap Anode



GENERAL ELECTRICAL DATA

Heater voltage	6.3 Volts
Heater current	300 mAmps
Focus	Magnetic
Deflection	Double magnetic
Deflection angle	40° (approx.)
Fluorescence	
G screen	Green
M screen (double layer)	Blue-green
Persistence	
G screen	Medium, P1
M screen	Long, P32

ELECTRODE CAPACITANCES

Grid to all other electrodes	9.0 μμF max.
Cathode to all other electrodes	7.0 μμF max.
Anode to external conductive coating	500 to 1500 μμF

ABSOLUTE MAXIMUM RATINGS

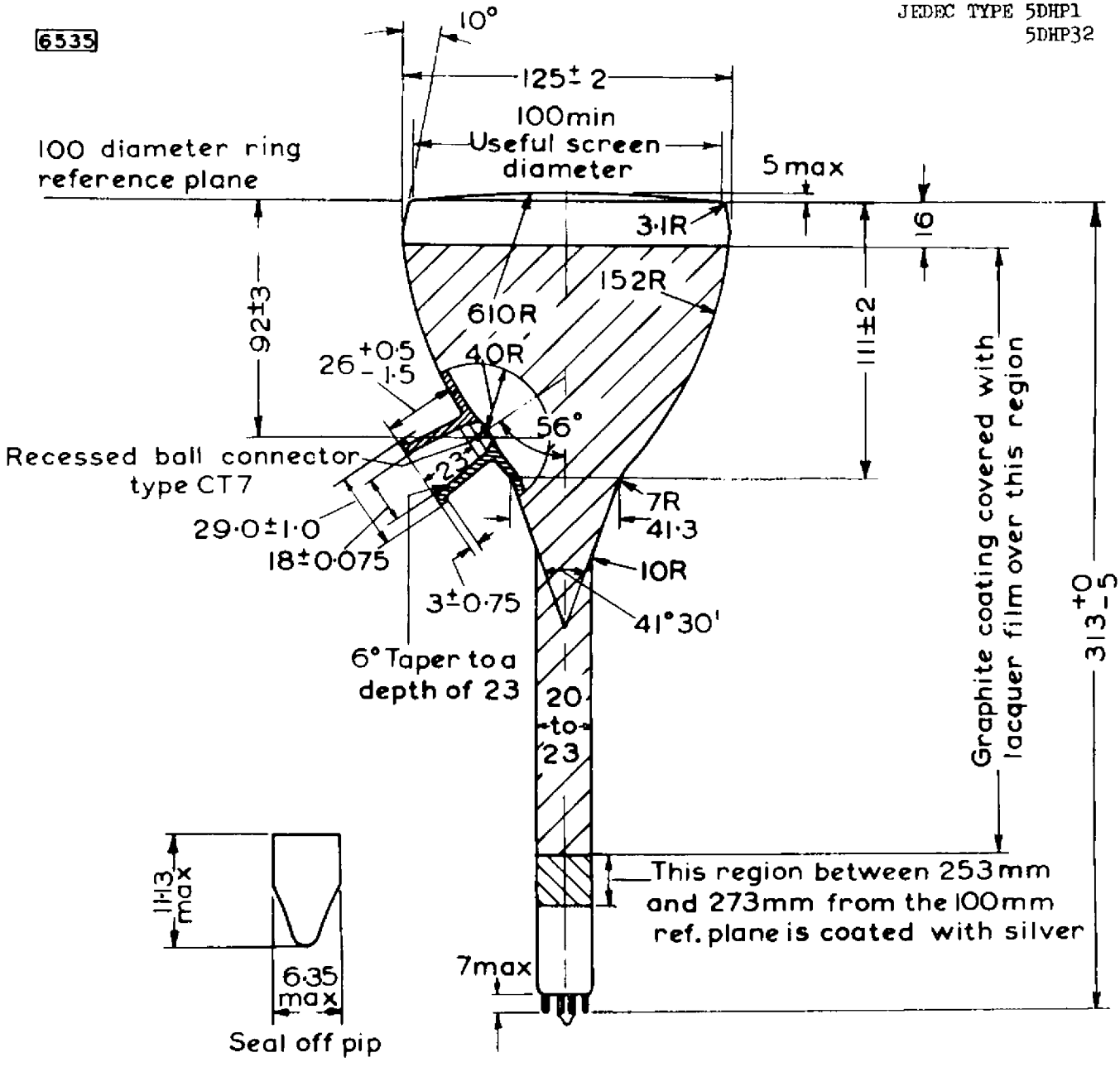
Anode voltage	27 kVolts max.
Anode voltage	18 kVolts min.
Negative grid voltage	150 Volts max.
Positive grid voltage	0 Volts max.
Peak positive grid voltage	2 Volts max.
Cathode current	200 μAmps max.
Heater to cathode voltage (heater negative)	300 Volts max.
Heater to cathode voltage (heater positive)	90 Volts max.
Grid resistance	1.5 Mohms max.

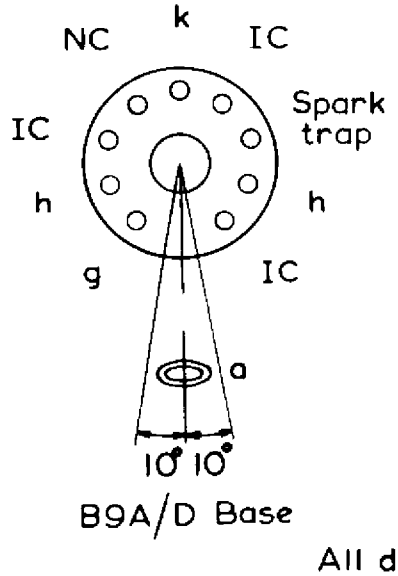
TYPICAL OPERATING CONDITIONS

Anode voltage	22 kVolts
Grid voltage for cut-off	-50 to -100 Volts

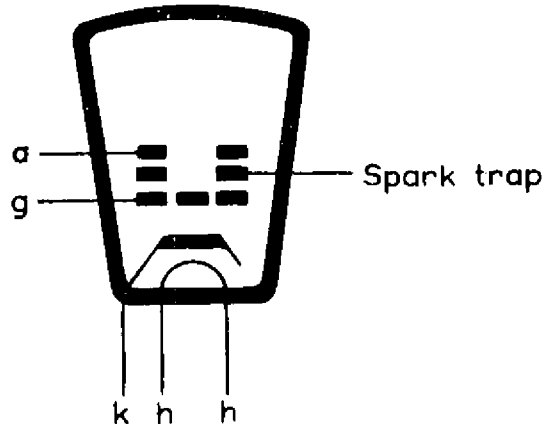
6535

JEDEC TYPE 5DHP1
5DHP32





B9A/D Base



All dimensions in mm

R.F. PENTODE

Short-grid base pentode primarily intended for use as r.f. amplifier.

6AU6

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES

Pentode connected	*Shielded*	*Unshielded*	
c_{in}	5.5	5.5	pF
c_{out}	5.0	5.0	pF
c_{a-g1}	<0.003	<0.003	pF
Triode connected			
c_{in}	3.2	3.2	pF
c_{out}	8.5	1.2	pF
c_{a-g1}	2.6	2.6	pF

CHARACTERISTICS

Pentode connected

V_a	100	250	250	V
V_{g3}	0	0	0	V
V_{g2}	100	125	150	V
V_{g1}	–1.0	–1.0	–1.0	V
I_a	5.0	7.6	10.6	mA
I_{g2}	2.1	3.0	4.3	mA
g_m	3.9	4.5	5.2	mA/V
r_a	0.5	1.5	1.0	MΩ
$V_{g1}(I_a = 10\mu A)$	–4.2	–5.5	–6.5	V

Triode connected (g_2 and g_3 connected to a)

V_a	250	V
V_{g1}	–4.0	V
I_a	12.2	mA
g_m	4.8	mA/V
r_a	7.5	kΩ
μ	36	

6AU6

R.F. PENTODE

Short-grid base pentode primarily intended for use as r.f. amplifier.

LIMITING VALUES

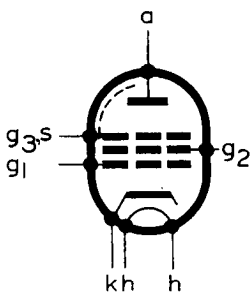
Pentode connected

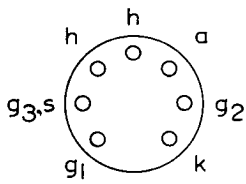
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	150	V
p_{g2} max.	650	mW
$+V_{g1}$ max.	0	V
$-V_{g1}$ max.	50	V
V_{h-k} max.	100	V

Triode connected

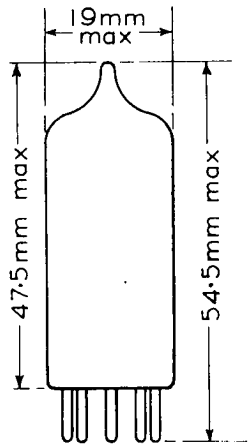
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.2	W
$+V_{g1}$ max.	0	V
$-V_{g1}$ max.	50	V
V_{h-k} max.	100	V

4750





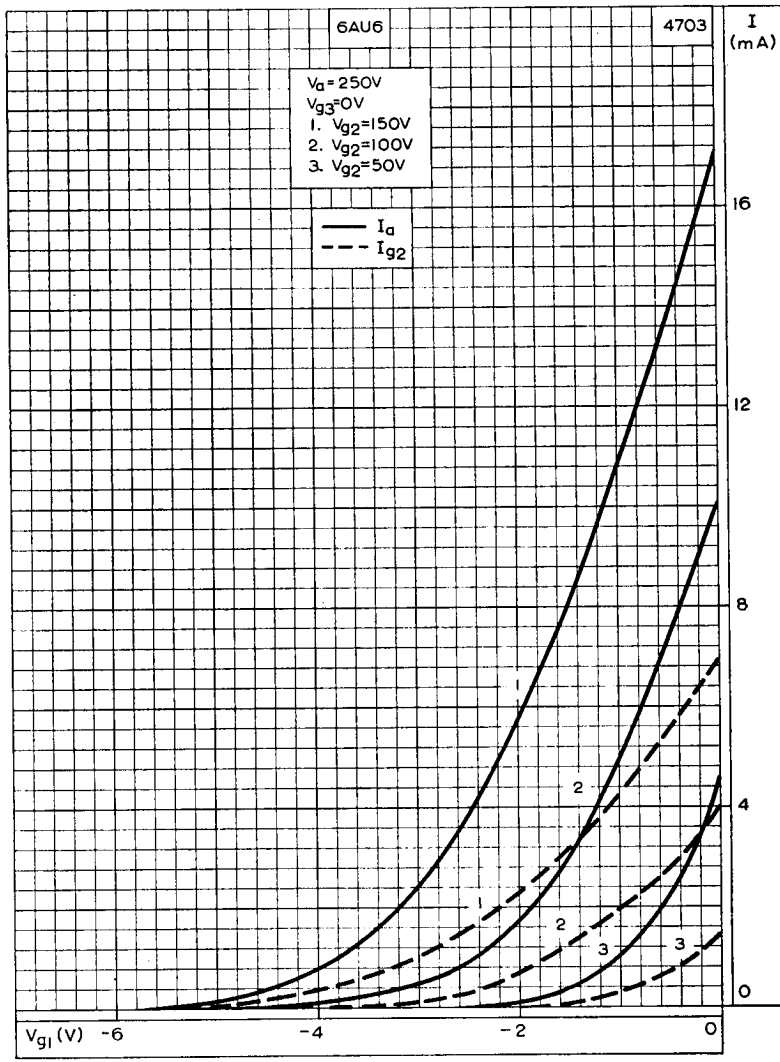
B7G Base



R.F. PENTODE

Short-grid base pentode primarily intended for use as r.f. amplifier.

6AU6

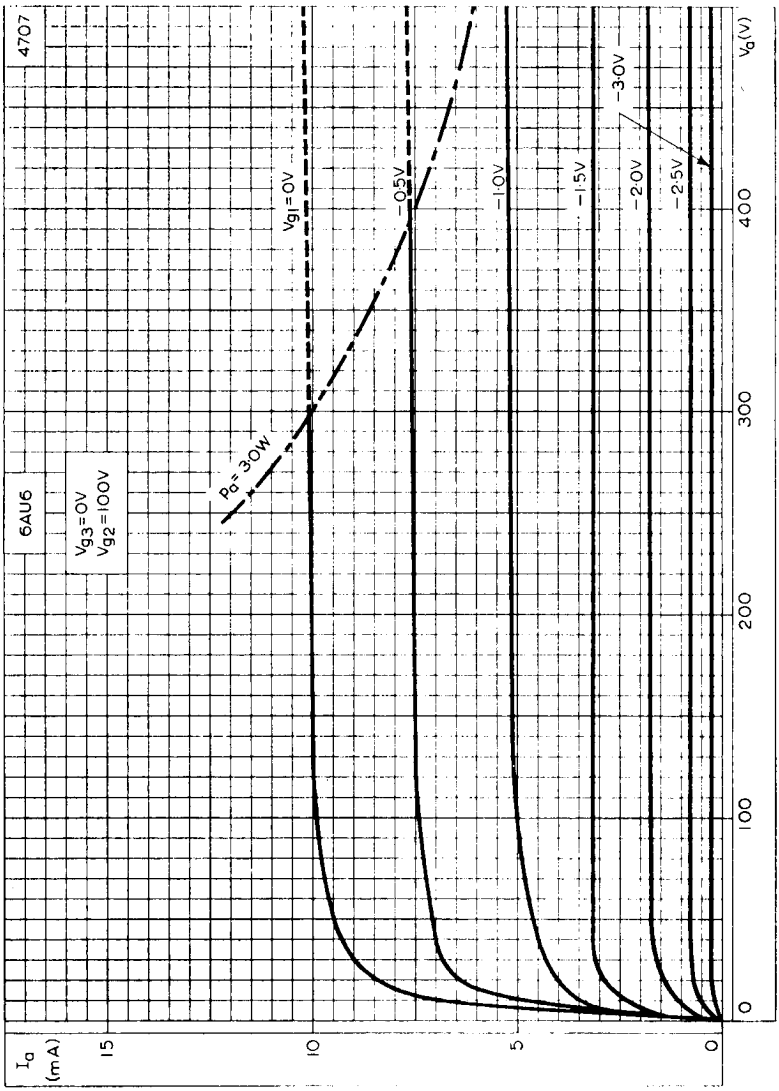


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

6AU6

R.F. PENTODE

Short-grid base pentode primarily intended for use as r.f. amplifier.

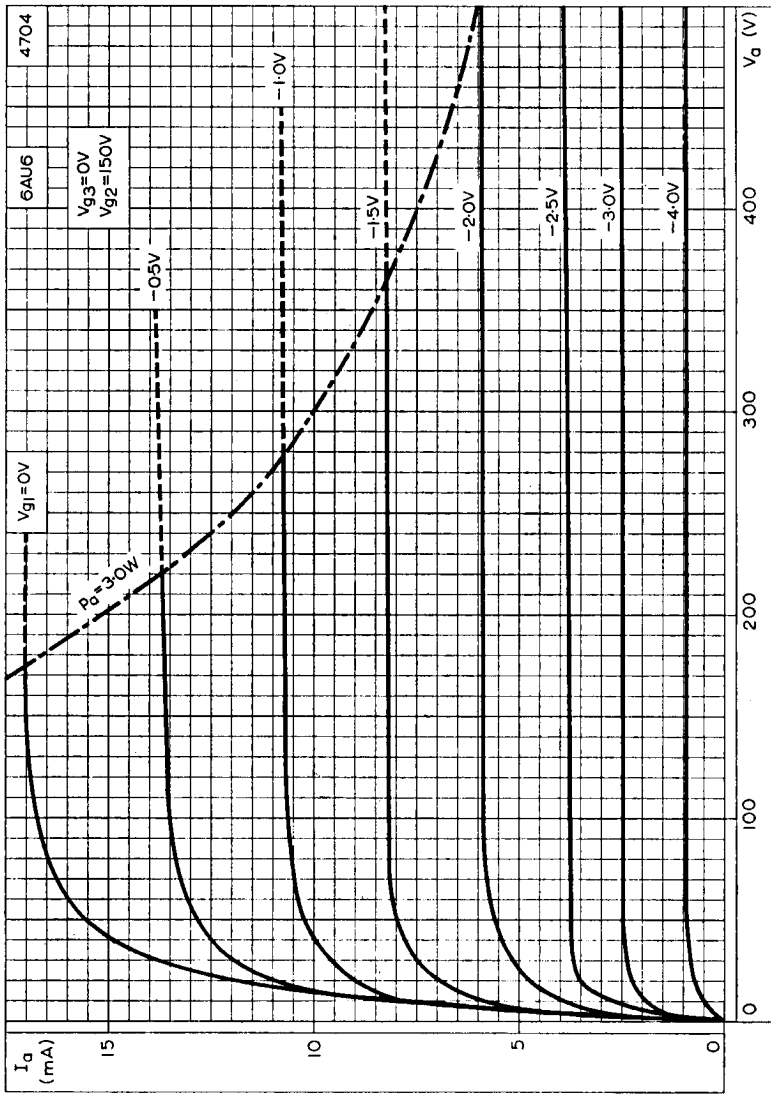


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} 100V

R.F. PENTODE

Short-grid base pentode primarily intended for use as r.f. amplifier.

6AU6

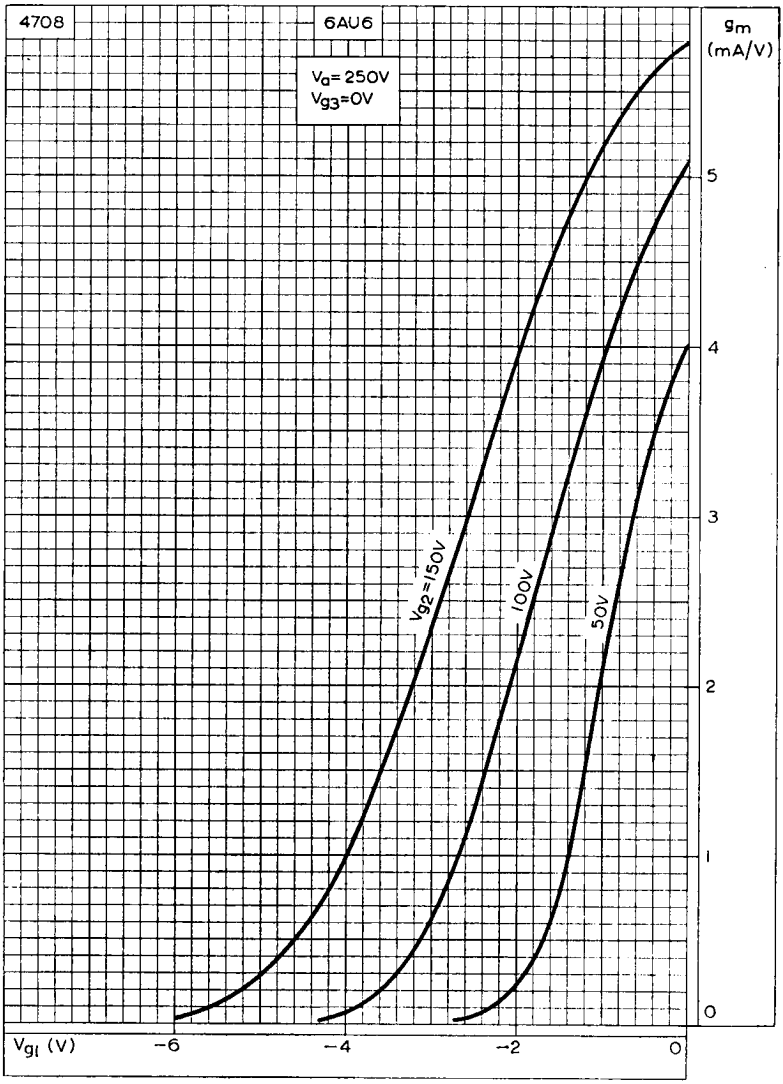


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 150V

6AU6

R.F. PENTODE

Short-grid base pentode primarily intended for use as r.f. amplifier.

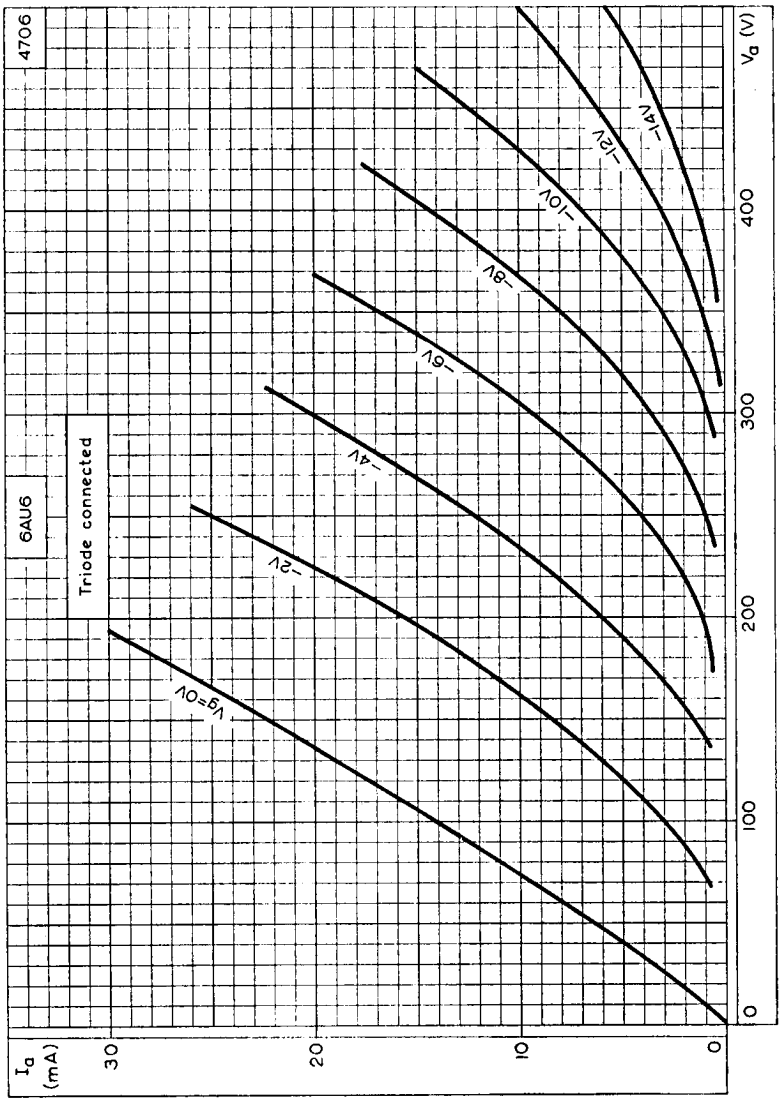


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

R.F. PENTODE

Short-grid base pentode primarily intended for use as r.f. amplifier.

6AU6



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED

R.F. PENTODE

6CB6

High slope pentode primarily intended for use as r.f. or i.f. amplifier.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES

	Shielded	*Unshielded*	
c_{in}	6.5	6.5	pF
c_{out}	3.0	1.9	pF
c_{a-g1}	<0.01	<0.02	pF

CHARACTERISTICS

V_a	200	V
V_{g3}	0	V
V_{g2}	150	V
V_{g1}	–2.2	V
I_a	9.5	mA
I_{g2}	2.8	mA
r_a	600	kΩ
g_m	8.0	mA/V
$V_{g1}(I_a = 10\mu A)$	–8.0	V

LIMITING VALUES

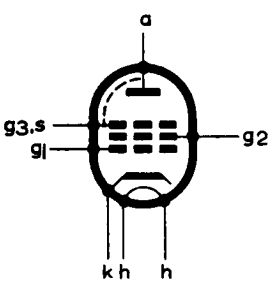
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	150	V
p_{g2} max.	500	mW
V_{h-k} max.	100	V
$v_{h-k(pk)}$ max.	200	V

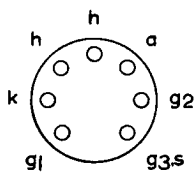
6CB6

R.F. PENTODE

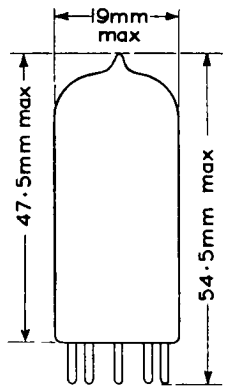
High slope pentode primarily intended for use as r.f. or i.f. amplifier.

4694





B7G Base



MULLARD LIMITED
Century House
Shaftesbury Avenue
London, W.C.2, England

Release No. 1169
Mar. 27, 1953

The EL38 is an output pentode designed for use as a line-time base output tube in television receivers

PHYSICAL SPECIFICATIONS

Cathode	Coated Unipotential
Base	Octal 7 pin
Bulb	Glass
Top Cap	Small
Max.overall length	5 17/32"
Max.seated height	5"
Maximum diameter	1 25/32"
Mounting position	Any

GENERAL ELECTRICAL DATA

Heater Voltage	6.3 volts
Heater Current	1.4 amps

DIRECT ELECTRODE CAPACITANCES

(No external shield)

Plate to grid mas.	1.2 uuF
Input	18 uuF
Output	6.5 uuF

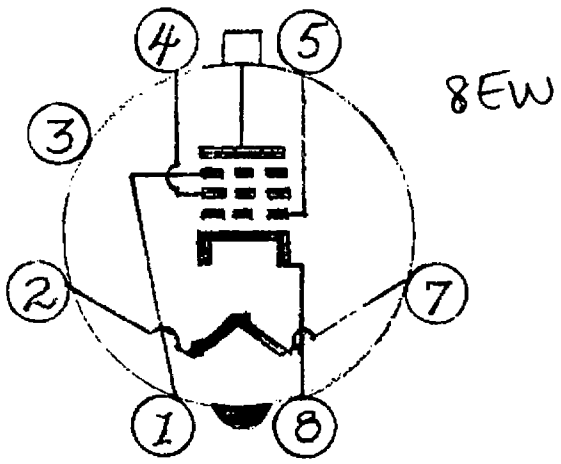
MAXIMUM RATINGS (Design Centre Values)

Peak plate voltage	8,000 volts
Plate supply voltage	1200 volts
Plate voltage	800 volts
Plate dissipation	25 watts
Grid No.2 supply voltage	800 volts
Grid No.2 voltage	400 volts
Grid No.2 dissipation	8 watts
Cathode current	200 mamps
Grid No.1 circuit resistance	500,000 ohms
External resistance between heater and cathode	20,000 ohms
Voltage between heater and cathode	100 volts

OPERATING CHARACTERISTICS

Plate voltage	275 volts
Grid No.2 voltage	275 volts
Plate current	91 mamps
Grid No.2 current	11 mamps
Grid No.1 voltage	-9 volts
Transconductance	14,000 micromhos
Plate resistance	20,000 ohms
Amplification factor of Grid No.2 with respect to Grid No.1	16.5

BASING DIAGRAM



8EW

BASING CONNECTIONS

Pin 1	Grid 3
Pin 2	Heater
Pin 3	No connection
Pin 4	Grid 2
Pin 5	Grid 1
Pin 6	No pin
Pin 7	Heater
Pin 8	Cathode
Top cap	Plate

from RTMA release #1169, March 27, 1953
RTMA type designation: 6CN6

TRIODE PENTODE

6U8

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

HEATER

V_h	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

CAPACITANCES

	Shielded	Unshielded	
C_{ap-at}	0.018	0.07	pF
C_{ap-gt}	0.0035	0.008	pF
C_{gp-at}	0.1	0.11	pF
C_{gp-gt}	0.0025	0.003	pF

Pentode section

C_{a-g1}	<0.006	<0.01	pF
C_{in}	5.0	5.0	pF
C_{out}	3.5	2.6	pF
C_{kp-h}	3.0	3.0	pF

Triode section

C_{a-k+h}	1.0	0.4	pF
C_{g-k+h}	2.5	2.5	pF
C_{a-g}	1.8	1.8	pF
C_{kt-h}	3.0	3.0	pF

CHARACTERISTICS

Pentode section

V_a	250	V
V_{g2}	110	V
I_a	10	mA
I_{g2}	3.5	mA
V_{g1}	−0.9	V
g_m	5.2	mA/V
r_a	400	kΩ
μ_{g1-g2}	35	
V_{g1} (I_a = 10μA)	−10	V

Triode section

V_a	150	V
I_a	18	mA
V_g	−1.0	V
g_m	8.5	mA/V
μ	40	
r_a	5.0	kΩ

6U8

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

TYPICAL OPERATING CONDITIONS

As a frequency changer

V_a	170	200	250	V
R_{g2}	30	45	70	kΩ
R_{g1}	1.0	1.0	1.0	MΩ
V_{g1}	0	0	0	V
I_a	4.7	4.9	5.2	mA
I_{g2}	2.0	1.9	1.9	mA
$V_{osc(r.m.s.)}$	3.0	3.0	3.0	V
I_{g1}	3.7	3.7	3.7	μA
g_c	1.65	1.8	1.9	mA/V

Triode section as an oscillator

V_b	170	200	250	V
R_a	20	20	20	kΩ
R_{g-k}	20	20	20	kΩ
I_a	3.3	4.1	5.7	mA
I_g	160	160	160	μA
$V_{osc(r.m.s.)}$	3.0	3.0	3.0	V
g_m (eff.)	2.8	3.2	4.0	mA/V

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.8	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	500	mW
I_k max.	20	mA
R_{g1-k} max.	1.0	MΩ
V_{g1} ($I_{g1} = +0.3\mu A$)	−1.3	V
V_{h-k} max. (cathode negative)	90	V
V_{h-k} max. (cathode positive)	90	V

Triode section

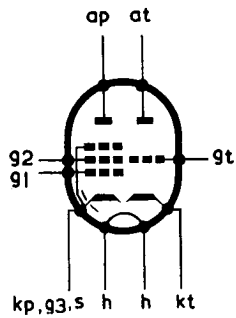
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.7	W
I_k max.	20	mA
R_{g-k} max.	1.0	MΩ
V_{h-k} max. (cathode negative)	90	V
V_{h-k} max. (cathode positive)	90	V
R_{h-k} max.	20	kΩ

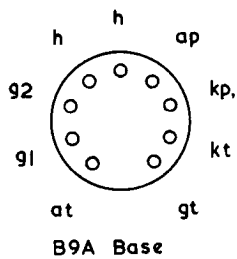
TRIODE PENTODE

6U8

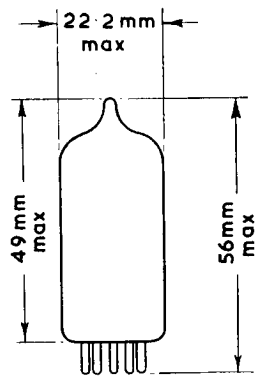
Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

3222





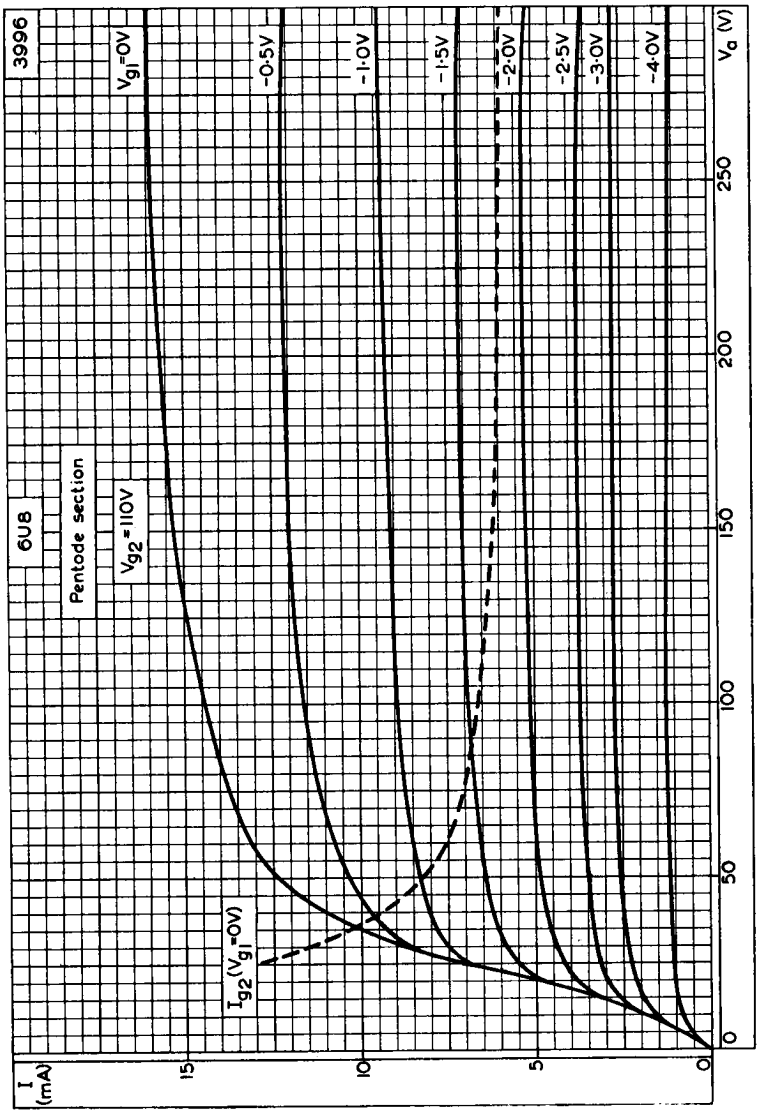
B9A Base



6U8

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE FOR PENTODE SECTION WITH CONTROL-GRID VOLTAGE AS PARAMETER

from JETEC release #1508,
Aug. 22, 1955 & release #1508A,
Dec. 27, 1955

DATA FOR R.E.T.M.A. REGISTRATION

MULLARD LIMITED,
Century House,
Shaftesbury Avenue,
LONDON, W.C.2.,
England.

CATHODE RAY TUBE TYPE 7AHP1

The 7AHP1 is a electrostatically focused and deflected cathode ray tube for radar or oscilloscope applications. It has a rectangular screen having an area of 5½ in. by 1½ in.

PHYSICAL SPECIFICATIONS

Base	Diheptal (B14A)
Bulb	Glass
Maximum overall length	$16\frac{15}{16}$" (430mm)
Maximum bulb width	$6\frac{7}{32}$" (158mm)
Maximum bulb height	$2\frac{11}{16}$" (67.5mm)
Screen width	6" (152mm)
Screen height	$2\frac{1}{2}$" (62mm)

BASING CONNECTIONS Basing 14AC

Pin 1	Heater	8	Deflecting plate y"
2	Cathode	9	Anode No.3
3	Grid No.1	10	Deflecting plate x"
4	Anode No.2	11	Deflecting plate x'
5	No connection	13 ~~12~~	Anode No.1
6	Fluorescent screen	12 ~~13~~	No connection
7	Deflecting plate y'	14	Heater

GENERAL ELECTRICAL DATA

Heater voltage	6.3 volts
Heater current	300 mamps
Focus	Electrostatic
* Deflection	Double electrostatic
Fluorescence	Green
Persistance	Medium, P1

* Both x and y plates are suitable for symmetrical or asymmetrical deflection.

ELECTRODE CAPACITANCES

Grid No.1 to all other electrodes	10 max. uuf
Deflecting plate x' to all other electrodes	20 max. uuf
Deflecting plate x" to all other electrodes	20 max. uuf
Deflecting plate y' to all other electrodes	16 max. uuf
Deflecting plate y" to all other electrodes	16 max. uuf

Deflecting plates x' to y'	3.0	uuf
Deflecting plates x' to y"	3.0	uuf
Deflecting plates x" to y'	3.0	uuf
Deflecting plates x" to y"	3.0	uuf

MAXIMUM RATINGS (Absolute values)

Anode No.3 voltage	6000	volts
Anode No.2 voltage	1100	volts
Anode No.1 voltage	2500	volts
Grid No.1 voltage		
Negative	150	volts
Positive	0	volts
Cathode current	300	µamp
Heater to cathode voltage	±150	volts
Grid No.1 resistor	1.5	megohms

CHARACTERISTICS

Anode No.3 voltage	5000	volts
Anode No.2 voltage	600 to 700	volts
Anode No.1 voltage	1800	volts
Grid No.1 voltage	-25 to -70	volts
Sensitivity		
x plates	0.19	mm/volt
y plates	0.21	mm/volt

DEFLECTION SENSITIVITY LIMITS

X plates	$\frac{850 \text{ to } 1000}{Va3}$	mm/volt
Y plates	$\frac{900 \text{ to } 1100}{Va3}$	mm/volt

DATA FOR E.I.A. REGISTRATION

from JEDEC release #2746, March 7, 1960

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON, W.C.1.,
England.

JEDEC Type
9RP33
Basing ~~9R~~
12R

CATHODE RAY TUBE TYPE AL22-10

The AL22-10 is an electrostatically focused, magnetically deflected cathode ray tube for radar applications. It has a screen of 9in. diameter.

PHYSICAL SPECIFICATIONS

Base	Duodecal B7-51
Cap	J1-21
Bulb	Glass
Maximum overall length	$16\frac{1}{16}$" (408mm)
Maximum bulb diameter	$9\frac{1}{16}$" (230mm)
Screen diameter	$7\frac{7}{8}$" (200mm)

BASING CONNECTIONS

Pin 1 Heater	7 Internally connected
2 Grid 1	8 No pin
3 No pin	9 No pin
4 No pin	10 Grid 2
5 No pin	11 Cathode
6 Grid 4	12 Heater
	Cap Anode

GENERAL ELECTRICAL DATA

Heater voltage	6.3 Volts
Heater current	300 mAmps
Focus	Electrostatic
Deflection	Magnetic
Fluorescence	Orange
Persistance	Long

ELECTRODE CAPACITANCES

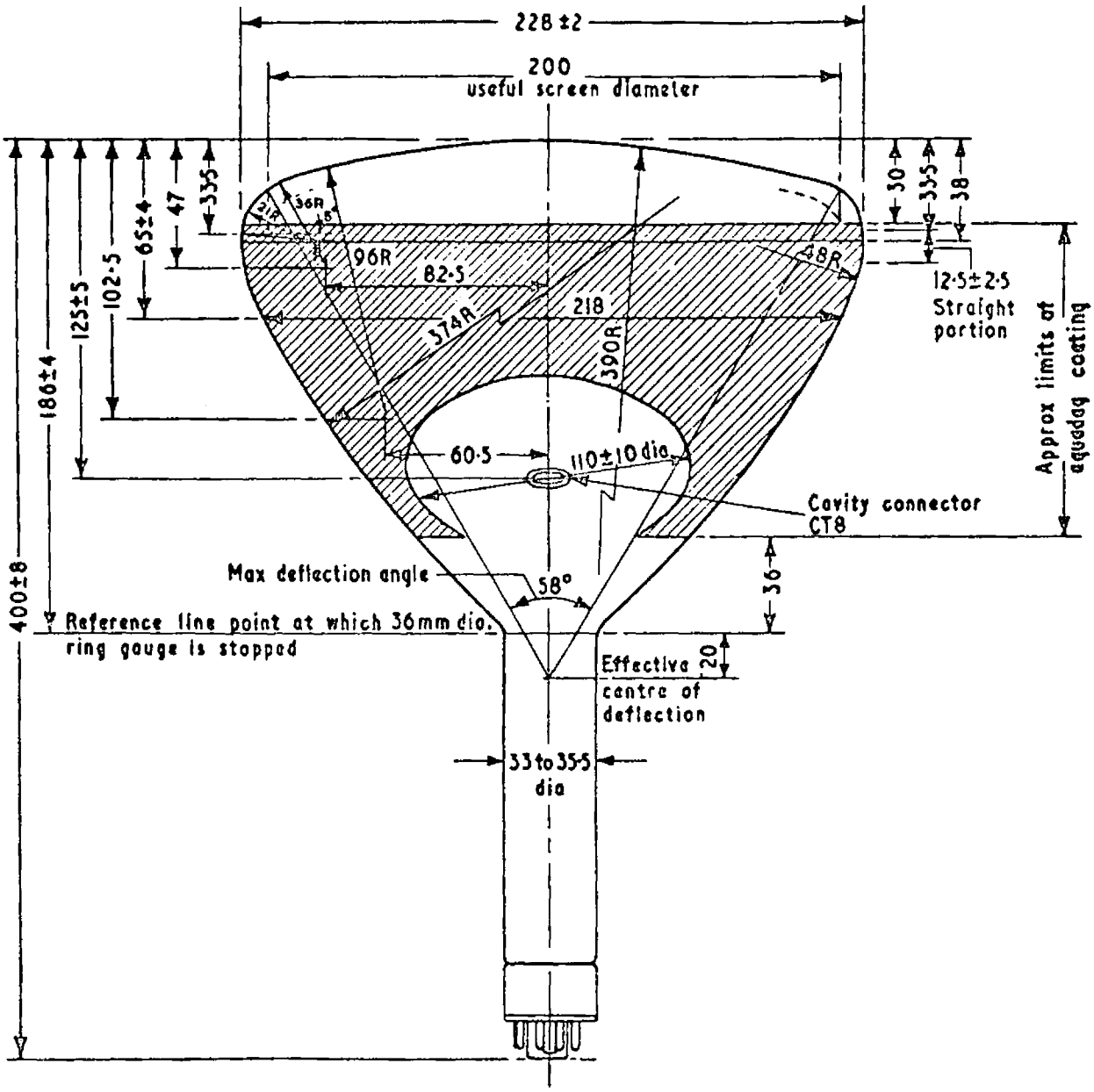
Grid No.1 to all other electrodes	8 max. µµF
Cathode to all other electrodes	8 max. µµF
Anode to external conductive coating	700 µµF

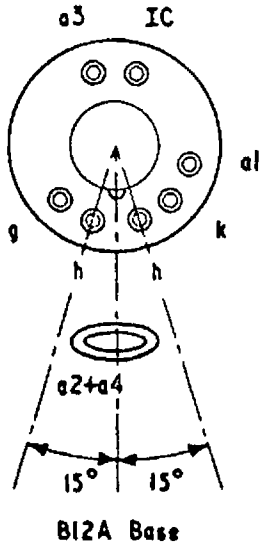
ABSOLUTE MAXIMUM RATINGS

Anode voltage	14 kVolts max.
Anode voltage	8 kVolts min.
Positive grid No.4 voltage	500 Volts max.
Negative grid No.4 voltage	-500 Volts max.
Grid No.2 voltage	500 Volts max.
Grid No.2 voltage	200 Volts min.
Grid No.1 voltage	-200 Volts max.
Grid No.1 voltage	-1 Volt min.
Heater to cathode voltage	±150 Volts.
Grid No.1 resistor	1.5 Mohms max.

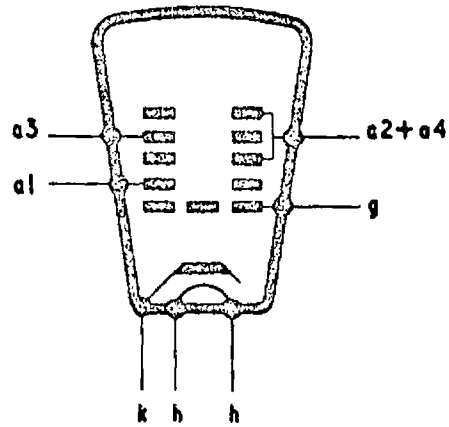
TYPICAL OPERATING CONDITIONS

Anode voltage	12 kVolts
Grid No.2 voltage	300 Volts
Grid No.4 voltage	-200 to +200 Volts
Grid No.4 current	-15 to +15 μAmps
Grid No.1 voltage for cut-off	-30 to -70 Volts





B12A Base



2036

All dimensions in mm

C

NOTE 1 - P33

A.2 Coordinates in C.I.E. system:

X = 0.559, Y = 0.440

A.3 Colour: Orange

B.1 The curves provided with the original data are the only ones which can be obtained. This phosphor cannot be used with a stationary or slowly moving spot without permanent damage to the phosphor.

B.2 Persistence: Very long

C. For use in radar tubes

D. Composition: Magnesium fluoride with a maganese activator

NOTE 2 - P32

Coordinates in C.I.E. system:

Yellowish-green component	X = 0.340, Y = 0.515
Purplish-blue component	X = 0.170, Y = 0.124

Colour: Purplish-blue fluorescence with yellowish-green phosphorescence

Persistence: Long

For use in radar tubes

Composition: cascade screen

Yellowish-green component: Zinc cadmium sulphide with a copper activator

Purplish-blue component: Calcium magnesium silicate with a titanium activator

NOTE 3 - P31

A.2 Coordinates in C.I.E. system:

Low brightness	X = 0.245, Y = 0.523
High brightness	X = 0.206, Y = 0.414

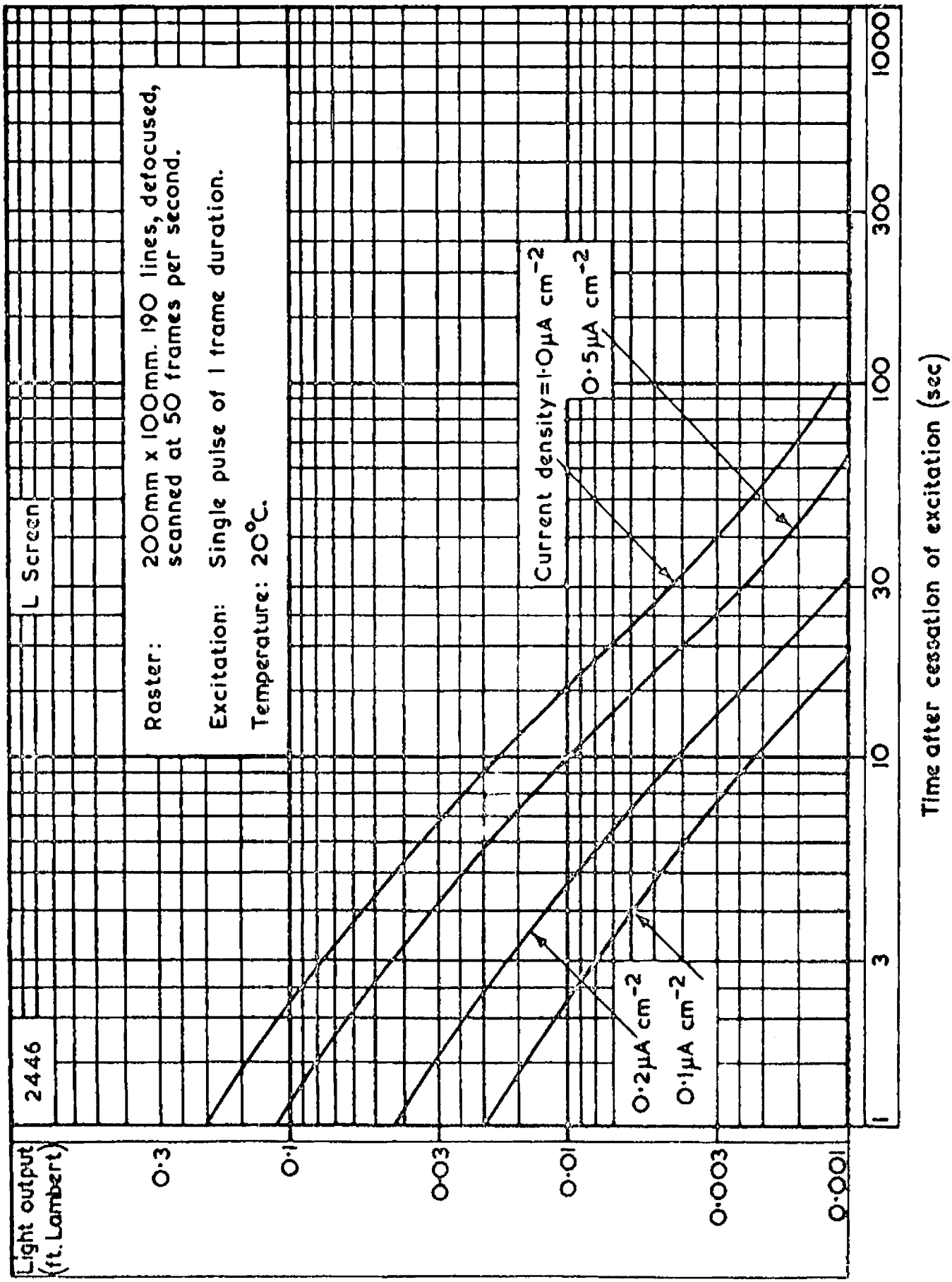
A.3 Colour: Green

B.2 Persistence: Medium short

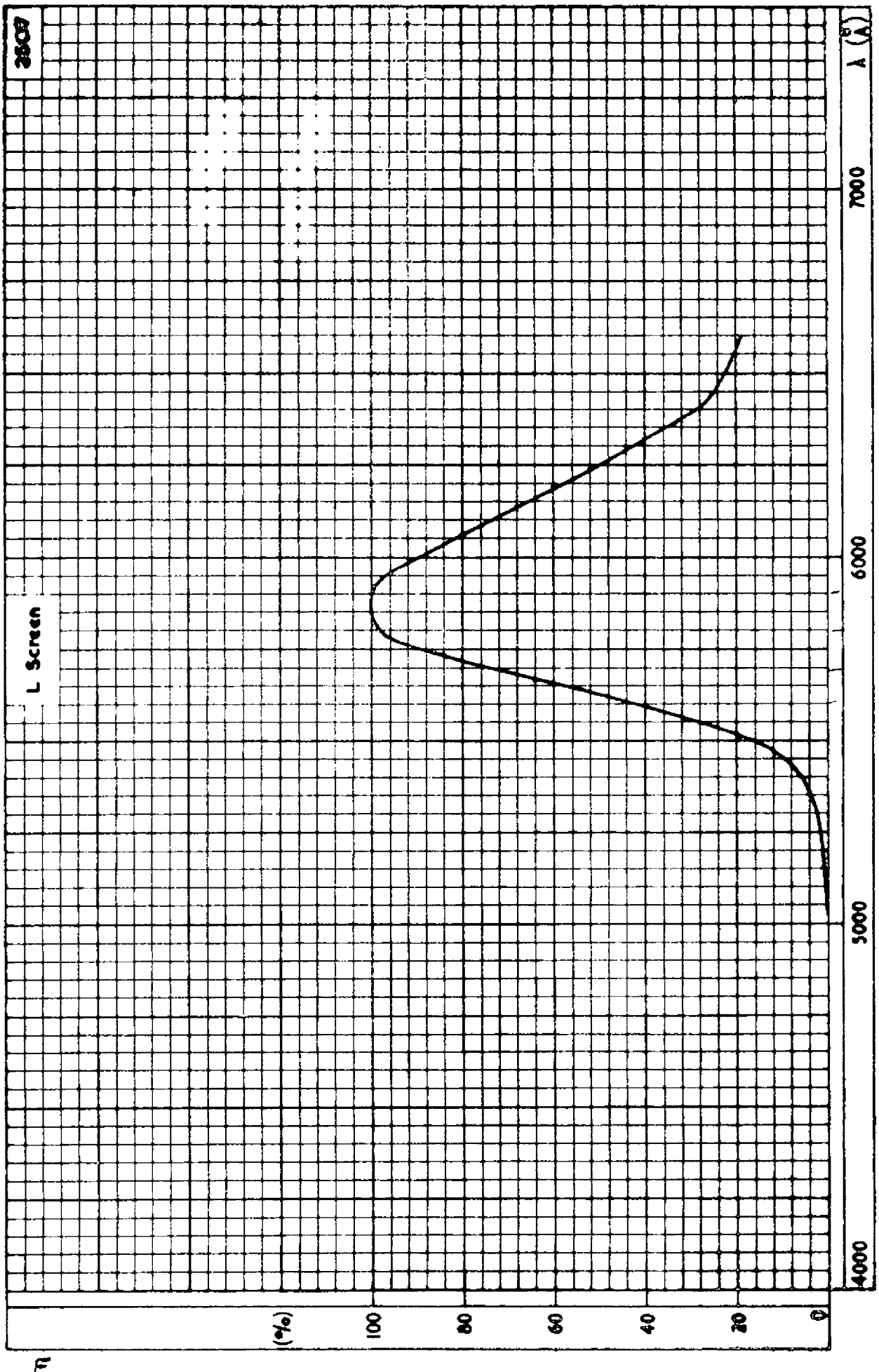
C. For use in oscillograph tubes

D. Composition: Zinc sulphide with a copper activator

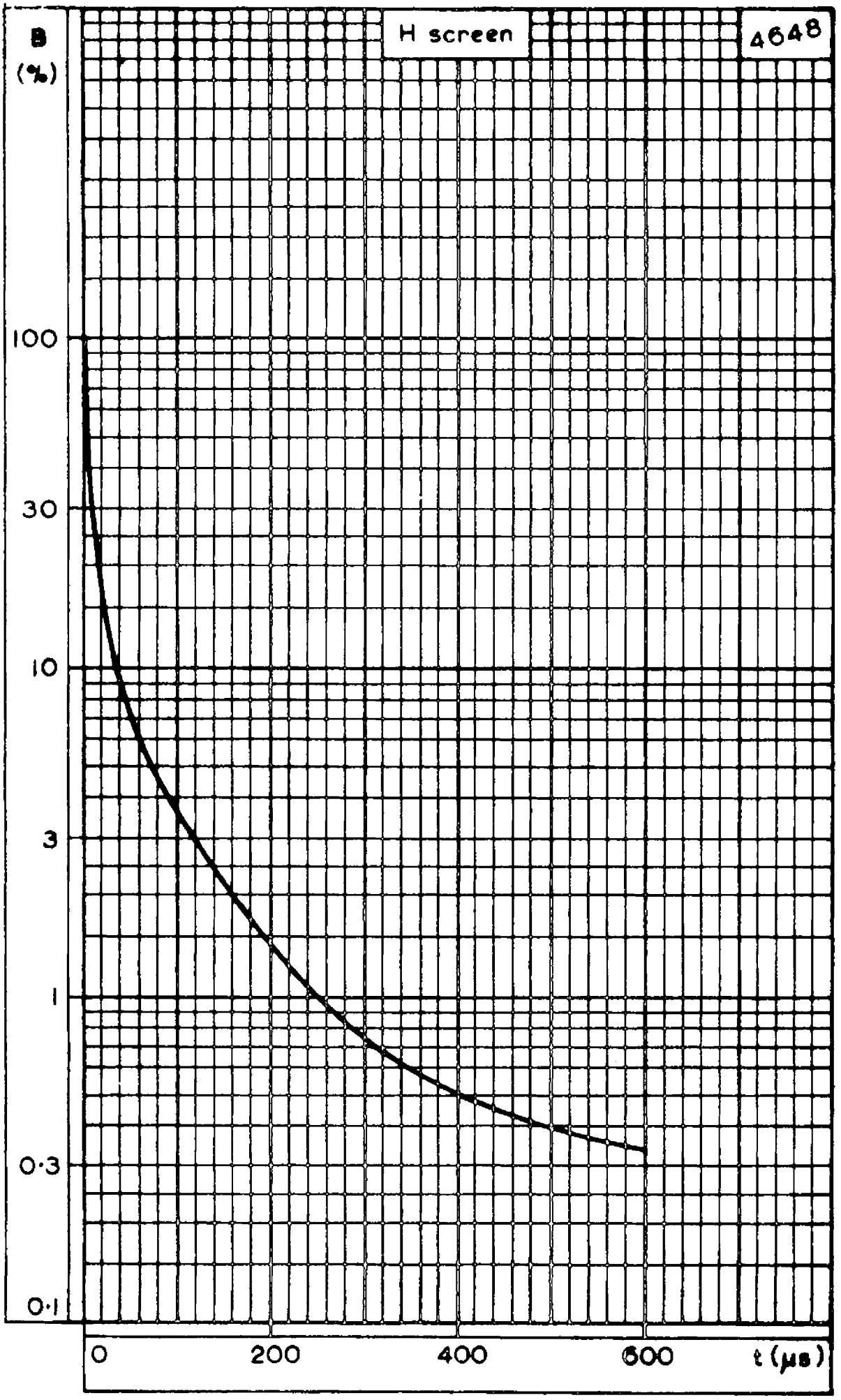
Phosphor Designation P33



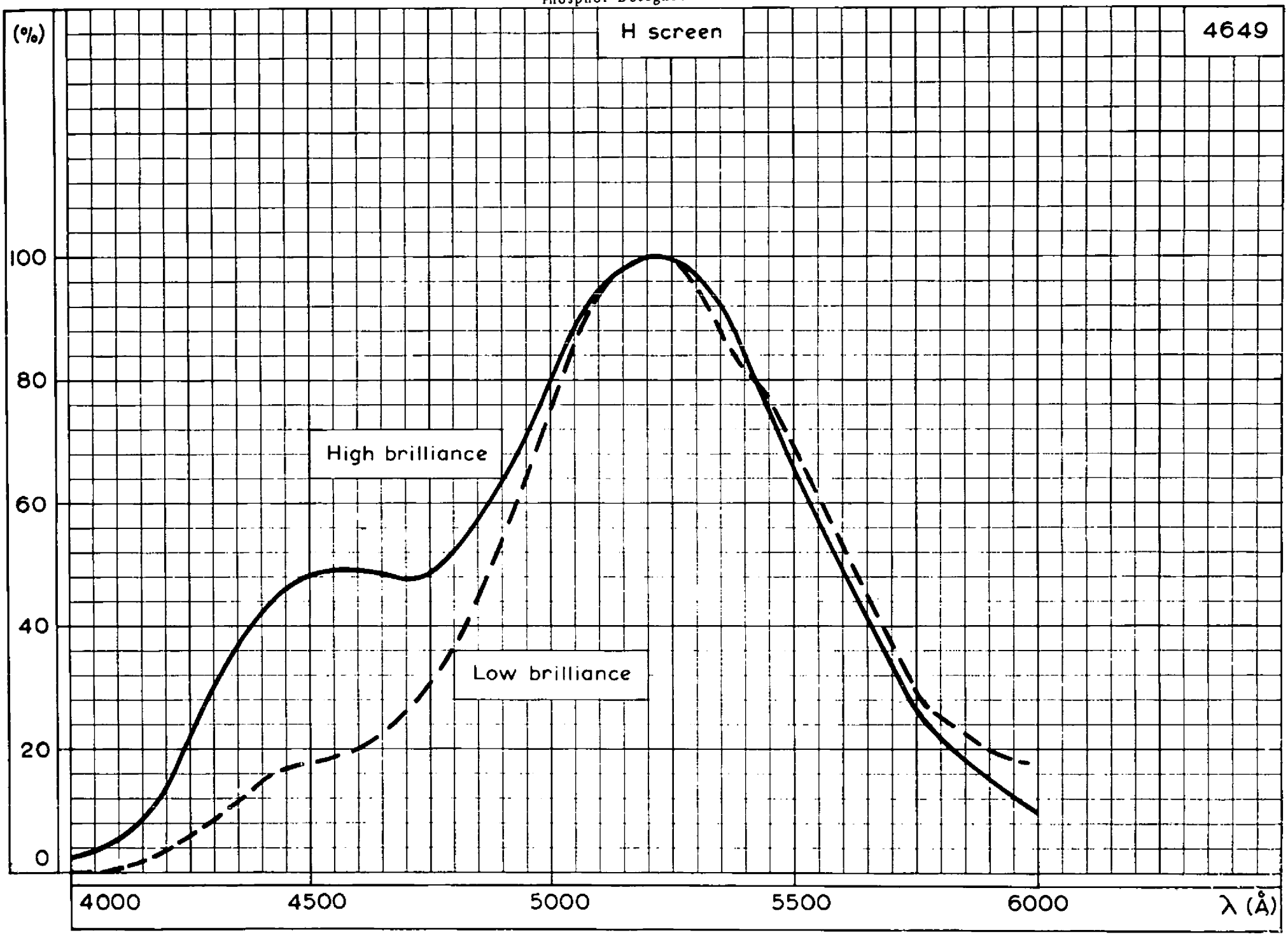
Phosphor Designation P33

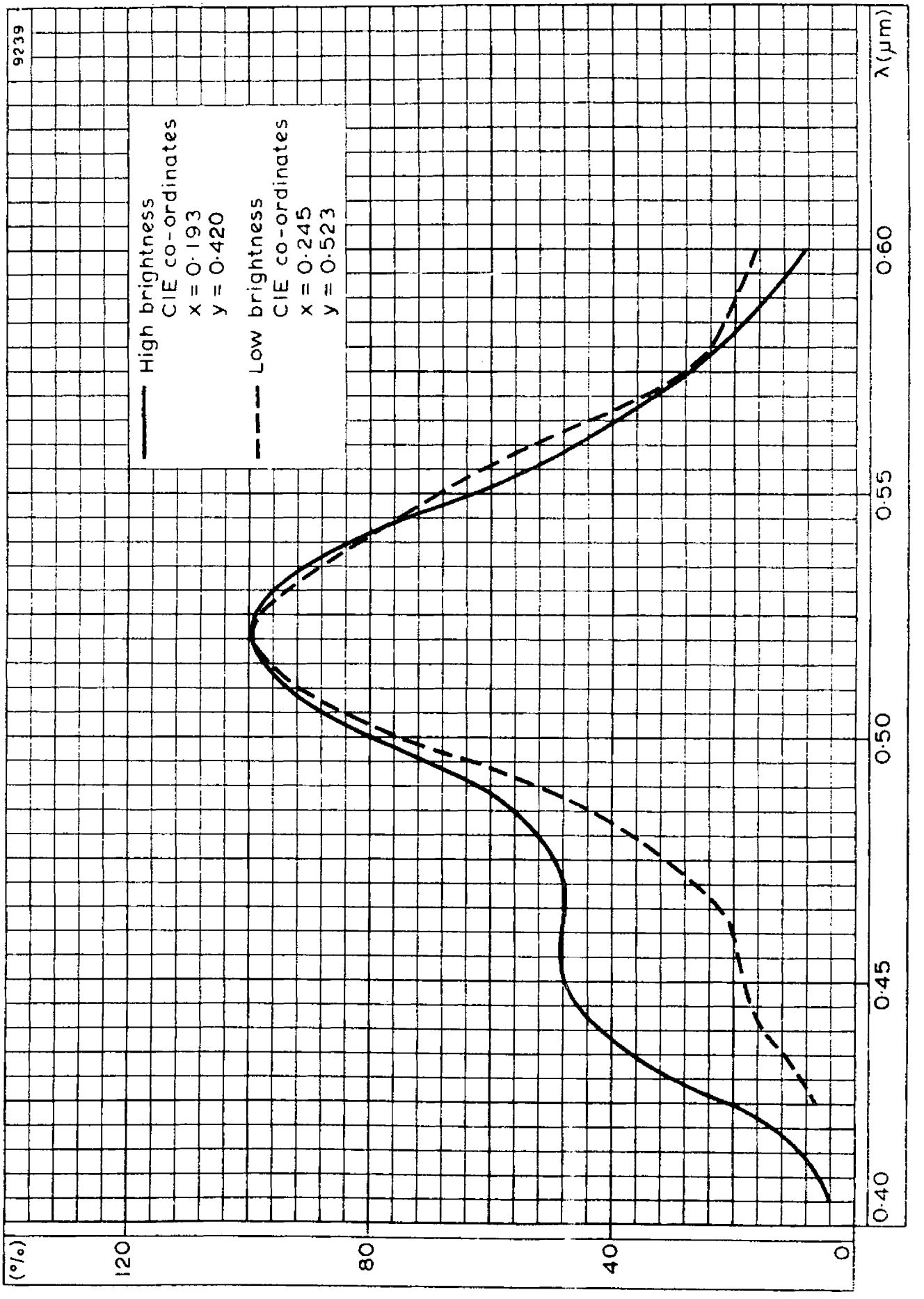


Phosphor Designation P31



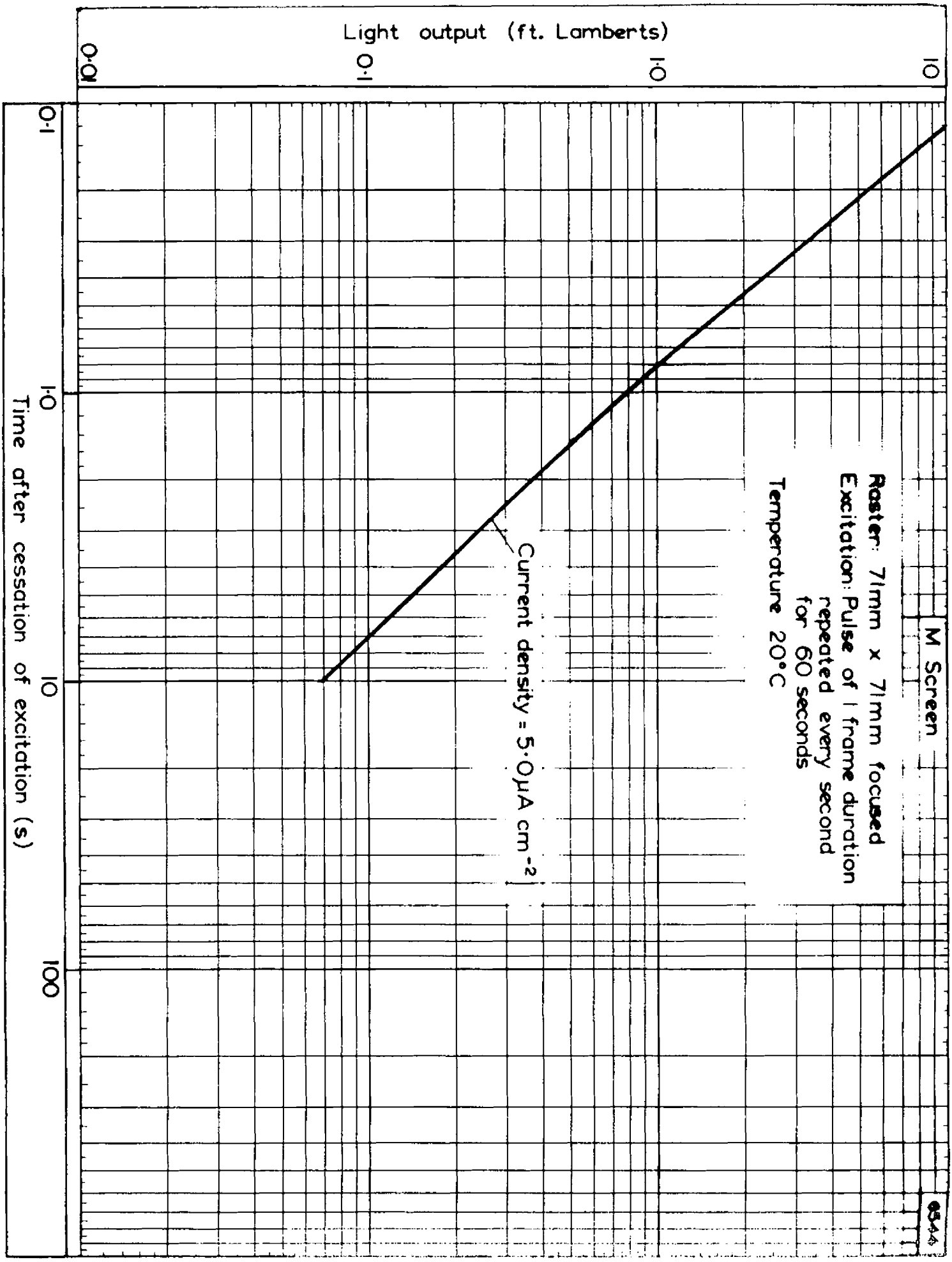
Phosphor Designation P31



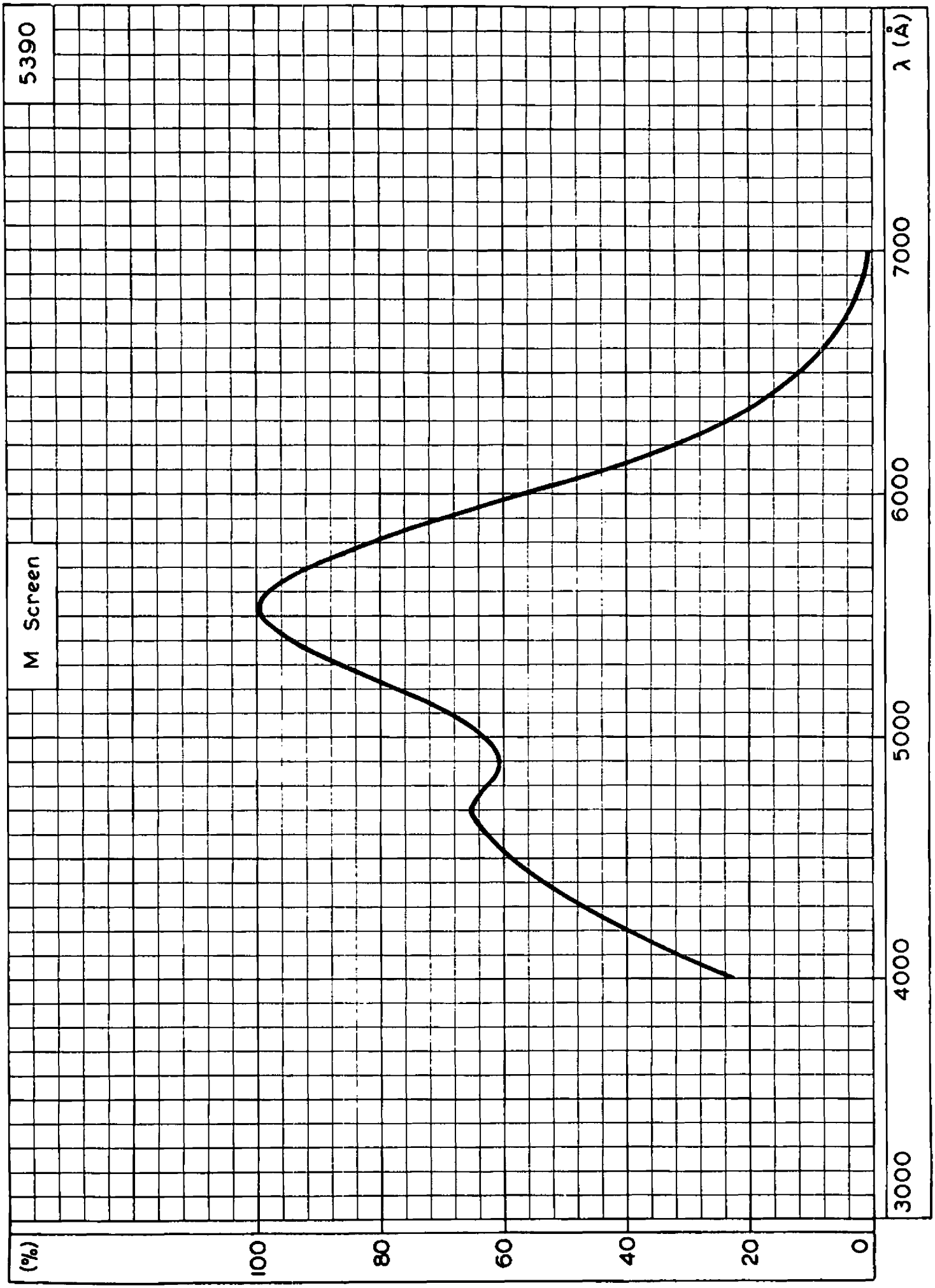

9239
High brightness
CIE co-ordinates
x = 0·193
y = 0·420
Low brightness
CIE co-ordinates
x = 0·245
y = 0·523
(%)
120
80
40
0
0·40
0·45
0·50
0·55
0·60
λ(μm)

P31

Phosphor Designation P32



Phosphor Designation: P32



STABILISING TUBE

75B1

Miniature gas-filled tube with auxiliary ignition electrode (priming anode) and intended for use as a voltage stabiliser.

PRELIMINARY DATA

LIMITING VALUES (absolute ratings)

Min. voltage necessary for ignition	110	V
Max. burning current	22	mA
Min. burning current	2.0	mA

CHARACTERISTICS (measured at 10mA)

*Max ignition voltage	110	V
Burning voltage (variation from tube to tube)	70 to 80	V
Max. burning voltage difference over current range 2 to 20mA	6.0	V

*The auxiliary ignition electrode (priming anode) should be connected to the anode through a nominal 15kΩ resistor.

OPERATING NOTES

1. To obtain a good life a reverse current must not be drawn from this tube. This condition is satisfied if any inverse voltage does not exceed 65V.
2. The maximum ignition voltage quoted is the greatest voltage which is necessary to ignite any tube in the presence of an ambient illumination of 5 to 50 foot-candles. A voltage of at least this value must be available if reliability of ignition is to be obtained. In complete darkness there may be some delay in igniting the tube.
3. The noise generated by the tube over the frequency range (50 to 5,000 c/s) and at a constant current (2 to 20mA) is less than 15mV$_{r.m.s.}$

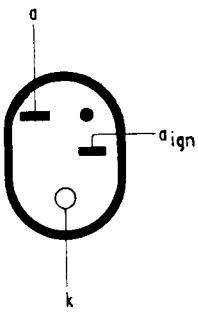
MAINTENANCE TYPE

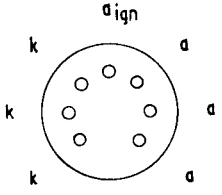
75B1

STABILISING TUBE

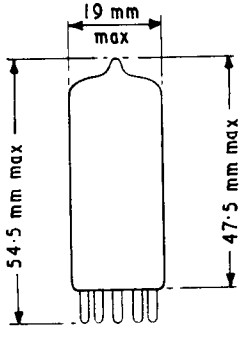
Miniature gas-filled tube with auxiliary ignition electrode (priming anode) and intended for use as a voltage stabiliser.

1881





B7G Base



VOLTAGE REFERENCE TUBE

85A1

Neon-filled two-electrode tube having a high order of stability over both long and short periods and very small variations from tube to tube.

This data should be read in conjunction with the GENERAL OPERATIONAL RECOMMENDATIONS—VOLTAGE STABILISER AND REFERENCE LEVEL TUBES which precede this section of the handbook.

LIMITING VALUES (absolute ratings)

Minimum voltage necessary for ignition	125	V
Burning current		
Maximum	8.0	mA
Minimum	1.0	mA
Maximum negative anode voltage	75	V

PREFERRED OPERATING CONDITION

Burning current	4.5±0.2	mA

CHARACTERISTICS

Measured at preferred operating condition

Maintaining voltage (variation from tube to tube)	83 to 86	V
Incremental resistance		
Average	290	Ω
Maximum	450	Ω
Maximum percentage variation of maintaining voltage for current change of 4.3 to 4.7mA	0.17	%
*Maximum percentage variation of maintaining voltage during life	0.5	%
Maximum percentage variation of maintaining voltage after the first 300 hours of life	0.2	%
Maximum short term (≦100 hours) variation of maintaining voltage after the first 300 hours of life	0.1	%

*After initial warming-up period of 3 minutes.

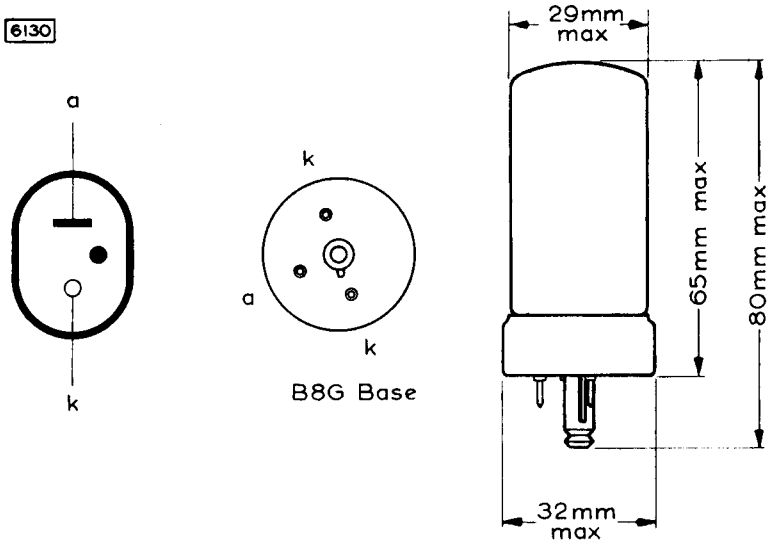
MAINTENANCE TYPE

85A1

VOLTAGE REFERENCE TUBE

NOTES

1. Equilibrium conditions are normally reached after 3 minutes' operation.
2. Over life, the incremental resistance will remain sensibly constant but the temperature coefficient of the maintaining voltage can be expected to decrease slightly.
3. The noise generated by the tube over a frequency band of 30 to 10,000c/s, is of the order of 70μV, which is equivalent to the noise generated by a resistance of approximately 30MΩ. The noise is evenly distributed over the frequency range.
4. This tube should not be subjected to shock or continuous vibration.



STABILISING TUBE

95A1

Miniature gas-filled tube with auxiliary ignition electrode (priming anode) and intended for use as a voltage stabiliser.

PRELIMINARY DATA

LIMITING VALUES (absolute ratings)

*Min. voltage necessary for ignition	110	V
Max. burning current	10	mA
Min. burning current	2.0	mA
Max. auxiliary anode current	0.5	mA

CHARACTERISTICS (measured at 5mA)

Max. auxiliary anode ignition voltage	150	V
*Max. ignition voltage	110	V
Burning voltage (variation from tube to tube)	90 to 100	V
Max. burning voltage difference over current range 2 to 10mA	5.0	V

*Auxiliary ignition electrode (priming anode) connected to 150V line through a nominal 270kΩ resistor.

If the auxiliary ignition electrode (priming anode) is not used it should be connected to the anode through a 3.3kΩ resistor. Under these conditions a line voltage of at least 150V will be required to strike the tube.

OPERATING NOTES

1. To obtain a good life a reverse current must not be drawn from this tube. This condition is satisfied if any inverse voltage does not exceed 85V.

2. The maximum ignition voltage quoted is the greatest voltage which is necessary to ignite any tube in the presence of an ambient illumination of 5 to 50 foot-candles. A voltage of at least this value must be available if reliability of ignition is to be obtained. In complete darkness there may be some delay in igniting the tube.

3. The noise generated by the tube over the frequency range (50 to 5,000 c/s) and at a constant current (2 to 10mA) will be less than $15mV_{r.m.s.}$

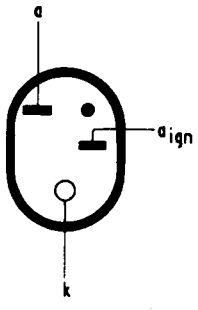
MAINTENANCE TYPE

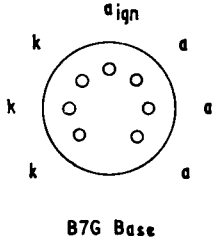
95A1

STABILISING TUBE

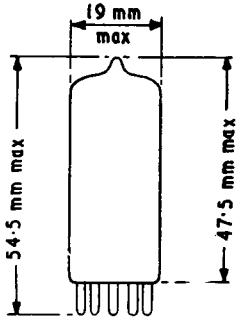
Miniature gas-filled tube with auxiliary ignition electrode (priming anode) and intended for use as a voltage stabiliser.

1881





B7G Base



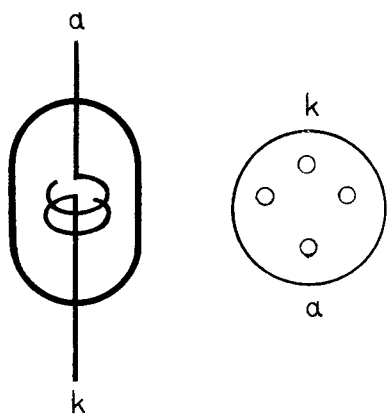
Mullard
NEON STABILISING TUBE

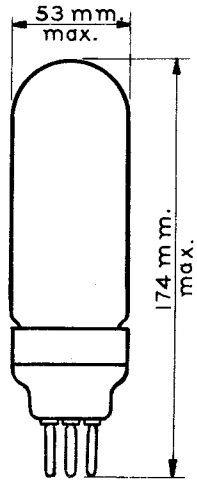
100E1

Operating Conditions

V max starting	140	V
V burning (50 mA)	90-105	V
I quiescent	125	mA
I max	200	mA
I min	50	mA
A.C. resistance max	30	ohms

Arrangement of electrodes and base connections.

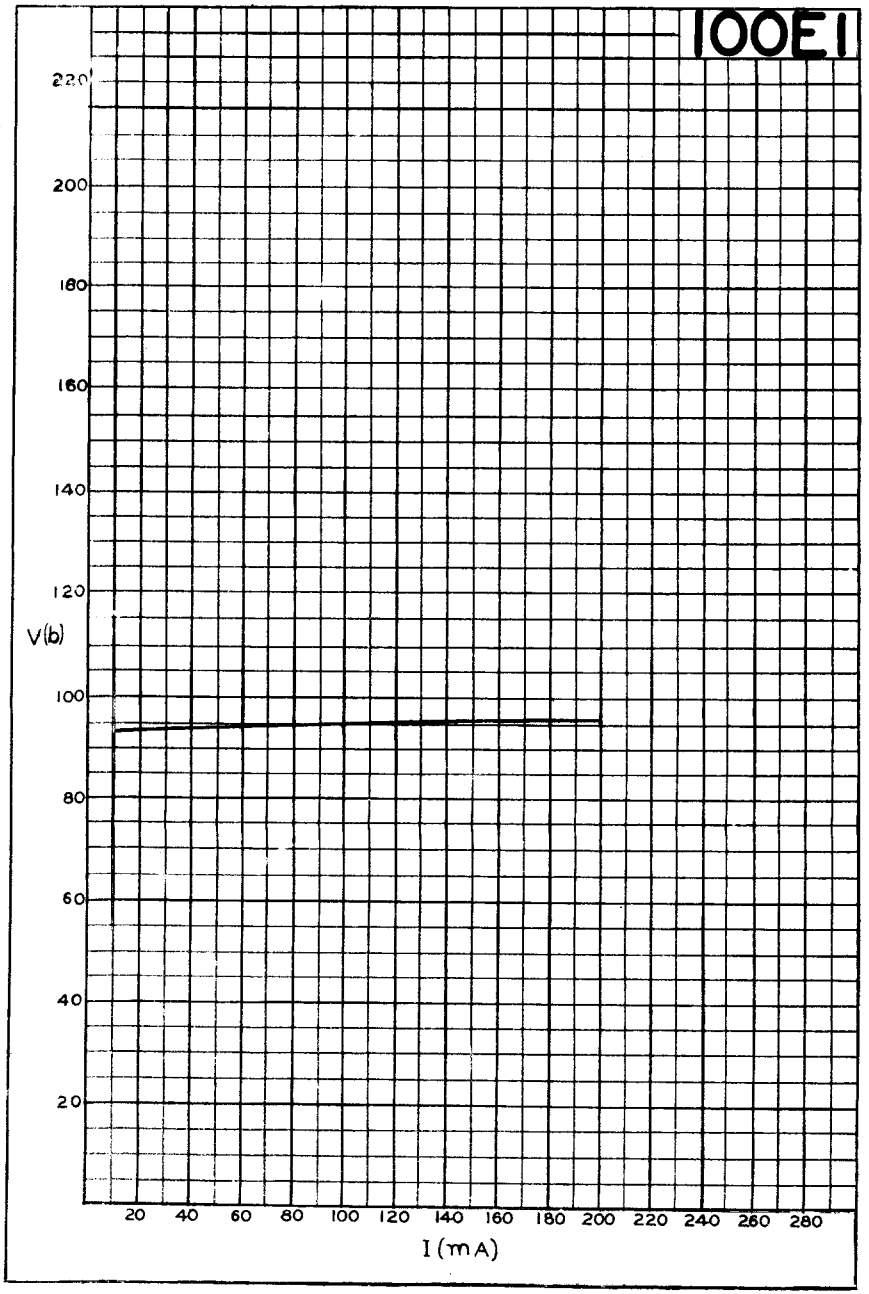




100E1

100E1

Mullard
NEON STABILISING TUBE



STABILISING TUBE

108C1

108Volt gas-filled stabiliser with current range 5.0 to 30mA.

LIMITING VALUES (absolute ratings)

Minimum voltage necessary for ignition in some ambient light	133	V
Minimum voltage necessary for ignition in complete darkness	210	V
Maximum burning current	30	mA
Minimum burning current	5.0	mA
Maximum starting current	75	mA
Maximum ambient temperature limits	−55 to +90	°C
Maximum negative anode voltage	75	V

CHARACTERISTICS

	Initial	*Over Life**	
Maximum burning voltage at I_a = 30mA (all tubes)	112	114	V
Minimum burning voltage at I_a = 5.0mA (all tubes)	105	101	V
Maximum difference between burning voltages at I_a = 30mA and I_a = 5.0mA (individual tube)	3.5	4.0	V
Typical difference between burning voltages at I_a = 30mA and I_a = 5.0mA (individual tube)	1.5	1.5	V
Maximum percentage variation of burning voltage at I_a = 17.5mA during 1000 hours life		±3.0	%
Typical percentage variation of burning voltage at I_a = 17.5mA during 1000 hours life		±1.0	%

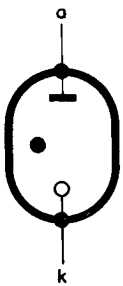
*This condition corresponds to an average current of 17.5mA

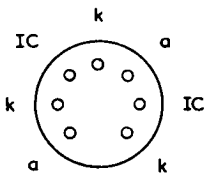
108C1

STABILISING TUBE

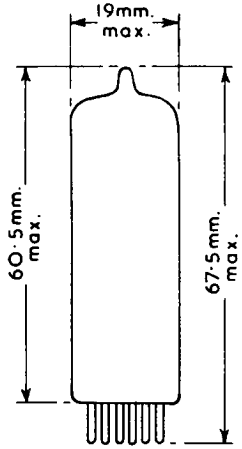
108Volt gas-filled stabiliser with current range 5.0 to 30mA.

1616





B7G Base.



STABILISING TUBE

150B3

Miniature gas-filled tube with auxiliary ignition electrode (priming anode) and intended for use as a voltage stabiliser.

MAINTENANCE TYPE

PRELIMINARY DATA

LIMITING VALUES (absolute ratings)

*Min. voltage necessary for ignition	170	V
Max. burning current	20	mA
Min. burning current	2.0	mA
Max. auxiliary anode current	0.5	mA

CHARACTERISTICS (measured at 10mA)

Max. auxiliary anode ignition voltage	240	V
*Max. ignition voltage	170	V
Burning voltage (variation from tube to tube)	145 to 160	V
Max. burning voltage difference over current range 2 to 20mA	5.0	V

*Auxiliary ignition electrode (priming anode) connected to 240V line through a nominal 270kΩ resistor.

If the auxiliary ignition electrode (priming anode) is not used, it should be connected to the anode through a 68kΩ resistor. Under these conditions a line voltage of at least 240V will be required to strike the tube.

OPERATING NOTES

1. To obtain a good life a reverse current must not be drawn from this tube. This condition is satisfied if any inverse voltage does not exceed 140V.

2. The maximum ignition voltage quoted is the greatest voltage which is necessary to ignite any tube in the presence of an ambient illumination of 5 to 50 foot-candles. A voltage of at least this value must be available if reliability of ignition is to be obtained. In complete darkness there may be some delay in igniting the tube.

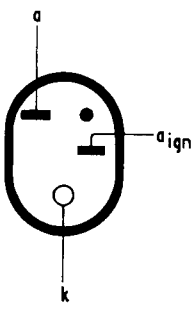
4. The noise generated by the tube over a frequency range (50 to 5,000 c/s) and at any constant current (2 to 20mA) is less than 15mV$_{r.m.s.}$

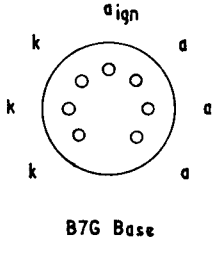
150B3

STABILISING TUBE

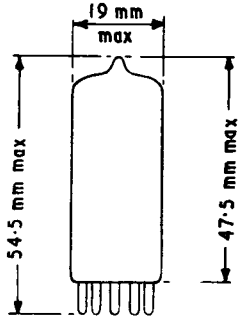
Miniature gas-filled tube with auxiliary ignition electrode (priming anode) and intended for use as a voltage stabiliser.

1881





B7G Base



STABILISING TUBE

Gas-filled two-electrode tube intended for use as a voltage stabiliser.

150C2

This data should be read in conjunction with the GENERAL OPERATIONAL RECOMMENDATIONS — VOLTAGE STABILISER AND REFERENCE LEVEL TUBES which precede this section of the handbook.

MAINTENANCE

LIMITING VALUES (absolute ratings)

Minimum voltage necessary for ignition	185	V
Burning current		
Maximum	30	mA
Minimum	5.0	mA
Maximum negative anode voltage	140	V
Ambient temperature limits	−55 to +90	°C

CHARACTERISTICS (measured at 17.5mA)

Maintaining voltage	150	V
Maximum difference between maintaining voltages at I_a = 30mA and I_a = 5.0mA	6.0	V
Maximum percentage variation of maintaining voltage during 1000 hours	± 2.0	%

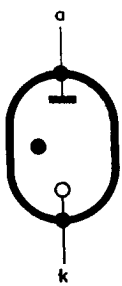
OPERATING NOTES

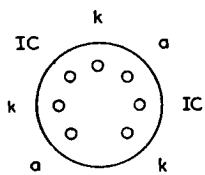
1. The maximum ignition voltage quoted is the greatest voltage which is necessary to ignite any tube in the presence of some ambient illumination. A voltage of at least this value must be available if reliability of ignition is to be obtained. In complete darkness there may be considerable delay in igniting the tube. If instantaneous ignition is required in darkness a voltage of not less than 225V is required.
2. Equilibrium conditions are normally reached after 3 minutes' operation.

150C2

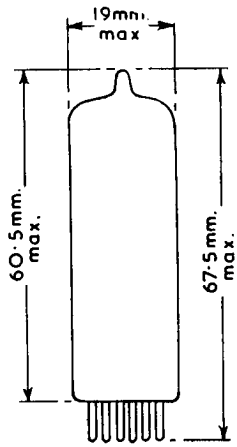
STABILISING TUBE

1616





B7G Base



STABILISING TUBE

150Volt gas-filled stabiliser with current range of 5.0 to 30mA.

150C4

LIMITING VALUES (absolute ratings)

Minimum voltage necessary for ignition in some ambient light	185	V
Minimum voltage necessary for ignition in complete darkness	225	V
Maximum burning current	30	mA
Minimum burning current	5.0	mA
Maximum starting current	75	mA
Maximum ambient temperature limits	−55 to + 90	C
Maximum negative anode voltage	125	V

CHARACTERISTICS

	Initial	*Over life**	
Maximum burning voltage at I_a = 30mA (all tubes)	158	161	V
Minimum burning voltage at I_a = 5.0mA (all tubes)	142	139	V
Maximum difference between burning voltages at I_a = 30mA and I_a = 5.0mA (individual tube)	5.0	8.0	V
Typical difference between burning voltages at I_a = 30mA and I_a = 5.0mA (individual tube)	3.0	3.0	V
Maximum percentage variation of burning voltage at I_a = 17.5mA during 1000 hours life	±3.0		%
Typical percentage variation of burning voltage at I_a = 17.5mA during 1000 hours life	1.0		%

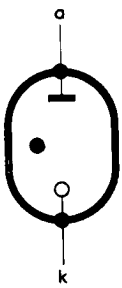
*This condition corresponds to an average current of 17.5mA

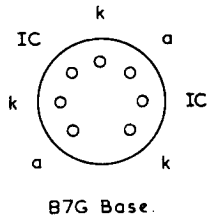
150C4

STABILISING TUBE

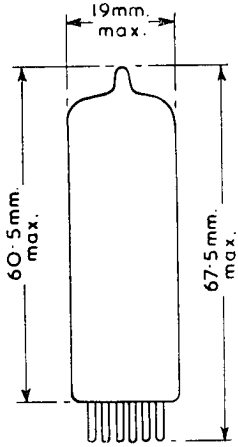
150Volt gas-filled stabiliser with current range of 5.0 to 30mA.

1616





B7G Base.



Mullard
HIGH VOLTAGE RECTIFIER

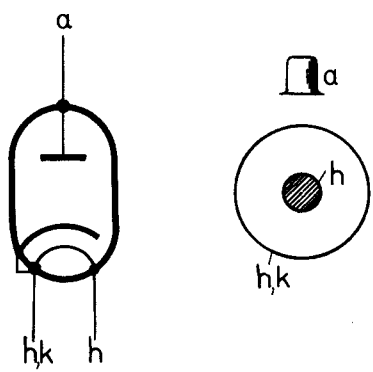
1878

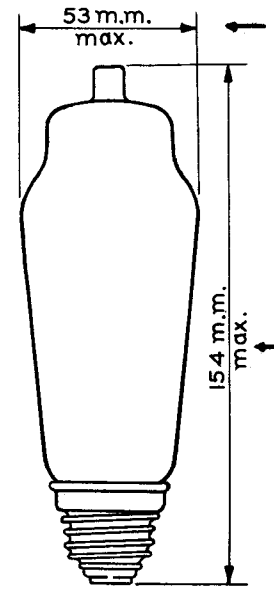
Heater	Vf	=	4.0 V
	If	=	0.7 A

Operating Conditions

Va max	.....	10,500 V
Ia max	.....	2 mA

Arrangement of electrodes and base connections.

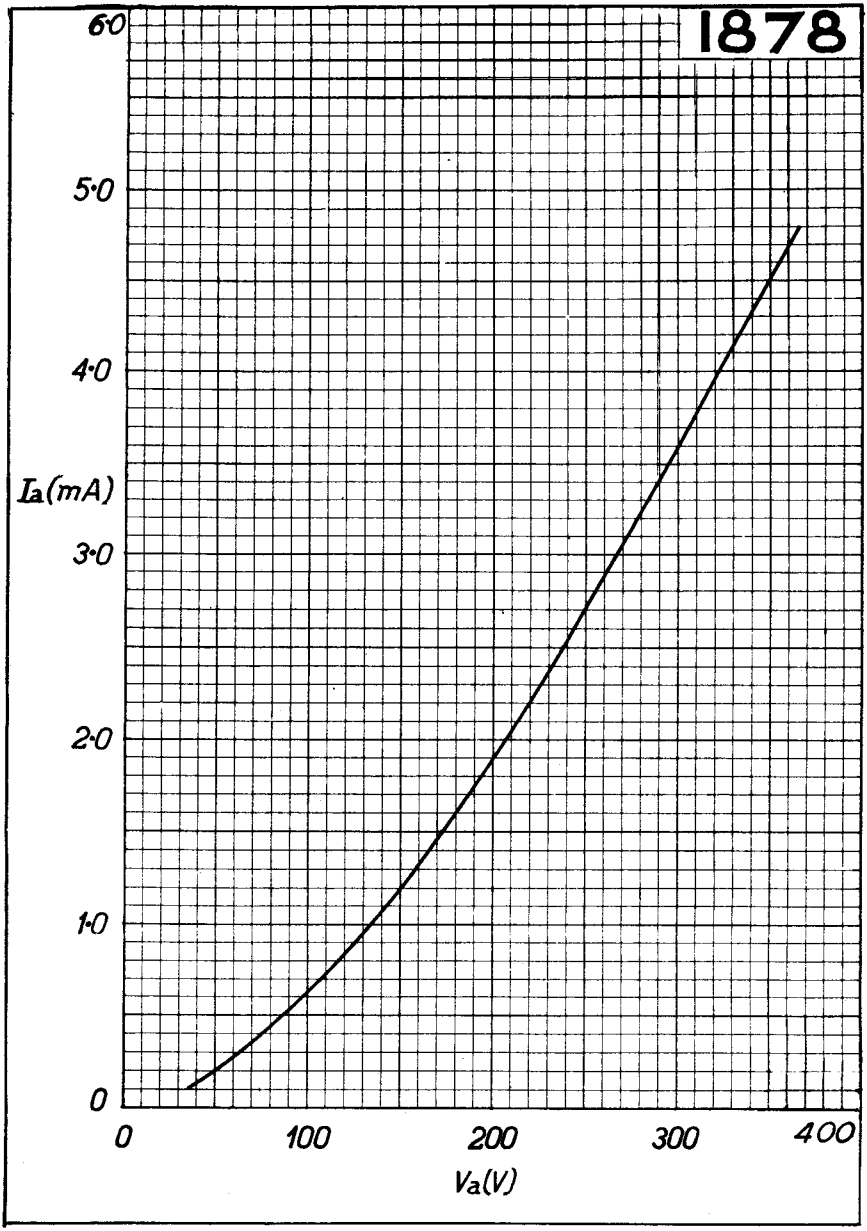




1878

1878

Mullard
HIGH VOLTAGE RECTIFIER



1539 /2

Mullard
PHOTO ELECTRIC CELL 3510

The 3510 Photo Electric Cell is of the high vacuum type with a Potassium Cathode.

OPERATING CHARACTERISTICS

Maximum Anode Voltage	Va_{max}	= 500 volts
Normal Anode Voltage	Va_{w}	= 100 volts
Maximum Anode Current	Ia_{max}	= 3 μA
Sensitivity		= 3 μA/Lm.
Maximum Light Flux		= 0·1 Lumen

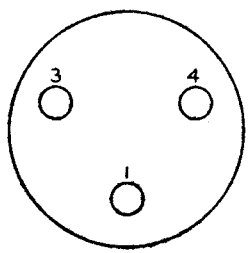
CAPACITY

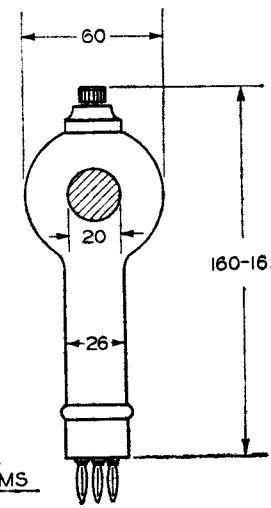
Anode—Cathode	Cak	= 3 $\mu\mu$F

CONNECTIONS

This cell is capped in a 3-pin base, to fit standard 4-pin valve holder.

PIN No. 1	ANODE
" 3	—
" 4	—
TOP CAP	CATHODE

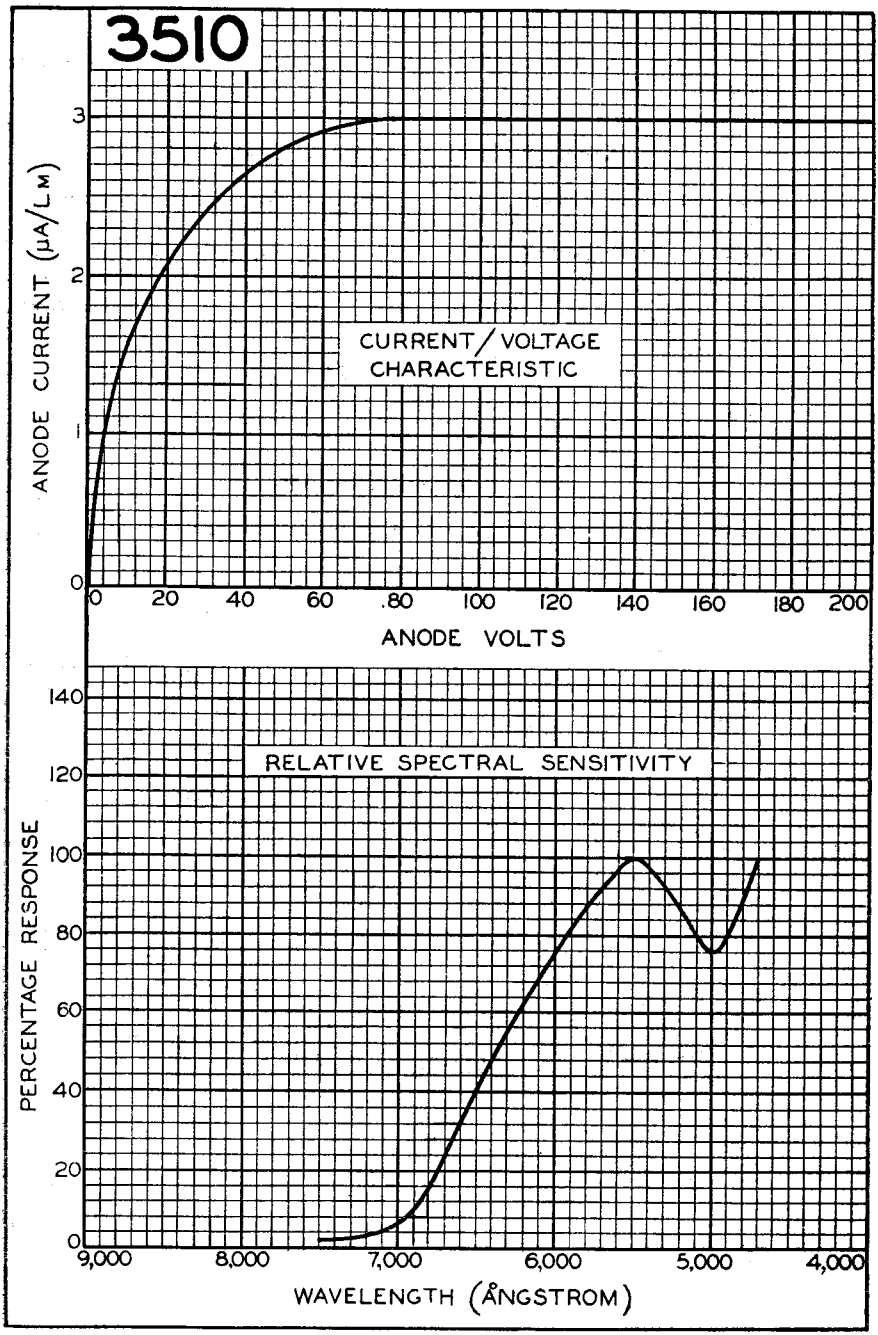




DIMENSIONS IN M/MS

3510

Mullard
PHOTO ELECTRIC CELL



Mullard
PHOTO ELECTRIC CELL

3512

The 3512 Photo Electric Cell is of the high vacuum type with a Caesium Cathode.

OPERATING CHARACTERISTICS

Maximum Anode Voltage	Va_{max}	= 500 volts
Normal Anode Voltage	Va_{w}	= 100 volts
Maximum Anode Current	Ia_{max}	= 5 μA
Sensitivity		= 20 μA/Lm.
Maximum Light Flux		= 0·1 Lumen

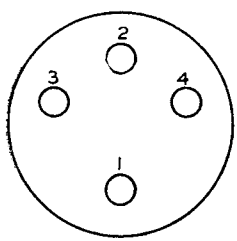
CAPACITY

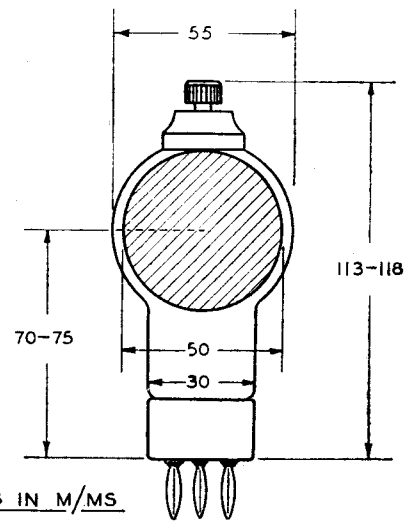
Anode—Cathode	Cak	= 3 $\mu\mu$F

CONNECTIONS

This cell is capped in a standard 4-pin base.

PIN NO.	1	ANODE
"	2	—
"	3	—
"	4	—
TOP CAP		CATHODE



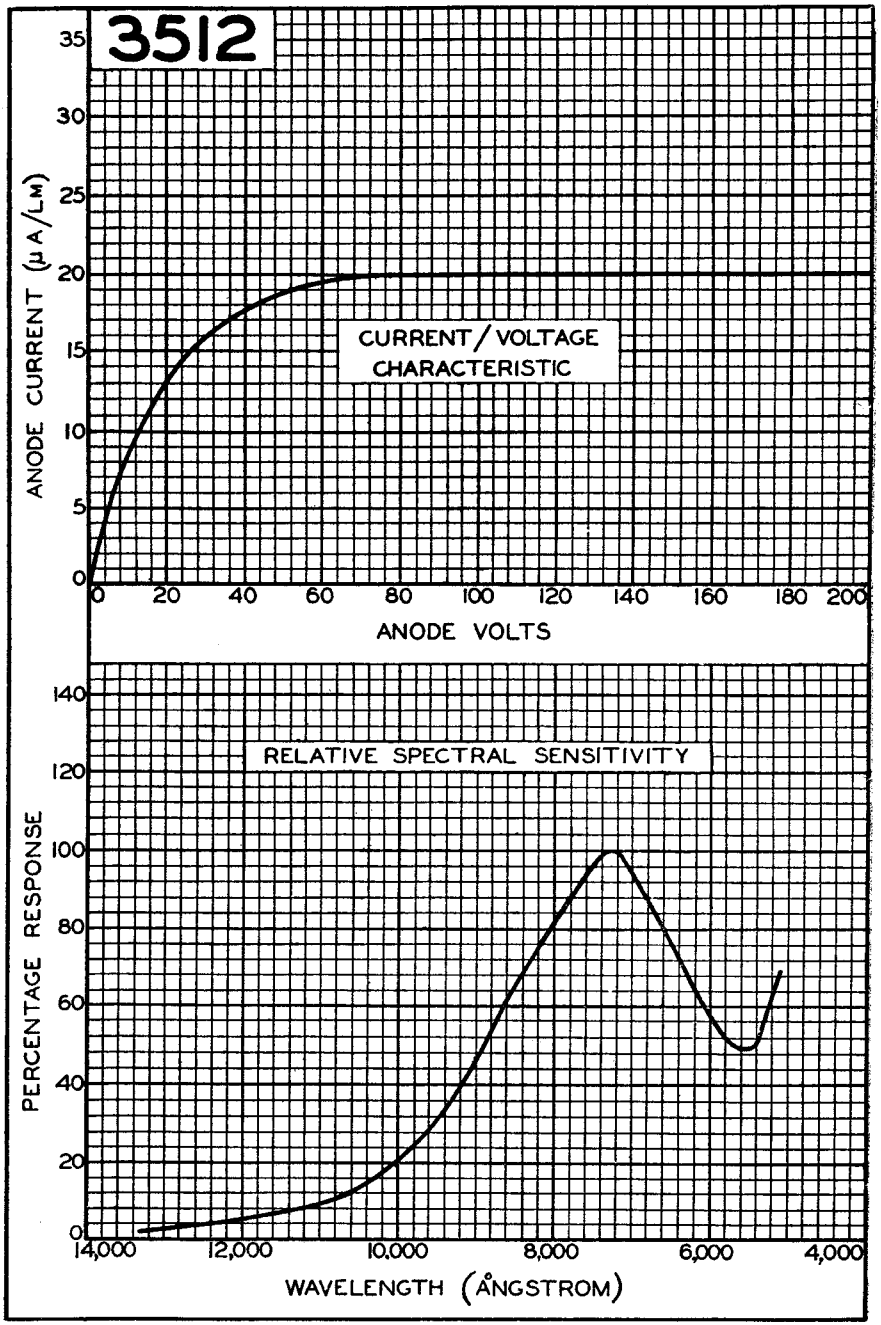


DIMENSIONS IN M/MS

3512

Mullard

PHOTO ELECTRIC CELL



Mullard
PHOTO ELECTRIC CELL

3530

The 3530 Photo Electric Cell is of the gas-filled type with a Caesium Cathode.

OPERATING CHARACTERISTICS

Maximum Anode Voltage	Va_{max}	=	100 volts
Normal Anode Voltage	Va_{w}	=	100 volts
Glow Voltage	Vs	=	140 volts
Maximum Anode Current	Ia_{max}	=	7·5 μA
Sensitivity		=	150 μA/Lm
Minimum Safety Resistance	Rl_{min}	=	0·1 megohm

CAPACITY

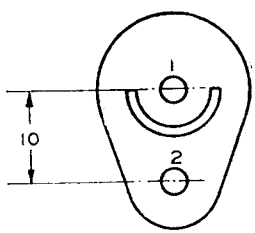
Anode—Cathode	Cak	=	5 $\mu\mu$F

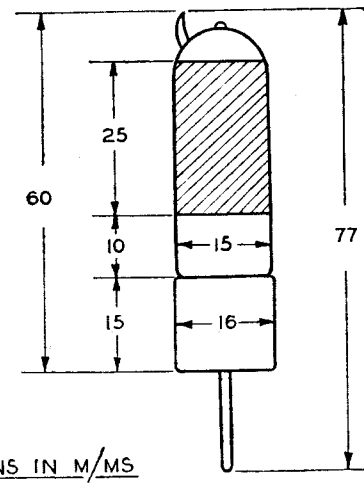
CONNECTIONS

This cell is capped in a special 2-pin base.

PIN No. 1 ANODE

" 2 CATHODE

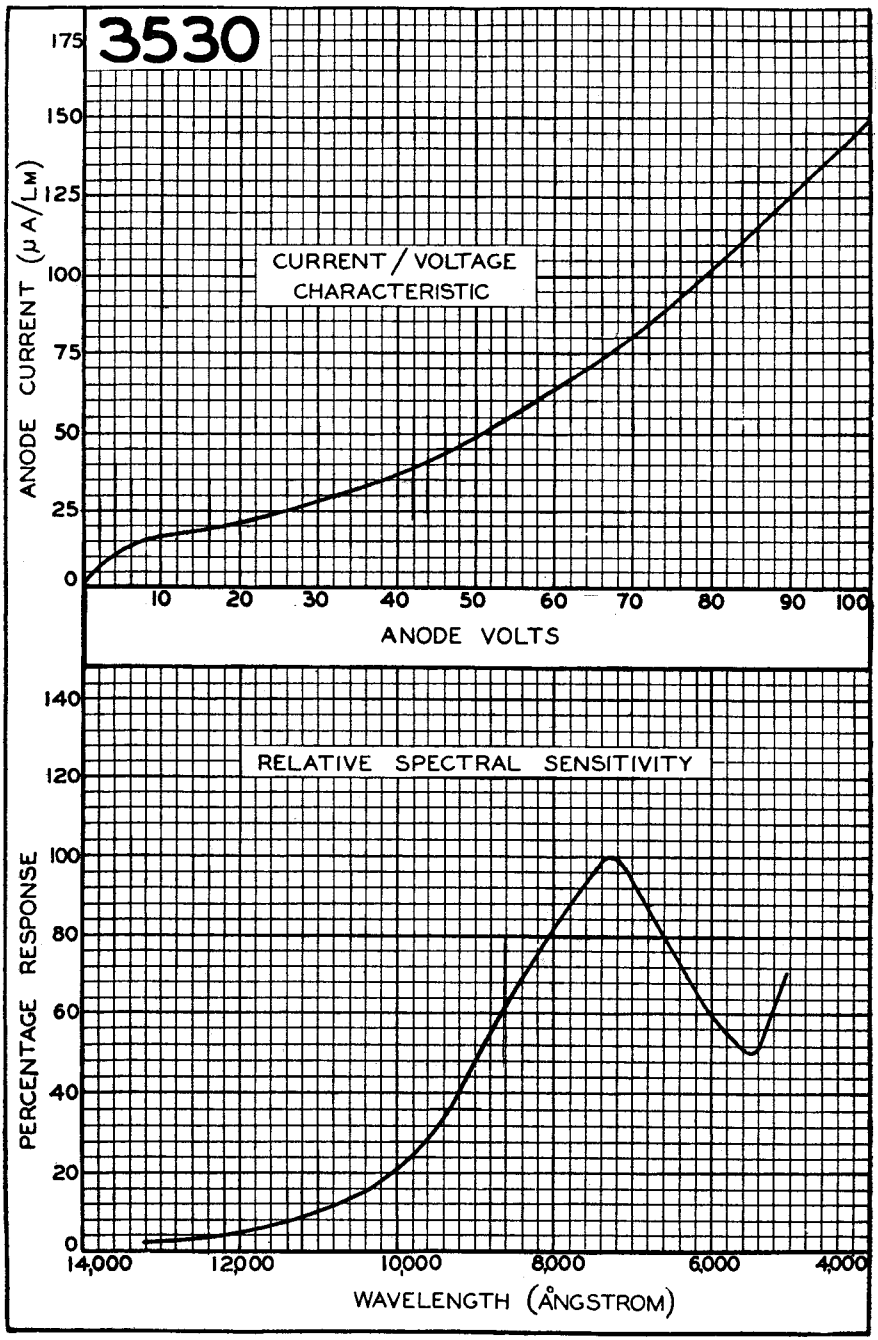




DIMENSIONS IN M/MS

3530

Mullard
PHOTO ELECTRIC CELL



Mullard
ELECTROMETER TRIODE 4060

The 4060 is a triode with a very low anode current. The special characteristics of this valve open up wide fields of measurements in Physical and Electro-medical Laboratories, for which the ordinary triode is unsuited by reason of its appreciable leakage and rather large inter-electrode capacity.

The chief applications at present are for the measurement of Hydrogenion concentration in solutions, and the measurement of X-ray intensities with an ionisation chamber, or the measurement of small light intensities (small photo electric currents).

FILAMENT CHARACTERISTICS

Filament Voltage ...	Vf=0·7 volt (approx.)
Filament Current ...	If=0·6 amp

DIMENSIONS

Overall Length	= 160 mm.
Overall Diameter	= 58 mm.

SPECIAL NOTE

The values of filament voltage and current for operating the 4060 are rather critical; the correct values are etched on each valve.

OPERATING CHARACTERISTICS

Anode Voltage	Va	= 4 volts
Grid Current	Ig	= 10^{-14} amps
Mutual Conductance (−Vg=2·5 V)	S	= 28 μA/V
Maximum Anode Voltage	Va_{max}	= 6 volts
Positive Grid Current commences at ...	−Vg	= 1·3 volts approx.

GENERAL DESCRIPTION

The electrometer valve resembles an ordinary screened grid valve in external appearance and dimensions. It has a four-pin base carrying the filament and ANODE connections, and a terminal at the top FOR THE GRID CONNECTION. This difference in anode and grid connections should be specially noted.

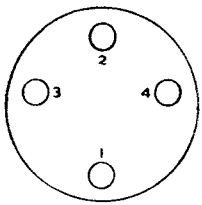
The arrangement of the electrodes in the valve is also unusual, the filament being arranged in a horizontal plane with a flat anode below it, supported from the filament foot, and a flat plate control electrode " Grid " arranged above the filament, supported on long glass insulators so that the leakage between the control electrode and the other electrodes is reduced to the lowest possible value.

4060 Mullard
ELECTROMETER TRIODE

PRECAUTIONS TO BE OBSERVED IN USE

To obtain the full benefit of the very high insulation of this valve, it must be thoroughly cleaned outside to remove any trace of moisture, and precautions should be taken to keep the bulb and surrounding air quite dry during use by means of a suitable drying agent such as calcium. The valve should be used in a light-proof box to prevent photo-electric emission from the control electrode, and for the same reason the filament must be run as dull as possible consistent with proper operation.

CONNECTIONS

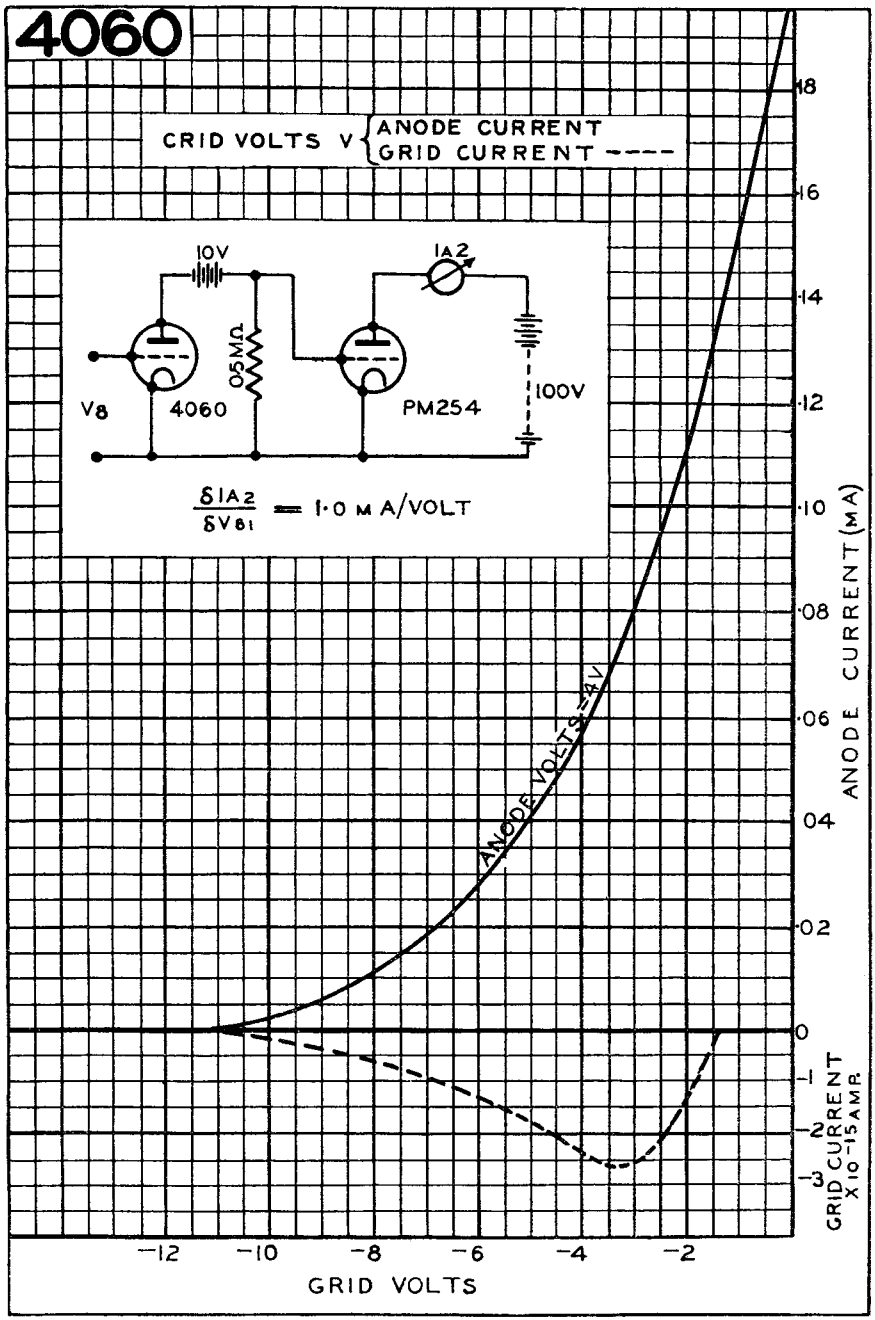


Viewed from free end of pins.

Pin No. 1 Anode
„ 2 Filament
„ 3 Filament
„ 4 —
Top Cap—Grid

Mullard
ELECTROMETER TRIODE

4060



Mullard
ACORN TRIODE

4671

Heater	Vf	=	6.3 V
	If	=	0.15 A

Capacities	Cag	=	1.4 uuF
	Cgk	=	1.0 uuF
	Cak	=	0.6 uuF
	Cgf	=	0.3 uuF

Operating Conditions as H.F. Amplifier

Va	90	135	180	V
Ia	2.5	3.5	4.5	mA
Vg	-2.5	-3.75	-5	V
g	25	25	25	
S (Ia = 2.5 mA)	1.7	-	-	mA/V
S (Ia = 3.5 mA)	-	1.9	-	mA/V
S (Ia = 4.5 mA)	-	-	2.0	mA/V
Ri (Ia = 2.5 mA)	14,700 ←	-	-	ohms
Ri (Ia = 3.5 mA)	-	13,200	-	ohms
Ri (Ia = 4.5 mA)	-	-	12,500	ohms

Operating Conditions as Oscillator

Va	.....	180 V
Ia	.....	7 mA
Ig	.....	1.5 mA
Vg	.....	-35 V
*Wo (λ = 5 m)	.....	0.5 W

* Up to 300 Mc., the output decreases only slightly. Above this figure the output decreases with frequency.

Operating Conditions as Detector

	Anode Bend Detector	Leaky Grid Detector	
Va	180	45	V
Vg	-7	0	V
Ra	0.25	-	ohms
Rk	50,000	-	ohms
Rg	-	1 - 5	megohms
Cg	-	250	uuF

4671

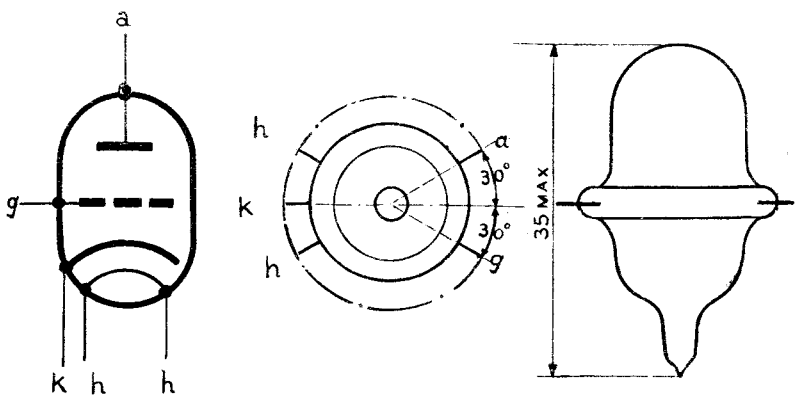
Mullard
ACORN TRIODE

Limiting Values

Va max	180	V
Wa max	1.5	W
Ik max	10	mA
Vg max (Ig = + 0.3 uA)	-1.3	V
Ig max	2	mA
Rgl max	5	megohms
Vfk max	50	V
Rfk max	20,000	ohms

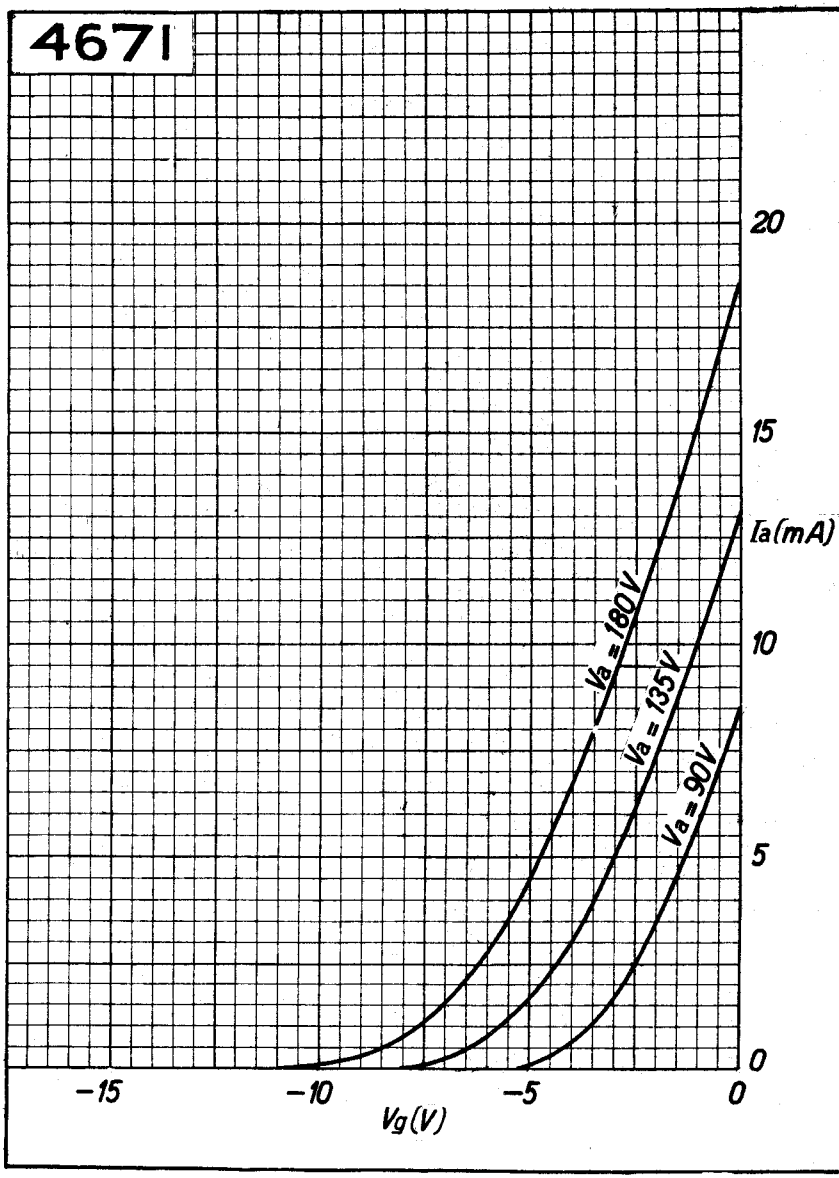
→ Damping	λ (m)	Zi (ohms)	Za (ohms)
	5	100,000	11,000
	7	45,000	11,000

Arrangement of electrodes and base connections.



Mullard
ACORN TRIODE

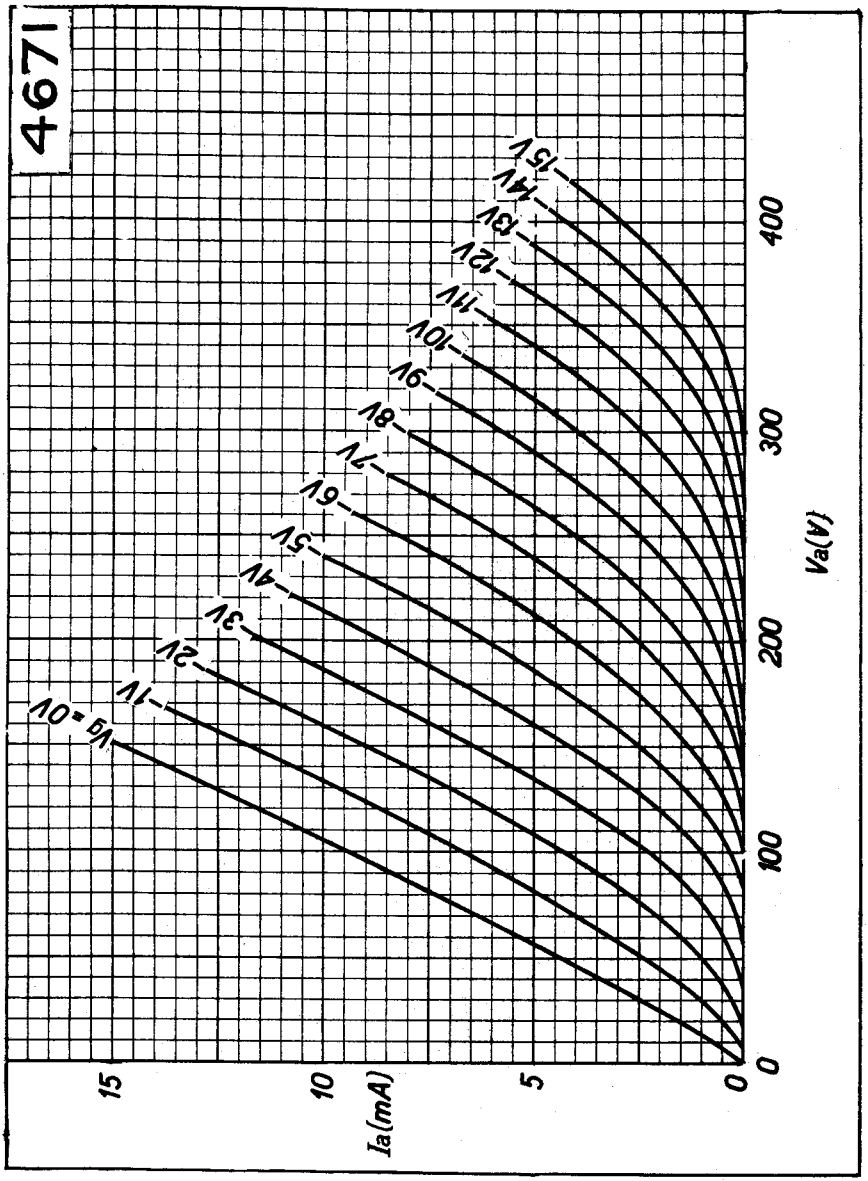
4671



1739/3

4671

Mullard
ACORN TRIODE



1739/4

Mullard
ACORN PENTODE

4672

Heater	Vf	=	6.3 V
	If	=	0.15 A

Capacities	Cagl	<	0.007 uuF
	Cgl	=	3.0 uuF
	Ca	=	3.4 uuF
	Cglf	=	0.18 uuF

Operating Conditions (k connected to g3)

Va	90	250	V
Vg2	90	100	V
Ia	1.2	2	mA
Vgl	-3	-3	V
Ig2 (Ia = 1.2 mA)	0.5	-	mA
Ig2 (Ia = 2 mA)	-	0.7	mA
S (Ia = 1.2 mA)	1.1	-	mA/V
S (Ia = 2 mA)	-	1.4	mA/V
g	1,100	2,100	
Ri (Ia = 1.2 mA)	1	-	megohm
Ri (Ia = 2 mA)	-	1.5	megohm
g (g1g2)	25	28	

Limiting Values

Va max	250	V
Wa max	0.8	W
Ik max	5	mA
Vgl max (Igl=+0.3 µA)	-1.3	V
Vg2 max	100	V
Wg2 max	0.15	W
Rgl max	3	megohms
Vfk max	50	V
Rfk max	20,000	ohms

→ Damping	λ (m)	Zi (ohms)	Za (ohms)
	5	45,000	< 200,000
	7	100,000	300,000

→ Operating Conditions as L.F. Amplifier
(Using resistance coupling and k connected to g3)

Ra Megohms	Va V	Rg2 Megohms	Rk Ohms	Ia mA	Ig2 mA	Vo / Vi	Vo Veff	D %
0.3	250	0.8	4000	0.5	0.20	165	14	1.5
0.2	250	0.5	2500	0.79	0.32	150	14	1.0
0.1	250	0.32	1250	1.3	0.51	100	14	1.3

4672

Mullard
ACORN PENTODE

→ Operating Conditions as Grid Detector
(Using resistance coupling with k connected to g3)

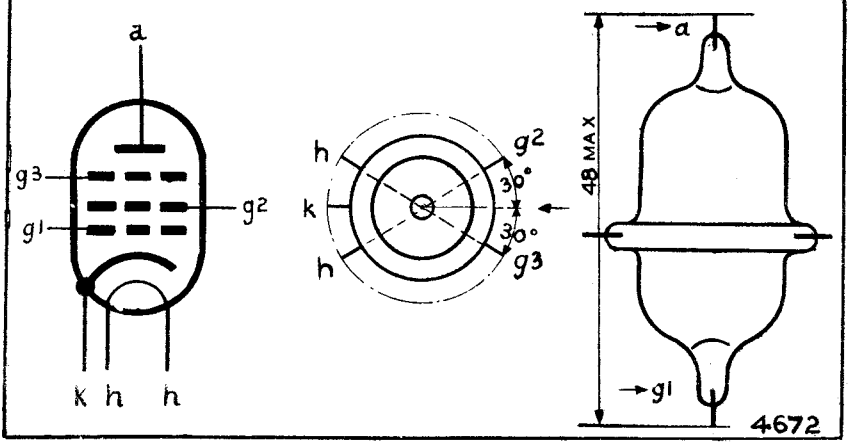
Ra Megohms	Va V	Rg2 Megohms	Ia mA	Ig2 mA	$\frac{Vo}{VI}$
0.3	250	0.8	0.6	0.25	20
0.2	250	0.5	0.9	0.4	20
0.1	250	0.1	2.7	1.5	16.5

These values of Ia and Ig2 were measured with no signal.

→ Operating Conditions as Anode Bend Detector
(With k connected to g3)

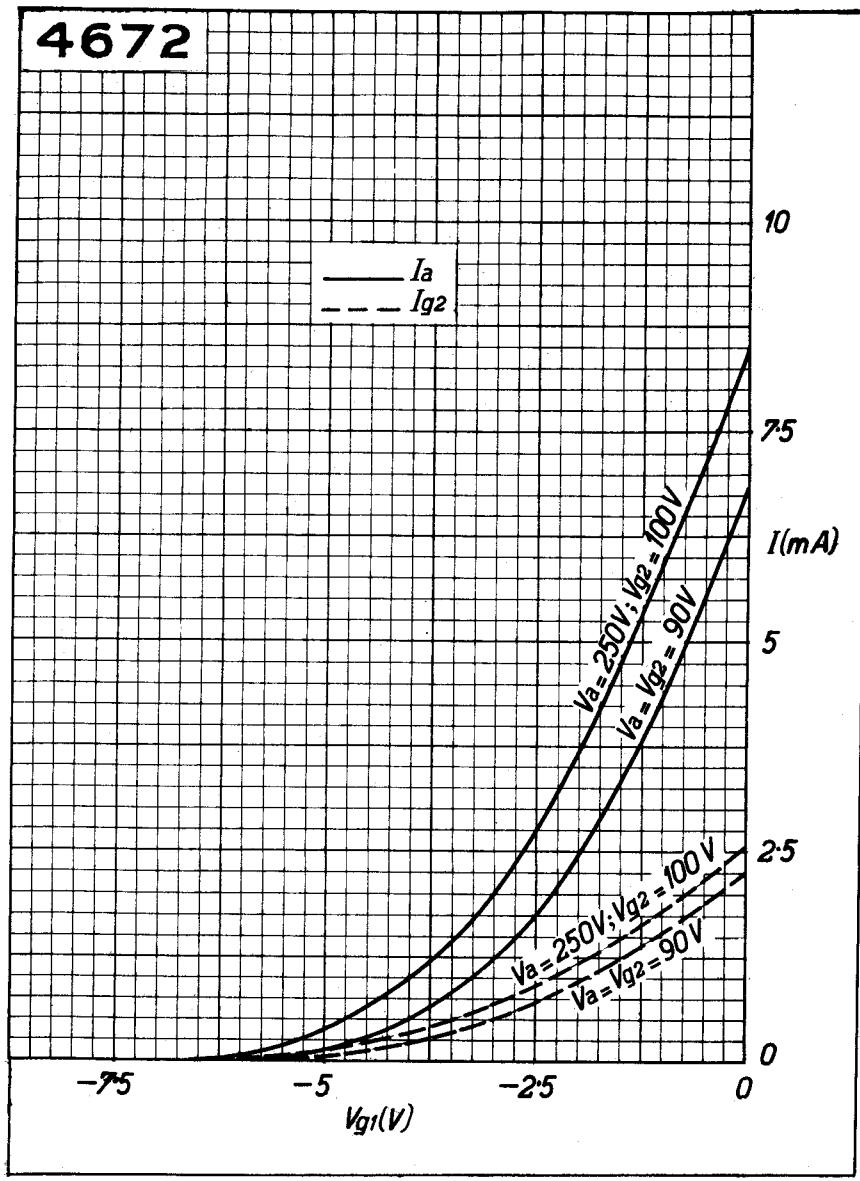
Va	250	V
Ia	0.2	mA
Vg2	60	V
Ig2	0.06	mA
Ra	0.3	megohm
Rk	5000	ohms
Amplification $\frac{Vo}{VI}$ (Vo = 2 V, m = 30%)	9	

Arrangement of electrodes and base connections.



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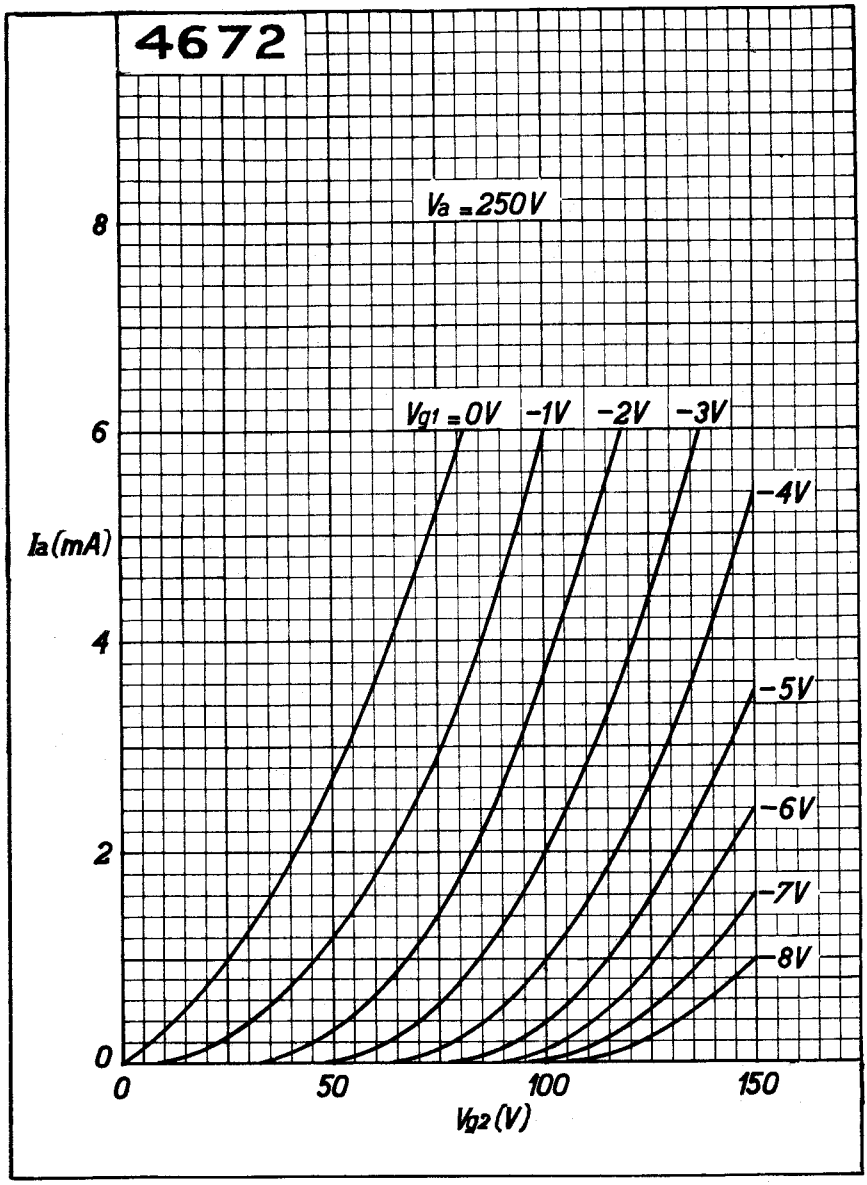
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1739/3

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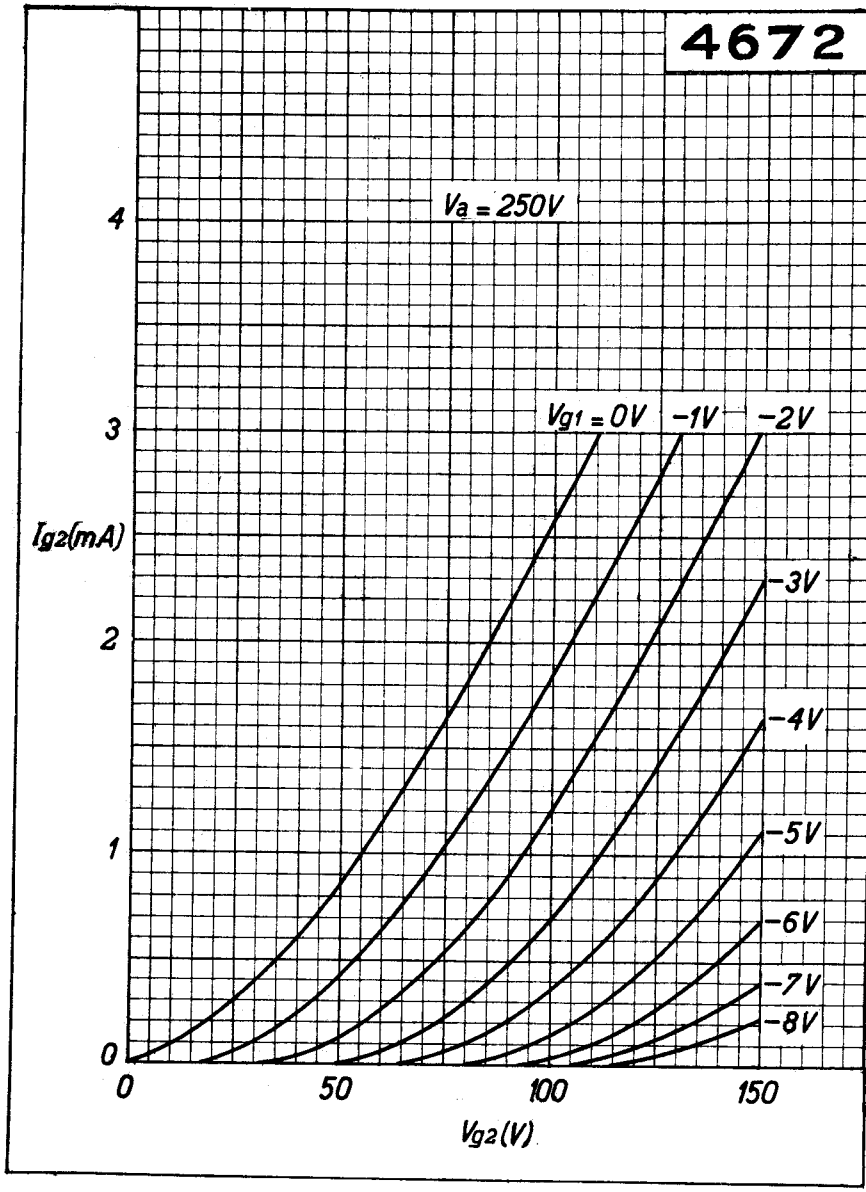
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ACORN PENTODE



1739/4

Mullard
ACORN PENTODE

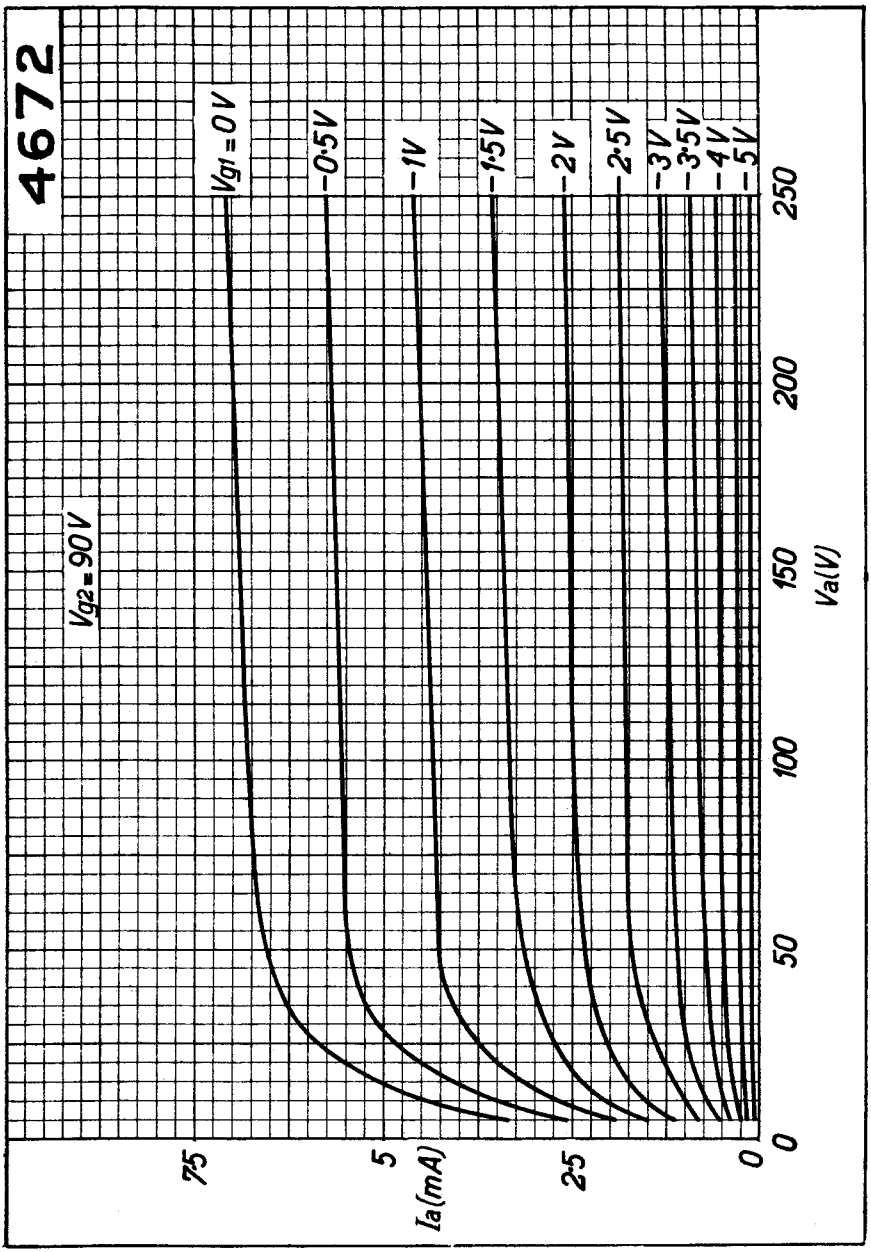
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1739/3

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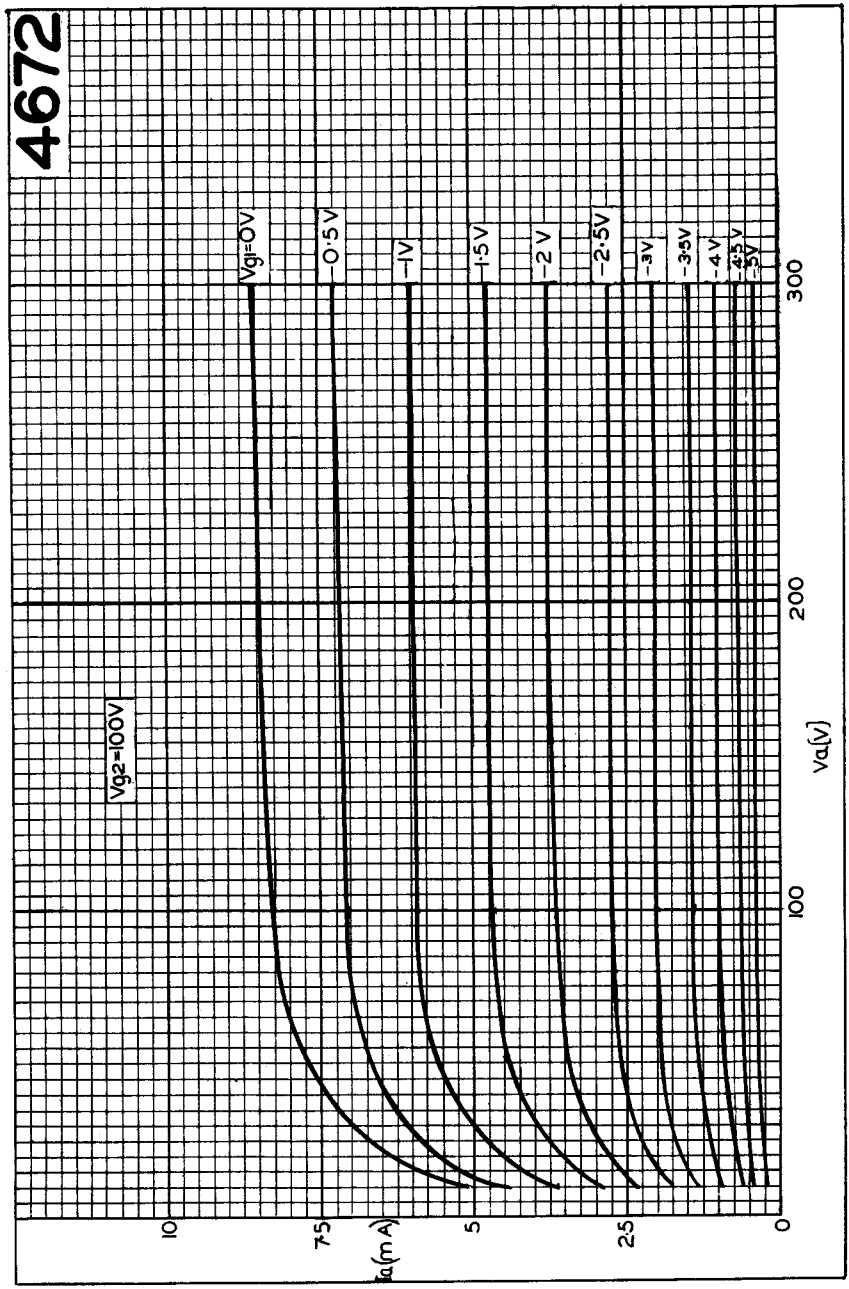
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1739.6

Mullard
ACORN PENTODE

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1739/7

Mullard
ACORN DIODE

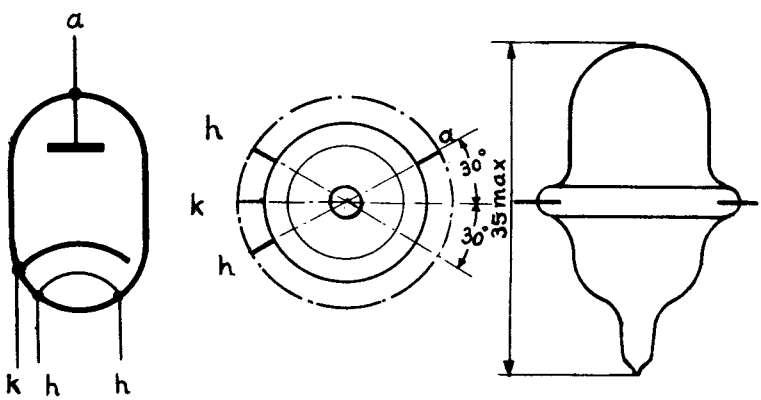
4674

Heater	Vf	=	6.3 V
	If	=	0.150 A
Capacities	Cak	=	0.3 uuF

Limiting Values

Va max	180	V
Ia max	0.8	mA
Vfk max	50	V
Rfk max	10,000	ohms
Va max (Ia = +0.3 uA)	-1.3	V

Arrangement of electrodes and base connections.



Mullard
ACORN PENTODE

4695

Heater			Vf =	6.3 V
			If =	0.15 A
Capacities		Cag1	<	0.007 uuF
		Cg1	=	3.3 uuF
		Ca	=	2.7 uuF
		Cg1f	=	0.20 uuF

Operating Conditions

Va		250	V
Vg2		100	V
Vg3		0	V
Ia	6.7	-	mA
-Vg1	3	46	V
Ig2	2.7	-	mA
g	1000	-	
S	1700	2	uA/V
Ri	0.6	>10	megohms

Limiting Values

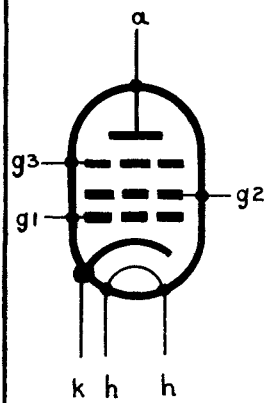
Va max	250	V
Wa max	1.5	W
Vg2 max	125	V
Wg2 max	0.5	W
Ik max	10	mA
-Vg1 max (Ig1=+0.3 µA)	1.3	V
Ig2 max	2.3	mA
Ig2 min	1.3	mA
Rg1 max	3	megohm
Vfk max	50	V
Rfk max	20,000	ohms

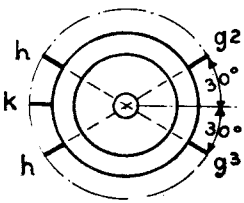
Damping	λ (m)	Zi (ohms)	Za (ohms)
	5	45,000	100,000
	7	>100,000	>400,000

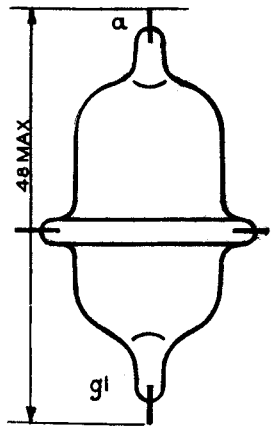
4695

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ACORN PENTODE

Arrangement of electrodes and base connections.





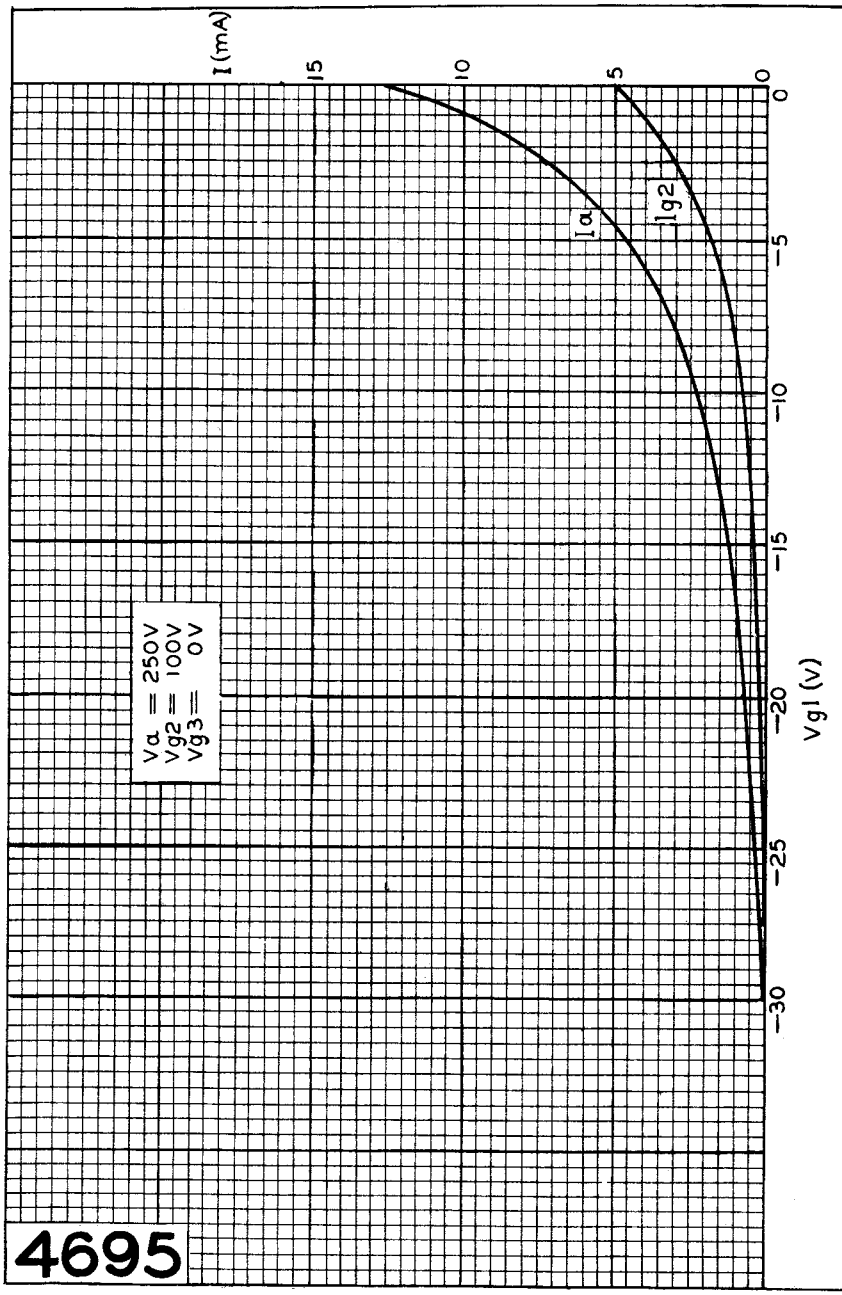


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1340/2

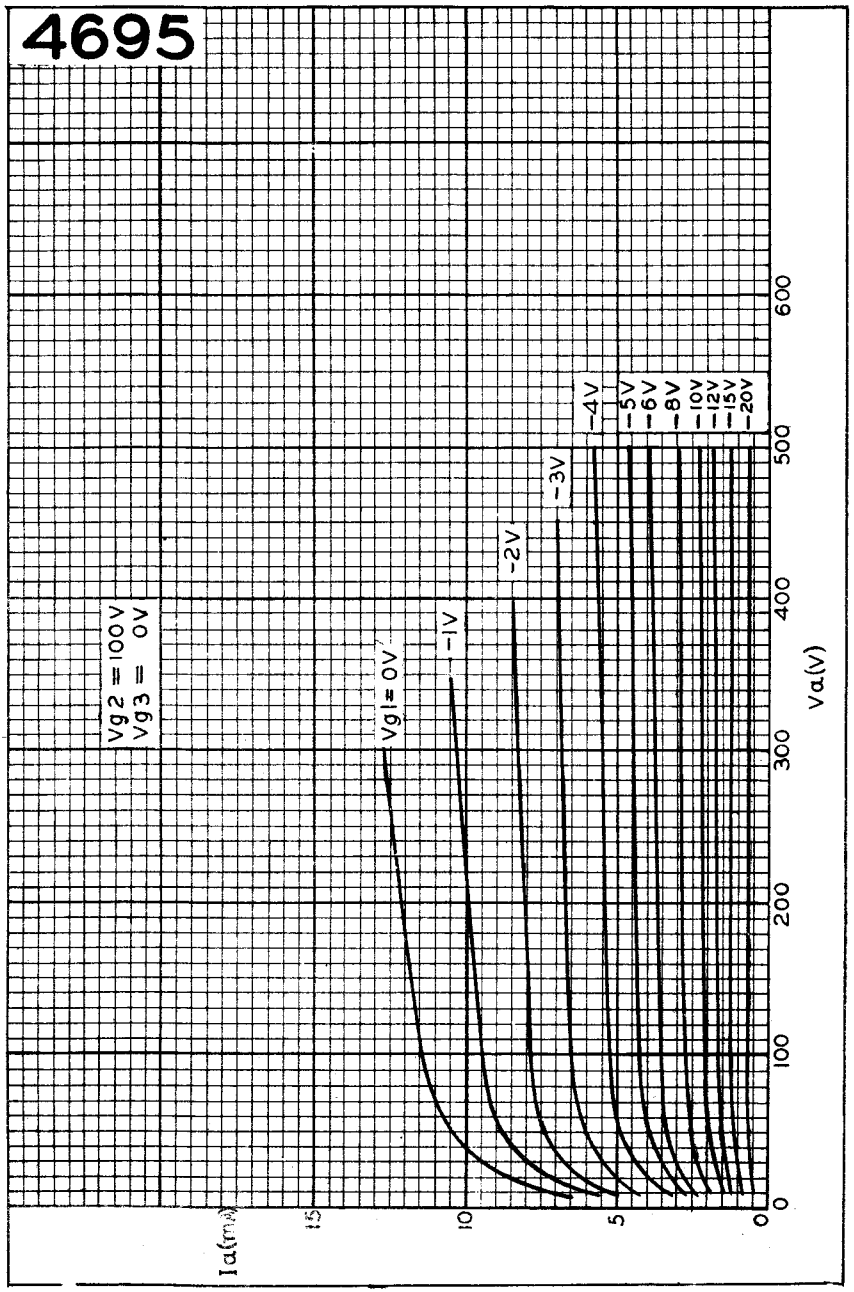
Mullard
ACORN PENTODE

4695



1340/3

Mullard
ACORN PENTODE



SPECIAL QUALITY R.F. PENTODE

5636

Special quality subminiature r.f. pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured with external shield)

c_{a-g1}	<20	mpF
c_{a-g3}	<1.1	pF
c_{g1-g3}	<150	mpF
$c_{in(g1)}$	4.0	pF
$c_{in(g3)}$	3.7	pF
c_{out}	3.4	pF

CHARACTERISTICS[3]

V_a	100	V
V_{g3}	0	V
V_{g2}	100	V
V_{g1}	−1.4	V
I_a	5.3	mA
I_{g2}	4.1	mA
$g_{m(g1-a)}$	3.2	mA/V
$g_{m(g3-a)}$	1.15	mA/V
μ_{g1-g2}	25	←
R_k	0	Ω
V_{g1} (I_a <100μA)	−7.5	V
V_{g3} (I_a <100μA)	−8.0	V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	550	mW
+V_{g3} max.	30	V
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	450	mW
I_{g2} max.	7.0	mA
+V_{g1} max.	0	V←
−V_{g1} max.	55	V
I_k max.	16	mA
V_{h-k} max.	200	V
R_{g1-k} max.	1.1	MΩ
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

5636

SPECIAL QUALITY R.F. PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g2-e} (V)	V_{g1-e} (V)	V_{g3-k} (V)	R_k (Ω)	C_k (μF)	V_{h-k} (V)
6.3	100	100	0	0	150	1000	0

TESTS	A.Q.L.[5] (%)	*Individuals*[6] Bogey[9]	Min.	Max.	*Lot average*[7] Min.	Max.	*Lot standard deviation*[8] Max.	
GROUP A								
Heater current	0.65	150	140	160	—	—	—	mA
	—	—	—	—	144	156	4.2	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	0.65	—	0	0.3	—	—	—	μA
Anode current	0.65	5.3	3.7	6.9	—	—	—	mA
	—	—	—	—	4.6	6.0	0.7	mA
Anode current $V_{g1} = -7.5V$, $R_k = 0\Omega$	0.65	—	—	100	—	—	—	μA
Mutual conductance	0.65	3.2	2.7	4.0	—	—	—	mA/V
	—	—	—	—	2.9	3.5	0.31	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at –300V	2.5	—	100	—	—	—	—	MΩ
g_1-rest, measured at –100V	2.5	—	100	—	—	—	—	MΩ
Change in mutual conductance $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Screen-grid current	2.5	—	2.8	5.4	—	—	—	mA
Anode current $V_{g3-e} = -8.0V$	2.5	—	—	100	—	—	—	μA
Mutual conductance $_{(g3-a)}$ $V_{g3-e} = -1.0V$	2.5	—	0.5	1.8	—	—	—	mA/V
Reverse grid current $V_h = 7.5V$, $V_{g1} = -7.5V$, $R_{g1} = 1.0M\Omega$, $R_k = 0\Omega$. Measured after 5 minutes preheat under standard test conditions, except $V_h = 7.5V$, $R_{g1} = 1.0M\Omega$	2.5	—	0	0.5	—	—	—	μA
†A.F. noise at anode, $V_{g2-e} = 19V$, $R_{g1} = 100k\Omega$, $R_{g2} = 1.0k\Omega$, $R_a = 200k\Omega$	2.5	—	—	70	—	—	—	mV
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	3.5	4.5	—	—	—	pF
C_{out}	—	—	2.9	3.9	—	—	—	pF
C_{g3-all}	—	—	3.5	4.5	—	—	—	pF
C_{a-g1}	—	—	—	20	—	—	—	mpF
C_{a-g3}	—	—	—	1.1	—	—	—	pF
C_{g1-g3}	—	—	—	150	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55±5mm Hg Voltage = 300V r.m.s. No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50 c/s, 15g min. peak acceleration, $R_a = 10k\Omega$	2.5	—	—	60	—	—	—	mV (r.m.s.)

†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

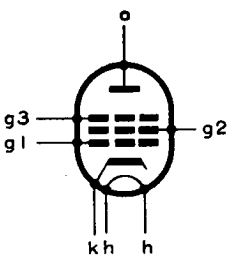
	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	—	20	—	—	—	μA
Change in mutual conductance	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	200	—	—	—	mV (r.m.s.)
Shock[15]								
V_{h-k} = 100V (cathode negative), R_{g1} = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	20	—	—	20	—	—	—	μA
Change in mutual conductance	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	200	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

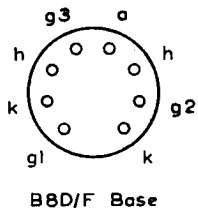
GROUP D

Heater cycling life test								
V_h = 7.0V 1 minute on, 4 minutes off								
V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature								
Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	15	—	—	—	%
Survival rate life test[14]								
Running conditions R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	2.35	—	—	—	—	mA/V
					A.Q.L.[5] (%)	*Min.*	*Max.*	
Intermittent life test								
Running conditions, R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), T_{bulb} min = 220°C								
Intermittent life test end points (500 hours)								
Inoperatives[16]					4.0	—	—	
Heater current					6.5	138	164	mA
Heater-to-cathode leakage current V_{h-k} = ±100V					6.5	—	10	μA
Reverse grid current R_{g1} = 1.0MΩ					4.0	0	0.9	μA
Change in mutual conductance (individuals)					4.0	—	20	%
Change in mutual conductance V_h = 5.7V					6.5	—	15	%
Insulation as in group B.					6.5	50	—	MΩ
Average change in mutual conductance					—	—	15	%
Sub-group quality level[10]					10	—	—	

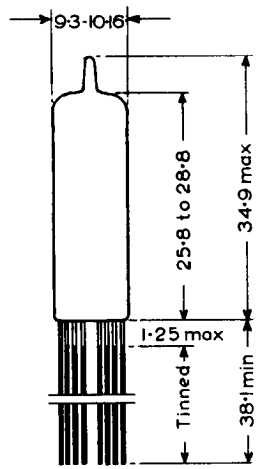
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SPECIAL QUALITY R.F. PENTODE





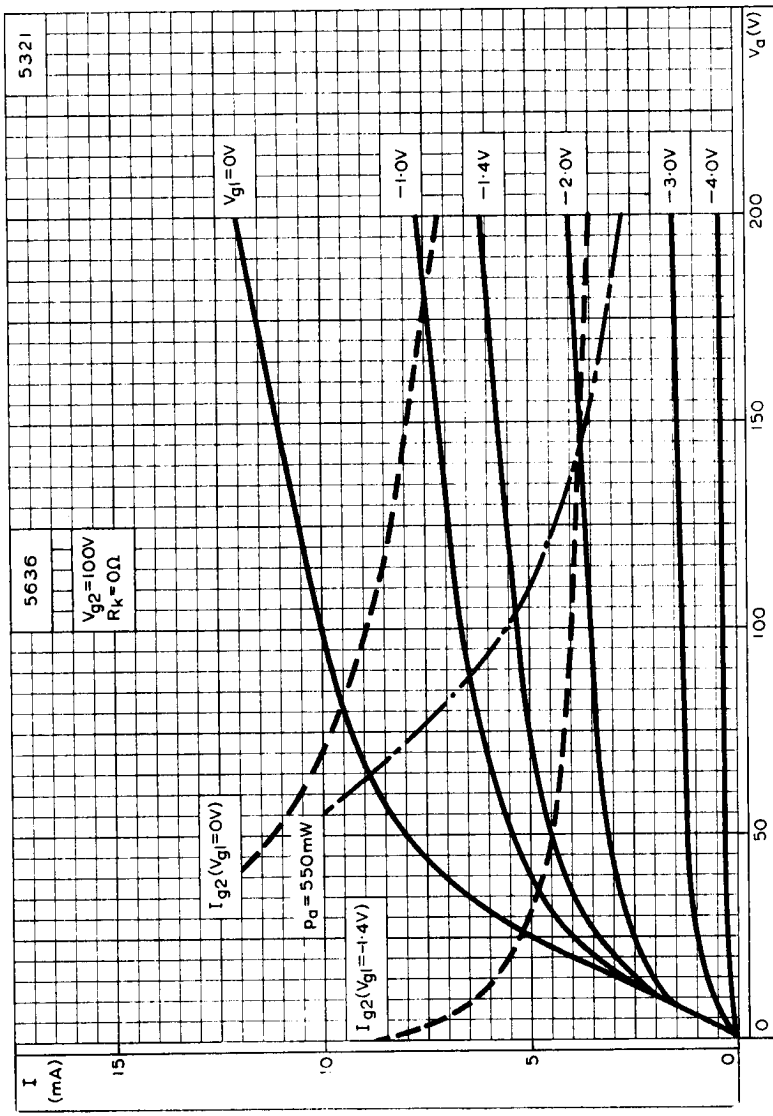
B8D/F Base



5325

All dimensions in mm

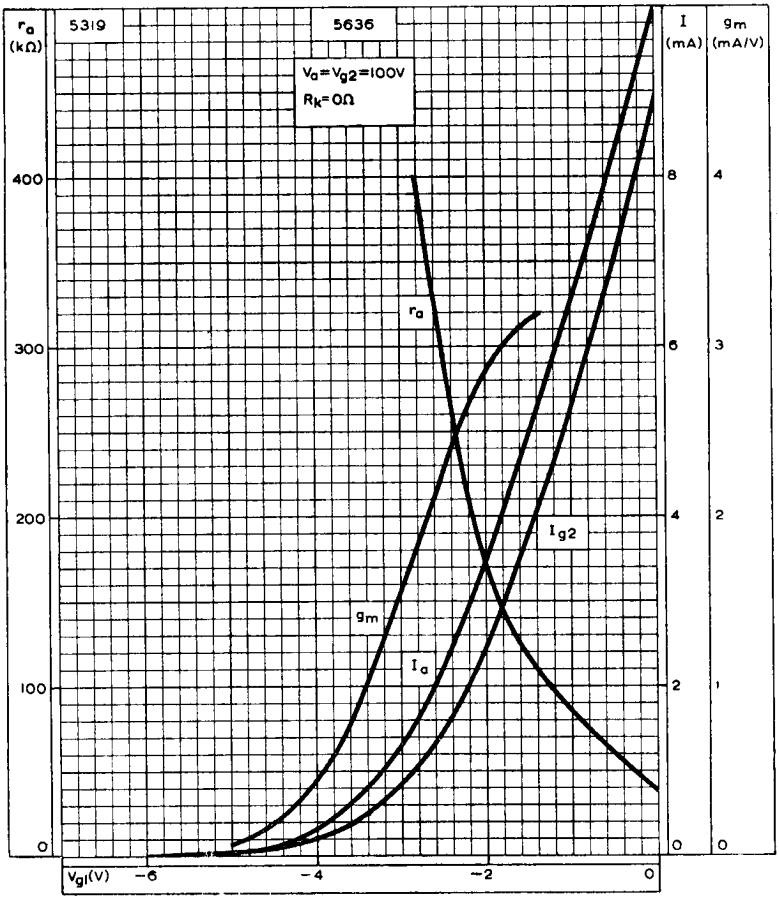
The bulb and base dimensions of this valve are in accordance with BS.448, Section B8D/F.



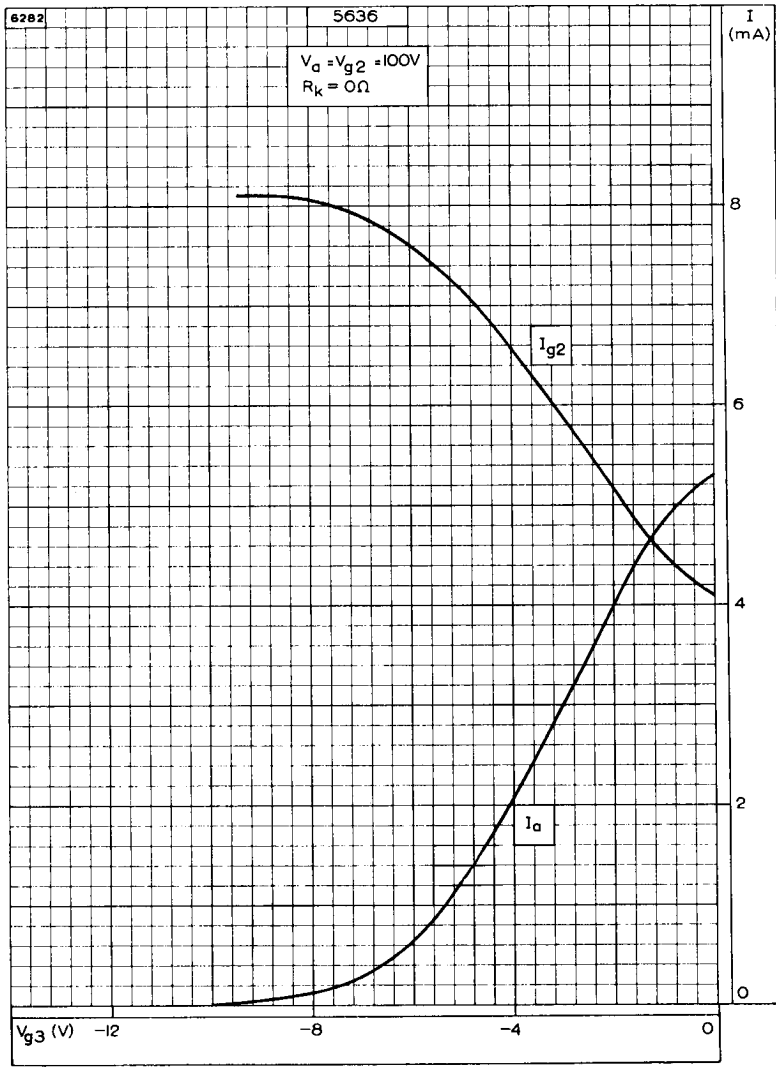
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

5636

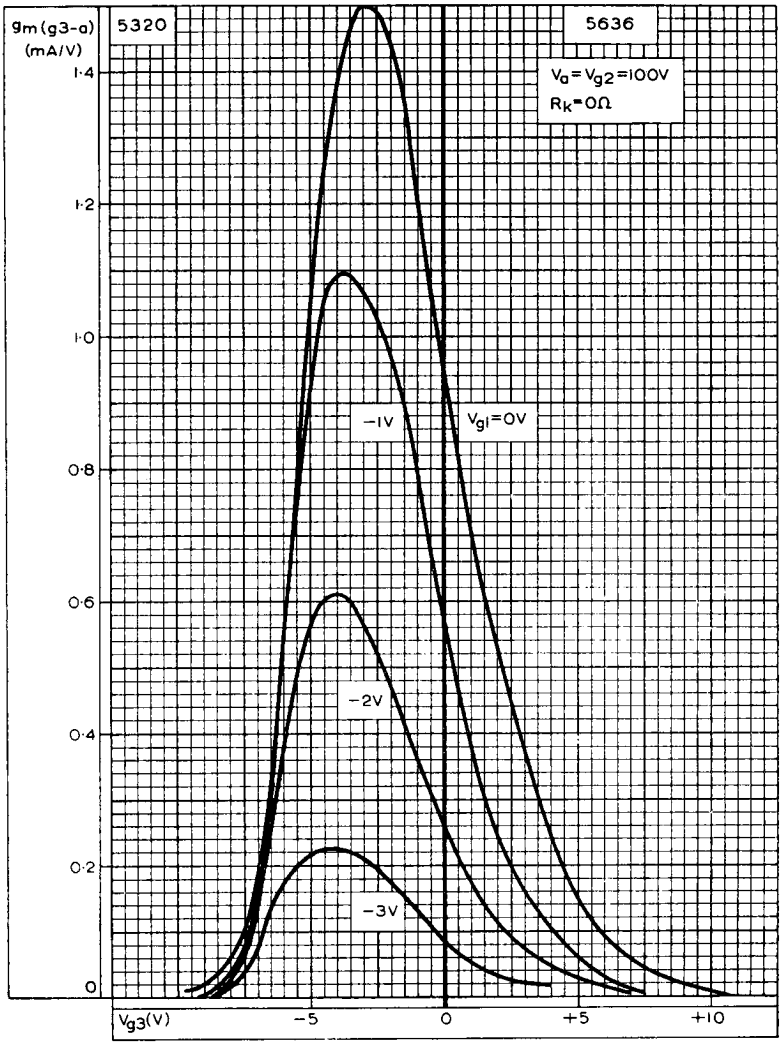
SPECIAL QUALITY R.F. PENTODE



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE



MUTUAL CONDUCTANCE (g_{3-a}) PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

HALF-WAVE RECTIFIER 5642

High voltage directly heated half-wave rectifier with wired-in connections, particularly suitable for use in the e.h.t. supply of oscilloscopes.

FILAMENT

Vf	1.25	V
If	200	mA

CAPACITANCE

ca-f	600	mpF

TYPICAL OPERATING CONDITIONS

Sine wave input

Vin(rms)	3.6	kV
Ia	250	μA
Rlim	470	kΩ
‡ C	0.02	μF
Vout	4.5	kV

DESIGN CENTRE RATINGS

Sine wave input

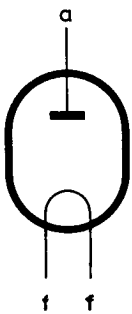
P.I.V. max.	10	kV
Ia max.	250	μA
ia(pk) max.	1.5	mA
‡ C max.	0.02	μF
Rlim min.	470	kΩ

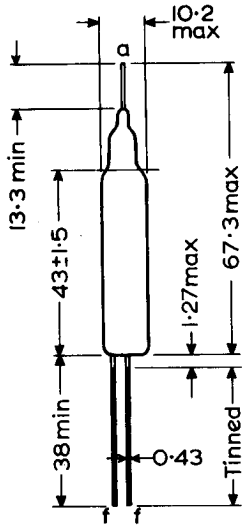
Pulse input

P.I.V. max.	10	kV
Ia max.	250	μA
* ia(pk) max.	5.0	mA
C max.	0.002	μF

* Duty factor max. = 15 %, tp max. = 10 μs.

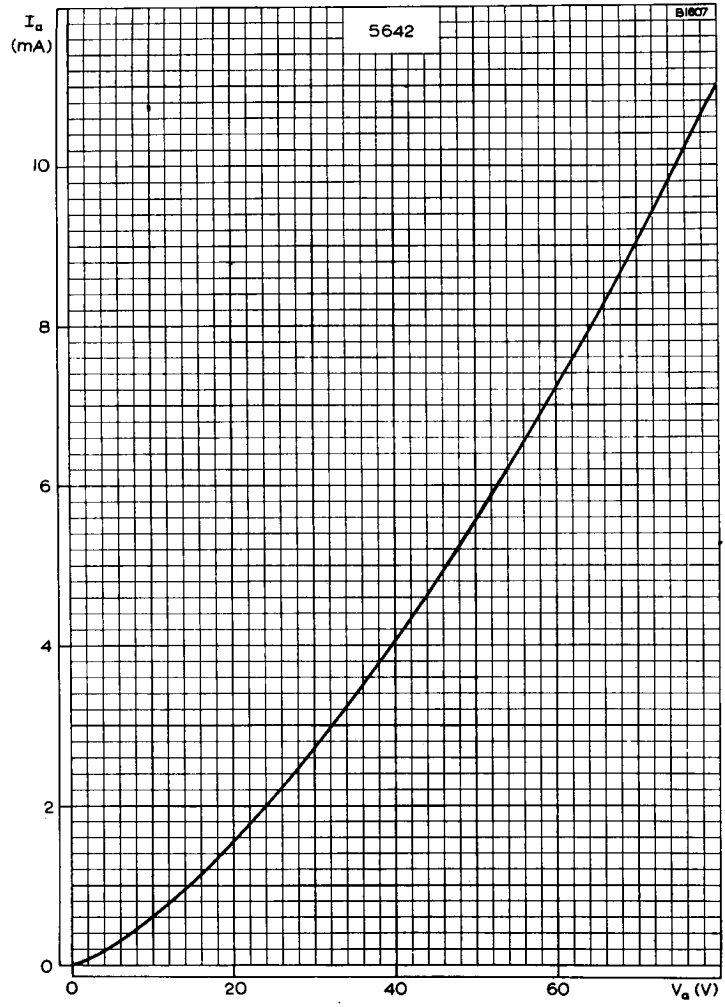
‡ 50 c/s supply





All dimensions in mm

B1576



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SPECIAL QUALITY U.H.F. TRIODE

5718

Special quality subminiature medium-μ triode for use as an oscillator at frequencies up to 500Mc/s in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured without external shield)

$c_{a\ g}$	1.3	pF
c_{in}	2.3	pF
c_{out}	800	mpF

CHARACTERISTICS[3]

V_a	100	V
V_g	−1.3	V
I_a	8.5	mA
g_m	5.8	mA/V
r_a	4.7	kΩ
μ	27	
R_k	0	Ω
$V_g(I_a < 100\mu A)$	−7.0	V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	900	mW
$+V_g$ max.	0	V ←
$-V_g$ max.	55	V
I_a max.	22	mA
I_g max.	5.5	mA
R_{g-k} max.	1.2	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

5718

SPECIAL QUALITY U.H.F. TRIODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g-e} (V)	R_k (Ω)	C_k (μF)	V_{h-k} (V)
6.3	100	0	150	1000	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	150	140	160	—	—	—	mA
	—	—	—	—	144	156	4.2	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_g = 1.0M\Omega$ $V_{a-e} = 150V$, $R_k = 380\Omega$	0.65	—	0	0.4	—	—	—	μA
Anode current	0.65	8.5	6.0	11	—	—	—	mA
	—	—	—	—	7.5	9.5	1.1	mA
Anode current $V_g = -7.0V$, $R_k = 0\Omega$	0.65	—	—	100	—	—	—	μA
Mutual conductance	0.65	5.8	4.8	6.8	—	—	—	mA/V
	—	—	—	—	5.4	6.2	0.4	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at –300V	2.5	—	100	—	—	—	—	MΩ
g-rest, measured at –100V	2.5	—	100	—	—	—	—	MΩ
Anode current $V_g = -4V$, $R_k = 0\Omega$	2.5	—	20	—	—	—	—	μA
Change in mutual conductance $V_h = 5.7V$	2.5	—	—	10	—	—	—	%
Reverse grid current $V_h = 7.5V$, $V_{g-e} = -7.0V$ $R_g = 1.0M\Omega$. Measured after 5 minutes pre-heat under standard test conditions, except $V_h = 7.5V$, $R_g = 1.0M\Omega$	2.5	—	0	0.4	—	—	—	μA
†A.F. noise at anode, $R_g = 100k\Omega$, $R_a = 10k\Omega$ $V_g = -4V$, $R_k = 0\Omega$	2.5	—	—	50	—	—	—	mV
Amplification factor	6.5	—	23	31	—	—	—	
Power oscillation f = 500Mc/s, $V_a = 150V$, R_g adjusted to give $I_a = 20mA$	6.5	—	600	—	—	—	—	mW
Capacitances[2] (unshielded). No applied voltages								
C_{in}	—	—	1.6	2.8	—	—	—	pF
C_{out}	—	—	500	900	—	—	—	mpF
C_{a-g}	—	—	1.1	1.8	—	—	—	pF
Low pressure voltage breakdown Pressure = 55±5mmHg Voltage = $300V_{r.m.s.}$ No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min peak acceleration, $R_a = 10k\Omega$	2.5	—	—	25	—	—	—	mV (r.m.s.)

†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V.	6.5	—	—	15	—	—	—	μA
Change in mutual conductance	6.5	—	—	15	—	—	—	%
Microphonic noise as in group B	6.5	—	—	100	—	—	—	mV
Shock[15]								
V_{h-k} = 100V (cathode negative), R_g = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	20	—	—	15	—	—	—	μA
Change in mutual conductance	20	—	—	15	—	—	—	%
Microphonic noise as in group B	20	—	—	100	—	—	—	mV
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

Heater cycling life test

V_h = 7.0V. 1 minute on, 4 minutes off
V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages — 2.5

Stability life test[14]

Running conditions R_g = 1.0MΩ,
V_{h-k} = 200V (cathode negative),
$T_{ambient}$ = Room temperature

Stability life test end points

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Survival rate life test[14]

Running conditions R_g = 1.0MΩ
V_{h-k} = 200V (cathode negative),
$T_{ambient}$ = Room temperature

Survival rate life test end points (100 hours)

Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	4.5	—	—	—	—	mA/V
					A.Q.L.[5] (%)	*Min.*	*Max.*	

Intermittent life test

Running conditions, Rg = 1.0MΩ,
V_{h-k} = 200V (cathode negative),
T_{bulb} min. = 220°C

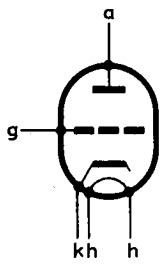
Intermittent life test end points (500 hours)

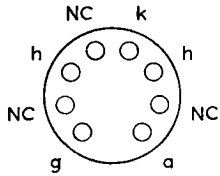
Inoperatives[16]					2.5	—	—	
Heater current					4.0	138	164	mA
Heater-to-cathode leakage current V_{h-k} = ±100V					4.0	—	10	μA
Reverse grid current R_g = 1.0MΩ					2.5	0	0.6	μA
Change in mutual conductance (individuals)					2.5	—	20	%
Change in mutual conductance V_h = 5.7V					4.0	—	15	%
Insulation as in group B					4.0	50	—	MΩ
Average change in mutual conductance					—	—	15	%
Sub-group quality level[10]					10	—	—	

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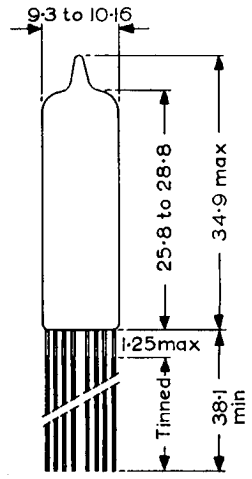
SPECIAL QUALITY U.H.F. TRIODE

5604



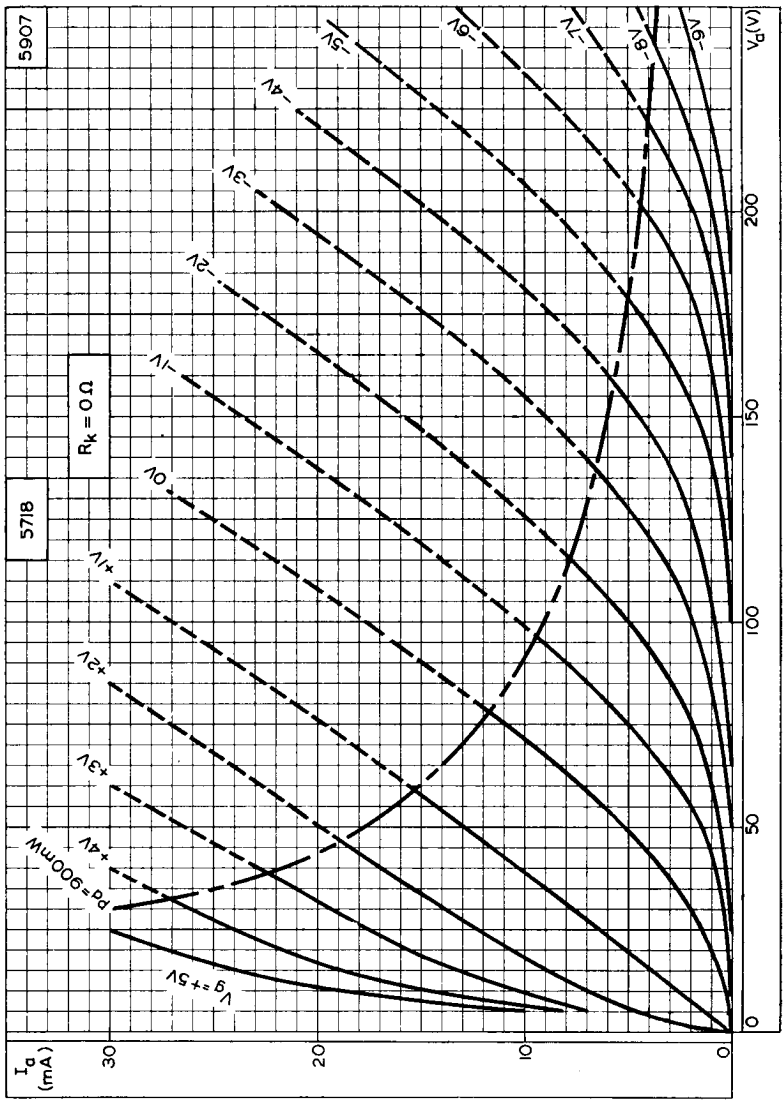


B8D/F Base



All dimensions in mm

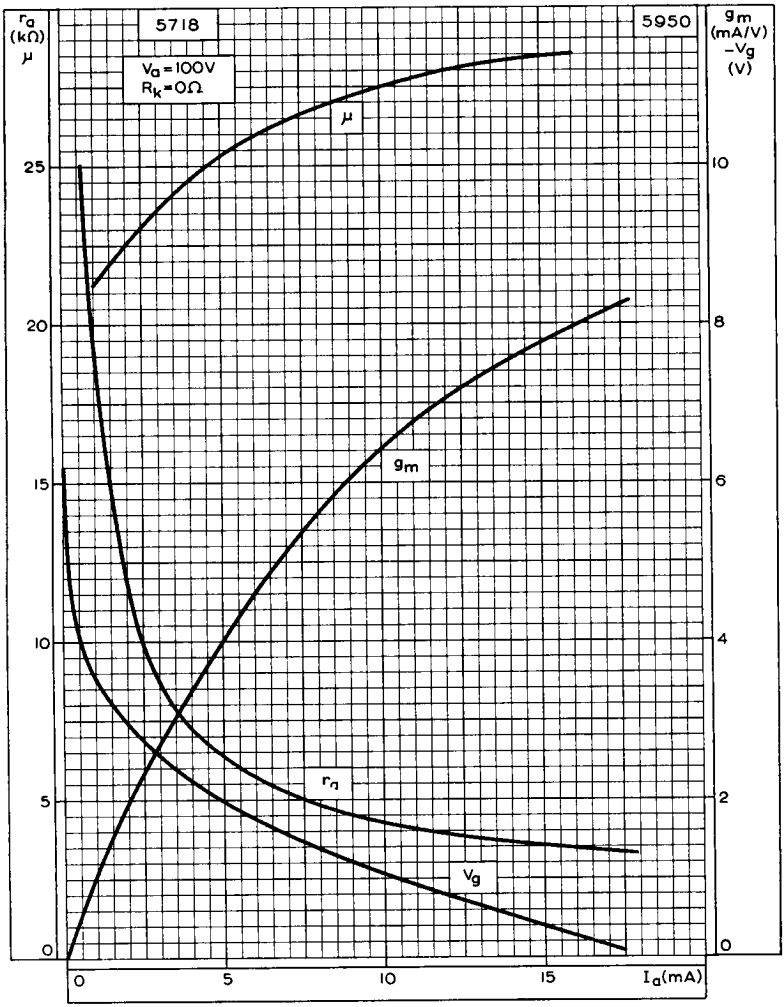
The base and bulb dimensions of this valve are in accordance with BS.448, Section B8D/F.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

5718

SPECIAL QUALITY U.H.F. TRIODE



ANODE IMPEDANCE, MUTUAL CONDUCTANCE, GRID VOLTAGE AND AMPLIFICATION FACTOR PLOTTED AGAINST ANODE CURRENT

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

5899

Special quality subminiature variable-mu r.f. pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured with an external shield)

c_{a-g1}	<15	mpF
c_{in}	4.3	pF
c_{out}	3.4	pF

CHARACTERISTICS[3]

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.1	V
I_a	7.2	mA
I_{g2}	2.0	mA
g_m	4.5	mA/V
r_a	>175	kΩ
R_k	0	Ω
g_m (V_{g1} = −15.5V)	25	μA/V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	750	mW
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	350	mW
+V_{g1} max.	0	V
−V_{g1} max.	55	V
I_k max.	16.5	mA
R_{g1-k} max.	1.1	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

5899

SPECIAL QUALITY VARIABLE-MU
R.F. PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	C_k (μF)
6.3	100	100	0	120	1000

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	150	140	160	—	—	—	mA
	—	—	—	—	144	156	4.2	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	0.65	—	0	0.3	—	—	—	μA
Anode current	0.65	7.2	5.2	9.2	—	—	—	mA
	—	—	—	—	6.4	8.0	0.8	mA
Screen-grid current	0.65	—	1.0	3.0	—	—	—	mA
Mutual conductance	0.65	4.5	3.8	5.2	—	—	—	mA/V
	—	—	—	—	4.2	4.8	0.28	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at –300V	2.5	—	100	—	—	—	—	MΩ
g_1-rest, measured at –100V	2.5	—	100	—	—	—	—	MΩ
Change in mutual conductance V_h = 5.7V	2.5	—	—	10	—	—	—	%
Mutual conductance V_{g1} = –14V, R_k = 0Ω	2.5	—	1.0	75	—	—	—	μA/V
Reverse grid current V_h = 7.5V, V_{g1} = –14V, R_{g1} = 1.0MΩ, R_k = 0Ω. Measured after 5 minutes preheat under standard test conditions except V_h = 7.5V, R_{g1} = 1.0MΩ	2.5	—	0	0.5	—	—	—	μA
†A.F. noise at anode, V_{g2-e} = 19V, R_{g1} = 100kΩ, R_{g2} = 1.0kΩ, R_a = 200kΩ	2.5	—	—	70	—	—	—	mV
Anode impedance	6.5	—	175	—	—	—	—	kΩ
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	3.5	4.5	—	—	—	pF
C_{out}	—	—	2.9	3.9	—	—	—	pF
C_{a-g1}	—	—	—	15	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55±5mmHg Voltage = $300V_{r.m.s.}$ No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min. peak acceleration, R_a = 10kΩ	2.5	—	—	60	—	—	—	mV (r.m.s.)

†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min 60c/s max for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	—	20	—	—	—	μA
Change in mutual conductance		—	—	20	—	—	—	%
Microphonic noise as in group B		—	—	200	—	—	—	mV (r.m.s.)
Shock[15]								
V_{h-k} = 100V (cathode negative), R_{g1} = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	20	—	—	20	—	—	—	μA
Change in mutual conductance		—	—	20	—	—	—	%
Microphonic noise as in group B		—	—	200	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

Heater cycling life test
V_h = 7.0V, 1 minute on, 4 minutes off
V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages — 2.5 — — — — — —

Stability life test[14]
Running conditions R_{g1} = 1.0MΩ
V_{h-k} = 200V (cathode negative)
$T_{ambient}$ = Room temperature

Stability life test end points
Change in mutual conductance after 1 hour — 1.0 — — 10 — — — %

Survival rate life test[14]
Running conditions R_{g1} = 1.0MΩ
V_{h-k} = 200V (cathode negative)
$T_{ambient}$ = Room temperature

Survival rate life test end points (100 hours)

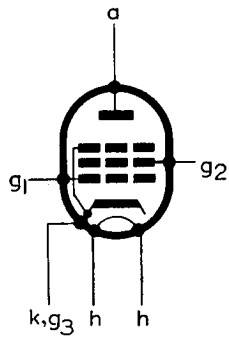
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	3.35	—	—	—	—	mA/V

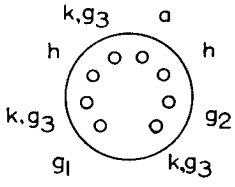
	A.Q.L.[5] (%)	Min.	Max.	
Intermittent life test				
Running conditions, R_{g1} = 1.0MΩ				
V_{h-k} = 200V, T_{bulb} min = 220°C				
Intermittent life test end points (500 hours)				
Inoperatives[16]	4.0	—	—	
Heater current	6.5	138	164	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	10	μA
Reverse grid current R_{g1} = 1.0MΩ	4.0	0	0.8	μA
Change in mutual conductance (individuals)	4.0	—	20	%
Change in mutual conductance V_h = 5.7V	6.5	—	15	%
Insulation as in group B	6.5	50	—	MΩ
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

5899

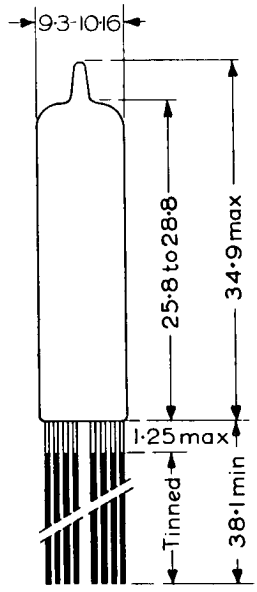
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

5494



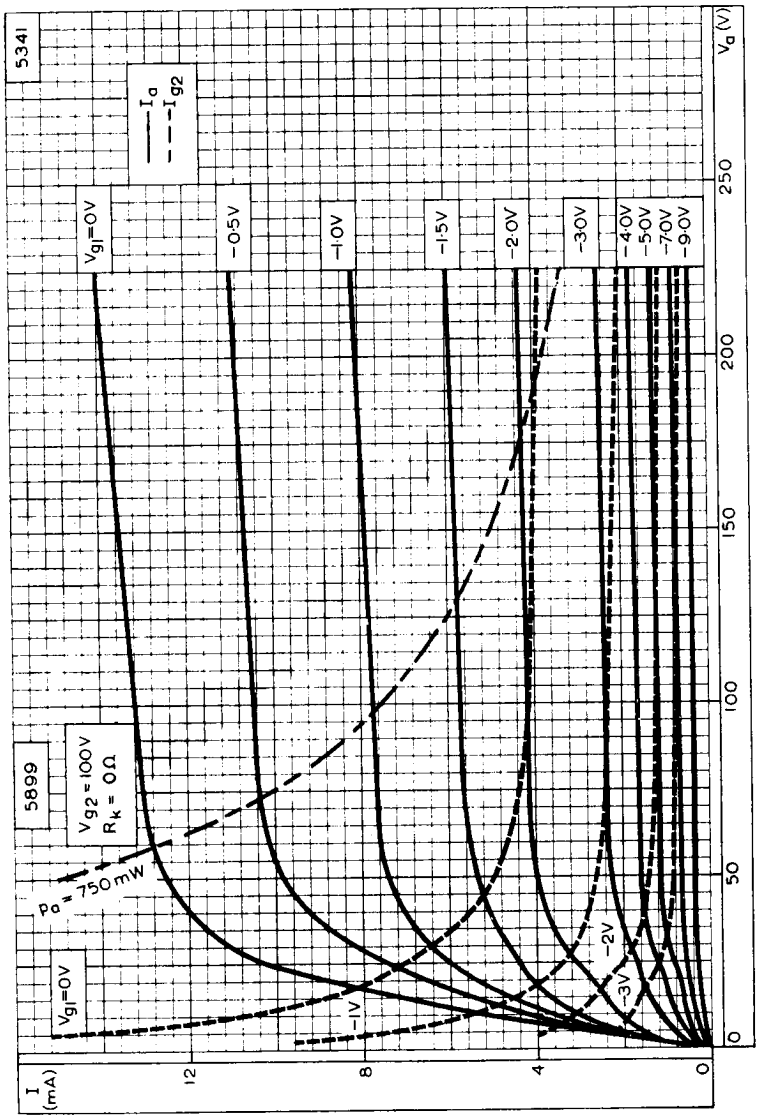


B8D/F Base

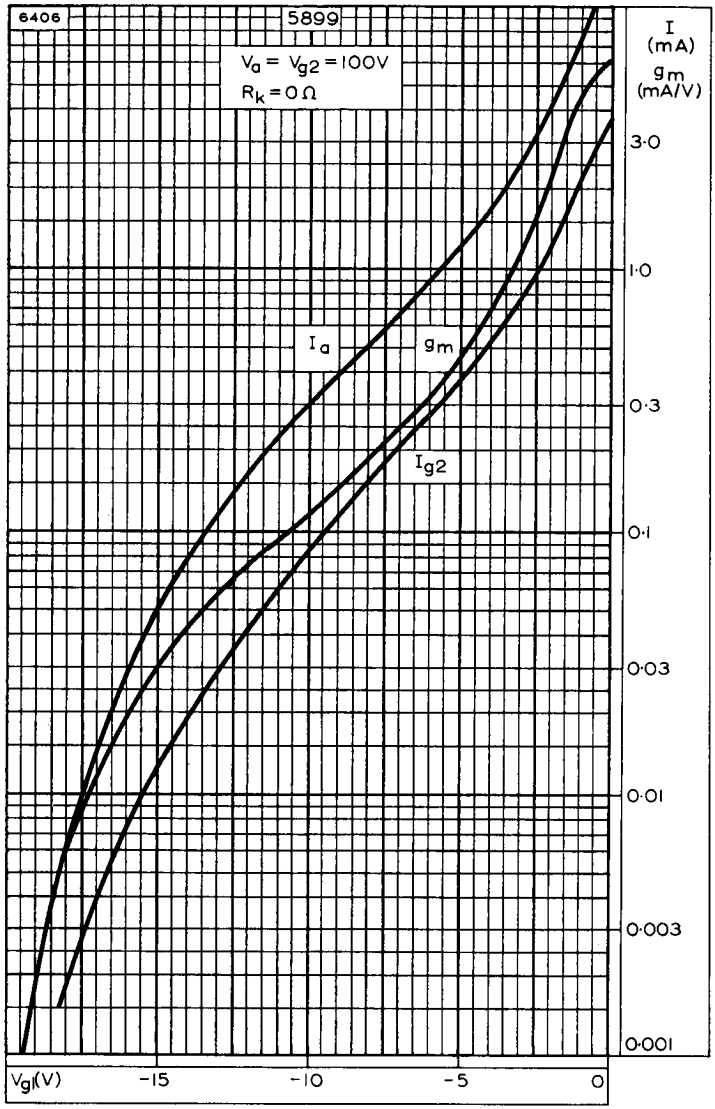


All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS.448, Section B8D/F.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

SPECIAL QUALITY OUTPUT PENTODE

5902

Special quality subminiature audio output pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured with an external shield)

c_{a-g1}	<200	mpF
c_{in}	6.5	pF
c_{out}	7.5	pF

CHARACTERISTICS[3]

V_a	100	V
V_{g2}	100	V
I_a	30	mA
I_{g2}	1.2	mA
g_m	4.2	mA/V
μ_{g1-g2}	6.0	←
r_a	>10	kΩ
V_{g1}	−8.3	V
R_k	0	Ω
V_{g1} (I_a <100μA)	−40	V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	3.7	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	400	mW
$+V_{g1}$ max.	0	V ←
$-V_{g1}$ max.	55	V
I_k max.	50	mA
R_{g1-k} max.	550	kΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	C_k (μF)	V_{h-k} (V)
6.3	110	110	0	270	1000	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	450	420	480	—	—	—	mA
	—	—	—	—	432	468	12.5	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	15	—	—	—	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	0.65	—	0	1.0	—	—	—	μA
Anode current	0.65	30	23	37	—	—	—	mA
	—	—	—	—	27	33	2.8	mA
Anode current $V_{g1} = -40V$, $R_k = 0\Omega$	0.65	—	—	100	—	—	—	μA
Power output $V_{in(r.m.s.)} = 6.4V$, $R_a = 3.0k\Omega$	0.65	—	750	—	—	—	—	mW
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at –300V	2.5	—	50	—	—	—	—	MΩ
g_1-rest, measured at –100V	2.5	—	50	—	—	—	—	MΩ
Change in power output $V_h = 5.7V$, $V_{in(r.m.s.)} = 6.4V$, $R_a = 3.0k\Omega$	2.5	—	—	15	—	—	—	%
Screen-grid current	2.5	—	0	4.0	—	—	—	mA
Mutual conductance	2.5	4.2	3.5	4.9	—	—	—	mA/V
	—	—	—	—	3.85	4.55	0.33	mA/V
Reverse grid current $V_h = 7.5V$, $V_{g1} = -40V$, $R_{g1} = 1.0M\Omega$, $R_k = 0\Omega$. Measured after 5 minutes preheat at $V_h = 7.5V$, $V_{a-e} = V_{g2-e} = 100V$, $R_k = 220\Omega$, $R_{g1} = 470k\Omega$	2.5	—	0	2.0	—	—	—	μA
†A.F. noise at anode, $V_{g2(b)} = 110V$, $V_{g1} = -8.7V$, $R_k = 0\Omega$, $R_{g1} = 500k\Omega$, $R_{g2} = 10k\Omega$, $R_a = 2.0k\Omega$, $C_{g2} = 4.0\mu F$	2.5	—	—	150	—	—	—	mV
Anode impedance	6.5	—	10	—	—	—	—	kΩ
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	5.5	7.5	—	—	—	pF
C_{out}	—	—	6.5	8.5	—	—	—	pF
C_{a-g1}	—	—	—	200	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55±5mm Hg. Voltage = $300V_{r.m.s.}$ No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min. peak acceleration, $R_a = 2.0k\Omega$	2.5	—	—	100	—	—	—	mV (r.m.s.)

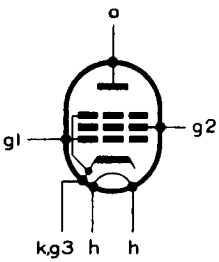
†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

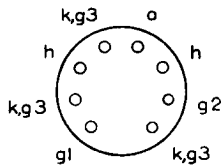
TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B]. 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	—	40	—	—	—	μA
Change in power output		—	—	20	—	—	—	%
Microphonic noise as in group B		—	—	300	—	—	—	mV (r.m.s.)
Shock[15]								
V_{h-k} = 100V (cathode negative), R_{g1} = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	20	—	—	40	—	—	—	μA
Change in power output		—	—	20	—	—	—	%
Microphonic noise as in group B		—	—	300	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

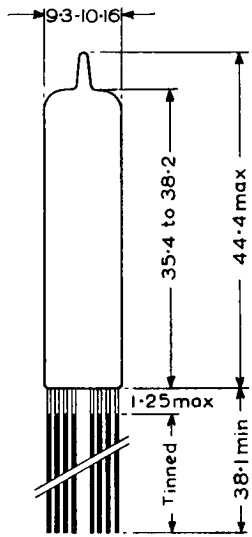
Heater cycling life test								
V_h = 7.0V, 1 minute on, 4 minutes off								
V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Heater cycling life test end point								
Heater-to-cathode leakage current V_{h-k} = ±100V	—	—	—	40	—	—	—	μA
Stability life test[14]								
Running conditions R_{g1} = 470kΩ, R_k = 220Ω, V_a=V_{g2}=100V, V_{h-k}=200V (cathode negative), $T_{ambient}$=Room temperature								
Stability life test end point								
Change in power output after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions R_{g1} = 470kΩ, R_k = 220Ω, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives	0.65	—	—	—	—	—	—	
Power output	1.0	—	650	—	—	—	—	mW
					A.Q.L.[5] (%)	*Min.*	*Max.*	
Intermittent life test								
Running conditions, R_{g1}=470kΩ, R_k=220Ω, V_a=V_{g2}=100V, V_{h-k} = 200V (cathode negative), T_{bulb} min. = 220°C								
Intermittent life test points (500 hours)								
Inoperatives[16]					4.0	—	—	
Heater current					6.5	414	492	mA
Heater-to-cathode leakage current V_{h-k} = ±100V					6.5	—	60	μA
Reverse grid current R_{g1} = 1.0MΩ					4.0	0	2.0	μA
Change in power output (individuals)					4.0	—	20	%
Change in power output V_h = 5.7V					6.5	—	15	%
Insulation as in group B					6.5	25	—	MΩ
Average change in power output					—	—	15	%
Sub-group quality level[10]					10	—	—	

5902 SPECIAL QUALITY OUTPUT PENTODE





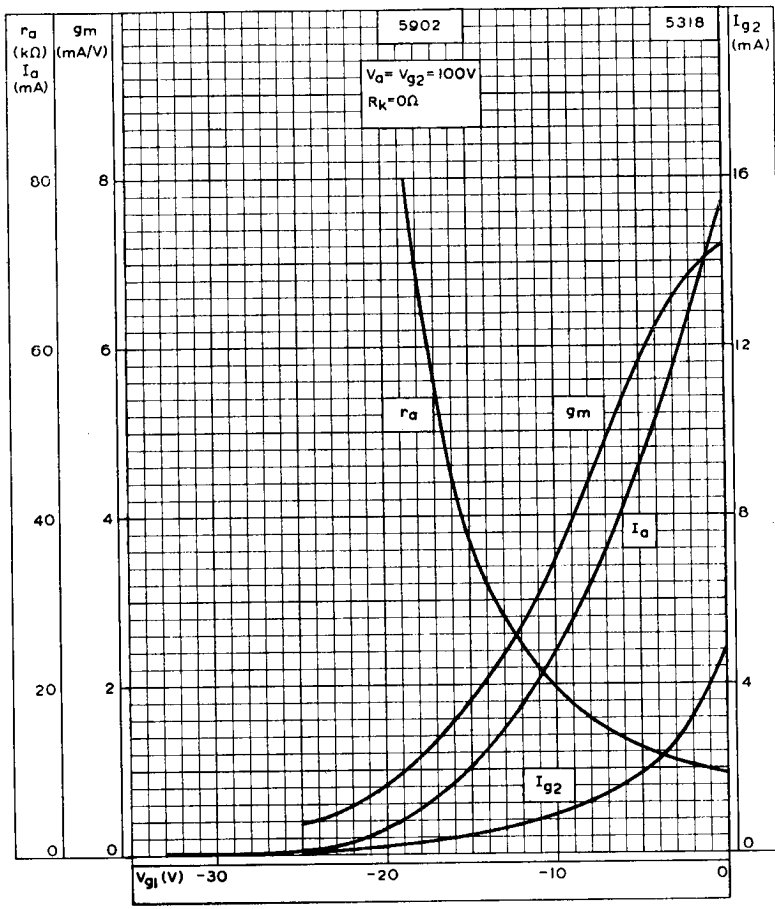
B8D/F Base



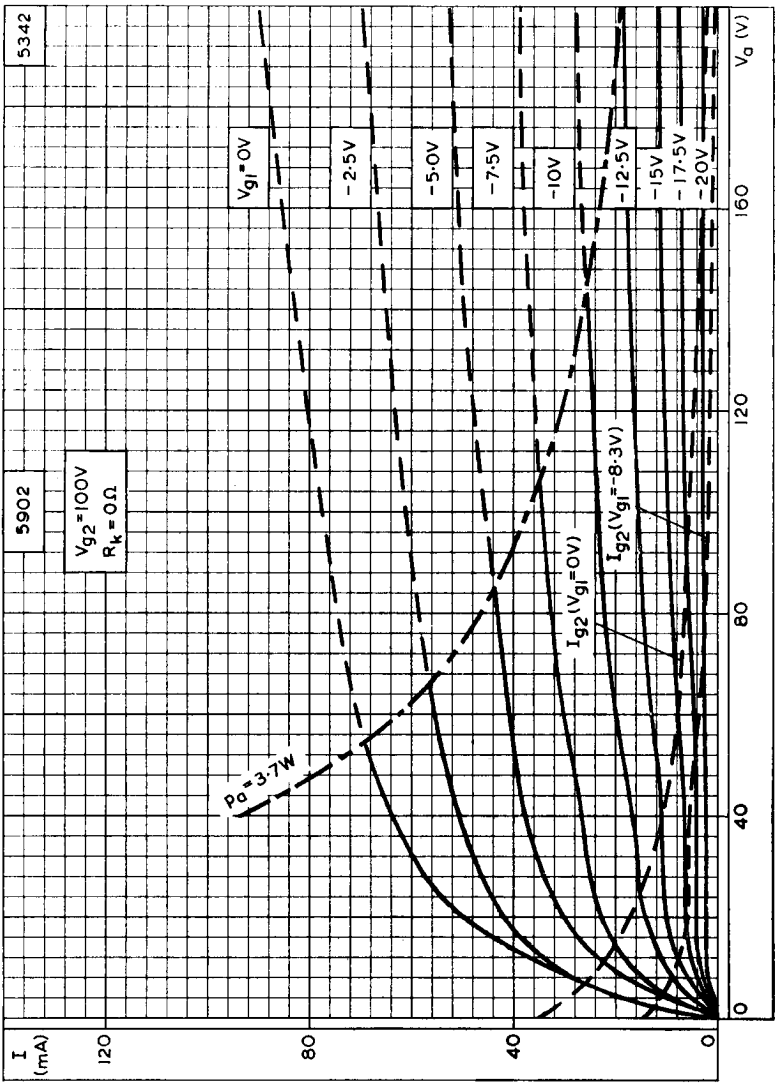
5326

All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, Section B8D/F.



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.

SPECIAL QUALITY R.F. PENTODE

6205

Special quality r.f. pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured with external shield)

c_{a-g1}	<15	mpF
c_{in}	4.2	pF
c_{out}	3.4	pF

CHARACTERISTICS[3]

V_a	100	V
*V_{g3}	0	V
V_{g2}	100	V
V_{g1}	−1.5	V
I_a	7.5	mA
I_{g2}	2.4	mA
g_m	5.0	mA/V
r_a	>175	kΩ
R_k	0	Ω
V_{g1} (I_a < 50μA)	−9.0	V

*The suppressor grid should not be used for control or gating purposes.

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	800	mW
V_{g3} max.	22	V
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	350	mW
+V_{g1} max.	0	V
−V_{g1} max.	55	V
I_k max.	16.5	mA
R_{g1-k} max.	1.1	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

6205

SPECIAL QUALITY R.F. PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g3-k} (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	C_k (μF)	V_{h-k} (V)
6.3	100	0	100	0	150	1000	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	150	140	160	—	—	—	mA
	—	—	—	—	144	156	4.2	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	0.65	—	0	0.3	—	—	—	μA
Anode current	0.65	7.5	5.5	9.5	—	—	—	mA
	—	—	—	—	6.7	8.3	0.8	mA
Anode current $V_{g1} = -9.0V$, $R_k = 0\Omega$	0.65	—	—	50	—	—	—	μA
Screen-grid current	0.65	—	1.5	3.3	—	—	—	mA
Mutual conductance	0.65	5.0	4.2	5.8	—	—	—	mA/V
	—	—	—	—	4.7	5.3	0.31	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at –300V	2.5	—	100	—	—	—	—	MΩ
g_1-rest, measured at –100V	2.5	—	100	—	—	—	—	MΩ
Change in mutual conductance $V_h = 5.7V$	2.5	—	—	10	—	—	—	%
Reverse grid current $V_h = 7.5V$, $V_{g1} = -9.0V$, $R_{g1} = 1.0M\Omega$, $R_k = 0\Omega$. Measured after 5 minutes preheat under standard test conditions, except $V_h = 7.5V$, $R_{g1} = 1.0M\Omega$	2.5	—	0	0.5	—	—	—	μA
†A.F. noise at anode, $V_{g2-e} = 19V$, $R_{g1} = 100k\Omega$ $R_{g2} = 1.0k\Omega$, $R_a = 200k\Omega$	2.5	—	—	70	—	—	—	mV
Anode impedance	6.5	—	175	—	—	—	—	kΩ
Capacitances[2] (shielded) No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.5	4.9	—	—	—	pF
c_{out}	—	—	2.9	3.9	—	—	—	pF
c_{a-g1}	—	—	—	15	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55±5mmHg Voltage = $300V_{r.m.s.}$ No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min. peak acceleration, $R_a = 10k\Omega$	—	—	—	60	—	—	—	mV (r.m.s.)

†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	—	20	—	—	—	μA
Change in mutual conductance	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	200	—	—	—	mV (r.m.s.)
Shock[15]								
V_{h-k} = 100V (cathode negative), R_{g1} = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	20	—	—	20	—	—	—	μA
Change in mutual conductance	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	200	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

Heater cycling life test

V_h = 7.0V 1 minute on, 4 minutes off, 2000 switchings. V_{h-k} = 140$V_{r.m.s.}$ (continuous)

No other applied voltages	2.5	—	—	—	—	—	—	

Stability life[14]

Running conditions: R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature

Stability life end points

								%
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	

Survival rate life test[14]

Running conditions R_{g1}=1.0MΩ, V_{h-k}=200V (cathode negative), $T_{ambient}$=Room temperature

Survival rate life test end points (100 hours)

Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	3.75	—	—	—	—	mA/V

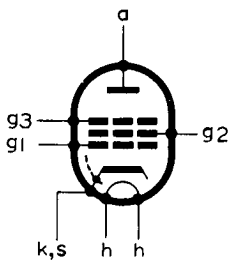
Intermittent life test

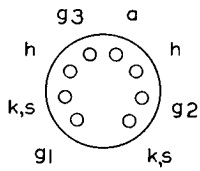
Running conditions: R_{g1} = 1.0MΩ, V_{h-k}=200V (cathode negative), T_{bulb}min.=220°C

Intermittent life test end points(500 hours)	*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Inoperatives[16]	2.5	—	—	
Heater current	4.0	138	164	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	4.0	—	10	μA
Reverse grid current R_{g1} = 1.0MΩ	2.5	0	0.8	μA
Change in mutual conductance (individuals)	2.5	—	20	%
Change in mutual conductance V_h = 5.7V	4.0	—	15	%
Insulation as in group B	4.0	50	—	MΩ
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

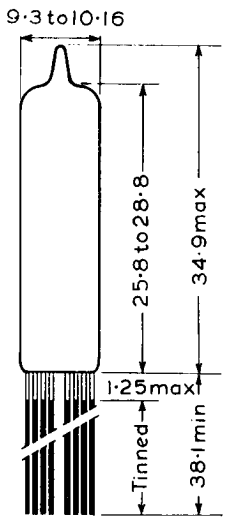
6205

SPECIAL QUALITY R.F. PENTODE





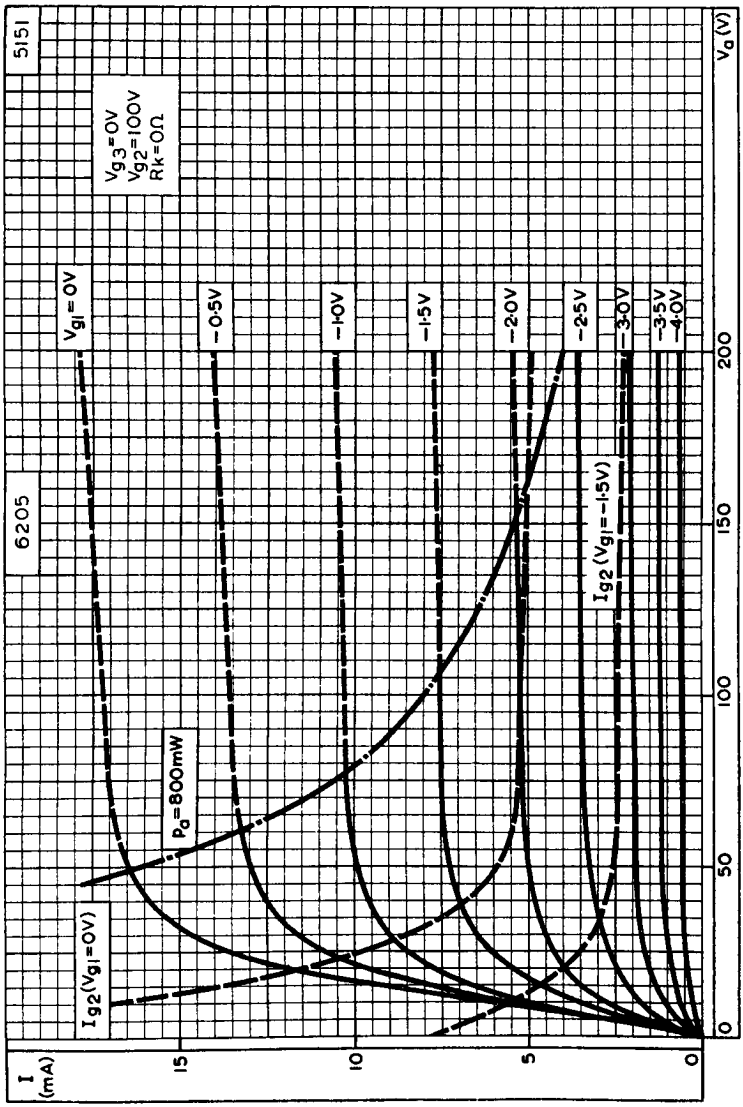
B8D/F Base



5544

All dimensions in mm

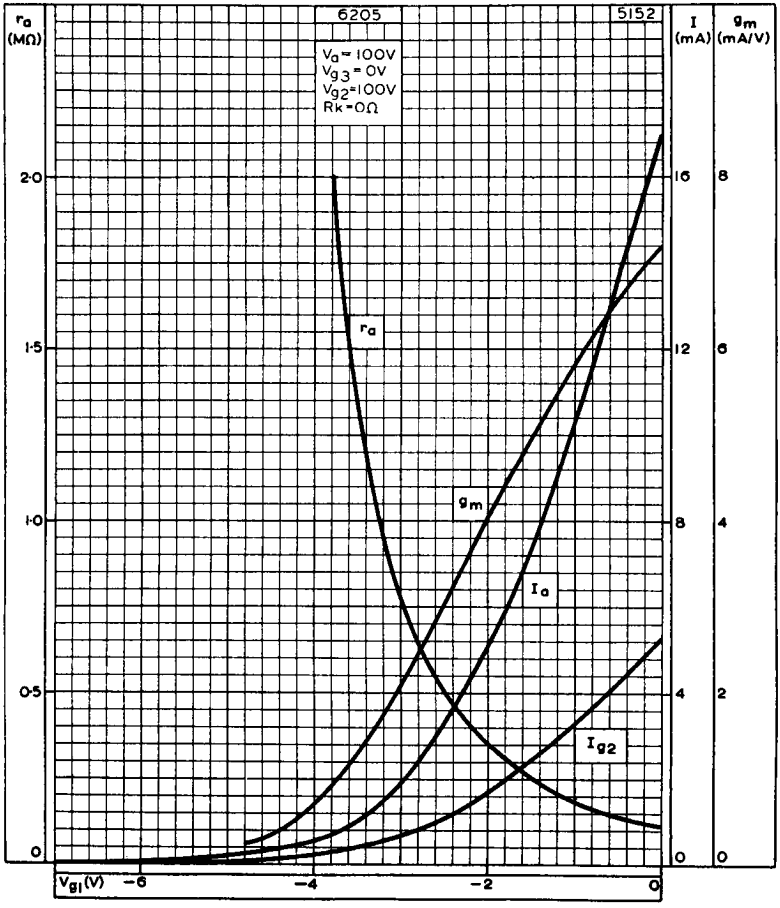
The bulb and base dimensions of this valve are in accordance with BS448, section B8D/F.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

6205

SPECIAL QUALITY R.F. PENTODE



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

SPECIAL QUALITY DOUBLE TRIODE

6211

Special quality double triode, with separate cathodes designed for use in industrial equipment where stability of characteristics and long life are required. This valve will maintain its emission capabilities after long periods of operation under cut-off conditions.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

The heater is centre-tapped and the two sections may be operated in series or in parallel with one another.

Series	V_h applied between pins 4 and 5
Parallel	V_h applied between pin 9 and pins 4 and 5 connected together

	Series	*Parallel*	
V_h[1]	12.6	6.3	V
I_h	150	300	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 15mA$.

In order to achieve a useful valve life with the heater in a series connected chain, the absolute maximum variation of heater current due to voltage fluctuations and tolerances should be $< \pm 1.5\%$.

CAPACITANCES[2] (measured without an external shield)

	Min.	*Av.*	*Max.*	
*C_{a-g}	2.0	2.5	3.0	pF
*C_{in}	2.1	2.6	3.1	pF
$C_{out'}$	250	400	550	mpF
$C_{out''}$	230	350	470	mpF
$C_{a'-a''}$	—	0.9	1.1	pF
$C_{g'-g''}$	—	—	60	mpF
*C_{h-k}	—	2.8	—	pF

*Each section

CHARACTERISTICS[3] (each section)

$V_{a\ k}$	100	V
R_k	470	Ω
I_a	4.6	mA
g_m	3.6	mA/V
r_a	7.8	kΩ
μ	28	

6211 SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	Initial range	End of life*	
Anode Current				
at V_{a-k} = 100V, R_k = 470Ω	4.6	3.6 to 5.6	—	mA
at V_a = 150V, V_g = –10V	—	<100	100	μA
at V_a = 85V, $V_{g(b)}$ = 85V R_g = 425kΩ	16	12 to 20	7.2	mA
Grid current at V_a = 100V, V_g = –2V, R_g = 100kΩ	—	<0.2	1.0	μA
Mutual conductance at V_{a-c} = 100V, R_k = 470Ω	3.6	2.7 to 4.5	1.6	mA/V

INSULATION

	Initial range	End of life*	
Between heater and cathode measured at V_{h-k} = 180V (cathode positive) R_{lim} = 1.0MΩ			
Leakage current	<15	30	μA
Between any two electrodes measured at 300V	>100	20	MΩ

*To allow for valve deterioration during life, circuits should be designed to function with a valve in which one or more of the characteristics have changed to the values stated.

LIMITING VALUES[4] (absolute ratings) each section

$V_{a(b)}$ max.	600	V
V_a max.	200	V
p_a max.	1.5	W
$+V_g$ max.	1.0	V
$-V_g$ max.	100	V
†$-v_{g(pk)}$ max.	200	V
I_g max.	2.0	mA
†$i_{g(pk)}$ max.	50	mA
I_k max.	14	mA
†$i_{k(pk)}$ max.	75	mA
R_{g-k} max. (fixed bias)	200	kΩ
V_{h-k} max. (cathode positive)	180	V
V_{h-k} max. (cathode negative)	90	V
$v_{h-k(pk)}$ max. (cathode negative)	180	V
T_{bulb} max.	120	°C

†Maximum duration = 10μs. Duty cycle = 1%.

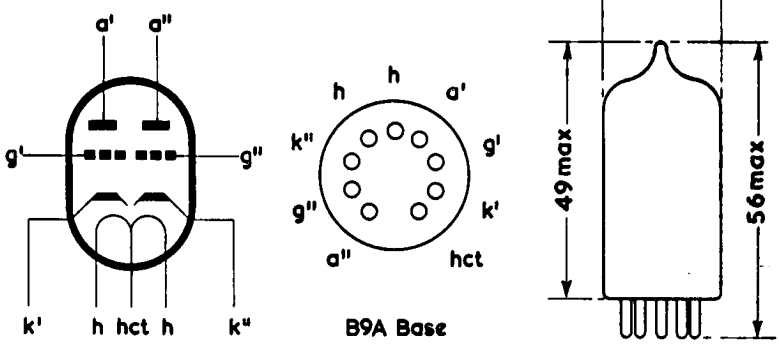
SHOCK AND VIBRATION

The 6211 can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 300g.

OPERATING NOTE

The 6211 will maintain its emission capabilities after long periods of operation under cut-off conditions but it is not intended to be used in circuits critical with regard to hum, microphony or noise.

6922



All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, Section B9A.

TUBE TYPE 6373

The 6373 is a subminiature R.F. output pentode for use in battery-operated equipment.

PHYSICAL SPECIFICATIONS.

Base	8 lead subminiature (B8D)
Bulb	Glass T-3
Maximum bulb length	1 3/4" (44.3 mm.)
Maximum bulb diameter	.400 (10.16 mm.)
Minimum lead length	1 9/32" (32 mm.)
Mounting position	Any

BASING CONNECTIONS (8CP)

Lead 1	Internal connection	5	Filament
2	Grid 1	6	No connection
3	No connection	7	Plate
4	Filament, Grid 3	8	Grid 2

GENERAL ELECTRICAL DATA.

Filament Voltage	1.25 volts
Filament Current	0.11 amps

ELECTRODE CAPACITANCES (Measured with external shield)

Plate to grid	0.1 uuF
Input	3.0 uuF
Output	7.0 uuF

MAXIMUM RATINGS (Design Centre Values)

Plate voltage	150 volts
Plate dissipation	1.0 watt
Grid No. 2 voltage	150 volts
Grid No. 2 dissipation	0.45 watts
Grid No. 1 voltage	-30 volts
Cathode current	13 mamps

OPERATING CHARACTERISTICS

Plate voltage	150 volts
Grid No. 2 voltage	90 volts
Grid No. 1 voltage	-7.5 volts
Plate current	6.5 mamps
Grid No. 2 current	1.4 mamps
Mutual conductance	1,500 micromhos

OPERATING CONDITIONS AS CLASS 'C' R.F. AMPLIFIER AT 100 Mc/s.

Plate voltage	150 volts
Grid No. 2 voltage	110 volts
Grid No. 1 voltage	-22 volts
Plate current	10 mamps
Grid No. 2 current	2.8 mamps
Power output	850 mwatts

MULLARD LIMITED.
Century House.
Shaftesbury Avenue,
LONDON.W.C.2.
ENGLAND

from RTMA release #1223, Aug. 14, 1953

TUBE TYPE 6374

The 6374 is an indirectly heated half wave rectifier primarily intended for operation at high altitudes.

PHYSICAL SPECIFICATIONS.

Base	E9-1 Small button noval 9 pin
Bulb	T6½
Top Cap	Skirted miniature
Maximum overall length	3 3/16"
Maximum seated height	2 15/16"
Maximum diameter	7/8"

BASING CONNECTIONS. (9BW)

Pin No.	1	Internal Connection	6	Internal Connection
	2	Internal Connection	7	Internal Connection
	3	Cathode	8	Internal Connection
	4	Heater	9	Internal Connection
	5	Heater		
Top Cap		Plate		

GENERAL ELECTRICAL DATA.

Heater Voltage	6.3 volts
Heater Current	1.0 amp

MAXIMUM RATINGS (Design Centre)

Plate peak inverse voltage	2,000 volts
Plate current (Plate voltage = 500 V r.m.s.)	150 mamps
Plate current (Plate voltage = 625 V r.m.s.)	125 mamps
Peak plate current	900 mamps
Peak heater to cathode voltage	500 volts

OPERATING CHARACTERISTICS.

Valve voltage drop (Plate current = 150 mamps)	22 volts

TYPICAL OPERATION - 2 VALVES AS FULL WAVE RECTIFIER.

Plate voltage r.m.s.	500-0-500	625-0-625 volts
Plate current (average)	300	250 mamps
Output voltage	500	635 volts
Reservoir condenser (f = 50c/s)	16	16 uF
Limiting resistance (per plate)	150	250 ohms

For 1600c/s operation the same I/V relation would be obtained using a capacitor of 0.5 uF.

MULLARD LIMITED.
Century House,
Shaftesbury Avenue,
LONDON.W.C.2.
ENGLAND

from RTMA release #1223, Aug. 14, 1953

TUBE TYPE 6375

The 6375 is a subminiature R.F. triode for use in battery-operated equipment at frequencies of the order of 500 Mc/s.

PHYSICAL SPECIFICATIONS.

Base	8 lead subminiature (B8D)
Bulb	Glass T-3
Maximum bulb length	1 3/4" (44.3 mm.)
Maximum bulb diameter	0.4" (10.16 mm.)
Minimum lead length	1 9/32" (32 mm.)
Mounting position	Any

BASING CONNECTIONS. 8FA

Lead 1	Grid 1	Lead 5	Filament
2	No connection	6	No connection
3	No connection	7	No connection
4	Filament	8	Plate

GENERAL ELECTRICAL DATA.

Filament voltage	1.25 volts
Filament current	0.2 amps

ELECTRODE CAPACITIES. (Measured with external shield and with pins 2, 3, 6 and 7 left unconnected)

Plate to grid	1.4 uuF
Grid to filament	1.3 uuF
Grid to filament	1.9 uuF

MAXIMUM RATINGS (Design Centre Values)

Plate voltage	150 volts
Plate dissipation	2.4 watts
Cathode current	20 mamps
Grid current	5 mamps

CHARACTERISTICS.

Anode voltage	150 volts
Anode current	12 mamps
Grid voltage	-4.5 volts
Mutual conductance	3,400 micromhos
Amplification factor	14

OPERATING CONDITIONS AS OSCILLATOR AT 500 Mc/s

Plate voltage	150 volts
Cathode current	20 mamps
Power output	450 mwatts

MULLARD LIMITED.
Century House.
Shaftesbury Avenue,
LONDON.W.C.2.
ENGLAND.

from RTMA release #1223, Aug. 14, 1953

TYPE 6391

The 6391 is a subminiature low microphony voltage amplifying pentode.

PHYSICAL SPECIFICATIONS.

Base	Special 8-lead subminiature
Bulb	Glass T-3
Maximum bulb length	1-1/2" (38 mm.)
Maximum bulb diameter	0.4" (10.16 mm.)
Minimum lead length	1-9/32" (32 mm.)
Mounting position	Any

GENERAL ELECTRICAL DATA

Heater Voltage	6.3 volts
Heater Current	0.2 amps

To reduce the possibility of hum the heater should be operated from D.C.

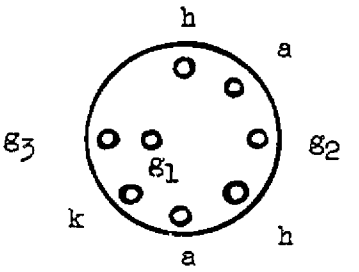
ELECTRODE CAPACITANCES - (Measured with external shield)

Plate to grid	< 0.15 μμF
Input	4 μμF
Output	5 μμF

MAXIMUM RATINGS - (Design Centre Values)

Plate voltage	175 volts
Plate dissipation	1.0 watts
Grid No.2 voltage	175 volts
Grid No.2 dissipation	0.4 watt
Cathode current	10 mamps

BASING



SPECIAL 8-LEAD BASE

CHARACTERISTICS

Plate voltage	100 volts
Grid No. 3 voltage	0 volts
Grid No. 2 voltage	100 volts
Plate current	7.0 mamps
Grid No. 2 current	2.2 mamps
Grid No. 1 voltage	-1.4 volts
Mutual conductance	3,000 micromhos
Anode impedance	180,000 ohms

MULLARD LIMITED, Century House, Shaftesbury Avenue, LONDON.W.C.2., ENGLAND

from RETMA release #1234, Sept. 11, 1953

SPECIAL QUALITY DOUBLE TRIODE

6463

Special quality double triode with separate cathodes designed for use in industrial equipment where stability of characteristics and long life are required. This valve will maintain its emission capabilities after long periods of operation under cut-off conditions.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

Suitable for parallel operation only, a.c. or d.c.
The heater is centre-tapped and the two sections may be operated in series or parallel with one another.

Series — V_h applied between pins 4 and 5

Parallel — V_h applied between pin 9 and pins 4 and 5 connected together.

	Series	*Parallel*	
V_h[1]	12.6	6.3	V
I_h	300	600	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 30mA$

CAPACITANCES[2] (measured without an external shield)

	Min.	*Av.*	*Max.*	
$c_{a'-g'}$	4.6	5.2	5.8	pF
*c_{in}	2.9	3.4	3.9	pF
c_{out}	400	600	800	mpF
*c_{h-k}	—	3.5	—	pF
$c_{a''-g''}$	4.8	5.4	6.0	pF
$c_{out''}$	350	500	650	mpF
$c_{g'-g''}$	—	—	25	mpF
$c_{a'-a''}$	—	0.9	1.2	pF

*Each section

CHARACTERISTICS[3]

V_{a-c}	250	V
R_k	620	Ω
I_a	14.5	mA
g_m	5.2	mA/V
r_a	3.85	kΩ
μ	20	

6463 SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of life**	
Anode current				
at V_a = 100V, I_g = 200μA	29	>24	17	mA
at V_a = 120V, V_g = −2V	21	14 to 28	10	mA
at V_a = 200V, V_g = −15V	—	<1.0	1.0	mA
Grid current				
at V_a = 120V, V_g = −2V, R_g = 100kΩ	—	<0.2	1.0	μA
Mutual conductance				
at V_{a-e} = 250V, R_k = 620Ω	5.2	3.9 to 6.5	—	mA/V

INSULATION

	Initial range	*End of life**	
Between heater and cathode measured at V_{h-k} = 200V (cathode positive) R_{lim} = 1.0MΩ			
Leakage current	<15	20	μA
Between any two electrodes measured at 300V	>100	20	MΩ

*To allow for valve deterioration during life, circuits should be designed to function with a valve in which one or more of the characteristics have changed to the values stated.

LIMITING VALUES[4] (absolute ratings) each section

$V_{a(b)}$ max.	660	V
$v_{a(pk)}$ max.	660	V
V_a max.	330	V
p_a max.	4.4	W
$p_{a'}+p_{a''}$ max.	7.7	W
+V_g max.	1.5	V
†+$v_{g(pk)}$ max.	25	V
−V_g max.	85	V
†−$v_{g(pk)}$ max.	350	V
I_g max.	5.5	mA
†$i_{g(pk)}$ max.	110	mA
I_k max.	31	mA
$i_{k(pk)}$ max.	350	mA
R_{g-k} max. (fixed bias)	500	kΩ
V_{h-k} max. (cathode positive)	200	V
V_{h-k} max. (cathode negative)	100	V
$v_{h-k(pk)}$ max. (cathode negative)	200	V
T_{bulb} max.	180	°C

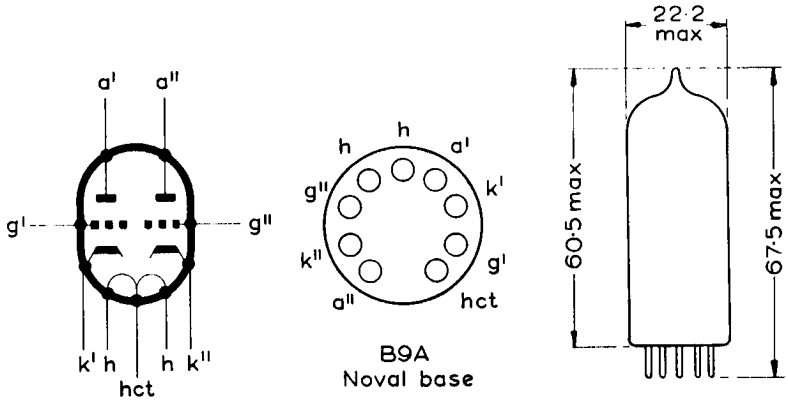
†Maximum duration = 10μs. Duty cycle = 1%

SHOCK AND VIBRATION

The 6463 can withstand vibrations of 2.5g and 25c/s for 96 hours and is proof against impact accelerations of approximately 500g.

OPERATING NOTE

The 6463 will maintain its emission capabilities after long periods of operation under cut-off conditions but is not intended to be used in circuits critical with regard to hum, microphony or noise.



5613 All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, Section B9A.

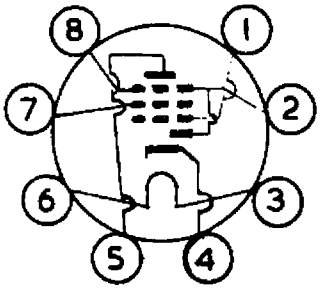
MULLARD LIMITED
Century House,
Shaftesbury Avenue,
London W. C. 2.
England.

The 6487 is a subminiature R. F. Pentode with a short suppressor grid base and having a diode internally connected to the suppressor.

PHYSICAL SPECIFICATIONS

Basing	8FW
Base	8 Lead subminiature (B8D)
Bulb	Glass T-3
Maximum bulb length	1½" (38mm.)
Maximum bulb diameter	0.4" (10.16 mm.)
Minimum lead length	1¼" (31.7 mm.)
Mounting position	Any

BASING DIAGRAM-8FW



BASING CONNECTIONS

Lead No. 1 Grid 1
No. 2 Grid 3
No. 3 Heater
No. 4 Cathode
No. 5 Plate
No. 6 Heater
No. 7 Grid 2
No. 8 Grid 3

GENERAL ELECTRICAL DATA

Heater voltage	6.3 volts
Heater current	0.2 amps

ELECTRODE CAPACITANCES (Measured with external shield)

Plate to grid	<0.02 uuF
Input	4.5 uuF
Output	4.7 uuF

MAXIMUM RATINGS (Design Centre Values unless otherwise specified)

Plate voltage (absolute)	190 volts
Plate dissipation	0.75 watt
Grid No. 2 voltage (absolute)	190 volts
Grid No. 2 dissipation	0.4 watt
Cathode current	10 mamps

CHARACTERISTICS

Plate voltage	100 volts
Grid No. 3 voltage	0 volts
Grid No. 2 voltage	100 volts
Plate current	3.0 mamps
Grid No. 2 current	2.45 mamps
Grid No. 1 voltage	-2.0 volts
Mutual conductance	2,500 micromhos
Anode impedance	100,000 ohms
Amplification factor (ug1-g2)	30

from JETEC release #1311, May 14, 1954

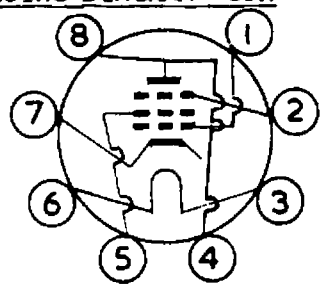
MULLARD LIMITED
Century House,
Shaftesbury Avenue,
London W. C.2.
England

The 6488 is a subminiature High Slope R.F. Pentode.

PHYSICAL SPECIFICATIONS

Basing	8 FX
Base	8 lead subminiature (B8D)
Bulb	Glass T-3
Maximum bulb length	1½" (38 mm)
Maximum bulb diameter	0.4" (10.16 mm.)
Minimum lead length	1¼" (31.7 mm.)
Mounting position	Any

BASING DIAGRAM -8FX



BASING CONNECTIONS

Lead No. 1 Grid 1
No. 2 Grid 3
No. 3 Heater
No. 4 Plate
No. 5 Grid 2
No. 6 Heater
No. 7 Cathode
No. 8 Plate

GENERAL ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current	0.2 Amps

ELECTRODE CAPACITANCES (Measured with external shield)

Plate to grid	<0.15 uuF
Input	4.5 uuF
Output	5.0 uuF

MAXIMUM RATINGS (Design Centre Values unless otherwise specified).

Plate voltage (absolute)	190 volts
Plate dissipation	1.5 watt
Grid No. 2 voltage (absolute)	190 volts
Grid No. 2 dissipation	1.0 watt
Total dissipation (absolute)	2.0 watt
Cathode current	14 mamps

CHARACTERISTICS

Plate voltage	100 volts
Grid No. 3 voltage	0 volts
Grid No. 2 voltage	100 volts
Plate current	7.5 mamps
Grid No. 2 current	2.5 mamps
Grid No. 1 voltage	-2.0 volts
Mutual conductance	5,250 micromhos
Anode impedance	250,000 ohms
Amplification factor (ug1-g2)	28
Grid No. 3 voltage (Plate current 0.1 mamp)	max. -60 volts.

from JETEC release #1311, May 14, 1954

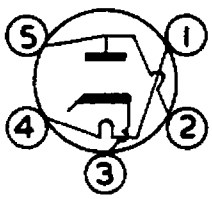
MULLARD LIMITED
Century House,
Shaftesbury Avenue,
Longon, W.C. 2.
ENGLAND

The 6489 is a subminiature single diode.

PHYSICAL SPECIFICATIONS

Base	5 lead subminiature (B5B)
Bulb	Glass
Maximum bulb length	1.12" (28.5 mm.)
Maximum bulb diameter	7/32" (5.4 mm.)
Minimum lead length	1¼" (31.7 mm.)
Mounting position	Any

BASING DIAGRAM



BASING CONNECTIONS

Lead No. 1 Heater
No. 2 Plate
No. 3 Cathode
No. 4 Heater
No. 5 Plate

GENERAL ELECTRICAL DATA

Heater voltage	6.3 volts
Heater current	0.15 amps

ELECTRODE CAPACITANCES (Measured with an external shield)

Plate to all	4.0 uuF
Cathode to all	4.0 uuF

CHARACTERISTICS

D. C. voltage drop (Plate current= 18 mamp) 3.1 volts

LIMITING VALUES (Absolute)

	Plate peak inverse voltage	460 volts
	Plate current	10 mamps
	Peak plate current	60 mamps
*	Heater to cathode voltage	360 volts

* Heater negative

TUBE TYPE 6538

MULLARD LIMITED
Century House,
Shaftesbury Avenue,
LONDON E. C. 2.
ENGLAND

The 6538 is a cold cathode inert gas-filled tube with priming discharge. Primarily intended for use in low current stabilizer circuits and also suitable for use in timers and protection equipment.

PHYSICAL SPECIFICATIONS

Base	Noval 9 pin
Bulb	Glass
Maximum overall length	1 25/32" (45 mm.)
Maximum bulb diameter	7/8" (22.2 mm.)
Basing designation	9EA

BASING CONNECTIONS

Pin 1	Auxiliary cathode
2	Plate
3	Internal connection
4	Auxiliary cathode
5	Trigger

BASING CONNECTIONS

Pin 6	Cathode
7	Cathode
8	Cathode
9	Trigger

CHARACTERISTICS AND RATINGS (Absolute values unless otherwise specified).

	*Minimum plate to cathode breakdown voltage	285 volts
**	‡Maximum mean cathode current	2.5 mamps
	‡Maximum peak cathode current	10 mamps
	Maximum auxiliary cathode current	10 u amps
	Nominal maintaining voltage at 2 mamps	110 volts
‡‡	Trigger voltage for strike	141 to 151 volts

* Vt = 100 volts, Iaux = 2 to 4 microamps
** Averaged over any interval of 15 secs.
‡ The cathode current can be divided in any way between trigger and plate.
‡‡ Va = 260 volts trigger resistance = 68 MΩ

from JETEC release #1359, Oct. 11, 1954

TUBE TYPE 6539

MULLARD LIMITED
Century House,
Shaftesbury Avenue,
LONDON E. C. 2
ENGLAND

The 6539 is a cold cathode inert gas-filled tube with priming discharge. Primarily intended for use in conjunction with Geiger-Muller tubes in radiation monitoring equipment and for use in low current stabilizer circuits.

PHYSICAL SPECIFICATIONS

Base	Noval 9 pin
Bulb	Glass
Maximum overall length	1 25/32" (45 mm.)
Maximum bulb diameter	7/8" (22.2 mm.)
Basing designation	9EB

BASING CONNECTIONS

Pin 1 Plate	Pin 7 Cathode
2 Auxiliary cathode	8 Auxiliary cathode
3 Trigger	9 Trigger
4 Auxiliary cathode	
5 Cathode	
6 Cathode	

CHARACTERISTICS AND RATINGS (Absolute values unless otherwise specified).

*Minimum plate to cathode breakdown voltage	170 volts
**†Maximum mean cathode current	2.5 mamps
†Maximum peak cathode current	10 mamps
**‡Maximum mean auxiliary cathode current	1.0 mamps
†Maximum peak auxiliary cathode current	4.0 mamps
*Nominal maintaining voltage at 2 mamps	105 volts

*$V_a = V_t$ = 170V: Vin (pulse) = 30 volts: P. R. F. = 30 c.p.s.:
**Averaged over any interval of 15 secs.
†The cathode current can be divided in any way between the trigger and plate. It is permissible for the peak current to be 20 mamps provided that the current averaged over any period of 1 msec. does not exceed 10 mamps.
‡The auxiliary cathode current can be divided in any way between trigger and plate.

from JETEC release #1359, Oct. 11, 1954

Mullard Limited, Century House,
Shaftesbury Avenue, London, W.C.2., England

from JETEC release #1480, June 13, 1955

TUBE TYPE 6778

Indirectly heated subminiature triode intended for use as an oscillator at frequencies of the order of 500Mc/s.

PHYSICAL SPECIFICATIONS

Cathode	Coated unipotential
Base	8 lead subminiature (B8D)
Bulb	Glass
Maximum bulb length	1½" (38mm)
Maximum bulb diameter	0.4" (10.16mm)
Minimum lead length	1½" (38mm)
Mounting position	Any

BASING CONNECTIONS (8GU)

Lead	No.1	Grid	No.5	No connection
	No.2	Plate	No.6	Heater
	No.3	Heater	No.7	Cathode
	No.4	Plate	No.8	Plate

GENERAL ELECTRICAL DATA

Heater voltage	6.3 V
Heater current	150 mA

ELECTRODE CAPACITANCES (Measured with external shield)

Plate to Grid	1.9 µµf
Input	1.7 µµf
Output	0.6 µµf

MAXIMUM RATINGS (Design Centre)

Plate supply voltage	300 V
Plate voltage	175 V
Plate dissipation	3.0 W
Cathode current	22 mA
Grid to cathode resistance	0.5 megohms
Heater to cathode voltage	100 V

CHARACTERISTICS

Plate voltage	100 V
Plate current	13 mA
Grid voltage	-2 V
Transconductance	5,500 µmhos
Plate resistance	3,600 ohms
Amplification factor	20

Mullard Limited, Century House,
Shaftesbury Avenue, London, W.C.2., England

from JETEC release #1480, June 13, 1955

TUBE TYPE 6779

Cold cathode inert gas-filled tube with priming discharge and stable trigger striking characteristics. Primarily intended for use in timers and over-voltage protection equipment.

PHYSICAL SPECIFICATIONS

Base	Noval 9 pin
Bulb	Glass
Maximum overall length	1 25/32" (45mm)
Maximum bulb diameter	7/8" (22.2mm)

BASING CONNECTIONS (9EZ)

Pin 1	Plate	6	Priming plate
2	Internal connection	7	Cathode
3	Internal connection	8	Trigger
4	Cathode	9	Trigger
5	Cathode		

CHARACTERISTICS

Nominal trigger breakdown voltage	132 V
Plate working voltage range	170 to 290 V
Nominal maintaining voltage	105 V
Priming current range	2 to 25µA
Recommended priming discharge resistor	10megohm

LIMITING VALUES (Absolute)

Maximum plate voltage at which self-ignition will not occur in any tube	290 V
Minimum triggering capacitance required to ensure breakdown with	
(a) +Va >160V	2,700 µµf
(b) +Va >200V	1,000 µµf
Maximum peak cathode current	25mA
Maximum average cathode current (averaging time 15 secs)	8.0mA
Maximum relay actuating current (max. duration 100 millesec)	60mA
● Maximum peak trigger current	8.0mA
Minimum priming plate breakdown voltage	150 V
Trigger breakdown voltage range (approx.)	128 to 137 V
Maximum increase in trigger breakdown voltage when plate voltage is changed from 290V to 170V	1 %
Stability of trigger ignition voltage during 2000 hours of life (approx.)	±1 %

● With triggering capacities >4,700µµf a limiting resistor of 5,600 ohms is required to limit the peak trigger current.

DATA FOR E.I.A. REGISTRATION

from JEDEC release #2392, Feb. 23, 1959

TUBE TYPE 7432

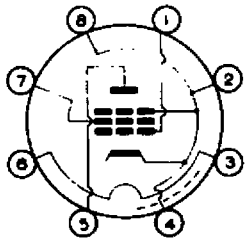
MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON.W.C.1.

The 7432 is a reliable subminiature r.f. pentode for use in guided weapons

PHYSICAL SPECIFICATIONS

Base	8 lead subminiature with flying leads (B8D/F)
Bulb	Glass T-3
Maximum bulb length	1.5" (38.1mm)
Maximum bulb diameter	0.4" (10.16mm)
Minimum lead length	1.5" (38.1mm)

BASING DIAGRAM



8DE

BASING CONNECTIONS

Lead No.1 Grid No.1.
No.2 Cathode, Grid No.3, shield
No.3 Heater
No.4 Cathode, Grid No.3, shield
No.5 Plate
No.6 Heater
No.7 Grid No.2.
No.8 Cathode, Grid No.3, shield

MECHANICAL RATINGS

Maximum shock (short duration)	500	g
*Maximum vibration (100hrs.max.duration)	5	g
(10 minutes max. duration)	20	g
Maximum operating altitude	60,000	ft.
Maximum bulb temperature	165	°C
Ambient storage temperature range	-60to+85	°C

*This rating assumes that the vibration frequency components are varying continuously over the band 10 to 1000 c/s in a random manner.

GENERAL ELECTRICAL DATA

Heater voltage	6.3	V
Heater current	175	mA

ELECTRODE CAPACITANCES (measured with external shield)

Plate to grid	<0.015	pF
Input	4.0	pF
Output	2.5	pF

MAXIMUM RATINGS (absolute values)

Plate supply voltage	350	V
Plate voltage	190	V
Plate dissipation	1.0	W
Grid No.2.supply voltage	350	V
Grid No.2.voltage	190	V
Grid No.2.dissipation	400	mW
Cathode current	12	mA
Heater-cathode voltage	100	V
Grid No.1 circuit resistance (fixed bias)	100	kΩ
(self bias)	500	kΩ

CHARACTERISTICS

Plate voltage	100 V
Grid No.2 voltage	100 V
Plate current	7.0 mA
Grid No.2 current	2.2 mA
Transconductance	5,000 micromhos
Amplification factor (μgl-g2)	36
Grid No.1 voltage	-1.4 V
Grid No.1 voltage (for plate current of <50μA)	-8 V
*Maximum noise output voltage	300 mV (r.m.s.)

*Measured across a plate resistor of 22kΩ with applied vibrational acceleration of 20g in the frequency range 60 to 1000 c/s.

DATA FOR E.I.A. REGISTRATION

from JEDEC release #2392, Feb. 23, 1959

TUBE TYPE 7433

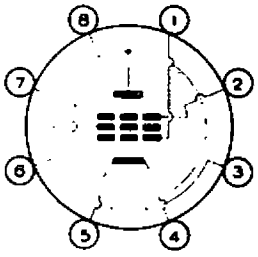
MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON.W.C.1.

The 7433 is a reliable subminiature pentode for use in guided weapons.

PHYSICAL SPECIFICATIONS

Base	8 lead subminiature with flying leads (B8D/F)
Bulb	Glass T-3
Maximum bulb length	1.5" (38.1mm)
Maximum bulb diameter	0.4" (10.16mm)
Minimum lead length	1.5" (38.1mm)

BASING DIAGRAM



8FX

BASING CONNECTIONS

Lead No.1 Grid No.1
No.2 Grid No.3
No.3 Heater
No.4 Plate
No.5 Grid No.2
No.6 Heater
No.7 Cathode
No.8 Plate

MECHANICAL RATINGS

Maximum shock (short duration)	500 g
*Maximum vibration(100hrs.max.duration)	5 g
(10 mins.max.duration)	20 g
Maximum operating altitude	60,000 ft.
Maximum bulb temperature	165 °C
Ambient storage temperature range	-60 to +85 °C

*This rating assumes that the vibration frequency components are varying continuously over the band 10 to 1000 c/s in a random manner.

GENERAL ELECTRICAL DATA

Heater voltage	6.3 V
Heater current	200

ELECTRODE CAPACITANCES (measured with external shield)

Input	5.0 pF
Output	4.5 pF
Plate to grid No.1	<0.015 pF

MAXIMUM RATINGS (absolute values)

Plate supply voltage		350 V
Plate voltage		190 V
Plate dissipation		1.5 W
Grid No.2 supply voltage		350 V
Grid No.2 voltage		190 V
Grid No.2 dissipation		1.0 W
Cathode current		14 mA
Heater-cathode voltage		100 V
Grid No.1 circuit resistance	(fixed bias)	100 kΩ
	(self bias)	500 kΩ

CHARACTERISTICS

Plate voltage	100	V
Grid No.3 voltage	0	V
Grid No.2 voltage	100	V
Grid No.1 voltage	-2	V
Plate current	7.5	mA
Grid No.2 current	2.5	mA
Mutual conductance	5500	micromhos
Amplification factor ($\mu g1-g2$)	28	
*Maximum noise output voltage	300 (r.m.s.)	mV

*Measured across a plate resistor of 22kΩ with applied minimum vibrational acceleration of 20g in the frequency range of 60 c/s to 1000 c/s.

DATA FOR E.I.A. REGISTRATION

TUBE TYPE 7434

from JEDEC release #2392, Feb. 23, 1959

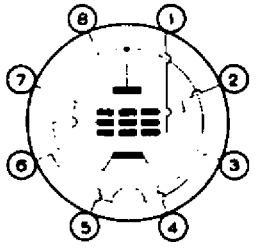
MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON.W.C.1.

The 7434 is a reliable subminiature pentode for use in guided weapons.

PHYSICAL SPECIFICATIONS

Base	8 lead subminiature with flying leads (B8D/F)
Bulb	Glass T-3
Maximum bulb length	1.5" (38.1mm)
Maximum bulb diameter	0.4" (10.16mm)
Minimum lead length	1.5" (38.1mm)

BASING DIAGRAM



8FX

BASING CONNECTIONS

Lead No.1 Grid No.1.
No.2 Grid No.3.
No.3 Heater
No.4 Plate
No.5 Grid No.2.
No.6 Heater
No.7 Cathode
No.8 Plate

MECHANICAL RATINGS

Maximum shock (short duration)	500	g
*Maximum vibration (100hrs. max. duration)	5	g
(10mins.max.duration)	20	g
Maximum operating altitude	60,000	ft.
Maximum bulb temperature	165	°C
Ambient storage temperature range	-60to+85	°C

*This rating assumes that the vibration frequency components are varying continuously over the band 10 to 1000 c/s in a random manner.

GENERAL ELECTRICAL DATA

Heater voltage	6.3	V
Heater current	200	mA

ELECTRODE CAPACITANCES (measured with external shield)

Input	3.8	pF
Output	4.4	pF
Plate to grid No.1	<0.3	pF

MAXIMUM RATINGS (absolute values)

Plate supply voltage	350	V
Plate voltage	190	V
Plate dissipation	1.0	W
Grid No.2 supply voltage	350	V
Grid No.2 voltage	190	V
Grid No.2 dissipation	400	mW
Cathode current	12	mA
Heater - cathode voltage	100	V
Grid No.1 circuit resistance		
(fixed bias)	250	kΩ
(self bias)	1.0	MΩ

CHARACTERISTICS

Plate voltage	100 V
Grid No.3 voltage	0 V
Grid No.2 voltage	100 V
Grid No1 voltage	-1.4 V
Plate current	7.0 mA
Grid No.2 current	2.4 mA
Mutual conductance	3100 micromhos
Amplification factor (μgl-g2)	28
*Maximum noise output voltage	200 mV (r.m.s.)

*Measured across a plate resistor of 22kΩ with applied minimum vibrational acceleration of 20g in the frequency range of 60 to 1000 c/s.

DATA FOR E.I.A. REGISTRATION

TUBE TYPE 7435

from JEDEC release #2392, Feb. 23, 1959

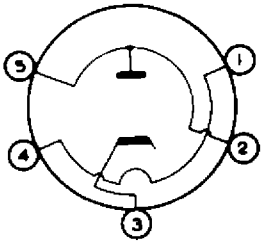
MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON.W.C.1.

The 7435 is a reliable subminiature diode for use in guided weapons.

PHYSICAL SPECIFICATIONS

Base	5 lead subminiature with flying leads (B5B)
Bulb	
Maximum bulb length	1.1" (28.5mm)
Maximum bulb diameter	0.21" (5.4mm)
Minimum lead length	1.5" (38.1mm)

BASING DIAGRAM



5DC

BASING CONNECTIONS

Lead No.1 Heater
No.2 Plate
No.3 Cathode
No.4 Heater
No.5 Plate

MECHANICAL RATINGS

Maximum shock (short duration)	500	g
*Maximum vibration (100hrs.max.duration)	5	g
(10 mins.max. duration)	20	g
Maximum operating altitude	60,000	ft.
Maximum bulb temperature	165	°C
Ambient storage temperature range	-60 to +85	°C

*This rating assumes that the vibration frequency components are varying continuously over the band 10 to 1000 c/s in a random manner.

GENERAL ELECTRICAL DATA

Heater voltage	6.3	V
Heater current	150	mA

ELECTRODE CAPACITANCES (measured with external shield)

Plate to cathode + heater	4.0	pF
Cathode to plate + heater	4.0	pF

MAXIMUM RATINGS (absolute values)

Peak inverse voltage	460	V
R.M.S. input voltage	165	V
Plate current	10	mA
Peak plate current	60	mA
Surge plate current	200	mA
Minimum source impedance	300	Ω
Reservoir capacitor	8	µF
Heater-cathode voltage		
(cathode positive)	300	V
(cathode negative)	100	V

DATA FOR E.I.A. REGISTRATION

TUBE TYPE 7436

from JEDEC release #2392, Feb. 23, 1959

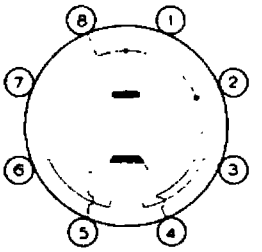
MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON.W.C.1.

The 7436 is a reliable subminiature half-wave rectifier for use in guided weapons.

PHYSICAL SPECIFICATIONS

Base	8 lead subminiature with flying leads (B8D/F)
Bulb	Glass T-3
Maximum bulb length	1.6" (44.4mm)
Maximum bulb diameter	0.4" (10.16mm)
Minimum lead length	1.5" (38.1mm)

BASING DIAGRAM



6CJ

BASING CONNECTIONS

Lead No.1 No connection
No.2 Plate
No.3 Heater
No.4 Plate
No.5 Cathode
No.6 Heater
No.7 No connection
No.8 Plate

MECHANICAL RATINGS.

Maximum shock (short duration)	500 g
*Maximum vibration (100hrs.max.duration)	5 g
(10 minutes max.duration)	20 g
Maximum operating altitude	60,000 ft.
Maximum bulb temperature	200 °C
Ambient storage temperature range	-60to+85 °C

*This rating assumes that the vibration frequency components are varying continuously over the band 10 to 1000 c/s in a random manner.

GENERAL ELECTRICAL DATA

Heater voltage	6.3 V
Heater current	400 mA

MAXIMUM RATINGS (absolute values)

Peak inverse voltage	930 V
Mean anode current	50 mA
Peak anode current	300 mA
Surge anode current	1.1 A
Minimum limiting resistance	300 Ω
Reservoir capacitor	16 µF
Heater-cathode voltage	465 V

TYPICAL OPERATING CONDITIONS

Capacitor Input

R.M.S. input voltage (50c/s)	275 V
Reservoir capacitor	16 µF
Load resistance	5 kΩ
Limiting resistance	300 Ω
Mean output voltage	250 V
Mean output current	50 mA

DATA FOR E.I.A. REGISTRATION

TUBE TYPE 7437

from JEDEC release #2392, Feb. 23, 1959

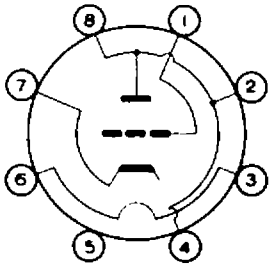
MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON.W.C.1.

The 7437 is a reliable subminiature triode for use in guided weapons.

PHYSICAL SPECIFICATIONS

Base	8 lead subminiature with flying leads (B8D/F)
Bulb	Glass T-3
Maximum bulb length	1.5" (38.1mm)
Maximum bulb diameter	0.4" (10.16mm)
Minimum lead length	1.5" (38.1mm)

BASING DIAGRAM



8JY

BASING CONNECTIONS

Lead No.1 Grid
No.2 Plate
No.3 Heater
No.4 Plate
No.5 No connection
No.6 Heater
No.7 Cathode
No.8 Plate

MECHANICAL RATINGS

Maximum shock (short duration)	500 g
*Maximum vibration (100hrs.max.duration)	5 g
(10 minutes max.duration)	20 g
Maximum operating altitude	60,000 ft.
Maximum bulb temperature	165 °C
Ambient storage temperature range	-60to+85 °C

*The rating assumes that the vibration frequency components are varying continuously over the band 10 to 1000 c/s in a random manner.

GENERAL ELECTRICAL DATA

Heater voltage	6.3 V
Heater current	150 mA

ELECTRODE CAPACITANCES (measured with external shield)

Plate to grid	2.1 pF
Input	2.0 pF
Output	2.8 pF

MAXIMUM RATINGS (absolute values)

Plate supply voltage		350 V
Plate voltage		190 V
Plate dissipation		3 W
Cathode current		20 mA
Heater-cathode voltage		100 V
Grid circuit resistance	(fixed bias)	100 kΩ
	(self bias)	500 kΩ

CHARACTERISTICS

Plate voltage	100 V
Plate current	8.0 mA
Transconductance	4200 micromhos
Amplification factor	20
Grid voltage	-3.0 V
*Maximum noise output voltage	100 mV (r.m.s.)

*Measured across a plate resistor of 22kΩ with applied vibrational acceleration of 20g in the frequency range 60 to 1000 c/s.

DATA FOR E.I.A. REGISTRATION

TUBE TYPE 7438

from JEDEC release #2392, Feb. 23, 1959

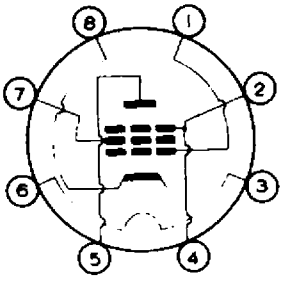
MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON.W.C.1.

The 7438 is a reliable subminiature short suppressor base pentode for use in guided weapons.

PHYSICAL SPECIFICATIONS

Base	8 lead subminiature with flying leads (B8D/F)
Bulb	Glass T-3
Maximum bulb length	1.5" (38.1mm)
Maximum bulb diameter	0.4" (10.16mm)
Minimum lead length	1.5" (38.1mm)

BASING DIAGRAM



8JZ

BASING CONNECTIONS

Lead No.1 Grid No.1
No.2 Grid No.3
No.3 Heater
No.4 Grid No.3
No.5 Plate
No.6 Heater
No.7 Grid No.2
No.8 Cathode

MECHANICAL RATINGS

Maximum shock (short duration)	500 g
*Maximum vibration (100hrs.max.duration)	5 g
(10 minutes max.duration)	20 g
Maximum operating altitude	60,000 ft.
Maximum bulb temperature	165 °C
Ambient storage temperature range	-60to+85 °C

*This rating assumes that the vibration frequency components are varying continuously over the band 10 to 1000 c/s in a random manner.

GENERAL ELECTRICAL DATA

Heater voltage	6.3 V
Heater current	175 mA

ELECTRODE CAPACITANCES (measured with external shield)

Plate to grid No.1	<0.015 pF
Plate to grid No.3	<3.0 pF
Grid No.3 to all electrodes	6.5 pF
Input	4.2 pF
Output	3.1 pF

MAXIMUM RATINGS (absolute values)

Plate supply voltage	350	V
Plate voltage	190	V
Plate dissipation	1.0	W
Grid No.3 voltage (negative)	100	V
(positive)	0	V
Grid No.2 supply voltage	350	V
Grid No.2 voltage	190	V
Grid No.2 dissipation	400	mW
Grid No.1 voltage (negative)	50	V
Cathode current	12	mA
Heater-cathode voltage	100	V
Grid No.1 circuit resistance (fixed bias)	100	kΩ
(self bias)	500	kΩ

CHARACTERISTICS

Plate voltage	100	V
Grid No.3 voltage	0	V
Grid No.2 voltage	100	V
Plate current	3.0	mA
Grid No.2 current	2.25	mA
Transconductance (Grid No.1)	2500	micromhos
*Transconductance (grid No.3)	350	micromhos
Amplification factor (μg1-g2)	34	
Grid No.1, voltage	-2.0	V

*Measured with a grid No.3 bias of -2.0V.

†Maximum noise output voltage 200 mV (r.m.s.)

†Measured across a plate resistor of 22kΩ with applied vibrational acceleration of 20g in the frequency range 60 to 1000 c/s.

DATA FOR E.I.A. REGISTRATION

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON, W.C.1.,
England.

JEDEC TYPE NO. 7632

PHOTOCONDUCTIVE CELL TYPE ORP10

The ORP10 is an indium antimonide photoconductive cell, being sensitive to infra-red radiation at wavelengths up to 7.5 microns at normal room temperature.

PHYSICAL SPECIFICATIONS

Maximum overall length, excluding leads	15/32" (12mm)
Maximum overall width	43/64" (17mm)
Maximum height	1/16" (1.5mm)
Minimum lead length	$1^{7}/16$" (37mm)
Sensitive area	1/4" x 1/64" (6mm x 0.5mm)

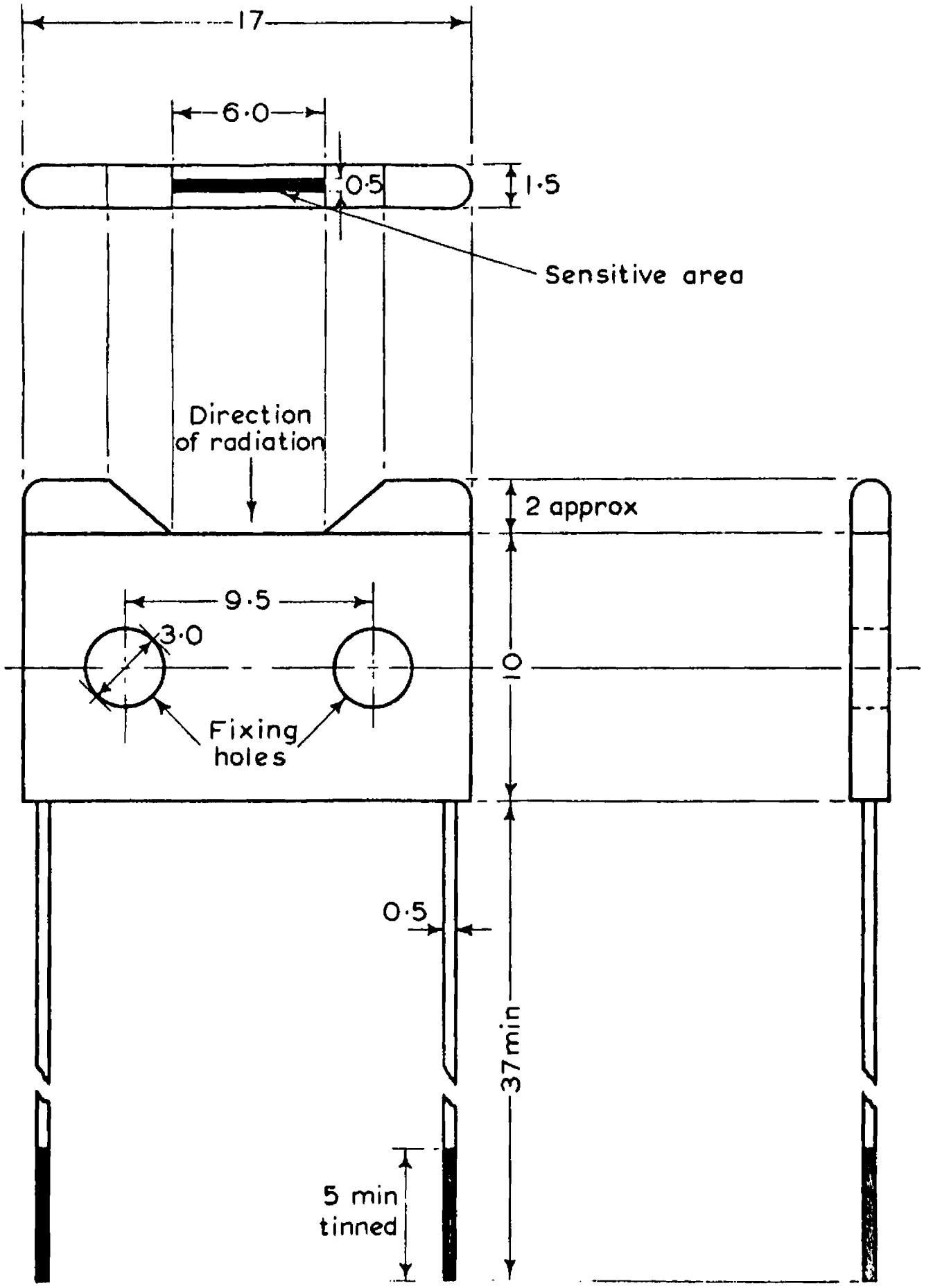
ABSOLUTE MAXIMUM RATINGS

Maximum direct current	100 mAmps
Maximum case temperature	70 °C

CHARACTERISTICS

Peak spectral response	6.0 to 6.5 microns
Spectral response range	Visible to 8.0 microns
Signal to noise ratio at 6 microns	>72
Noise equivalent power at 6 microns in 1c/s bandwidth	$<4 \times 10^{-9}$ Watts
Cell resistance	75 Ohms
Time constant	<1.0 μsec.

from JEDEC release #2680, Dec. 28, 1959


17
6·0
0·5
1·5
Sensitive area
Direction of radiation
2 approx
9·5
3·0
10
Fixing holes
0·5
37 min
5 min tinned

from JEDEC release
#2680, Dec. 28, 1959

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON.W.C.1.,
England.

JEDEC TYPE NO. 7633

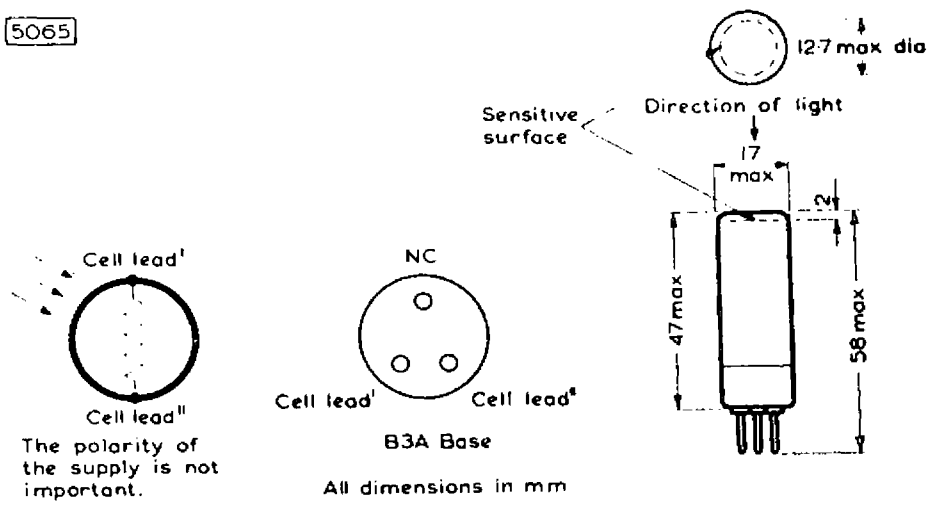
PHOTO CONDUCTIVE CELL TYPE ORP11

The ORP11 is a cadmium-sulphide photoconductive cell with high sensitivity, having maximum response in the red/infra-red region, for use with end-on illumination.

PHYSICAL SPECIFICATION

Maximum overall length	$2^{5}/16$" (58mm)
Maximum seated height	$1^{7}/8$" (47mm)
Maximum diameter	21/32" (17mm)
Sensitive area	0.2 sq. in. (1.25cm^2)
Base	Pee-wee 3 pin
Mounting position	Any

BASING DIAGRAM AND CONNECTIONS



ABSOLUTE MAXIMUM RATINGS

Cell voltage	
Maximum d.c.	100 Volts
Maximum r.m.s.	70 Volts
Cell dissipation	
At 25°C	200 mWatts
At 60°C	200 mWatts
At 70°C	50 mWatts
Ambient temperature range	-40 to +70 °C

CHARACTERISTICS (measured at 25°C)

Cell current at 10V d.c., 5.0 lumens/ft^2, lamp colour temperature = 2700°K.

Minimum	3.0 mAmps
Average	6.0 mAmps
Maximum	14 mAmps

Maximum ultimate dark current at 100V d.c.	5.0 µAmps

DATA FOR E.I.A. REGISTRATION

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON.W.C.1.,
England.

JEDEC TYPE NO. 7634

PHOTOCONDUCTIVE CELL TYPE 61SV

The 61SV is an uncooled lead sulphide photoconductive cell intended for use with a chopped or pulsating radiation, having a high infra-red sensitivity at normal room temperatures.

PHYSICAL SPECIFICATIONS

Maximum overall length	$1\frac{5}{8}$" (41mm)
Maximum seated height	$1\frac{1}{8}$" (28.5mm)
Maximum diameter	7/8" (22mm)
Base	2-pin
Sensitive area	0.06 sq. in. (0.36cm^2)

ABSOLUTE MAXIMUM RATINGS

Maximum applied voltage	250 Volts
Maximum current	500 µAmps
Maximum operating ambient temperature	60°C
Maximum storage temperature	60°C

CHARACTERISTICS

Peak spectral response	2.5 microns
Spectral response range	0.3 to 3.5 microns
Sensitivity	
a) Black body at 200°C	180 µVrms/µW (peak)
Signal to noise ratio	150
Noise equivalent power (bandwidth = 1c/s)	5.0 x 10^{-9} Watts

(Conditions:- 4.9 µWatts of radiation falling on the cell area with 200 Volts applied to the cell and with a 1.0 M ohm load resistor. The interruption frequency of the radiation is 800c/s and the measuring amplifier has a bandwidth of 50c/s).

from JEDEC release #2680, Dec. 28, 1959

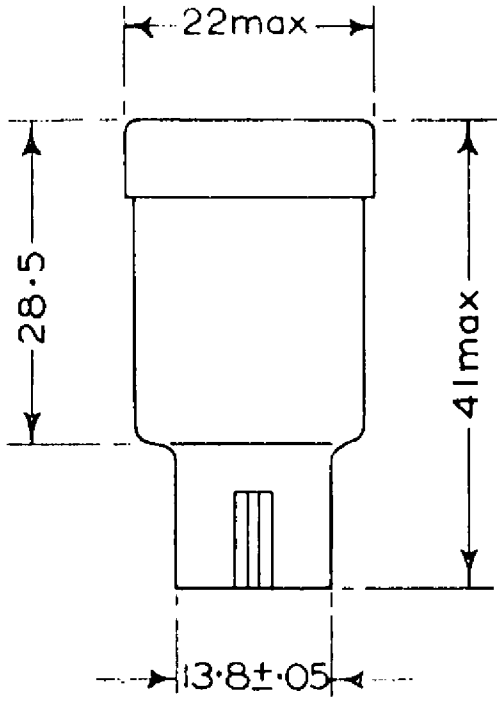
CHARACTERISTICS (continued)

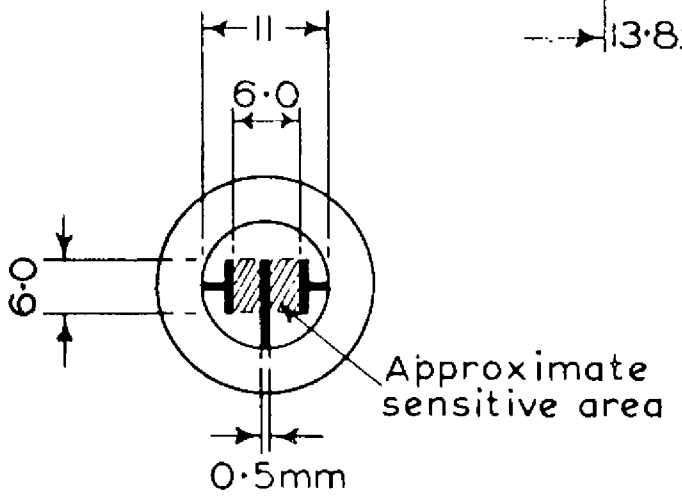
Sensitivity

b) Tungsten light 3.0 mAmps(pk)/lm

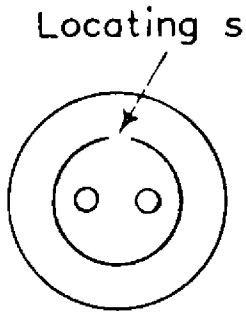
(Conditions:- Chopped light, 0.05 lumens from a lamp at colour temperature 2700°K falling on the cell area, and with 200 Volts applied to the cell).

Cell resistance	1.0 to 4.0 M ohms
Time constant	75 μsec.
Noise equivalent power at 2 ± 0.05 microns	5.5×10^{-11} Watts
Variation of dark resistance with ambient temperature	-2 % per °C





View of window



View of B2B Base

All dimensions in mm

from JEDEC release
#2680, Dec. 28, 1959

DATA FOR E.I.A. REGISTRATION

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON.W.C.1.,
England.

JEDEC TYPE NO. 7635

TUBE TYPE BA9-20

The BA9-20 is a packaged backward wave oscillator for amplitude pulse or frequency modulation operation in the frequency range of 7.0 to 11.5 Gc/s with a power output of 20 to 180 mWatts.

MECHANICAL INFORMATION

Base	Medium shell giant 7 pin with bayonet J.E.T.E.C. A7-17
Envelope	Metal
Maximum overall length	10.275" (261mm)
Maximum overall diameter	3.9" (86.1mm)
Cathode	Indirectly heated
Mounting position	Any
Cooling	Natural

HEATER RATINGS

Heater voltage	6.3 Volts
Heater current	1.7 Amps
Heater warm-up time	60 Seconds

MAXIMUM RATINGS (absolute values)

Maximum delay structure voltage	1.4 kVolts
Minimum delay structure voltage	250 Volts
Maximum cathode current	28 mAmps
Maximum anode voltage	500 Volts
Maximum anode current	10 mAmps
Maximum positive grid voltage	0 Volts
Minimum distance from ferrous bodies	9 inches

CHARACTERISTICS

	Min.	Max.	
Frequency electronically tunable over the range	7.0	11.5	Gc/s
Sensitivity over frequency band	2	10	Mc/s per Volt
Power output over frequency band	20	180	mWatts
Grid voltage for maximum output	-	0	Volts
Grid voltage for zero output	—	-100	Volts
Grid power for amplitude modulation	-	0	Watts

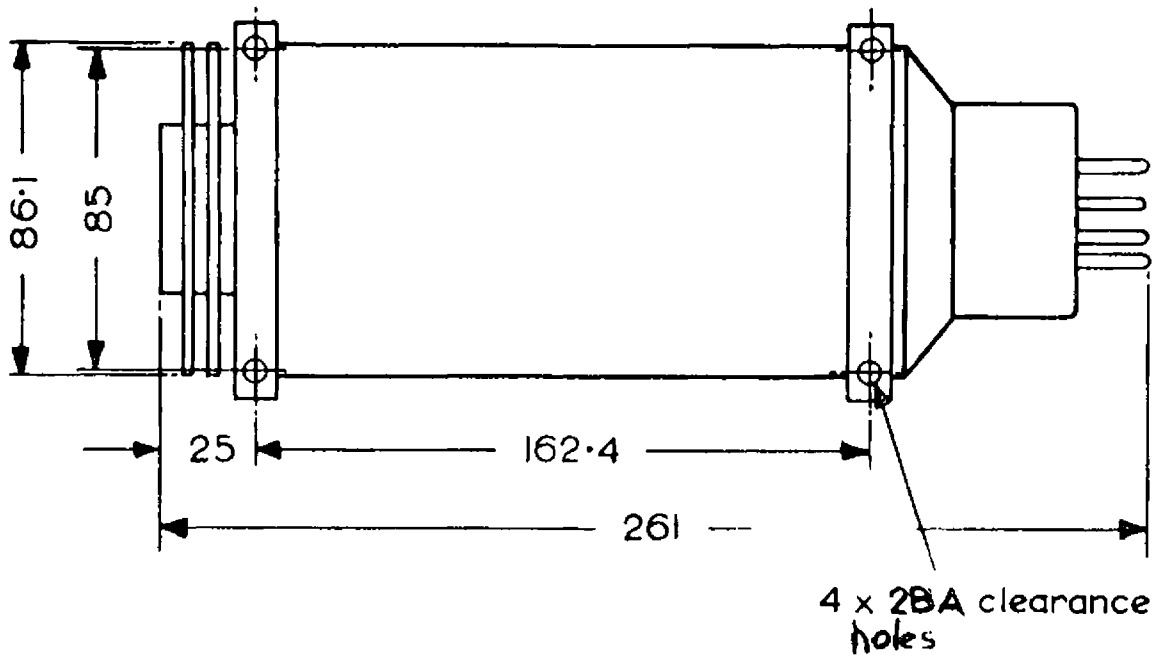
OPERATING CONDITIONS

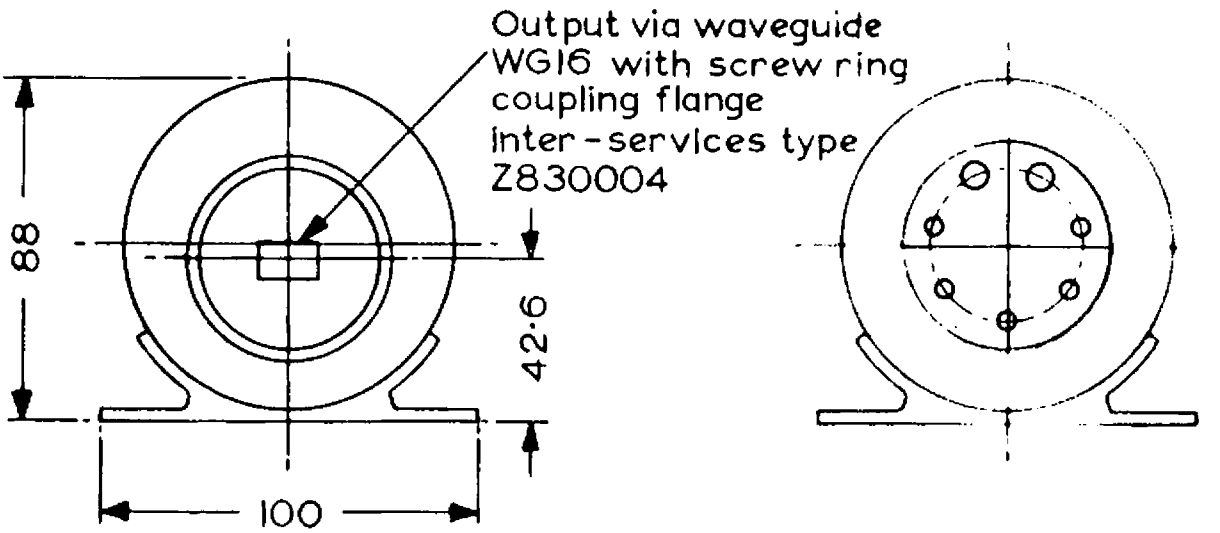
Frequency	8.0	9.4	11	Gc/s
Delay structure voltage	390	630	1,090	Volts
Delay structure current	20	21	22	mAmps
Anode voltage	350	350	350	Volts
Anode current	5	5	5	mAmps
Grid voltage	0	0	0	Volts
Power output	52	100	120	mWatts

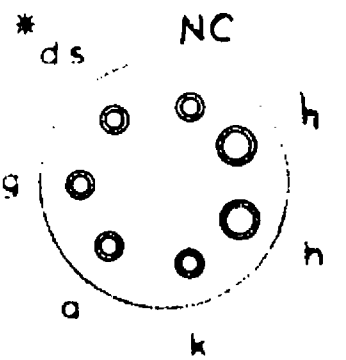
OPERATING NOTE

Electrode supplies must be connected in the following order and disconnected in the reverse order:-

1	2	3	4
heater	grid	delay structure	anode







*delay structure

All dimensions in mm

B7D base

from JEDEC release
#2680, Dec. 28, 1959

MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON, W.C.1.,
England.

JEDEC TYPE NO. 7636

TUBE TYPE BA16-10

The BA16-10 is a packaged backward wave oscillator for amplitude pulse or frequency modulation operation in the frequency range of 11 to 18 Gc/s with a power output of 10 to 70 mWatts.

MECHANICAL INFORMATION

Base	Medium shell giant 7 pin with bayonet J.E.T.E.C. A7-17
Envelope	Metal
Maximum overall length	10" (255mm)
Maximum overall diameter	4.33" (110mm)
Cathode	Indirectly heated
Mounting position	Any
Cooling	Natural

HEATER RATINGS

Heater voltage	6.3 Volts
Heater current	1.0 Amps
Heater warm-uptime	60 Seconds

MAXIMUM RATINGS (absolute values)

Maximum delay structure voltage	2.5 kVolts
Minimum delay structure voltage	500 Volts
Maximum cathode current	13 mAmps
Maximum anode voltage	500 Volts
Maximum anode current	2 mAmps
Maximum positive grid voltage	0 Volts
Minimum distance from ferrous bodies	9 inches

CHARACTERISTICS

	Min.	Max.	
Frequency electronically tunable over the range	11	18	Gc/s
Sensitivity over frequency band	2	9	Mc/s per Volt
Power output over frequency band	10	70	mWatts
Grid voltage for maximum output		0	Volts
Grid voltage for zero output		-100	Volts
Grid power for amplitude modulation		0	Watts

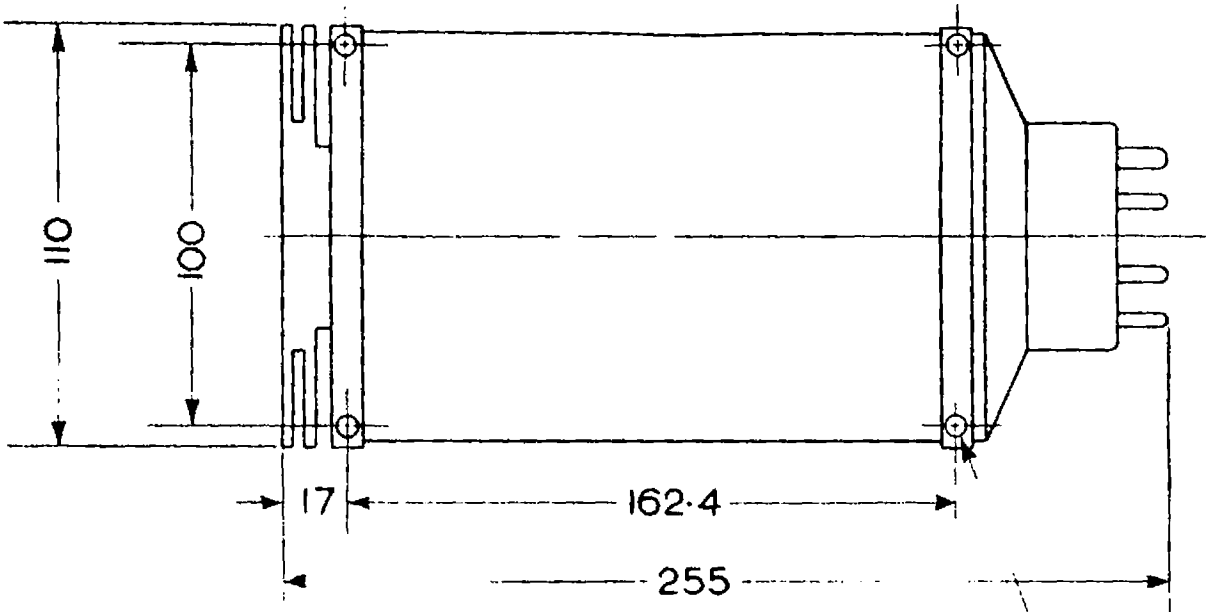
OPERATING CONDITIONS

Frequency	12	15	17.5	Gc/s
Delay structure voltage	0.7	1.3	2.1	kVolts
Delay structure current	12	12	12	mAmps
Anode voltage	330	330	330	Volts
Anode current	1	1	1	mAmp
Grid voltage	0	0	0	Volts
Power output	20	45	35	mWatts

OPERATING NOTE

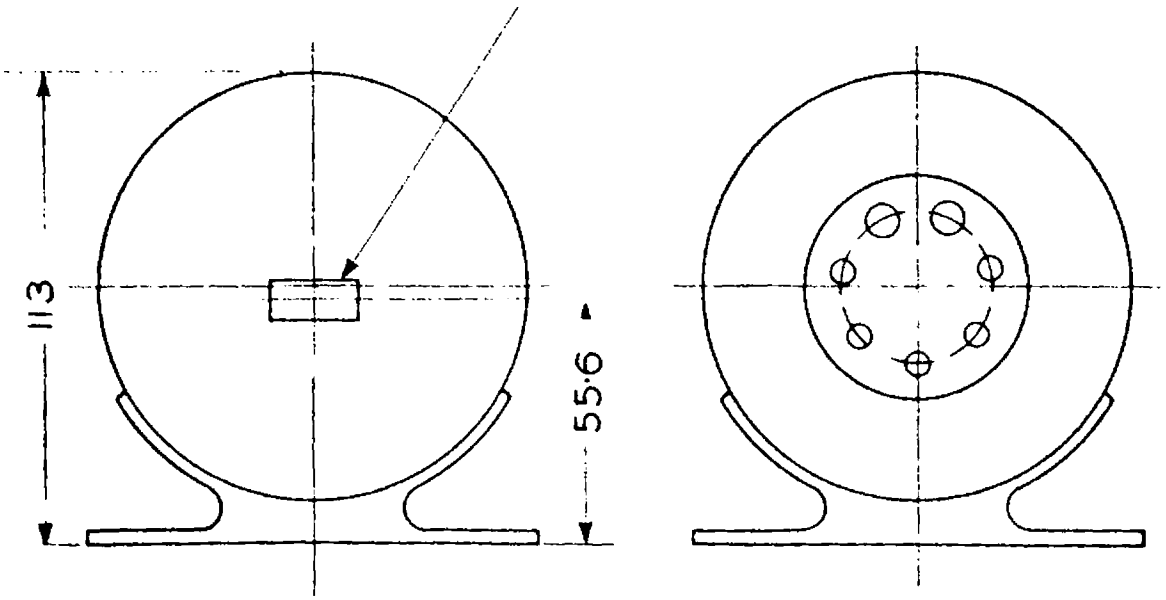
Electrode supplies must be connected in the following order and disconnected in the reverse order:-

1	2	3	4
heater	grid	delay structure	anode

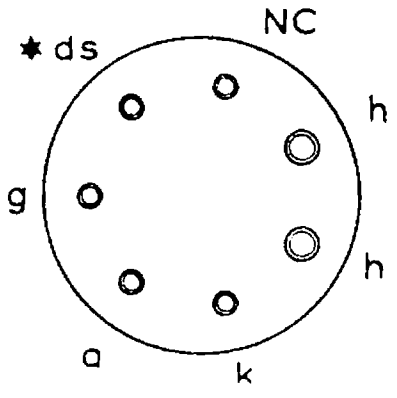


Output via waveguide WG18 with bolted flange inter-services type Z830030

4 x 2BA clearance holes



All dimensions in mm



★ delay structure

from JEDEC release
#2680, Dec. 28, 1959

DATA FOR E.I.A. REGISTRATION

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON.W.C.1.,
England.

JEDEC TYPE NO. 7637

TUBE TYPE LA4-250

The LA4-250 is a travelling wave tube of unpackaged construction intended for operation as an intermediate amplifier in the 4Gc/s band.

MECHANICAL INFORMATION

Envelope	Glass
Maximum overall length	18.86" (479mm)
Maximum overall diameter	1.26" (32mm)
Base	Terminal connector
Cathode	Indirectly heated
Mounting position	Any

HEATER RATINGS

Heater voltage	6.3 Volts
Heater current	750 mAmps

MAXIMUM RATINGS (absolute values)

Maximum anode 1 voltage	500 Volts
Maximum anode 2 voltage	1.6 kVolts
Maximum anode 1 current	50 µAmps
Maximum anode 2 current	100 µAmps
Maximum helix voltage	1.5 kVolts
Maximum helix current	500 µAmps
Maximum heater-cathode voltage	50 Volts
Maximum collector voltage	1.5 kVolts
Maximum collector current	5.0 mAmps
Maximum collector dissipation	7.5 Watts
Maximum input signal	1.0 Watt

CHARACTERISTICS	Min.	Max.	
Frequency band	3.6	4.2	Gc/s
Minimum gain (low power level)	30	-	dB
Noise factor	-	25	dB
Saturation power output	200	-	mWatts
Attenuation (cathode current = 0 mAmps)	50	-	dB

OPERATING CONDITIONS

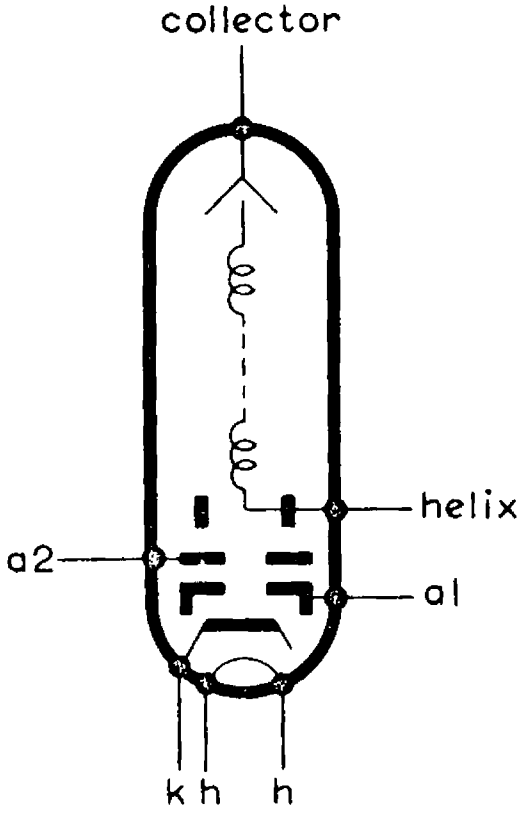
As an intermediate amplifier using a periodic permanent magnet system of approved design.

Frequency	3.9 Gc/s
Anode 1 voltage	200 Volts
Anode 2 voltage	1.2 kVolts (1.0 to 1.5)
Helix voltage	1.2 kVolts
Collector voltage	1.25 kVolts
Collector current	3.5 mAmps
Gain	31 dB
Noise factor	24 dB
Power output	30 mWatts
Input match in recommended mount with matching device adjusted	
At 3.9 Gc/s v.s.w.r.	1.02
At ±15 Mc/s about 3.9 Gc/s v.s.w.r.	1.10
Output match in recommended mount with matching device adjusted	
At 3.9 Gc/s v.s.w.r.	1.02
At ±15 Mc/s about 3.9 Gc/s v.s.w.r.	1.10

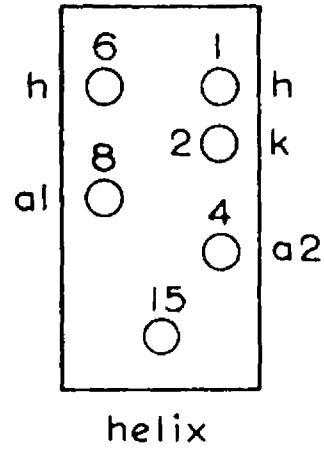
DIMENSIONS

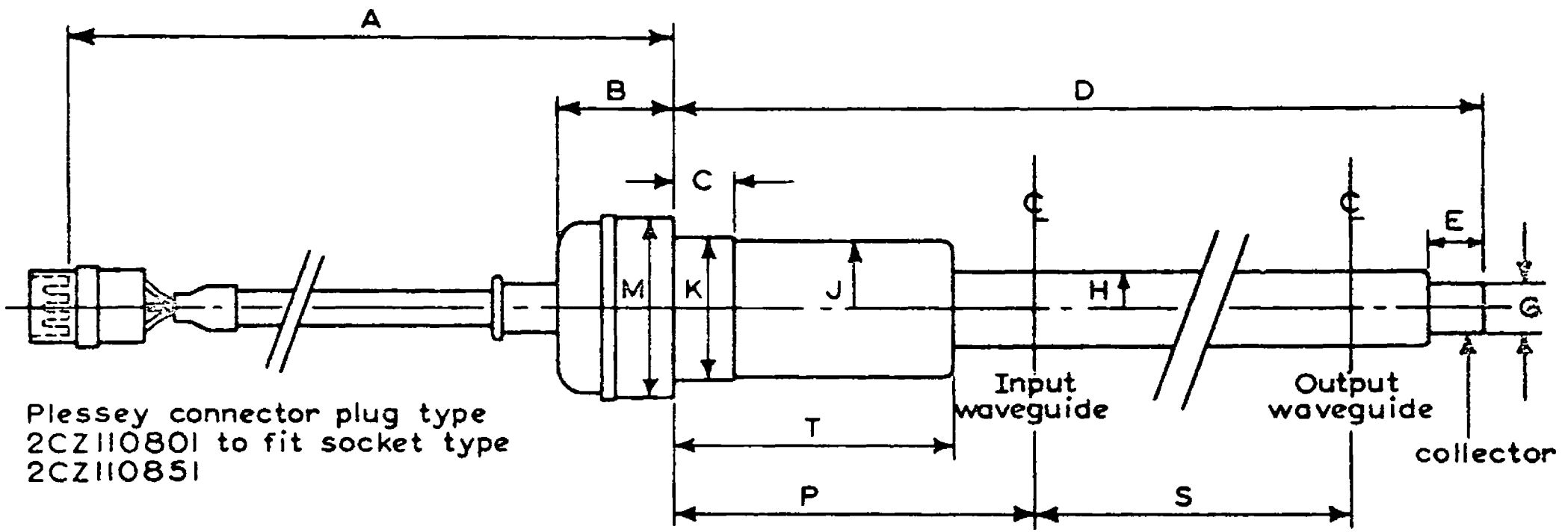
Waveguide dimensions 2.372 x 0.197 inches, 60.25 x 5.00mm.

	Inches	Millimetres	
A	4.331	110	min.
B	1.299	33	max.
C	0.650	16.5	max.
D	14.528	369	max.
E	0.906 ± 0.004	23 ± 0.1	
G	0.276 ± 0.004	7.0 ± 0.1	
H	0.150	3.8	max.
J	0.465	11.8	max.
K	1.063	27	max.
M	1.260	32	max.
P	3.071 ± 0.008	78 ± 0.2	
S	9.445 ± 0.004	239.9 ± 0.1	
T	2.051	52.1	max.



Connections viewed looking at plug




A
B
D
C
M
K
J
H
E
G
T
P
S
Input waveguide
Output waveguide
collector
Plessey connector plug type 2CZ110801 to fit socket type 2CZ110851

from JEDEC release
#2680, Dec. 28, 1959

MULLARD LIMITED
Mullard House,
Torrington Place,
LONDON.W.C.1.,
England.

JEDEC TYPE NO. 7638

TUBE TYPE LA9-3

The LA9-3 ia a travelling wave tube of unpackaged construction for use as a broadband low power amplifier in the 7 to 11.5 Gc/s. band.

MECHANICAL INFORMATION

Base	Terminal connector
Envelope	Glass
Maximum overall length	16.97" (426mm)
Maximum overall diameter	1.26" (32mm)
Cathode	Indirectly heated
Mounting position	Any

HEATER RATINGS

Heater voltage	6.3 Volts
Heater current	500 mAmps

MAXIMUM RATINGS (absolute values)

Maximum anode 1 voltage	200 Volts
Maximum anode 2 voltage	400 Volts
Maximum anode 1 current	10 µAmps
Maximum anode 2 current	10 µAmps
Maximum helix voltage	1.4 kVolts
Maximum helix current	50 µAmps
Maximum focus electrode voltage	-100 Volts
Maximum focus electrode current	10 µAmps
Maximum collector voltage	1.5 kVolts
Maximum collector current	600 µAmps
Maximum collector dissipation	900 mWatts
Maximum input signal	500 mWatts
Maximum heater cathode voltage	50 Volts

CHARACTERISTICS	Min.	Max.	
Frequency band	7.0	11.5	Gc/s
Gain (low power level)	20	-	dB
Noise factor	-	25	dB
Saturation power output	-	6.0	mWatts
Attenuation (cathode current = 0mA)	-	40	dB

OPERATING CONDITIONS

As an input amplifier using a periodic permanent magnet system of approved design.

Frequency	9 Gc/s
Focus electrode voltage	-70 Volts
Anode 1 voltage	155 Volts
Anode 2 voltage	135 Volts
Helix voltage	1.25 kVolts
Collector voltage	1.35 kVolts
Collector current	550 µAmps
Gain[1]	27 dB
Noise factor (broadband)	23 dB
Power output	50 µWatts
Input match in recommended mount v.s.w.r.	3.0
Output match in recommended mount v.s.w.r.	3.0

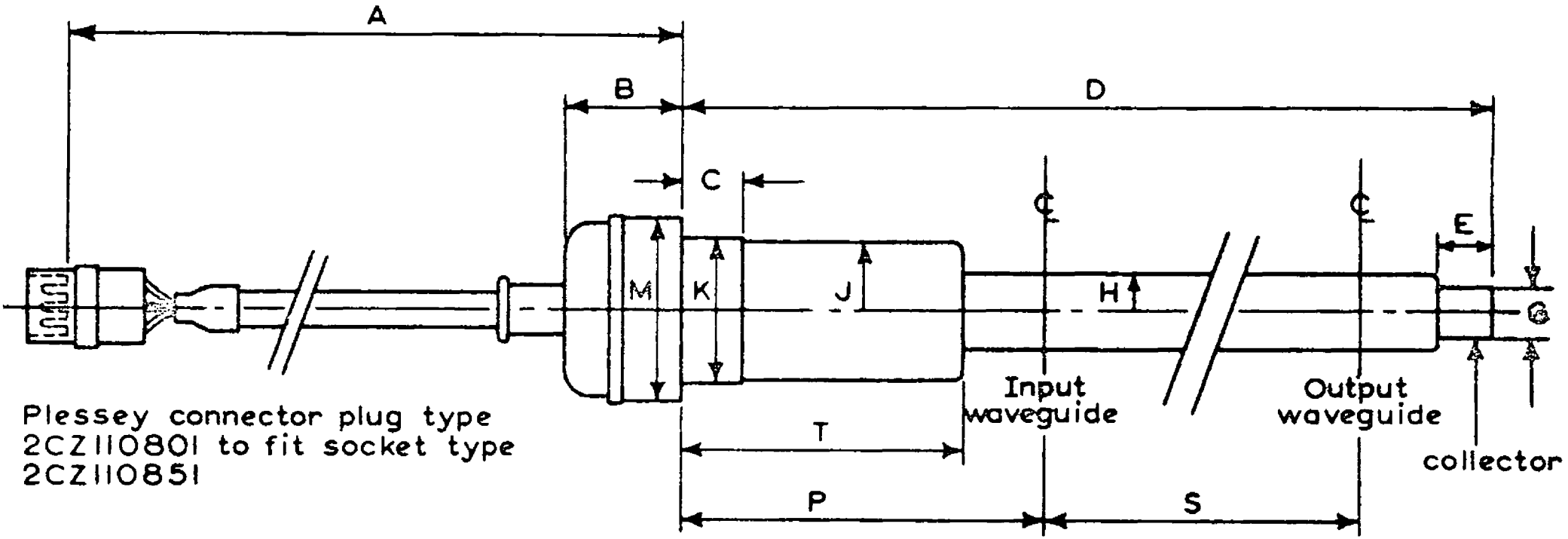
NOTE

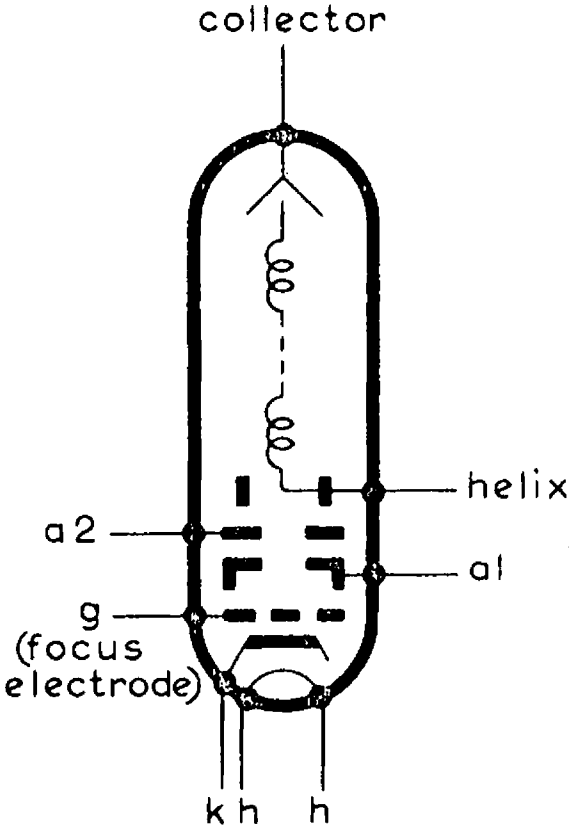
Using a solenoid of approved design, up to 5dB improvement in noise factor can be obtained.

DIMENSIONS

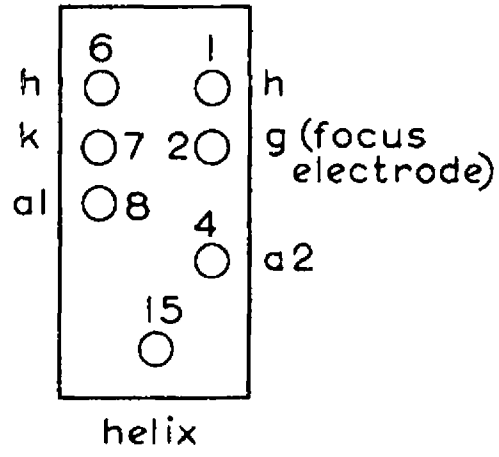
Waveguide dimensions 0.900 x 0.079inches, 22.86 x 2.00mm.

	Inches	Millimetres	
A	4.331	110	min.
B	1.299	33	max.
C	0.650	16.5	max.
D	12.638	316	max.
E	0.394 ± 0.004	10	min.
G	0.167 ± 0.002	5.0 ± 0.05	
H	0.125	3.17	max.
J	0.441	12	max.
K	1.063	27	max.
M	1.260	32	max.
P	2.835 ± 0.008	72 ± 0.2	
S	8.150 ± 0.004	207 ± 0.1	
T	2.265	57.5	max.


A
B
D
C
E
M
K
J
H
G
T
P
S
Input waveguide
Output waveguide
collector
Plessey connector plug type 2CZ110801 to fit socket type 2CZ110851



Connections viewed looking at plug



from JEDEC release
#2680, Dec. 28, 1959

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON.W.C.1.,
England.

JEDEC TYPE NO. 7639

TUBE TYPE LA16-2

The LA16-2 is a travelling wave tube of unpackaged construction for use as a low power, broadband amplifier in the band 11.5 to 18 Gc/s.

MECHANICAL INFORMATION

Base	Terminal connector
Envelope	Glass
Maximum overall length	16.93" (430mm)
Maximum overall diameter	1.259" (32mm)
Cathode	Indirectly heated
Mounting position	Any

HEATER RATINGS

Heater voltage	6.3 Volts
Heater current	400 mAmps

When the minimum noise factor is required the heater voltage specified with the tube should be used. The required heater voltage will lie in the range 6.0 to 9.0V and should be set to $\pm$250mV of the value stated.

MAXIMUM RATINGS (absolute values)

Maximum collector voltage	1.85 kVolts
Maximum collector current	450 µAmps
Maximum collector dissipation	800 mWatts
Maximum helix voltage	1.75 kVolts
Maximum helix current	45 µAmps
Maximum anode 2 voltage	200 Volts
Maximum anode 2 current	20 µAmps
Maximum anode 1 voltage	350 Volts
Maximum anode 1 current	20 µAmps
Maximum focus electrode voltage	-120 Volts
Maximum focus electrode current	10 µAmps
Maximum input signal	300 mWatts
Maximum heater-cathode voltage	50 Volts

CHARACTERISTICS	Min.	Max.	
Frequency band	11.5	18	Gc/s
Gain (low power level)	20	–	dB
Noise factor	–	28	dB
Saturation power output	3.0	–	mWatts
Attenuation (at cathode current = 0mA)	40	–	dB

OPERATING CONDITIONS

As an input amplifier using a periodic permanent magnet system of approved design.

Frequency	15 Gc/s
Collector voltage	1.7 kVolts
Helix voltage	1.6 kVolts
Anode 2 voltage	150 Volts
Anode 1 voltage	320 Volts
Focus electrode voltage	-100 Volts
Collector current	350 µAmps
Gain	22 dB
*Noise factor (broadband)	26 dB
Power output	10 µWatts

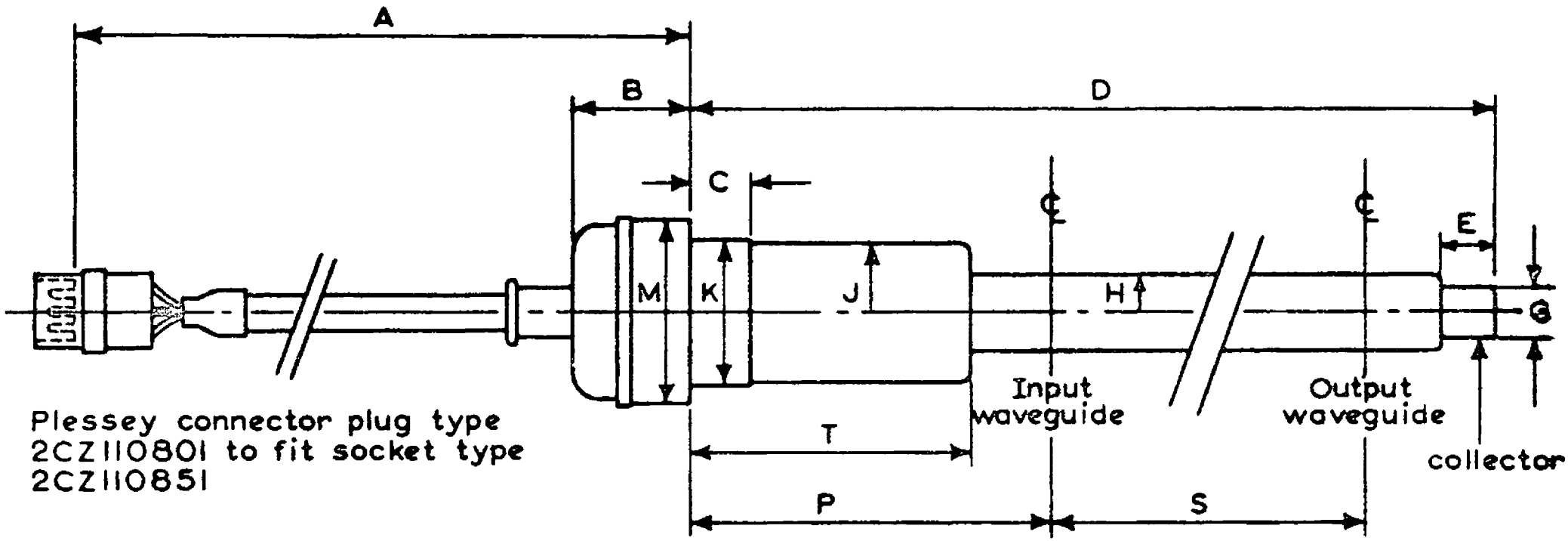
NOTE

*Using a solenoid of approved design, up to 6 dB improvement in noise factor can be obtained.

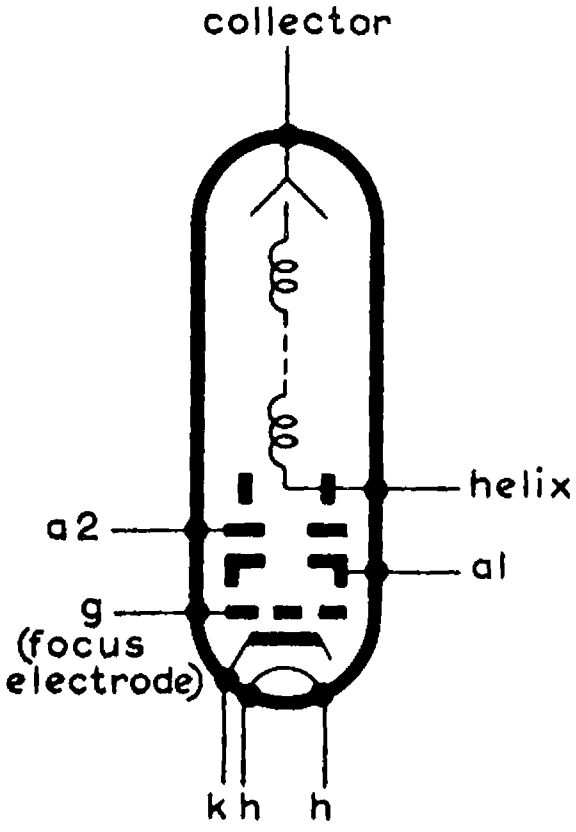
DIMENSIONS

Waveguide dimensions 0.622 x 0.311ins. 15.78 x 7.90mm.

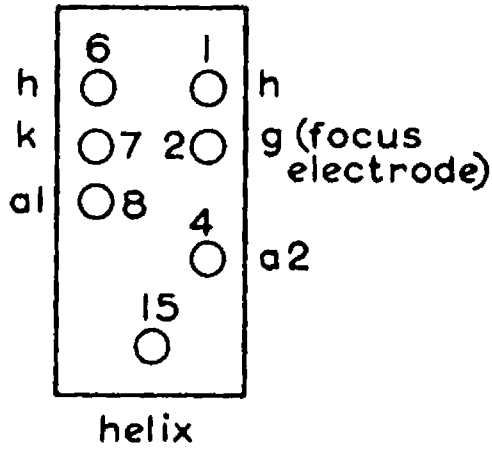
	Inches	Millimetres	
A	4.331	110	min.
B	1.299	33	max.
C	0.650	16.5	max.
D	12.598	320	max.
E	0.394	10	min.
G	0.081	2.05	max.
H	0.108	2.75	max.
J	0.472	12	max.
K	1.063	27	max.
M	1.259	32	max.
P	2.614 ± 0.008	66.5 ± 0.2	
S	8.130 ± 0.004	206.5 ± 0.1	
T	1.898	48.2	max.



Plessey connector plug type 2CZ110801 to fit socket type 2CZ110851



Connections viewed looking at plug



JEDEC TYPE NO. 7980
MULLARD TYPE NO. 83A1

DATA FOR E.I.A. REGISTRATION

MULLARD LIMITED,
Mullard House,
Torrington Place,
L O N D O N, W.C.1.
ENGLAND.

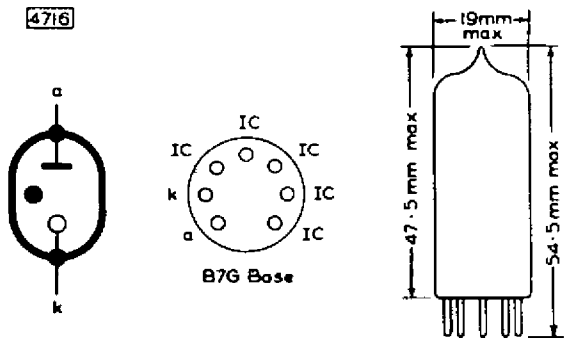
VOLTAGE REFERENCE TUBE TYPE 83A1

The 83A1 is a miniature voltage reference tube of the cold cathode discharge type.

PHYSICAL SPECIFICATION

Base	E7-1
Bulb	Glass
Maximum overall length	$2\frac{1}{8}$" (54.5mm)
Maximum seated height	$1\frac{7}{8}$" (47.5mm)
Maximum bulb diameter	3/4" (19.0mm)

BASING DIAGRAM AND CONNECTIONS



MAXIMUM RATINGS (Absolute values)

*Minimum DC starting voltage	130	volts
**Maximum starting current	10	milliamperes
Maximum cathode current	6.0	milliamperes
Minimum cathode current	3.5	milliamperes
Maximum bulb temperature (during operation)	150	°C
Maximum bulb temperature (during stand-by and storage)	100	°C
Maximum negative anode voltage	50	volts

The effective series resistance should never be less than 2000 ohms.

*This value holds good over the life of the tube, and in light or in darkness. In total darkness a starting delay of 5 seconds may occur.

**To be restricted for long life to approximately 30 seconds once or twice in each 8 hours of operation.

CHARACTERISTICS

Preferred operating cathode current	4.5	milliamperes
DC operating voltage at preferred cathode current	83.0 to 84.5	volts
†Maximum jump voltage (over the range 3.5 to 6.0 milliamperes)	1.0	milli volts
†Typical r.m.s. noise voltage (30c/s to 10kc/s)	100	microvolts
†Maximum incremental resistance	350	ohms
†Minimum incremental resistance	110	ohms
†Nominal temperature coefficient (averaged over the range 25 to 120°C)	(-0.003 %/°C (-2.5 millivolts/°C	

†These values hold good with little or no change over the life of the tube.

LIFE PERFORMANCE

Limits of the typical variations of operating voltage at the temperatures shown and over the period indicated.

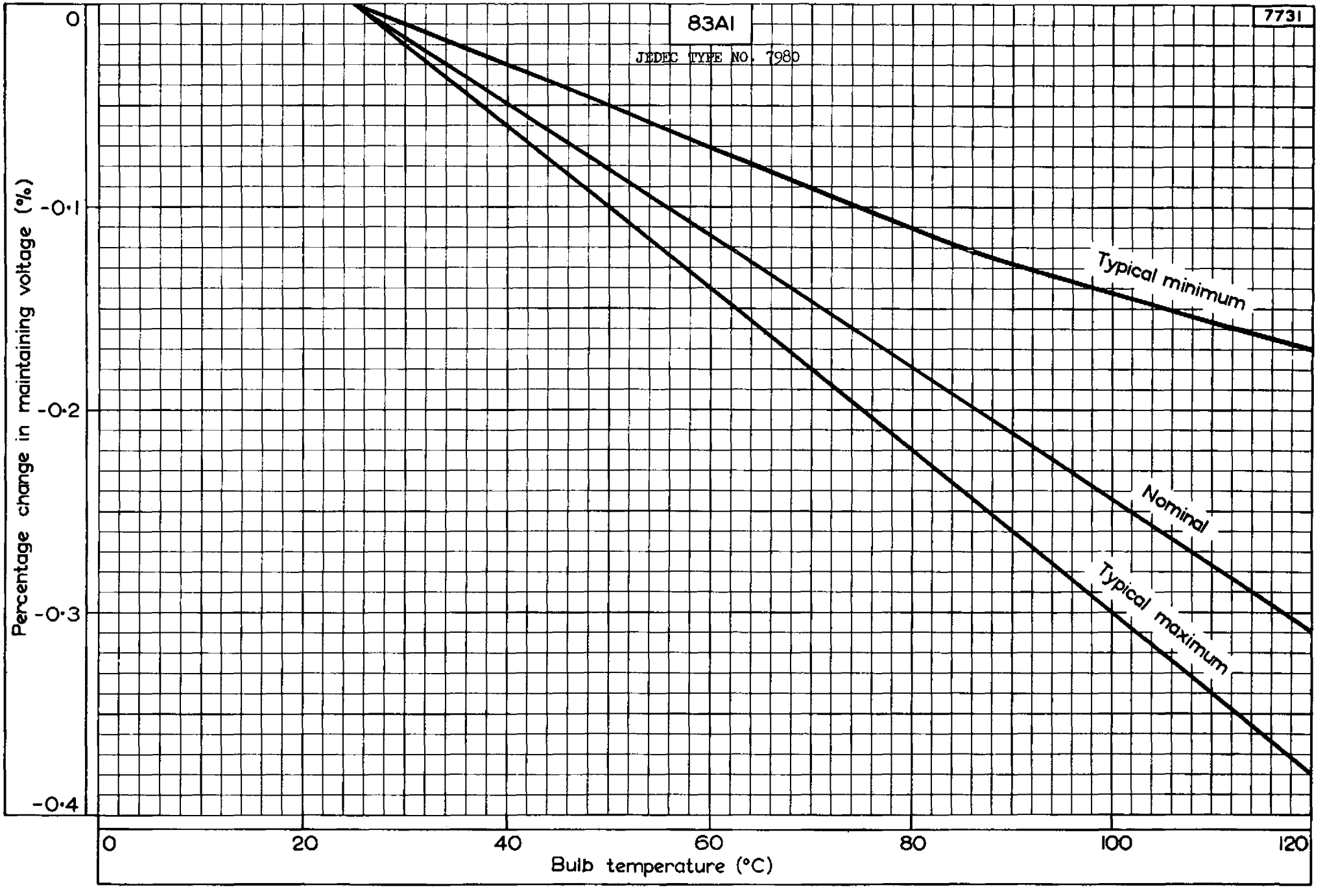
Continuous operation at preferred current

Bulb temperature:	25	100	150	°C
Life period				
0 to 300 hours	0 to+0.35	0 to+0.35	0 to+2.0	volts
300 to 2500 hours	0 to+0.20	0 to+0.20	-2.0 to+4.0	volts
300 to 10,000 hours	+0.05 to+0.35	+0.05 to+0.35	-	volts

For storage or stand-by

Period				
0 to 500 hours	negligible	<1.5††	-	volts
0 to 3500 hours	negligible	<6.0††	-	volts

††Subsequent operation of the tube for approximately 50 hours at the preferred operating cathode current and at a bulb temperature lower than 100°C will restore the operating voltage to within 0.2 volt of the original value.


83AI
JEDEC TYPE NO. 7980
7731
Percentage change in maintaining voltage (%)
0
-0·1
-0·2
-0·3
-0·4
Typical minimum
Nominal
Typical maximum
0
20
40
60
80
100
120
Bulb temperature (°C)

JEDEC TYPE NO. 7981
MULLARD TYPE NO. XR1-3200A

DATA FOR E.I.A. REGISTRATION

MULLARD LIMITED,
Mullard House,
Torrington Place,
LONDON.W.C.1.
England.

THREE ELECTRODE THYRATRON XR1-3200A

The XR1-3200A is a three electrode inert gas-filled thyratron with a negative control characteristic. This tube is designed primarily for motor control applications.

MAXIMUM RATINGS

Maximum Peak Anode Voltage		
Inverse	1500	volts
Forward	1500	volts
Maximum Cathode Current		
Peak	40	amperes
Average	3.2	amperes
Surge (maximum duration 0.1 second)	560	amperes
Maximum Averaging Time	15	seconds
Maximum Negative Control Grid Voltage		
Before Conduction	250	volts
During Conduction	10	volts
Maximum Positive Control Grid Current (during the time that the anode voltage is more positive than -10 volts)		
Peak	2.5	amperes
Average (Averaging Time One Cycle)	0.20	ampere
Maximum Positive Control Grid Current (during the time that the anode voltage is more negative than -10 volts)		
Peak	25	milliamperes
Maximum Control Grid Resistor	100,000	ohms
Maximum Commutation Factor	130	
Ambient Temperature Limits	-55 to +70	°C

GENERAL

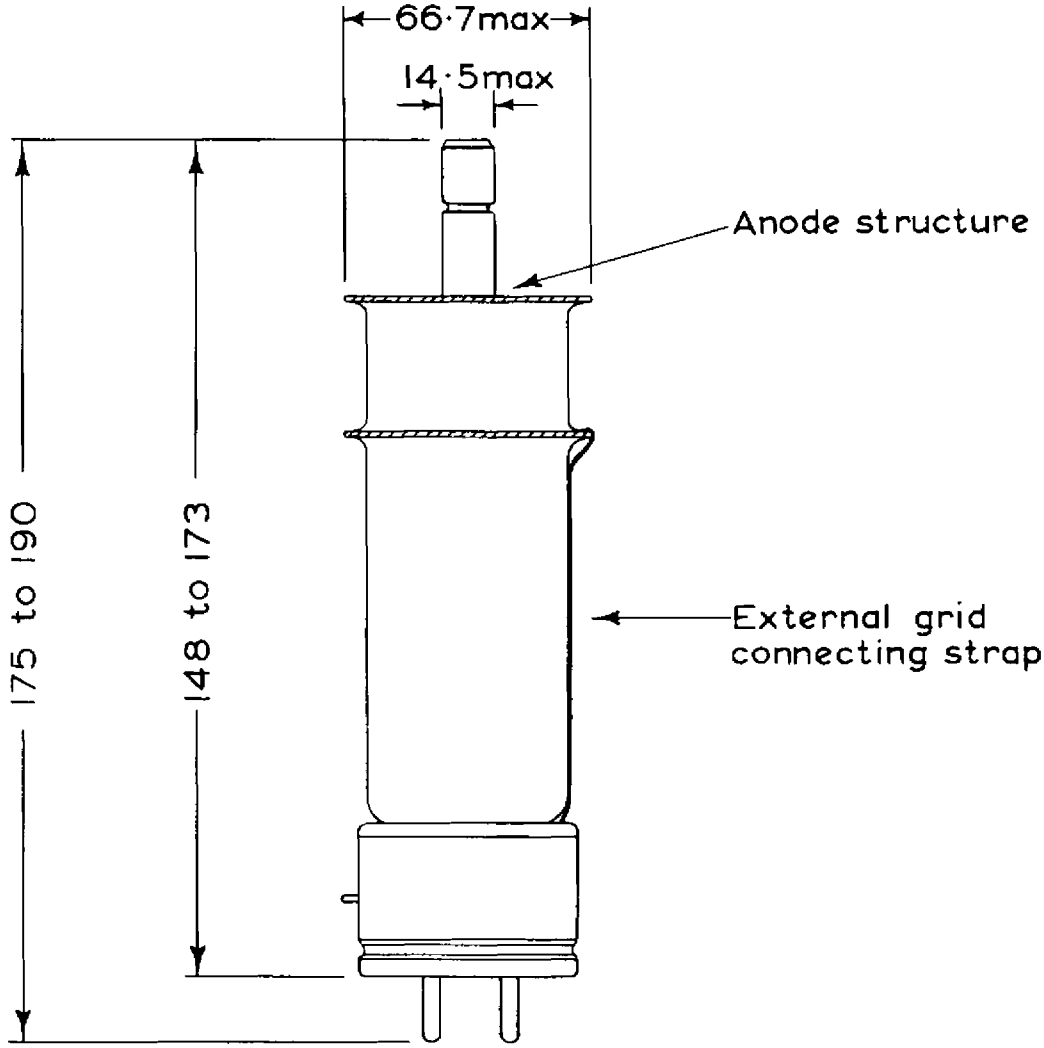
	Minimum	Bogey	Maximum	
Electrical Data				
Filament Voltage	2.37	2.5	2.63	volts
Filament Current at 2.5 volts		12	13.5	amperes
Cathode Heating Time	60.0			seconds
Anode to Control Grid Capacitance		7.5		μμf
Control Grid to Cathode Capacitance		5.0		μμf
Deionisation Time				
Grid Voltage = -250volts			40 approx.	μseconds
Grid Voltage = -12 volts			400 approx.	μseconds
Ionisation Time			10 approx.	μseconds
Anode Voltage Drop			16 approx.	volts
Critical Control Grid Current at Anode Voltage = 1500 Volts			<20	μamperes

Mechanical Data

*Mounting Position	Any between horizontal and vertical with base down	
**Cooling	Convection	
Maximum Net Weight	10.6	ounces

*Care should be taken to avoid damage to or contact with the external grid connecting strap.

**The anode structure must be left free to ensure adequate cooling by free convection.





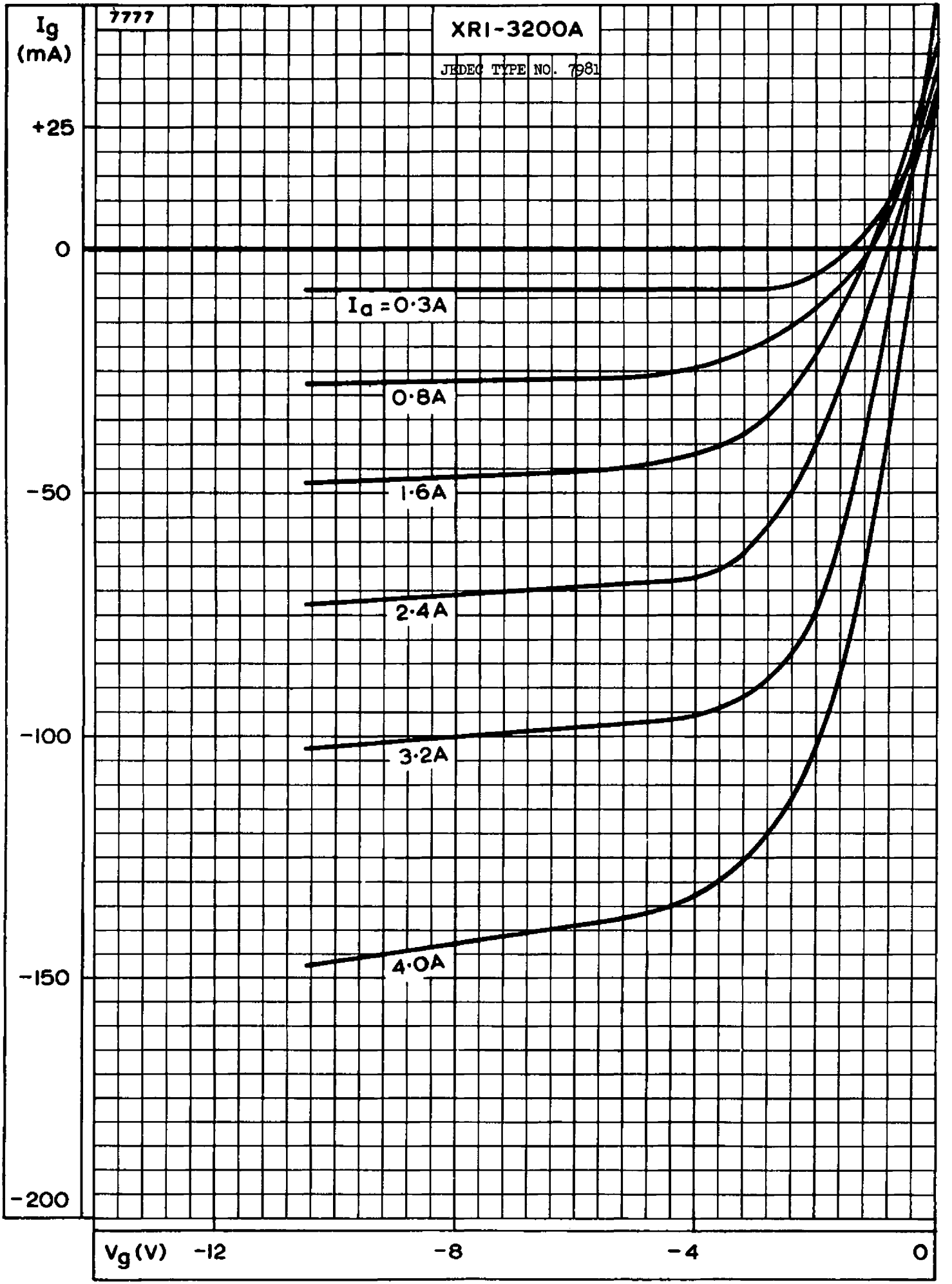
B4D Base

All dimensions in mm

The anode structure must be left free to ensure adequate cooling by free convection.

Care should be taken to avoid damage to or contact with the external grid connecting strap.

7431


7777
XR1-3200A
JEDEC TYPE NO. 7981
Ig (mA)
+25
0
-50
-100
-150
-200
Ia = 0·3A
0·8A
1·6A
2·4A
3·2A
4·0A
Vg (V)
-12
-8
-4
0

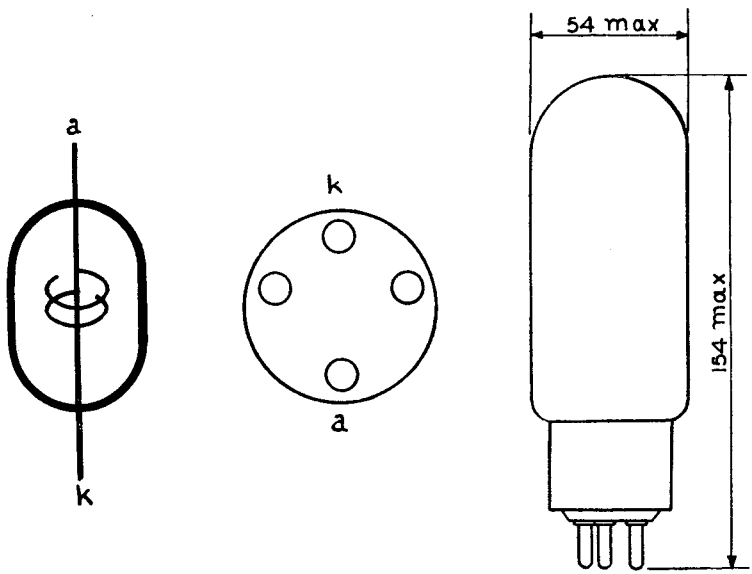
Mullard
NEON STABILISING TUBE

13201

Operating Conditions

V starting.max	135	V
V burning	90-110	V
I quiescent	100	mA
I max	200	mA
I min	15	mA
A.C. resistance	80	ohms

Arrangement of electrodes and base connections

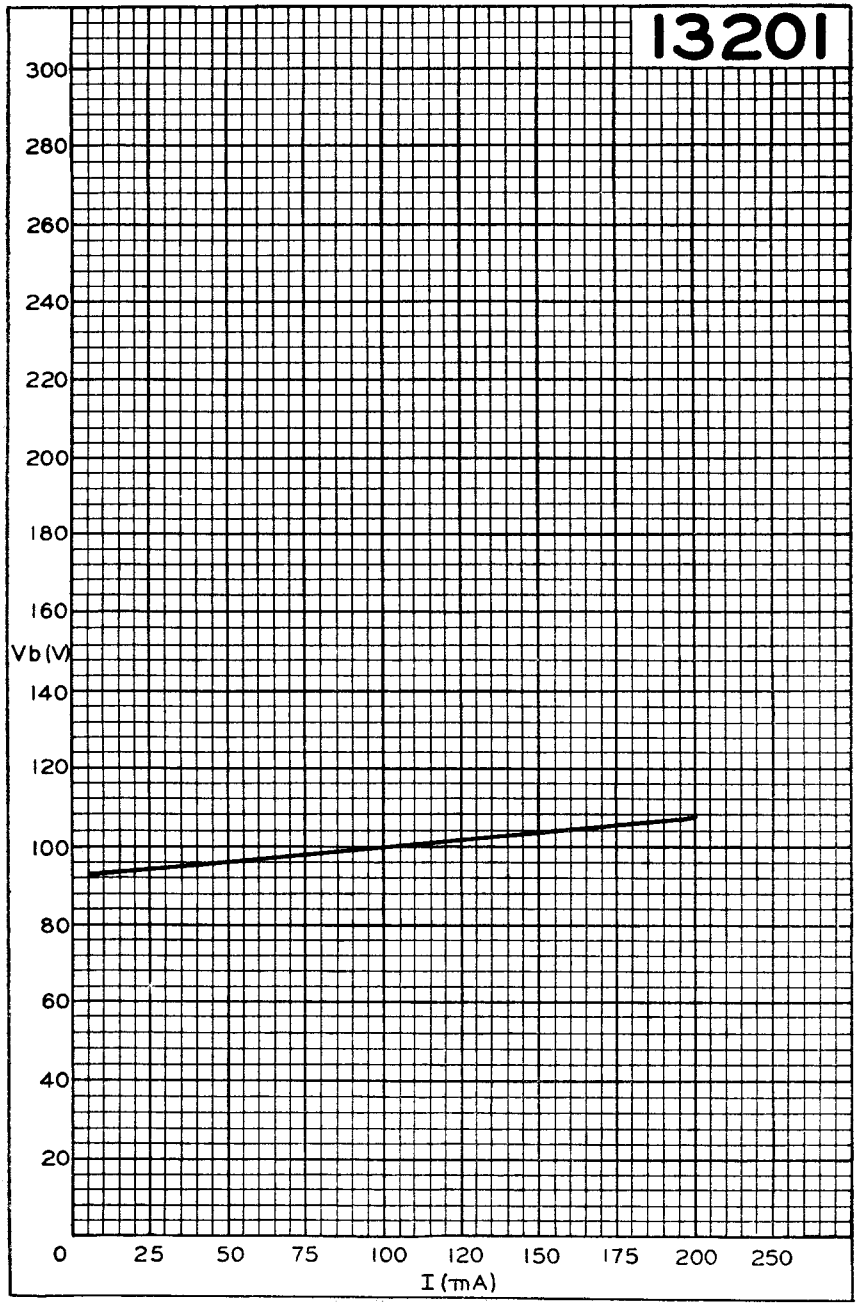


13201

13201

Mullard

NEON STABILISING TUBE



1339/2

STABILISING TUBE

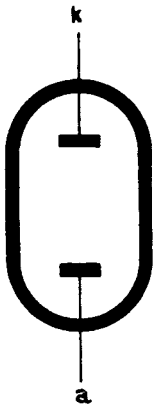
13201A

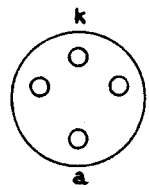
Heavy-duty neon-filled voltage stabiliser.

OPERATING CONDITIONS

V ignition max.	135	V
V burning	90–110	V
I quiescent	100	mA
I max	200	mA
I min	15	mA
A.C. resistance	80	Ω

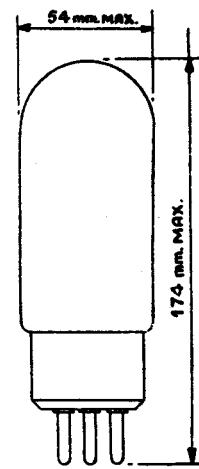
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS





BRITISH 4-PIN BASE

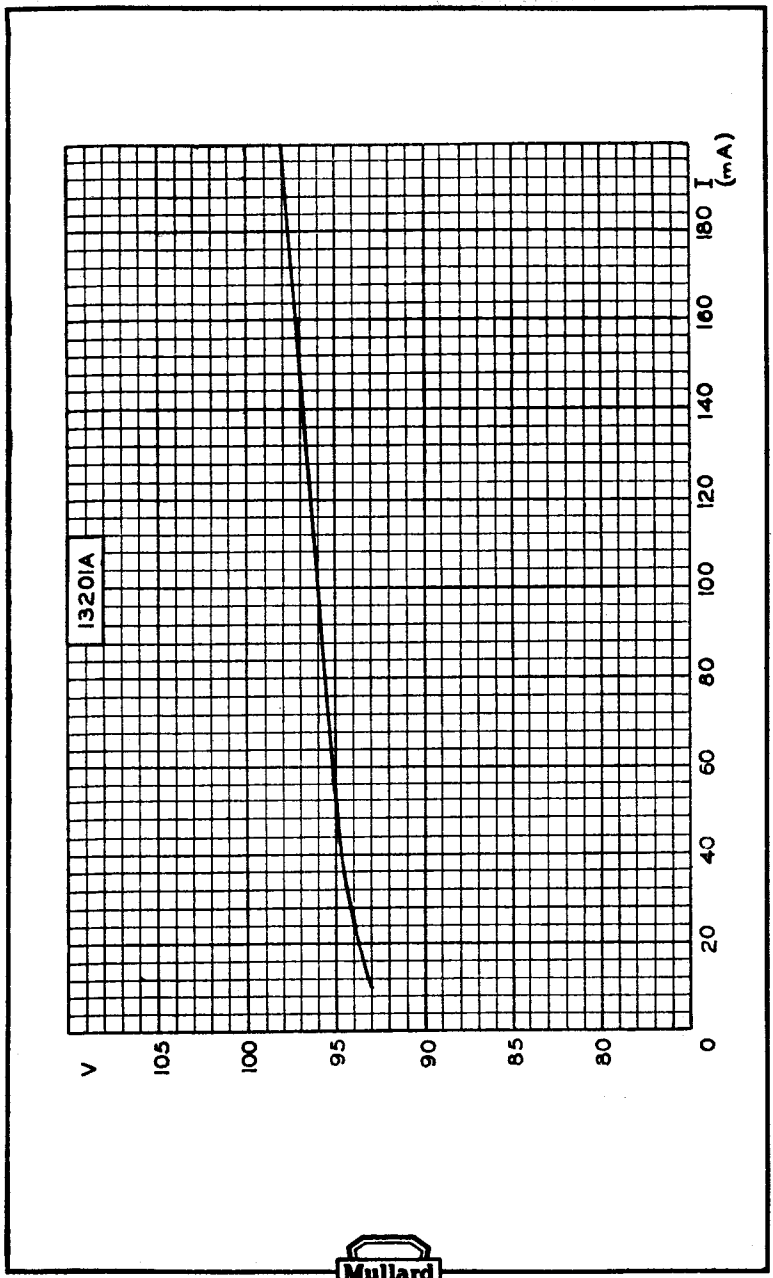
DIMENSIONS



13201A

STABILISING TUBE

Heavy-duty neon-filled voltage stabiliser.



from JEDEC release #3255, May 1, 1961

DATA FOR E.I.A. REGISTRATION

MULLARD LIMITED,
Mullard House,
Torrington Place,
L O N D O N W.C.1.
ENGLAND.

THREE ELECTRODE THYRATRON XR1-1600A JEDEC TYPE 8063

The XR1-1600A is a three electrode, inert gas-filled thyratron with a negative control characteristic. This tube is designed primarily for power control.

MAXIMUM RATINGS

	General Control Service	Ignitor Firing Service	
Maximum Peak Anode Voltage			
Inverse	1500	1500	volts
Forward	1500	1500	volts
Maximum Cathode Current			
Peak (25c/s and above)	20	30	amperes
Average	1.6	0.5	amperes
Maximum Averaging Time	15	15	seconds
Maximum Negative Control Grid Voltage			
Before Conduction	250	250	volts
During Conduction	10	10	volts
Maximum Positive Control Grid Current (during the time that the Anode Voltage is more positive than -10V)			
Peak	1.25	1.25	amperes
Average (Averaging Time One Cycle)	0.10	0.10	ampere
Maximum Positive Control Grid Current (during the time that the Anode Voltage is more negative than -10V)			
Peak	5.0	5.0	milliamperes
Maximum Grid Resistor	100,000	100,000	ohms
Maximum Commutation Factor	10	10	
Maximum Ambient Temperature	+70	+70	°C

GENERAL

	min.	bogey	max.	min.	bogey	max.	
Electrical Data							
Filament Voltage	2.37	2.5	2.63	2.61	2.75	2.89	volts
Filament Current		8.5	9.5		9.2	10.3	amperes
Cathode Heating Time	10						seconds
Anode to Control Grid Capacitance					0.35		µµf
Control Grid to Cathode Capacitance					10.0		µµf
Deionisation Time							
Grid Voltage=-250volts					200 approx.		µseconds
Grid Voltage=-100volts					300 approx.		µseconds
Ionisation Time					10 approx.		µseconds
Anode Voltage Drop					10 approx.		volts
Critical Control Grid Current (at Anode Voltage=1500 volts)					<20		µamperes

Note: When two or more tubes are operated from a common filament transformer, the transformer center taps must be used for the cathode return, and may also be connected to the filament center taps.

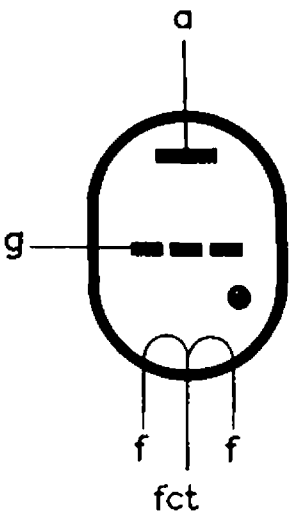
Mechanical Data

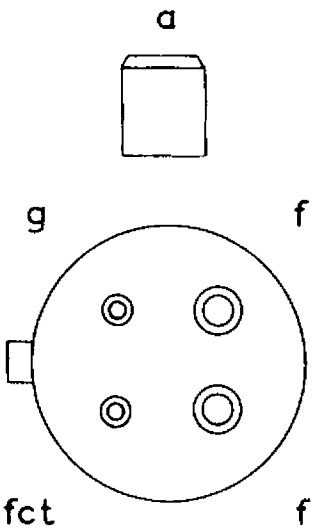
Mounting Position	Any between horizontal and vertical with base down.
*Cooling	Convection
Maximum Net Weight	4.1 ounces

*The anode structure must be left free, to ensure adequate cooling by free convection.

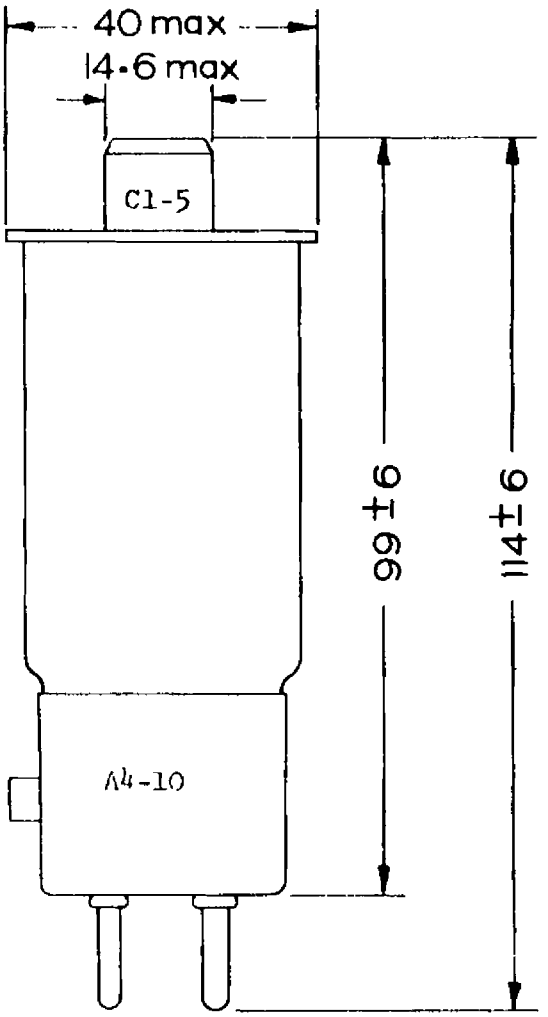
6215

JEDEC TYPE 8063

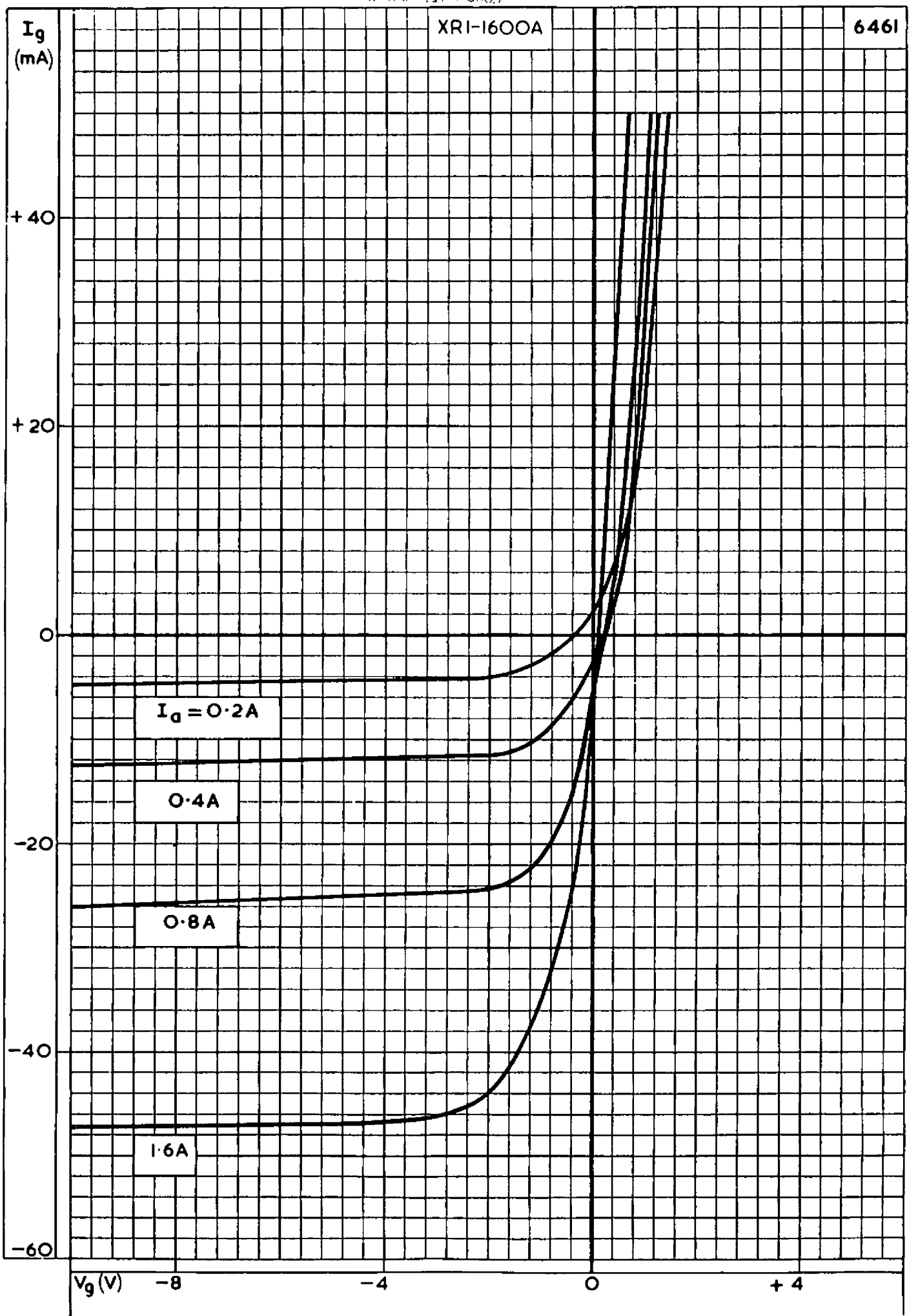


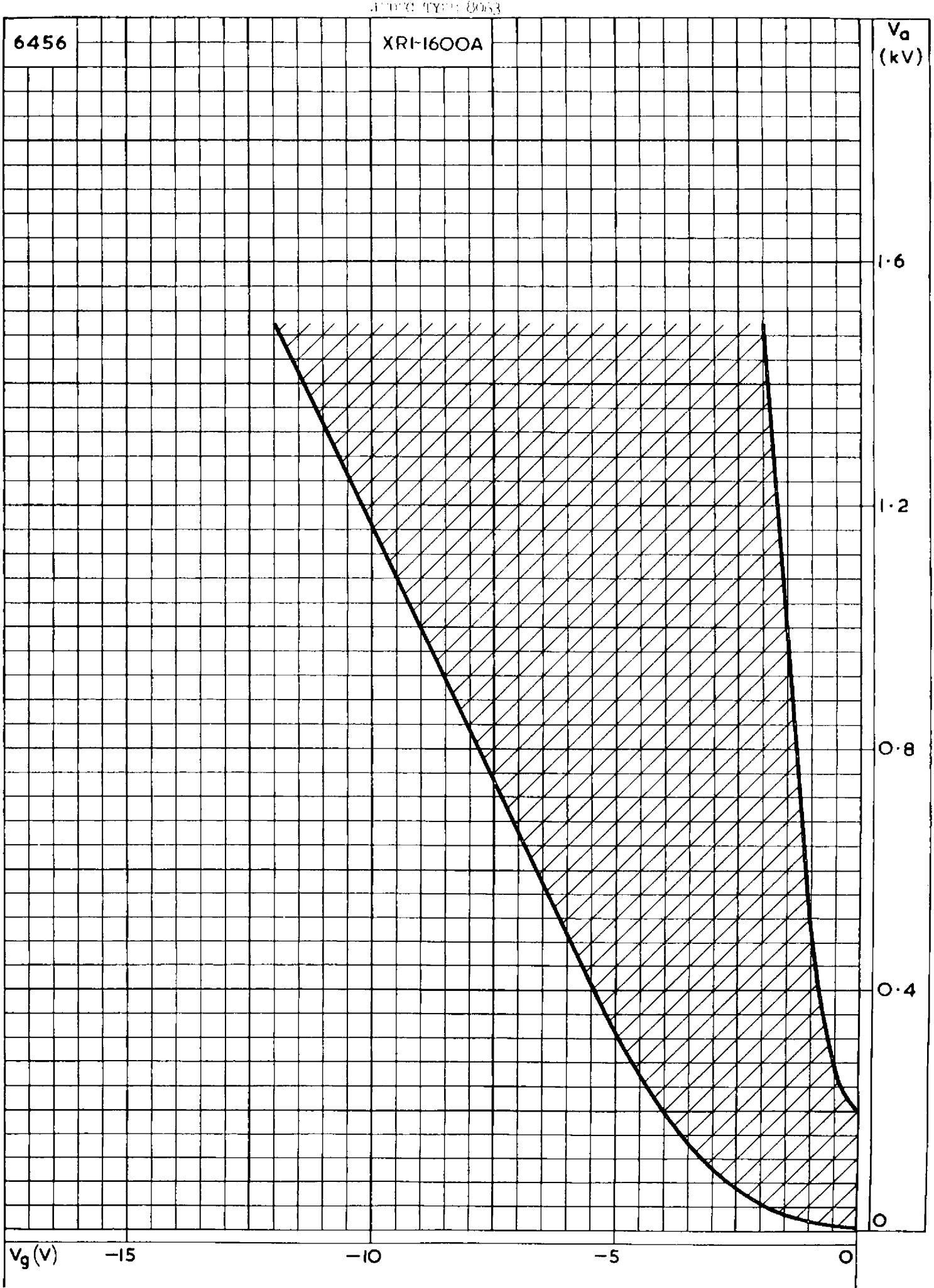


Medium 4-pin base
with bayonet catch



All dimensions in mm


XR1-1600A
6461
I_g (mA)
+40
+20
0
-20
-40
-60
I_a = 0·2A
0·4A
0·8A
1·6A
V_g (V)
-8
-4
0
+4


6456
XR1-1600A
V_a (kV)
1·6
1·2
0·8
0·4
0
V_g (V)
−15
−10
−5
0

DECADE SELECTOR AND COUNTING TUBE

Short all-glass cold-cathode selector tube with neon-type glow viewed through the dome of the bulb. The tube has 10 main cathodes with separate connections, and counts in either direction at speeds up to 5kc/s.

Z504S

8433

This data should be read in conjunction with OPERATING NOTES – COUNTING AND SELECTOR TUBES which precede this section of the handbook.

This tube has been designed to close mechanical tolerances so that no individual adjustment is necessary to align the bulb with the escutcheon.

In circuits where less than 10 outputs are required (e.g. counting circuits), the unused cathodes should be connected together and returned to zero voltage.

All voltages are referred to the most positive supply potential to which any main cathode (not guide cathode) is returned.

RECOMMENDED OPERATING CONDITIONS

For double pulse and integrated pulse drive

Anode supply voltage	475		V
Anode resistor	820		kΩ
Anode current (nominal)	340		μA
Guide bias supply voltage	+40		V
Guide pulse amplitude	100		V
*Guide pulse duration	75		μs
Bias supply voltage to any main cathode	0	−12	V
**Cathode resistor	82	120	kΩ
Output pulse (nominal)	23	35	V

*This figure applies for counting at 4kc/s. For operation at lower frequencies, a longer pulse duration is desirable.

For counting at frequencies up to 5kc/s the limit operating conditions should be consulted.

**Where a cathode is returned to a potential of −12V, a cathode series resistor of 47kΩ minimum should be included. Where a cathode is returned to 0V and no output is required, the cathode resistor can be omitted.

from JEDEC release #4108, Jan. 28, 1963

Z504S

DECADE SELECTOR AND COUNTING TUBE

8433

CHARACTERISTICS AND LIMIT OPERATING CONDITIONS

The values given state the range over which the tube will operate both initially and during life. No allowance has been made for supply voltage and component variations.

Supply voltage		
Maximum	550	V
Minimum	375	V
†Minimum time constant of rise of anode supply voltage when switching on	1.0	ms
Nominal maintaining voltage ($V_{a(b)}$ = 475V, R_a = 820kΩ)	195	V
Cathode current		
Maximum	525	μA
Minimum	250	μA
Maximum negative bias voltage on any main cathode	20	V
Guide voltage		
Positive bias		
Maximum	60	V
Minimum for counting speeds up to 5kc/s	35	V
Minimum for counting speeds up to 1kc/s	25	V
Minimum negative to ensure stepping	45	V
††Negative reset pulse voltage to any main cathode		
Minimum required	120	V
Maximum permitted	225	V
Maximum voltage between any two main or guide cathodes	140	V
Maximum counting rate	5.0	kc/s
Minimum time between two successive input pulses	200	μs
Minimum period of discharge on each guide or main cathode	60	μs

†If the power supply does not have a suitable time constant as one of its characteristics, it can conveniently be obtained by inserting a 5kΩ resistor in series with the anode supply and a 0.2μF capacitor to earth.

††The permitted reset pulse should have minimum time constants of rise and fall of 1ms.

ABSOLUTE MAXIMUM RATINGS

Maximum supply voltage	550	V
Maximum cathode current	525	μA
Maximum voltage between any two main or guide cathodes	140	V
Maximum positive guide bias voltage	60	V
Maximum ambient temperature	50	°C

DECADE SELECTOR AND COUNTING TUBE

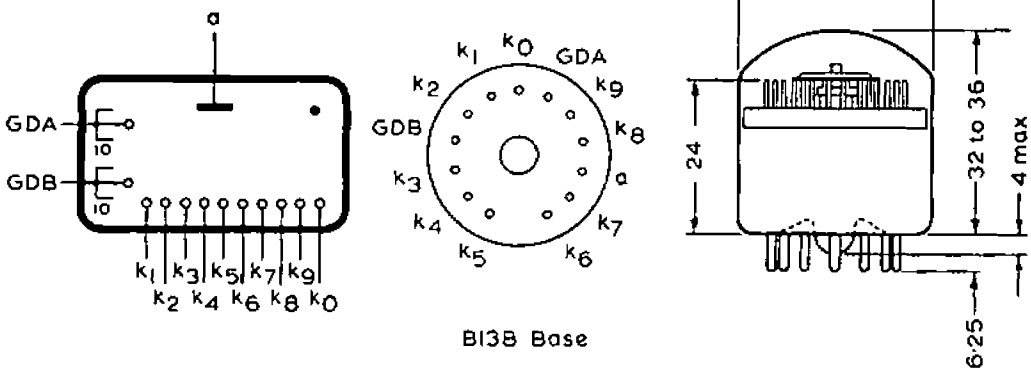
Z504S

OPERATING NOTE

1. It is preferable to store and operate the tube as near as possible to room temperature.

ACCESSORIES

Valve holder	B8 700 67



B13B Base

All dimensions in mm

k_0 is aligned with pin 7 to within ±3°

9129

TELEVISION TUBE A28-14W

TENTATIVE DATA

QUICK REFERENCE DATA

28cm (11in) rectangular direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. Especially for use in portable receivers with push-through presentation.

Deflection angle	90	deg
Focusing	Electrostatic	
Light transmission	55	%
Maximum overall length	25	cm

This data should be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES

HEATER

V_h	11	V
I_h	68	mA

The heater supply circuit should provide a nominal voltage of 11V, either d.c. or a.c.
For supply from a.c. mains, see General Operational Recommendations - Cathode Ray Tubes.
For supply direct from a battery, the heater voltage cycle must be within the limits of the graph on page C1. In any discharge cycle, the time of V_h above 13V must not exceed 30 minutes.

OPERATING CONDITIONS

V_{a2+a4}	11	kV
V_{a3} (focus electrode control range)	0 to 350	V
V_{a1}	250	V
V_g for visual extinction of focused raster	-35 to -69	V
*V_k for visual extinction of focused raster	approx. 45	V

*For cathode modulation, all voltages are measured with respect to grid.

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission (approx.)	55	%
Useful screen area	see page D7	

FOCUSING

Electrostatic

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 100μA.

DEFLECTION

Double magnetic

The deflection coils should be designed so that their internal contour is in accordance with the reference line gauge shown on page D10.

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	3.0	pF
$c_{a2+a4-M}$	550 to 850	pF
$c_{a2+a4-B}$	150	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

RASTER CENTRING

See notes under this heading in 'General Operational Recommendations - Cathode Ray Tubes'.

Centring magnet field intensity	0 to 10	Gs
Maximum distance of centre of centring field from reference line	55	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

see page D10

TELEVISION TUBE A28-14W

QUICK REFERENCE DATA

28cm (11in) rectangular direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. Especially for use in portable receivers with push-through presentation.

Deflection angle	90	deg
Focusing	Electrostatic	
Light transmission	50	%
Maximum overall length	250	mm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TELEVISION PICTURE TUBES

HEATER

V_h	11	V
I_h	68	mA

The heater supply circuit should provide a nominal voltage of 11V, either d.c. or a.c.

For supply from a.c. mains, see General Operational Recommendations - Television Picture Tubes.

For supply direct from a battery, the heater voltage cycle must be within the limits of the graph on page 11. In any discharge cycle, the time of V_h above 13V must not exceed 30 minutes.

OPERATING CONDITIONS

V_{a2+a4}	11	kV
V_{a3} (focus electrode control range)	0 to 350	V
V_{a1}	250	V
V_g for visual extinction of focused raster	-35 to -69	V
*V_k for visual extinction of focused raster	approx. 45	V

*For cathode modulation, all voltages are measured with respect to grid.

SCREEN

Metal backed		
Fluorescent colour	White	
Light transmission (approx.)	50	% ←
Useful screen area	see page 7	

FOCUSING

Electrostatic

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 100μA.

DEFLECTION

Magnetic

Diagonal deflection angle	90	deg
Horizontal deflection angle	80	deg
Vertical deflection angle	63	deg

The deflection coils should be designed so that their internal contour is in accordance with the reference line gauge shown on page 10.

CAPACITANCES

$c_{g\text{-all}}$	7.0	pF
$c_{k\text{-all}}$	3.0	pF
$c_{a2+a4\text{-}M}$	550 to 850	pF
$c_{a2+a4\text{-}B}$	150	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

RASTER CENTRING

See notes under this heading in 'General Operational Recommendations - Television Picture Tubes'.

Centring magnet field intensity	0 to 800	A/m
Maximum distance of centre of centring field from reference line	55	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

see page 10

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after the installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM unless otherwise stated)

V_{a2+a4} max. (at $I_{a2+a4}=0$) (see note 1)	12	kV
V_{a2+a4} min. (absolute limit)	7.5	kV
$+V_{a3}$ max.	500	V
$-V_{a3}$ max.	50	V
V_{a1} max.	350	V
V_{a1} min.	200	V
$-v_{g(pk)}$ max. (see note 2)	350	V
$-V_{g}$ max. (see note 3)	100	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5.0	μA
V_{h-k}		
d.c. max.	110	V
pk max.	130	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ

Notes

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the tube.
2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

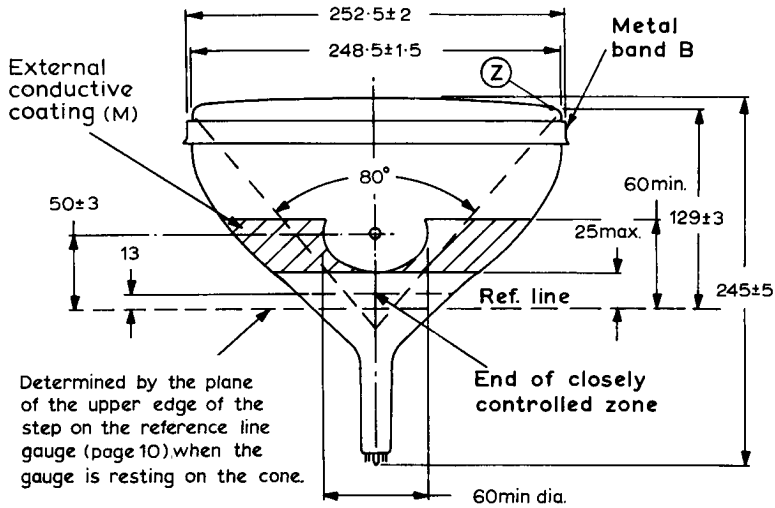
3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1.0V. It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

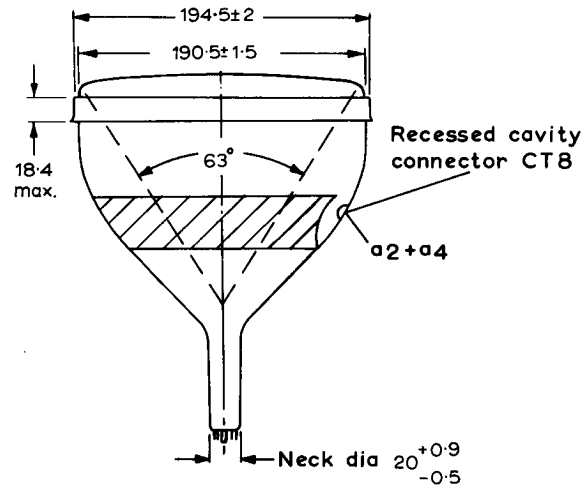
4. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2MΩ.

   The mounting lugs will be in electrical contact with the metal band.

WEIGHT

Tube alone (approx.)	2.2	kg

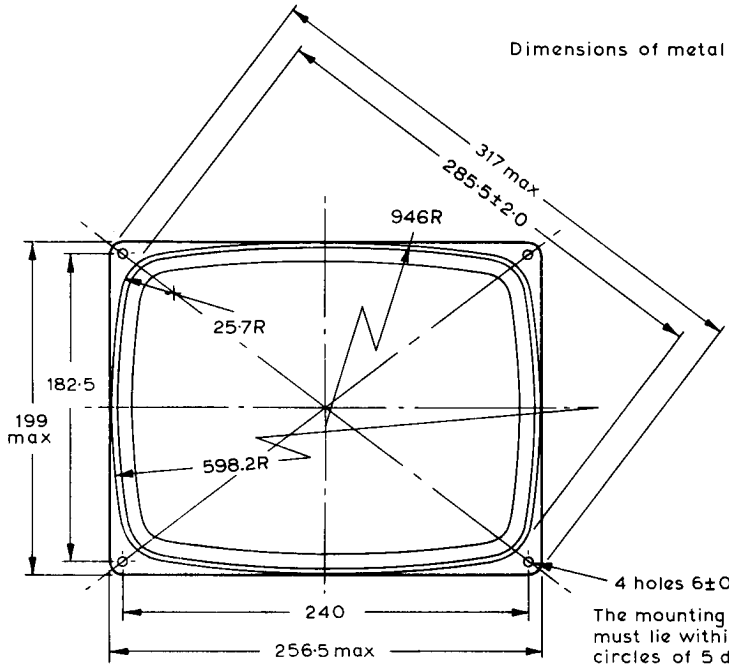




All dimensions in mm

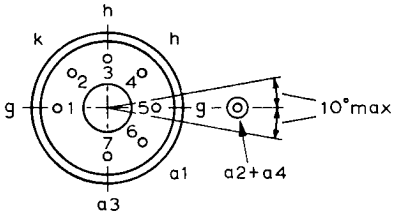
B7707

Dimensions of metal band



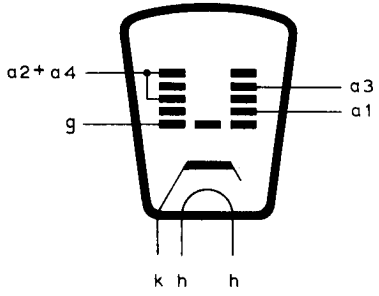
4 holes 6±0·3 dia

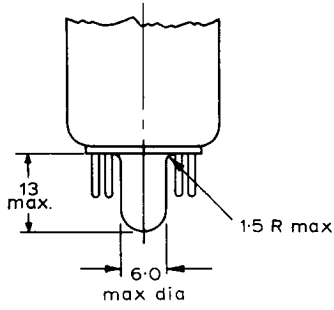
The mounting bolts must lie within circles of 5 dia. centred on the true geometric position of these holes.



Pin dimensions as in B7G base.

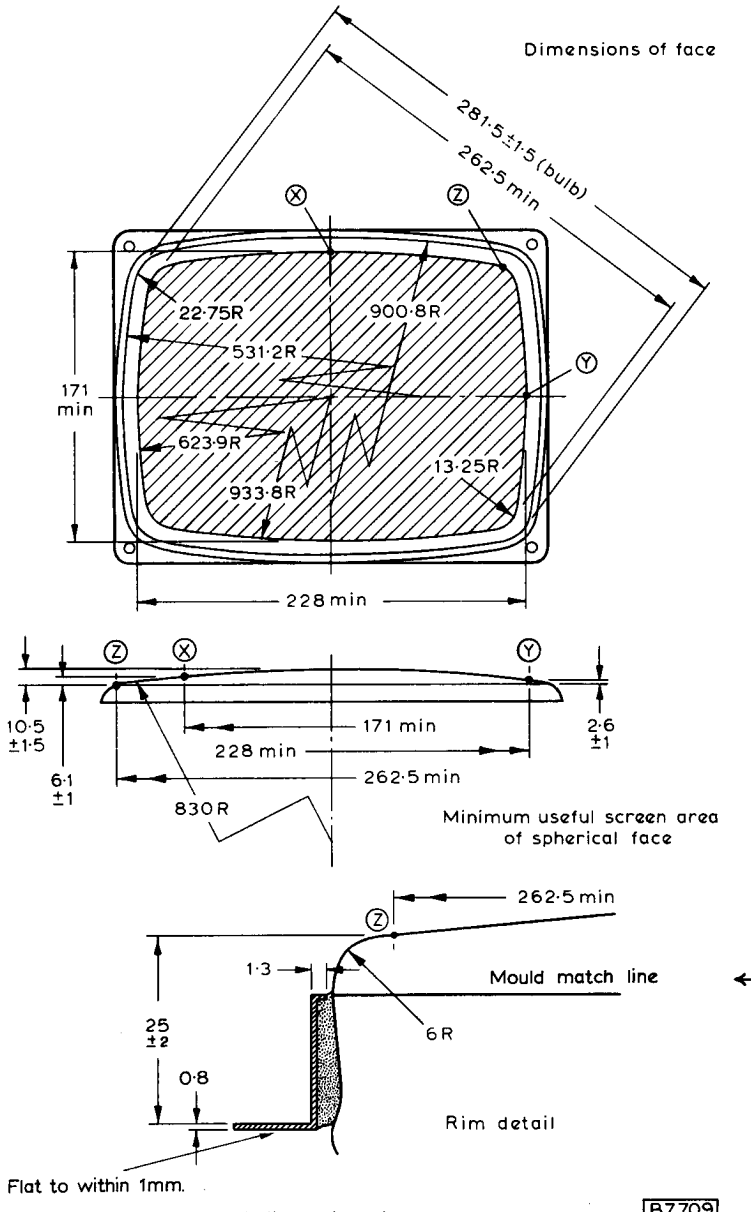
The centre of the socket must allow entry of the pump stem.

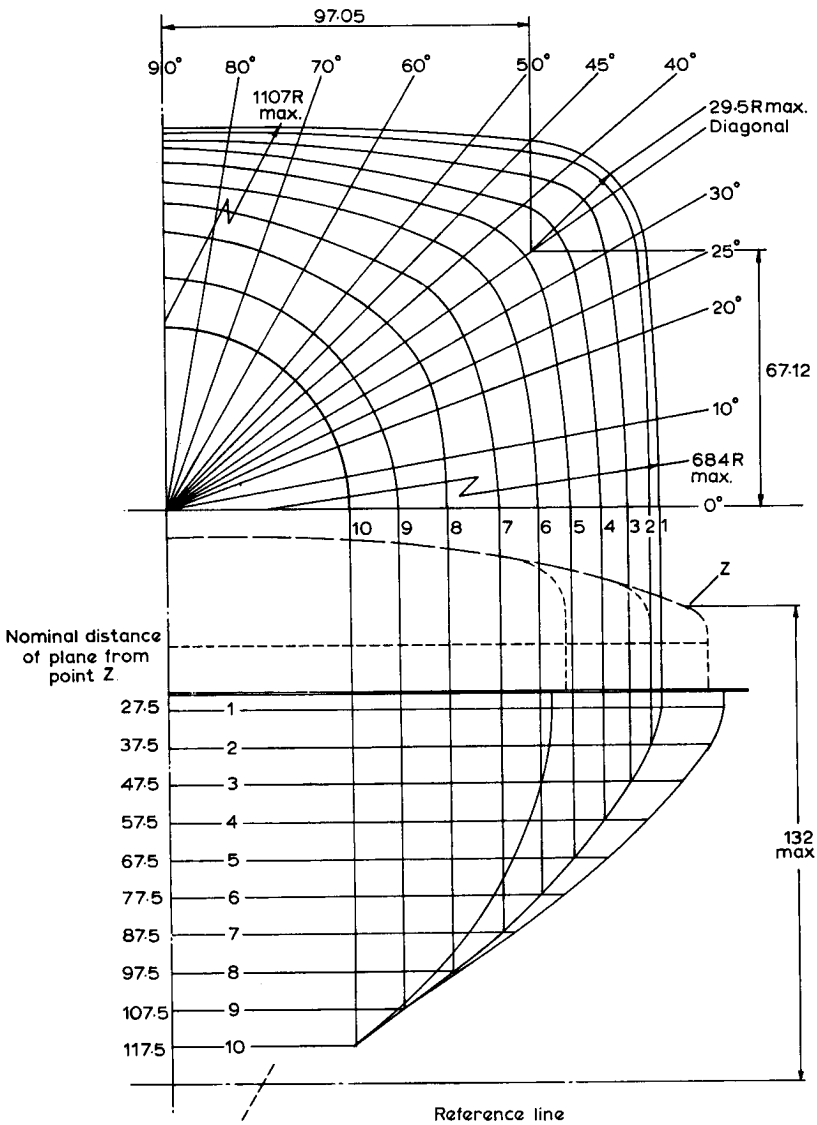




All dimensions in mm

B7708


Dimensions of face
281·5±1·5 (bulb)
262·5 min
X
Z
Y
22·75R
900·8R
531·2R
171 min
623·9R
933·8R
13·25R
228 min
Z
X
Y
10·5 ±1·5
6·1 ±1
171 min
228 min
262·5 min
830R
2·6 ±1
Minimum useful screen area of spherical face
262·5 min
Z
1·3
Mould match line
6R
25 ±2
0·8
Rim detail
Flat to within 1mm.
All dimensions in mm
B7709



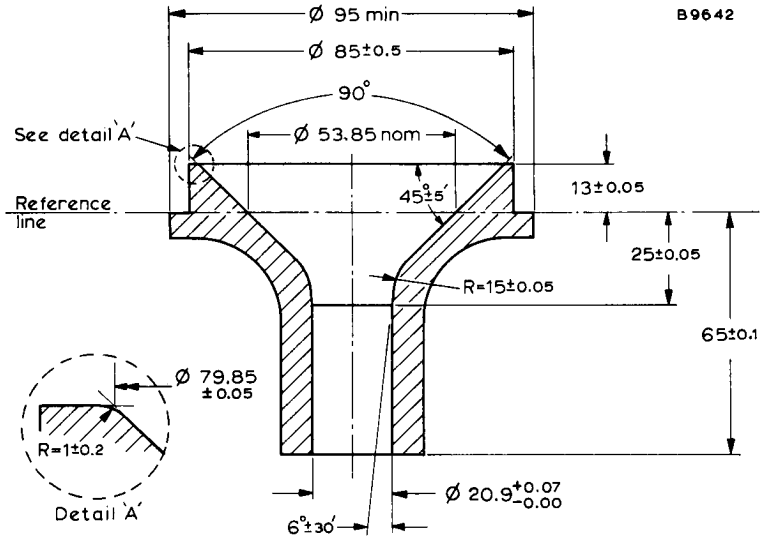
All dimensions in mm.

DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING

Distance from centre

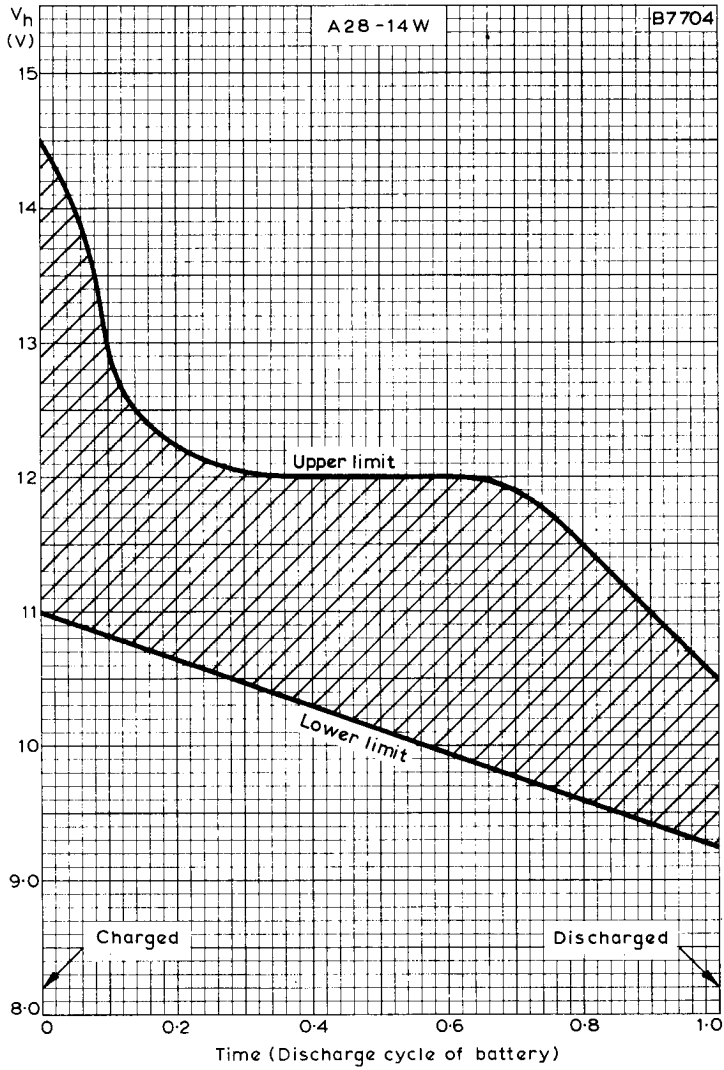
Section	0° long	10°	20°	25°	30°	34°40' diagonal	40°	45°	50°	60°	70°	80°	90° short
1	130.0	131.6	136.6	140.6	145.5	147.5	144.9	136.8	127.9	114.9	106.8	102.4	101.0
2	127.4	128.9	133.8	137.7	142.4	144.9	141.8	133.3	124.8	112.6	105.2	101.2	99.9
3	121.1	122.6	126.8	130.4	134.7	137.6	133.9	125.6	118.4	108.2	102.0	99.0	97.9
4	114.0	115.2	118.7	121.6	125.2	127.3	124.5	117.5	111.6	103.1	98.1	95.8	95.2
5	106.4	107.2	110.0	112.2	114.8	116.4	114.2	108.8	104.0	97.2	93.5	92.0	91.8
6	97.6	98.2	100.0	101.4	103.3	104.4	102.8	98.8	95.1	90.0	87.4	86.8	87.0
7	87.4	87.8	88.8	89.7	90.7	91.4	90.2	87.7	85.2	81.7	80.4	80.5	81.0
8	75.0	75.4	76.2	76.7	77.0	76.8	76.0	74.9	73.8	72.4	72.2	72.8	73.4
9	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.4	60.2	60.6	61.0	61.4
10	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0

All dimensions in mm

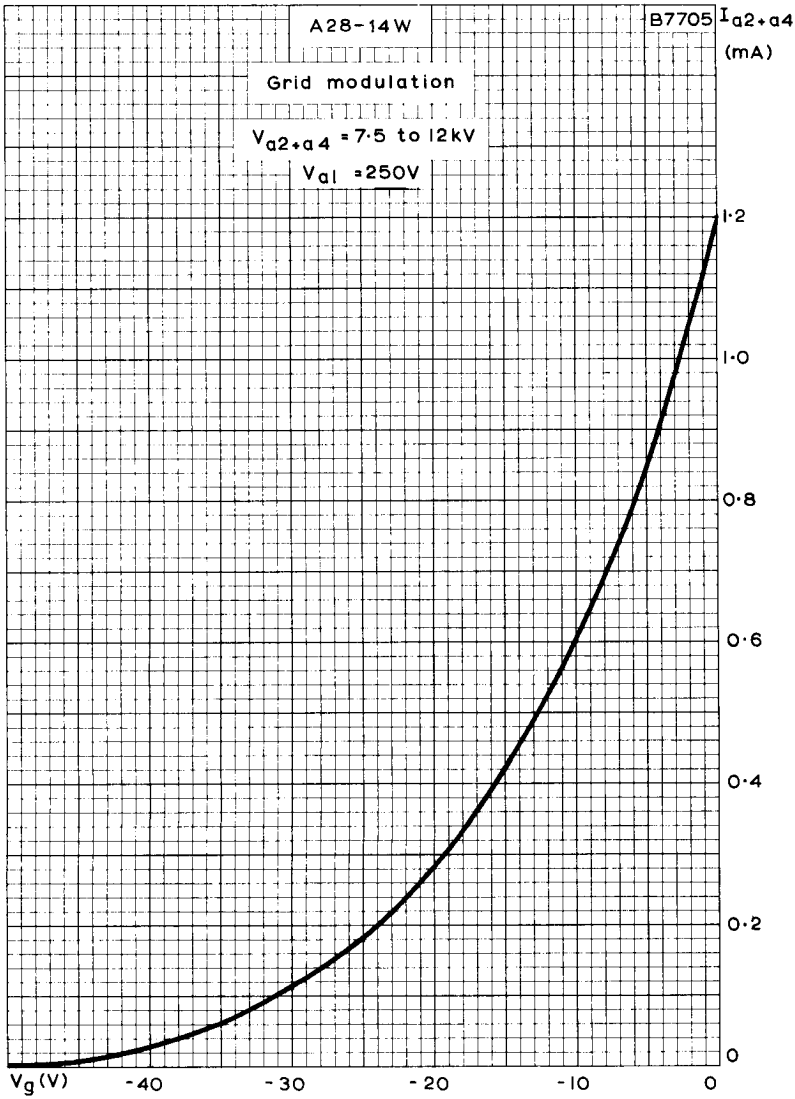


REFERENCE LINE GAUGE

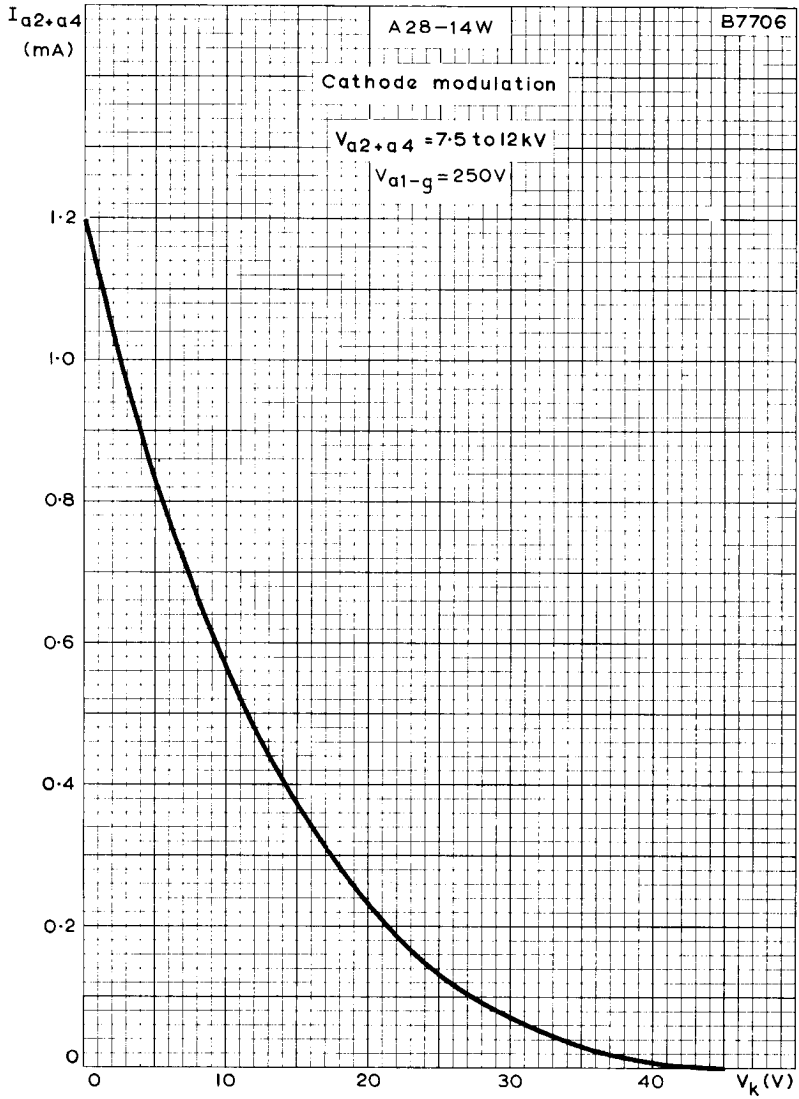
All dimensions in mm



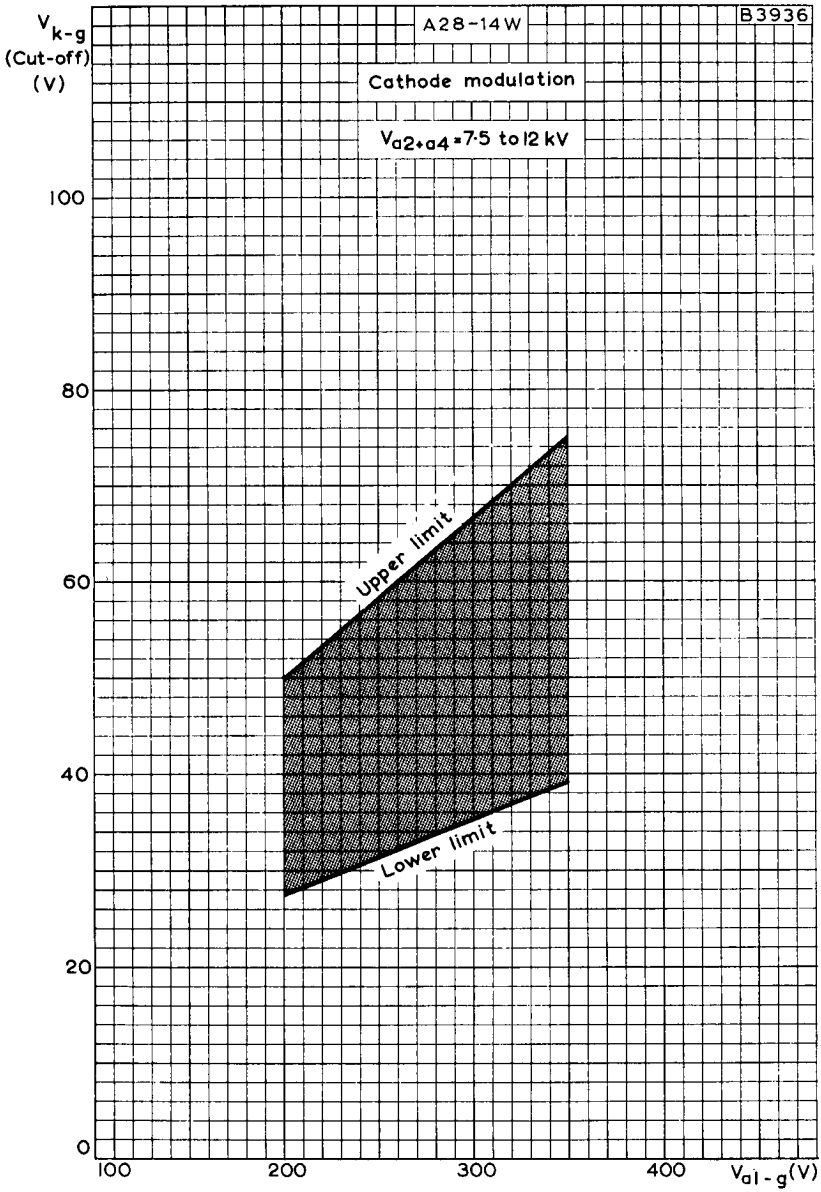
HEATER VOLTAGE PLOTTED AGAINST BATTERY DISCHARGE CYCLE



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
GRID MODULATION



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE, CATHODE MODULATION



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.

Mullard
OSCILLOGRAPH TUBE

A40-G3/N3

CATHODE RAY TUBE FOR OSCILLOGRAPHIC USE

3 - Inch Screen.

Heater	Vf	=	4.0 V
	If	=	1.0 A
Capacities	Cg	=	6.0 uuF
	CD1D1'	=	1.0 uuF
	CD2D2'	=	3.0 uuF

	A40-G3	A40-N3
Fluorescent Colour	Green	Green - long persistence

Deflection — Double electrostatic - for asymmetrical circuit.

Operating Conditions

Va2	500	800 V
Va1 (approx. for focus)	140	220 V
Vg .....(1)	0- -20	0- -30 V
N1	0.35	0.22 mm/V
N2	0.24	0.14 mm/V

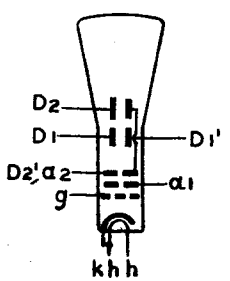
(1) The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

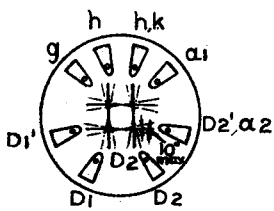
Max. writing speed — 0.3 km/sec

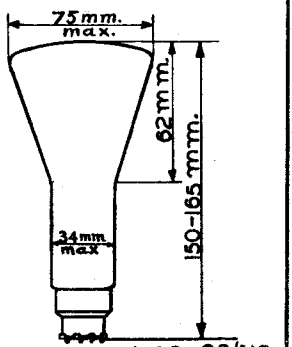
Limiting Values

Va2 max	800 V
Va1 max	275 V

Arrangement of electrodes and base connections.



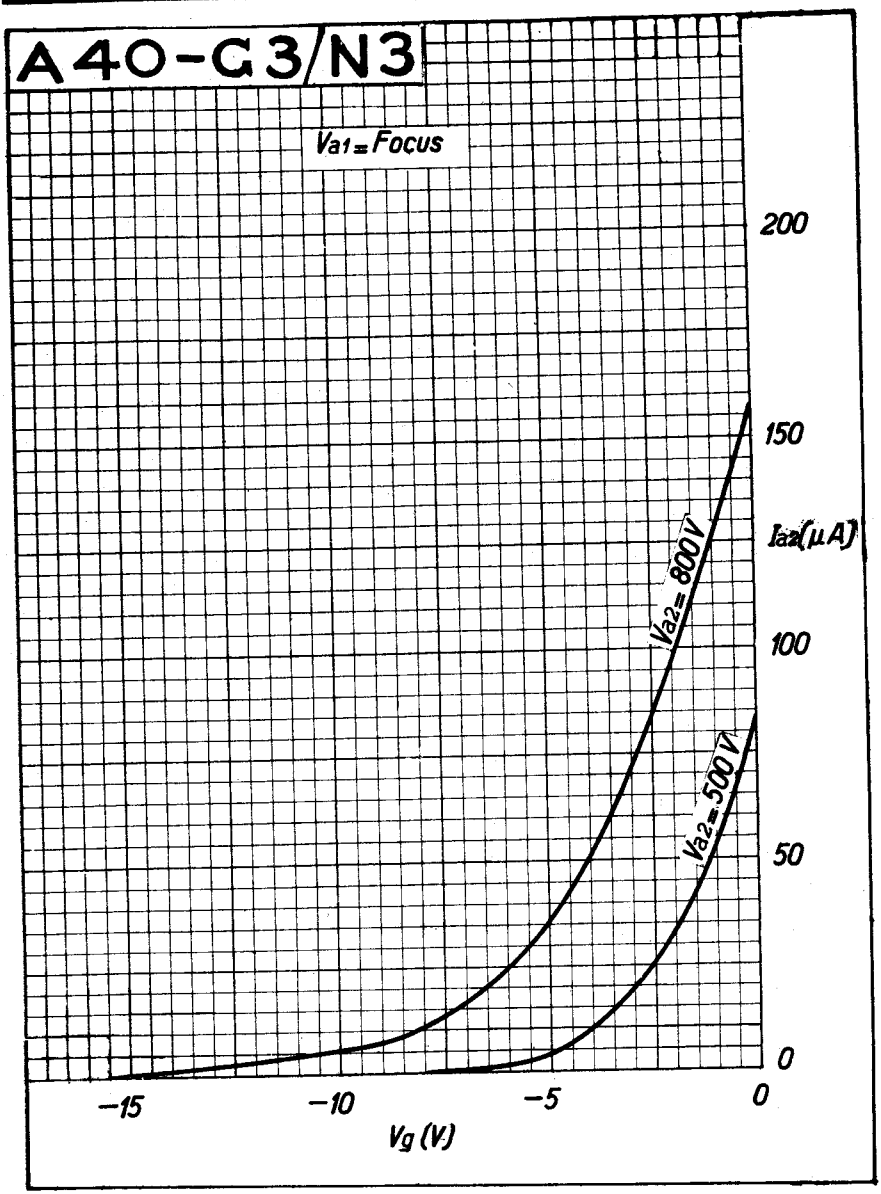




A40-G3/N3

A40-G3/N3

Mullard
OSCILLOGRAPH TUBE



1739/2

Mullard
OSCILLOGRAPH TUBE

A41-G4/B4/N4

CATHODE RAY TUBE FOR OSCILLOGRAPHIC USE

4 - Inch Screen

Heater	Vf	=	4.0 V
	If	=	1.0 A
Capacities	Cg	=	7.5 uuF
	CD1D1'	=	2.6 uuF
	CD2D2'	=	2.8 uuF

Fluorescent Colour - A41-G4 - Green
" " - A41-B4 - Blue
" " - A41-N4 - Green - Long Persistence.

Deflection - Double electrostatic for asymmetrical operation. D2' to be connected to a2.

Operating Conditions

Va2	1,000 V
Va1 (approx. for focus)	400 V
Vg .....(1)	0- -40 V
N1	0.40 mm/V
N2	0.31 mm/V

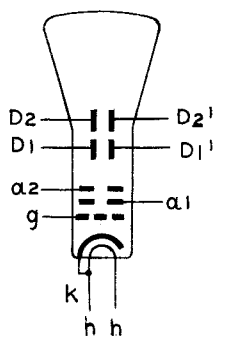
(1) The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

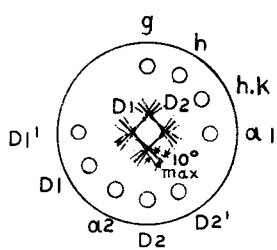
Max. writing speed ..... 0.5 km/sec

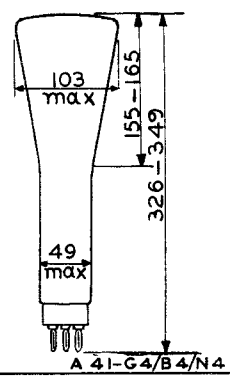
Limiting Values

Va2 max	1,200 V
Va1 max	500 V

Arrangement of electrodes and base connections.

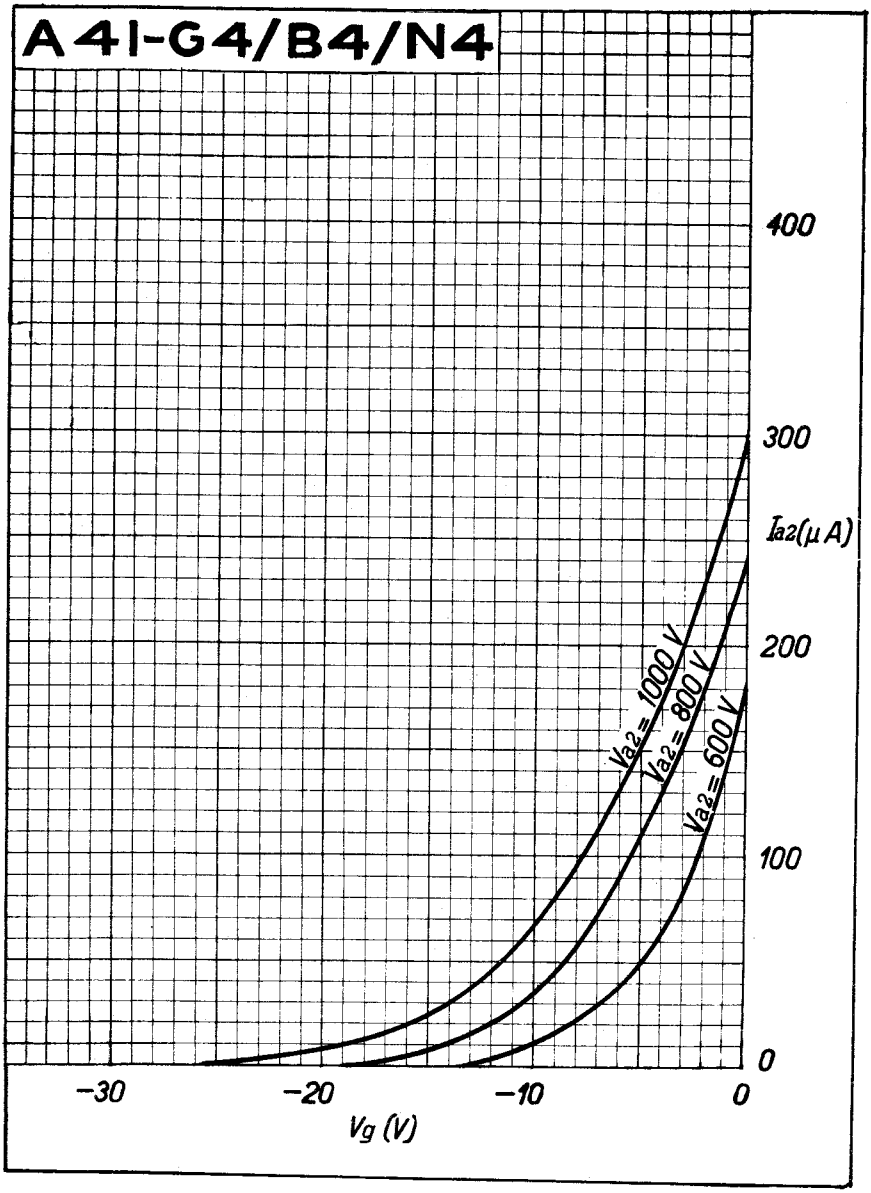






A41-G4/B4/N4

Mullard
OSCILLOGRAPH TUBE



1839/2

TELEVISION TUBE A44-120W/R

QUICK REFERENCE DATA

44cm (17in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. Suitable for use in receivers with push-through presentation. This tube is fitted with a ring trap base.

Deflection angle	110	deg
Focusing		Electrostatic
Light transmission	48	%
Maximum overall length	291	mm

This data should be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS-CATHODE RAY TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations-Cathode Ray Tubes'.

Note:- (Applies to series operation only)

The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	18	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
V_g for visual extinction of focused raster	-40 to -77	V
*V_k for visual extinction of focused raster	36 to 66	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN (Metal backed)

Fluorescent colour		White
Light transmission	48	%
Useful screen area		See page 6

FOCUSING (Electrostatic)

The range of focus voltage shown in 'Operating Conditions' results in optimum overall focus at a beam current of 250μA.

DEFLECTION (Magnetic)

Diagonal deflection angle	110	deg
Horizontal deflection angle	100	deg
Vertical deflection angle	83	deg

CAPACITANCES

$c_{g\text{-all}}$	7.0	pF
$c_{k\text{-all}}$	5.0	pF
$c_{a2+a4\text{-M}}$	700 to 1300	pF
$c_{a2+a4\text{-B}}$	200	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

RING TRAP

For flashover protection to the receiver, parallel spark gaps are included for all the pins in the base of this tube, and the common connection is made to pin 5. These spark gaps are intended as part of a system for full flashover protection. A direct connection must always be made from pin 5 to the external conductive coating. Any electrode supplied directly from a high energy source (such as the H.T. line) should be provided with a series resistor.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations-Cathode Ray Tubes'.

Centring magnet field intensity	0 to 800	A/m
Maximum distance between centre of centring field and reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations-Cathode Ray Tubes'.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred on the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4} = 0$) (see note 1)	18	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f=50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50Hz)	500	kΩ

NOTES

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to + 5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds, $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on, a decrease in $V_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2.0MΩ.

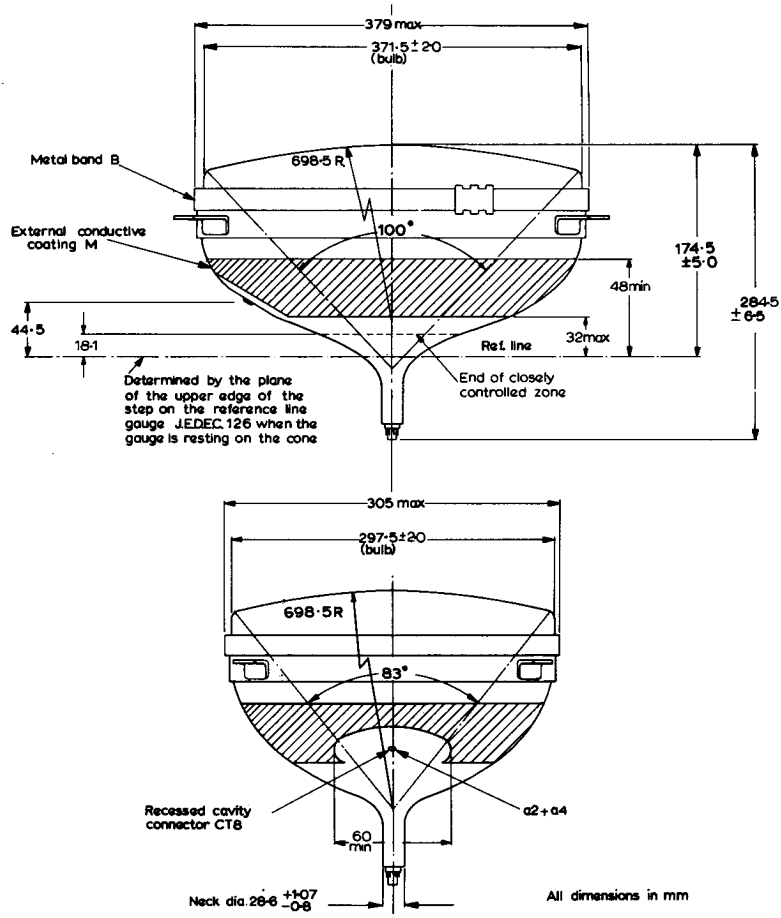
   The mounting lugs will be in electrical contact with the metal band.

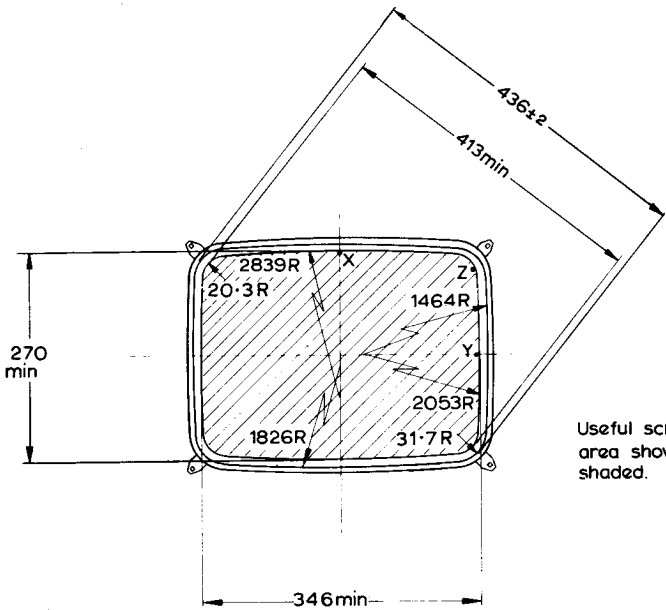
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 18kV.

WEIGHT

Tube alone (approx.)	5.5	kg

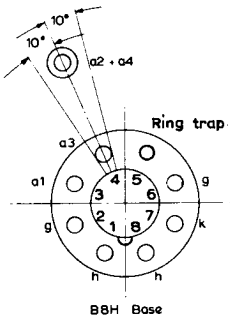

379 max
371·5±2·0 (bulb)
Metal band B
698·5 R
External conductive coating M
100°
174·5 ±5·0
48 min
284·5 ±6·5
44·5
18·1
32 max
Ref. line
Determined by the plane of the upper edge of the step on the reference line gauge J.E.D.E.C. 126 when the gauge is resting on the cone
End of closely controlled zone
305 max
297·5±2·0 (bulb)
698·5R
83°
Recessed cavity connector CT8
α2+α4
60 min
Neck dia. 28·6 +1·07 −0·8
All dimensions in mm



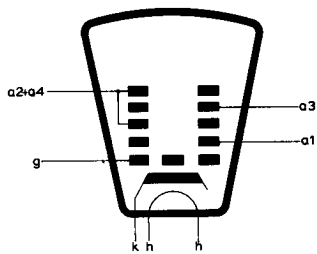
Useful screen area shown shaded.

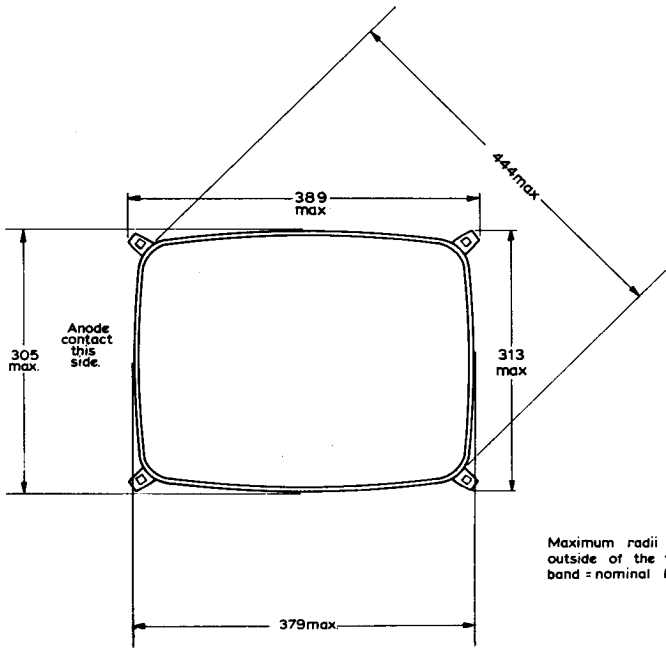
Bulb dimensions

All dimensions in mm

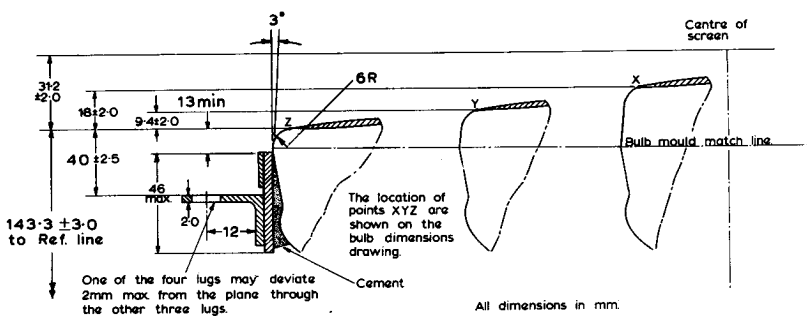


B8H Base



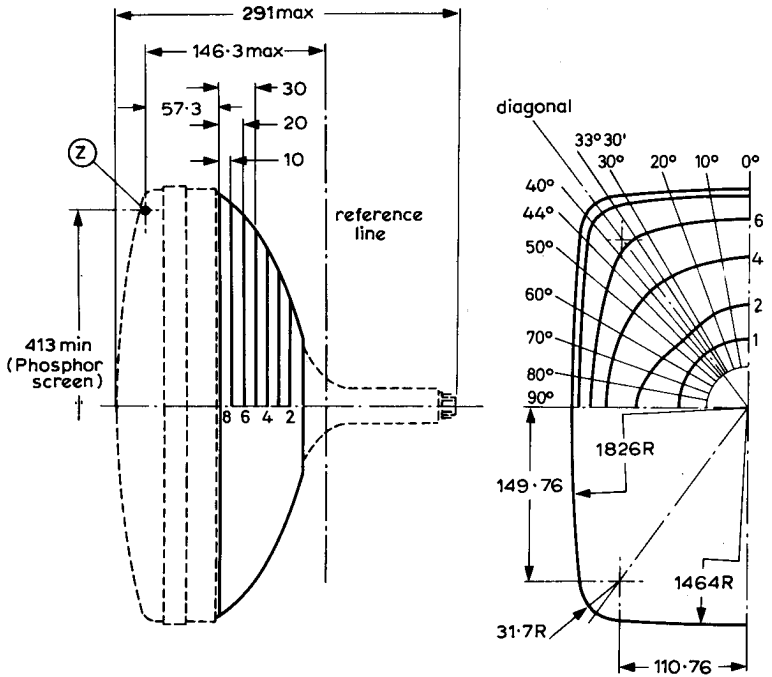


Maximum radii of the outside of the tension band = nominal bulb radius + 4·0



All dimensions in mm.

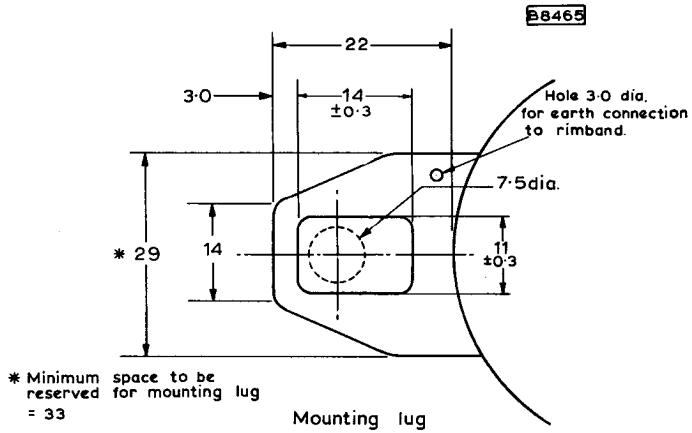
MAXIMUM CONE CONTOURS



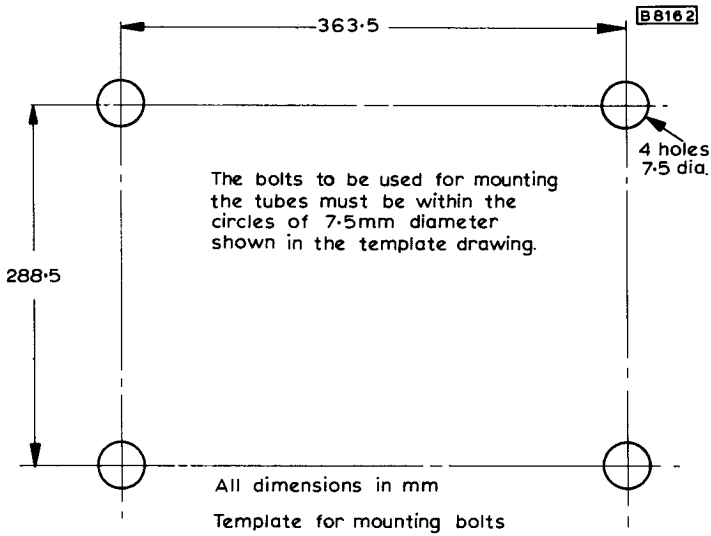
DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page 8)

Section	Nominal distance from point "Z"	Distance from centre (max. values) 0° Long axis	10°	20°	30°	33°30'	36°30' Diagonal	40°	44°	50°	60°	70°	80°	90° Short axis
1	128	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
2	117.3	95.9	95.2	93.0	92.3	92.1	92.1	92.3	92.6	93.1	93.8	94.6	94.9	95.1
3	107.3	118.1	117.8	118.3	118.3	118.6	119.2	117.8	117.7	117.2	115.5	113.3	111.2	109.8
4	97.3	135.0	136.1	138.3	139.9	141.0	141.6	141.1	138.5	135.4	130.5	125.6	121.8	120.8
5	87.3	149.5	151.1	155.1	159.1	161.3	162.0	161.5	157.5	151.0	142.0	135.8	130.8	129.5
6	77.3	162.5	164.0	168.8	176.0	179.0	179.5	178.0	173.5	163.4	150.8	143.3	138.3	136.4
7	67.3	172.5	174.4	180.1	190.0	194.1	196.3	194.9	186.8	174.5	159.1	149.3	143.9	141.7
8	57.3	179.7	183.1	189.3	201.1	207.4	210.9	206.1	196.0	182.8	165.5	154.0	147.9	145.6

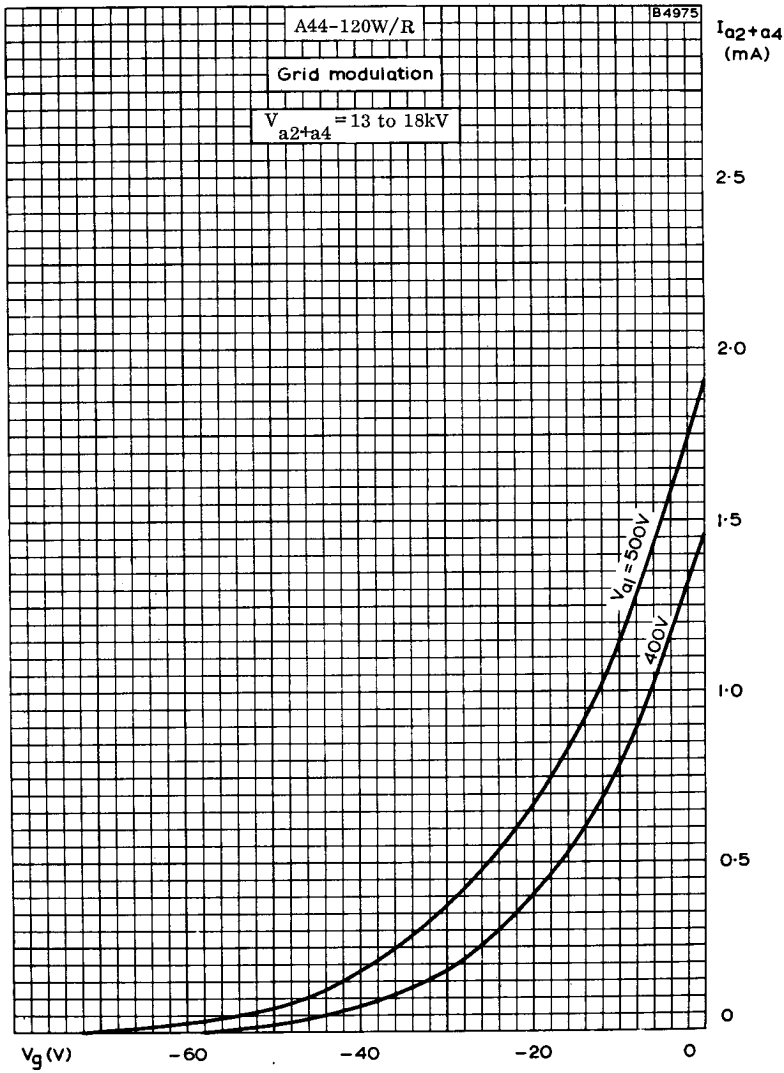
All dimensions in millimetres



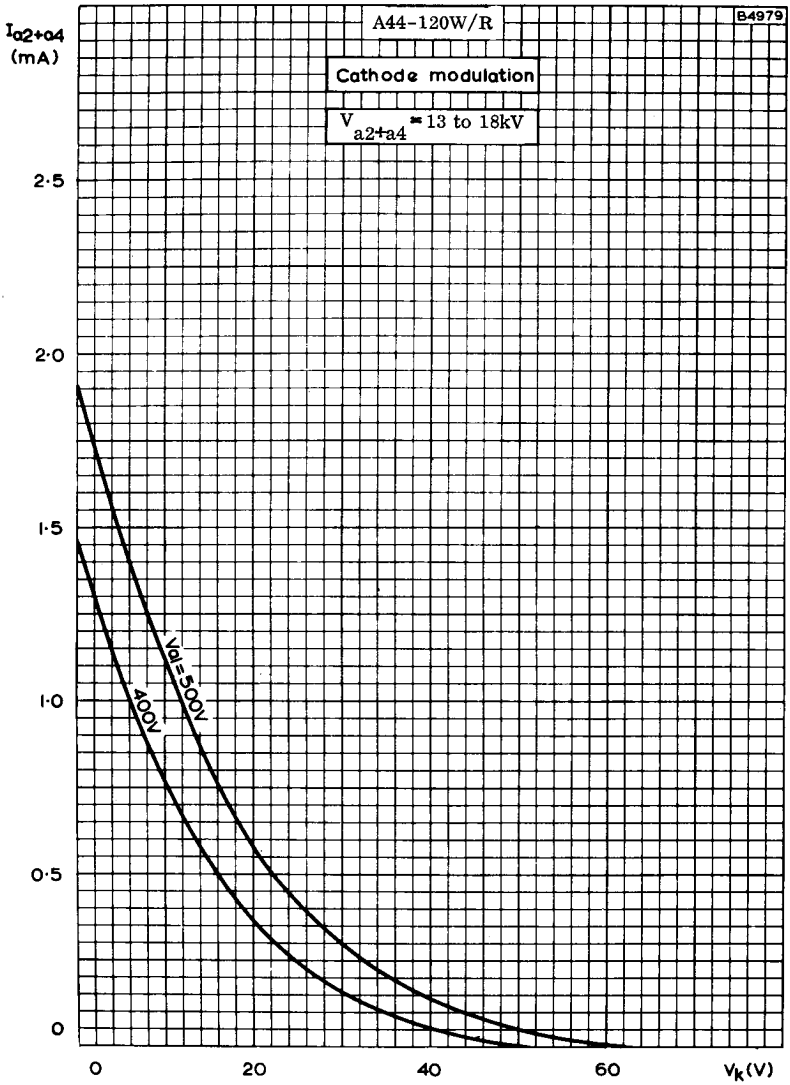
Mounting lug



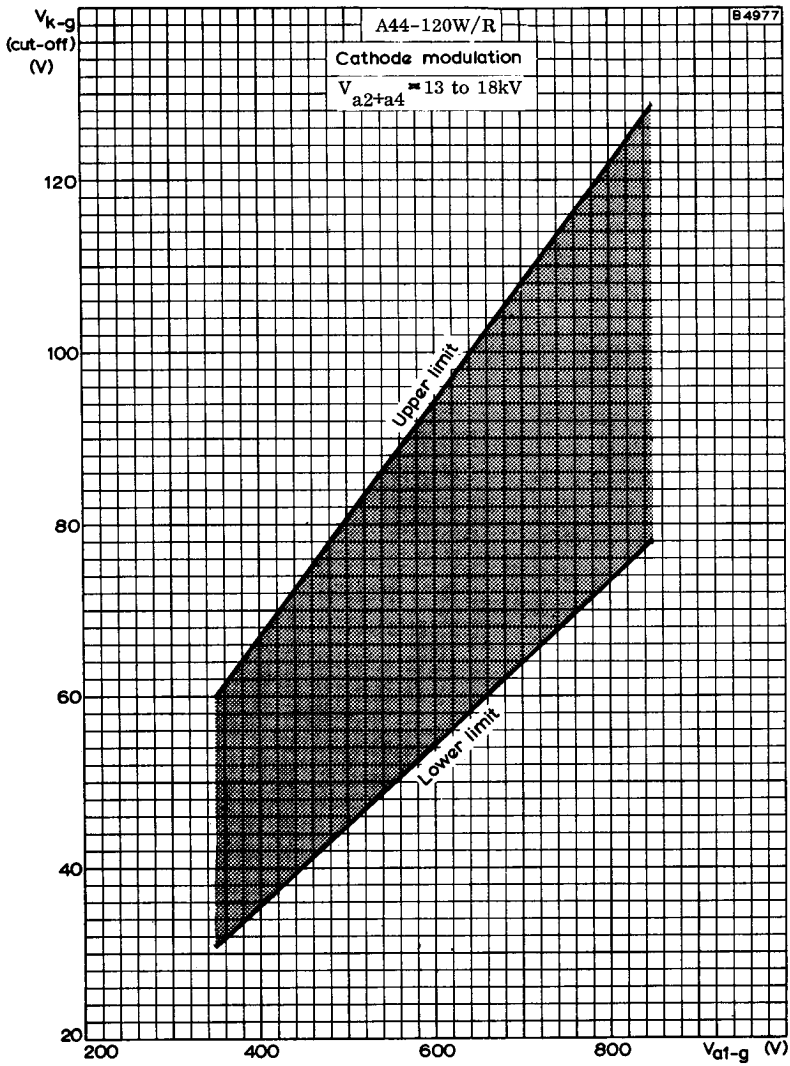
Template for mounting bolts



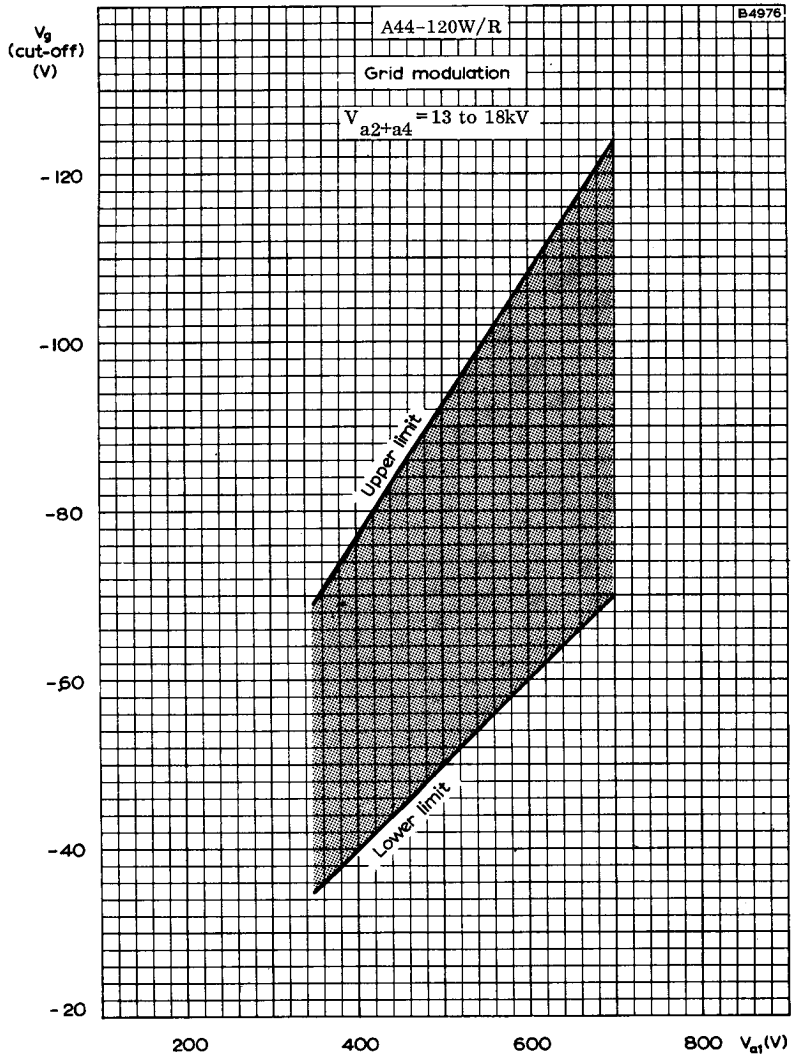
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE
CATHODE MODULATION



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE.
CATHODE MODULATION



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION

QUICK REFERENCE DATA

47cm (19 in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. This tube is electrically identical to the A47-14W.

Deflection	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	50	%
Maximum overall length	30.9	cm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES, which precede this section of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV ←
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission (approx.)	50	%
Useful screen area	see page D6	

FOCUSING

Electrostatic

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 250μA.

DEFLECTION

Double magnetic

The deflection coils should be designed so that their internal contour is in accordance with J.E.D.E.C. gauge 126, and should provide a pull-back of 4mm on a nominal tube.

CAPACITANCES

$c_{g\text{-all}}$	6.0	pF
$c_{k\text{-all}}$	4.0	pF
$c_{a2+a4\text{-}M}$	1000 to 1500	pF
$c_{a2+a4\text{-}B}$	250	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be earthed, and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations - Cathode Ray Tubes'.

Centring magnet field intensity	0 to 10	Gs
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations - Cathode Ray Tubes'.

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4} = 0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
$+v_{a3(pk)}$ max. (see note 2)	2.5	kV
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on a decrease in $V_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) must be connected to the chassis via a 2MΩ resistor. Soldering tags are provided for this purpose.

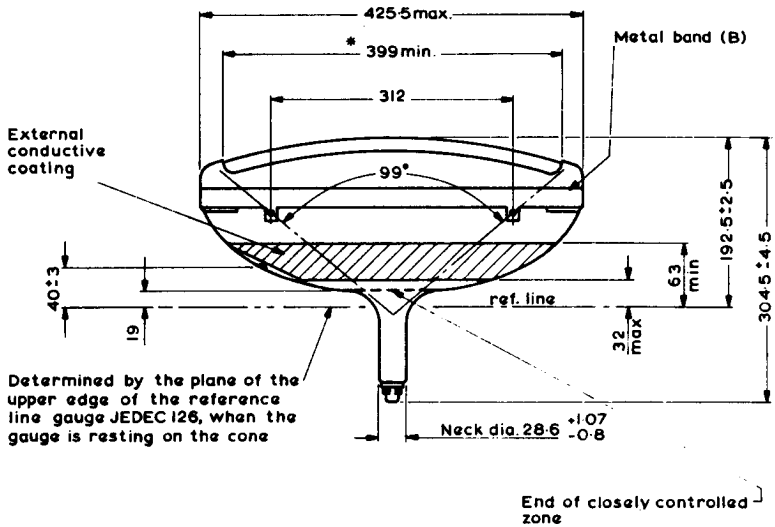
   The mounting lugs will not necessarily be in electrical contact with the metal band.

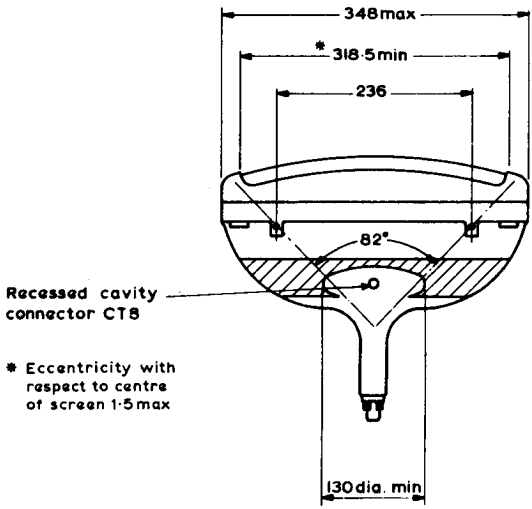
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

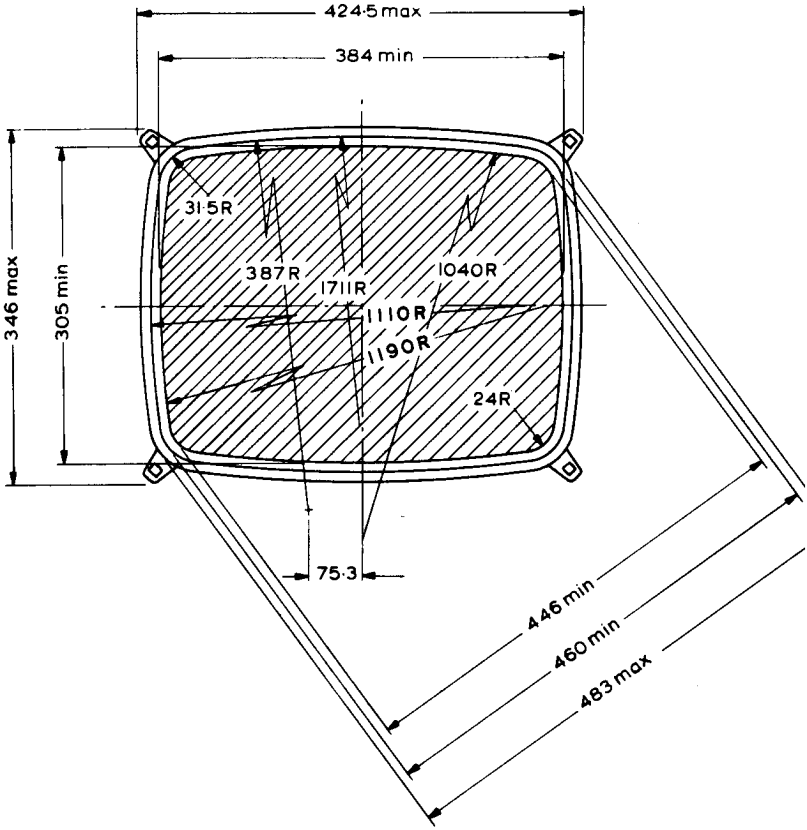
WEIGHT

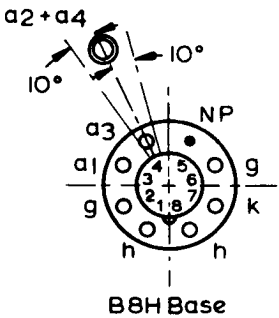
Tube alone	7.5	kg
	16.5	lb

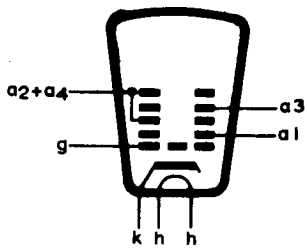




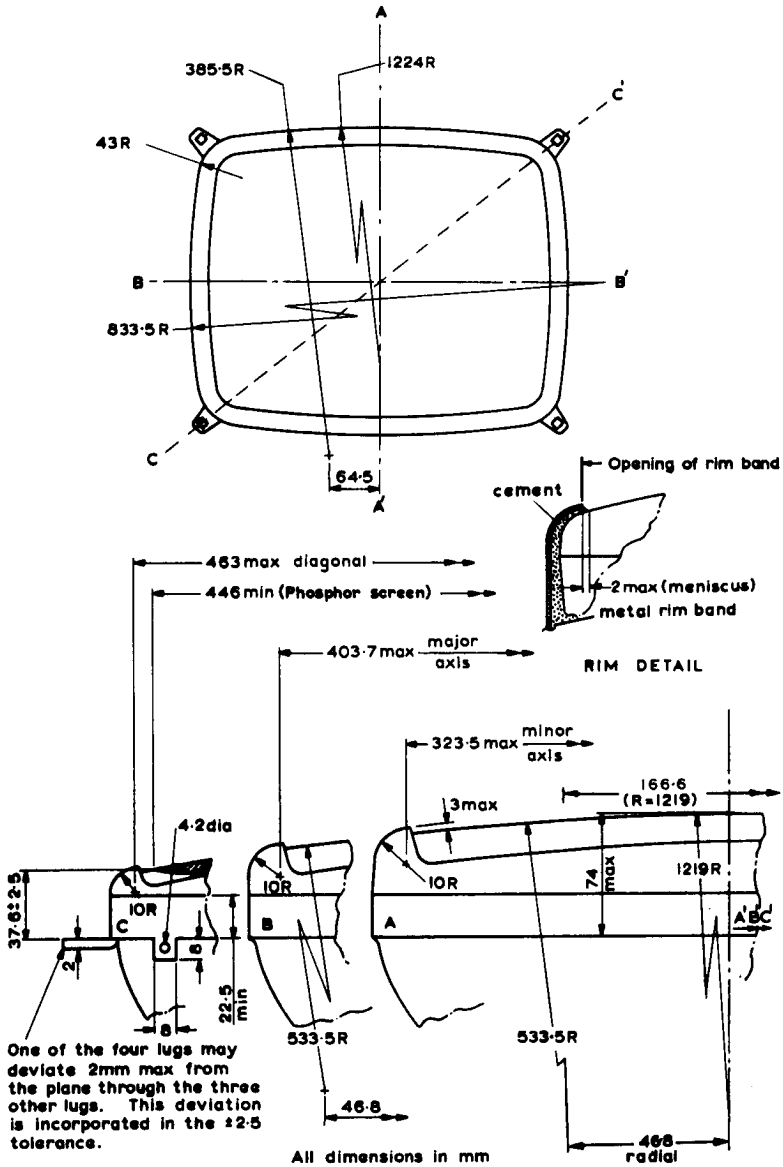
All dimensions in mm.

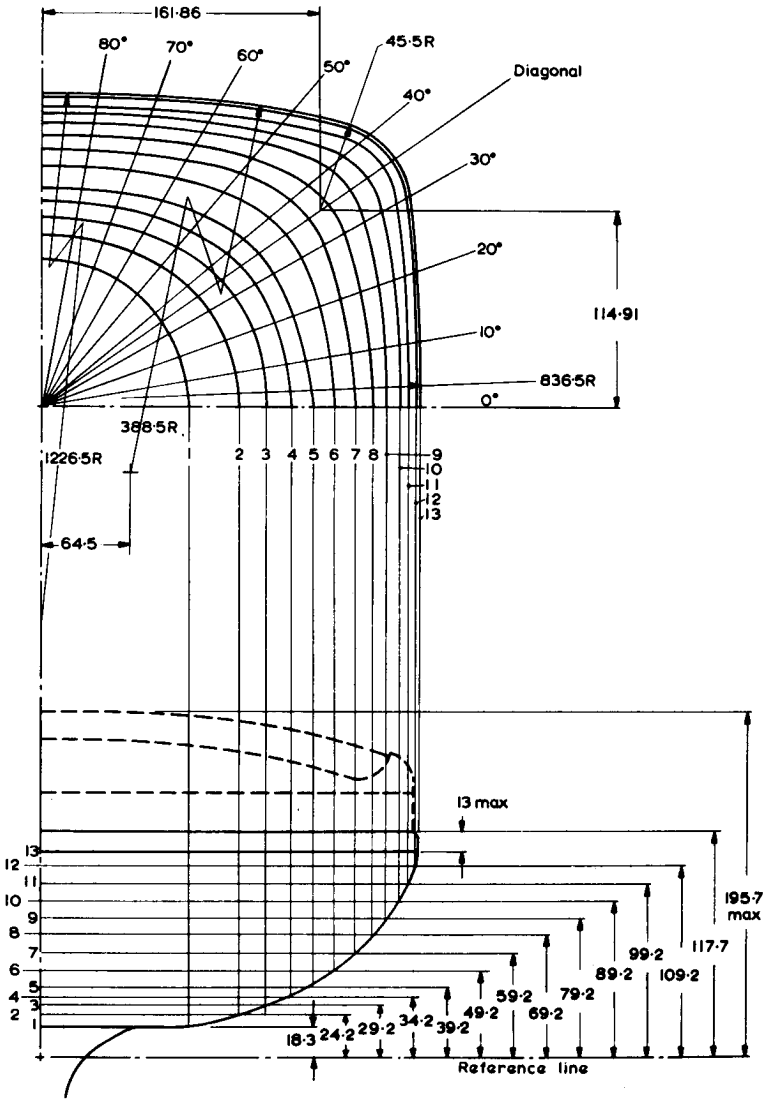






All dimensions in mm


A
385·5R
1224R
C'
43R
B
B'
833·5R
C
64·5
A'
Opening of rim band
cement
2 max (meniscus)
metal rim band
463 max diagonal
446 min (Phosphor screen)
403·7 max major axis
RIM DETAIL
323·5 max minor axis
166·6 (R=1219)
3 max
4·2 dia
10R
37·6±2·5
C
6
2
8
22·5 min
B
A
74 max
1219R
A'B'C'
533·5R
533·5R
46·8
466 radial
One of the four lugs may deviate 2mm max from the plane through the three other lugs. This deviation is incorporated in the ±2·5 tolerance.
All dimensions in mm

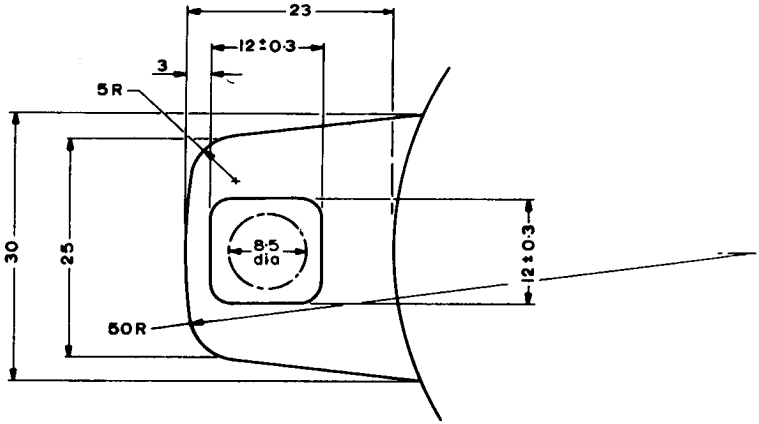


MAXIMUM CONE CONTOURS

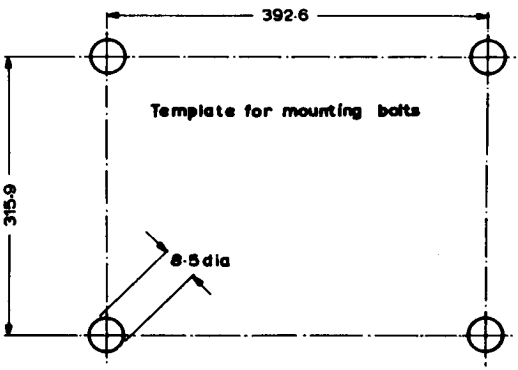
DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page D8)

Section	0° long	10°	20°	30°	35°22' diagonal	40°	50°	60°	70°	80°	90° short
1	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5
2	111.2	111.2	110.8	108.8	107.7	106.3	103.7	100.6	98.1	96.2	95.6
3	128.5	182.5	127.3	125.5	124.0	122.2	117.9	113.2	108.9	106.6	106.2
4	142.2	141.1	140.3	138.8	137.5	135.9	130.6	124.4	119.0	115.8	115.3
5	152.1	151.1	150.9	150.6	149.5	147.6	140.6	133.4	127.2	123.6	122.7
6	166.7	166.6	167.6	169.5	169.1	167.0	158.1	148.2	140.9	136.5	134.9
7	178.1	178.6	180.6	184.7	185.7	183.1	172.1	160.7	151.7	146.3	144.7
8	187.5	188.3	191.6	198.0	200.1	197.2	183.7	170.3	160.2	154.4	152.5
9	195.4	196.6	201.7	210.3	213.7	210.1	194.1	178.8	167.9	161.4	159.3
10	202.1	203.9	210.1	221.2	225.3	221.1	202.8	185.8	174.4	167.5	165.4
11	208.4	210.4	217.8	230.5	235.3	231.2	209.9	192.0	180.0	172.7	170.5
12	213.6	216.1	223.9	237.0	241.8	238.1	215.4	197.2	184.6	177.3	175.0
13	215.8	218.2	225.8	239.2	244.0	240.4	218.1	199.7	186.6	179.3	177.0

All dimensions in mm

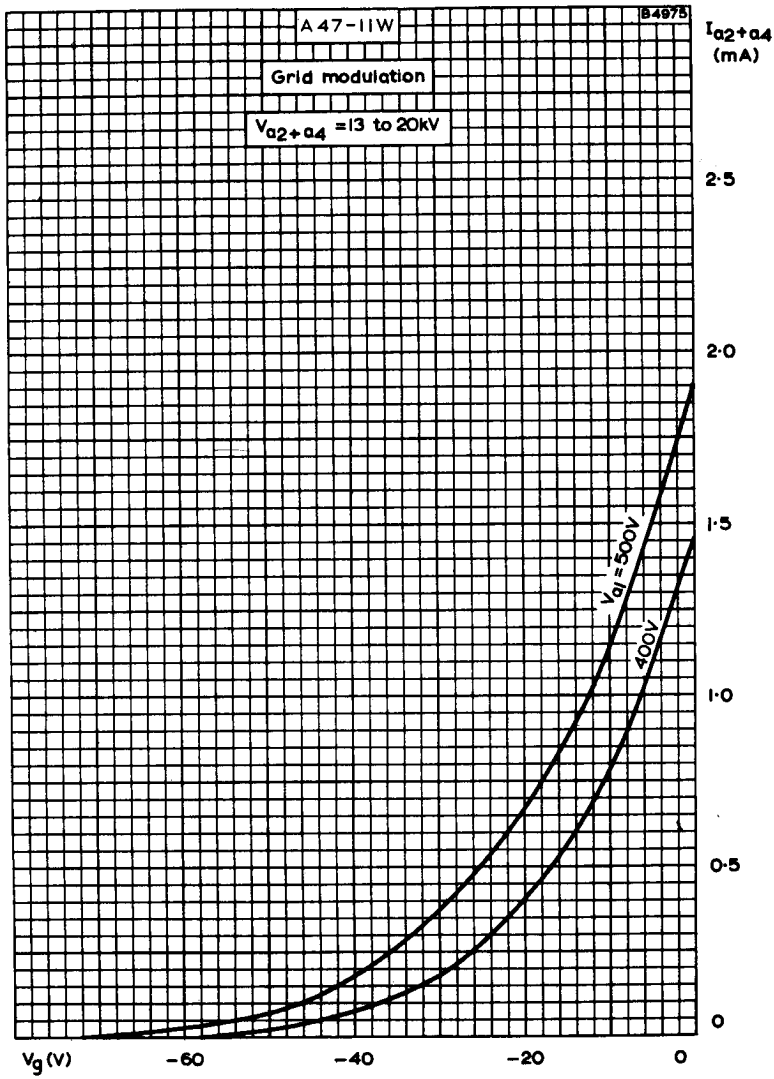


Mounting lug

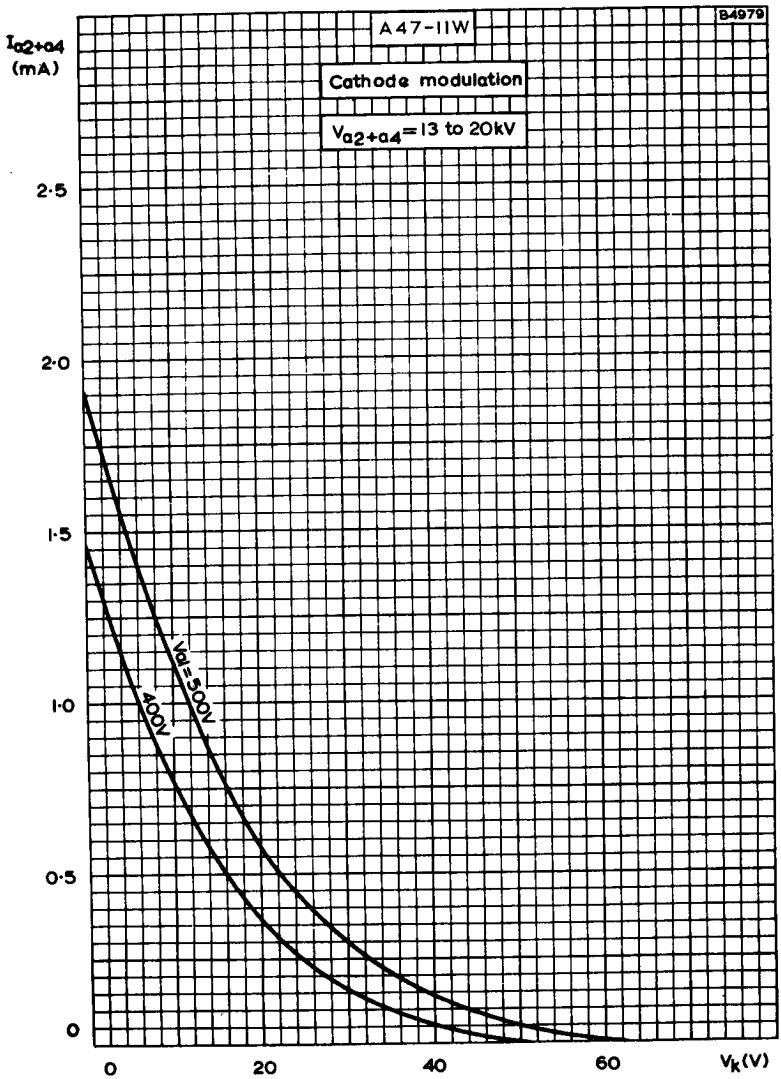


All dimensions in mm.

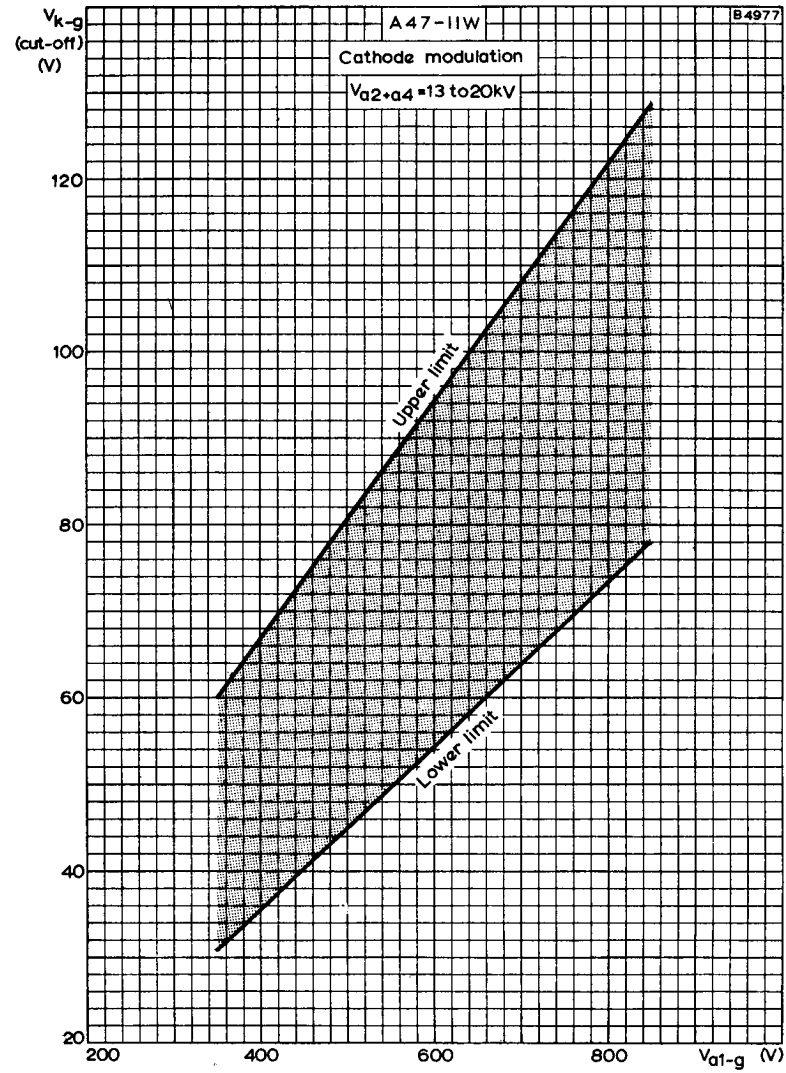
The bolts to be used for mounting the tube must be within the circles of 8,5mm diameter shown in the template drawing.



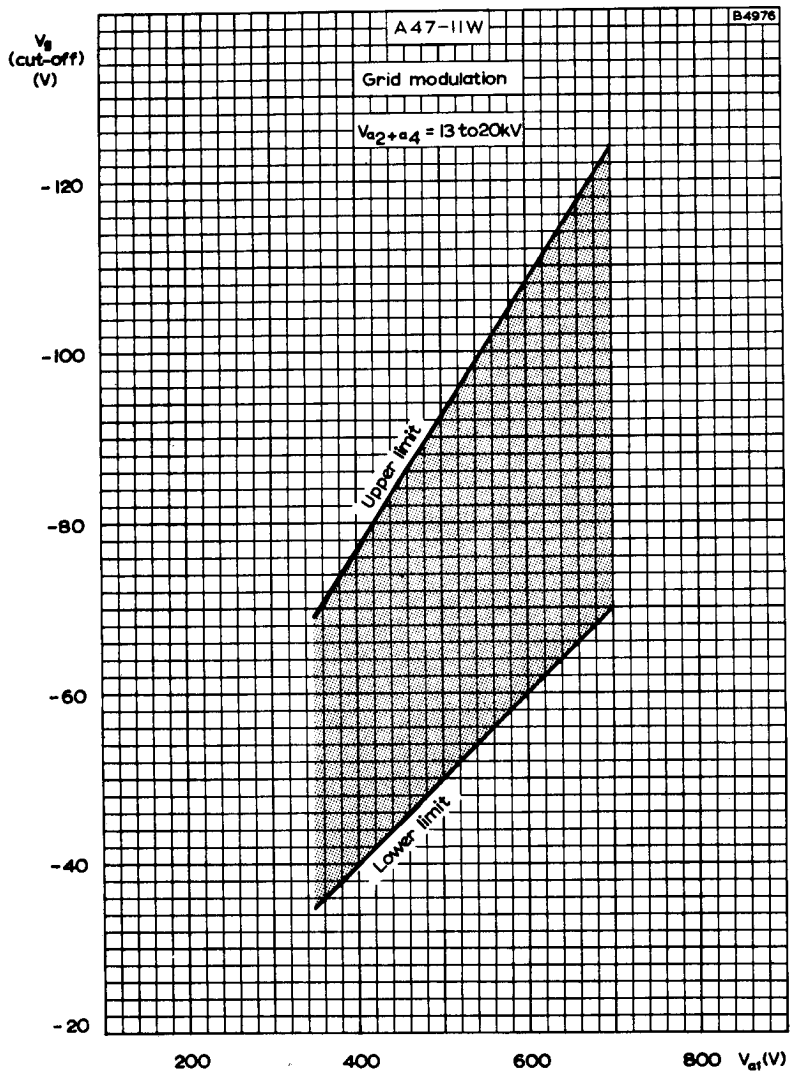
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION.

TELEVISION TUBE A47-14W

QUICK REFERENCE DATA		
47cm (19in) direct viewing television tube with metal backed screen. This tube is electrically identical to the A47-11W.		
Deflection	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	50	%
Maximum overall length	30.9	cm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES, which precede this section of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission (approx.)	50	%
Useful screen area	see page D6	

FOCUSING

Electrostatic

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 250μA.

DEFLECTION

Double magnetic

The deflection coils should be designed so that their internal contour is in accordance with J.E.D.E.C. gauge 126, and should provide a pull-back of 4mm on a nominal tube.

CAPACITANCES

c_{g-all}	6.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	1000 to 1500	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be earthed, and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations - Cathode Ray Tubes'.

Centring magnet field intensity	0 to 10	Gs
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations - Cathode Ray Tubes'.

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4} = 0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
$+v_{a3(pk)}$ max. (see note 2)	2.5	kV
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

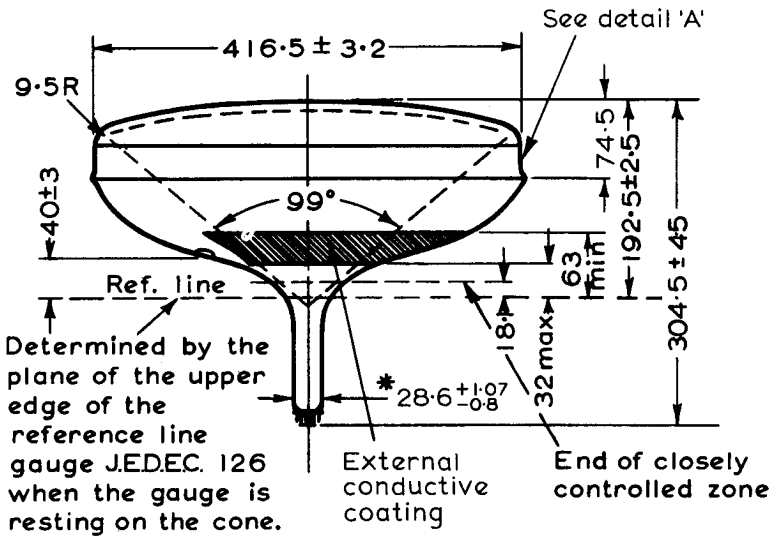
4. During an equipment warm-up period not exceeding 15 seconds $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on a decrease in $v_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

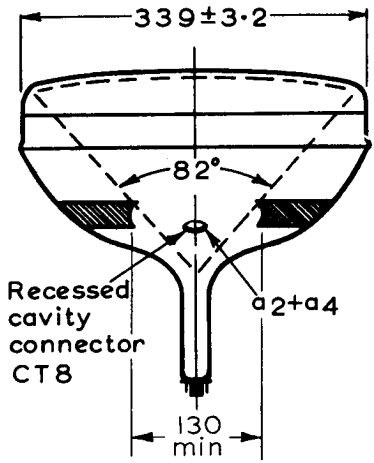
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

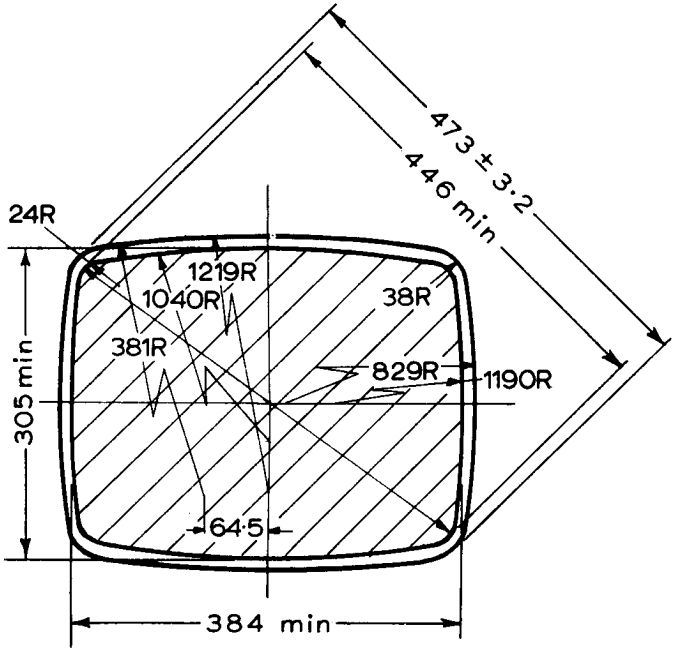
WEIGHT

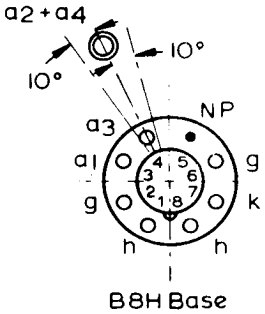
Tube alone	7.0	kg
	15.4	lb

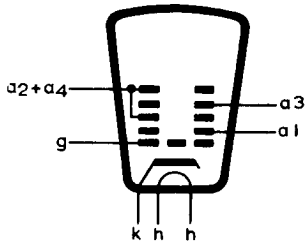




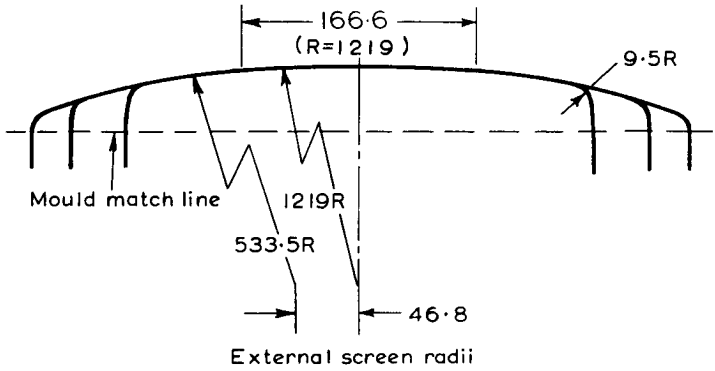
*The maximum value is determined by the reference line gauge



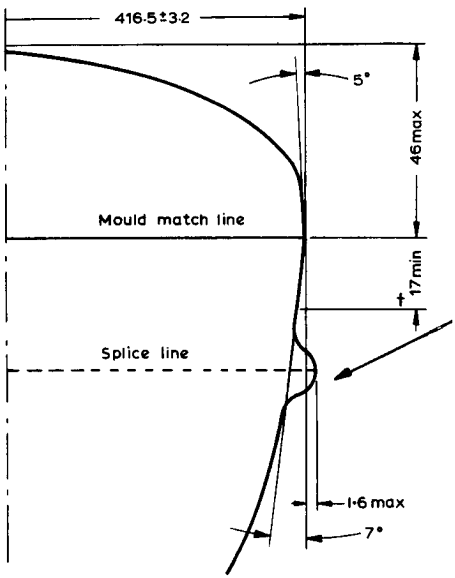




All dimensions in mm



Detail 'A'



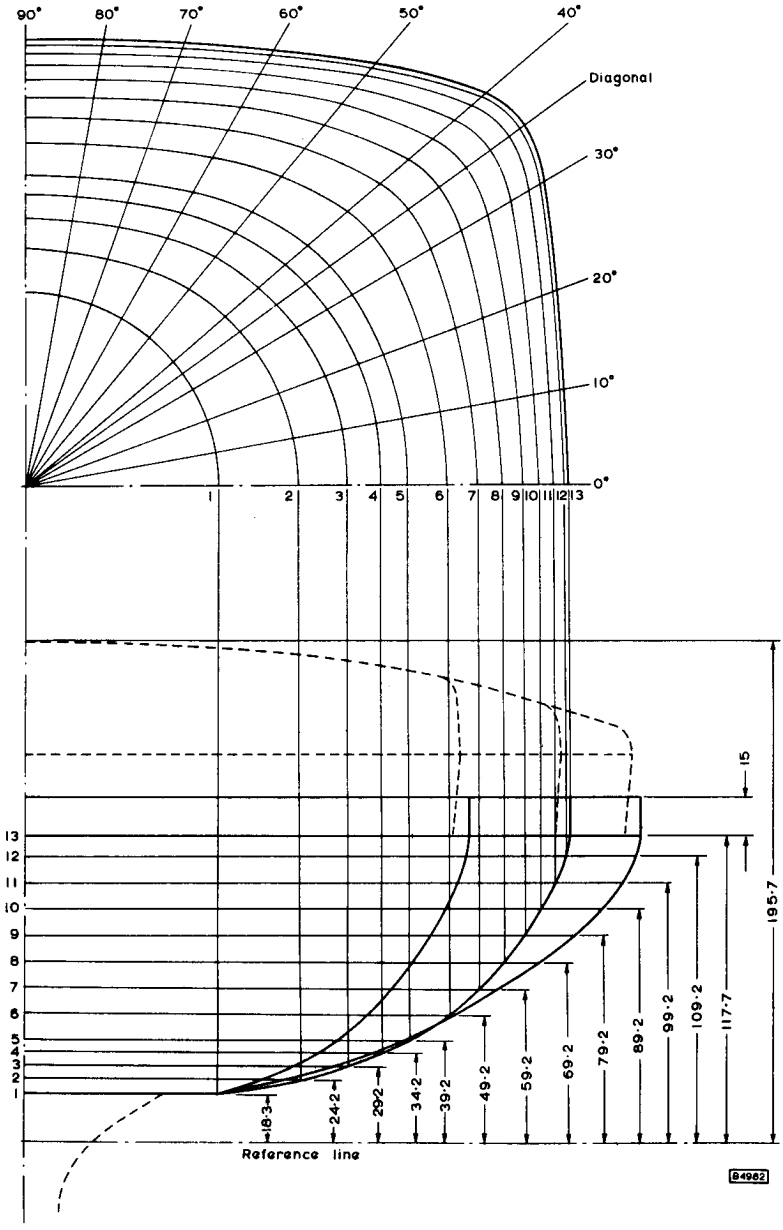
†Undisturbed area between mould match line and splice line

All dimensions in mm B5009

The bulge at the splice line seal may increase the indicated maximum values for envelope width, diagonal and height by not more than 3.2mm, but at any point around the seal, the bulge will not protrude more than 1.6mm beyond the envelope surface at the mould match line.

The mounting arrangement should be designed such that for satisfactory clamping it does not depend on the presence of a bulge at the splice line.

The undisturbed area between mould match line and splice line is 15mm minimum. This should be the width of the tube support band.

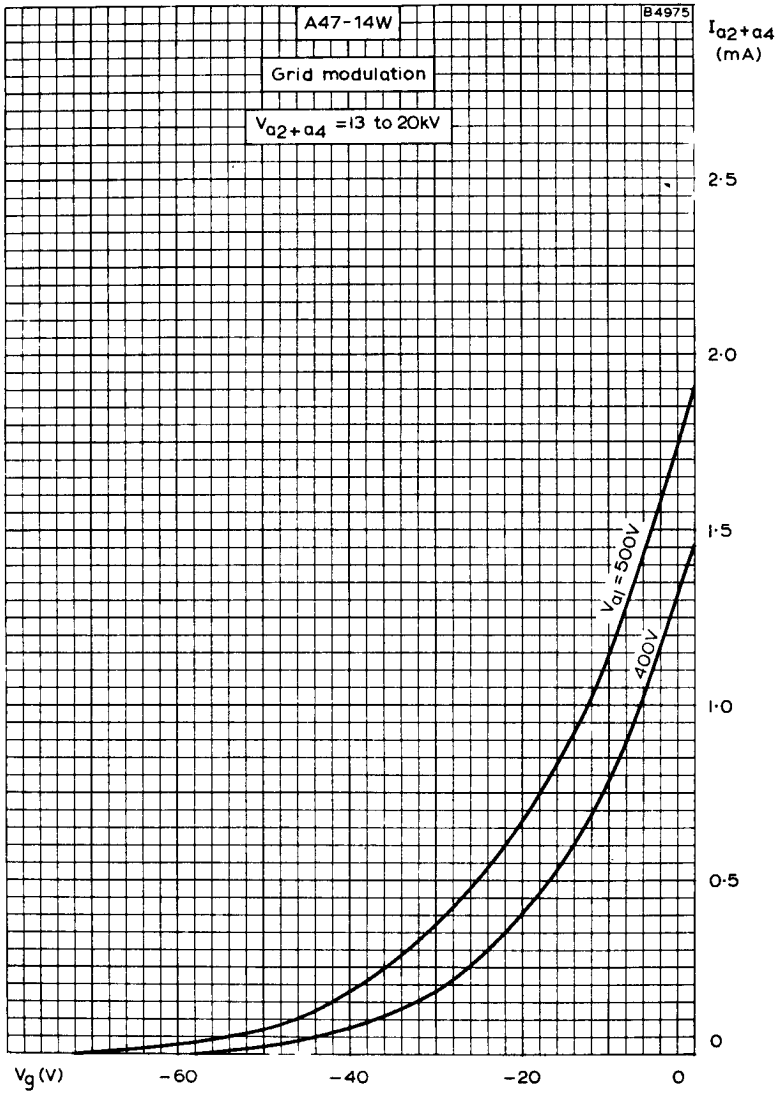


MAXIMUM CONE CONTOURS

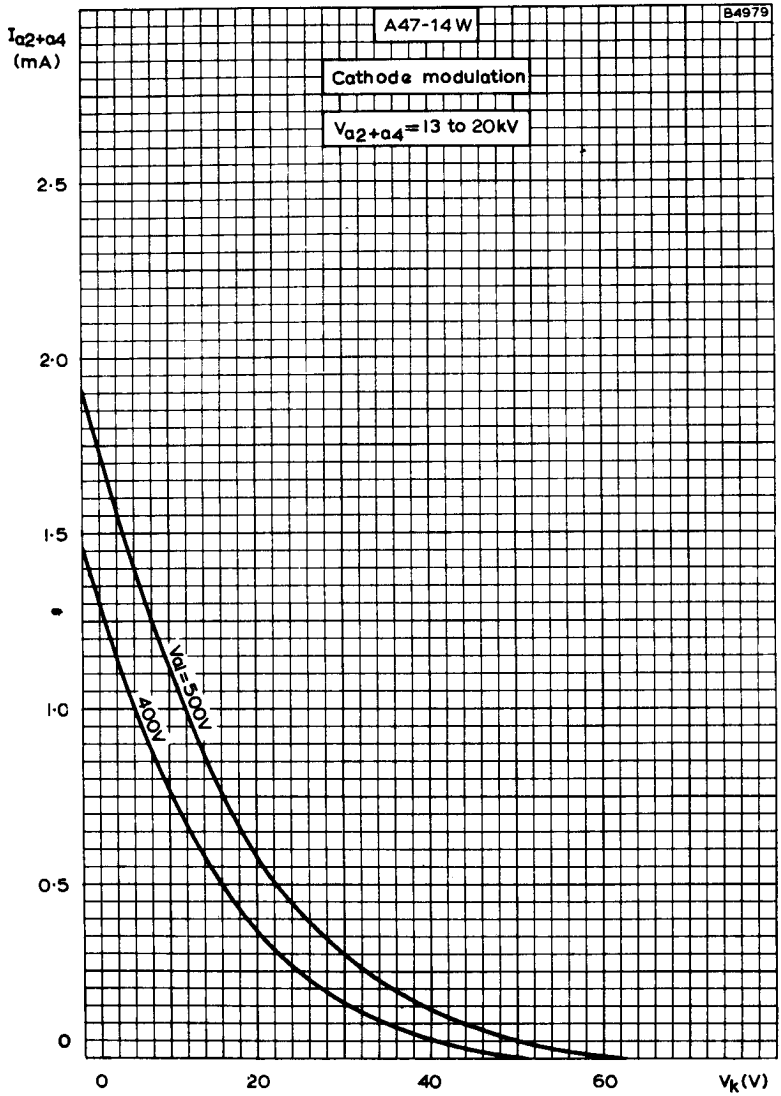
DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page D8)

Section	Nominal height above Ref. line	0° long	10°	20°	30°	Diagonal	40°	50°	60°	70°	80°	90° short
1	18.3	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
2	24.2	106.1	105.6	105.6	103.8	102.7	101.6	99.1	96.2	93.7	92.4	92.4
3	29.2	125.3	125.7	124.6	122.3	120.6	118.9	115.1	111.0	106.7	104.2	103.9
4	34.2	138.2	138.9	137.8	136.0	134.3	132.3	127.5	121.8	117.0	113.7	113.0
5	39.2	148.6	149.0	148.5	147.7	146.3	144.2	138.0	131.3	125.2	121.6	120.6
6	49.2	164.5	164.6	165.2	167.3	166.8	164.6	156.0	146.8	139.0	134.5	133.1
7	59.2	176.5	176.6	178.7	183.4	184.0	181.4	170.2	158.9	149.8	144.6	142.9
8	69.2	186.3	186.5	190.3	197.0	198.9	195.8	182.3	169.0	158.9	152.8	151.1
9	79.2	194.2	195.0	200.2	209.1	212.0	208.6	192.5	177.5	166.2	159.8	157.9
10	89.2	200.7	202.1	208.4	219.6	223.5	219.7	200.4	184.2	172.3	165.8	163.4
11	99.2	206.0	208.0	215.0	227.9	232.8	228.6	206.6	189.2	176.9	170.0	167.9
12	109.2	210.0	212.3	219.6	233.0	238.1	233.9	210.9	193.2	180.5	173.6	171.3
13	117.7	212.2	214.6	221.8	234.9	240.5	236.0	213.1	195.1	182.6	175.7	173.5

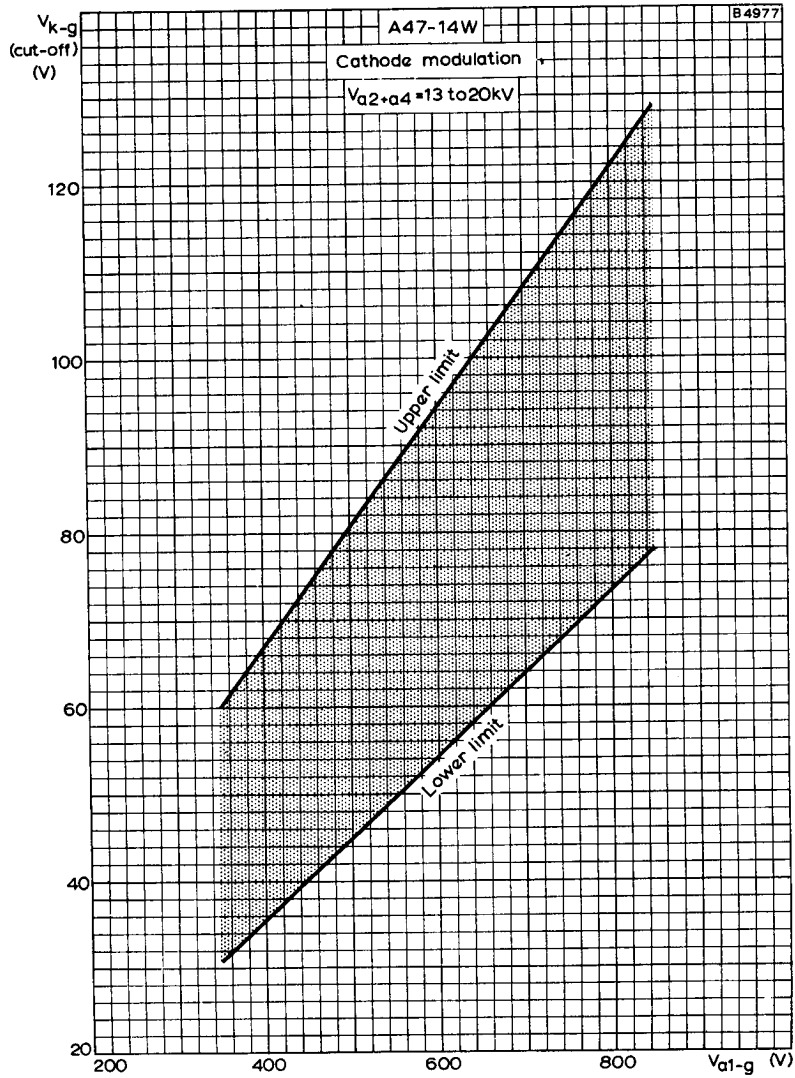
All dimensions in mm.



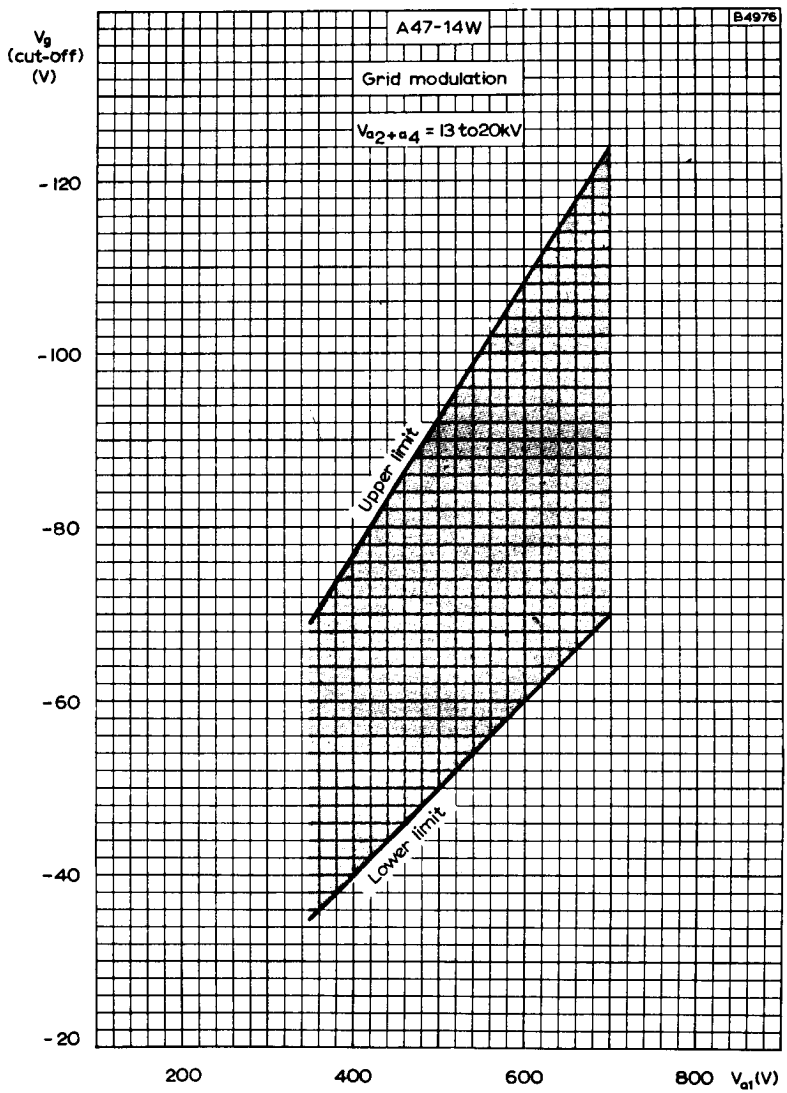
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE. GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION

TELEVISION TUBE A47-18W

PRELIMINARY DATA

QUICK REFERENCE DATA

47 cm (19 in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. This tube is electrically identical to the AW47-91.

Deflection	**110**	**deg**
Focusing	**Electrostatic**	
Light transmission	**75**	**%**
Overall length	**30.9**	**cm**

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS-CATHODE RAY TUBES, which precede this section of the handbook.

HEATER

Suitable for series or parallel operation

Vh	6.3	V
Ih	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5 Vr.m.s. when the supply is switched on. When used in a series heater chain, a current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

Va2 + a4	18	18	kV
Va3 (focus electrode control range)	0 to 400	0 to 400	V
Va1	400	500	V
Vg for visual extinction of focused raster	-40 to -77	-50 to -93	V
* Vk for visual extinction of focused raster	36 to 66	45 to 79	V

* For cathode modulation, all voltages are measured with respect to the grid.

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission (approx.)	75	%
Useful screen area	see pages D5 and D6	

FOCUSING

Electrostatic

The range of focus voltages shown in "OPERATING CONDITIONS" results in optimum overall focus at a beam current of 100 μA.

DEFLECTION

Double magnetic

The deflection coils should be designed so that their internal contour is in accordance with JEDEC gauge 126, and should provide a pull-back of 4 mm on a nominal tube.

CAPACITANCES

cg - all	6.0	pF
ck - all	4.0	pF
ca2 + a4 - M	1000 to 1500	pF
ca2 + a4 - B	250	pF

EXTERNAL CONDUCTIVE COATING

This tube has and external conductive coating, M, which must be earthed, and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

RASTER CENTRING

See note under this heading in "General Operational Recommendations - Cathode Ray Tubes".

Centring magnet field intensity	0 to 10	G
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

JEDEC 126, For details see 'General Operational Recommendations - Cathode Ray Tubes'.

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40 mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handing the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

DESIGN CENTRE RATINGS

* Va2+a4 max. (at Ia2+a4 = 0)	18	kV
Va2+a4 min.	13	kV
+Va3 max.	1.0	kV
-Va3 max.	500	V
**+va3 (pk) max.	2.5	kV
Va1 max.	700	V
Va1 min.	350	V
**-vg (pk) max.	400	V
‡-Vg max.	150	V
±Ia3 max.	25	μA
±Ia1 max.	5	μA
† Vh-k		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
Rh-k max.	1.0	MΩ
Zk-e max. (f = 50 c/s)	100	kΩ

R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

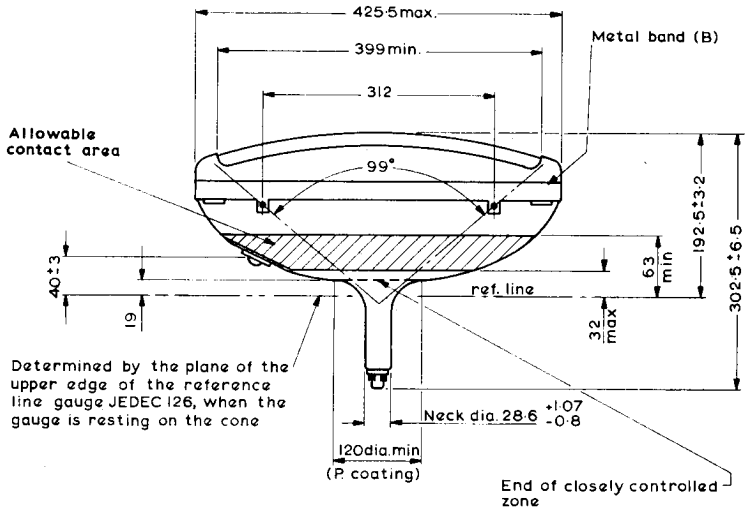
* Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

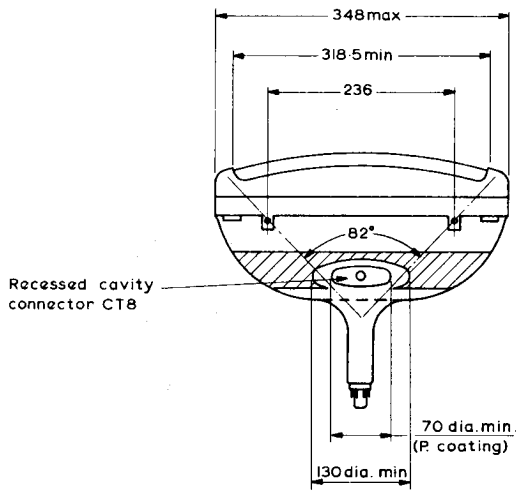
** Maximum pulse duration 22 % of a cycle with a maximum of 1.5 ms.

‡ The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to + 2V.
It is advisable to limit the positive excursion of the video signal to + 5V (pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

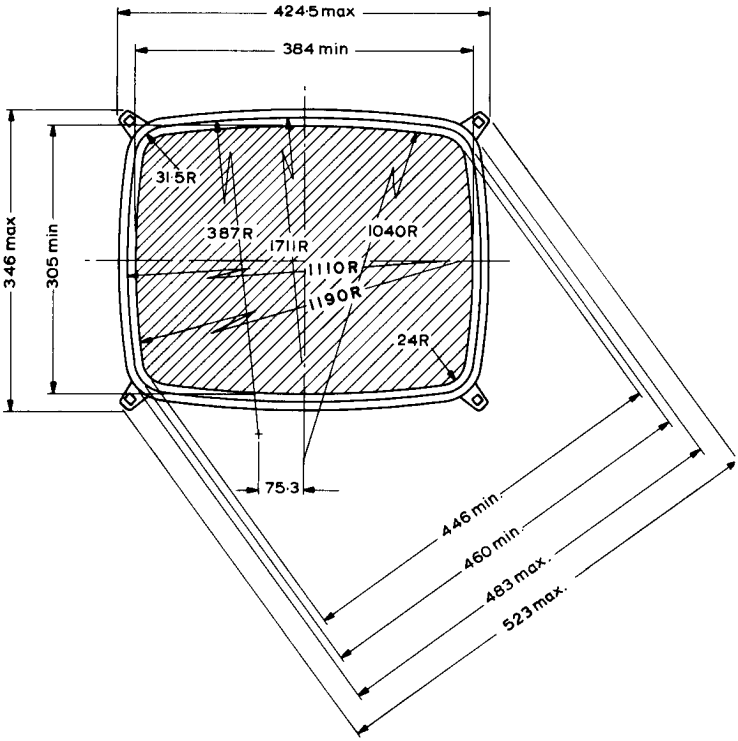
†During an equipment warm-up period not exceeding 15 seconds $V_{h-k\ (pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching-on a decrease in $V_{h-k\ (pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

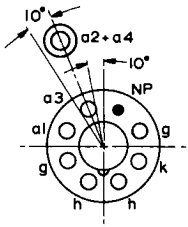
Note. - The metal band (B) must be connected to the chassis via a 2 MΩ resistor, soldering tags are provided for this purpose.
The mounting lugs will not necessarily be in electrical contact with the metal band.



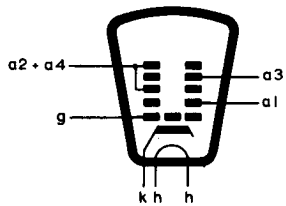


All dimensions in mm.





B8H Base



All dimensions in mm

TELEVISION TUBE A47-26W

TENTATIVE DATA

QUICK REFERENCE DATA

47cm (19in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. This tube is electrically identical to the A47-11W. Suitable for use in receivers with push-through presentation.

Deflection	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	50	%
Maximum overall length	30.9	cm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission (approx.)	50	%
Useful screen area	See page D6	

FOCUSING

Electrostatic

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 250μA.

DEFLECTION

Magnetic

Diagonal deflection angle	110	deg
Horizontal deflection angle	99	deg
Vertical deflection angle	82	deg

The deflection coils should be designed to provide a pull-back of 4.0mm on a nominal tube.

CAPACITANCES

$c_{g\text{-all}}$	6.0	pF
$c_{k\text{-all}}$	4.0	pF
$c_{a2+a4\text{-M}}$	1000 to 1500	pF
$c_{a2+a4\text{-B}}$	250	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations - Cathode Ray Tubes'.

Centring magnet field intensity	0 to 10	Gs
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations - Cathode Ray Tubes'.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4}=0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
$+v_{a3(pk)}$ max. (see note 2)	2.5	kV
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_g$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flash-over within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on, a decrease in $v_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2.0MΩ.

   The mounting lugs will be in electrical contact with the metal band.

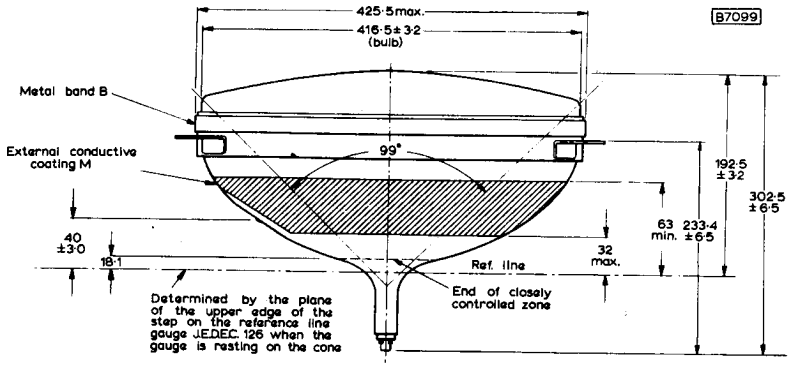
WARNING

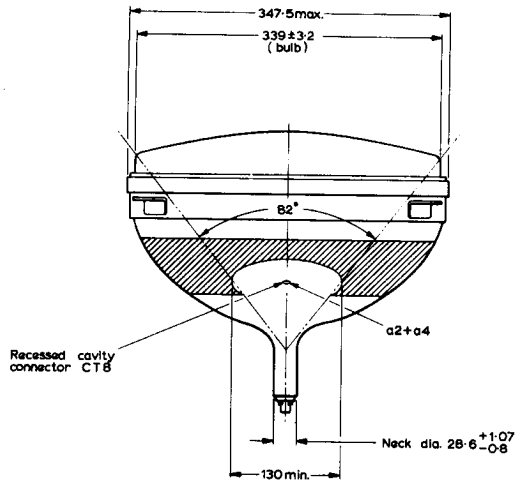
X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

WEIGHT

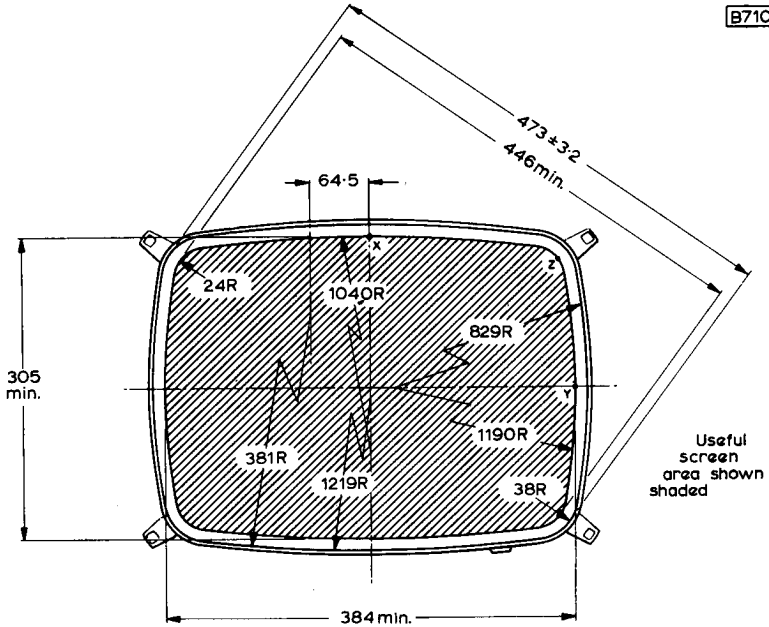
Tube alone (approx.)	8.0	kg

TELEVISION TUBE A47-26W

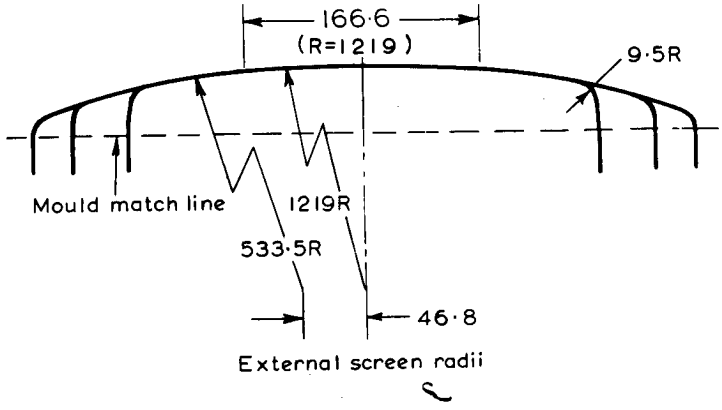




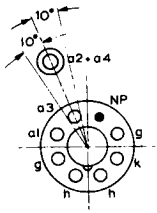
All dimensions in mm



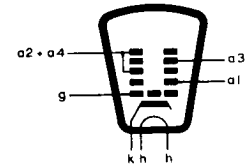
Bulb dimensions

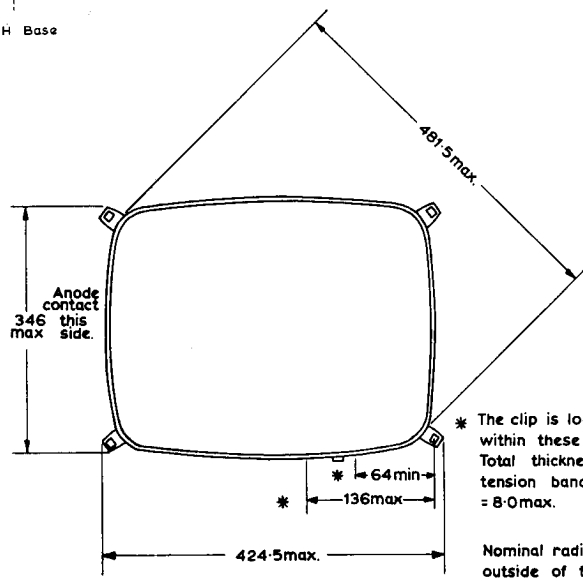


External screen radii



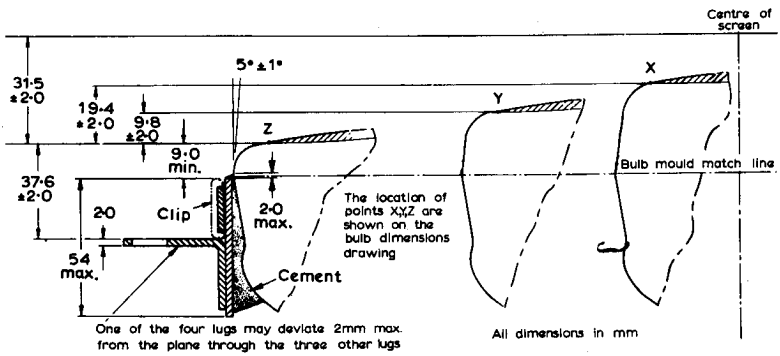
B8H Base

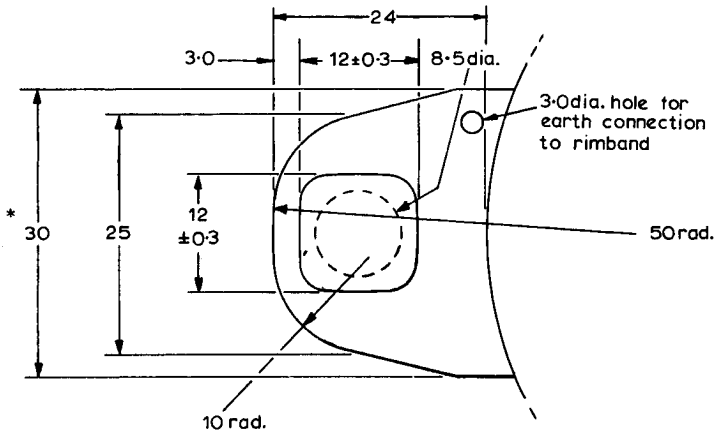




* The clip is located within these dimensions. Total thickness of rimband tension band and clip = 8·0max.

Nominal radii of the outside of the tension band = bulb radius + 2·5

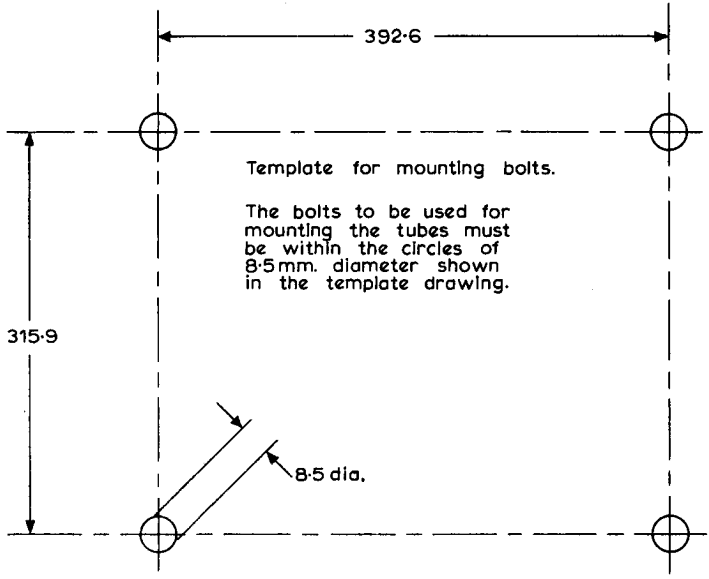




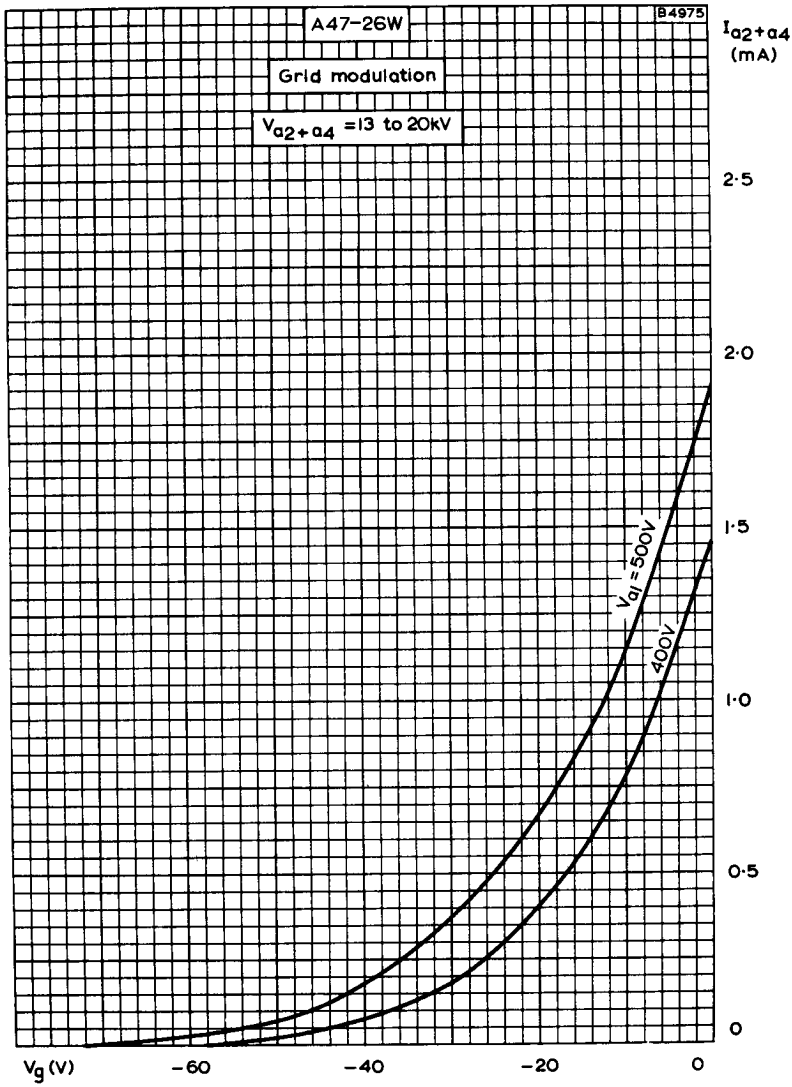
* Minimum space to be reserved for mounting lugs = 37mm.

Mounting lug

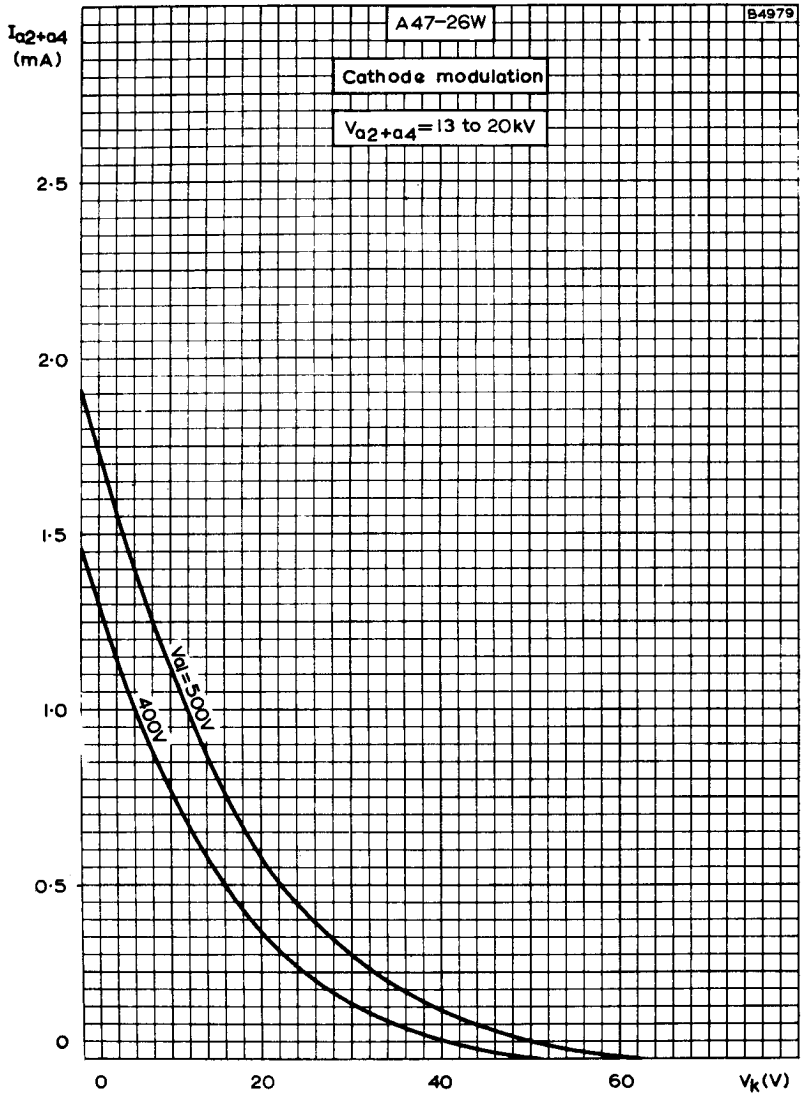
B7746



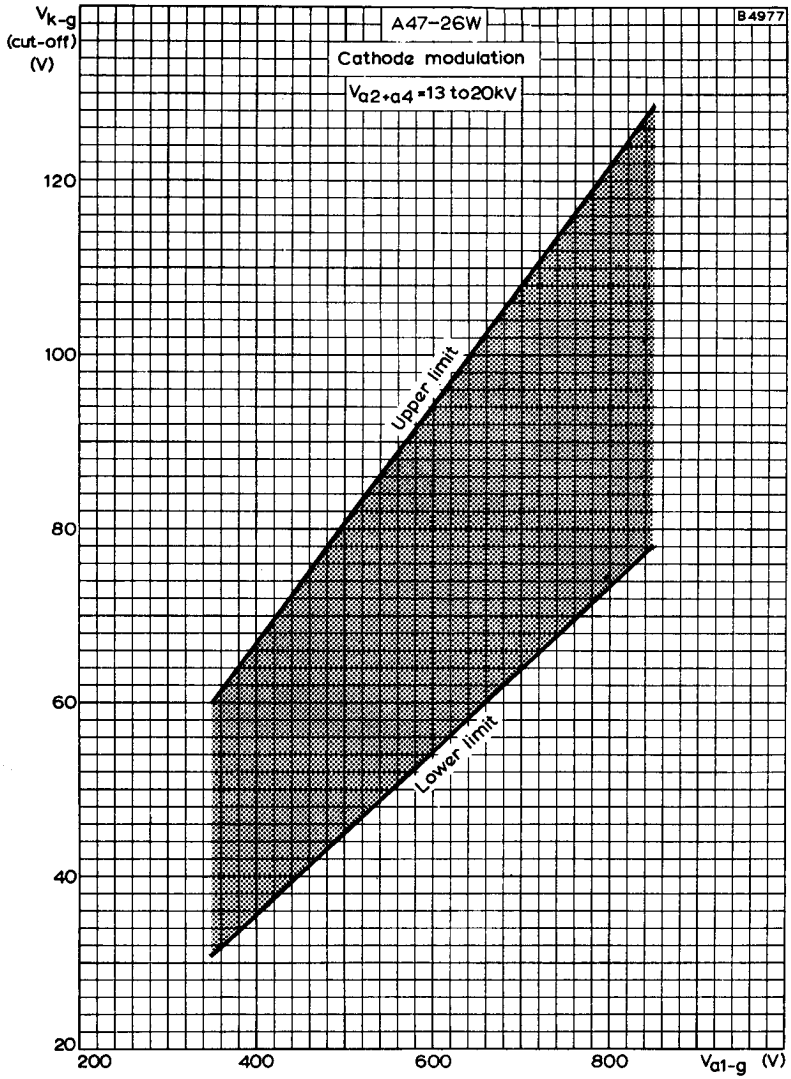
All dimensions in mm.



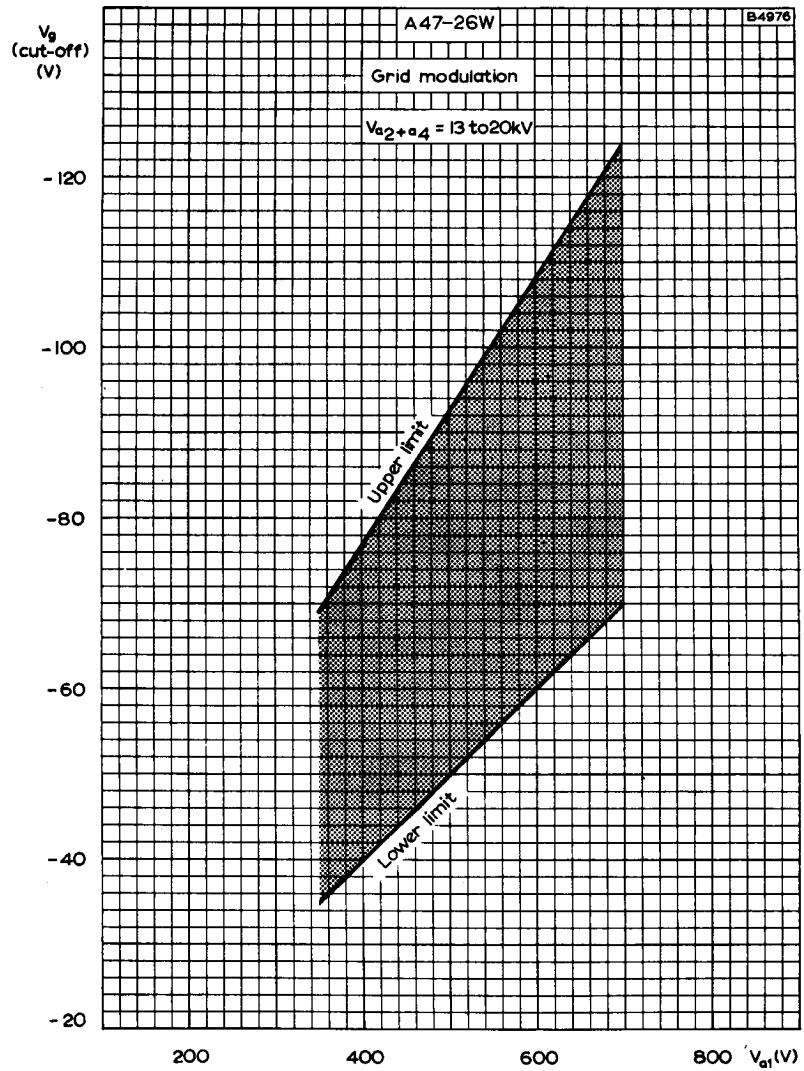
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION.

TELEVISION TUBE A47-26W/R

QUICK REFERENCE DATA

47cm (19in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. This tube is fitted with a ring trap base but in all other respects is electrically identical to the A47-11W. Suitable for use in receivers with push-through presentation.

Deflection angle	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	48	%
Maximum overall length	309	mm

This data should be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN (Metal backed)

Fluorescent colour		White
Light transmission (approx.)	48	%
Useful screen area		See page 6

FOCUSING (Electrostatic)

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 250μA.

DEFLECTION (Magnetic)

Diagonal deflection angle	110	deg
Horizontal deflection angle	99	deg
Vertical deflection angle	82	deg

The deflection coils should be designed to provide a pull-back of 4.0mm on a nominal tube.

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	5.0	pF
$c_{a2+a4-M}$	1000 to 1500	pF
$c_{a2+a4-B}$	400	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

RING TRAP

For flashover protection to the receiver, parallel spark gaps are included for all the pins in the base of this tube, and the common connection is made to pin 5. These spark gaps are intended as part of a system for full flashover protection. A direct connection must always be made from pin 5 to the external conductive coating. Any electrode supplied directly from a high energy source (such as the H.T. line) should be provided with a series resistor.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations-Cathode Ray Tubes'.

Centring magnet field intensity	0 to 800	A/m
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations-Cathode Ray Tubes'.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at I_{a2+a4} = 0) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ

NOTES

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flash-over within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on, a decrease in $v_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2.0MΩ.

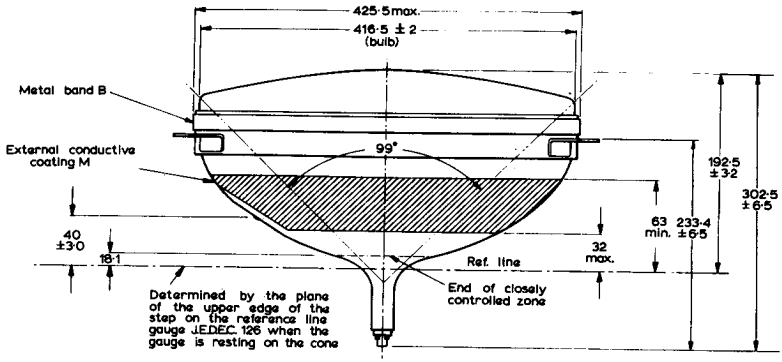
   The mounting lugs will be in electrical contact with the metal band.

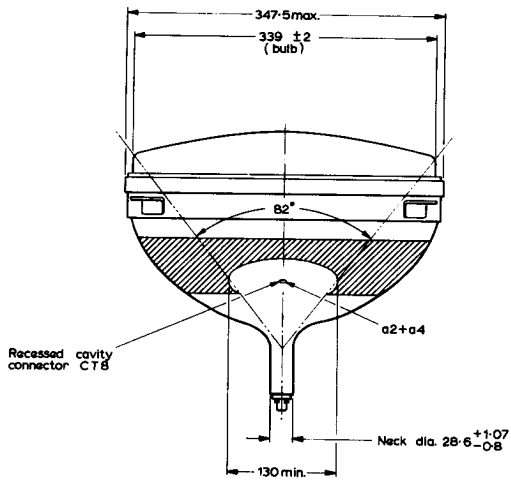
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

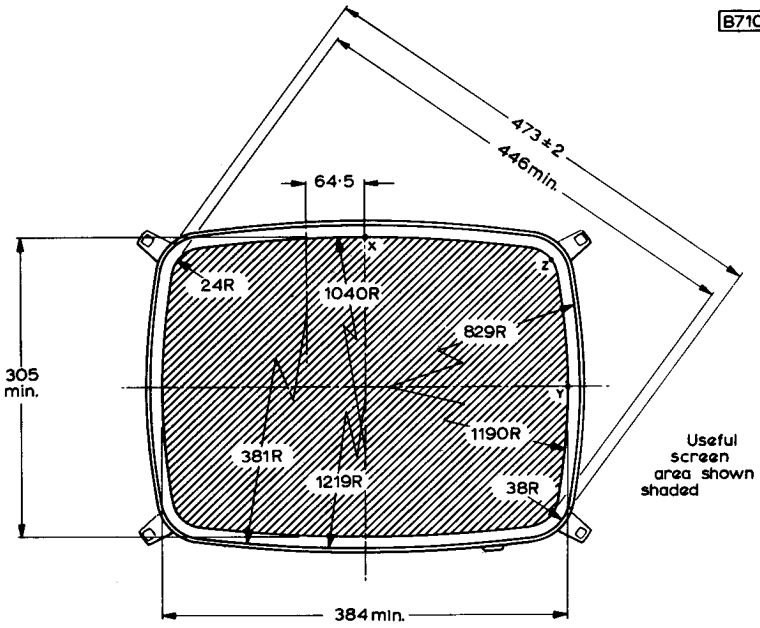
WEIGHT

Tube alone (approx.)	8.0	kg

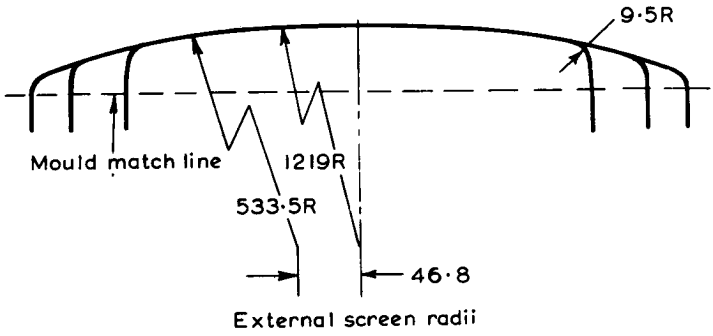




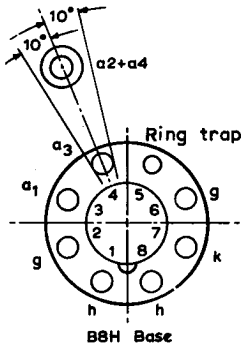
All dimensions in mm



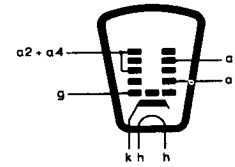
Bulb dimensions

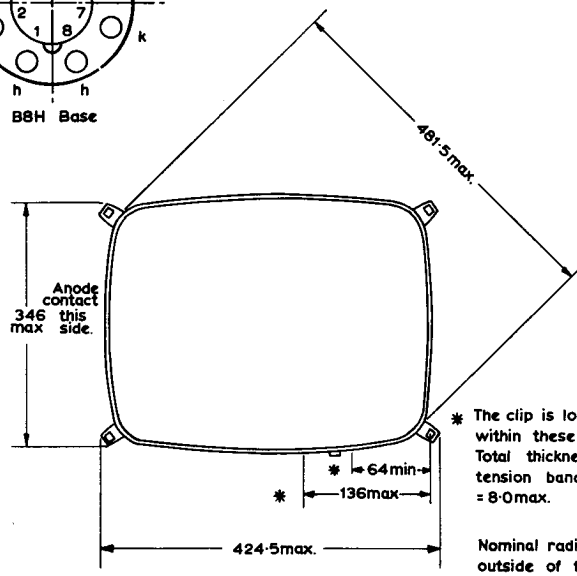


External screen radii



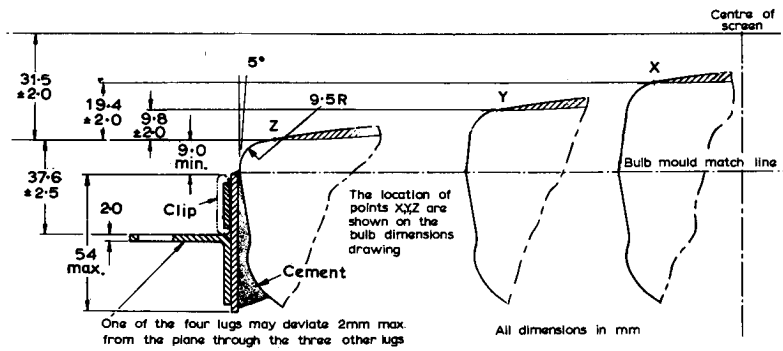
B8H Base



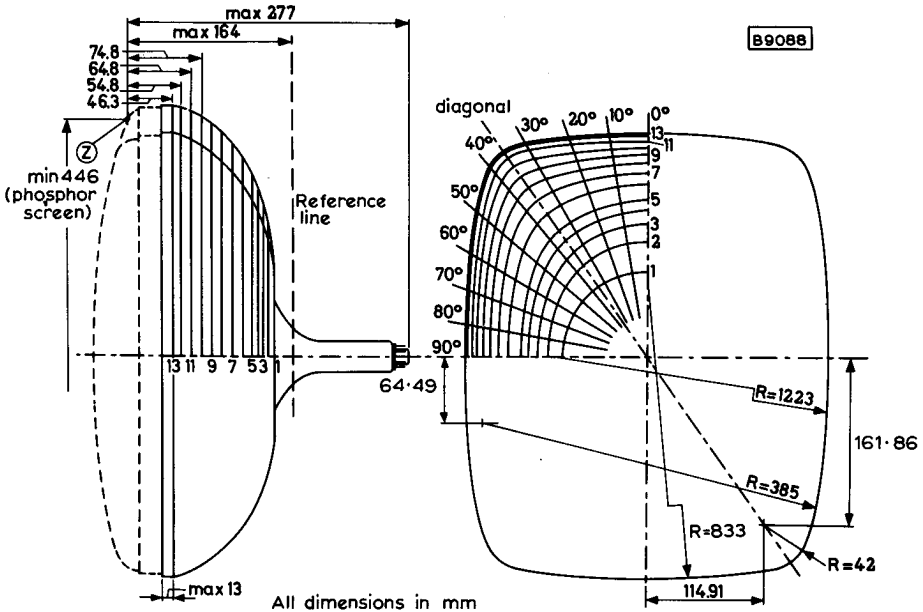


* The clip is located within these dimensions. Total thickness of rimband tension band and clip = 8·0max.

Nominal radii of the outside of the tension band = bulb radius + 2·5



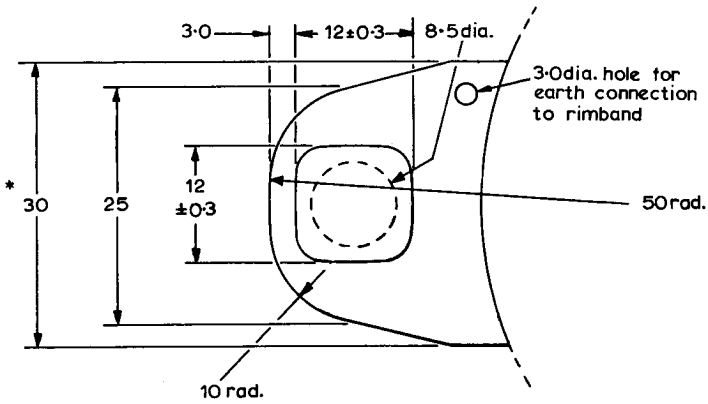
MAXIMUM CONE CONTOURS



DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page 8)

Section	Nominal distance from point "Z"	Distance from centre (max. values)										
		0° Long axis	10°	20°	30°	35° 22' Diagonal	40°	50°	60°	70°	80°	90° Short axis
1	145.7	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
2	139.8	106.1	105.6	105.6	103.8	102.7	101.6	99.1	96.2	93.7	92.4	92.4
3	134.8	125.3	125.7	124.6	122.3	120.6	118.9	115.1	111.0	106.7	104.2	103.9
4	129.8	138.2	138.9	137.8	136.0	134.3	132.3	127.5	121.8	117.0	113.7	113.0
5	124.8	148.6	149.0	148.5	147.7	146.3	144.2	138.0	131.3	125.2	121.6	120.6
6	114.8	164.5	164.6	165.2	167.3	166.8	164.6	156.0	146.8	139.0	134.5	133.1
7	104.8	176.5	176.6	178.7	183.4	184.0	181.4	170.2	158.9	149.8	144.6	142.9
8	94.8	186.3	186.5	190.3	197.0	198.9	195.8	182.3	169.0	158.9	152.8	151.1
9	84.8	194.2	195.0	200.2	209.1	212.0	208.6	192.5	177.5	166.2	159.8	157.9
10	74.8	200.7	202.1	208.4	219.6	223.5	219.7	200.4	184.2	172.3	165.8	163.4
11	64.8	206.0	208.0	215.0	227.9	232.8	228.6	206.6	189.2	176.9	170.0	167.9
12	54.8	210.0	212.3	219.6	233.0	238.1	233.9	210.9	193.2	180.5	173.6	171.3
13	46.3	212.3	214.7	222.2	235.5	240.5	236.7	214.1	195.8	183.0	175.8	173.5

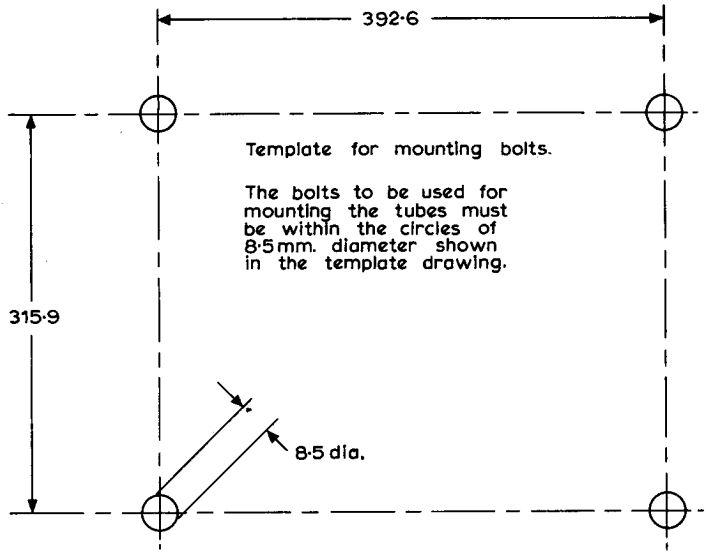
All dimensions in mm.



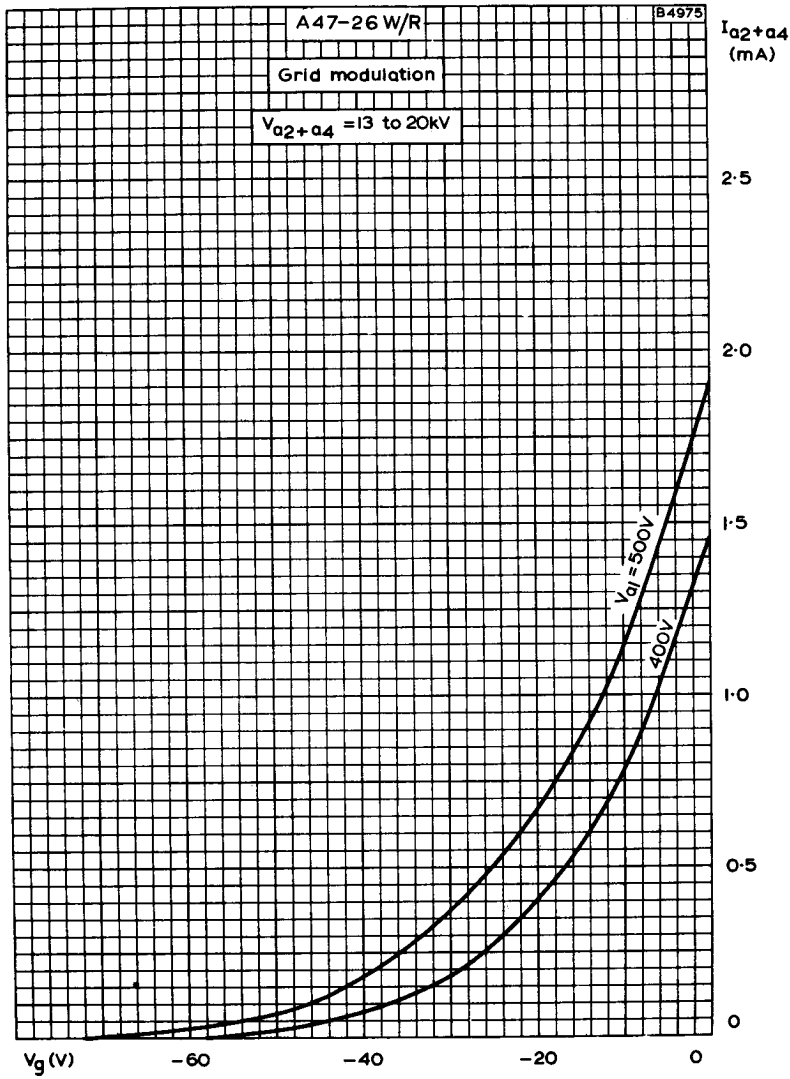
* Minimum space to be reserved for mounting lugs = 37mm.

Mounting lug

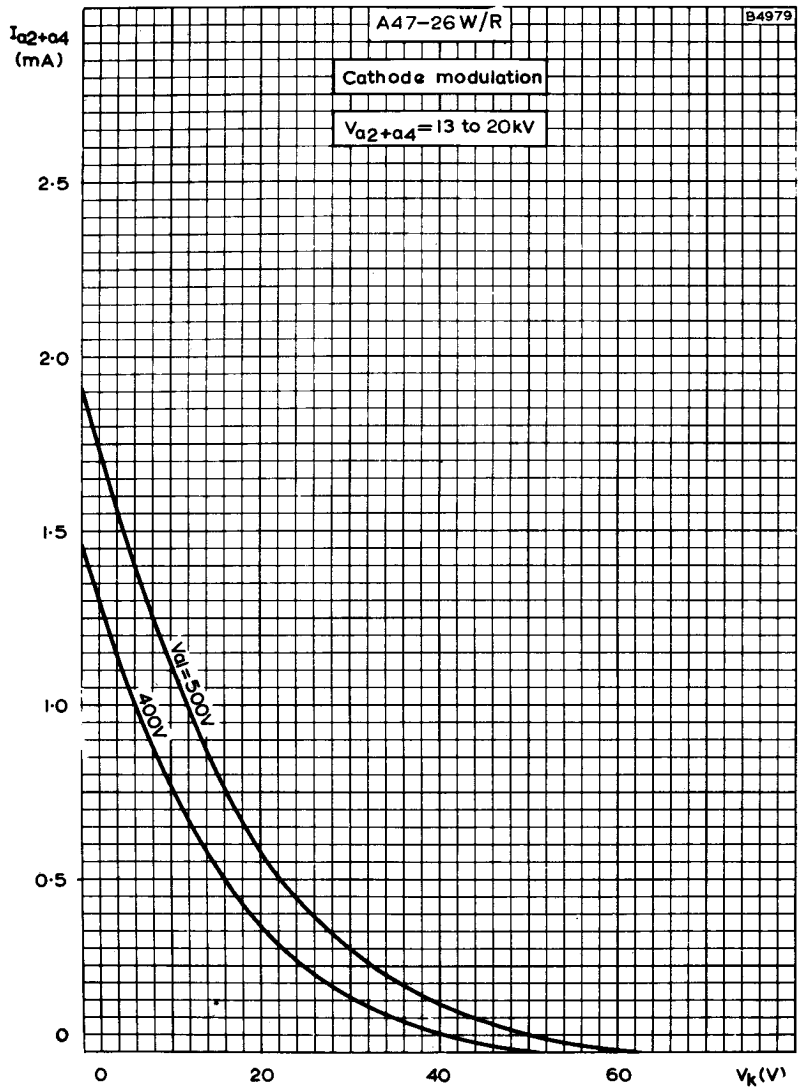
B7746



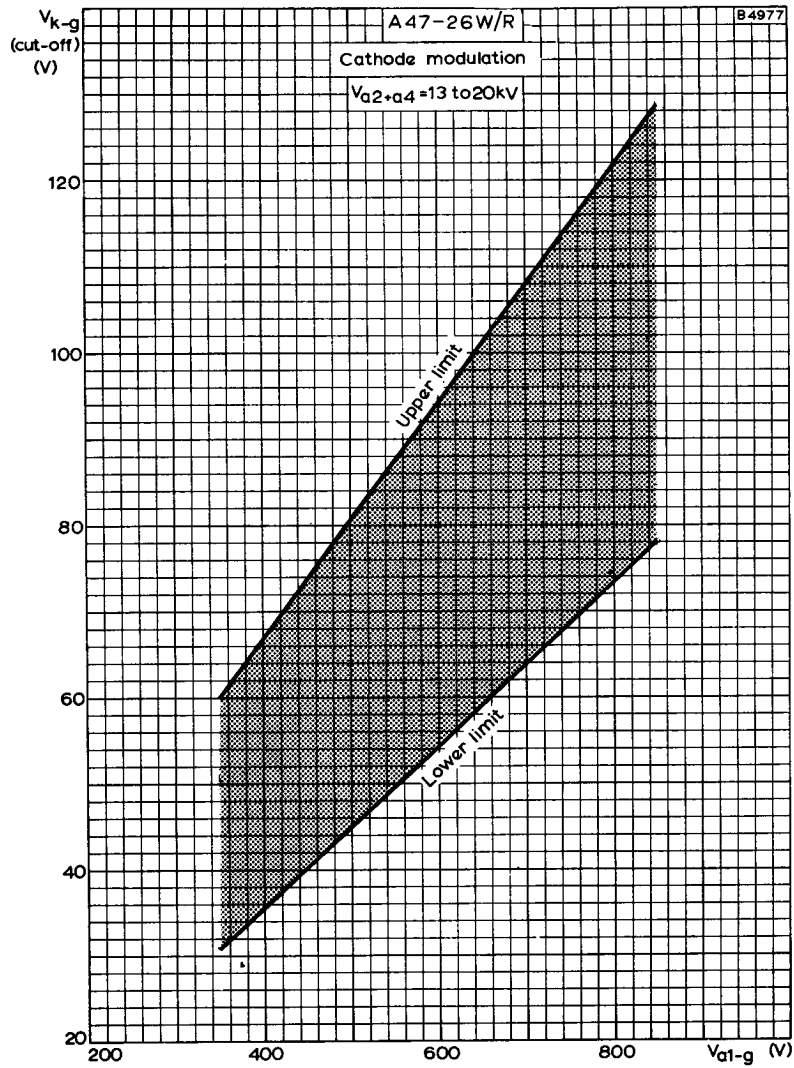
All dimensions in mm.



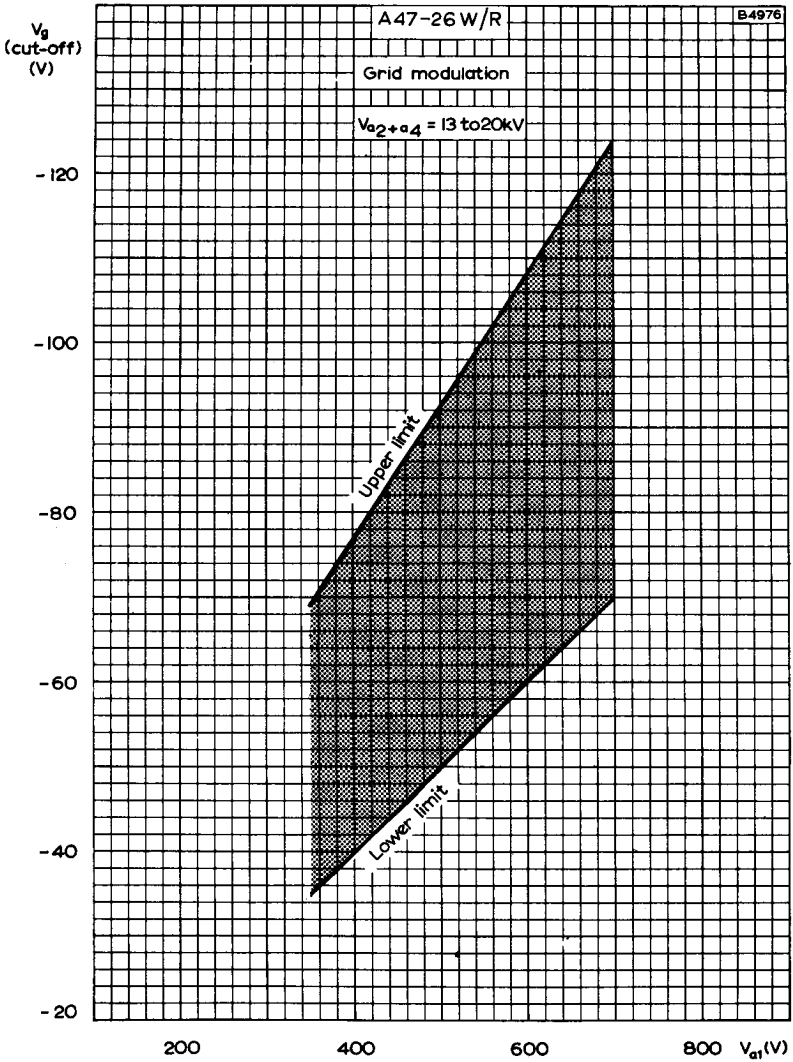
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION.

COLOUR TELEVISION TUBE

A49-11X

TENTATIVE DATA

QUICK REFERENCE DATA

49cm (19in) rectangular shadow-mask colour television tube incorporating three guns and a metal-backed three-colour phosphor dot screen.
Advanced red phosphor, europium activated. ←
Increased white brightness. ←
Unity current ratio for white point x=0.281, y=0.311 ←
Temperature compensated shadow-mask maintains purity during warm-up. Shadow-mask optimised for minimum moiré effect on 625 line system. ←
Reinforced tube envelope-separate safety screen not required.

Deflection angle	90	deg
Focusing	Electrostatic	
Light transmission (approx.)	54	%
Maximum overall length	458	mm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TELEVISION PICTURE TUBES

HEATER

V_h (see note 1)	6.3	V
I_h	900	mA

The limits of heater voltage and current are contained in General Operational Recommendations - Television Picture Tubes.

OPERATING CONDITIONS (each gun)

V_{a3+a4}	25	kV
V_{a2} (focus electrode control range)	4.2 to 5.0	kV
V_{a1} (at V_g -100V for visual extinction of focused raster)	210 to 495	V
V_g (at V_{a1} = 300V for visual extinction of focused raster)	-65 to -135	V
*Light output at screen centre (at I_{a3+a4} = 750μA)	130	cd/m^2 (nits)

*To product white of colour co-ordinates x=0.281, y=0.311 with a focused raster size of 39.6 × 31.0cm

SCREEN

Metal backed

Phosphor types for separate fluorescent colours:

Red	Europium activated rare earth	
Green	Sulphide	
Blue	Sulphide	
Useful screen area (approx.)	1160	cm^2
Spacing between centres of adjacent phosphor dot triads (approx.)	0.63	mm
Light transmission (approx.)	54	%

FOCUSING

Electrostatic

DEFLECTION

Magnetic

Diagonal deflection angle	90	deg
Horizontal deflection angle	79	deg
Vertical deflection angle	62	deg

CONVERGENCE

Magnetic

CAPACITANCES (approx.)

$c_{g\text{-all}}$ (each gun)	7.0	pF
$c_{(kR+kG+kB)\text{ - all}}$	15	pF
$c_{kR\text{-all}}$	5.0	pF
$c_{kG\text{-all}}$	5.0	pF
$c_{kB\text{-all}}$	5.0	pF
$c_{a2\text{-all}}$	7.0	pF
$c_{a3+a4\text{-M}}$	1500 to 2000	pF
$c_{a3+a4\text{-B}}$	300	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

REFERENCE LINE GAUGE

See page 10.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 52.5mm diameter which is centred upon the perpendicular from the centre of the face.

MAGNETIC SHIELDING

Magnetic shielding must be provided to minimise the effects of extraneous magnetic fields, including the earth's magnetic field. This shielding, in the form of a metal shell extending 22cm over the cone of the tube measured from the centre of the screen, should be constructed of cold-rolled mild steel of 0.5mm minimum thickness. The magnetic shield should be connected to the outer conductive coating. See page 10 for physical dimensions.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a3+a4} max. (absolute rating) (see notes 2 and 3)	27.5	kV
V_{a3+a4} min. (absolute rating) (see note 4)	20	kV
I_{a3+a4} (long term average max. for three guns: see note 5)	750	μA
V_{a2} max. (see note 3)	6.0	kV
v_{a1} (pk) max.	1.0	kV
$-V_g$ max.	400	V
V_g max.	0	V
V_{h-k} max. (see note 6)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{g-k} max.	750	kΩ

EQUIPMENT DESIGN VALUES (each gun if applicable)

Valid for V_{a3+a4} = 20 to 27.5kV

V_{a2}				16.8 to 20% of V_{a3+a4}	
V_{a1}				see page 14	
V_g				see page 14	
Variation in cut-off voltage between guns				Minimum value is at least 65% of the maximum value.	
I_{a2}				-15 to +15	μA
I_{a1}				-5 to +5	μA
I_g at V_g = -150				-5 to +5	μA
To produce white of colour co-ordinates:	x	0.310	0.265	0.281	←
	y	0.316	0.290	0.311	
Percentage of total anode current supplied by each gun (typical)					←
Red gun		43.5	27.9	32.2	%
Green gun		30.0	34.9	35.6	%
Blue gun		26.5	37.2	32.2	%
Ratio of cathode currents					←
Red gun to green gun	min.	1.05	0.60	0.65	
	av.	1.45	0.80	0.90	
	max.	2.00	1.10	1.25	
Red gun to blue gun	min.	1.20	0.55	0.75	
	av.	1.65	0.75	1.00	
	max.	2.25	1.05	1.35	

Maximum electron beam shift required from purity magnets	±0.11	mm
Maximum required raster shift	±12	mm
Maximum lateral convergence shift of blue beam with respect to the converged red and green beams	±5.5	mm
Maximum radial convergence shift, excluding effects of dynamic convergence (each beam, see note 8)	±8.0	mm

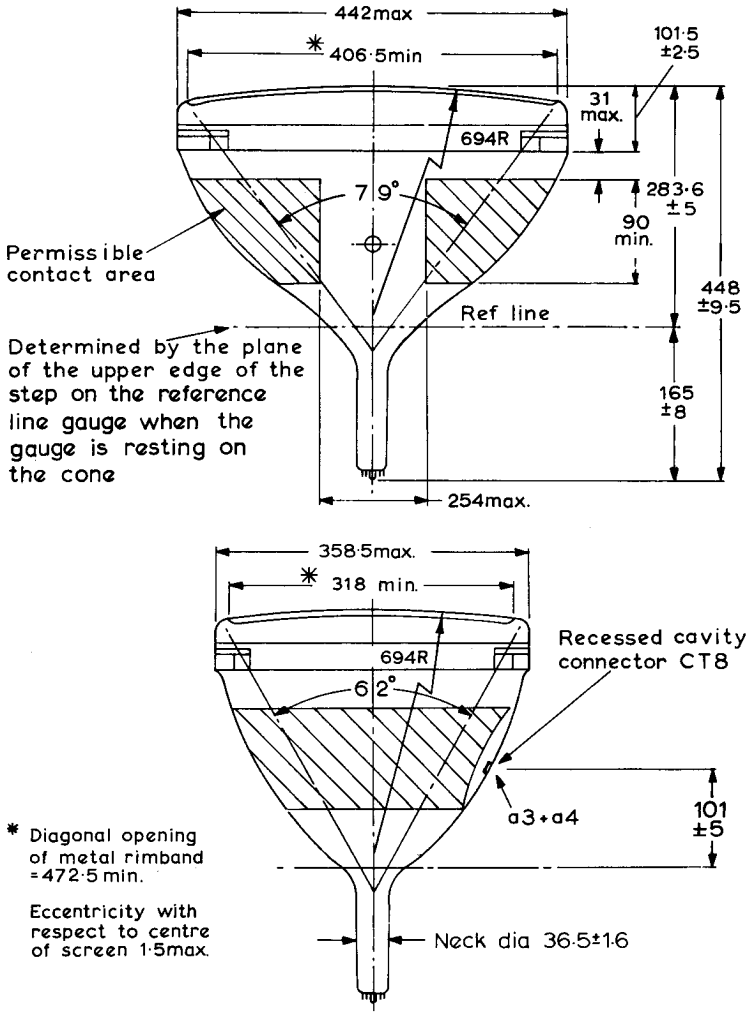
WEIGHT

Tube alone (approx.)	11	kg

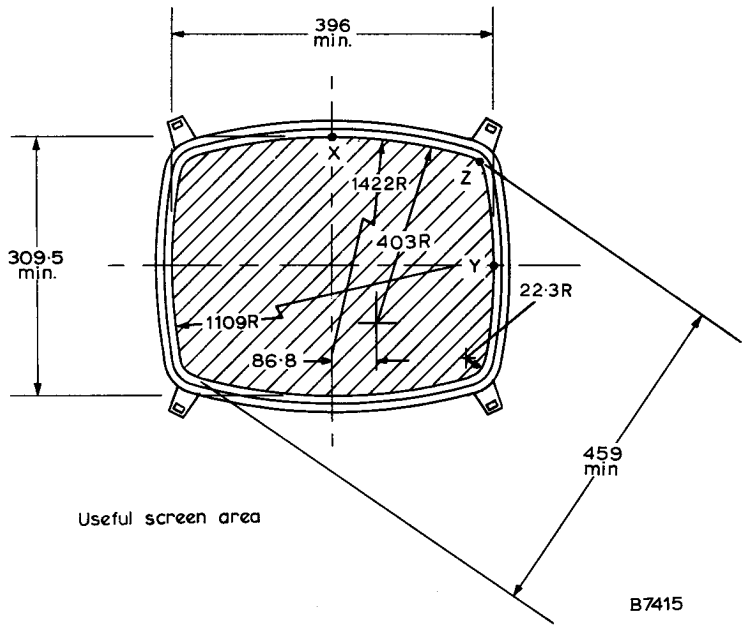
NOTES·

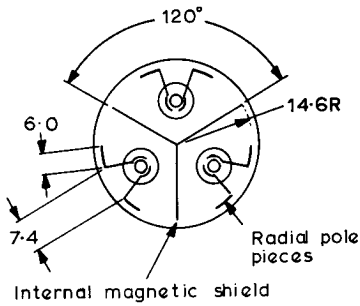
1. For maximum cathode life, it is recommended that the heater supply be regulated at 6.3V.
2. The tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5kV at zero beam current and with an internal impedance ≥500kΩ.
3. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube. In view of the high voltage on a2, adequate precautions should be taken to ensure freedom from flashover on all connections to this electrode.
4. Operation at lower voltages impairs brightness and resolution and may have a detrimental effect on colour purity.
5. The limiting value "long term average maximum current" of 750μA will be met provided a device is incorporated in the circuit to limit the short term average current to 1.1mA.
6. In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible (< 20V r.m.s.).

   During an equipment warm-up period not exceeding 15 seconds v_{h-k} (pk) max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on a decrease in v_{h-k} (pk) max. (cathode positive) proportional with time from 410 to 250V is permissible.
7. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver.
8. The dynamic convergence to be effected by currents of approximately parabolic waveshape synchronised with scanning.



All dimensions in mm [B7414]

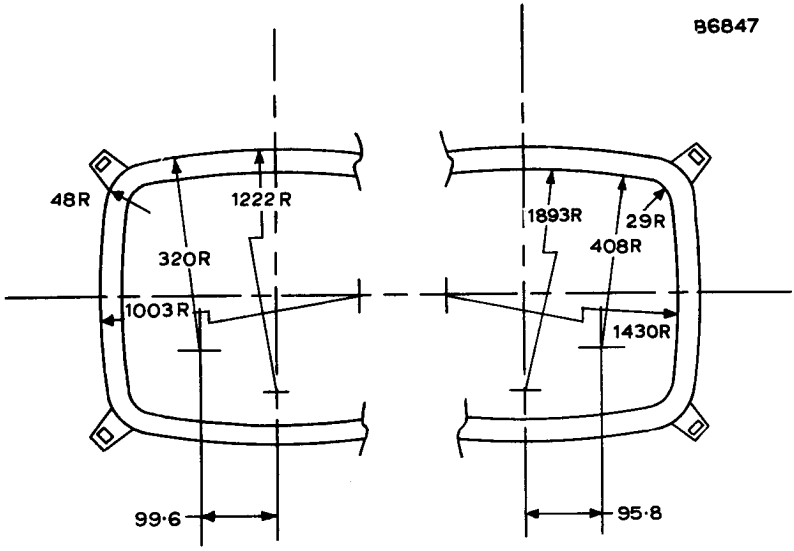




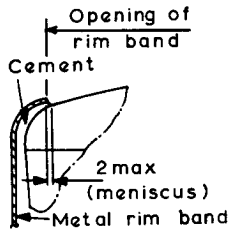
Location of radial convergence pole pieces viewed from screen end of guns

All dimensions in mm

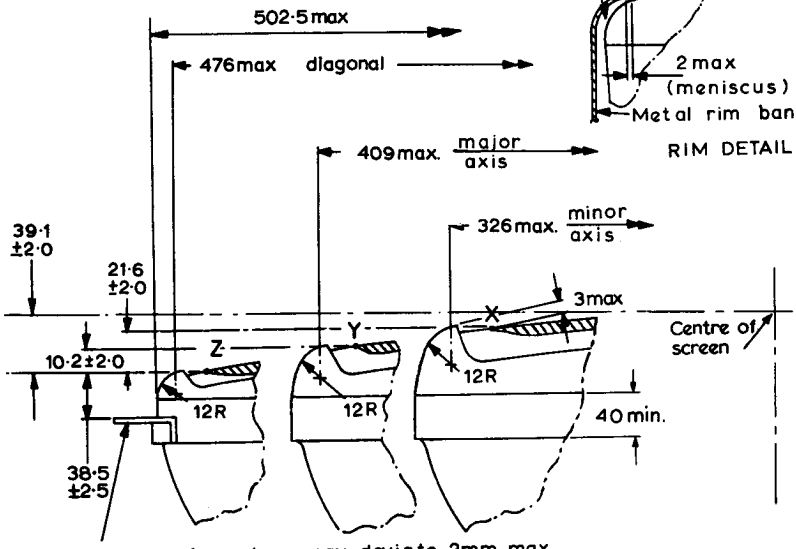
B6847



Dimensions of metal band



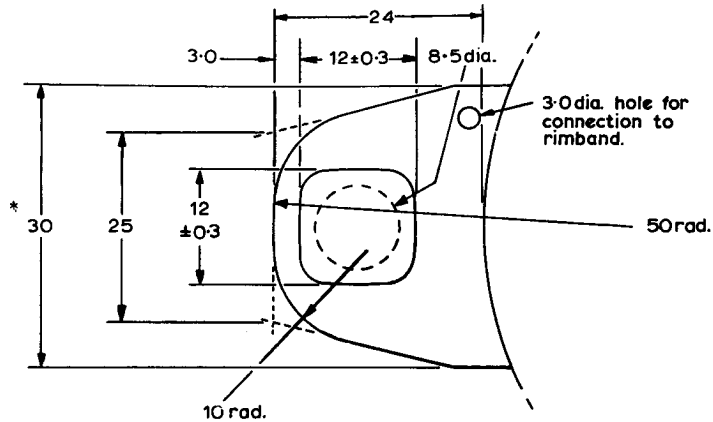
RIM DETAIL



One of the four lugs may deviate 2mm max. from the plane through the three other lugs This deviation is incorporated in the ±2·5 tolerance.

All dimensions in mm

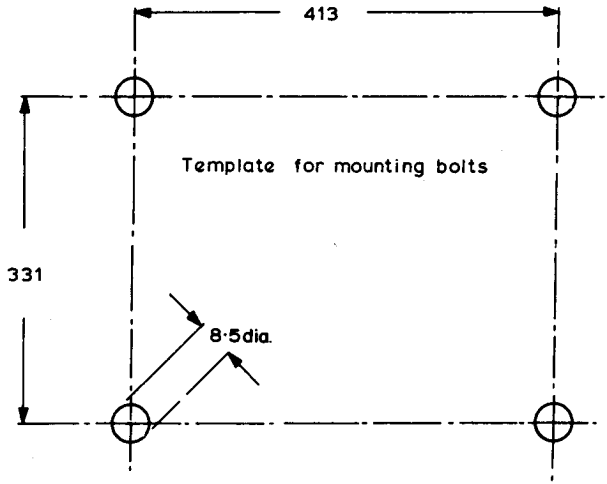
B7416



* Minimum space to be reserved for mounting lugs = 37mm.

Mounting lug

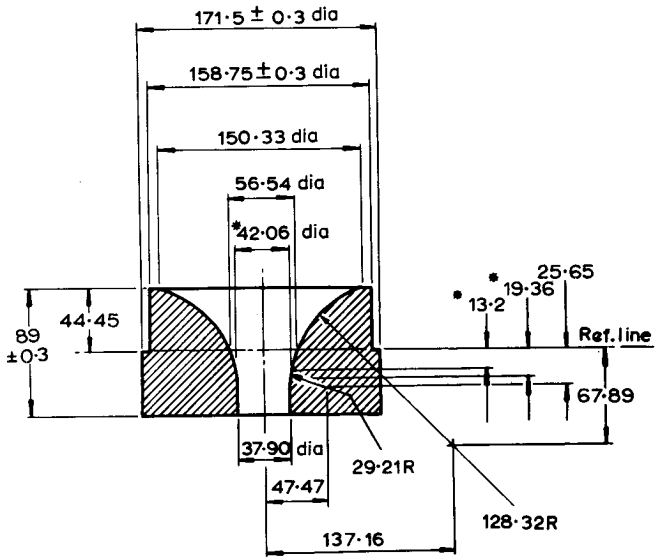
B7746



All dimensions in mm

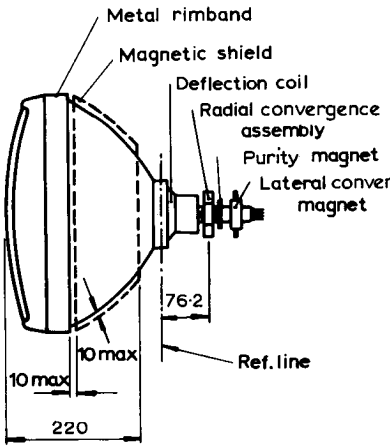
The bolts to be used for mounting the tube must be within the circles of 8.5mm diameter shown in the template drawing.

B7830

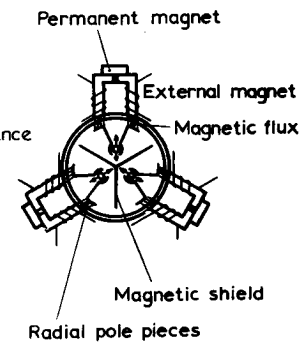


Reference line gauge

* These dimensions define extent of 29·21R

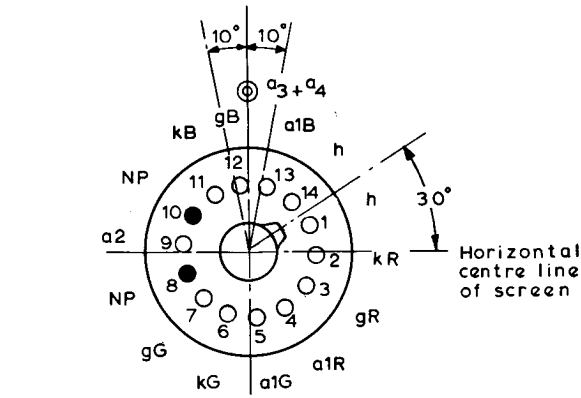


Outline of tube with components

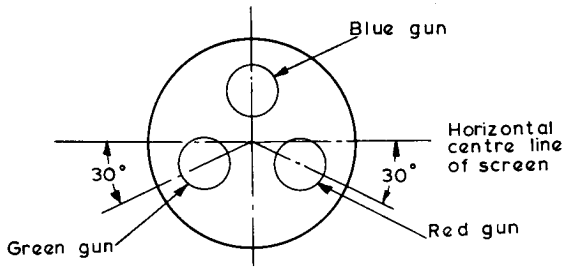


Radial convergence system

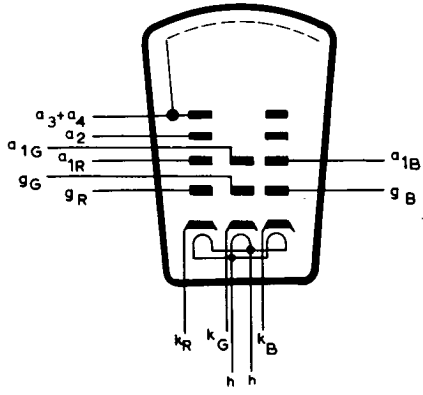
All dimensions in mm

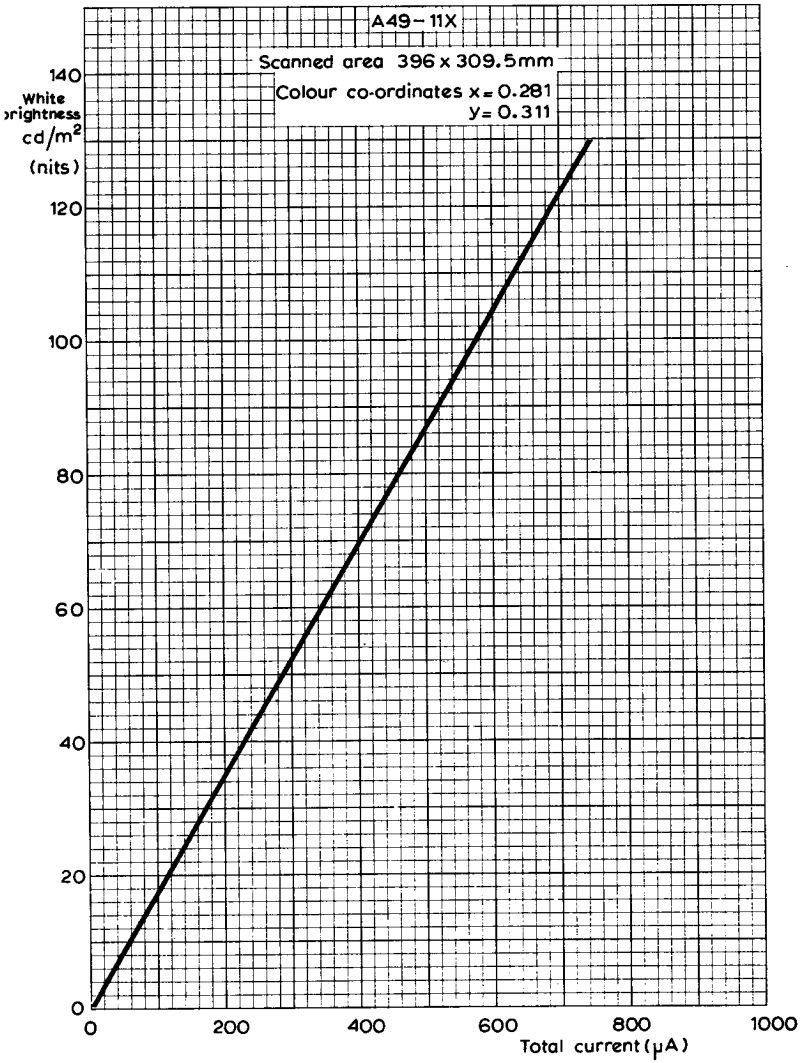


As J.E.D.E.C. B12-244 Base but with shorter spigot

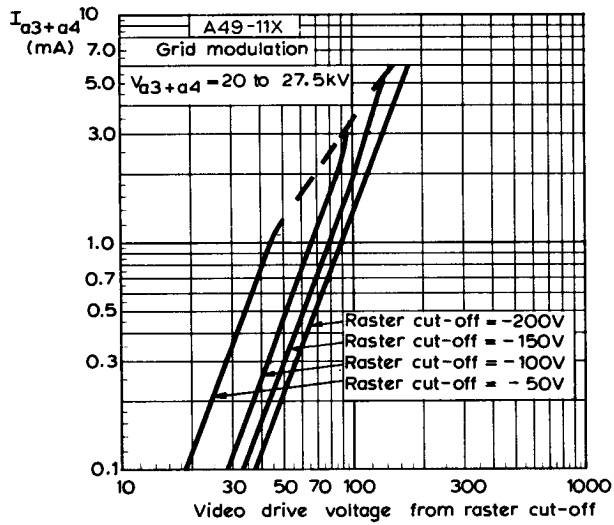


View looking from base

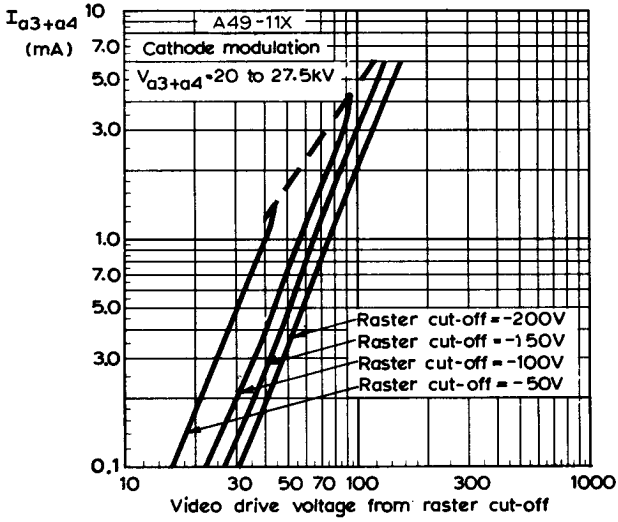




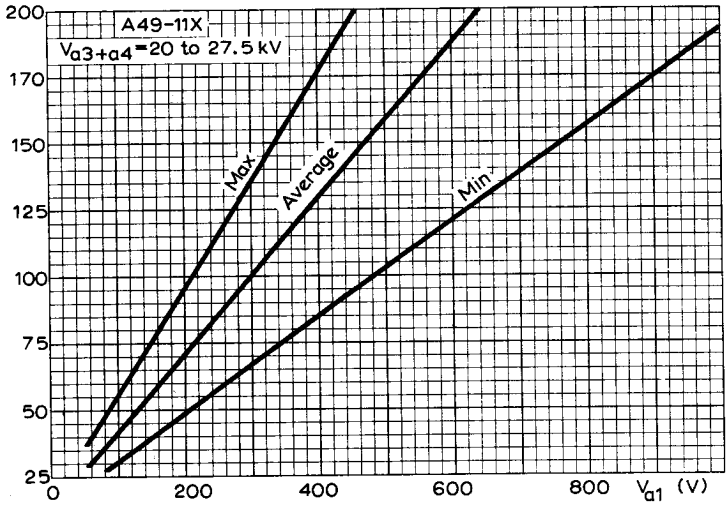
BRIGHTNESS AT CENTRE OF SCREEN PLOTTED AGAINST TOTAL CURRENT FOR WHITE OF COLOUR COORDINATES x = 0.281, y = 0.311



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
GRID MODULATION



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION



CUT-OFF DESIGN CHART

TELEVISION TUBE A50-120W/R

QUICK REFERENCE DATA

50cm (20in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. Suitable for use in receivers with push-through presentation. This tube is fitted with a ring trap base.

Deflection angle	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	45	%
Maximum overall length	319	mm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TELEVISION PICTURE TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Television Picture Tubes.

Note - applies to series operation only

The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN (metal backed)

Fluorescent colour		White
Light transmission (approx.)	45	%
Useful screen area		See page 6

FOCUSING (Electrostatic)

The range of focus voltage shown in 'Operating Conditions' results in optimum overall focus at a beam current of 250μA. In general, acceptable resolution will be obtained with a fixed focus voltage.

DEFLECTION (Magnetic)

Diagonal deflection angle	110	deg
Horizontal deflection angle	98	deg
Vertical deflection angle	81	deg

The deflection coils should be designed to provide a pull-back of 4.0mm on a nominal tube.

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	5.0	pF
$c_{a2+a4-M}$	1100 to 1600	pF
$c_{a2+a4-B}$	500	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

RING TRAP

For flashover protection to the receiver, parallel spark gaps are included for all the pins in the base of this tube, and the common connection is made to pin 5. These spark gaps are intended as part of a system for full flashover protection. A direct connection must always be made from pin 5 to the external conductive coating. Any electrode supplied directly from a high energy source (such as the H.T. line) should be provided with a series resistor.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations-Television Picture Tubes.

Centring magnet field intensity	0 to 800	A/m
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in the brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations-Television Picture Tubes.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred on the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4}=0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.(	MΩ
Z_{k-e} max. (f=50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50Hz)	500	kΩ

NOTES

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on, a decrease in $V_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2.0MΩ.

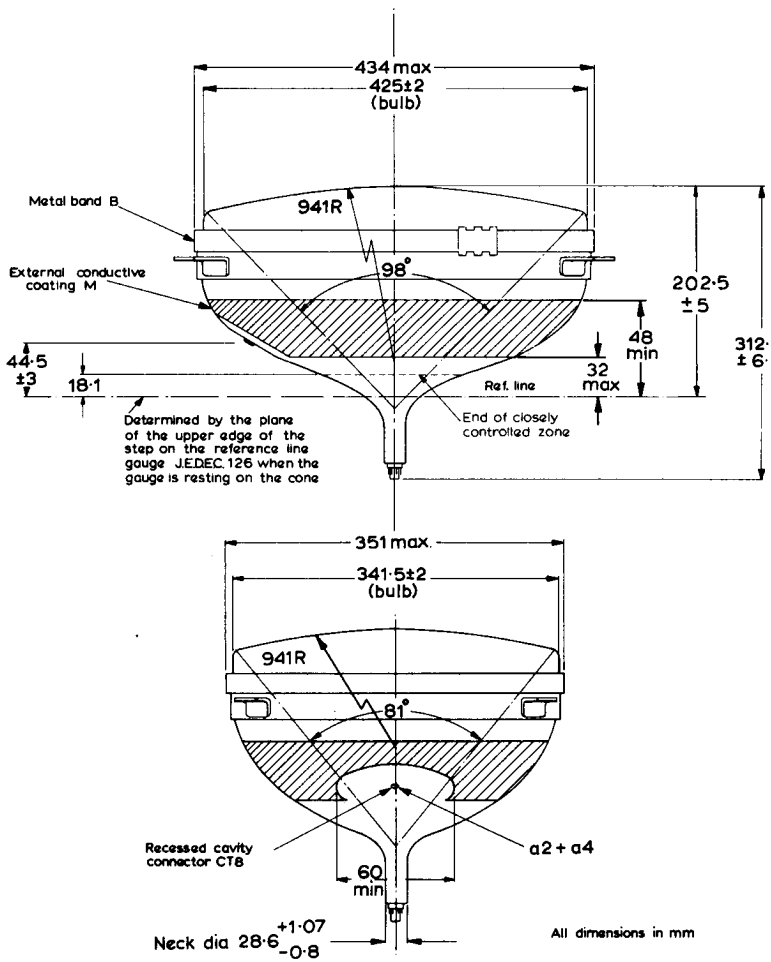
   The mounting lugs will be in electrical contact with the metal band.

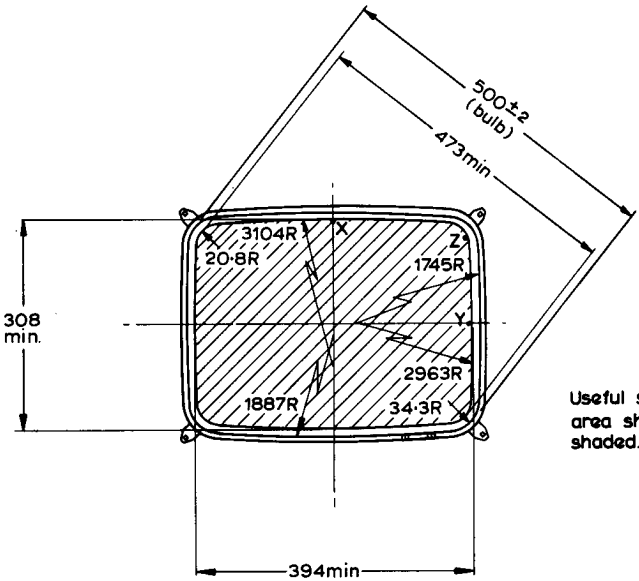
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

WEIGHT

Tube alone (approx.)	8.5	kg

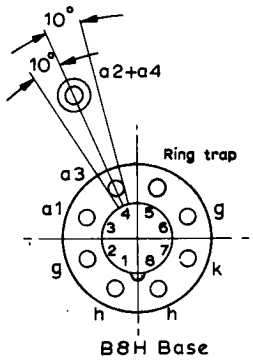

434 max
425±2
(bulb)
Metal band B
941R
98°
External conductive coating M
202·5 ±5
48 min
312·5 ±6·5
44·5 ±3
18·1
32 max
Ref. line
End of closely controlled zone
Determined by the plane of the upper edge of the step on the reference line gauge J.E.D.E.C. 126 when the gauge is resting on the cone
351 max.
341·5±2
(bulb)
941R
81°
Recessed cavity connector CT8
a2 + a4
60 min
Neck dia 28·6 +1·07 -0·8
All dimensions in mm



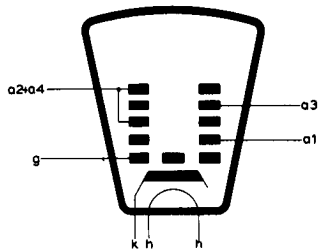
Useful screen area shown shaded.

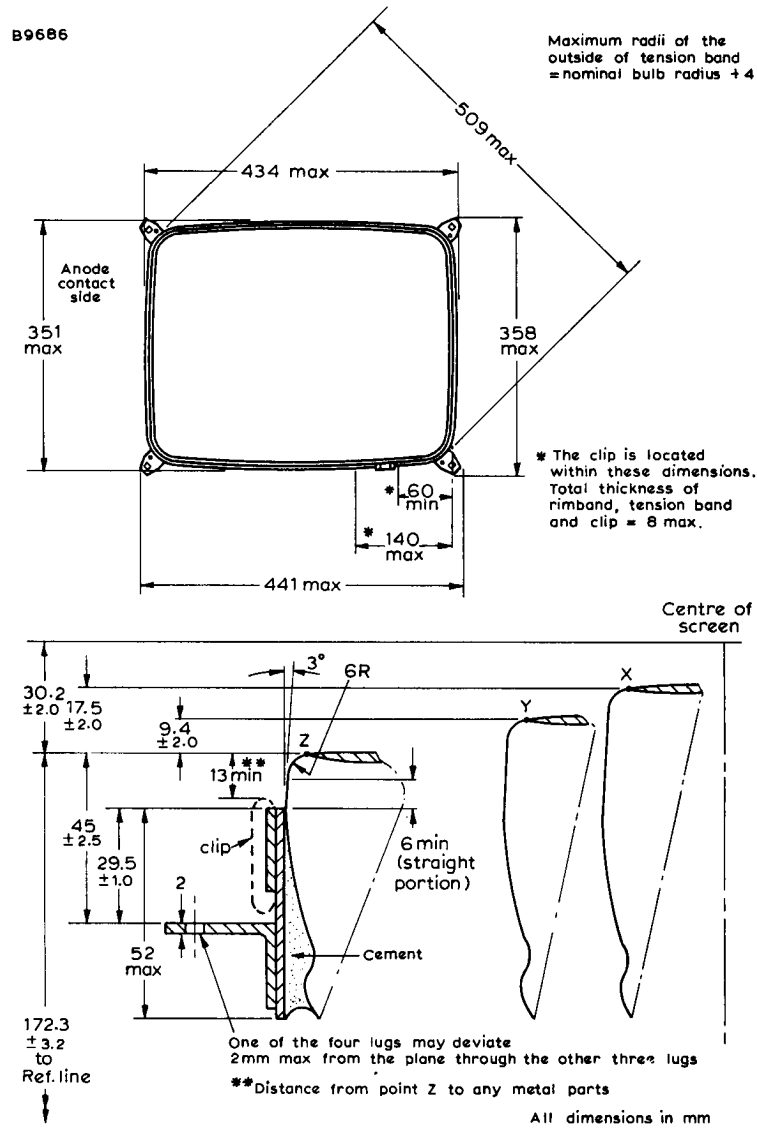
Bulb dimensions

All dimensions in mm

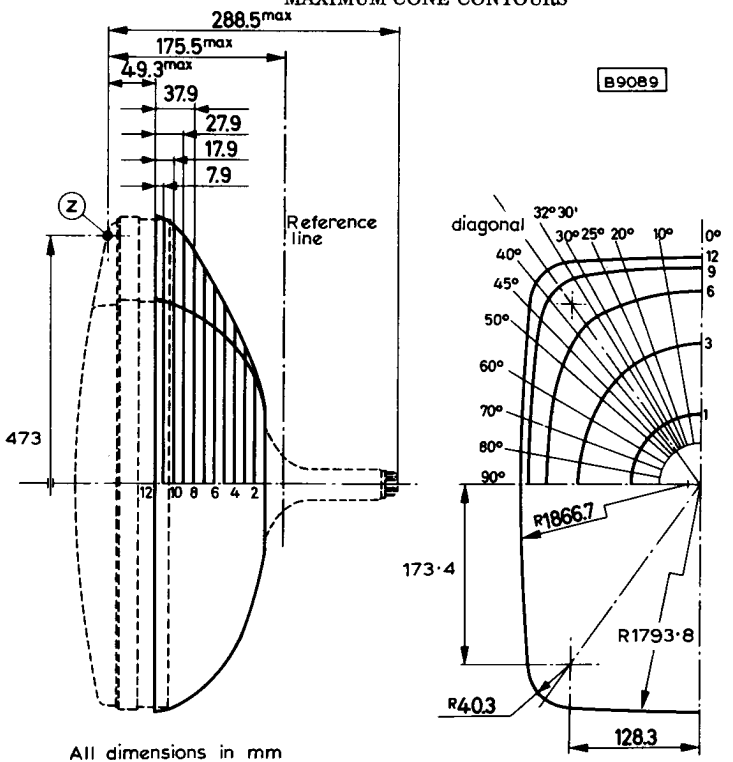


B8H Base




B9686
Maximum radii of the outside of tension band = nominal bulb radius + 4
509 max
434 max
Anode contact side
351 max
358 max
* The clip is located within these dimensions. Total thickness of rimband, tension band and clip = 8 max.
*60 min
*140 max
441 max
Centre of screen
3°
6R
X
Y
Z
30.2 ±2.0
17.5 ±2.0
9.4 ±2.0
**13 min
45 ±2.5
29.5 ±1.0
2
clip
6 min (straight portion)
52 max
Cement
172.3 ±3.2 to Ref. line
One of the four lugs may deviate 2mm max from the plane through the other three lugs
**Distance from point Z to any metal parts
All dimensions in mm

MAXIMUM CONE CONTOURS

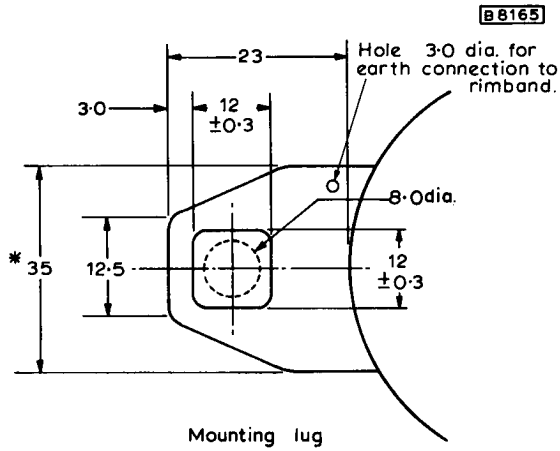


All dimensions in mm

DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page 8)

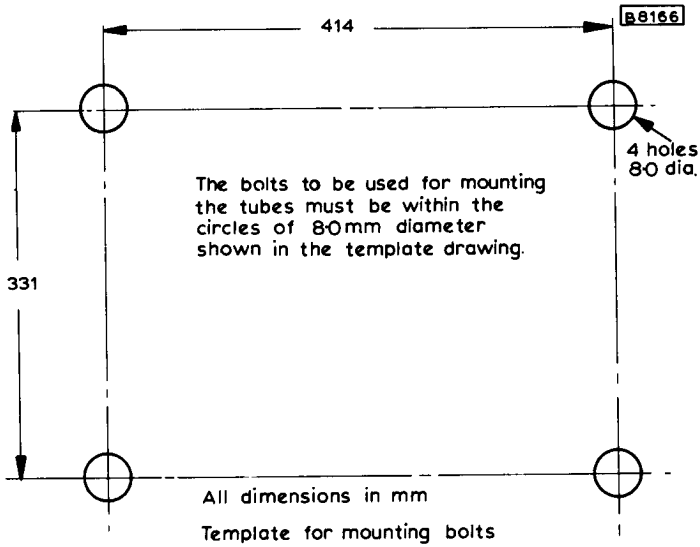
Section	Section distance from point "Z"	Distance from centre (max. values)													
		0° Long axis	10°	20°	25°	30°	32° 30'	36° 30' Diagonal	40°	45°	50°	60°	70°	80°	90° Short
1	157.2	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0
2	147.2	109.2	107.8	107.1	106.4	106.0	105.9	105.5	105.0	104.5	103.9	102.8	102.6	102.8	103.4
3	137.2	136.7	134.5	133.7	133.0	132.3	131.8	130.7	129.3	127.5	125.3	121.9	120.7	120.2	120.2
4	127.2	157.2	156.5	155.7	154.8	153.8	153.0	151.5	150	147.5	144.7	138.7	134.9	133.4	132.5
5	117.2	174.2	174.0	174.4	174.3	173.4	172.8	171.0	169.3	165.7	160.8	152.0	146.5	143.7	142.3
6	107.2	185.8	186.3	188.4	190.0	191.2	191.2	189.5	186.7	181.7	174.7	163.2	156.0	151.7	150.4
7	97.2	194.5	195.7	202.2	203.8	206.9	207.3	206.4	203.5	196.4	187.4	173.0	163.5	158.6	156.9
8	87.2	201.7	203.8	210.2	215.4	220.6	222.1	222.2	218.8	210.5	198.8	181.2	170.3	174.7	162.7
9	77.2	208.2	210.6	218.5	224.8	231.4	234.8	236.5	233.5	222.2	208.5	188.5	176.6	169.9	167.9
10	67.2	213.1	215.9	225.2	231.9	239.8	244.3	248.5	244.8	230.3	216.0	194.7	181.6	174.5	172.0
11	57.2	215.6	219.0	228.2	235.4	244.5	249.6	253.7	250.2	235.7	220.5	198.6	184.8	177.2	174.7
12	49.3	217.0	219.8	229.3	236.6	246.0	251.2	254.5	251.7	237.2	222.0	199.6	185.6	177.8	175.7

All dimensions in mm.

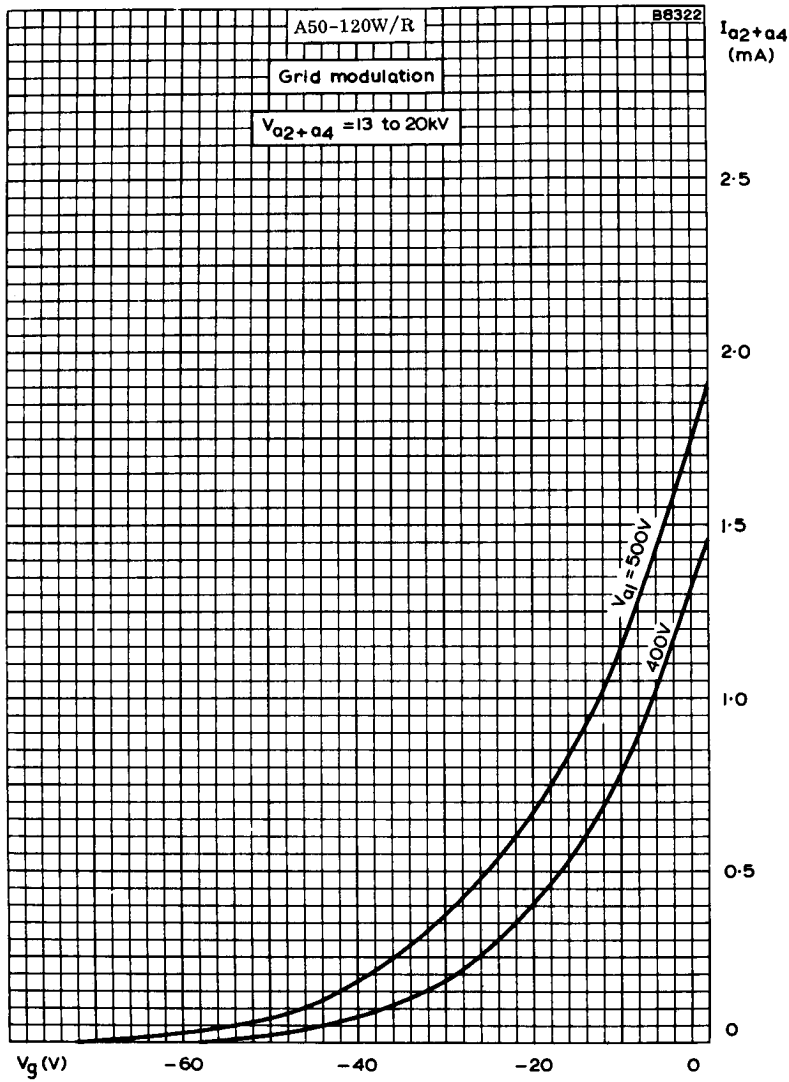


Mounting lug

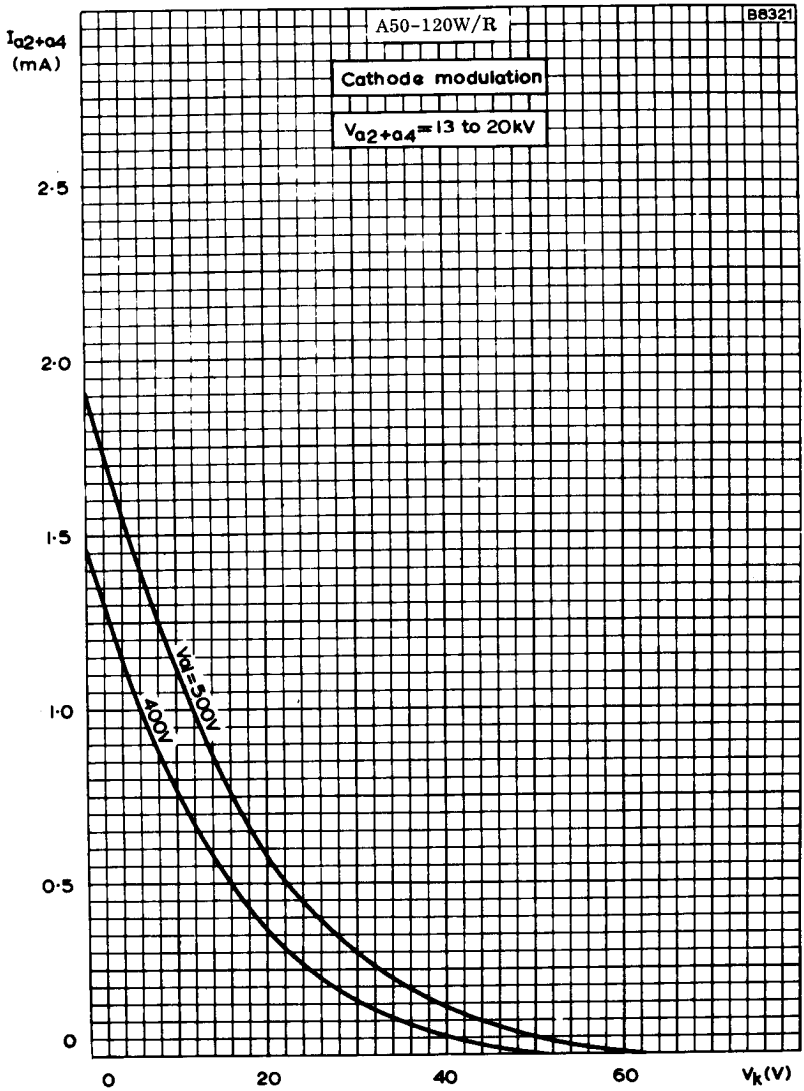
* Minimum space to be reserved for mounting lug=39



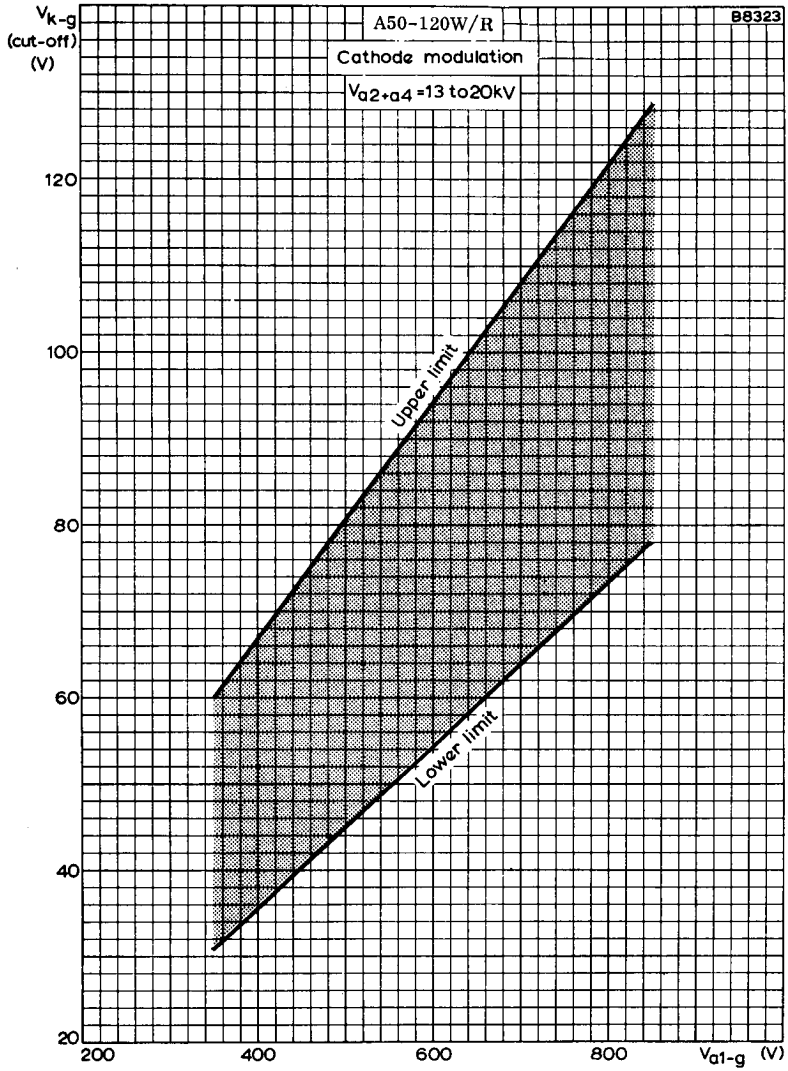
Template for mounting bolts



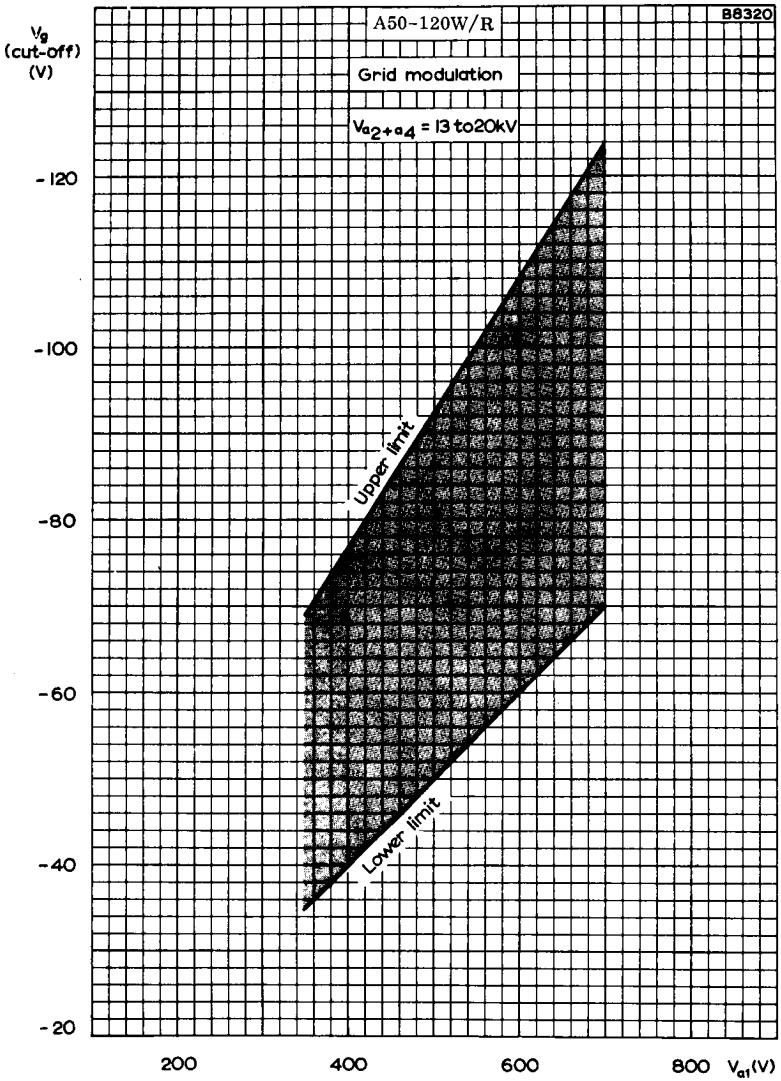
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION

COLOUR TELEVISION TUBE

A56-120X

TENTATIVE DATA

QUICK REFERENCE DATA

56cm (22in) rectangular shadow-mask colour television tube incorporating three guns and a metal-backed three-colour phosphor dot screen.
Advanced red phosphor, europium activated.
Increased white brightness.
Unity current ratio for white point x = 0.281, y = 0.311
Temperature compensated shadow-mask maintains purity during warm-up. Shadow-mask optimised for minimum moiré effect on 625 line system.
Reinforced tube envelope-separate safety screen not required.

Deflection angle	92	deg
Focusing	Electrostatic	
Light transmission (approx.)	53	%
Maximum overall length	482	mm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TELEVISION PICTURE TUBES

HEATER

V_h (see note 1)	6.3	V
I_h	900	mA

The limits of heater voltage and current are contained in General Operational Recommendations - Television Picture Tube.

OPERATING CONDITIONS (each gun)

V_{a3+a4}	25	kV
V_{a2} (focus electrode control range)	4.2 to 5.0	kV
V_{a1} (at V_g = -100V for visual extinction of focused raster)	210 to 495	V
V_g (at V_{a1} = 300V for visual extinction of focused raster)	-65 to -135	V
*Light output at screen centre (at I_{a3+a4} = 800μA)	120	cd/m^2(nits)

*To produce white of colour co-ordinates x = 0.281, y = 0.311 with a focused raster size of 447 × 337mm.

SCREEN

Metal backed

Phosphor types for separate fluorescent colours:		
Red	Europium activated rare earth	
Green	Sulphide	
Blue	Sulphide	
Useful screen area	See page 7	
Spacing between centres of adjacent phosphor dot triads (approx.)	0.68	mm
Light transmission (approx.)	53	%

FOCUSING

Electrostatic

DEFLECTION

Magnetic

Diagonal deflection angle	92	deg
Horizontal deflection angle	79	deg
Vertical deflection angle	61	deg

CONVERGENCE

Magnetic

CAPACITANCES (approx.)

$c_{g\text{-all}}$ (each gun)	7.0	pF
$c_{(kR+kG+kB)\text{ - all}}$	15	pF
$c_{kR\text{ - all}}$	5.0	pF
$c_{kG\text{ - all}}$	5.0	pF
$c_{kB\text{ - all}}$	5.0	pF
$c_{a2\text{-all}}$	7.0	pF
$c_{a3+a4\text{-M}}$	1700 to 2300	pF
$c_{a3+a4\text{-B}}$	400	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

REFERENCE LINE GAUGE

See page 10

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 55mm diameter which is centred upon the perpendicular from the centre of the face.

MAGNETIC SHIELDING

Magnetic shielding must be provided to minimise the effects of extraneous magnetic fields, including the earth's magnetic field. This shielding, in the form of a metal shell extending 250mm over the cone of the tube measured from the centre of the screen, should be constructed of cold-rolled mild steel of 0.5mm minimum thickness. The magnetic shield should be connected to the outer conductive coating. See page 10 for physical dimensions.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a3+a4} max. (absolute rating) (see notes 2 and 3)	27.5	kV
V_{a3+a4} min. (absolute rating) (see note 4)	20	kV
I_{a3+a4} (long term average max. for three guns: see note 5)	1.0	mA
V_{a2} max. (see note 3)	6.0	kV
$v_{a1(pk)}$ max.	1.0	kV
$-V_g$ max.	400	V
V_g max.	0	V
V_{h-k} max. (see note 6)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{g-k} max.	750	kΩ

EQUIPMENT DESIGN VALUES (each gun if applicable)

Valid for V_{a3+a4} = 20 to 27.5kV

V_{a2}			16.8 to 20% of V_{a3+a4}		
V_{a1}			see page 14		
V_g			see page 14		
Variation in cut-off voltage between guns			Minimum value is at least 65% of the maximum value.		
I_{a2}			-15 to +15		μA
I_{a1}			-5 to +5		μA
I_g at V_g = -150V			-5 to +5		μA
To produce white of colour co-ordinates:	x	0.310	0.265	0.281	
	y	0.316	0.290	0.311	
Percentage of total anode current supplied by each gun (typical)					
Red gun		43.5	27.9	32.2	%
Green gun		30.0	34.9	35.6	%
Blue gun		26.5	37.2	32.2	%
Ratio of cathode currents					
Red gun to green gun	min.	1.05	0.60	0.65	
	av.	1.45	0.80	0.90	
	max.	2.00	1.10	1.25	
Red gun to blue gun	min.	1.20	0.55	0.75	
	av.	1.65	0.75	1.00	
	max.	2.25	1.05	1.35	
Maximum electron beam shift required from purity magnets				±0.115	mm
Maximum required raster shift				±13	mm
Maximum lateral convergence shift of blue beam with respect to the converged red and green beams				±6	mm
Maximum radial convergence shift, excluding effects of dynamic convergence (each beam)				±9	mm

WEIGHT

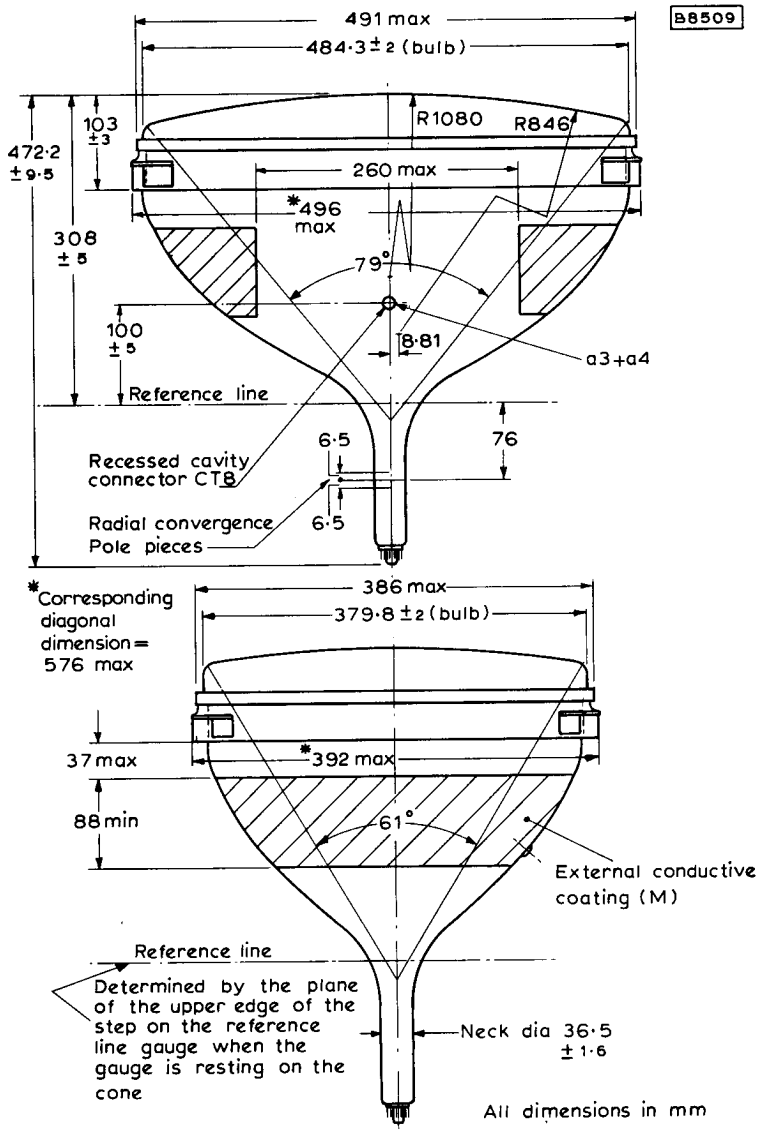
Tube alone (approx.)	15	kg

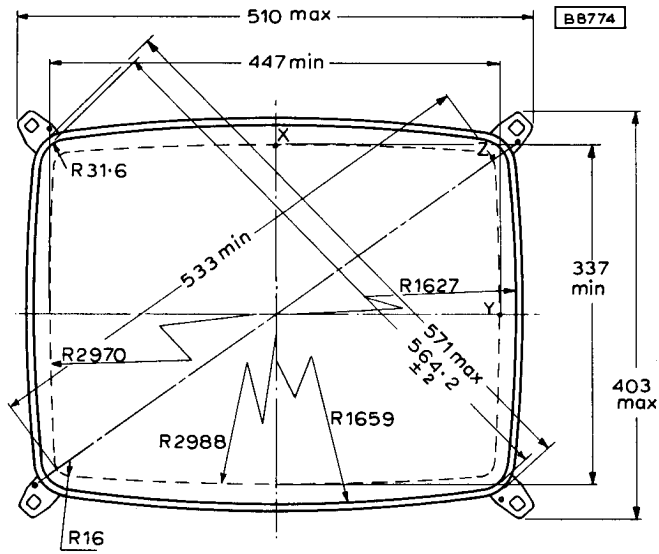
NOTES

1. For maximum cathode life, it is recommended that the heater supply be regulated at 6.3V.
2. The tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5kV at zero beam current and with an internal impedance ≥500kΩ.
3. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube. In view of the high voltage on a2, adequate precautions should be taken to ensure freedom from flashover on all connections to this electrode.
4. Operation at lower voltages impairs brightness and resolution and may have a detrimental effect on colour purity.
5. The limiting value "long term average maximum current" of 1.0mA will be met provided a device is incorporated in the circuit to limit the short term average current to 1.5mA.
6. In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible (≤20Vr.m.s.)

   During an equipment warm-up period not exceeding 15 seconds $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on a decrease in $v_{h-k(pk)}$ max. (cathode positive) proportional with time from 410 to 250V is permissible.
7. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver.
8. The dynamic convergence to be effected by currents of approximately parabolic waveshape synchronised with scanning.

OUTLINE DRAWING

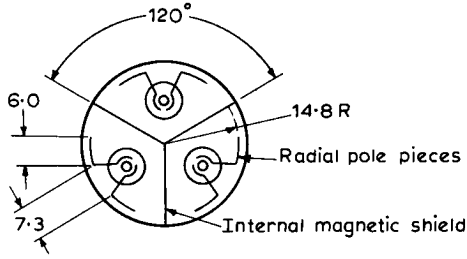




Useful screen area within dotted line.

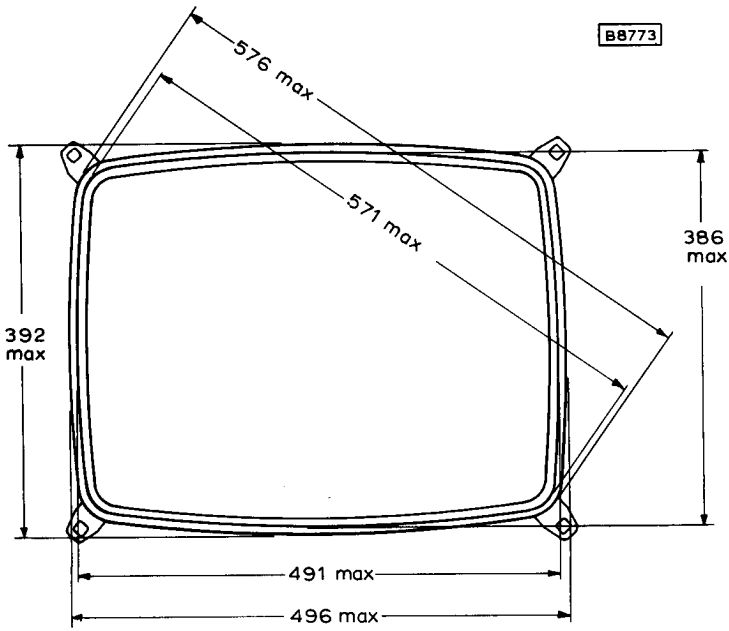
All dimensions in mm

Bulb dimensions

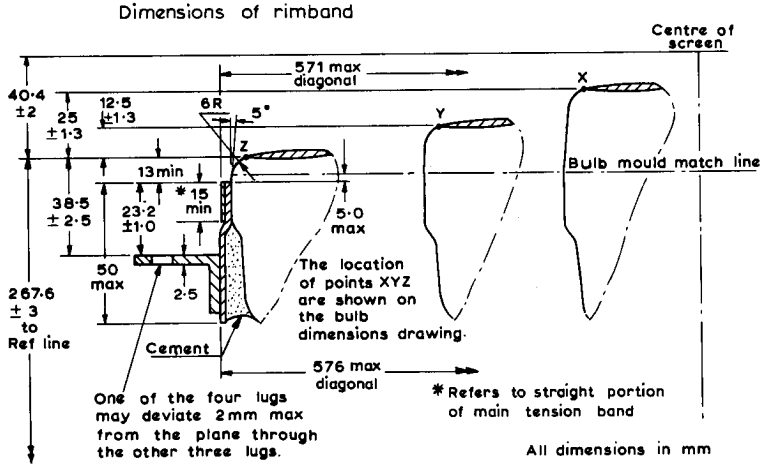


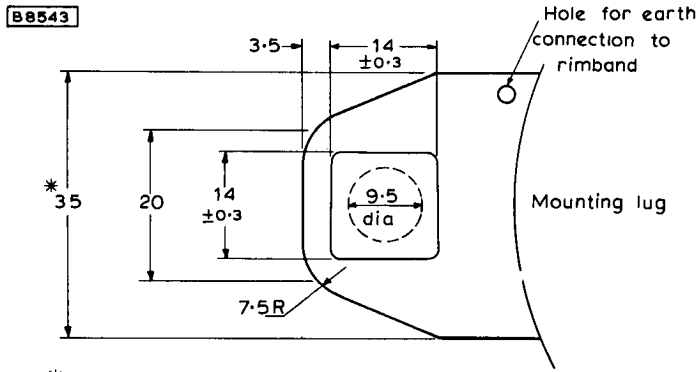
Location of radial convergence pole pieces viewed from screen end of guns.

All dimensions in mm

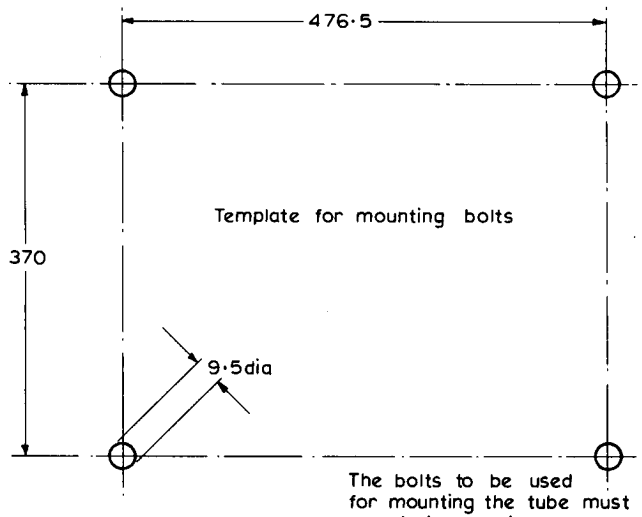


Dimensions of rimband





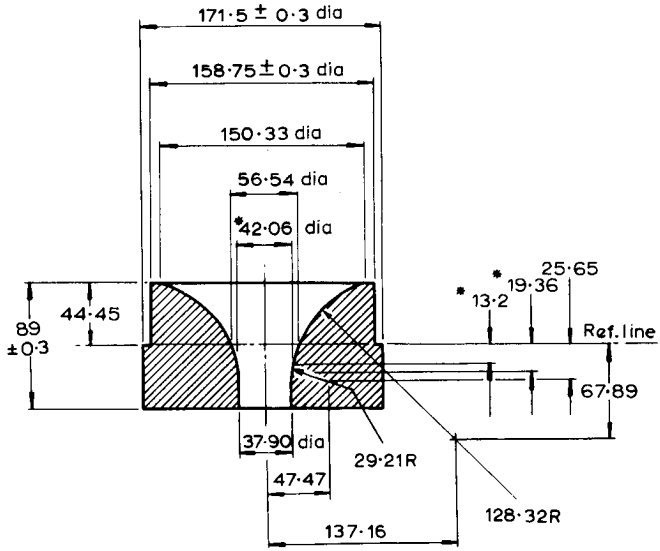
*Minimum space to be reserved for mounting lugs = 40mm



The bolts to be used for mounting the tube must be within the circles of 9·5mm diameter shown in the template drawing.

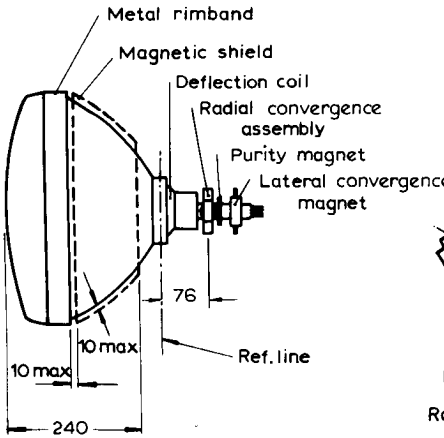
All dimensions in mm

B8468

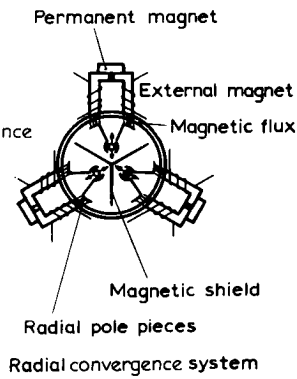


Reference line gauge

* These dimensions define extent of 29·21R



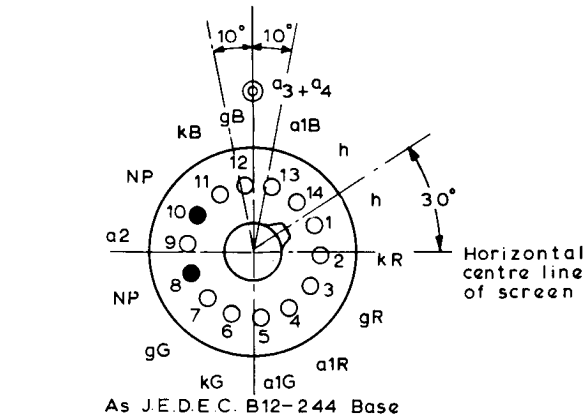
Outline of tube with components



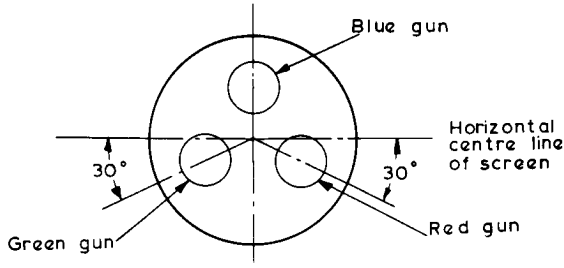
Radial convergence system

All dimensions in mm

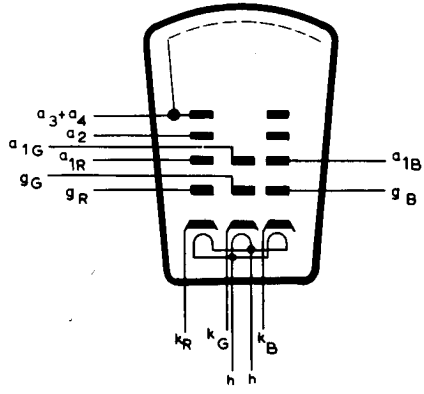
B8469



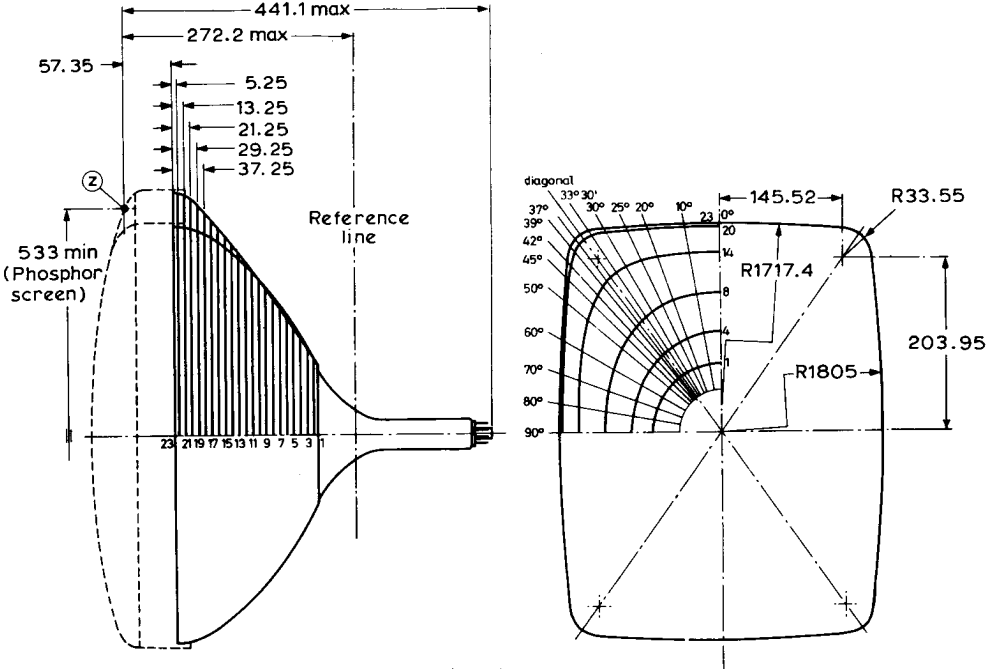
As J.E.D.E.C. B12-244 Base but with shorter spigot



View looking from base



MAXIMUM CONE CONTOURS

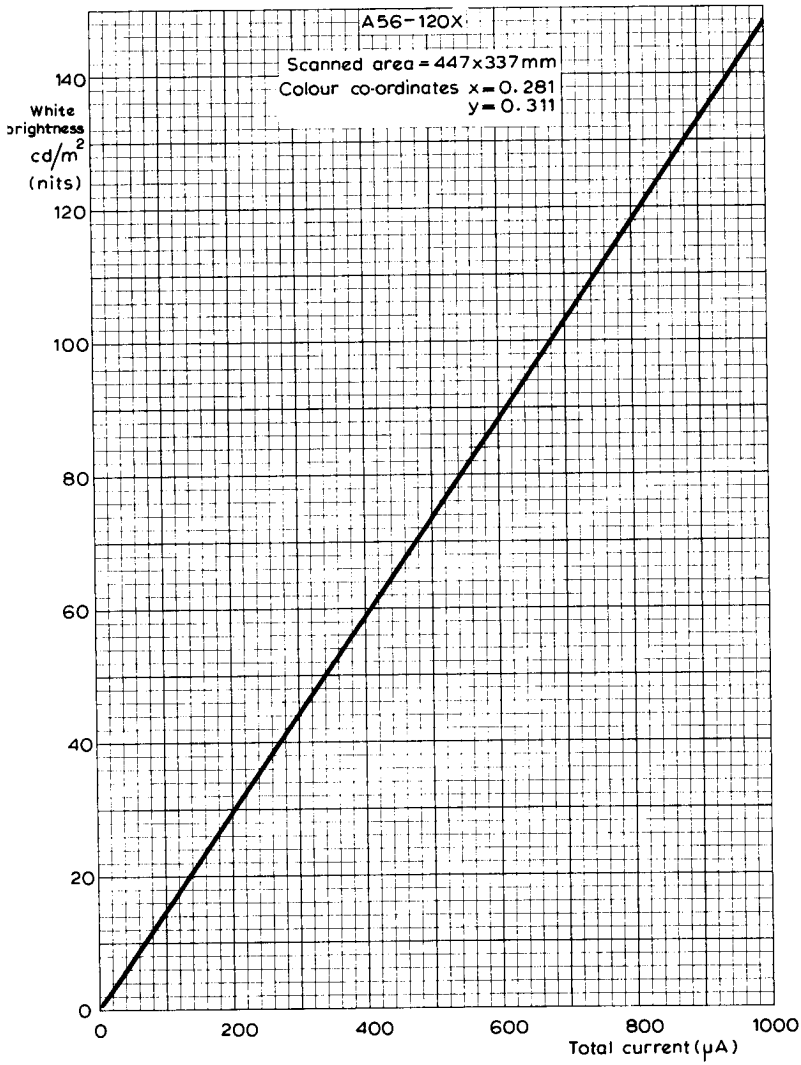


All dimensions in mm

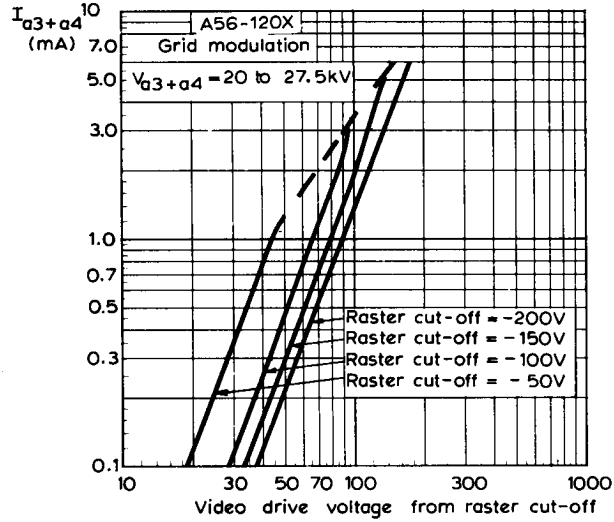
DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page 12)

Section	Nominal distance from point 'Z'	Distance from centre (max. values)															
		0° Long axis	10°	20°	25°	30°	33°30′	35°30′ Diagonal	37°	39°	42°	45°	50°	60°	70°	80°	90° Short axis
1	227·2	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9	79·9
2	222·6	87·7	87·7	87·6	87·6	87·5	87·5	87·5	87·4	87·4	87·4	87·4	87·3	87·2	87·2	87·1	87·1
3	214·6	103·3	103·0	102·1	101·6	101·0	100·6	100·4	100·2	100·0	99·6	99·3	98·9	98·1	97·5	97·4	97·3
4	206·6	118·0	117·5	116·0	115·1	114·1	113·3	112·9	112·6	112·2	111·6	101·0	110·0	108·3	107·1	106·4	106·2
5	198·6	131·0	130·5	129·0	127·9	126·6	125·7	125·1	124·7	124·1	123·2	122·4	120·9	118·3	116·2	114·9	114·4
6	190·6	142·7	142·4	141·1	140·1	138·8	137·7	137·0	136·5	135·8	134·7	133·5	131·6	127·9	124·8	122·8	122·1
7	182·6	153·3	153·3	152·6	151·7	150·5	149·3	148·6	148·0	147·2	145·8	144·4	142·0	137·1	132·9	130·1	129·2
8	174·6	163·0	163·4	163·4	162·9	161·8	160·7	159·9	159·3	158·3	156·8	155·0	152·0	145·8	140·5	137·0	135·8
9	166·6	172·1	172·8	173·7	173·6	172·8	171·7	170·9	170·2	169·2	167·4	165·4	161·6	154·0	147·6	143·4	141·9
10	158·6	180·6	181·6	183·5	183·9	183·5	182·5	181·7	180·9	179·8	177·7	175·3	170·9	161·7	154·2	149·4	147·7
11	150·6	188·6	190·0	192·7	193·7	193·8	193·0	192·2	191·4	190·1	187·8	185·0	179·7	169·0	160·3	154·9	153·1
12	142·6	196·2	197·8	201·6	203·2	203·8	203·3	202·5	201·6	200·2	197·5	194·3	188·1	175·8	166·0	160·1	158·1
13	134·6	203·3	205·3	209·9	212·2	213·5	213·3	212·5	211·6	210·1	206·9	203·1	196·1	182·1	171·4	164·9	162·8
14	126·6	210·1	212·3	217·8	220·8	222·9	223·1	222·3	221·4	219·7	216·0	211·6	203·5	187·9	176·3	169·4	167·2
15	118·6	216·4	218·9	225·3	229·0	231·9	232·6	231·9	231·0	229·0	224·7	219·6	210·4	193·2	180·8	173·6	171·2
16	110·6	222·5	225·1	232·3	236·8	240·6	241·9	241·4	240·3	238·1	233·0	227·1	216·7	198·1	184·3	177·4	175·0
17	102·6	228·2	231·0	239·0	244·2	249·0	251·0	250·6	249·4	247·0	241·0	234·1	222·5	202·5	188·3	181·0	178·5
18	94·6	233·4	236·3	245·0	250·9	256·9	259·9	259·6	258·4	255·6	248·5	240·6	227·8	206·4	192·2	184·3	181·7
19	86·6	237·4	240·5	249·7	256·5	264·0	268·3	268·4	267·3	264·2	255·7	246·6	232·3	209·9	195·3	187·2	184·6
20	78·6	240·3	243·5	253·2	260·7	269·8	276·1	276·9	275·9	272·6	262·4	251·7	236·1	212·8	198·1	189·9	187·3
21	70·6	242·3	245·5	255·4	263·3	273·2	280·6	281·8	281·0	277·6	266·4	254·9	238·6	214·9	200·1	191·9	189·3
22	62·6	243·4	246·6	256·6	264·5	274·7	282·4	283·7	283·0	279·5	268·2	256·4	240·0	216·2	201·3	193·1	190·4
23	57·35	243·9	247·1	257·1	265·0	275·2	282·8	284·2	283·4	280·0	268·7	257·0	240·5	216·7	201·8	193·5	190·9

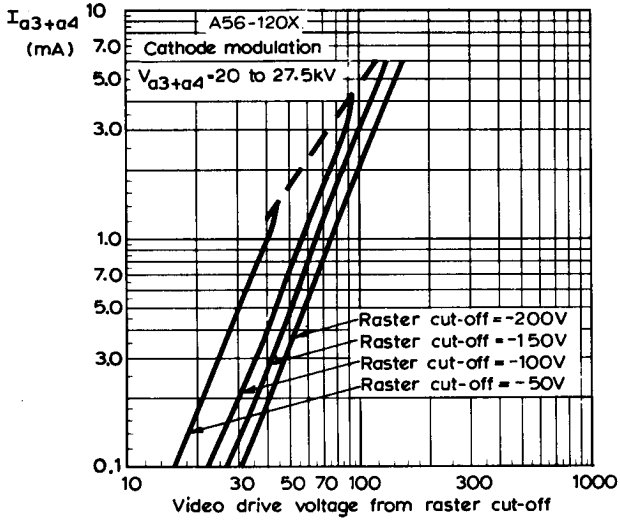
All dimensions in mm



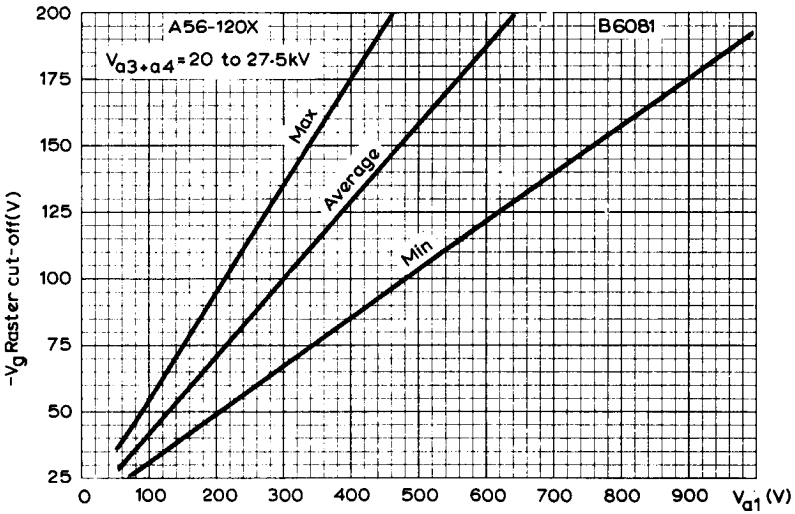
BRIGHTNESS AT CENTRE OF SCREEN PLOTTED AGAINST TOTAL CURRENT FOR WHITE OF COLOUR COORDINATES x = 0.281, y = 0.311



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE. GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION



CUT-OFF DESIGN CHART

TELEVISION TUBE A59-11W

QUICK REFERENCE DATA

59cm (23 in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. This tube is electrically identical to the A59-15W.

Deflection	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	50	%
Maximum overall length	36.7	cm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES, which precede this section of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission (approx.)	50	% ←
Useful screen area	see page D6	

FOCUSING

Electrostatic

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 250μA. ←

DEFLECTION

Double magnetic

The deflection coils should be designed so that their internal contour is in accordance with J.E.D.E.C. gauge 126, and should provide a pull-back of 4mm on a nominal tube.

CAPACITANCES

$c_{g\text{-all}}$	6.0	pF
$c_{k\text{-all}}$	4.0	pF
$c_{a2+a4\text{-}M}$	1700 to 2500	pF
$c_{a2+a4\text{-}B}$	350	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating M, which must be earthed, and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations - Cathode Ray Tubes'.

Centring magnet field intensity	0 to 10	Gs
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations - Cathode Ray Tubes'.

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4} = 0$) (see note 1)	20	kV ←
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
$+v_{a3(pk)}$ max. (see note 2)	2.5	kV
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on a decrease in $V_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) must be connected to the chassis via a 2MΩ resistor. Soldering tags are provided for this purpose.

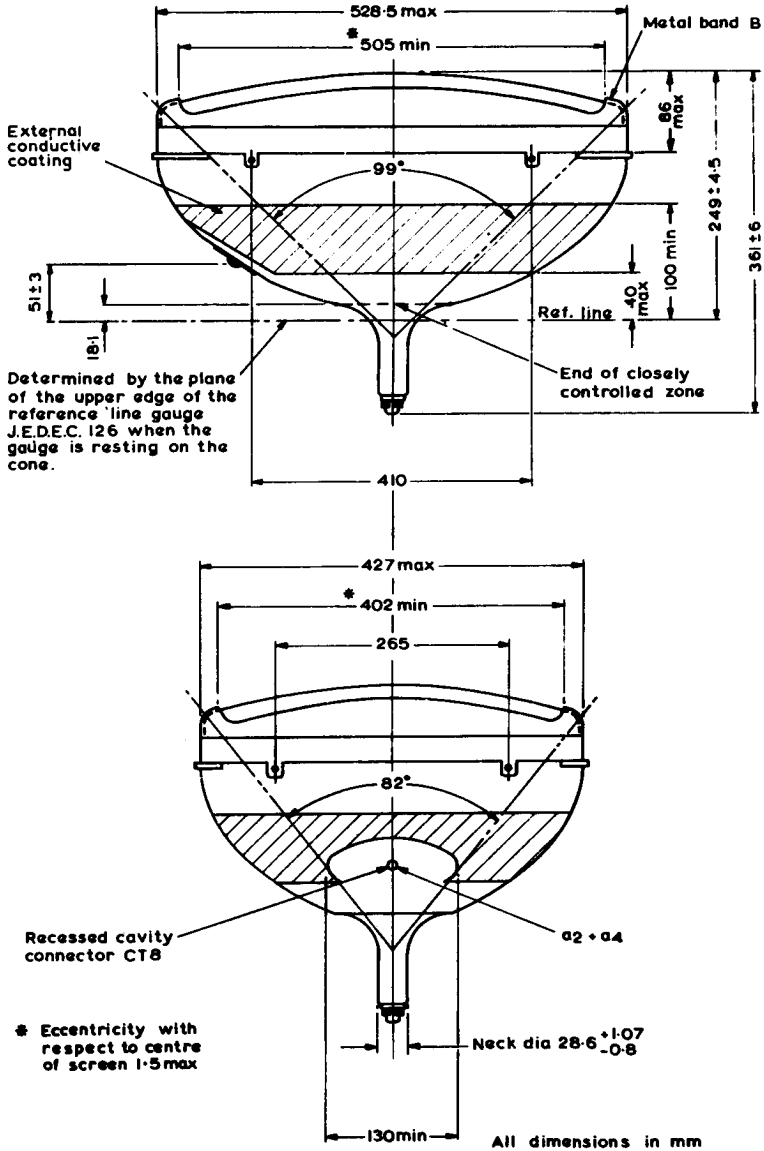
   The mounting lugs will not necessarily be in electrical contact with the metal band.

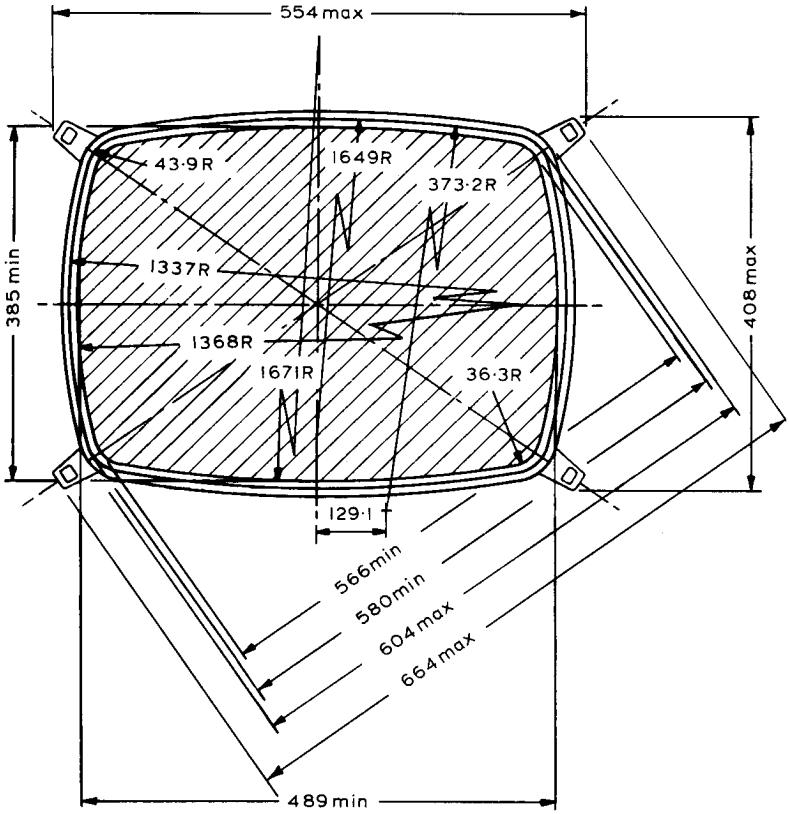
WARNING ←

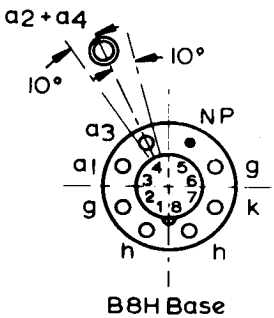
X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

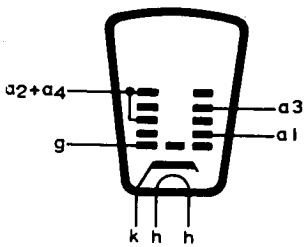
WEIGHT ←

Tube alone	13	kg
	28.7	lb

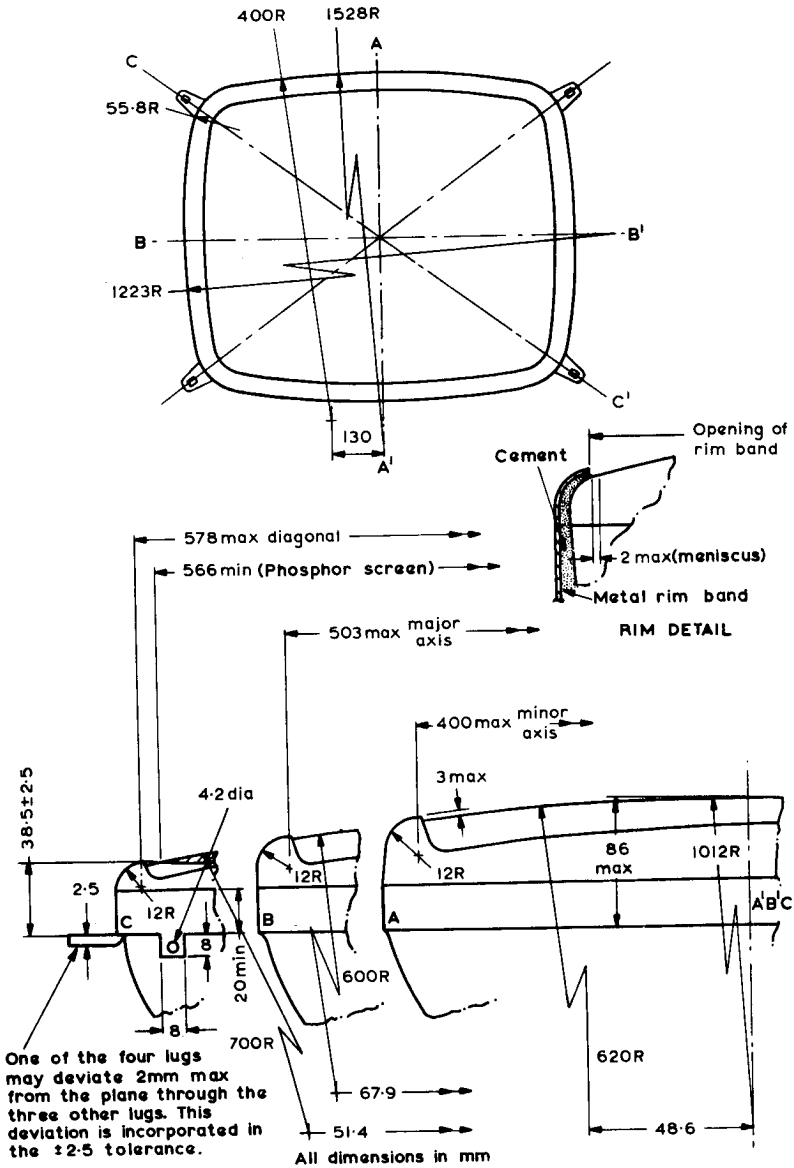

528·5 max
Metal band B
* 505 min
86 max
249±4·5
361±6
External conductive coating
99°
100 min
40 max
Ref. line
51±3
18±1
Determined by the plane of the upper edge of the reference line gauge J.E.D.E.C. 126 when the gauge is resting on the cone.
End of closely controlled zone
410
427 max
* 402 min
265
82°
Recessed cavity connector CT8
a2 + a4
* Eccentricity with respect to centre of screen 1·5 max
Neck dia 28·6 +1·07 -0·8
130 min
All dimensions in mm

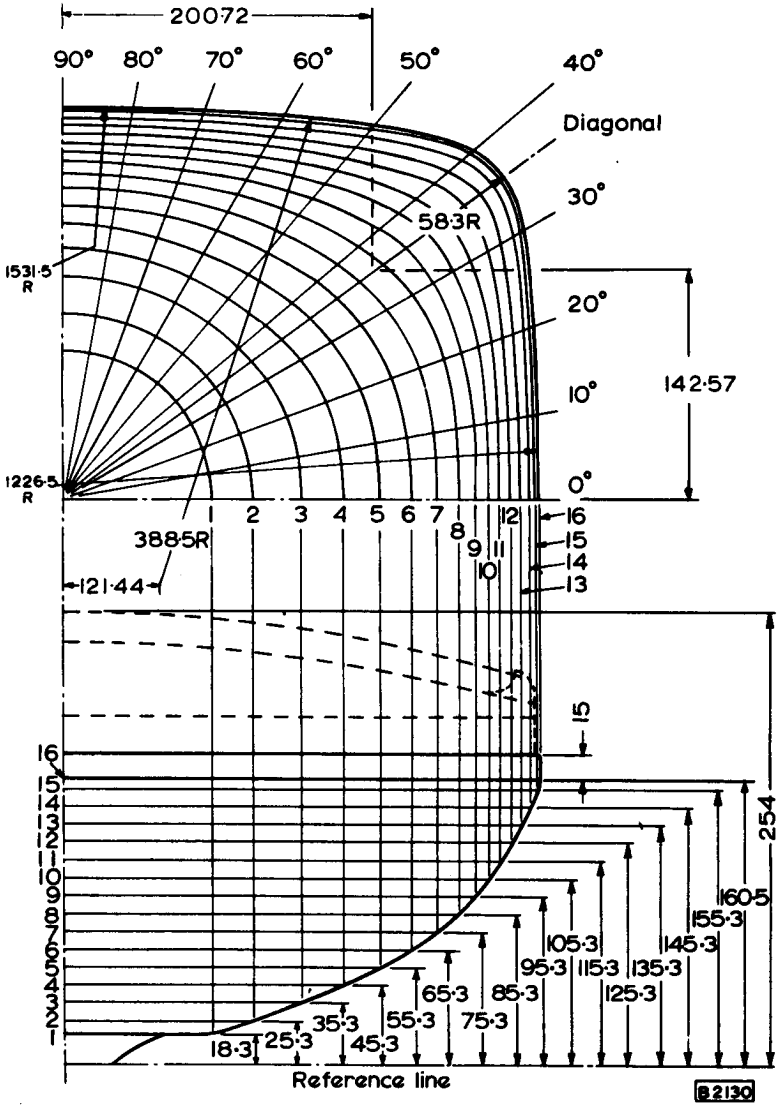






All dimensions in mm


400R
1528R
A
C
55·8R
B
B'
1223R
C'
130
A'
Cement
Opening of rim band
2 max(meniscus)
Metal rim band
RIM DETAIL
578 max diagonal
566 min (Phosphor screen)
503 max major axis
400 max minor axis
3 max
38·5±2·5
4·2 dia
2·5
12R
C
D
8
20 min
8
12R
B
600R
700R
12R
A
86 max
1012R
A'B'C'
620R
67·9
51·4
48·6
One of the four lugs may deviate 2mm max from the plane through the three other lugs. This deviation is incorporated in the ±2·5 tolerance.
All dimensions in mm

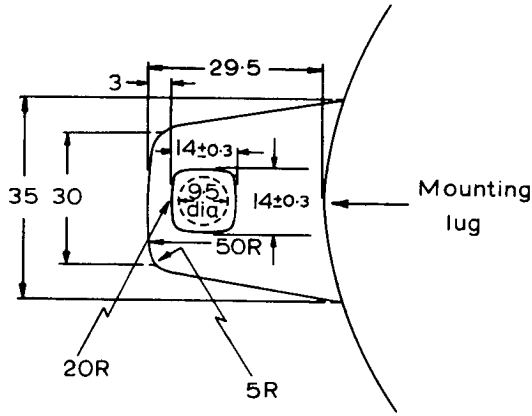


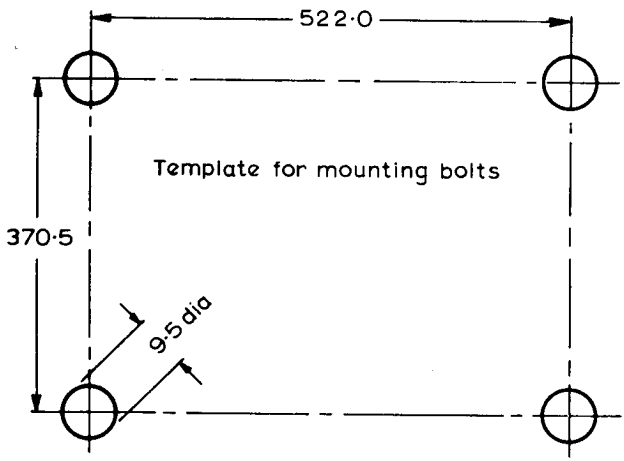
MAXIMUM CONE CONTOURS

DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page D8)

Section	0° long	10°	20°	30°	35°23' diagonal	40°	50°	60°	70°	80°	90° short
1	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5
2	107.3	107.2	106.7	105.5	105.0	104.6	104.0	103.6	102.8	102.3	102.3
3	135.0	135.3	135.2	132.9	131.3	129.6	127.2	124.9	123.9	123.9	123.9
4	158.0	158.4	158.8	155.1	152.1	149.8	144.6	141.1	139.5	139.3	139.3
5	178.4	179.0	179.1	175.6	171.6	168.4	161.4	156.6	153.8	152.5	152.2
6	196.0	197.0	197.3	194.6	190.0	186.0	177.7	171.1	166.3	164.0	163.1
7	210.8	212.0	213.4	211.6	206.7	202.2	192.6	183.7	177.4	174.0	172.4
8	223.3	225.1	228.1	227.2	222.8	217.9	206.1	194.4	187.0	182.3	180.4
9	233.2	235.2	240.1	240.7	238.0	232.7	217.8	203.9	194.4	189.3	187.1
10	240.8	243.3	249.4	253.2	252.5	246.8	228.6	212.4	200.9	195.1	192.8
11	247.2	249.7	257.0	264.9	266.2	259.9	238.3	219.9	206.7	200.2	197.7
12	253.1	255.8	264.0	275.5	278.8	272.3	247.4	226.5	212.4	205.2	202.7
13	258.4	261.4	270.4	285.4	290.2	283.5	255.7	232.9	217.8	209.9	207.5
14	263.2	266.3	276.0	293.4	299.5	293.3	263.2	238.6	222.9	214.6	211.9
15	267.0	270.3	280.3	297.8	303.7	299.3	268.9	243.7	227.6	218.9	216.1
16	267.8	271.0	280.9	298.6	304.5	300.2	270.2	244.9	228.8	219.9	217.0

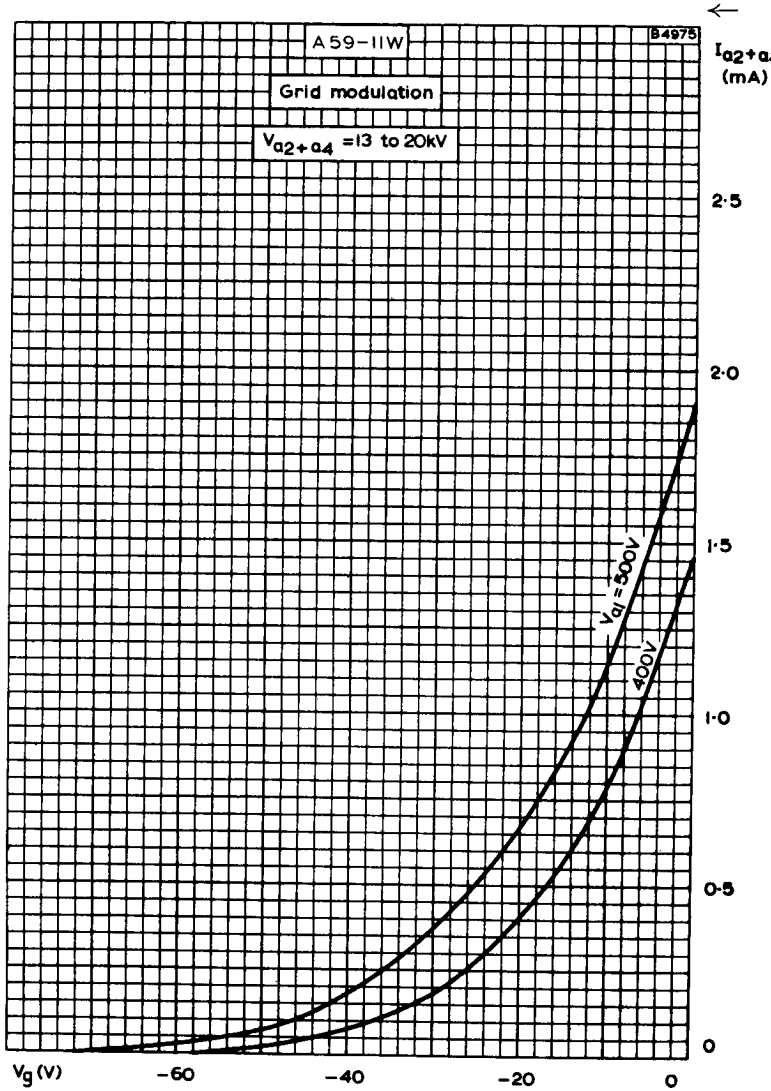
All dimensions in mm



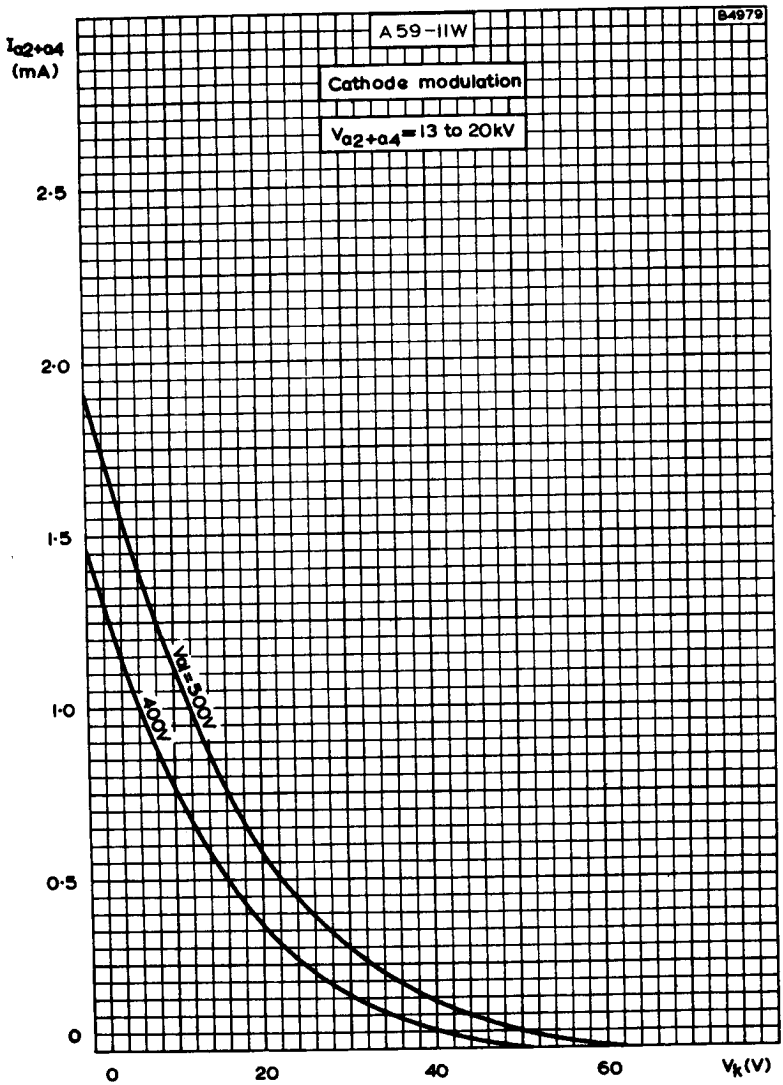


All dimensions in mm

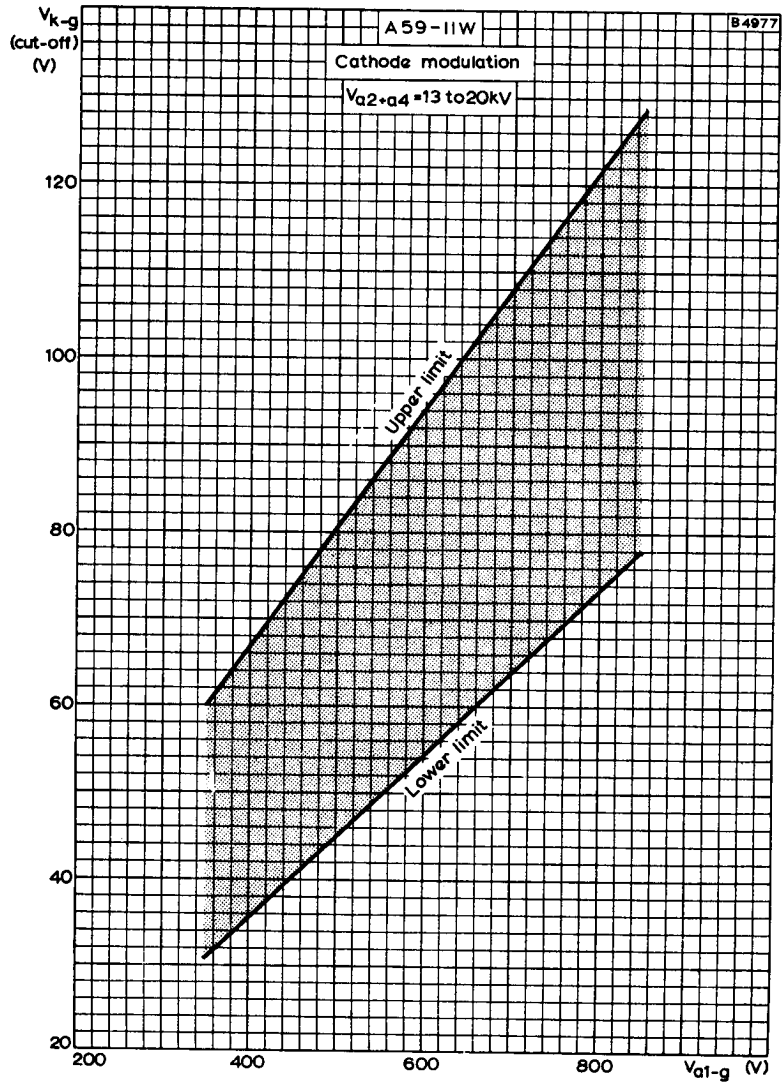
The bolts to be used for mounting the tube must be within the circles of 9.5mm diameter shown in the template drawing.



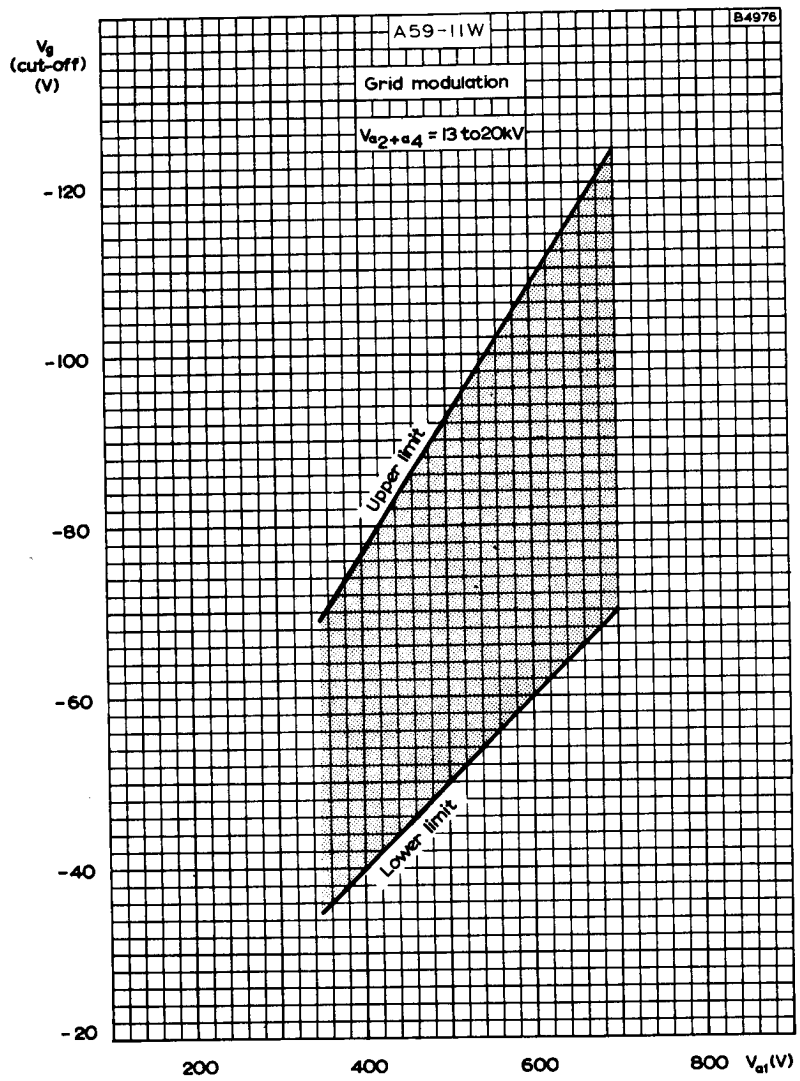
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION.

TELEVISION TUBE A59-15W

QUICK REFERENCE DATA		
59cm (23in) direct viewing television tube with metal backed screen. This tube is electrically identical to the A59-11W.		
Deflection	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	50	%
Maximum overall length	36.7	cm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES, which precede this section of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN

Metal backed

Fluorescent colour	White
Light transmission (approx.)	50%
Useful screen area	see page D6

FOCUSING

Electrostatic

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 250μA.

DEFLECTION

Double magnetic

The deflection coils should be designed so that their internal contour is in accordance with J.E.D.E.C. gauge 126, and should provide a pull-back of 4mm on a nominal tube.

CAPACITANCES

C_{g-all}	6.0	pF
C_{k-all}	4.0	pF
$C_{a2+a4-M}$	1700 to 2500	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating M, which must be earthed, and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations - Cathode Ray Tubes'.

Centring magnet field intensity	0 to 10	Gs
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations - Cathode Ray Tubes'.

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4} = 0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
$+v_{a3(pk)}$ max. (see note 2)	2.5	kV
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

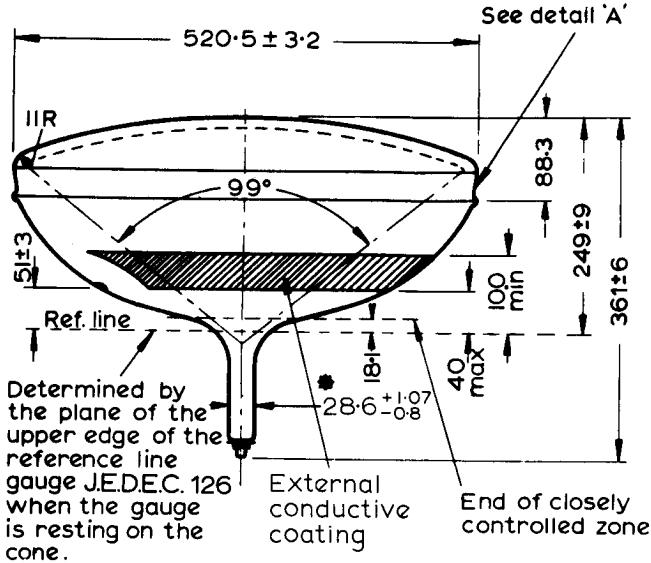
4. During an equipment warm-up period not exceeding 15 seconds $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on a decrease in $V_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

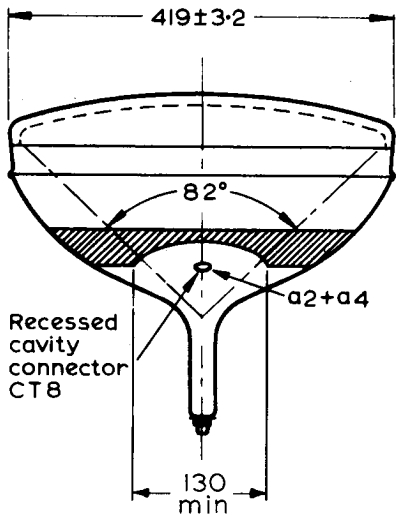
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

WEIGHT

Tube alone	12	kg
	26.5	lb

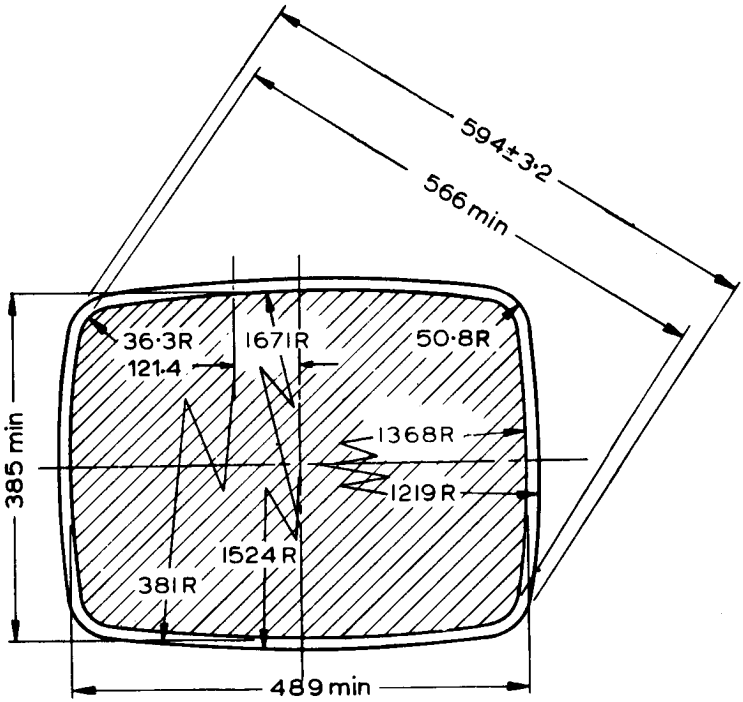


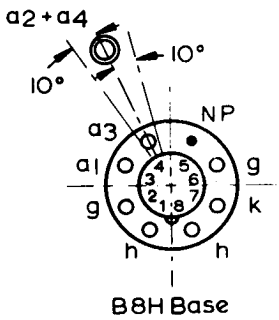


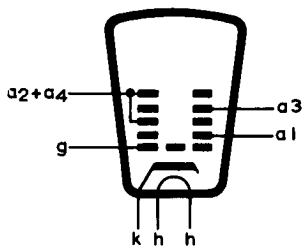
✱ The maximum value is determined by the reference line gauge

All dimensions in mm

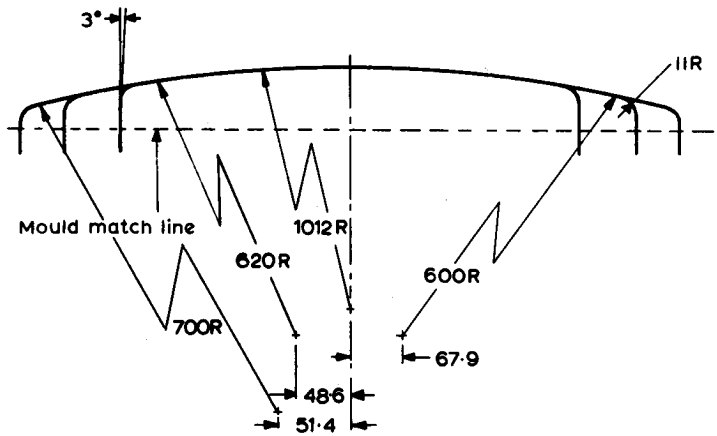
B5073





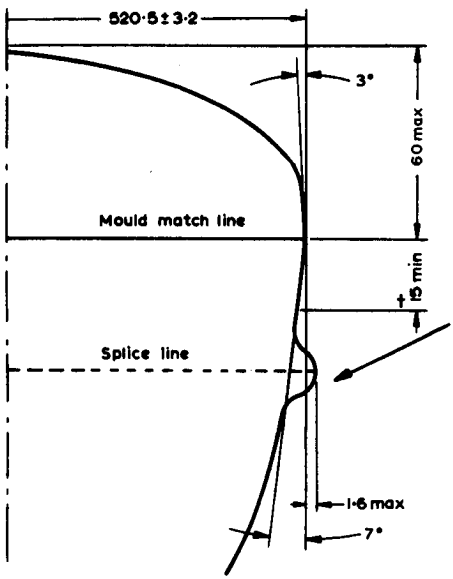


All dimensions in mm



External screen radii B4981

Detail 'A'



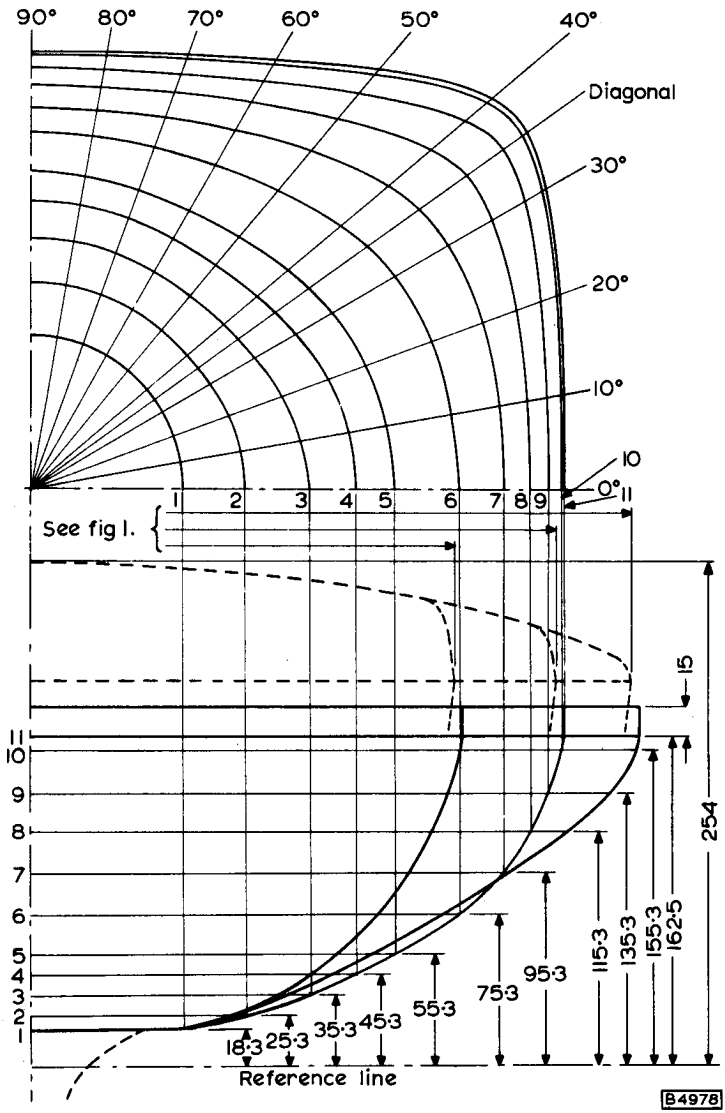
†Undisturbed area between mould match line and splice line

All dimensions in mm B5021

The bulge at the splice line seal may increase the indicated maximum values for envelope width, diagonal and height by not more than 3.2mm, but at any point around the seal, the bulge will not protrude more than 1.6mm beyond the envelope surface at the mould match line.

The mounting arrangement should be designed such that for satisfactory clamping it does not depend on the presence of a bulge at the splice line.

The undisturbed area between mould match line and splice line is 15mm minimum. This should be the width of the tube support band.

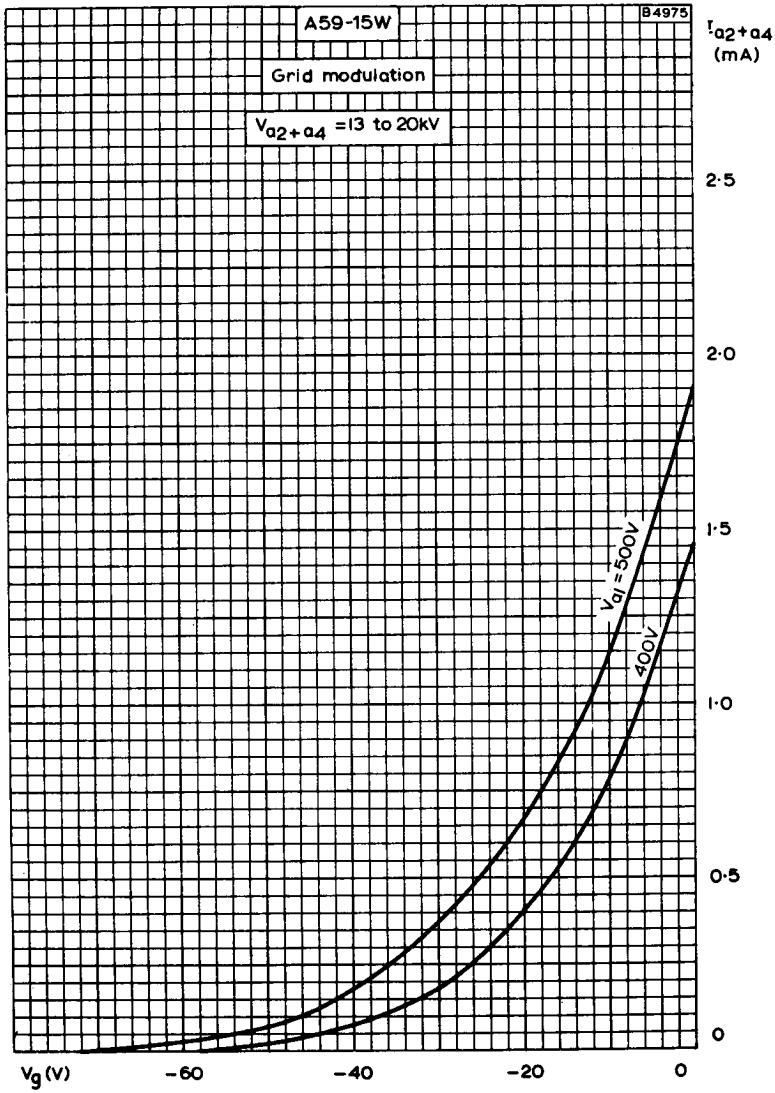


MAXIMUM CONE CONTOURS

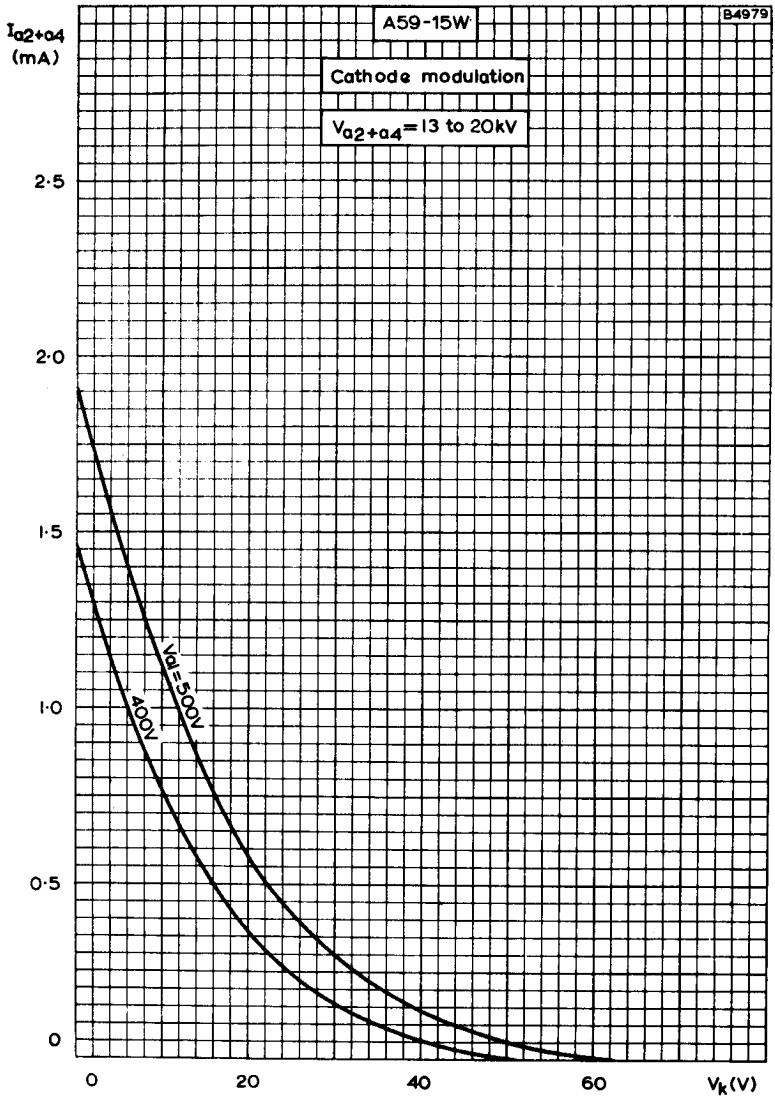
DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page D8)

Section	Nominal height above Ref. line	0° long	10°	20°	30°	Diagonal	40°	50°	60°	70°	80°	90° short
1	18.3	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
2	25.3	106.0	104.4	102.4	101.6	101.0	101.0	101.0	101.0	101.0	101.0	101.0
3	35.3	137.7	136.0	132.0	128.6	126.4	125.3	123.2	122.1	121.8	121.6	122.5
4	45.3	160.8	160.0	155.9	151.2	148.6	146.7	142.6	140.0	138.5	138.5	138.8
5	55.3	180.0	179.0	176.5	172.2	168.5	165.8	159.8	155.3	152.8	152.0	151.6
6	75.3	211.8	211.0	210.9	208.3	204.3	200.2	190.7	182.5	176.4	172.8	172.0
7	95.3	233.8	234.6	237.8	238.5	235.7	230.9	215.9	202.2	193.1	188.0	187.0
8	115.3	247.0	249.0	255.6	263.3	263.6	258.3	236.2	218.0	206.2	199.7	198.0
9	135.3	256.5	259.0	267.8	282.1	287.0	280.4	252.0	230.1	216.0	208.5	206.5
10	155.3	263.0	266.0	275.1	292.5	299.2	294.8	263.6	239.0	223.2	214.8	212.2
11	162.5	264.2	267.5	277.0	294.2	301.5	298.0	266.2	241.2	225.2	216.2	213.5

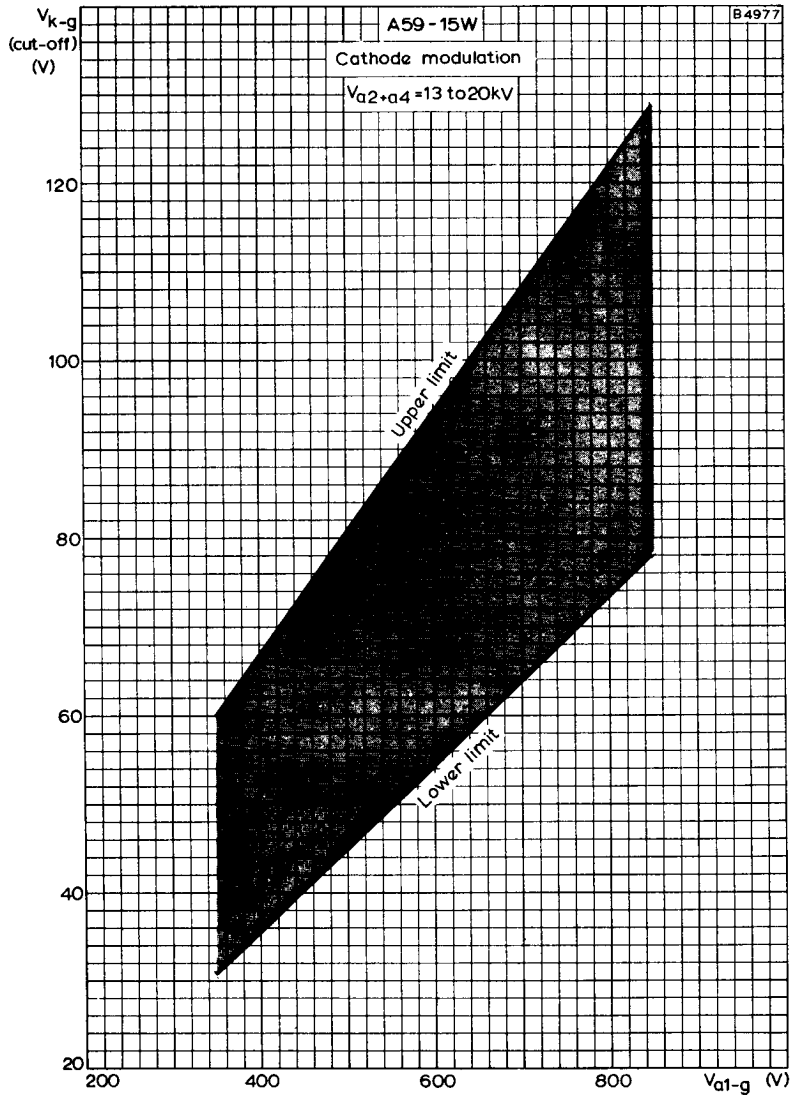
All dimensions in mm



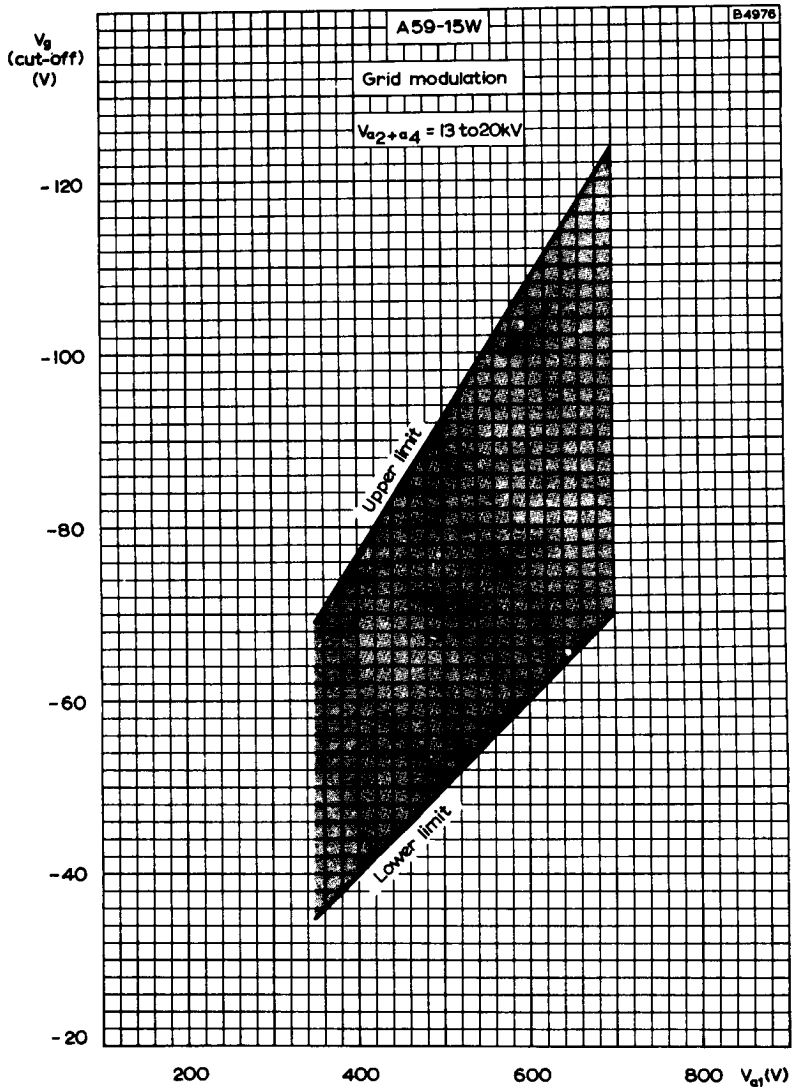
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION.

TELEVISION TUBE A59-23W

TENTATIVE DATA

QUICK REFERENCE DATA

59cm (23in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. This tube is electrically identical to the A59-11W. Suitable for use in receivers with push-through presentation.

Deflection	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	50	%
Maximum overall length	36.7	cm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission (approx.)	50	%
Useful screen area	See page D6	

FOCUSING

Electrostatic

The range of focus voltages shown in 'OPERATING CONDITIONS' results in optimum overall focus at a beam current of 250μA.

DEFLECTION

Magnetic

Diagonal deflection angle	110	deg
Horizontal deflection angle	99	deg
Vertical deflection angle	82	deg

The deflection coils should be designed to provide a pull-back of 4.0mm on a nominal tube.

CAPACITANCES

c_{g-all}	6.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	1700 to 2500	pF
$c_{a2+a4-B}$	350	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations - Cathode Ray Tubes'.

Centring magnet field intensity	0 to 10	Gs
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations - Cathode Ray Tubes'.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4}=0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
$+v_{a3(pk)}$ max. (see note 2)	2.5	kV
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 3)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ

NOTES

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flash-over within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on, a decrease in $V_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver.

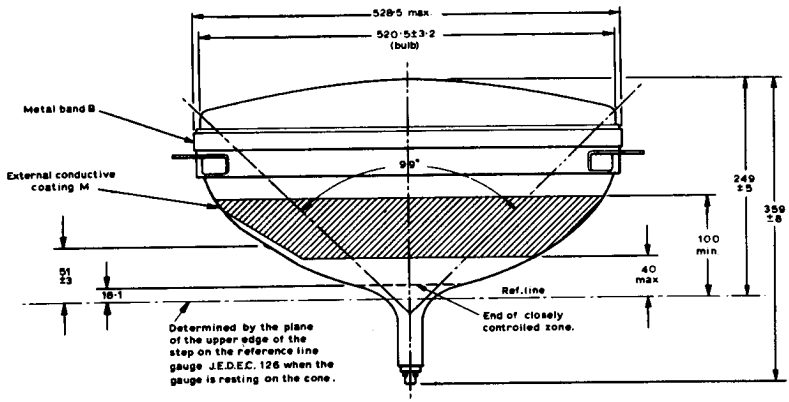
   The mounting lugs will be in electrical contact with the metal band.

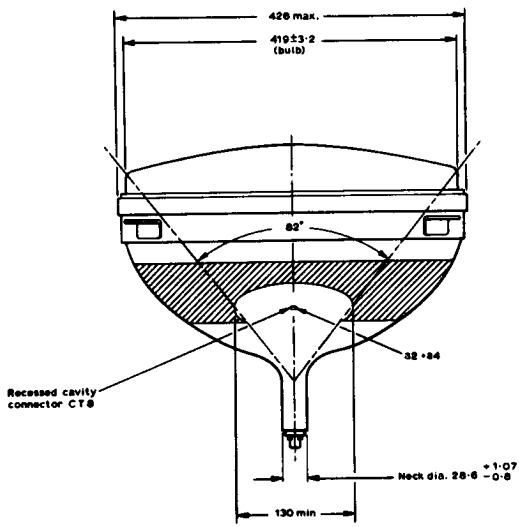
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

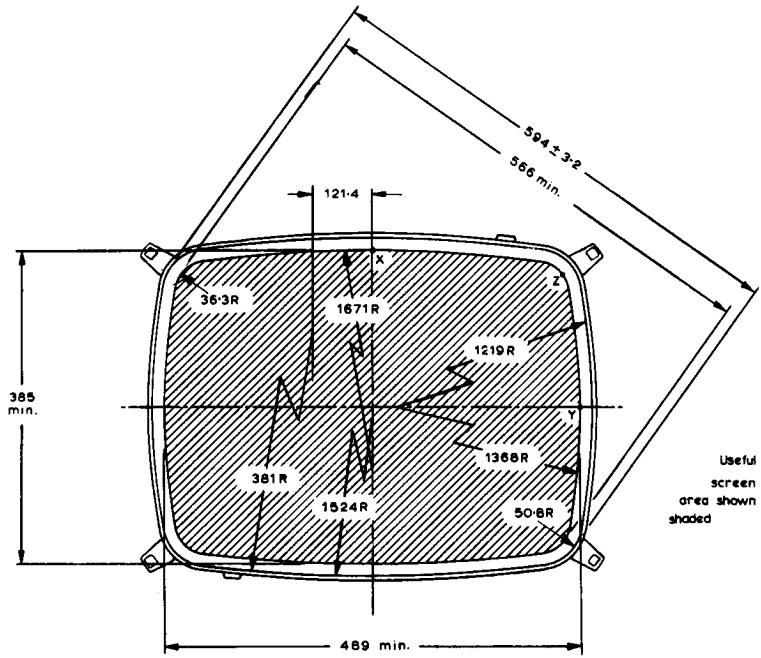
WEIGHT

Tube alone (approx.)	13	kg

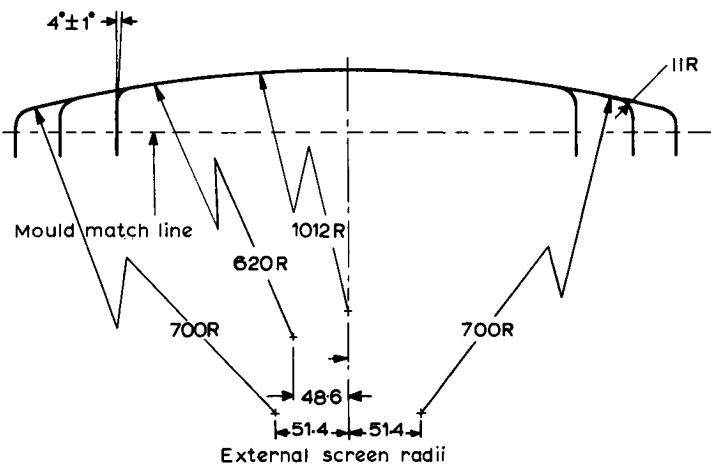




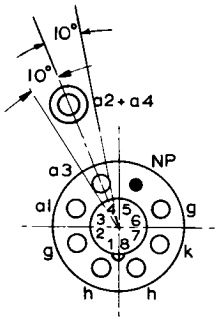
All dimensions in mm.



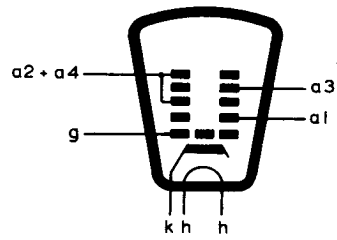
Bulb dimensions

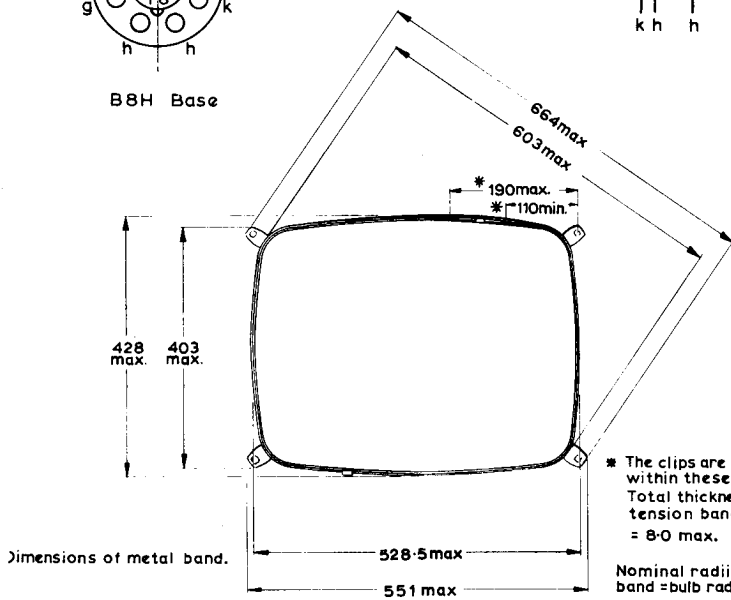


TELEVISION TUBE A59-23W



B8H Base

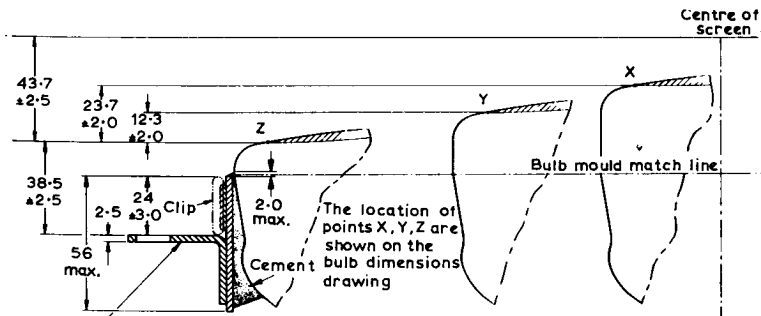




Dimensions of metal band.

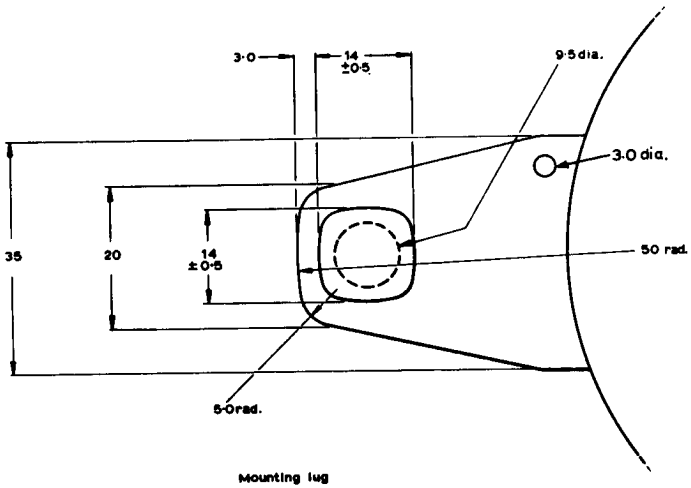
* The clips are located within these dimensions. Total thickness of rimband, tension bands and clip = 8·0 max.

Nominal radii of tension band = bulb radius + 2·5mm

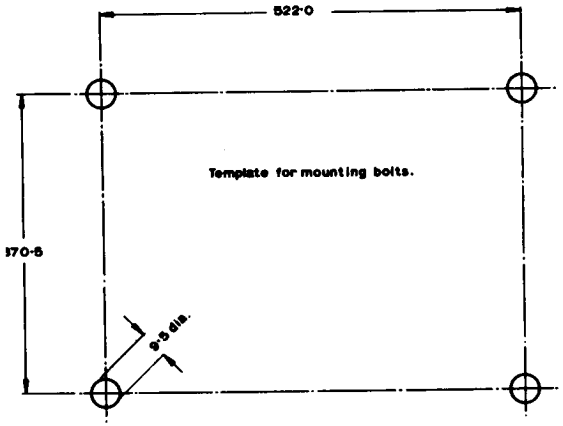


One of the four lugs may deviate 2mm max. from the plane through the three other lugs. This deviation is incorporated in the ±2·5 tolerance

All dimensions in mm



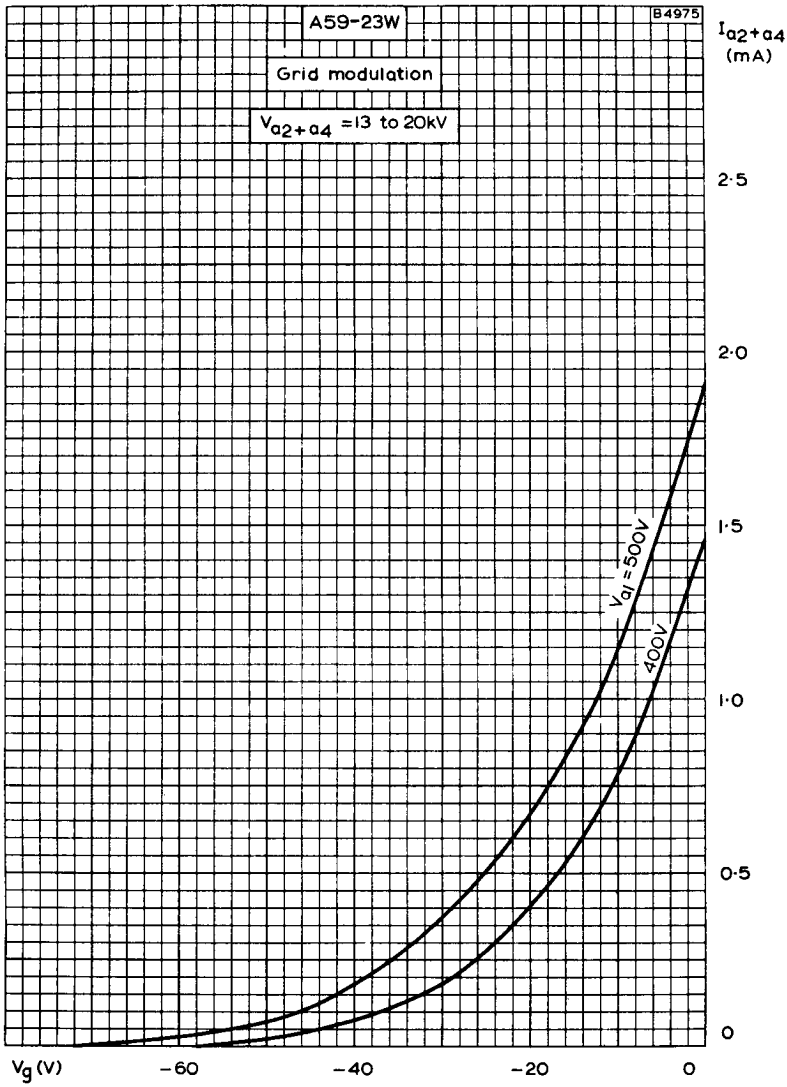
Mounting lug



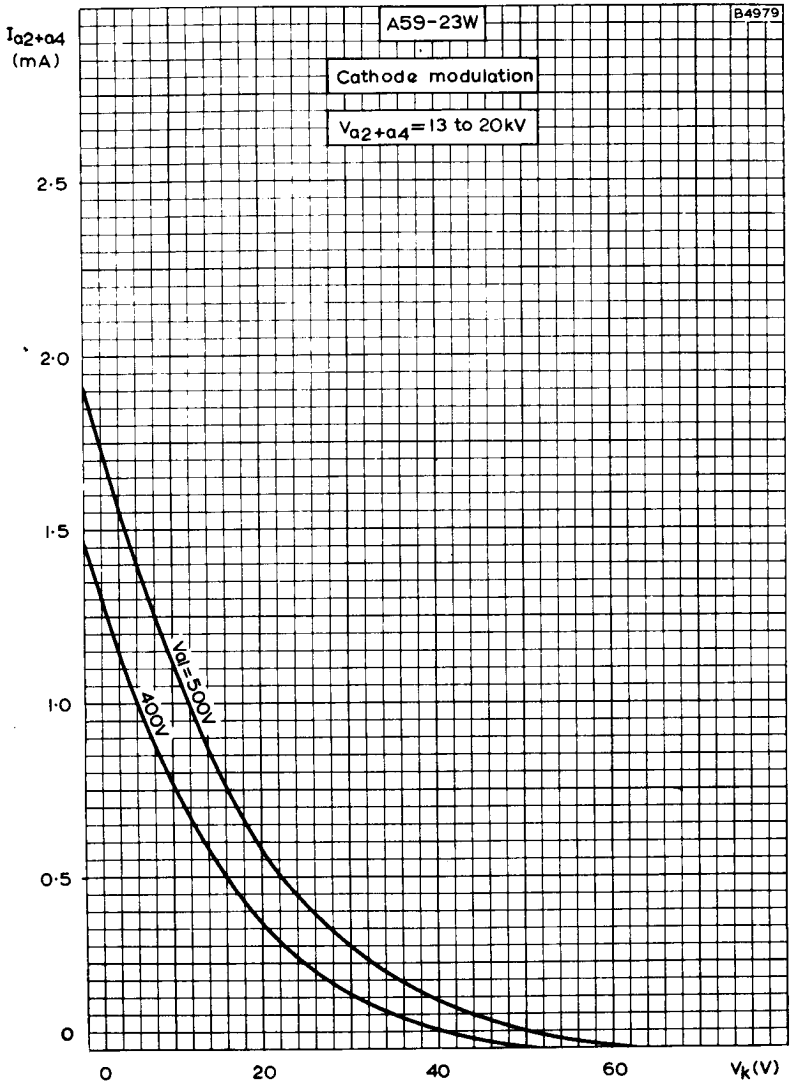
Template for mounting bolts.

All dimensions in mm.

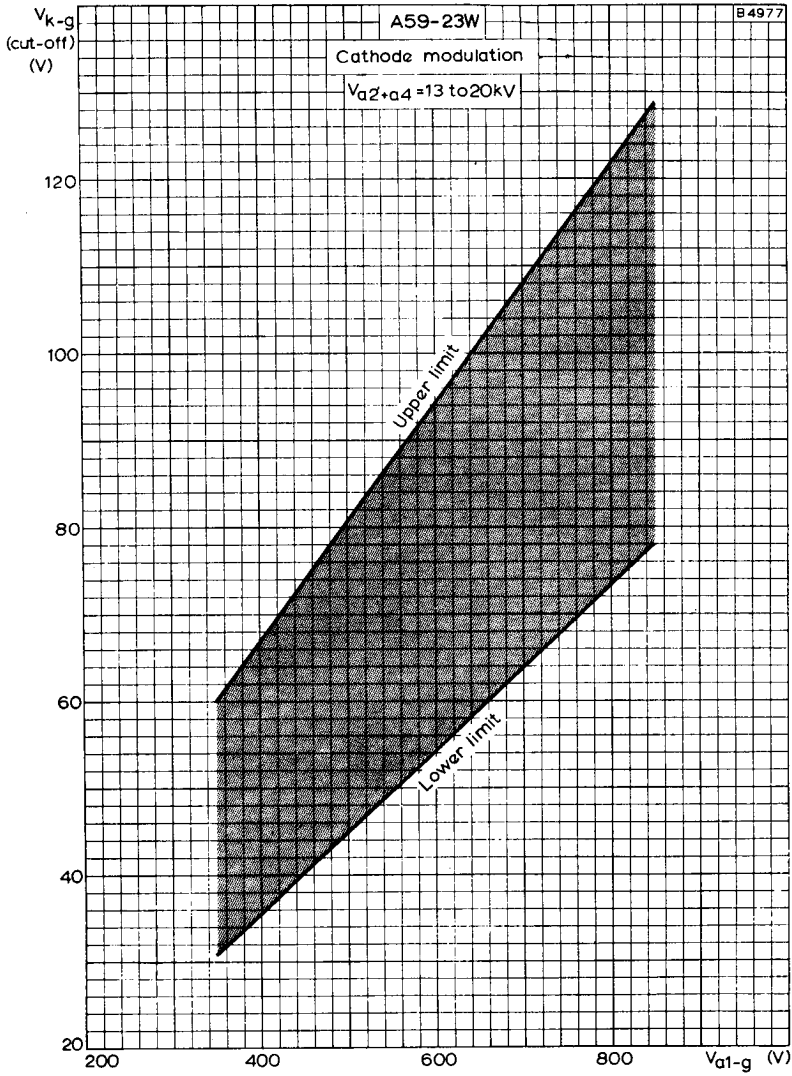
The bolts to be used for mounting the tube must be within the circles of 9·5mm diameter shown in the template drawing.



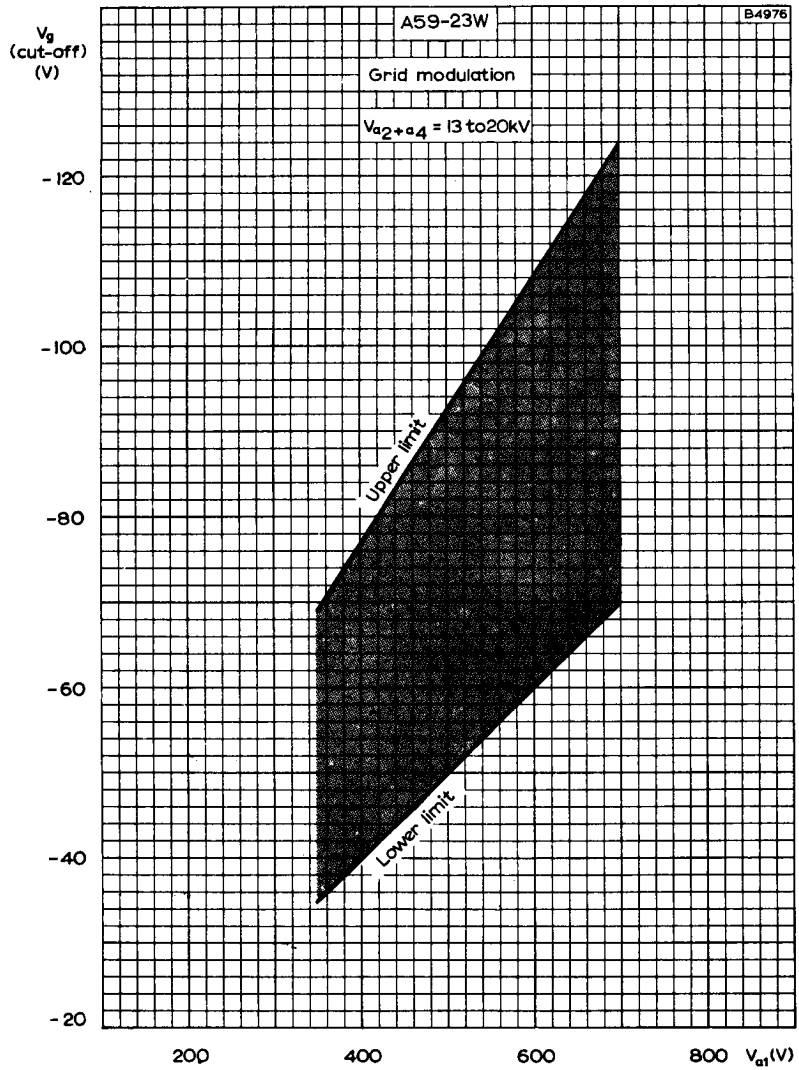
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION.

TELEVISION TUBE A59-23W/R

QUICK REFERENCE DATA

59cm (23in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. This tube is fitted with a ring trap base but in all other respects is electrically identical to the A59-11W. Suitable for use in receivers with push-through presentation.

Deflection angle	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	45	%
Maximum overall length	367	mm

This data should be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - CATHODE RAY TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Cathode Ray Tubes'.

Note - (applies to series operation only). The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN (Metal backed)

Fluorescent colour		White
Light transmission (approx.)	45	%
Useful screen area		See page 6

FOCUSING (Electrostatic)

The range of focus voltages shown in 'OPERATING CONDITIONS" results in optimum overall focus at a beam current of 250μA. In general, acceptable resolution will be obtained with a fixed focus voltage.

DEFLECTION (Magnetic)

Diagonal deflection angle	110	deg
Horizontal deflection angle	99	deg
Vertical deflection angle	82	deg

The deflection coils should be designed to provide a pull-back of 4.0mm on a nominal tube.

CAPACITANCES

$c_{g\text{-all}}$	7.0	pF
$c_{k\text{-all}}$	5.0	pF
$c_{a2+a4\text{-}M}$	1700 to 2500	pF
$c_{a2+a4\text{-}B}$	450	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

RING TRAP

For flashover protection to the receiver, parallel spark gaps are included for all the pins in the base of this tube, and the common connection is made to pin 5. These spark gaps are intended as part of a system for full flashover protection. A direct connection must always be made from pin 5 to the external conductive coating. Any electrode supplied directly from a high energy source (such as the H.T. line) should be provided with a series resistor.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations - Cathode Ray Tubes'.

Centring magnet field intensity	0 to 800	A/m
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations - Cathode Ray Tubes'.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4}=0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
$Z_{k-'e}$ max. (f = 50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ

NOTES

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on, a decrease in $V_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2.0MΩ.

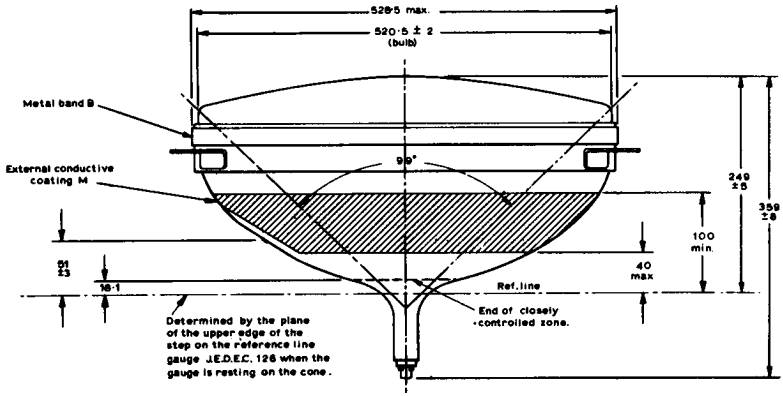
   The mounting lugs will be in electrical contact with the metal band.

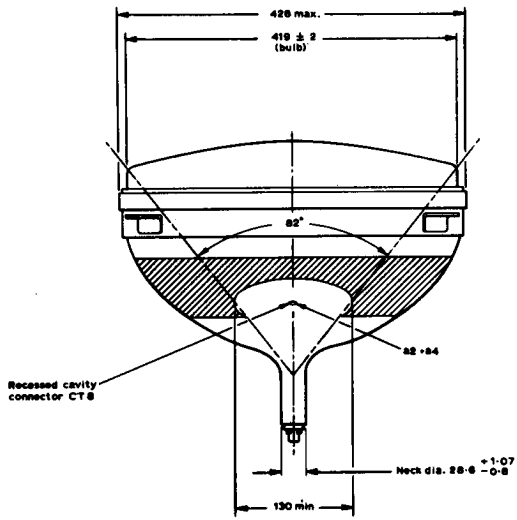
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

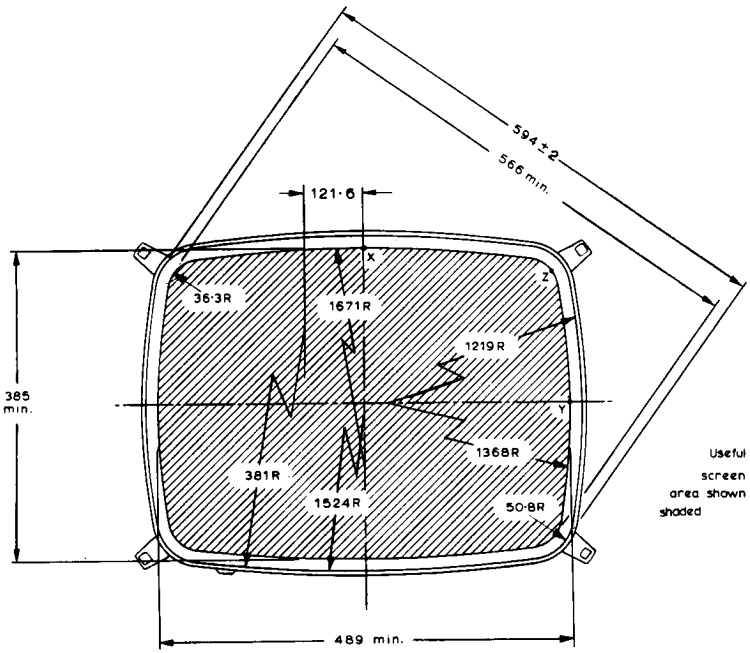
WEIGHT

Tube alone (approx.)	13	kg

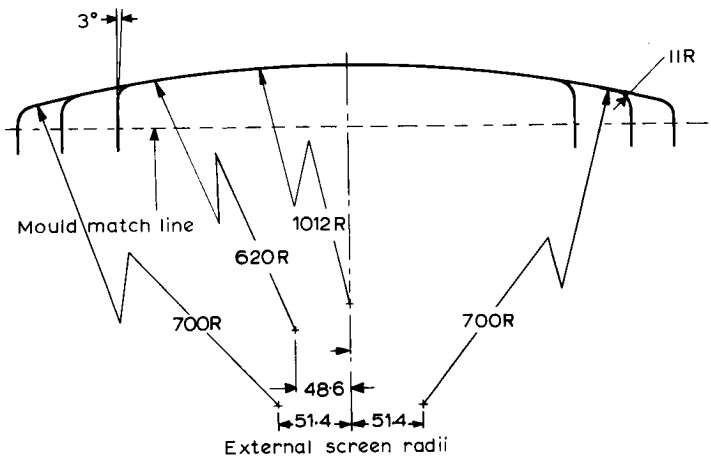




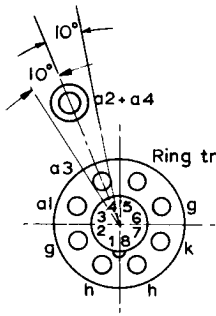
All dimensions in mm.



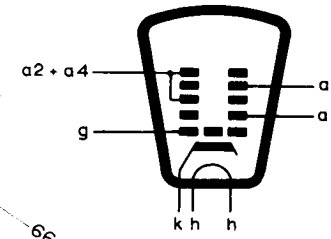
Bulb dimensions

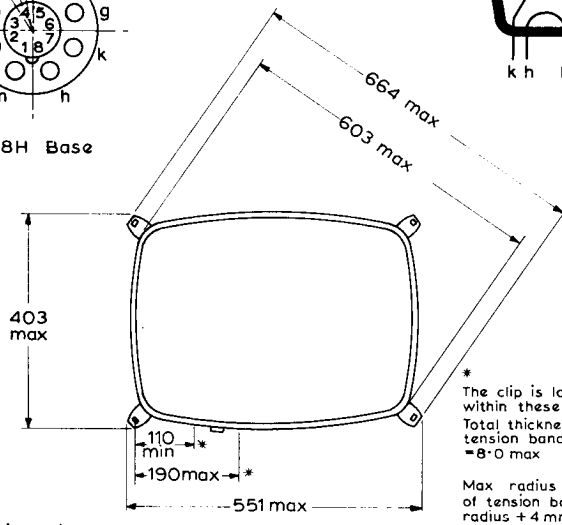


External screen radii



B8H Base



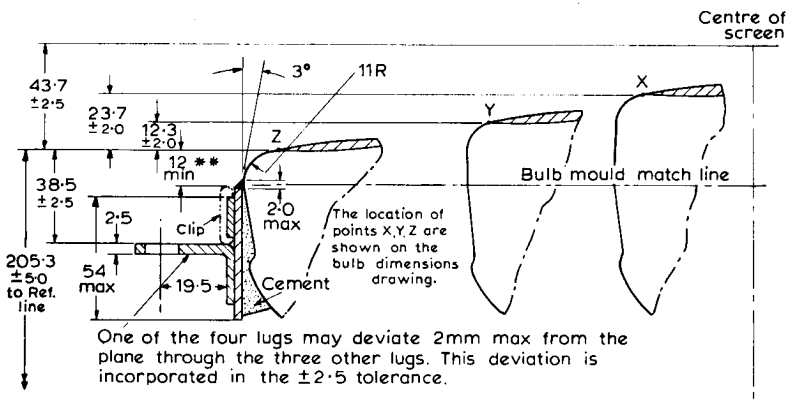


* The clip is located within these dimensions

Total thickness of rimband, tension band and clip = 8·0 max

Max radius of outside of tension band = bulb radius + 4 mm

Dimensions of metal band

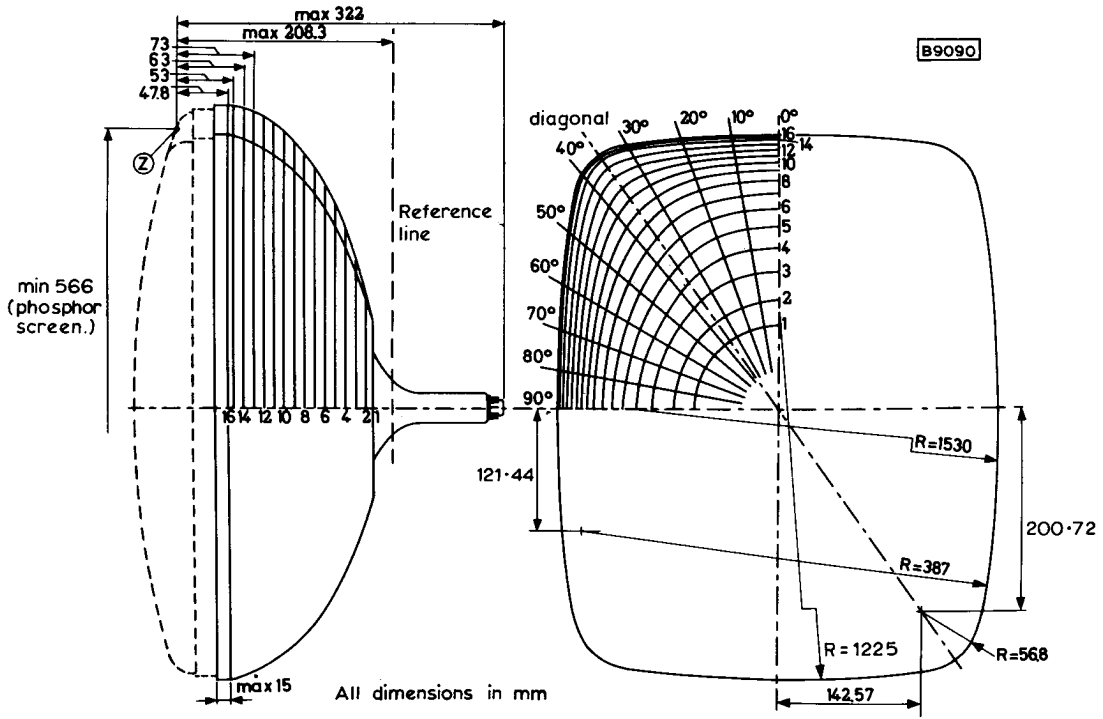


One of the four lugs may deviate 2mm max from the plane through the three other lugs. This deviation is incorporated in the ±2·5 tolerance.

** Distance from point Z to any metal parts

All dimensions in mm

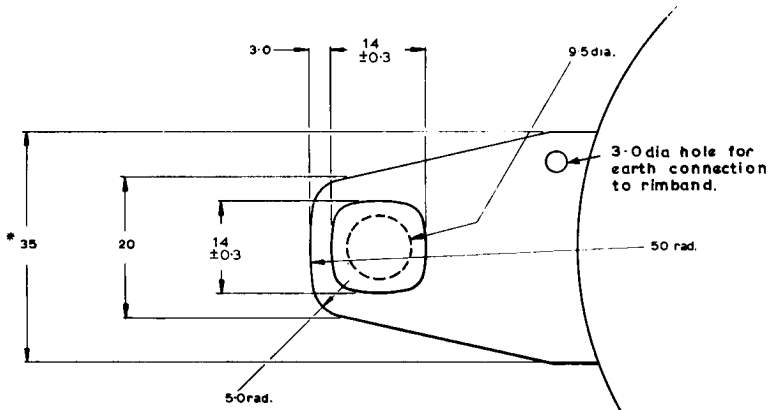
MAXIMUM CONE CONTOURS



DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page 8)

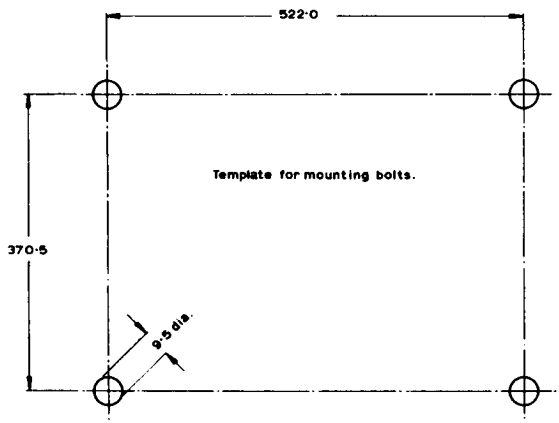
Section	Nominal distance from point "Z"	Distance from centre (max.) 0° Long axis	10°	20°	30°	35° 23' Diagonal	40°	50°	60°	70°	80°	90° Short axis
1	190	77.5	77.5	77.5	77.5	77.5	77.5	77.5	77.5	77.5	77.5	77.5
2	183	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
3	173	130.3	131.0	131.1	129.6	127.9	126.3	123.5	121.8	121.1	120.7	121.1
4	163	154.5	155.0	155.8	152.0	149.1	146.6	142.1	138.6	136.8	136.4	136.8
5	153	175.0	175.7	176.1	172.9	168.8	165.6	159.3	154.2	151.0	149.7	149.8
6	143	192.7	193.7	194.3	191.9	187.2	183.1	175.4	168.7	164.4	161.5	161.0
7	133	207.9	209.4	210.9	209.0	204.1	199.3	190.2	181.8	176.2	171.9	170.5
8	123	221.0	222.8	225.4	224.6	220.3	215.0	203.9	193.8	186.5	181.2	178.8
9	113	231.8	233.8	238.1	239.2	235.7	230.3	216.5	204.4	195.7	189.5	186.9
10	103	241.5	243.6	248.7	252.6	250.3	244.7	228.3	214.4	203.7	196.8	194.1
11	93	249.6	252.0	258.5	264.4	263.9	258.2	239.1	223.2	211.0	203.3	200.9
12	83	255.9	258.7	266.2	274.9	276.3	271.0	249.0	230.6	217.1	208.8	206.5
13	73	260.7	263.7	272.3	284.4	287.6	282.8	257.7	236.3	221.7	213.2	210.7
14	63	264.0	267.1	276.6	292.0	297.2	292.7	264.4	240.3	224.8	216.3	213.7
15	53	265.9	269.1	279.0	296.2	302.3	297.7	267.7	242.8	226.7	218.0	215.2
16	47.8	266.3	269.5	279.4	297.1	303.0	298.7	268.5	243.3	227.3	218.4	215.5

All dimensions in mm.



*Minimum space to be reserved for mounting lug = 44

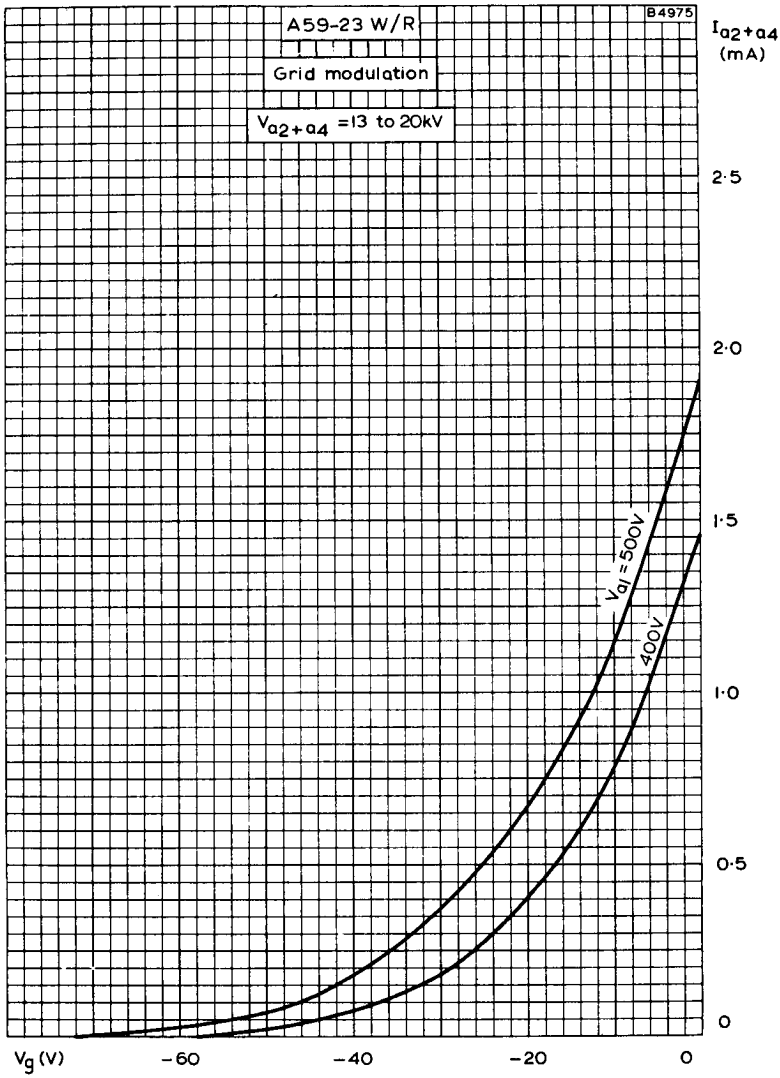
Mounting lug



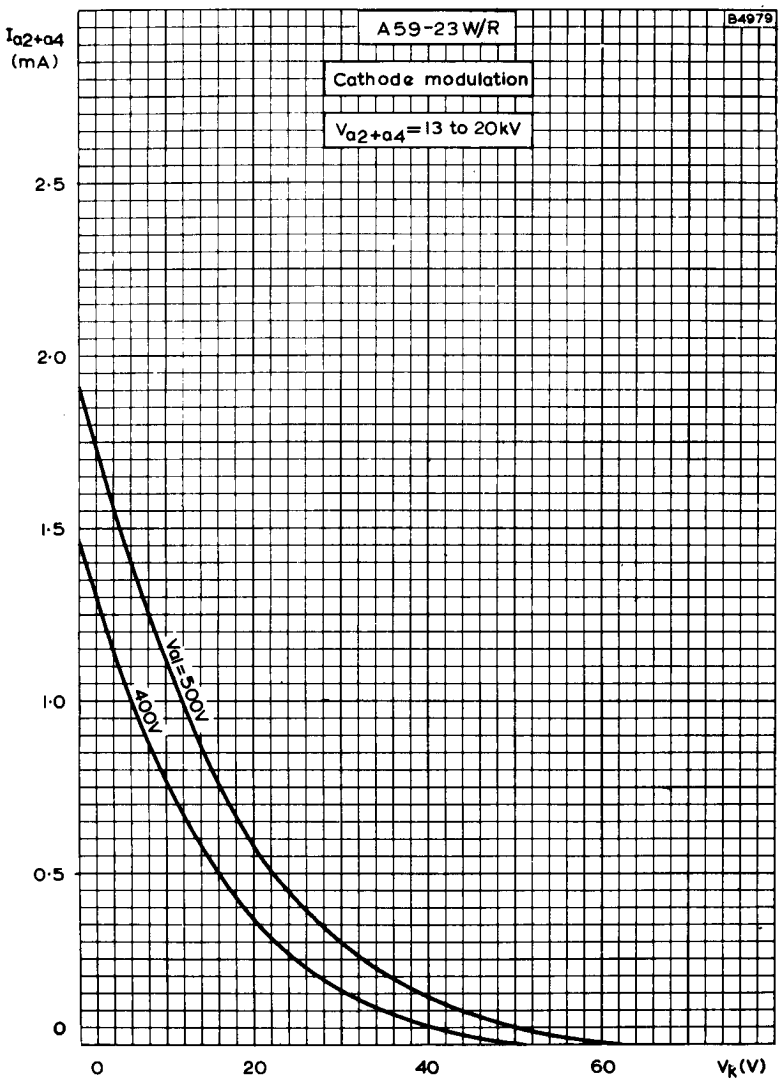
Template for mounting bolts.

All dimensions in mm.

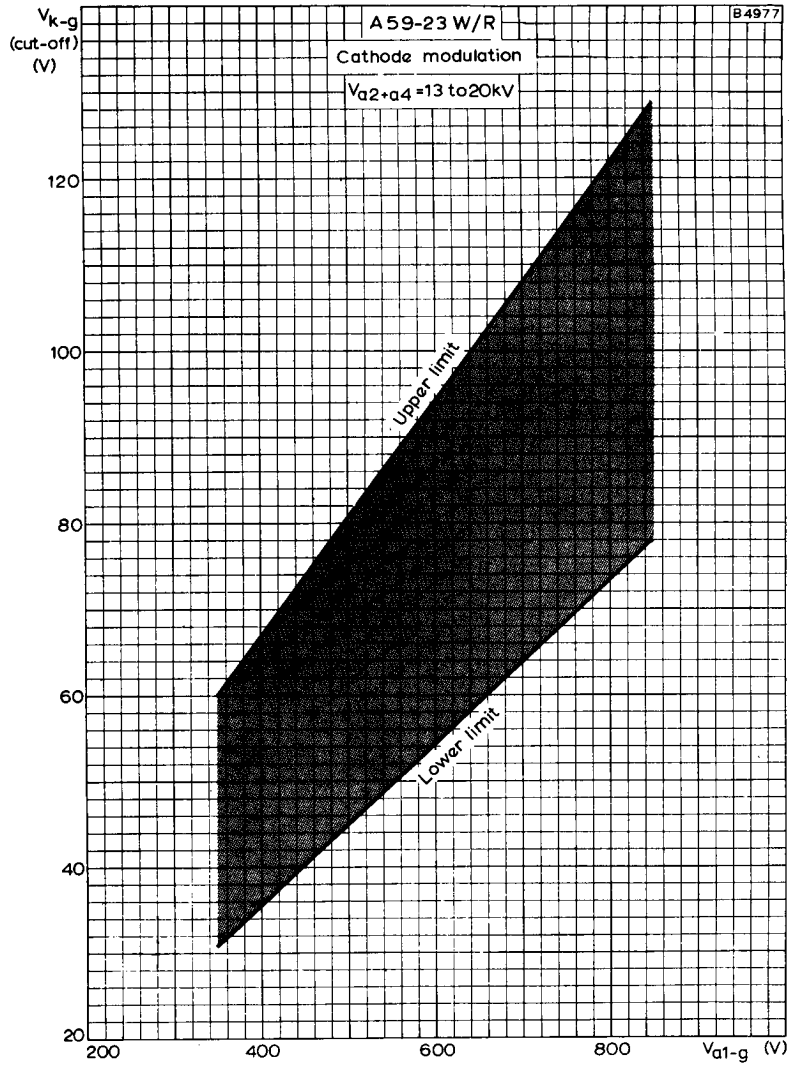
The bolts to be used for mounting the tube must be within the circles of 9·5mm diameter shown in the template drawing.



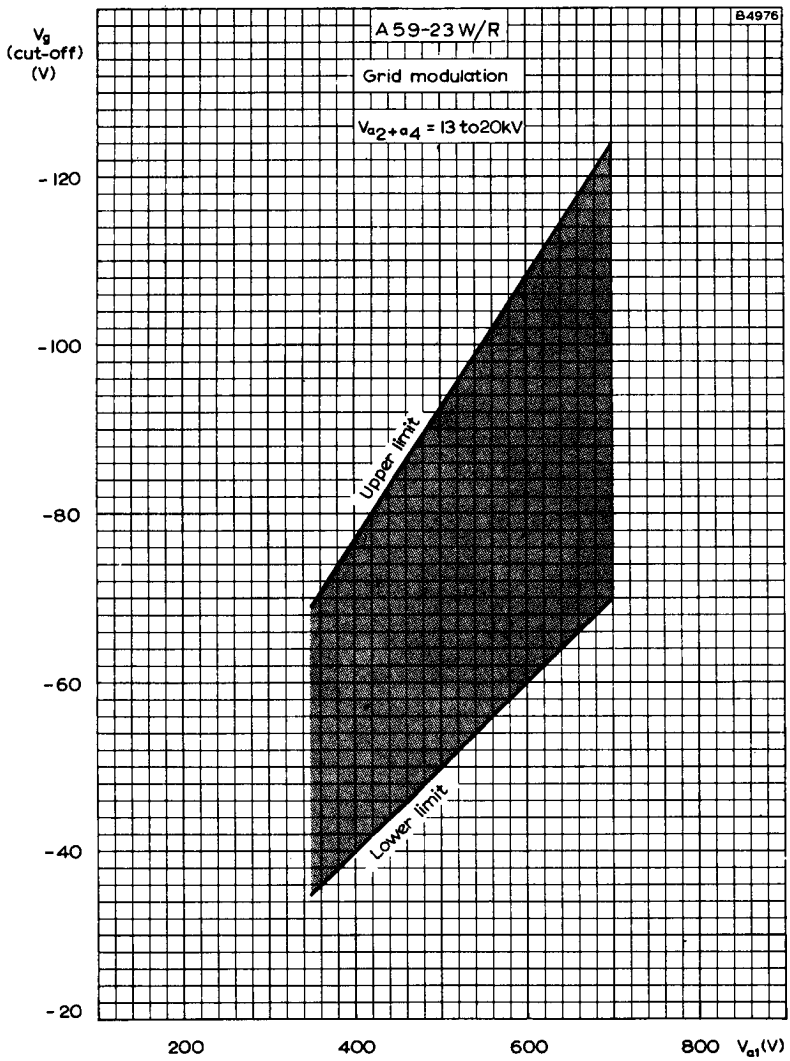
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION.

TELEVISION TUBE A61-120W/R

TENTATIVE DATA

QUICK REFERENCE DATA

61 cm (24in)direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. Suitable for use in receivers with push-through presentation. This tube is fitted with a ring trap base.

Deflection angle	110	deg
Focusing	Electrostatic	
Light transmission (approx.)	42	%
Maximum overall length	370	mm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TELEVISION PICTURE TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General Operational Recommendations - Television Picture Tubes.

Note - applies to series operation only

The surge heater voltage must not exceed 9.5V r.m.s. when the supply is switched on. A current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	20	20	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	-40 to -77	-50 to -93	V
*V_k for visual extinction of focused raster	36 to 66	45 to 80	V

*For cathode modulation, all voltages are measured with respect to the grid.

SCREEN (metal backed)

Fluorescent colour		White
Light transmission (approx.)	42	%
Useful screen area		See page 6

FOCUSING (Electrostatic)

The range of focus voltage shown in 'Operating Conditions' results in optimum overall focus at a beam current at 250μA.

DEFLECTION (Magnetic)

Diagonal deflection angle	110	deg
Horizontal deflection angle	98	deg
Vertical deflection angle	81	deg

The deflection coils should be designed to provide a pull-back of 4.0mm on a nominal tube.

CAPACITANCES

$c_{g\text{-all}}$	7.0	pF
$c_{k\text{-all}}$	5.0	pF
$c_{a2+a4\text{-M}}$	1700 to 2500	pF
$c_{a2+a4\text{-B}}$	600	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, and in accordance with the General Operating Recommendations this should be connected directly to pin 5 and not to chassis. The electrical connection to this coating must be made within the area specified on the tube outline drawing. The capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply.

RING TRAP

For flashover protection of the receiver, parallel spark gaps are included for all the electrodes in the base of this tube, and the common connection is made to pin 5. These spark gaps are intended as part of a system for full flashover protection. A direct connection must always be made from pin 5 to chassis, and the external conductive coating returned to chassis only via pin 5, using short leads. Any electrode supplied directly from a high energy source (such as the h.t. line) should be provided with a series resistor.

RASTER CENTRING

See note under this heading in 'General Operational Recommendations - Television Picture Tubes'.

Centring magnet field intensity	0 to 800	A/m
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in the brightness of the raster occurs.

REFERENCE LINE GAUGE

J.E.D.E.C. 126. For details see 'General Operational Recommendations-Television Picture Tubes'.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred on the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4}=0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ

NOTES

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.

   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on, a decrease in $V_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

5. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2.0MΩ.

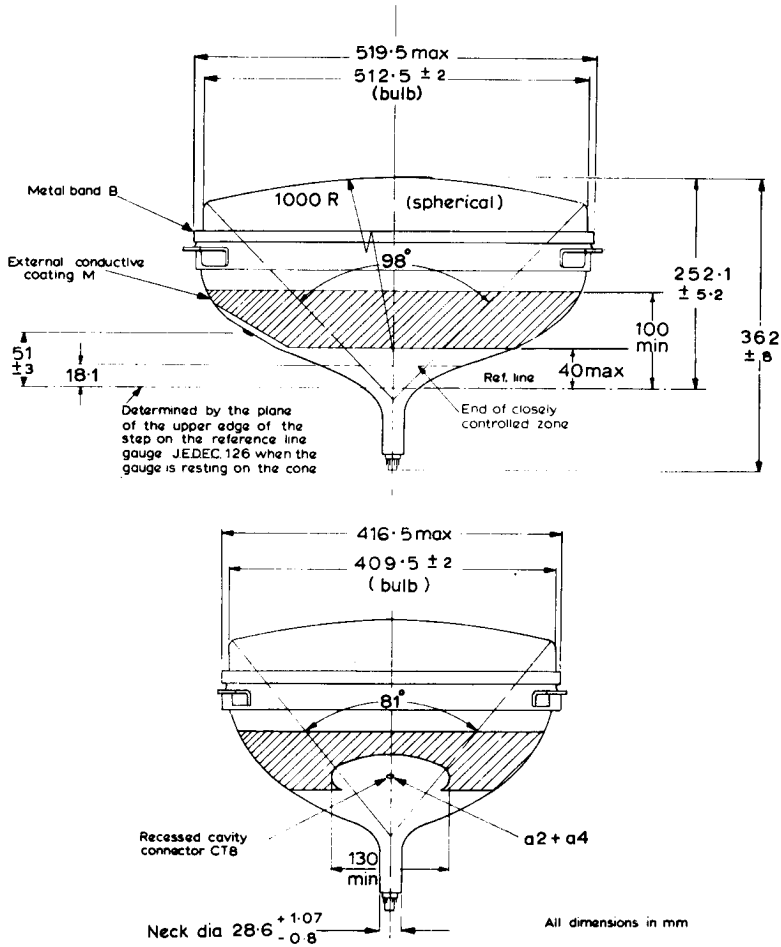
   The mounting lugs will be in electrical contact with the metal band.

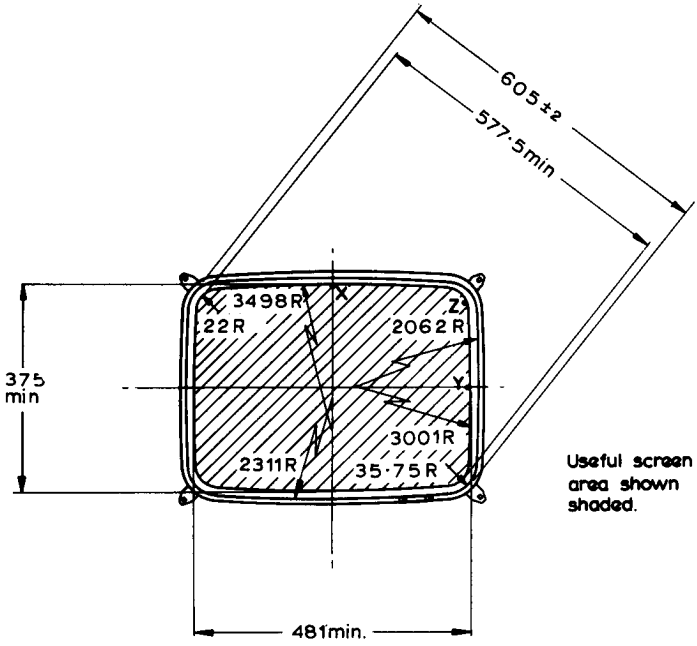
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

WEIGHT

Tube alone (approx.)	13.5	kg

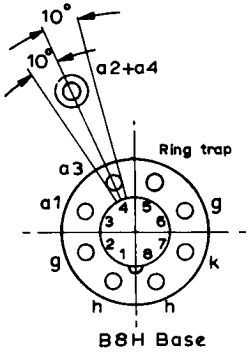

519·5 max
512·5 ± 2
(bulb)
Metal band B
1000 R
(spherical)
External conductive coating M
98°
252·1 ± 5·2
100 min
362 ± 8
51 ± 3
18·1
Ref. line
40 max
Determined by the plane of the upper edge of the step on the reference line gauge JEDEC 126 when the gauge is resting on the cone
End of closely controlled zone
416·5 max
409·5 ± 2
(bulb)
81°
Recessed cavity connector CT8
a2 + a4
130 min
Neck dia 28·6 +1·07 -0·8
All dimensions in mm



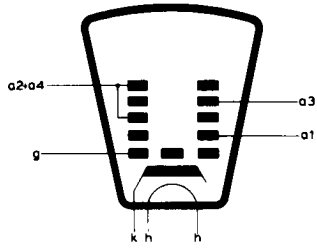
Useful screen area shown shaded.

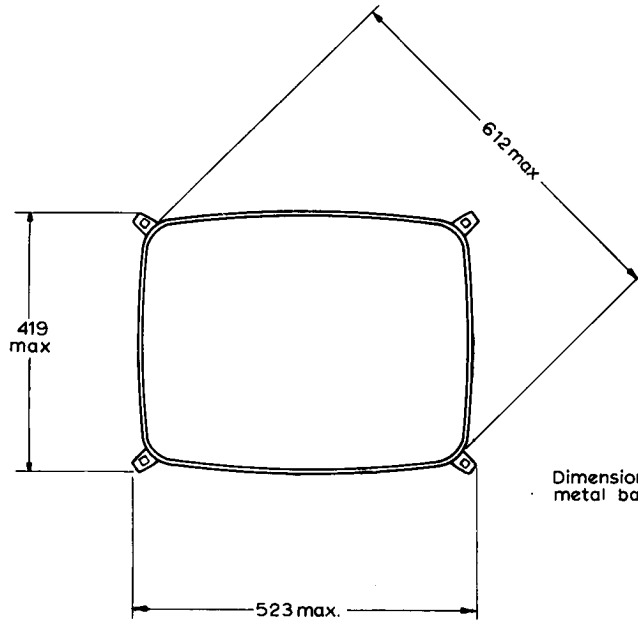
Bulb dimensions

All dimensions in mm

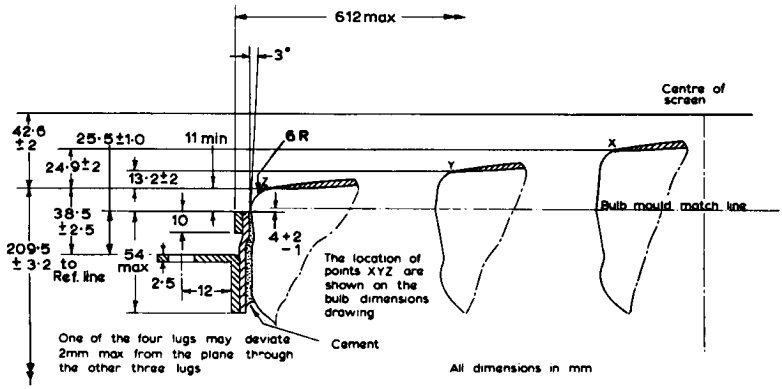


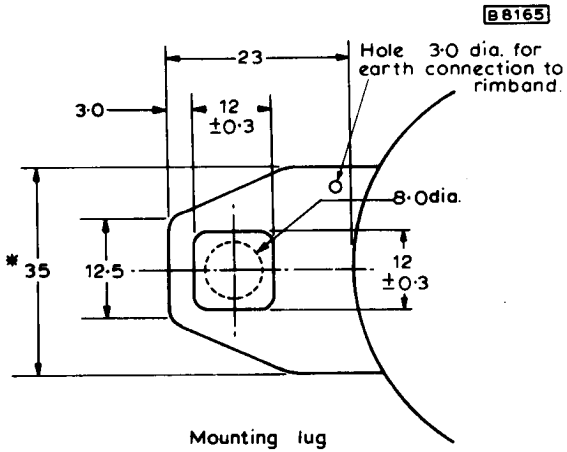
B8H Base





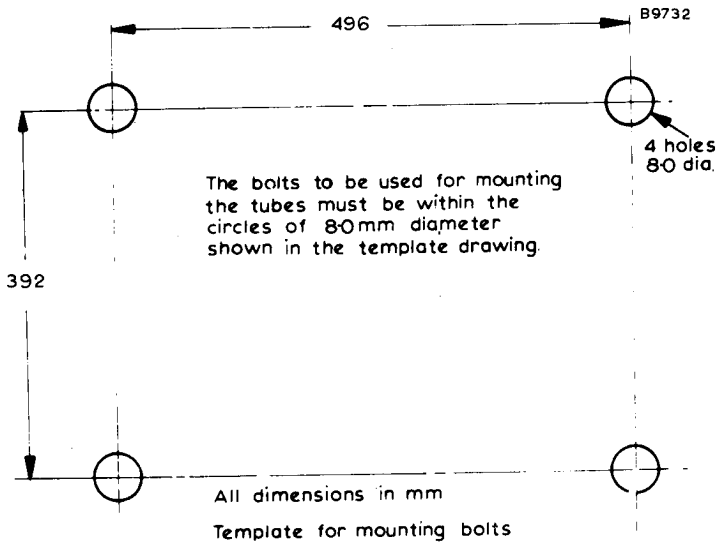
Dimensions of metal band



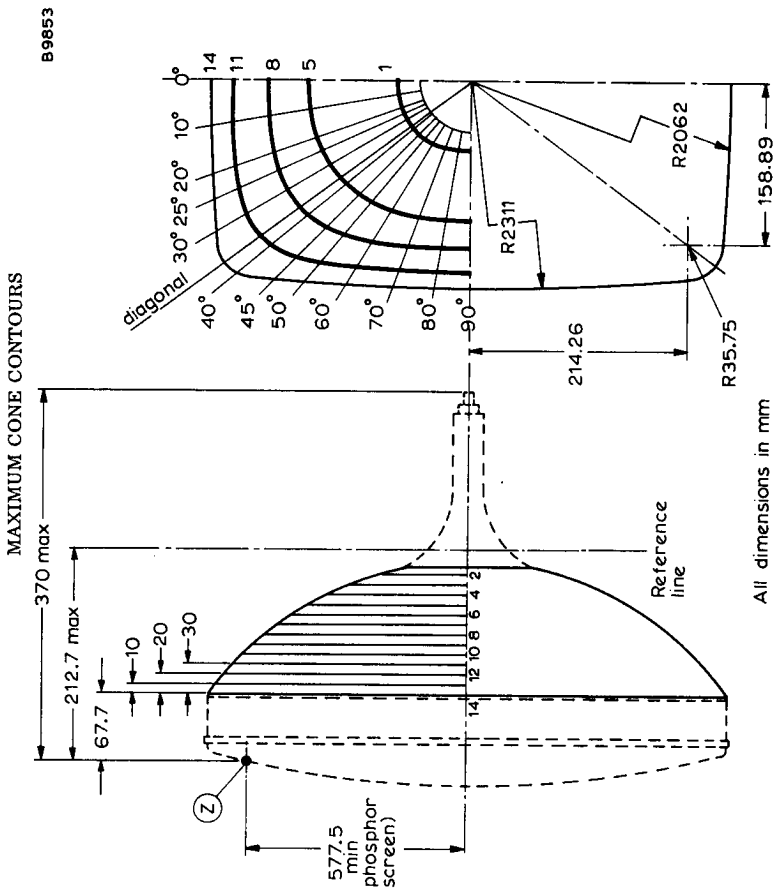


Mounting lug

* Minimum space to be reserved for mounting lug = 39



Template for mounting bolts

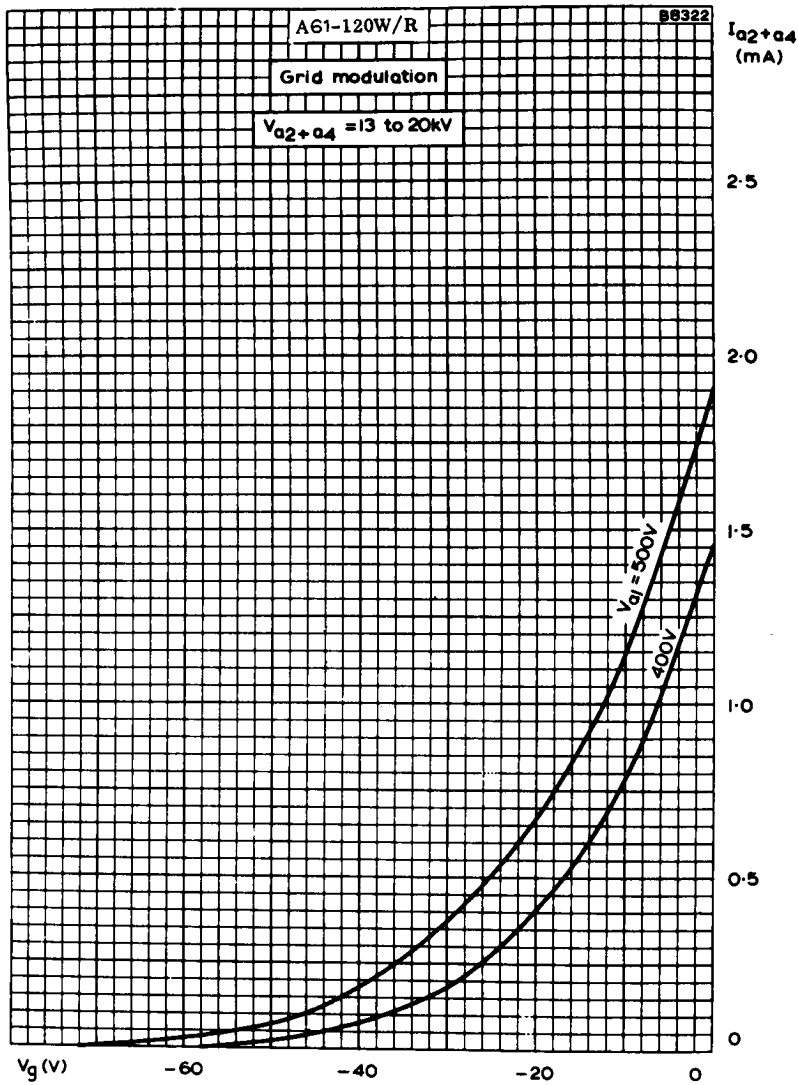

B9853
MAXIMUM CONE CONTOURS
370 max
212.7 max
67.7
10
20
30
diagonal
0°
10°
20°
25°
30°
40°
45°
50°
60°
70°
80°
90°
14
11
8
5
1
R2311
R2062
158.89
214.26
R35.75
Reference line
577.5 min (phosphor screen)
Z
All dimensions in mm

DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING

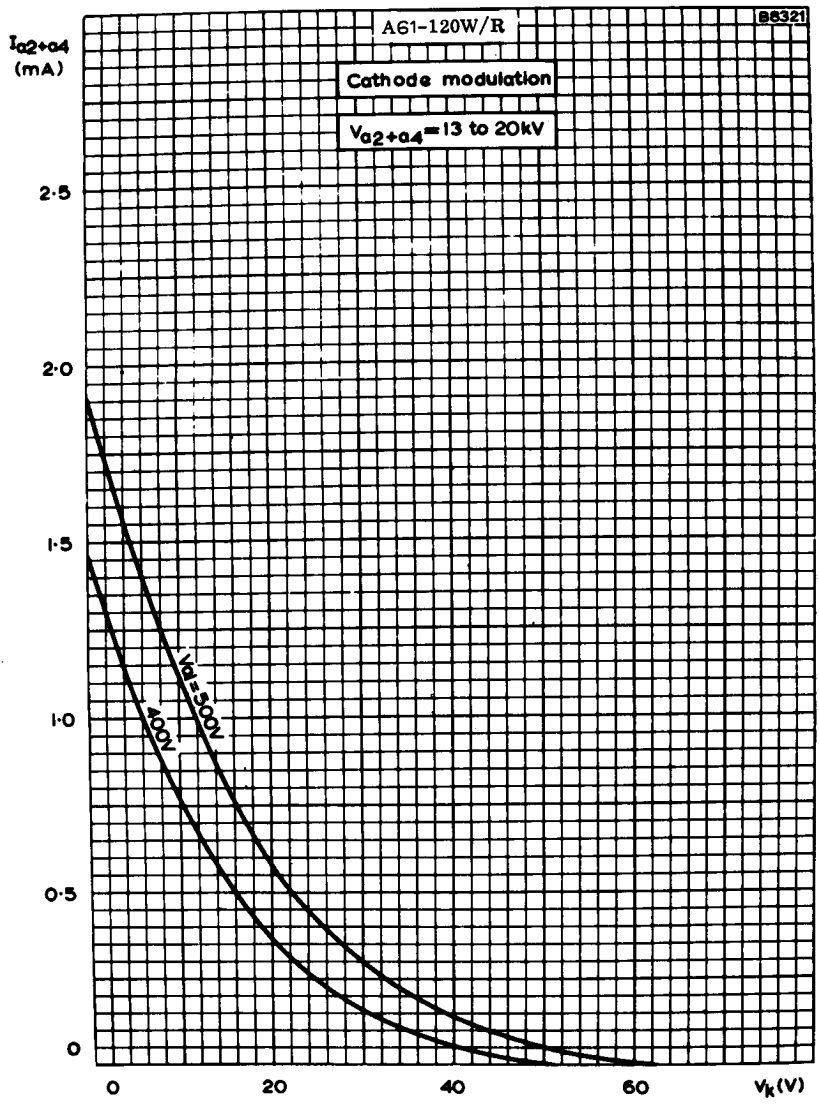
Distance from centre (max. values)

Section	Nominal distance from point 'Z'	0° Long axis	10°	20°	25°	30°	36°34'	40°	45°	50°	60°	70°	80°	90° Short axis
							Diagonal							
1	194.4	74.6	72.5	71.1	70.8	70.3	70.6	70.9	71.4	72.1	73.3	72.3	73.0	72.8
2	187.7	100.0	95.6	93.1	92.0	91.3	91.2	91.0	91.0	90.8	90.7	91.8	93.2	95.5
3	177.7	130.4	126.5	121.3	119.6	118.2	117.1	116.4	115.1	114.1	114.3	114.7	115.8	118.0
4	167.7	152.8	149.8	145.0	143.1	141.8	140.0	138.8	137.0	135.3	133.4	131.9	132.4	133.7
5	157.7	172.1	169.2	165.6	164.3	163.1	160.4	158.8	156.2	153.8	150.3	146.9	145.6	146.0
6	147.7	188.1	186.4	184.8	183.9	182.7	179.4	177.3	173.8	170.7	163.9	158.6	156.0	155.8
7	137.7	202.1	201.2	201.8	201.8	201.3	197.0	194.1	190.1	185.2	176.2	168.7	164.9	164.2
8	127.7	214.0	214.5	217.0	217.9	217.8	213.3	210.0	205.0	198.6	187.3	177.6	172.8	171.5
9	117.7	223.7	225.1	229.0	231.3	233.0	229.1	225.3	219.2	211.2	197.6	185.8	180.2	178.2
10	107.7	231.9	233.0	239.0	242.9	246.4	243.9	240.2	232.8	223.6	206.7	193.6	186.8	184.3
11	97.7	238.6	240.2	247.6	253.0	258.7	258.6	255.1	245.7	234.8	215.2	200.5	193.1	190.1
12	87.7	244.6	246.9	256.4	262.4	269.4	272.6	268.9	257.7	244.5	222.3	206.7	198.6	195.5
13	77.7	250.6	253.4	263.4	270.8	279.2	286.0	282.6	268.5	253.0	228.5	212.2	203.4	200.2
14	67.7	255.6	259.1	269.6	278.0	288.4	298.6	294.9	277.2	259.3	233.3	216.3	207.2	204.2

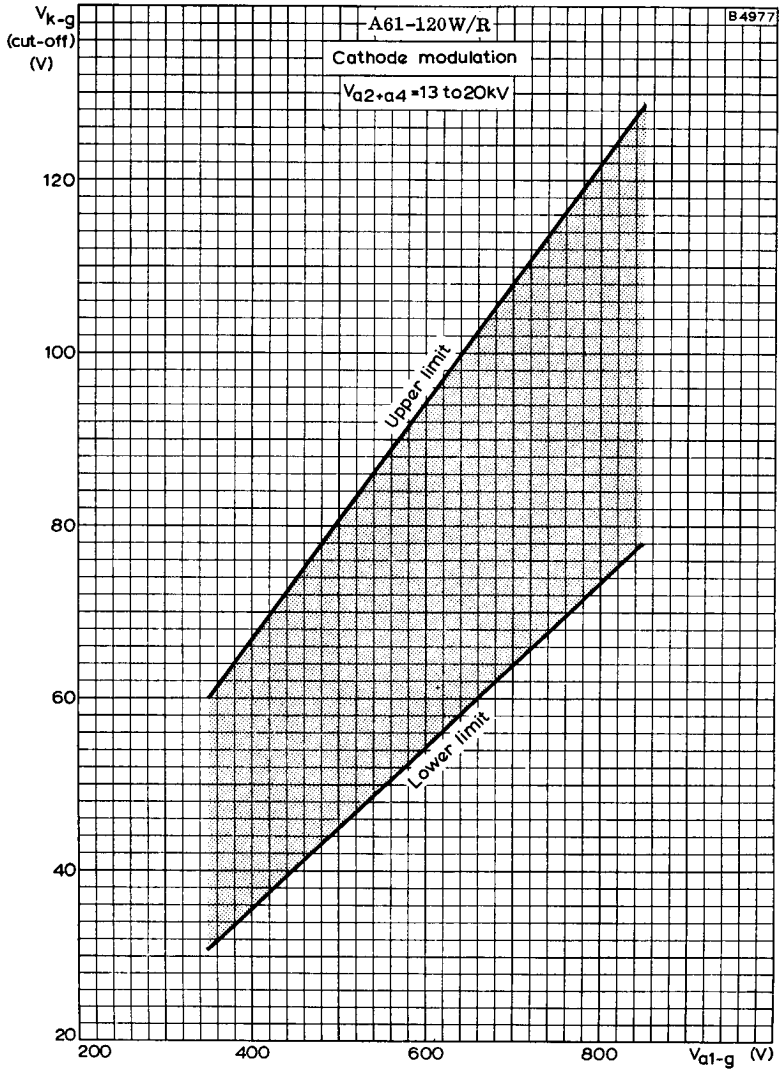
All dimensions in mm



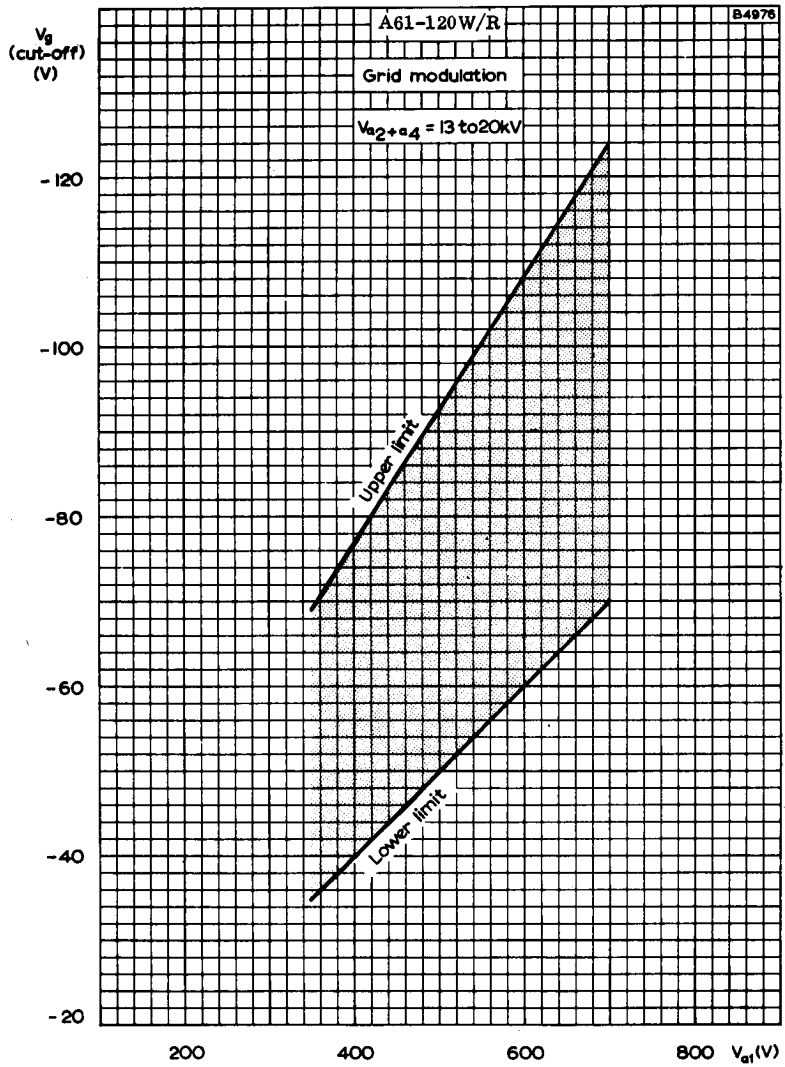
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION

COLOUR TELEVISION TUBE

A63-11X

QUICK REFERENCE DATA

63cm (25in) rectangular shadow-mask colour television tube incorporating three guns and a metal-backed three-colour phosphor dot screen.
Advanced red phosphor, europium activated. ←
Increased white brightness. ←
Unity current ratio for white point x = 0.281, y = 0.311 ←
Temperature compensated shadow-mask maintains purity during warm-up. Shadow-mask optimised for minimum moiré effect on 625 line system. ←
Reinforced tube envelope-separate safety screen not required.

Deflection angle	90	deg
Focusing	Electrostatic	
Light transmission (approx.)	52	%
Maximum overall length	531	mm

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TELEVISION PICTURE TUBES

HEATER

V_h (see note 1)	6.3	V
I_h	900	mA

The limits of heater voltage and current are contained in General Operational Recommendations - Television Picture Tubes.

OPERATING CONDITIONS (each gun)

V_{a3+a4}	25	kV
V_{a2} (focus electrode control range)	4.2 to 5.0	kV
V_{a1} (at V_g = -100V for visual extinction of focused raster)	210 to 495	V
V_g (at V_{a1} = 300V for visual extinction of focused raster)	-65 to -135	V
*Light output at screen centre (at I_{a3+a4} = 800μA)	90	cd/m^2(nits) ←

*To produce white of colour co-ordinates x = 0.281, y = 0.311 with a focused raster size of 50.4 x 39.6cm.

SCREEN

Metal backed

Phosphor types for separate fluorescent colours:

Red	Europium activated rare earth	
Green	Sulphide	
Blue	Sulphide	
Useful screen area (approx.)	1905	cm^2
Spacing between centres of adjacent phosphor dot triads (approx.)	0.81	mm
Light transmission (approx.)	52	%

FOCUSING

Electrostatic

DEFLECTION

Magnetic

Diagonal deflection angle	90	deg
Horizontal deflection angle	79	deg
Vertical deflection angle	62	deg

CONVERGENCE

Magnetic

CAPACITANCES (approx.)

$c_{g\text{-all}}$ (each gun)	7.0	pF
$c_{(kR+kG+kB)\text{-all}}$	15	pF
$c_{kR\text{-all}}$	5.0	pF
$c_{kG\text{-all}}$	5.0	pF
$c_{kB\text{-all}}$	5.0	pF
$c_{a2\text{-all}}$	7.0	pF
$c_{a3+a4\text{-}M}$	2000 to 2500	pF
$c_{a3+a4\text{-}B}$	500	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be connected to chassis, and the capacitance of this coating to the final anode is used to provide smoothing for the e.h.t. supply. The electrical connection to this coating must be made within the area specified on the tube outline drawing.

REFERENCE LINE GAUGE

See page 10.

MOUNTING POSITION

Any. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 55mm diameter which is centred upon the perpendicular from the centre of the face.

MAGNETIC SHIELDING

Magnetic shielding must be provided to minimise the effects of extraneous magnetic fields, including the earth's magnetic field. This shielding, in the form of a metal shell extending 28cm over the cone of the tube measured from the centre of the screen, should be constructed of cold-rolled mild steel of 0.5mm minimum thickness. The magnetic shield should be connected to the outer conductive coating. See page 10 for physical dimensions.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a3+a4} max. (absolute rating) (see notes 2 and 3)	27.5	kV
V_{a3+a4} min. (absolute rating) (see note 4)	20	kV
I_{a3+a4} (long term average max. for three guns: see note 5)	1.0	mA
V_{a2} max. (see note 3)	6.0	kV
$v_{a1(pk)}$ max.	1.0	kV
$-V_g$ max.	400	V
V_g max.	0	V
V_{h-k} max. (see note 6)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{g-k} max.	750	kΩ

EQUIPMENT DESIGN VALUES (each gun if applicable)

Valid for V_{a3+a4} = 20 to 27.5kV

V_{a2}				16.8 to 20% of V_{a3+a4}	
V_{a1}				See page 16.	
V_g				See page 16.	
Variation in cut-off voltage between guns				Minimum value is at least 65% of the maximum value.	
I_{a2}				-15 to +15	μA
I_{a1}				-5 to +5	μA
I_g at V_g = -150V				-5 to +5	μA
To produce white of colour co-ordinates:	x	0.310	0.265	0.281	←
	y	0.316	0.290	0.311	
Percentage of total anode current supplied by each gun (typical)					←
Red gun		43.5	27.9	32.2	%
Green gun		30.0	34.9	35.6	%
Blue gun		26.5	37.2	32.2	%
Ratio of cathode currents					←
Red gun to green gun	min.	1.05	0.60	0.65	
	av.	1.45	0.80	0.90	
	max.	2.00	1.10	1.25	
Red gun to blue gun	min.	1.20	0.55	0.75	
	av.	1.65	0.75	1.00	
	max.	2.25	1.05	1.35	
Maximum electron beam shift required from purity magnets				±0.13	mm
Maximum required raster shift				±15	mm
Maximum lateral convergence shift of blue beam with respect to the converged red and green beams				±6.5	mm
Maximum radial convergence shift, excluding effects of dynamic convergence (each beam)				±9.5	mm

WEIGHT

Tube alone (approx.)				18.8	kg

NOTES

1. For maximum cathode life, it is recommended that the heater supply be regulated at 6.3V.

2. The tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5kV at zero beam current and with an internal impedance $\geq$500kΩ.

3. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube. In view of the high voltage on a2, adequate precautions should be taken to ensure freedom from flashover on all connections to this electrode.

4. Operation at lower voltages impairs brightness and resolution and may have a detrimental effect on colour purity.

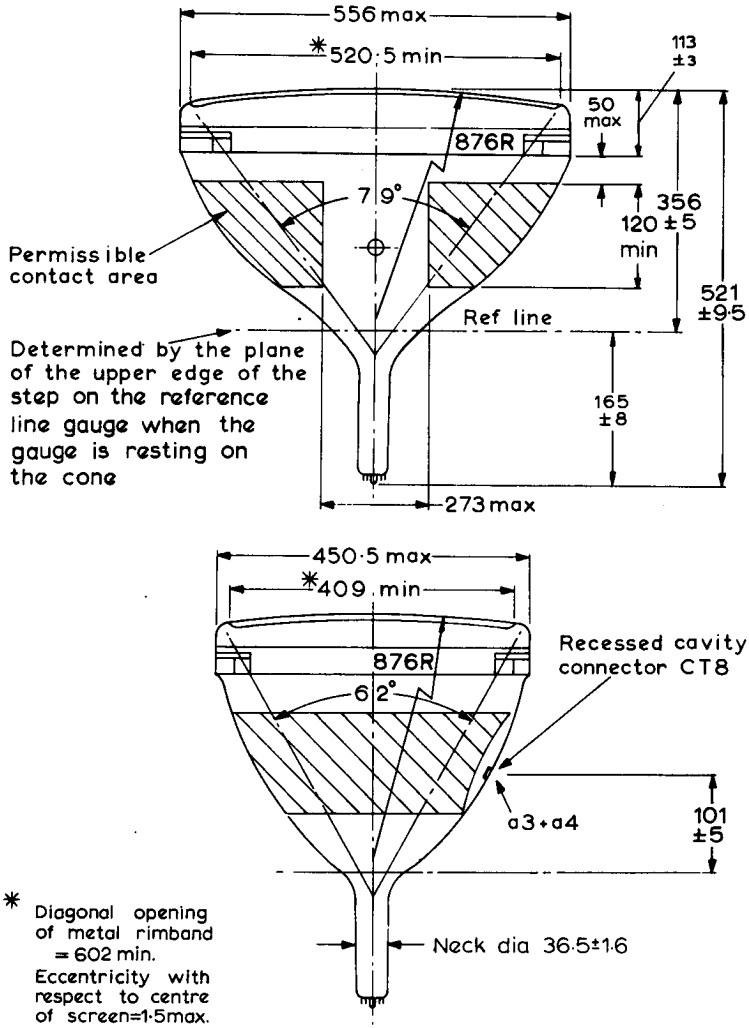
5. The limiting value "long term average maximum current" of 1.0mA will be met provided a device is incorporated in the circuit to limit the short term average current to 1.5mA.

6. In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible (< 20V r.m.s.).

   During an equipment warm-up period not exceeding 15 seconds $v_{h-k}(pk)$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on a decrease in $v_{h-k}(pk)$ max. (cathode positive) proportional with time from 410 to 250V is permissible.

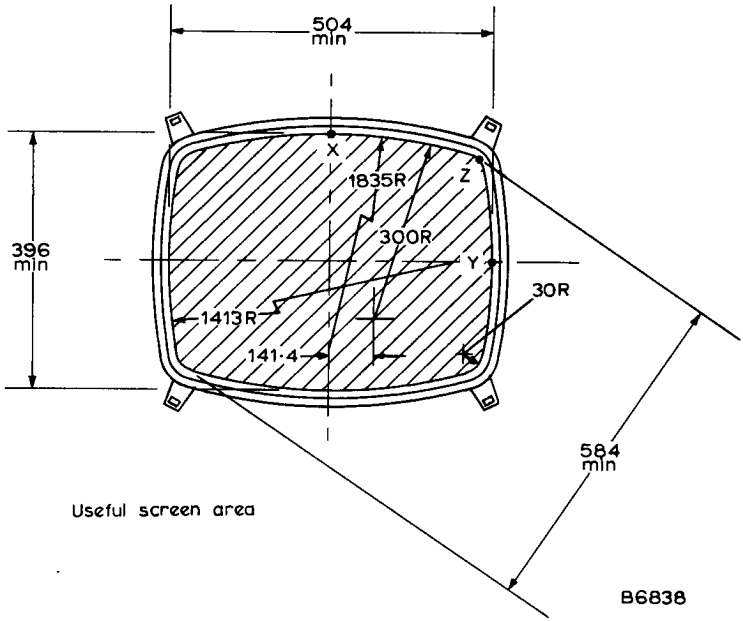
7. The metal band (B) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver.

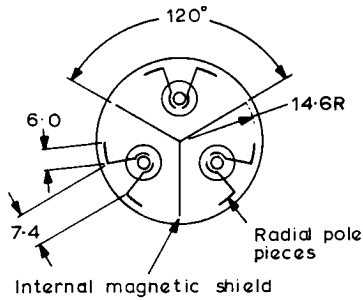
8. The dynamic convergence to be effected by currents of approximately parabolic waveshape synchronised with scanning.



All dimensions in mm

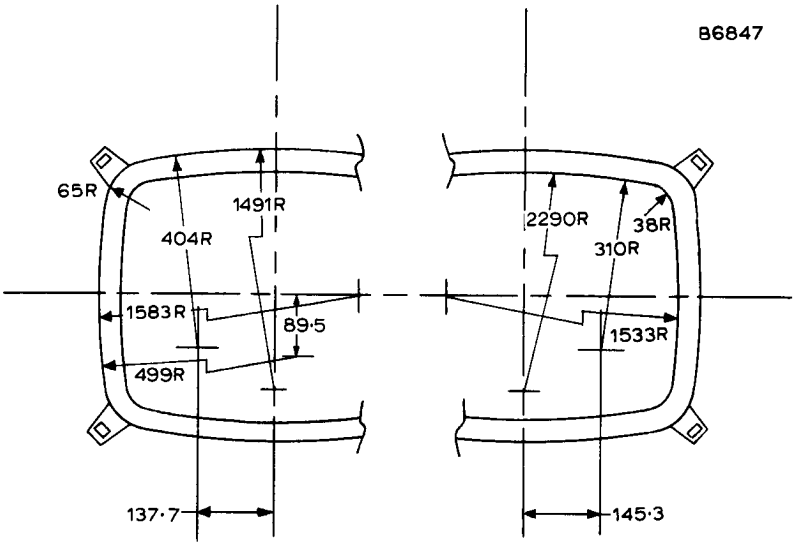
B7413



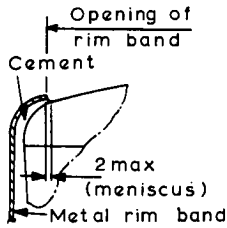


Location of radial convergence pole pieces viewed from screen end of guns

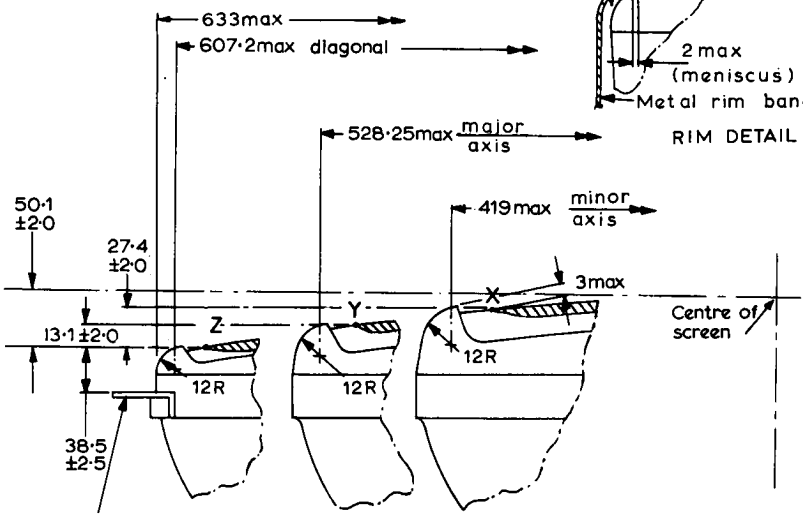
All dimensions in mm



Dimensions of metal band



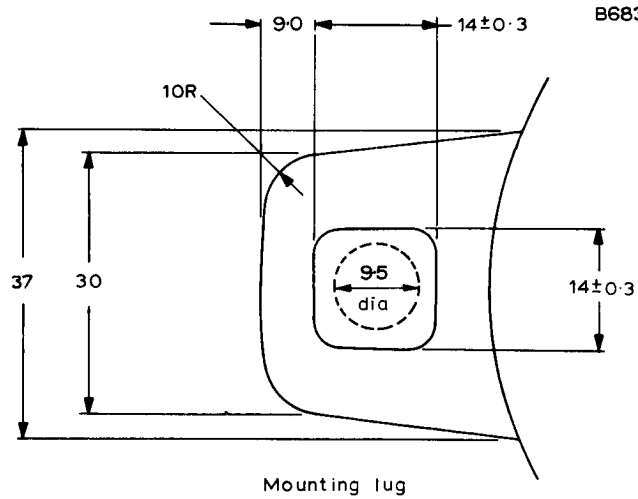
RIM DETAIL



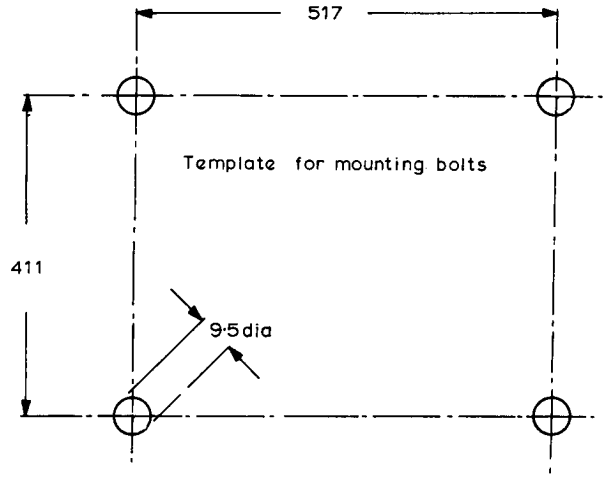
One of the four lugs may deviate 2mm max. from the plane through the three other lugs. This deviation is incorporated in the ±2·5 tolerance.

All dimensions in mm

B7412



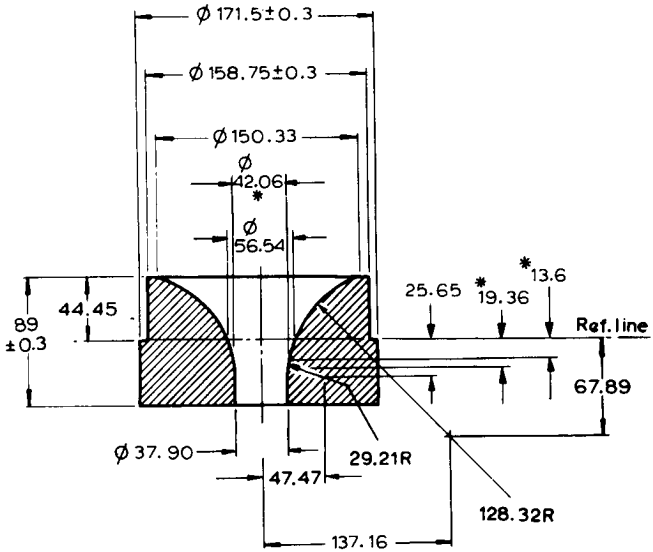
Mounting lug



Template for mounting bolts

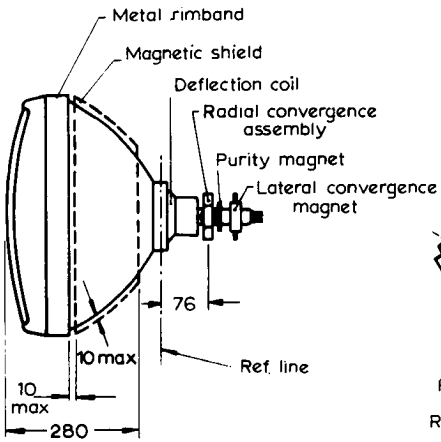
All dimensions in mm

The bolts to be used for mounting the tube must be within the circles of 9.5mm diameter shown in the template drawing.

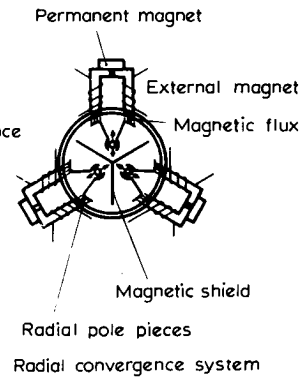


Reference line gauge

* These dimensions define extent of 29.21R

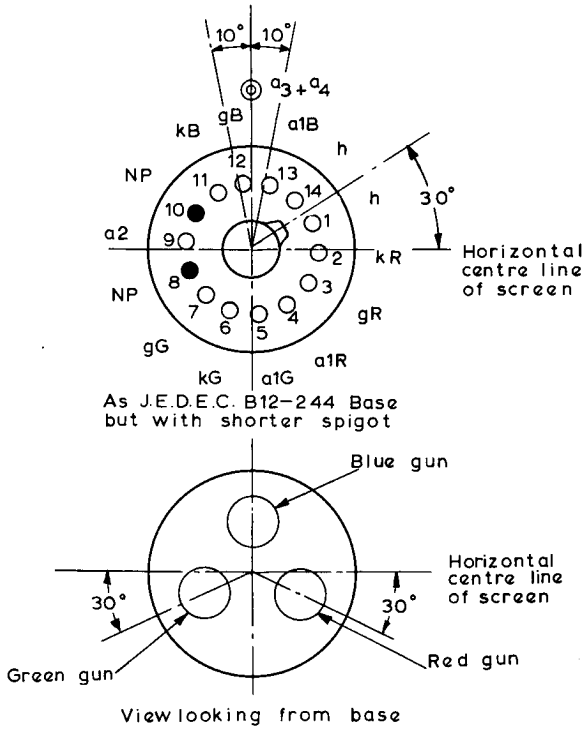


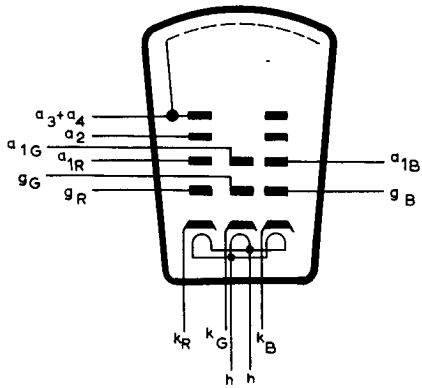
Outline of tube with components

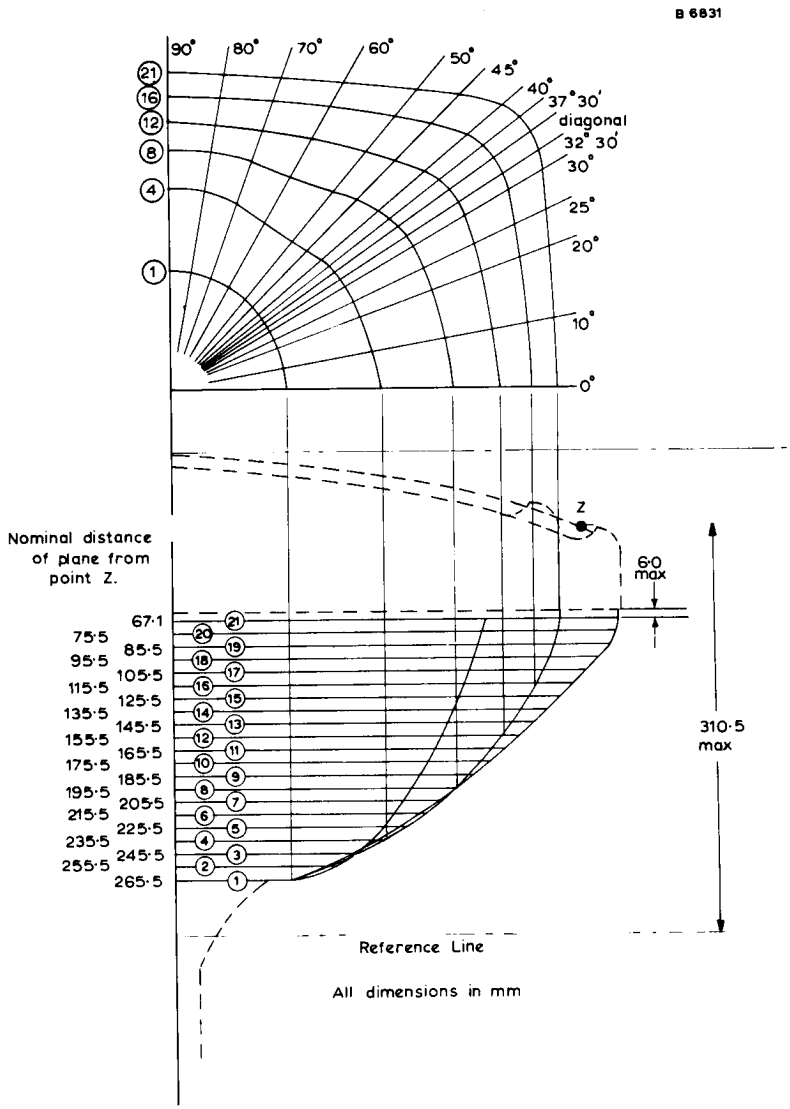


Radial convergence system

All dimensions in mm


10°
10°
a3+a4
gB
kB
a1B
h
NP
12
11
13
14
h
30°
10
1
a2
9
2
kR
Horizontal centre line of screen
8
3
NP
7
6
5
4
gR
gG
a1R
kG
a1G
As J.E.D.E.C. B12-244 Base but with shorter spigot
Blue gun
Horizontal centre line of screen
30°
30°
Green gun
Red gun
View looking from base


a3+a4
a2
a1G
a1R
a1B
gG
gR
gB
kR
kG
kB
h
h

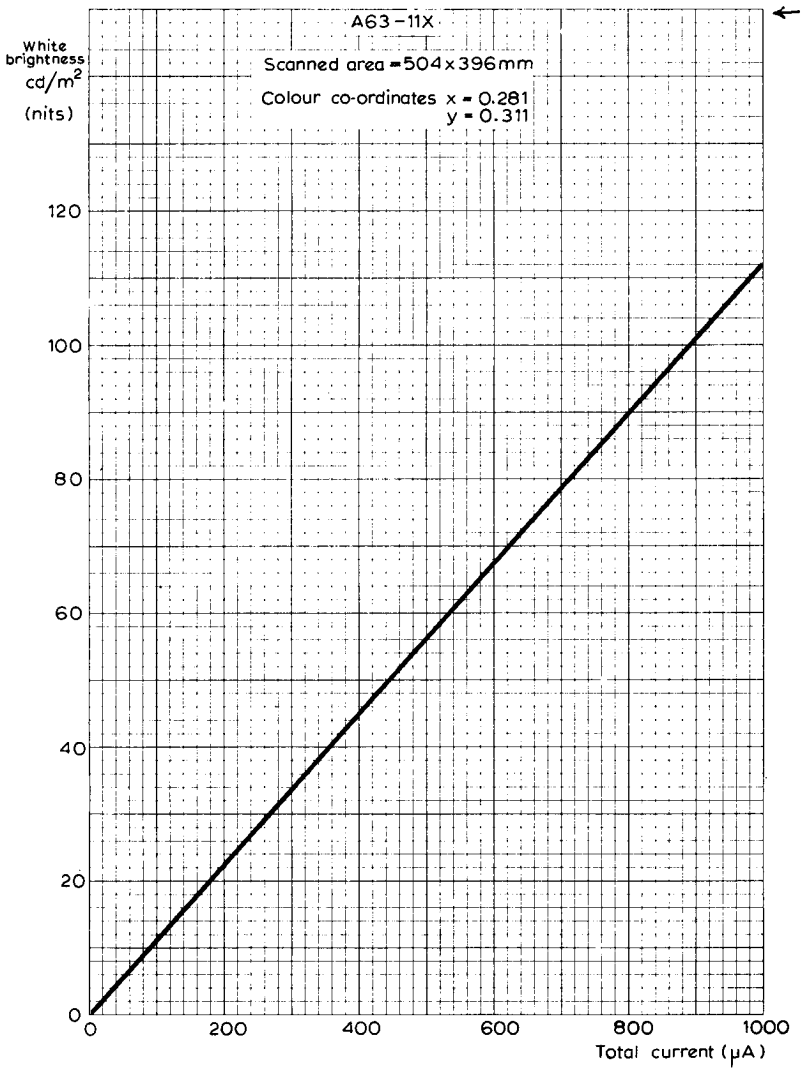


MAXIMUM CONE CONTOURS

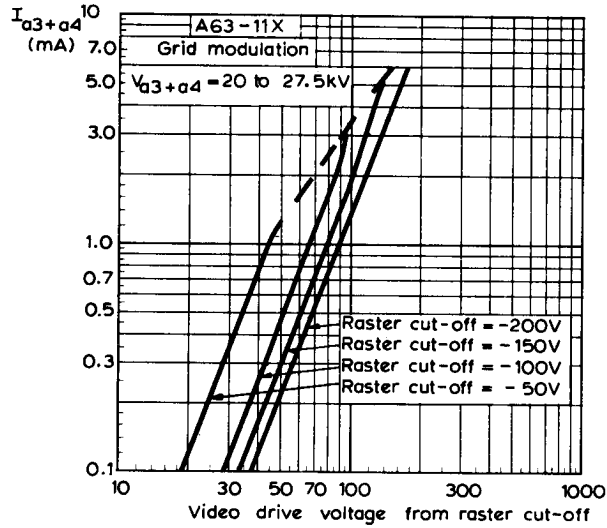
DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING

Section	0° long axis	10°	20°	25°	30°	32°30'	35°22' diagonal	37°30'	40°	45°	50°	60°	70°	80°	90° short axis
1	82.5	82.6	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.3	83.5	83.5	83.0	82.8	82.8
2	107.6	107.4	106.7	106.1	105.7	105.5	105.2	105.1	105.0	104.7	104.5	106.3	111.0	115.0	115.5
3	129.3	128.5	128.0	127.3	126.6	125.8	124.8	124.0	123.2	122.2	121.4	122.5	126.9	129.9	130.2
4	147.4	147.2	146.0	145.0	144.8	144.2	142.6	141.2	139.6	137.2	135.4	134.7	138.0	140.0	140.0
5	162.8	162.8	161.6	160.7	160.3	159.4	157.7	156.2	154.3	150.4	147.7	145.0	146.4	148.2	148.0
6	176.3	176.3	175.4	175.0	174.3	173.5	171.6	169.9	167.9	163.1	159.0	154.4	154.0	155.4	155.3
7	188.2	188.2	187.8	187.6	187.2	186.6	185.2	183.4	181.1	175.4	169.9	163.5	161.2	161.6	161.5
8	198.8	199.0	199.2	199.4	199.6	199.1	197.8	196.1	193.4	186.9	180.3	171.9	170.0	167.4	167.2
9	208.2	208.8	209.6	210.3	211.1	210.9	209.7	207.8	205.3	197.9	190.3	179.7	174.4	172.9	172.7
10	216.9	217.9	219.2	220.5	222.2	222.2	221.3	213.9	216.1	208.0	199.4	187.2	180.8	178.2	178.1
11	224.7	225.6	227.7	229.7	231.9	232.2	231.6	229.6	226.4	217.5	208.0	194.4	186.9	183.5	182.9
12	231.9	232.9	233.9	238.5	241.4	242.1	241.9	240.1	237.0	226.9	216.4	201.5	191.5	188.6	187.7
13	238.2	239.7	243.6	246.8	250.5	251.7	251.9	250.4	247.0	236.0	224.5	208.3	198.0	193.4	192.?
14	244.4	246.3	251.0	254.8	259.5	261.3	261.8	260.5	257.1	245.3	238.6	214.8	203.4	198.2	196.8
15	250.3	252.2	258.0	262.3	268.1	270.5	271.3	270.1	266.3	254.0	240.4	220.9	208.5	202.4	200.3
16	256.1	258.2	264.9	270.0	276.6	279.6	280.7	279.3	275.4	262.4	247.8	226.8	213.7	206.6	204.1
17	260.0	263.4	270.8	276.8	284.7	287.9	289.3	287.9	283.9	270.0	254.7	232.3	218.5	210.5	207.7
18	265.6	268.3	276.4	283.3	292.4	296.7	297.6	296.3	292.1	276.0	261.0	237.6	223.1	214.3	211.2
19	269.4	272.4	281.5	289.0	299.0	302.8	305.2	304.2	299.5	283.4	266.7	242.5	227.2	217.9	214.7
20	272.0	275.2	285.4	293.6	303.8	308.8	311.1	310.3	305.5	288.4	271.2	246.0	229.8	220.9	217.8
21	273.2	276.6	287.3	295.6	306.3	311.3	313.3	312.2	308.0	290.0	272.7	247.3	231.1	222.2	219.3

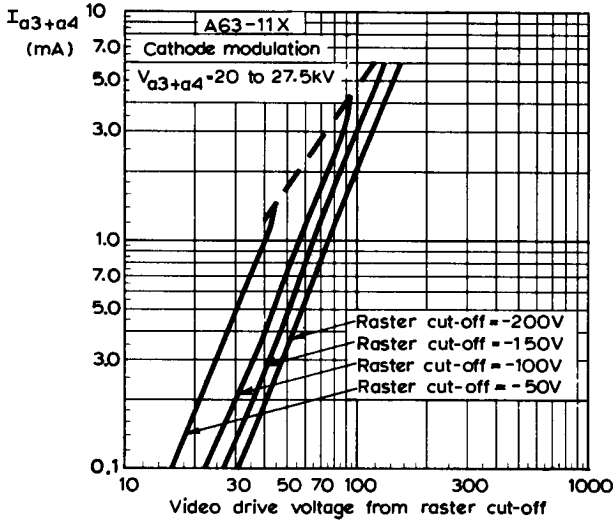
All dimensions in mm



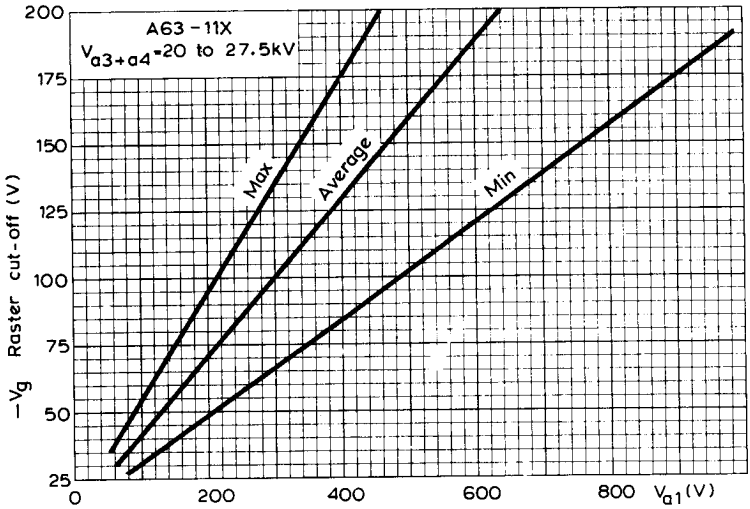
BRIGHTNESS AT CENTRE OF SCREEN AS A FUNCTION OF TOTAL CURRENT FOR WHITE OF COLOUR COORDINATES x = 0.281, y = 0.311



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE. GRID MODULATION



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION



CUT-OFF DESIGN CHART

A65-11W
Page 1 and 2 are missing

MOUNTING POSITION

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

RATINGS (DESIGN CENTRE SYSTEM)

V_{a2+a4} max. (at $I_{a2+a4} = 0$) (see note 1)	20	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
$+v_{a3(pk)}$ max. (see note 2)	2.5	kV
V_{a1} max.	700	V
V_{a1} min.	350	V
$-v_{g(pk)}$ max. (see note 2)	400	V
$-V_{g}$ max. (see note 3)	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	μA
V_{h-k} (see note 4)		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

1. Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

2. Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

3. The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +2V.
   It is advisable to limit the positive excursion of the video signal to +5V(pk) max. This may be achieved automatically by the series connection of a 10kΩ resistor.

4. During an equipment warm-up period not exceeding 15 seconds $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching on a decrease in $v_{h-k(pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

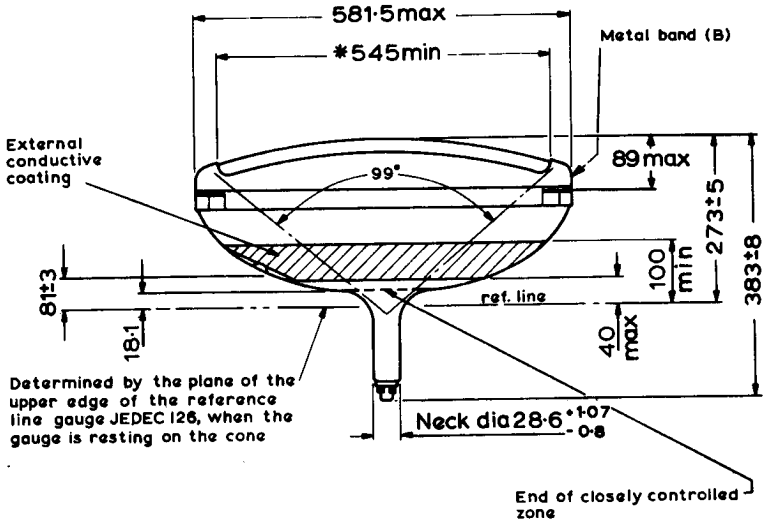
5. The metal band (B) must be connected to the chassis via a 2MΩ resistor. The mounting lugs have electrical contact with the metal band.

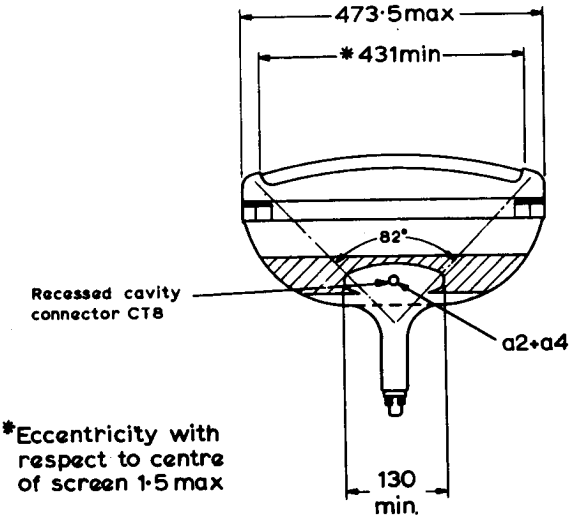
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 20kV.

WEIGHT

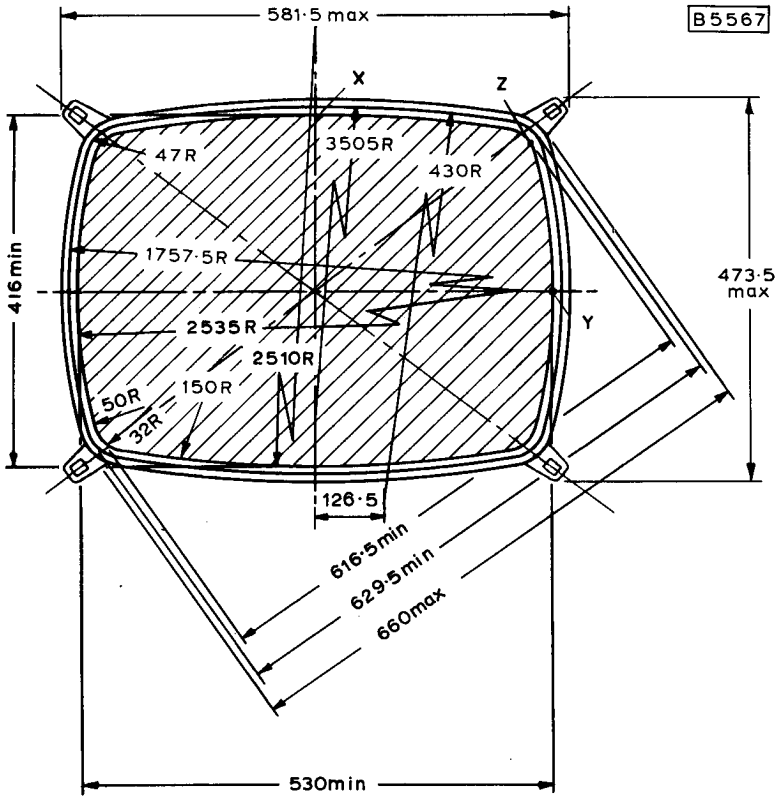
Tube alone	18	kg
	40	lb

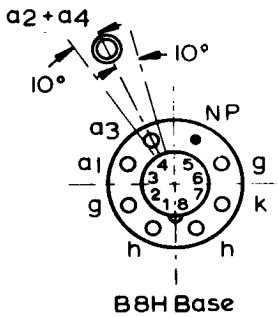


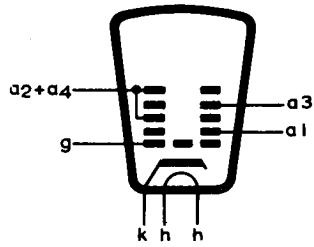


All dimensions in mm.

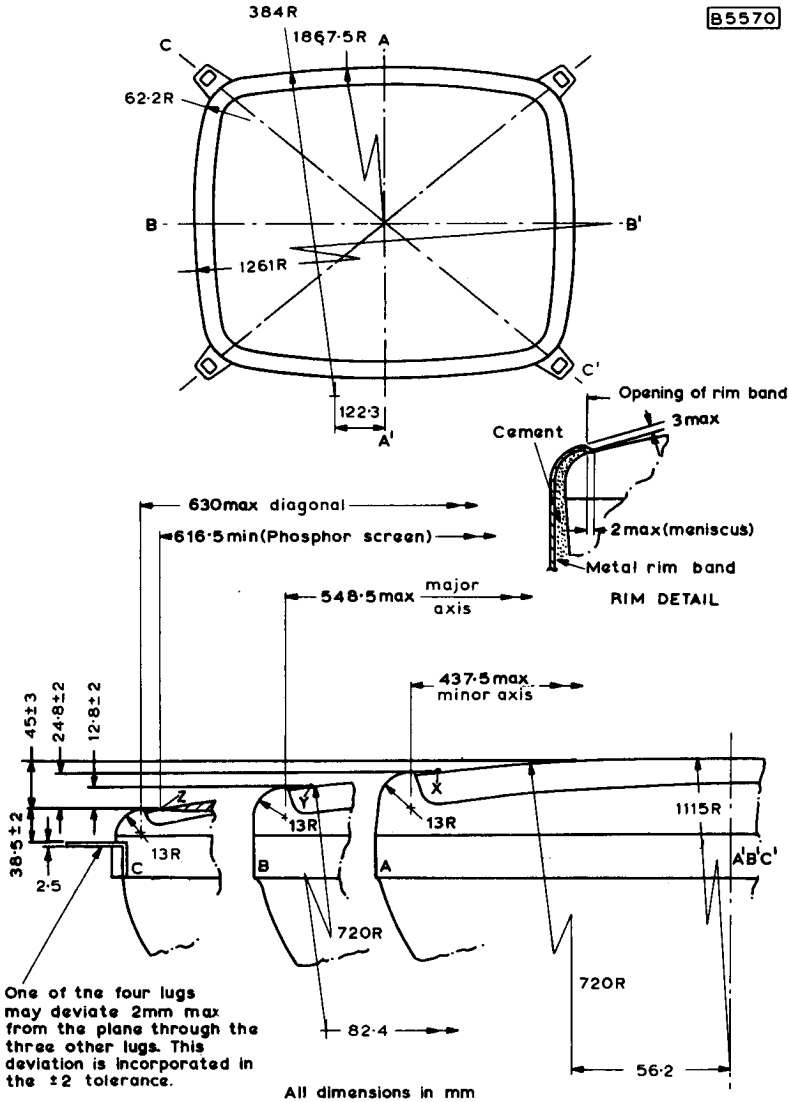
B5563

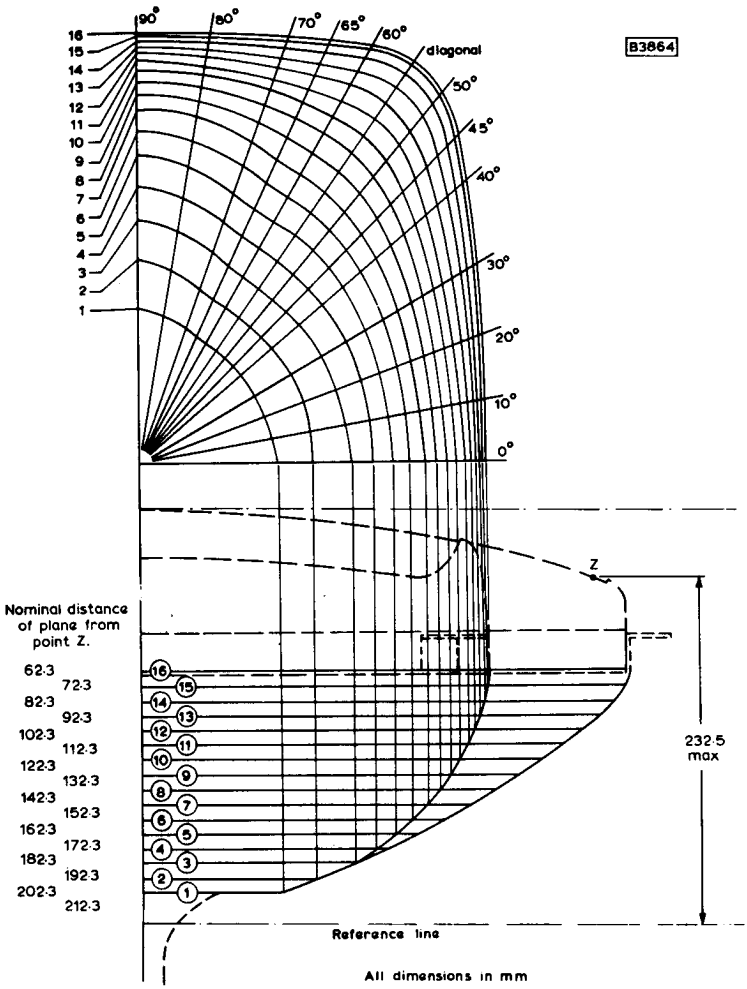






All dimensions in mm


B5570
384R
1867·5R
A
C
62·2R
B
B'
1261R
C'
122·3
A'
Opening of rim band
3max
Cement
2max(meniscus)
Metal rim band
RIM DETAIL
630max diagonal
616·5min(Phosphor screen)
548·5max major axis
437·5max minor axis
45±3
24·8±2
12·8±2
38·5±2
2·5
13R
C
13R
B
13R
A
1115R
A'B'C'
720R
720R
82·4
56·2
One of tne four lugs may deviate 2mm max from the plane through the three other lugs. This deviation is incorporated in the ±2 tolerance.
All dimensions in mm



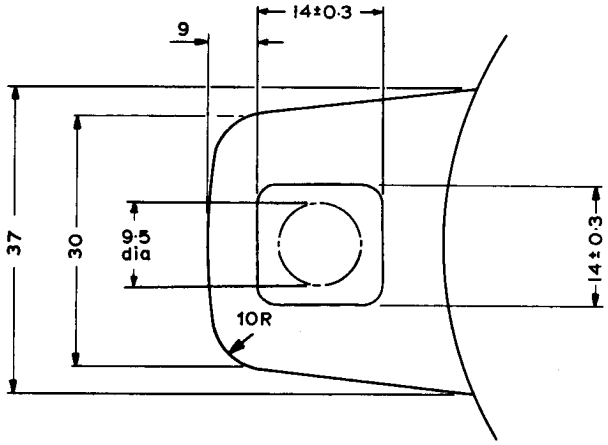
MAXIMUM CONE CONTOURS

DIMENSIONS FOR MAXIMUM CONE CONTOUR DRAWING (Page D8)

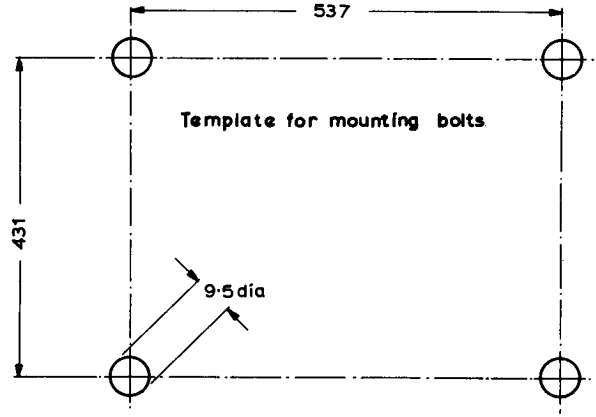
Section	0° short	10°	20°	30°	40°	45°	50°	54°41' diagonal	60°	65°	70°	80°	90° long
1	92.2	92.2	92.2	92.2	92.2	92.2	92.2	92.2	92.5	93.4	94.7	100.4	104.7
2	119.9	119.9	119.9	119.9	119.9	119.9	119.9	119.9	120.4	121.8	124.1	132.3	137.8
3	143.5	143.6	143.7	143.9	144.2	144.4	144.5	144.5	145.1	146.9	149.8	159.2	164.6
4	161.0	161.2	161.9	163.1	164.8	165.7	166.5	166.8	167.5	169.6	173.0	182.7	187.7
5	174.8	175.2	176.5	179.0	182.7	184.7	186.6	187.2	188.0	190.3	194.1	203.8	208.1
6	186.2	186.8	188.9	192.7	198.6	201.9	205.1	206.1	207.0	209.4	213.6	222.2	225.2
7	195.8	196.7	199.5	204.7	212.9	217.6	222.2	223.8	224.7	227.3	230.9	236.6	238.5
8	204.0	205.1	208.7	215.4	225.9	232.0	238.3	240.3	241.2	243.1	245.2	248.4	249.4
9	211.1	212.4	216.8	224.9	237.9	245.5	253.3	255.9	256.2	256.7	257.3	258.2	258.6
10	217.2	218.8	223.8	233.5	248.9	258.0	267.5	270.7	269.9	268.7	267.8	266.7	266.3
11	222.4	224.2	230.1	241.2	259.1	269.8	280.9	284.6	282.6	279.4	276.9	273.8	272.9
12	226.8	228.9	235.6	248.2	268.5	280.8	293.6	298.0	294.4	289.0	284.9	279.9	278.4
13	230.5	232.8	240.3	254.5	277.3	291.1	305.7	310.6	305.3	297.7	292.0	285.2	283.1
14	233.5	236.1	244.4	260.2	285.6	300.9	317.1	322.6	315.6	305.5	298.2	289.6	287.0
15	235.9	238.8	247.9	265.3	292.2	307.8	324.0	329.5	322.5	311.9	303.6	293.3	290.2
16	237.7	240.8	250.5	268.2	295.1	310.7	327.0	332.4	325.4	314.8	306.5	295.9	292.5

All dimensions in mm

B5569

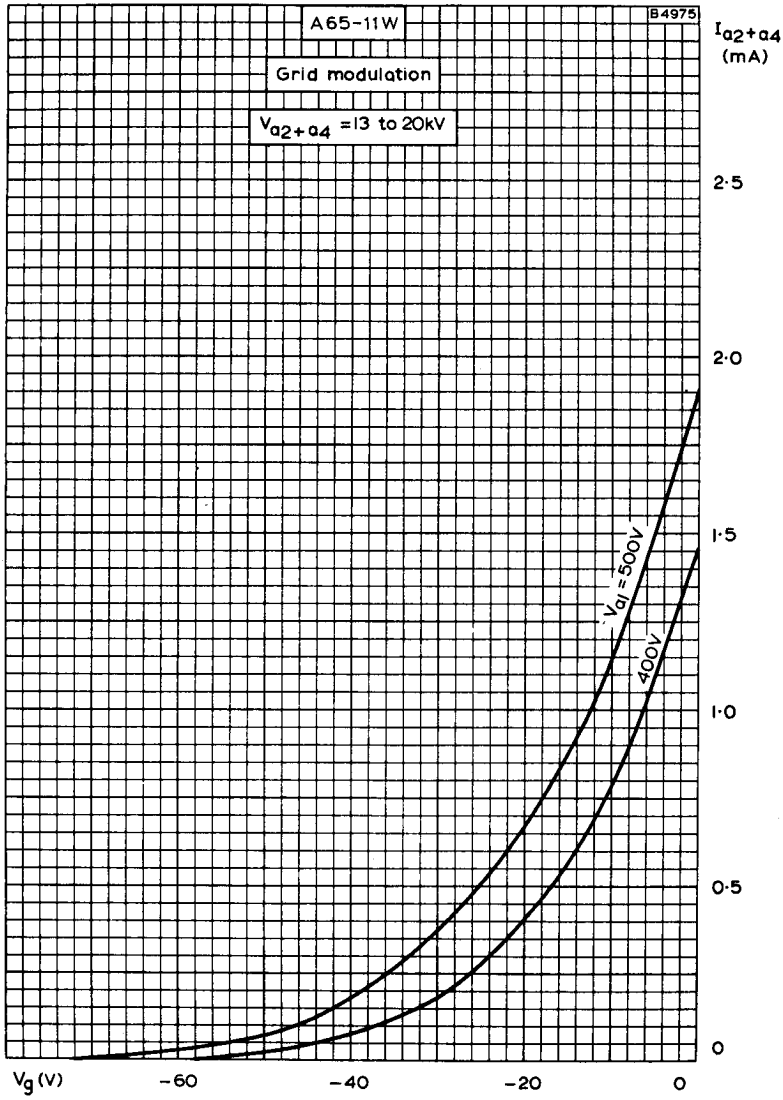


Mounting lug

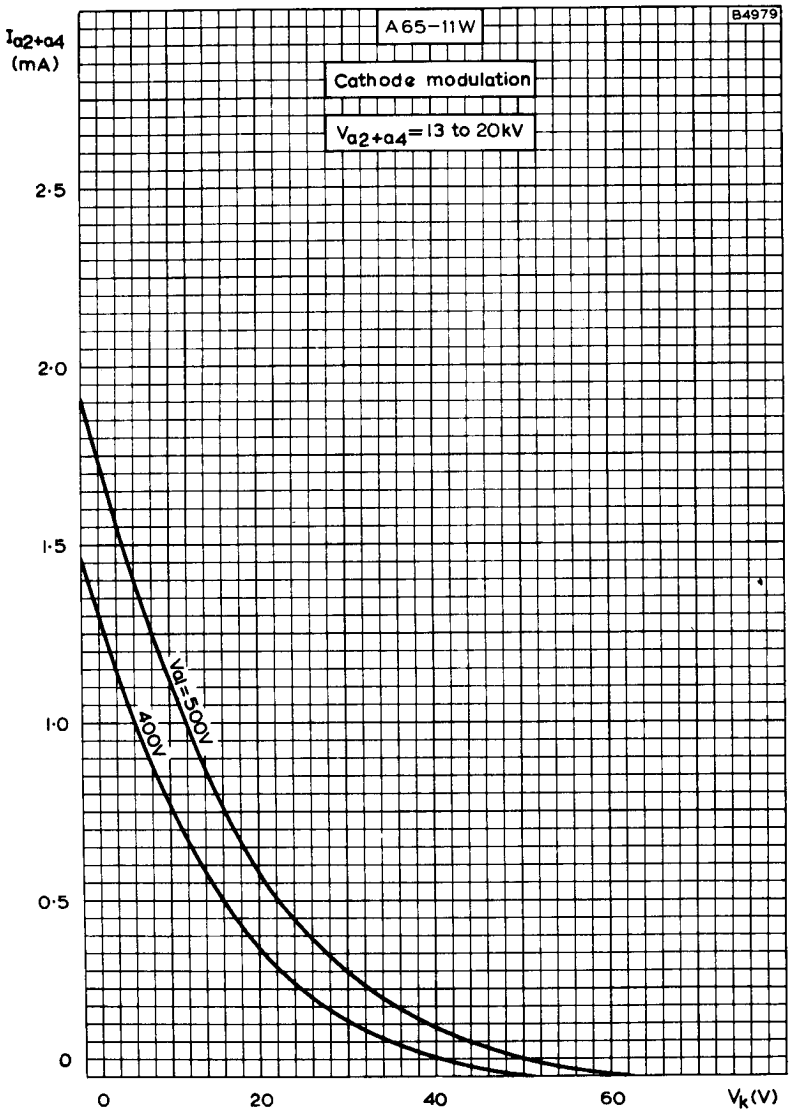


All dimensions in mm.

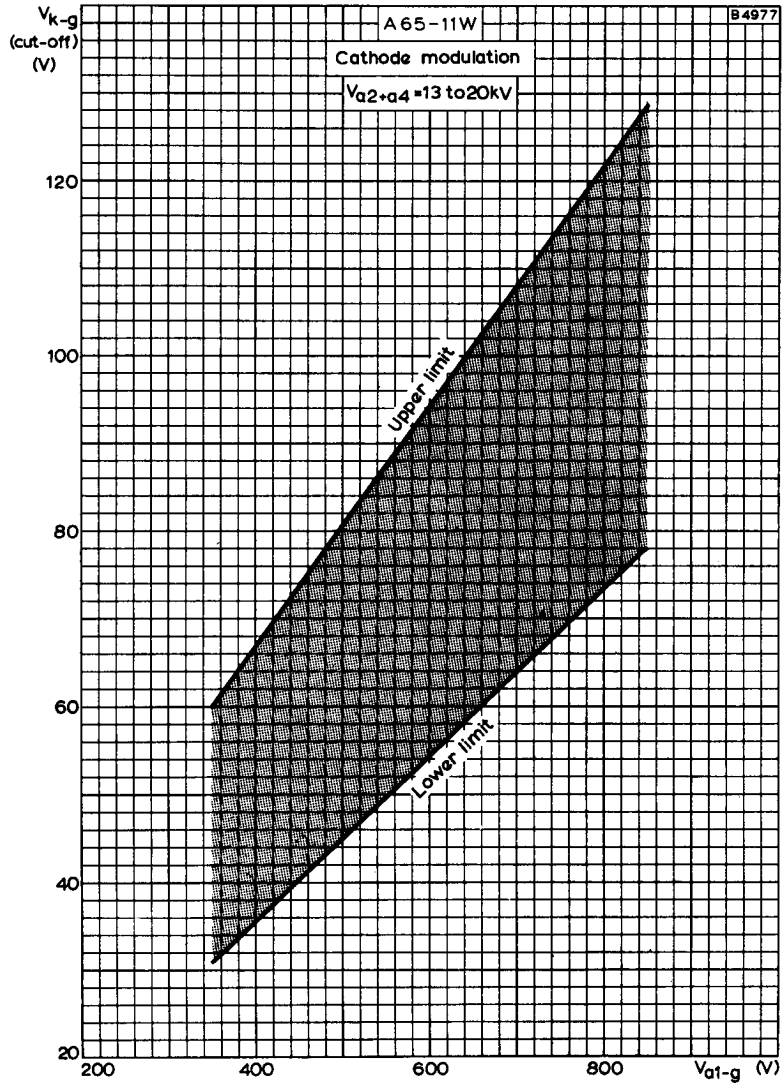
The bolts to be used for mounting the tube must be within the circles of 9.5mm diameter shown in the template drawing.



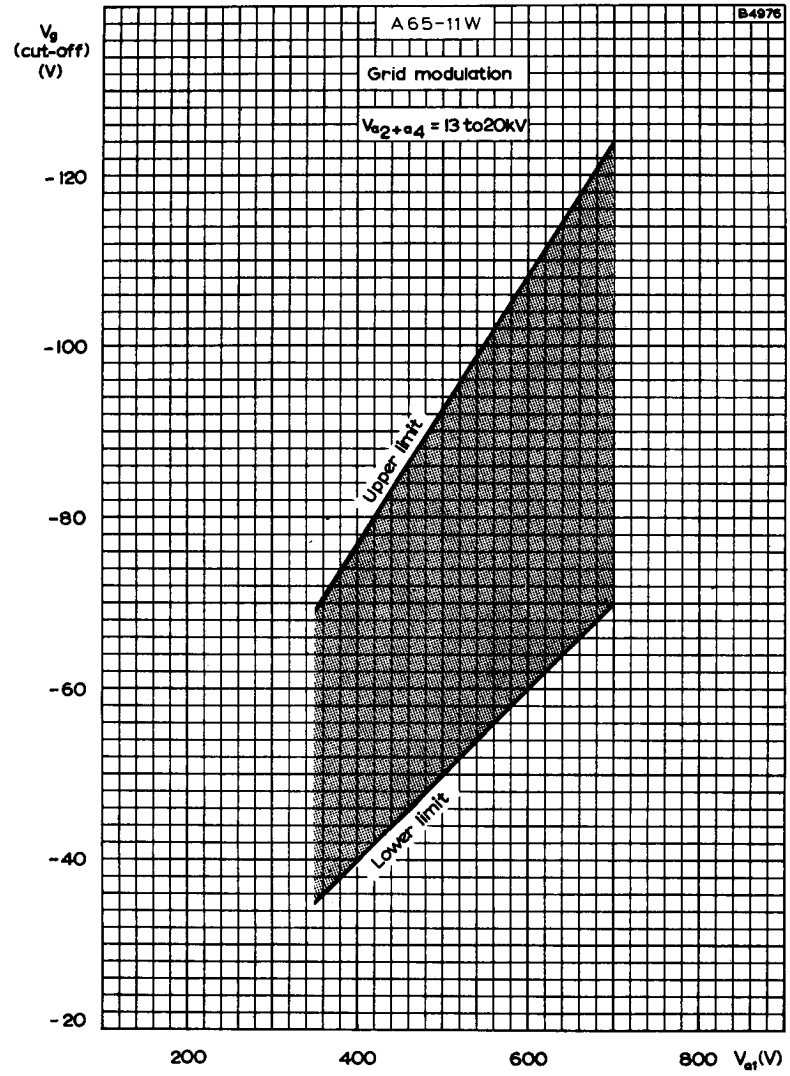
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION.



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF CATHODE-TO-GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE-TO-GRID VOLTAGE. CATHODE MODULATION.



LIMITS OF GRID CUT-OFF VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE. GRID MODULATION.

RADAR TUBE

Direct viewing radar tube with 9-in. diameter metal-backed magnesium fluoride screen, magnetic deflection and low voltage electrostatic focusing lens.

AF22-10
AL22-10

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES which precede this section of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

CAPACITANCES

C_{g-all}	<8.0	pF
C_{k-all}	<8.0	pF
$C_{a2+a4-M}$	700	pF

SCREEN

Metal-backed		
Fluorescent colour	orange with orange afterglow	
Useful screen diameter	200	mm

PERSISTENCE

F screen	very long
L screen	long

See curves included in this section of the handbook for screen types F and L.

FOCUSING

Low voltage electrostatic

DEFLECTION

Double magnetic

MOUNTING POSITION

Any, except vertical with the screen downwards and the axis of the tube making an angle of less than 20° with the vertical.

OPERATING CONDITIONS

V_{a2+a4}	12	kV
†V_{a3} (focus electrode)	−200 to +200	V
V_{a1}	300	V
I_{a3}	−15 to +15	μA
V_g for cut-off	−30 to −70	V

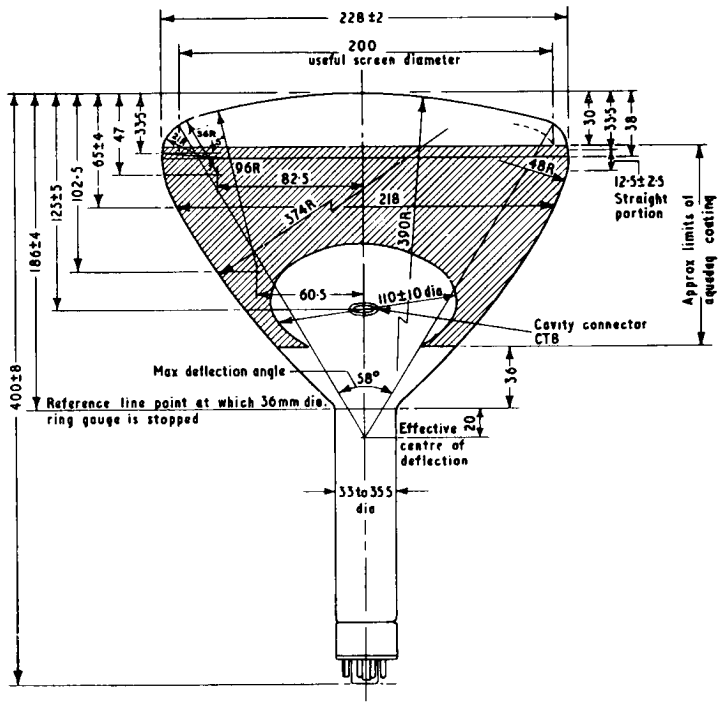
†With the small change in focus spot size with variation of focus voltage the limit of −200 to +200V is such that an acceptable focus quality is obtained within this range. If it is required to pass through the point of focus a voltage of at least −300 to +300V will be required.

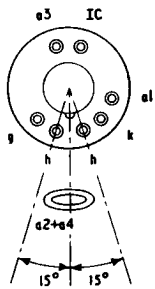
LIMITING VALUES (absolute ratings)

V_{a2+a4} max.	14	kV
V_{a2+a4} min.	8.0	kV
$+V_{a3}$ max.	500	V
$-V_{a3}$ max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
$-V_g$ max.	200	V
$-V_g$ min.	1.0	V
Z_{g-k} max. (f = 50c/s)	500	kΩ
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	±150	V
R_{h-k} max.	See note*	

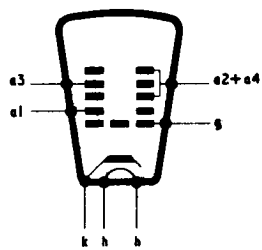
*When the heater is supplied from a separate transformer R_{h-k} max. is 1MΩ.

When the heater is in a series chain or earthed Z_k max. is 100kΩ where Z_k is the 50c/s impedance between earth and cathode.



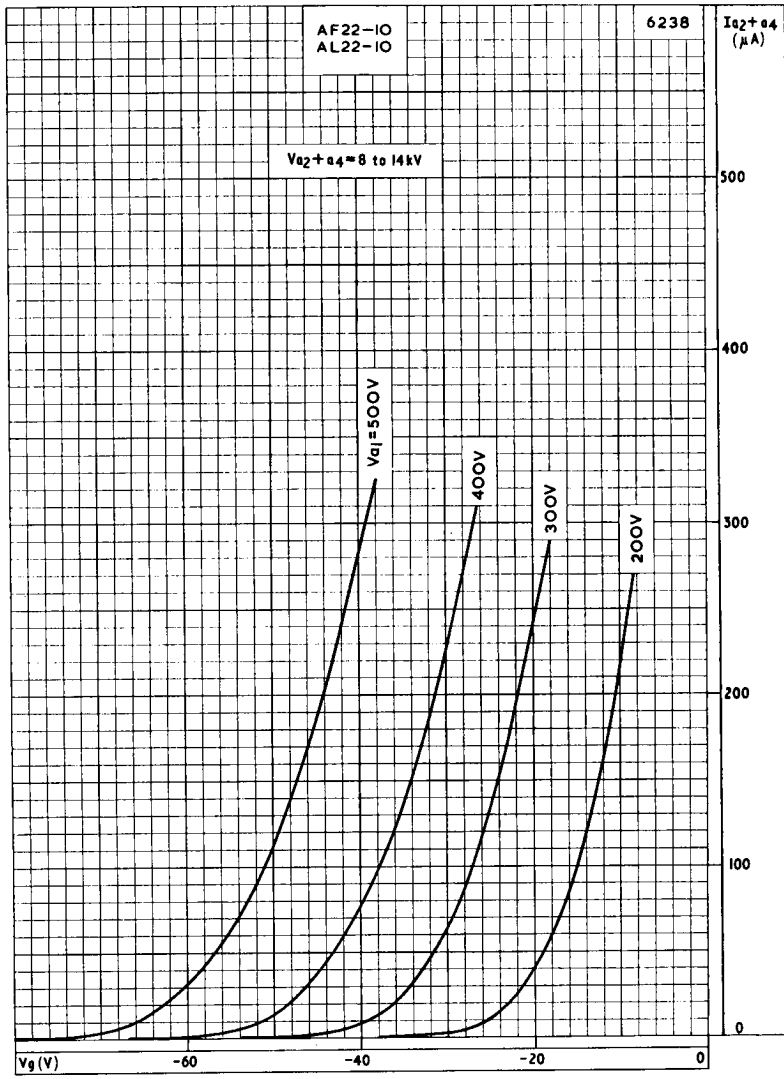


B12A Base

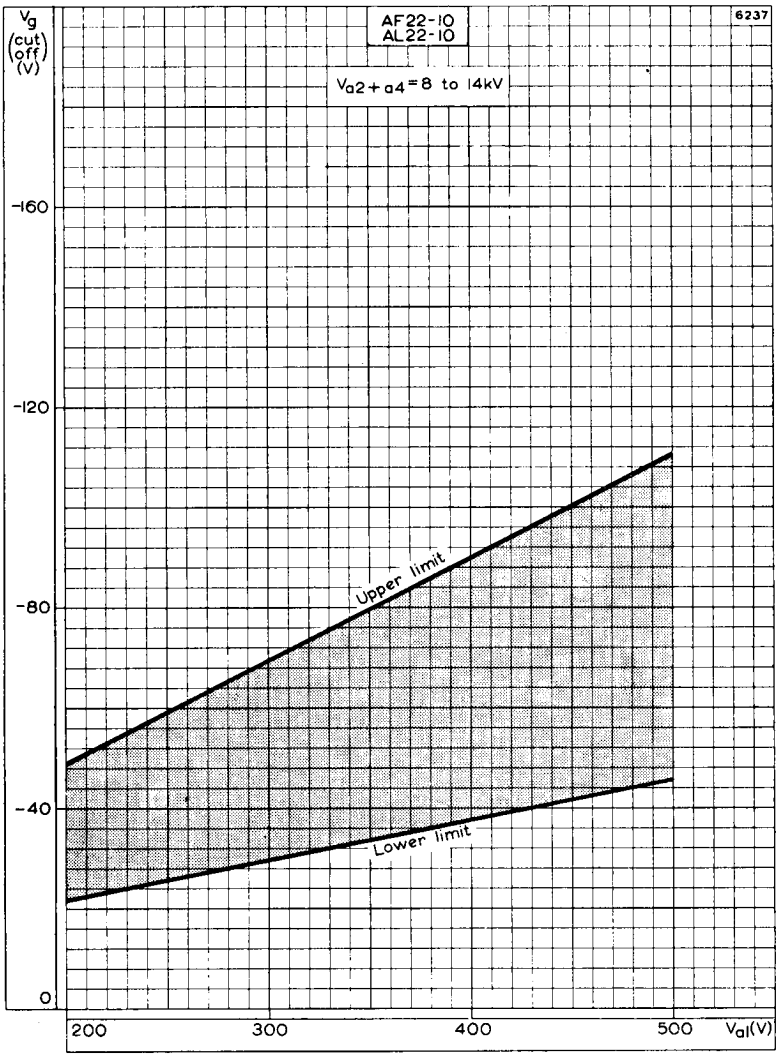


2036

All dimensions in mm



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE



LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES FROM 200 TO 500V

RADAR TUBE

Direct-viewing radar tube with 12-in. diameter metal-backed magnesium fluoride screen, magnetic deflection and low voltage electrostatic focusing lens.

AF31-10
AL31-10

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES which precede this section of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

CAPACITANCES

$c_{g\ all}$	<8.0	pF
c_{k-all}	<8.0	pF
$c_{a2+a4-M}$	1200	pF

SCREEN

Metal-backed		
Fluorescent colour	orange with orange afterglow	
Useful screen diameter	265	mm

PERSISTENCE

F screen	very long
L screen	long

See curves included in this section of the handbook for screen types F and L.

FOCUSING

Low voltage electrostatic

DEFLECTION

Double magnetic

MOUNTING POSITION

Any, except vertical with the screen downwards and the axis of the tube making an angle of less than 20° with the vertical.

OPERATING CONDITIONS

$V_{a2,a4}$	12	kV
†V_{a3} (focus electrode)	−200 to +200	V
V_{a1}	300	V
I_{a3}	−15 to +15	μA
V_g for cut-off	−30 to −70	V

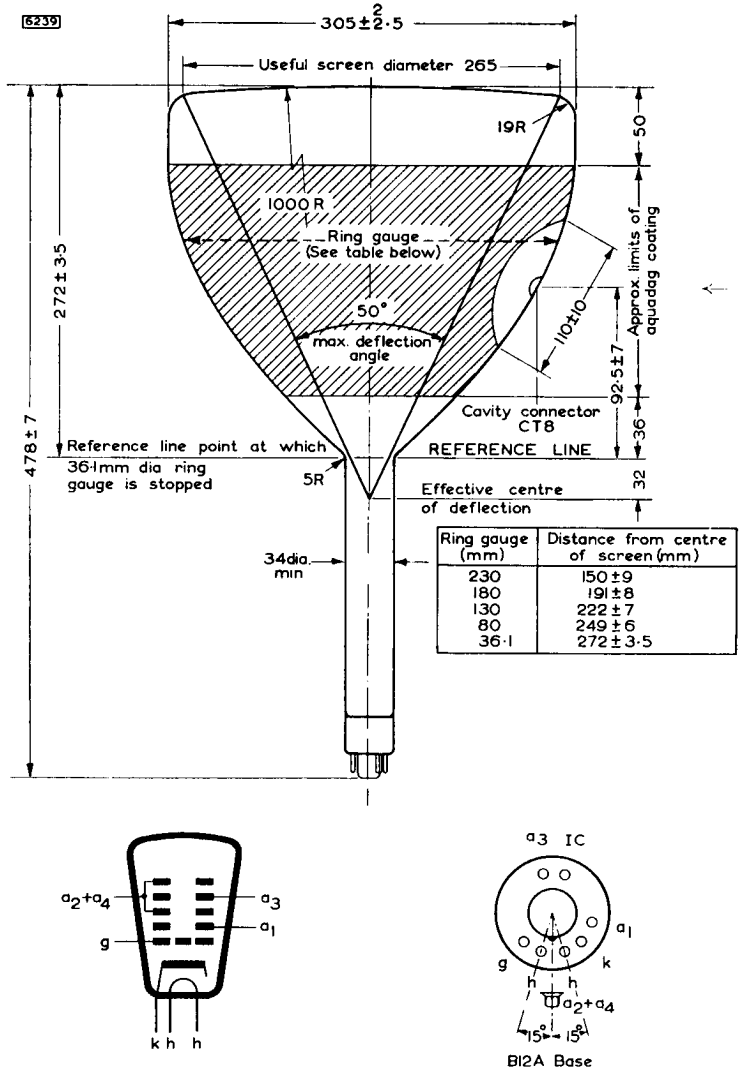
†With the small change in focus spot size with variation of focus voltage the limit of −200V to +200V is such that an acceptable focus quality is obtained within this range. If it is required to pass through the point of focus a voltage of at least −300V to +300V will be required.

LIMITING VALUES (absolute ratings)

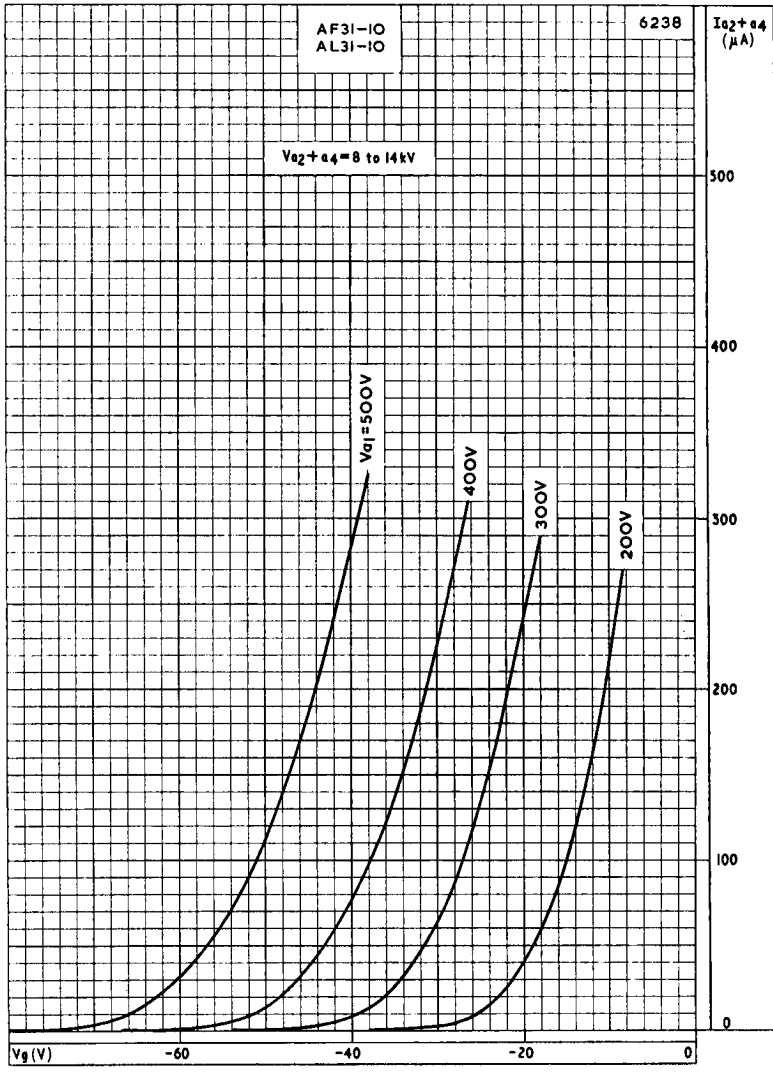
$V_{a2,a4}$ max.	18	kV
$V_{a2,a4}$ min.	8.0	kV
+V_{a3} max.	500	V
−V_{a3} max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
−V_g max.	200	V
−V_g min.	1.0	V
Z_{g-k} max. (f = 50c/s)	500	kΩ
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	±150	V
R_{h-k} max.	See note*	

*When the heater is supplied from a separate transformer R_{h-k} max. is 1.0MΩ.

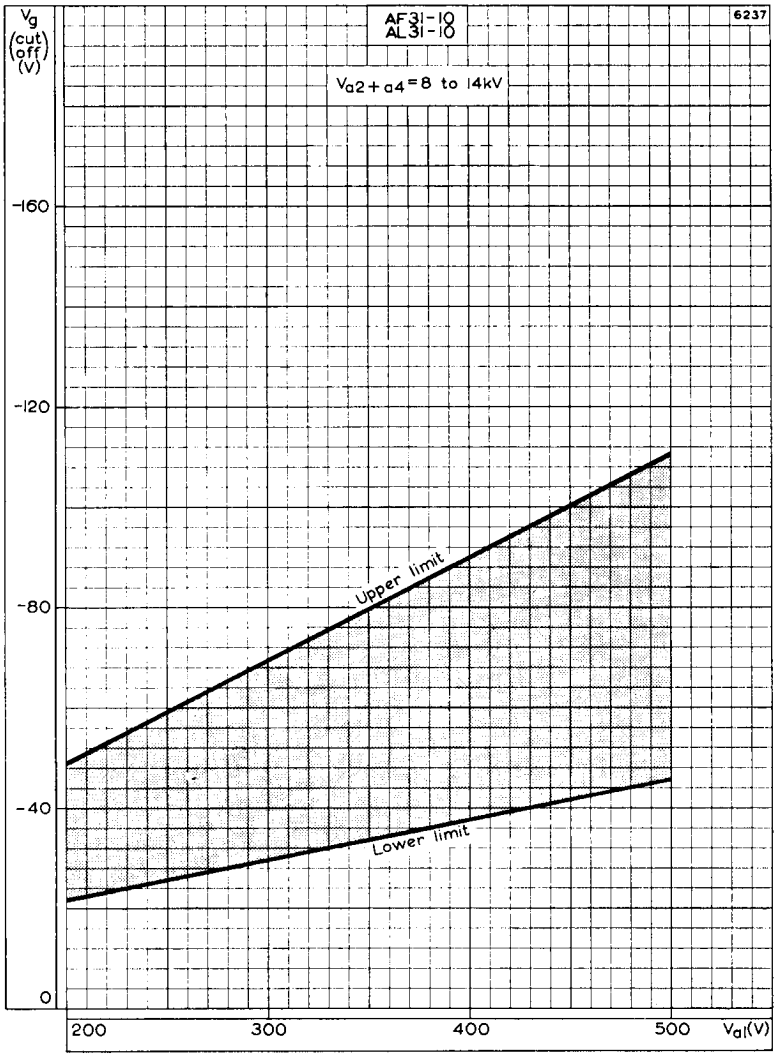
When the heater is in a series chain or earthed, Z_k max. is 100kΩ where Z_k is the 50c/s impedance between earth and cathode.



All dimensions in mm



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE



LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES FROM 200V TO 500V

TRIODE THYRATRON

AN1

Triode inert-gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

This data sheet should be read in conjunction with "DEFINITIONS AND OPERATIONAL RECOMMENDATIONS—THYRATRONS", preceding this section of the Handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	1.3	kV
Forward	650	V
Max. cathode current		
Peak	2.0	A
Average (max. averaging time 15 secs.)	300	mA
Surge (fault protection max. duration 0.1 secs.)	15	A
Max. negative control-grid voltage		
Before conduction	125	V
During conduction	10	V
Max. average positive control-grid current for anode voltage more positive than −10 V (averaging time 1 cycle)	20	mA
Max. peak positive control-grid current during the time that the anode voltage is more negative than −10 V	1.0	mA
Max. control-grid resistor	1.0	MΩ
Max. peak heater-cathode voltage		
Heater positive	25	V
Heater negative	100	V
Heater voltage limits	3.7 to 4.3	V
Min. valve heating time	30	s
Ambient temperature limits	−75 to +90	°C

OBSOLESCENT
NOT FOR NEW DESIGN

AN1

TRIODE THYRATRON

Triode inert-gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

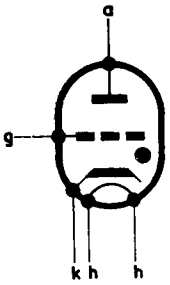
CHARACTERISTICS

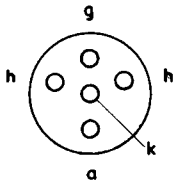
Electrical

Heater voltage	4.0	V
Heater current at 4.0 V		
Average	1.45	A
Maximum	1.6	A
Anode to control-grid capacitance	3.3	μμF
Control-grid to cathode capacitance	4.5	μμF
Deionisation time (approx.)	500	μs
Anode voltage drop (approx.)	9	V
Control ratio	28	

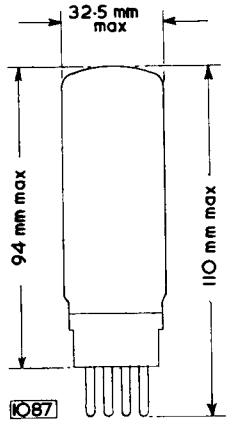
Mechanical

Type of cooling	Convection	
Mounting position	Any	
Max. net weight	1.4	oz
	40	g





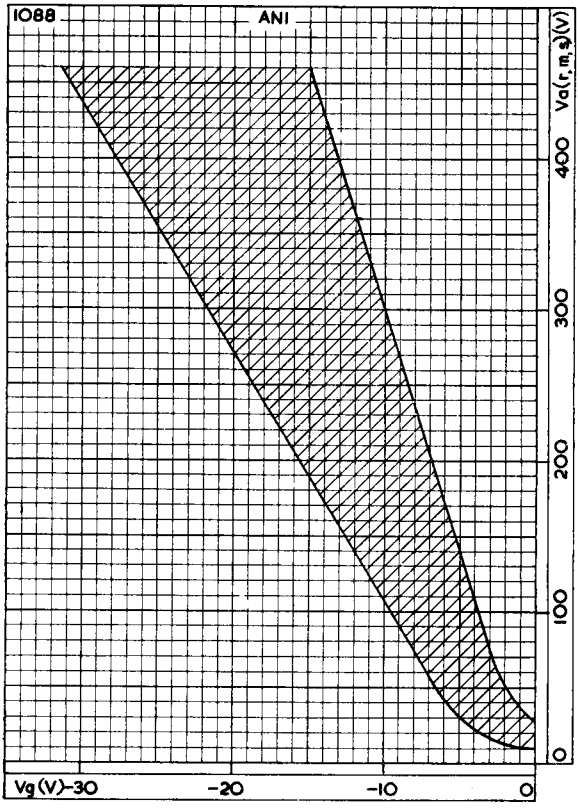
British 5-Pin Base



TRIODE THYRATRON

AN1

Triode inert-gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

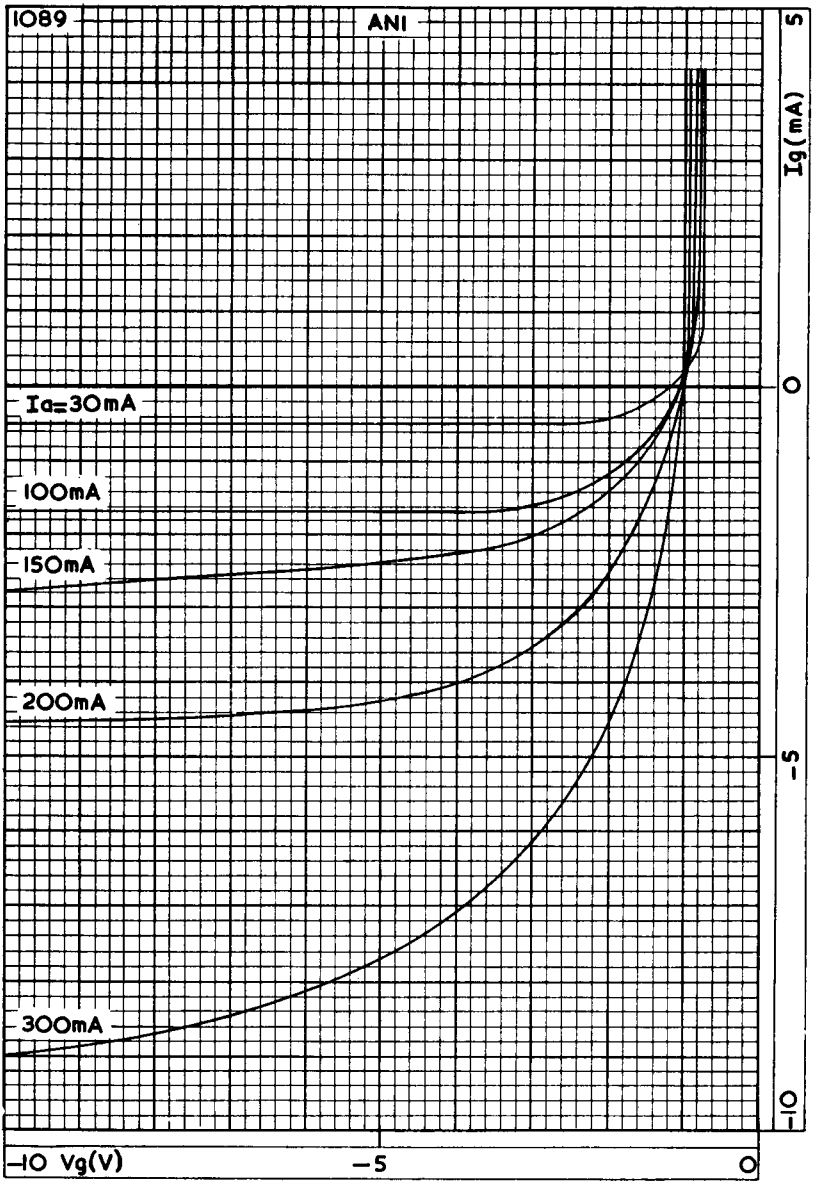


CONTROL CHARACTERISTIC

AN1

TRIODE THYRATRON

Triode inert-gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.



GRID ION CURRENT CHARACTERISTIC

Mullard
ACORN PENTODE

AP4

Heater	Vf	=	4.0 V
	If	=	0.25 A
Capacities	Cagl	=	0.02 μμF
	*Cagl	=	0.011 μμF
	Cgl	=	3.0 μμF
	Ca	=	2.7 μμF

*With valve projecting through metal screen

Operating Conditions as R.F. Amplifier

Va	250	V
Vg2	100	V
Ia	2.0	mA
Ig2	0.7	mA
-Vg1	3.0	V
g (Ia = 2 mA)	5,000	
S (Ia = 2 mA)	1.4	mA/V
Ri (Ia = 2 mA)	3.5	MΩ

Operating Conditions as Anode Detector

Va	250	V
Vg2	100	V
-Vg1	6.0	V
Iao	0.1	mA
Ra	0.25	MΩ
Rk	20,000	Ω

Limiting Values

Va max.	250	V
Vg2 max	100	V
Ik max	4.0	mA
Vg1 max (Ig1 = 0.3 μA)	-1.3	V
Rg1 max	1.0	MΩ
Vfk max	50	V
Rfk max	20,000	Ω

Operating Notes.

The AP4 is an Acorn type specially designed for operation at ultra high frequencies up to 430 Mc.

The use of the AP4 at ultra high frequencies necessitates special precautions in the circuit design.

It is essential that the components, lay out and screening conform to the requirements of the frequency at which the valve is to operate.

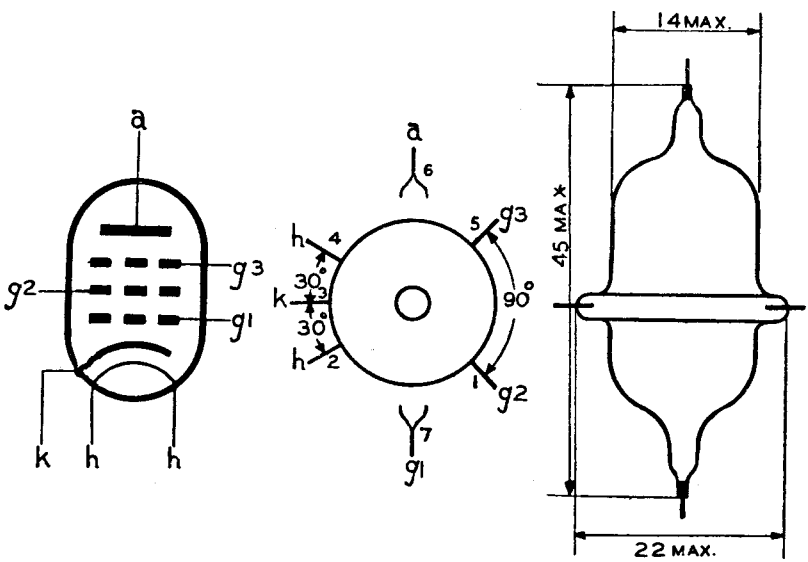
Mullard
ACORN PENTODE

Earth return leads from the control grid, anode, suppressor and screen grid circuits must be kept as short as possible and earthed at a common point in the cathode circuit to avoid any radio frequency inter-action. By-pass condensers must be of good quality mica dielectric.

It will be found advisable to use R.F. chokes placed as near as possible to the by-pass condensers for decoupling purposes in place of the normal resistance arrangement.

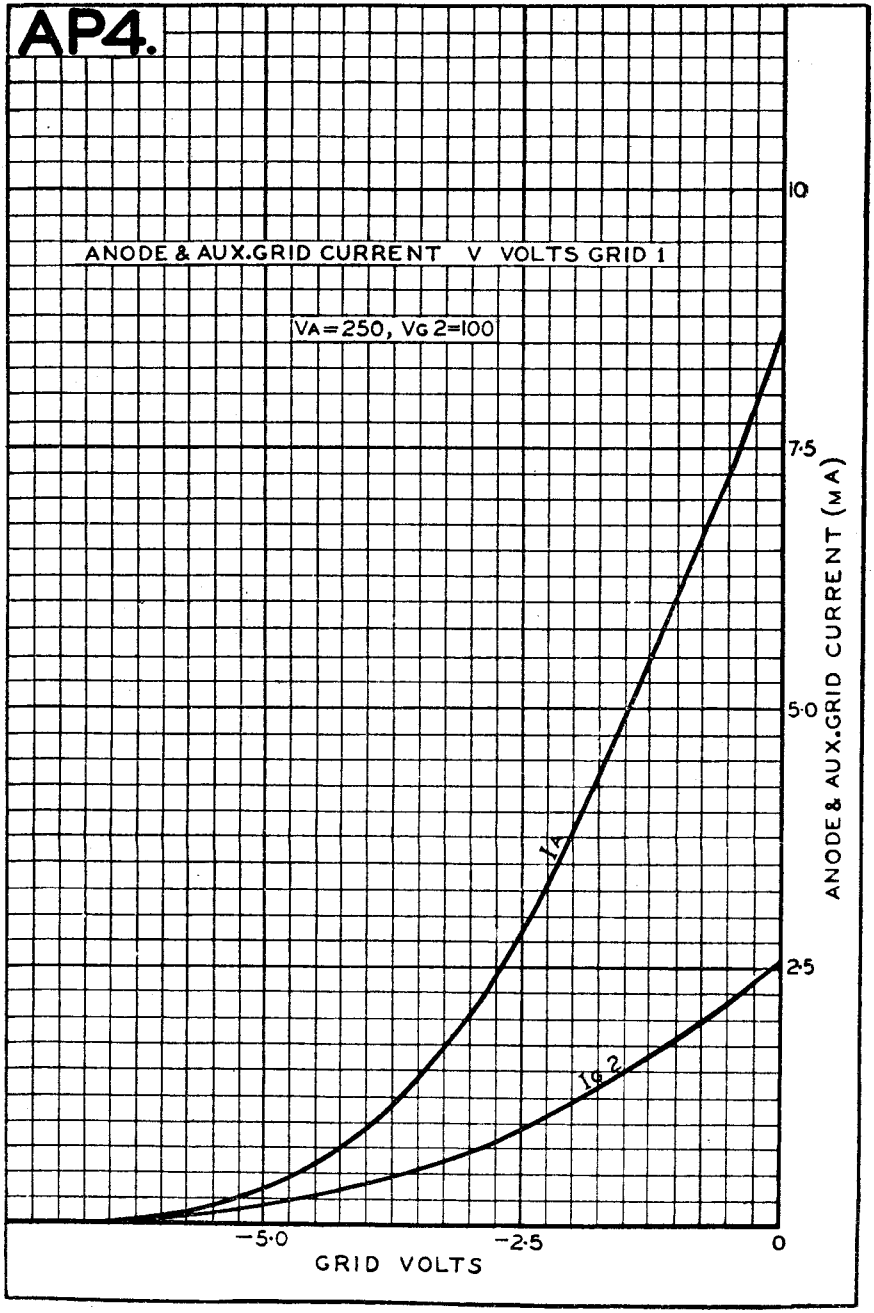
The connections must not be soldered to the contacts on the valve.

Arrangement of electrodes and base connections



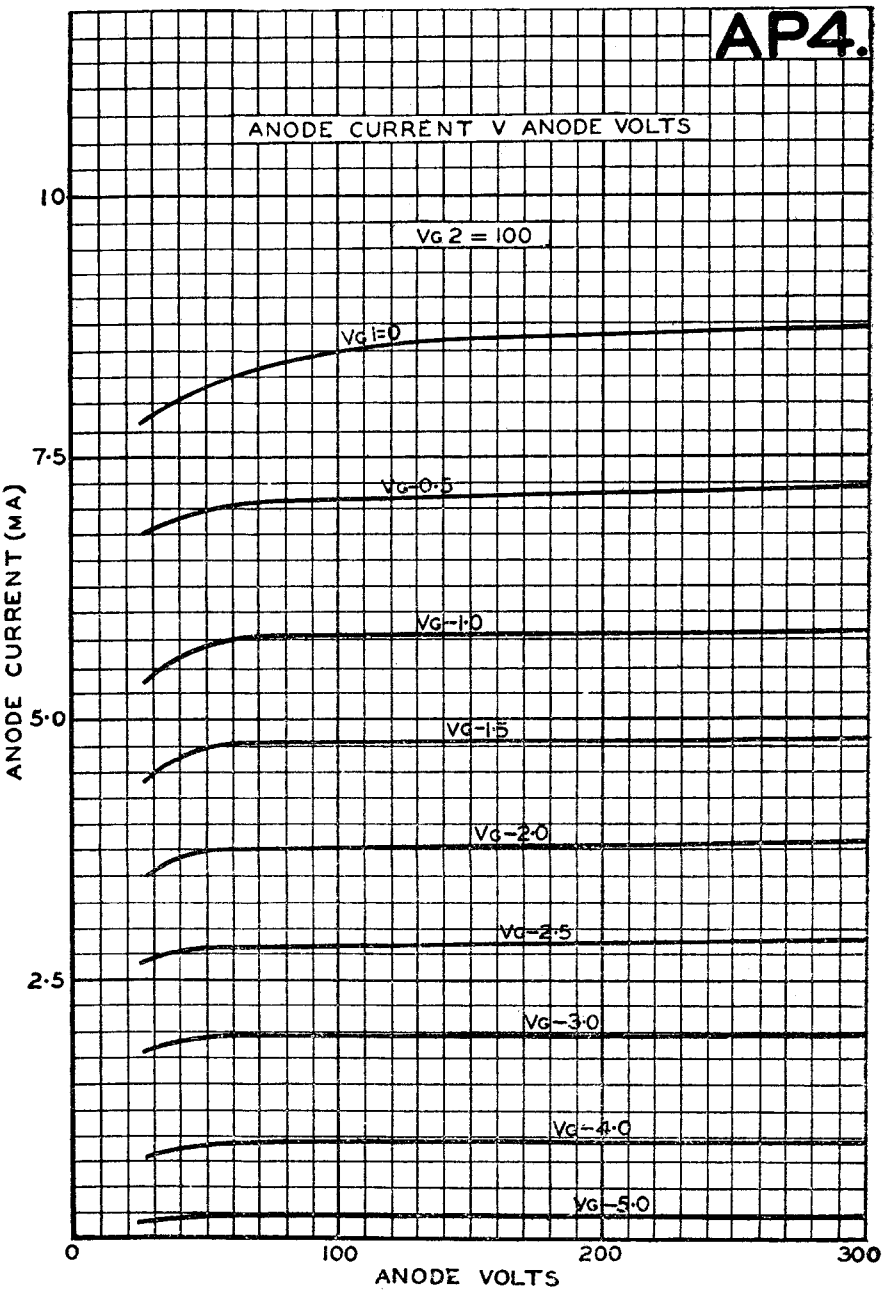
Mullard
ACORN PENTODE

AP4



AP4

Mullard
ACORN PENTODE



Mullard
ACORN TRIODE

AT4

Heater

Vf = 4.0 V
If = 0.25 A

Capacities

Cagl = 1.4 μμF
Cak = 0.6 μμF
Cgk = 1.0 μμF

Operating Conditions

Va	200 V
Ia	4.5 mA
-Vg	6.0 V
g (Ia = 4.5 mA)	25
S (Ia = 4.5 mA)	2.0 mA/V
Ri (Ia = 4.5 mA)	12,500 Ω

Operating Conditions as Oscillator or H.F. Amplifier (Class C)

Va	200 V
Ia	8.0 mA
-Vg	35 V
Ig	2.0 mA
*Wo	0.5 W

*Approximate value at 60 Mc. This output can be maintained up to 300 Mc. but above this the output will decrease as the frequency is increased.

Operating Conditions as Detector

	Anode detector	Grid detector
Va	180	45 V
-Vg	7	0 V
Ia	0.2	- mA
Ra	0.25	- MΩ
Rk	50,000	- Ω
Rg	-	1 to 5 MΩ
Cg	-	250 μμF

Limiting Values

Va max	200 V
Wa max	1.1 W
Ik max	6.0 mA
Vgl max (Ig = 0.3 μA)	-1.3 V
Rg max	0.5 MΩ
Vfk max	50 V
Rfk max	20,000 Ω

AT4

Mullard
ACORN TRIODE

Operating Notes.

The AT4 is an Acorn type specially designed for operation at ultra high frequencies up to 430 Mc.

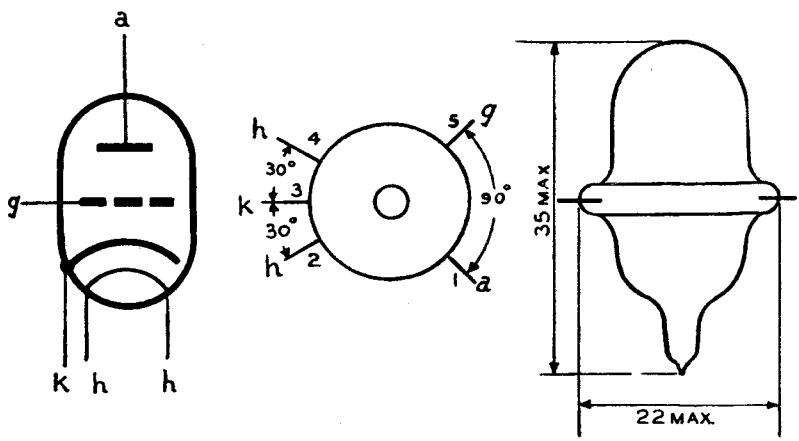
The use of the AT4 at ultra high frequencies necessitates special precautions in the circuit design.

It is essential that the components, lay out and screening conform to the requirements of the frequency at which the valve is to operate.

By-pass condensers must be of good quality mica dielectric and where used for decoupling, should be located as near the valve terminals as possible.

All leads should be of the minimum possible length and all earthed points should be as close together as possible. The connections must not be soldered to the contacts on the valve.

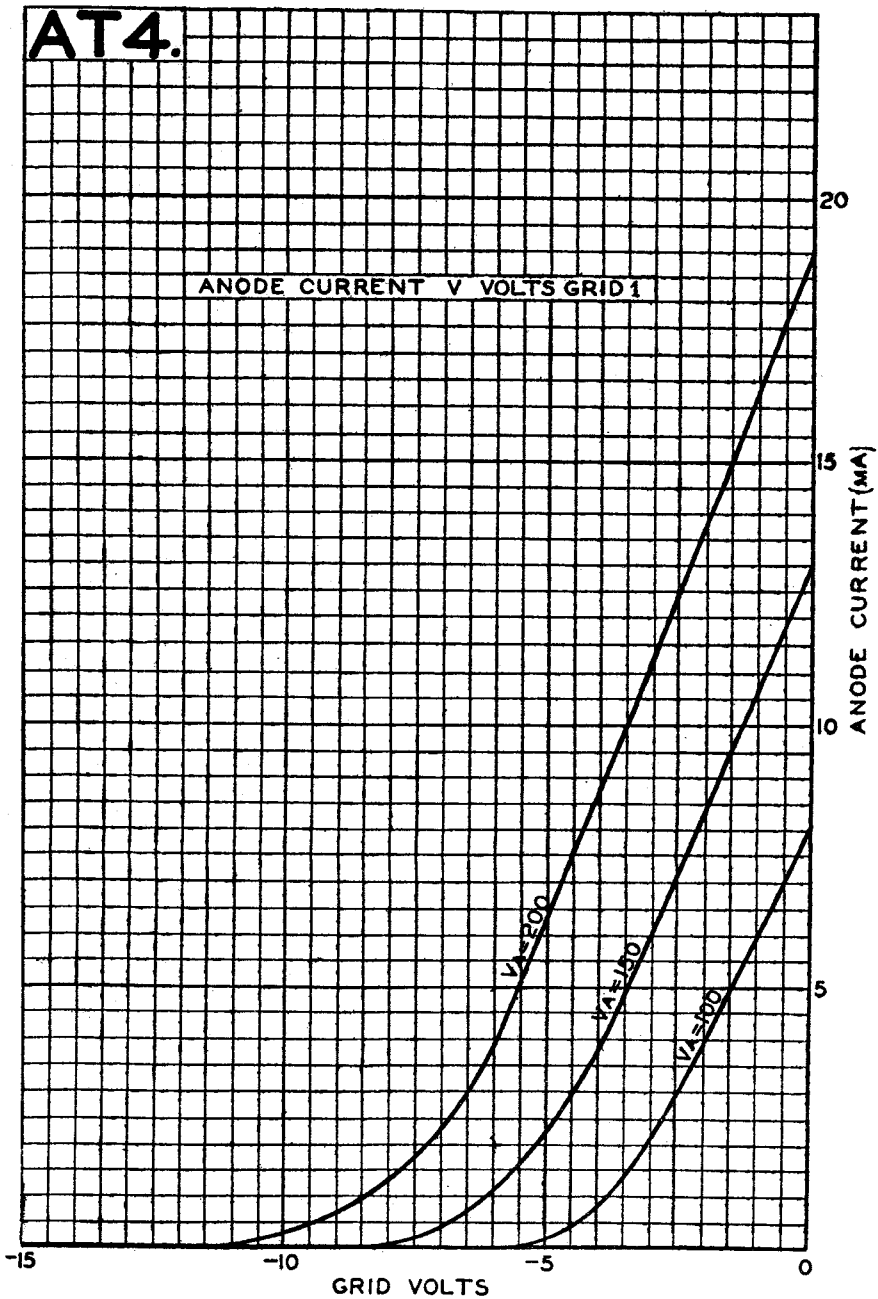
Arrangement of electrodes and base connections



AT4

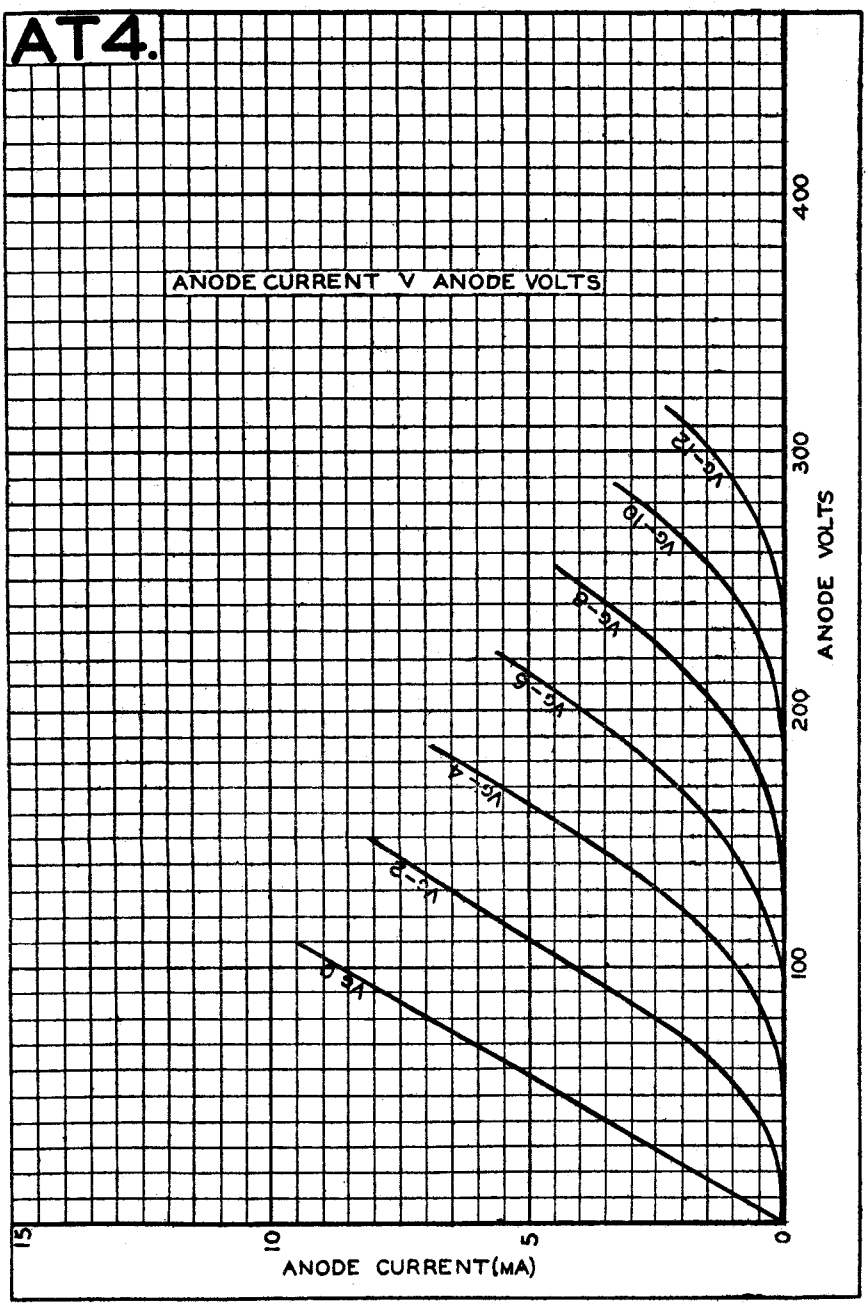
Mullard
ACORN TRIODE

AT4



AT4

Mullard
ACORN TRIODE



TELEVISION VIEWFINDER TUBE

AW13-36

Direct viewing television tube with 5-in. diameter metal-backed screen. Having electrostatic focusing and good resolution it is primarily intended for use as a television camera viewfinder tube.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES included in this volume of the handbook.

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note (applies to series operation only)—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

CAPACITANCES

c_{g-all}	<8.0	pF
c_{k-all}	<8.0	pF

SCREEN

Metal-backed		
Fluorescent colour	White	
Useful screen diameter	108	mm

FOCUSING

Low voltage electrostatic.

DEFLECTION

Double magnetic.

MOUNTING POSITION

Any, except vertical with the screen downward and the axis of the tube making an angle less than 20° with the vertical.

TYPICAL OPERATING CONDITIONS

$V_{a2,a4}$	12	kV
V_{a1}	300	V
*V_{a3} (focusing electrode)	−200 to +200	V
I_{a3}	−15 to +15	μA
V_g for cut-off	−30 to −70	V

*With the small change in focus spot size with variation of focus voltage the limit of −200 to +200V is such that an acceptable focus quality is obtained within this range. If it is required to pass through the point of focus a voltage of at least −300 to +300V will be required.

AW13-36

TELEVISION VIEWFINDER TUBE

Direct viewing television tube with 5-in. diameter metal-backed screen. Having electrostatic focusing and good resolution it is primarily intended for use as a television camera viewfinder tube.

LIMITING VALUES (absolute ratings)

**V_{a2+a4} max.	14	kV
V_{a2+a4} min.	8.0	kV
+V_{a3} max.	500	V
−V_{a3} max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
−V_g max.	200	V
*−V_g min.	1.0	V
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
††$v_{h-k(pk)}$ max. (cathode positive)	410	V
Z_{g-k} max. (f = 50c/s)	500	kΩ
R_{g-k} max.	1.5	MΩ
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the equipment on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a2+a4} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

††During a warming-up period not exceeding 45s.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ, where Z_k is the 50c/s impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1MΩ.

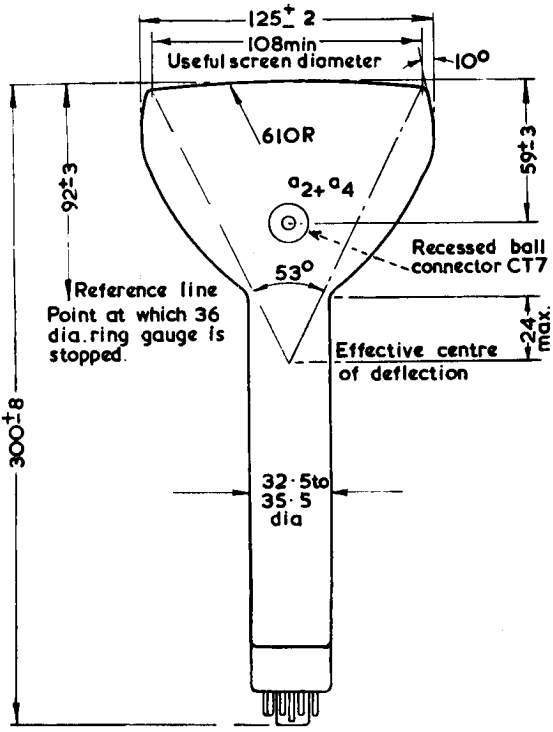
WEIGHT

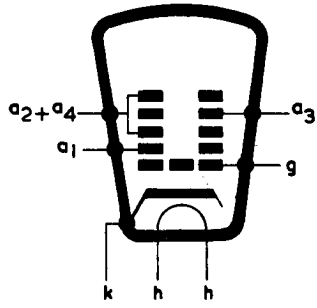
Tube alone	500 g 1 lb 2 oz

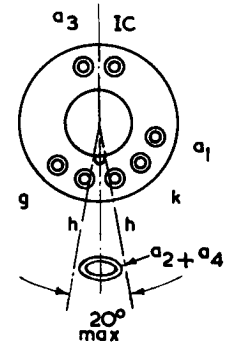
TELEVISION VIEWFINDER TUBE

AW13-36

Direct viewing television tube with 5-in. diameter metal-backed screen. Having electrostatic focusing and good resolution primarily intended for use as a television camera viewfinder tube.







2558

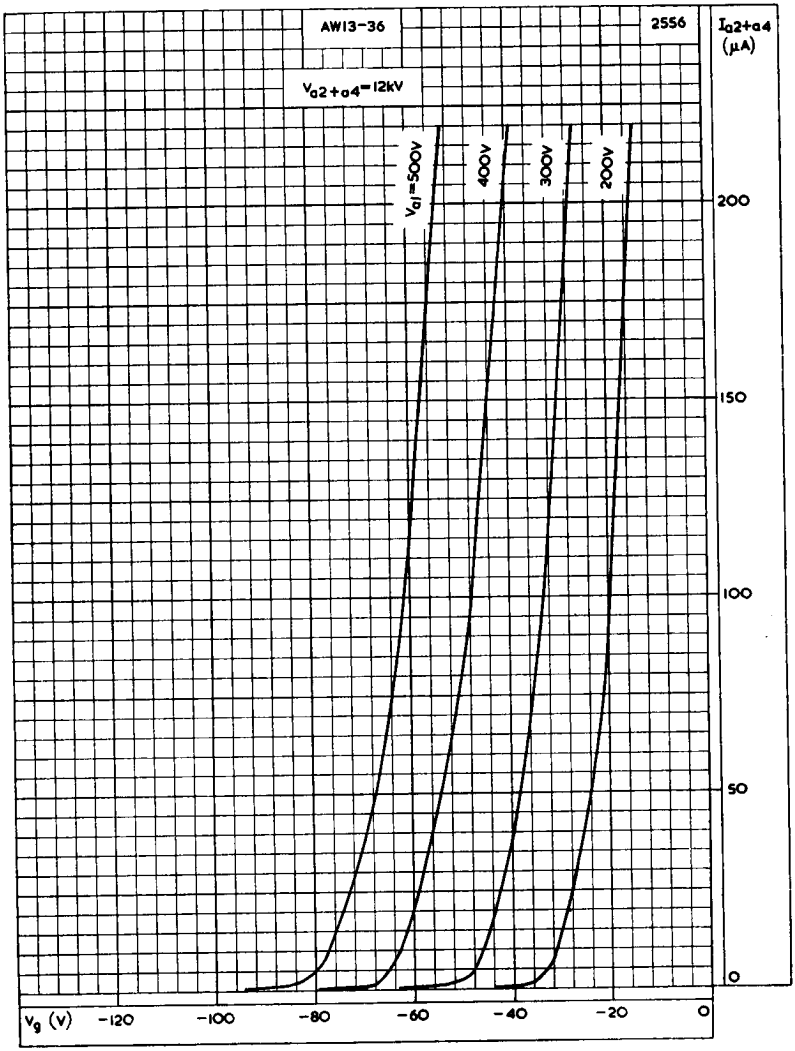
All dimensions in mm.

B12A Base

AW13-36

TELEVISION VIEWFINDER TUBE

Direct viewing television tube with 5-in. diameter metal-backed screen. Having electrostatic focusing and good resolution it is primarily intended for use as a television camera viewfinder tube.

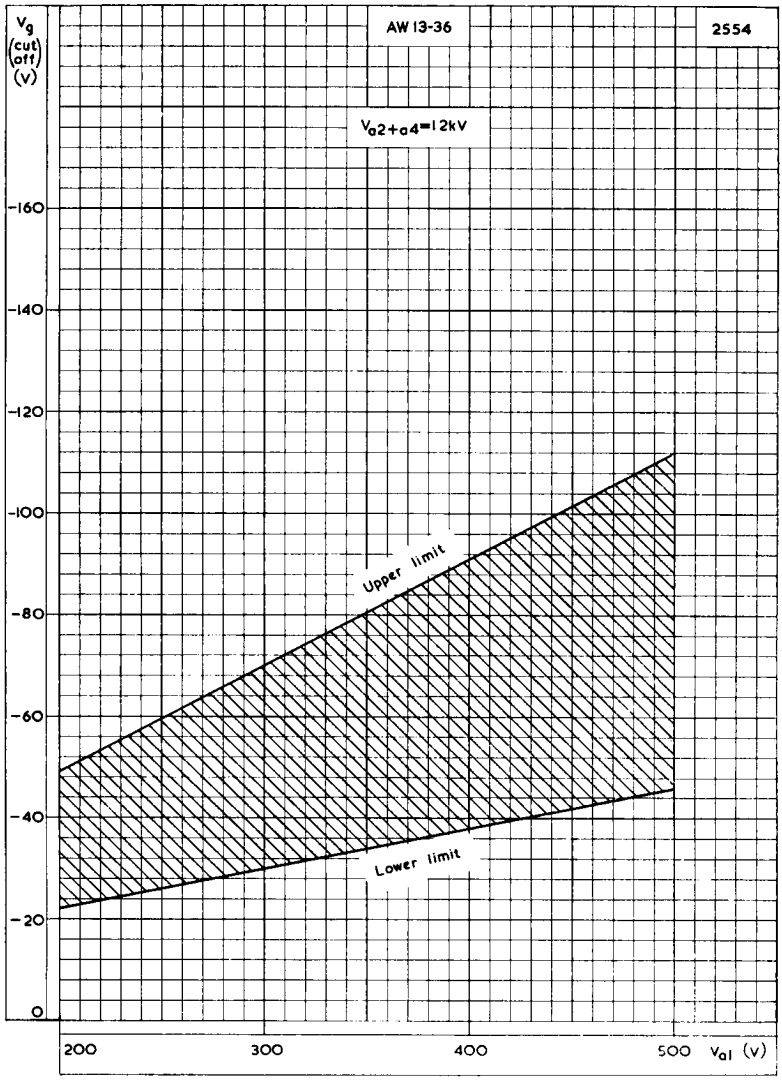


FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

TELEVISION VIEWFINDER TUBE

AW13-36

Direct viewing television tube with 5-in. diameter metal-backed screen. Having electrostatic focusing and good resolution it is primarily intended for use as a television camera viewfinder tube.

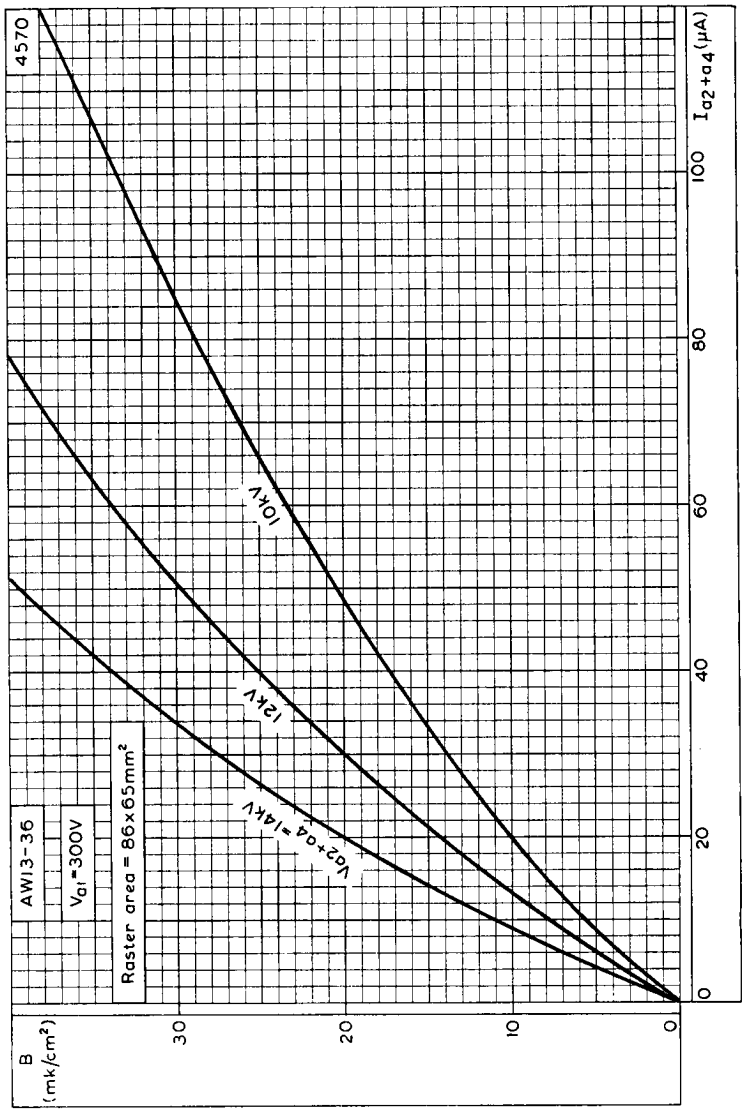


LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES FROM 200 TO 500V

AW13-36

TELEVISION VIEWFINDER TUBE

Direct viewing television tube with 5-in. diameter metal-backed screen. Having electrostatic focusing and good resolution it is primarily intended for use as a television camera viewfinder tube.



LIGHT OUTPUT PLOTTED AGAINST FINAL ANODE CURRENT ←
(1 mk/cm² = 2.9 e.f.c. = 2.9 ft—lambert)

TELEVISION TUBE

AW21-11

Direct viewing television tube with 8½in. diagonal metal-backed rectangular grey glass screen, intended for use in portable transistor television receivers. This tube is electrostatically focused and has a 90° deflection angle. An ion trap magnet is not required.

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – CATHODE RAY TUBES, which precede this section of the handbook.

HEATER

Suitable for parallel operation

*V_h	11.5	V
I_h	60	mA

*The heater supply must be designed to provide a nominal 11.5V. The heater voltage must not rise above 13.8V and must not fall below 9.25V.

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be earthed and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

CAPACITANCES

C_{g-all}	7.0	pF
C_{k-all}	4.0	pF
$C_{a2+a4-M}$	250	pF

SCREEN

Metal backed

Fluorescent colour	White
Useful screen area	see drawing on page D4

FOCUSING

Electrostatic

The range of focus voltage shown in 'Operating conditions' results in optimum overall focus at a beam current of 50μA.

DEFLECTION

Double magnetic

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with the reference line gauge shown on page D3.

REFERENCE LINE GAUGE

See page D5

RASTER CENTRING

See notes under this heading in 'General operational recommendations – cathode ray tubes'.

Centring magnet field intensity	0 to 10	G

Adjustment of the centring magnet should not be such that a general reduction in brightness or shading of the raster occurs.

MOUNTING POSITION

Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40mm which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

OPERATING CONDITIONS

V_{a2+a4}	12	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
†V_g for visual extinction of focused raster	–32 to –69	V
†V_k for visual extinction of focused raster	29 to 62	V

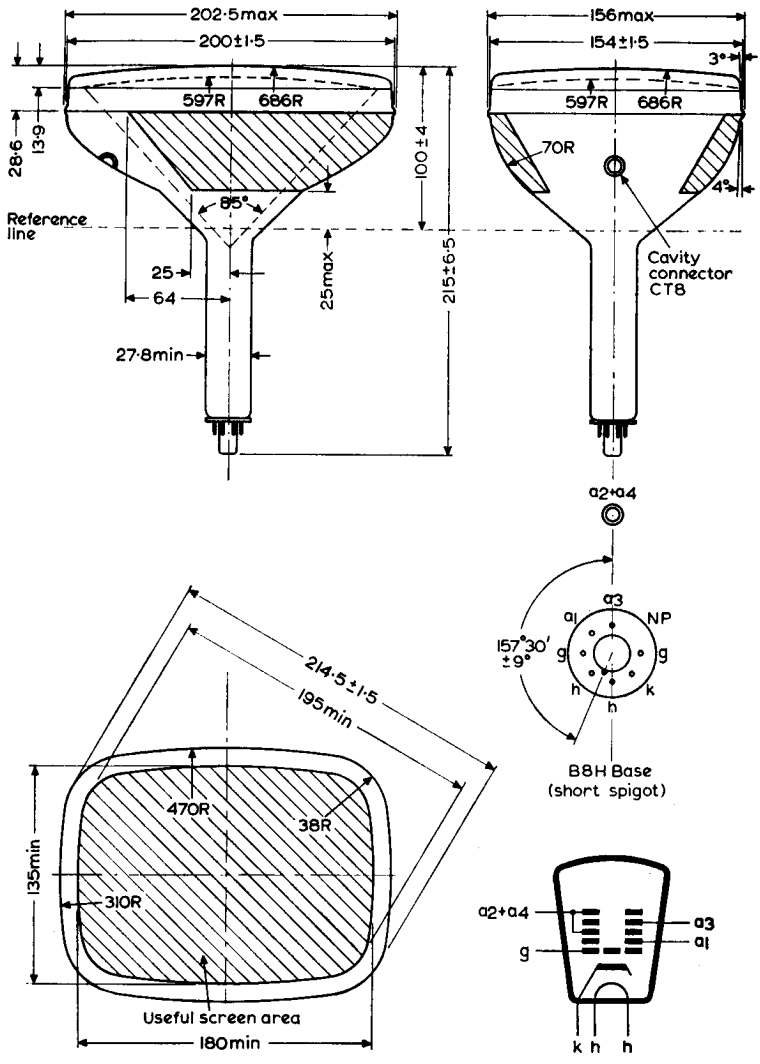
†For grid modulation all voltages are measured with respect to the cathode; for cathode modulation, all voltages are measured with respect to the grid.

ABSOLUTE MAXIMUM RATINGS

V_{a2+a4} max.	16	kV
V_{a2+a4} min.	8.0	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	800	V
$v_{a1(pk)}$ min.	300	V
**$-v_{g(pk)}$ max.	400	V
*$-V_g$ max.	180	V
$+V_g$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	15	μA
R_{a1} max.	1.0	MΩ
R_{a3} max.	3.0	MΩ
V_{h-k}		
Cathode positive		
d.c. max.	80	V
pk. max.	130	V
Cathode negative		
d.c. max.	80	V
pk. max.	130	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f=50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50c/s)	500	kΩ

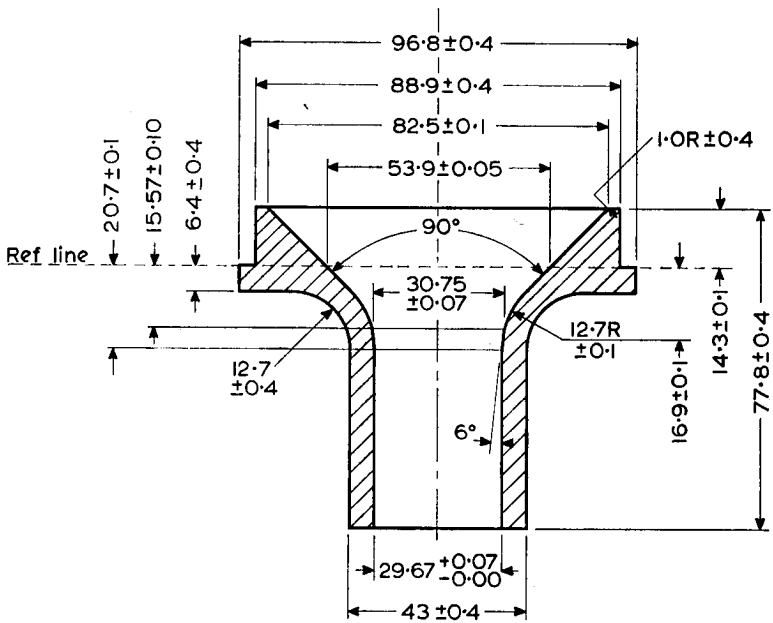
*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V and at this voltage the grid current may be expected to be approximately 2mA.

**Maximum pulse duration 22% of a cycle with a maximum of 1.5ms.



All dimensions in mm

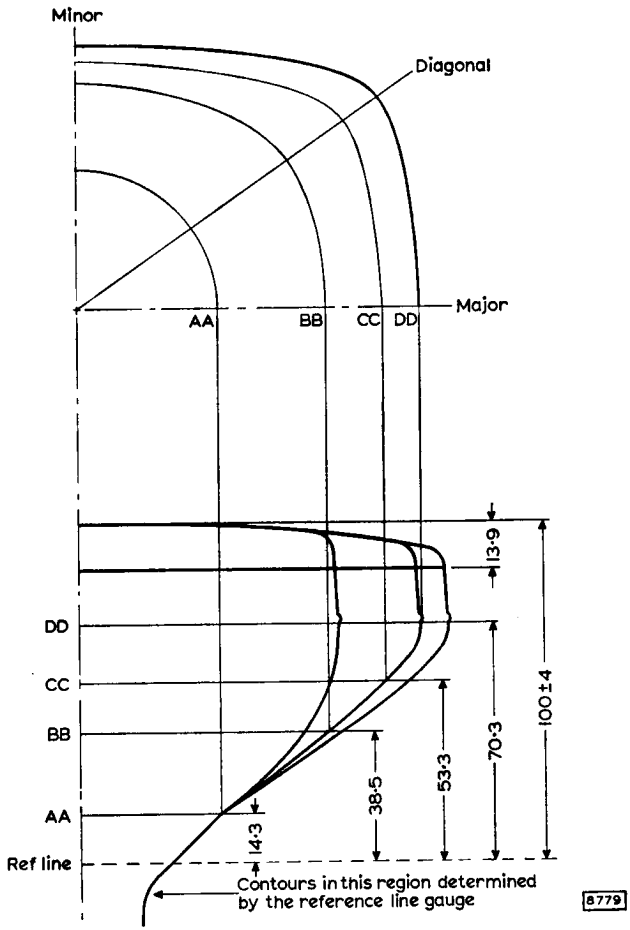
9074

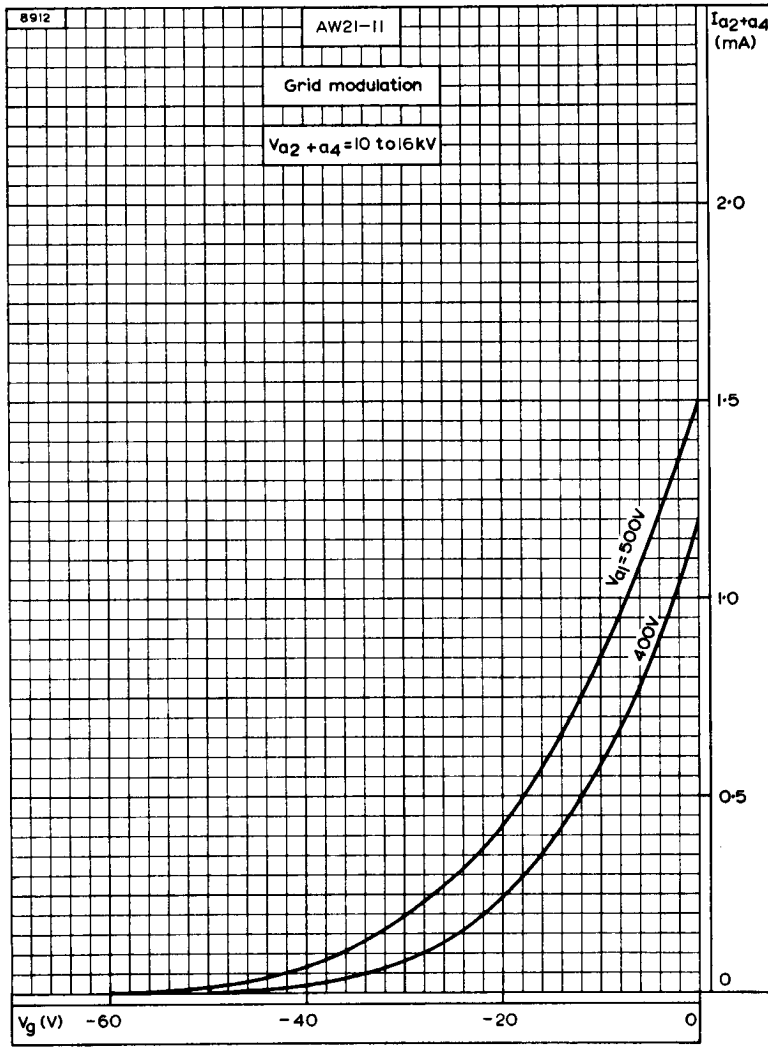


All dimensions in mm

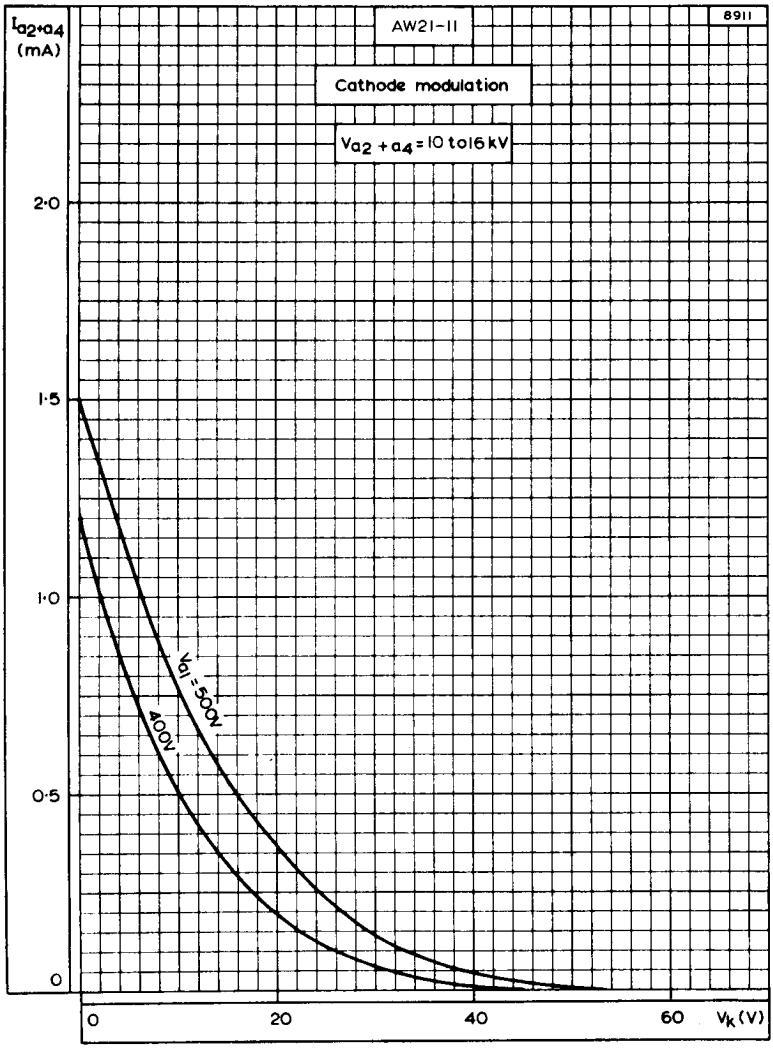
6343

Section	Nominal height above reference line (mm)	Major (mm)	Minor (mm)	Diagonal (mm)
AA	14·3	Circle 87·4 mm dia		
BB	38·5	151	139	158
CC	53·3	185	154	198
DD	70·3	206	160	221

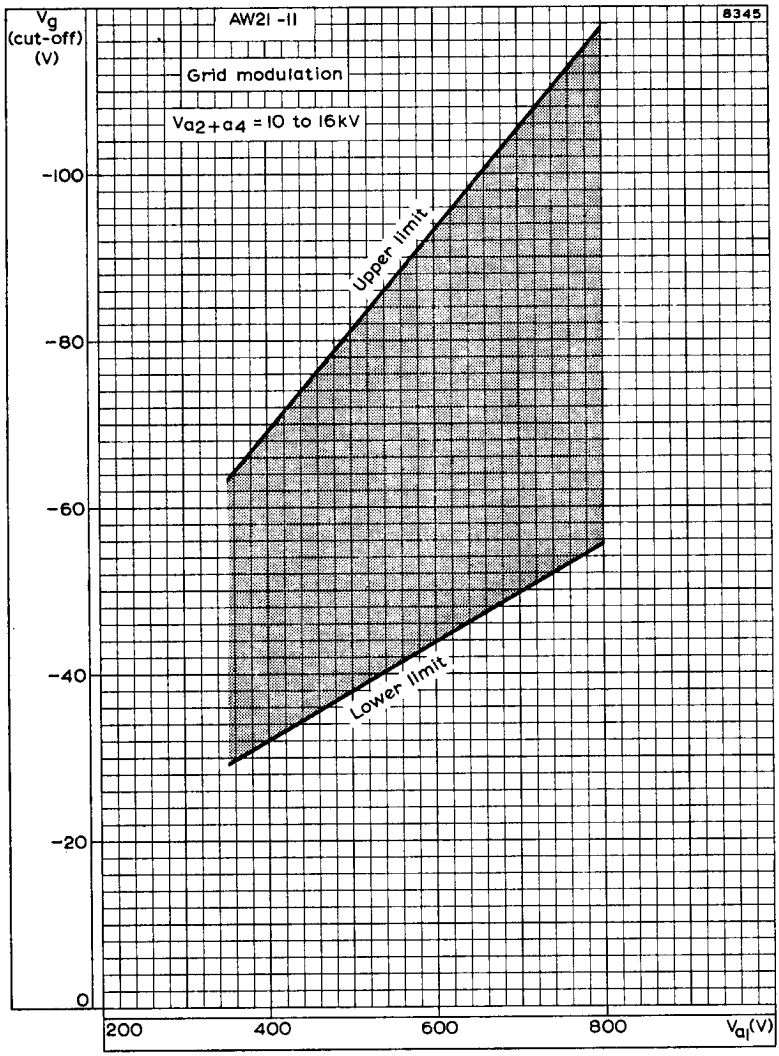




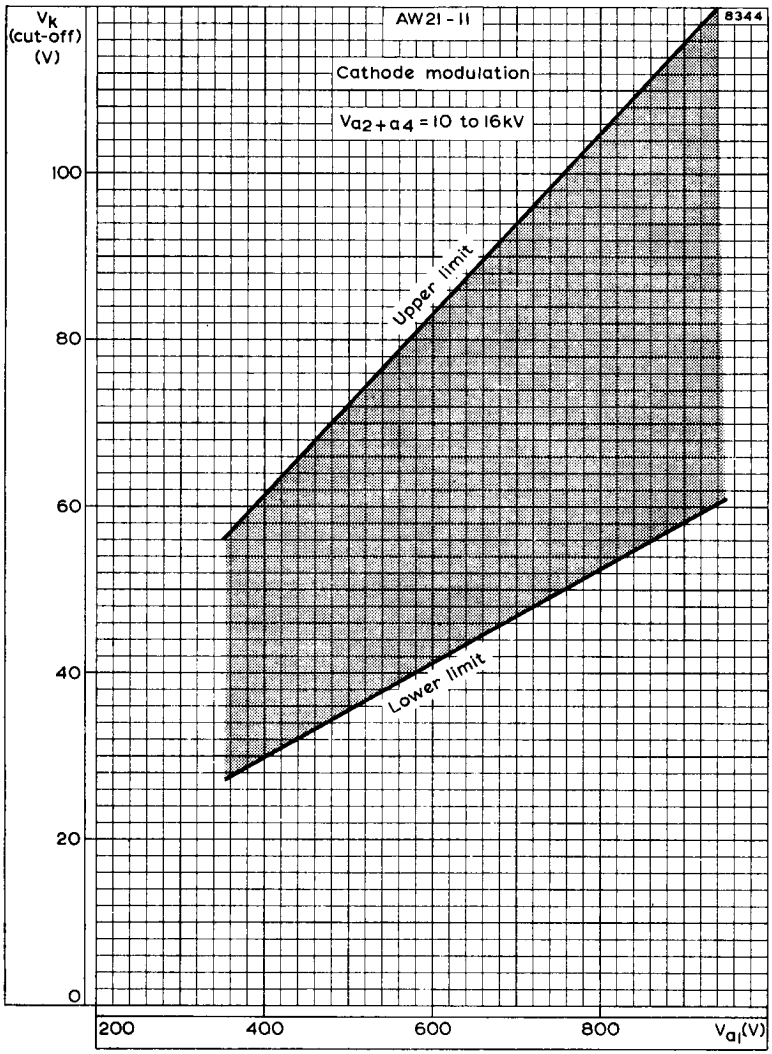
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.
GRID MODULATION



FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION



LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES OF 350 TO 800V. GRID MODULATION



LIMITS OF CATHODE-TO-GRID VOLTAGE FOR FIRST ANODE VOLTAGES OF 350 TO 950V. CATHODE MODULATION

TELEVISION MONITOR TUBE

AW22-10

Direct viewing television tube with 9-in. diameter metal-backed screen, magnetic deflection and low voltage electrostatic focusing lens. Primarily intended for use as a television studio monitor tube.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES, included in this volume of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

Note (applies to series operation only). The surge heater voltage must not exceed $9.5V_{r.m.s}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

CAPACITANCES

C_{g-all}	<8.0	pF
C_{k-all}	<8.0	pF
$C_{a_{2+a_4}-M}$	700	pF

SCREEN

Metal-backed		
Fluorescent colour	white	
Useful screen diameter	200	mm

FOCUSING

Low voltage electrostatic

DEFLECTION

Double magnetic

MOUNTING POSITION

Any, except vertical with the screen downward and the axis of the tube making an angle of less than 20° with the vertical.
The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely.

TYPICAL OPERATING CONDITIONS

$V_{a_{2+a_4}}$	12	kV
V_{a_1}	300	V
**V_{a_3} (focusing electrode)	−200 to +200	V
I_{a_3}	−15 to +15	μA
V_g (for cut-off)	−30 to −70	V

**With the small change in focus spot size with variation of focus voltage the limit of −200 to +200V is such that an acceptable focus quality is obtained within this range. If it is required to pass through the point of focus a voltage of at least −300 to +300V will be required.

AW22-10

TELEVISON MONITOR TUBE

Direct viewing television tube with 9-in. diameter metal-backed screen, magnetic deflection and low voltage electrostatic focusing lens. Primarily intended for use as a television studio monitor tube.

LIMITING VALUES (absolute ratings)

‡$V_{a_{2+a_4}}$ max.	14	kV
$V_{a_{2+a_4}}$ min.	8.0	kV
+V_{a_3} max.	500	V
−V_{a_3} max.	500	V
V_{a_1} max.	500	V
V_{a_1} min.	200	V
*−V_g max.	200	V
−V_g min.	1.0	V
†V_{h-k} max. (cathode negative)	125	V
††$V_{h-k(pk)}$ max. (cathode positive)	410	V
†V_{h-k} max. (cathode positive)	200	V
Z_{g-k} max. (f=50c/s)	500	kΩ
R_{g-k} max.	1.5	MΩ
R_{h-k} max.	See note §	
Max. $_{a_1}$ supply source impedance	1.5	MΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

‡The product of V_{a_2} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

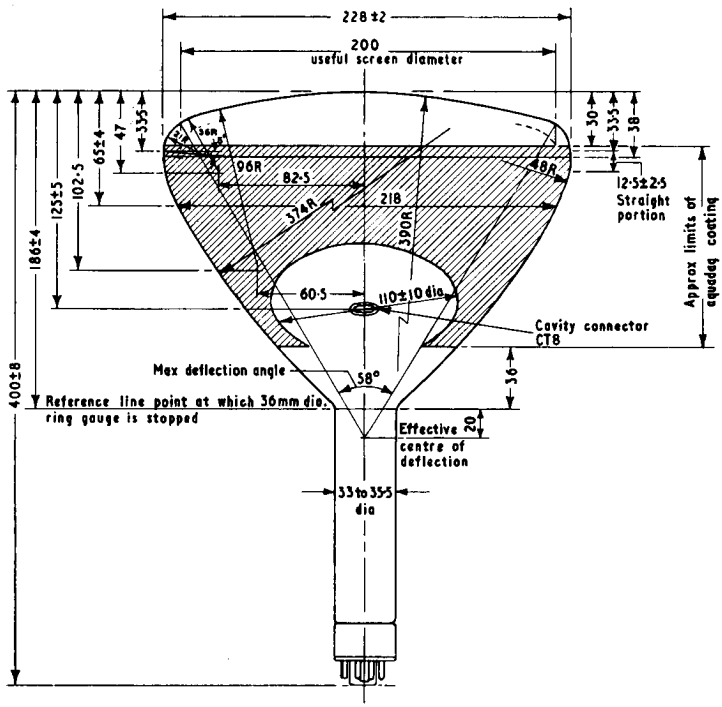
††During a warming-up period not exceeding 45sec.

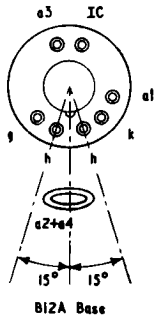
§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ, where Z_k is the 50c/s impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1MΩ.

TELEVISION MONITOR TUBE

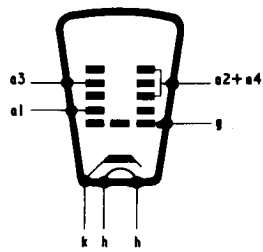
AW22-10

Direct viewing television tube with 9-in. diameter metal-backed screen, magnetic deflection and low voltage electrostatic focusing lens. Primarily intended for use as a television studio monitor tube.





B12A Base



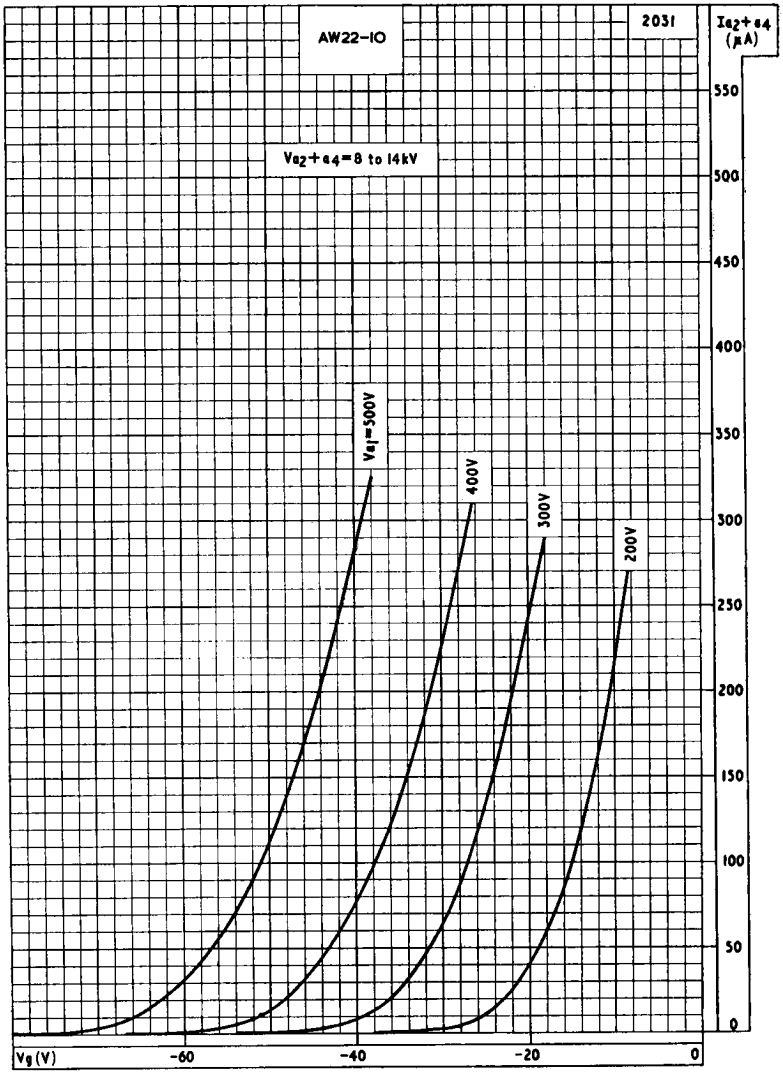
2030

All dimensions in mm

AW22-10

TELEVISION MONITOR TUBE

Direct viewing television tube with 9-in. diameter metal-backed screen, magnetic deflection and low voltage electrostatic focusing lens. Primarily intended for use as a television studio monitor tube.

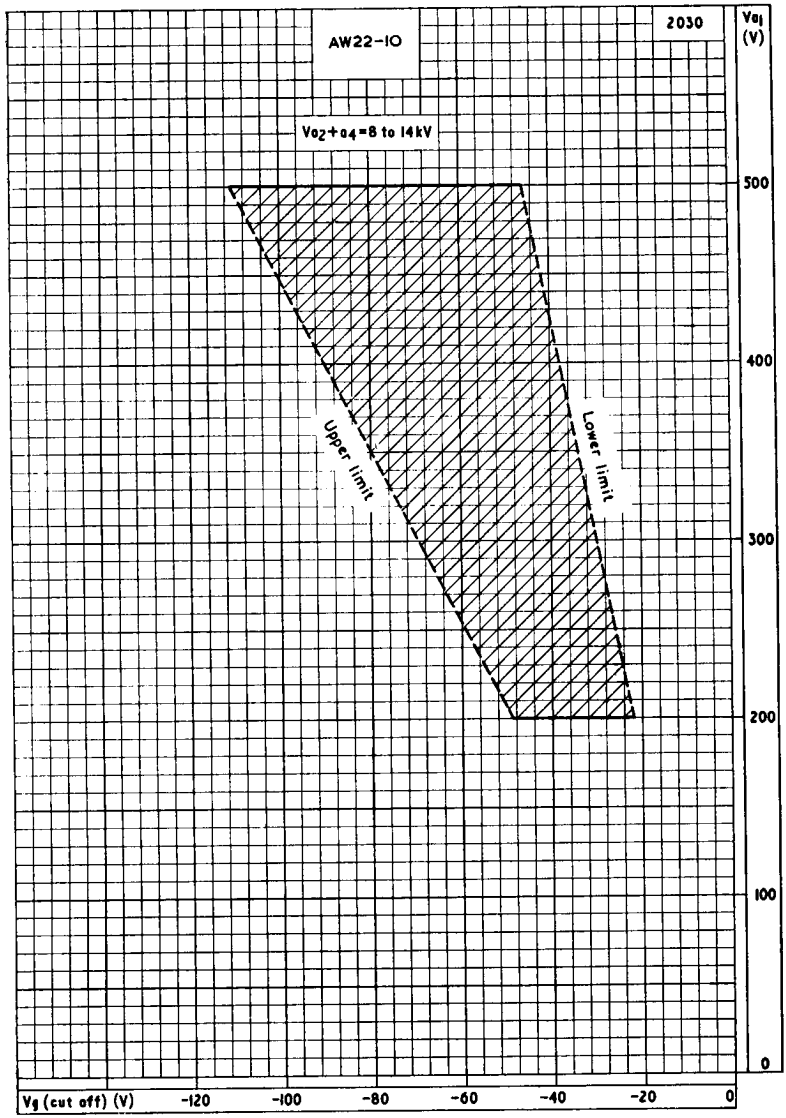


FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

TELEVISION MONITOR TUBE

AW22-10

Direct viewing television tube with 9-in. diameter metal-backed screen, magnetic deflection and low voltage electrostatic focusing lens. Primarily intended for use as a television studio monitor tube.

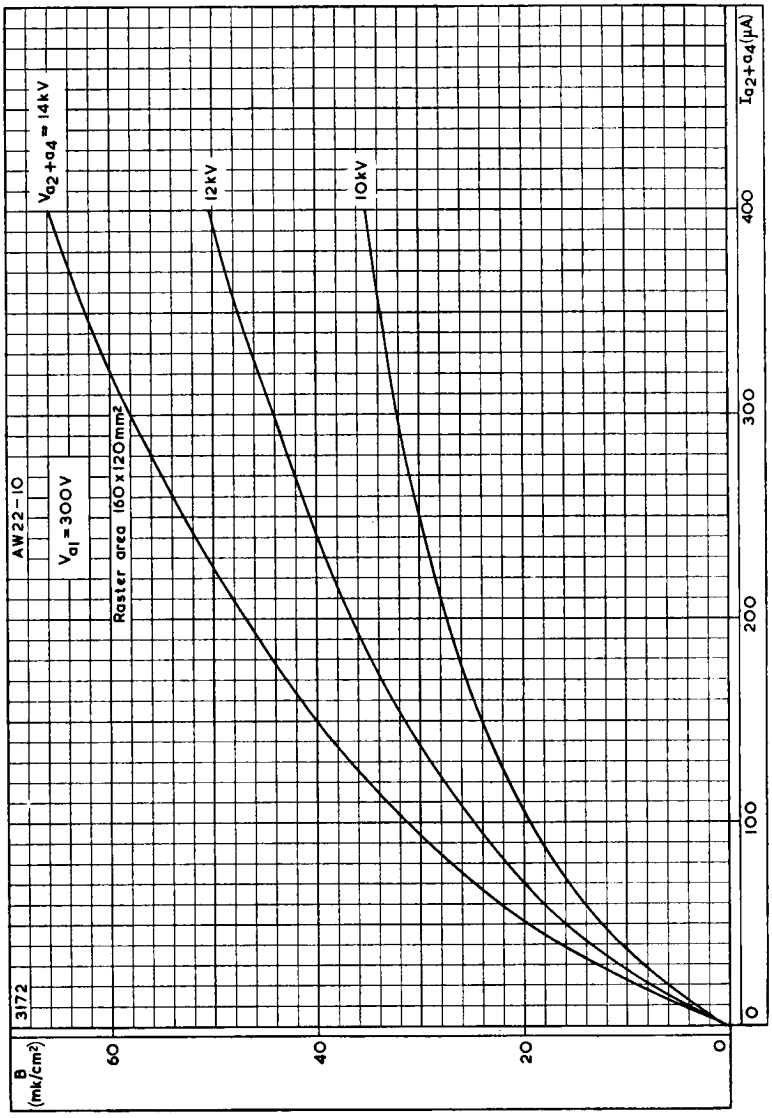


LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES FROM 200 to 500V

AW22-10

TELEVISION MONITOR TUBE

Direct viewing television tube with 9-in. diameter metal-backed screen, magnetic deflection and low voltage electrostatic focusing lens. Primarily intended for use as a television studio monitor tube.



LIGHT OUTPUT PLOTTED AGAINST FINAL ANODE CURRENT
(1mk/cm² = 2.9 e.f.c. = 2.9 ft-lambert)

TELEVISION TUBE

AW36-20Z

Direct viewing television tube with 14-in. diagonal rectangular metal-backed grey-glass screen. This tube has electrostatic focusing and 70° magnetic deflection.

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note (applies to series operation only).—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

CAPACITANCES

C_{g-all}	<8.0	pF
C_{k-all}	<6.0	pF
$C_{a3+a5-M}$	900	pF

SCREEN

Fluorescent colour	white	
Light transmission	70	%
Useful screen area	See drawing on p. 3	

FOCUSING

Electrostatic

The range of focus voltage shown under "typical operating conditions" results in optimum focus at the centre of the screen. An increase in focus voltage of 100 to 200V in the positive direction will give a greater uniformity of focus over the whole screen.

DEFLECTION

Double magnetic

REFERENCE LINE

See 'General operational recommendations—cathode ray tubes'

ION TRAP

This tube does not use an external ion trap magnet. When used as a replacement for ion trap types, the ion trap magnet and any lead connected to it should be discarded.

RASTER CENTRING

See note under this heading in 'General operational recommendations—cathode ray tubes'.

Centring magnet field intensity	0 to 10	G
Maximum distance of centre of centring field from reference line	70	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness or shading of the raster occurs.

MOUNTING POSITION

Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 55mm which is centred upon the perpendicular from the centre of the face.

TYPICAL OPERATING CONDITIONS

$V_{a_3+a_5}$	12	kV
$V_{a_2+a_4}$ (focus electrode)	−55 to +145	V
V_{a_1}	300	V
V_g for cut-off	−40 to −80	V

LIMITING VALUES (design centre ratings)

**$V_{a_3+a_5}$ max.	14	kV
$V_{a_3+a_5}$ min.	9.0	kV
+$V_{a_2+a_4}$ max.	500	V
−$V_{a_2+a_4}$ max.	500	V
V_{a_1} max.	410	V
V_{a_1} min.	200	V
*−V_g max.	150	V
±$I_{a_2+a_4}$ max.	15	μA
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
‡$V_{h-k(pk)}$ max. (cathode positive)	410	V
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

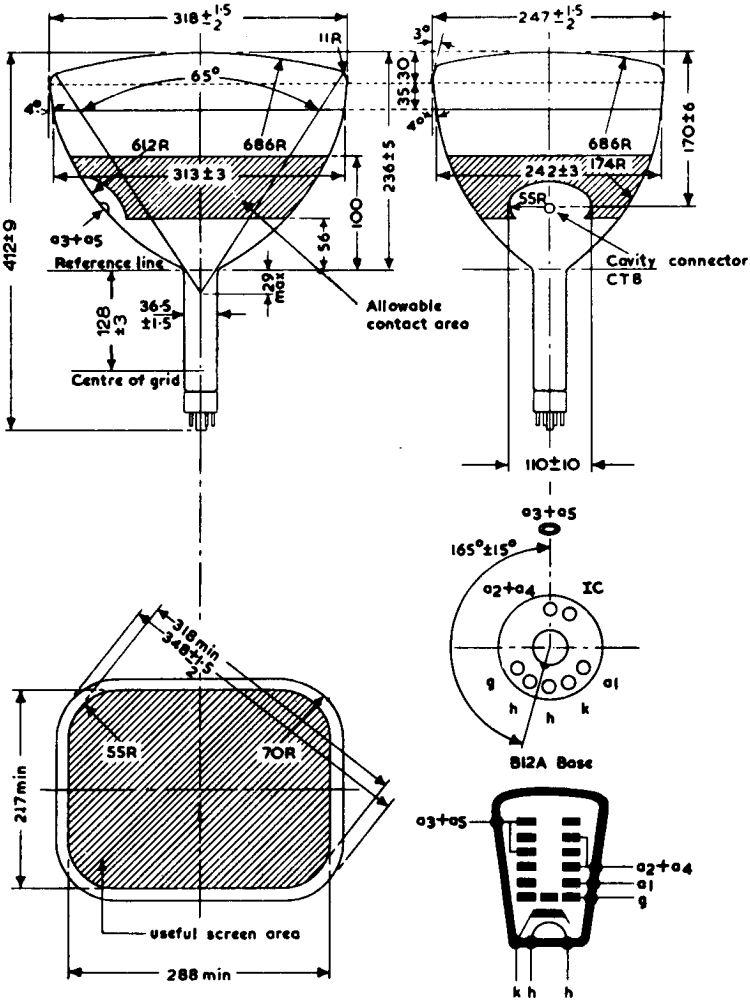
**The product of $V_{a_3+a_5}$ and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($< 20V_{r.m.s.}$).

‡During a warming-up period not exceeding 45s.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50Hz impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1.0MΩ.

AW36-20Z



All dimensions in mm

The indicated radius of faceplate curvature is not an exact but an average value.

TELEVISION TUBE

AW43-80Z

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. This tube has electrostatic focusing and 90° magnetic deflection.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

Note—(applies to series operation only). The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

CAPACITANCES

C_{g-all}	7.0	pF
C_{k-all}	4.0	pF
$C_{a3+a5-M}$	1200	pF

SCREEN

Metal-backed		
Fluorescent colour	white	
Light transmission	70	%
Useful screen area	See drawing on p. 3	

FOCUSING

Electrostatic

The range of focus voltage shown under "typical operating conditions" results in optimum focus at the centre of the screen. An increase in focus voltage of 100 to 200V in the positive direction will give a greater uniformity of focus over the whole screen.

DEFLECTION

Double magnetic

ION TRAP

This tube does not use an external ion trap magnet. When used as a replacement for ion trap types, the ion trap magnet and any lead connected to it should be discarded.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes.'

RASTER CENTRING

See notes under this heading in 'General operational recommendations—cathode ray tubes.'

Centring magnet field intensity	0 to 10	G
Maximum distance of centre of centring field from reference line	75	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness or shading of the raster occurs.

MOUNTING POSITION

Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 55mm which is centred upon the perpendicular from the centre of the face.

TYPICAL OPERATING CONDITIONS

V_{a3+a5}	16	kV
V_{a2+a4} (focus electrode)	0 to +210	V
V_{a1}	300	V
V_g for cut-off	−40 to −80	V

LIMITING VALUES (design centre ratings)

**V_{a3+a5} max.	16	kV
V_{a3+a5} min.	12	kV
+V_{a2+a4} max.	500	V
−V_{a2+a4} max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
*−V_g max.	150	V
±I_{a2+a4} max.	10	μA
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
‡$V_{h-k(pk)}$ max. (cathode positive)	410	V
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50Hz)	500	kΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

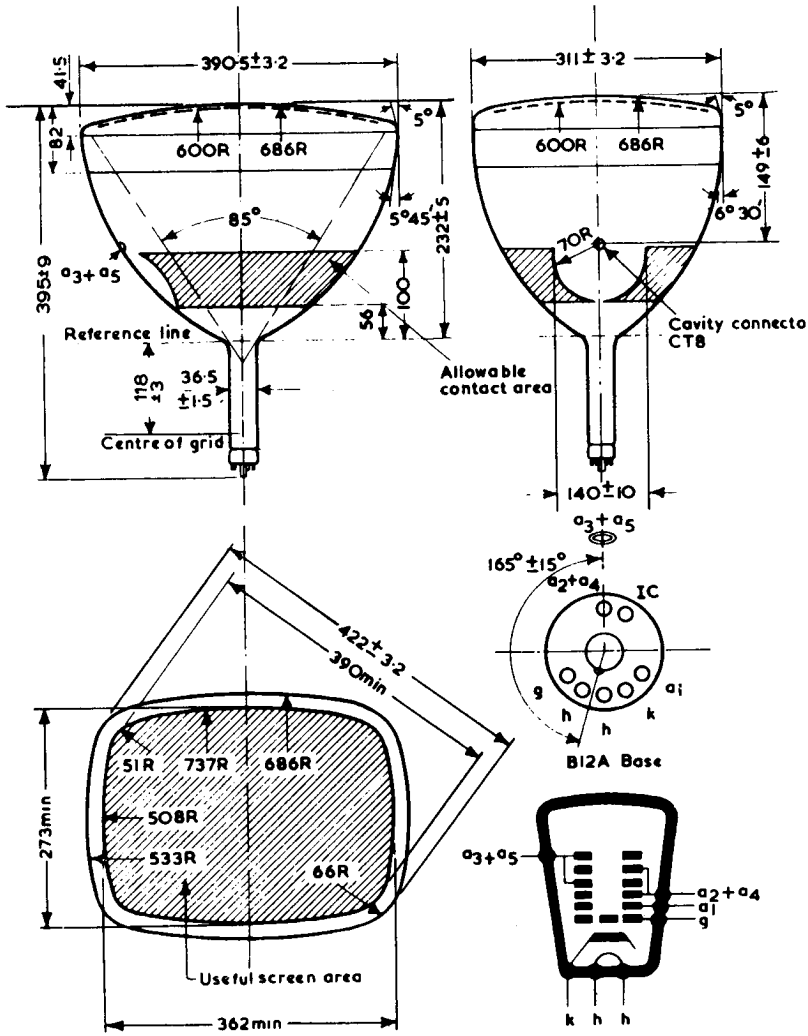
**The product of V_{a3+a5} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

‡During a warming-up period not exceeding 45s.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50Hz impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1.0MΩ.

AW43-80Z



All dimensions in mm

The indicated radius of faceplate curvature is not an exact but an average value.

TELEVISION TUBE

AW47-90

Direct viewing television tube with 19in. diagonal metal-backed rectangular grey glass screen. This tube is electrostatically focused and has a 110° deflection angle. An ion trap magnet is not required.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES, which precede this section of the handbook.

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes.'

Note—(applies to series operation only). The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be earthed and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

CAPACITANCES

C_{g-all}	6.0	pF
C_{k-all}	4.0	pF
$C_{a2+a4-M}$	1150	pF

SCREEN

Metal backed		
Fluorescent colour	white	
Light transmission	75	%
Useful screen area	See drawing on pages D4 and D7	

FOCUSING

Electrostatic

The range of focus voltage shown in 'Typical operating conditions' results in optimum overall focus at a beam current of 100μA.

DEFLECTION

Double magnetic

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with JETEC gauge 126.

MAINTENANCE TYPE

AW47-90

TELEVISION TUBE

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations—cathode ray tubes.'

RASTER CENTRING

See notes under this heading in 'General operational recommendations—cathode ray tubes.'

Centring magnet field intensity	0 to 10	G
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness or shading of the raster occurs.

MOUNTING POSITION

Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 45mm which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in an equipment.

TYPICAL OPERATING CONDITIONS

$V_{a2\ a1}$	16	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
†V_g for visual extinction of focused raster	−38 to −94	V
†V_K for visual extinction of focused raster	36 to 78	V

†For grid modulation all voltages are measured with respect to the cathode: for cathode modulation, all voltages are measured with respect to the grid.

LIMITING VALUES (design centre ratings)

‡V_{a2+a4} max.	18	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
**$-v_{g(pk)}$ max.	400	V
*$-V_g$ max.	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	15	μA
†V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

‡Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

**Maximum pulse duration 22% of a cycle with a maximum of 1.5ms.

*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V and at this voltage the grid current may be expected to be approximately 2mA.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).
During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WEIGHT

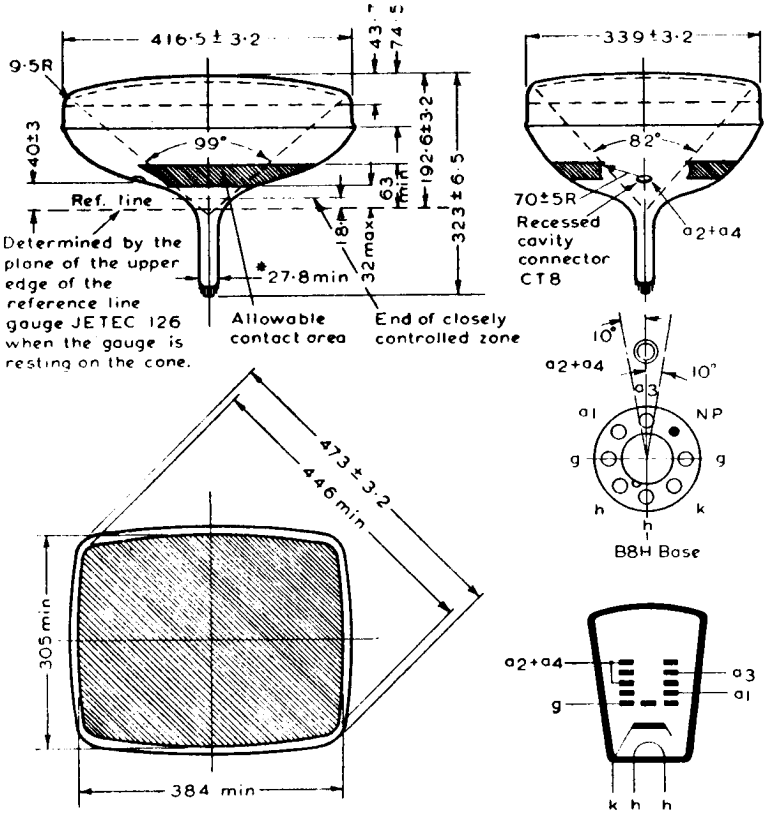
Tube alone	7 15	kg lb

WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 16 kV.

AW47-90

TELEVISION TUBE



All dimensions in mm

*The maximum value is determined by the reference line gauge

7646

TELEVISION TUBE

Direct viewing television tube with 21in. diagonal metal-backed rectangular grey glass screen. This tube is electrostatically focused and has a 110° deflection angle. An ion trap magnet is not required.

AW53-89

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES, which precede this section of the handbook.

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes'

Note—(applies to series operation only). The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be earthed, and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

CAPACITANCES

C_{g-all}	7.0	pF
C_{k-all}	5.0	pF
C_{a3-M}	1850	pF

SCREEN

Metal backed		
Fluorescent colour	white	
Light transmission (approx.)	75	%
Useful screen area	see drawing on page D4	

FOCUSING

Electrostatic

The range of focus voltage shown in the curves results in optimum centre focus at a beam current of 100μA.

DEFLECTION

Double magnetic
For timebase designs the following spreads in the useful screen area should be considered

	Min.	*Max.*	
Picture height	382.5	388	mm
Picture width	484	490	mm
Picture diagonal	514.5	520	mm

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with JETEC gauge 126.

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations—cathode ray tubes'.

RASTER CENTRING

See notes under this heading in 'General operational recommendations—cathode ray tubes'.

Centring magnet field intensity	0 to 15	G
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness or shading of the raster occurs.

MOUNTING POSITION

Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle having a diameter of 40mm which is centred upon the perpendicular from the centre of the face.
This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.
It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in an equipment.

OPERATING CONDITIONS

	**Grid modulation*	**Cathode modulation*	
V_{a3}	16	16	kV
V_{a2} (focus electrode control range)	0 to 400	40 to 440	V
V_{a1}	500	540	V
V_g for visual extinction of focused raster	−35 to −75	—	V
V_k for visual extinction of focused raster	—	35 to 69	V

*For grid modulation, all voltages are measured with respect to the cathode; for cathode modulation; all voltages are measured with respect to the grid.

LIMITING VALUES (design centre ratings)

V_{a3} max.	16	kV
V_{a3} min.	13	kV
$+V_{a2}$ max.	750	V
$-V_{a2}$ max.	500	V
V_{a1} max.	700	V
V_{a1} min.	500	V
$-v_{g(pk)}$ max.	400	V
$-V_g$ max.	150	V
$\pm I_{a2}$ max.	15	μA
$\pm I_{a1}$ max.	5.0	μA
†V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f=50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50c/s)	500	kΩ

*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V and at this voltage the grid current may be expected to be approximately 2mA.

**Maximum pulse duration 22% of a cycle with a maximum of 1.5ms.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

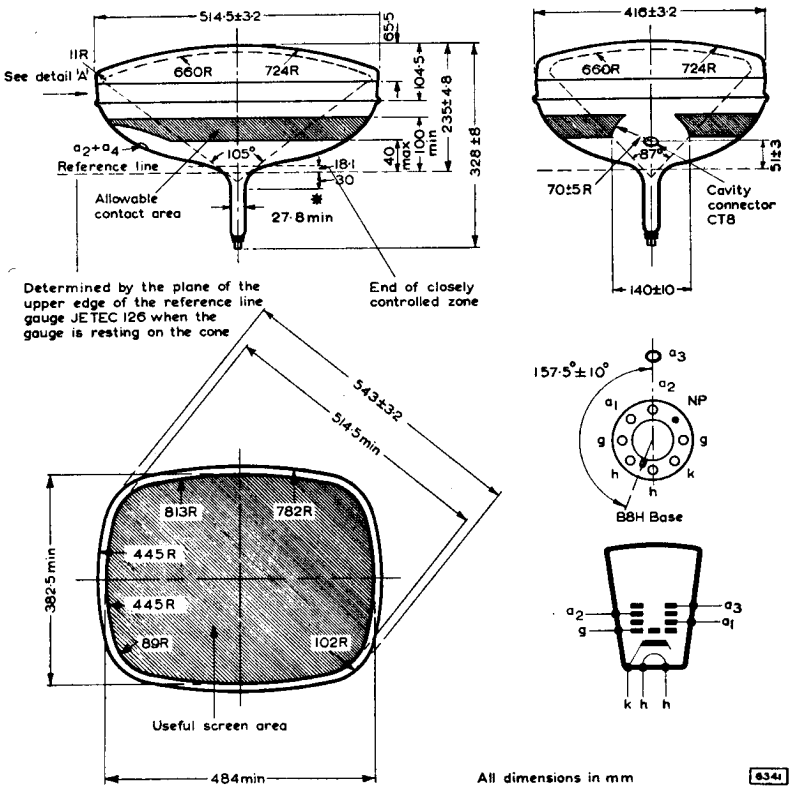
During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WEIGHT

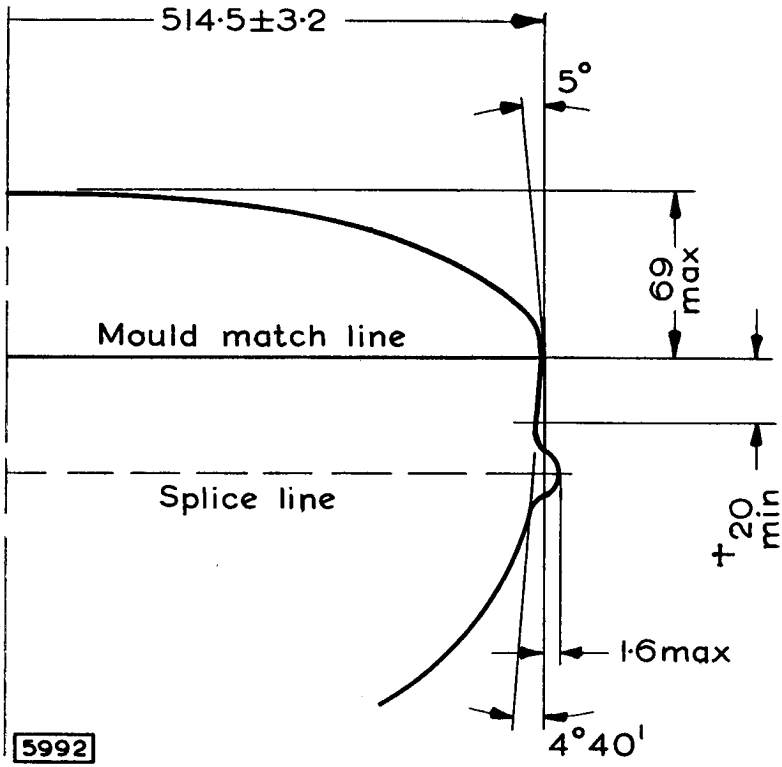
Tube alone	10 22	kg lb

AW53-89

TELEVISION TUBE



*The maximum value is determined by the reference line gauge.



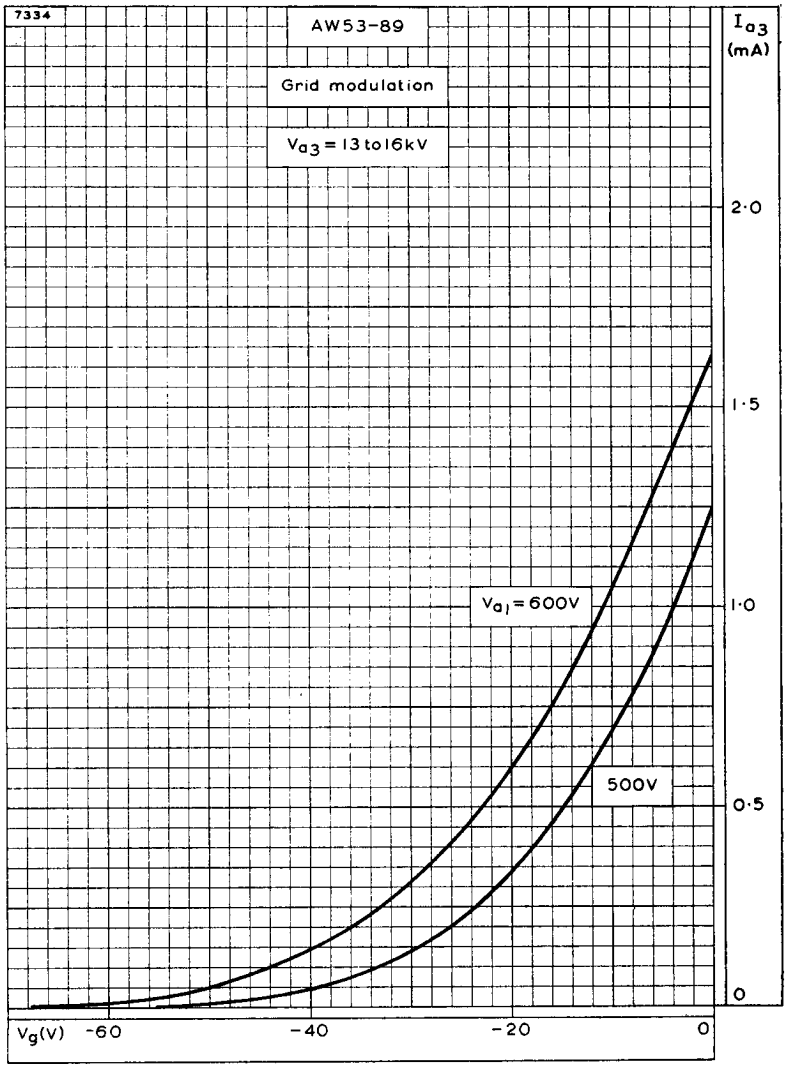
† Undisturbed area between mould match line and splice line.

Detail 'A'

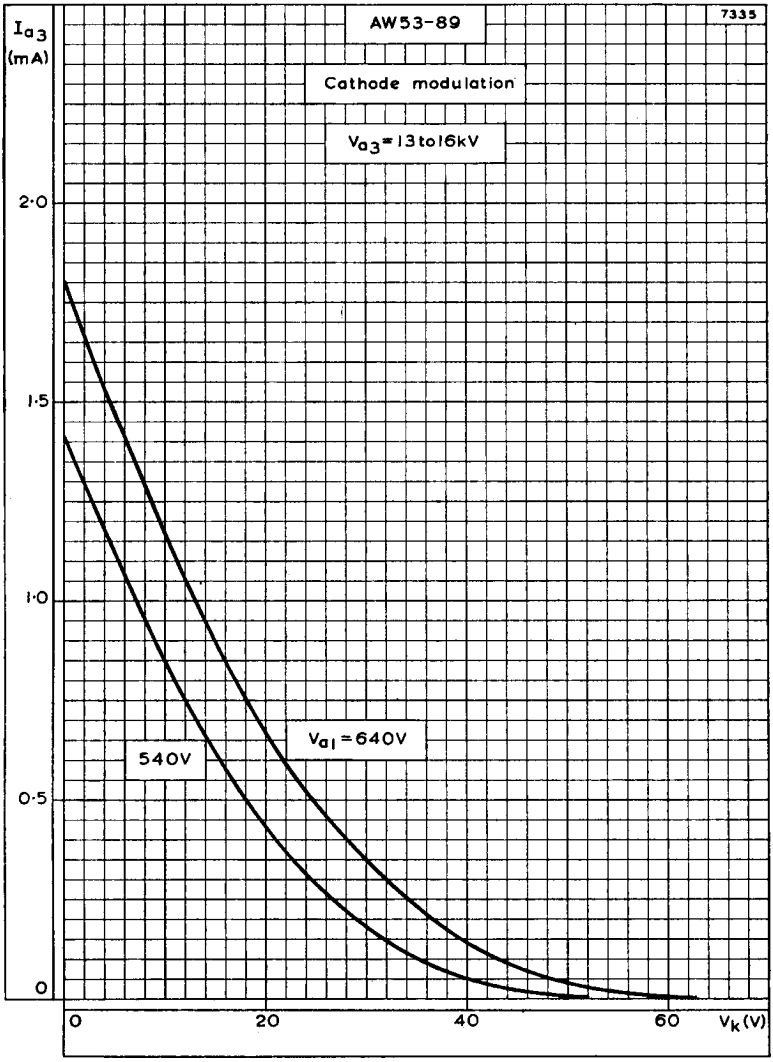
The bulge at the splice line seal may increase the indicated maximum value for envelope width, diagonal and height by not more than 3.2mm, but at any point around the seal the bulge will not protrude more than 1.6mm beyond the envelope surface at the mould match line.

The undisturbed area between mould match line and splice line is 20mm minimum. This should be the width of the tube support band.

AW53-89

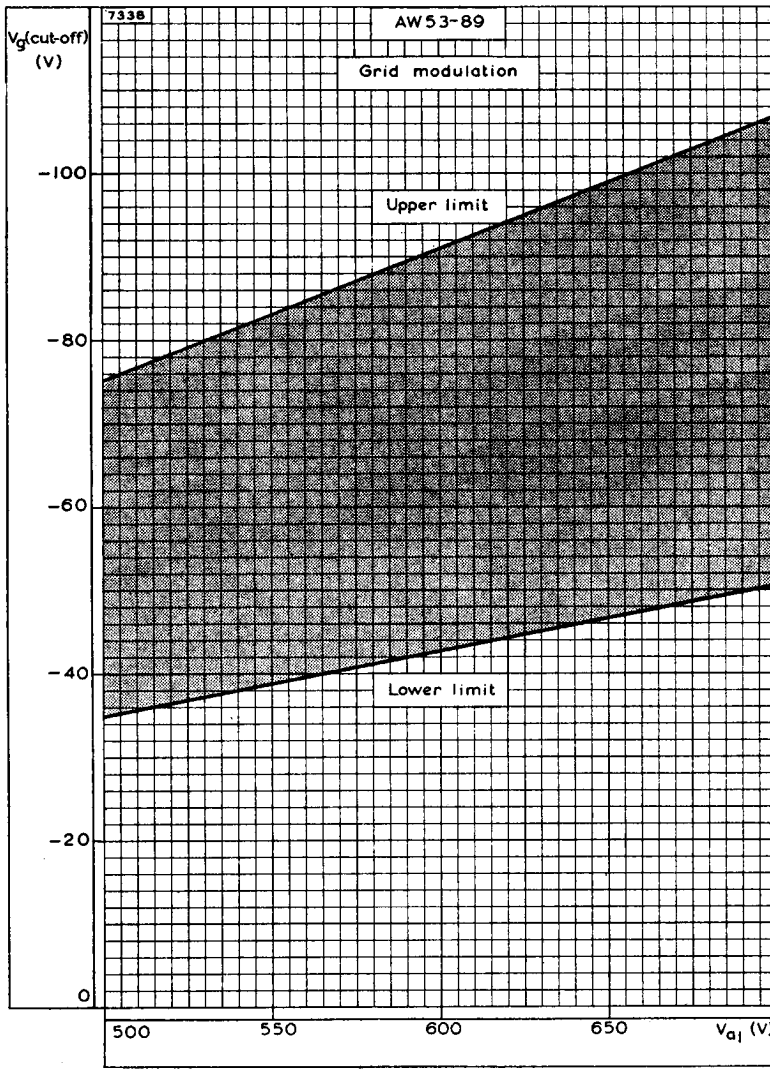


FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE. GRID MODULATION

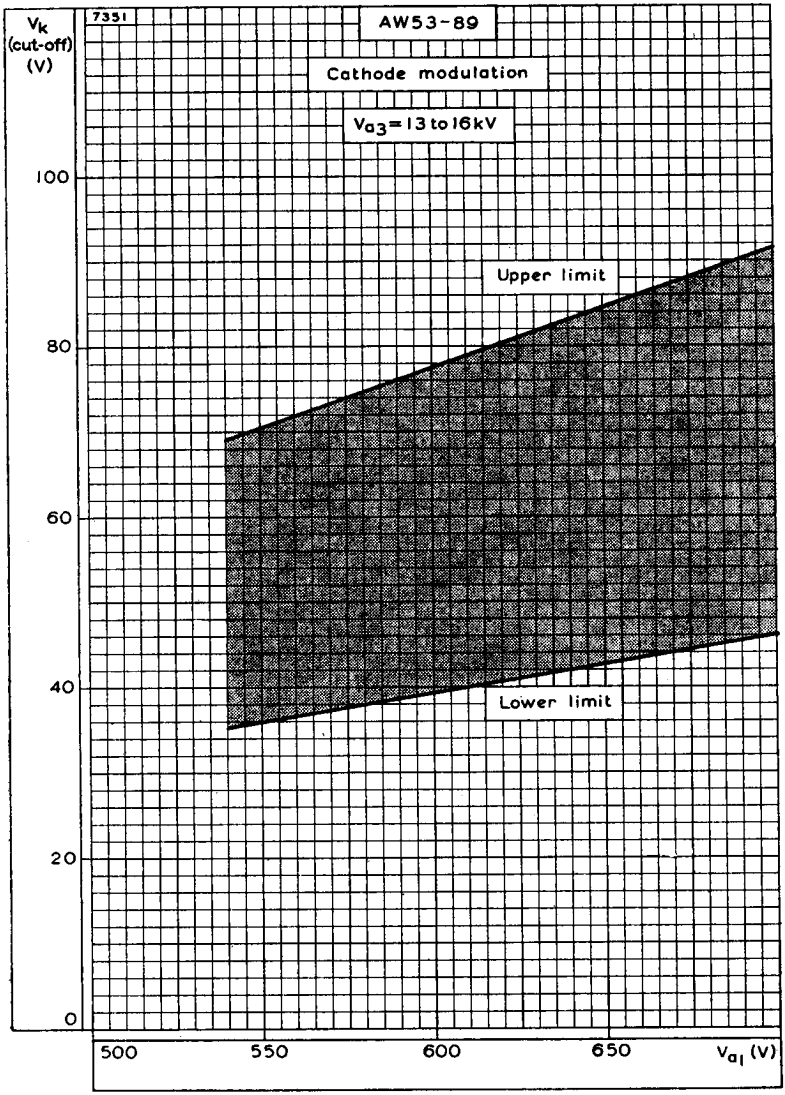


FINAL ANODE CURRENT PLOTTED AGAINST CATHODE-TO-GRID VOLTAGE. CATHODE MODULATION

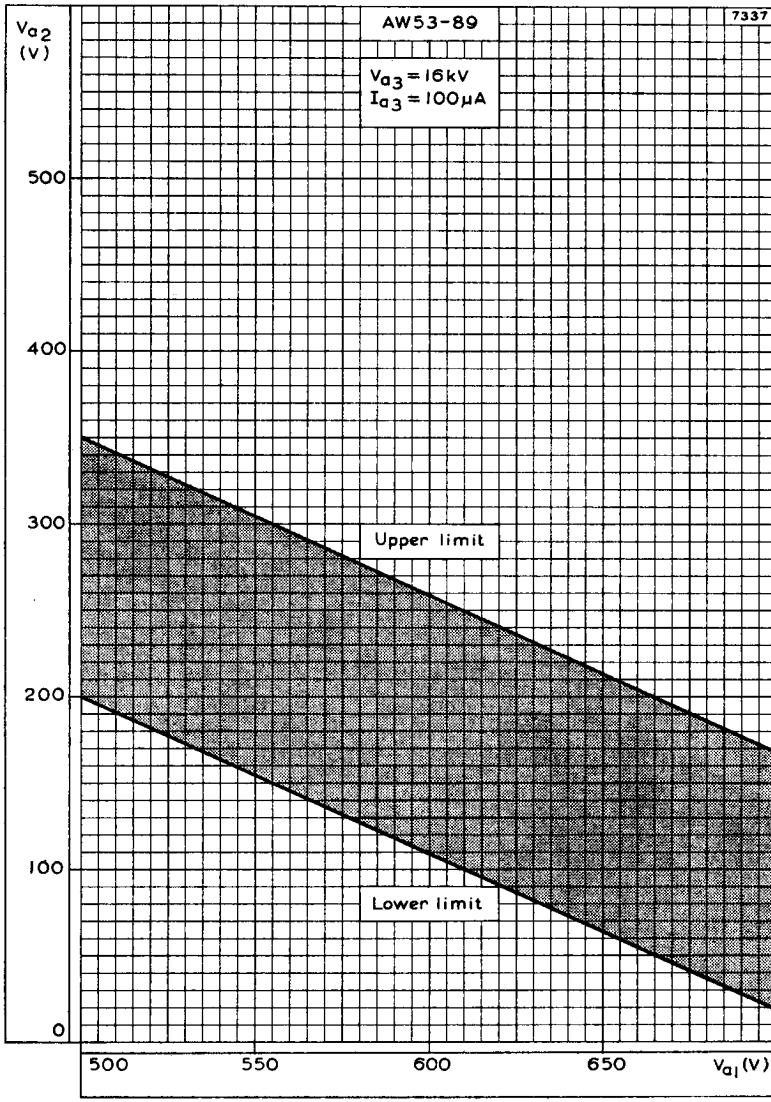
AW53-89



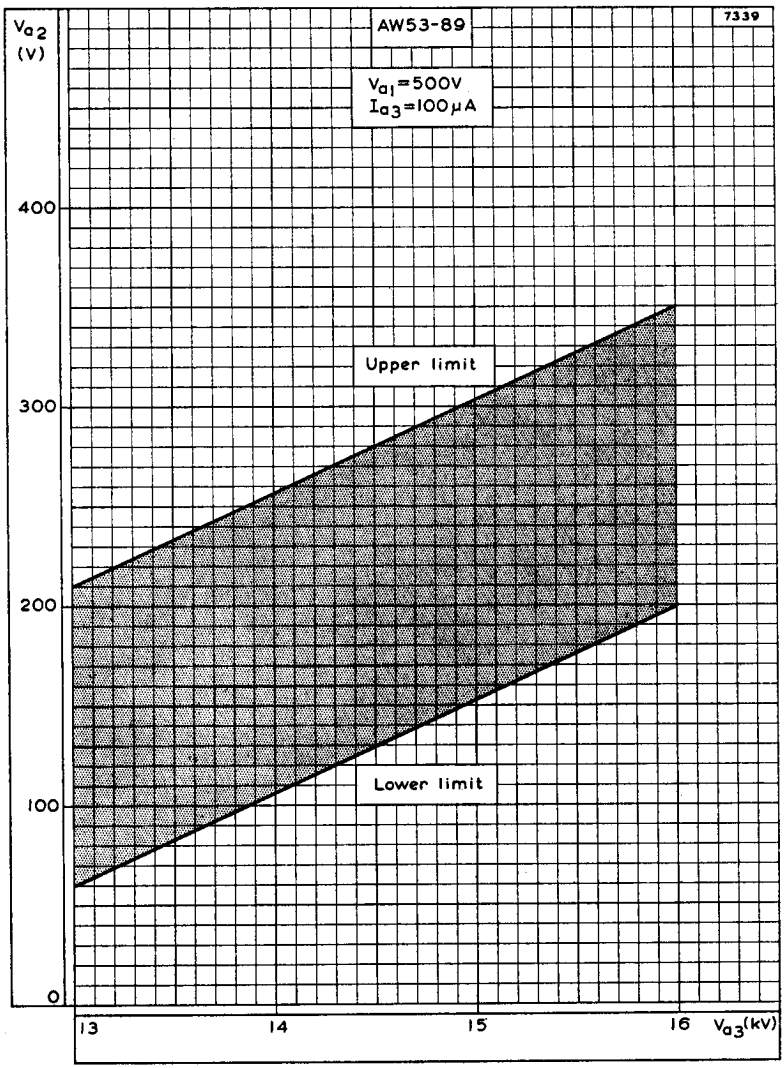
LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES OF 500V to 700V. GRID MODULATION



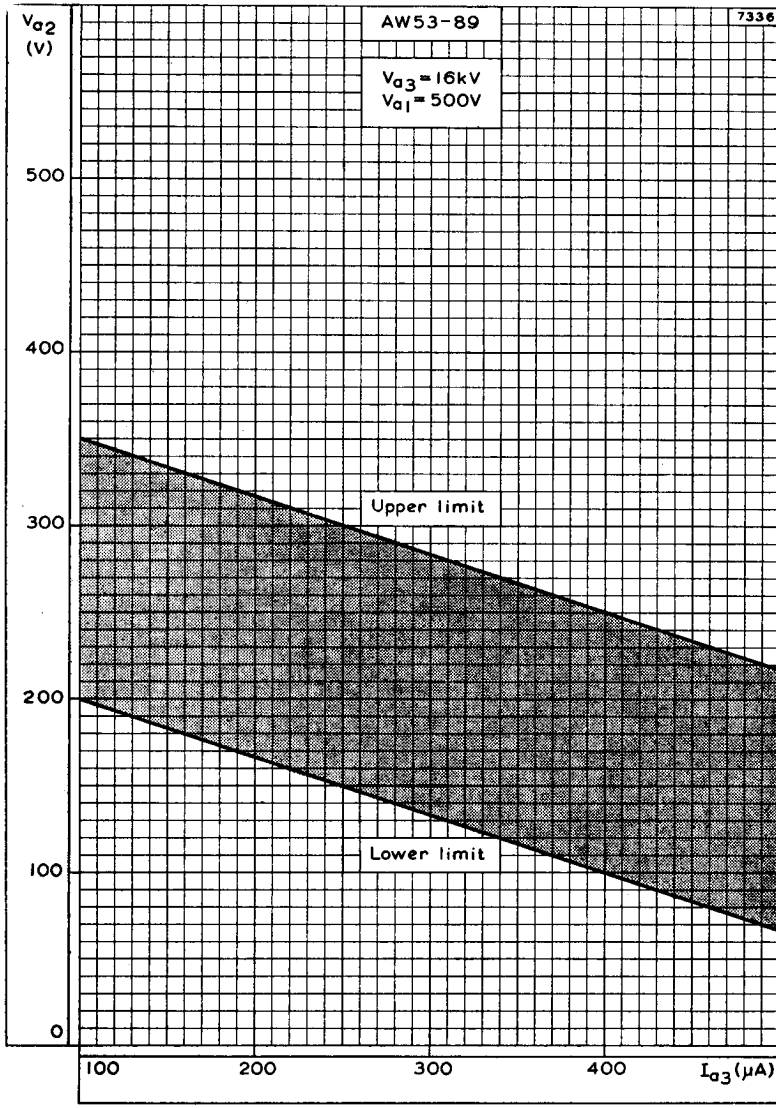
LIMITS OF CATHODE-TO-GRID VOLTAGE FOR FIRST ANODE VOLTAGES OF 540V to 700V. CATHODE MODULATION



RANGE OF FOCUS VOLTAGE PLOTTED AGAINST FIRST ANODE VOLTAGE



RANGE OF FOCUS VOLTAGE PLOTTED AGAINST FINAL ANODE VOLTAGE



RANGE OF FOCUS VOLTAGE PLOTTED AGAINST FINAL ANODE CURRENT

Mullard
DIRECTLY HEATED RECTIFIER

AZ1

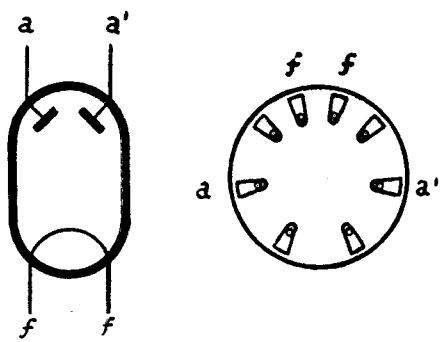
Filament

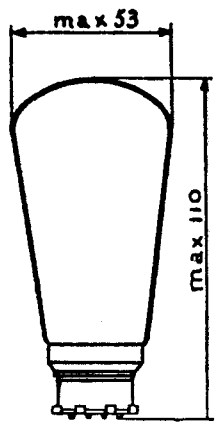
Vf	=	4.0 V
If	=	1.1 V

Limiting Values

Va max	.....	2 x 500 V
Ia max	.....	60 mA
Va max	.....	2 x 400 V
Ia max	.....	75 mA
Va max	.....	2 x 300 V
Ia max	.....	100 mA

Arrangement of electrodes and base connections.



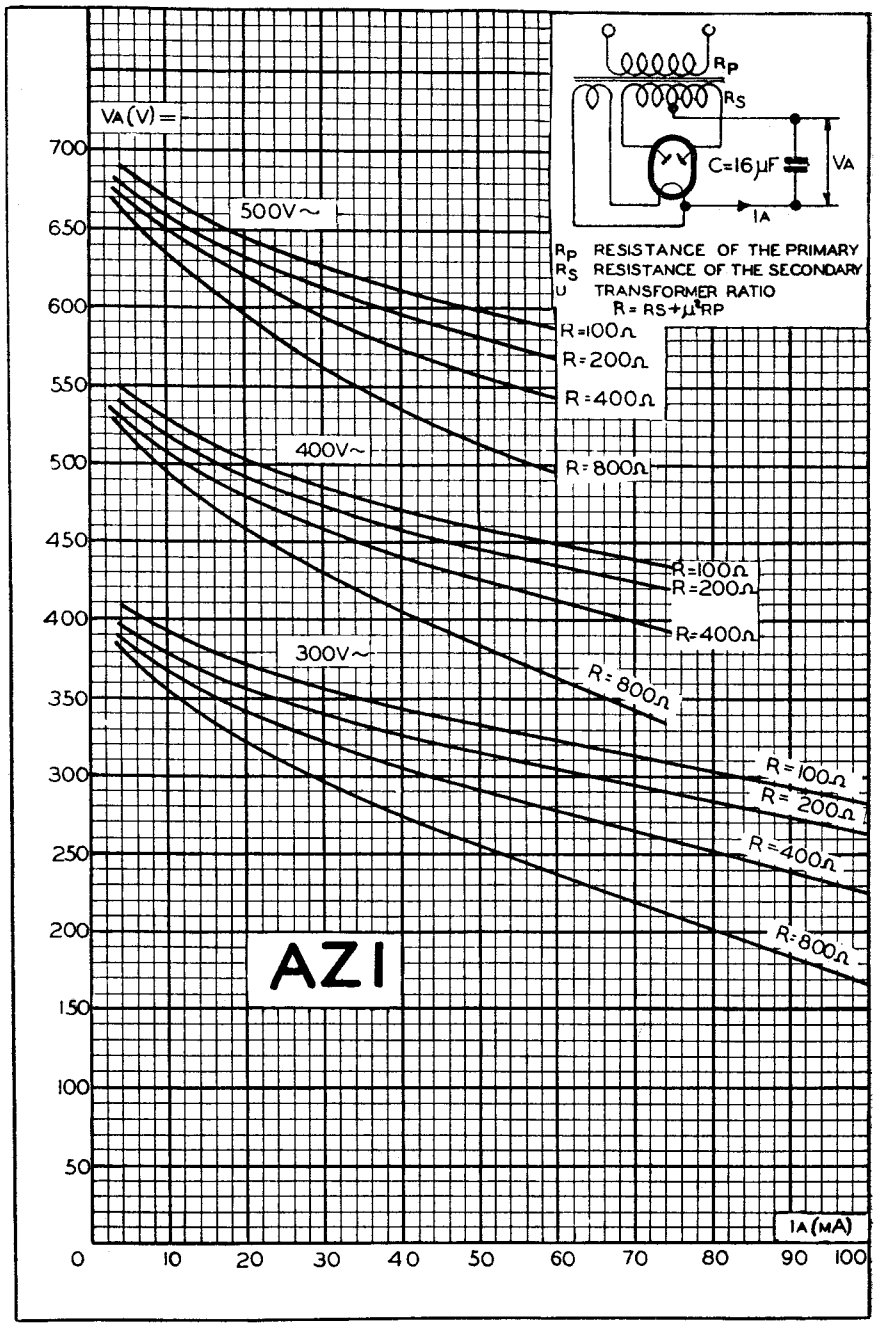


AZ1

AZ1

Mullard

DIRECTLY HEATED RECTIFIER



BACKWARD-WAVE OSCILLATOR

BA9-20

Frequency: *'X' band, electronically tunable.*
Power output: *20mW minimum.*
Construction: *Demountable, prefocused capsule, with d.c. voltage isolation between the output connection and delay structure.*
Modulation: *Amplitude, pulse or frequency.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES: INTRODUCTION and BACKWARD-WAVE OSCILLATORS which precede this section of the handbook.

CHARACTERISTICS

	Min.	*Max.*	
Frequency electronically tunable over the range	7.5	12	Gc/s
Delay structure voltage			
f = 7.5Gc/s	380	410	V
f = 11.5Gc/s	1.3	1.5	kV
Sensitivity over frequency range	2.0	10	Mc/s per V
Power output over frequency range	20	—	mW
Grid voltage for maximum output	—	0	V
for zero output	—	−100	V
Signal to noise ratio per c/s of bandwidth	160	—	dB per c/s

CATHODE

Indirectly heated

V_h	6.3	V
I_h	1.7	A
$I_{h(surge)}$ max.	4.0	A

The cathode must be heated for at least 2 minutes before the application of h.t. voltage.

CAPACITANCES

$C_{h,k\text{-all}}$	< 10	pF
$C_{g\text{-all}}$	< 13	pF
$C_{a\text{-all}}$	< 6.0	pF
$C_{\text{delay structure-all}}$	< 8.0	pF

TYPICAL OPERATION

f	7.5	9.0	11	Gc/s
$V_{\text{delay structure}}$	0.39	0.64	1.2	kV
$I_{\text{delay structure}}$	20	21	22	mA
V_a	150	150	150	V
I_a	4.0	4.0	4.0	mA
V_g	0	0	0	V
P_{out}	30	75	75	mW

OPERATING SEQUENCE

See appropriate section in General operational recommendations – microwave devices: backward-wave oscillators.

BA9-20 BACKWARD-WAVE OSCILLATOR

COOLING

Forced-air.

The cooling air requirements for the tube in the mounts SB–1 and SB–2 are given in the curve on page C3.

When the mount PB–1 is used a minimum flow of cooling air of 3ft³/min. should be directed as shown on the outline drawing on page D3.

T_{mount} max. (at specified point)	120	°C

ABSOLUTE MAXIMUM RATINGS

$V_{delay\ structure}$ max.	1.8	kV
$V_{delay\ structure}$ min.	300	V
$P_{delay\ structure}$ max.	50	W
I_k max.	35	mA
V_a max.	200	V
I_a max.	10	mA
$+V_g$ max.	0	V
$-V_g$ max.	250	V
$v_{h-k(pk)}$ max.	±100	V

MOUNTING POSITION

Any

PHYSICAL DATA

Weight (mount only) PB–1	13	lb
	5.9	kg
SB–1, SB–2	11	lb
	5.0	kg

OUTPUT CONNECTION

Rectangular waveguide WG16 with screwed ring flange 5985–99–0830003.

ACCESSORIES

Permanent magnet mount	PB–1
Mount with aluminium foil solenoid for operation at low ambient temperatures	SB–1
Mount with aluminium foil solenoid for operation at high ambient temperatures	SB–2

SOLENOID OPERATING CONDITIONS

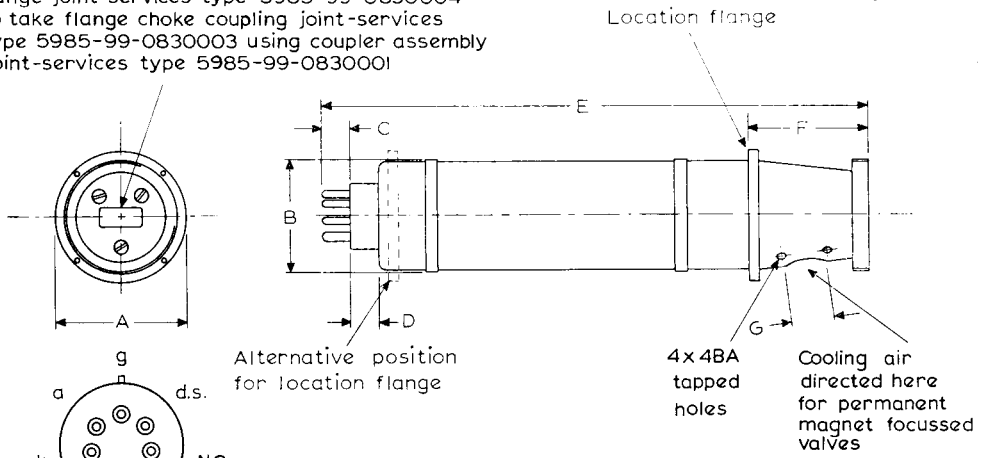
The three types are intended for constant current operation.

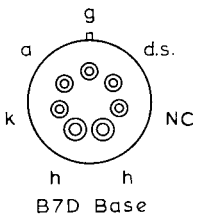
	SB–1	SB–2	
Current	7.5	13	A
Voltage	26	17	V
T_{amb}	25	25	°C
Cooling	Forced-air	Forced-air	

BA9-20

Outlet via waveguide WG16 with screwed ring flange joint-services type 5985-99-0830004 to take flange choke coupling joint-services type 5985-99-0830003 using coupler assembly joint-services type 5985-99-0830001

9483



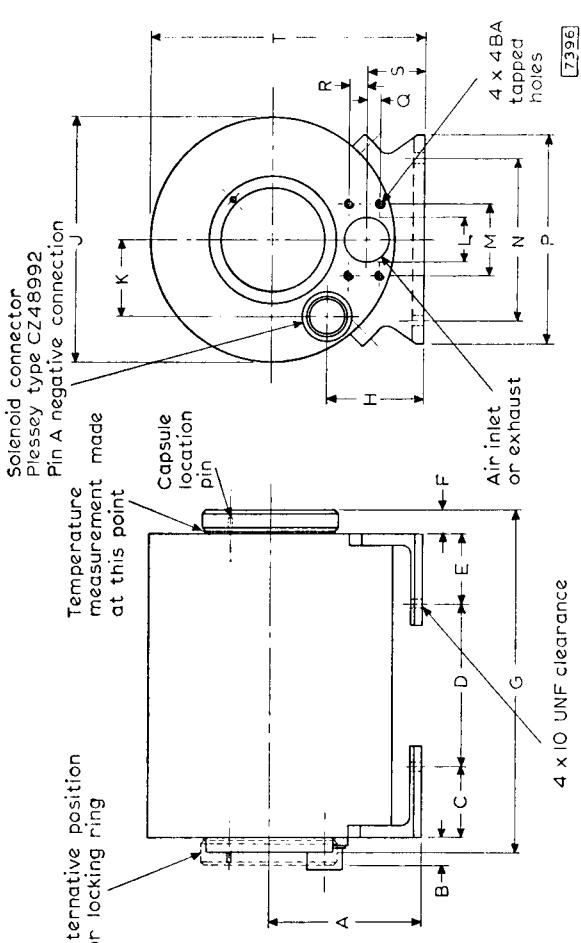


B7D Base

DIMENSIONS

	Inches	Millimetres		Inches	Millimetres
A	2.717 ± 0.020	69.0 ± 0.5	E	$11.142^{+0.000}_{-0.394}$	283^{+0}_{-10}
B	2.284 ± 0.002	58.00 ± 0.05			
C	0.591	15 max.	F	2.461 ± 0.039	62.5 ± 1.0
D	$0.591^{+0.000}_{-0.197}$	15^{+0}_{-5}	G	1.000 ± 0.008	25.4 ± 0.2

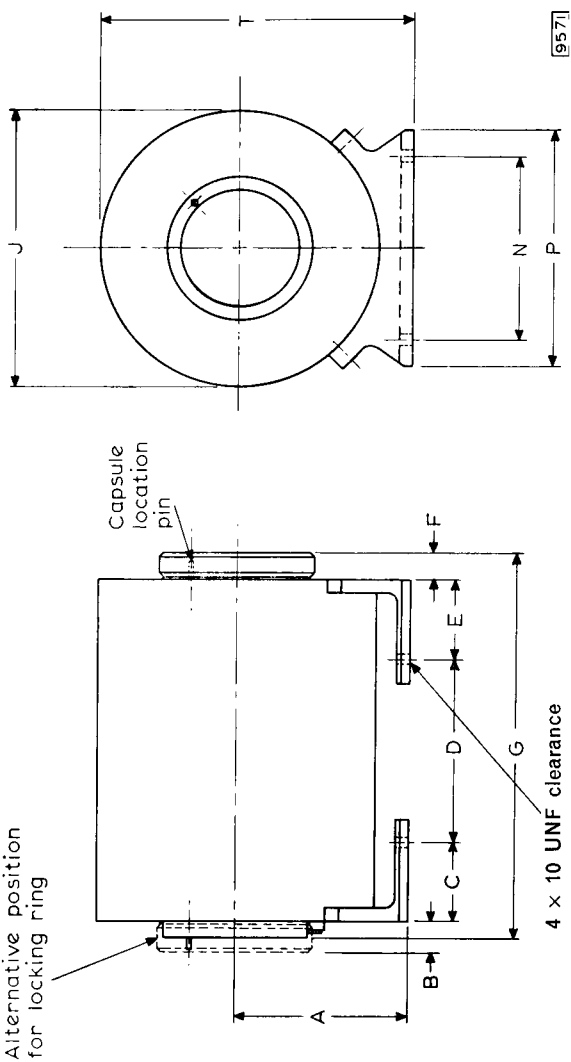
OUTLINE AND DIMENSIONS OF MOUNTS SB-1 AND SB-2



DIMENSIONS

	Inches	Millimetres		Inches	Millimetres		Inches	Millimetres
A	3.248 ± 0.197	82.5 ± 5	G	7.520 ± 0.079	191 ± 2	N	3.543 ± 0.008	90.0 ± 0.2
B	0.591 ± 0.039	15 ± 1	H	2.283 ± 0.197	58 ± 5	P	4.606 ± 0.020	117.0 ± 0.5
C	1.535 ± 0.039	39 ± 1	J	5.354	136 max.	Q	0.276 ± 0.004	7.0 ± 0.1
D	3.543 ± 0.008	90.0 ± 0.2	K	1.772 ± 0.197	45 ± 5	R	0.394 ± 0.004	10.0 ± 0.1
E	1.535 ± 0.039	39 ± 1	L	1.000 ± 0.008	25.4 ± 0.2	S	1.260 ± 0.079	32 ± 2
F	0.591 ± 0.039	15 ± 1	M	1.575 ± 0.004	40.0 ± 0.1	T	6.043	153.5 max.

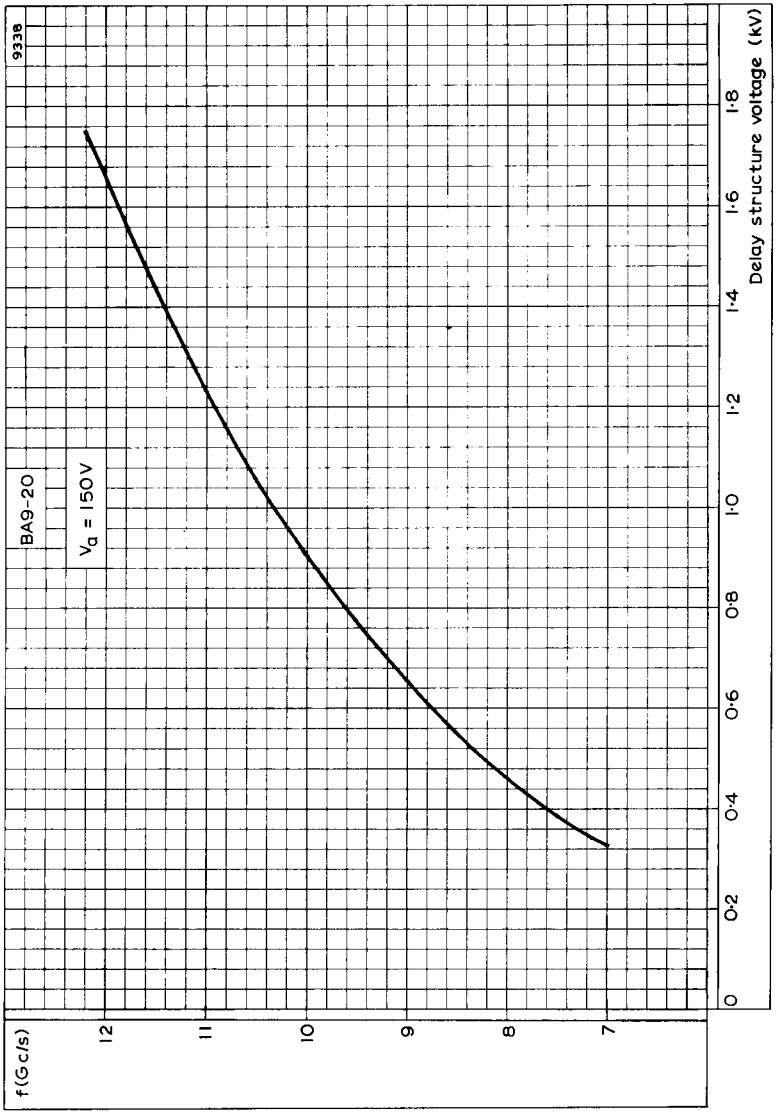
OUTLINE AND DIMENSIONS OF MOUNT PB-1



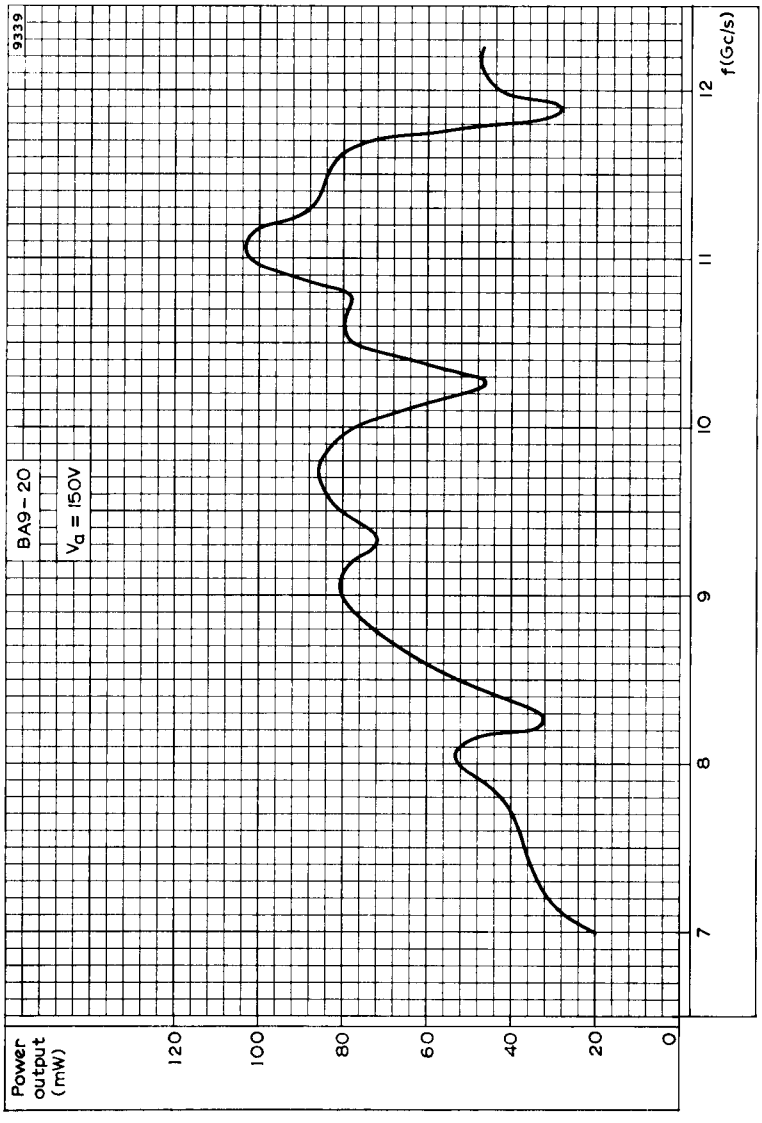
DIMENSIONS

	Inches	*Millimetres*
A	3.248 ± 0.197	82.5 ± 5
B	0.591 ± 0.039	15 ± 1
C	1.535 ± 0.039	39 ± 1
D	3.543 ± 0.008	90 ± 0.2
E	1.535 ± 0.039	39 ± 1
F	0.591 ± 0.039	15 ± 1

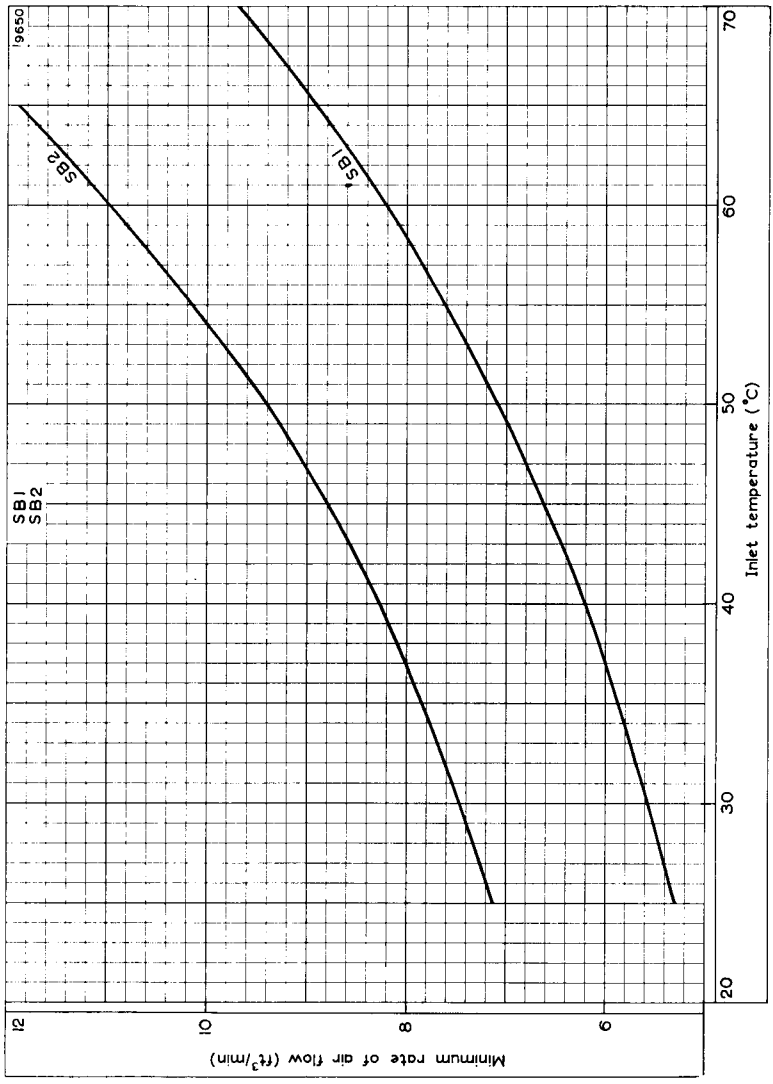
	Inches	*Millimetres*
G	7.520 ± 0.079	191 ± 2
J	5.354	136 max.
N	3.543 ± 0.008	90 ± 0.2
P	4.606 ± 0.020	117 ± 0.5
T	6.043	153.5 max.



FREQUENCY PLOTTED AGAINST DELAY STRUCTURE VOLTAGE

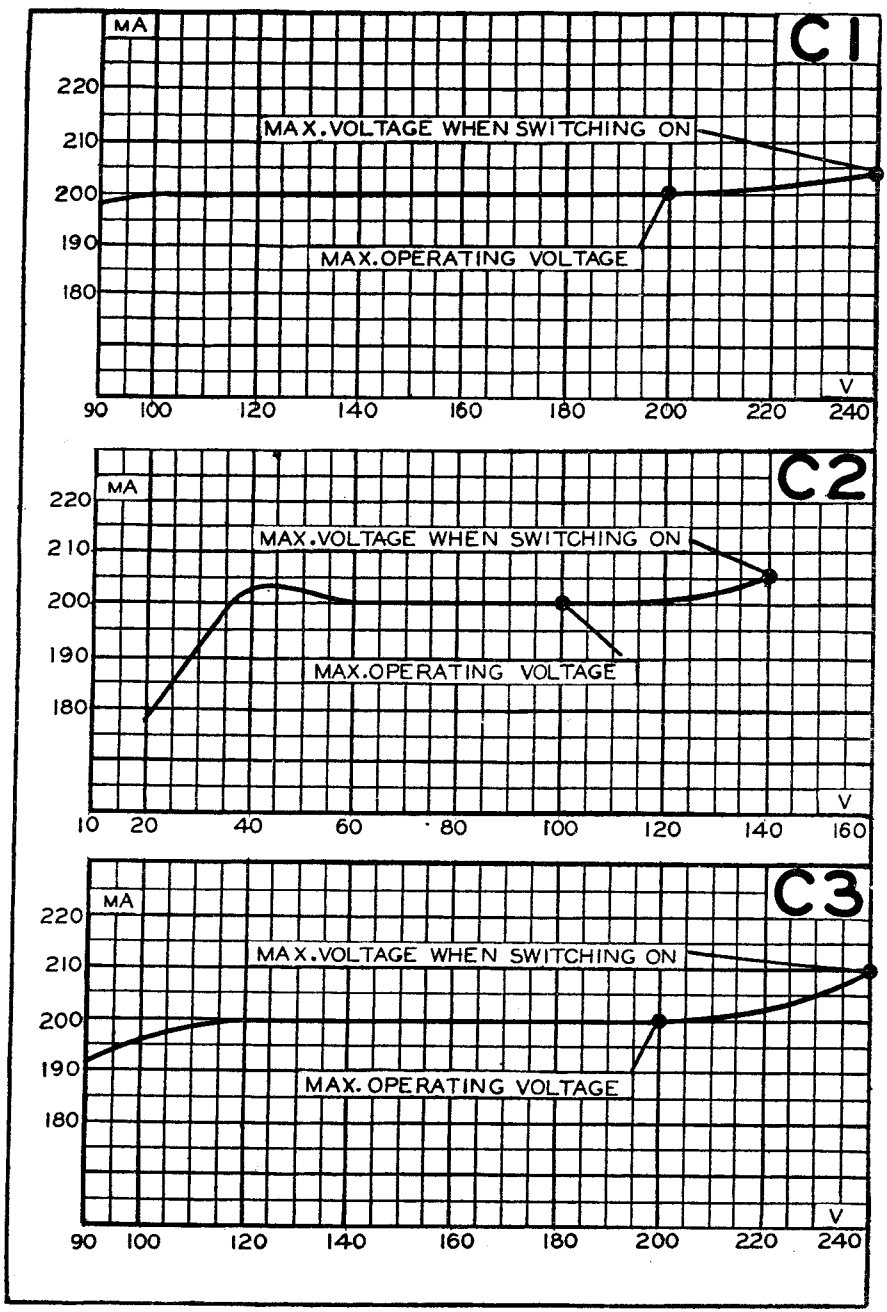


TYPICAL POWER OUTPUT PLOTTED AGAINST FREQUENCY



MINIMUM RATE OF AIR FLOW PLOTTED AGAINST INLET TEMPERATURE FOR MOUNTS SB–1 AND SB–2 FOR T_{mount} max = 120°C

C1; C2; C3


C1
MA
220
210
200
190
180
MAX.VOLTAGE WHEN SWITCHING ON
MAX.OPERATING VOLTAGE
V
90 100 120 140 160 180 200 220 240
C2
MA
220
210
200
190
180
MAX.VOLTAGE WHEN SWITCHING ON
MAX.OPERATING VOLTAGE
V
10 20 40 60 80 100 120 140 160
C3
MA
220
210
200
190
180
MAX.VOLTAGE WHEN SWITCHING ON
MAX.OPERATING VOLTAGE
V
90 100 120 140 160 180 200 220 240

Mullard

DOUBLE DIODE OUTPUT PENTODE

CBL1

Heater (This valve is suitable for D.C/A.C. operation)	Vf	=	44.0	V
	If	=	0.2	A

Capacities			
Cdd'		< 0.25	uuF
Cdk		3.1	uuF
Cd'k		3.2	uuF
Cda		0.2	uuF
Cd'a		0.2	uuF
Cdg		0.08	uuF
Cd'g		0.08	uuF

Operating Conditions

Va	200	V
Vg2	200	V
Vg1	-8.5	V
Ia	45	mA
Ig2	6	mA
S	8	mA/V
Ri	35,000	ohms
Ra	4,500	ohms
Vg1 eff	5	V
Vg1 eff (Wo = 50 mW)	0.5	V
Wo	4	W
d_{tot}	10	%
Rk	167	ohms

Limiting Values

Vao max	550	V
Va max	250	V
Wa max	9	W
Ik max	70	mA
Vg2o max	550	V
Vg2 max	250	V
Wg2 max	2	W
Vg1 max (Ig1 = + 0.3 uA)	-1.3	V
Rg1a max	1	megohm

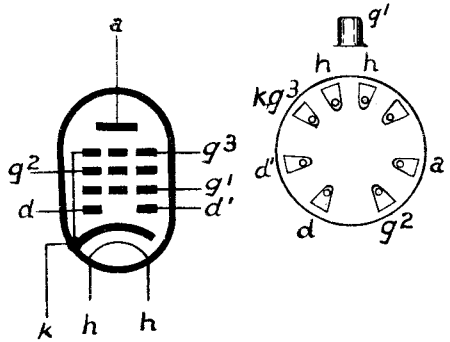
CBL1

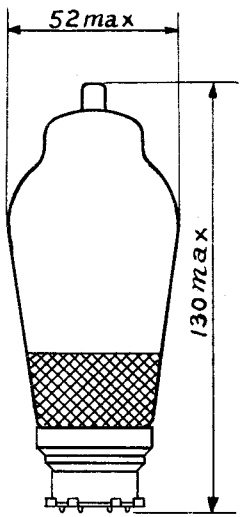
Mullard

DOUBLE DIODE OUTPUT PENTODE

Vfk max	125	V
Rfk max	5,000	ohms
Vd max	200	V
Vd' max	200	V
Id max	0.8	mA
Id' max	0.8	mA
Vd max (Id = + 0.3 uA)	-1.3	V
Vd' max (Id' = + 0.3 uA)	-1.3	V

Arrangement of electrodes and base connections.

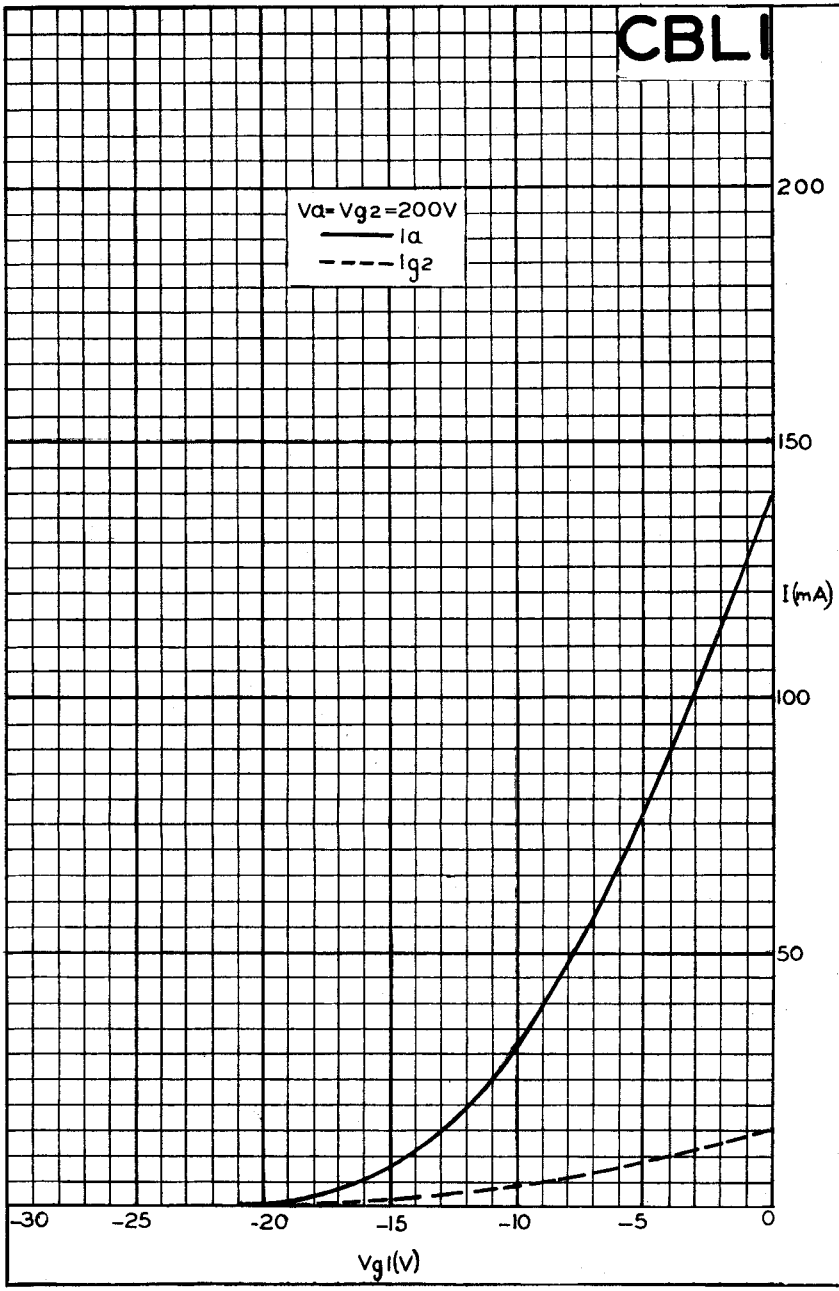




Mullard

DOUBLE DIODE OUTPUT PENTODE

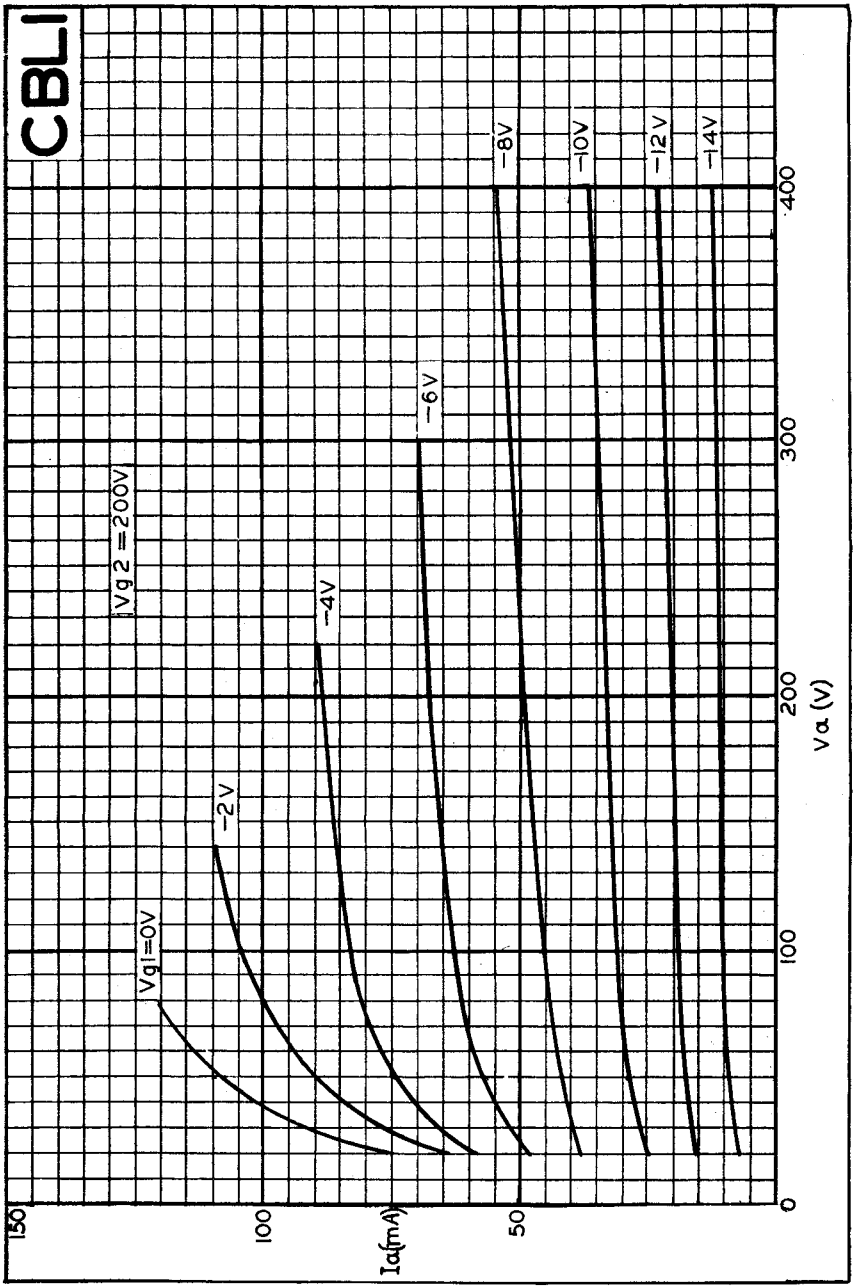
CBL1



CBL1

Mullard

DOUBLE DIODE OUTPUT PENTODE

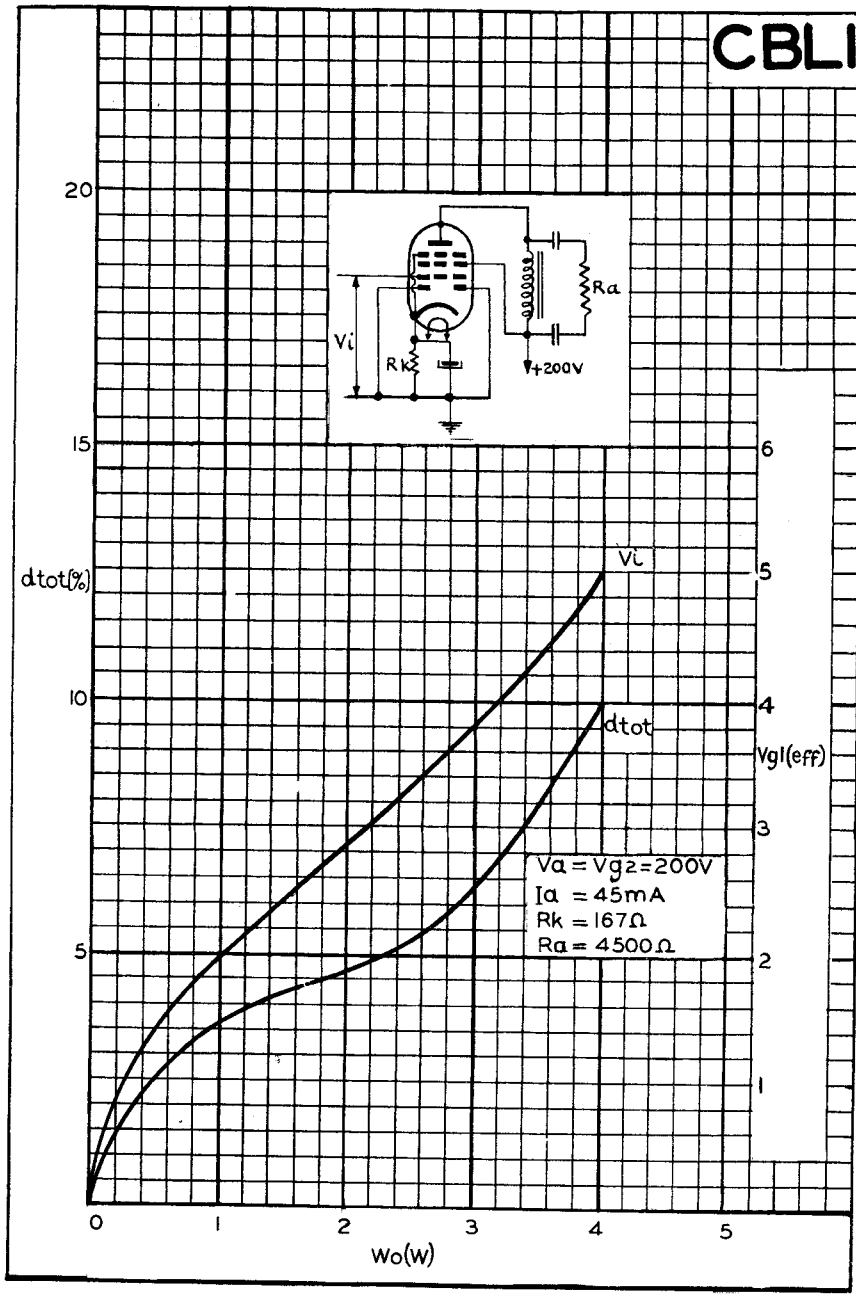


1739/4

Mullard

DOUBLE DIODE OUTPUT PENTODE

CBL1



1739/5

DOUBLE DIODE OUTPUT PENTODE

CBL31

High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.

HEATER

This valve is suitable for DC/AC operation.

V_h	44.0	V
I_h	0.2	A

CAPACITANCES

$c_{ad'-k}$	3.5	μμF
$c_{ad''-k}$	3.5	μμF
$c_{ad'-ad''}$	< 0.5	μμF
$c_{ad'-g1}$	< 0.2	μμF
$c_{ad''-g1}$	< 0.2	μμF

OPERATING CONDITIONS

V_a	200	V
V_{g2}	200	V
V_{g1}	-8.5	V
I_a	45	mA
I_{g2}	6	mA
g_m	8	mA/V
r_a	35,000	ohms
R_a	4,500	ohms
V_{in} rms	5	V
V_{in} rms(W_{out}=50 mW)	0.5	V
W_{out}	4	W
D_{tot}	10	%
R_k	167	ohms

LIMITING VALUES

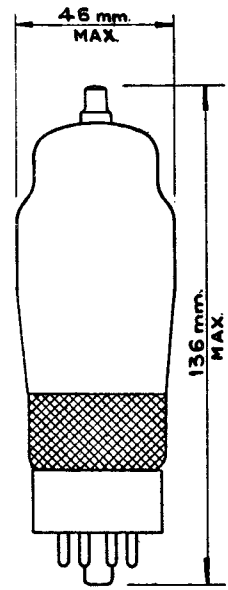
$V_{a(b)}$ max.	550	V
V_a max.	250	V
w_a max.	9	W
I_k max.	70	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
w_{g2} max.	2	W
V_{g1} max.(I_{g1}=+0.3μA)	-1.3	V
R_{g1} max.(self bias)	1	megohm
V_{h-k} max.	125	V
R_{h-k} max.	5,000	ohms
$V_{ad'}$ max.	200	V
$V_{ad''}$ max.	200	V
$I_{ad'}$ max.	0.8	mA
$I_{ad''}$ max.	0.8	mA
$V_{ad'}$ max. ($I_{ad'}$ = +0.3 μA)	-1.3	V
$V_{ad''}$ max. ($I_{ad''}$ = +0.3 μA)	-1.3	V

CBL31

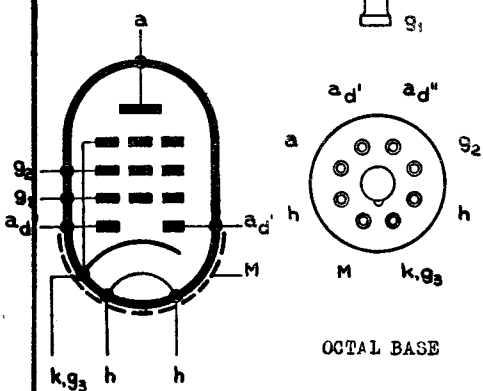
DOUBLE DIODE OUTPUT PENTODE

High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.

DIMENSIONS



ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS

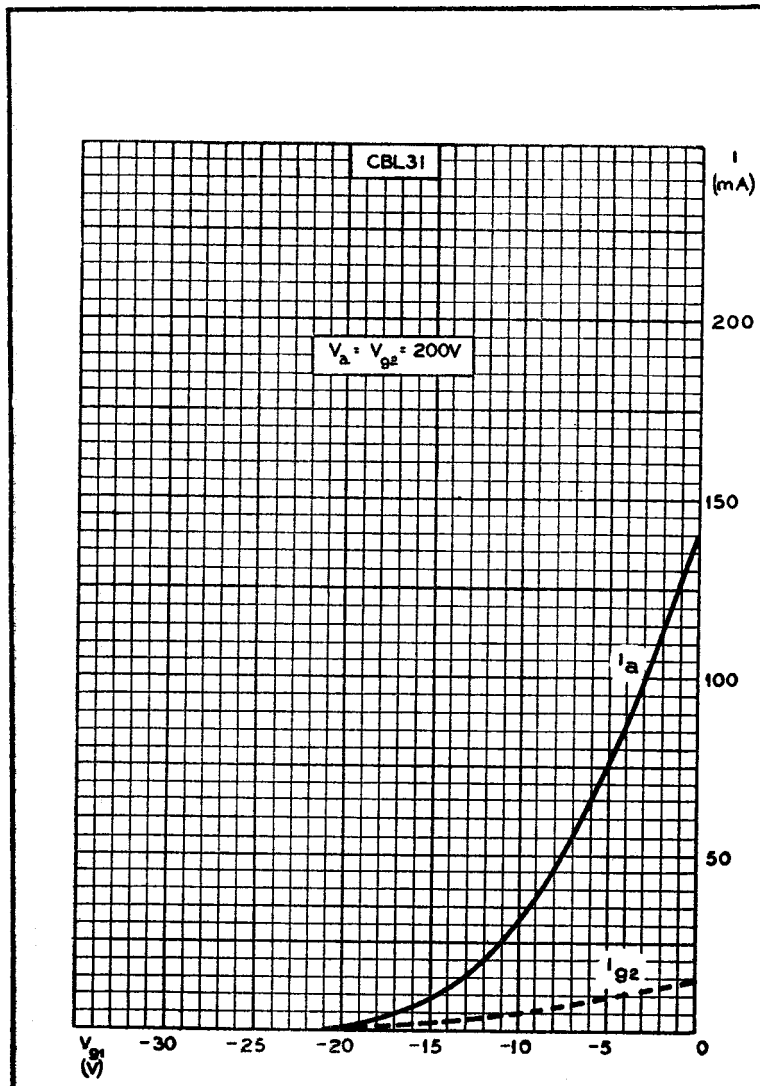


OCTAL BASE

DOUBLE DIODE OUTPUT PENTODE

CBL31

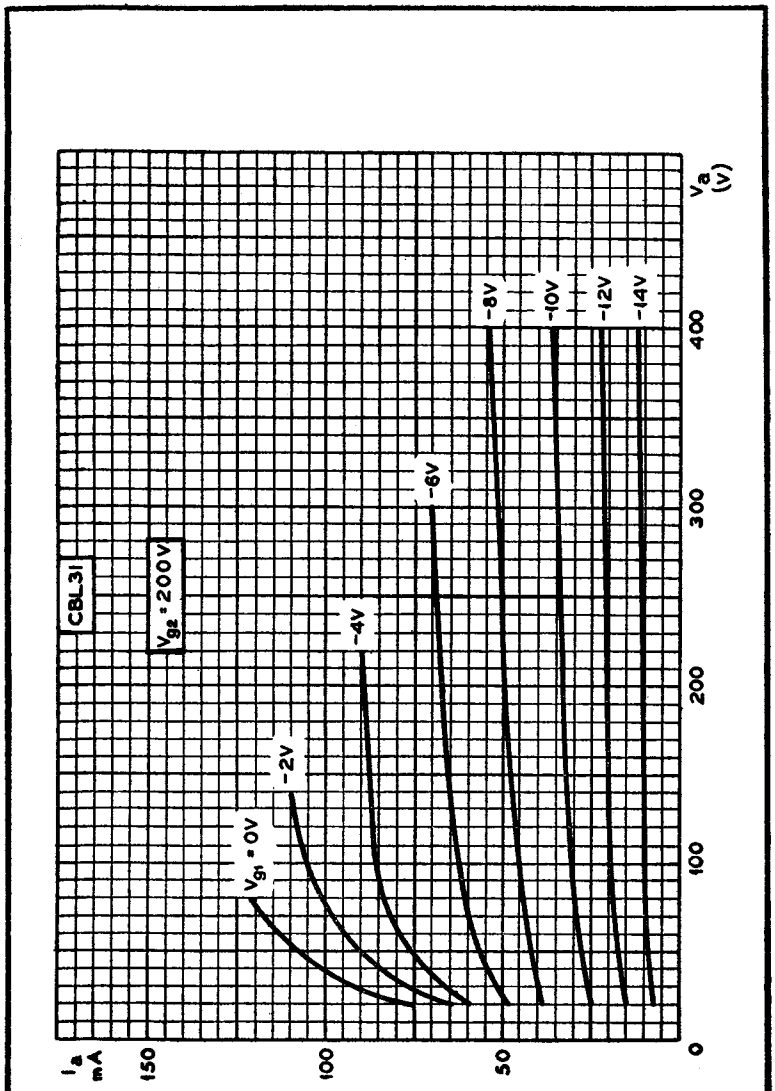
High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.



CBL31

DOUBLE DIODE OUTPUT PENTODE

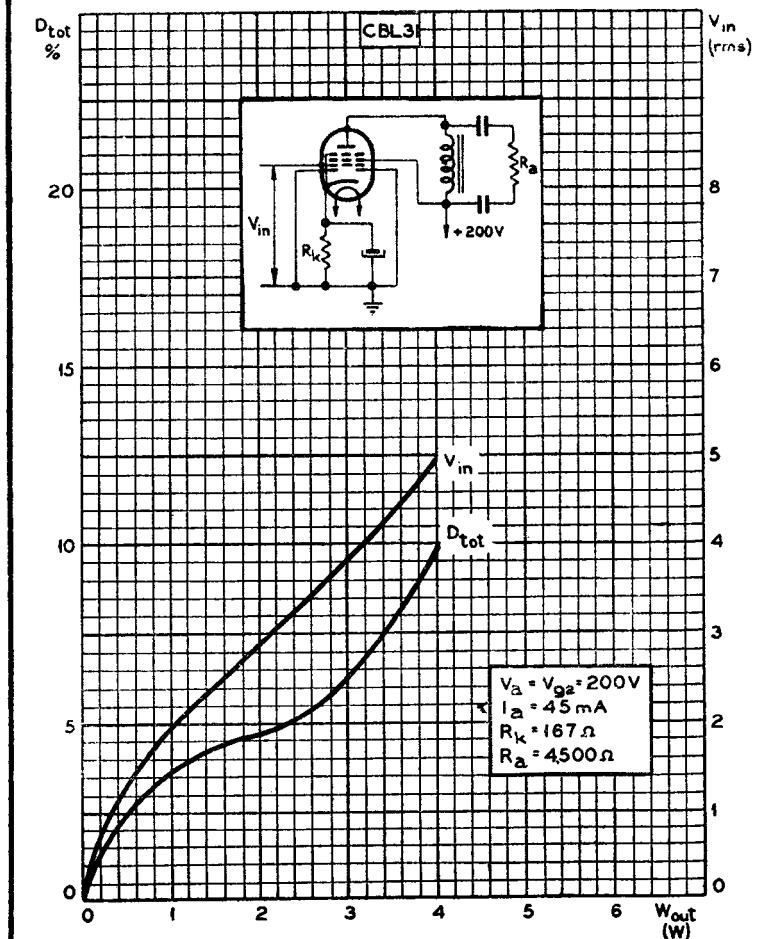
High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.



DOUBLE DIODE OUTPUT PENTODE

CBL31

High-sensitivity output pentode for use in D.C./A.C. mains-operated equipment and combined with twin diodes.



TRIODE HEXODE

CCH35

Triode hexode for use as frequency changer. The hexode section is designed for operation with a.g.c.

HEATER

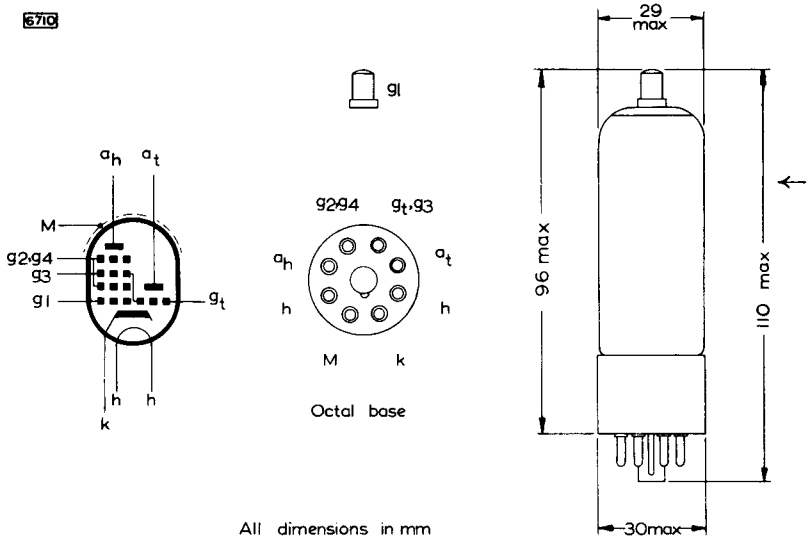
Suitable for a.c. or d.c. operation

I_h	200	mA
V_h	7.0	V

CHARACTERISTICS

For characteristics, curves and operating conditions, see data for type ECH35.

Except for the heater voltage and current, the ECH35 and CCH35 are identical.



Mullard
OUTPUT PENTODE

CL4

Heater (This valve is suitable for D.C/A.C operation.)	Vf	=	33.0 V
	If	=	0.2 A

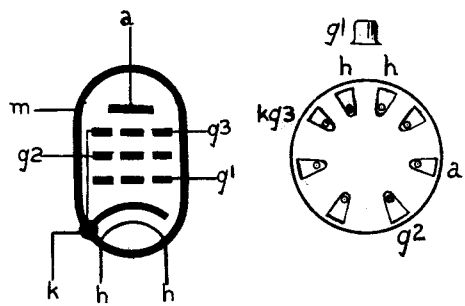
Operating Conditions

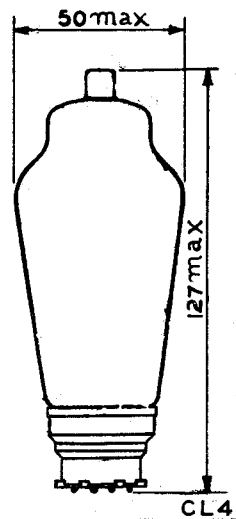
Va	200	V
Vg2	200	V
Vgl	-8.5	V
Ia	45	mA
Ig2	6	mA
S	8	mA/V
Ri	35,000	ohms
Ra	4,500	ohms
Vgl eff	5.6	V
Vgl eff (Wo=50 mW)	0.5	V
Wo	4.0	W
d_{tot}	10	%
Rk	167	ohms

Limiting Values

Vao max	400	V ←
Va max	250	V
Wa max	9	W
Ik max	70	mA
Vg2o max	400	V ←
Vg2 max	250	V
Wg2 max	2	W
Vgl max (Igl = + 0.3 uA)	-1.3	V
Rgla max	1.0	megohm
Vfk max	175	V ←
Rfk max	5,000	ohms

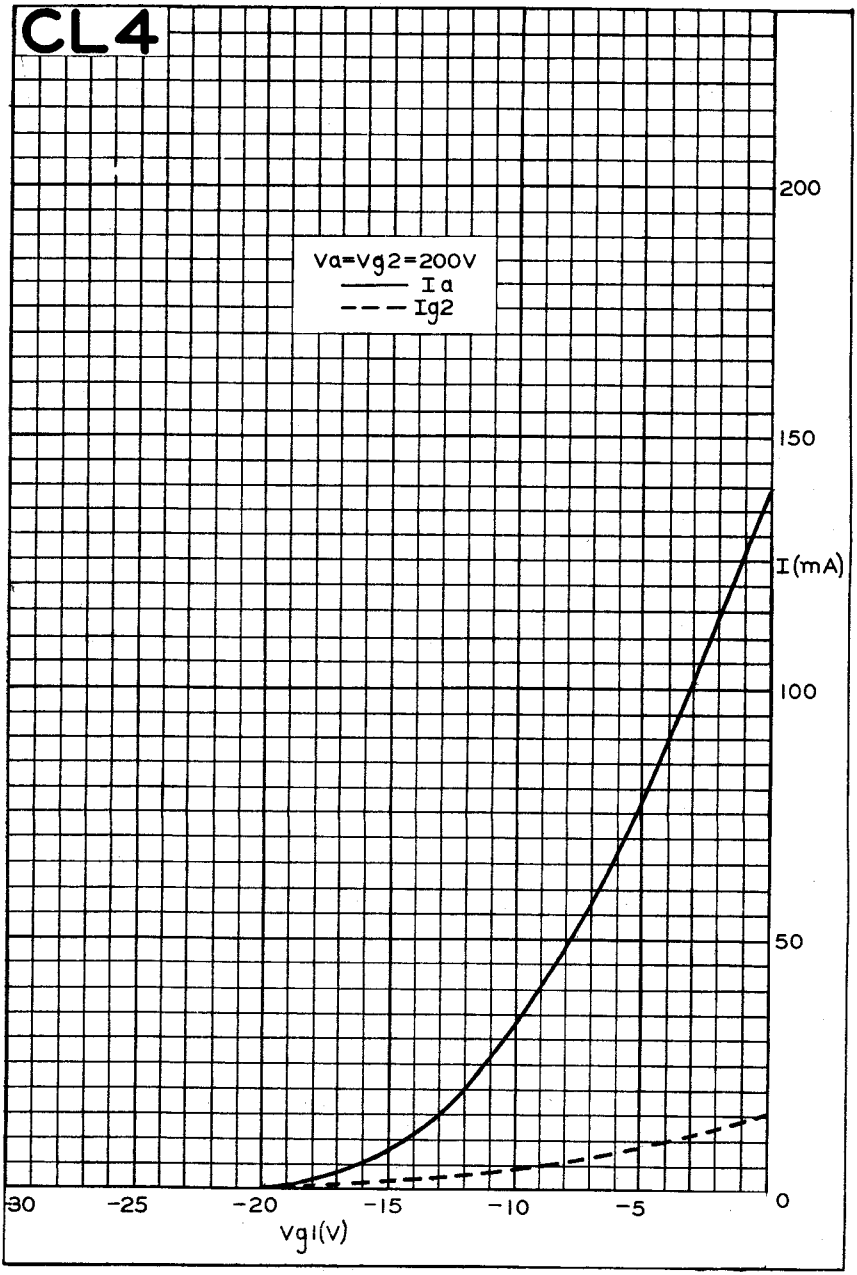
Arrangement of electrodes and base connections.





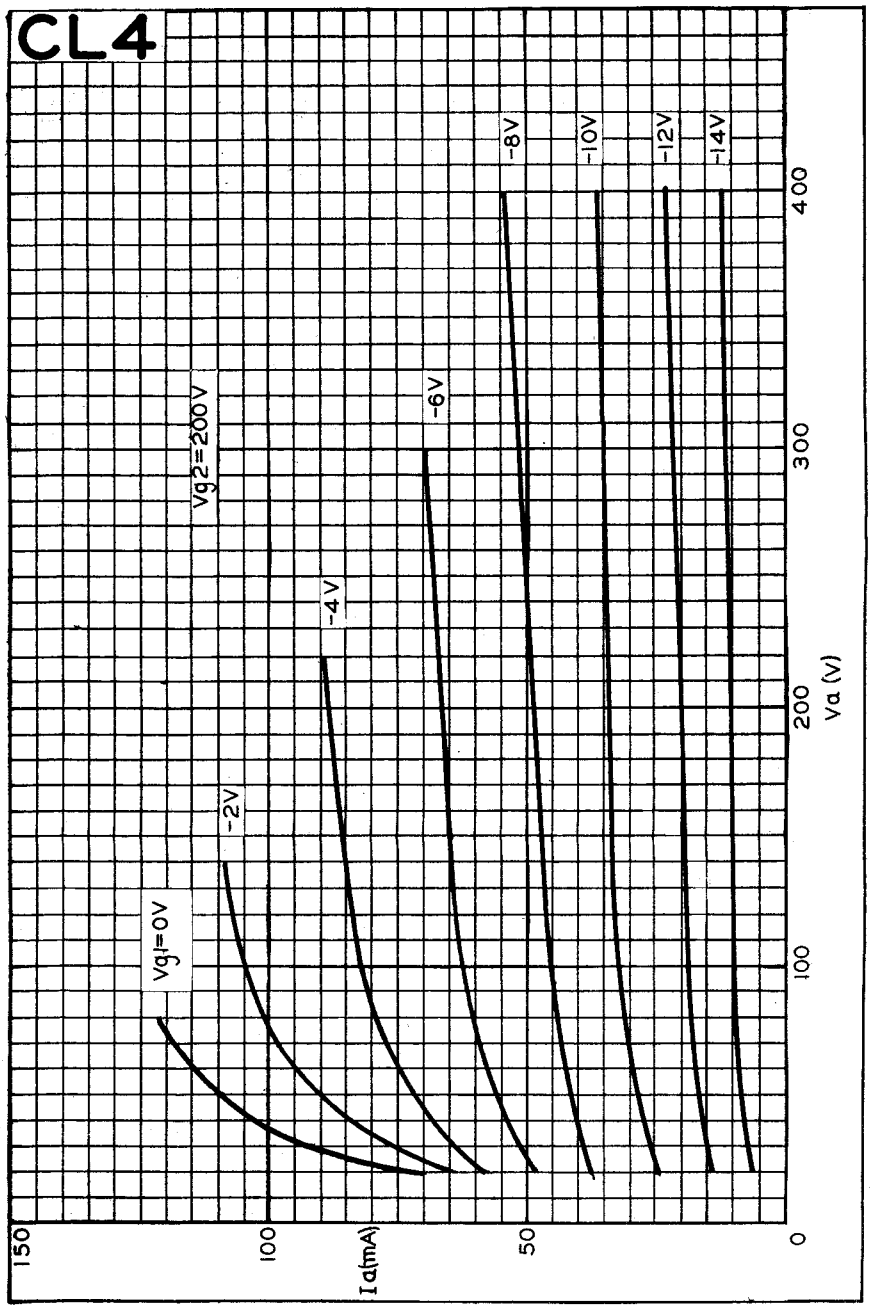
CL4

Mullard
OUTPUT PENTODE



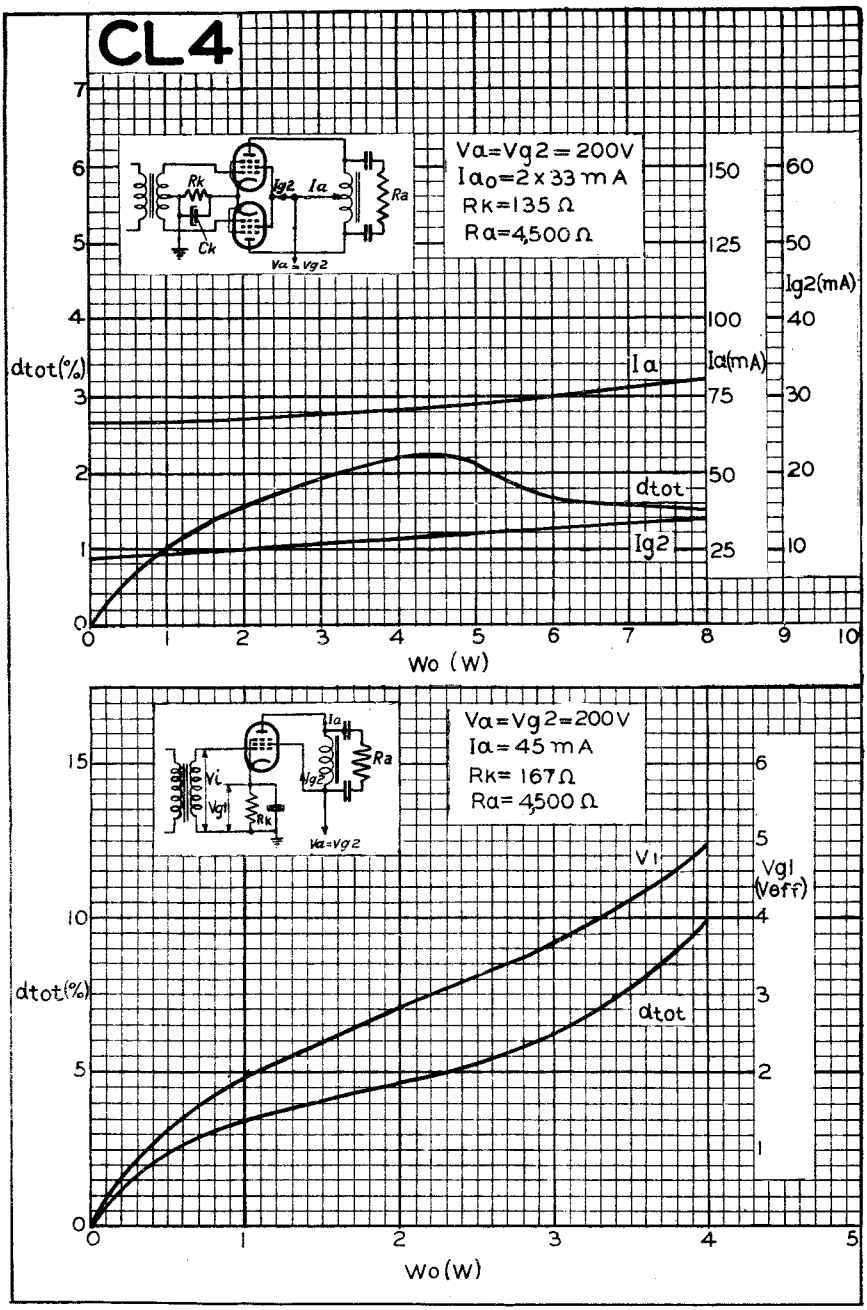
Mullard
OUTPUT PENTODE

CL4



CL4

Mullard
OUTPUT PENTODE



Mullard
OUTPUT PENTODE

CL6

Heater (This valve is suitable for DC/AC operation.)	Vf = 35 V If = 0.2 A
Capacity	Cag1 < 0.5 μμF

Operating Conditions

Va	100	200 V
Vg2	100	100 V
Ia	50	45 mA
-Vg1	8.3	9.5 V
Ig2	9	5.5 mA
S	8.5	8 mA/V
Ri	12,000	19,000 ohms
g (g2g1)	7	6.5
Wo	2.1	4 W
Ra	2,000	4,500 ohms
Vg1 eff	5.6	5.6 V
Vg1 eff (Wo = 50 mW)	0.62	0.47 V
d_{tot}	10	10 %
Rk	140	190 ohms

Operating Conditions for 2 valves in push-pull

Va	100	250 V
Vg2	100	125 V
Iao	2 x 42	2 x 36 mA
Ia max	2 x 42	2 x 42.5 mA
Ig2o	2 x 7.5	2 x 4.1 mA
Ig2 max	2 x 12.5	2 x 12.5 mA
Rk	2 x 190	2 x 365 ohms
Ra	3,000	7,000 ohms
Wo	4	13.5 W
d_{tot} (Wo max)	5.6	6.3 %
Vg1 eff (Wo max)	6.7	13.7 V

1439/1

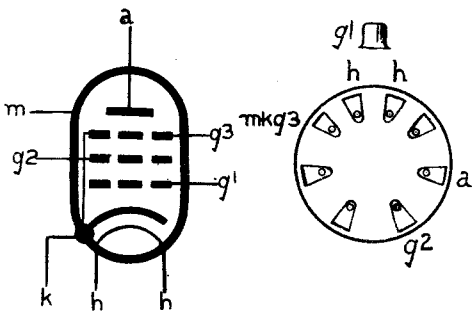
CL6

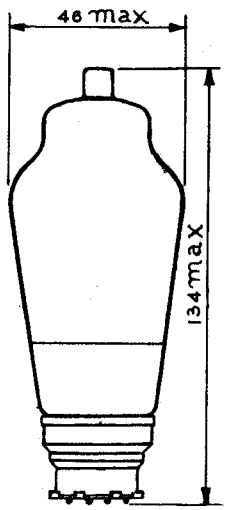
Mullard
OUTPUT PENTODE

Limiting Values.

Vao max	550	V
Va max	250	V
Wa max	9	W
Vg2o max	550	V
Vg2 max	125	V
Wg2 max (Vg1 eff = 0)	1	W
Wg2 max (Wo max)	1.5	W
Ig2 max (Ia = 50 mA, Vg2 = 100 V)	11.5	mA
Ig2 min (Ia = 50 mA, Vg2 = 100 V)	7.5	mA
Ig2 max (Ia = 45 mA, Vg2 = 100 V)	7.0	mA
Ig2 min (Ia = 45 mA, Vg2 = 100 V)	4.0	mA
Ik max	70	mA
Vg1 max (Ig1 = +0.3 uA)	-1.3	V
Rg1a max	1	Megohm
Vfk max	175	V
Rfk max	5,000	ohms

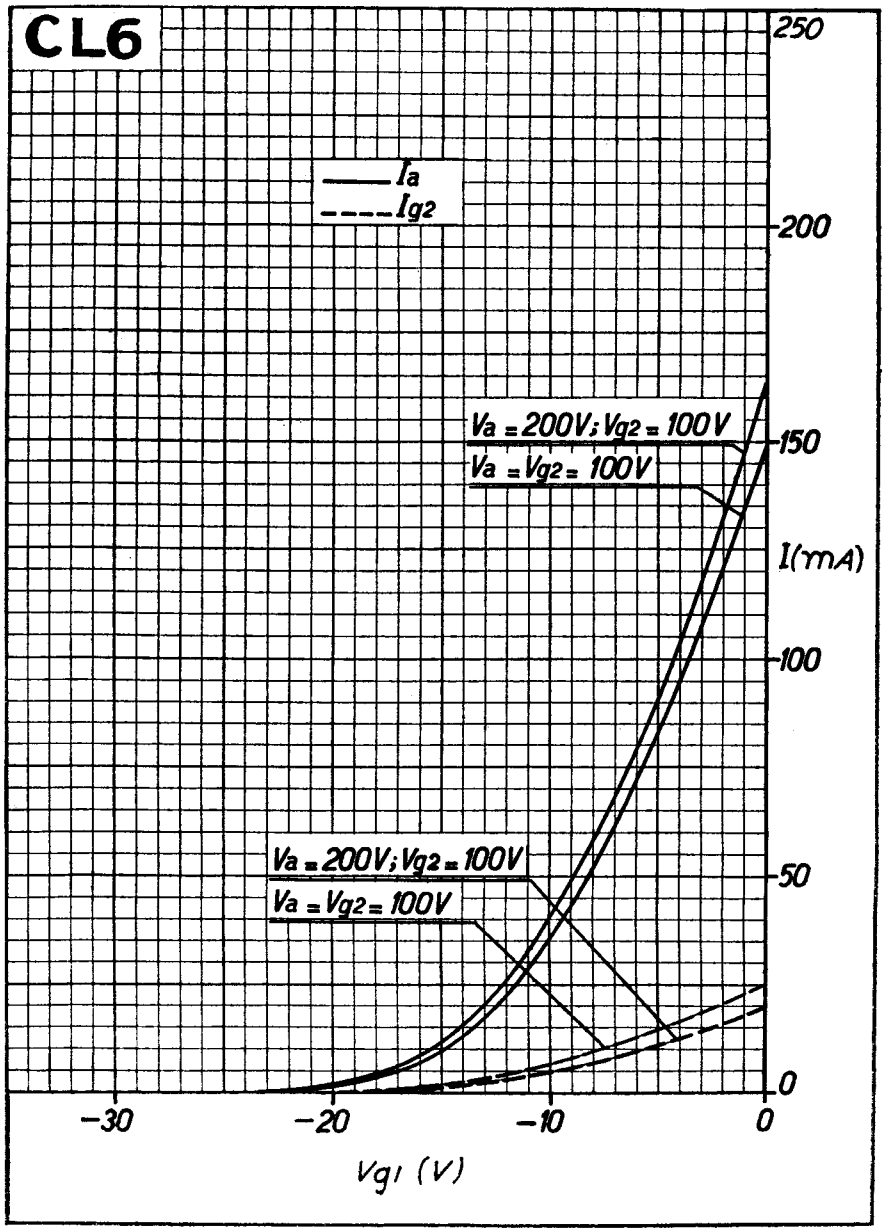
Arrangement of electrodes and base connections





Mullard
OUTPUT PENTODE

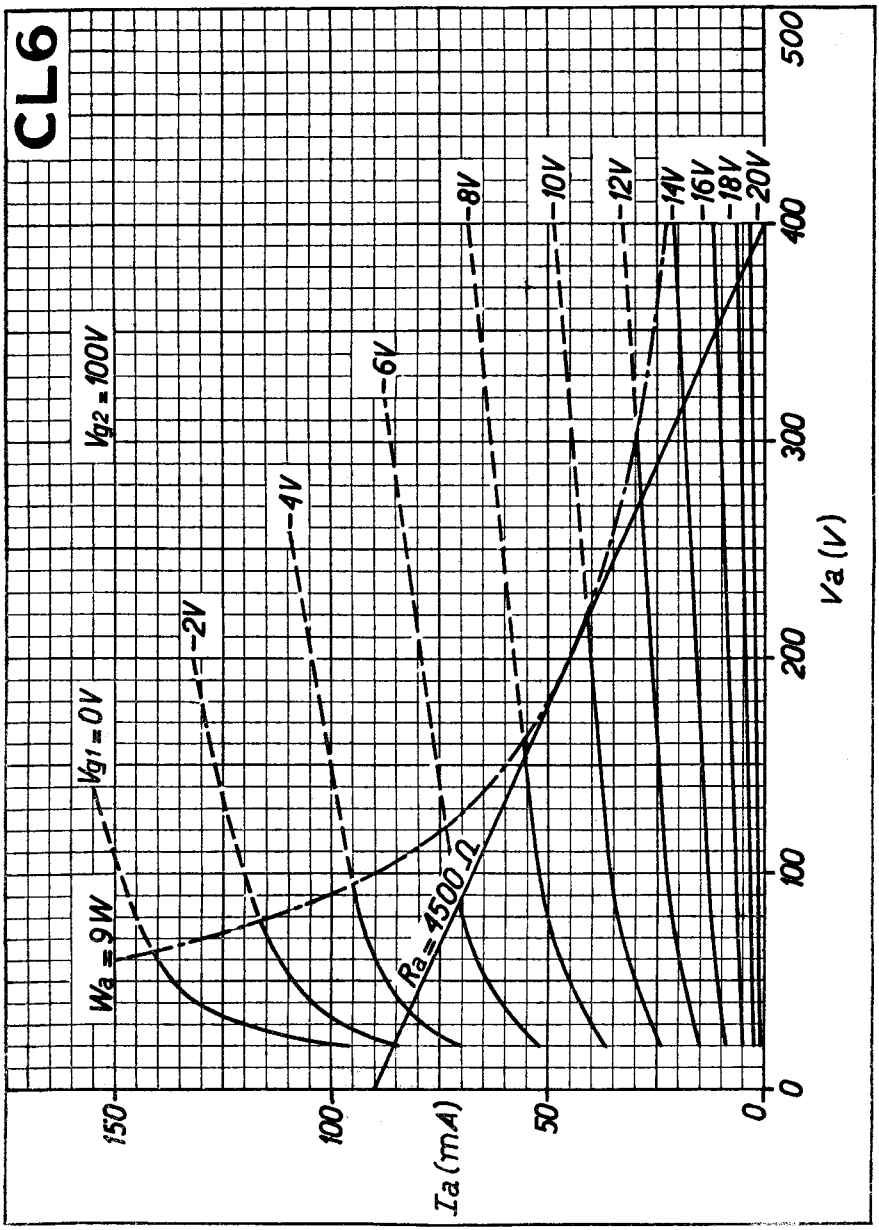
CL6



I339/3

CL6

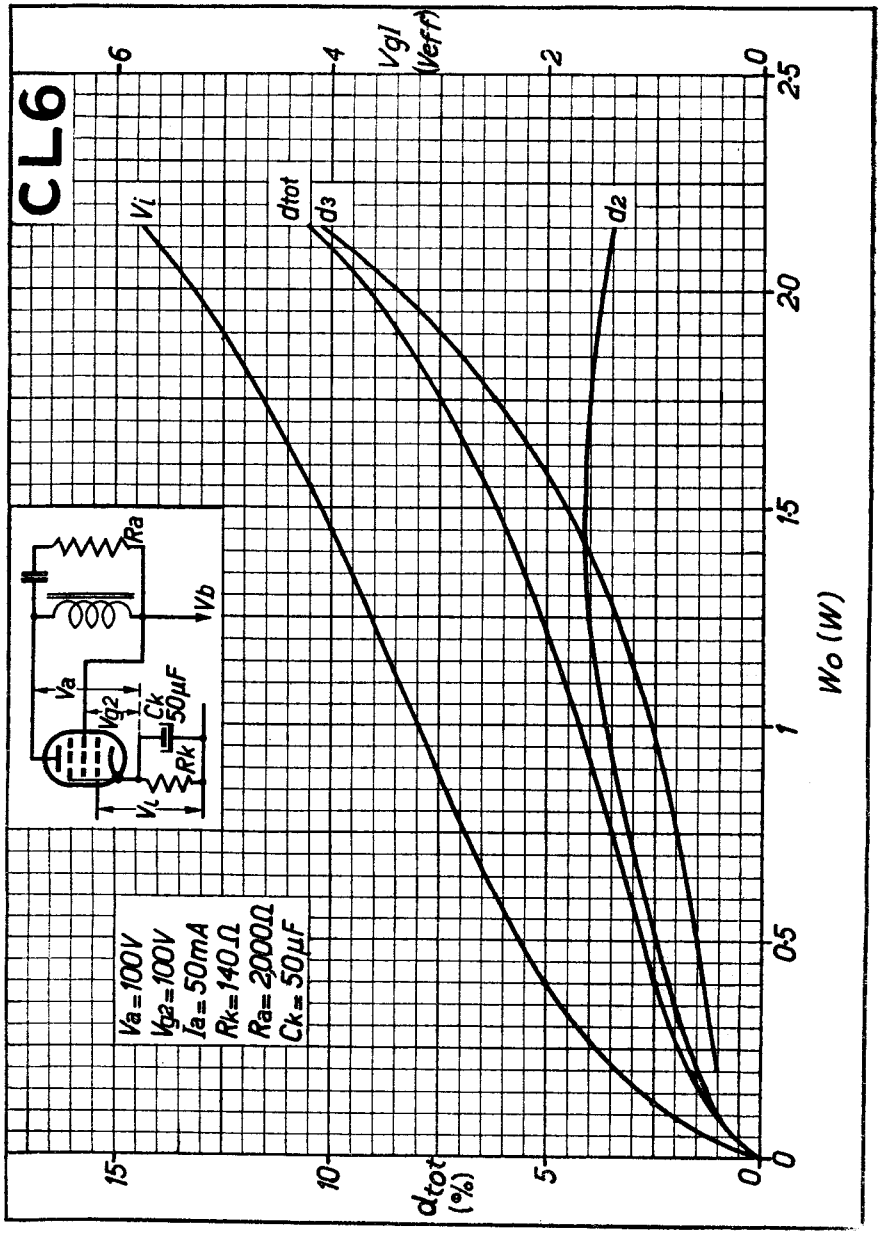
Mullard
OUTPUT PENTODE



I339/4

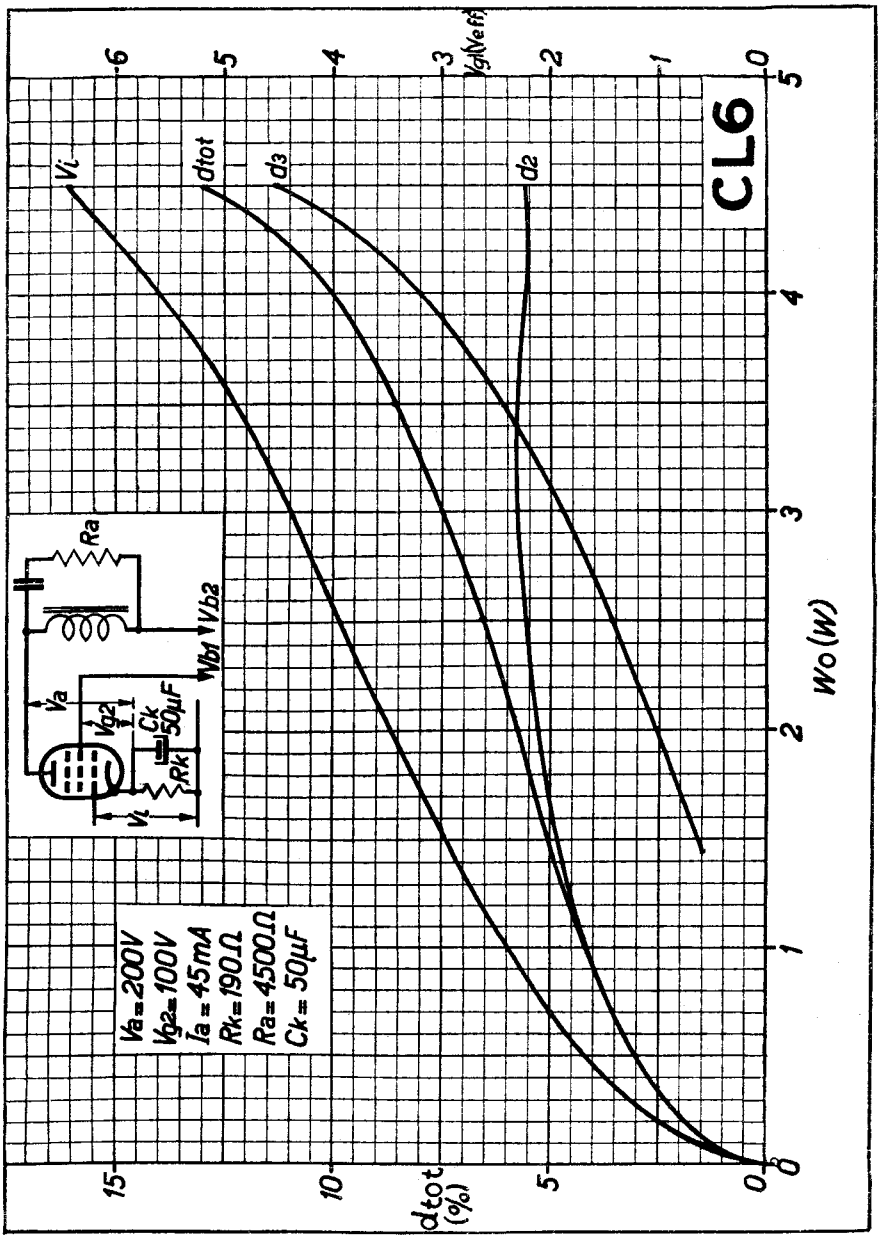
Mullard
OUTPUT PENTODE

CL6



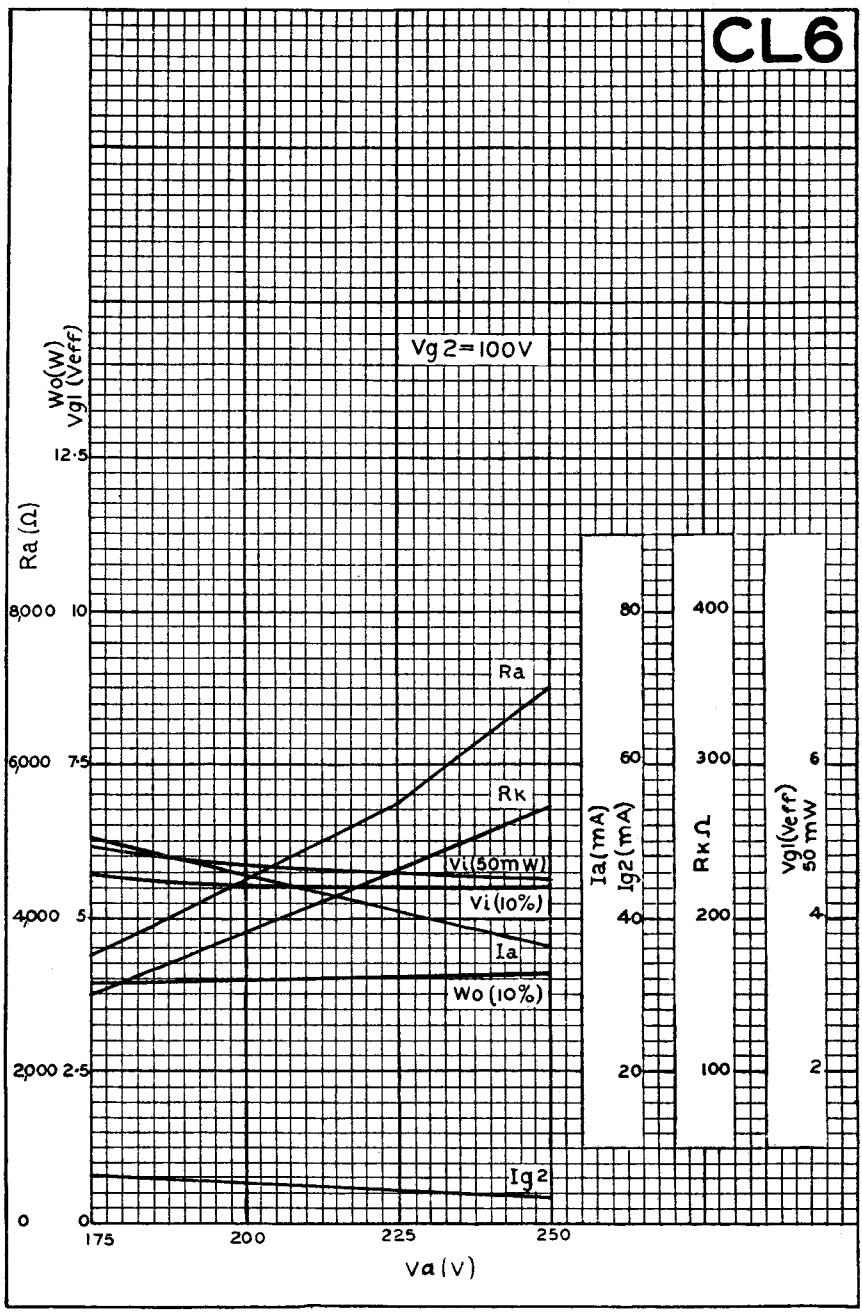
CL6

Mullard
OUTPUT PENTODE



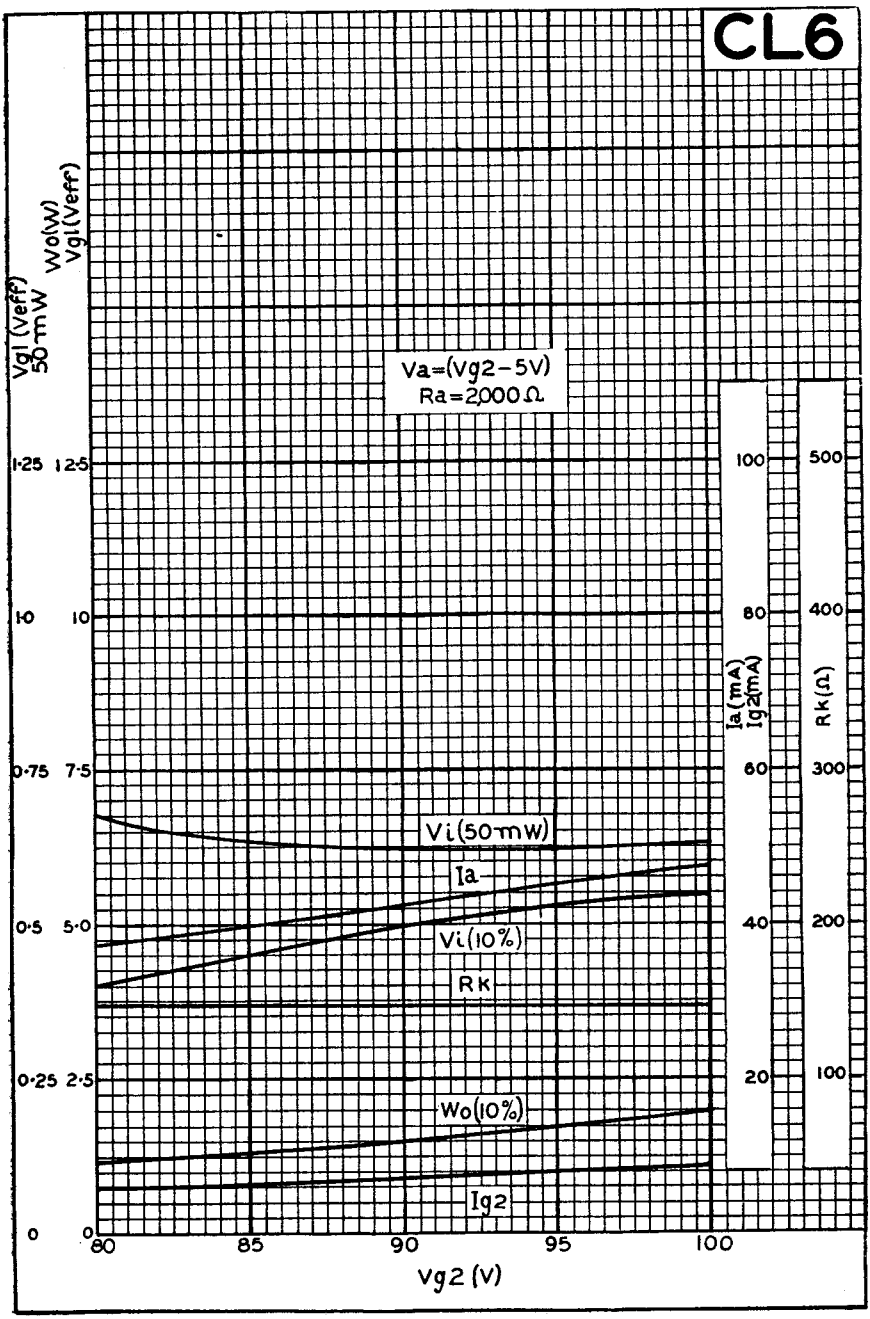
Mullard
OUTPUT PENTODE

CL6



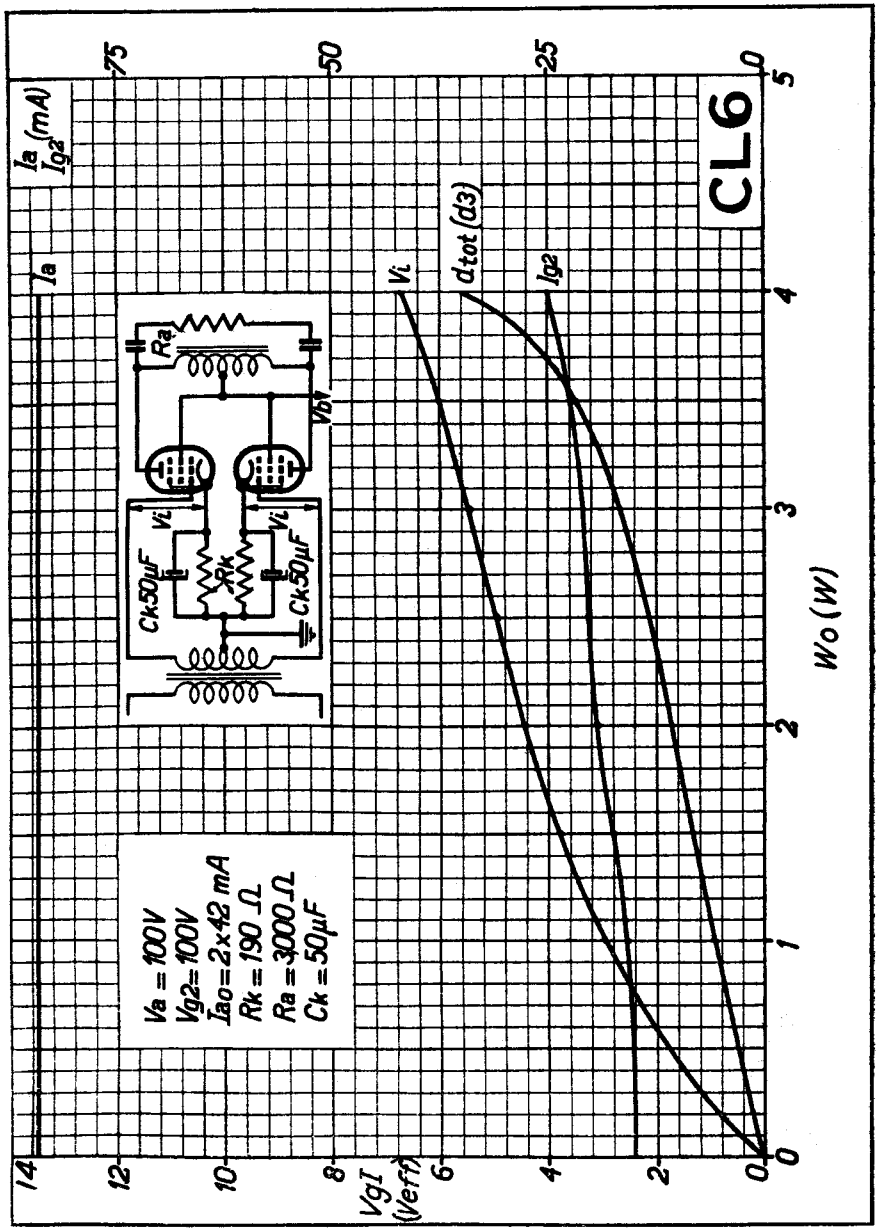
CL6

Mullard
OUTPUT PENTODE



Mullard
OUTPUT PENTODE

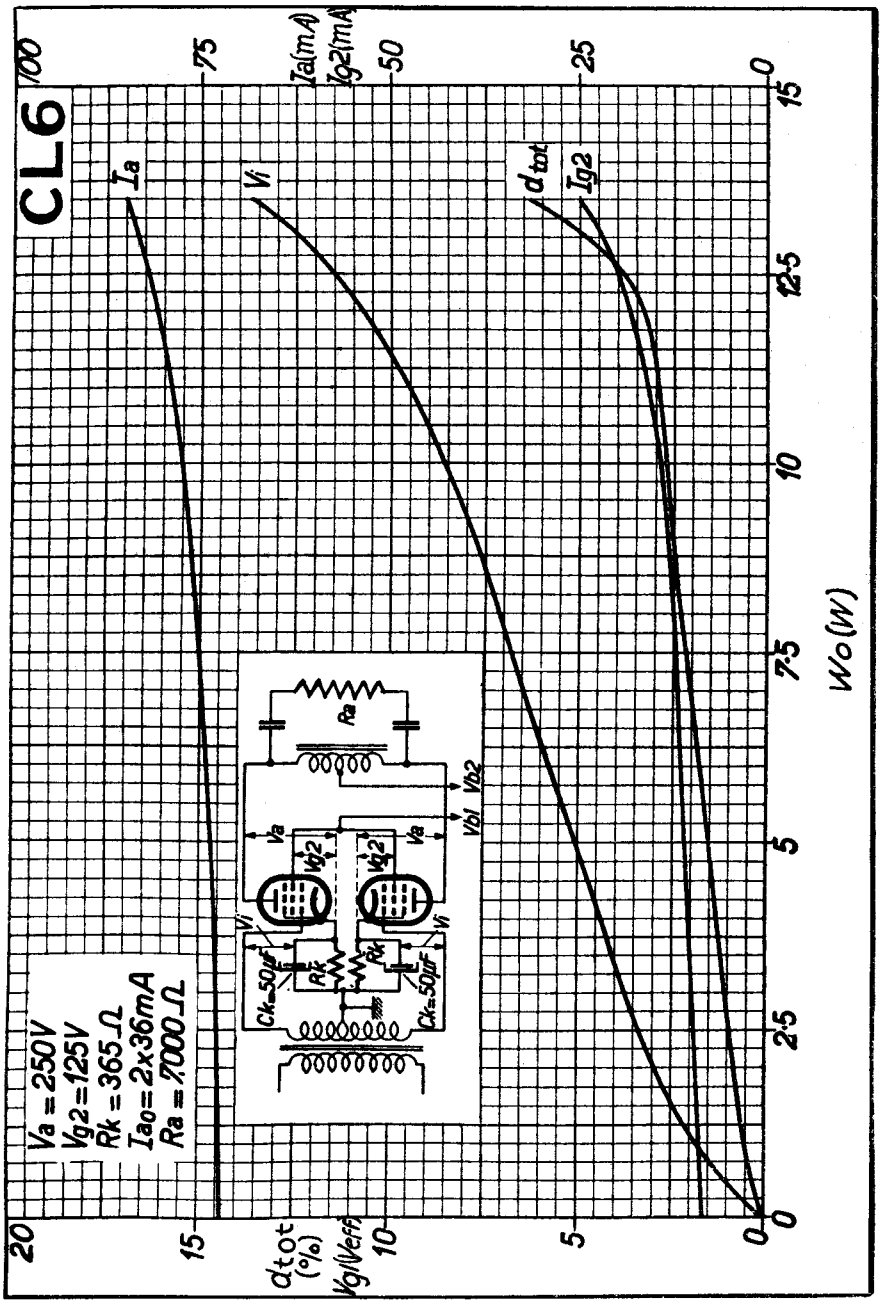
CL6



1339/9

CL6

Mullard
OUTPUT PENTODE



OUTPUT PENTODE

CL33

High-sensitivity output pentode for use in DC/AC mains-operated equipment.

HEATER

This valve is suitable for DC/AC operation.

V_h	33.0	V
I_h	0.2	A

OPERATING CONDITIONS

V_a	200	V
V_{g2}	200	V
V_{g1}	-8.5	V
I_a	45	mA
I_{g2}	6	mA
S_m	8	mA/V
r_a	35,000	ohms
ug1-g2	13.5	
R_a	4,500	ohms
V_{in} rms	5.0	V
V_{in} rms (Wout = 50 mW)	0.5	V
W_{out}	4.0	W
Dtot	10	%
R_k	167	ohms

LIMITING VALUES

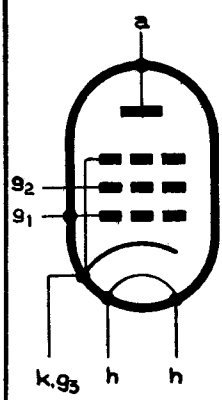
$V_{a(b)}$ max.	400	V
V_a max.	250	V
w_a max.	9	W
I_k max.	70	mA
$V_{g2(b)}$ max.	400	V
V_{g2} max.	250	V
w_{g2} max.	2	W
V_{g1} max. (I_{g1}=+0.3μA)	-1.3	V
R_{g1} max. (self bias)	1.0	M.ohm
V_{h-k} max.	175	V
R_{h-k} max.	5,000	ohms

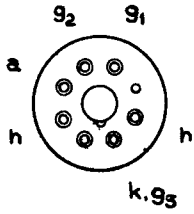
CL33

OUTPUT PENTODE

High-sensitivity output pentode for use in DC/AC mains-operated equipment.

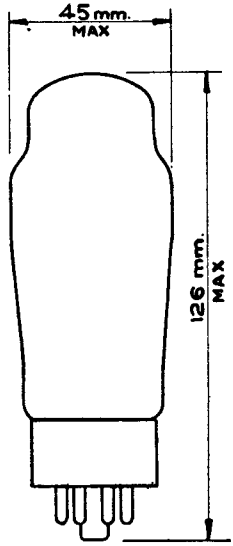
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS





OCTAL BASE

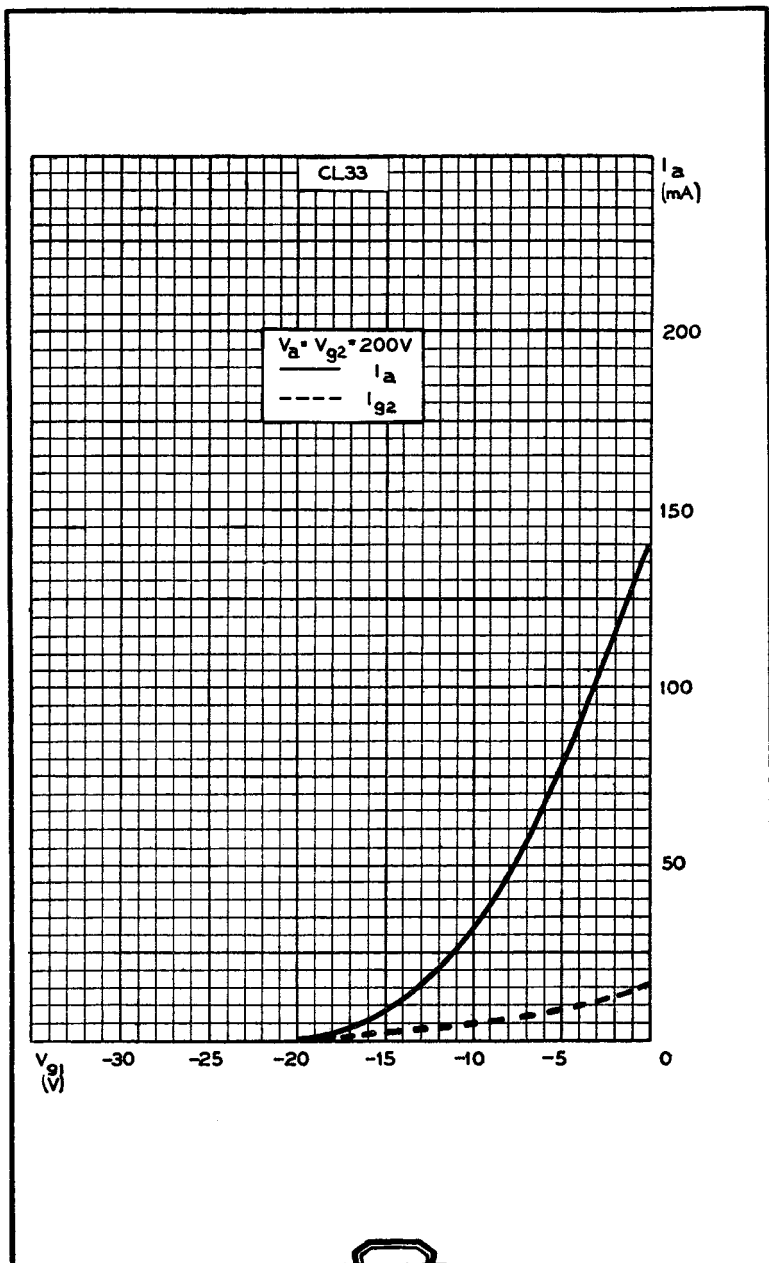
DIMENSIONS



OUTPUT PENTODE

CL33

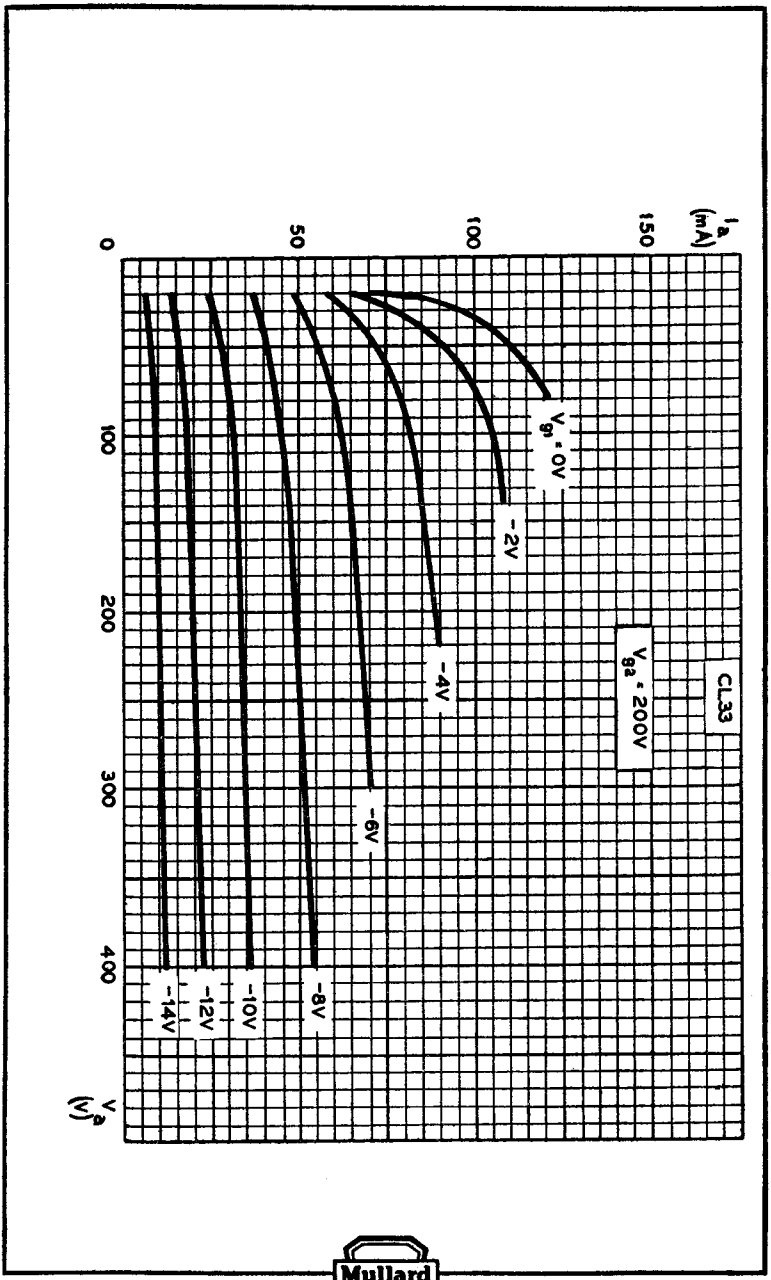
High-sensitivity output pentode for use in DC/AC mains-operated equipment.



CL33

OUTPUT PENTODE

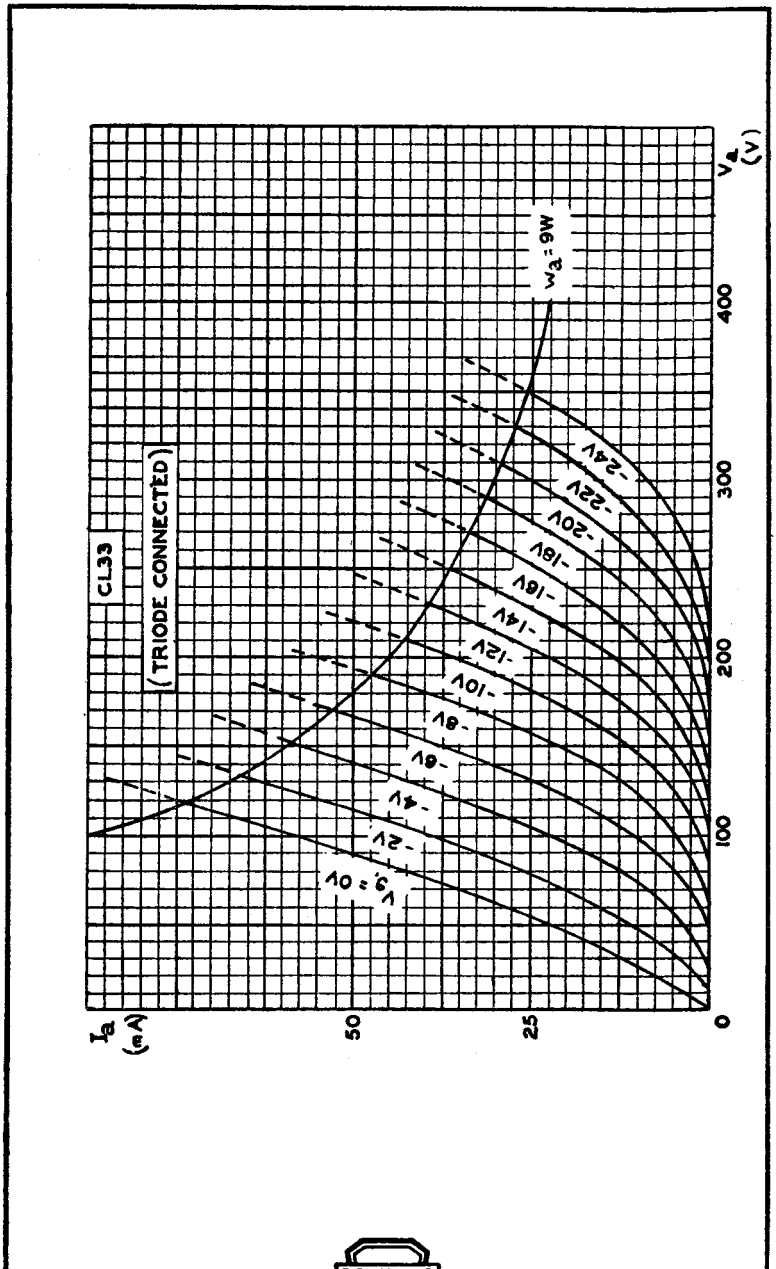
High-sensitivity output pentode for use in DC/AC mains-operated equipment.



OUTPUT PENTODE

CL33

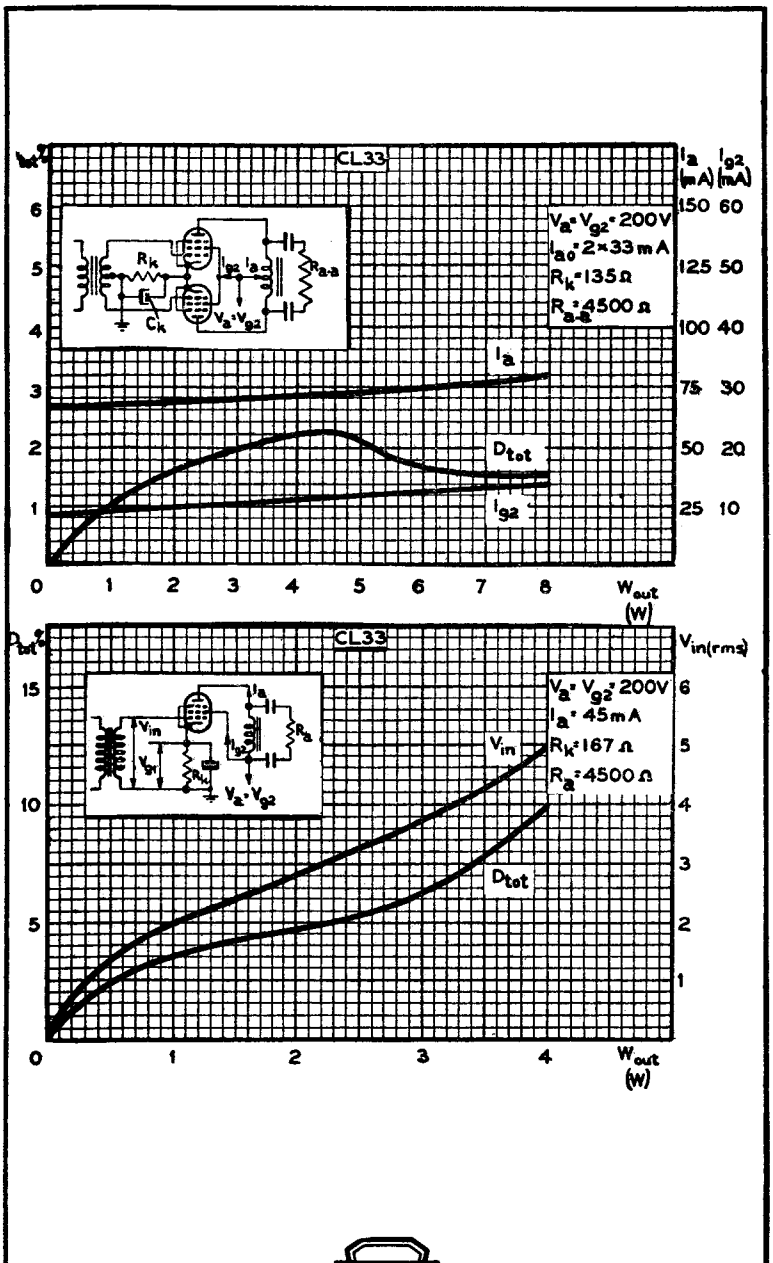
High-sensitivity output pentode for use in DC/AC mains-operated equipment.



CL33

OUTPUT PENTODE

High-sensitivity output pentode for use in DC/AC mains-operated equipment.



Mullard

INDIRECTLY HEATED RECTIFIER

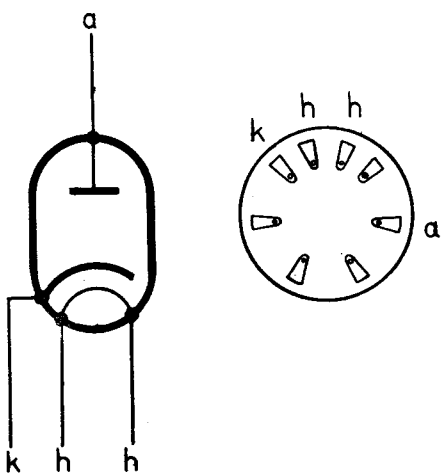
CY1

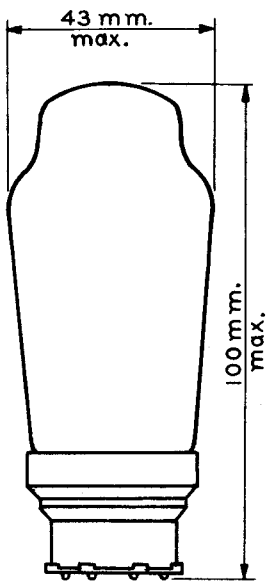
Heater

Vf	=	20 V
If	=	0.2 A

For operating data and characteristic curve refer to valve type UR1C. Except for base connections and overall length the CY1 and UR1C are identical.

Arrangement of electrodes and base connections.





Mullard
INDIRECTLY HEATED RECTIFIER

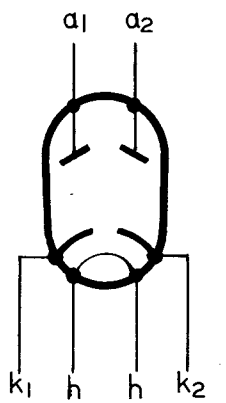
CY2

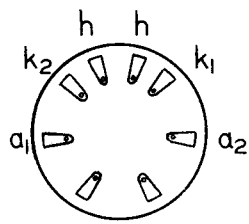
Heater

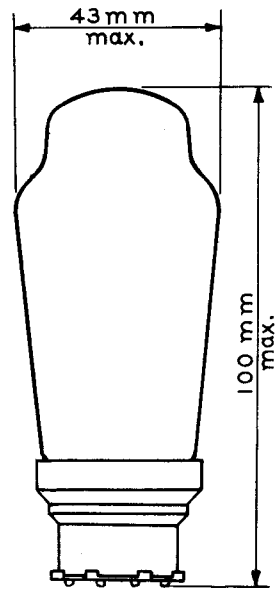
Vf	=	30 V
If	=	0.2 A

For operating data and characteristic curve refer to valve type UR3C. Except for base connections and overall length the CY2 and UR3C are identical.

Arrangement of electrodes and base connections.







HALF WAVE RECTIFIER

CY31

Indirectly-heated power rectifier for D.C./A.C. mains-operated equipment.

HEATER

This valve is suitable for DC/AC operation.

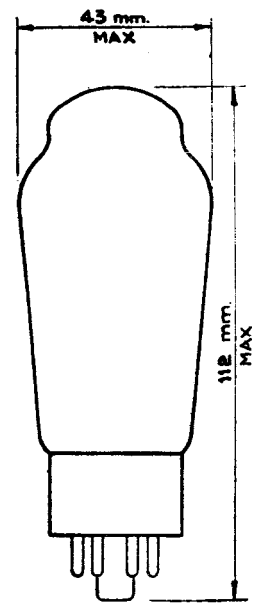
V_h	20	V
I_h	0.2	A
Heating time	70	secs

OPERATING CONDITIONS

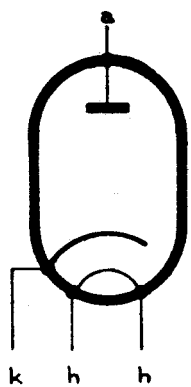
Max. anode voltage	250	V.rms
Max. rectified current	120	mA
Max. voltage, heater to cathode	350	Vpk

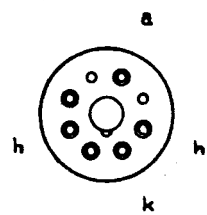
Max. Capacitance of Reservoir Condenser (μF)	Limiting Resistance in Series with anode (ohms)
8.0	0
16.0	75
32.0	125

DIMENSIONS



ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS





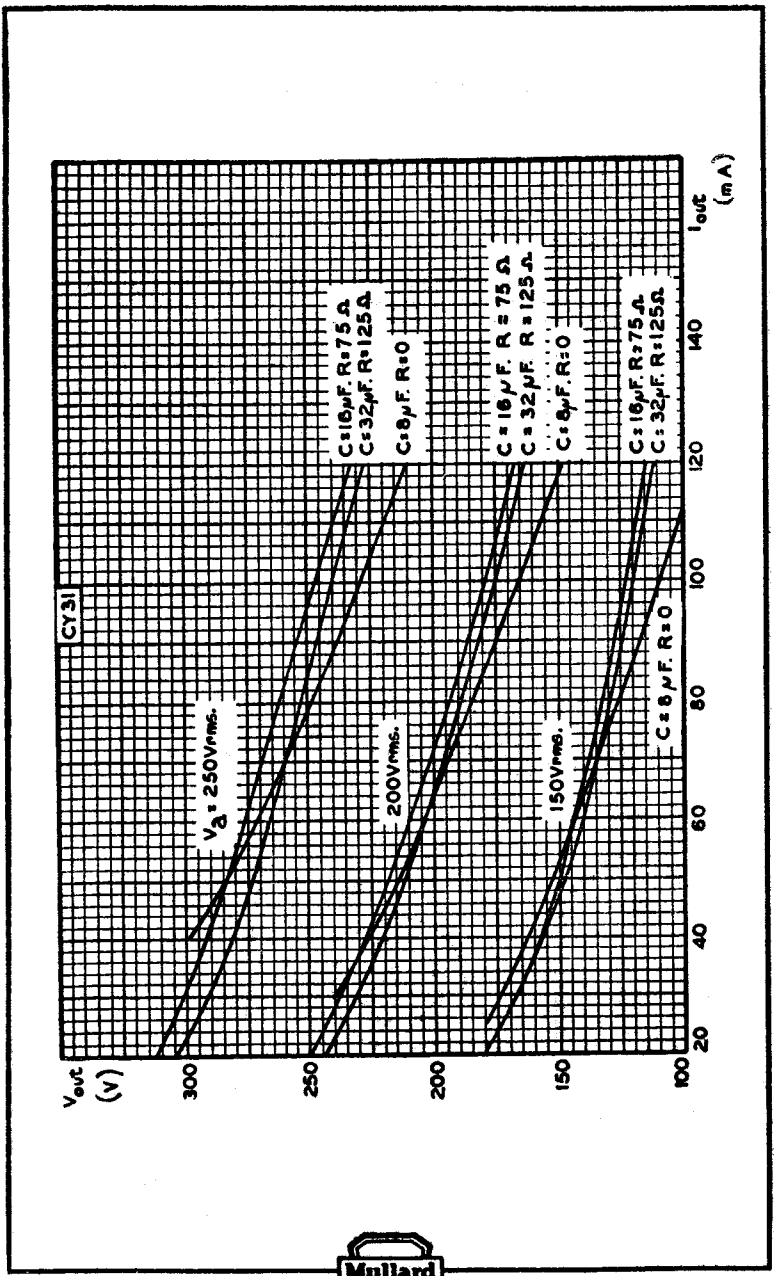
OCTAL BASE

Mullard

CY31

HALF WAVE RECTIFIER

Indirectly-heated power rectifier for D.C./A.C. mains-operated equipment.



Mullard

Mullard
MEDIUM IMPEDANCE TRIODE

DA1

The DA1 is a medium impedance triode for use as a low frequency amplifier in compact equipment such as deaf aids.

FILAMENT CHARACTERISTICS

Filament Voltage ...	... 2·0 volts
Filament Current ...	... 0·05 amp

DIMENSIONS

Overall Length ...	= 60 mm.
Overall Diameter...	= 19 mm.

OPERATING DATA

Anode Voltage	Va_W	= 20	40 volts
Anode Current	Ia_W	= 100	250 μA
Grid Voltage	$-Vg1_W$	= 0·15	0·25 volt
Slope	S_W	= 0·2	0·4 mA/V
Internal Resistance	Ri_W	= 150,000	80,000 ohms
Amplification Factor	G_W	= 30	32

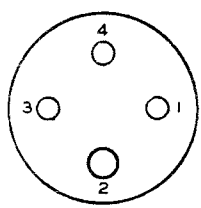
CAPACITIES

Anode to Control Grid	Cag1	= 1·6 $\mu\mu$F
Input	Cg1	= 3·8 $\mu\mu$F
Output	Ca	= 5·4 $\mu\mu$F

LIMITS

Maximum Anode Voltage	Va_{max}	= 100 volts
Maximum Resistance in Grid Circuit	$Rg1f_{max}$	= 1·0 megohm
Range of Grid Voltage for 1 μA Grid Current at Va=40 V	Vg1	= 0 to +1·0 volt

CONNECTIONS

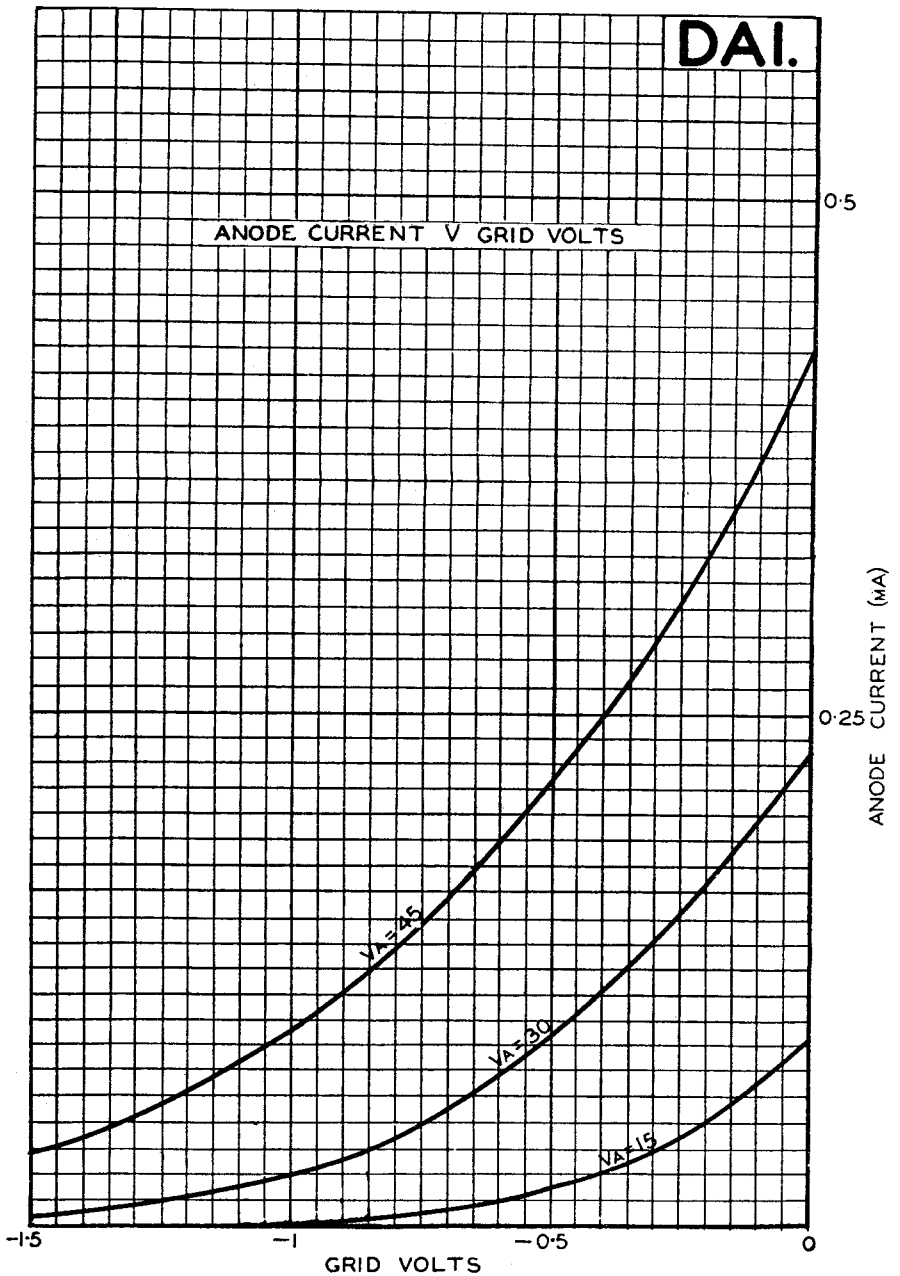


Pin No. 1 Anode
„ 2 Grid
„ 3 Filament
„ 4 Filament

Viewed from free end of pins.

DA1

Mullard
MEDIUM IMPEDANCE TRIODE



1537

Mullard
MEDIUM IMPEDANCE TRIODE

DA2

The DA2 is a medium impedance triode for use as a voltage amplifier or output valve in compact equipment such as deaf aids.

FILAMENT CHARACTERISTICS

Filament Voltage ...	... 2·0 volts
Filament Current ...	... 0·05 amp

DIMENSIONS

Overall Length ...	= 60 mm.
Overall Diameter...	= 19 mm.

OPERATING DATA

Anode Voltage	Va_W	= 20	40 volts
Anode Current	Ia_W	= 0·5	1·25 mA
Grid Voltage	$-Vg1_W$	= 0·9	2·15 volts
Slope	S_W	= 0·35	0·5 mA/V
Internal Resistance	Ri_W	= 18,900	13,600 ohms
Amplification Factor	G_W	= 6·6	6·9

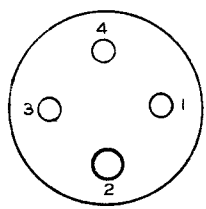
CAPACITIES

Anode to Control Grid	Cag1	= 1·4 $\mu\mu$F
Input	Cg1	= 3·4 $\mu\mu$F
Output	Ca	= 5·4 $\mu\mu$F

LIMITS

Maximum Anode Voltage	Va_{max}	= 100 volts
Maximum Resistance in Grid Circuit	$Rg1_{max}$	= 1·0 megohm
Range of Grid Voltage for 1 μA Grid Current at Va=40 V	Vg1	= +0·3 to +1·3 volts

CONNECTIONS



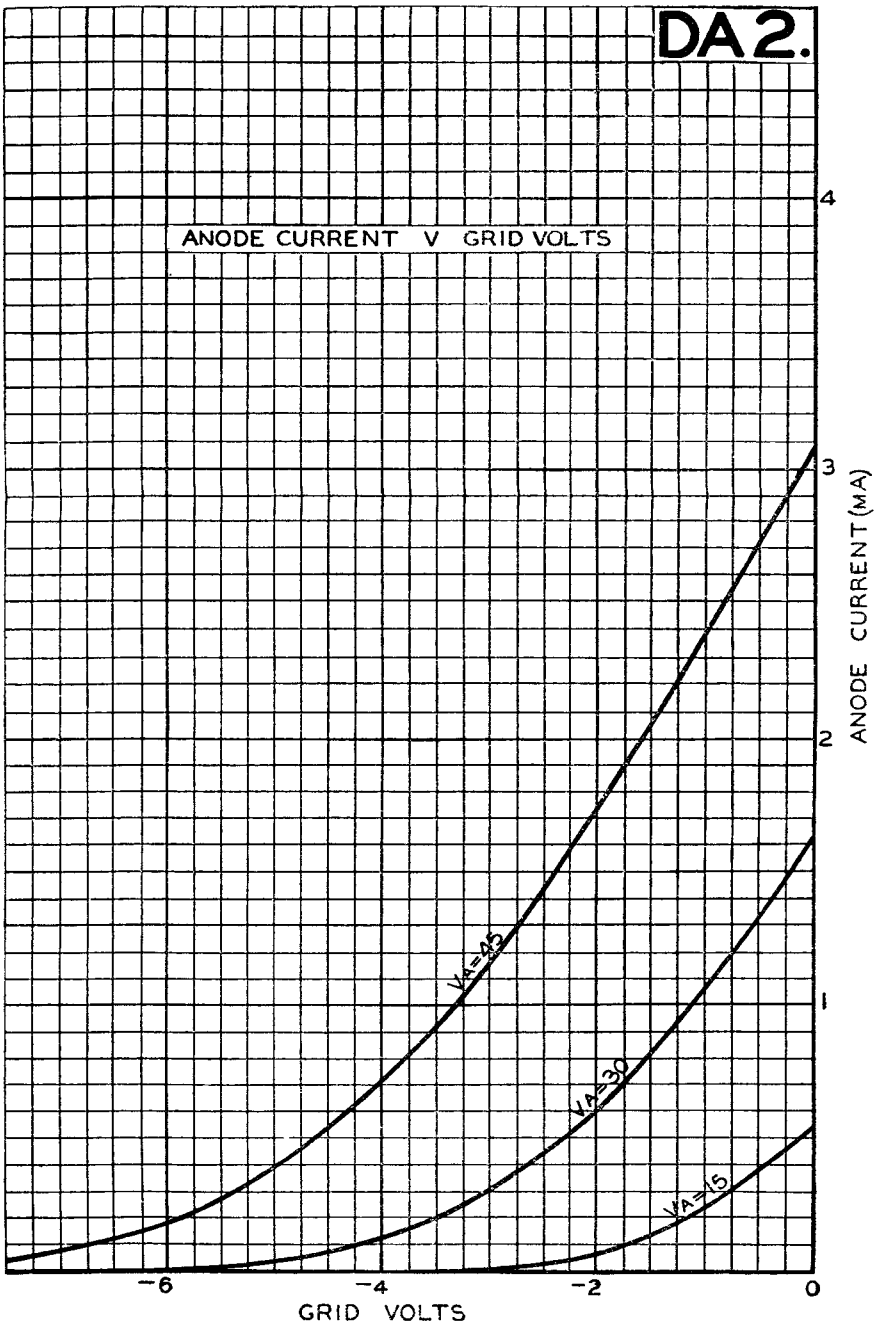
Pin No. 1 Anode
„ 2 Grid
„ 3 Filament
„ 4 Filament

Viewed from free end of pins.

DA2

Mullard

MEDIUM IMPEDANCE TRIODE



1537

Mullard
MEDIUM IMPEDANCE TRIODE

DA3

TENTATIVE DATA

Filament

Vf = 2.0 V
If = 0.055 A

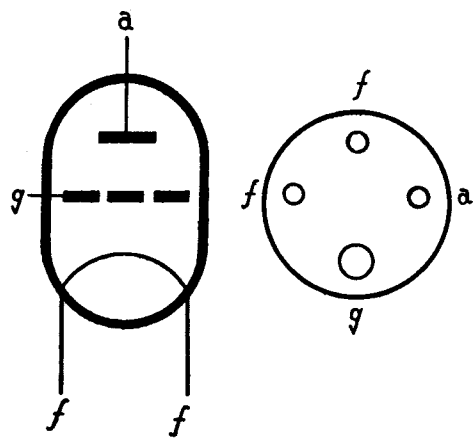
Operating Conditions

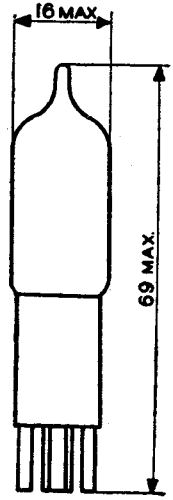
Va	20	40 V
Ia	0.5	1.8 mA
-Vg1	1.0	2.8 V
μ	4.7	4.7
S	0.35	0.62 mA/V
Ri	13,500	7,600 Ω

Limiting Values

Va max	100 V
Rg1 max	1.0 MΩ

Arrangement of electrodes and base connections

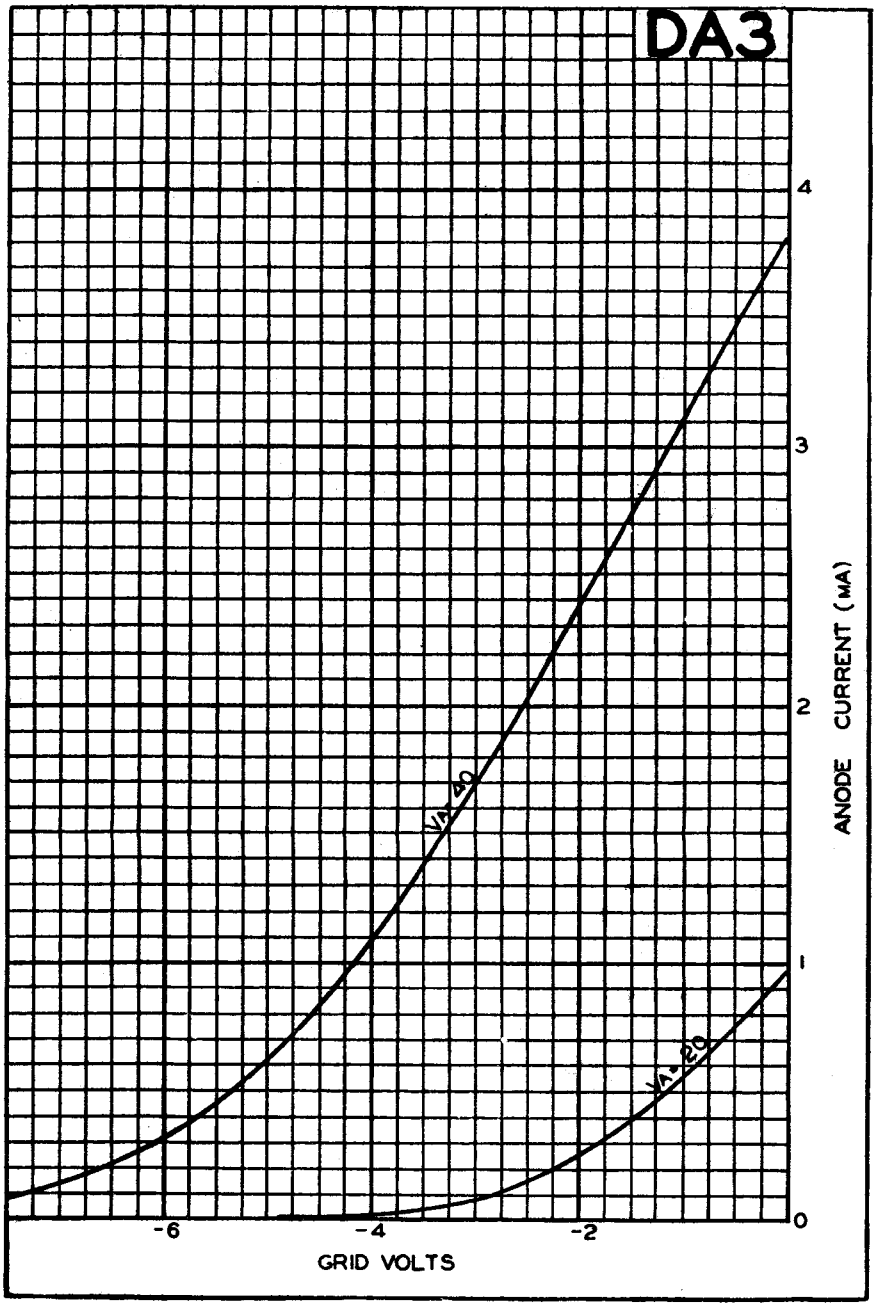




DA3

Mullard

MEDIUM IMPEDANCE TRIODE



SINGLE DIODE

DA90

Indirectly-heated single diode primarily intended for use in battery-operated equipment.

HEATER

V_h	1.4	V
I_h	0.15	A

MOUNTING POSITION Any

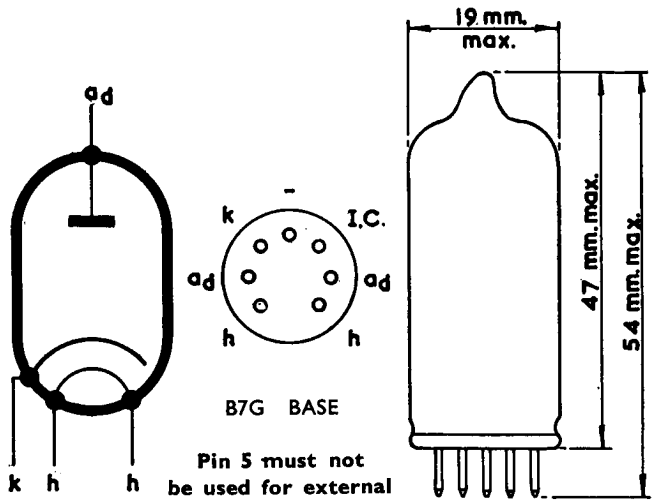
CAPACITANCES (measured without external shield)

C_{a-k}	0.4	μμF
C_{a-h}	0.8	μμF
C_{h-k}	0.6	μμF

RESONANT FREQUENCY (approximate) 1,000 Mc/s

LIMITING VALUES

P.I.V. max.	330	V
I_a max.	0.5	mA
$i_{a(pk)}$ max.	5	mA
V_{h-k} max.	140	V



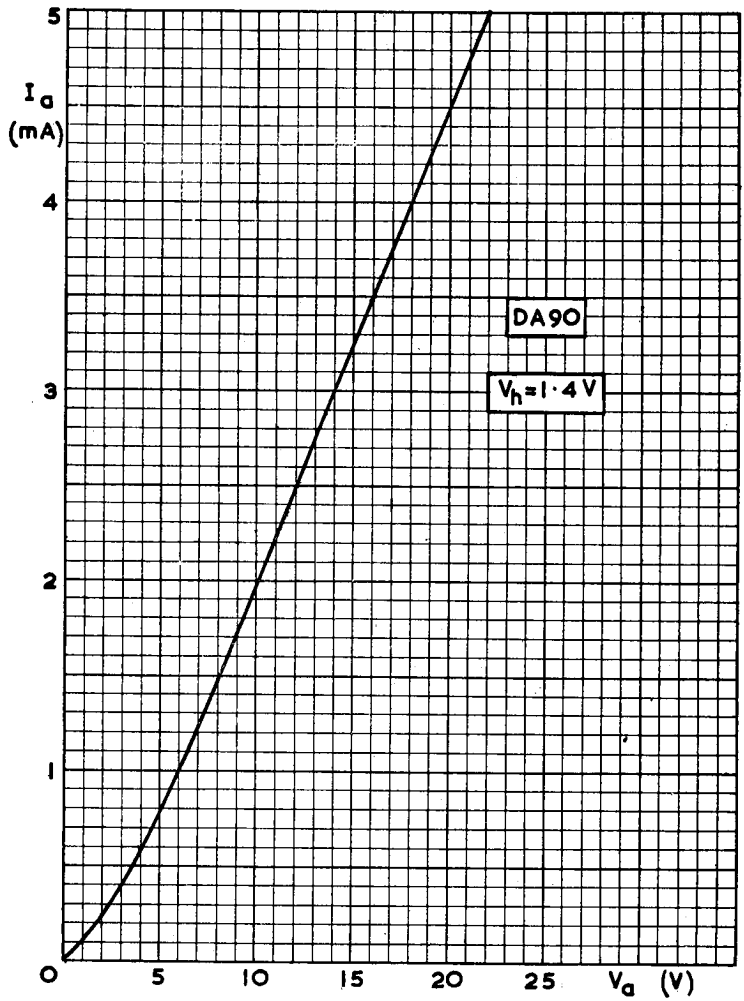
B7G BASE

Pin 5 must not be used for external connections.

DA90

SINGLE DIODE

Indirectly-heated single diode primarily intended for use in battery-operated equipment.



SUBMINIATURE DIODE A.F. PENTODE

DAF70

Subminiature a.f. pentode, combined with a single diode, suitable for battery operation.

FILAMENT

V_f	1.25	V
I_f	25	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm. from the seal and any bending of the valve leads must be at least 1.5mm. from the seal.

CAPACITANCES (measured with external shield)

C_{a-g1}	0.15	pF
C_{in}	2.0	pF
C_{out}	4.3	pF
C_{ad-g}	0.1	pF

CHARACTERISTICS

V_a	67.5	V
V_{g2}	67.5	V
I_a	1.0	mA
I_{g2}	250	μA
V_{g1}	0	V
g_m	440	μA/V
r_a	400	kΩ
μ_{g1-g2}	16	

OPERATING CONDITIONS AS R.C. COUPLED A.F. AMPLIFIER

V_b	67.5	V
R_a	1.0	MΩ
R_{g2}	4.7	MΩ
*R_{g1}	3.3	MΩ
V_{out}	73	
V_{in}		

* Grid resistor of following valve.

MAINTENANCE TYPE

DAF70

SUBMINIATURE DIODE A.F. PENTODE

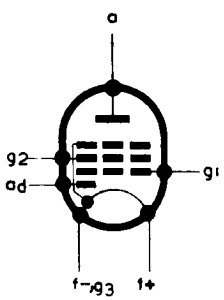
Subminiature a.f. pentode, combined with a single diode, suitable for battery operation.

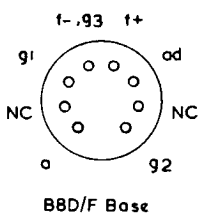
OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_a	67.5	90	V
V_{g2}	67.5	90	V
V_{g1}	−1.8	−2.6	V
$I_{a(o)}$	400	600	μA
$I_{g2(o)}$	85	135	μA
R_a	150	150	kΩ
P_{out}	10.5	20	mW
D_{tot}	10	10	%

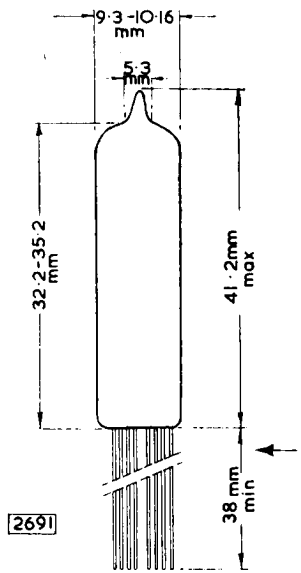
LIMITING VALUES

V_a max.	90	V
V_{g2} max.	90	V
I_k max.	1.3	mA
I_{ad} max.	250	μA





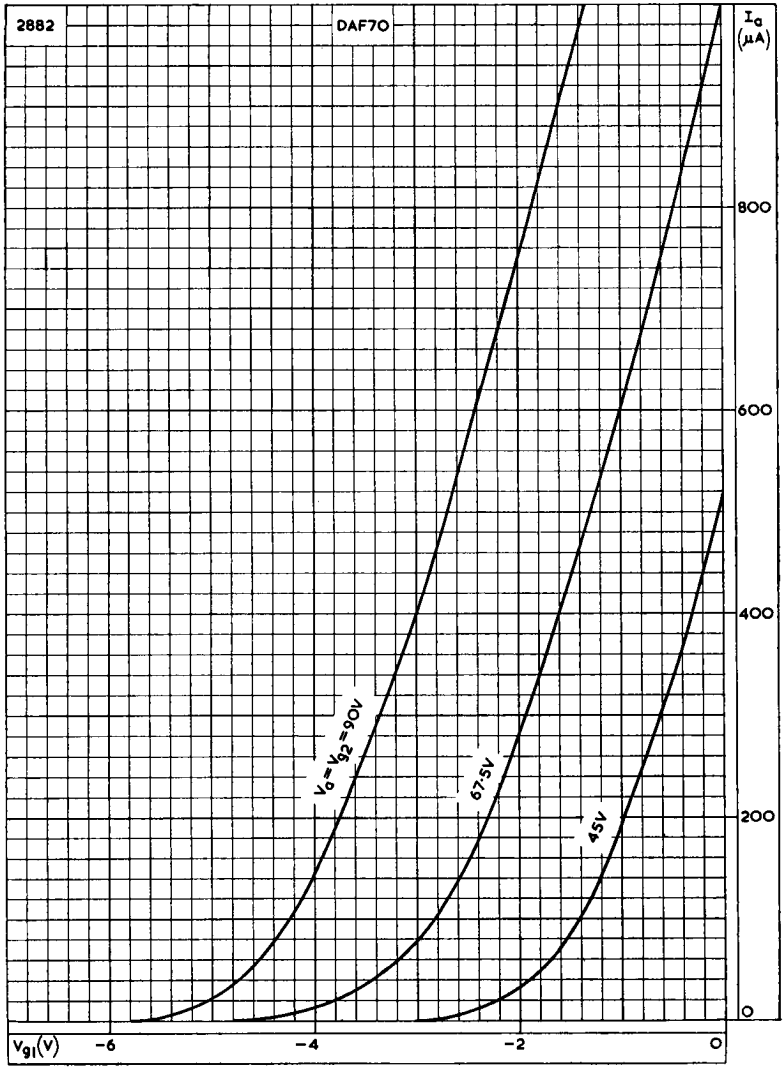
B8D/F Base



SUBMINIATURE DIODE A.F. PENTODE

DAF70

Subminiature a.f. pentode, combined with a single diode, suitable for battery operation.

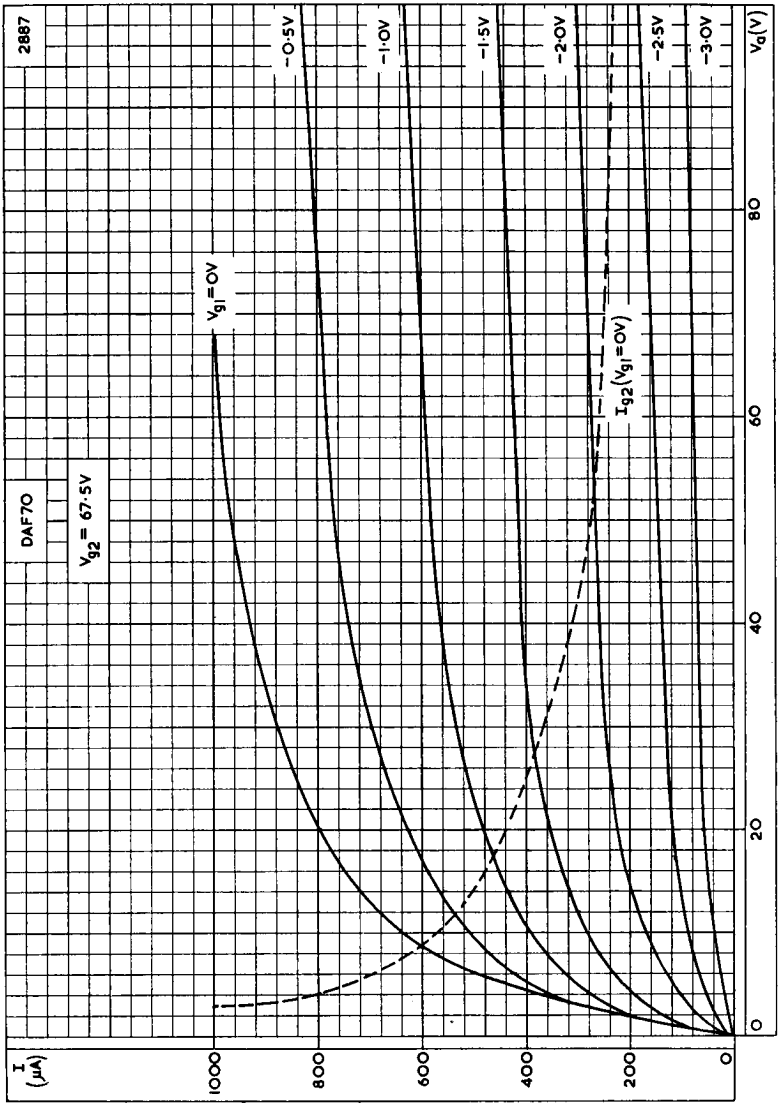


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

DAF70

SUBMINIATURE DIODE A.F. PENTODE

Subminiature a.f. pentode, combined with a single diode, suitable for battery operation.

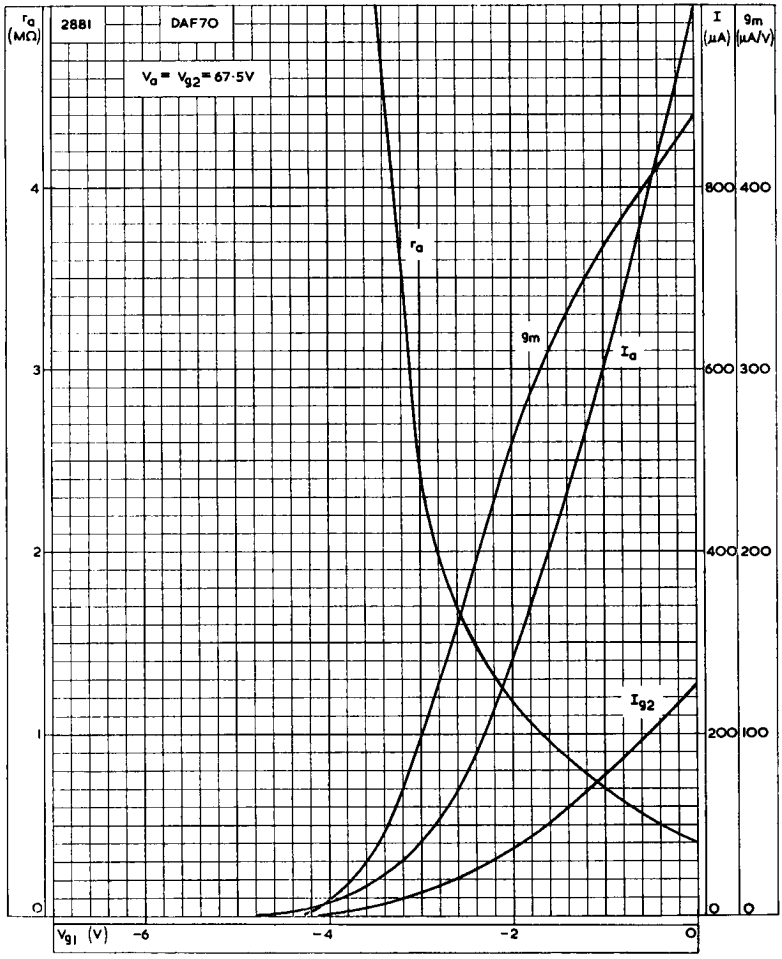


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SUBMINIATURE DIODE A.F. PENTODE

DAF70

Subminiature a.f. pentode, combined with a single diode, suitable for battery operation.

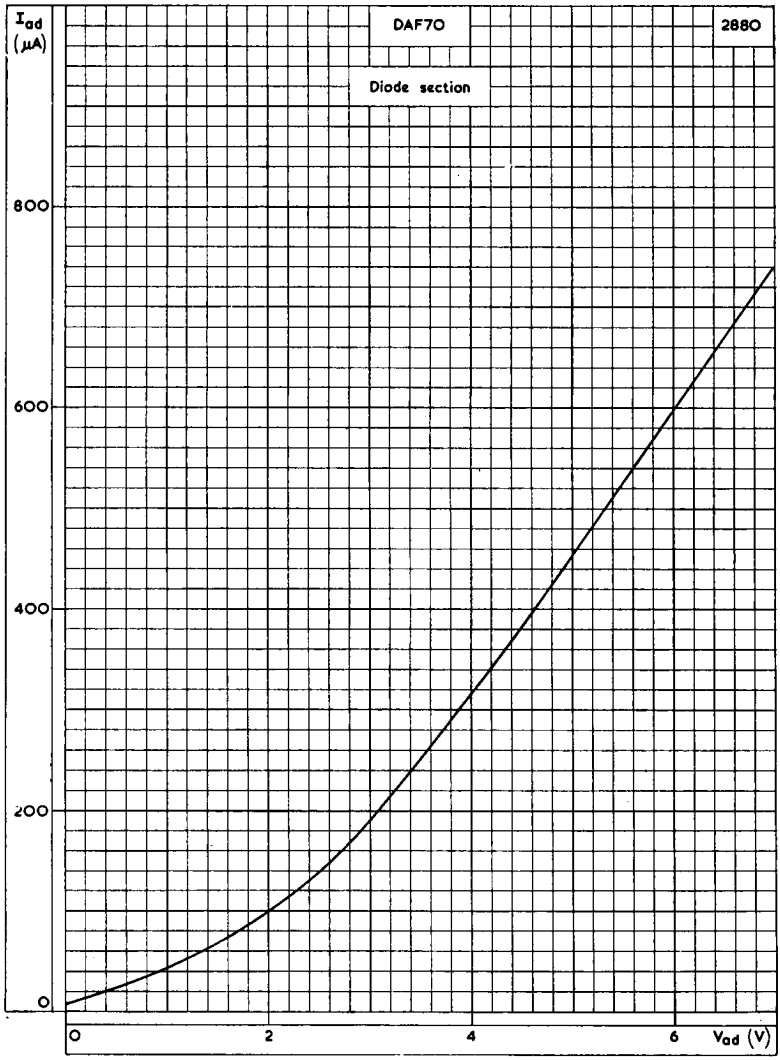


ELECTRODE CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

DAF70

SUBMINIATURE DIODE A.F. PENTODE

Subminiature a.f. pentode, combined with a single diode, suitable for battery operation.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE (DIODE SECTION)

DIODE A.F. PENTODE

DAF96

Short grid-base pentode, suitable for a.f. voltage amplification in battery operated receivers, combined with a single diode.

FILAMENT

Suitable for d.c. operation from a series or parallel supply.

	Series	*Parallel*	
V_f	1.3	1.4	V
I_f	24	25	mA

CAPACITANCES (measured without external shield)

C_{a-g1}	< 0.3	pF
C_{in}	1.8	pF
C_{out}	2.5	pF
C_{ad-all}	1.1	pF
C_{ad-ap}	< 0.9	pF
$C_{ad\ g1}$	0.03	pF

CHARACTERISTICS

Pentode section

V_a	67.5	V
V_{g2}	67.5	V
I_a	170	μA
I_{g2}	55	μA
V_{g1}	−1.5	V
g_m	170	μA/V
μ_{g1-g2}	16	
V_{g1} max. ($I_{g1} = +0.3\mu A$)	0	V

Diode section

The diode anode is located at the negative end of the filament.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

Pentode connection

V_b* (V)	R_a (MΩ)	R_{g2}** (MΩ)	R_{g1} (MΩ)	Source impedance (kΩ)	R_{g1}*** (MΩ)	I_k (μA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	D_{tot} (%)
85	1.0	2.7	10	0	1.0	85	55	5.0	2.5
85	1.0	2.7	10	470	1.0	85	50	5.0	2.5
85	1.0	2.7	10	0	2.0	85	65	5.0	2.0
85	1.0	2.7	10	470	2.0	85	60	5.0	2.5
64	1.0	2.7	10	0	1.0	60	45	5.0	4.0
64	1.0	2.7	10	470	1.0	60	40	5.0	4.0
64	1.0	2.7	10	0	2.0	60	57	5.0	3.5
64	1.0	2.7	10	470	2.0	60	52	5.0	3.5

*Based on line voltages of 67.5 and 90V decreased by the negative bias for the output valve.

**R_{g2} by-passed to earth by 0.47μF capacitor.

***Grid resistor of following valve.

DAF96

DIODE A.F. PENTODE

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

Triode connection (g_2 to a)

V_b* (V)	R_a (MΩ)	R_{g1} (MΩ)	Source impedance (MΩ)	R_{g1}** (MΩ)	I_k (μA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	D_{tot} (%)
85	0.22	10	0	1.0	210	11	5.0	2.0
85	1.0	10	0	1.0	60	12.5	5.0	2.0
64	0.22	10	0	1.0	135	11	5.0	3.0
64	1.0	10	0	1.0	40	12	5.0	3.0

*Based on line voltages of 67.5 and 90V decreased by the negative bias for the output valve.

**Grid resistor of following valve.

LIMITING VALUES

Pentode section

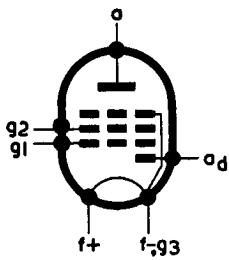
V_b max. (absolute)	110	V
V_a max.	90	V
p_a max.	30	mW
V_{g2} max.	90	V
p_{g2} max.	10	mW
I_k max.	250	μA
R_{g1-f} max. ($I_k < 250\mu A$)	3.0	MΩ
R_{g1-f} max. ($I_k < 100\mu A$)	22	MΩ

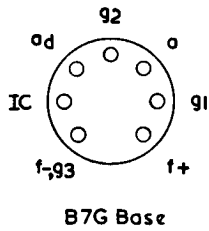
This valve can be used without special precautions against microphony in circuits in which the input voltage, V_{in}, is not less than 20mV for an output of 50mW from the output stage.

Diode section

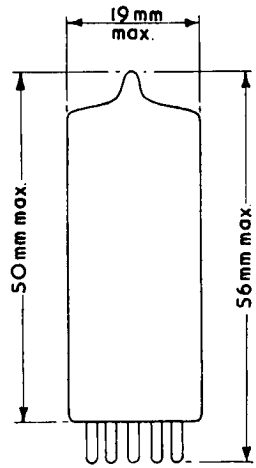
P.I.V.	100	V
I_{ad} max.	200	μA
$i_{ad(pk)}$ max.	1.2	mA

DAF96





B7G Base



2375

Mullard
SCREENED TETRODE

DAS1

TENTATIVE DATA

Filament		Vf =	2.0 V
		If =	0.06 A
Capacities	Cag1 =		0.07 μμF
	Cg1 =		5.7 μμF
	Ca =		3.4 μμF

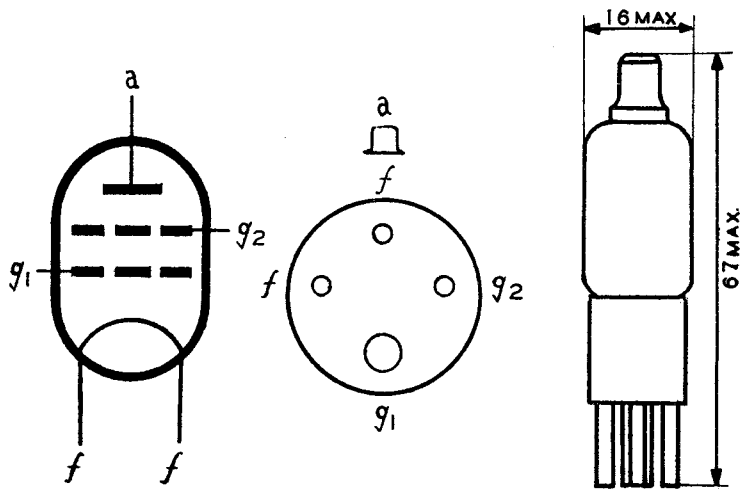
Operating Conditions

Va	120	120	V
Vg2	45	60	V
-Vg	2.0	2.7	V
Ia	0.8	1.5	mA
S	0.43	0.58	mA/V
Ri	0.65	0.5	MΩ

Limiting Values

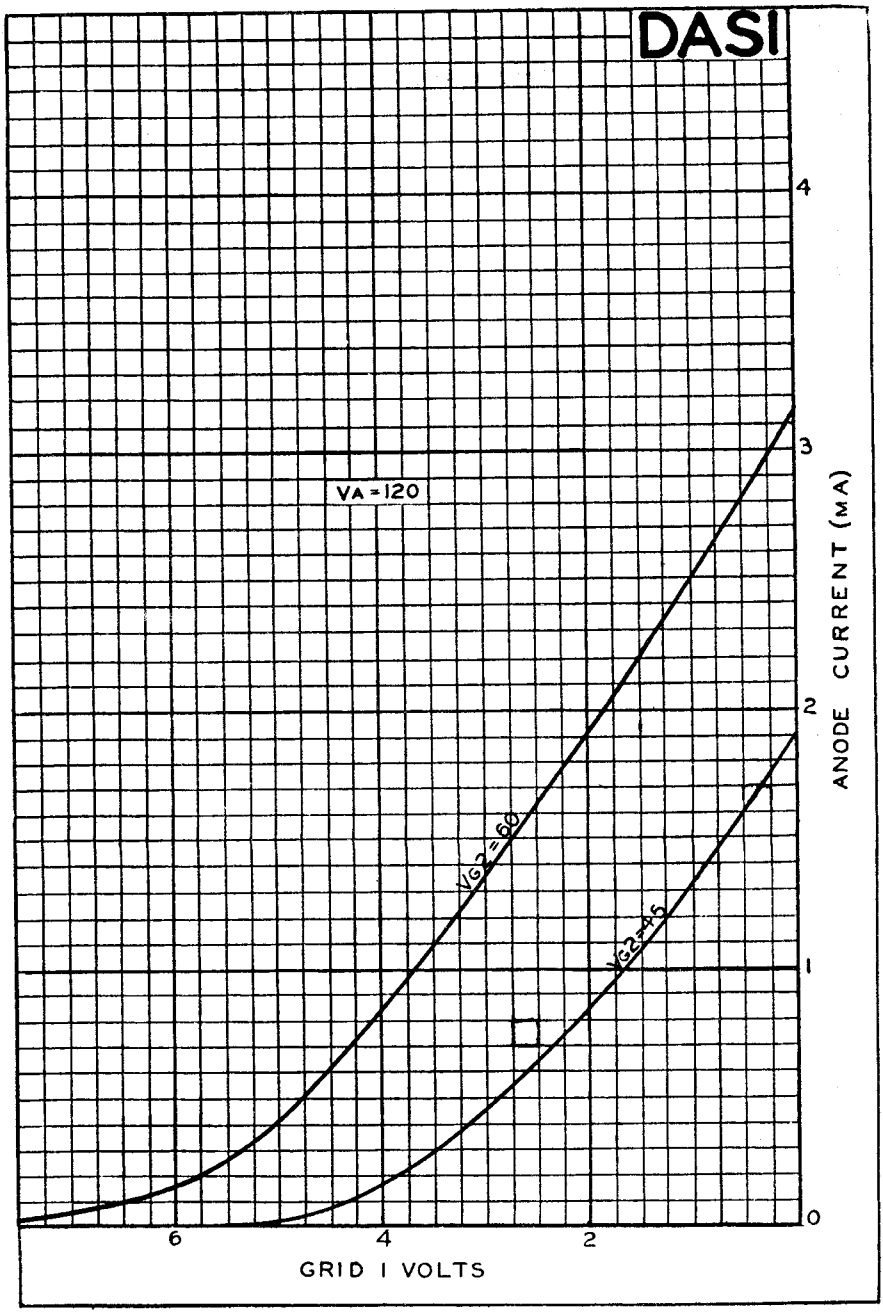
Va max	120 V
Vg2 max.....	60 V
Rg1 max	2.0MΩ

Arrangement of electrodes and base connections.



DAS1

Mullard
SCREENED TETRODE



Mullard
MEDIUM IMPEDANCE TRIODE

DB1

TENTATIVE DATA.

Filament	Vf	=	1.5 V
	If	=	0.07 A
Capacities	Cagl	=	1.6 μμF
	Cgl	=	3.8 μμF
	Ca	=	5.4 μμF

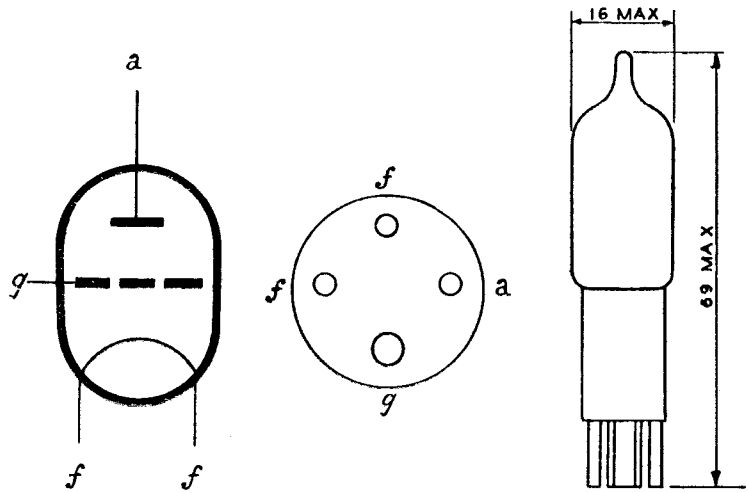
Operating Conditions

Va	20	40	V
Ia	100	250	μA
-Vgl	0.15	0.25	V
S	0.2	0.4	mA/V
g	30	32	
Ri	150,000	80,000	

Limiting Values

Va max		100	V
Rglf max		1.0	M
Vgl max (Ig = 1.0 μA)	0 to	1.0	V

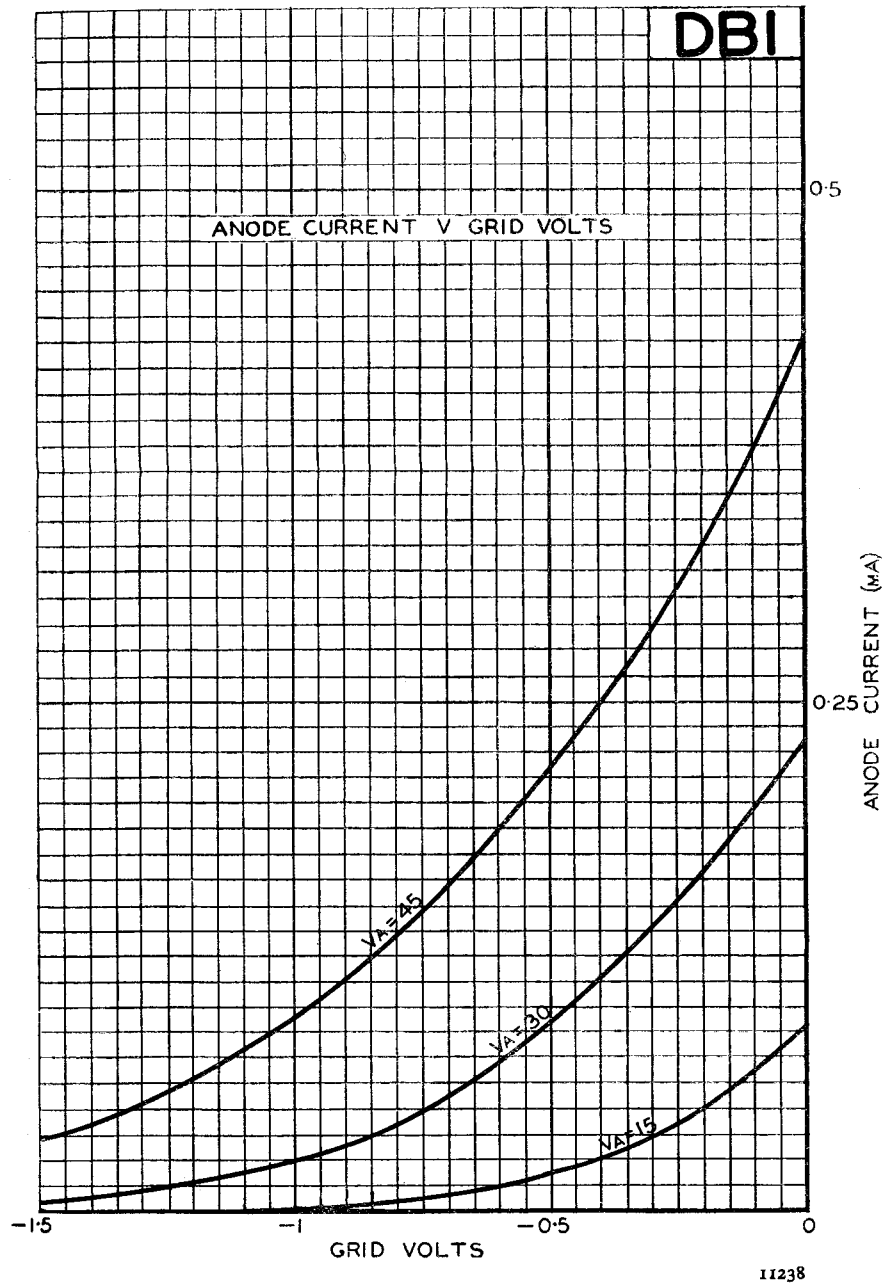
Arrangement of electrodes and base connections.



DB1

Mullard

MEDIUM IMPEDANCE TRIODE



11238

Mullard
MEDIUM IMPEDANCE TRIODE

DB3

TENTATIVE DATA

Filament

Vf = 1.5 V
If = 0.07 A

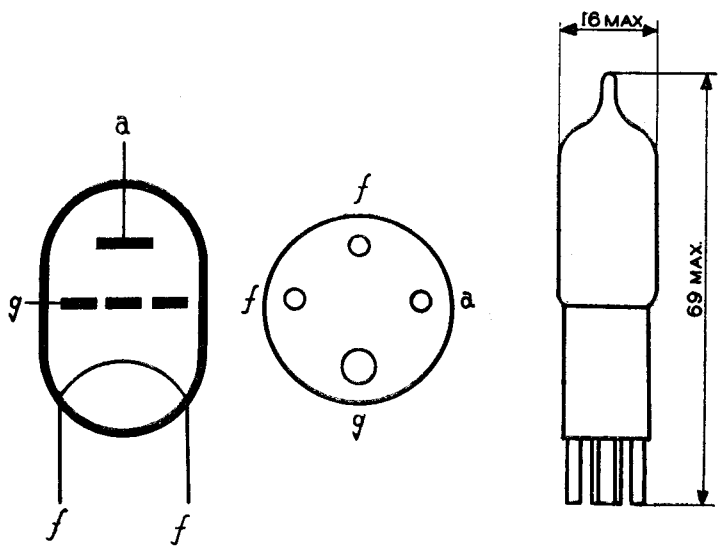
Operating Conditions

Va	20	40	V
Ia	0.5	1.8	mA
-Vg1	1.0	2.8	V
μ	4.7	4.7	
S	0.35	0.62	mA/V
Ri	13,500	7,600	Ω

Limiting Values

Va max	100 V
Rg1 max	1.0 MΩ

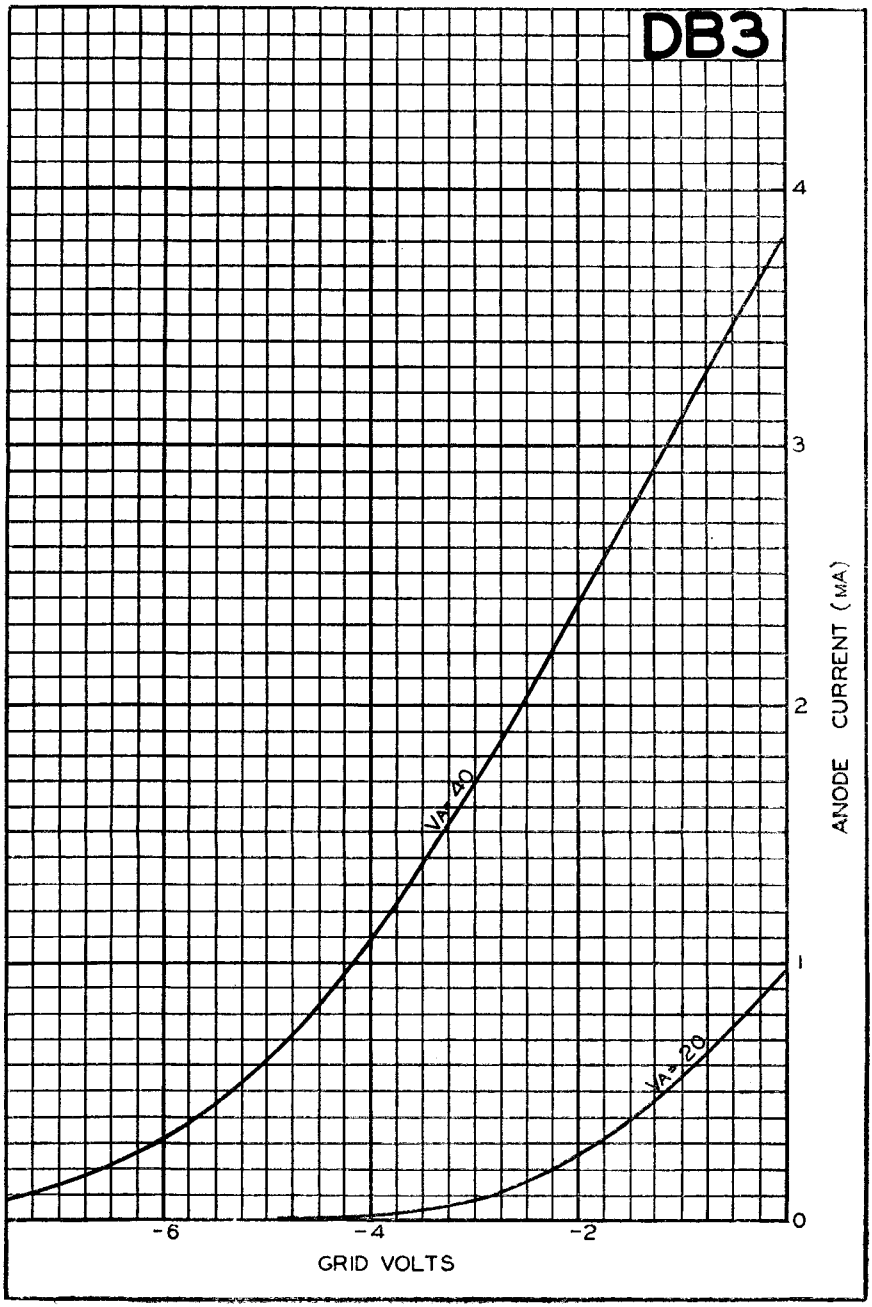
Arrangement of electrodes and base connections



DB3

DB3

Mullard
MEDIUM IMPEDANCE TRIODE



11238

Mullard
SCREENED TETRODE

DBS1

TENTATIVE DATA

Filament		Vf =	1.5 V
		If =	0.07 A
Capacities	Cag1 =		0.07 μμF
	Cg1 =		5.7 μμF
	Ca =		3.4 μμF

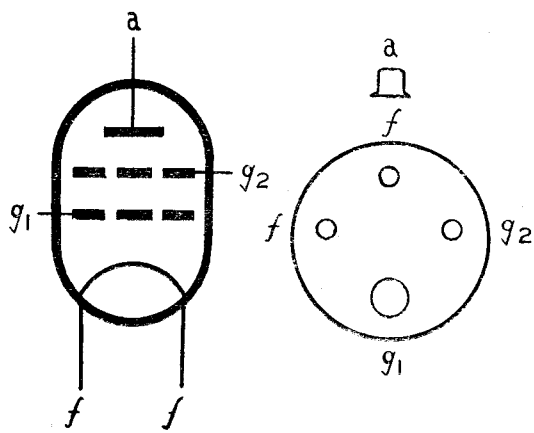
Operating Conditions

Va	120	120	V
Vg2	45	60	V
-Vg	2.0	2.7	V
Ia	0.8	1.5	mA
S	0.43	0.58	mA/V
Ri	0.65	0.5	MΩ

Limiting Values

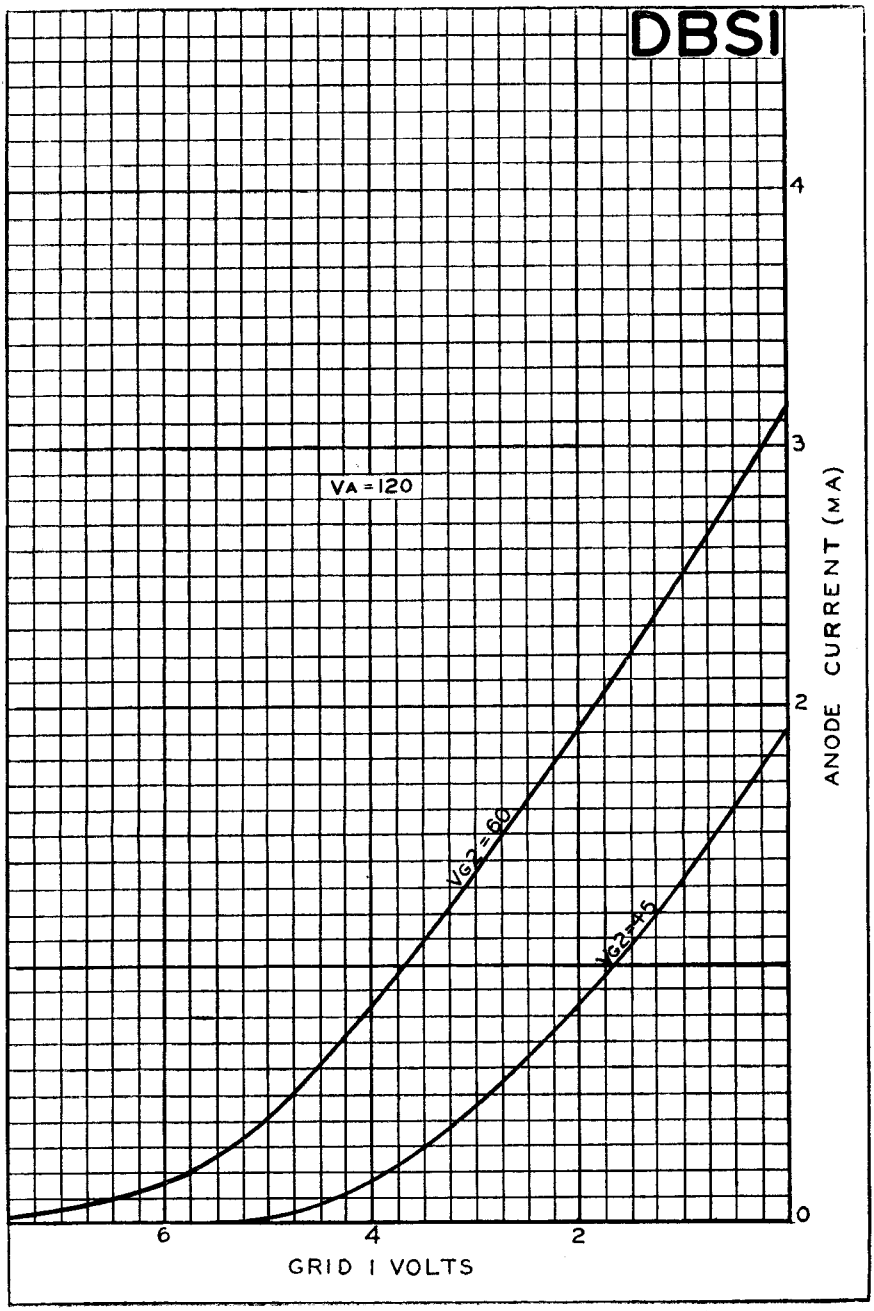
Va max	120 V
Vg2 max.	60 V
Rg1 max	2.0MΩ

Arrangement of electrodes and base connections.



DBS1

Mullard
SCREENED TETRODE



11238

SUBMINIATURE U.H.F. TRIODE

DC70

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.

This valve is primarily intended for use in communications equipment of the 'push to talk' type and its continuous life rating under typical supply voltage conditions is relatively short and is chiefly a function of hours of filament operation and filament temperature.

Under 'push to talk' conditions an operating life of about 200 hours may be expected.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	200	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

If the valve is used with an earthed metal clip a decrease in output power of approximately 10% can be expected up to 200Mc/s.

CAPACITANCES

	Shielded	Unshielded	
C_{a-g}	1.5	1.5	pF
C_{g-f}	1.3	1.25	pF
C_{a-f}	1.9	1.0	pF

CHARACTERISTICS

V_a	150	V
I_a	14.5	mA
V_{g1}	−4.5	V
g_m	3.75	mA/V
r_a	4.0	kΩ
μ	15	

OPERATING CONDITIONS AS CLASS 'C' TELEGRAPHY R.F. OSCILLATOR

f	10	50	200	400	500	Mc/s
V_a	150	150	150	150	150	V
I_a	17.1	17.1	17.3	18.5	18.7	mA
I_g	2.9	2.9	2.7	1.5	1.3	mA
R_g	5.6	4.7	3.9	6.8	6.8	kΩ
P_{load}	1.4	1.4	1.0	0.8	0.55	W
η_{load}	55	55	39	29	20	%
$V_{a(pk)}$	120					V
$V_{g(pk)}$	32					V

DC70

SUBMINIATURE U.H.F. TRIODE

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s

OPERATING CONDITIONS AS CLASS 'C' TELEGRAPHY R.F. AMPLIFIER

f	50	200	Mc/s
V_a	150	150	V
V_g	−18	−18	V
I_a	16.4	16.8	mA
I_g	3.6	3.2	mA
P_{load}	1.5	1.2	W
η_{load}	61	48	%

P_{drive} measured at the grid is approximately 200mW at f=200Mc/s and does not include the power lost in the grid tuned circuit.

OPERATING CONDITIONS AS FREQUENCY MULTIPLIER

Single valve doubler

f_{out}	50	Mc/s
V_a	150	V
V_g	−45	V
I_a	17.3	mA
I_g	2.7	mA
P_{load}	1.0	W
η_{load}	39	%

Two valve push-push doubler

f_{out}	200	470	500	Mc/s
V_a	150	150	150	V
V_g	−45	−40	−40	V
I_a	2×18	2×11.8	2×11.9	mA
I_g	2×2.0	2×0.7	2×0.6	mA
P_{load}	1.6	0.38	0.34	W
η_{load}	30	11	10	%

Single valve trebler

f_{out}	50	470	500	Mc/s
V_a	150	150	150	V
V_g	−80	−80	−80	V
I_a	18.1	14.3	14.4	mA
I_g	1.9	0.7	0.6	mA
P_{load}	650	220	190	mW
η_{load}	24	10	9.0	%

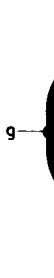
SUBMINIATURE U.H.F. TRIODE

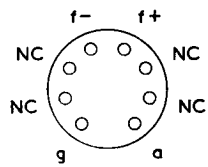
DC70

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.

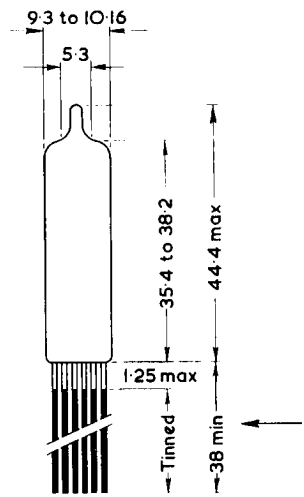
LIMITING VALUES

V_a max.	150	V
p_a max.	2.4	W
I_g max.	5.0	mA
R_{g-f} max.	500	kΩ
V_f max. (absolute)	1.35	V
V_g max.:—r.f. amplifier	−30	V
frequency doubler	−45	V
push-push doubler (f<400Mc/s)	−45	V
push-push doubler (f>400Mc/s)	−40	V
frequency trebler	−80	V
I_k max.:—	20	mA
push-push doubler (f<400Mc/s)	2×20	mA
push-push doubler (f>400Mc/s)	2×12.5	mA
frequency trebler (f>400Mc/s)	15	mA





B8D/F Base



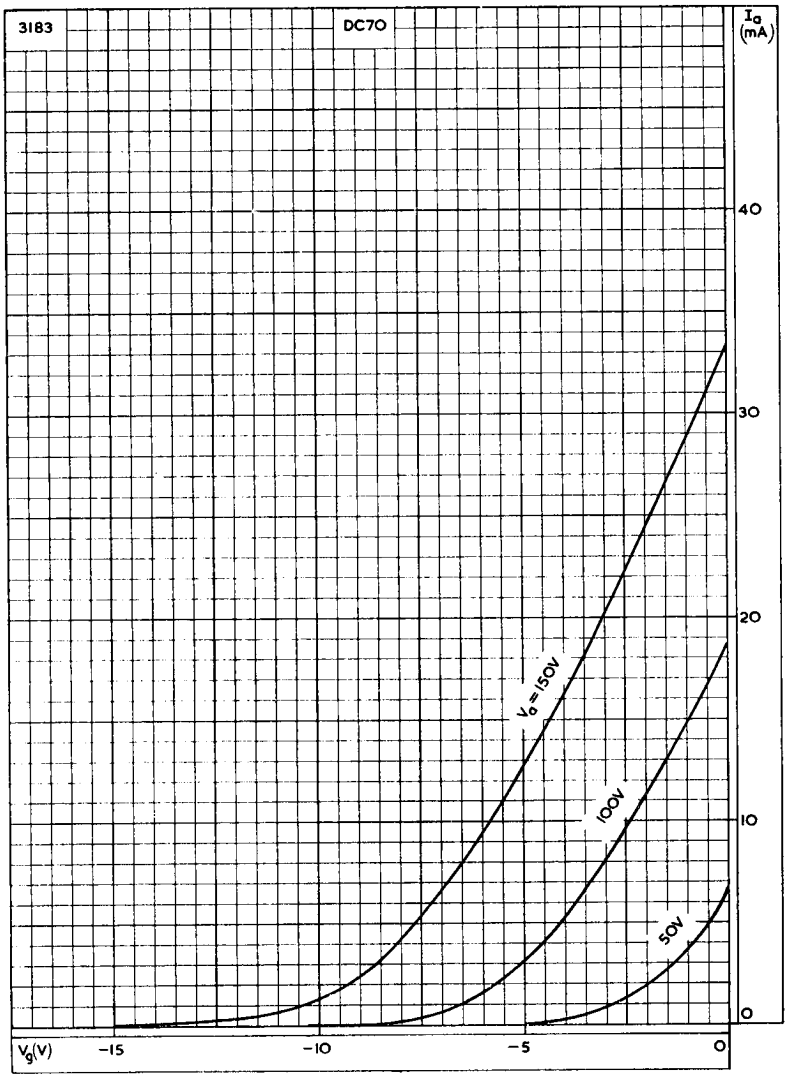
3228

All dimensions in mm

DC70

SUBMINIATURE U.H.F. TRIODE

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.

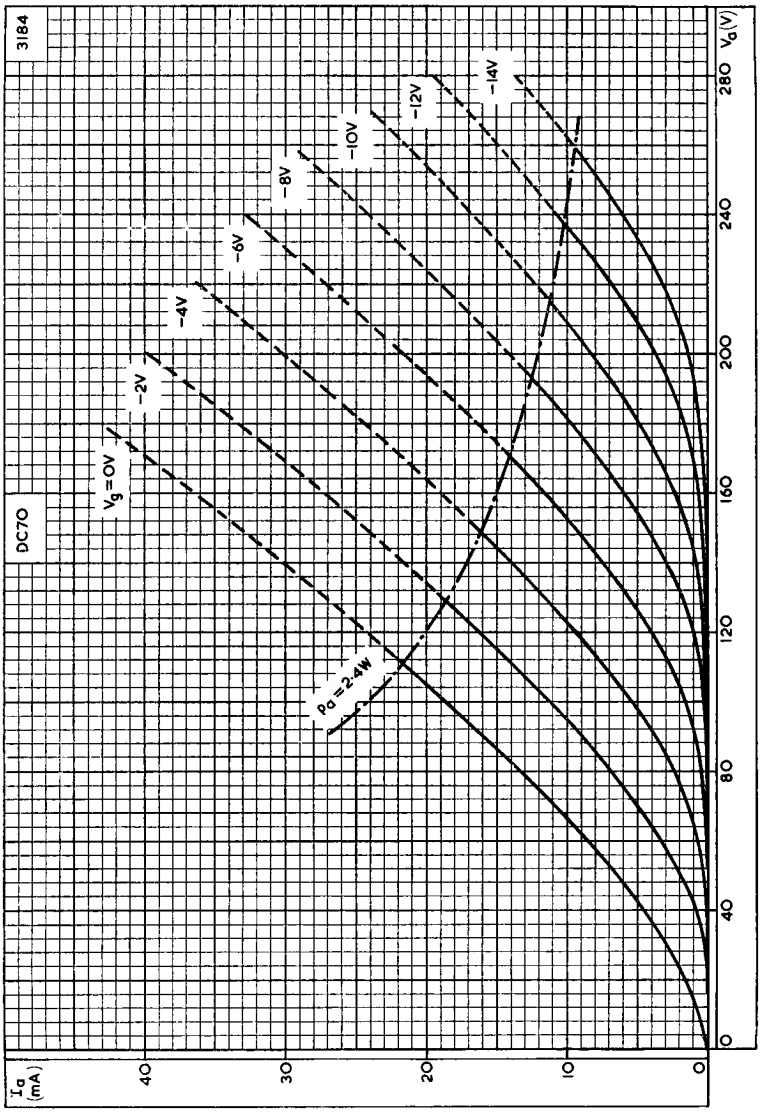


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

SUBMINIATURE U.H.F. TRIODE

DC70

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.

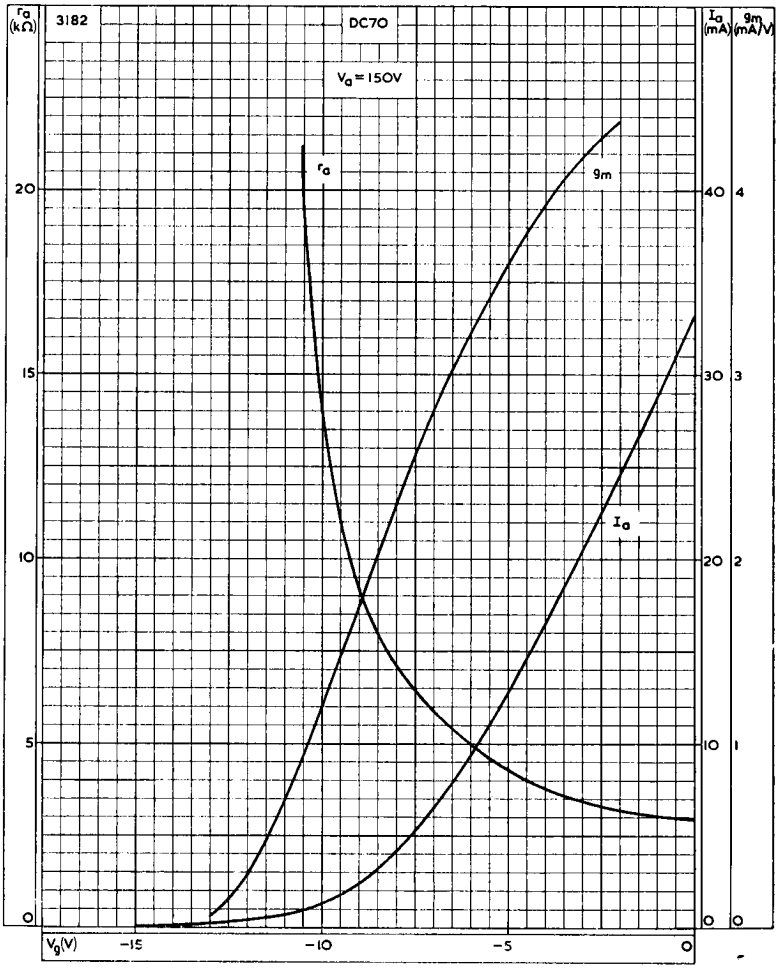


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

DC70

SUBMINIATURE U.H.F. TRIODE

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.



ANODE CURRENT, ANODE IMPEDANCE AND MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE

MINIATURE DOUBLE TRIODE

DCC90

R.F. double triode primarily intended for use in battery-operated portable transmitters.

FILAMENT

This valve is suitable for d.c. operation only.

Series. V_f applied across two sections in series between pins 1 and 7. V_g referred to pin 1.

Parallel. V_f applied across the two filament sections in parallel between pin 4 and pins 1 and 7 connected together.
V_g referred to pins 1 and 7 connected together.

	Series	*Parallel*	
V_f	2.8	1.4	V
I_f	0.11	0.22	A

For series filament operation a shunting resistor must be connected across one filament section, between pins 1 and 4 to by-pass the excess cathode current in this section. The value of the resistor should be such that the voltage across the shunted section equals that across the other section.

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

$c_{a'-a''}$	0.32	μμF
c_{g-f} (each section)	0.9	μμF
c_{a-f} (each section)	1.0	μμF
c_{a-g} (each section)	3.2	μμF

CHARACTERISTICS (each section)

V_a	90	V
V_g	−2.5	V
I_a	3.7	mA
μ	15	
r_a	8.3	kΩ
g_m	1.8	mA/V

DCC90

MINIATURE DOUBLE TRIODE

R.F. double triode primarily intended for use in battery-operated portable transmitters.

OPERATING CONDITIONS AS PUSH PULL R.F. AMPLIFIER OR OSCILLATOR AT 40 Mc/s. (Intermittent operation)

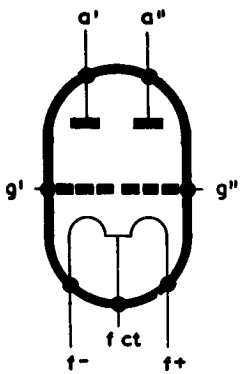
V_a	135	V
*V_g	−20	V
R_g	4	kΩ
R_k	570	Ω
$v_{in(pk)}$	2×45	V
I_a	2×15	mA
I_g (approx.)	2×2.5	mA
p_g (approx.)	0.2	W
P_{out} (approx.)	2	W

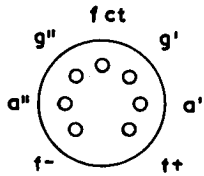
* Obtained from fixed supply, or by means of cathode or grid resistor of valve shown.

LIMITING VALUES (Intermittent operation)

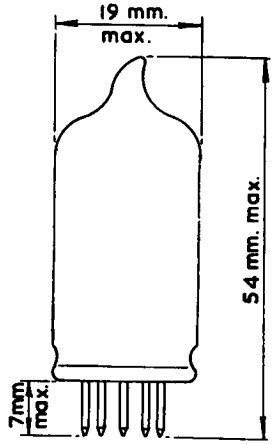
V_a max.	135	V
V_g max.	−30	V
I_a max.	2×15	mA
I_g max.	2×2.5	mA
p_a max.	2×1	W

For continuous operation the above maximum current and power ratings must be reduced by 50%.





B7G BASE



DDR100

ACCELEROMETER DOUBLE DIODE

GENERAL

A double diode with the anodes elastically supported so that the anode impedance is varied when subjected to acceleration. When arranged in a bridge circuit the out-of-balance voltage produced by the variation in anode impedance is a linear function of the acceleration.

The frequency range over which the response to a sinusoidal acceleration can be considered independent of frequency is 0 to 250 c/s

HEATER

V_h	6.3	V
I_h	0.6	A

The valve should be allowed 15 minutes warming up time.

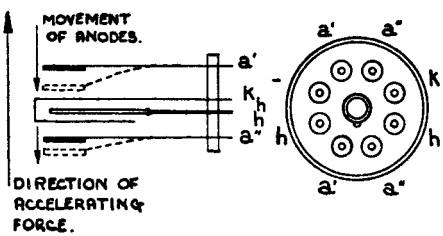
CHARACTERISTICS (In bridge circuit given overleaf)

V_a max.	10	V
I_a max.	60	mA
Max. acceleration	100	g
Resonant frequency	1	Kc/s

SENSITIVITY

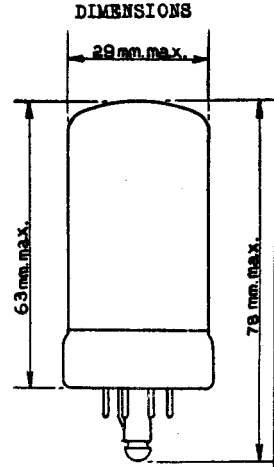
Sensitivity 7.5 mV/g (across bridge)

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS.



B8G BASE

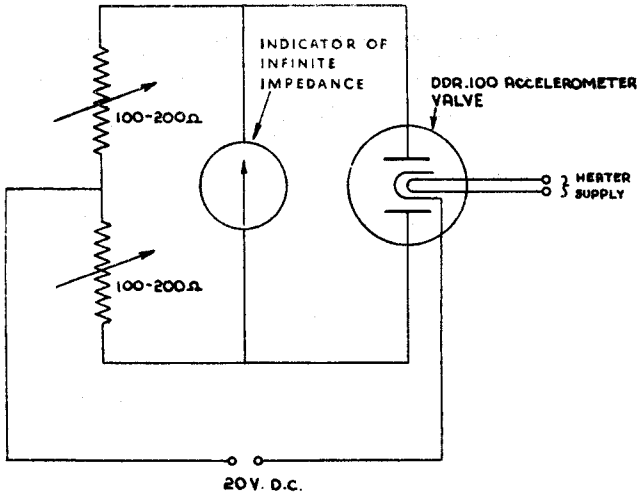
DIMENSIONS



Mullard

DDR100

ACCELEROMETER DOUBLE DIODE



Recommended bridge circuit for use with the DDR.100

DF33

VARIABLE-MU R.F. PENTODE

Variable-mu r.f. pentode for use as a controlled r.f. or i.f. amplifier.

FILAMENT

Suitable for d.c. operation only.

V_f	1.4	V
I_f	50	mA

CAPACITANCES

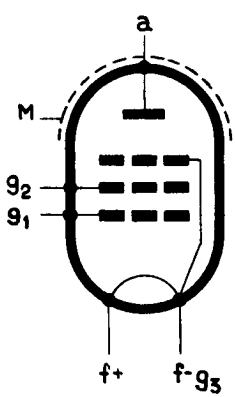
c_{a-g1}	< 0.007	pF
c_{in}	3.8	pF
c_{out}	9.5	pF

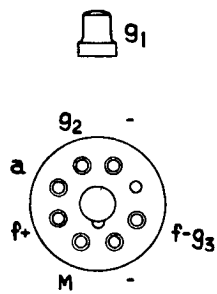
TYPICAL OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_a	90	V
V_{g2}	90	V
V_{g1}	0	V
I_a	1.2	mA
I_{g2}	300	μA
r_a	1.5	MΩ
g_m	750	μA/V
V_{g1} (for 150 : 1 reduction in g_m)	−4.0	V

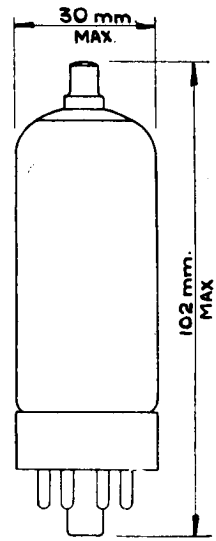
LIMITING VALUES

V_a max.	110	V
V_{g2} max.	110	V





OCTAL BASE



SUBMINIATURE R.F. PENTODE

DF60

Subminiature sharp cut-off r.f. pentode for use in battery-operated equipment.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	50	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	3.7	pF
c_{out}	4.6	pF

CHARACTERISTICS

V_a	45	67.5	V
V_{g2}	45	67.5	V
V_{g1}	0	0	V
R_{g1}	5.0	5.0	MΩ
I_a	0.8	1.8	mA
I_{g2}	220	480	μA
g_m	0.82	1.1	mA/V
r_a	1.2	1.0	MΩ
V_{g1} (g_m = 10μA/V)	−3.0	−4.0	V
R_{in} (f = 50Mc/s)	–	34.5	kΩ
R_{eq}	–	8.2	kΩ

OPERATING CONDITIONS AS A FREQUENCY CHANGER

V_a	45	67.5	V
V_{g2}	45	67.5	V
R_{g1}	100	100	kΩ
I_a	0.56	1.06	mA
I_{g2}	150	300	μA
$V_{osc(r.m.s.)}$	3.0	4.0	V
I_{g1}	33	40	μA
g_c	270	320	μA/V
g_m(eff)	320	400	μA/V
r_a	1.6	1.46	MΩ

DF60

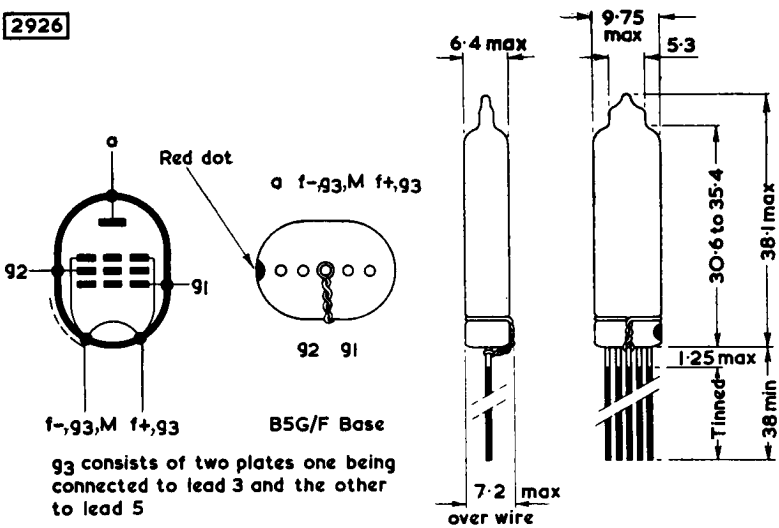
SUBMINIATURE R.F. PENTODE

Subminiature sharp cut-off r.f. pentode for use in battery-operated equipment.

LIMITING VALUES

V_a max.	90	V
V_{g_2} max.	67.5	V
I_k max.	4.0	mA

2926



All dimensions in mm

SUBMINIATURE R.F. PENTODE

DF61

R.F. Pentode for use in battery operated receivers.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	25	mA

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	3.1	pF
c_{out}	3.6	pF

CHARACTERISTICS

V_a	45	67.5	V
V_{g2}	45	67.5	V
V_{g1}	0	0	V
I_a	0.8	1.7	mA
I_{g2}	200	450	μA
g_m	750	950	μA/V
r_a	1.4	1.6	MΩ
μ_{g1-g2}	21	21	
V_{g1} (for 100:1 reduction in g_m)	−2.6	−4.0	V
R_{in} (f=50Mc/s)	—	57	kΩ
R_{eq}	—	10	kΩ

OPERATING CONDITIONS AS A FREQUENCY CHANGER

V_a	45	67.5	V
V_{g2}	45	67.5	V
R_{g1-f}	100	100	kΩ
I_a	0.6	1.35	mA
I_{g2}	140	400	μA
$V_{osc(r.m.s.)}$	3.0	4.0	V
I_{g1}	30	30	μA
g_c	220	290	μA/V
g_m(eff)	300	450	μA/V
r_a	1.4	2.0	MΩ

LIMITING VALUES

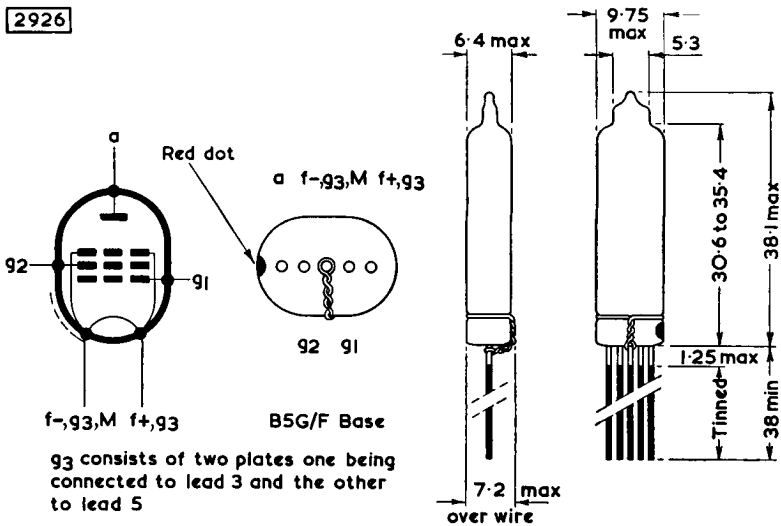
V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	67.5	V
I_k max.	2.5	mA
V_{g1}(I_{g1} = +0.3μA)	>0	V

DF61

SUBMINIATURE R.F. PENTODE

R.F. Pentode for use in battery operated receivers.

2926



All dimensions in mm

SUBMINIATURE R.F. PENTODE

DF62

Subminiature sharp cut-off R.F. Pentode for use in battery operated equipment.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	100	mA

CAPACITANCES

c_{a-g_1}	<0.01	pF
c_{in}	4.0	pF
c_{out}	4.0	pF

CHARACTERISTICS

V_a	45	V
V_{g_2}	45	V
V_{g_1}	0	V
R_{g_1}	2.0	MΩ
I_a	3.0	mA
I_{g_2}	800	μA
g_m	2.0	mA/V
r_a	500	kΩ
$\mu_{g_1-g_2}$	17.5	
R_{in} (f=50Mc/s)	20	kΩ
R_{eq}	5.5	kΩ

OPERATING CONDITIONS AS A FREQUENCY CHANGER

V_a	45	67.5	V
V_{g_2}	45	67.5	V
R_{g_1-f}	100	100	kΩ
I_a	0.8	1.4	mA
I_{g_2}	250	450	μA
$V_{osc(r.m.s.)}$	3.5	4.0	V
I_{g_1}	40	45	μA
g_c	490	600	μA/V
g_m(eff)	600	800	μA/V
r_a	525	450	kΩ

LIMITING VALUES

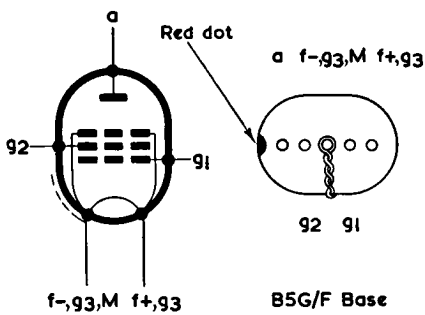
V_a max.	90	V
V_{g_2} max.	90	V
I_k max.	6.5	mA
V_{g_1}(I_{g_1} = +0.5μA)	−0.5	V

DF62

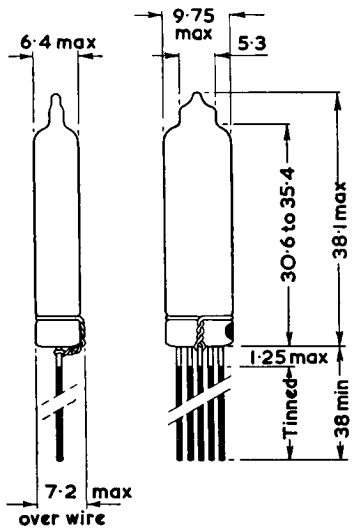
SUBMINIATURE R.F. PENTODE

Subminiature sharp cut-off R.F. Pentode for use in battery operated equipment.

2926



g_3 consists of two plates one being connected to lead 3 and the other to lead 5



All dimensions in mm

SUBMINIATURE VARIABLE-MU R.F. PENTODE

DF63

Subminiature variable-mu r.f. pentode suitable for battery operated equipment.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	25	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	3.0	pF
c_{out}	3.5	pF

CHARACTERISTICS

V_a	67.5	V
V_{g2}	67.5	V
V_{g1}	0	V
I_a	1.7	mA
I_{g2}	490	μA
g_m	850	μA/V
r_a	1.6	MΩ
V_{g1} (for 100 : 1 reduction in g_m)	−14	V
$+V_{g1}$ min. (I_{g1} = +0.3μA)	0	V

LIMITING VALUES

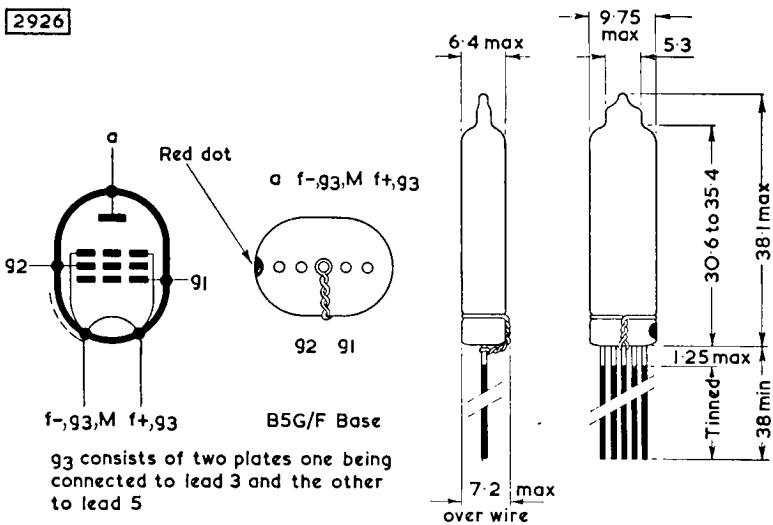
V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	67.5	V
I_k max.	2.5	mA

DF63

SUBMINIATURE VARIABLE-MU R.F. PENTODE

Subminiature variable-mu r.f. pentode suitable for battery operated equipment.

2926



g3 consists of two plates one being connected to lead 3 and the other to lead 5

All dimensions in mm

SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

DF64

Subminiature voltage amplifying pentode suitable for use in hearing aids. It has a filament current of 10mA and is primarily intended for use with an h.t. battery supply of 15volts.

FILAMENT

V_f	0.62	V
I_f	10	mA

MOUNTING POSITION

Any

Note.—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES (measured without external shield)

c_{a-g1}	<0.2	pF
c_{in}	1.8	pF
c_{out}	2.0	pF

CHARACTERISTICS

V_a	15	V
V_{g2}	15	V
I_a	50	μA
V_{g1}	−0.75	V
I_{g2}	17	μA
g_m	90	μA/V
r_a	1.2	MΩ
μ_{g1-g2}	7.5	

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER (see circuit for component references)

With fixed bias

V_b	15	V
R_a	2.2	MΩ
R_{g2}	2.7	MΩ
V_{g1}	−0.62	V
I_k	6.6	μA
Gain	27.4	dB
R_{out}	5.0	MΩ

With grid current biasing (zero source impedance)

V_b	15	V
R_a	2.2	MΩ
R_{g2}	4.7	MΩ
R_{g1}	10	MΩ
I_k	5.9	μA
Gain	28	dB
R_{out}	5.0	MΩ

LIMITING VALUES

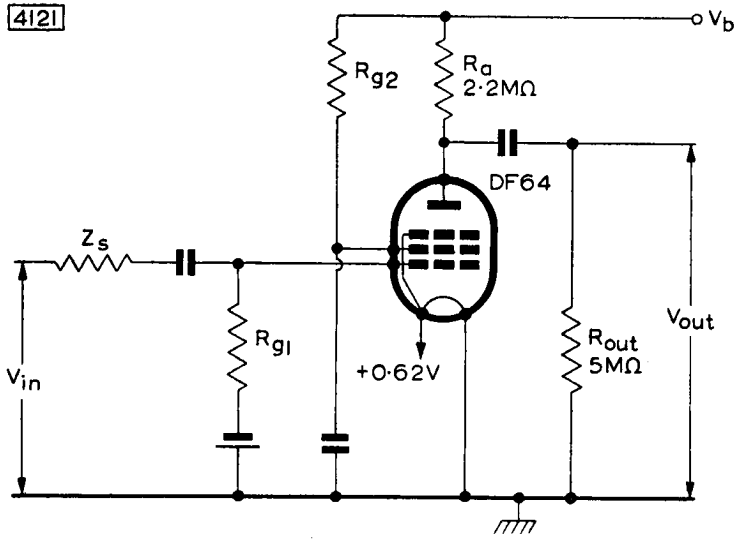
V_a max.	45	V
V_{g2} max.	45	V
I_k max.	75	μA

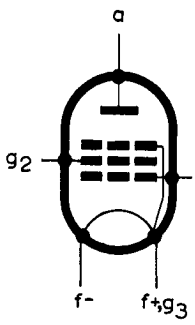
DF64

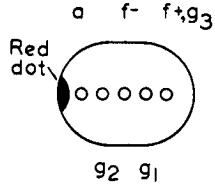
SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

Subminiature voltage amplifying pentode suitable for use in hearing aids. It has a filament current of 10mA and is primarily intended for use with an h.t. battery supply of 15volts.

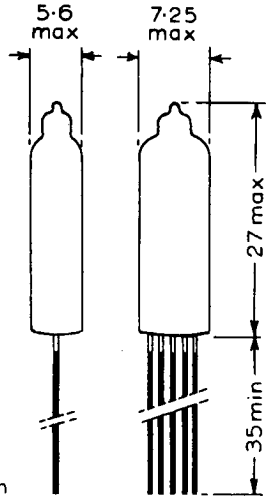
4121







B5A/F Base



4134

All dimensions in mm

SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

DF66

Subminiature voltage amplifying pentode suitable for use in hearing-aids. It has a filament current of 15 mA and is primarily intended for use with an H.T. battery supply of 22.5 volts.

FILAMENT

V_f	0.625	V
I_f	15	mA

MOUNTING POSITION

Any.

Note—Direct soldered connections to the leads of this valve must be at least 5 mm. from the seal and any bending of the valve leads must be at least 1.5 mm. from the seal.

CAPACITANCES (measured without external screen)

c_{a-g1}	0.15	μμF
c_{in}	1.6	μμF
c_{out}	2.2	μμF

CHARACTERISTICS

V_a	22.5	V
V_{g2}	22.5	V
I_a	50	μA
I_{g2}	15	μA
V_{g1}	−1.05	V
g_m	100	μA/V
r_a	>2	MΩ
μ_{g1-g2}	11.5	

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER (*see circuit overleaf*)

(*a*) With fixed bias

V_b	22.5	V
R_a	1.0	MΩ
R_{g2}	2.0	MΩ
V_{g1}	−0.625	V
I_k	16	μA
V_{out}/V_{in}	33	
R_{out}	5	MΩ

(*b*) With grid current biasing

V_b	22.5	V
R_a	1.0	MΩ
R_{g2}	2.7	MΩ
R_{g1}	10	MΩ
Z_s	0	
I_k	16	μA
V_{out}/V_{in}	35	
R_{out}	5	MΩ

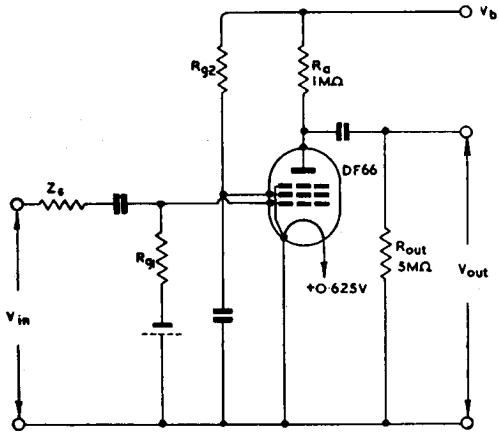
LIMITING VALUES

V_a max.	45	V
V_{g2} max.	45	V
I_k max.	100	μA

DF66

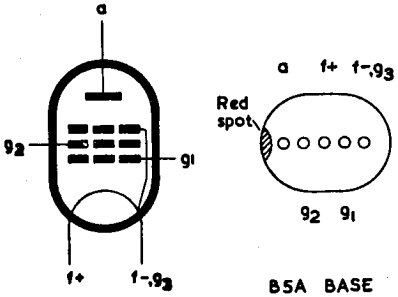
SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

Subminiature voltage amplifying pentode suitable for use in hearing-aids. It has a filament current of 15 mA and is primarily intended for use with an H.T. battery supply of 22.5 volts.

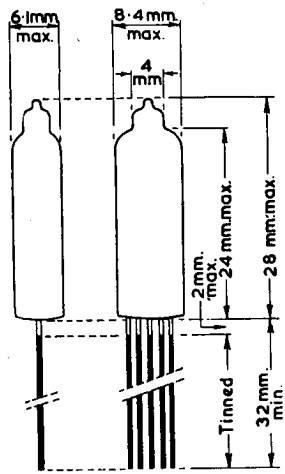


472

Circuit of DF66 as Resistance Coupled A.F. Amplifier



458



MINIATURE VARIABLE-MU R.F. PENTODE

DF91

Variable-mu pentode for use as a controlled R.F. or I.F. amplifier.

FILAMENT

This valve is suitable for d.c. operation only.

V_f	1.4	V
I_f	0.05	A

CAPACITANCES

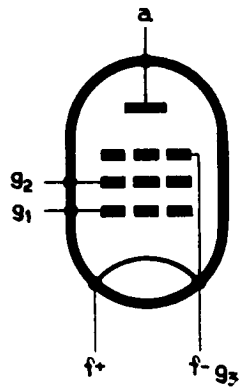
c_{a-g1}	<0.01	μμF
c_{in}	3.6	μμF
c_{out}	7.5	μμF

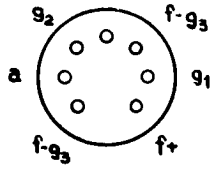
OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

V_a	45	67.5	90	90	V
V_{g2}	45	67.5	45	67.5	V
V_{g1}	0	0	0	0	V
I_a	1.7	3.4	1.8	3.5	mA
I_{g2}	0.7	1.5	0.65	1.4	mA
g_m	700	875	750	900	μA/V
V_{g1} (g_m=10 μA/V)	−10	−16	−10	−16	V
r_a	350	250	800	500	kΩ

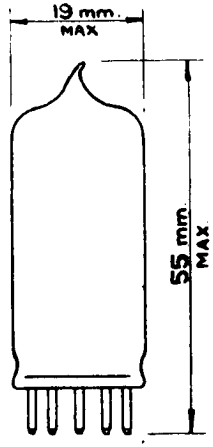
LIMITING VALUES

V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	67.5	V
V_{g1} max.	0	V
I_k max.	5.5	mA





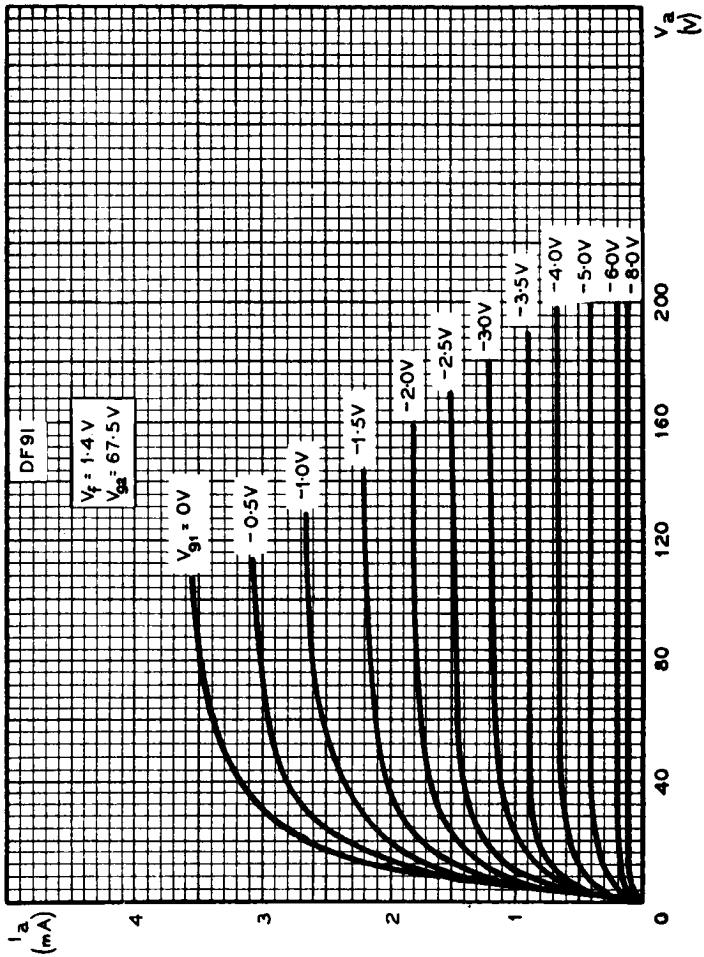
B7G BASE



DF91

MINIATURE VARIABLE-MU R.F. PENTODE

Variable-mu pentode for use as a controlled R.F. or I.F. amplifier.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

R.F. PENTODE

DF92

Short grid-base miniature R.F. pentode for use in battery-operated equipment.

FILAMENT This valve is suitable for D.C. operation only.

V_f	1.4	V
I_f	0.05	A

MOUNTING POSITION Any.

CAPACITANCES (Measured without external screening.)

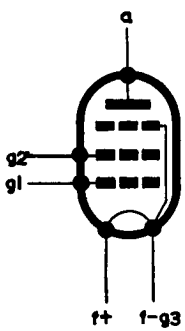
c_{a-g1}	<0.01	μμF
c_{in}	3.6	μμF
c_{out}	7.5	μμF

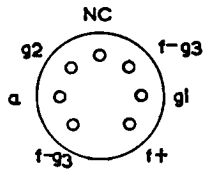
CHARACTERISTICS

V_a	90	90	V
V_{g2}	45	67.5	V
V_{g1}	0	0	V
I_a	1.9	3.7	mA
I_{g2}	0.7	1.4	mA
g_m	0.85	1.0	mA/V
r_a	900	500	kΩ
μ_{g1-g2}	11	11	

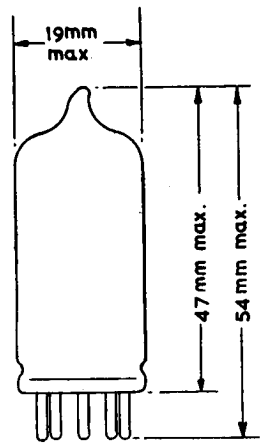
LIMITING VALUES

V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	70	V
V_{g1} max.	0	V
I_k max.	6.0	mA





B7G BASE

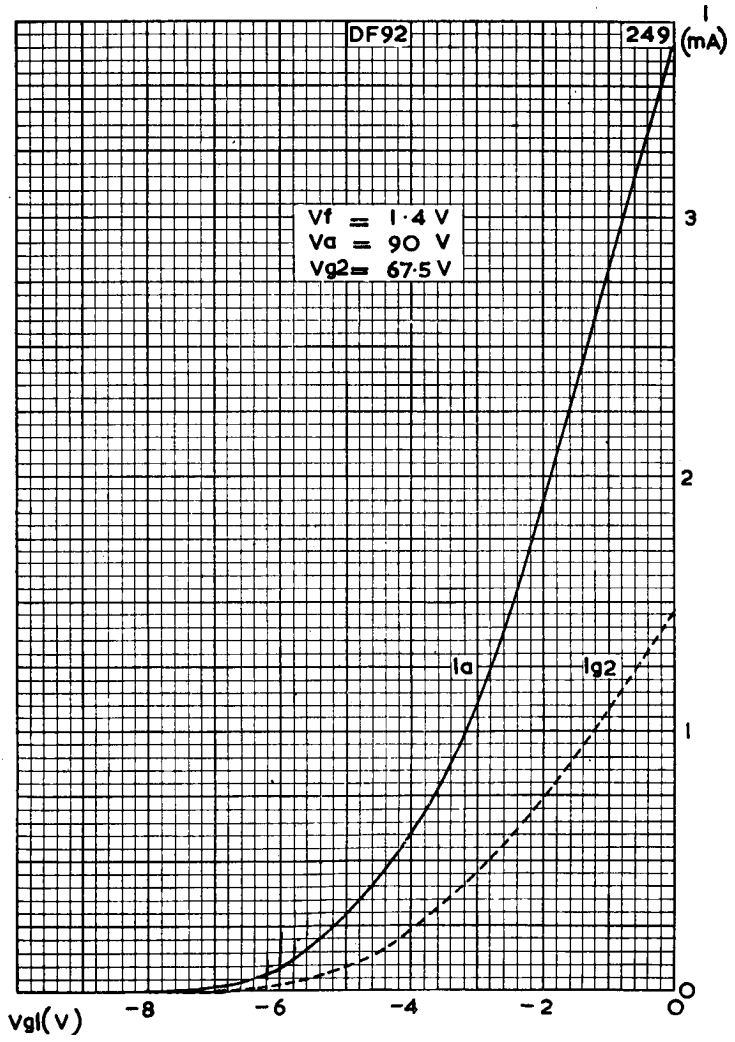


265

DF92

R.F. PENTODE

Short grid-base miniature R.F. pentode for use in battery-operated equipment.



ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

MINIATURE I.F. PENTODE

DF96

Variable-mu pentode for use as an i.f. amplifier in battery operated receivers.

FILAMENT

Suitable for d.c. operation from a series or parallel supply

	Series	*Parallel*	
V_f	1.3	1.4	V
I_f	24	25	mA

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	3.3	pF
c_{out}	7.8	pF

OPERATING CONDITIONS AS I.F. AMPLIFIER

*$V_a = V_b$	64	85	V
R_{g2}	0	39	kΩ
V_{g1}	0	0	V
V_{g2}	64	64	V
I_a	1.65	1.65	mA
I_{g2}	550	550	μA
g_m	850	850	μA/V
r_a	0.7	1.0	MΩ
μ_{g1-g2}	18	18	
$V_{g1}(g_m = 10\mu A/V)$	−4.1	−5.5	V
R_{eq}	14	14	kΩ

*Based on line voltages of 67.5 and 90V decreased by the negative bias for the output valve.

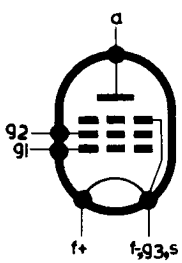
LIMITING VALUES

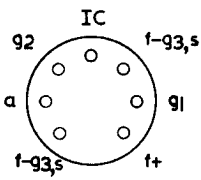
V_b max. (absolute)	110	V
V_a max.	90	V
p_a max.	250	mW
V_{g2} max.	90	V
p_{g2} max.	100	mW
I_k max.	2.2	mA
R_{g1-k} max.	3.0	MΩ
V_{g1} max. ($I_{g1} = +0.3\mu A$)	0	V

DF96

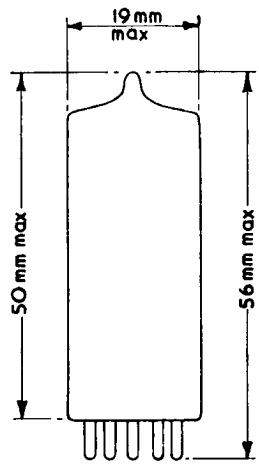
MINIATURE I.F. PENTODE

Variable-mu pentode for use as an i.f. amplifier in battery operated receivers.





B7G Base



2380

R.F. PENTODE

DF97

R.F. pentode for use as an i.f. amplifier, frequency changer or self-oscillating mixer in f.m./a.m. receivers.

FILAMENT

This valve is not recommended for operation in a series filament chain.

V_f	1.4	V
I_f	25	mA

CAPACITANCES

Pentode connection

C_{in}	3.7	pF
$C_{in(g3)}$	5.2	pF
C_{out}	7.5	pF
C_{a-g1}	<0.01	pF
C_{g1-g3}	<0.1	pF
C_{g1-g2}	2.5	pF

Triode connection (g_2 and g_3 connected to a)

C_{in}	1.1	pF
C_{out}	8.1	pF
C_{a-g1}	2.6	pF

CHARACTERISTICS

*V_a = V_b	64	64	85	85	V
V_{g3}	0	0	0	0	V
R_{g2}	1.5	4.7	33	47	kΩ
V_{g2}	63	61	62	57	V
V_{g1}	0	0	0	0	V
I_a	1.7	1.6	1.7	1.5	mA
I_{g2}	780	725	700	595	μA
g_m	880	870	940	900	μA/V
r_a	250	270	450	525	kΩ
μ_{g1-g2}	20	20	20	20	
V_{g1} (g_m = 10μA/V)	−3.8	−3.8	−5.0	−5.0	V

TYPICAL OPERATING CONDITIONS

Frequency changer with oscillator voltage on g_3

*V_a = V_b	64	85	V
R_{g2}	4.7	47	kΩ
V_{g2}	58	47	V
R_{g3}	300	300	kΩ
V_{g1}	0	0	V
I_a	670	540	μA
I_{g2}	1.25	0.8	mA
$V_{osc(r.m.s.)}$	12	12	V
g_c	280	265	μA/V
r_a	300	500	kΩ
V_{g1} (g_m = 10μA/V)	−3.5	−4.6	V

DF97

R.F. PENTODE

R.F. pentode for use as an i.f. amplifier, frequency changer or self-oscillating mixer in f.m./a.m. receivers.

Self-oscillating mixer (triode connection, g_2 and g_3 connected to a)

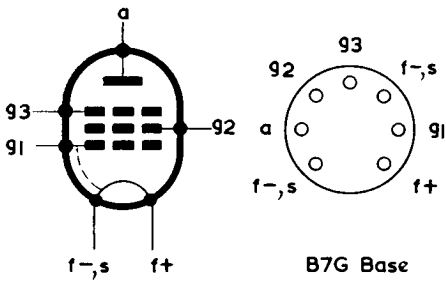
*$V_a = V_b$	64	85	V
I_a	1.3	1.9	mA
R_{g-f}	1.0	1.0	MΩ
I_{g1}	3.1	4.4	μA
$V_{osc(r.m.s.)}$	3.0	4.0	V
g_c	465	500	μA/V
r_a	29	26	kΩ

*Based on battery voltages of 67.5 and 90V decreased by the negative bias for the output valve.

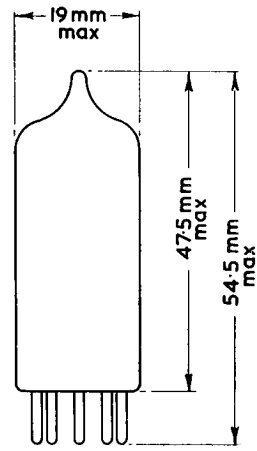
LIMITING VALUES

V_b max. (absolute)	150	V
V_b max.	120	V
V_a max.	120	V
p_a max.	250	mW
V_{g2} max.	90	V
p_{g2} max.	150	mW
I_k max.	2.5	mA
R_{g1-f} max.	3.0	MΩ
R_{g3-f} max.	1.5	MΩ
$+V_{g1}$ min. (I_{g1} = +0.3μA)	0	V

3383



B7G Base



Mullard
OSCILLOGRAPH TUBE

DG3-1

CATHODE RAY TUBE FOR OSCILLOGRAPHIC USE
1 - Inch Screen

Heater	Vf	=	6.3 V
	If	=	0.63 A
Capacities	Cg	=	7.5 uuF
	CD1D1	=	1.75 uuF
	CD2D2	=	2.0 uuF

Fluorescent Colour - Green

Deflection - Double Electrostatic

Operating Conditions

	Va2	500 V
*	Va1 (approx. for focus)	130 V
**	-Vg1	35 V
	N1	0.1 mm/V
	N2	0.08mm/V

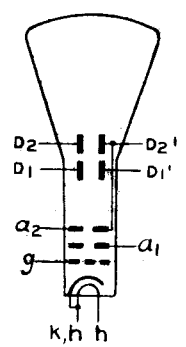
* At Va2 = 250 sensitivity is doubled

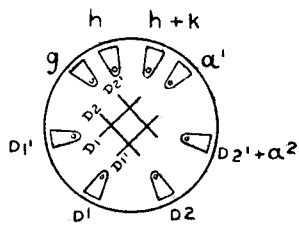
** The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

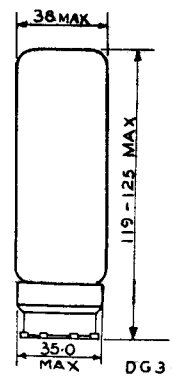
Limiting Values

Va2 max	500	V
Va1 max	150	V

Arrangement of electrodes and base connections

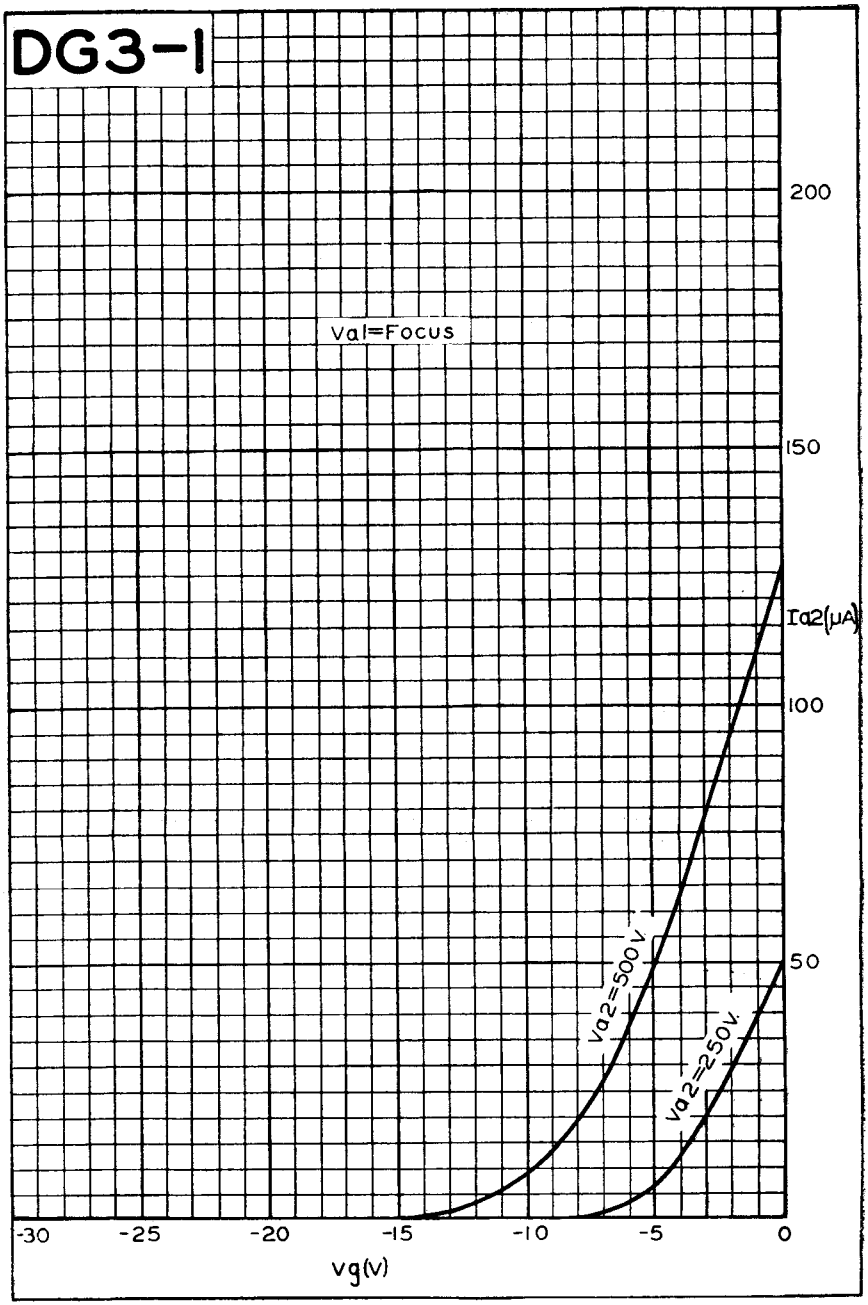






DG3-1

Mullard
OSCILLOGRAPH TUBE



HEPTODE FREQUENCY CHANGER

DK32

Heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.

FILAMENT

This valve is suitable for D.C. operation only.

V_f	1.4	V
I_f	0.05	A

CAPACITANCES

c_{a-g4}	<	0.5	μμF
c_{out}		10.0	μμF
c_{g4-all}		7.0	μμF
c_{g2-g4}	<	0.4	μμF
c_{g1-g4}	<	0.2	μμF
c_{g1-g2}		0.9	μμF
c_{g2-all} (less g_1)		4.4	μμF
c_{g1-all} (less g_2)		4.0	μμF

TYPICAL OPERATING CONDITIONS

V_a	90	90	V
V_{g3+g5}	45	45	V
V_{g2}	90	90	V
V_{g4}	0	-3	V
I_a	0.6	-	mA
I_{g3+g5}	0.7	-	mA
I_{g2}	1.2	-	mA
I_{g1}	35	-	μA
I_k	2.5	-	mA
R_{g1}	200,000	200,000	ohms
r_a	0.6	-	M.ohm
g_c	250	5.0	μA/V

CHARACTERISTICS OF OSCILLATOR SECTION (V_{osc} = 0)

V_a	90	V
V_{g3+g5}	45	V
V_{g4}	0	V
V_{g2}	90	V
V_{g1}	0	V
g_m	550	μA/V

DK32

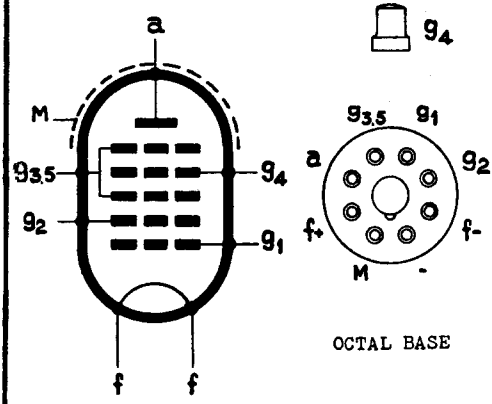
HEPTODE FREQUENCY CHANGER

Heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.

LIMITING VALUES

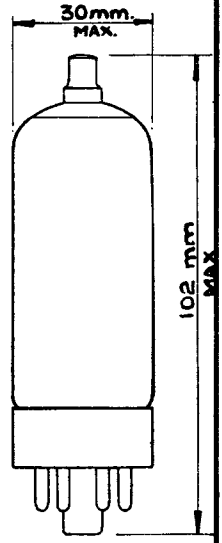
V_a max.	110	V
$V_{g3+g5(b)}$ max.	110	V
V_{g3+g5} max.	60	V
V_{g2} max.	110	V
I_{ko} max.	4	mA
R_{g4} min.	1	M ohm

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



OCTAL BASE

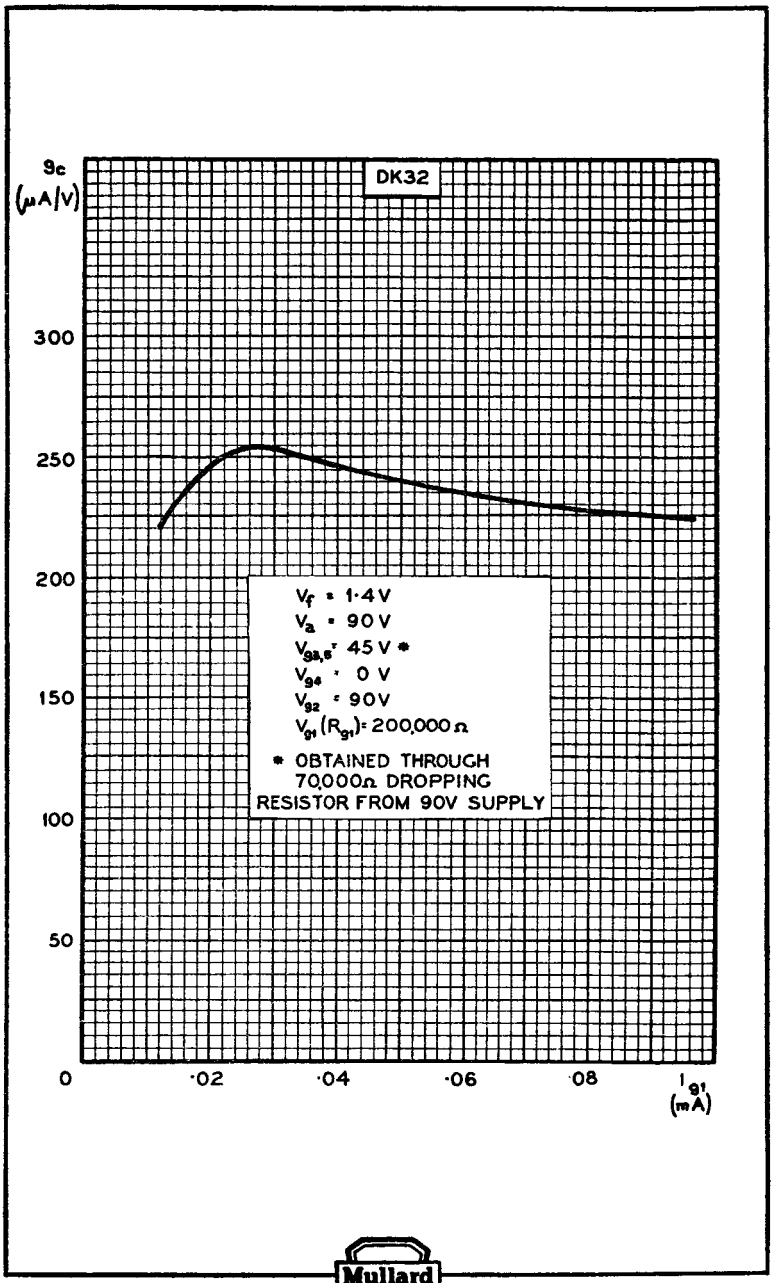
DIMENSIONS



HEPTODE FREQUENCY CHANGER

DK32

Heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.



MINIATURE HEPTODE FREQUENCY CHANGER

DK91

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.

FILAMENT

This valve is suitable for d.c. operation only.

V_f	1.4	V
I_f	0.05	A

CAPACITANCES

C_{g3-all}	7.0	μμF
C_{a-all}	7.5	μμF
C_{g1-all}	3.8	μμF
C_{g3-a}	<0.4	μμF
C_{g3-g1}	<0.2	μμF
C_{a-g1}	<0.1	μμF

OPERATING CONDITIONS

V_a	45	67.5	90	90	V
V_{g2+g4}	45	67.5	45	67.5	V
V_{g3}	0	0	0	0	V
R_{g1}	100	100	100	100	KΩ
r_a	600	500	800	600	KΩ
g_c	235	280	250	300	μA/V
V_{g3} (g_c=5 μA/V)	−9	−14	−9	−14	V
I_a	0.7	1.4	0.8	1.6	mA
I_{g2+g4}	1.9	3.2	1.9	3.2	mA
I_{g1}	150	250	150	250	μA
I_k	2.75	5.0	2.75	5.0	mA

OSCILLATOR SECTION

$V_{g1}=V_{g3}$	0	V
$V_{g2}=V_{g4}=V_a$	67.5	V
$g_{m\ (g1-g2+g4+a)}$	1.4	mA/V

LIMITING VALUES

V_a max.	90	V
$V_{g2+g4(b)}$ max.	90	V
V_{g2+g4} max.	67.5	V
V_{g3} max.	0	V
$I_{k(o)}$ max.	5.5	mA

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.

CIRCUITS

Frequency changer circuits employing the DK91, for a medium and long wave receiver and for an all-wave receiver are given on page 3

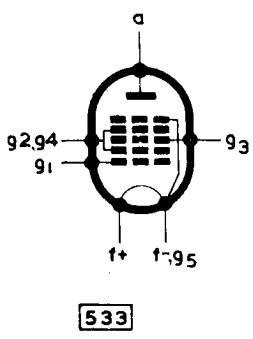
In these circuits—

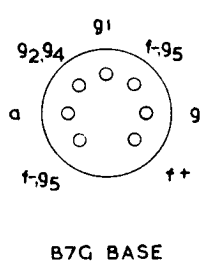
C designates a decoupling capacitor.

L_C is a filament choke of 12 μH inductance and with a d.c. resistance of less than 0.5 Ω.

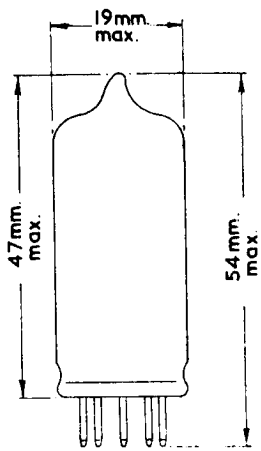
L_B is the booster coil which should be designed to resonate in conjunction with its associated capacitor at a frequency just below the lower limit of the short wave band. For a receiver covering the range 5.8 to 18.7 Mc/s and having an intermediate frequency of 465 kc/s the booster circuit should resonate at 4.75 Mc/s. Suitable values are : C=100 μμF, L_B=11 μH.

L_D is the short wave coil and should have a Q of approximately 115 at 6.5 Mc/s.





B7G BASE

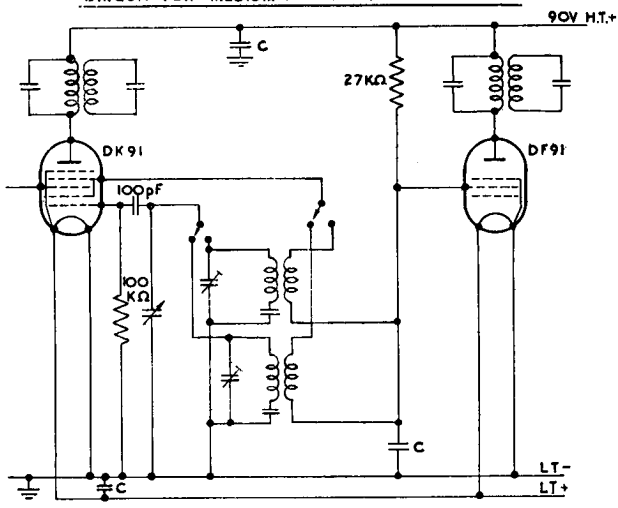


MINIATURE HEPTODE FREQUENCY CHANGER

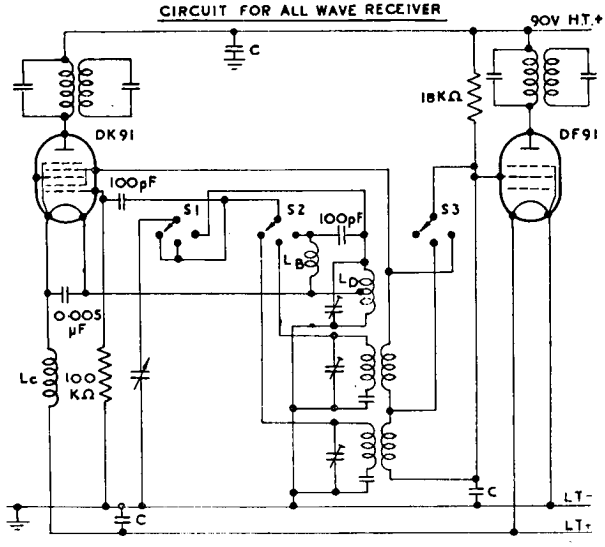
DK91

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.

CIRCUIT FOR MEDIUM AND LONG WAVE RECEIVER



CIRCUIT FOR ALL WAVE RECEIVER

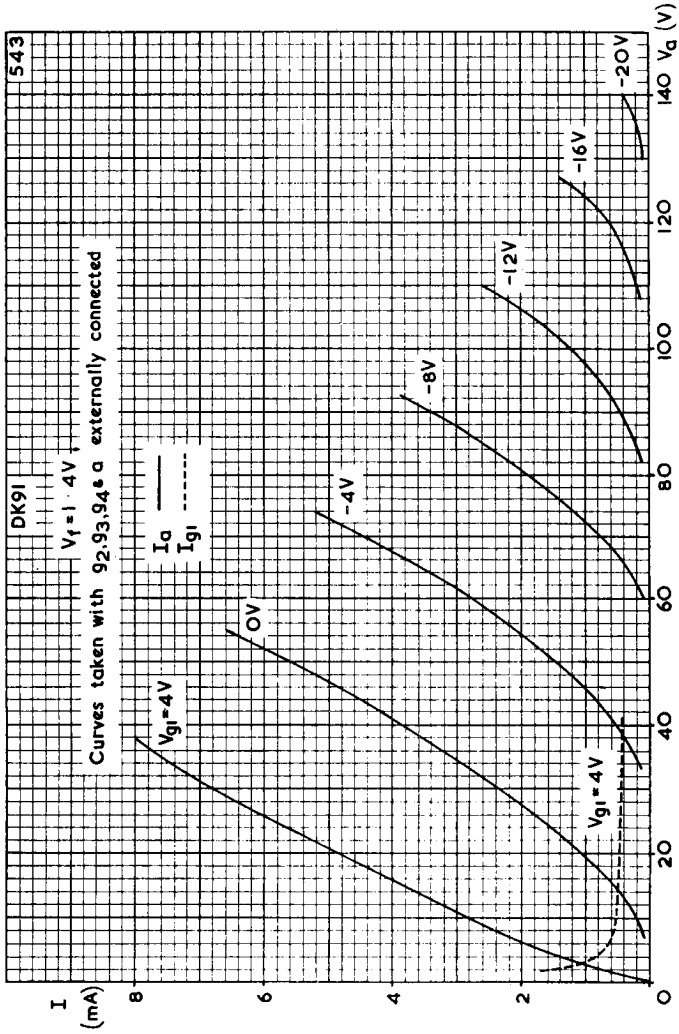


063

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

HEPTODE FREQUENCY CHANGER

DK92

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for a.v.c. It combines a high conversion conductance for this type of valve with a low oscillator drive voltage.

FILAMENT

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

	Series	*Parallel*	
V_f	1.3	1.4	V
I_f	48	50	mA

CAPACITANCES

C_{a-all}	8.5	pF
C_{g3-all}	7.5	pF
C_{g2-all}	5.0	pF
C_{g1-all}	4.0	pF
C_{a-g3}	<400	mpF
C_{g2-g3}	1.6	pF
C_{g1-g3}	<200	mpF
C_{g1-g2}	3.0	pF

OPERATING CONDITIONS

$V_a = V_b$	85	V
V_{g3}	0	V
R_{g4}	180	kΩ
R_{g2}	33	kΩ
R_{g1-f+}	27	kΩ
V_{g4} (approx.)	60	V
V_{g2} (approx.)	30	V
$V_{g1(r.m.s.)}$	4.0	V
I_k	2.55	mA
I_a	700	μA
I_{g4}	150	μA
I_{g2}	1.6	mA
*I_{g1}	100	μA
g_c	325	μA/V
r_a	650	kΩ
V_{g3} (for 100 : 1 reduction in g_c)	−6.0	V

*Optimum value. In a typical circuit, I_{g1} should be between 50μA and 250μA.

Oscillator Section (with $_{g1}$ connected to f+)

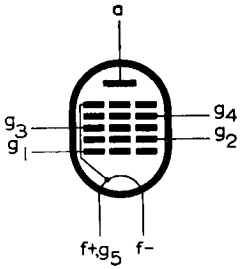
V_a	85	V
V_{g4}	60	V
V_{g3}	0	V
V_{g2}	30	V
I_{g2}	2.5	mA
$g_{m(g1-g2)}$	900	μA/V
μ_{g1-g2}	7.5	

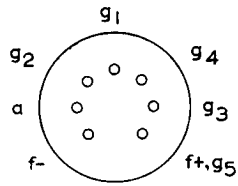
DK92

HEPTODE FREQUENCY CHANGER

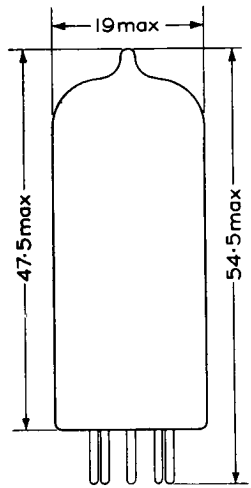
LIMITING VALUES

V_b max. (absolute)	140	V
V_b max.	120	V
V_a max.	90	V
V_{g4} max.	90	V
V_{g2} max.	60	V
I_k max.	4.0	mA
R_{g3-f} max.	3.0	MΩ
R_{g1-f} max.	35	kΩ





B7G Base



7081

All dimensions in mm

MINIATURE HEPTODE FREQUENCY CHANGER

DK96

Miniature heptode, primarily intended for use as a frequency changer in battery operated receivers and suitable for a.g.c.

FILAMENT

Suitable for d.c. operation from a series or parallel supply.

	Series	*Parallel*	
V_f	1.3	1.4	V
I_f	24	25	mA

CAPACITANCES

C_{a-all}	8.1	pF
C_{g1-all}	3.9	pF
C_{g2-all}	4.8	pF
C_{g3-all}	7.4	pF
C_{a-g1}	<0.11	pF
C_{a-g2}	<0.3	pF
C_{a-g3}	<0.36	pF
C_{g1-g2}	3.0	pF
C_{g1-g3}	<0.2	pF
C_{g2-g3}	1.6	pF

TYPICAL OPERATING CONDITIONS

*$V_a = V_b$	64	85	V
V_{g3}	0	0	V
R_{g4}	0	120	kΩ
R_{g2}	18	33	kΩ
R_{g1-f+}	27	27	kΩ
V_{g4}(approx.)	64	68	V
V_{g2}(approx.)	35	35	V
$V_{g1(r.m.s.)}$	4.0	4.0	V
I_k	2.45	2.4	mA
I_a	550	600	μA
I_{g1}	120	140	μA
I_{g2}	1.6	1.5	mA
I_{g1}	85	85	μA
g_c	275	300	μA/V
r_a	750	800	kΩ
V_{g3} (for 100 : 1 reduction in g_c)	−4.5	−6.5	V

OSCILLATOR SECTION (With g_1 connected to f+)

$V_a = V_b$	64	85	V
V_{g4}	64	64	V
V_{g3}	0	0	V
V_{g2}	35	35	V
V_{g1}	+1.4	+1.4	V
I_{g2}	1.7	1.7	mA
$g_{m(g1-g2)}$	600	600	μA/V
μ_{g1-g2}	7.5	7.5	

*Based on line voltages of 67.5 and 90V decreased by the negative bias for the output valve.

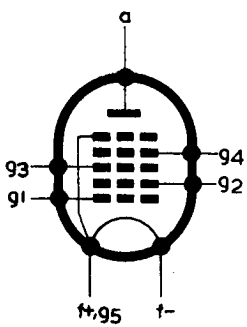
DK96

MINIATURE HEPTODE FREQUENCY CHANGER

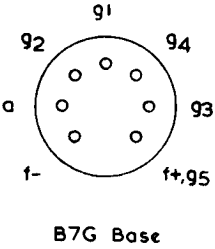
Miniature heptode, primarily intended for use as a frequency changer in battery operated receivers and suitable for a.g.c.

LIMITING VALUES

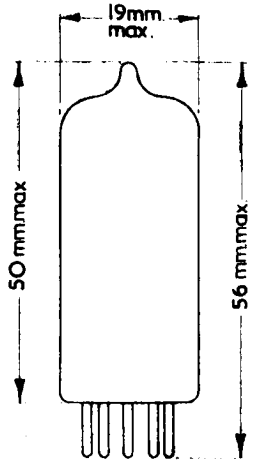
V_b max. (absolute)	110	V
V_b max.	90	V
V_a max.	90	V
p_a max.	150	mW
V_{g2} max.	60	V
p_{g2} max.	100	mW
V_{g4} max.	90	V
p_{g4}	30	mW
I_k max.	2.6	mA
R_{g3-f} max.	3.0	MΩ
R_{g1-f} max.	100	kΩ
V_{g3} max. (I_{g3} = +0.3μA)	+1.0	V
V_{g1} max. (I_{g1} = +0.3μA)	0	V



2389



B7G Base



OUTPUT PENTODE

DL33

Output pentode with centre-tapped filament for use in battery operated equipment.

DL35

OVERLEAF

FILAMENT

Suitable for d.c. operation only.

	Series	*Parallel*	
V_f	2.8	1.4	V
I_f	50	100	mA

TYPICAL OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

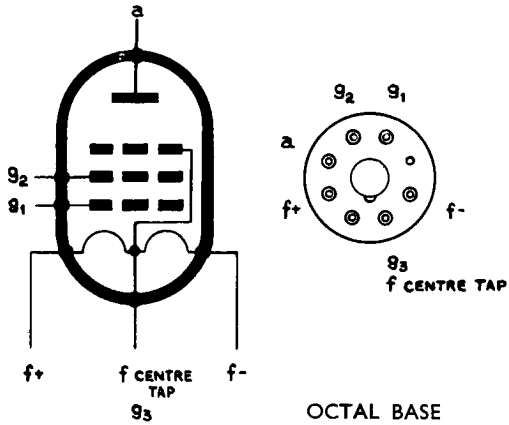
Filament connection:

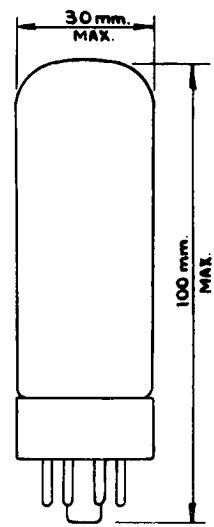
	Series			*Parallel*		
V_a	90	110	85	90	110	V
V_{g2}	90	110	85	90	110	V
V_{g1}	−4.5	−6.6	−5.0	−4.5	−6.6	V
V_{in} (r.m.s.)	3.2	3.6	3.5	3.2	3.8	V
I_a	8.0	8.5	7.0	9.5	10	mA
I_{g2}	1.0	1.1	0.8	1.3	1.4	mA
g_m	2.0	2.0	1.95	2.2	2.2	mA/V
r_a	80	110	70	90	100	kΩ
R_a	8	8	9	8	8	kΩ
P_{out}	230	330	250	270	400	mW
D_{tot}	8.5	8.5	5.5	6.0	6.0	%

LIMITING VALUES

V_a max.	110	V
V_{g2}	110	V
*I_k max.	6	mA
R_{g1} max.	1.0	MΩ

* I_k max. is 6mA for each 1.4V filament section.





DL35

OUTPUT PENTODE

Output pentode for use in battery operated equipment.

FILAMENT

Suitable for d.c. operation only.

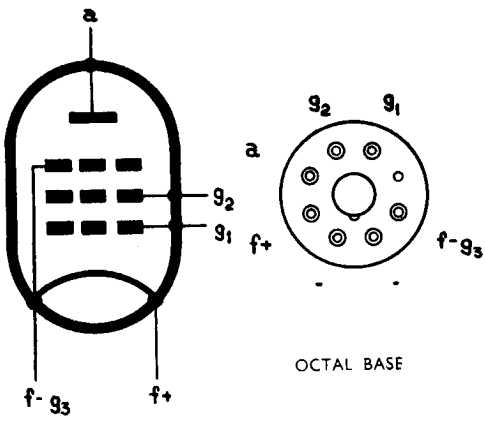
V_f	1.4	V
I_f	100	mA

TYPICAL OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

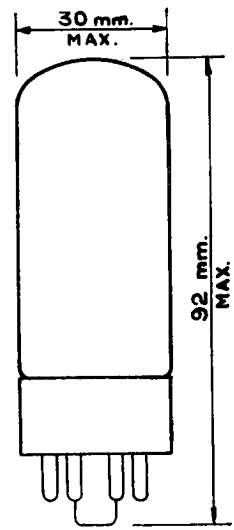
V_a	83	90	V
V_{g2}	83	90	V
V_{g1}	−7.0	−7.5	V
$V_{in(r.m.s.)}$	5.0	5.3	V
I_a (max. sig.)	7.3	7.8	mA
$I_{a(o)}$	7.0	7.5	mA
I_{g2} (max. sig.)	3.5	3.5	mA
$I_{g2(o)}$	1.6	1.6	mA
r_a	110	115	kΩ
g_m	1.5	1.55	mA/V
R_a	9	8	kΩ
$P_{out}(D_{tot}=10\%)$	200	240	mW

LIMITING VALUES

V_a max.	110	V
V_{g2} max.	110	V
I_k max.	12	mA



OCTAL BASE



SUBMINIATURE OUTPUT PENTODE

DL64

Subminiature output pentode suitable for use in hearing aids. It has a filament current of 10mA and is primarily intended for use with an H.T. battery supply of 15 volts.

FILAMENT

V_f	1.25	V
I_f	10	mA

MOUNTING POSITION

Any

Note.—Direct soldered connections to the leads of this valve must be at least 5 mm. from the seal and any bending of the valve leads must be at least 1.5 mm. from the seal.

CAPACITANCES (Measured without external screen)

c_{a-g1}	<0.25	μμF
c_{in}	2.5	μμF
c_{out}	2.4	μμF

CHARACTERISTICS

V_a	15	V
V_{g2}	15	V
I_a	160	μA
I_{g2}	40	μA
V_{g1}	−1.5	V
g_m	180	μA/V
r_a	400	kΩ
μ_{g1-g2}	4.5	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

V_a	15	V
V_{g2}	15	V
V_{g1}	−1.55	V
R_a	100	kΩ
$I_{a(o)}$	150	μA
$I_{g2(o)}$	37	μA
$V_{in(r.m.s.)}$	0.85	V
P_{out}	950	μW
D_{tot}	10	%

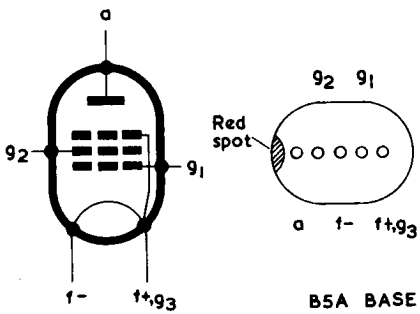
LIMITING VALUES

V_a max.	45	V
V_{g2} max.	45	V
I_k max.	600	μA

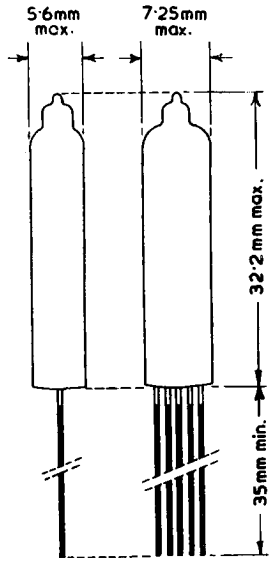
DL64

SUBMINIATURE OUTPUT PENTODE

Subminiature output pentode suitable for use in hearing aids. It has a filament current of 10mA and is primarily intended for use with an H.T. battery supply of 15 volts.



B5A BASE



1338

SUBMINIATURE OUTPUT PENTODE

DL68

Subminiature output pentode suitable for use in hearing-aids. It has a filament current of 25mA and is primarily intended for use with an H.T. battery supply of 22.5 volts.

FILAMENT

V_f	1.25	V
I_f	25	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5 mm. from the seal and any bending of the valve leads must be at least 1.5 mm. from the seal.

CAPACITANCE

c_{a-g1}	0.15	μμF

CHARACTERISTICS

V_a	22.5	V
V_{g2}	22.5	V
I_a	600	μA
I_{g2}	150	μA
V_{g1}	−2.2	V
g_m	430	μA/V
r_a	100	kΩ
μ_{g1-g2}	5.0	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

V_b	22.5	V
V_{g2}	22.5	V
V_{g1}	−2.2	V
R_a	37.5	kΩ
$I_{a(o)}$	600	μA
$I_{g2(o)}$	150	μA
$V_{in\ (r.m.s.)}$	1.3	V
P_{out}	5.0	mW
D_{tot}	10	%

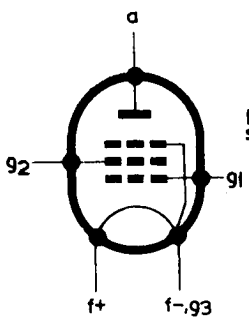
LIMITING VALUES

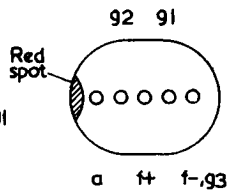
V_a max.	45	V
V_{g2} max.	45	V
p_a max.	100	mW
p_{g2} max.	25	mW
I_k max.	2.3	mA

DL68

SUBMINIATURE OUTPUT PENTODE

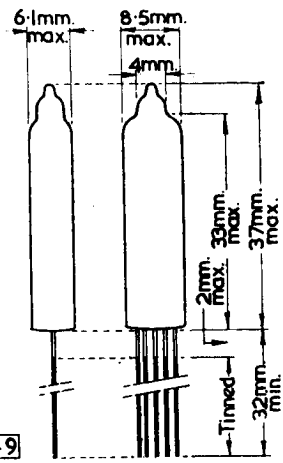
Subminiature output pentode suitable for use in hearing-aids. It has a filament current of 25mA and is primarily intended for use with an H.T. battery supply of 22.5 volts.





B5A BASE

849



SUBMINIATURE OUTPUT PENTODE

DL69

Subminiature output pentode suitable for battery operation with an h.t. supply of 90V.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	25	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads must be at least 5mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

CAPACITANCES (shielded)

c_{a-g1}	50	mpF
c_{in}	2.9	pF
c_{out}	3.2	pF

CHARACTERISTICS

V_a	90	V
V_{g2}	90	V
I_a	1.75	mA
I_{g2}	400	μA
V_{g1}	−2.5	V
g_m	850	μA/V
r_a	800	kΩ
μ_{g1-g2}	15	

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	67.5	90	V
V_{g2}	67.5	90	V
$I_{a(o)}$	0.9	1.3	mA
$I_{g2(o)}$	200	300	μA
V_{g1}	−2.0	−3.0	V
R_a	70	60	kΩ
$V_{in(r.m.s.)}$	1.2	1.6	V
P_{out}	23	50	mW
D_{tot}	10	10	%

DL69

SUBMINIATURE OUTPUT PENTODE

Subminiature output pentode suitable for battery operation with an h.t. supply of 90V.

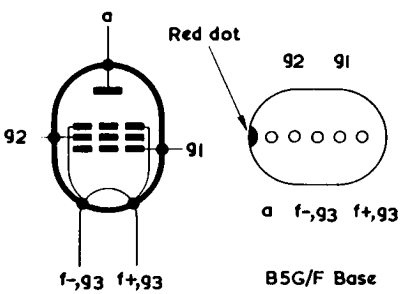
OPERATING CONDITIONS FOR TWO VALVES IN CLASS 'AB' PUSH-PULL

V_{a-e}	90	V
V_{g2-e}	90	V
$I_{a(o)}$	2×800	μA
I_a(max. sig.)	2×1.0	mA
$I_{g2(o)}$	2×150	μA
I_{g2}(max. sig.)	2×425	μA
R_k	1.8	kΩ
R_{a-a}	100	kΩ
$V_{in(g1-g1)r.m.s.}$	8.0	V
P_{out}	100	mW
D_{tot}	5.0	%

LIMITING VALUES

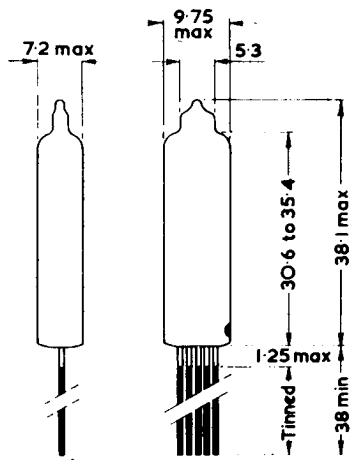
V_a max.	90	V
V_{g2} max.	90	V
I_k max.	2.5	mA

2927



B5G/F Base

g3 consists of two plates one being connected to lead 3 and the other to lead 5



All dimensions in mm

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

This valve is primarily intended for use in communications equipment of the 'push to talk' type and its continuous life rating under typical supply voltage conditions is relatively short and is chiefly a function of hours of filament operation and filament temperature.

Under 'push to talk' conditions an operating life of about 200 hours may be expected.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	110	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

If the valve is used with an earthed metal clip a decrease in output power of approximately 10% can be expected up to 200Mc/s.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g1}	<0.1	0.08	pF
c_{in}	3.0	3.1	pF
c_{out}	5.6	3.9	pF

CHARACTERISTICS

V_a	135	V
V_{g2}	90	V
I_a	7.5	mA
I_{g2}	1.5	mA
V_{g1}	−7.5	V
g_m	1.9	mA/V
r_a	150	kΩ
μ_{g1-g2}	6.5	

OPERATING CONDITIONS AS A CLASS 'C' TELEGRAPHY R.F. OSCILLATOR

f	10	50	Mc/s
V_a	150	150	V
V_{g2}	110	110	V
I_a	10	10	mA
I_{g2}	3.0	3.0	mA
I_{g1}	40	40	μA
R_{g1}	470	390	kΩ
P_{load}	800	800	mW
η_{load}	53	53	%
$v_{a(pk)}$	120	—	V
$v_{g1(pk)}$	23	—	V

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

OPERATING CONDITIONS AS A CLASS 'C' TELEGRAPHY R.F. AMPLIFIER

f	50	200	Mc/s
V_a	150	150	V
V_{g2}	110	110	V
V_{g1}	−22	−22	V
I_a	9.7	10.5	mA
I_{g2}	3.2	2.5	mA
I_{g1}	80	60	μA
P_{load}	820	450	mW
η_{load}	56	29	%

P_{drive} measured at the control-grid is approximately 50mW at f=200Mc/s and does not include the power lost in the grid tuned circuit.

OPERATING CONDITIONS AS A FREQUENCY MULTIPLIER

Doubler

f_{out}	50	50	100	100	Mc/s
V_a	90	150	90	150	V
V_{g2}	90	110	90	110	V
V_{g1}	−32	−40	−32	−40	V
I_a	4.3*	9.4	4.7*	9.9	mA
I_{g2}	1.5	3.4	1.3	3.0	mA
I_{g1}	13	140	8.0	90	μA
P_{load}	180	590	150	510	mW
η_{load}	47	42	36	34	%

Trebler

f_{out}	50	50	100	100	Mc/s
V_a	90	150	90	150	V
V_{g2}	90	110	90	110	V
V_{g1}	−60	−70	−60	−70	V
I_a	4.4*	9.3	4.6*	9.7	mA
I_{g2}	1.6	3.4	1.4	3.1	mA
I_{g1}	30	24	24	190	μA
P_{load}	140	420	120	360	mW
η_{load}	35	30	29	25	%

Quadrupler

f_{out}	50	50	Mc/s
V_a	90	150	V
V_{g2}	90	110	V
V_{g1}	−65	−80	V
I_a	4.5*	6.2	mA
I_{g2}	1.5	1.8	mA
I_{g1}	32	27	μA
P_{load}	100	220	mW
η_{load}	25	24	%

*For class 'C' r.f. operation at $V_a \leqq 90V$, I_k max. = 6.0mA.

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	45	67.5	90	120	135	V
V_{g2}	45	67.5	90	120	90	V
V_{g1}	−2.9	−3.8	−6.5	−12	−7.5	V
I_a	3.0	7.5	9.0	8.0	7.5	mA
$I_{g2(o)}$	0.8	1.8	2.1	1.8	1.5	mA
I_{g2}(max. sig.)	1.2	2.7	3.1	3.0	2.5	mA
R_a	12	6.5	7.0	13	16	kΩ
$V_{in(r.m.s.)}$ (P_{out}=50mW)	1.9	1.5	1.5	1.3	1.1	V
P_{out}	58	190	360	460	500	mW
$V_{in(r.m.s.)}$	2.2	3.4	4.7	4.7	4.0	V
D_{tot}	10	10	10	10	10	%

OPERATING CONDITIONS FOR TWO VALVES IN CLASS 'AB' PUSH-PULL

V_{a-a}	90	150	V
V_{g2-a}	90	120	V
$I_{a(o)}$	2×6.5	2×6.3	mA
I_a(max. sig.)	2×7.6	2×7.95	mA
$I_{g2(o)}$	2×1.5	2×1.4	mA
I_{g2}(max. sig.)	2×2.6	2×2.65	mA
R_k	390	680	Ω
R_{a-a}	11	18	kΩ
$V_{in(g1-g1)r.m.s.}$(P_{out}=50mW)	2.8	4.2	V
P_{out}	0.65	1.35	W
$V_{in(g1-g1)r.m.s.}$	14.5	11.3	V
D_{tot}	5.7	4.7	%

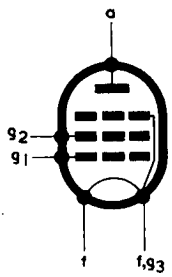
LIMITING VALUES

V_a max.	150	V
p_a max.	1.0	W
V_{g2} max.	150	V
p_{g2} max.	450	mW
R_{g1-f} max.	2.2	MΩ
V_f max. (absolute)	1.35	V
V_{g1} max.:—r.f. amplifier	−25	V
frequency doubler	−40	V
frequency trebler	−70	V
frequency quadrupler	−80	V
I_k max.:—	13	mA
frequency quadrupler ($V_a \geqq 90V$)	8.0	mA

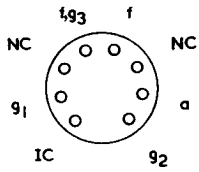
DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

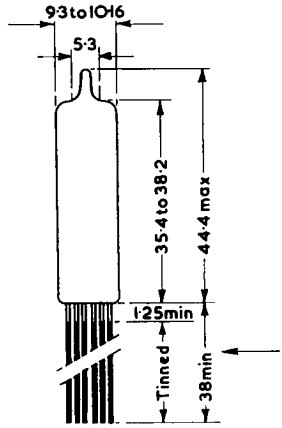


3230



B8D/F Base

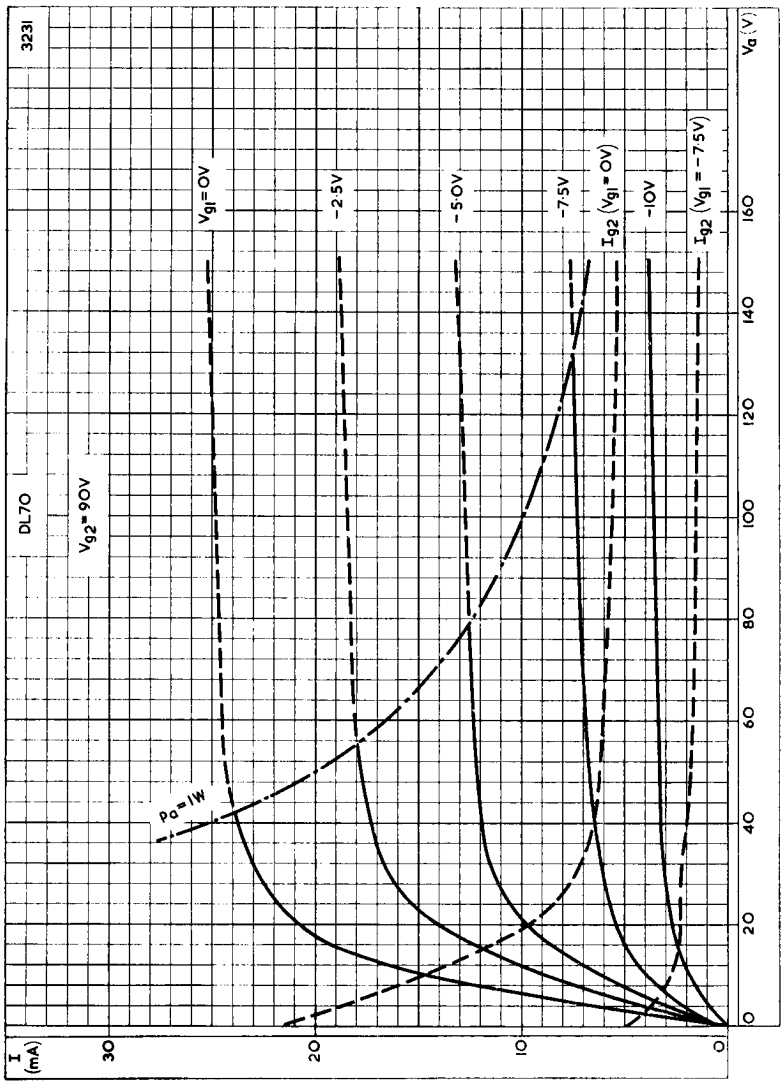
All dimensions in mm



SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

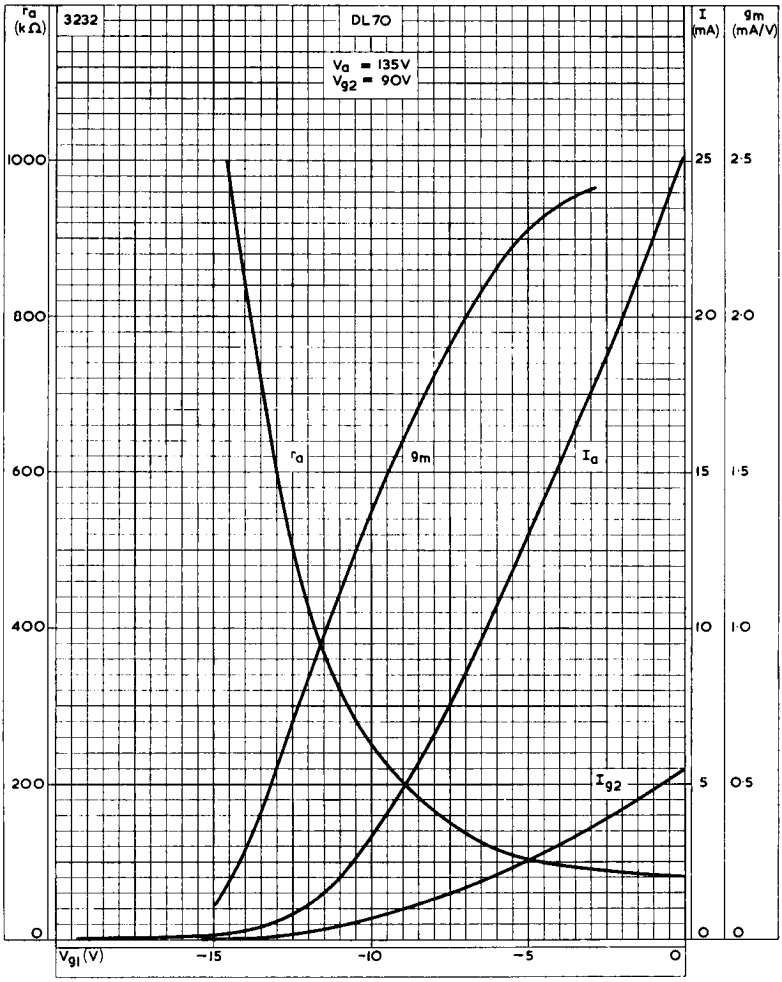


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2}=90V

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



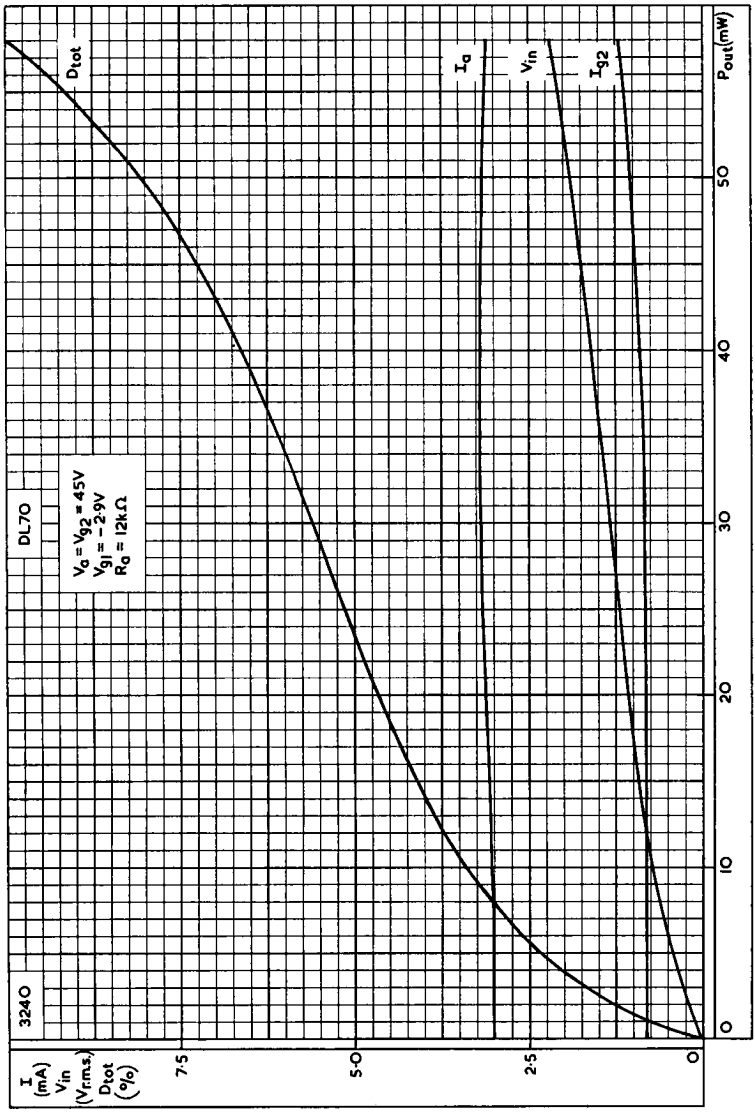
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

V_a=135V, V_{g2}=90V

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

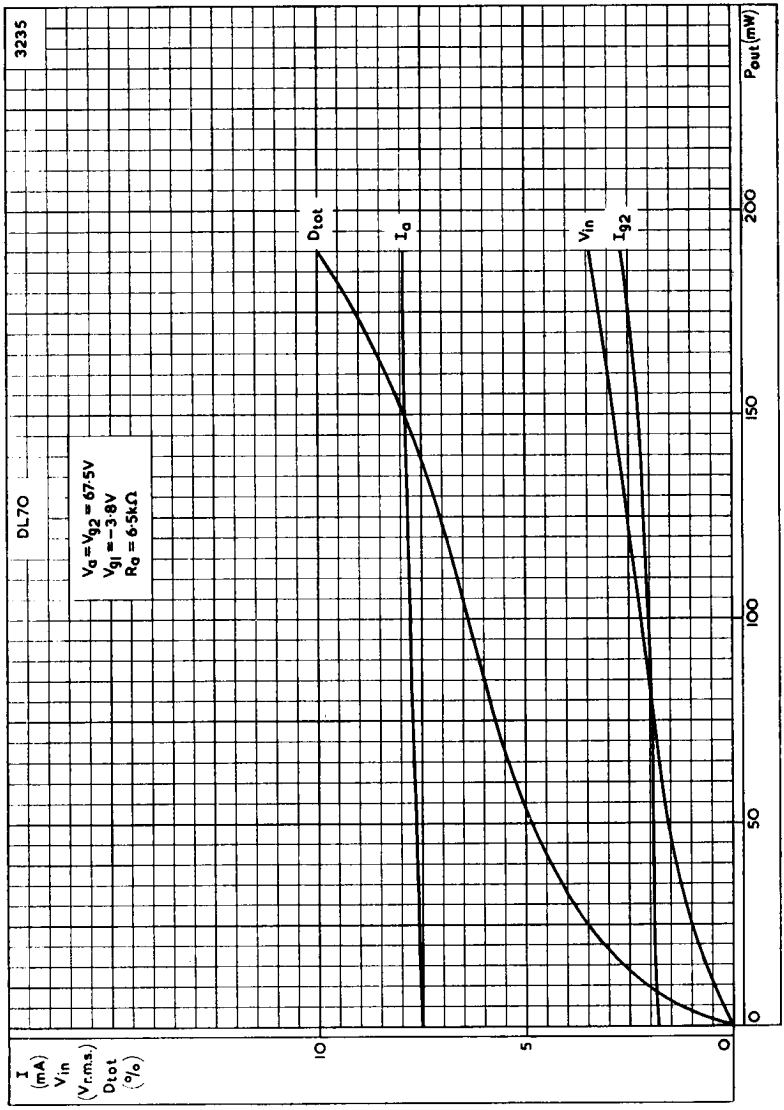


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_a = V_{g_2} = 45V$

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

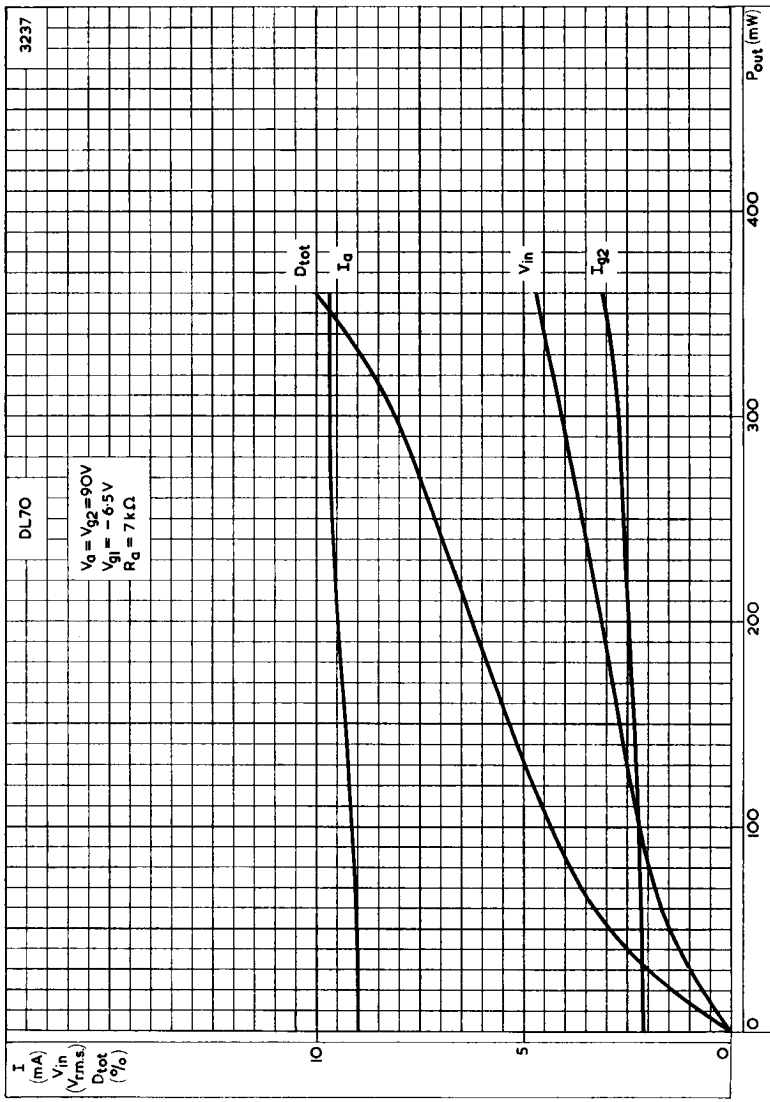


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_u = V_{g2} = 67.5V$

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

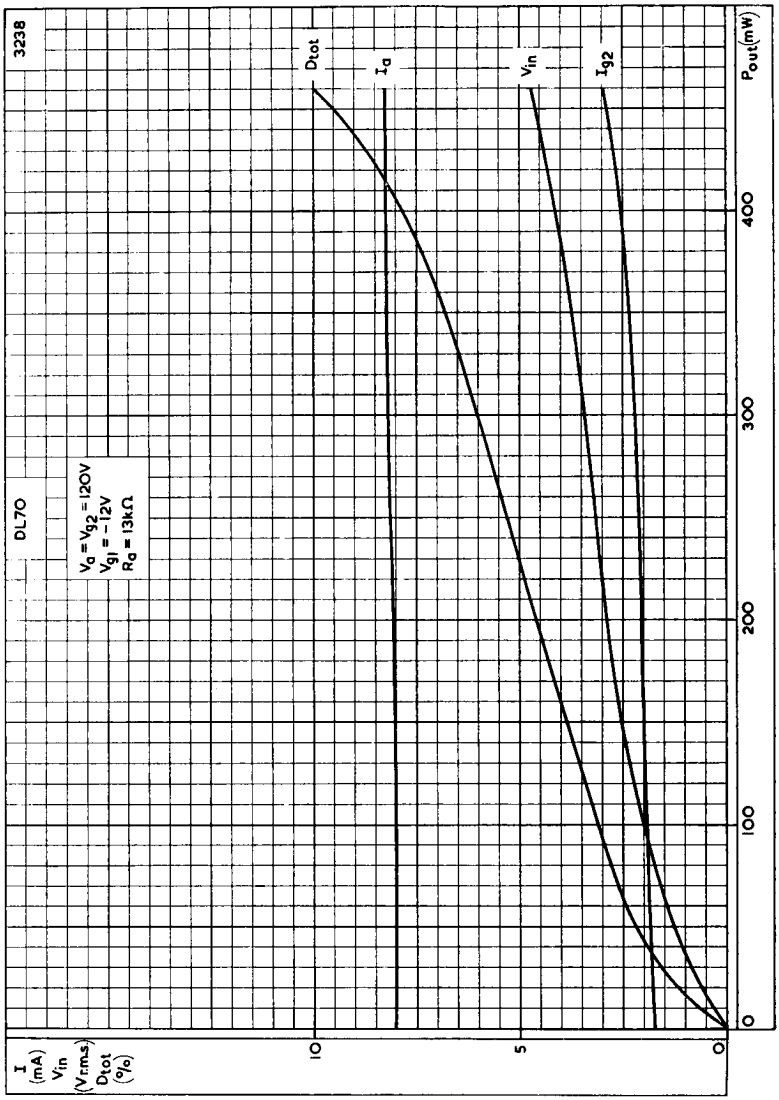


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_a = V_{g2} = 90V$

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

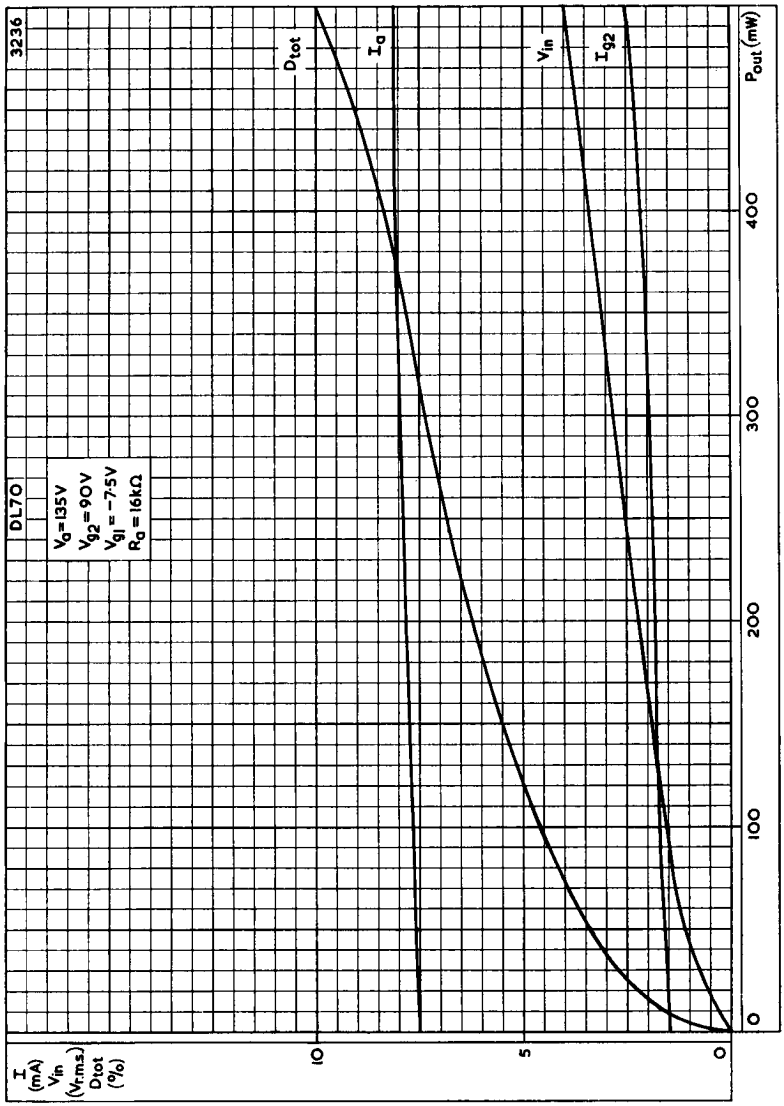


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_a = V_{g2} = 120V$

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

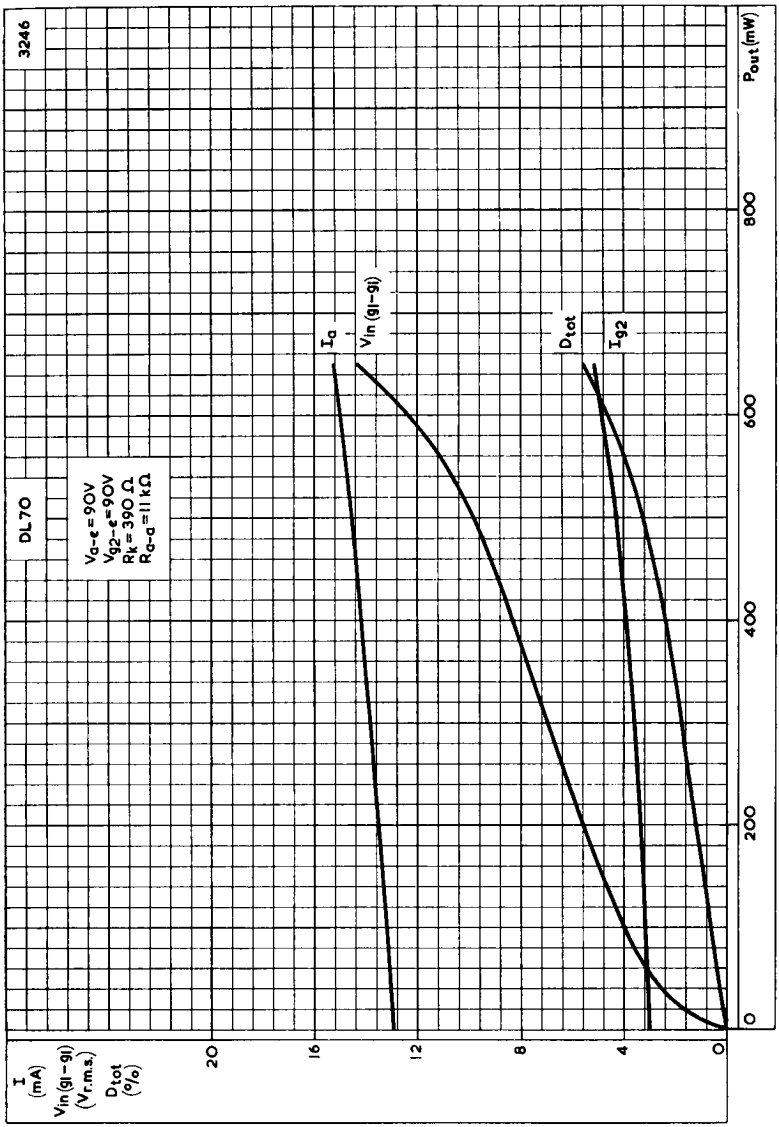


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. V_a=135V, V_{g_2}=90V

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

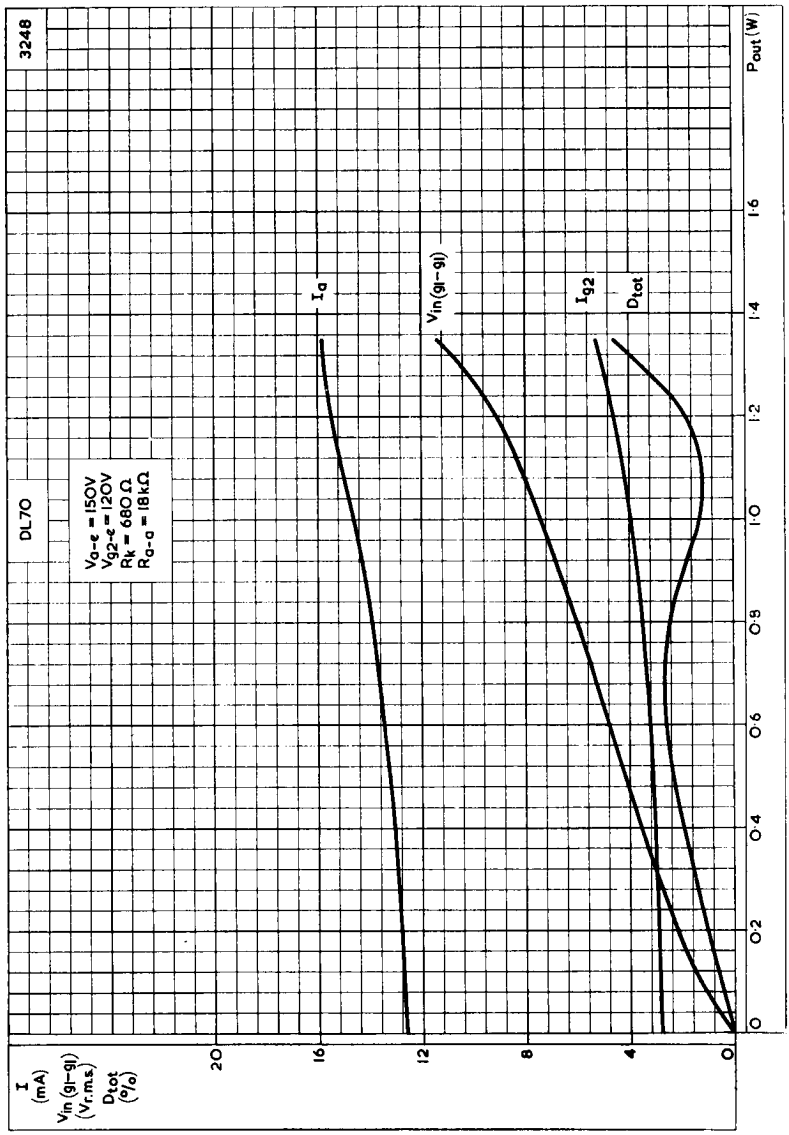


PERFORMANCE OF TWO DL70 IN CLASS 'AB' PUSH-PULL
$V_{a-e}=V_{g2-e}=90V$

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



PERFORMANCE OF TWO DL70 IN CLASS 'AB' PUSH-PULL
V_{a-e}=150V, V_{g2-e}=120V

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL73

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

This valve is primarily intended for use in communications equipment of the 'push to talk' type and its continuous life rating under typical supply voltage conditions is relatively short and is chiefly a function of hours of filament operation and filament temperature.

Under 'push to talk' conditions an operating life of about 200 hours may be expected.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	200	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

If the valve is used with an earthed metal clip a decrease in output power of approximately 10% can be expected up to 200Mc/s.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g1}	<0.15	<0.1	pF
c_{in}	3.6	3.5	pF
c_{out}	3.9	3.0	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	−9.0	V
I_a	15	mA
I_{g2}	3.8	mA
g_m	2.5	mA/V
r_a	16	kΩ
μ_{g1-g2}	6.0	

OPERATING CONDITIONS AS A CLASS 'C' TELEGRAPHY R.F. OSCILLATOR

f	10	50	Mc/s
V_a	150	150	V
V_{g2}	75	75	V
I_a	17	17	mA
I_{g2}	7.0	7.0	mA
I_{g1}	1.0	1.0	mA
R_{g1}	22	18	kΩ
P_{load}	1.4	1.4	W
η_{load}	55	55	%
$v_{a(pk)}$	130	—	V
$v_{g1(pk)}$	32	—	V

DL73

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

OPERATING CONDITIONS AS A CLASS 'C' TELEGRAPHY R.F. AMPLIFIER

Single valve

f	50	180	200	Mc/s
V_a	150	150	150	V
V_{g2}	75	75	75	V
V_{g1}	−20	−20	−20	V
I_a	17.3	18.3	18.6	mA
I_{g2}	6.7	5.8	5.6	mA
I_{g1}	1.0	0.9	0.8	mA
P_{load}	1.6	1.3	1.2	W
η_{load}	62	47	43	%

P_{drive} measured at the control-grid is approximately 100mW at f=200Mc/s and does not include the power lost in the grid tuned circuit.

P_{load} is approximately 1W at f=250Mc/s.

Two valves in push-pull

f	180	250	Mc/s
V_a	150	150	V
V_{g2}	75	75	V
V_{g1}	−20	−20	V
I_a	2×18.1	2×18.7	mA
I_{g2}	2×5.6	2×5.0	mA
I_{g1}	2×1.2	2×1.2	mA
P_{load}	2.8	2.3	W
η_{load}	52	41	%

Two valves parallel connected

f		180	Mc/s
V_a		150	V
V_{g2}		75	V
V_{g1}		−20	V
I_a		2×18.2	mA
I_{g2}		2×5.6	mA
I_{g1}		2×1.2	mA
P_{load}		2.5	W
η_{load}		46	%

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL73

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

OPERATING CONDITIONS AS FREQUENCY MULTIPLIER

Doubler

f	50	Mc/s
V_a	150	V
V_{g2}	75	V
V_{g1}	–35	V
I_a	17.7	mA
I_{g2}	6.2	mA
I_{g1}	1.1	mA
P_{load}	1.1	W
η_{load}	42	%

Trebler

f	50	Mc/s
V_a	150	V
V_{g2}	75	V
V_{g1}	–70	V
I_a	17.9	mA
I_{g2}	5.8	mA
I_{g1}	1.3	mA
P_{load}	800	mW
η_{load}	30	%

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	120	150	V
V_{g2}	90	90	V
V_{g1}	–8.8	–8.5	V
$I_{a(o)}$	12	13	mA
I_a (max. sig.)	11.6	12.8	mA
$I_{g2(o)}$	2.5	2.3	mA
I_{g2} (max. sig.)	6.6	6.3	mA
R_a	9.0	10	kΩ
$V_{in(r.m.s.)}$ (P_{out}=50mW)	1.3	1.2	V
P_{out}	730	900	mW
$V_{in(r.m.s.)}$	6.9	6.5	V
D_{tot}	10	10	%

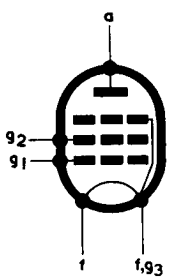
LIMITING VALUES

V_a max.	150	V
p_a max.	2.0	W
V_{g2} max.	150	V
p_{g2} max.	700	mW
I_k max.	25	mA
R_{g1-f} max.	2.2	MΩ
V_f max. (absolute)	1.35	V
V_{g1} max.:—r.f. amplifier	–30	V
frequency doubler	–35	V
frequency trebler	–70	V

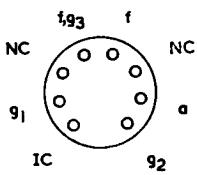
DL73

SUBMINIATURE V.H.F. OUTPUT PENTODE

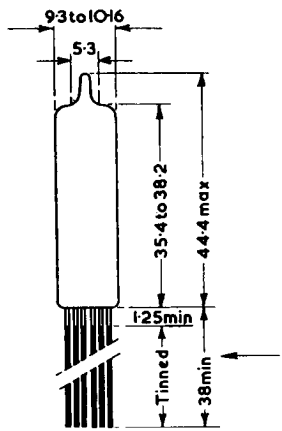
Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



3230



B8D/F Base

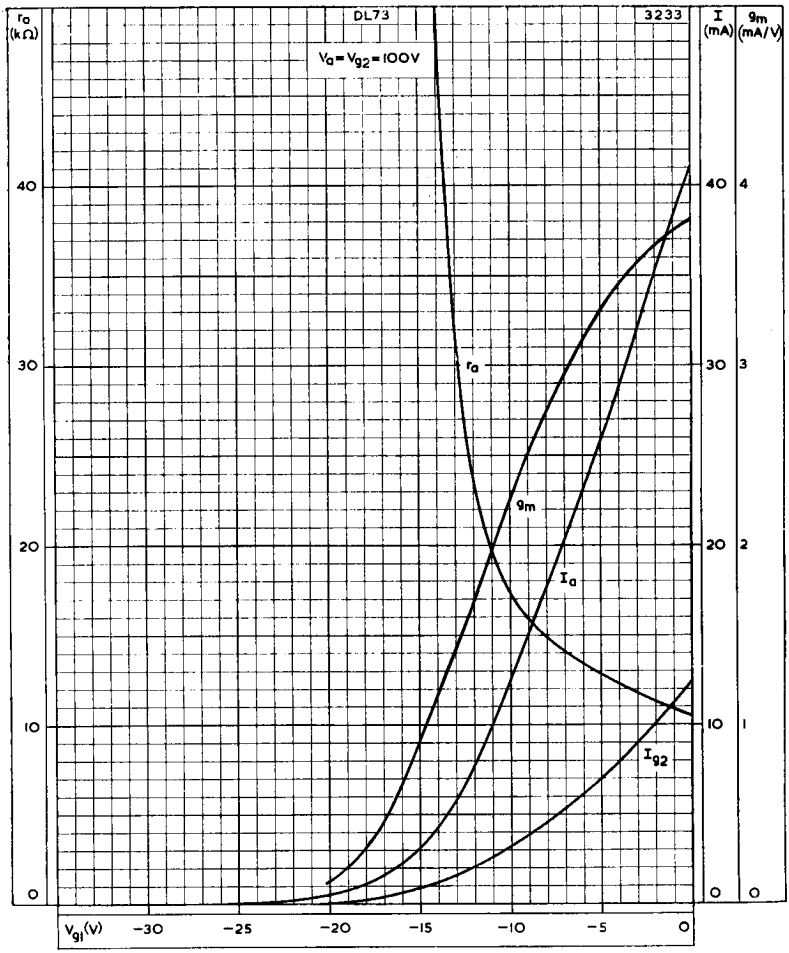


All dimensions in mm

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL73

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

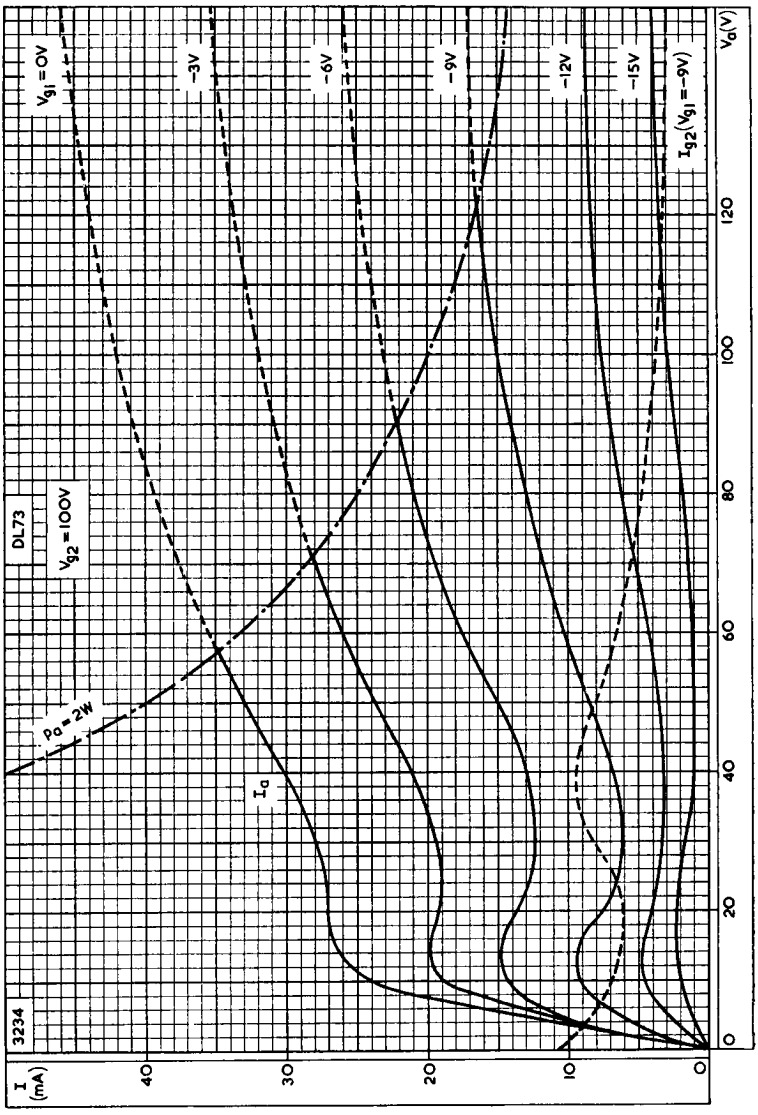


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE

DL73

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

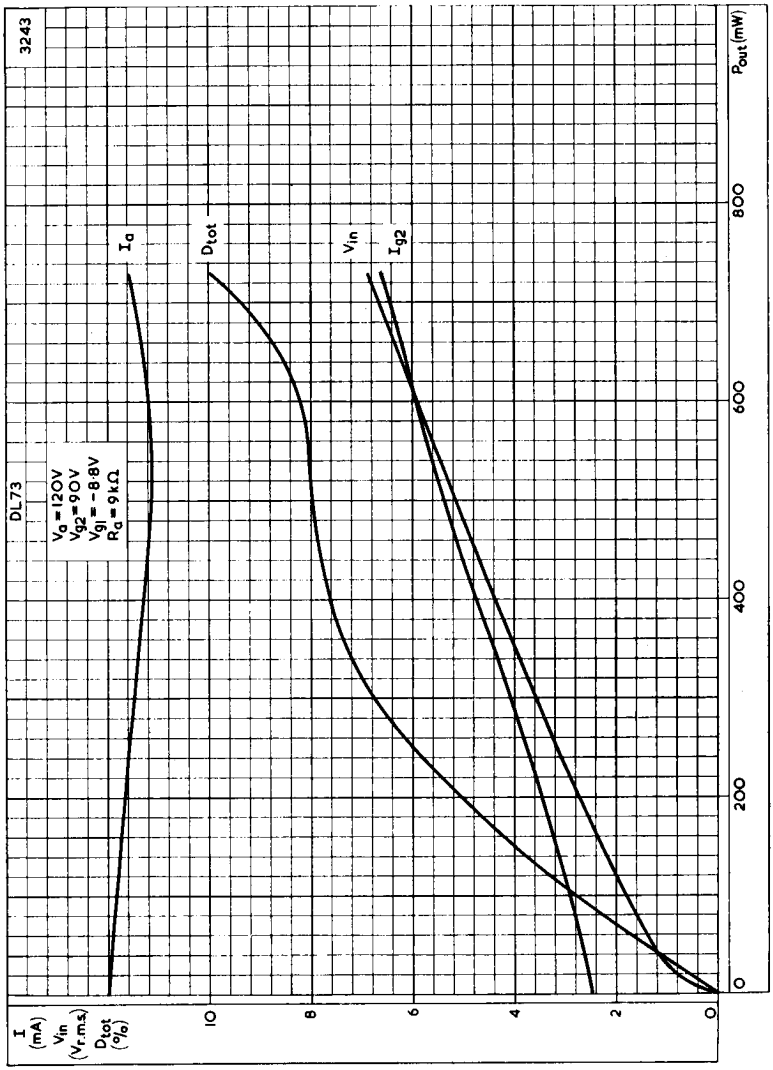


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL73

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

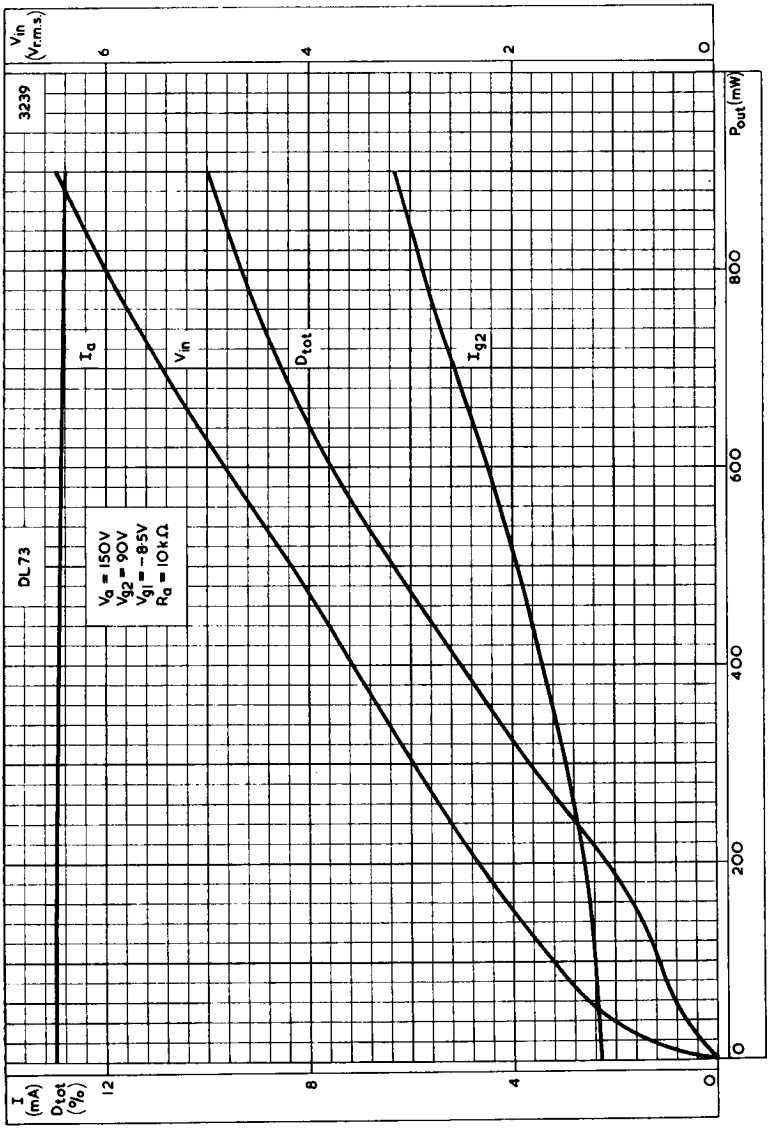


PERFORMANCE OF SINGLE DL73 AS CLASS 'A' AMPLIFIER
V_a = 120V

DL73

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



PERFORMANCE OF SINGLE DL73 AS CLASS 'A' AMPLIFIER
V_a=150V

MINIATURE OUTPUT PENTODE

DL92

Output pentode with centre-tapped filament for use in battery operated equipment.

FILAMENT

This valve is suitable for D.C. operation only.

Series	V_f applied across the two filament sections in series, between pins 1 and 7. V_{g1} referred to pin 1.
Parallel	V_f applied across the two filament sections in parallel, between pin 5 and pins 1 and 7 connected together. V_{g1} referred to pin 5.
Single Section	V_f applied across one section of the filament only, between pin 5 and either pin 1 or pin 7.

	Series	*Parallel*	*Single Section*	
V_f	2.8	1.4	1.4	V
I_f	0.05	0.1	0.05	A

MOUNTING POSITION

Any

CAPACITANCES

c_{a-g1}	<0.4	μμF
c_{in}	4.35	μμF
c_{out}	6.0	μμF

CHARACTERISTICS

	Filament Connection				
	Series		*Parallel*		
V_a	45	90	45	90	V
V_{g2}	45	67.5	45	67.5	V
V_{g1}	–4.5	–7	–4.5	–7	V
I_a	3.0	6.1	3.8	7.4	mA
I_{g2}	0.7	1.1	0.8	1.4	mA
g_m	1.1	1.42	1.15	1.57	mA/V
μ_{g1-g2}	5.0	5.0	5.0	5.0	
r_a	100	100	100	100	kΩ

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Series filament connection

V_a	45	67.5	90	V
V_{g2}	45	67.5	67.5	V
V_{g1}	–4.5	–7	–7	V
$I_{a(o)}$	3.0	6.0	6.1	mA
$I_{g2(o)}$	0.7	1.2	1.1	mA
R_a	8.0	5.0	8.0	kΩ
$V_{in\ (r.m.s.)}$	3.5	5.5	5.5	V
P_{out}	50	160	235	mW
D_{tot}	12.5	12	13	%

DL92

MINIATURE OUTPUT PENTODE

Output pentode with centre-tapped filament for use in battery operated equipment.

Parallel filament connection

V_a	45	67.5	90	82	V
V_{g2}	45	67.5	67.5	82	V
V_{g1}	−4.5	−7	−7	−8.2	V
$I_{a(o)}$	3.8	7.2	7.4	10	mA
$I_{g2(o)}$	0.8	1.5	1.4	2.2	mA
R_a	8.0	5.0	8.0	5.5	kΩ
$V_{in(r.m.s.)}$	3.5	5.5	5.5	6.3	V
P_{out}	65	180	270	320	mW
D_{tot}	12	10	12	13	%

Single section of filament

V_a	62	82	V
V_{g2}	62	82	V
V_{g1}	−5.6	−8.3	V
$I_{a(o)}$	3.8	5.0	mA
$I_{g2(o)}$	0.8	1.1	mA
R_a	12	12	kΩ
$V_{in(r.m.s.)}$	4.6	6.6	V
P_{out}	91	192	mW
D_{tot}	10.5	12.3	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Series or parallel filament connection

V_a	67.5	76	90	V
V_{g2}	67.5	76	90	V
V_{g1}	−12	−13.6	−16.5	V
$I_{a(o)}$	2×1.5	2×1.5	2×2.0	mA
I_a (max. sig.)	2×5.6	2×7.0	2×8.4	mA
$I_{g2(o)}$	2×0.25	2×0.35	2×0.35	mA
I_{g2} (max. sig.)	2×1.5	2×2.6	2×2.7	mA
R_{a-a}	10	9.0	10	kΩ
$V_{in(g-g)(r.m.s.)}$	17	20	23	V
P_{out}	340	490	780	mW
D_{tot}	5.0	5.5	6.0	%

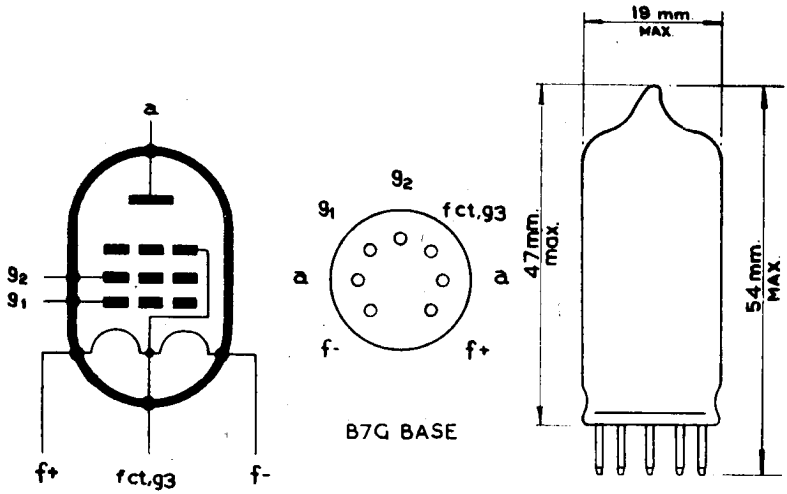
LIMITING VALUES

V_a max.	90	V
p_a max.	0.7	W
V_{g2} max.	90	V
p_{g2} max.	0.15	W
I_k max.	12	mA
R_{g1-f} max.	2.0	MΩ

MINIATURE OUTPUT PENTODE

DL92

Output pentode with centre-tapped filament for use in battery operated equipment.

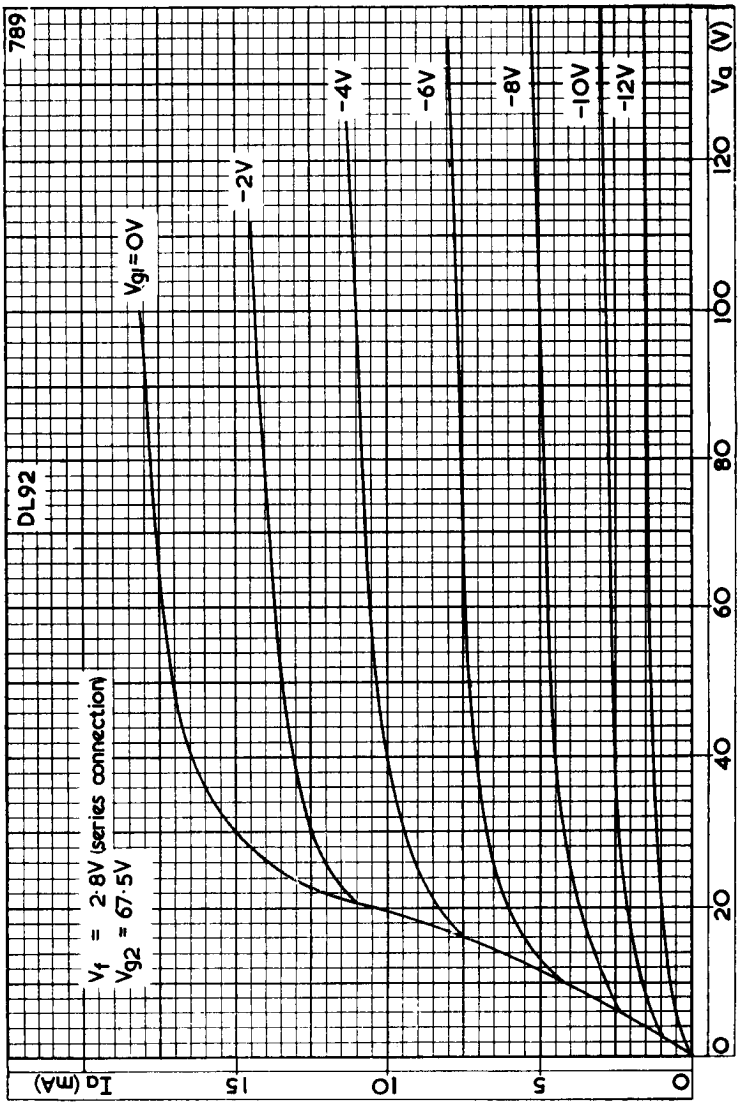


788

DL92

MINIATURE OUTPUT PENTODE

Output pentode with centre-tapped filament for use in battery operated equipment.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER FOR BOTH SECTIONS OF FILAMENT IN SERIES

OUTPUT PENTODE

DL93

Output pentode with centre-tapped filament, suitable for R.F. and A.F. applications.

FILAMENT

This valve is suitable for D.C. operation only.

Series V_f applied across the two filament sections in series, between pins 1 and 7. V_{g1} referred to pin 1.

Parallel V_f applied across the two filament sections in parallel, between pin 5 and pins 1 and 7 connected together. V_{g1} referred to pin 5.

	Series	*Parallel*	
V_f	2.8	1.4	V
I_f	0.1	0.2	A

For series filament operation a shunting resistor must be connected across one filament section, between pins 1 and 5 to by-pass the excess cathode current in this section. The value of the resistor should be such that the voltage across the shunted section equals that across the other section.

MOUNTING POSITION

Any

CAPACITANCES (without external shield)

C_{a-g1}	<0.34	μμF
C_{in}	4.8	μμF
C_{out}	4.2	μμF

OPERATING CONDITIONS AS CLASS "A" A.F. AMPLIFIER.

Parallel filament connection

V_a	135	150	V
V_{g2}	90	90	V
V_{g1}	–7.5	–8.4	V
$I_{a(o)}$	14.8	13.3	mA
I_a (max. sig.)	14.9	14.1	mA
$I_{g2(o)}$	2.6	2.2	mA
I_{g2} (max. sig.)	3.5	3.5	mA
g_m	1.9	1.9	mA/V
r_a	90	100	kΩ
R_a	8	8	kΩ
$V_{in(pk)}$	7.5	8.4	V
P_{out}	600	700	mW
D_{tot}	5	6	%

DL93

OUTPUT PENTODE

Output pentode with centre-tapped filament, suitable for R.F. and A.F. applications.

OPERATING CONDITIONS

As R.F. power amplifier at 50 Mc/s. (Intermittent operation)

V_a	150	V
V_{g2}	135	V
R_{g1}	200	kΩ
I_a	18.3	mA
I_{g2}	6.5	mA
I_{g1}	0.13	mA
P_{out} (approx.)	1.2	W

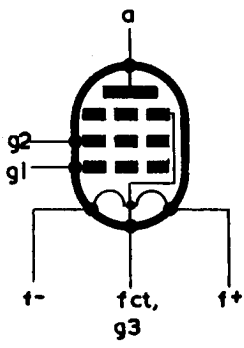
LIMITING VALUES

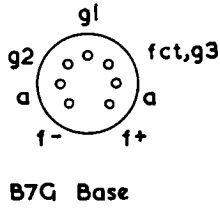
(*a*) A.F. power amplifier

V_a max.	150	V
V_{g2} max.	90	V
p_a max.	2	W
p_{g2} max.	0.4	W
$I_{k(o)}$ max.	18	mA

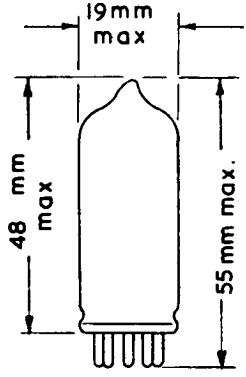
(*b*) R.F. power amplifier (intermittent operation)

V_a max.	150	V
V_{g2} max.	135	V
V_{g1} max.	−30	V
p_a max.	2	W
p_{g2} max.	0.9	W
p_{in} max.	3	W
I_a max.	20	mA
I_{g1} max.	0.25	mA
I_k max.	25	mA





B7G Base



123

MINIATURE OUTPUT PENTODE

DL94

Output pentode with centre-tapped filament for use in battery operated equipment. Designed for operation with equal voltages on anode and screen-grid.

FILAMENT

This valve is suitable for D.C. operation only.

Series V_f applied across the two filament sections in series, between pins 1 and 7. V_{g1} referred to pin 1.

Parallel V_f applied across the two filament sections in parallel, between pin 5 and pins 1 and 7 connected together. V_{g1} referred to pin 5.

Single-Section V_f applied across one section of the filament only, between pin 5 and either pin 1 or pin 7.

	Series	*Parallel*	*Single-Section*	
V_f	2.8	1.4	1.4	V
I_f	0.05	0.1	0.05	A

MOUNTING POSITION

Any

CAPACITANCES (Measured without external screening)

c_{a-g1}	0.2	μμF
c_{in}	5.5	μμF
c_{out}	3.8	μμF

CHARACTERISTICS

	Filament Connection		
	Series	*Parallel*	
V_a	90	90	V
V_{g2}	90	90	V
V_{g1}	−4.5	−4.5	V
I_a	7.7	9.5	mA
I_{g2}	1.7	2.1	mA
g_m	2.0	2.15	mA/V
μ_{g1-g2}	7.5	7.5	
r_a	0.12	0.1	MΩ

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Series filament connection.

V_a	90	V
V_{g2}	90	V
V_{g1}	−4.5	V
$I_{a(o)}$	7.7	mA
$I_{g2(o)}$	1.7	mA
R_a	10	kΩ
$V_{in(r.m.s.)}$	3.2	V
P_{out}	240	mW
D_{tot}	7	%

Parallel filament connection.

V_a	85	90	V
V_{g2}	85	90	V
V_{g1}	−5.0	−4.5	V
$I_{a(o)}$	6.9	9.5	mA
$I_{g2(o)}$	1.5	2.1	mA
R_a	10	10	kΩ
$V_{in(r.m.s.)}$	3.5	3.2	V
P_{out}	250	270	mW
D_{tot}	10	7	%

DL94

MINIATURE OUTPUT PENTODE

Output pentode with centre-tapped filament for use in battery operated equipment. Designed for operation with equal voltages on anode and screen-grid.

Single section of filament.

V_a	85	V
V_{g2}	85	V
V_{g1}	−5.0	V
$I_{a(o)}$	3.5	mA
$I_{g2(o)}$	0.8	mA
R_a	20	kΩ
$V_{in(r.m.s.)}$	3.9	V
P_{out}	150	mW
D_{tot}	12	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Series or parallel filament connection.

V_a	82	90	V
V_{g2}	82	90	V
V_{g1}	−8.2	−9.4	V
$I_{a(o)}$	2×2.0	2×2.0	mA
I_a(max. sig.)	2×5.6	2×6.4	mA
$I_{g2(o)}$	2×0.5	2×0.5	mA
I_{g2}(max. sig.)	2×2.1	2×2.3	mA
R_{a-a}	14	14	kΩ
$V_{in(g-g)(r.m.s.)}$	12.2	14	V
P_{out}	460	580	mW
D_{tot}	3.5	3.8	%

Single section of filament.

V_a	82	90	V
V_{g2}	82	90	V
V_{g1}	−8.0	−9.1	V
$I_{a(o)}$	2×1.0	2×1.0	mA
I_a(max. sig.)	2×2.9	2×3.3	mA
$I_{g2(o)}$	2×0.3	2×0.3	mA
I_{g2}(max. sig.)	2×1.1	2×1.3	mA
R_{a-a}	30	30	kΩ
$V_{in(g-g)(r.m.s.)}$	12	13.8	V
P_{out}	230	300	mW
D_{tot}	2.6	2.7	%

LIMITING VALUES

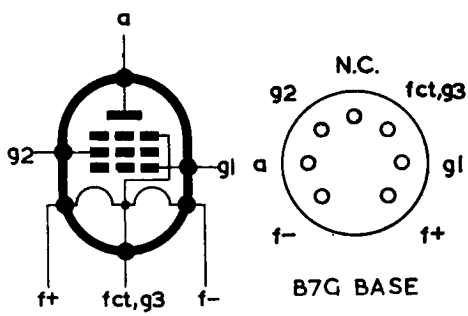
V_a max.	90	V
p_a max.	1	W
V_{g2} max.	90	V
p_{g2} max.	0.3	W
*I_k max.	12	mA
R_{g1-f} max.	1.0	MΩ

*I_k max. for each 1.4-volt section of filament is 6mA.

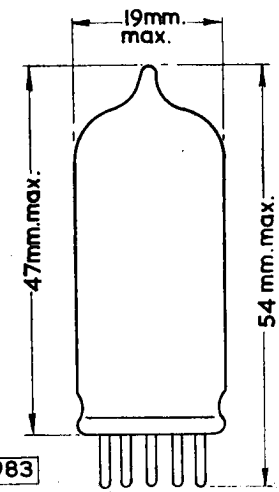
MINIATURE OUTPUT PENTODE

DL94

Output pentode with centre-tapped filament for use in battery operated equipment. Designed for operation with equal voltages on anode and screen-grid.



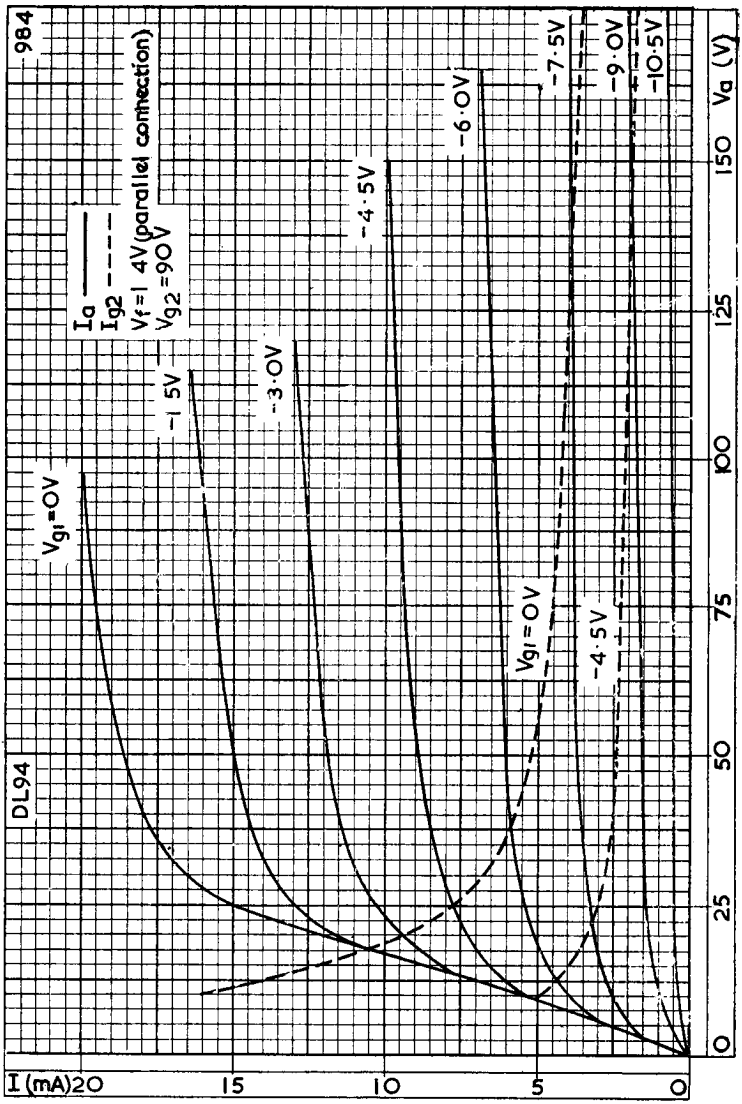
B7G BASE



DL94

MINIATURE OUTPUT PENTODE

Output pentode with centre-tapped filament for use in battery operated equipment. Designed for operation with equal voltages on anode and screen-grid.



ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR BOTH SECTIONS OF FILAMENT IN PARALLEL

OUTPUT PENTODE

DL96

Output pentode with centre-tapped filament for use in battery operated equipment.

FILAMENT

This valve is suitable for d.c. operation only.

Series

V_f applied across the two filament sections in series, between pins 1 and 7. V_{g1} referred to pin 1.

Parallel

V_f applied across the two filament sections in parallel, between pin 5 and pins 1 and 7 connected together. V_{g1} referred to pin 5.

Single Section

V_f applied across one section of the filament only, between pin 5 and either pin 1 or 7.

From a parallel supply

	Series	*Parallel*	
V_f	2.8	1.4	V
I_f	25	50	mA

From a series supply

V_f	2.6	1.3	V
I_f	24	48	mA

The filament must be shunted to ensure the correct filament voltage across each section. If separate l.t. and h.t. batteries are employed it is recommended that each filament section is shunted separately to h.t.

If a pair of valves are used in push-pull in a 50mA series chain, then the corresponding filament sections of each valve must be connected in parallel and the pairs of sections in series. A resistor must shunt the more negative pair of sections. V_{g1} referred to pin 1.

CAPACITANCES

c_{a-g1}	< 0.4	pF
c_{in}	4.8	pF←
c_{out}	4.4	pF←

CHARACTERISTICS (parallel filament connection)

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	3.5	5.0	mA
I_{g2}	650	900	μA
g_m	1.3	1.4	mA/V
μ_{g1-g2}	7.0	7.0	
r_a	170	150	kΩ

V_{g1} max. ($I_{g1} = +0.3\mu A$) 0 V

DL96

OUTPUT PENTODE

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER ←

Series filament connection

V_b	90	V
V_a	85	V
V_{g2}	85	V
V_{g1}	−5.2	V
I_a	4.3	mA
I_{g2}	700	μA
R_a	15	kΩ
$V_{in(r.m.s.)}$	3.0	V
P_{out}	160	mW
D_{tot}	10	%

Parallel filament connection

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	3.5	5.0	mA
I_{g2}	650	900	μA
R_a	15	13	kΩ
$V_{in(r.m.s.)}$	2.6	3.5	V
P_{out}	100	200	mW
D_{tot}	10	10	%

Single section of filament

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	1.75	2.5	mA
I_{g2}	330	450	μA
R_a	30	25	kΩ
$V_{in(r.m.s.)}$	2.6	3.6	V
P_{out}	50	100	mW
D_{tot}	10	10	%

OPERATING CONDITIONS FOR TWO VALVES IN CLASS "AB" PUSH-PULL

All filament sections in parallel

V_b	67.5	90	V
*R_k	470	560	Ω
$I_{a(o)}$	2×2.3	2×3.25	mA
I_a (max. sig.)	2×3.4	2×4.75	mA
$I_{g2(o)}$	2×430	2×600	μA
I_{g2} (max. sig.)	2×0.95	2×1.5	mA
R_{a-a}	20	20	kΩ
$V_{in(g1-g1)r.m.s.}$	11.4	15.8	V
P_{out}	220	420	mW
D_{tot}	3.0	4.0	%

*An additional 3.5mA is fed through R_k to simulate the current from previous stages.

OUTPUT PENTODE

DL96

Output pentode with centre-tapped filament for use in battery operated equipment.

FILAMENT

This valve is suitable for d.c. operation only.

Series

V_f applied across the two filament sections in series, between pins 1 and 7. V_{g1} referred to pin 1.

Parallel

V_f applied across the two filament sections in parallel, between pin 5 and pins 1 and 7 connected together. V_{g1} referred to pin 5.

Single Section

V_f applied across one section of the filament only, between pin 5 and either pin 1 or 7.

From a parallel supply

	Series	*Parallel*	
V_f	2.8	1.4	V
I_f	25	50	mA

From a series supply

V_f	2.6	1.3	V
I_f	24	48	mA

The filament must be shunted to ensure the correct filament voltage across each section. If separate l.t. and h.t. batteries are employed it is recommended that each filament section is shunted separately to h.t.

If a pair of valves are used in push-pull in a 50mA series chain, then the corresponding filament sections of each valve must be connected in parallel and the pairs of sections in series. A resistor must shunt the more negative pair of sections. V_{g1} referred to pin 1.

CAPACITANCES

c_{a-g1}	< 0.4	pF
c_{in}	4.8	pF
c_{out}	4.4	pF

CHARACTERISTICS (parallel filament connection)

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	3.5	5.0	mA
I_{g2}	650	900	μA
g_m	1.3	1.4	mA/V
μ_{g1-g2}	7.0	7.0	
r_a	170	150	kΩ

V_{g1} max. ($I_{g1} = +0.3\mu A$) 0 V

DL96

OUTPUT PENTODE

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER ←

Series filament connection

V_b	90	V
V_a	85	V
V_{g2}	85	V
V_{g1}	−5.2	V
I_a	4.3	mA
I_{g2}	700	μA
R_a	15	kΩ
$V_{in(r.m.s.)}$	3.0	V
P_{out}	160	mW
D_{tot}	10	%

Parallel filament connection

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	3.5	5.0	mA
I_{g2}	650	900	μA
R_a	15	13	kΩ
$V_{in(r.m.s.)}$	2.6	3.5	V
P_{out}	100	200	mW
D_{tot}	10	10	%

Single section of filament

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	1.75	2.5	mA
I_{g2}	330	450	μA
R_a	30	25	kΩ
$V_{in(r.m.s.)}$	2.6	3.6	V
P_{out}	50	100	mW
D_{tot}	10	10	%

OPERATING CONDITIONS FOR TWO VALVES IN CLASS "AB" PUSH-PULL

All filament sections in parallel

V_b	67.5	90	V
*R_k	470	560	Ω
$I_{a(o)}$	2 × 2.3	2 × 3.25	mA
I_a (max. sig.)	2 × 3.4	2 × 4.75	mA
$I_{g2(o)}$	2 × 430	2 × 600	μA
I_{g2} (max. sig.)	2 × 0.95	2 × 1.5	mA
R_{a-a}	20	20	kΩ
$V_{in(g1-g1)r.m.s.}$	11.4	15.8	V
P_{out}	220	420	mW
D_{tot}	3.0	4.0	%

*An additional 3.5mA is fed through R_k to simulate the current from previous stages.

OPERATING CONDITIONS FOR TWO VALVES IN CLASS "B" PUSH-PULL

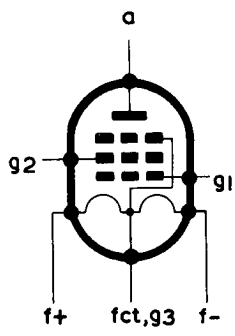
All filament sections in parallel

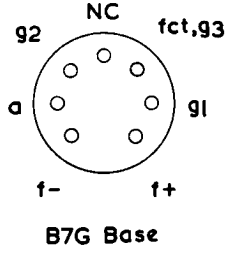
V_b	67.5	90	V
V_a	61.5	81.5	V
V_{g2}	61.5	81.5	V
V_{g1}	−5.8	−8.5	V
$I_{a(o)}$	2×0.75	2×1.0	mA
I_a (max. sig.)	2×3.4	2×5.0	mA
$I_{g2(o)}$	2×140	2×180	μA
I_{g2} (max. sig.)	2×0.95	2×1.3	mA
R_{a-a}	20	16	kΩ
$V_{in(g1-g1)r.m.s.}$	11.4	15.8	V
P_{out}	220	440	mW
D_{tot}	3.0	2.6	%

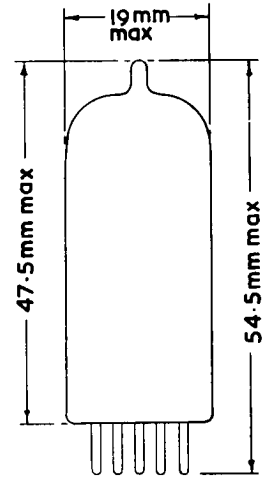
LIMITING VALUES

V_b max. (absolute)	110	V
V_b max.	90	V
V_a max.	90	V
p_a max.	600	mW
V_{g2} max.	90	V
p_{g2} max.	200	mW
*I_k max. (parallel filament connection)	6.0	mA
R_{g1-f} max.	2.0	MΩ

*I_k max. for each 1.4V section of the filament is 3mA.







3373

R.F. OUTPUT PENTODE

DL98

R.F. output pentode intended for use in portable equipment as a class 'C' r.f. amplifier, oscillator and frequency multiplier.

FILAMENT

		Series	*Parallel*	
V_f		2.5	1.25	V
I_f		165	330	mA

When the filament sections are series connected, the lower section of the filament should be shunted by a resistor to by-pass the cathode current of the upper section.

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{a-g1}	< 160		mpF
c_{in}	4.6		pF
c_{out}	7.6		pF

CHARACTERISTICS

V_a	90	135	V←
V_{g2}	90	120	V←
I_a	15	30	mA
I_{g2}	1.0	1.8	mA
g_m	1.7	2.15	mA/V←
r_a	22	22	kΩ
μ_{g1-g2}	3.2	3.45	
V_{g1}	−9.9	−10	V

OPERATING CONDITIONS

As class 'C' amplifier or oscillator		†	
f	100	100	Mc/s
V_a	90	150	V
V_{g2}	90	135	V
V_{g1}	−18	−39	V
I_a	15	25	mA
I_{g2}	4.8	6.2	mA
I_{g1}	400	550	μA
P_{drive}	30	70	mW
P_{load}	0.45	1.25	W

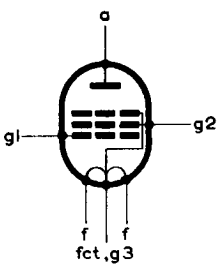
†This condition represents operation at the absolute limit of V_a, V_{g2} and I_a

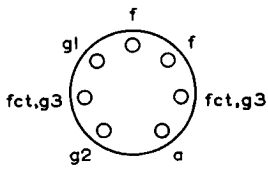
DL98

R.F. OUTPUT PENTODE

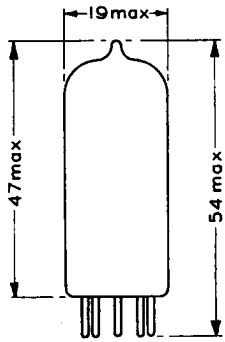
ABSOLUTE MAXIMUM RATINGS

V_a max.	150	V
p_a max.	3.0	W
V_{g2} max.	135	V
p_{g2} max.	1.1	W
$-V_{g1}$ max.	75	V
I_a max.	25	mA
I_{g1} max.	1.5	mA
R_{g1-k} max.	100	kΩ
I_k max.	32	mA





B7G Base



5485

All dimensions in mm

SUBMINIATURE OUTPUT PENTODE

DL620

Subminiature output pentode suitable for battery operation with an h.t. supply of 90V.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	50	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES (measured without external shield)

c_{a-g1}	<0.2	pF
c_{in}	2.8	pF
c_{out}	3.5	pF

CHARACTERISTICS

V_a	67.5	V
V_{g2}	67.5	V
I_a	3.1	mA
I_{g2}	950	μA
V_{g1}	−6.5	V
g_m	650	μA/V
r_a	110	kΩ
μ_{g1-g2}	5.0	

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	45	67.5	90	V
V_{g2}	45	67.5	67.5	V
$I_{a(o)}$	1.8	3.25	3.25	mA
$I_{g2(o)}$	0.6	1.0	0.9	mA
$I_{g2\ (max.sig.)}$	1.1	1.75	1.5	mA
V_{g1}	−3.8	−6.2	−6.7	V
$V_{in(r.m.s.)}$	3.4	5.0	4.8	V
R_a	20	15	25	kΩ
P_{out}	30	85	110	mW
D_{tot}	10	10	10	%

DL620 SUBMINIATURE OUTPUT PENTODE

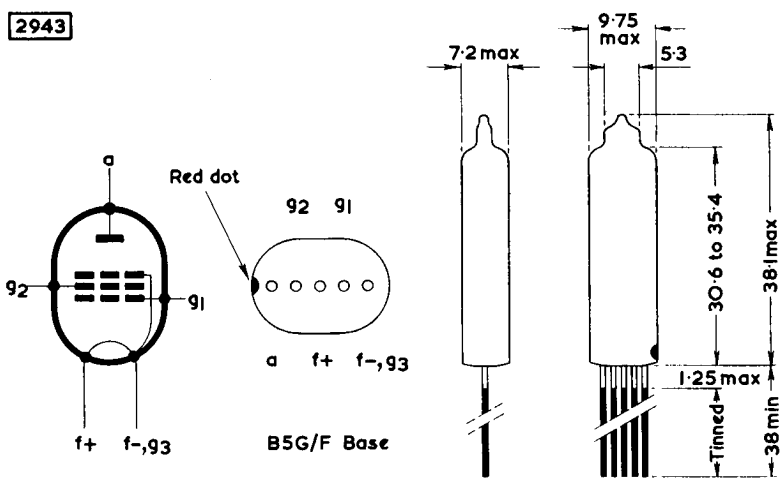
Subminiature output pentode suitable for battery operation with an h.t. supply of 90V.

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL CLASS 'AB'

V_{a-e}	67.5	V
V_{g2-e}	67.5	V
$I_{a(o)}$	3.3	mA
$I_{a\ (max.\ sig.)}$	3.6	mA
$I_{g2(o)}$	1.0	mA
$I_{g2\ (max.\ sig.)}$	2.25	mA
R_k	1.8	kΩ
R_{a-a}	30	kΩ
$V_{in(g1-g1)r.m.s.}$	16	V
P_{out}	100	mW
D_{tot}	3.0	%

LIMITING VALUES

V_a max.	90	V
V_{g2} max.	90	V
I_k max.	5.0	mA



All dimensions in mm

SUBMINIATURE TUNING INDICATOR

DM70

Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

FILAMENT

V_f	1.4	V
I_f	25	mA

Notes on filament voltage supplies :—

Battery-operated receivers

The filament may be fed from a 1.4V battery or it may be connected in series with the filaments of other valves in the receiver, provision being made for a suitable shunting resistor if necessary. The operating conditions indicate which filament pin should be connected to the earthed side of the demodulator circuit.

Mains-operated receivers (V_f=1.3V)

The filament may be fed from a 6.3V heater transformer provided it is connected in series with a 220Ω, 1W, 5% resistor. If the heater transformer has a centre-tap giving 3.15V, a series resistor of 82Ω, 0.5W, 10% may be used.

If desired, the filament, shunted by a suitable resistor, may be included in a series heater chain provided it also includes a current limiting device.

With either form of connection in mains-operated receivers, pin 5 must be connected to the earth side of the demodulation circuit for satisfactory operation.

VALVE CONSTRUCTION AND MOUNTING POSITION

This valve is a triode in which the grid is in the form of a plate containing a tapered aperture. The anode is coated with fluorescent material which is viewed through the grid aperture. The length, L, of the fluorescent " column " observed through the grid aperture decreases as the grid potential goes negative.

The valve may be mounted in any position, the direction of viewing being indicated on the diagram of pin connections.

Direct soldered connections to the leads of this valve must be at least 5 mm. from the seal and any bending of the valve leads must be at least 1.5 mm. from the seal.

DM70 SUBMINIATURE TUNING INDICATOR

Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

OPERATING CONDITIONS

Battery-operated receivers

	Pin 4 earthed	Pin 5 earthed	
V_b	90	67.5	V
V_a	85	60	V
V_g	0	0	V
I_a	170	105	μA
*L	11	10	mm
V_g (for complete extinction)	−10	−7	V

Mains-operated receivers (Pin 5 earthed)

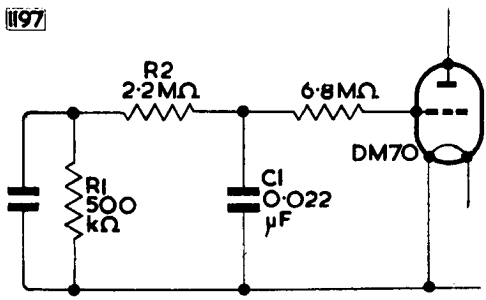
V_b	110	170	250	V
R_a	0.47	1.0	1.8	MΩ
V_g	0	0	0	V
I_a	105	110	105	μA
*L	10	10	10	mm
V_g (for complete extinction)	−15	−23	−34	V

*Length of fluorescent column observed, measured from the top of the aperture. The maximum value is approximately 14 mm.

Notes on operation in mains receivers

(a) In order to reduce the possibility of hum it is recommended that the anode be fed from the H.T. line by a series resistor, R_a, as indicated in the operating conditions and not direct to the screen grid of other valves in the receiver.

(b) The following filter is recommended for inclusion in the grid circuit.



R_1 is the load of the demodulator or the A.G.C. diode of the receiver. In addition, in receivers having normal undelayed A.G.C. the decoupling network R_2, C_1 already exists and the only additional component is the 6.8 MΩ resistor. In receivers having delayed A.G.C. it is necessary to control the DM70 from the demodulator circuit. The decoupling network R_2, C_1 is then added to the 6.8 MΩ resistor.

SUBMINIATURE TUNING INDICATOR

DM70

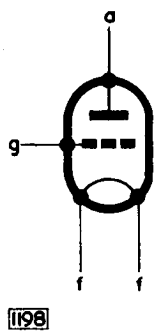
Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

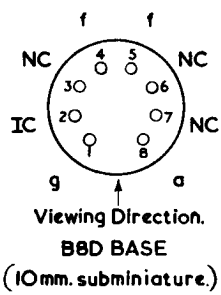
LIMITING VALUES

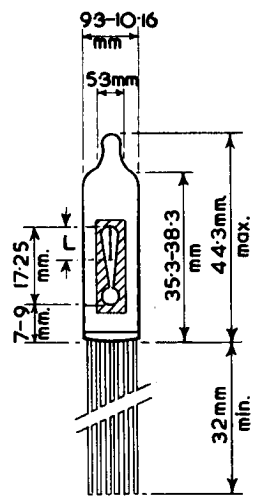
$V_{b(o)}$ max.	450	V
V_b max.	300	V
*V_a max.	90	V
V_a min.	45	V
**p_a max. ($V_a \leq 90$ V)	25	mW
**p_a max. ($V_a = 200$ V)	10	mW
I_k max.	300	μA
R_{g-f} max.	10	MΩ

*In circuits without anode series resistor.

**Values of p_a max. for intermediate values of V_a may be determined by linear interpolation.



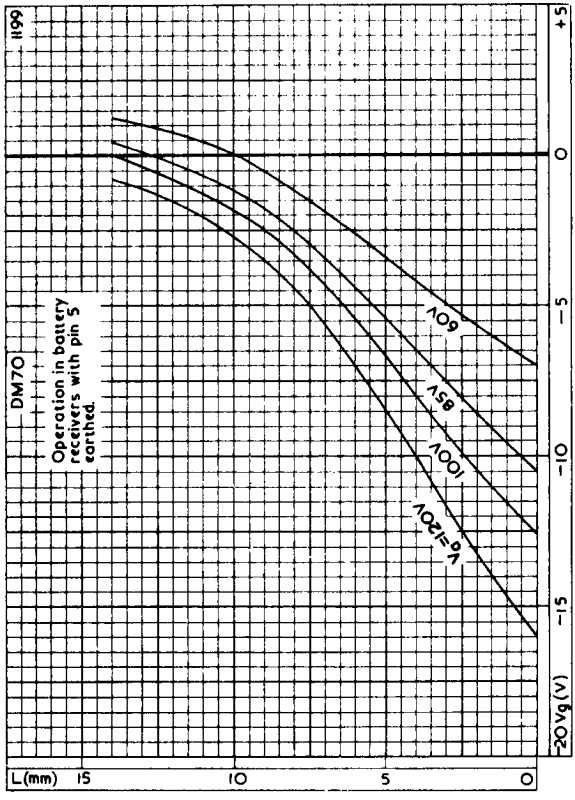




DM70

SUBMINIATURE TUNING INDICATOR

Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.



LENGTH OF FLUORESCENT COLUMN PLOTTED AGAINST GRID VOLTAGE AT VARIOUS VALUES OF ANODE VOLTAGE WHEN CONNECTED IN BATTERY-OPERATED RECEIVERS (PIN 5 EARTHED.)

DIRECTLY HEATED FULL-WAVE RECTIFIER

DW4-350

FILAMENT

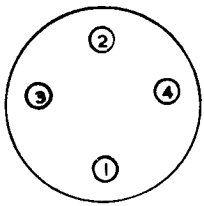
V_f	4.0	V
I_f	2.0	A

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×350	V
I_{out} max.	120	mA
C max.	16	μF
R_{llm} min.	0	Ω

CONNECTIONS

Brit. 4-Pin Base



Pin No. 1 Anode
,, 2 Anode
,, 3 Filament
,, 4 Filament

DIMENSIONS

Overall length	142	mm.
Overall diameter	51	mm.

Mullard
OSCILLOGRAPH TUBE

E40-G3

CATHODE RAY TUBE FOR OSCILLOGRAPHIC USE

3 - Inch Screen

Heater	Vf	=	4.0 V
	If	=	1.0 A
Capacities	Cg	=	6.0 uuF
	CD1D1'	=	1.0 uuF
	CD2D2'	=	3.0 uuF

Fluorescent Colour - Green

Deflection - Double electrostatic for symmetrical operation.

Operating Conditions

Va2	500	800	V
Va1 (approx. for focus)	140	220	V
Vg .....(1)	0- -20	0- -30	V
N1	0.35	0.22	mm/V
N2	0.24	0.14	mm/V

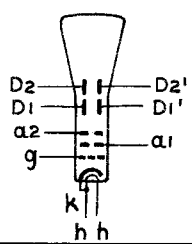
(1) The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

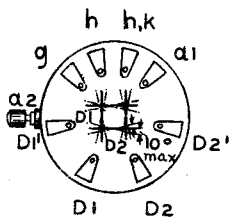
Max. writing speed ..... 0.3 km/sec

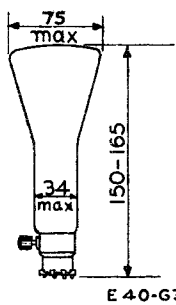
Limiting Values

Va2 max	800 V
Va1 max	275 V

Arrangement of electrodes and base connections.

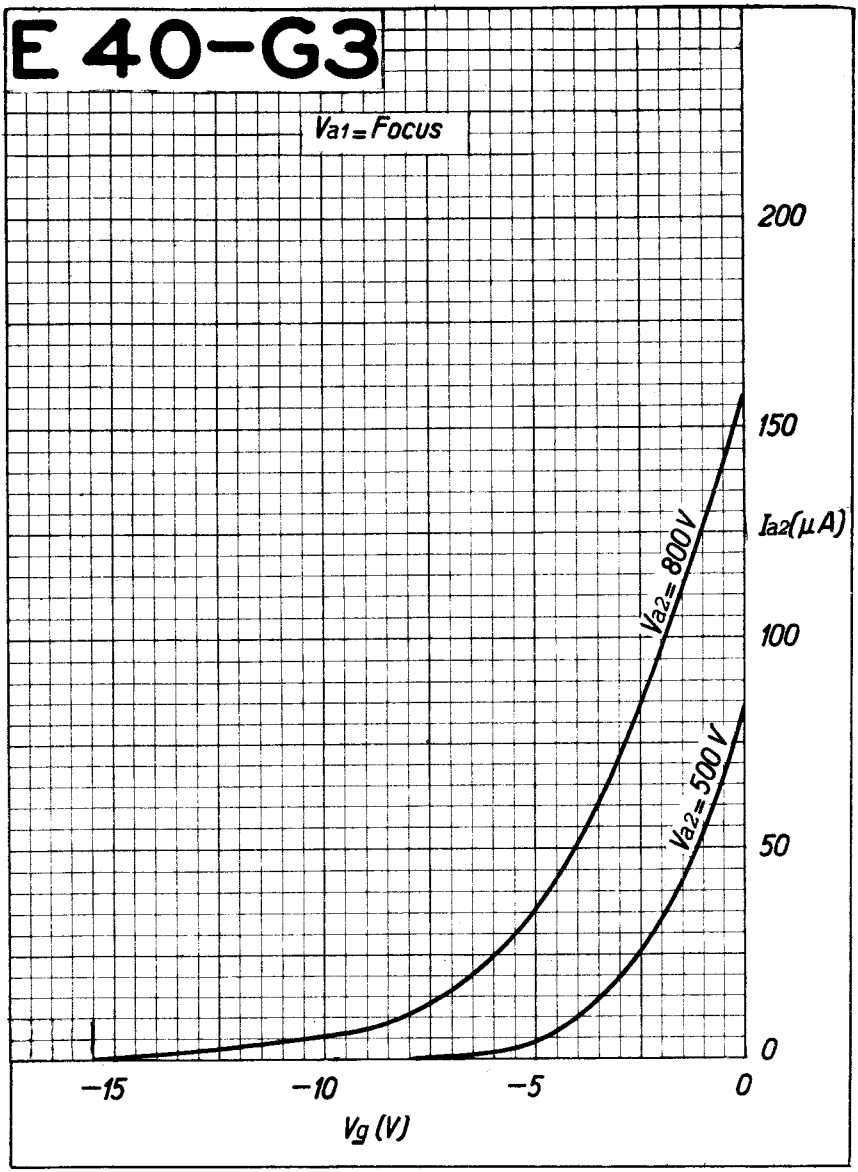






E40-G3

Mullard
OSCILLOGRAPH TUBE



1839/2

Mullard
OSCILLOGRAPH TUBE

E41-G4/B4

CATHODE RAY TUBE FOR OSCILLOGRAPHIC USE

4 - Inch Screen

Heater	Vf	=	4.0 V
	If	=	1.0 A
Capacities	Cg	=	7.5 uuF
	CD1D1'	=	2.6 uuF
	CD2D2'	=	2.8 uuF

Fluorescent Colour - Green(G4) Blue (B4)

Deflection - Double electrostatic for symmetrical operation.

Operating Conditions

Va2	1,000 V
Va1 (approx. for focus)	400 V
Vg .....(1)	0- -40 V
N1	0.40 mm/V
N2	0.31 mm/V

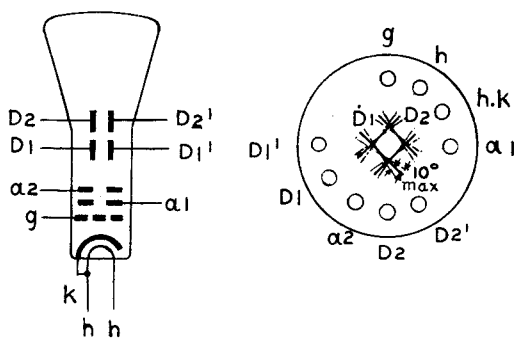
(1) The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

Max. writing speed ..... 0.5 km/sec

Limiting Values

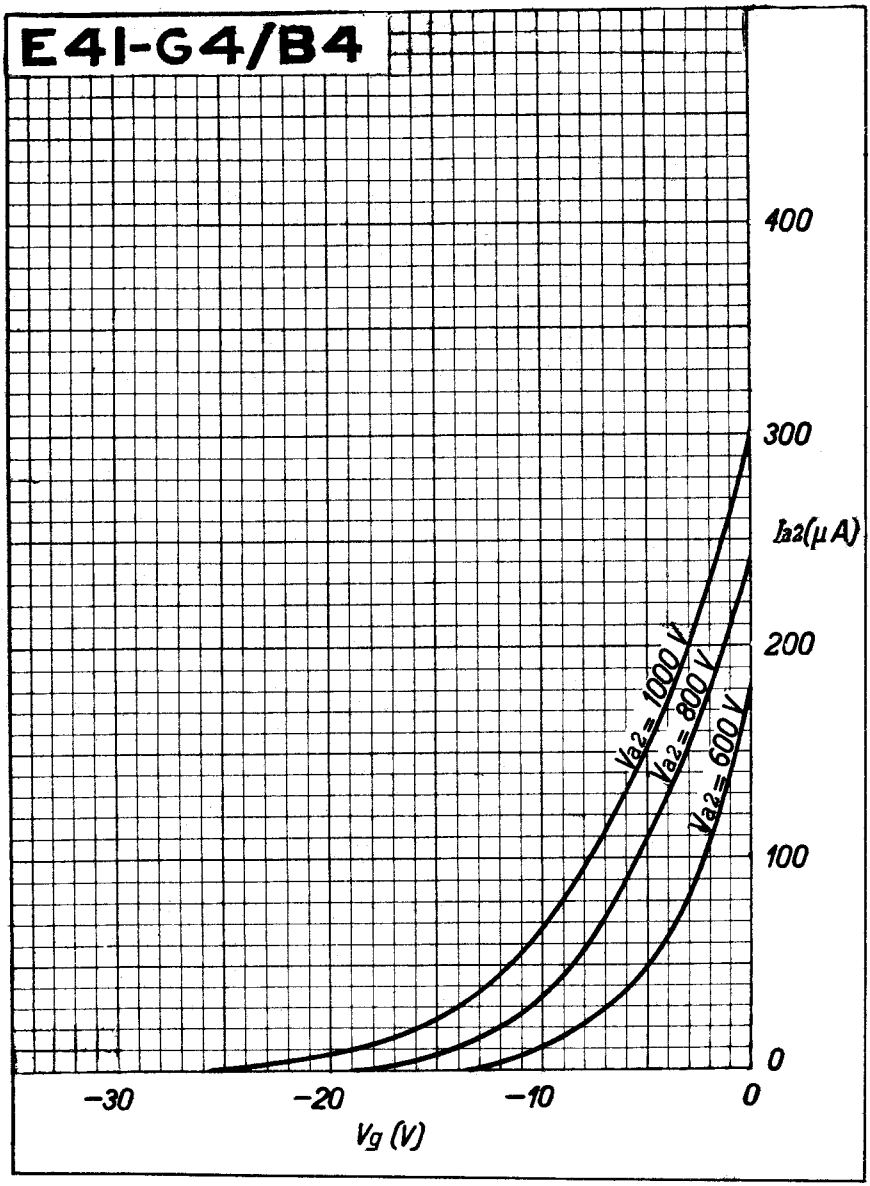
Va2 max	1,200 V
Va1 max	500 V

Arrangement of electrodes and base connections.



E41-G4/B4

Mullard
OSCILLOGRAPH TUBE



1839

Mullard
OSCILLOGRAPH TUBE

E42-G6/B6

CATHODE RAY TUBES FOR OSCILLOGRAPHIC USE

6 - Inch Screen

Heater	Vf	=	4.0 V
	If	=	1.0 A
Capacities	Cg	=	12 uuF
	CD1D1'	=	6 uuF
	CD2D2'	=	7 uuF

Fluorescent Colour - Green (G6) Blue (B6)

Deflection - Double electrostatic for symmetrical operation.

→Operating Conditions

Va2	1000	2000	V
Va1 (approx.)	200	400	V
-Vg*	0-35	0-35	V
N1	0.54	0.27	mm/V
N2	0.40	0.20	mm/V

*The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

Limiting Values

Va2 max	2000	V
Va1 max	600	V
Max. writing speed	0.5	km/sec

E42-G6/B6

Mullard
OSCILLOGRAPH TUBE

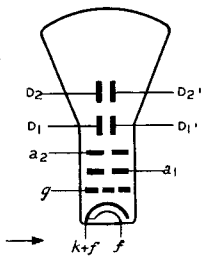


FIG 1

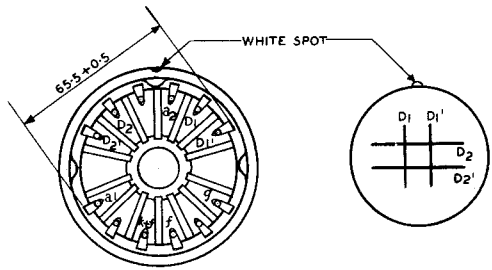


FIG 2

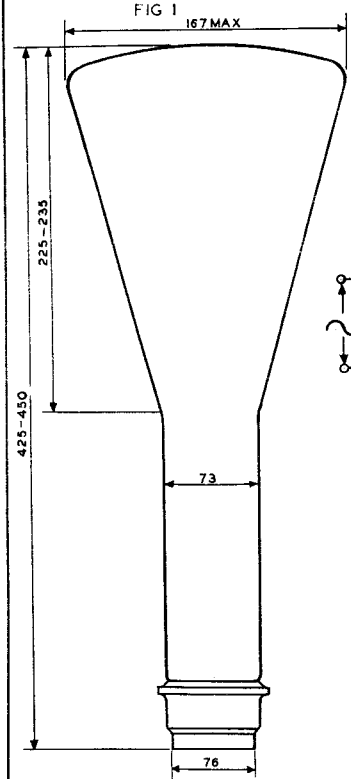


FIG 3

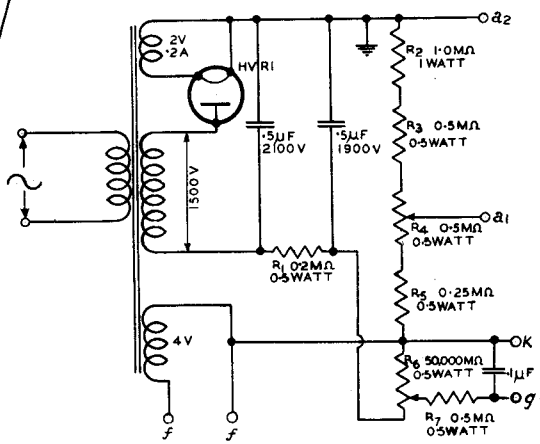
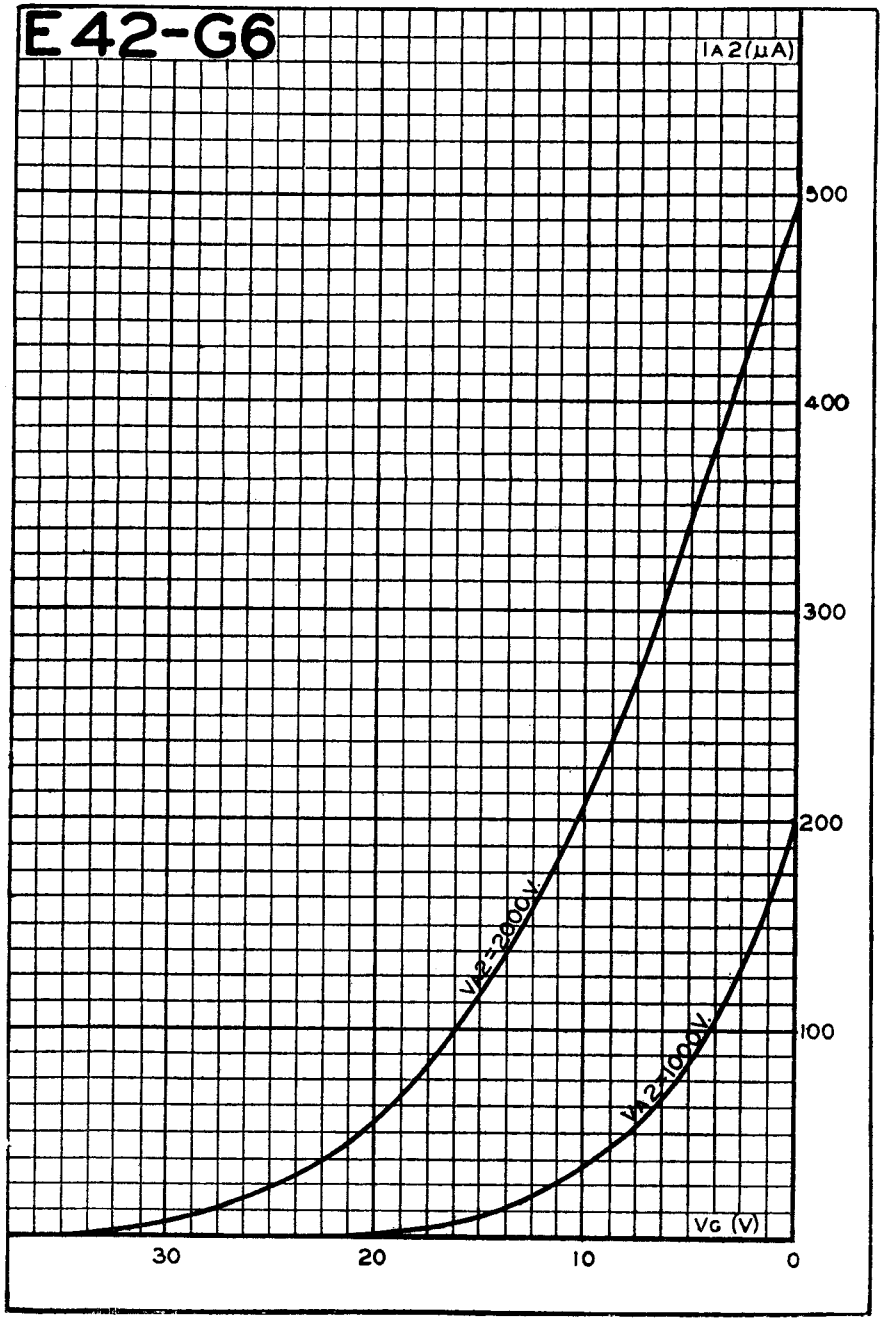


FIG 4

DIMENSIONS IN M/M

Mullard
OSCILLOGRAPH TUBE E42-G6 & E42-B6



Mullard
OSCILLOGRAPH TUBE

E46-G10/B10

CATHODE RAY TUBES FOR OSCILLOGRAPHIC USE.

10 - Inch Screen

Heater	Vf	=	4.0 V
	If	=	1.0 A
Capacities	Cg	=	15.0 uuF
	CD1D1'	=	6.5 uuF ←
	CD2D2'	=	5.5 uuF ←

Fluorescent Colour - Green (G10) Blue (B10)

Deflection - Double electrostatic for symmetrical operation.

Operating Conditions

Va3	5000	V
Va2 .....(approx.)	1400	V
Va1	250	V
-Vg*	0-60.0	V
N1	0.13	mm/V ←
N2	0.11	mm/V ←

*The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

Limiting Values

Va3 max	5000	V
Va2 max	1700	V
Va1 max	250	V
Max. writing speed	0.5	km/sec ←

E46-G10/B10

Mullard
OSCILLOGRAPH TUBE

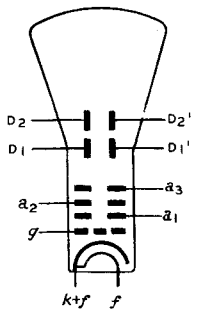
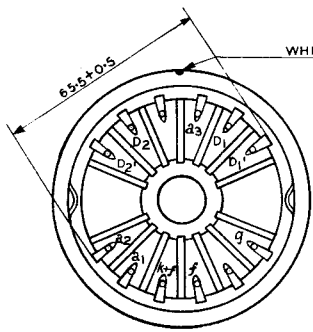
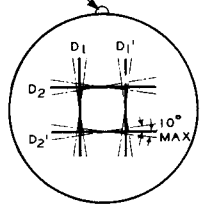


FIG 1





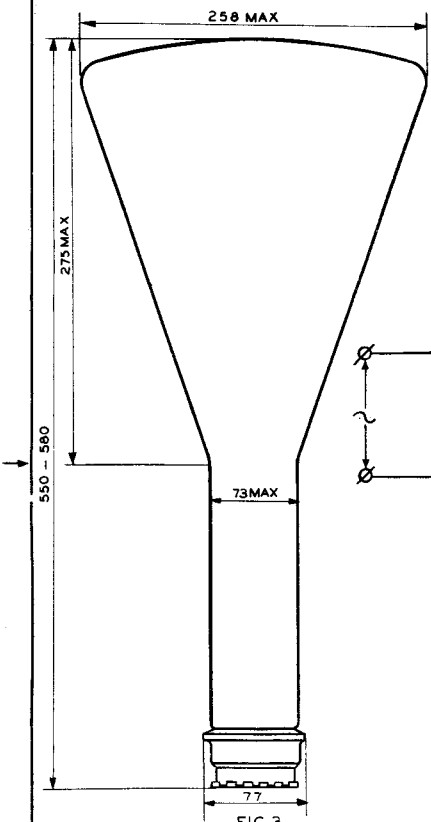
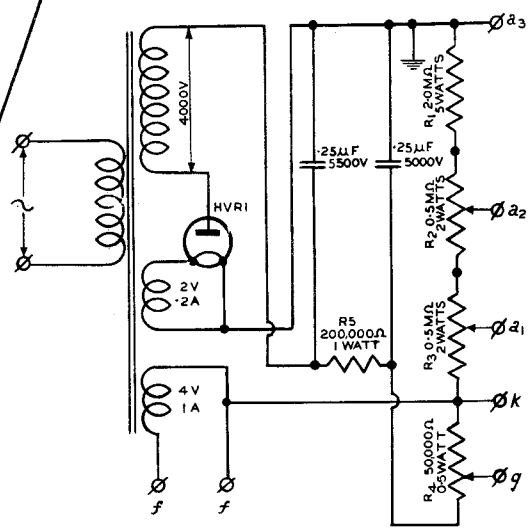


FIG 3

DIMENSIONS IN M/M



1340/2

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

E55L

Special quality high slope output pentode intended for general industrial applications where stability of characteristics and long life are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	600	mA

CAPACITANCES[2]

Pentode connected

Shielded

	Minimum	*Average*	*Maximum*	
c_{a-g1}	—	80	120	mpF
c_{in}	15	18	21	pF
c_{in} (w) (I_k = 55.5mA)	—	28	—	pF
c_{out}	5.8	6.5	7.2	pF

Unshielded

c_{a-g1}	—	110	150	mpF
c_{in}	15	18	20	pF
c_{in} (w) (I_k = 55.5mA)	—	28	—	pF
c_{out}	3.6	4.0	4.4	pF

Triode connected

Shielded

c_{a-g}	5.5	6.2	6.9	pF
c_{in}	10	11.8	13.6	pF
c_{out}	9.4	10.5	11.6	pF
c_{h-k}	—	6.0	—	pF

Unshielded

c_{a-g}	5.6	6.3	7.0	pF
c_{in}	10	11.8	13.6	pF
c_{out}	7.0	7.8	8.6	pF
c_{h-k}	—	6.0	—	pF

E55L

SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

CHARACTERISTICS[3]

Pentode connected		
V_a	125	V
V_{g2}	125	V
V_{g3}	0	V
V_{g1}	-3.0	V
R_k	0	Ω
I_a	50	mA
I_{g2}	5.5	mA
g_m	45	mA/V
r_a	20	kΩ
μ_{g1-g2}	30	
r_{g1} (f = 50Mc/s)	1.0	kΩ
Triode connected		
V_a	125	V
I_a	55.5	mA
V_g	-3.0	V
g_m	50	mA/V
μ	30	
r_a	600	Ω

OPERATING CONDITIONS

V_{a-e}	140	V
V_{g2-e}	140	V
V_{g3-k}	0	V
V_{g1-e}	+12	V
R_k	270	Ω
I_a	50	mA
I_{g2}	5.5	mA
g_m	45	mA/V

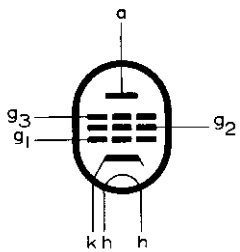
CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN ←

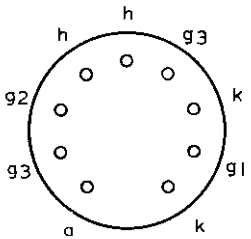
	Average	*Initial range*	*End of life**	
Anode Current at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	50	48 to 52	—	mA←
Grid-cathode voltage at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	-3.0	-2.3 to -3.7	-1.8	V←
Screen-grid current at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	5.5	4.5 to 6.5	—	mA←
Mutual conductance at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	45	38 to 52	Δg_m max. = 25%	mA/V←
Negative control-grid current (max.) at V_{a-e} = 140V, V_{g2-e} = 140V, V_{g1-e} = +12V, R_k = 270Ω	—	—	2.0	μA←

*To allow for valve deterioration during life, circuits should be designed to function with a valve in which one or more of the characteristics have changed to the values stated.

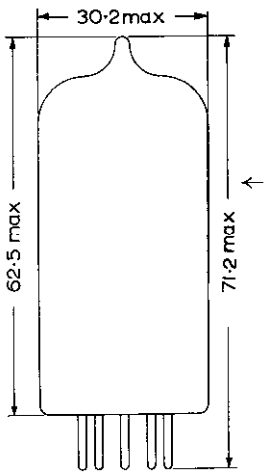
SPECIAL QUALITY WIDEBAND OUTPUT PENTODE

E55L



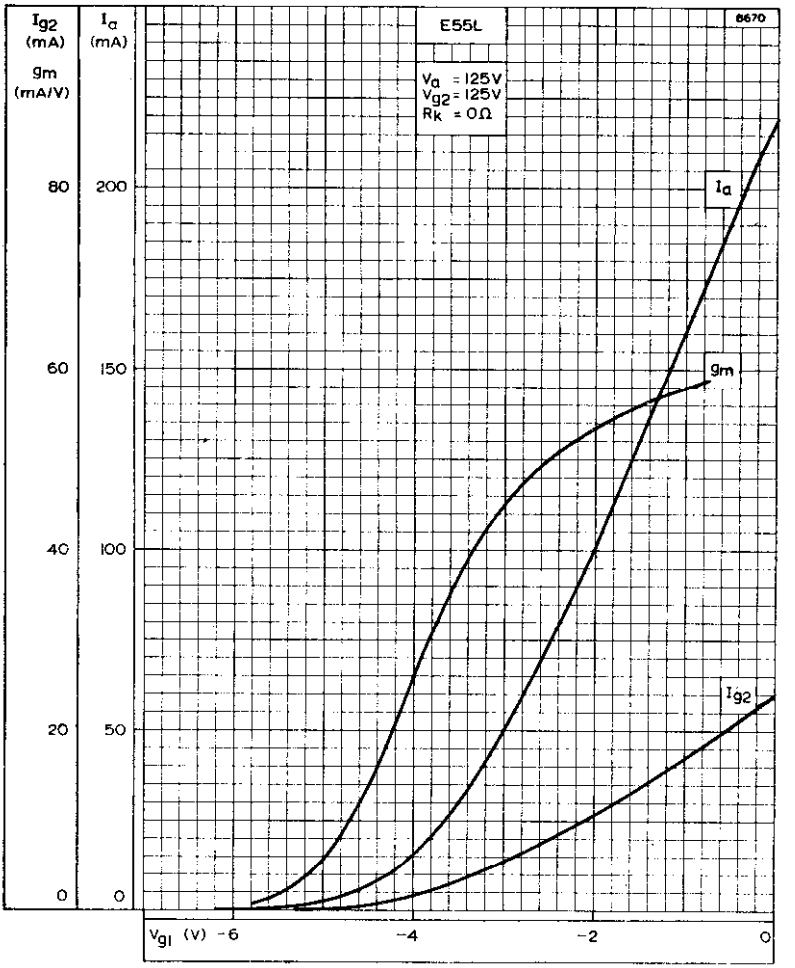


B9D Base



9862

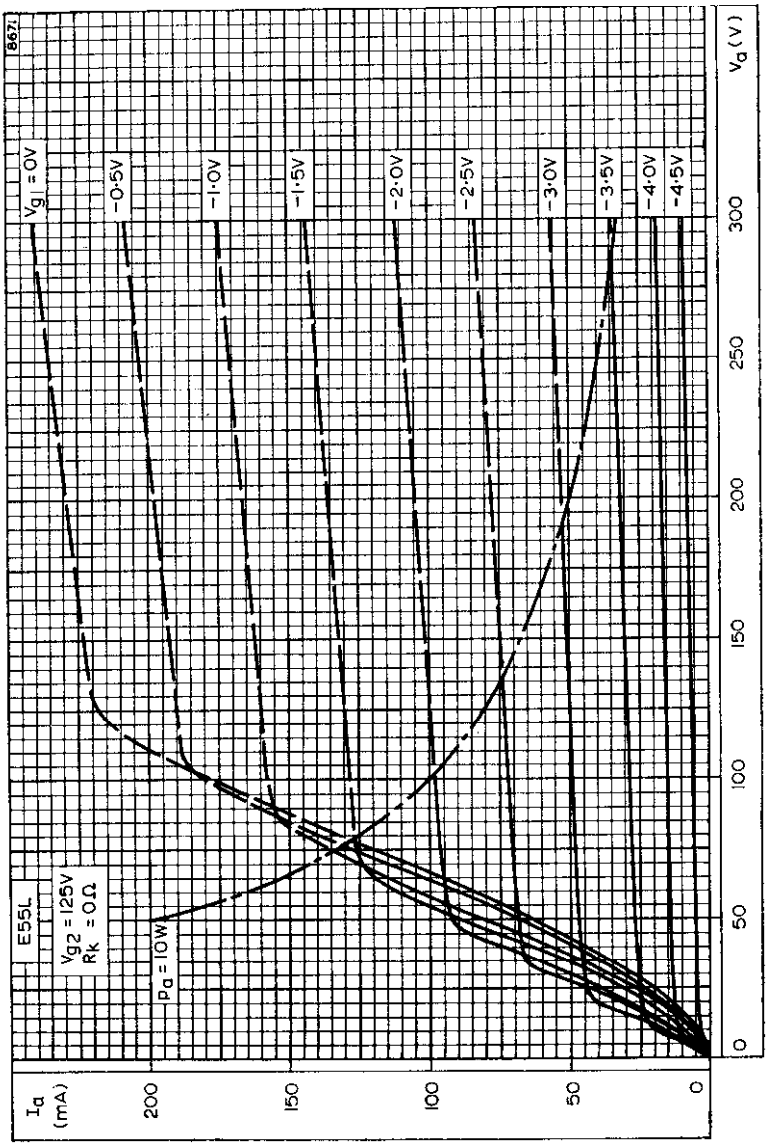
All dimensions in mm



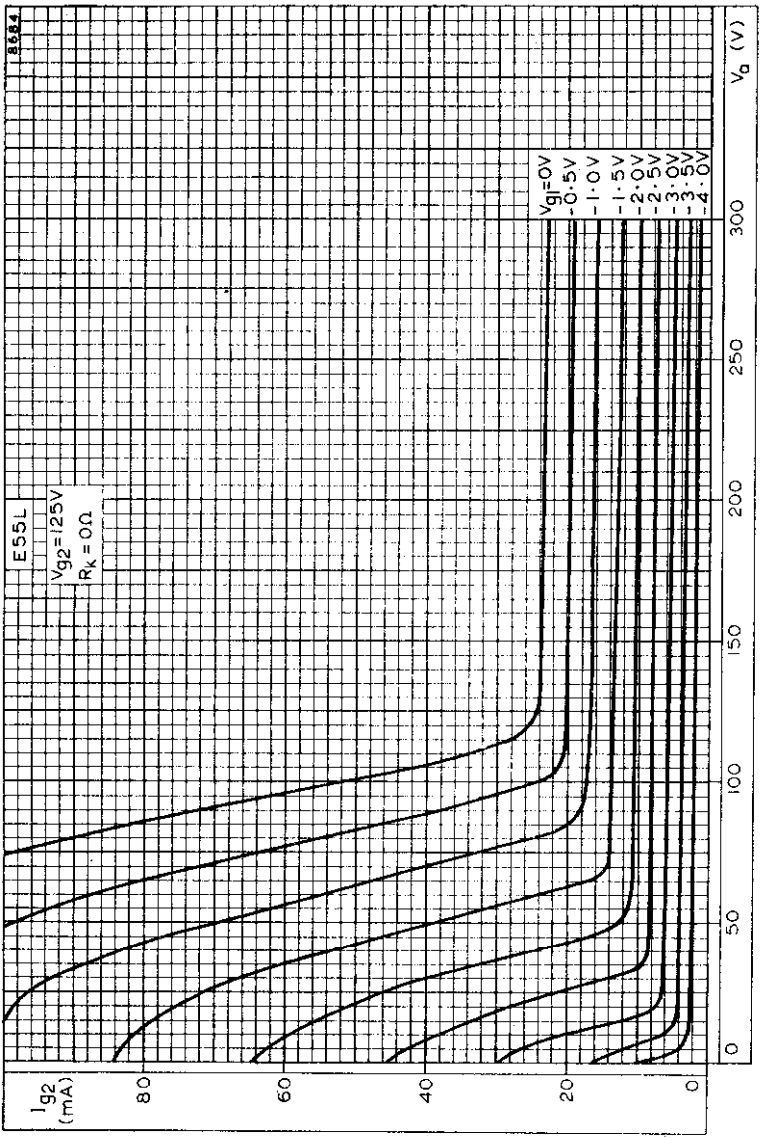
ANODE AND SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. V_{g2} = 125V

E55L

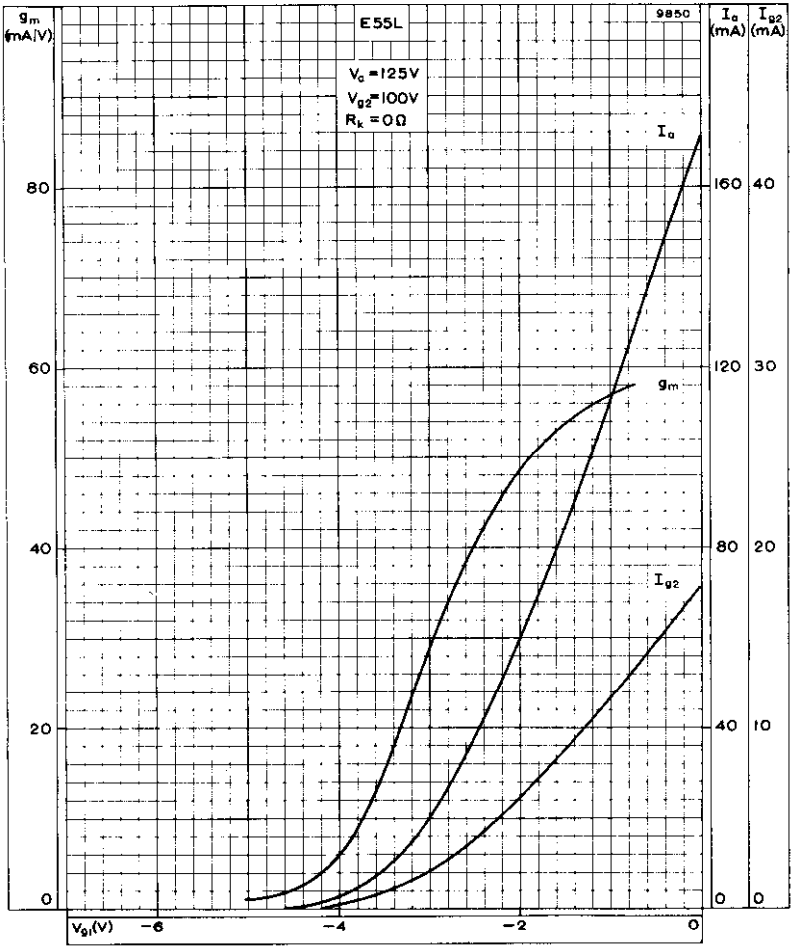
SPECIAL QUALITY WIDEBAND OUTPUT PENTODE



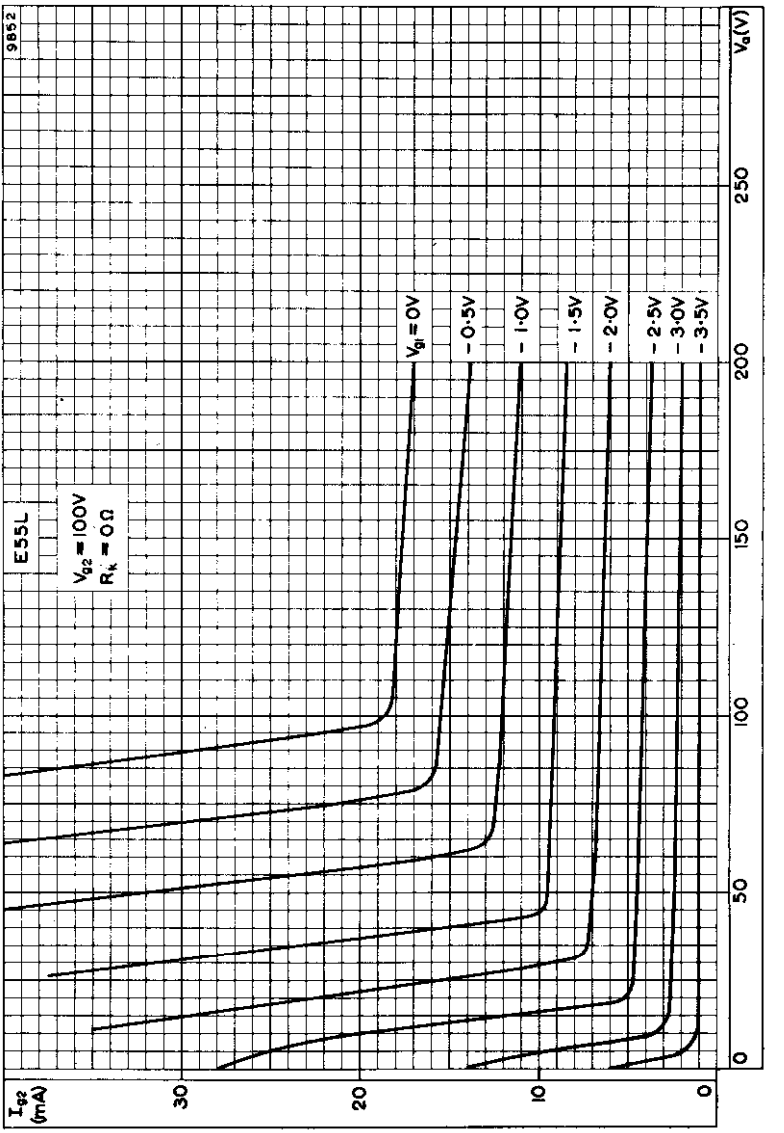
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



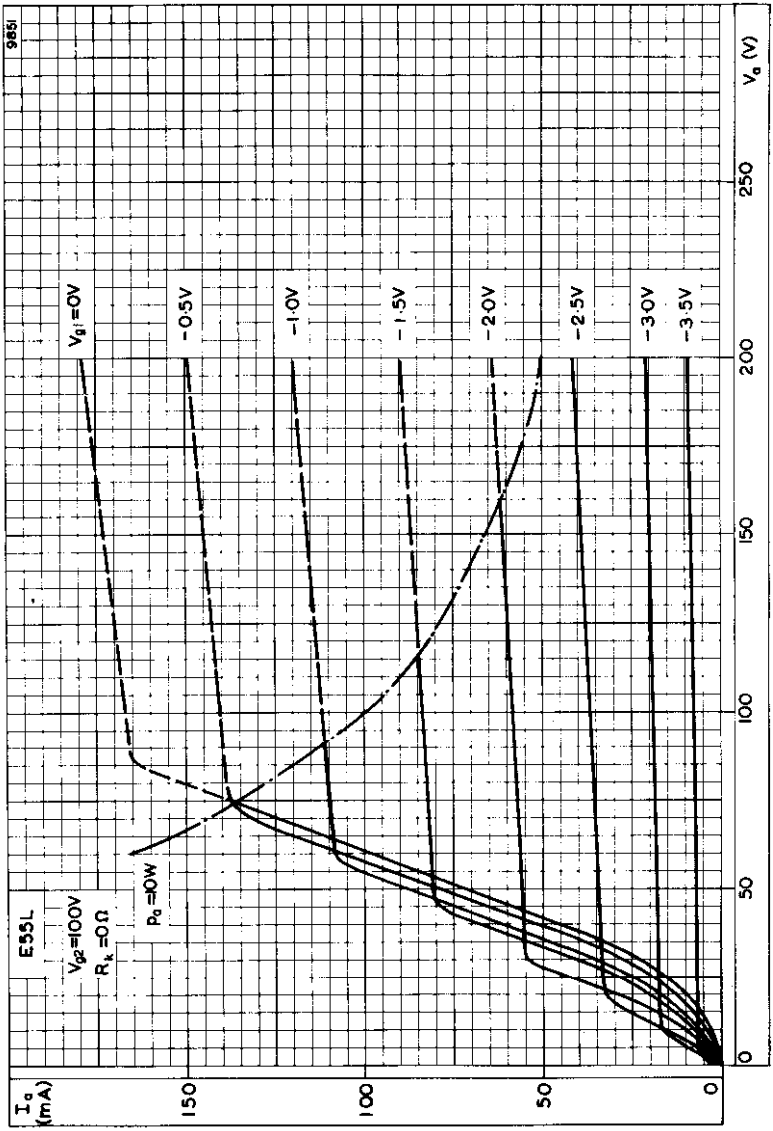
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 125V



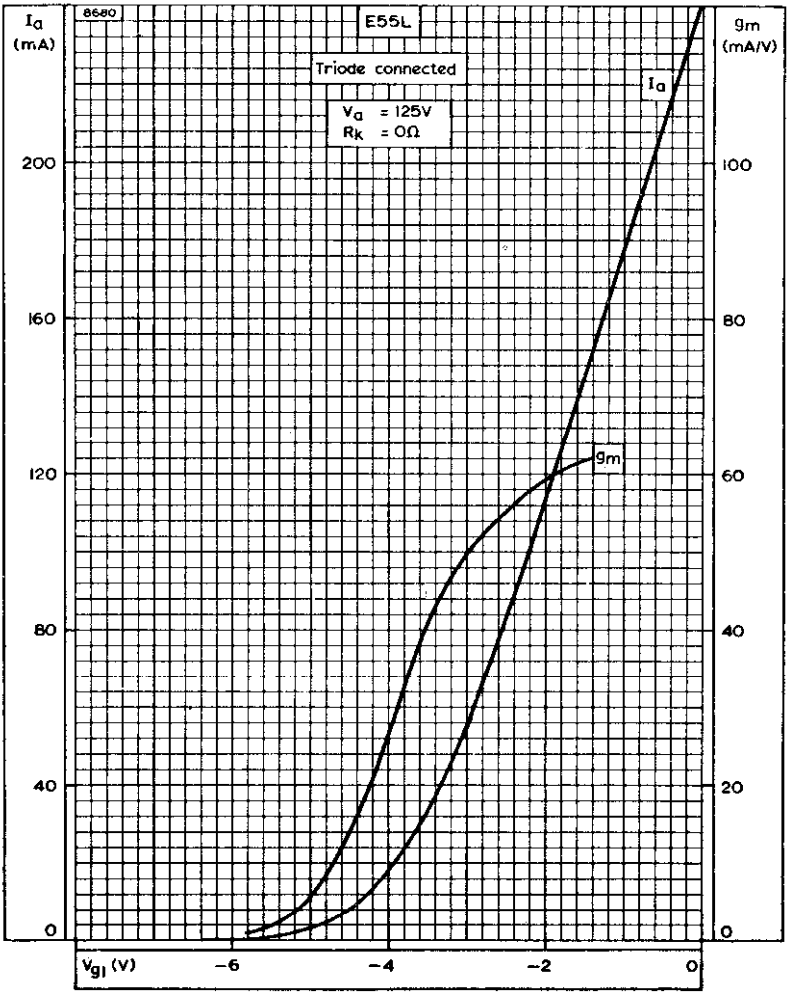
ANODE AND SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. V_{g2} = 100V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 100V



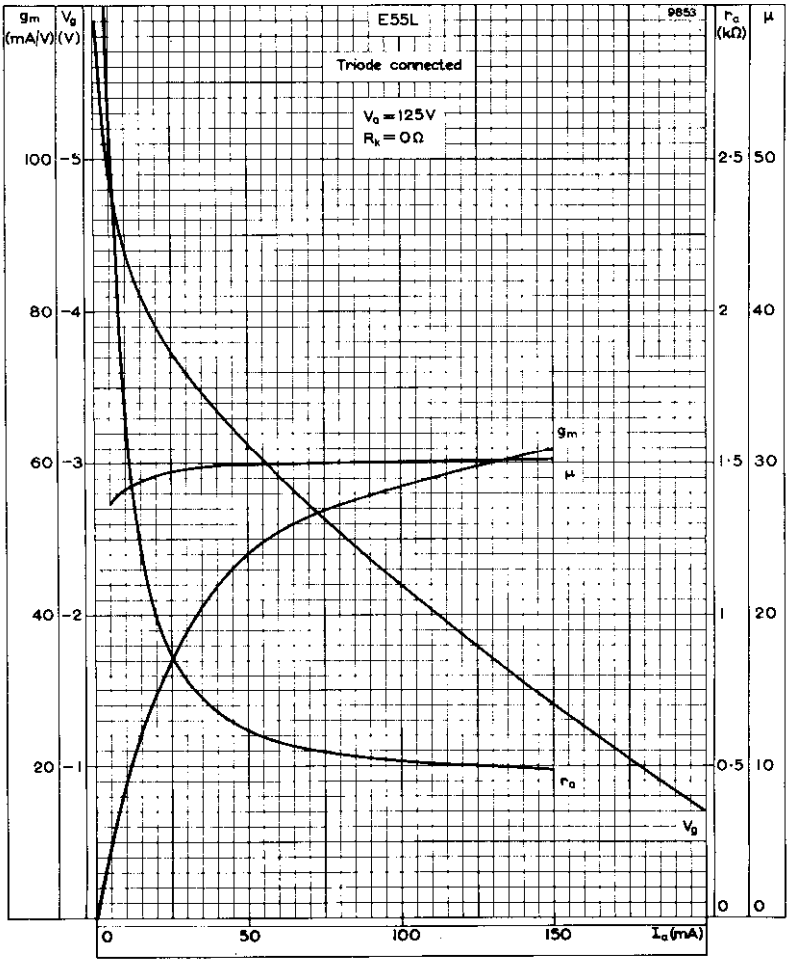
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 100V



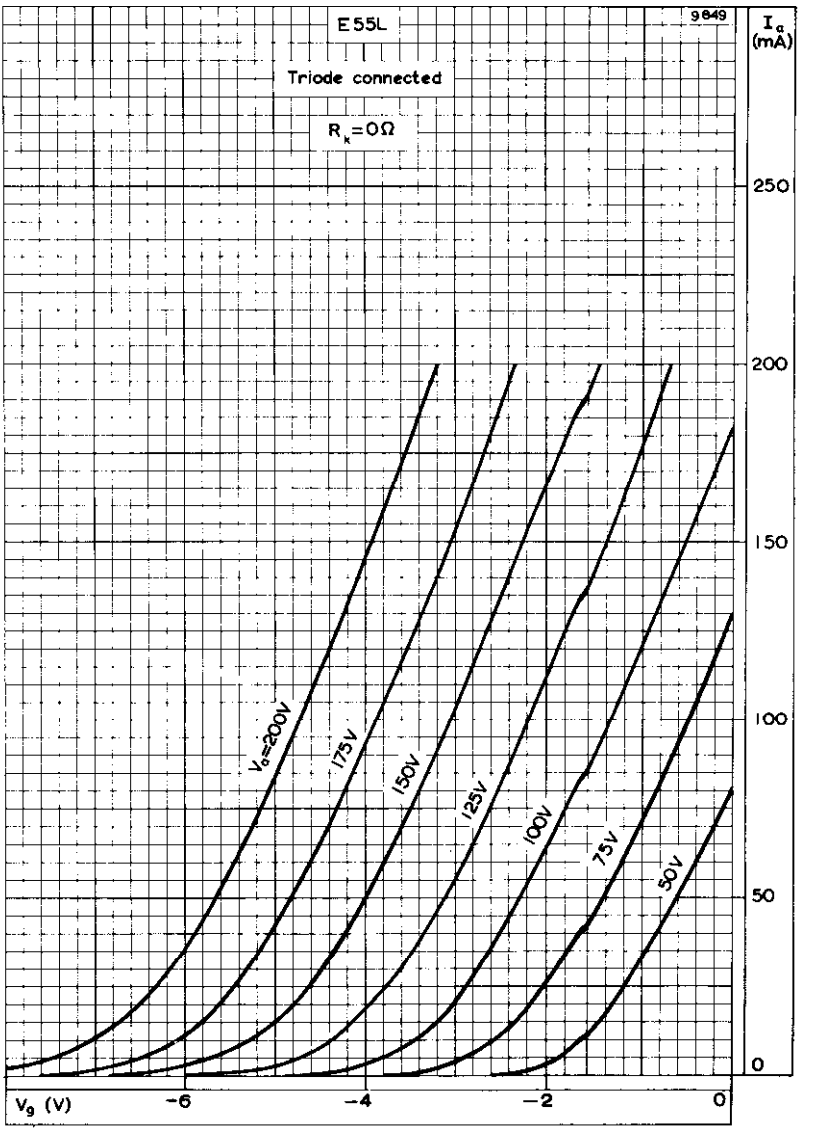
ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE, WHEN TRIODE CONNECTED

E55L

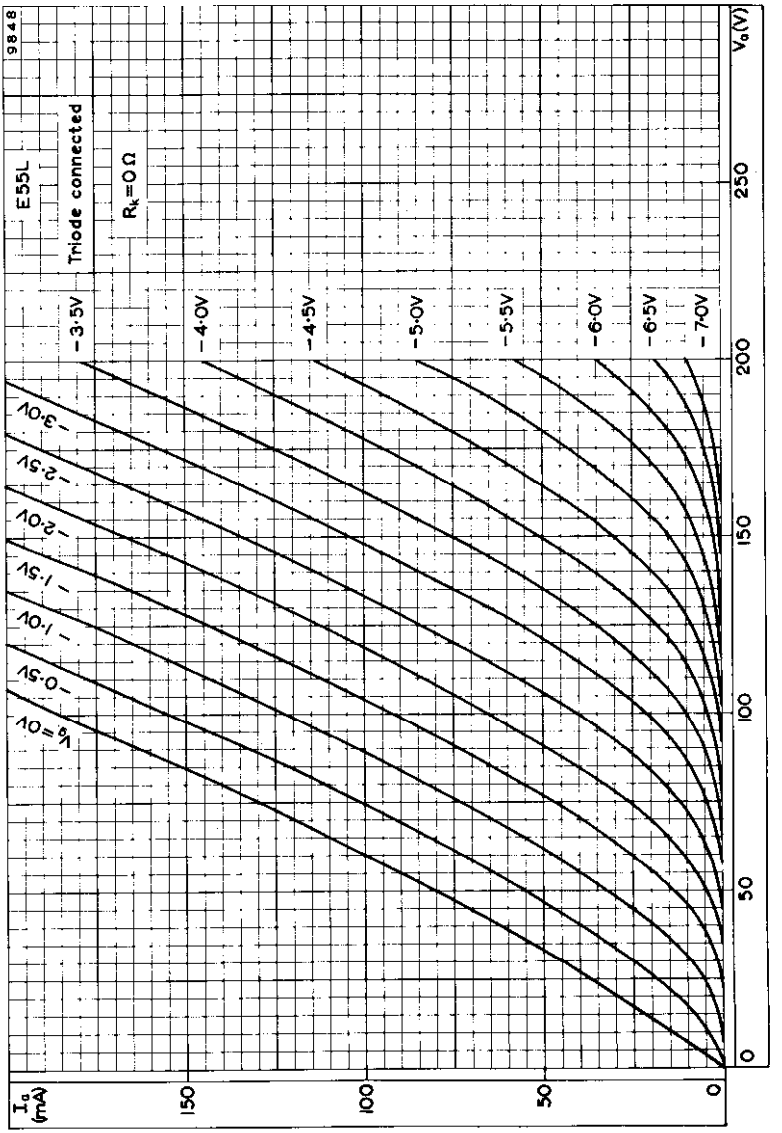
SPECIAL QUALITY WIDEBAND OUTPUT PENTODE



ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT, WHEN TRIODE CONNECTED



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED

Mullard
TELEVISION TUBE

E46-12

Cathode Ray Tube for Television Reception.

12-INCH SCREEN

HEATER CHARACTERISTICS

Heater Voltage	Vf	= 4·0 volts
Heater Current	If	= 1·0 amp

OPERATING CHARACTERISTICS

Third Anode Voltage	Va3	= 5,000 volts
Second Anode Voltage	Va2	= 1,400 volts
First Anode Voltage	Va1	= 250 volts
*Grid Voltage	−Vg	= 0-60 volts
Cathode internally connected to Heater—		
Deflection Sensitivity of Plates nearest Cathode	N1	= 0·17 mm/V
Deflection Sensitivity of Plates nearest Screen...	N2	= 0·13 mm/V

CAPACITIES

Grid to all other Electrodes	Cg	= 15 $\mu\mu$F
Between Deflection Plates nearest Cathode ...	CD1D1'	= 5·5 $\mu\mu$F
Between Deflection Plates nearest Screen ...	CD2D2'	= 6·5 $\mu\mu$F

FLUORESCENT COLOUR

White.

DEFLECTION

Double Electrostatic.

LIMITS

Maximum Third Anode Voltage	$Va3_{max}$	= 5,000 volts
Maximum Second Anode Voltage	$Va2_{max}$	= 1,700 volts
Maximum First Anode Voltage	Val_{max}	= 250 volts
Maximum Grid Voltage	$-Vg_{max}$	= 200 volts

* The grid voltage should be adjusted to give the required light intensity and definition. The voltage should never become positive or damage to the tube will result.

E46-12

Mullard
TELEVISION TUBE

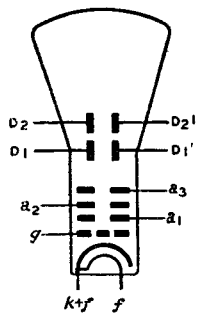


FIG 1

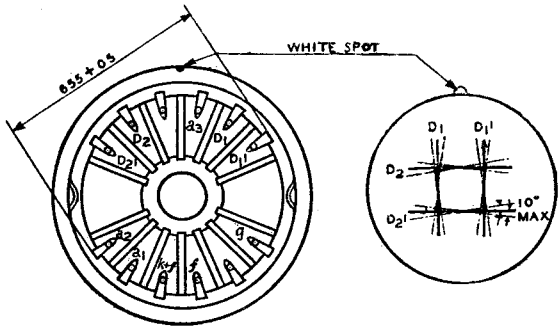


FIG 2

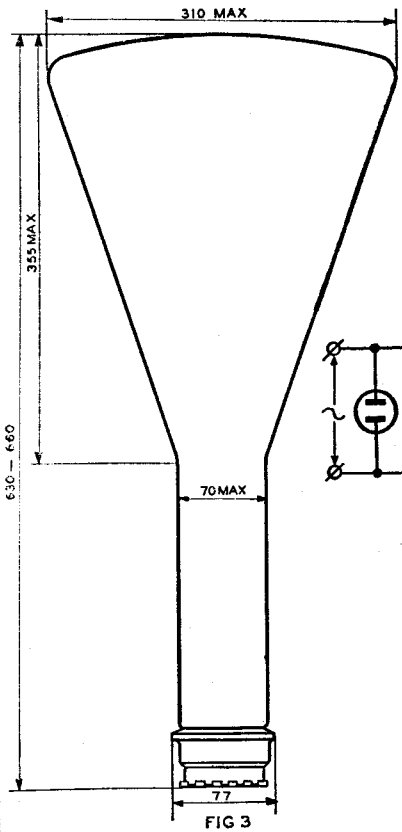


FIG 3

DIMENSIONS IN M/M

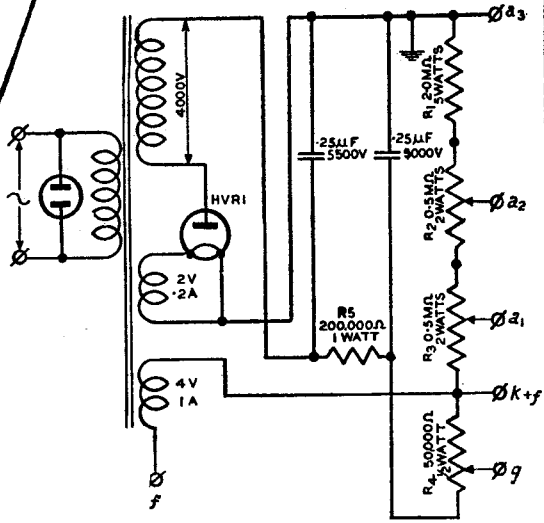
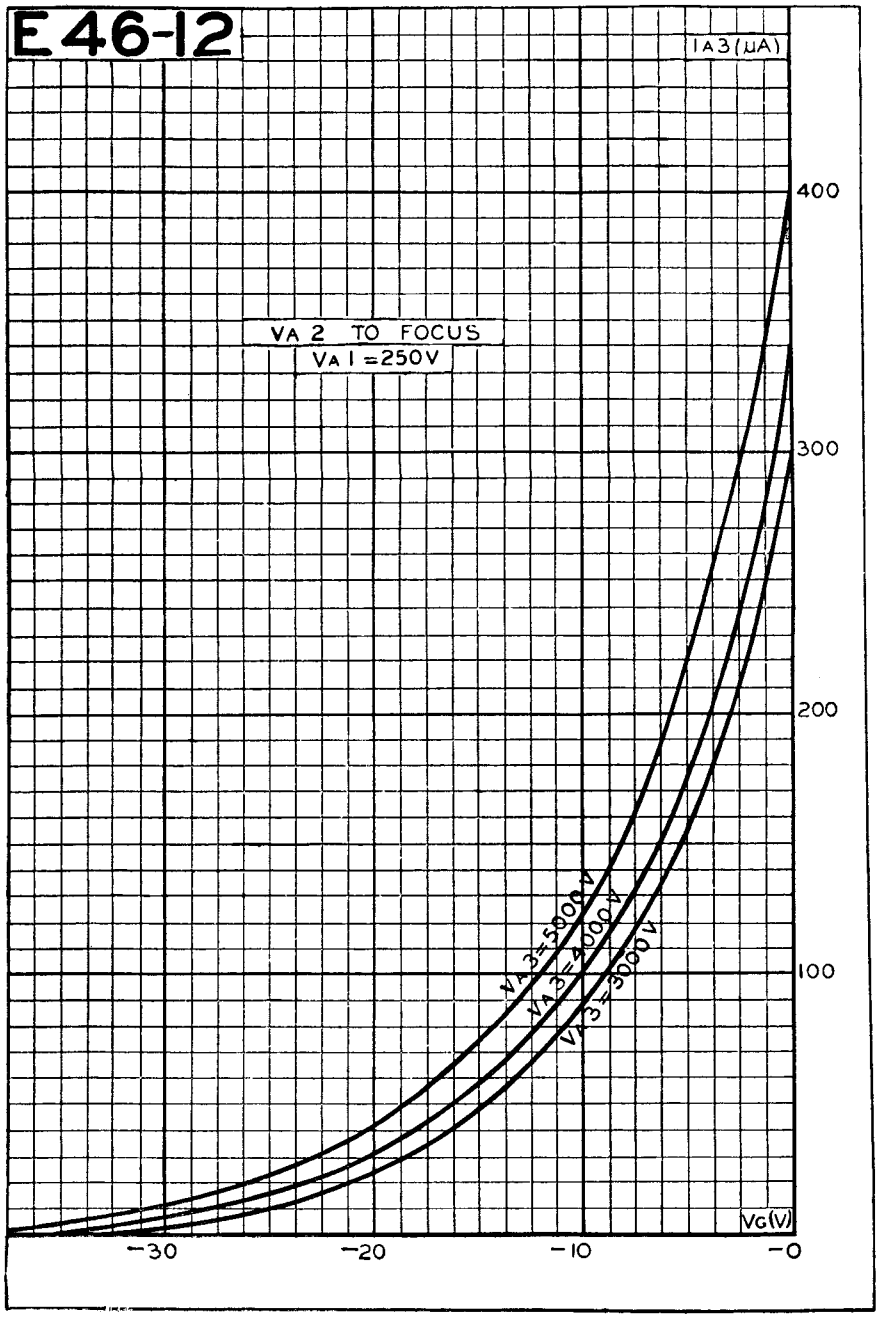


FIG 4

Mullard
TELEVISION TUBE

E46-12



SUBMINIATURE SINGLE DIODE

EA76

Indirectly-heated subminiature diode with 6.3V heater.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

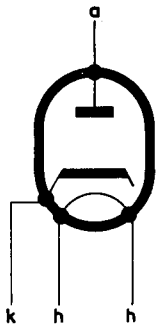
In operation this valve may become very hot and therefore, in the interests of long life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis.

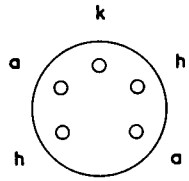
CAPACITANCES

	Shielded	Unshielded	
c_{a-k+h}	4.0	3.1	pF
c_{k-a+h}	4.5	4.55	pF
c_{a-h}	0.74	0.9	pF
c_{h-k}	1.98	2.0	pF

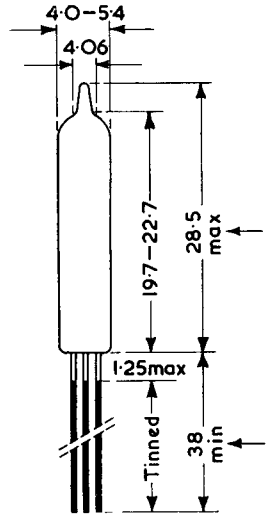
LIMITING VALUES

P.I.V. max.	420	V
V_a max.	150	V
I_a max.	9.0	mA
$i_{a(pk)}$ max.	54	mA
$v_{h-k(pk)}$ max. (cathode positive)	330	V





B5B/F Base



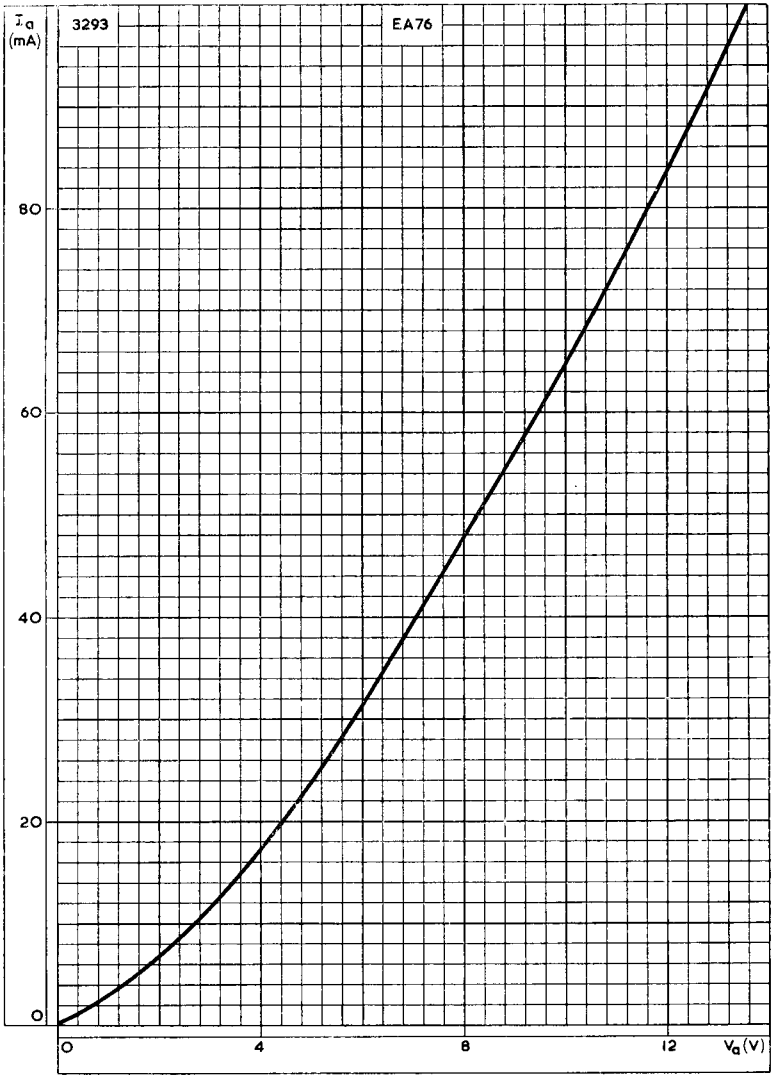
3274

All dimensions in mm

EA76

SUBMINIATURE SINGLE DIODE

Indirectly-heated subminiature diode with 6.3V heater.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

MINIATURE DIODE TRIODE

EAC91

Oscillator triode combined with a single diode for use as a frequency changer.

HEATER

V_h	6.3	V
I_h	0.3	A

CAPACITANCES

c_{in}	1.7	μμF
c_{out}	0.4	μμF
c_{at-g}	1.6	μμF
c_{g-ad}	<0.1	μμF
c_{at-ad}	0.4	μμF
c_{ad-kd}	1.5	μμF
c_{kt-kd}	0.4	μμF

CHARACTERISTICS (Triode Section)

V_a	200	V
I_a	7.5	mA
V_g	-2.8	V
S_m	2.8	mA/V
μ	36	
r_a	12,800	Ω

OPERATING CONDITIONS AS U.H.F. FREQUENCY CHANGER

See circuit overleaf

Coil data -

L_1	Turns	3½
	Coil diameter	10 mm.
	Coil length	7 mm.
	Dia. of wire	1 mm.
L_2	Dust cored, to tune to intermediate frequency.	
L_3) L_4)	Dependent upon signal frequency.	

LIMITING VALUES

Triode Section	V_a max.	250	V
	w_a max.	2	W
	I_k max.	10	mA
	V_{h-k} max.	50	V
Diode Section	V_a max.	50	V
	I_a max.	5	mA
	Max. Operating Frequency as Frequency Changer	300	Mc/s
	Limiting Frequency of Oscillation	600	Mc/s

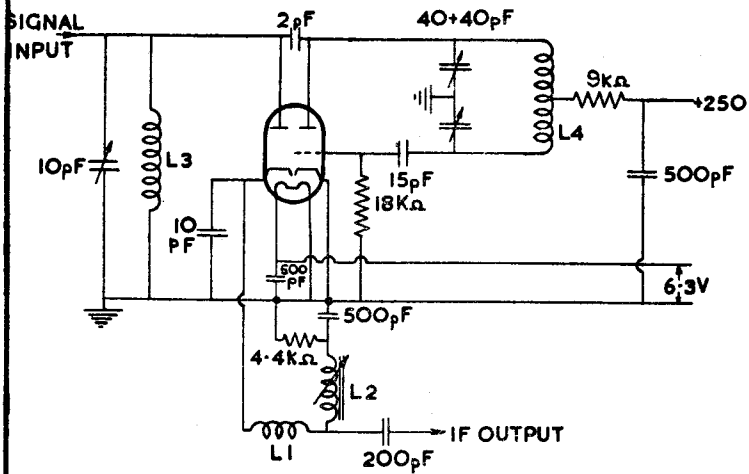
EAC91

MINIATURE DIODE TRIODE

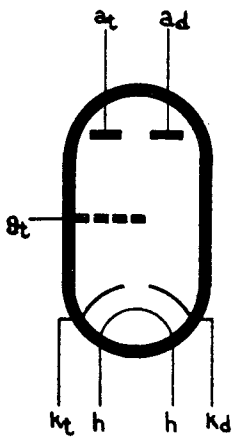
Oscillator triode combined with a single diode for use as a frequency changer.

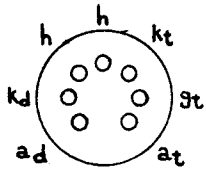
UHF FREQUENCY CHANGER CIRCUIT FOR USE UP TO 300Mc/s.

INTERMEDIATE FREQUENCY 12 TO 45 Mc/s.



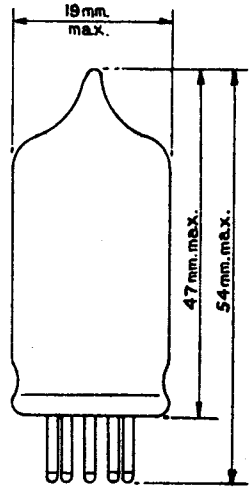
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS





B7G BASE

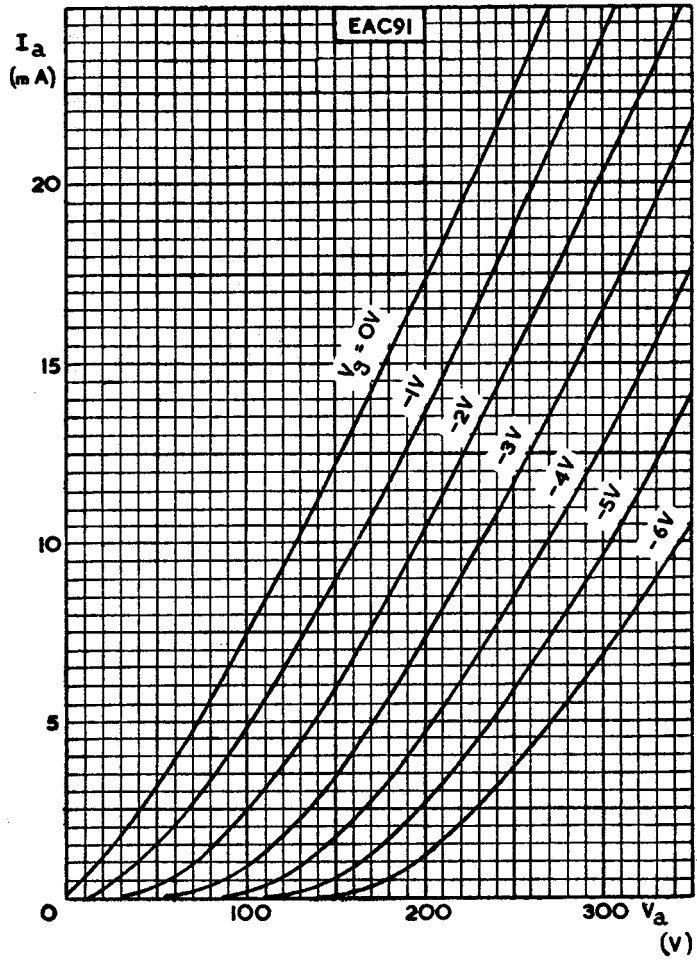
DIMENSIONS



MINIATURE DIODE TRIODE

EAC91

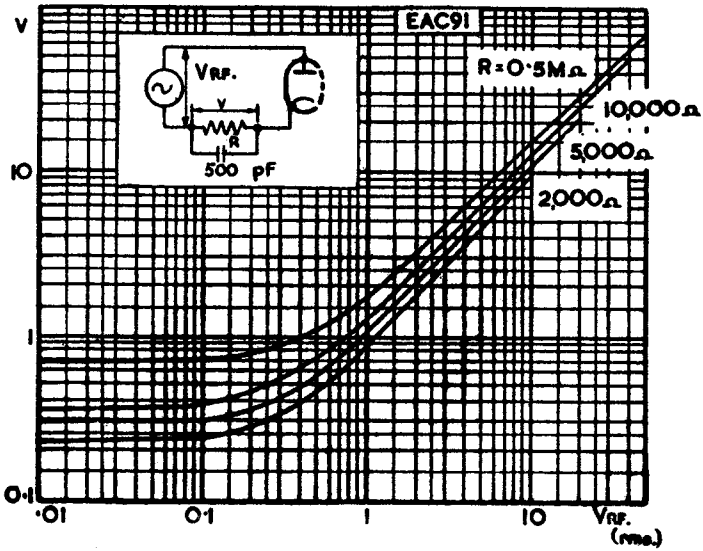
Oscillator triode combined with a single diode for use as a frequency changer.



EAC91

MINIATURE DIODE TRIODE

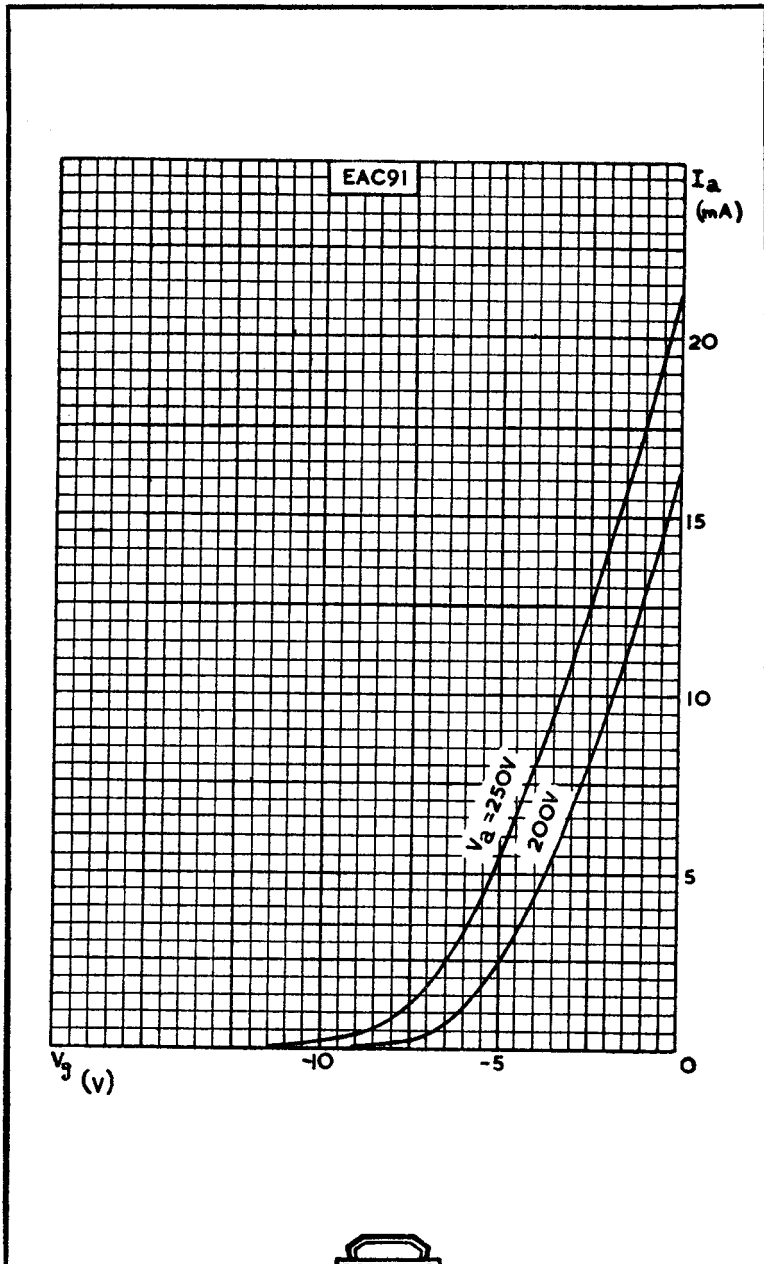
Oscillator triode combined with a single diode for use as a frequency changer.



MINIATURE DIODE TRIODE

EAC91

Oscillator triode combined with a single diode for use as a frequency changer.



Mullard

DOUBLE DIODE

EB34

Double diode with separate cathodes.
Each section is internally screened.

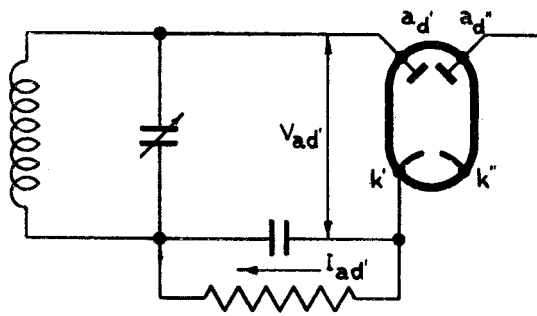
HEATER

This valve is suitable for DC/AC operation.

V_h	6.3	V
I_h	0.2	A

CAPACITANCES

$C_{ad'-k}$	4.5	μμF
$C_{ad''-k}$	4.5	μμF
$C_{ad'-ad''}$	0.5	μμF



LIMITING VALUES

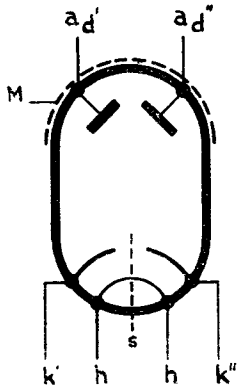
$V_{ad'}$ max.	200	V
$V_{ad''}$ max.	200	V
$I_{ad'}$ max.	0.8	mA
$I_{ad''}$ max.	0.8	mA
$V_{h-k'}$ max.	75	V
$V_{h-k''}$ max.	75	V
$R_{h-k'}$ max.	20,000	ohms
$R_{h-k''}$ max.	20,000	ohms
$V_{ad'}$ max. ($I_{ad'}$=0.3μA)	-1.3	V
$V_{ad''}$ max. ($I_{ad''}$=0.3μA)	-1.3	V
$V_{k'-k''}$ max.	50	V

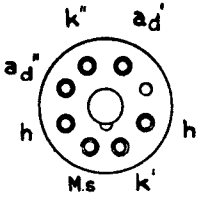
EB34

DOUBLE DIODE

Double diode with separate cathodes.
Each section is internally screened.

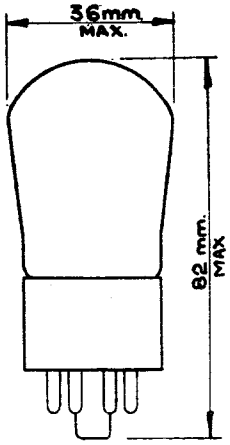
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS





OCTAL BASE

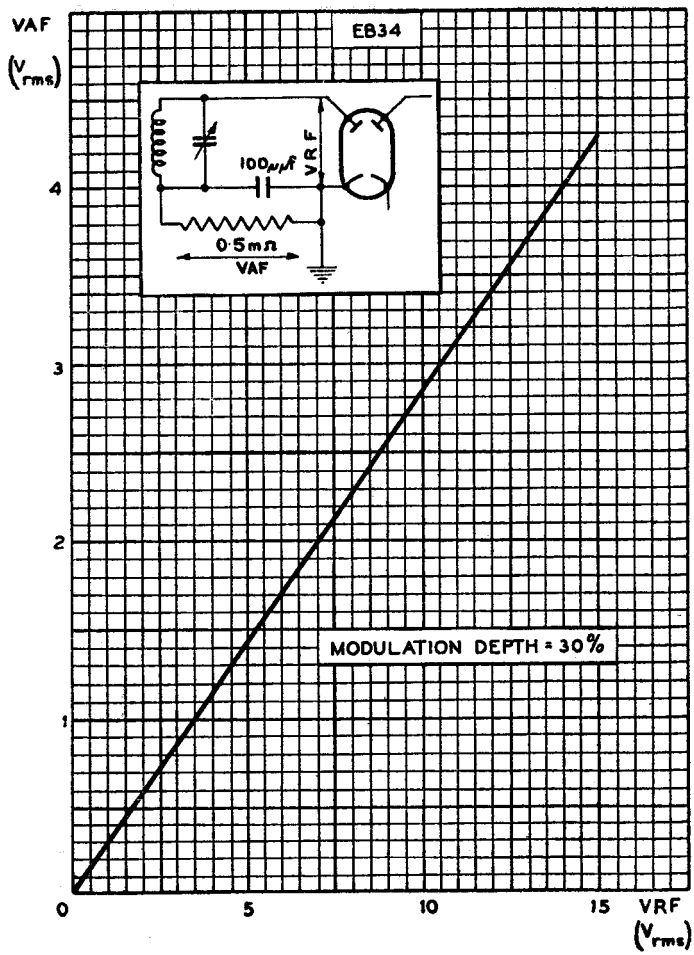
DIMENSIONS



DOUBLE DIODE

EB34

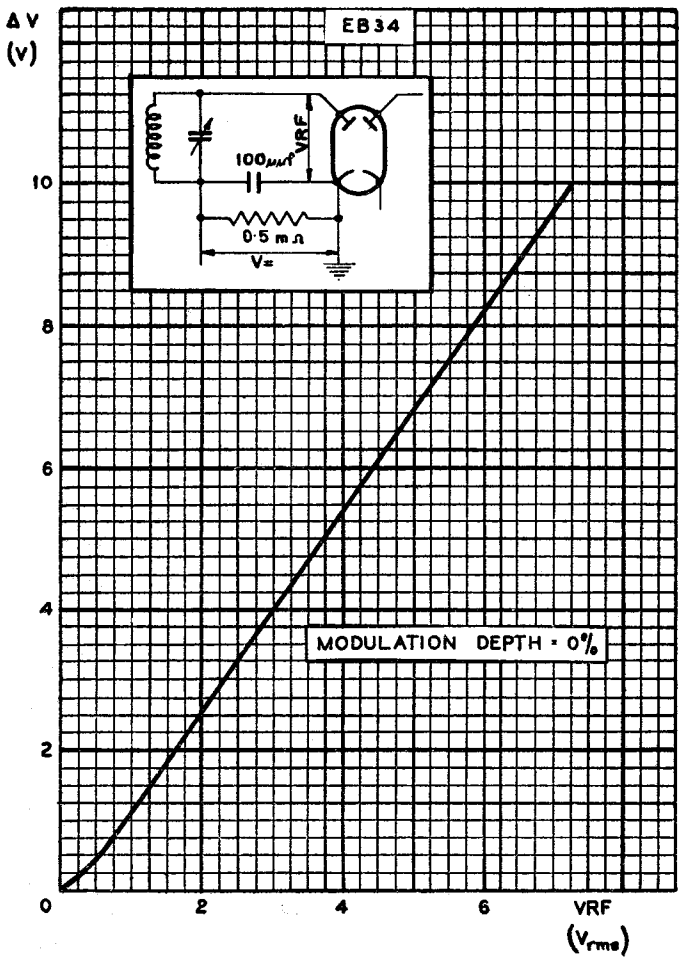
Double diode with separate cathodes.
Each section is internally screened.



EB34

DOUBLE DIODE

Double diode with separate cathodes.
Each section is internally screened.



DOUBLE DIODE

EB91

Miniature double diode with separate cathodes and internal screening between sections.

HEATER

Suitable for series or parallel operation, A.C. or D.C.

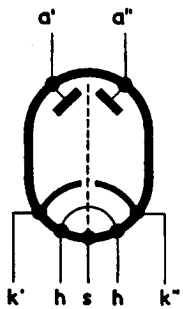
V_h	6.3	V
I_h	0.3	A

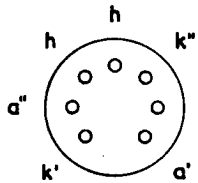
CAPACITANCES

$c_{a'-k'+h+s}$	3.0	μμF
$c_{a''-k''+h+s}$	3.0	μμF
$c_{k'-a'+h+s}$	3.4	μμF
$c_{k''-a''+h+s}$	3.4	μμF
$c_{a'-a''}$	<0.025	μμF

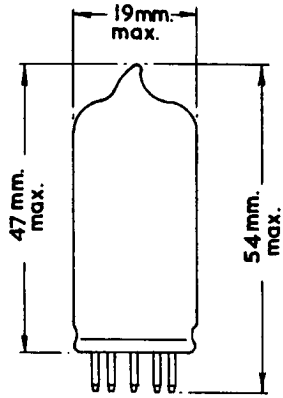
LIMITING VALUES (each section)

P.I.V. max.	420	V
I_a max.	9	mA
$i_{a(pk)}$ max.	54	mA
V_a max (I_a=0.3 μA)	−1.3	V
$v_{h-k(pk)}$ max.	330	V





B7G BASE

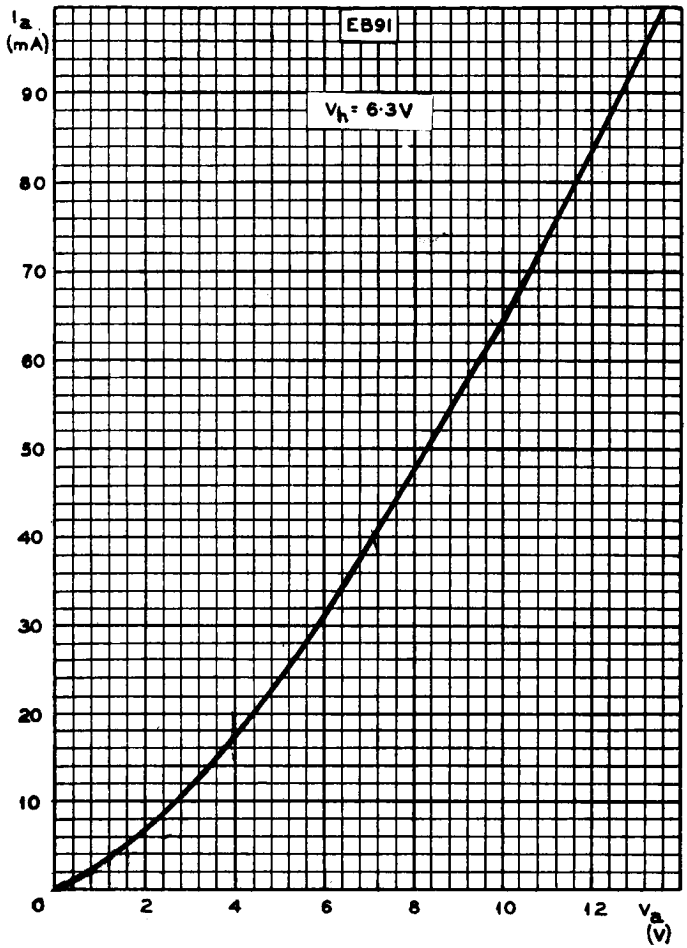


518

EB91

DOUBLE DIODE

Miniature double diode with separate cathodes and internal screening between sections.

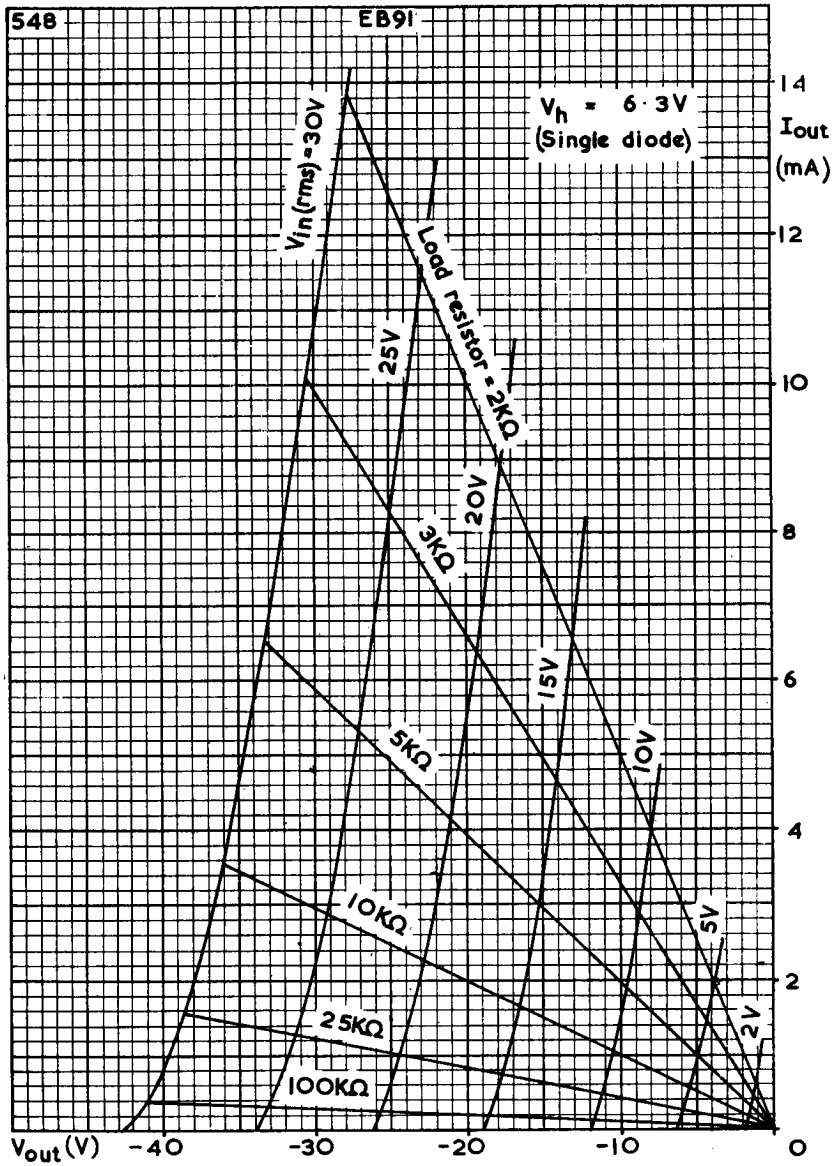


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

DOUBLE DIODE

EB91

Miniature double diode with separate cathodes and internal screening between sections.



OUTPUT CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE AS PARAMETER

DOUBLE DIODE TRIODE

EBC90

High gain triode for use as a.f. voltage amplifier combined with twin diodes.

HEATER

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

V_h	6.3	V
I_h	300	mA

CAPACITANCES (measured without an external shield)

$c_{a''d-g}$	< 0.025	pF

Triode section

c_{a-g}	2.1	pF
c_{g-k}	2.3	pF
c_{a-k}	1.1	pF

CHARACTERISTICS

V_a	100	250	V
V_g	−1.0	−3.0	V
I_a	0.8	1.0	mA
g_m	1.3	1.2	mA/V
μ	70	70	
r_a	54	58	kΩ

LIMITING VALUES

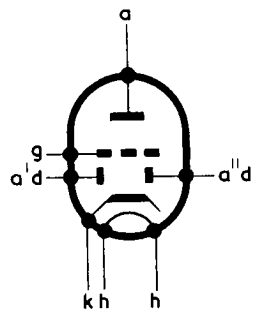
Triode section

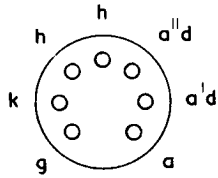
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
R_{g-k} max.	3.0	MΩ
V_{h-k} max.	90	V

Diode sections (each section)

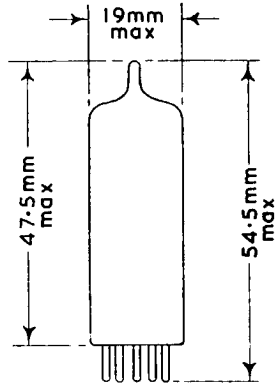
I_{ad} max.	1.0	mA

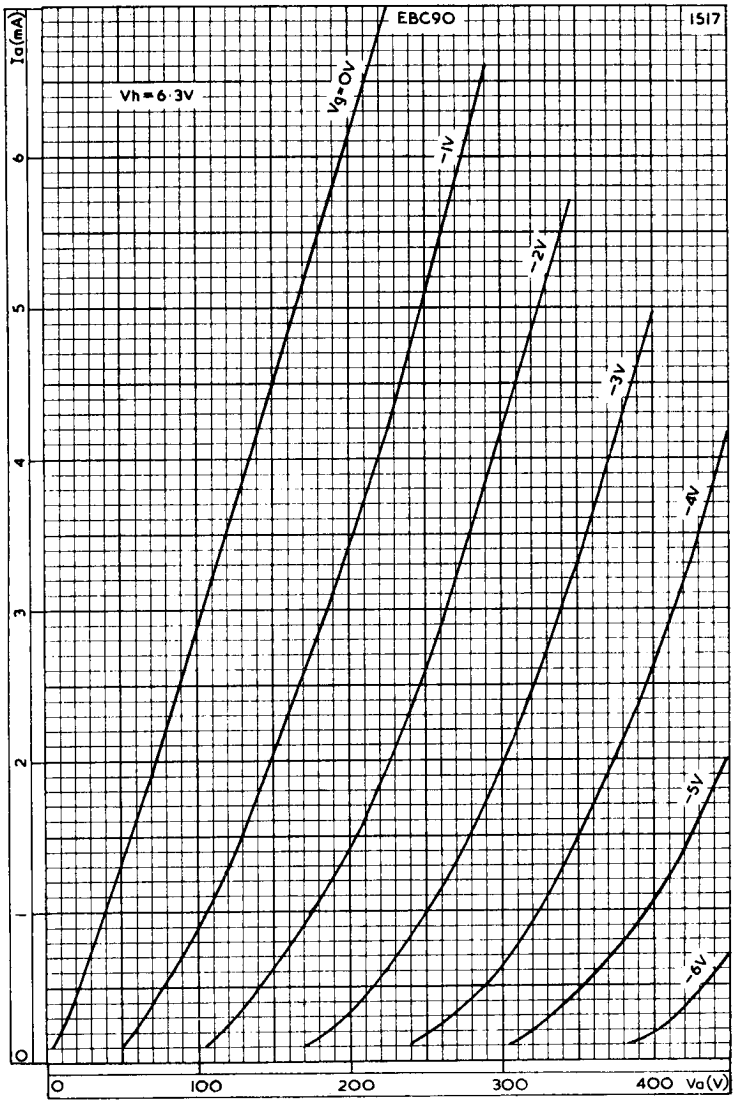
4520





B7G Base





ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER

DOUBLE DIODE TRIODE

EBC91

High gain triode for use as a.f. voltage amplifier combined with twin diodes.

HEATER

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

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{a^*d-g}	0.04	pF
Triode section		
c_{a-g}	2.0	pF
c_{in}	2.2	pF
c_{out}	0.8	pF

CHARACTERISTICS

V_a	100	250	V
I_a	0.5	1.2	mA
V_g	−1.0	−2.0	V
g_m	1.25	1.6	mA/V
r_a	80	62.5	kΩ
μ	100	100	

LIMITING VALUES

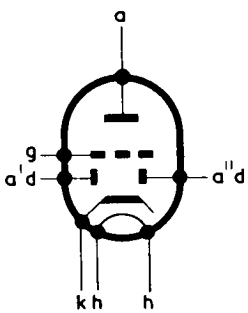
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	500	mW
I_k max.	1.0	mA
$i_{k(pk)}$ max.	6.0	mA
V_g max.	0	V
$-V_g$ max.	50	V
V_{h-k} max.	100	V

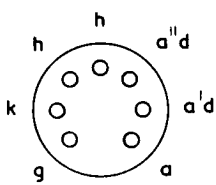
EBC91

DOUBLE DIODE TRIODE

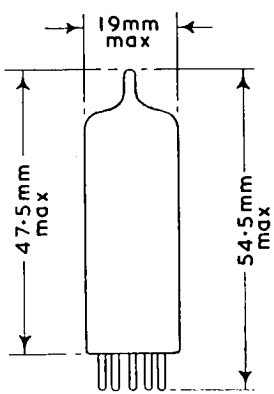
High gain triode for use as a.f. voltage amplifier combined with twin diodes.

4520





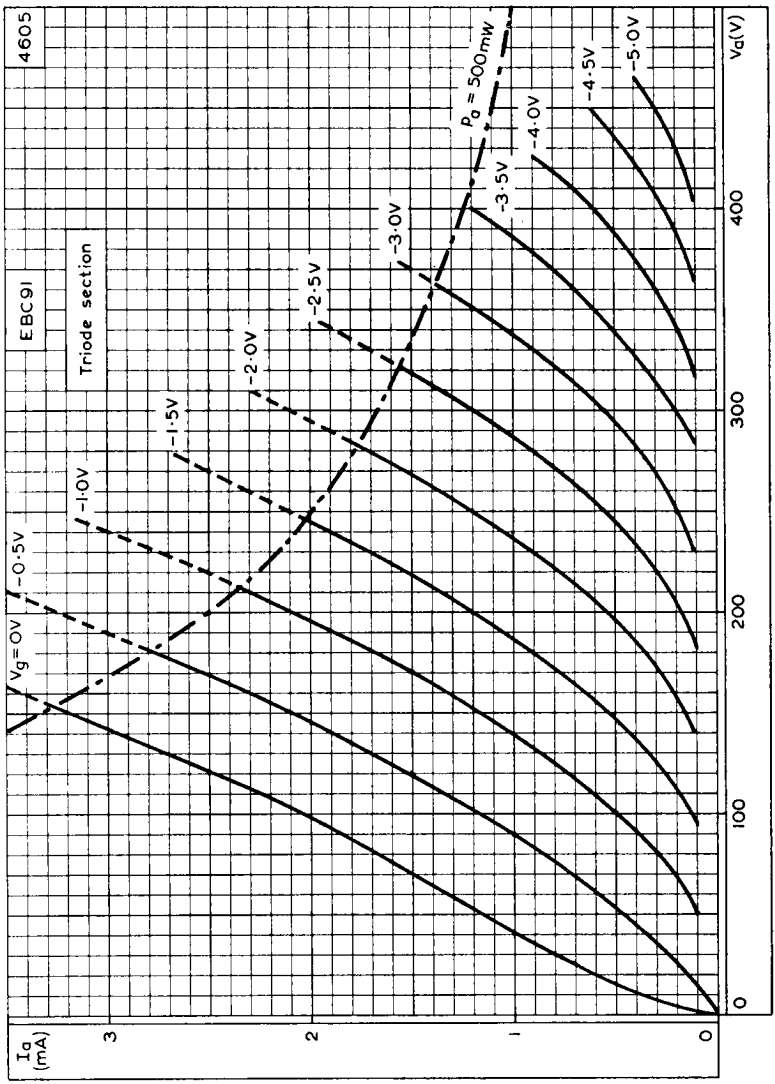
B7G Base



DOUBLE DIODE TRIODE

EBC91

High gain triode for use as a.f. voltage amplifier combined with twin diodes.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR TRIODE SECTION WITH GRID VOLTAGE AS PARAMETER

DOUBLE DIODE OUTPUT PENTODE

EBL31

High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.

HEATER

V_h	6.3	V
I_h	1.5	A

CAPACITANCES

$c_{ad'-ad''}$	< 0.35	μμF
$c_{ad'-k}$	3.0	μμF
$c_{ad''-k}$	3.6	μμF
$c_{ad'-g1}$	< 0.15	μμF
$c_{ad''-g1}$	< 0.15	μμF
$c_{ad'-a}$	< 1.0	μμF
$c_{ad''-a}$	< 0.5	μμF

OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_a	250	V
V_{g2}	250	V
I_a	36	mA
R_k	146	ohms
V_{g1}	-6.0	V
I_{g2}	5.0	mA
g_m	9.5	mA/V
r_a	50,000	ohms
R_a	7,000	ohms
W_{out}	4.3	W
D_{tot}	10	%
V_{in} (rms)	3.6	V
V_{in} (rms) (50 mW)	0.35	V

EBL31

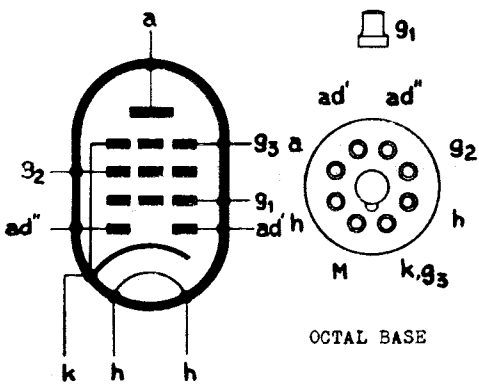
DOUBLE DIODE OUTPUT PENTODE

High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.

LIMITING VALUES

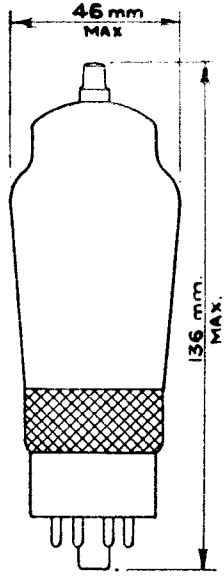
$V_{a(b)}$	550	V
V_a max.	250	V
w_a max.	9	W
I_k max.	55	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
w_{g2} max.	1.5	W
V_{g1} max. (I_{g1}=0.3μA)	-1.3	V
R_{g1-a} max.	1	megohm
V_{h-k} max.	50	V
R_{h-k} max.	5,000	ohms
$V_{ad'}$ max.	200	V
$V_{ad''}$ max.	200	V
$I_{ad'}$ max.	0.8	mA
$I_{ad''}$ max.	0.8	mA
$V_{ad'}$ max. ($I_{d'}$=0.3μA)	-1.3	V
$V_{ad''}$ max. ($I_{d''}$=0.3μA)	-1.3	V

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



OCTAL BASE

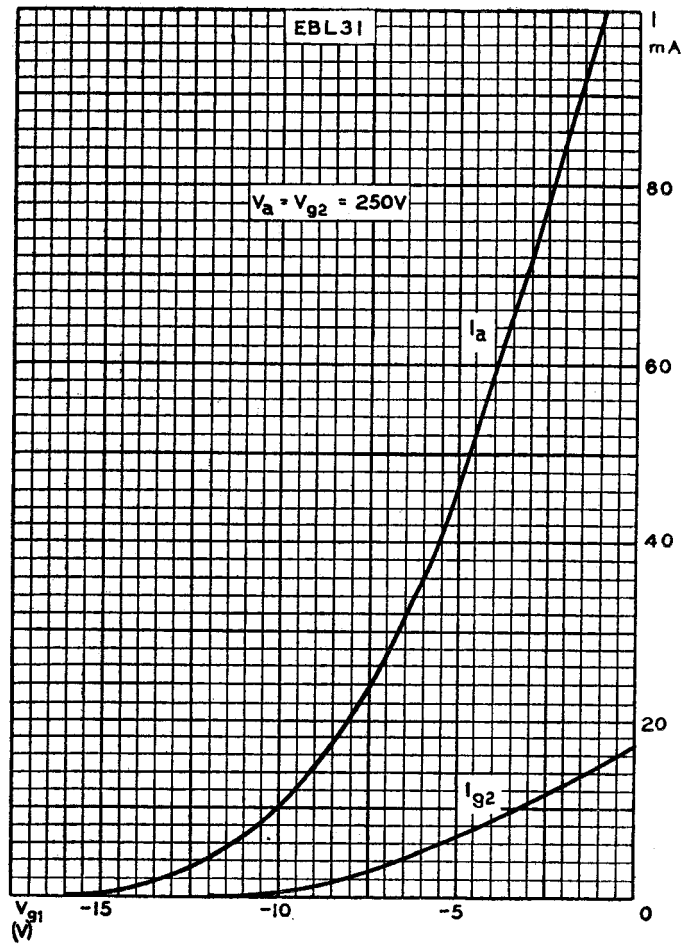
DIMENSIONS



DOUBLE DIODE OUTPUT PENTODE

EBL31

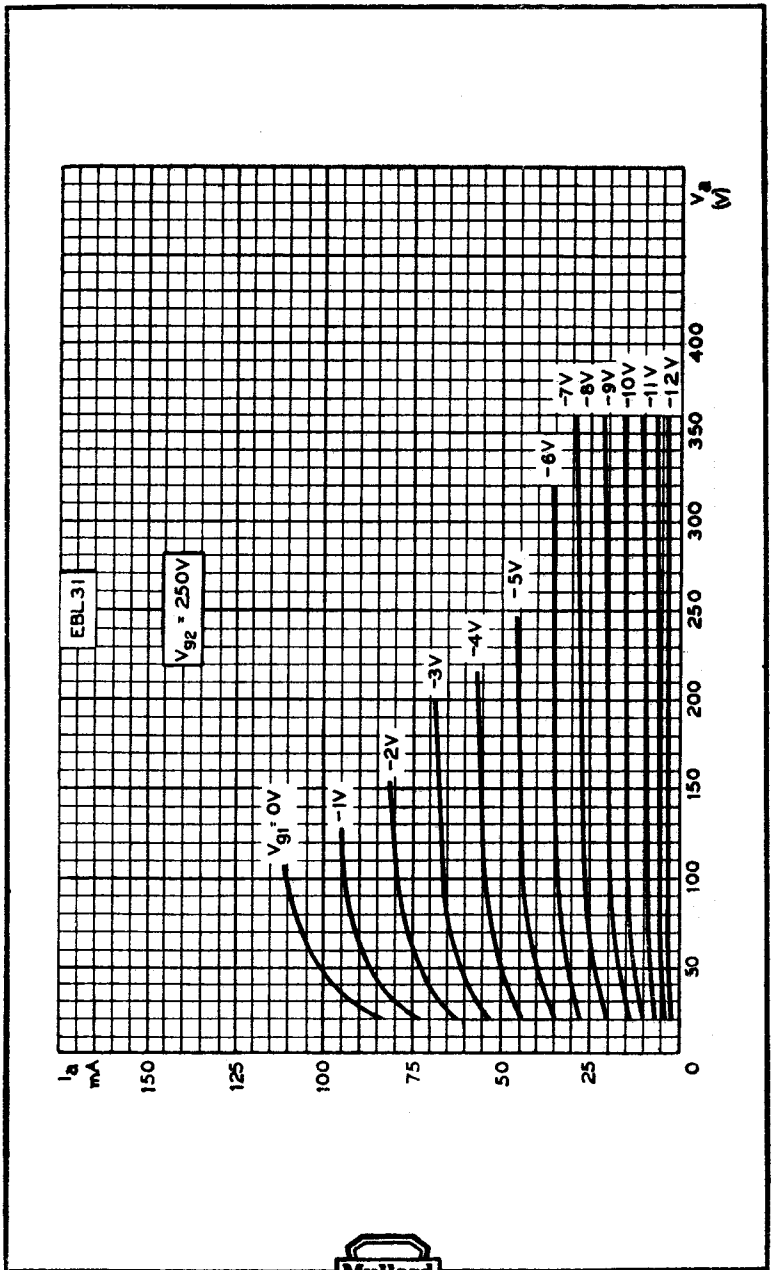
High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.



EBL31

DOUBLE DIODE OUTPUT PENTODE

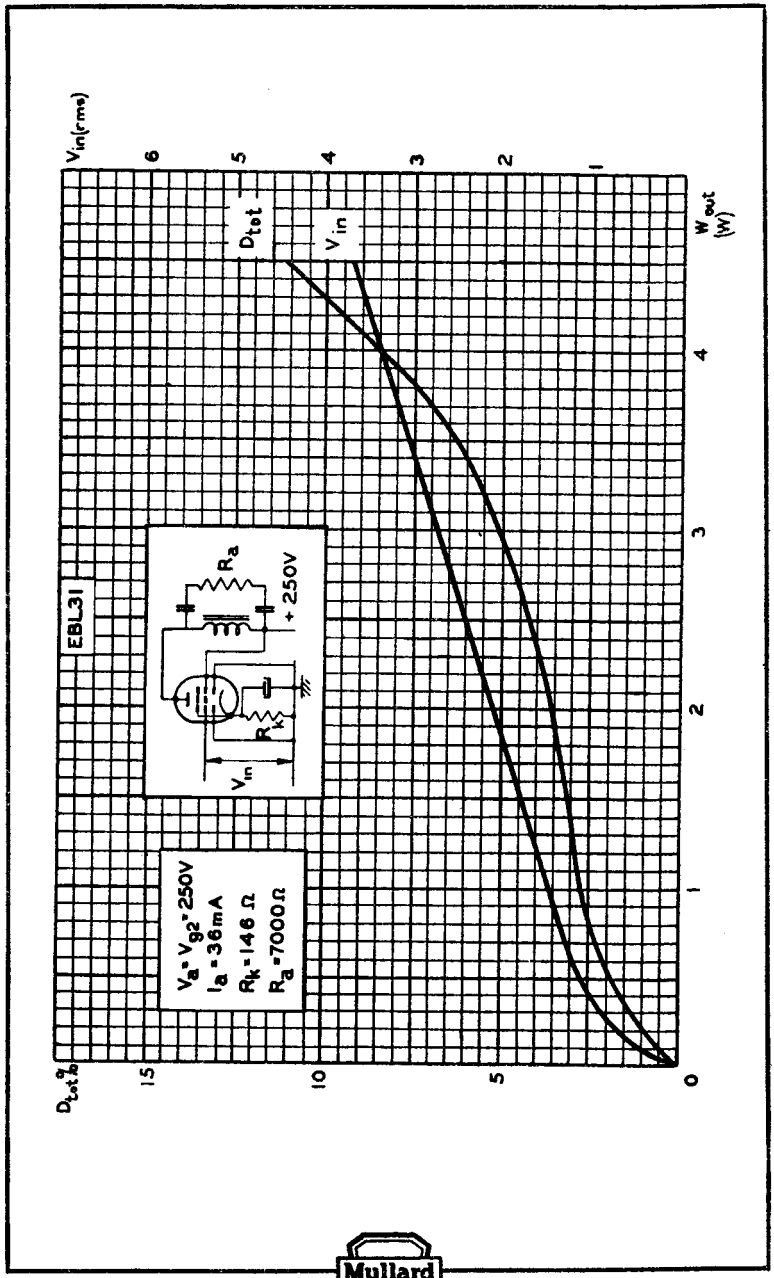
High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.



DOUBLE DIODE OUTPUT PENTODE

EBL31

High-sensitivity output pentode for use in A.C. mains-operated equipment, and combined with twin diodes.



Mullard

Mullard
GAS TRIODE

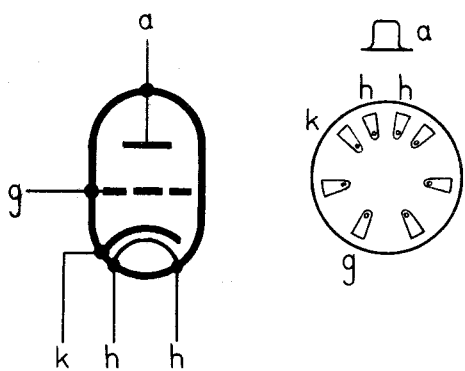
EC50

Heater	Vf	=	6.3 V
	If	=	1.3 A
Capacities	Cak	=	3.8 uuF
	Cgk	=	6.1 uuF
	Cag	=	2.7 uuF

Operating Conditions

V max (peak) between any two electrodes ..	1,500	V
Va max (peak)	1,000	V
Ia max (average)	10	mA
Ia max (peak)	750	mA
Rg min	1,000	Ω/V
Rg max	0.5	mΩ/V
Gas Voltage Drop	35	V
Control Ratio	35	
Vfk max	100	V

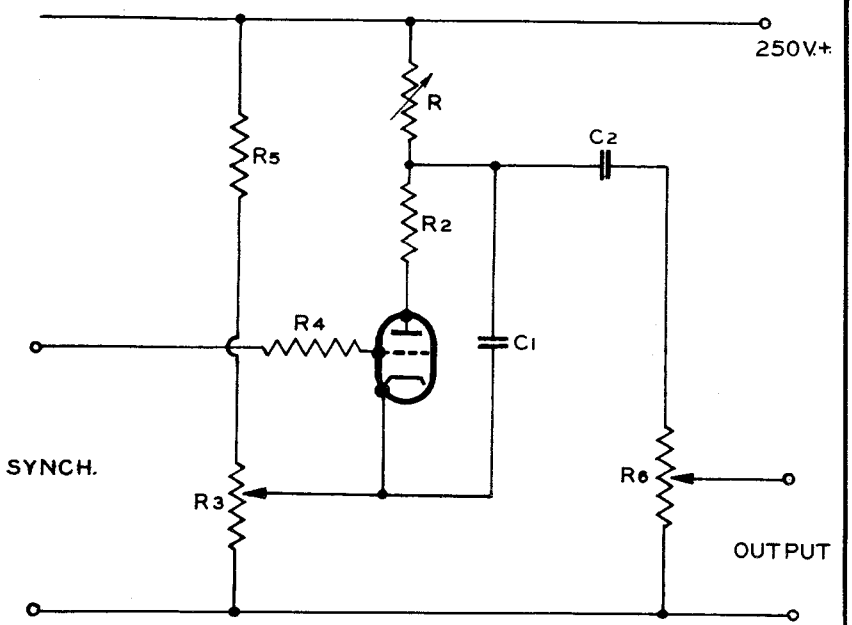
Arrangement of electrodes and base connections.



EC50

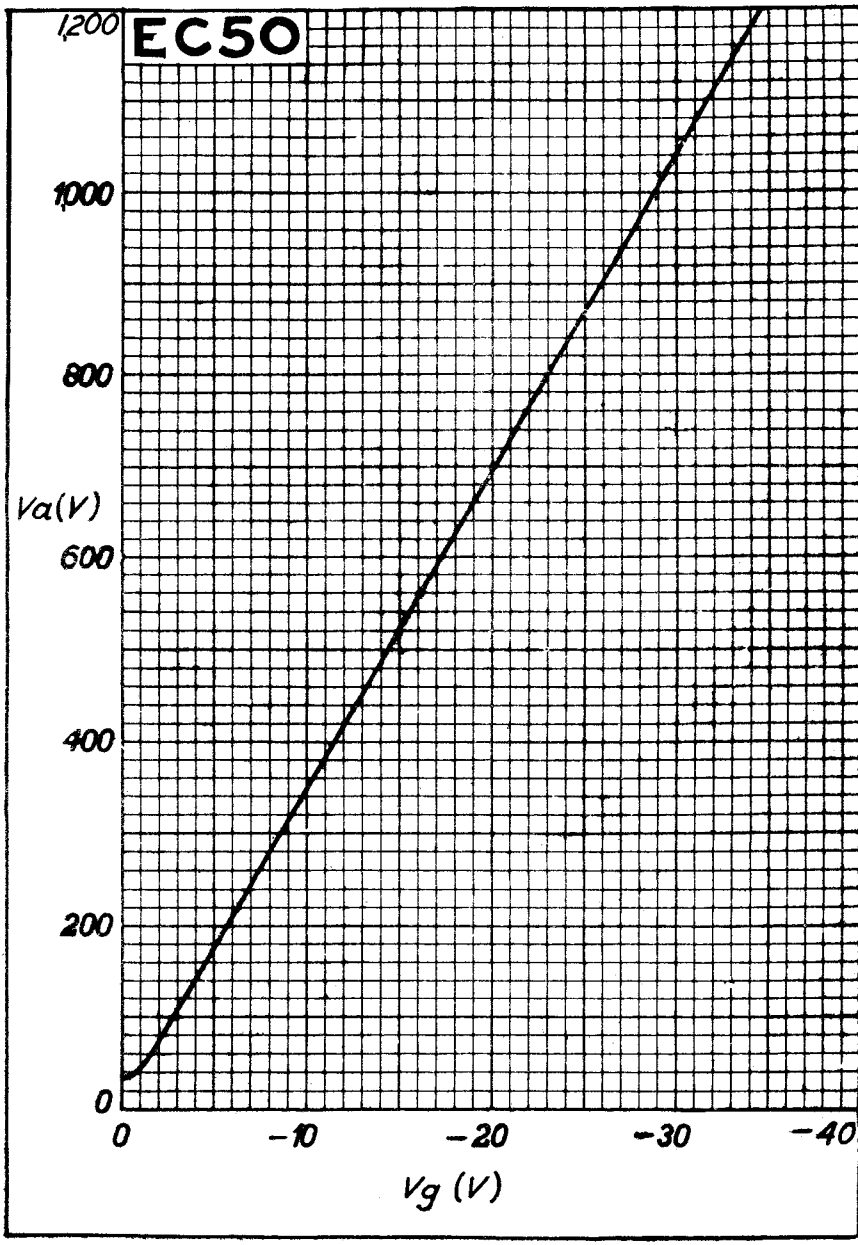
Mullard
GAS TRIODE

CIRCUIT DIAGRAM



CIRCUIT CONSTANTS

Grid resistance R4	=	1,000	ohms/V
Anode resistance R2	=	2	ohms/V
Peak discharge current	=	500	mA
D.C. drain (including R5)	=	4-10	mA
R1	=	0-0.5	megohm
R3	=	0-10,000	ohms
R5	=	0.1	megohm
R6 min.	=	0.5	megohm
C1	=	1,000 uuF to 0.5 uF	
C2	=	0.5	uF
Frequency Range	=	25-25,000	cs.


EC50
1,200
1,000
800
Va(V)
600
400
200
0
0
-10
-20
-30
-40
Vg (V)

SHORT WAVE TRIODE

EC52

Single-ended short wave triode for use as low power oscillator.

HEATER

Vh	6.3	V
Ih	0.43	A

CAPACITANCES

cin	5.2	μμF
cout	1.3	μμF
ca-g1	3.1	μμF

CHARACTERISTICS

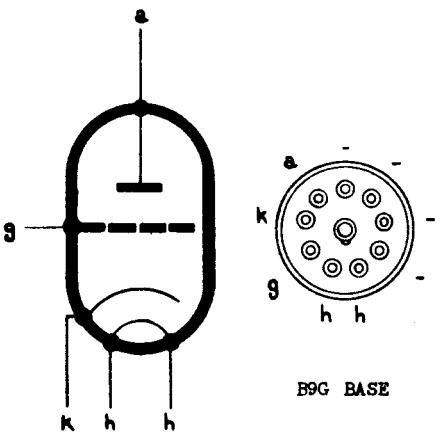
Va	250	V
Vg1	-2.6	V
Ia	10	mA
&m	6.5	mA/V
μ	60	
ra	9200	Ω
Equivalent noise resistance.	310	Ω

LIMITING VALUES

V_a max.	400	V
W_a max.	7.5	W
Limiting frequency of oscillation.	400	Mc/s

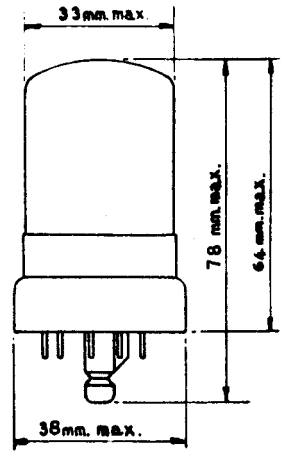
NOTE: Up to 300 Mc/s the inductance of the heater leads is sufficiently low to allow the heater pins to be earthed capacitatively.

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



B9G BASE

DIMENSIONS

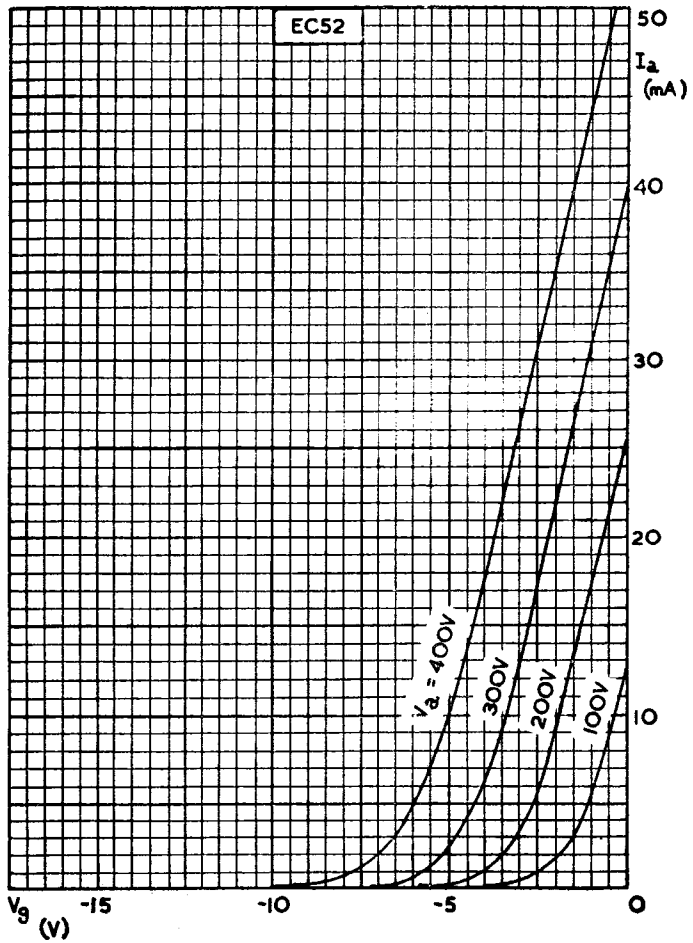


Mullard

EC52

SHORT WAVE TRIODE

Single-ended short wave triode for use as low power oscillator.

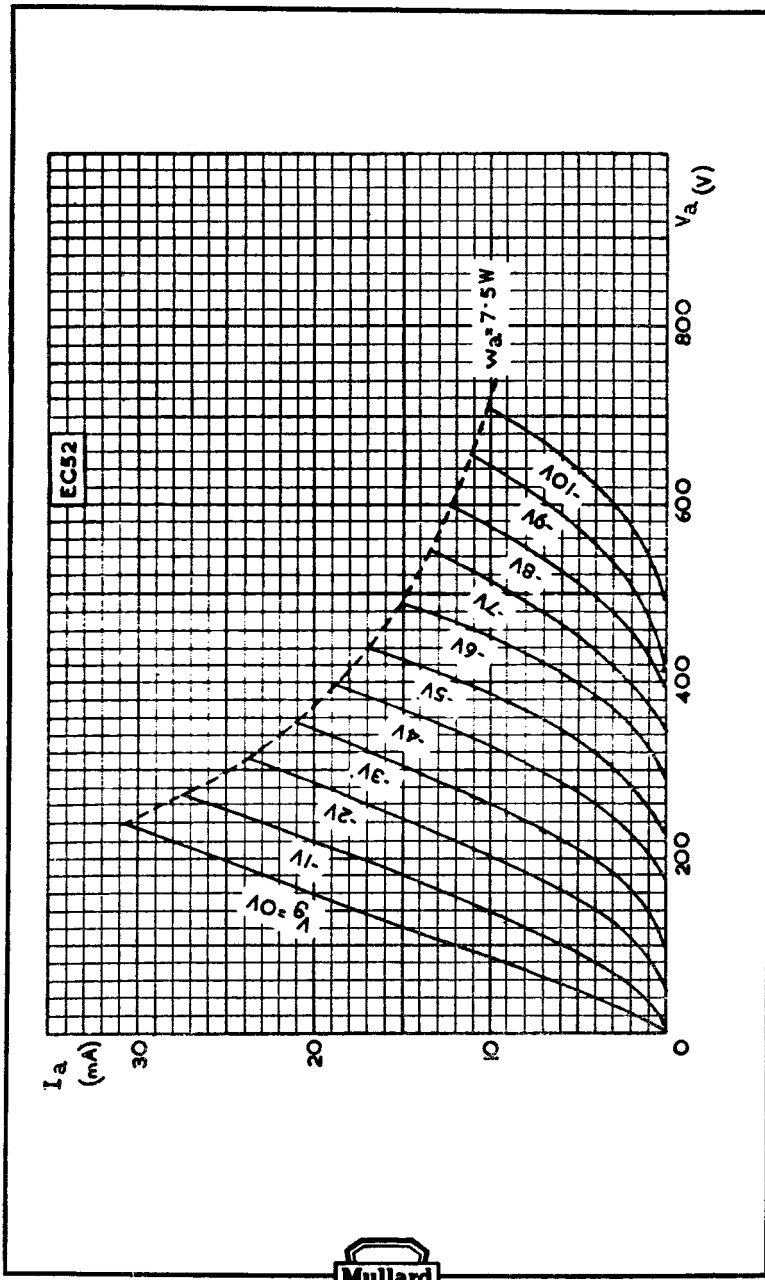


Mullard

SHORT WAVE TRIODE

EC52

Single-ended short wave triode for use as low power oscillator.



MINIATURE ULTRA SHORT WAVE TRIODE

EC53

Miniature triode for use as low power oscillator at frequencies up to 600 M.c/s.

HEATER

V_h	6.3	V
I_h	0.25	A

CAPACITANCES

c_{in}	1.3	μμF
c_{out}	0.13	μμF
c_{a-g}	1.3	μμF

CHARACTERISTICS

V_a	200	V
V_g	-3.3	V
I_a	7.5	mA
g_m	2.9	mA/V
μ	33	
r_a	11,400	Ω
g_m (V_g=0)	4.0	mA/V

OPERATING CONDITIONS AS POWER OSCILLATOR UP TO 400 Mc/s

f Mc/s	V_a V	I_a mA	I_g mA	W_{out} W	η %	Refer to circuit
110	250	14.5	5	1.3	35	A
165	250	14.5	5	1.2	33	A
210	250	12.5	3.6	0.8	26	A
285	250	12.5	3.6	0.5	16	B
335	200	12.5	3.6	0.35	14	B
400	200	12.5	3.6	0.3	12	B

NOTE: The input power is reduced at the higher frequencies in order to keep within the rated maximum anode dissipation.

LIMITING VALUES

V_a max.	250	V
W_a max.	2.5	W
I_k max.	20	mA
V_g max. (I_{g1}=+0.3μA)	-1.5	V
R_g max.	0.5	MΩ
V_{h-k}	40.0	V
R_{h-k}	20,000	Ω
Max. operating frequency	600	Mc/s

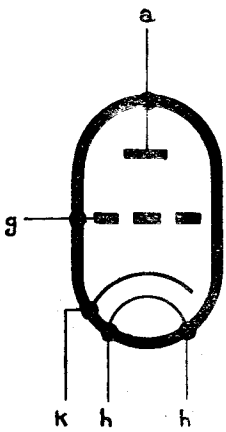
Mullard

EC53

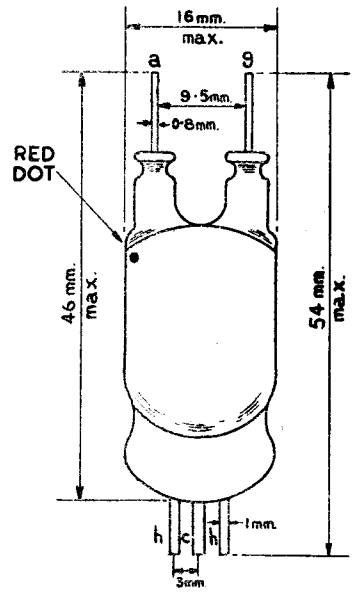
MINIATURE ULTRA SHORT WAVE TRIODE

Miniature triode for use as low power oscillator at frequencies up to 600 M.c/s.

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS.



DIMENSIONS

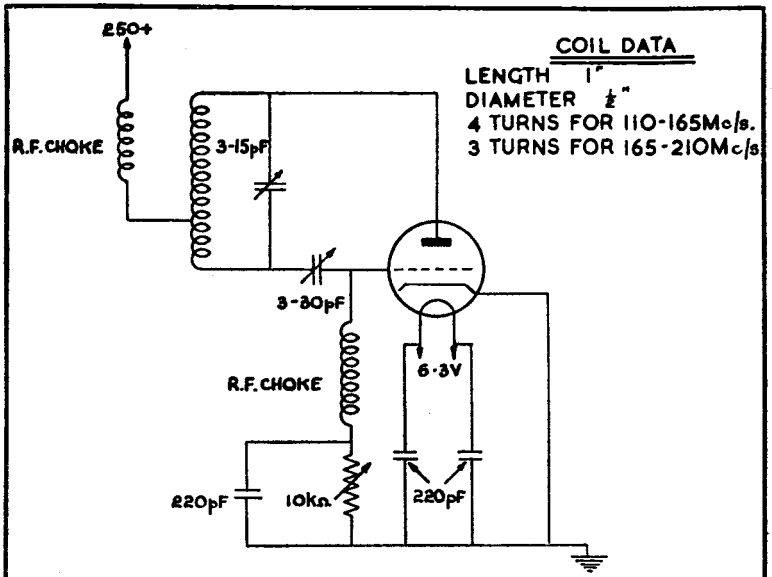


Mullard

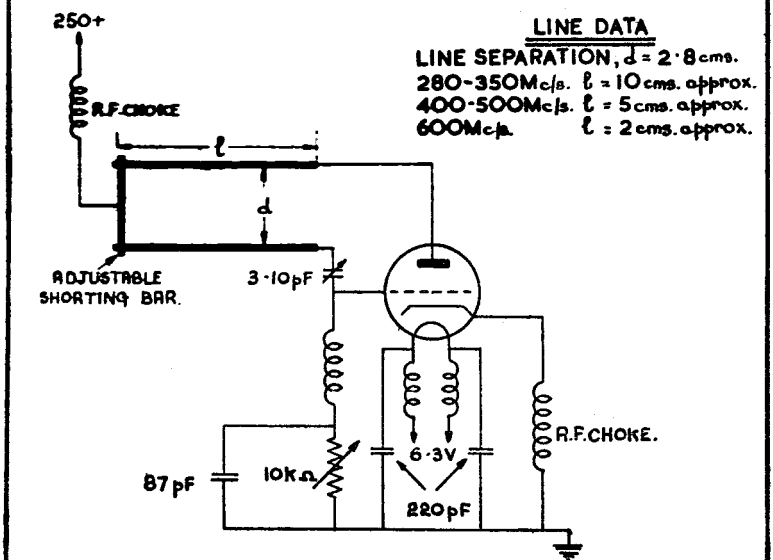
MINIATURE
ULTRA SHORT WAVE TRIODE

EC53

Miniature triode for use as low power oscillator at frequencies up to 600 M.c/s.



CIRCUIT "A" FOR USE AT FREQUENCIES BETWEEN 110 AND 210 Mc/s.



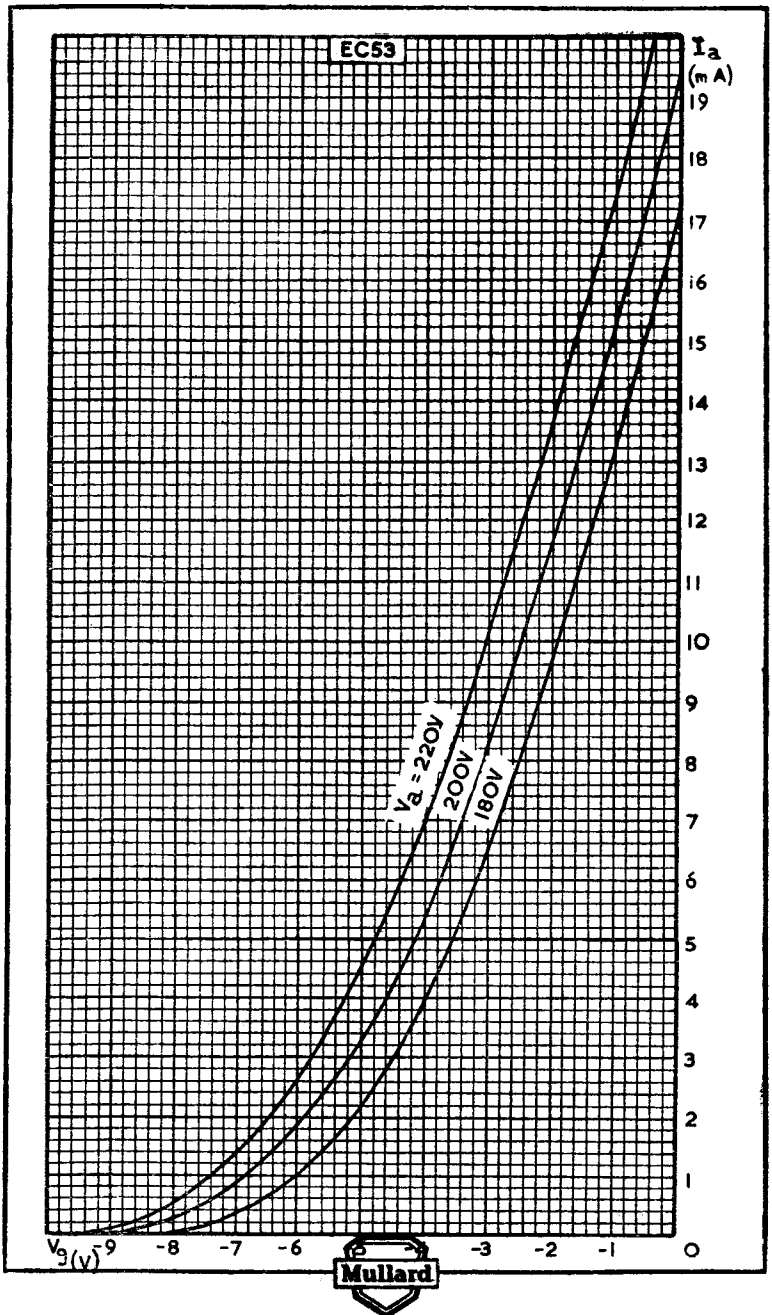
CIRCUIT "B" FOR USE AT FREQUENCIES OF 280Mc/s. AND ABOVE

Mullard

EC53

MINIATURE
ULTRA SHORT WAVE TRIODE

Miniature triode for use as low power oscillator at frequencies up to 600 M.c/s.



SUBMINIATURE U.H.F. TRIODE

EC70

Triode primarily intended for use as an oscillator at frequencies of the order of 500Mc/s.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm. from the seal and any bending of the valve leads must be at least 1.5mm. from the seal.

COOLING

In operation this valve may become very hot and therefore, in the interests of satisfactory life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis and should result in a bulb temperature of approximately 100°C.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g}	2.1	2.1	pF
c_{g-k}	1.8	1.7	pF
c_{a-k}	2.8	0.6	pF

CHARACTERISTICS

V_a	100	V
V_g	−2.0	V
I_a	13	mA
g_m	5.5	mA/V
μ	20	
r_a	3.6	kΩ

TYPICAL OPERATING CONDITIONS AS AN OSCILLATOR AT 500 Mc/s

V_a	175	V
I_a	20	mA
I_g	2.0	mA
R_{g-k}	5.6	kΩ
P_{load}	750	mW

MAINTENANCE TYPE

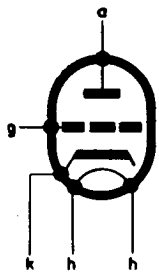
EC70

SUBMINIATURE U.H.F. TRIODE

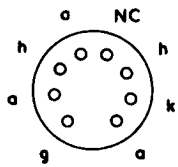
Triode primarily intended for use as an oscillator at frequencies of the order of 500Mc/s.

LIMITING VALUES

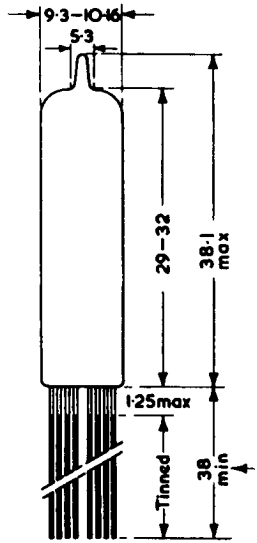
$V_{a(b)}$ max.	300	V
V_a max.	175	V
p_a max.	3.0	W
I_k max.	22	mA
R_{g-k} max.	500	kΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V



3273



B8D/F Base



All dimensions in mm

SUBMINIATURE U.H.F. TRIODE

EC71

Subminiature medium-μ triode intended for use as an oscillator at frequencies up to 500Mc/s.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
$c_{a\ g}$	1.2	1.3	pF
c_{in}	2.4	2.3	pF
c_{out}	2.3	0.8	pF

CHARACTERISTICS

V_a	100	V
I_a	8.5	mA
g_m	5.8	mA/V
r_a	4.7	kΩ
μ	27	
V_g	–1.3	V
$V_g(I_a = 10\mu A)$	–7.0	V

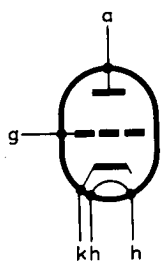
LIMITING VALUES (absolute ratings)

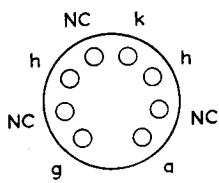
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	3.3	W
$-V_g$ max.	55	V
I_k max.	22	mA
I_g max.	5.5	mA
V_{h-k} max.	200	V

EC71

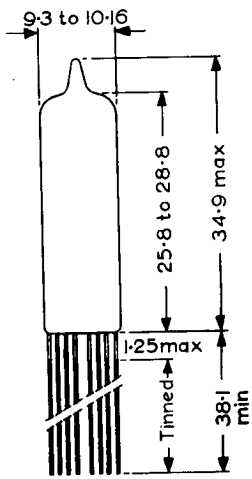
SUBMINIATURE U.H.F. TRIODE

5604





B8D/F Base



All dimensions in mm

MINIATURE GROUNDED GRID TRIODE

EC91

Miniature screened triode for use as a grounded grid amplifier.

HEATER

V_h	6.3	V
I_h	0.3	A

CAPACITANCES

c_{a-g}	2.5	μμF
c_{a-k+h}	<0.2	μμF
c_{g-k+h}	8.5	μμF

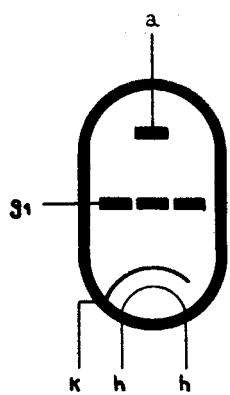
OPERATING CONDITIONS

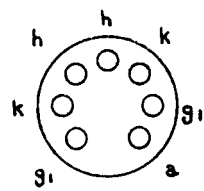
V_a	250	V
V_g	-1.5	V
R_k	150	Ω
I_a	10	mA
g_m	8.5	mA/V
μ	100	
r_a	12000	Ω
Equivalent Noise Resistance.	400	Ω

LIMITING VALUES

V_a max.	250	V
w_a max.	2.5	W
I_k max.	15	mA
V_{h-k}	150	V
V_{g-k}	100	V
Maximum Operating Frequency	250	Mc/s

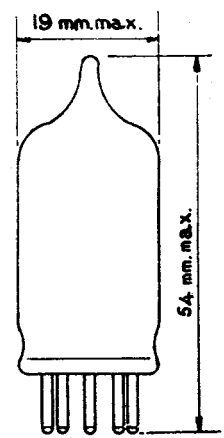
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS





B7G BASE

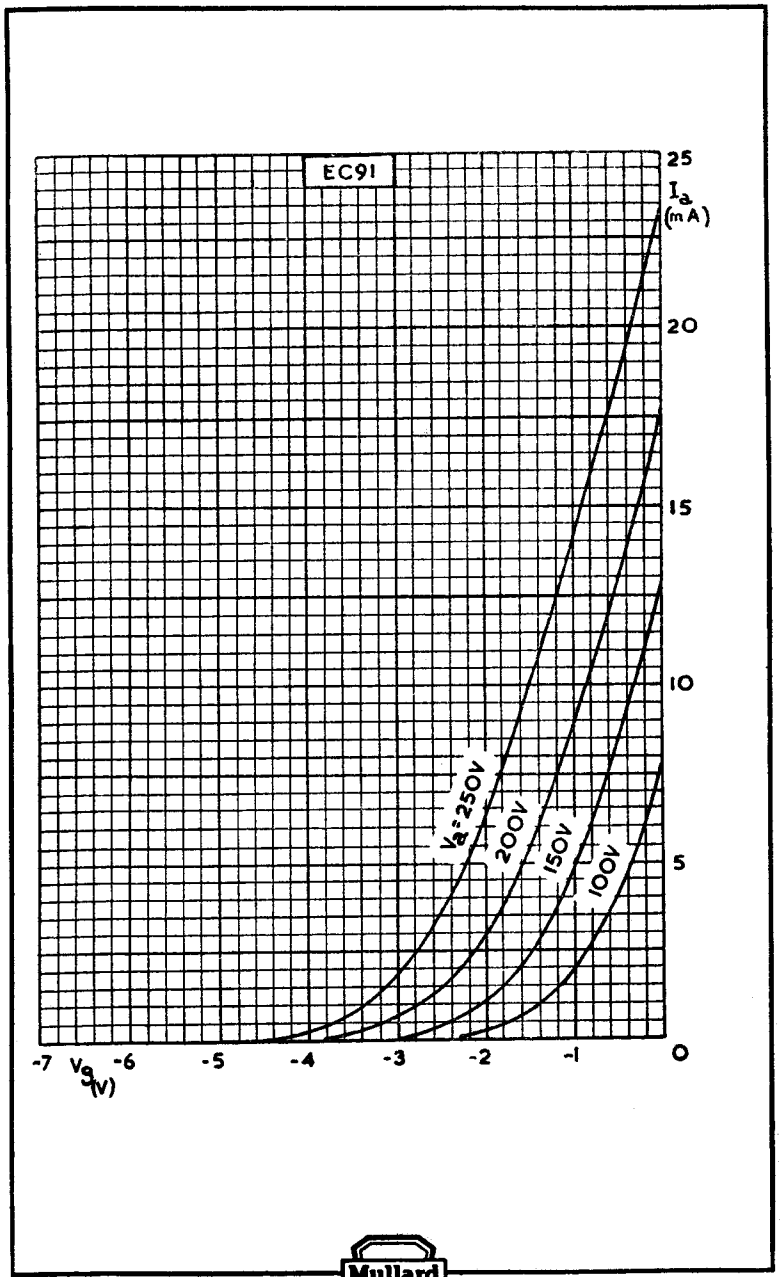
DIMENSIONS



EC91

MINIATURE GROUNDED GRID TRIODE

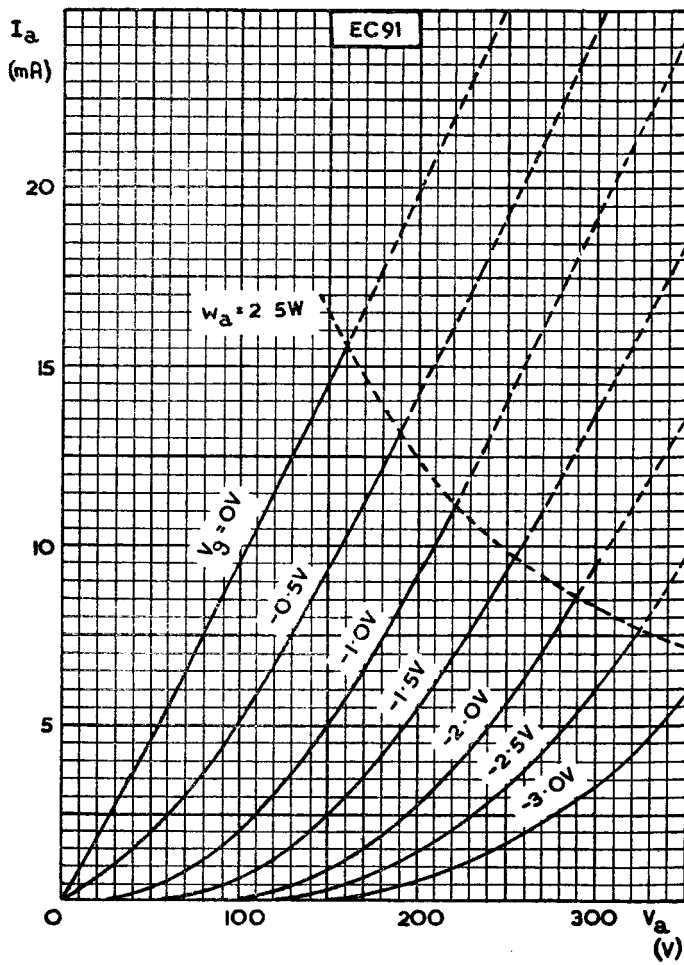
Miniature screened triode for use as a grounded grid amplifier.



MINIATURE GROUNDED GRID TRIODE

EC91

Miniature screened triode for use as a grounded grid amplifier.



U.H.F. TRIODE

EC98

Triode intended for use as a grounded-grid amplifier in U.H.F. receivers.

HEATER

V_h	6.3	V
I_h	400	mA

CAPACITANCES (measured with external shield)

C_{a-g}	2.8	pF
C_{a-k}	80	mpF
C_{h-k}	3.8	pF
$C_{k-g+h+S}$	8.8	pF
$C_{a-g+h+S}$	4.0	pF

CHARACTERISTICS

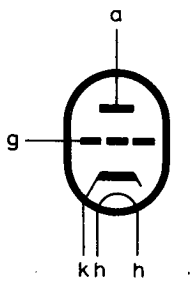
V_a	150	V
I_a	13.5	mA
V_g	−1.35	V
g_m	13.5	mA/V
μ	50	
r_a	3.7	kΩ
R_k	0	Ω
V_g ($I_a \leqslant 60\mu A$)	−15	V

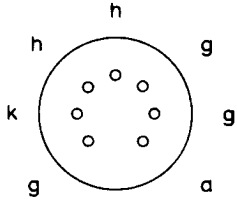
DESIGN CENTRE RATINGS

$V_{a(b)}$ max.	300	V
V_a max.	150	V
p_a max.	2.2	W
$-V_g$ max.	50	V
$+V_g$ max.	0	V
I_k max.	18	mA
I_g max.	3.2	mA
R_{g-k} max.	250	kΩ
V_{h-k} max.	90	V

EC98

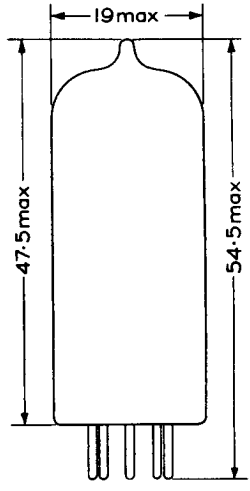
U.H.F. TRIODE





B7G Base

All dimensions in mm



7824

DOUBLE TRIODE

ECC32

Double triode with separate cathodes for use as a paraphase A.F. amplifier and in phase inverters, multi-vibrators, etc.

HEATER

V_h	6.3	V
I_h	0.95	A

CAPACITANCES

c_{a-s}	0.8	μμF
c_{a-g} (each section)	4.3	μμF
c_{g-k} (each section)	4.3	μμF
c_{a-k} (each section)	2.0	μμF

CHARACTERISTICS (each section)

V_a	250	V
V_g	−4.6	V
I_a	6.0	mA
g_m	2.3	mA/V
μ	32	
r_a	14	kΩ

OPERATING CONDITIONS AS RESISTANCE-CAPACITY-COUPLED AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* (V)	D_{tot} (%)	R_{g1}** (kΩ)
400	47	3.9	1.2	21	67	3.7	150
350	47	3.4	1.2	20.5	57	3.6	150
300	47	2.9	1.2	20	48	3.5	150
250	47	2.4	1.2	19.5	37	3.4	150
200	47	1.9	1.2	19.5	26	3.2	150
400	100	2.1	2.7	25	81	3.0	330
350	100	1.8	2.2	25	69	2.9	330
300	100	1.6	2.2	24.5	54	2.8	330
250	100	1.3	2.2	24.5	44	2.6	330
200	100	1.05	2.2	24	32	2.4	330
400	220	1.1	3.9	27.5	81	2.3	680
350	220	0.95	3.9	27.5	68	2.2	680
300	220	0.85	3.9	27	56	2.2	680
250	220	0.7	3.9	27	45	2.1	680
200	220	0.55	3.9	26.5	34	2.0	680

*V_{out} = Output voltage at start of I_{g1} or at D_{tot} = 10%.

**R_{g1} = Grid resistance of following valve.

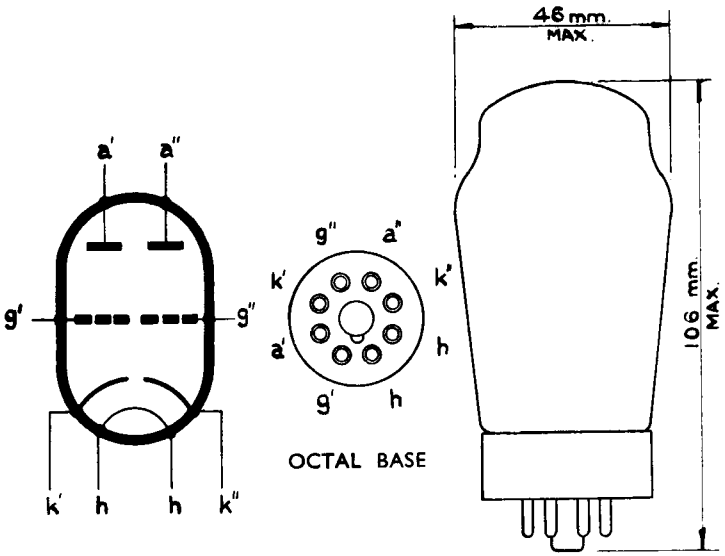
LIMITING VALUES (each section)

V_a max.	300	V
p_a max.	5	W
I_k max.	50	mA
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ

ECC32

DOUBLE TRIODE

Double triode with separate cathodes for use as a paraphase A.F. amplifier and in phase inverters, multi-vibrators, etc.



DOUBLE TRIODE

ECC33

High slope, low impedance double triode with low heater consumption, primarily intended for use in flip-flop, scaling and computor circuits.

HEATER (The heaters of the two cathodes are connected in series)

V_h	6.3	V
I_h	0.4	A

CAPACITANCES

$c_{a'-a''}$	0.75	μμF
c_{a-g} (each section)	2.5	μμF
c_{g-k} (each section)	3.5	μμF
$c_{a'-k'}$	1.2	μμF
$c_{a''-k''}$	1.5	μμF

CHARACTERISTICS (each section)

V_a	250	V
V_g	−4.0	V
I_a	9.0	mA
g_m	3.6	mA/V
μ	35	
r_a	9.7	kΩ

LIMITING VALUES (each section)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
I_k max.	20	mA
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

OPERATING CONDITIONS AS R.C. COUPLED A.F. AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	*V_{out} ($V_{r.m.s.}$)	D_{tot} (%)	**R_{g1} (kΩ)
400	47	4.0	1.2	25.5	74	6.1	150
350	47	3.5	1.2	25	62.5	5.9	150
300	47	3.0	1.2	25	50	5.6	150
250	47	2.5	1.2	25	41	5.6	150
200	47	2.0	1.2	24.5	30.5	5.3	150
400	100	2.05	2.2	28	78.5	5.7	330
350	100	1.8	2.2	27.5	66.5	5.6	330
300	100	1.55	2.2	27	54.5	5.6	330
250	100	1.3	2.2	27	43	5.4	330
200	100	1.05	2.2	26.5	32	5.2	330
400	220	1.1	3.9	28	74.5	5.1	680
350	220	0.98	3.9	28	63	5.0	680
300	220	0.83	3.9	28	51	5.0	680
250	220	0.7	3.9	27.5	41	4.8	680
200	220	0.53	3.9	27	30.5	4.8	680

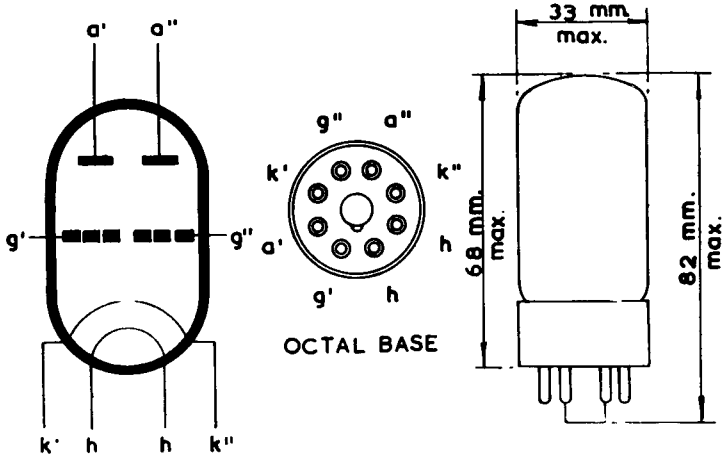
*Output voltage at the start of I_g. At output voltages lower than those shown the distortion is approximately proportional to voltage.

**Grid resistor of following valve.

ECC33

DOUBLE TRIODE

High slope, low impedance double triode with low heater consumption, primarily intended for use in flip-flop, scaling and computor circuits.



DOUBLE TRIODE

ECC34

Low impedance double triode with separate cathodes for use as combined frame time base oscillator and current amplifier to feed the deflector coils in A.C. television receivers.

HEATER

V_h	6.3	V
I_h	0.95	A

CAPACITANCES

$c_{a'-a''}$	0.48	μμF
*c_{a-g}	4.0	μμF
*c_{g-k}	3.5	μμF
*c_{a-k}	1.8	μμF

*Each section

TYPICAL OPERATING CONDITIONS (each section)

V_a	250	V
I_a	10	mA
V_g	–16	V
g_m	2.2	mA/V
r_a	5.2	k Ω
μ	11.5	

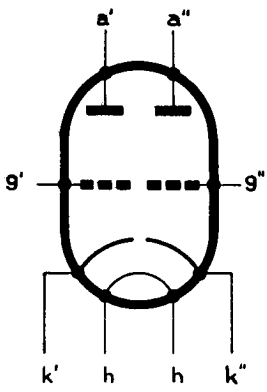
LIMITING VALUES (each section)

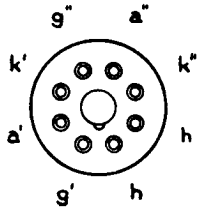
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.25	W
I_k max.	50	mA
V_{h-k} max.	50	V
R_{h-k} max.	20	k Ω
R_{g-k} max.	2.0	M Ω

ECC34

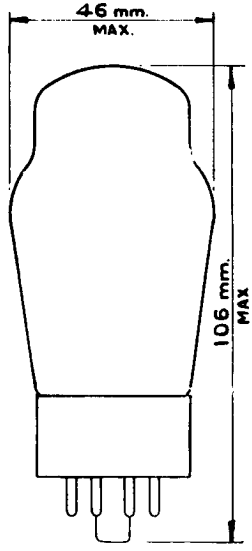
DOUBLE TRIODE

Low impedance double triode with separate cathodes for use as combined frame time base oscillator and current amplifier to feed the deflector coils in A.C. television receivers.





OCTAL BASE



DOUBLE TRIODE

ECC35

High-gain double triode with separate cathodes for use in paraphase A.F. voltage amplifiers.

HEATER

V_h	6.3	V
I_h	0.4	A

CAPACITANCES

$c_{a'-a''}$	0.75	μμF
$c_{a'-g'}$	2.5	μμF
$c_{in'}$	3.0	μμF
$c_{out'}$	1.0	μμF
$c_{a''-g''}$	3.0	μμF
$c_{in''}$	3.0	μμF
$c_{out''}$	1.3	μμF

CHARACTERISTICS (each section)

V_a	250	V
V_g	−2.5	V
i_a	2.3	mA
g_m	2.0	mA/V
μ	68	
r_a	34	kΩ

LIMITING VALUES (each section)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.5	W
I_k max.	8.0	mA
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	90	V

ECC35

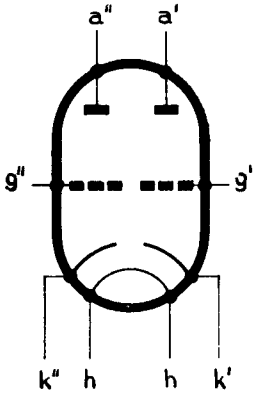
DOUBLE TRIODE

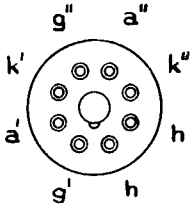
High-gain double triode with separate cathodes for use in paraphase A.F. voltage amplifiers.

OPERATING CONDITIONS AS R.C. COUPLED A.F. AMPLIFIER

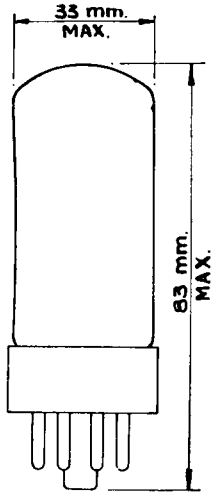
V_b (V)	R_a (k Ω)	I_a (mA)	R_k (k Ω)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	V_{out}† ($V_{r.m.s.}$)	D_{tot} (%)	R_{gl}‡ (k Ω)
400	100	1.3	2.7	40.5	37.5	66.2	10	330
350	100	1.1	2.7	40.5	32.2	57.0	10	330
300	100	1.0	2.7	40	28.0	48.7	10	330
250	100	0.8	2.7	40	23.2	41.1	10	330
200	100	0.65	2.7	39.5	18.7	28.5	8	330
400	220	0.73	4.7	46	44	80	10	680
350	220	0.63	4.7	45.5	38	69.3	10	680
300	220	0.53	4.7	45.5	32.5	59	10	680
250	220	0.45	4.7	45	27	43	8.5	680
200	220	0.38	4.7	45	21.5	33.6	8.2	680

* At D_{tot}=5%
† At D_{tot}=10% or start of I_g
‡ Grid resistor of following valve.





OCTAL BASE



SUBMINIATURE DOUBLE TRIODE

ECC70

Subminiature medium-μ double triode intended for use at v.h.f.

HEATER

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
$c_{a'-a''}$	<0.33	<0.52	pF
c_{a-g} (each section)	1.4	1.6	pF
$c_{g'\ g''}$	<0.011	<0.015	pF
c_{in} (each section)	—	2.4	pF
$c_{out'}$	1.2	0.3	pF
$c_{out''}$	1.3	0.35	pF

CHARACTERISTICS (each section)

V_a	100	V
V_g	−1.0	V
I_a	6.5	mA
g_m	5.4	mA/V
r_a	6.5	kΩ
μ	35	
V_g (I_a = 10μA)	−6.5	V

LIMITING VALUES (absolute ratings) each section

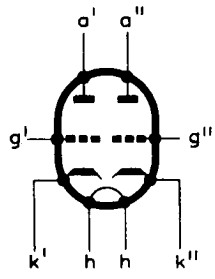
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
I_a max.	22	mA
$-V_g$ max.	55	V
I_g max.	5.5	mA
V_{h-k} max.	200	V

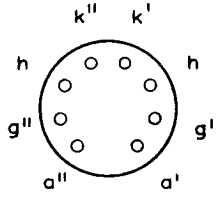
ECC70

SUBMINIATURE DOUBLE TRIODE

Subminiature medium-μ double triode intended for use at v.h.f.

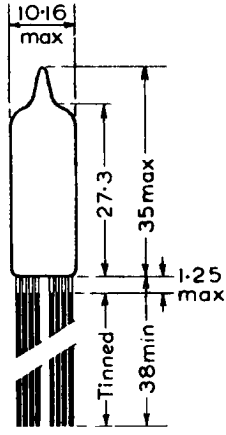
5262





B8D/F Base

All dimensions in mm



MINIATURE V.H.F. DOUBLE TRIODE

ECC91

Double triode with common cathode for use as R.F. power amplifier or oscillator.

HEATER

V_h	6.3	V
I_h	0.45	A

CAPACITANCES (Each Unit)

c_{a-g}	1.6	μμF
c_{in}	2.2	μμF
c_{out}	0.4	μμF

CHARACTERISTICS. (Each Unit)

V_a	100	V
I_a	8.5	mA
R_k	100	Ω
S_m	5.3	mA/V
μ	38	
r_a	7,100	Ω

OPERATING CONDITIONS AS CLASS C TELEGRAPHY PUSH-PULL R.F. AMPLIFIER AND OSCILLATOR AT 80 Mc/s APPROX.

V_a	150	V
V_g *	-10	V
R_g	625	Ω
R_k	220	Ω
I_a	2x15	mA
I_g	2x8	mA
W_{drive}	0.35	W
W_{out}	3.5	W

* Obtained from a fixed supply or from a grid or cathode resistor of value shown.

NOTE: An output of 1 watt may be obtained from an ECC.91 in a push-pull oscillator at 250 Mc/s with V_a = 150V W_a = 2x1.5W and a common grid resistor of 2000 ohms.

LIMITING VALUES

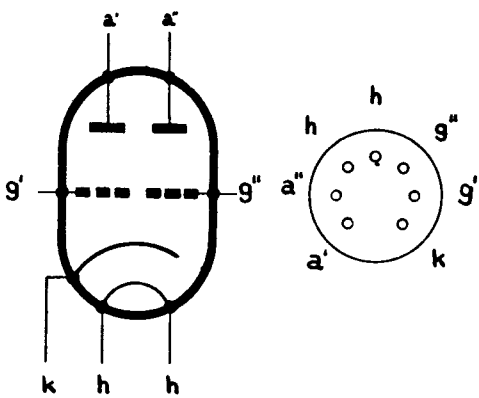
V_a max	300	V
W_a max	2x1.5	W
V_g max	-40	V
I_g max	2x8	mA
V_{h-k} max	100	V
R_g max (self bias)	0.5	mΩ

ECC91

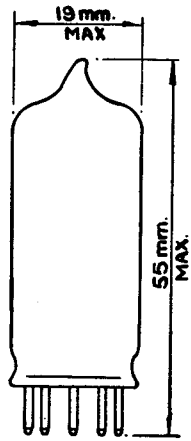
MINIATURE V.H.F. DOUBLE TRIODE

Double triode with common cathode for use as R.F. power amplifier or oscillator.

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



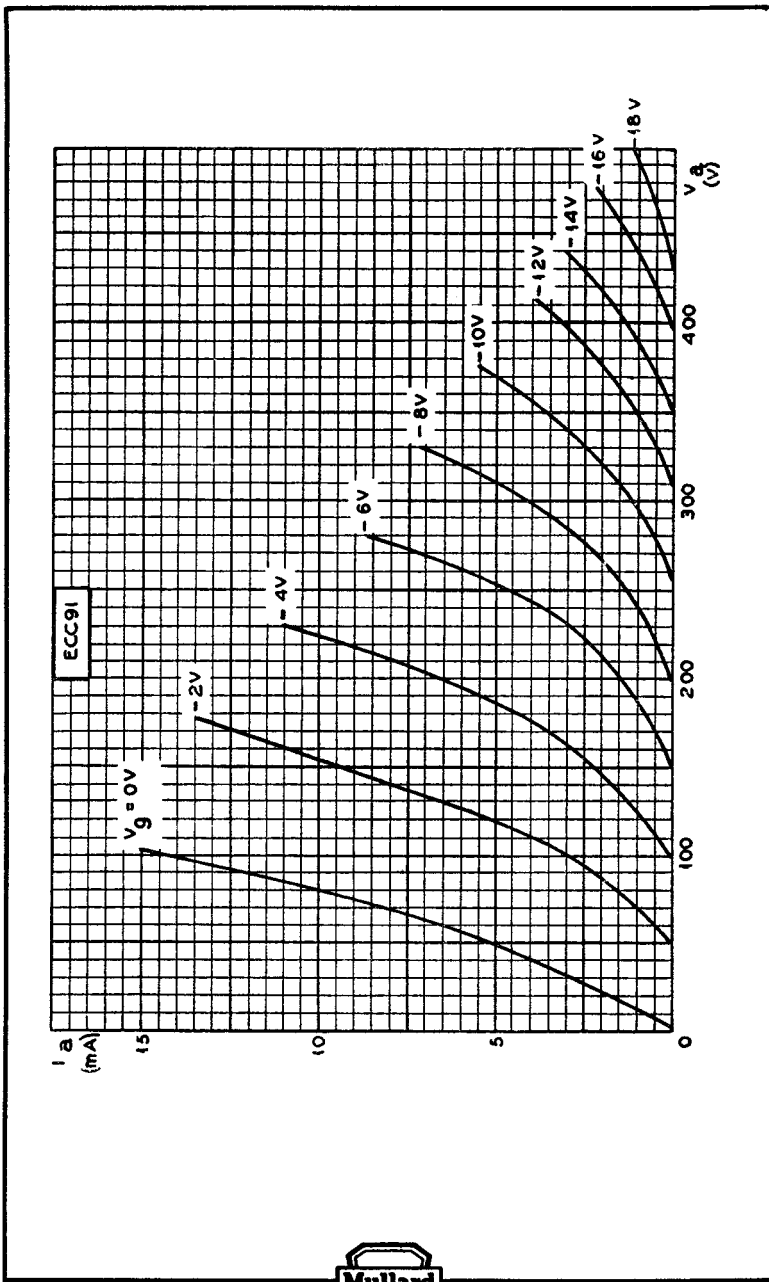
DIMENSIONS



MINIATURE V.H.F. DOUBLE TRIODE

ECC91

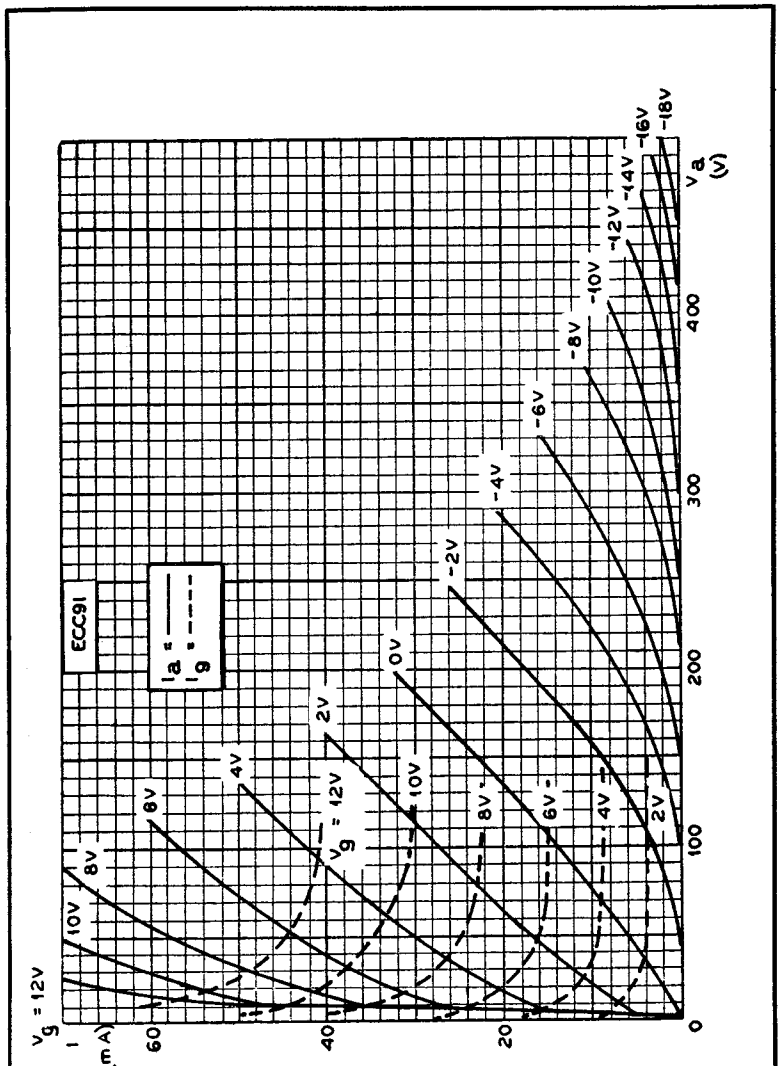
Double triode with common cathode for use as
R.F. power amplifier or oscillator.



ECC91

MINIATURE V.H.F. DOUBLE TRIODE

Double triode with common cathode for use as R.F. power amplifier or oscillator.



TRIODE HEXODE

ECH35

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

HEATER

V_h	6.3	V
I_h	0.3	A

CAPACITANCES

	c_{gt-gl}	< 0.3	μμF
Hexode	c_{gl-k}	5.0	μμF
	c_{a-k}	10.0	μμF
	c_{a-gl}	< 0.003	μμF
Triode	c_{g-k}	9.0	μμF
	c_{a-k}	3.0	μμF
	c_{a-gl}	1.6	μμF

OPERATING CONDITIONS - HEXODE SECTION

(a) With fixed screen grid voltage

V_a			250	V
V_{g2+g4}			100	V
R_k			215	ohms
R_{g3}			50,000	ohms
I_{g3}			200	μA
V_{gl}	-2	-17	-23	V
I_a	3	-	-	mA
I_{g2+g4}	3	-	-	mA
g_c	650	6.5	1.5	μA/V
r_a	1.3	> 5.0	> 6.0	M.ohms

(b) With screen grid fed by a potentiometer (See diagram overleaf)

$V_a = V_b$			250	V
R1			24,000	ohms
R2			33,000	ohms
R_k			215	ohms
R_{g3}			50,000	ohms
I_{g3}			200	μA
V_{gl}	-2	-23.5	-31	V
V_{g2+g4}	100	-	145	V
I_{ah}	3	-	-	mA
I_{g2+g4}	3	-	-	mA
g_c	650	6.5	1.5	μA/V
r_a	1.3	> 3.0	> 4.0	M.ohms

ECH35

TRIODE HEXODE

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

OPERATING CONDITIONS - TRIODE SECTION

V_b		100	250 V
R^a		-	45,000 ohms
I_a	(R_{gt} = 50,000 ohms, I^{gt} = 200 µA)	3.3	3.3 mA
I_a	(V_{gt} = 0 V) V_{osc} = 0 V)	10	4.5 mA
g_m	(V_{gt} = 0 V, V_{osc} = 0 V)	2.8	2.2 mA/V
µ	(V_{gt} = 0 V, V_{osc} = 0 V)	24	24

LIMITING VALUES - HEXODE SECTION

$V_{a(b)}$ max.	550 V
V_a max.	300 V
w_a max.	1.2 W
V_{g2+g4} (b) max	550 V
V_{g2+g4} max. (I_a = 4.5mA)	125 V
V_{g2+g4} max. (I_a = <0.5mA)	200 V
w_{g2+g4} max.	0.6 W
V_{g1} max. (I_{g1} = +0.3uA)	-1.3 V
V_{g3} max. (I_{g3} = +0.3uA)	-1.3 V
I_k max.	15 mA
R_{g1-k} max.	3 Mohm
R_{h-k} max.	20,000 ohms
V_{h-k}	100 V
R_{g3-k}	0.1 Mohm

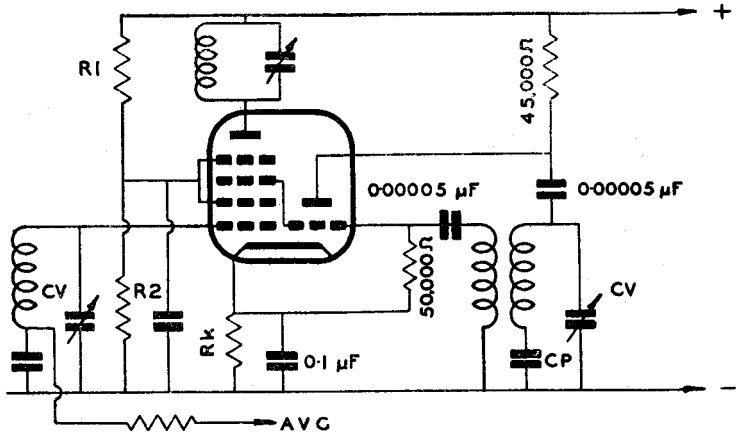
LIMITING VALUES - TRIODE SYSTEM

$V_{a(b)}$ max.	550 V
V_a max.	100 V
w_a max.	1.5 W
V_{gt} max. (I_{g1} = +0.3 µA)	-1.3 V
R_{gt} max.	100,000 ohms

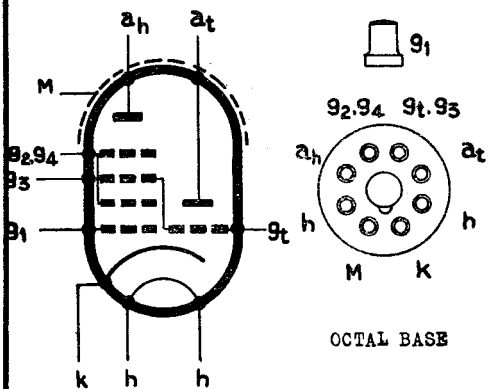
TRIODE HEXODE

ECH35

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

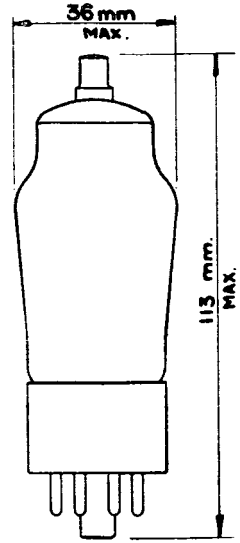


ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



OCTAL BASE

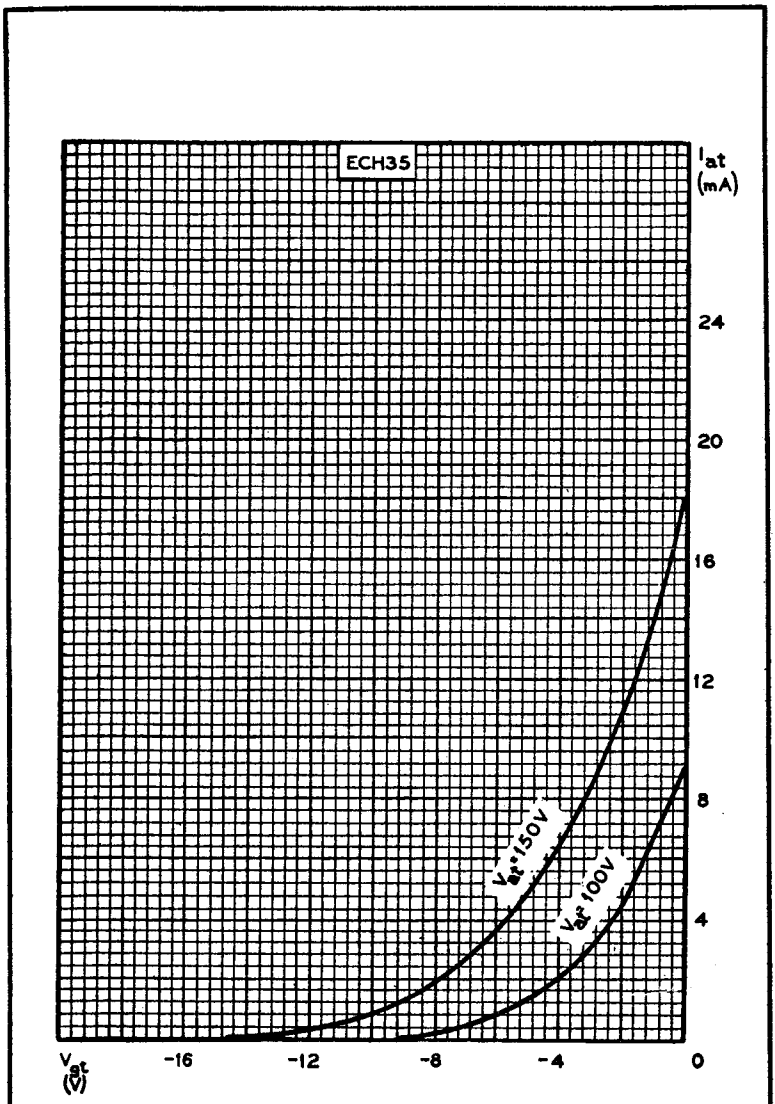
DIMENSIONS



ECH35

TRIODE HEXODE

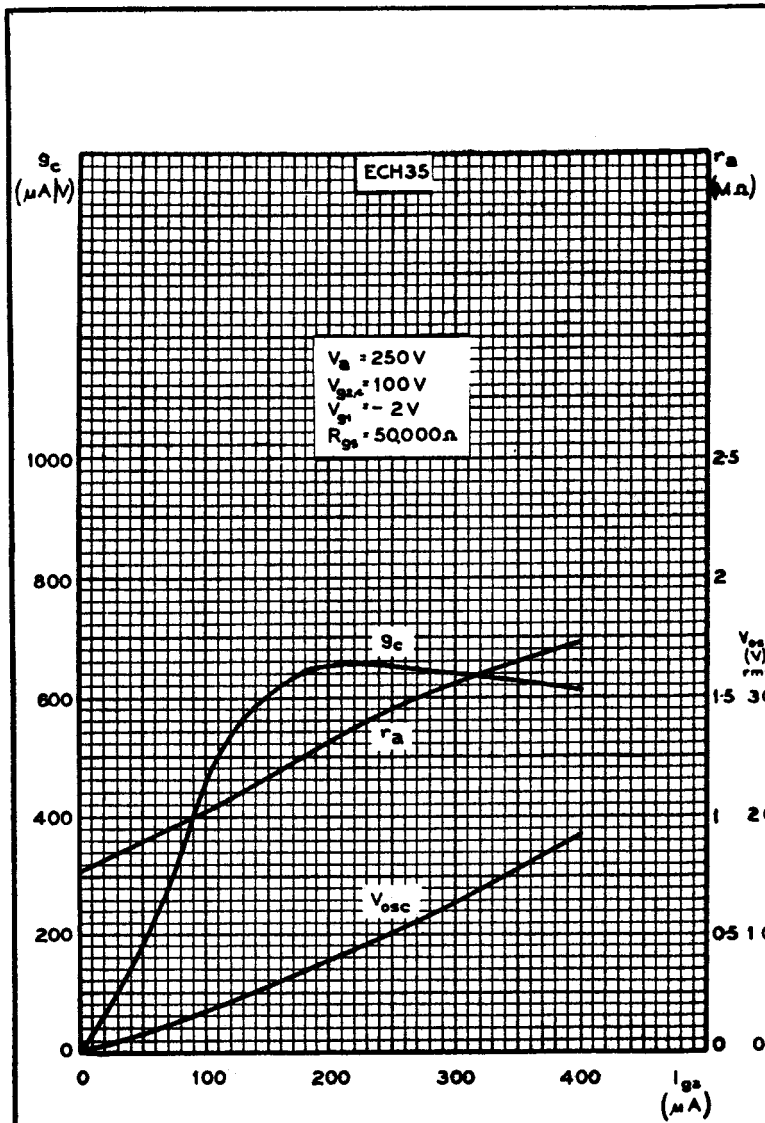
Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.



TRIODE HEXODE

ECH35

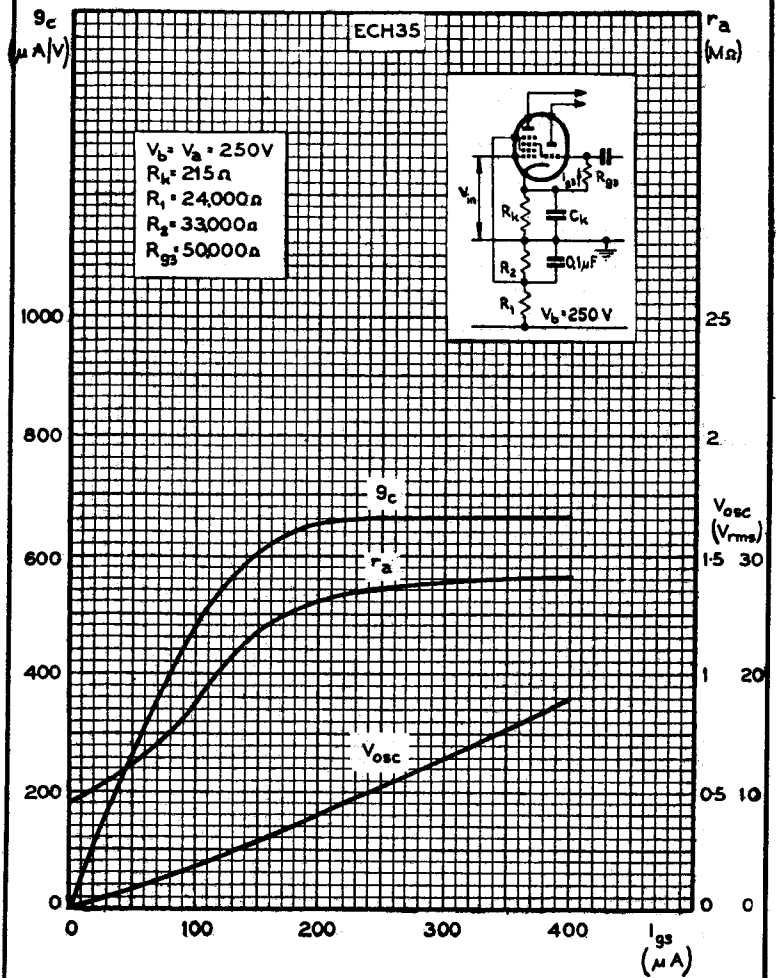
Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.



ECH35

TRIODE HEXODE

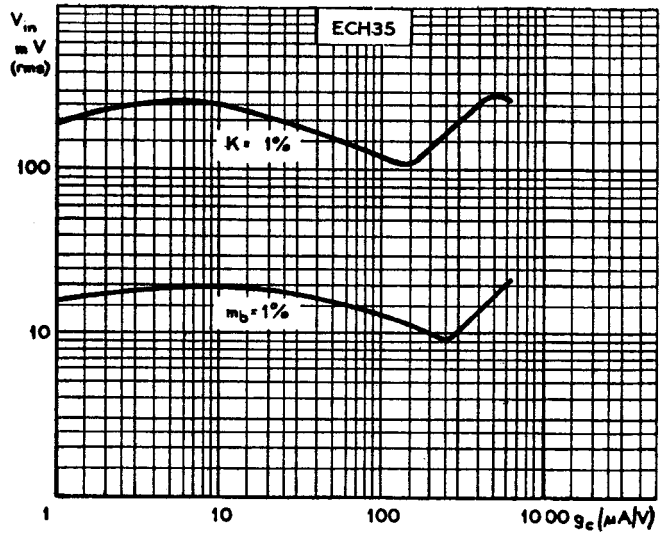
Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

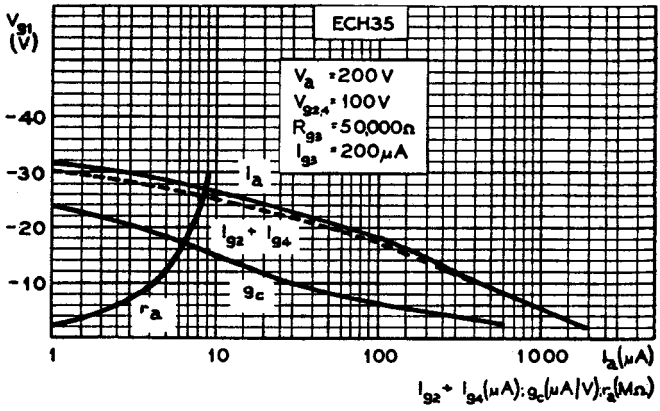


TRIODE HEXODE

ECH35

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

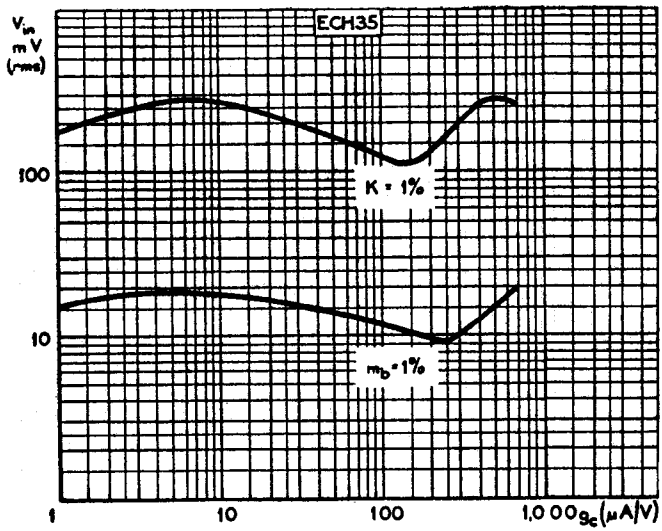


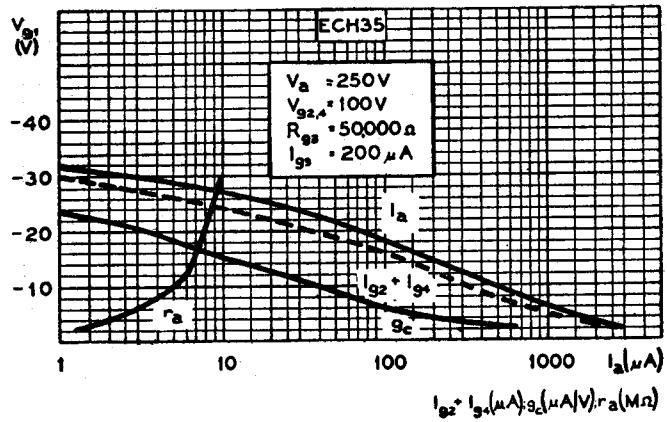


ECH35

TRIODE HEXODE

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A V.C.

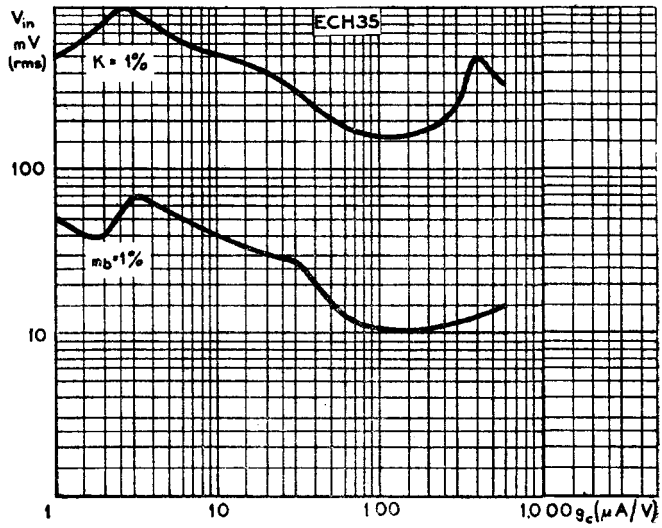


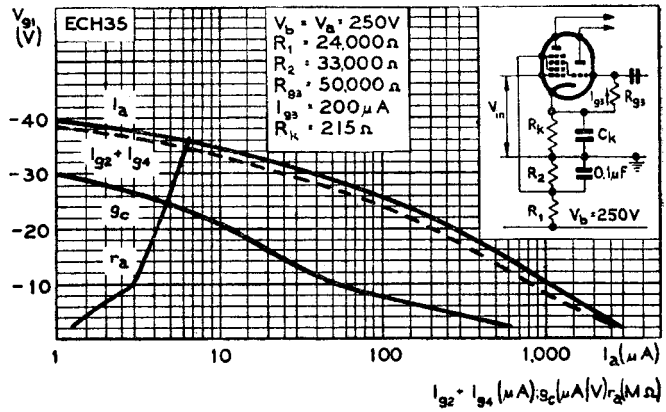


TRIODE HEXODE

ECH35

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.





TRIODE PENTODE

ECL83

Combined triode and output pentode with separate cathodes intended for use in audio frequency applications.

HEATER Suitable for parallel operation a.c. or d.c.

V_h	6.3	V
I_h	600	mA

MOUNTING POSITION Any

CAPACITANCES (measured without an external shield)

c_{at-gp}	<0.1	pF
c_{at-ap}	<1.6	pF
c_{gt-gp}	<0.03	pF
c_{gt-ap}	<0.05	pF

Pentode section

c_{a-g1}	<0.2	pF
c_{in}	5.7	pF
c_{out}	4.7	pF
c_{g1-h}	0.4	pF

Triode section

c_{a-g}	1.6	pF
c_{in}	2.3	pF
c_{out}	0.32	pF

CHARACTERISTICS

Pentode section

V_a	170	200	V
V_{g2}	170	200	V
I_a	30	27	mA
I_{g2}	5.0	4.4	mA
V_{g1}	−9.5	−13	V
g_m	5.5	5.0	mA/V
r_a	53	65	kΩ
μ_{g1-g2}	10	10	

Triode section

V_a	170	200	V
I_a	1.6	2.4	mA
V_g	−1.5	−1.5	V
g_m	2.1	2.5	mA/V
r_a	40	34	kΩ
μ	82	85	

ECL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use in audio frequency applications.

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−9.5	−13	V
$I_{a(o)}$	30	27	mA
$I_{g2(o)}$	5.0	4.4	mA
R_k	270	410	Ω
R_a	5.5	7.5	kΩ
$V_{in(r.m.s.)}$	5.0	5.2	V
P_{out}	2.2	2.5	W
D_{tot}	10	10.5	%

Two valves in class 'AB' push-pull

V_a	170	200	V
V_{g2}	170	200	V
*R_k	180	220	Ω
$I_{a(o)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g2(o)}$	2×3.8	2×3.9	mA
I_{g2} (max. sig.)	2×6.25	2×8.5	mA
R_{a-a}	6.5	7.5	kΩ
$V_{in(g1-g1)r.m.s.}$	17	23.5	V
P_{out}	5.0	7.2	W
D_{tot}	3.6	4.2	%

*Common cathode bias resistor

TRIODE SECTION AS A.F. VOLTAGE AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (μA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	R_{g1}* (kΩ)
170	100	650	1.8	49	15.3	330
200	100	720	2.2	47	17.7	330

$\frac{V_{out}}{V_{in}}$ measured with an input of 100mV

V_{out} measured for a total harmonic distortion of 5%

*Grid resistor of following valve.

TRIODE PENTODE

ECL83

Combined triode and output pentode with separate cathodes intended for use in audio frequency applications.

LIMITING VALUES

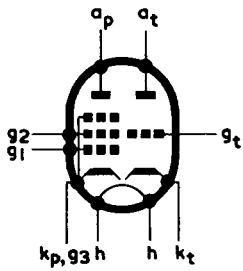
Pentode section

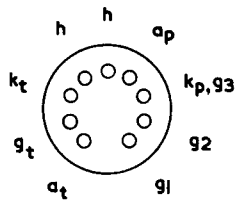
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	5.4	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.2	W
p_{g2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g1-k} max. (self-bias)	500	kΩ
R_{g1-k} max. (fixed bias)	250	kΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

Triode section

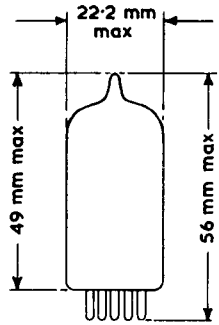
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k} max. (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

3749





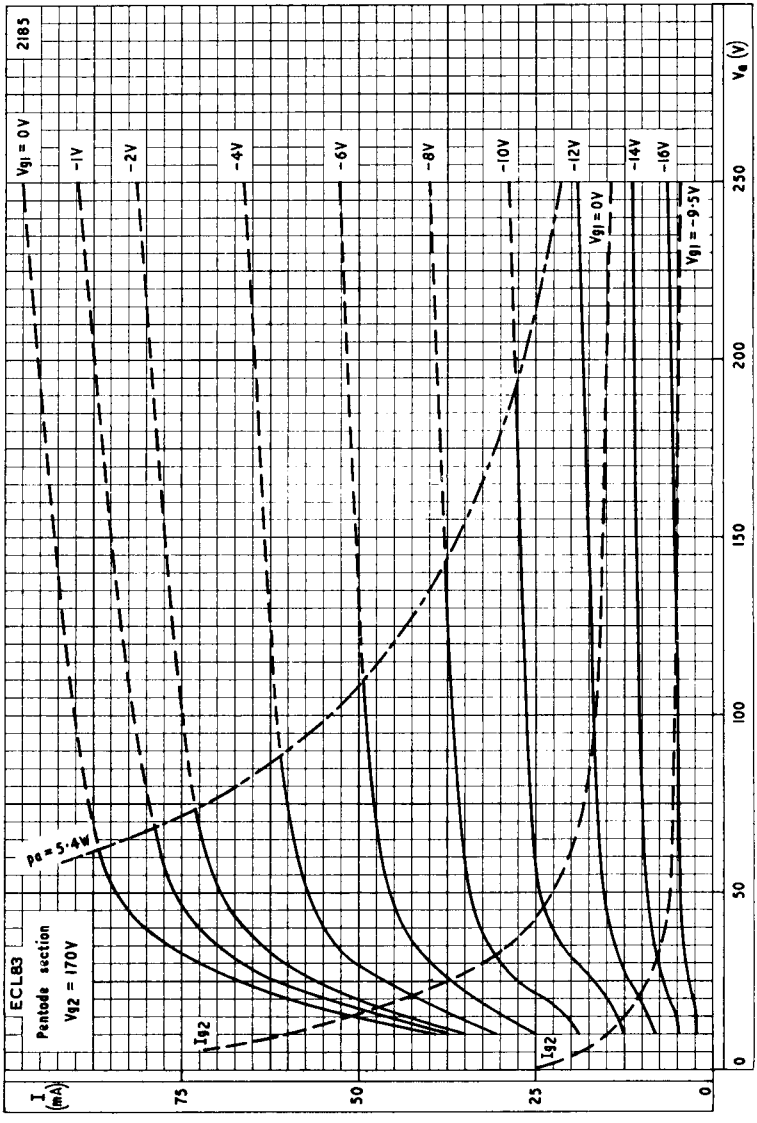
B9A Base



ECL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes intended for use in audio frequency applications.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g_2} = 170V

CATHODE RAY TUBE

ECR30

Oscilloscope tube with 3-in. diameter screen.

HEATER

V_h	4.0	V
I_h	1.0	A

CAPACITANCES

Grid to all other electrodes	< 20	uuF
Each X plate or each Y plate to all other electrodes	< 15	uuF
One X plate to one Y plate	< 3	uuF

FLUORESCENT COLOUR

Green. Non-persistent.

DEFLECTION

Electrostatic. The tube is primarily intended for symmetrical operation.

OPERATING CONDITIONS

$V_{a1}=V_{a3}$	800	V
V_{a2}	100 to 170	V
V_g	-1.0 to -18	V

LIMITING VALUES

$V_{a1}=V_{a3}$ max	1000	V
V_{h-k} max	50	V

DEFLECTION SENSITIVITY

X and Y plates $\frac{170}{V_{a3}}$ mm/V

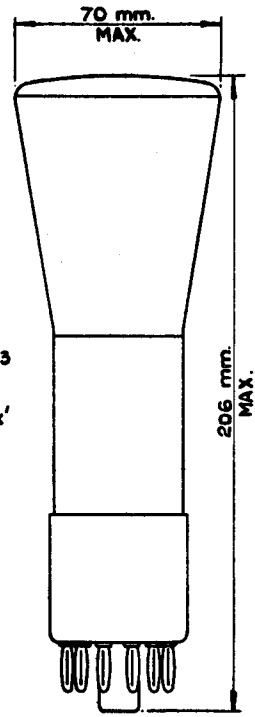
ECR30

CATHODE RAY TUBE

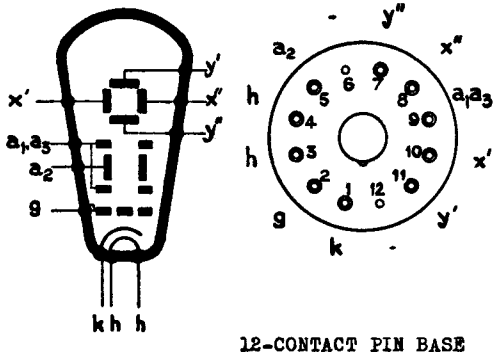
Oscilloscope tube with 3-in. diameter screen.

Viewed from the screen end, and with the tube positioned so that the spigot key of the base is uppermost, a positive voltage on X' will deflect the spot to the left, and a positive voltage on Y' will deflect the spot upwards.

DIMENSIONS



ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



12-CONTACT PIN BASE

CATHODE RAY TUBES

High-sensitivity oscilloscope tubes with 3½-in. diameter screen.

ECR35
ECR35P

HEATER

V_h	4.0	V
I_h	1.0	A

CAPACITANCES

Grid to all other electrodes	< 25	uuF
Each X plate or each Y plate to all other electrodes	< 25	uuF
One X plate to one Y plate	< 5	uuF

FLUORESCENT COLOUR

ECR.35 Green. Non-persistent.
ECR.35P Blue, with yellow-green afterglow.

DEFLECTION

Electrostatic. The tube is suitable for either symmetrical or asymmetrical operation.

With asymmetrical deflection the trapezoidal distortion is such that the angle between adjacent sides of a 45 mm x 70 mm scan is between 85° and 95°.

OPERATING CONDITIONS

$V_{a1}=V_{a3}$	1,200	V
V_{a2}	150 to 250	V
V_g	-1.0 to -50	V

LIMITING VALUES

$V_{a1}=V_{a3}$ max	2,500	V
V_{h-k} max	50	V

DEFLECTION SENSITIVITY

X plates	$\frac{360}{V_{a3}}$	mm/V
Y plates	$\frac{780}{V_{a3}}$	mm/V

ECR35
ECR35P

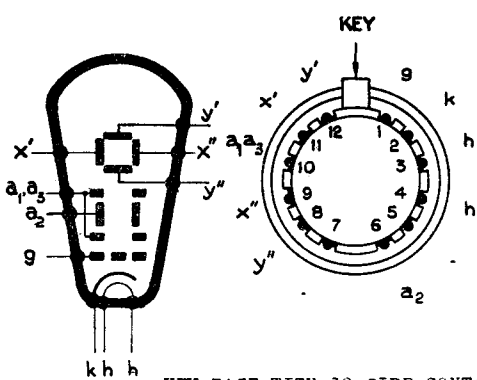
CATHODE RAY TUBES

High-sensitivity oscilloscope tubes with 3½-in. diameter screen.

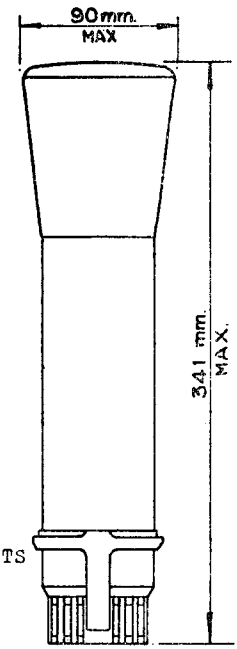
Viewed from the screen end, and with the tube positioned so that the key of the base is uppermost, a positive voltage on X' will deflect the spot to the left, and a positive voltage on Y' will deflect the spot upwards.

DIMENSIONS

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



KEY BASE WITH 12 SIDE CONTACTS



Contacts 5, 7 and 10 should be connected together externally

CATHODE RAY TUBE

ECR60

High-sensitivity oscilloscope tube with 6-in. diameter screen.

HEATER

V_h	4.0	V
I_h	1.0	A

CAPACITANCES

Grid to all other electrodes	<	25	uuF
Each X plate or each Y plate to all other electrodes	<	25	uuF
One X plate to one Y plate	<	5	uuF

FLUORESCENT COLOUR

Green. Non-persistent.

DEFLECTION

Electrostatic. The tube is suitable for either symmetrical or asymmetrical operation

With asymmetrical deflection the trapezoidal distortion is such that the angle between adjacent sides of an 80 mm x 80 mm scan is between 85° and 95°

OPERATING CONDITIONS

$V_{a1}=V_{a3}$	2,000	V
V_{a2}	250 to 450	V
V_g	-1.0 to -100	V

LIMITING VALUES

$V_{a1}=V_{a3}$ max	2,500	V
V_{h-k}	50	V

DEFLECTION SENSITIVITY

X plates	$\frac{600}{V_{a3}}$	mm/V
Y plates	$\frac{1150}{V_{a3}}$	mm/V

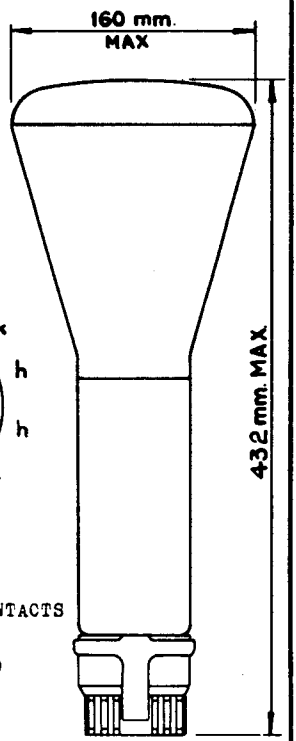
ECR60

CATHODE RAY TUBE

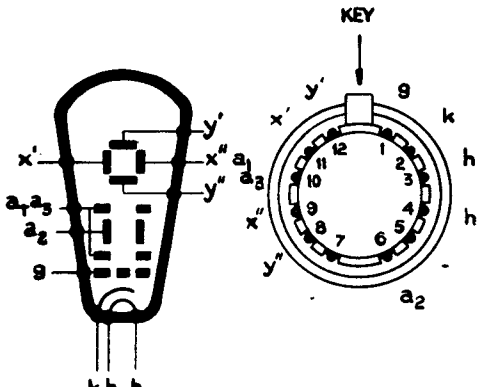
High-sensitivity oscilloscope tube with 6-in. diameter screen.

Viewed from the screen end, and with the tube positioned so that the key of the base is uppermost, a positive voltage on X' will deflect the spot to the left, and a positive voltage on Y' will deflect the spot upwards.

DIMENSIONS



ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



KEY BASE WITH 12 SIDE CONTACTS

Contacts 5, 7 and 10 should be connected together externally

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

EE50

TENTATIVE DATA

Heater	Vf	=	6.3 V
	If	=	0.3 A
Capacities	Ca	=	7.7 uuF
	Cg1	=	7.7 uuF
	Cag1	=	< 0.005 uuF

Operating Conditions

Va	250	V
Vg2	250	V
Vk2	150	V
-Vg1	3	V
Ia	10	mA
Ig2	0.6	mA
-Ik2	8	mA
S (Ia = 10 mA)	14	mA/V
Ri (Ia = 10 mA)	0.25	megohm

Limiting Values

Vao max	550	V
Va max	250	V
Wa max	2.5	W
Vg2o max	550	V
Vg2 max	250	V
Wg2 max	0.2	W
Vk2o max	550	V
Vk2 max	150	V
Wk2 max	1.5	W
Ik max	5	mA
Vg1 max (Ig1 = + 0.3 uA)	-1.3	V
Rg1 max	0.7	megohm
Vfk max	50	V
Rfk max	20,000	ohms

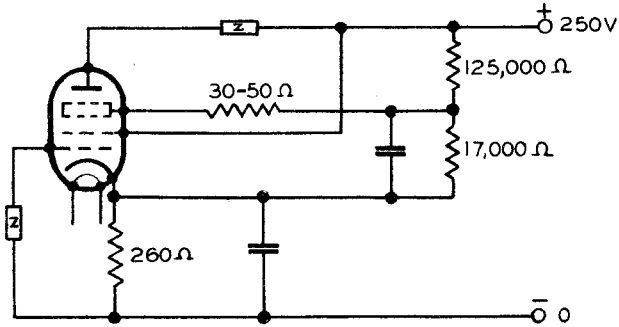
T1639/1

EE50

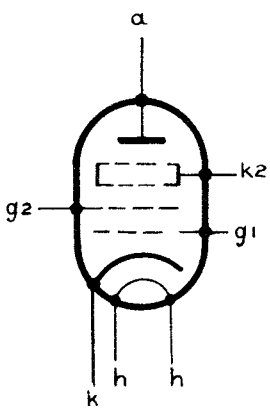
Mullard

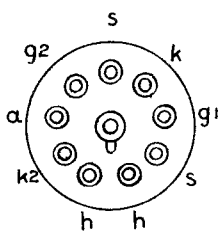
SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

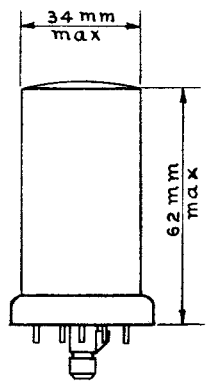
CIRCUIT DIAGRAM



Arrangement of electrodes and base connections







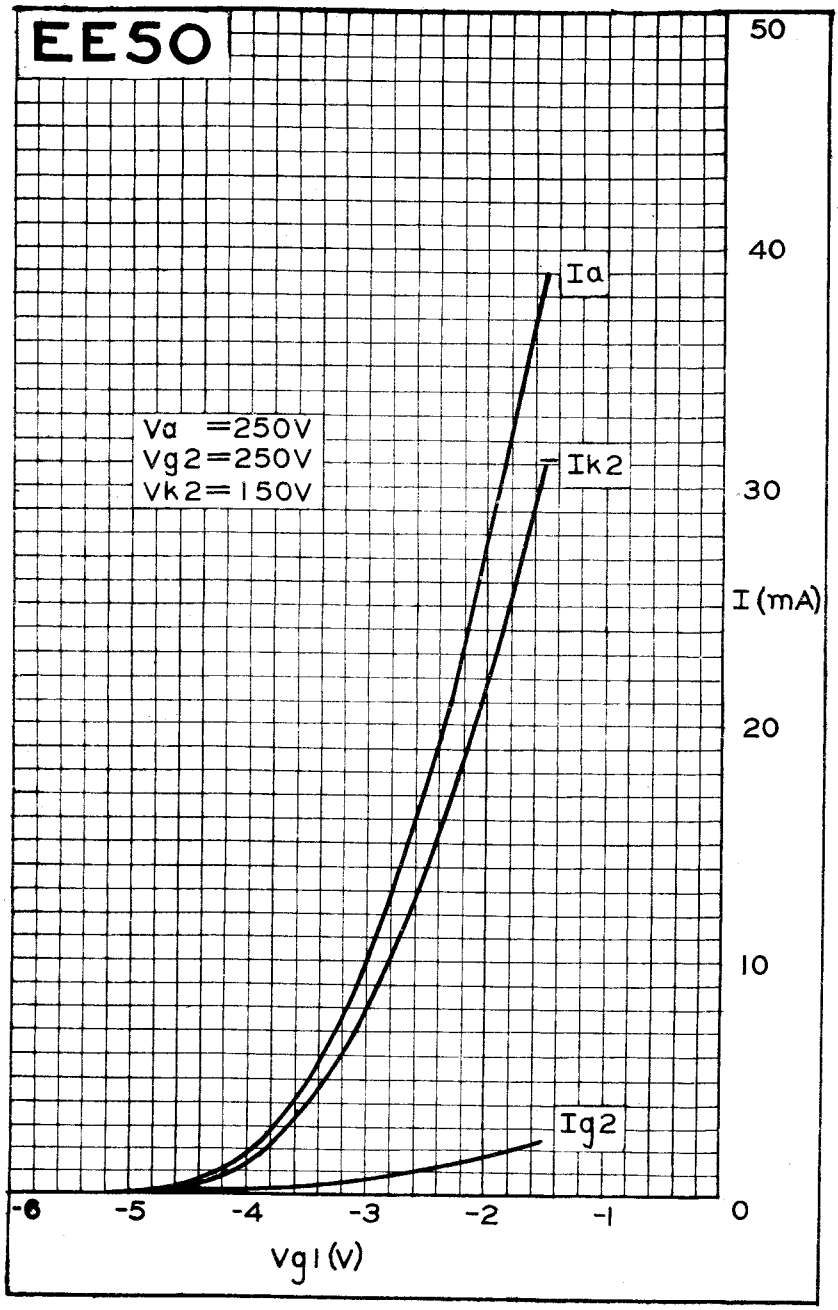
EE50

T1639/2

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

EE50

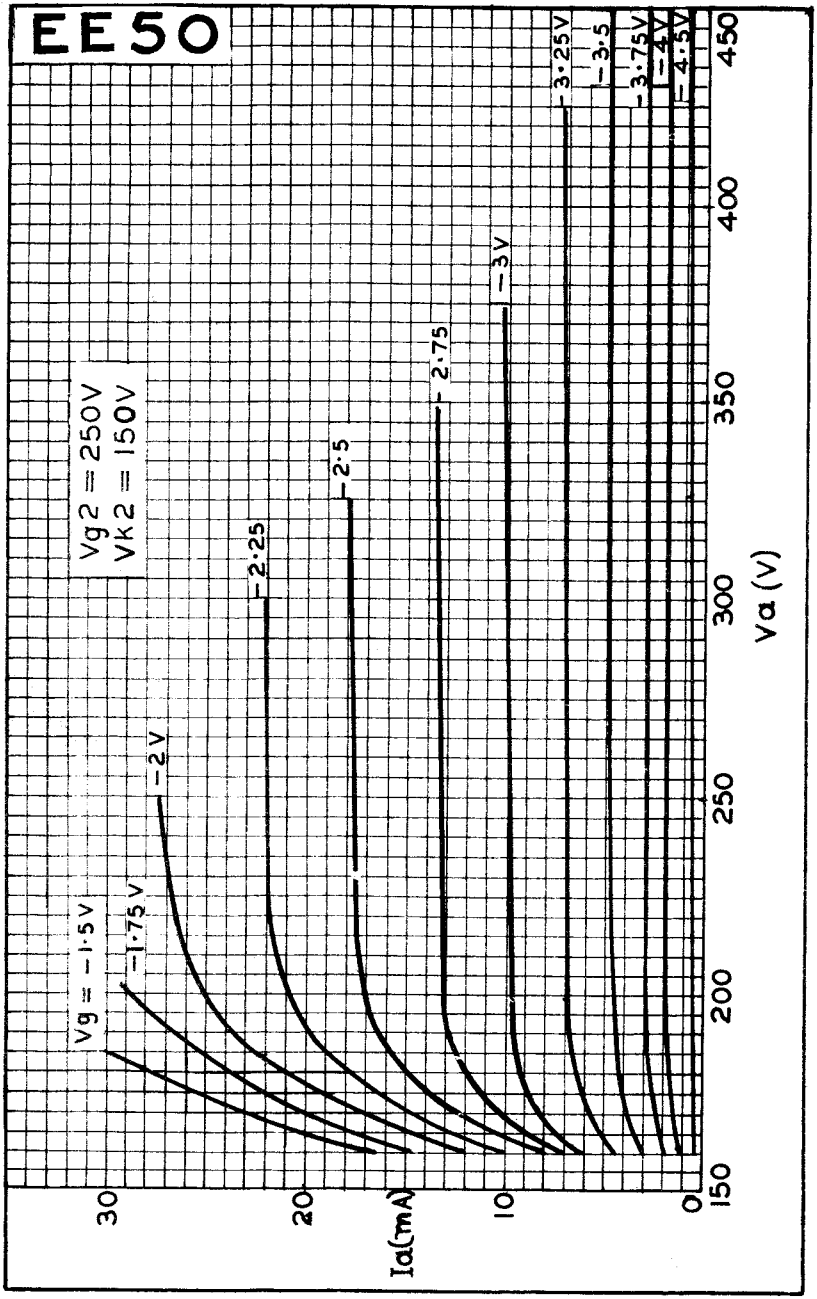


T1639/3

EE50

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

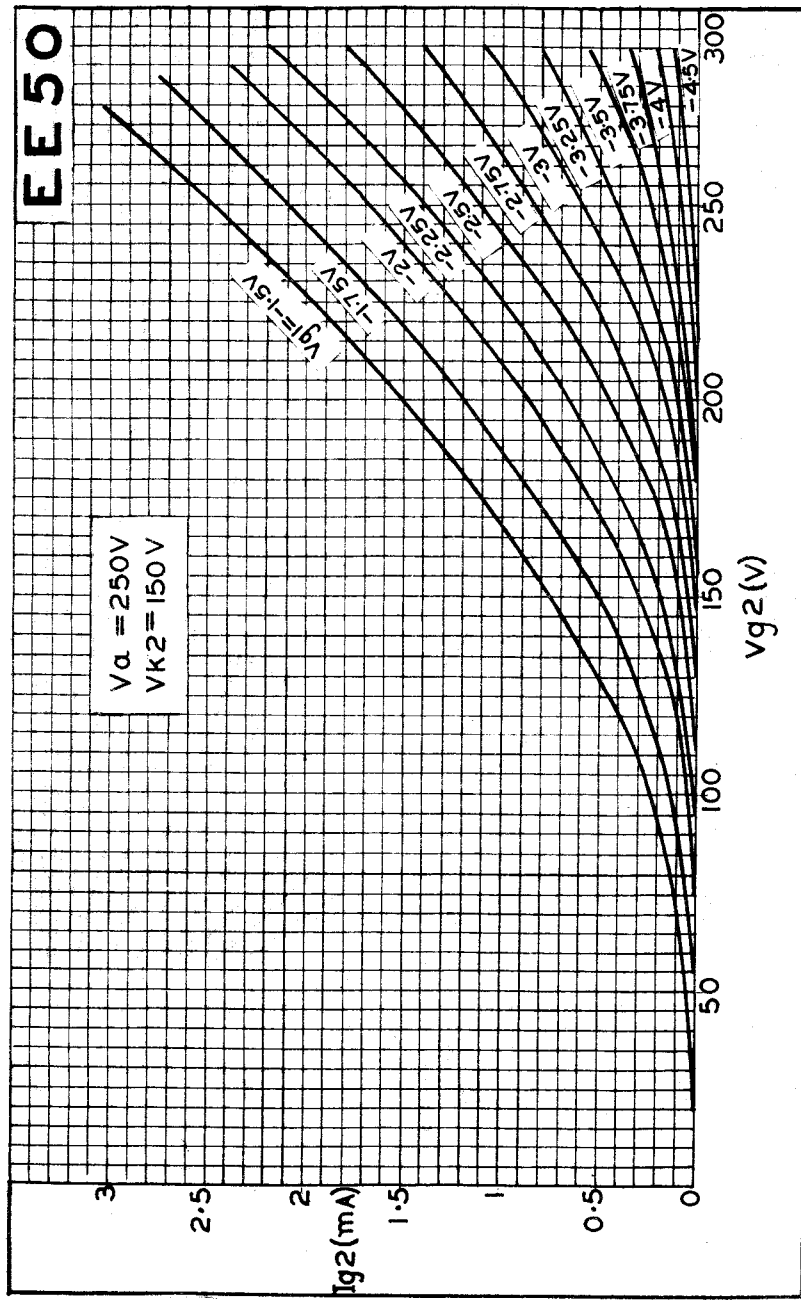


T1639/4

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

EE50

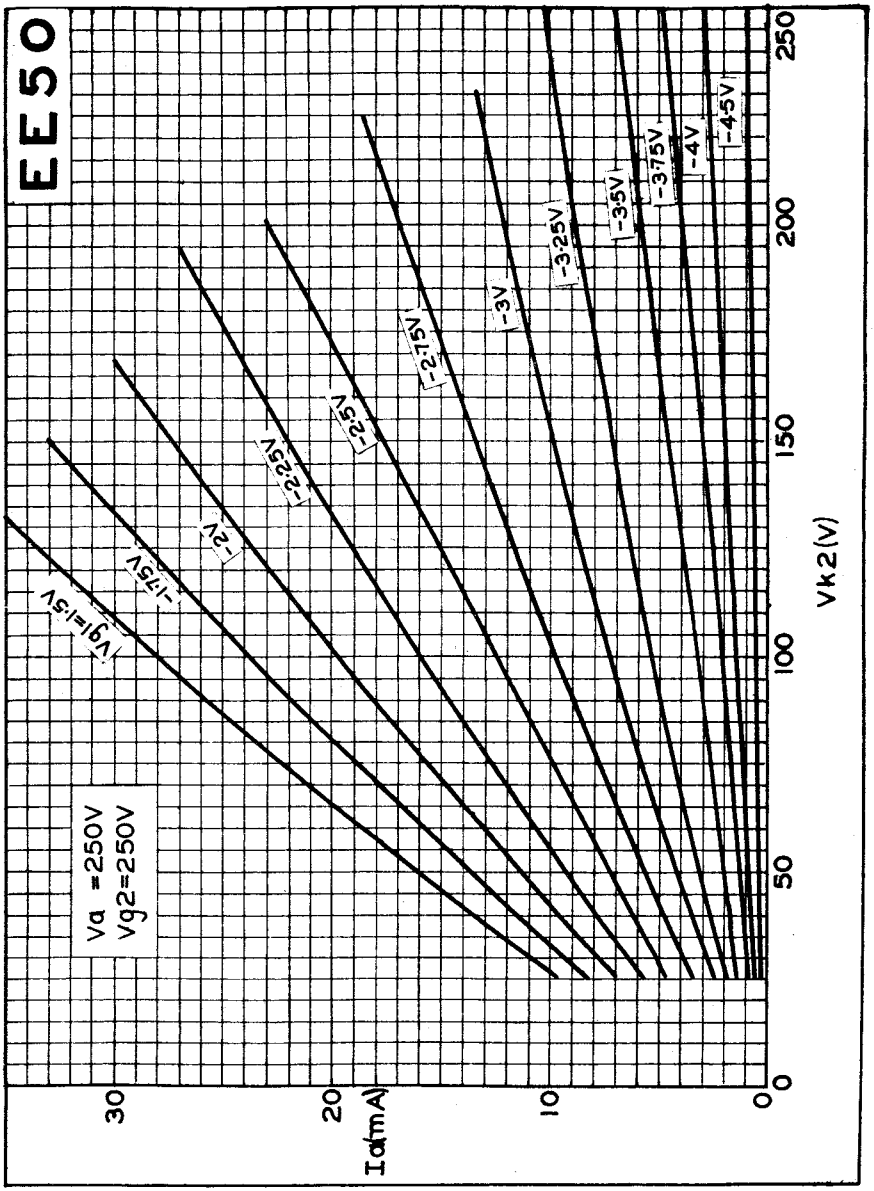


T1639/5

EE50

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

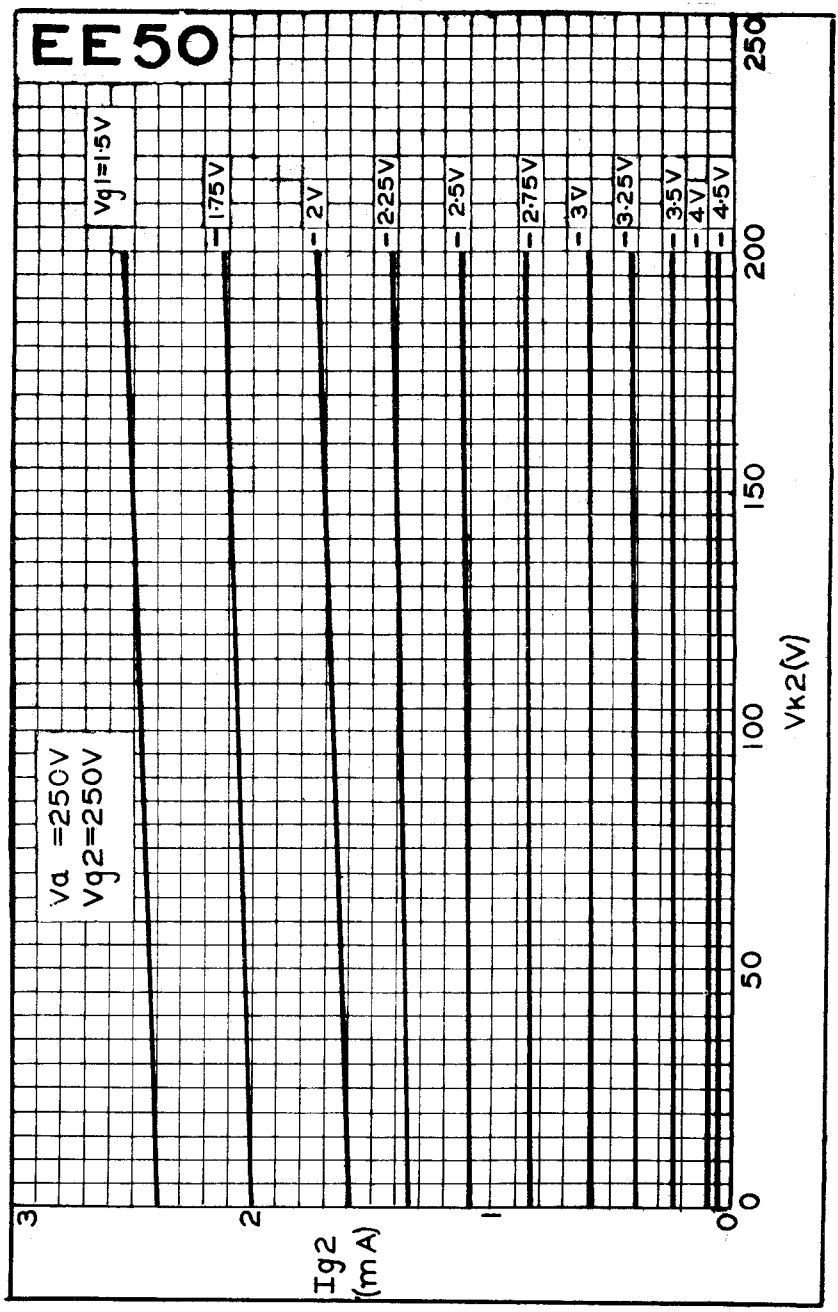


T1639/6

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

EE50

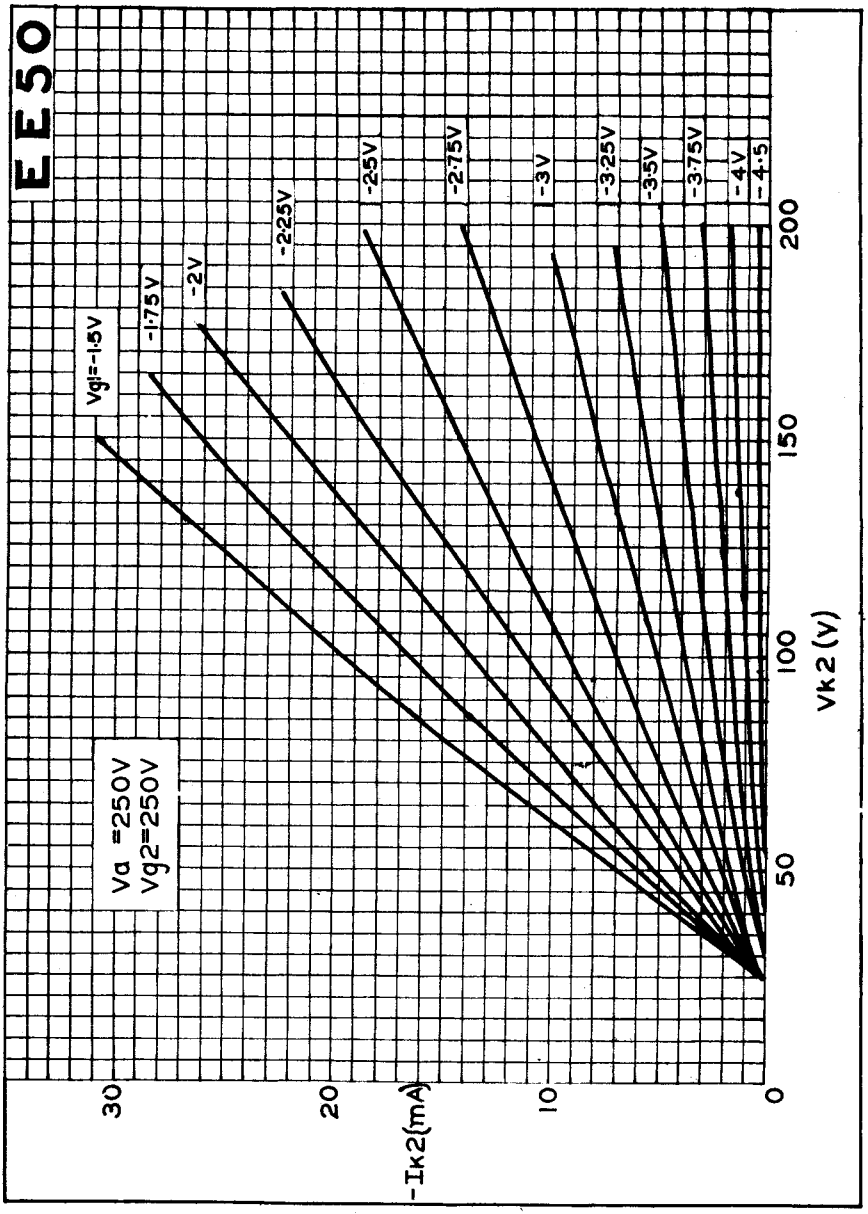


T1739/7

EE50

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

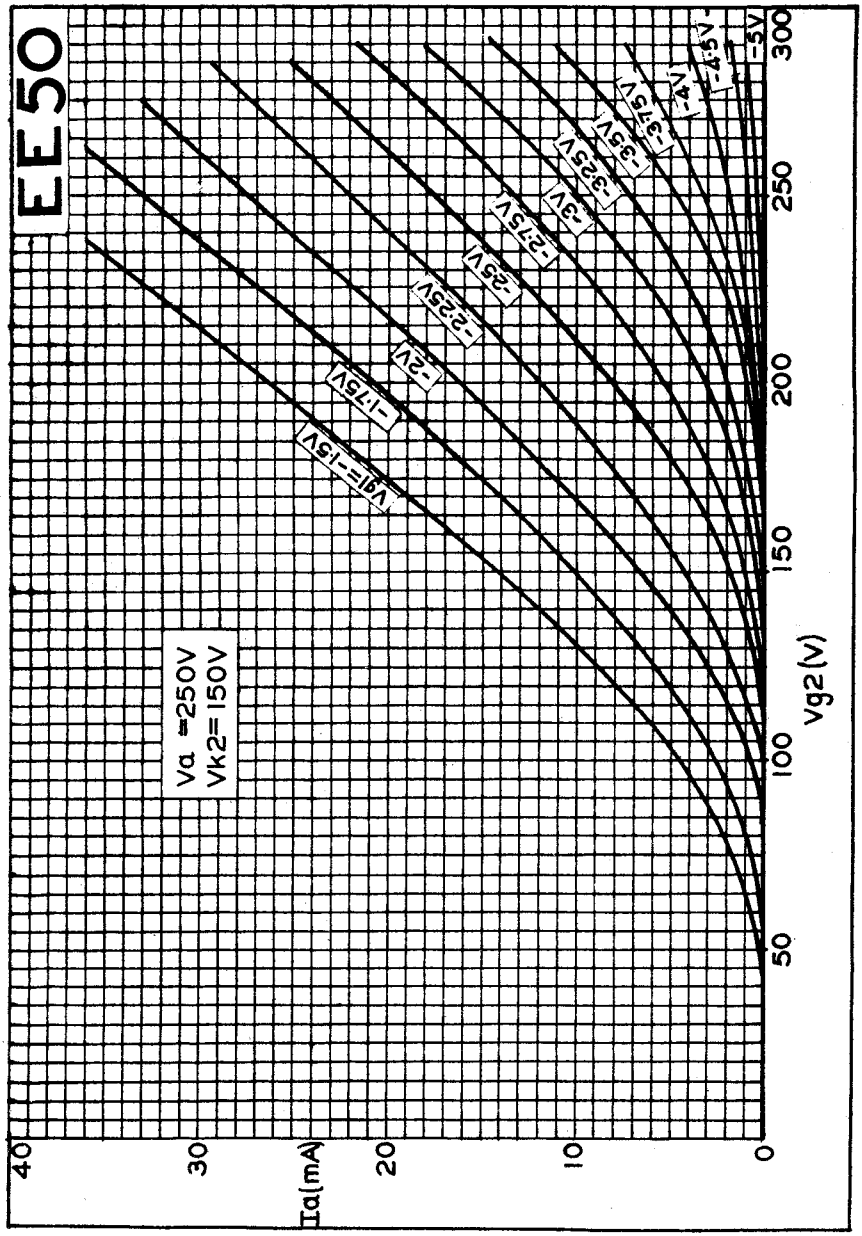


T1739/8

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

EE50

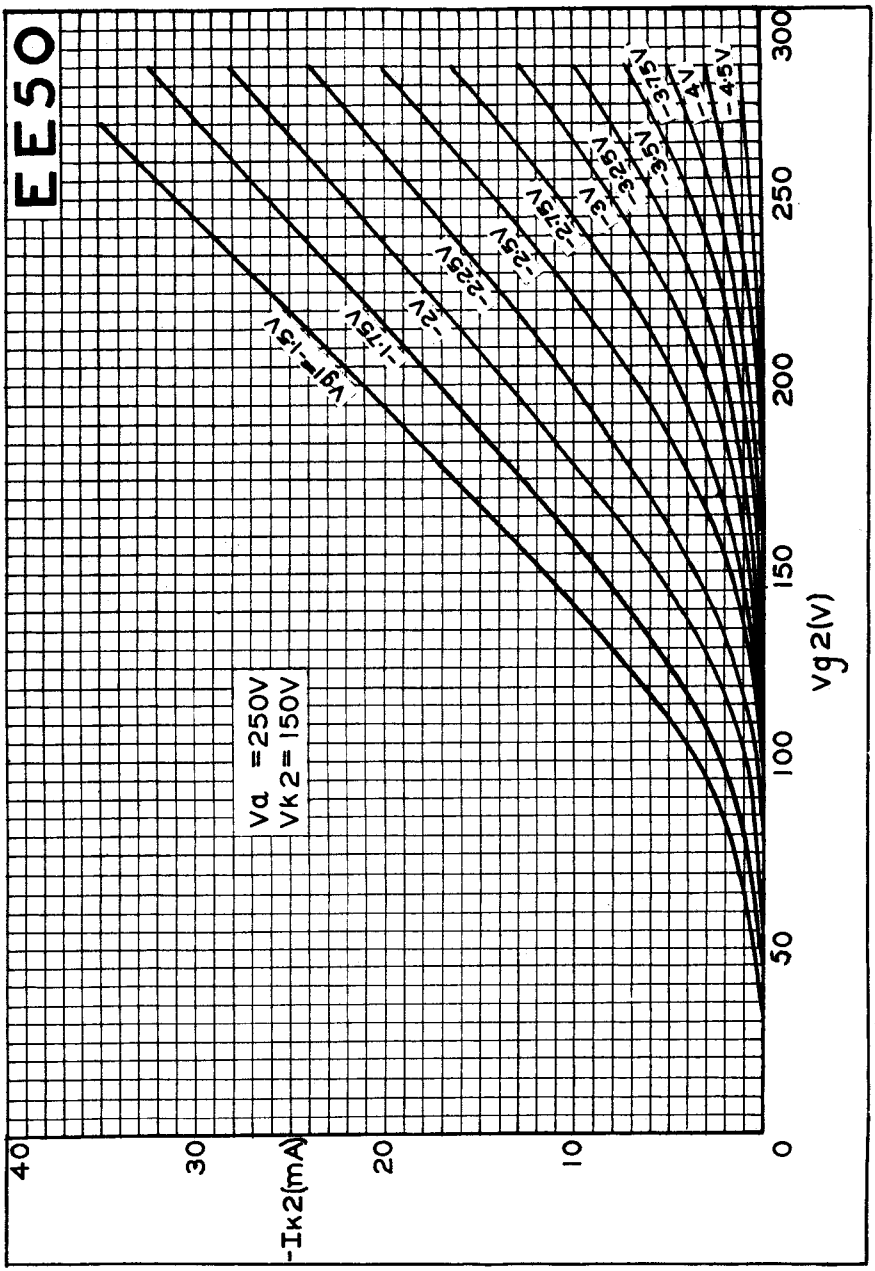


T1739/9

EE50

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

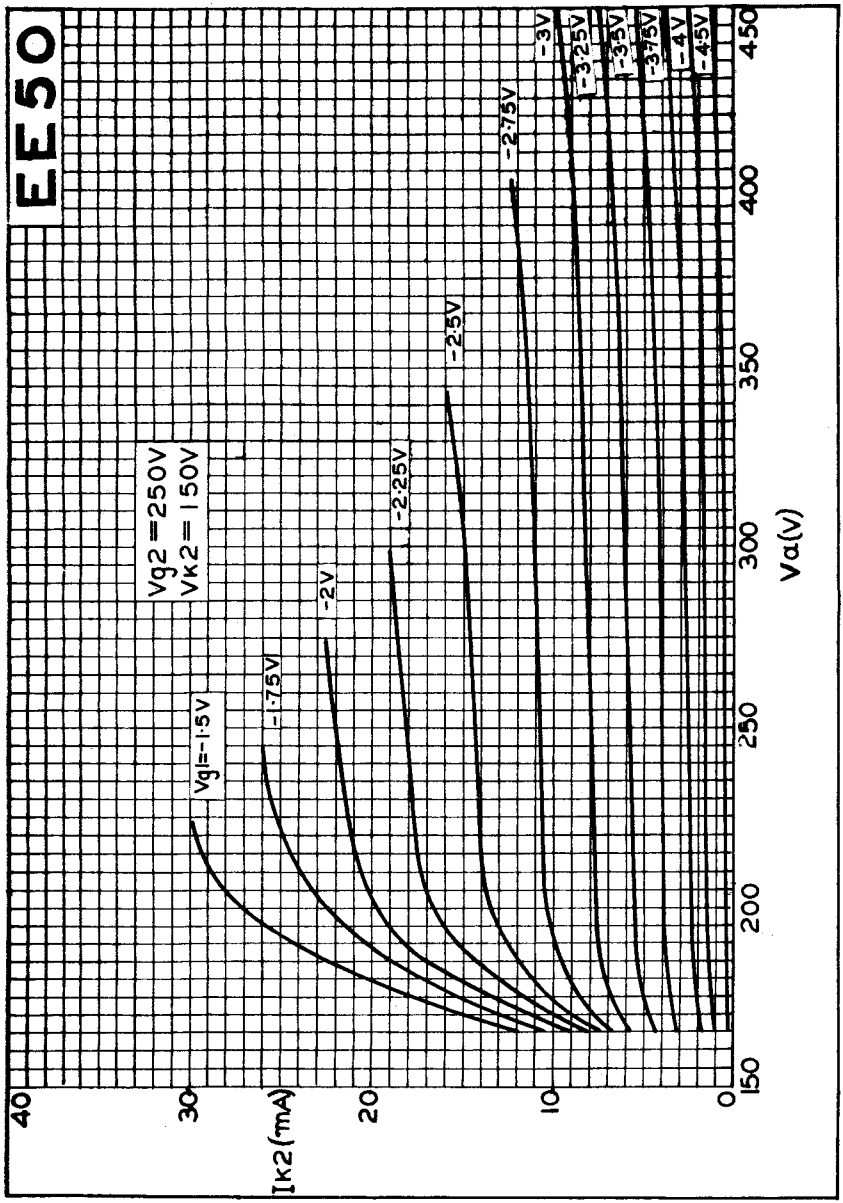


T1739/10

Mullard

SINGLE ENDED TELEVISION SECONDARY EMISSION VALVE

EE50



T1739/11

A.F. VOLTAGE AMPLIFYING PENTODE

EF36

EF37A

High gain pentode for use in a.f. amplifiers.

The EF37A has an anti-microphonic construction and its heater is designed to reduce hum. Except for these differences, the valve is identical to the EF36.

HEATER

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

V_h	6.3	V
I_h	200	mA

In order to reduce the hum to a minimum the centre tap of the transformer winding which feeds the heaters should be connected to the chassis. The impedance between cathode and chassis should be as small as possible ($<40\Omega$).

CAPACITANCES

c_{a-g1}	<0.02	pF
c_{in}	5.5	pF
c_{out}	8.5	pF

CHARACTERISTICS

V_a	250	V
V_{g2}	100	V
V_{g3}	0	V
I_a	3.0	mA
V_{g1}	−2.0	V
I_{g2}	800	μA
g_m	1.8	mA/V
r_a	2.5	MΩ
μ_{g1-g2}	28	

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER, CONNECTED AS A PENTODE

V_b (V)	R_a (kΩ)	I_k (mA)	R_{g2} (kΩ)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	R_{g1}** (kΩ)
400	100	3.4	330	1.2	115	80	330
350	100	2.9	330	1.2	112	69	330
300	100	2.5	330	1.2	108	59	330
250	100	2.1	330	1.2	103	49	330
200	100	1.7	330	1.2	98	39	330
400	220	1.8	680	2.2	180	81	680
350	220	1.6	680	2.2	176	69	680
300	220	1.3	680	2.2	170	58	680
250	220	1.1	680	2.2	163	48	680
200	220	0.9	680	2.2	152	37	680

* $D_{tot}=5\%$.

** R_{g1} is the grid resistance of the following valve.

EF36

EF37A

A.F. VOLTAGE AMPLIFYING PENTODE

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER, CONNECTED AS A TRIODE

With g_2 connected to a, g_3 connected to k.

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	D_{tot}* (%)	R_{g1}** (kΩ)
400	47	4.6	1.2	18.4	67	4.5	150
350	47	4.0	1.2	18.2	57	4.4	150
300	47	3.4	1.2	18.0	48	4.3	150
250	47	2.8	1.2	17.7	38	4.2	150
200	47	2.3	1.2	17.5	29	4.0	150
400	100	2.4	2.2	20.1	66	3.9	330
350	100	2.1	2.2	20.0	57	3.9	330
300	100	1.8	2.2	19.9	48	3.8	330
250	100	1.5	2.2	19.7	38	3.7	330
200	100	1.2	2.2	19.5	28	3.5	330
400	220	1.2	3.9	20.6	61	3.4	680
350	220	1.0	3.9	20.4	52	3.3	680
300	220	0.9	3.9	20.3	44	3.3	680
250	220	0.8	3.9	20.2	35	3.2	680
200	220	0.6	3.9	20.0	26	3.0	680

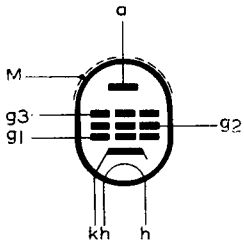
* Output voltage and distortion at the start of positive grid current. At lower output voltages the distortion is approximately proportional to the voltage.

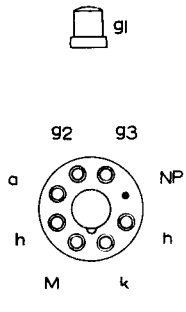
** R_{g1} is the grid resistance of the following valve.

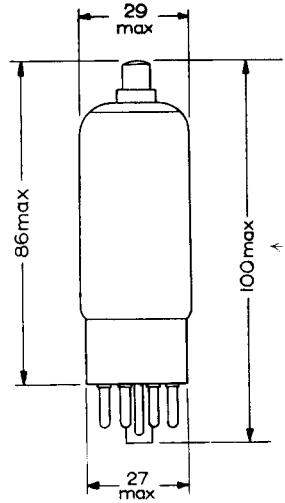
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	200	V
p_{g2} max.	300	mW
I_k max.	6.0	mA
V_{g1} max. (I_{g1} = +0.3 μA)	−0.6	V
I_{g2} max.	1.4	mA
R_{g1-k} max. (self bias)	3.0	MΩ
R_{g1-k} max. (fixed bias)	1.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

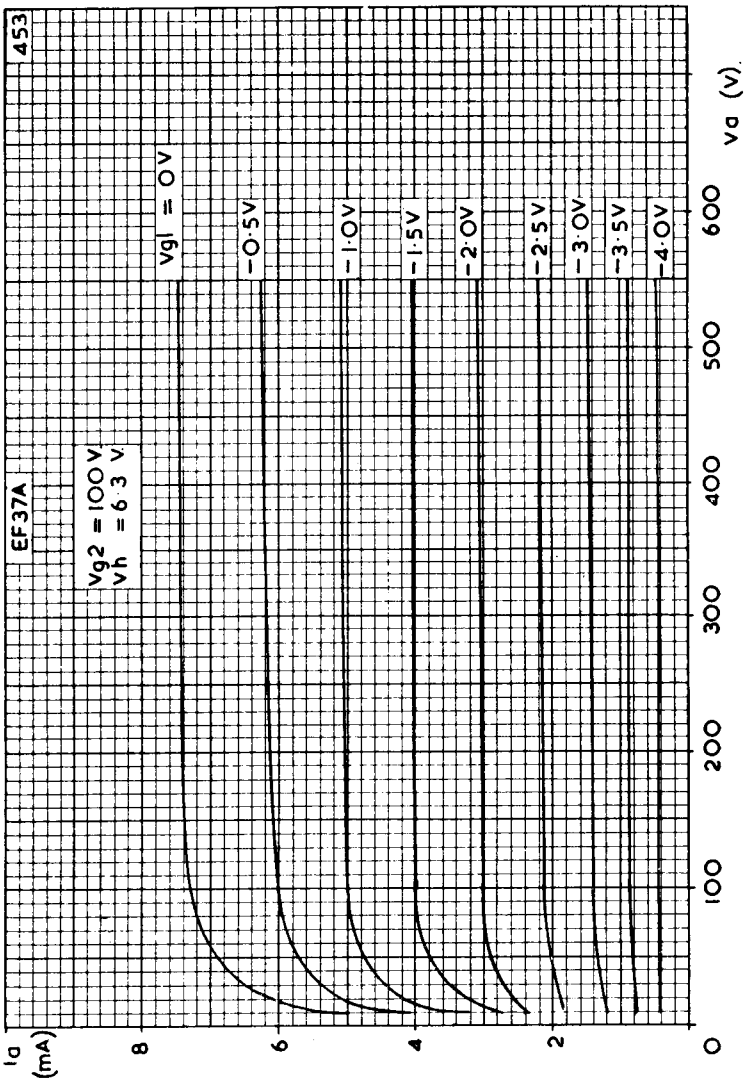
6709







All dimensions in mm



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE.
$V_{g2} = 100V$.

LOW MICROPHONY R.F. OR A.F. PENTODE

EF37

High gain pentode with special anti-microphonic construction, for use in pre-amplifier stages.

HEATER

This valve is suitable for DC/AC operation.

V_h	6.3	V
I_h	0.2	A

CAPACITANCES

c_{a-g}	< 0.02	μμF
c_{in}	5.5	μμF
c_{out}	8.5	μμF

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

V_a	100	200	250	V
V_{g2}	100	100	100	V
I_a	3	3	3	mA
V_{g1}	-2	-2	-2	V
I_{g2}	0.8	0.8	0.8	mA
μ	1,800	3,600	4,500	
g_m	1.8	1.8	1.8	mA/V
r_a	1.0	2.0	2.5	megohms

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
w_a max.	1	W
I_k max.	6	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max.	125	V
w_{g2} max.	0.3	W
V_{g1} max. (I_{g1}=0.3μA)	-0.6	V
I_{g2} max.	1.4	mA
I_{g2} min.	0.8	mA
R_{g1} max (self bias)	3	megohms
R_{g1} max (fixed bias)	1	megohm
V_{h-k} max.	100	V
R_{h-k} max.	20,000	ohms

OPERATING CONDITIONS CONNECTED AS TRIODE

g2 connected to a; g3 connected to k

V_a	150	V
V_{g1}	-3	V
I_a	6	mA
μ	28	
g_m	2.8	mA/V
r_a	10,000	ohms

EF37

LOW MICROPHONY R.F. OR A.F. PENTODE

High gain pentode with special anti-microphonic construction, for use in pre-amplifier stages.

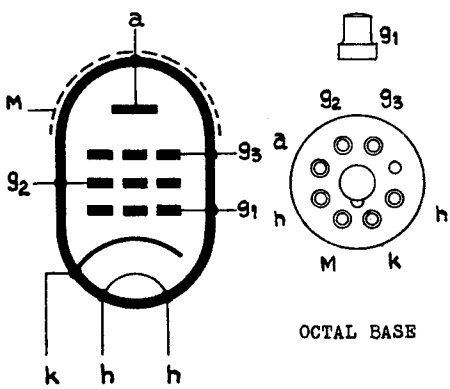
OPERATING CONDITIONS AS RESISTANCE-COUPLED A.F. AMPLIFIER CONNECTED AS PENTODE

V_b V	R_a MΩ	I_a mA *	R_{g2} mΩ	I_{g2} mA *	R_k Ω	V_{out} (Vrms)	$\frac{V_{out}}{V_{in}}$	D_{tot} (%)
300	0.3	0.7	0.8	0.25	4000	11.2	175	1.4
250	0.3	0.6	0.8	0.2	4000	8.5	165	1.6
200	0.3	0.45	0.6	0.17	6400	5.0	130	1.8
100	0.3	0.22	0.6	0.08	6400	2.4	105	<1.0
300	0.2	1.1	0.4	0.4	3000	11.2	150	<1.0
250	0.2	0.9	0.4	0.35	3000	8.5	140	1.3
200	0.2	0.6	0.4	0.23	5000	5.0	115	1.0
100	0.2	0.3	0.4	0.12	5000	2.4	100	0.9
300	0.1	1.9	0.25	0.65	1600	11.2	115	1.0
250	0.1	1.6	0.25	0.5	1600	8.5	110	1.0
200	0.1	1.2	0.2	0.4	3000	5.0	95	<1.0
100	0.1	0.6	0.2	0.2	3000	2.4	85	<1.0

* Ia and Ig2 measured at zero signal.

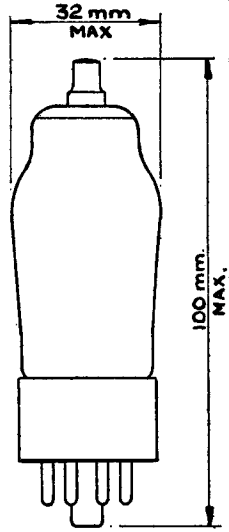
NOTE: Resistance of grid leak of following valve = 0.7 MΩ

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



OCTAL BASE

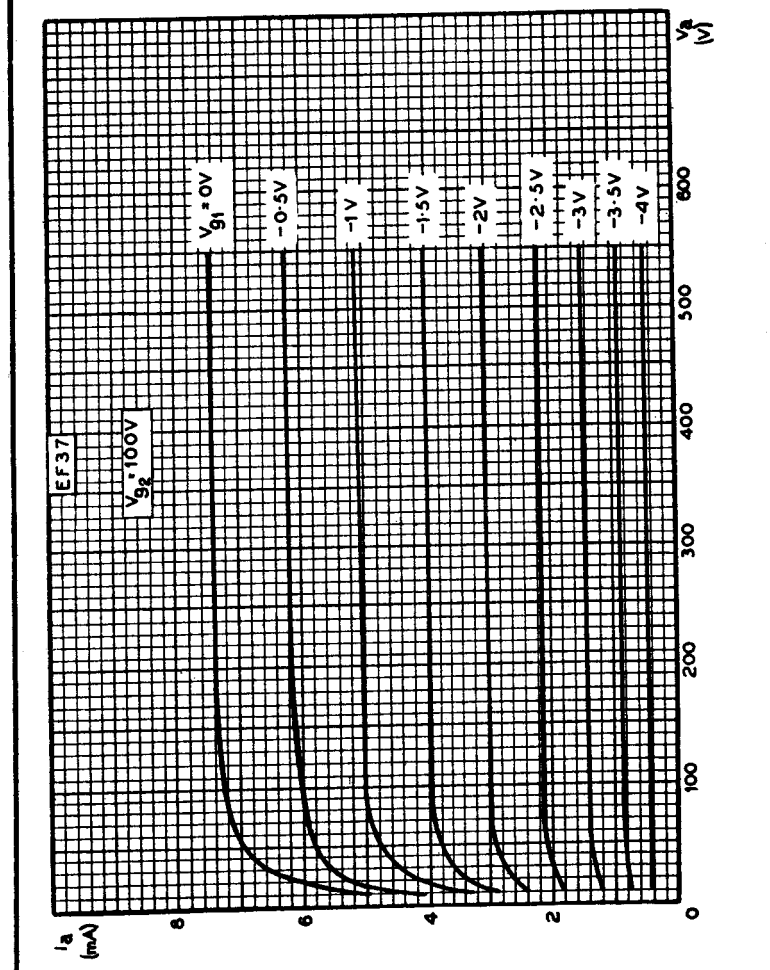
DIMENSIONS



LOW MICROPHONY
R.F. OR A.F. PENTODE

EF37

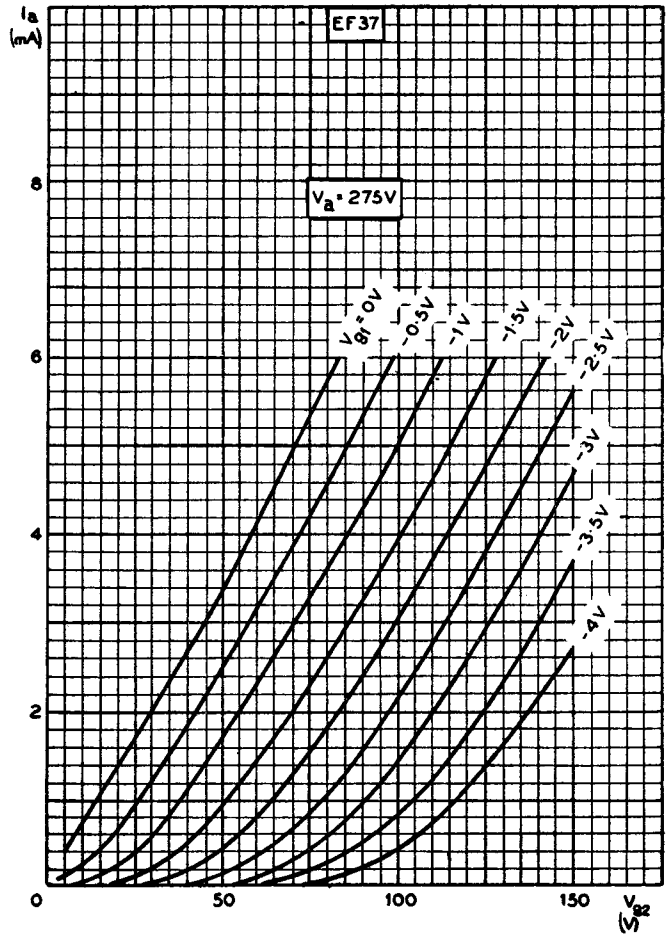
High gain pentode with special anti-microphonic construction, for use in pre-amplifier stages.



EF37

LOW MICROPHONY R.F. OR A.F. PENTODE

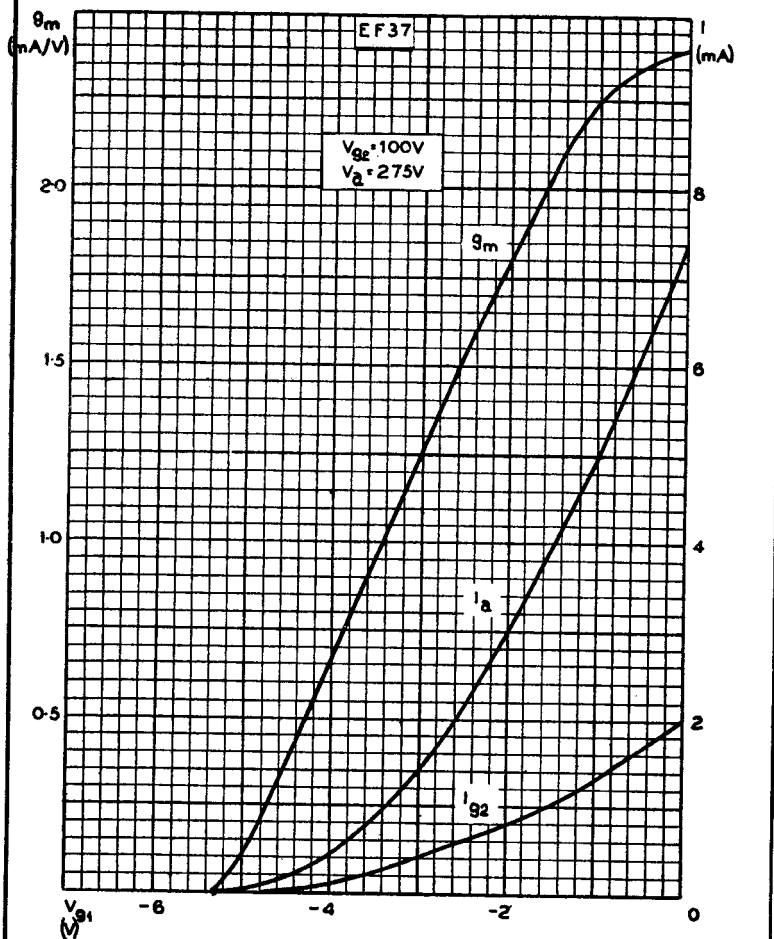
High gain pentode with special anti-microphonic construction, for use in pre-amplifier stages.



LOW MICROPHONY
R.F. OR A.F. PENTODE

EF37

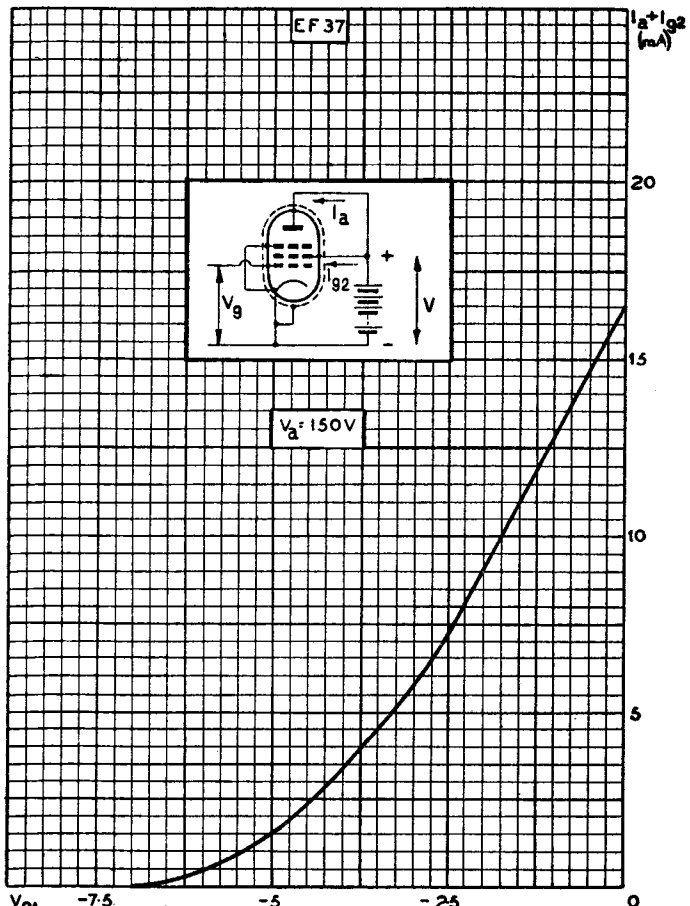
High gain pentode with special anti-microphonic construction, for use in pre-amplifier stages.



EF37

LOW MICROPHONY R.F. OR A.F. PENTODE

High gain pentode with special anti-microphonic construction, for use in pre-amplifier stages.

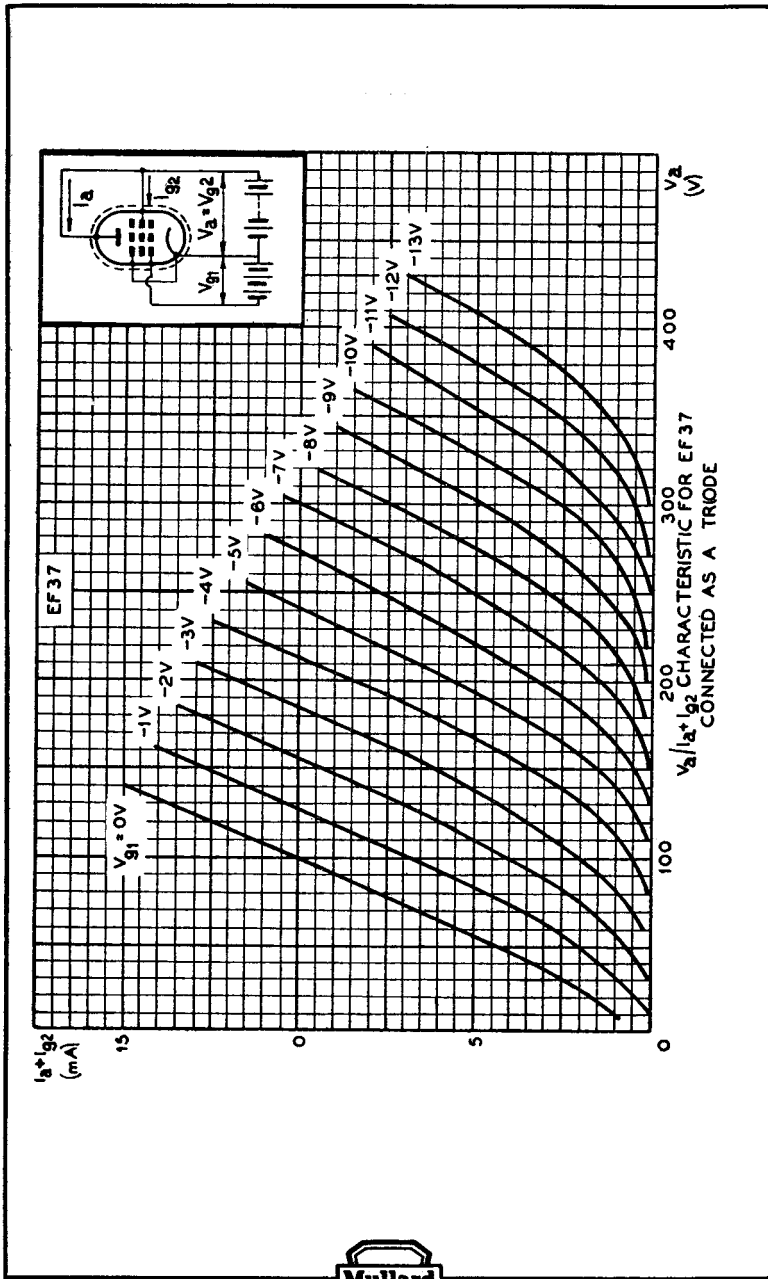


V_{g1}/I_a+I_{g2} CHARACTERISTIC FOR EF37 CONNECTED AS A TRIODE

LOW MICROPHONY
R.F. OR A.F. PENTODE

EF37

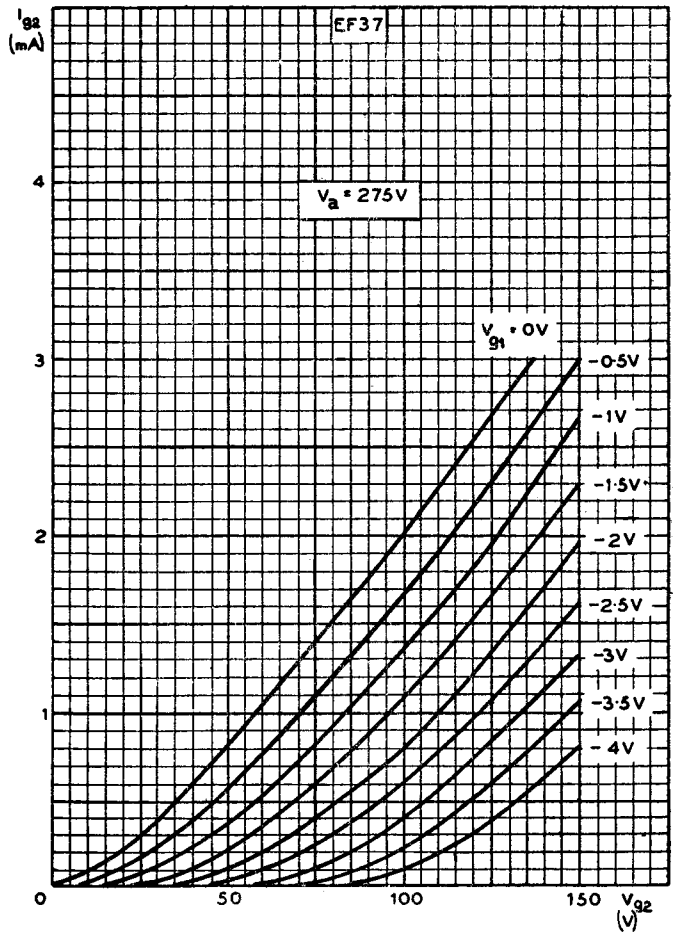
High gain pentode with special anti-microphonic construction, for use in pre-amplifier stages.



EF37

LOW MICROPHONY R.F. OR A.F. PENTODE

High gain pentode with special anti-microphonic construction, for use in pre-amplifier stages.



VARIABLE-MU R.F. PENTODE

EF39

Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.

HEATER

This valve is suitable for DC/AC operation.

V_h	6.3	V
I_h	0.2	A

CAPACITANCES

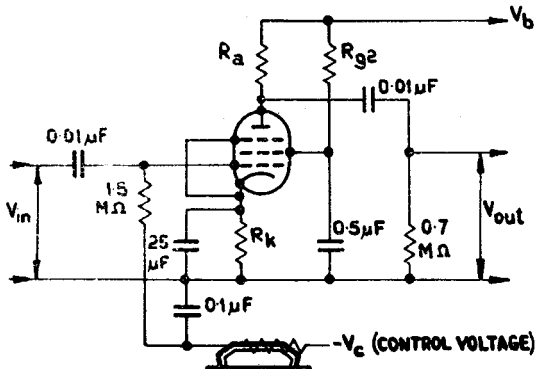
c_{a-g1}	<0.003	μμF
c_{in}	5.5	μμF
c_{out}	7.2	μμF

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

V_a	200	200	250	250	V
R_{g2}	60,000	60,000	90,000	90,000	Ω
V_{g2}	100	200	100	250	V
V_{g3}	0	0	0	0	V
V_{g1}	-2.5	-39	-2.5	-49	V
I_a	6.0	-	6.0	-	mA
I_{g2}	1.7	-	1.7	-	mA
g_m	2.2	0.0055	2.2	0.0045	mA/V
r_a	0.9	> 10	1.25	> 10	MΩ
R_k	325	325	325	325	Ω

OPERATING CONDITIONS AS CONTROLLED-GAIN R.C. COUPLED AMPLIFIER

V_b (V)	R_a (MΩ)	R_{g2} (MΩ)	I_a (mA)	I_{g2} (mA)	R_k (Ω)	V_c -(V)	V_{out} (Vrms)	$\frac{V_{out}}{V_{in}}$	D_{tot} (%)
250	0.2	0.8	0.87	0.26	1750	0	10	106	2.7
250	0.2	0.8	0.69	0.21	1750	5	10	40	2.7
250	0.2	0.8	0.55	0.17	1750	10	10	23	3.7
250	0.2	0.8	0.37	0.11	1750	18	10	11.6	4.8
250	0.2	0.8	0.17	0.05	1750	25	10	6.7	8.8
250	0.1	0.4	1.6	0.45	1000	0	10	85	2.5
250	0.1	0.4	1.22	0.36	1000	5	10	36	2.7
250	0.1	0.4	0.92	0.28	1000	10	10	20	4.1
250	0.1	0.4	0.57	0.18	1000	18	10	9.2	6.1
250	0.1	0.4	0.36	0.11	1000	25	10	5.5	9.5



EF39

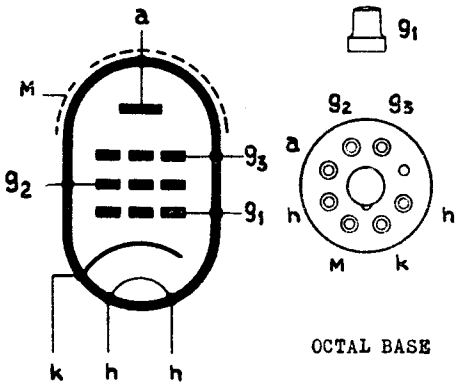
VARIABLE-MU R.F. PENTODE

Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.

LIMITING VALUES

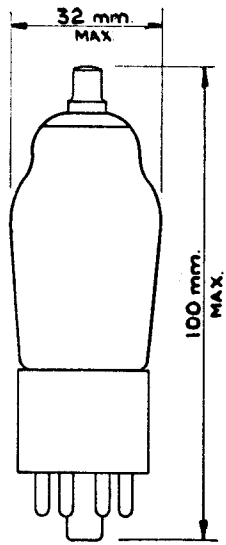
$V_{a(b)}$ max.	550	V
V_a max.	300	V
w_a max.	2	W
I_k max.	10	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max. (I_a=6mA)	125	V
V_{g2} max. (I_a=3mA)	300	V
w_{g2} max.	0.3	W
I_{g2} max. (I_a=6mA; V_{g2}=100)	2.0	mA
I_{g2} min. (I_a=6mA; V_{g2}=100)	1.2	mA
V_{g1} max. (I_g=+0.3μA)	-1.3	V
R_{g1} max.	3	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20,000	Ω

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



OCTAL BASE

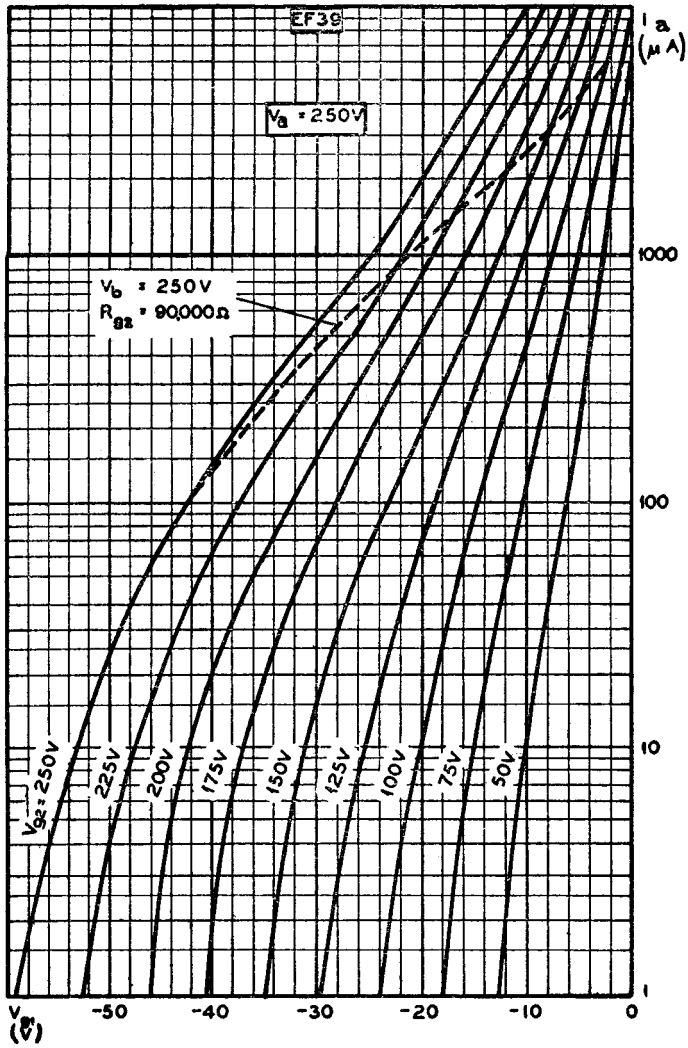
DIMENSIONS



VARIABLE-MU R.F. PENTODE

EF39

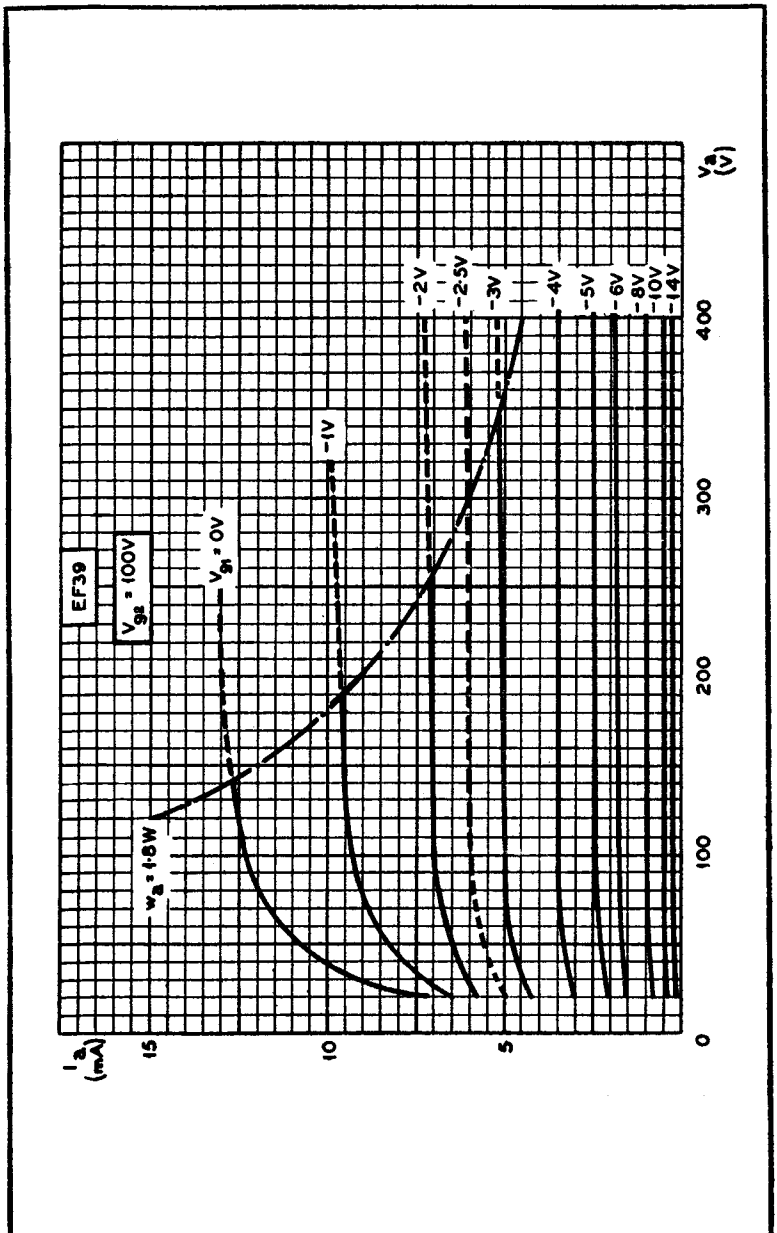
Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.



EF39

VARIABLE-MU R.F. PENTODE

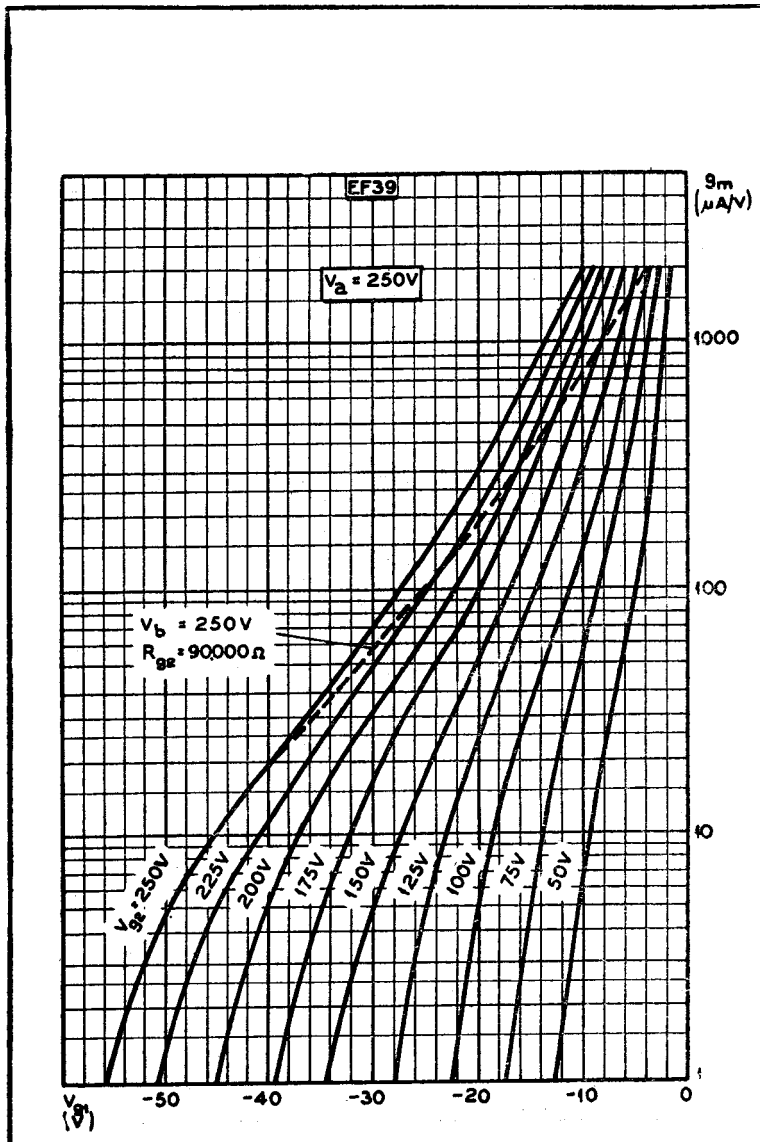
Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.



VARIABLE-MU R.F. PENTODE

EF39

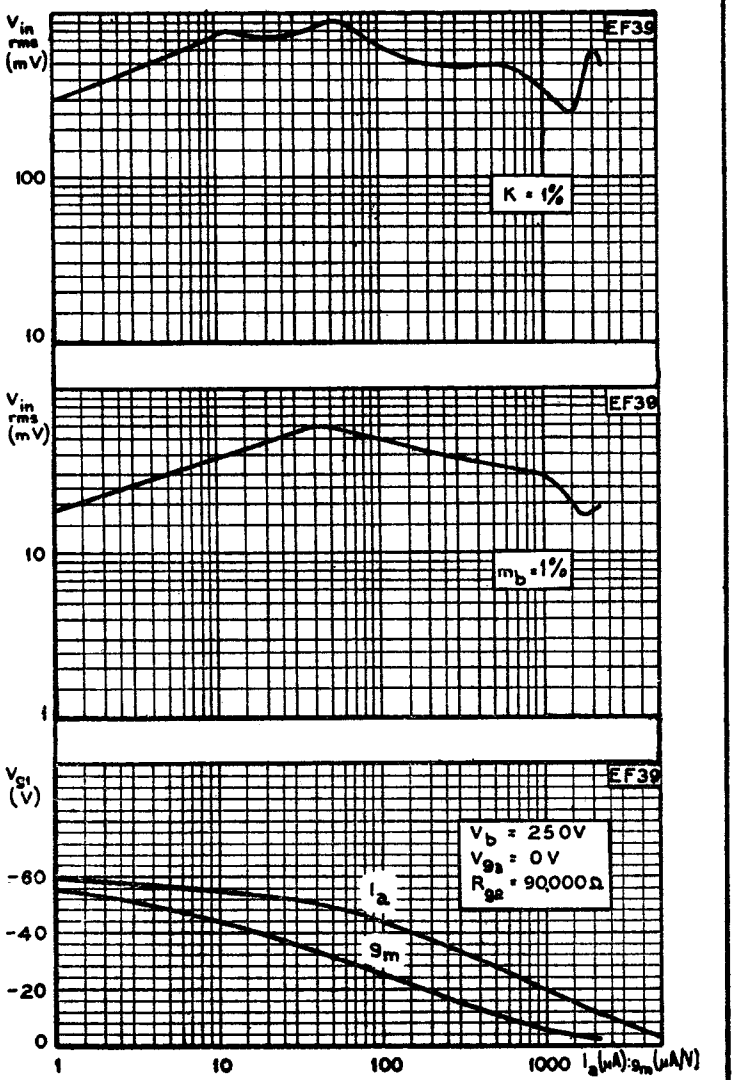
Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.



EF39

VARIABLE-MU R.F. PENTODE

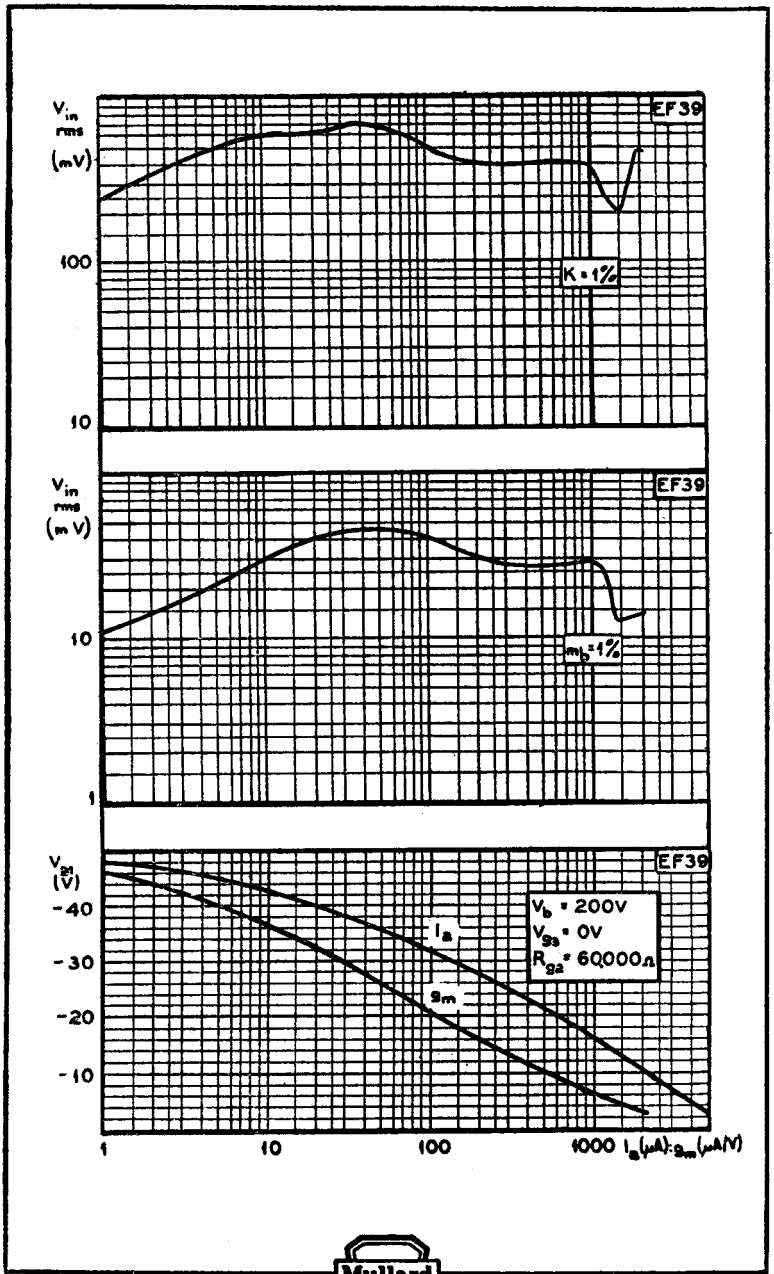
Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.



VARIABLE-MU R.F. PENTODE

EF39

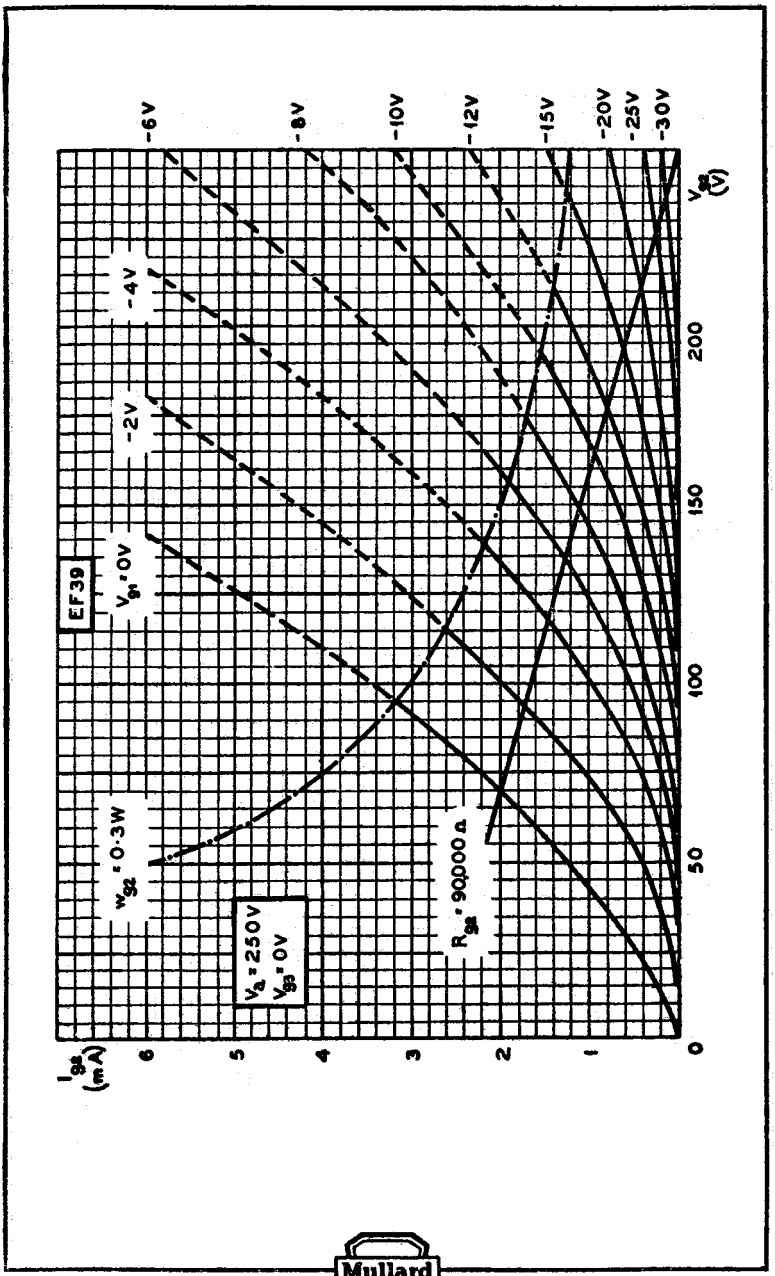
Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.



EF39

VARIABLE-MU R.F. PENTODE

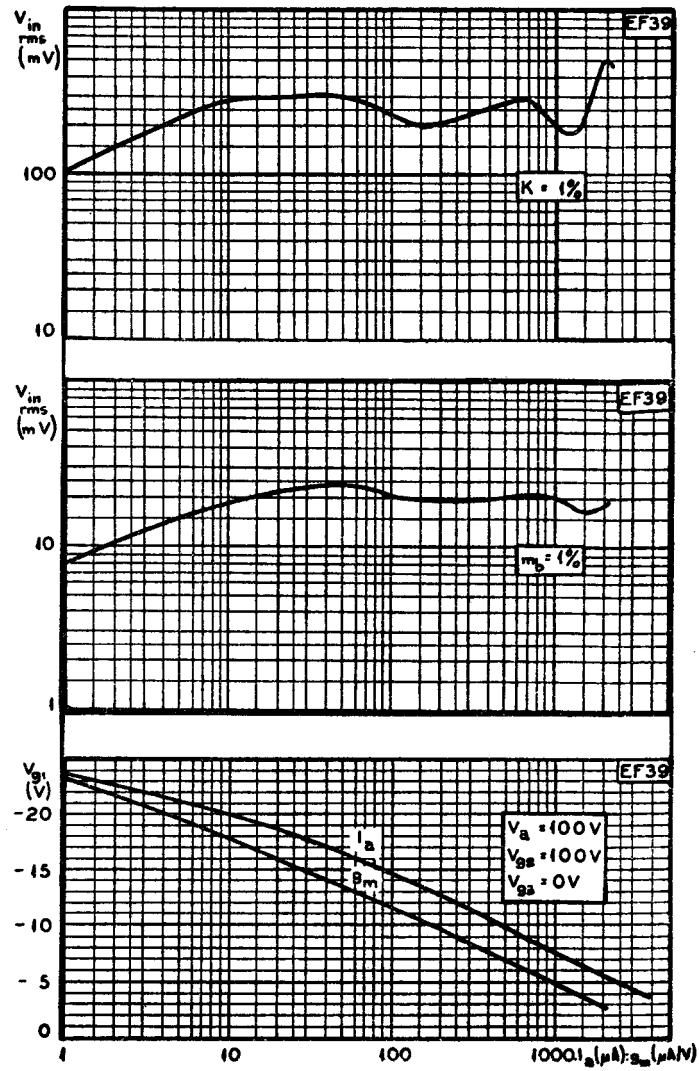
Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.



VARIABLE-MU R.F. PENTODE

EF39

Variable-mu R.F. pentode with sliding screen characteristics, for use as controlled R.F. or I.F. amplifier.



R.F. PENTODE

EF50

Single-ended r.f. pentode, fully controlled by voltages of 0 to —6V or 0 to —55V according to the circuit used.

HEATER

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

V_h	6.3	V
I_h	300	mA

CAPACITANCES

	Min.	Av.	Max.	
$C_{a\ g1}$	—	—	0.007	pF
C_{g1-g2}	—	2.4	—	pF
C_{in}	7.1	8.3	9.5	pF
C_{out}	4.8	5.2	5.6	pF

OPERATING CONDITIONS

V_a	250	250	250	250	V
V_{g2}	250	250	250	250	V
V_{g1} c	−2	−1.55*	**	††	V
V_{g3}	0*	0	−30*	−20*	V
I_a	10	10	10	10	mA
I_{g2}	3.0	3.0	5.5	4.0	mA
g_m	6.5	6.5	5.2	6.0	mA/V
r_a	1.0	1.0	0.1	0.2	MΩ
$\mu_{g1\ g2}$	75	—	—	—	
R_{eq}	1.4	—	—	—	kΩ
Input damping (f = 50Mc/s)	4.0	—	—	—	kΩ
Output damping (f = 50Mc/s)	50	—	—	—	kΩ
R_k	0	32	0	32	Ω
C_k	0	50	0	50	pF
V_{g1} (for 10 : 1 reduction in g_m)	—	−4.5	**	††	V
V_{g3} (for 10 : 1 reduction in g_m)	−53	—	−55.5	−51.5	V

* Valve not controlled by a.g.c.

** V_{g1} is obtained from V_{g3} by means of a potentiometer of 50kΩ and 3kΩ.

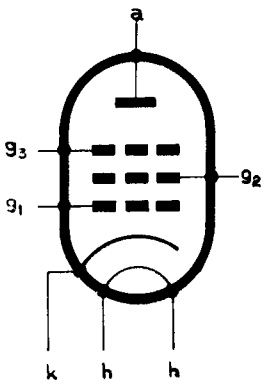
†† V_{g1} is obtained from V_{g3} by means of a potentiometer of 50kΩ and 4kΩ.

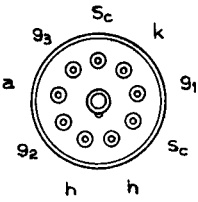
EF50

R.F. PENTODE

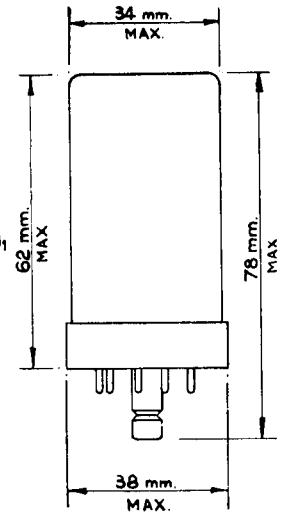
LIMITING VALUES

$V_{a\ (b)}$ max.	550	V
V_a max.	300	V
p_a max.	3	W
I_k max.	15	mA
$V_{g2\ (b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	1.7	W
V_{g1} max. (I_{g1} = +0.3μA)	−1.3	V
V_{g3} max. (I_{g3} = +0.3μA)	−1.3	V
R_{g1} max.	3	MΩ
R_{g3} max.	3	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ





B9G BASE



SHORT WAVE R.F. PENTODE

EF54

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.

HEATER

V_h	6.3	V
I_h	0.3	A

CAPACITANCES

c_{in}	6.2	μμF
c_{out}	4.9	μμF
c_{a-g_1}	0.02	μμF
c_{g1-g2}	2.2	μμF

OPERATING CONDITIONS

V_a	250	V
V_{g2}	250	V
V_{g1}	-1.7	V
R_k	150	Ω
I_a	10	mA
I_{g2}	1.45	mA
g_m	7.7	mA/V
r_a	0.5	MΩ
μ_{g1-g2}	80	
Equivalent Noise Resistance	700	Ω
Input Resistance (at 50 Mc/s)	10,000	Ω

LIMITING VALUES

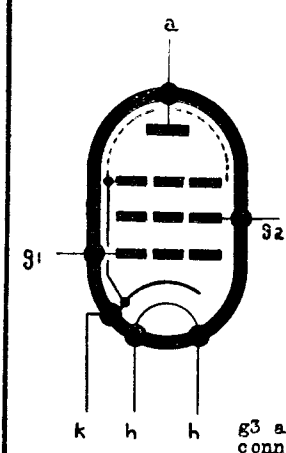
$V_{a(b)}$ max	550	V
V_a max	300	V
W_a max	3	W
$V_{g2(b)}$ max	550	V
V_{g2} max	300	V
W_{g2} max	1.7	W
I_k max	15	mA
V_{g1} max (I_{g1}=+0.3μA)	-1.3	V
R_{g1} max	3	MΩ
V_{h-k} max	100	V
R_{h-k} max	20,000	Ω
Max. Operating Frequency	250	Mc/s

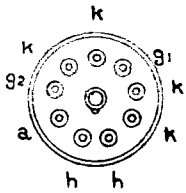
EF54

SHORT WAVE R.F. PENTODE

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS

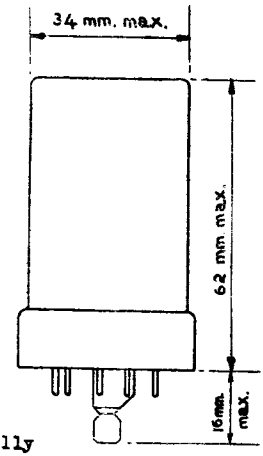




B9G BASE

g3 and screen internally connected to cathode

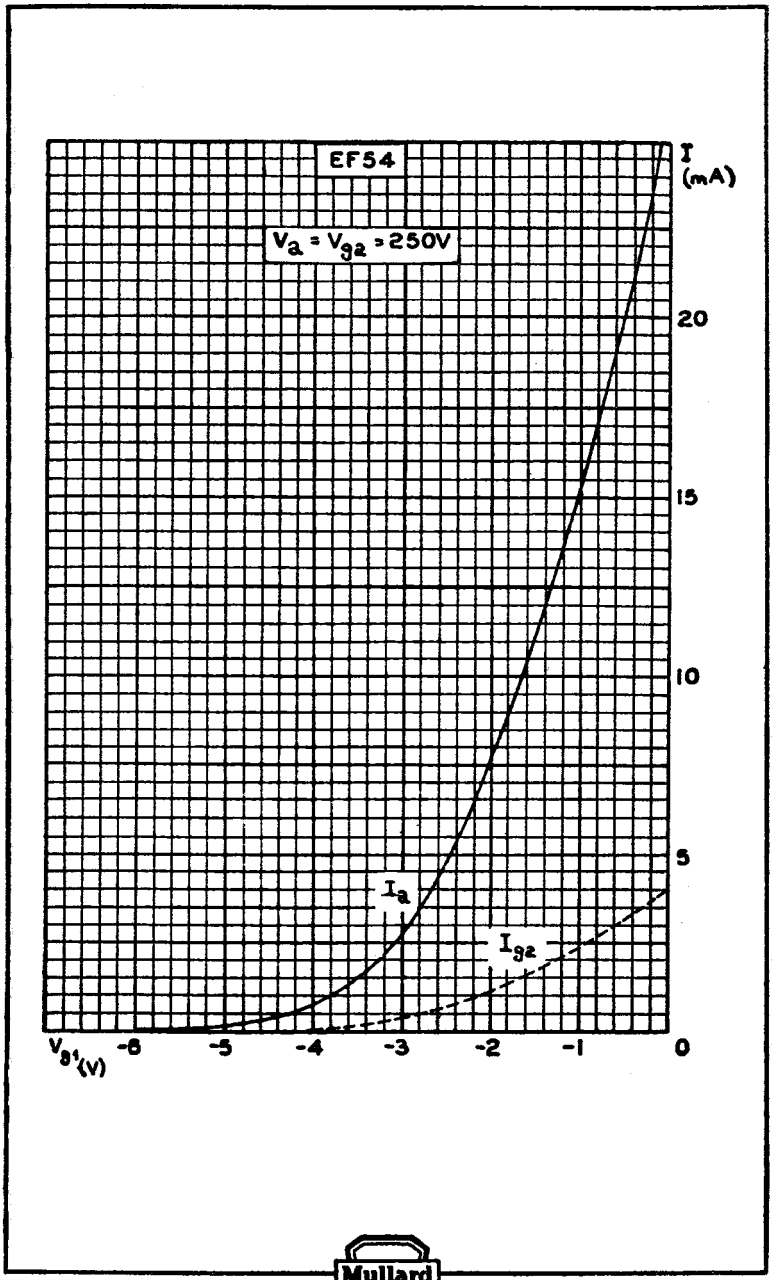
DIMENSIONS



SHORT WAVE R.F. PENTODE

EF54

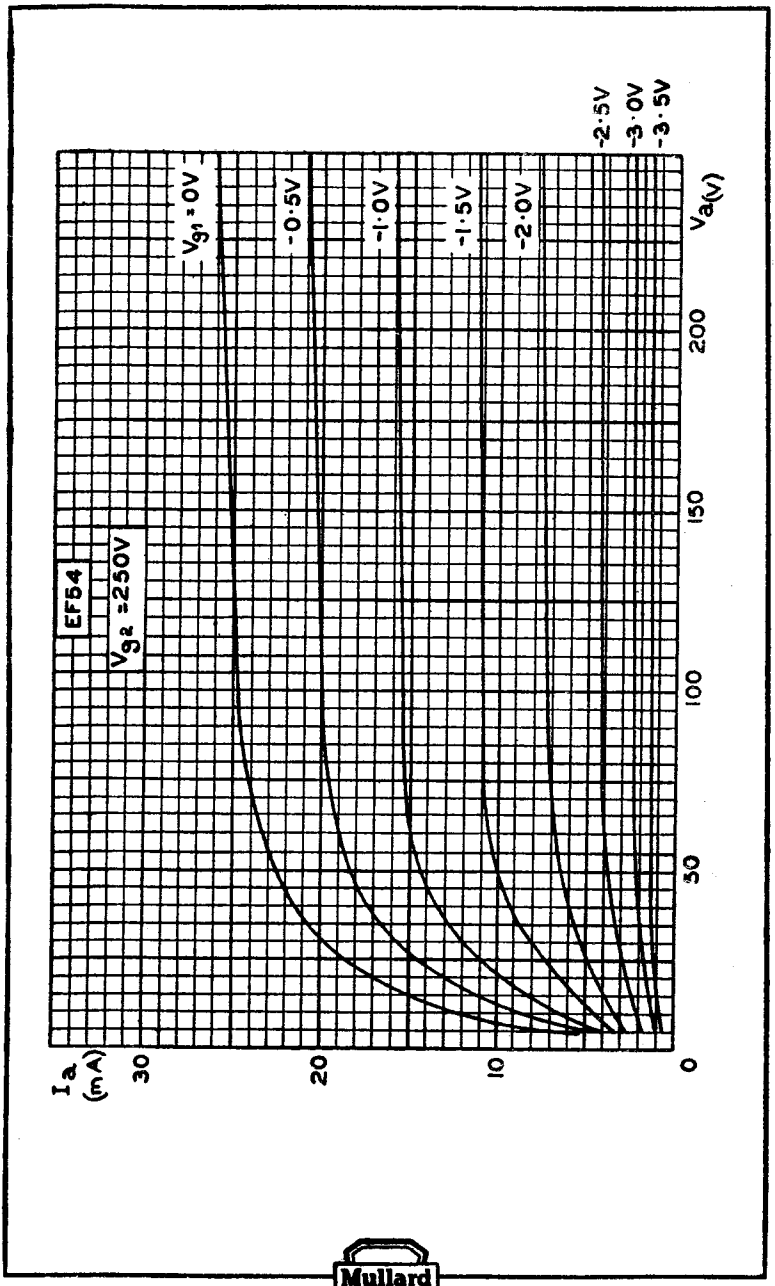
Single-ended R.F. pentode with high mutual conductance and sharp cut-off.



EF54

SHORT WAVE R.F. PENTODE

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.

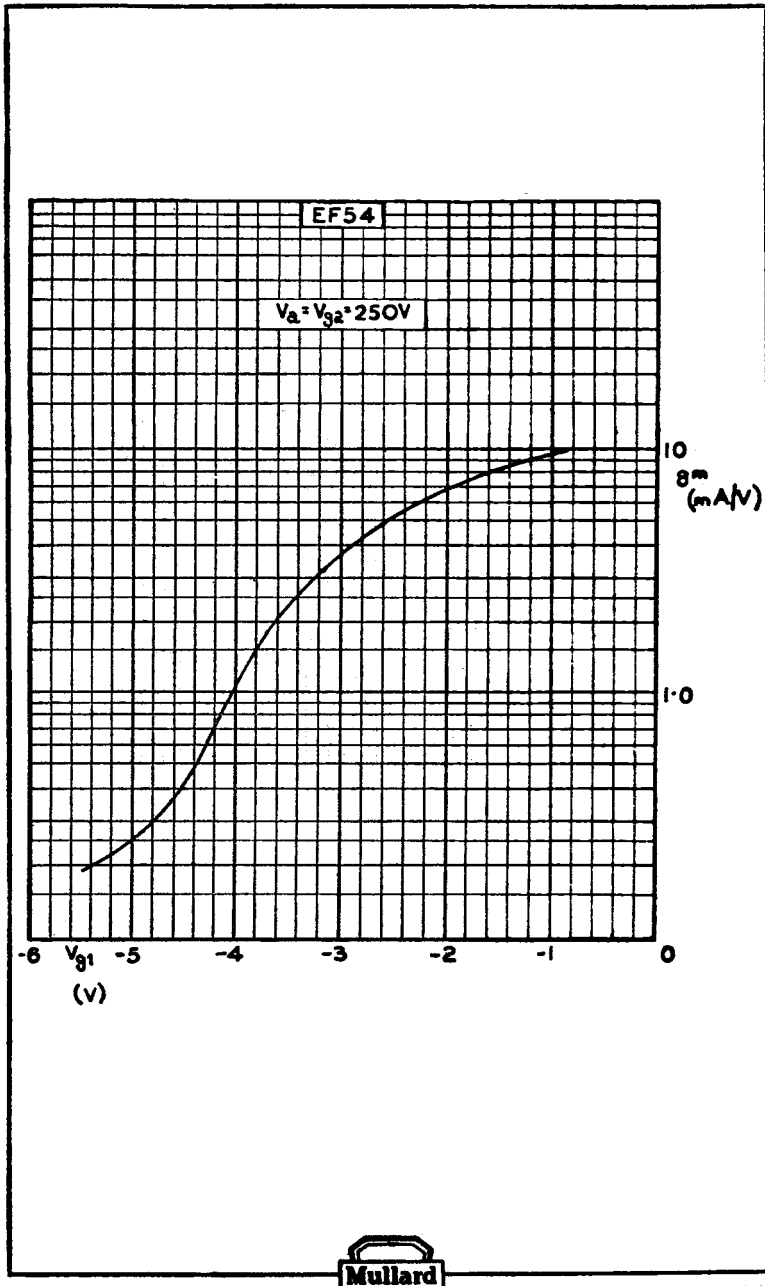


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SHORT WAVE R.F. PENTODE

EF54

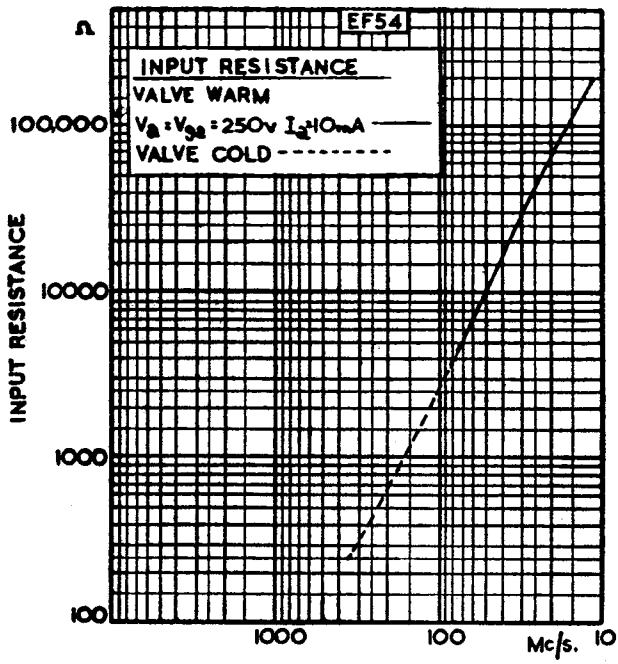
Single-ended R.F. pentode with high mutual conductance and sharp cut-off.



EF54

SHORT WAVE R.F. PENTODE

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.



VIDEO FREQUENCY PENTODE

EF55

Single-ended R.F. pentode with very high mutual conductance and sharp cut-off.

HEATER

V_h	6.3	V
I_h	1.0	A

CAPACITANCES

c_{out}	12	μμF
c_{in}	15	μμF
c_{a-g1}	0.15	μμF

OPERATING CONDITIONS

V_a	250	250	V
V_{g2}	250	150	V
V_{g1}	-4.5	-4.0	V
I_a	40	10	mA
I_{g2}	5.5	1.0	mA
R_k	100	360	ohms
g_m	12.0	7.0	mA/V
μ_{g2-g1}	28	27	
r_a	55,000	100,000	ohms

LIMITING VALUES

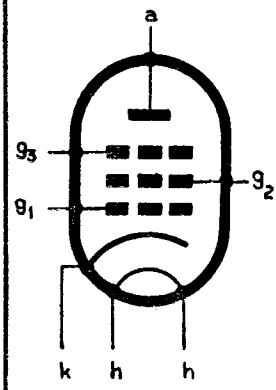
w_a max.	10	W
w_{g2} max.	2	W
$V_{a(b)}$ max.	500	V
V_a max.	300	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	250	V
V_{h-k} max.	150	V
R_{g1} max.	0.7	M.ohm
I_k peak (with 50 μ.sec., 500 c/s pulse)	1.5	A

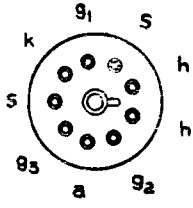
EF55

VIDEO FREQUENCY PENTODE

Single-ended R.F. pentode with very high mutual conductance and sharp cut-off.

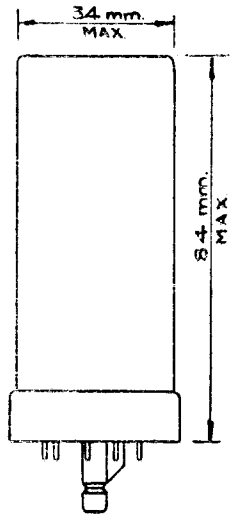
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS





B9G BASE

DIMENSIONS



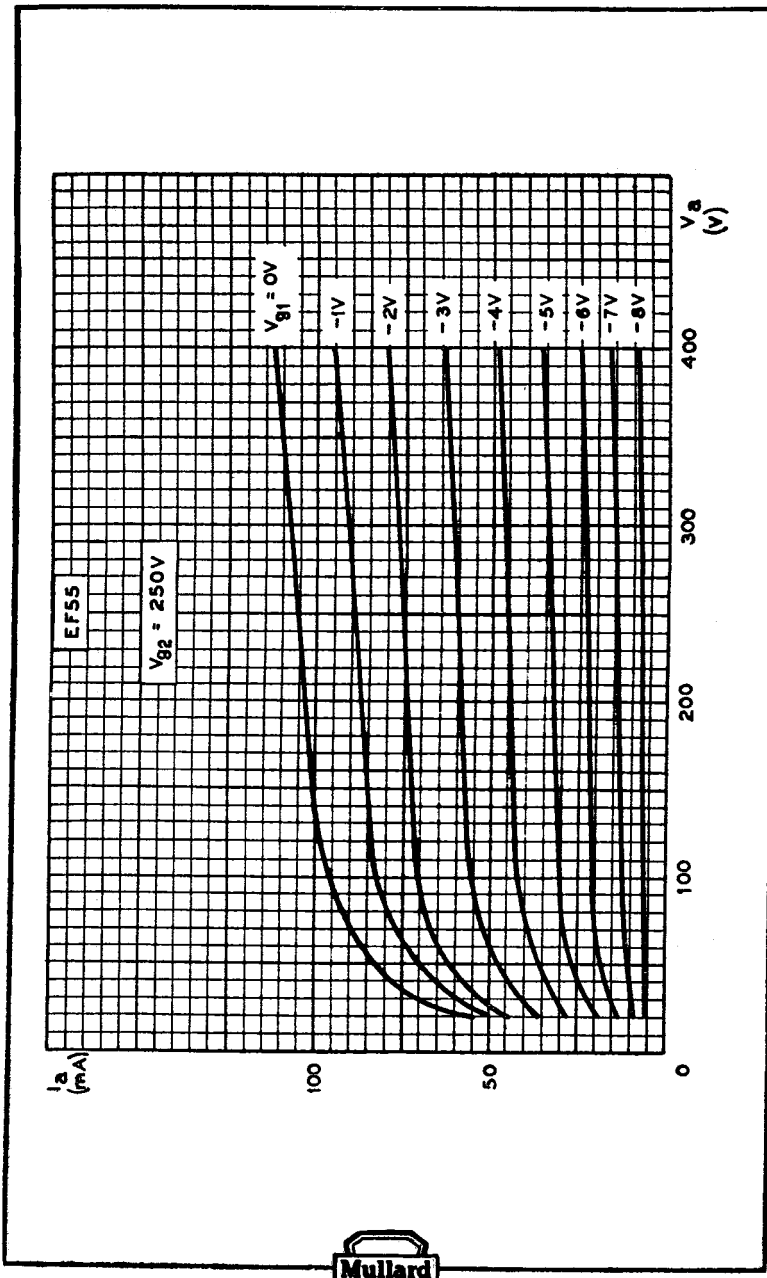
Note: If mounted horizontally, Pins 4 and 8 must be in a vertical plane.

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VIDEO FREQUENCY PENTODE

EF55

Single-ended R.F. pentode with very high mutual conductance and sharp cut-off

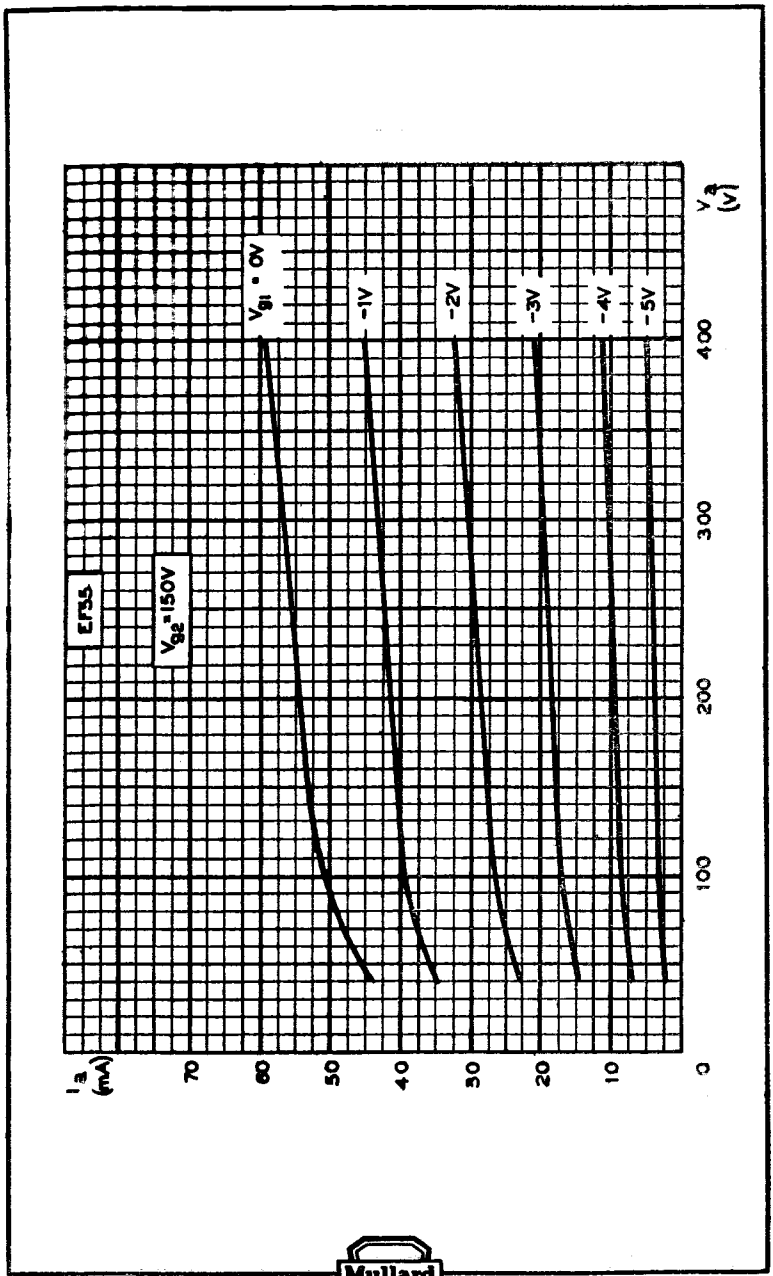


Mullard

EF55

VIDEO FREQUENCY PENTODE

Single-ended R.F. pentode with very high mutual conductance and sharp cut-off.

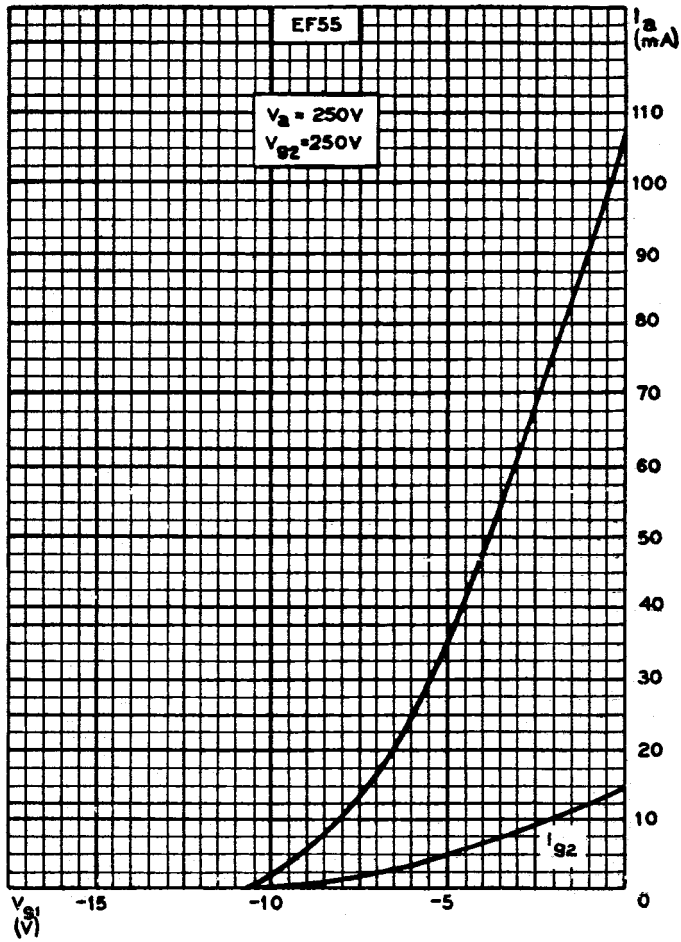


Mullard

VIDEO FREQUENCY PENTODE

EF55

Single-ended R.F. pentode with very high mutual conductance and sharp cut-off.

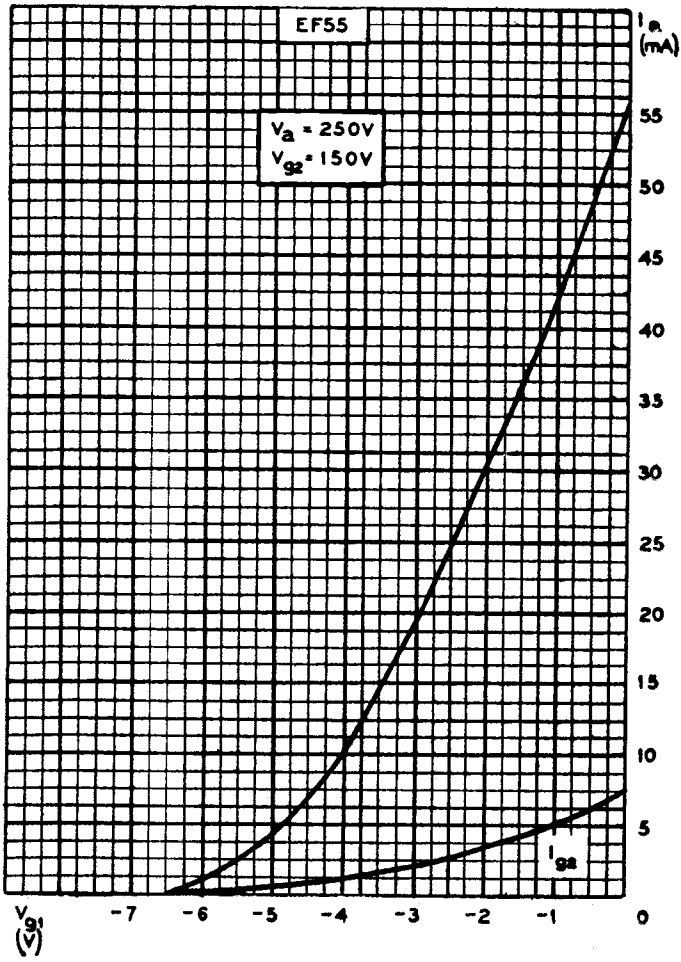


Mullard

EF55

VIDEO FREQUENCY PENTODE

Single-ended R.F. pentode with very high mutual conductance and sharp cut-off



Mullard

SUBMINIATURE R.F. PENTODE

EF70

Subminiature high slope r.f. pentode with a short suppressor grid base. A diode is connected internally to the suppressor grid to prevent this grid locking at a positive voltage.

MAINTENANCE TYPE

HEATER

V_h	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and, therefore, in the interests of satisfactory life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis and should result in a bulb temperature of 100°C.

CAPACITANCES (measured with external shield)

C_{a-g1}	<0.025	pF ←
C_{in}	4.5	pF
C_{out}	4.7	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g3}	0	V
I_a	3.0	mA
I_{g2}	2.25	mA ←
V_{g1}	−2.0	V
g_m	2.5	mA/V
r_a	100	kΩ
μ_{g1-g2}	38	
$V_{g3}(I_a=100\mu A)$	−8.0	V ←

EF70

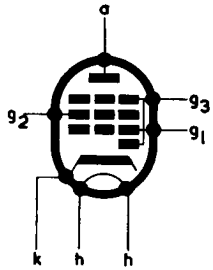
SUBMINIATURE R.F. PENTODE

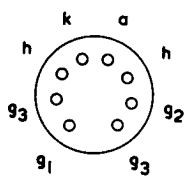
Subminiature high slope r.f. pentode with a short suppressor grid base. A diode is connected internally to the suppressor grid to prevent this grid locking at a positive voltage.

LIMITING VALUES

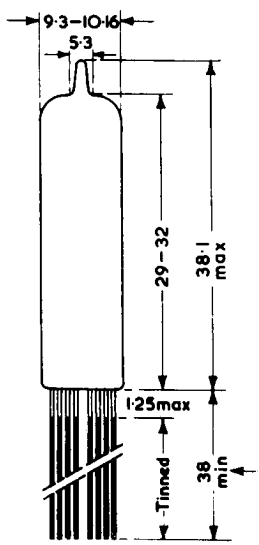
$V_{a(b)}$ max.	300	V
V_a max.	175	V
p_a max.	750	mW
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
p_{g2} max.	400	mW
I_k max.	10	mA
R_{g1-k} max.	500	kΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V

Note – A diode is connected internally to g_3 in order to prevent this grid locking at a positive voltage.





B8D/F Base



3270

All dimensions in mm

SUBMINIATURE VARIABLE-MU R.F. PENTODE

EF71

Variable-mu pentode suitable for use in controlled r.f. amplifiers.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES

	Shielded	Unshielded	
c_{in}	4.5	4.0	pF
c_{out}	3.4	1.9	pF
c_{a-g1}	<0.015	<0.035	pF

CHARACTERISTICS

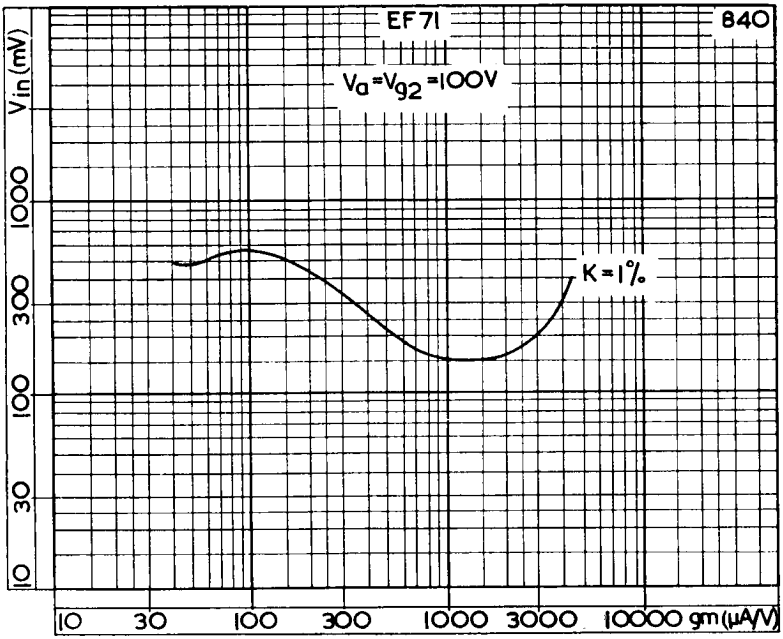
V_a	100	V
V_{g2}	100	V
R_k	120	Ω
I_a	7.2	mA
I_{g2}	2.2	mA
g_m	4.5	mA/V
r_a	260	kΩ
V_{g1} (g_m = 25μA/V)	−14	V

LIMITING VALUES

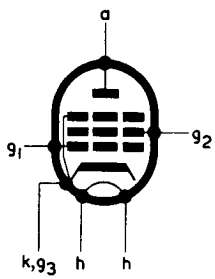
$V_{a(b)}$ max.	300	V
V_a max.	175	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
p_{g2} max.	500	mW
I_k max.	10	mA
R_{g1-k} max.	500	kΩ
$V_{h\,k}$ max.	100	V

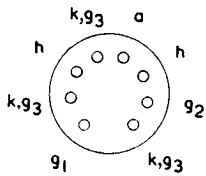
EF71

SUBMINIATURE VARIABLE-MU R.F. PENTODE

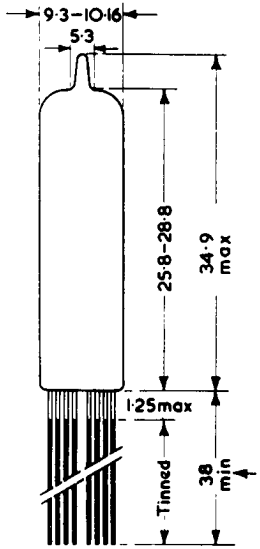


CROSS-MODULATION CURVE





B8D/F Base



3267

All dimensions in mm

SUBMINIATURE R.F. PENTODE

EF72

High slope r.f. pentode

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and therefore, in the interests of long life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis and should result in a bulb temperature of approximately 100°C.

CAPACITANCES

Pentode connected

	Shielded	Unshielded	
c_{a-g1}	<0.015	<0.02	pF
c_{in}	4.1	4.0	pF
c_{out}	2.5	2.0	pF

Triode connected

c_{a-g1}	1.65	pF
c_{in}	2.8	pF
c_{out}	4.2	pF

CHARACTERISTICS

Pentode connected

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.4	V
I_a	7.0	mA
I_{g2}	2.2	mA
g_m	5.0	mA/V
r_a	250	kΩ
μ_{g1-g2}	36	
R_{eq}	1.6	kΩ
R_{in} (f = 50Mc/s)	25	kΩ

Triode connected

V_a	100	V
V_{g1}	−1.4	V
I_a	9.2	mA
g_m	6.8	mA/V
r_a	5.3	kΩ
μ	36	

MAINTENANCE TYPE

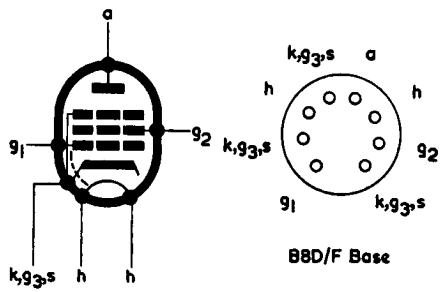
EF72

SUBMINIATURE R.F. PENTODE

High slope r.f. pentode

LIMITING VALUES

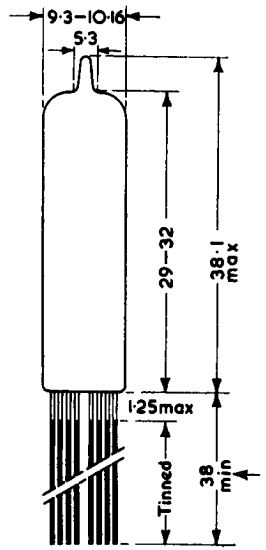
$V_{a(b)}$ max.	300	V
V_a max.	175	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
p_a max.	800	mW
p_{g2} max.	300	mW
p_{a+g2} max.	1.0	W
I_k max.	12	mA
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ



B8D/F Base

3271

All dimensions in mm



SUBMINIATURE HIGH SLOPE PENTODE

EF73

High slope pentode primarily intended for industrial applications.

HEATER

V_h	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and, therefore, in the interests of satisfactory life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis and should result in a bulb temperature of 100°C.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g1}	<0.15	<0.2	pF
c_{in}	4.5	5.0	pF
c_{out}	5.0	3.0	pF

CHARACTERISTICS

V_a	100	V
V_{g1}	0	V
V_{g2}	100	V
I_a	7.5	mA
I_{g2}	2.5	mA
V_{g1}	−2.0	V
g_m	5.5	mA/V
r_a	250	kΩ
μ_{g1-g2}	28	
V_{g3}max. (for I_a=100μA)	−60	V

MAINTENANCE TYPE

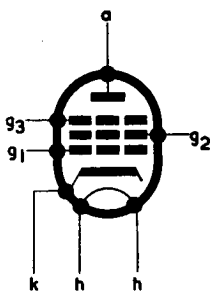
EF73

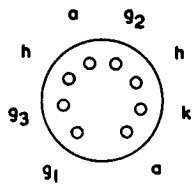
SUBMINIATURE HIGH SLOPE PENTODE

High slope pentode primarily intended for industrial applications.

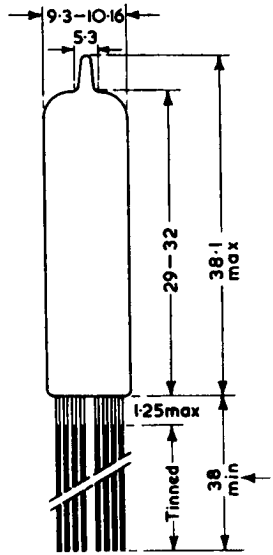
LIMITING VALUES

$V_{a(b)}$ max.	300	V
V_a max.	175	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
I_k max.	14	mA
p_a max.	1.5	W
p_{g2} max.	1.0	W
p_{a+g2} max.	2.0	W
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
R_{g1-k} max.	500	kΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V





B8D/F Base



3272

All dimensions in mm

SUBMINIATURE R.F. PENTODE

EF730

R.F. pentode with short suppressor-grid base.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
c_{a-g1}	<0.02	<0.034	pF
c_{a-g3}	<1.1	<1.1	pF
c_{g1-g3}	<0.15	<0.17	pF
$c_{in(g1)}$	4.0	4.0	pF
$c_{in(g3)}$	3.7	3.7	pF
c_{out}	3.4	2.1	pF

CHARACTERISTICS

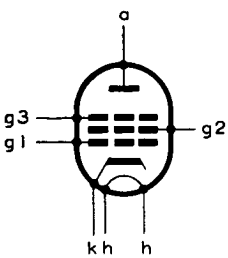
V_a	100	V
V_{g3}	0	V
V_{g2}	100	V
V_{g1}	−1.4	V
I_a	5.3	mA
I_{g2}	4.1	mA
$g_{m(g1-a)}$	3.2	mA/V
$g_{m(g3-a)}$	500	μA/V
r_a	110	kΩ
V_{g1} (I_a = 10μA)	−7.5	V
V_{g3} (I_a = 10μA)	−8.0	V

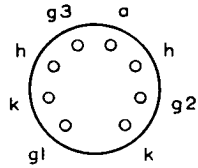
LIMITING VALUES (absolute ratings)

$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
+V_{g3} max.	30	V
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
−V_{g1} max.	55	V
p_{g2} max.	700	mW
I_a max.	11	mA
I_{g2} max.	7.0	mA
V_{h-k} max.	200	V

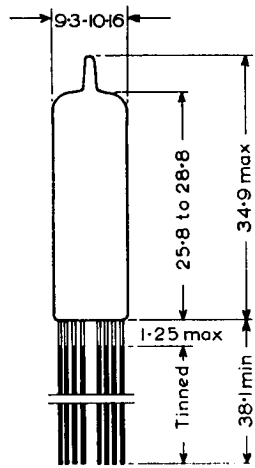
EF730

SUBMINIATURE R.F. PENTODE





B8D/F Base



5325

All dimensions in mm

SUBMINIATURE VARIABLE-MU R.F. PENTODE

EF731

Subminiature variable-mu r.f. pentode for use as a controlled r.f. amplifier.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
c_{a-g1}	<0.015	<0.03	pF
c_{in}	4.3	4.0	pF
c_{out}	3.4	1.9	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.1	V
I_a	7.2	mA
I_{g2}	2.2	mA
g_m	4.5	mA/V
r_a	260	kΩ
g_m (V_{g1} = −14V)	25	μA/V

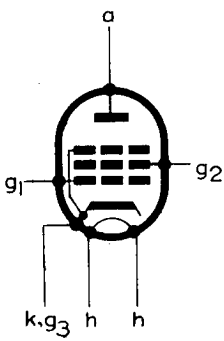
LIMITING VALUES (absolute ratings)

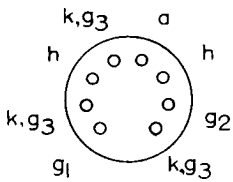
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	550	mW
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
V_{h-k} max.	200	V

EF731

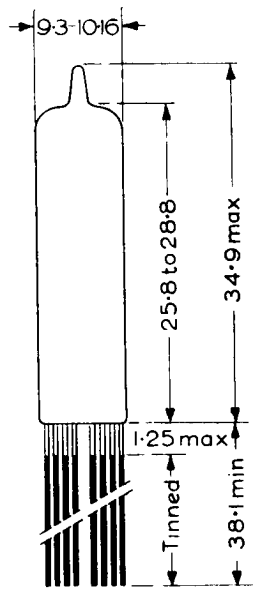
SUBMINIATURE VARIABLE-MU R.F. PENTODE

5494





B8D/F Base



All dimensions in mm

SUBMINIATURE R.F. PENTODE

EF732

High slope r.f. pentode.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	shielded	*unshielded*	
$c_{a\ g1}$	<0.015	<0.03	pF
c_{in}	4.2	4.0	pF
c_{out}	3.4	1.9	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.5	V
I_a	7.5	mA
I_{g2}	2.4	mA
g_m	5.0	mA/V
r_a	260	kΩ
V_{g1} (I_a = 10μA)	−9.0	V

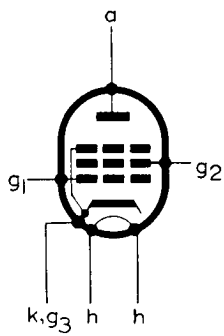
LIMITING VALUES (absolute ratings)

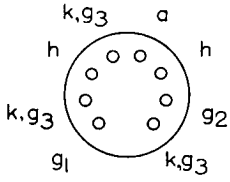
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	550	mW
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
$V_{h\ k}$ max.	200	V

EF732

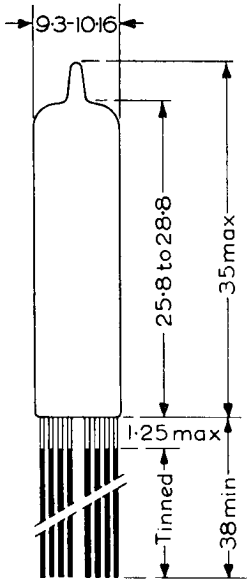
SUBMINIATURE R.F. PENTODE

High slope r.f. pentode.





B8D/F Base



4071

All dimensions in mm

SUBMINIATURE R.F. PENTODE

EF734

High slope r.f. pentode.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	shielded	*unshielded*	
C_{a-g1}	<0.015	<0.03	pF
C_{in}	4.2	4.0	pF
C_{out}	3.4	1.9	pF

CHARACTERISTICS

V_a	100	V
*V_{g3}	0	V
V_{g2}	100	V
V_{g1}	−1.5	V
I_a	7.5	mA
I_{g2}	2.4	mA
g_m	5.0	mA/V
r_a	260	kΩ
V_{g1} (I_a = 10μA)	−9.0	V

*The suppressor grid should not be used for control or gating purposes.

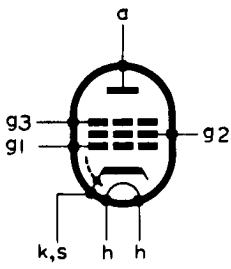
LIMITING VALUES (absolute ratings)

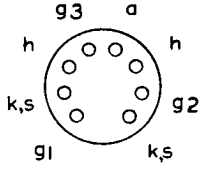
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	550	mW
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
V_{h-k} max.	200	V

EF734

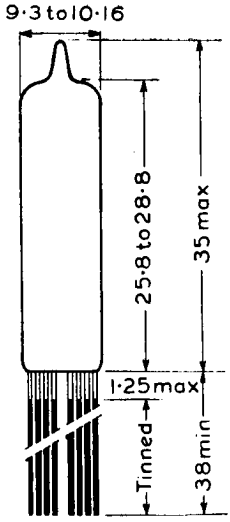
SUBMINIATURE R.F. PENTODE

High slope r.f. pentode.





B8D/F Base



5164

All dimensions in mm

SUBMINIATURE LOW MICROPHONY PENTODE

EF74

Voltage amplifying pentode primarily designed for low microphony applications.

HEATER

V_h	6.3	V
I_h	200	mA

To reduce the possibility of hum the heater should be operated from d.c.

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and therefore, in the interest of long life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis.

CAPACITANCES (measured with external shield)

C_{a-g1}	<0.3	pF
C_{in}	3.6	pF
C_{out}	4.2	pF

CHARACTERISTICS

V_a	100	V
V_{g3}	0	V
V_{g2}	100	V
I_a	7.0	mA
I_{g2}	2.4	mA
V_{g1}	−1.4	V
g_m	3.1	mA/V
r_a	200	kΩ
μ_{g1-g2}	28	

MAINTENANCE TYPE

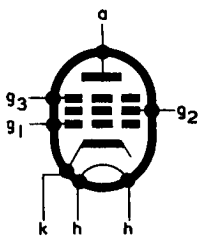
EF74

SUBMINIATURE LOW MICROPHONY PENTODE

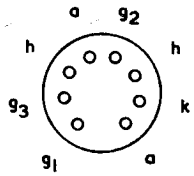
Voltage amplifying pentode primarily designed for low microphony applications.

LIMITING VALUES

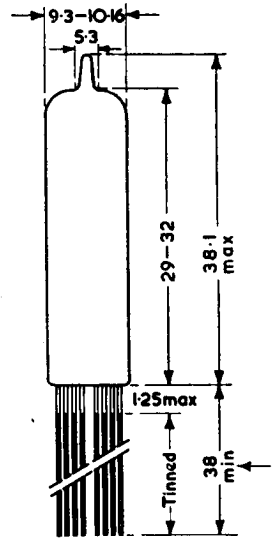
$V_{a(b)}$ max.	300	V
V_a max.	175	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
p_a max.	900	mW←
p_{g2} max.	350	mW←
I_k max.	10	mA
R_{g1-k} max. (cathode bias)	3.0	MΩ
R_{g1-k} max. (fixed bias)	1.0	MΩ
V_{h-k} max.	100	V



3326



B8D/F Base



All dimensions in mm

MINIATURE R.F. PENTODE

EF91

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.

HEATER

V_h	6.3	V
I_h	0.3	A

CAPACITANCES

cin	7.0	μμF
cout	2.0	μμF
ca-g1	<0.008	μμF

OPERATING CONDITIONS

V_a	250	V
V_{g2}	250	V
V_{g3}	0	V
V_{g1}	-2.0	V
I_a	10	mA
I_{g2}	2.55	mA
S_m	7.65	mA/V
r_a	1.0	MΩ
μ_{g1-g2}	70	
Equivalent Noise Resistance	1200	Ω
Input Damping (at 40 Mc/s)	5000	Ω

LIMITING VALUES

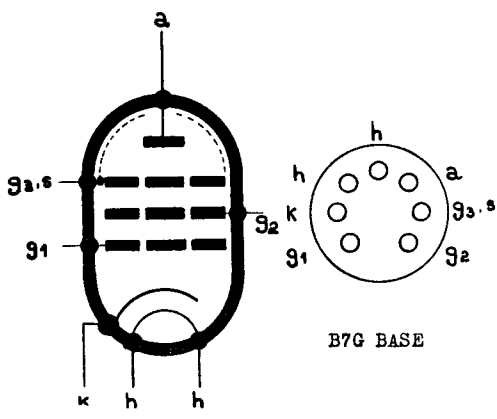
$V_{a(b)}$ max	550	V
V_a max	300	V
W_a max	2.5	W
$V_{g2(b)}$ max	550	V
V_{g2} max	300	V
W_{g2} max	0.65	W
I_k max	15	mA
V_{g1} (I_{g1}=+0.3μA)	-1.3	V
V_{g3} (I_{g3}=+0.3μA)	-1.3	V
R_{g1} max	1.0	MΩ
V_{h-k} max	50	V

EF91

MINIATURE R.F. PENTODE

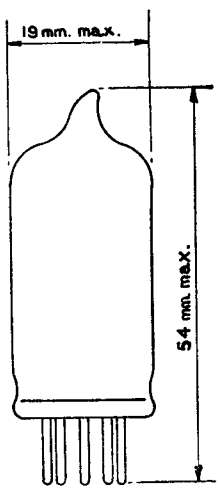
Single-ended R.F. pentode with high mutual conductance and sharp cut-off.

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



B7G BASE

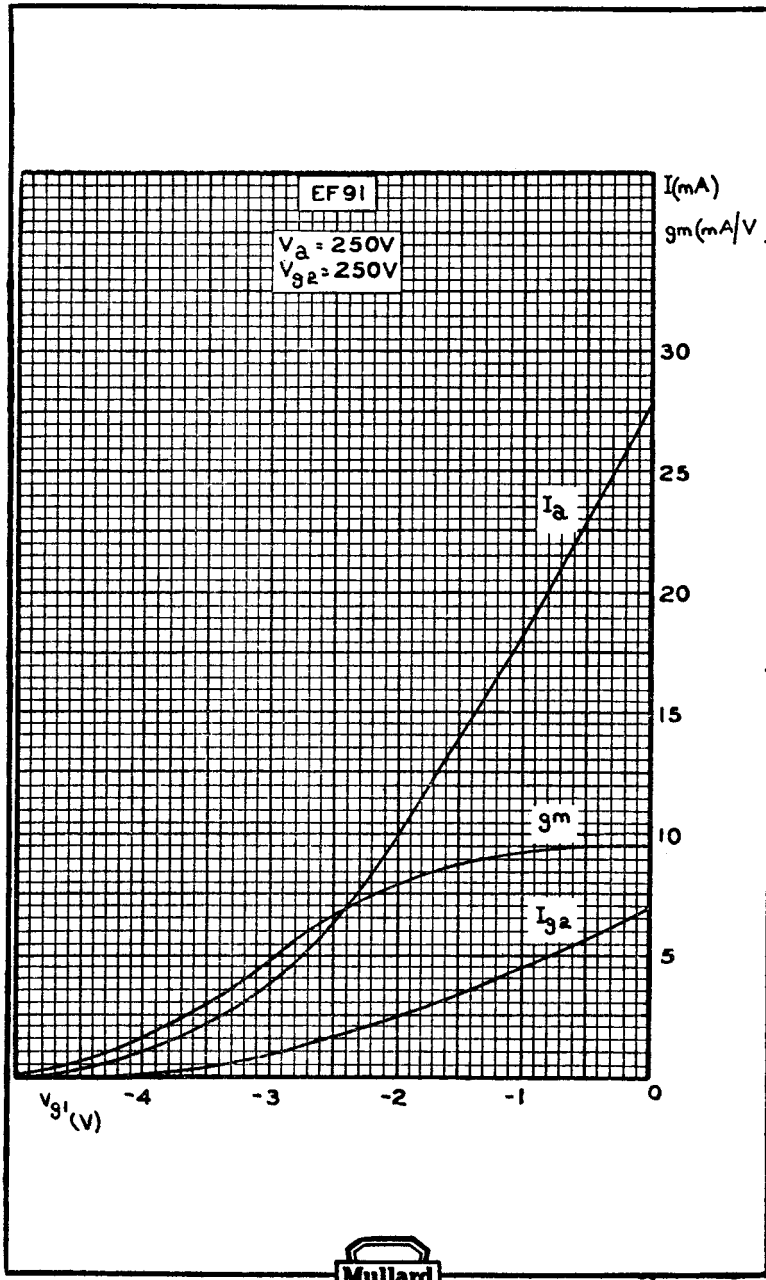
DIMENSIONS



MINIATURE R.F. PENTODE

EF91

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.

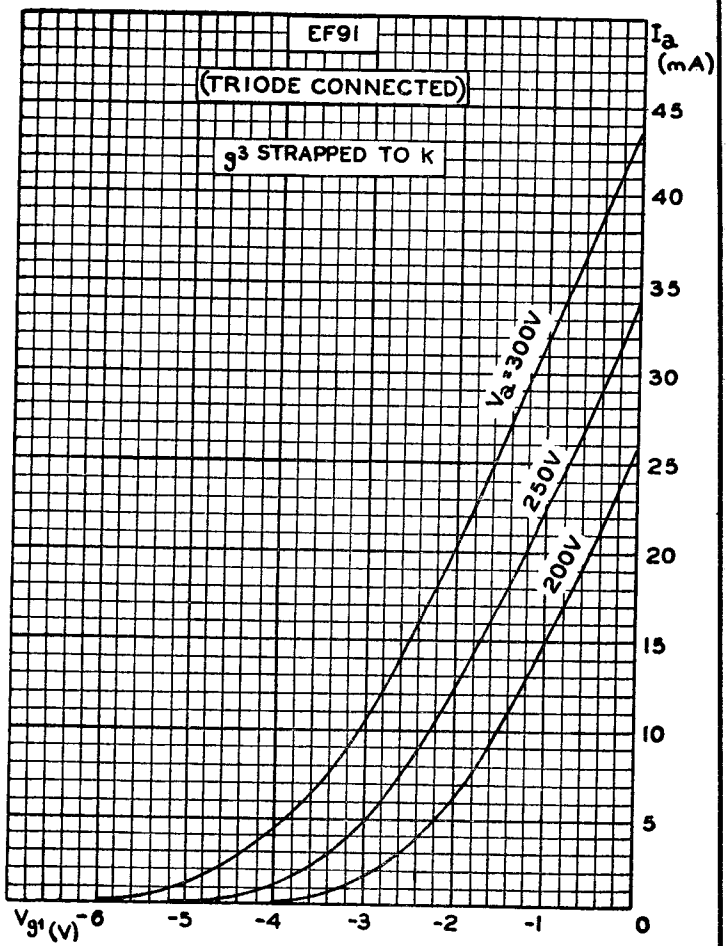


Mullard

EF91

MINIATURE R.F. PENTODE

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.

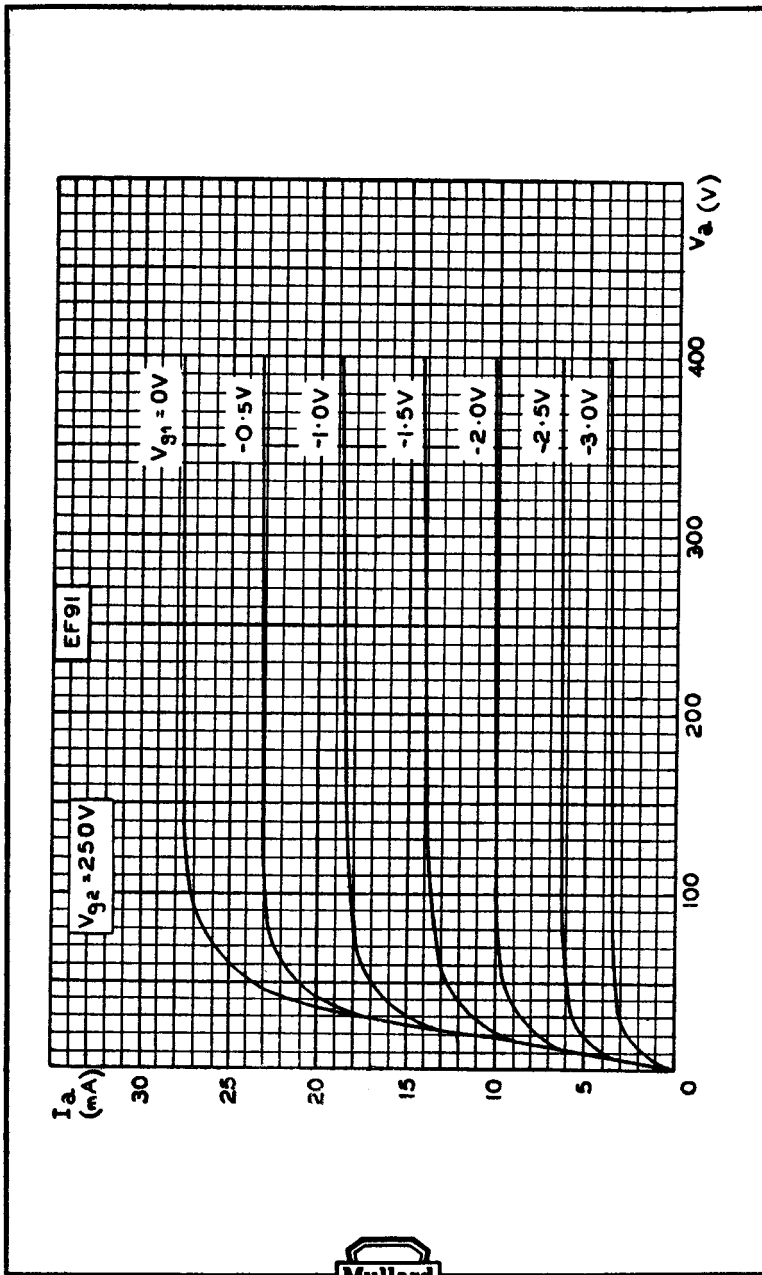


Mullard

MINIATURE R.F. PENTODE

EF91

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.

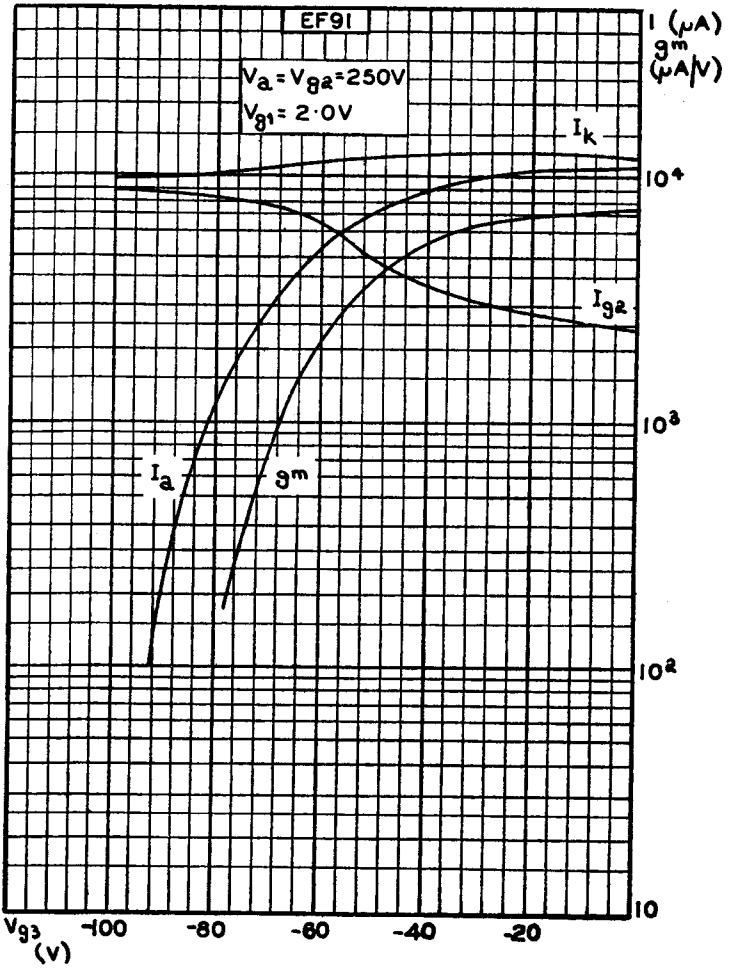


Mullard

EF91

MINIATURE R.F. PENTODE

Single-ended R.F. pentode with high mutual conductance and sharp cut-off.



Mullard

MINIATURE VARIABLE-MU R.F. PENTODE

EF92

Variable-mu R.F. pentode for use as a controlled R.F. or I.F. amplifier.

HEATER

V_h	6.3	V
I_h	0.2	A

CAPACITANCES (Measured with close fitting metal can and shielded socket)

c_{in}	4.5	μμF
c_{out}	7.0	μμF
c_{a-g1}	0.004	μμF

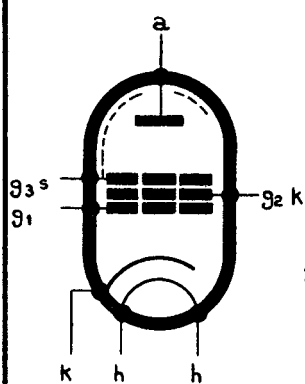
CHARACTERISTICS

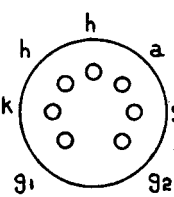
V_a	250	250		V
V_{g2}	150	200		V
V_{g1}	-0.65	-2.5	-28	V
I_a	8.0	8.0	-	mA
I_{g2}	2.0	2.1	-	mA
g_m	2.5	2.5	0.005	mA/V

LIMITING VALUES

$V_{a(b)}$ max.	300	V
V_a max.	250	V
w_a max.	2.5	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	250	V
w_{g2} max.	0.6	W
Max. operating frequency	160	Mc/s

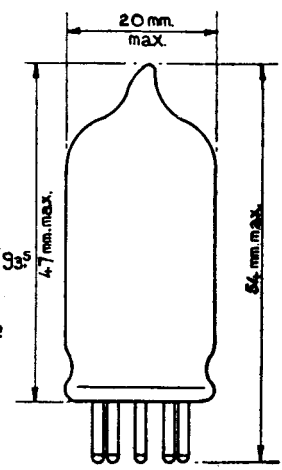
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS.





B7G BASE

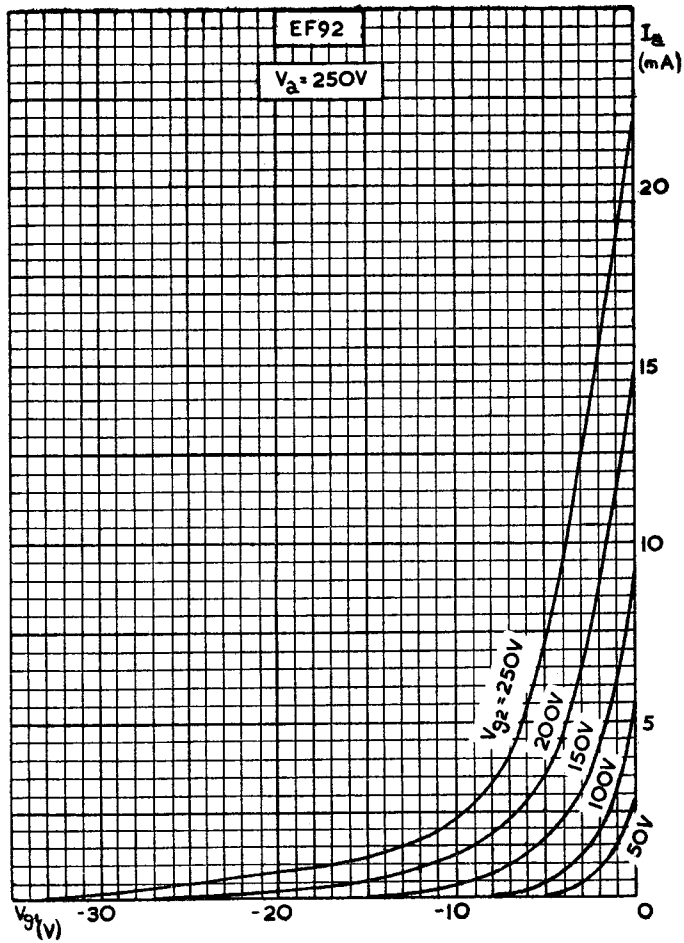
DIMENSIONS



EF92

MINIATURE VARIABLE-MU R.F. PENTODE

Variable-mu R.F. pentode for use as a controlled R.F. or I.F. amplifier.

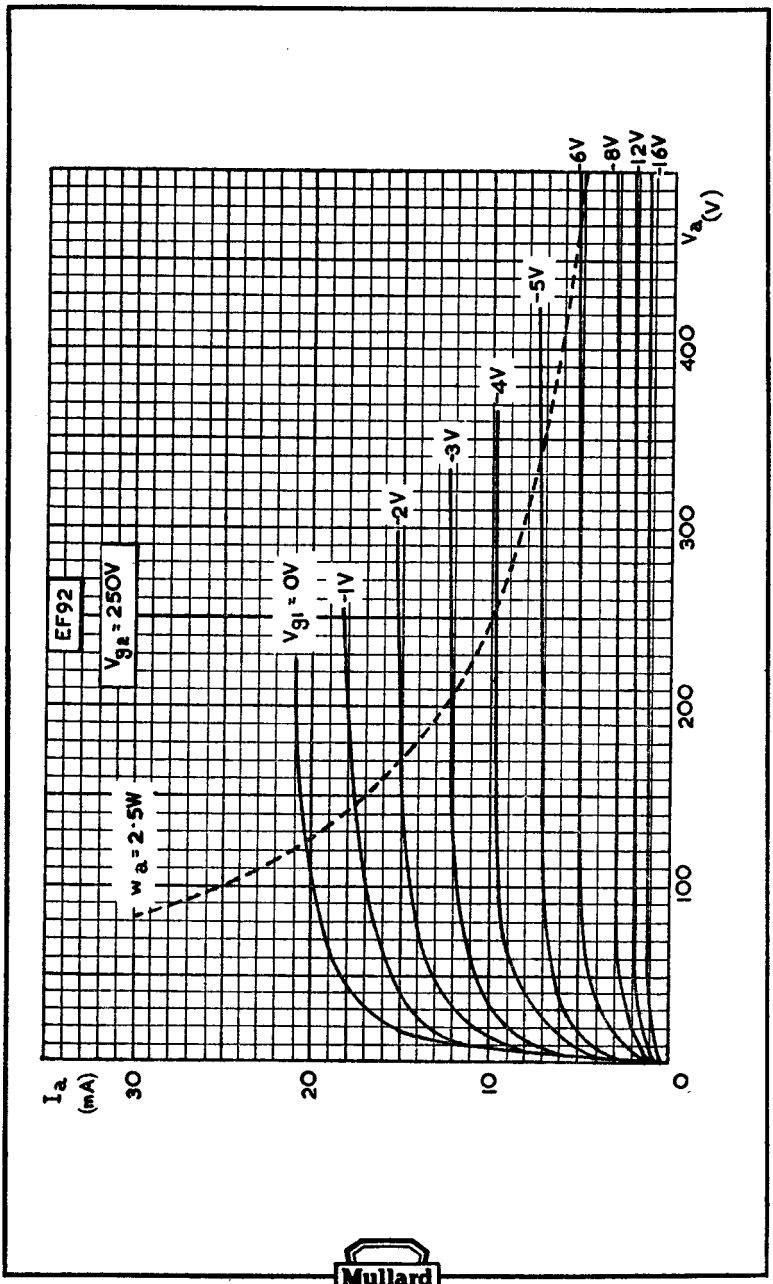


Mullard

MINIATURE VARIABLE-MU R.F. PENTODE

EF92

Variable-mu R.F. pentode for use as a controlled R.F. or I.F. amplifier.



VARIABLE-MU R.F. PENTODE

EF93

Variable-mu pentode for use as r.f. or i.f. amplifier.

HEATER

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

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{in}	5.5	pF
c_{out}	5.0	pF
c_{a-g1}	3.5	mpF

CHARACTERISTICS

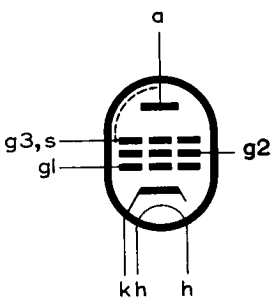
V_a	100	250	V
V_{g3}	0	0	V
R_{g2}	0	33	kΩ
V_{g2}	100	100	V
I_a	10.8	11	mA
I_{g2}	4.4	4.2	mA
V_{g1}	−1.0	−1.0	V
g_m	4.3	4.4	mA/V
r_a	0.25	1.5	MΩ
V_{g1} for 100 : 1 reduction in g_m	−20	−20	V

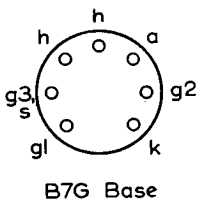
LIMITING VALUES

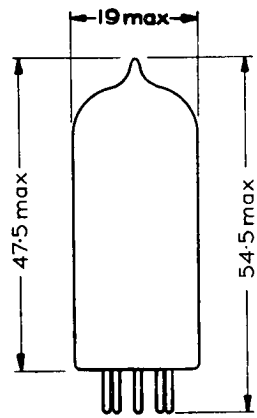
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	125	V
p_{g2} max.	600	mW
I_k max.	18	mA
R_{g1-k} max.	3.0	MΩ
V_{h-k} max.	90	V

EF93

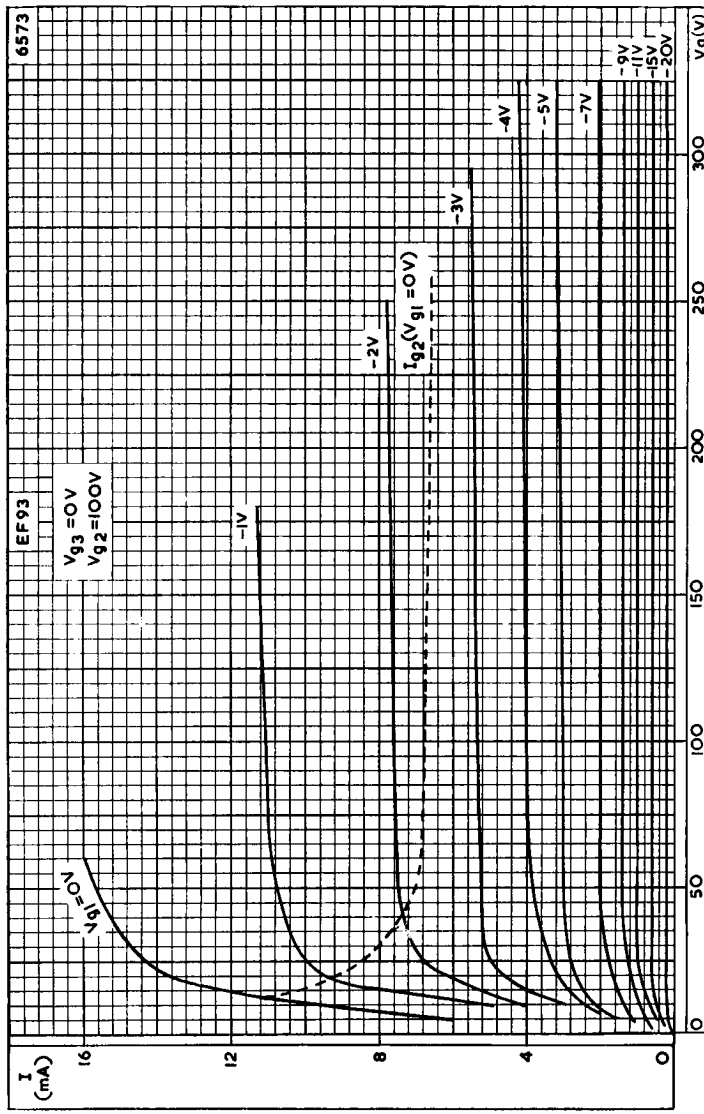
VARIABLE-MU R.F. PENTODE



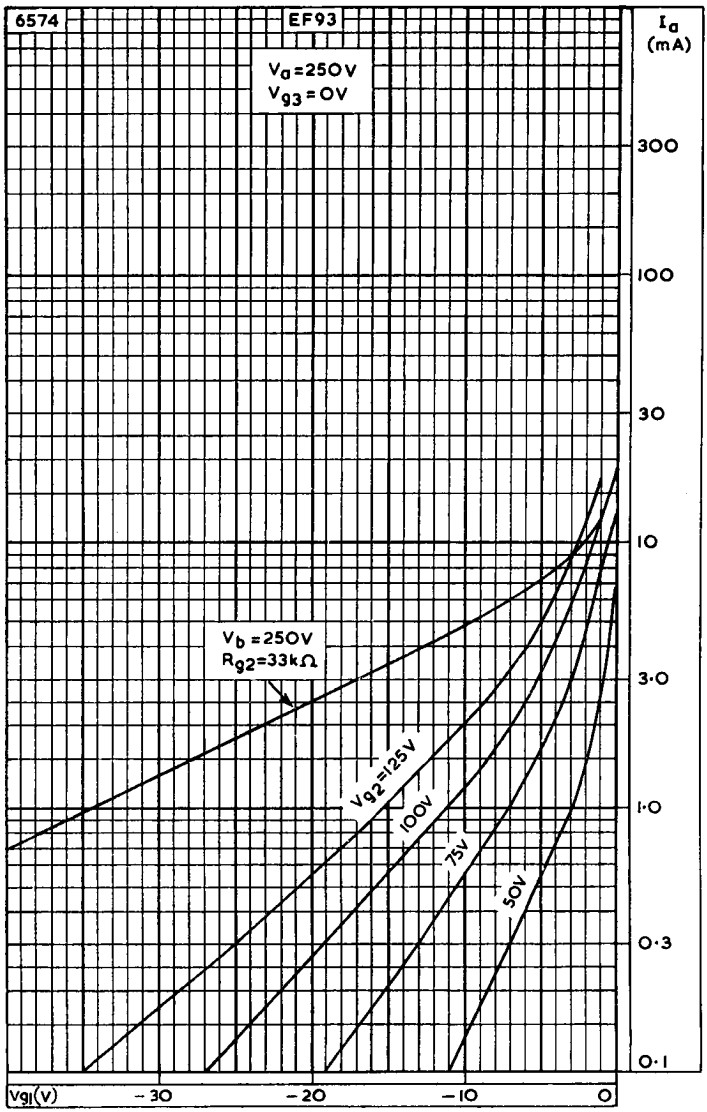




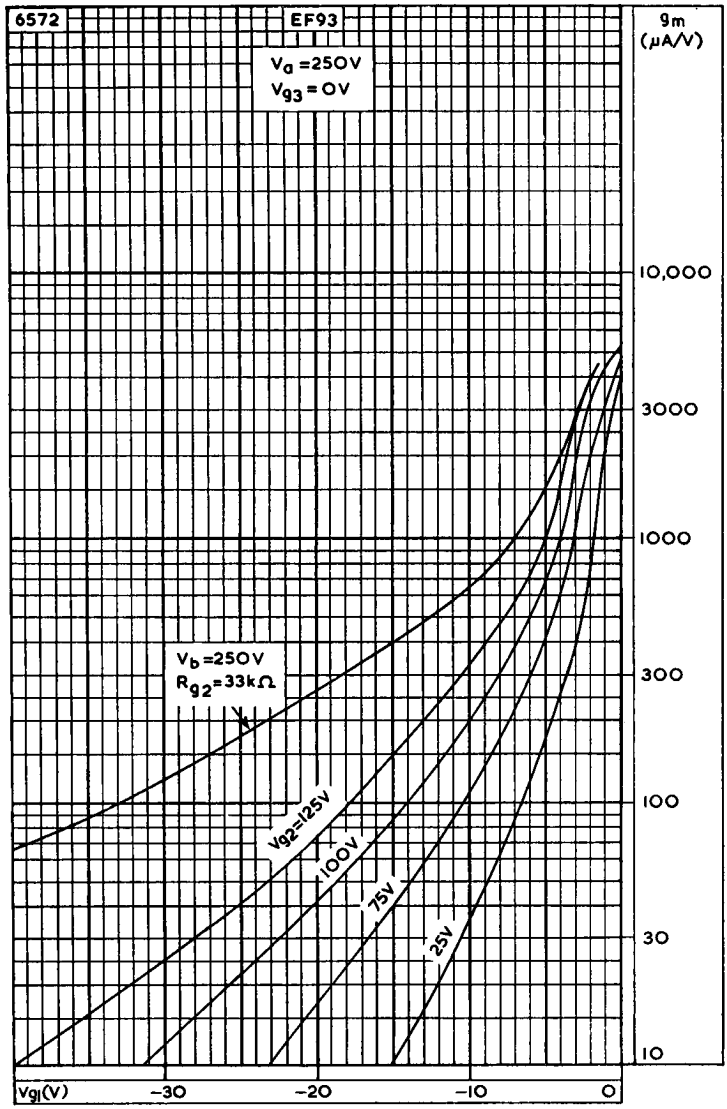
All dimensions in mm



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

V.H.F. PENTODE

Low noise, high slope pentode primarily intended for use as an r.f. and i.f. amplifier.

EF95

HEATER

V_h	6.3	V
I_h	175	mA

CAPACITANCES

	Unshielded	*Shielded*	
Pentode connection			
C_{in}	4.0	4.0	pF
C_{out}	2.2	3.1	pF
C_{a-g1}	23	< 20	mpF
C_{h-k}	2	2	pF
Triode connection			
C_{in}	2.7	2.8	pF
C_{out}	4.2	5.1	pF
C_{a-g}	1.4	1.4	pF

CHARACTERISTICS

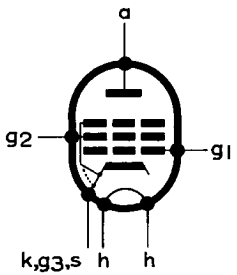
Pentode connection			
V_a	120	180	V
V_{g2}	120	120	V
I_a	7.5	7.7	mA
I_{g2}	2.5	2.4	mA
V_{g1}	−2.0	−2.0	V
g_m	5.0	5.1	mA/V
r_a	250	400	kΩ
μ_{g1-g2}	35	35	
R_{eq}	2	2	kΩ
r_{g1} (f = 50Mc/s)	25	25	kΩ
Triode connection			
V_a		120	V
I_a		10	mA
V_g		−2	V
g_m		6.8	mA/V
r_a		5.2	kΩ
μ		35	
R_{eq}		900	Ω

DESIGN CENTRE RATINGS

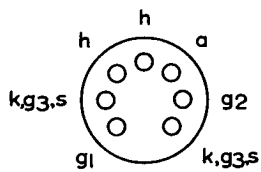
$V_{a(b)}$ max.	300	V
V_a max.	180	V
p_a max.	1.7	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	140	V
p_{g2} max.	500	mW
$-V_{g1}$ max.	50	V
R_{g1-k} max.	3.0	MΩ←
I_k max.	18	mA
V_{h-k} max.	120	V
T_{bulb} max.	170	°C

EF95

V.H.F. PENTODE

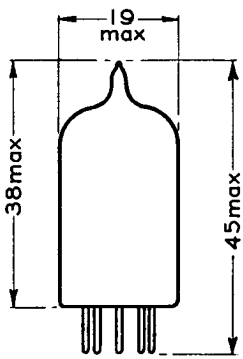


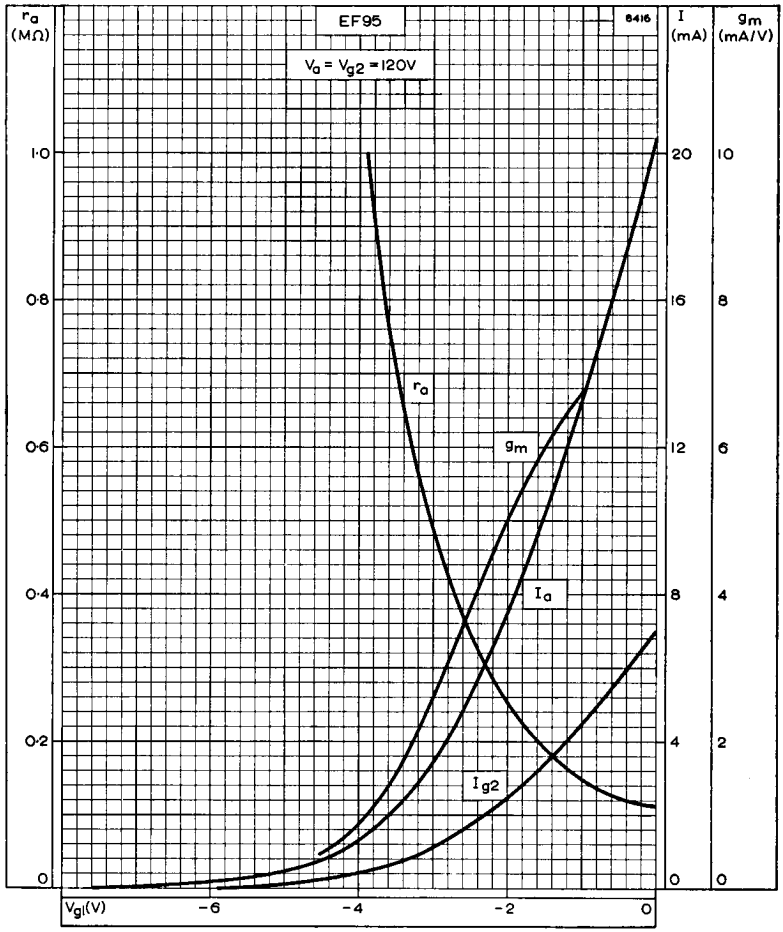
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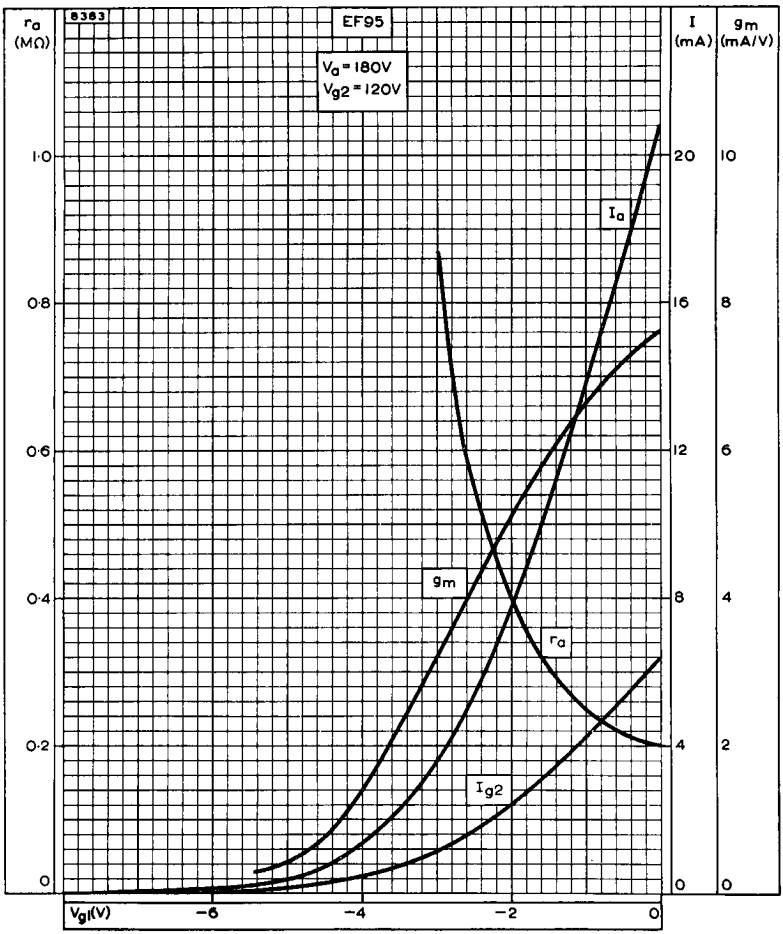
B7G Base

All dimensions in mm

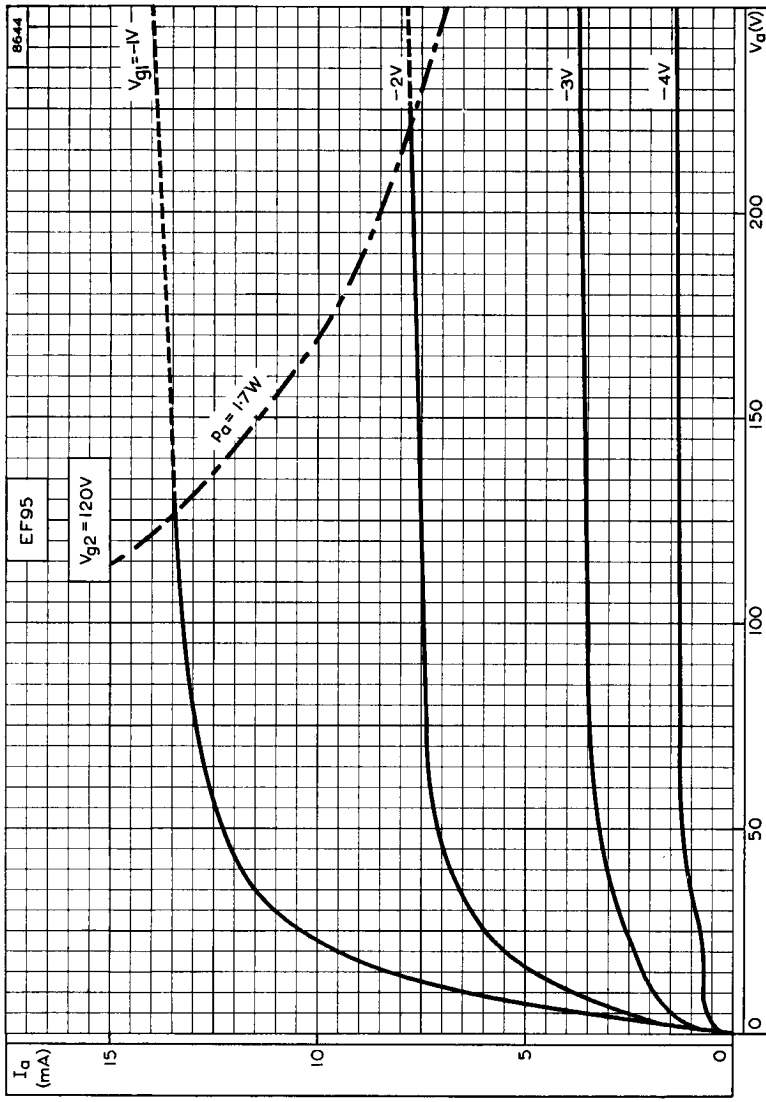




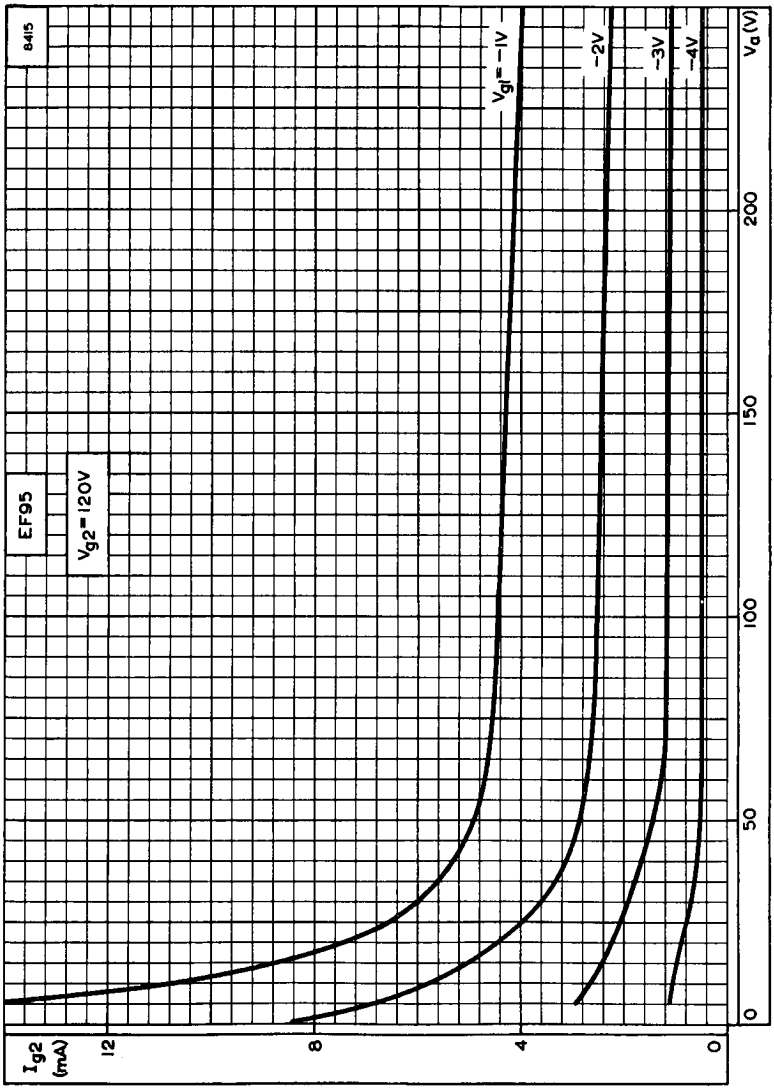
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = 120V$



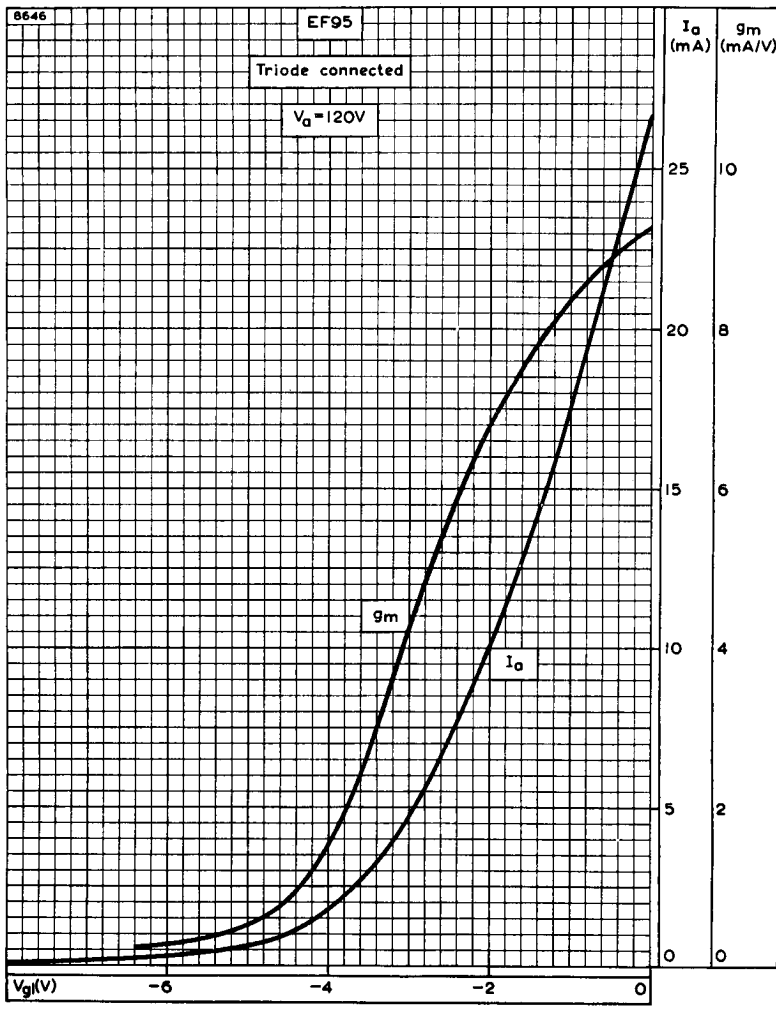
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Va = 180V



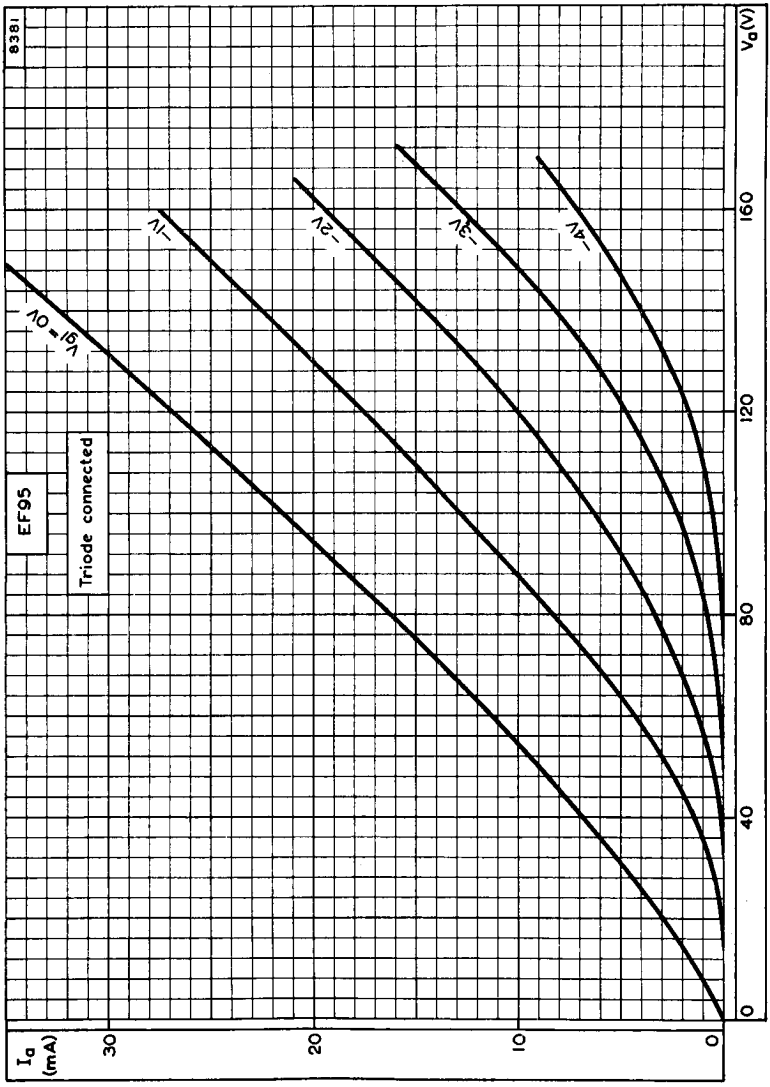
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE, WHEN TRIODE CONNECTED



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER,
WHEN TRIODE CONNECTED

HEPTODE FREQUENCY CHANGER

EK90

Heptode primarily intended for use as a frequency changer.

HEATER

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

V_h	6.3	V
I_h	0.3	A

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{a-all}	8.6	μμF
c_{g1-all}	5.5	μμF
c_{g3-all}	7.2	μμF
c_{a-g1}	<0.05	μμF
c_{a-g3}	<0.3	μμF
c_{g1-g3}	<0.15	μμF
c_{g1-k}	2.8	μμF

OPERATING CONDITIONS (with separate excitation)*

V_a	100	250	V
V_{g2+g4}	100	100	V
V_{g3}	−1.5	−1.5	V
R_{g1-k}	20	20	kΩ
I_k	10.6	10.6	mA
I_a	2.8	3.0	mA
I_{g2+g4}	7.3	7.1	mA
I_{g1}	500	500	μA
g_c	455	475	μA/V
r_a	0.5	1.0	MΩ
V_{g1} (for 100 : 1 reduction in g_c)	−30	−30	V

*The operating conditions shown with separate excitation correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.

OSCILLATOR SECTION

V_a	100	V
V_{g2+g4}	100	V
V_{g3}	0	V
V_{g1}	0	V
I_a	25	mA
$g_{m(g1-g2+g4+a)}$	7.25	mA/V
$\mu_{(g1-g2+g4+a)}$	20	

LIMITING VALUES

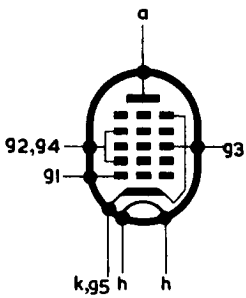
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2+g4(b)}$ max.	300	V
V_{g2+g4} max.	100	V
p_{g2+g4} max.	1.0	W
I_k max.	14	mA
R_{g3-k} max.	3.0	MΩ
V_{h-k} max.	90	V

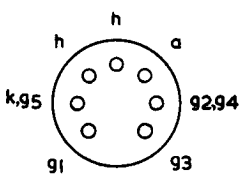
EK90

HEPTODE FREQUENCY CHANGER

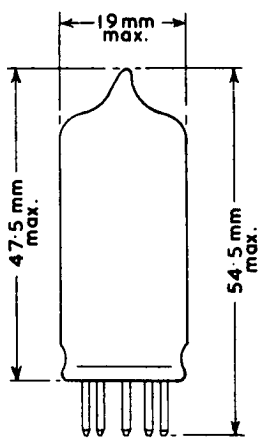
Heptode primarily intended for use as a frequency changer.

1507





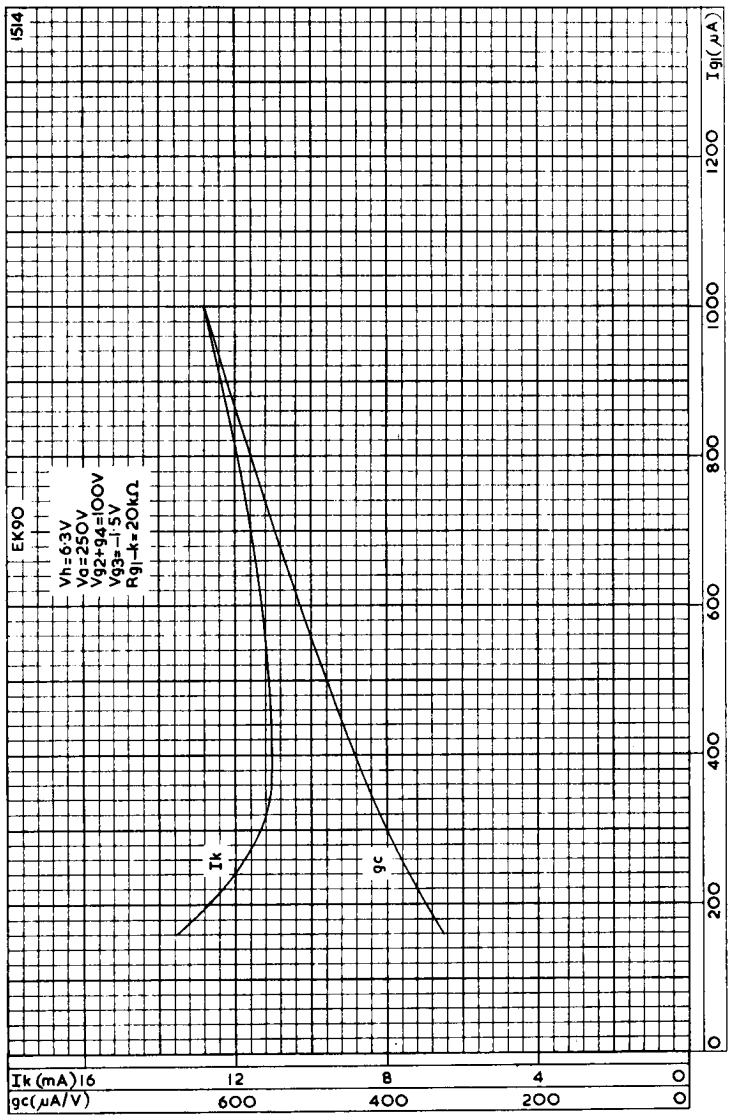
B7G BASE



HEPTODE FREQUENCY CHANGER

EK90

Heptode primarily intended for use as a frequency changer.

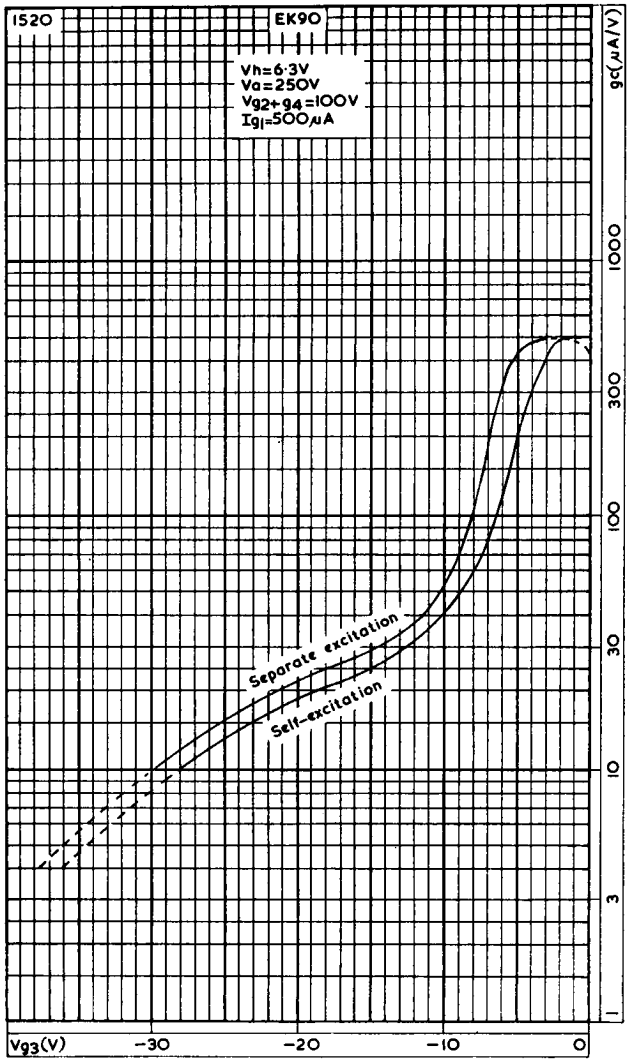


CONVERSION CONDUCTANCE AND CATHODE CURRENT PLOTTED AGAINST OSCILLATOR GRID CURRENT

EK90

HEPTODE FREQUENCY CHANGER

Heptode primarily intended for use as a frequency changer.



CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL GRID VOLTAGE

APPLICATION REPORT

Mullard

25 WATT PENTODE

EL31

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MAY, 1948

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1. INTRODUCTION

The EL310 is a 25-watt pentode particularly suited for use in the output stages of power amplifiers. It is primarily intended for use in the push-pull stages of equipments having an effective output of 50 - 100 watts, but for completeness data is provided covering the lower power operating conditions which, however, are normally satisfied by two valves type EL37 in push-pull.

The EL310 has an octal base with an anode top cap, to permit a maximum anode voltage of 800 V to be used with safety. It is on account of the higher operating voltage that a higher output is obtainable than is possible with the EL37.

1.1 Push-pull Operation

In paragraphs 4, 5 and 6 data is presented covering operation both with H.T. supplies having good regulation and with H.T. supplies having poor regulation. Although a supply having good regulation is much to be preferred because higher outputs are then obtainable, it is rarely practicable to fulfil this condition, and in most cases the power supply will have appreciable internal resistance. This means that the H.T. voltage at full drive will be less than at no drive, due to the increase in the cathode current of the output valves.

In order to present data in a useful yet concise form, the full-drive cathode current I_k (max.sig.), the no-signal cathode current $I_{k(o)}$ and the output power Pout are plotted as functions of the total H.T. voltage V_b. This has been done for various operating conditions.

If the regulation curve (I - V characteristic) of the H.T. supply is superimposed upon these figures, the no-signal conditions can be found at the point where this curve cuts the $I_{k(o)}$ curve. The full drive conditions I_k (max. sig.) and V_b are found at the point where the H.T. regulation curve cuts the I_k (max. sig.) curve. The output can be found by drawing a vertical line from this point till it cuts the P_{out} curve.

When maximum power output is required, the H.T. supply should be so designed that its regulation curve cuts the $I_{k(o)}$ curve at the maximum point (extreme right) at which P_a = 25 watts per valve. This, of

course, is not always necessary and the process can be reversed if a lower output is required. In this case the vertical line is drawn first, through the required point on the Pout curve, till it cuts the I_k (max. sig.) curve. Thus the H.T. voltage and current necessary at full drive are found. The no-signal H.T. voltage and current can be found by drawing a line corresponding to the expected internal resistance of the H.T. source through the full drive point on the I_k (max. sig.) curve till it cuts the $I_{k(o)}$ curve.

1.2 H.T. Supplies having Good Regulation

The terms 'good regulation' and 'poor regulation' as applied to H.T. supplies, are used relatively. A supply having good regulation is deemed to be one which has a good regulation curve and low internal resistance (of the order of 100 ohms), such as would be obtained by the use of choke input and low resistance transformer windings. A supply having poor regulation, on the other hand, covers the more common case of capacitance input filters and small mains transformers.

2. STATIC DATA

Heater

V_h	6.3	V
I_h	1.4	A

Capacitances

c_{out}	6.5	μμF
c_{in}	17.5	μμF
c_{a-g}	1.2	μμF

Characteristics

V_a	275	600	V
V_{g2}	275	400	V
V_{g1}	-9	-22	V
I_a	91	42	mA
I_{g2}	11	5	mA
g_m	14.0	7.0	mA/V
ra	20,000	43,000	Ω
μg1-g2	16.5		

Limiting Values

$V_{a(b)}$ max.	1200	V
V_a max.	800	V
$V_{g2(b)}$ max.	800	V
V_{g2} max.	400	V
V_{g1} (I_{g1} = 0.3 μA) max.	-1.3	V
V_{h-k} max.	100	V
R_{h-k} max.	20,000	Ω
R_{g1-k} max. (self-bias)	0.5	MΩ
R_{g1-k} max. (fixed bias)	0.1	MΩ
p_a max.	25	W
p_{g2} max.	8	W
I_k max.	200	mA

Characteristic curves

I_a/V_a curves taken with V_{g2} = 275V and 400V are shown in figures 1 and 2 respectively.

3. SINGLE VALVE OPERATION

For conventional operation the grid bias is obtained by means of a resistor in the cathode circuit, this resistor being capacitively by-passed for audio frequency currents.

The following table gives typical operating conditions.

V_a	225	250	275	300	V
V_{g2}	225	250	275	300	V
I_a	73	81	91	83	mA
I_{g2} (max. sig.)	17	20.9	24.8	23.9	mA
p_a	16.5	20.2	25	25	W
R_k	93	93	93	126	Ω
R_a	3000	3000	3000	3500	Ω
V_{in} (for 50mW P_{out})	-	-	0.3	-	Vrms
P_{out} (start of I_{g1})	7.0	9.3	12.0	12.5	W
D_{tot} (start of I_{g1})	11	12	13.1	13.5	%
V_{in} (start of I_{g1})	5.3	6.1	7.1	7.5	Vrms

The distortion curve for $V_a = V_{g2}$ = 275V is shown in Fig. 3.

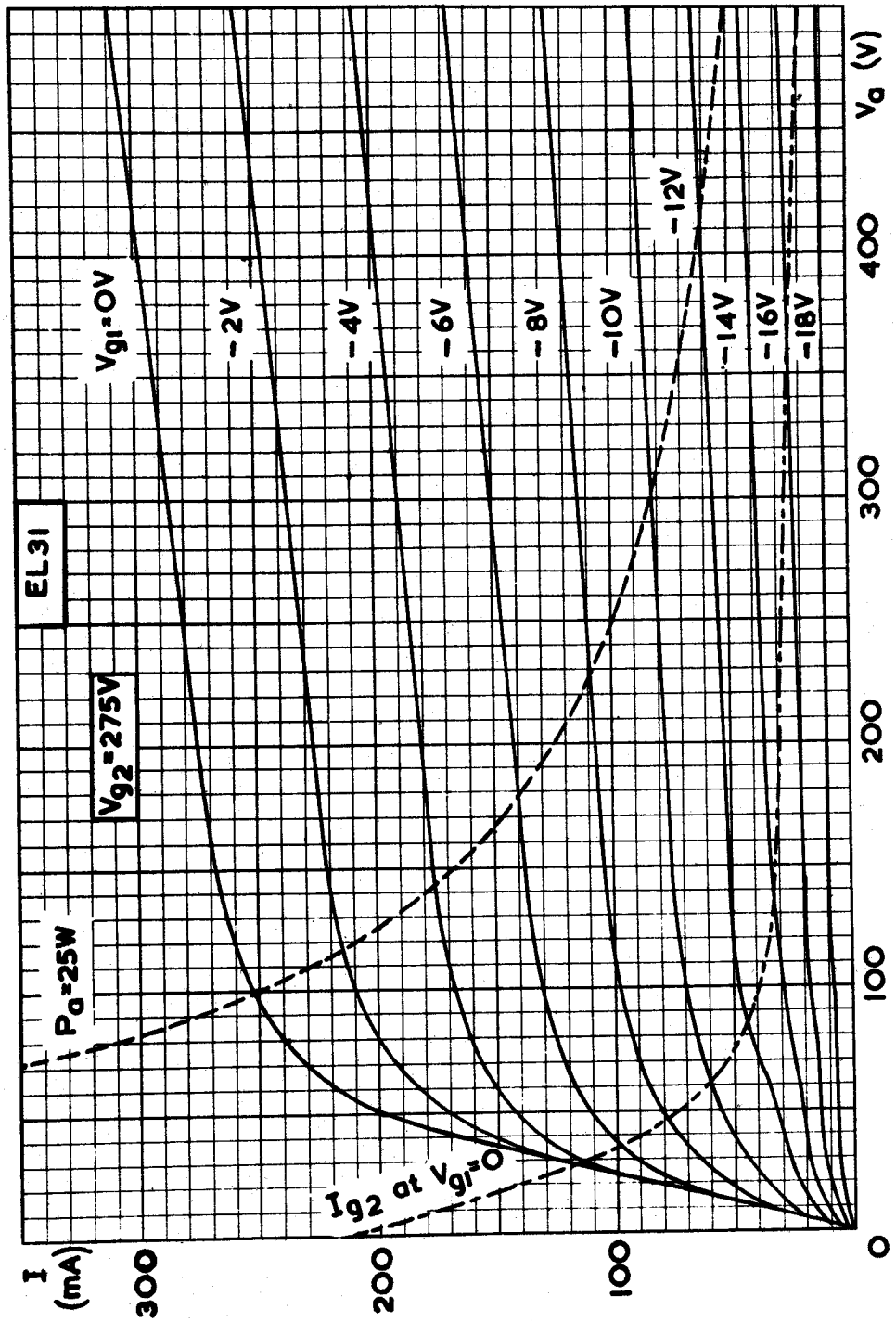


Fig. 1. I_a/V_a curve for V_{g2} = 275 V.

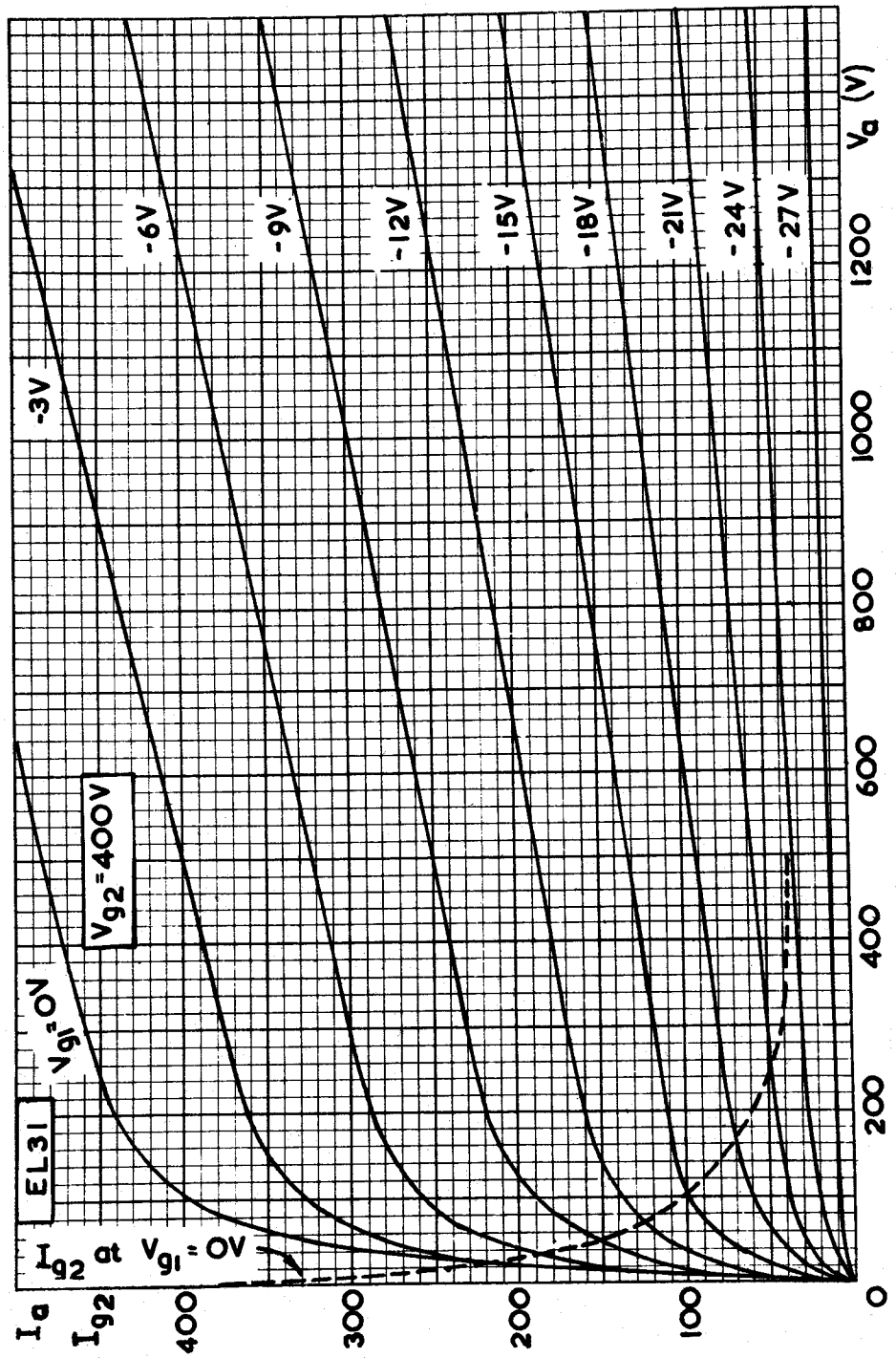


Fig. 2. I_a/V_a curve for V_{g2} = 400 V.

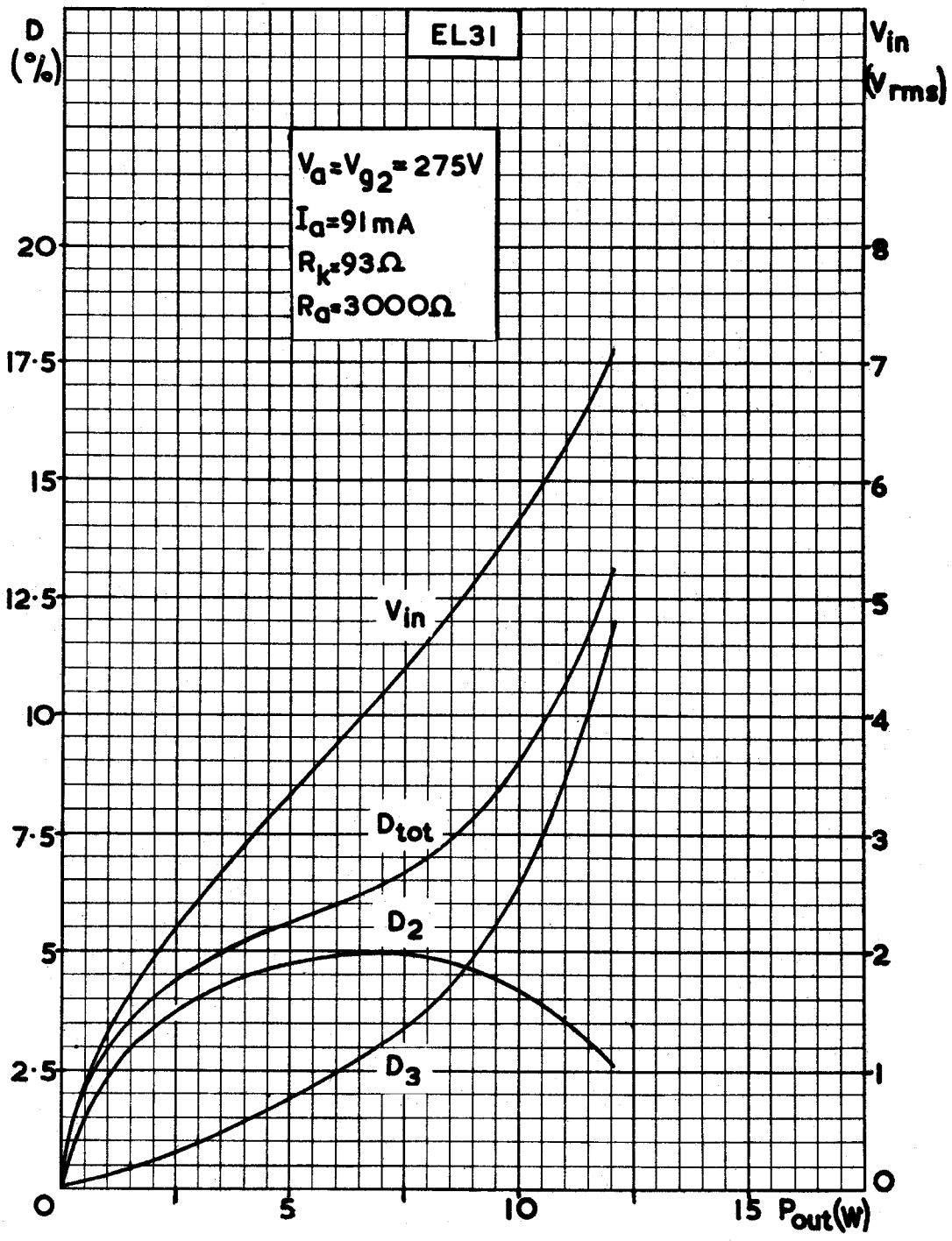


Fig. 3. Distortion curve for single valve at $V_a = V_{g2} = 275$ V.

3.1 Single Valve operation with Simple Feedback

Appreciably lower distortion will be obtained when the cathode by-pass capacitor is omitted but an increased drive voltage will be required.

V_a	225	250	275	300	V
V_{g2}	225	250	275	300	V
I_a	73	81	91	83	mA
P_a	16.4	20.2	25	25	W
R_k	93	93	93	126	Ω
I_{g2} (max. sig.)	15.2	18.3	22.1	21.7	mA
R_a	2800	2800	2800	3250	Ω
P_{out} (start of I_{g1})	6.7	8.9	11.7	12.5	W
D_{tot} (start of I_{g1})	7.8	8.8	10.0	11.0	%
V_{in} (start of I_{g1})	11.3	13.2	15.2	18.9	Vrms.

It will be noted that, when using negative feedback by this method, the optimum load resistance is roughly 7% lower than with no feedback.

Distortion curves for this condition taken at $V_a = V_{g2} = 275V$ are given in Fig. 4.

4. PUSH PULL OPERATION WITH EQUAL ANODE AND SCREEN VOLTAGES AND SELF BIAS

The following tables show the operating conditions for different supply voltages when the power output is limited by the start of grid current.

4.1 p_a = 25 watts at $V_a = V_{g2} = 350V$ ($V_b = 367V$)
$R_k = 100\ \Omega$
$R_{a-a} = 5000\ \Omega$

V_b V	$I_{a(o)}$ mA	$I_{g2(o)}$ mA	I_a (max. sig) mA	I_{g2} (max. sig) mA	V_{in} (gl-gl) Vrms	P_{out} W	D_{tot} %
367	2 x 71	2 x 8.8	2 x 83	2 x 23.5	29.4	38	4.2
350	2 x 67	2 x 8.5	2 x 78	2 x 21.5	27.0	34	4.0
325	2 x 62	2 x 8.0	2 x 73	2 x 19	24.8	28.5	3.7
300	2 x 57	2 x 7.2	2 x 66	2 x 16	22.0	22.8	3.3
275	2 x 52	2 x 6.6	2 x 60	2 x 14.5	20.0	18.2	3.2
250	2 x 47	2 x 5.9	2 x 55	2 x 11.9	17.6	15.2	2.4

The distortion curve shown in Fig. 5 was taken under this condition with $V_a = V_{g2} = 350V$ ($V_b = 367V$).

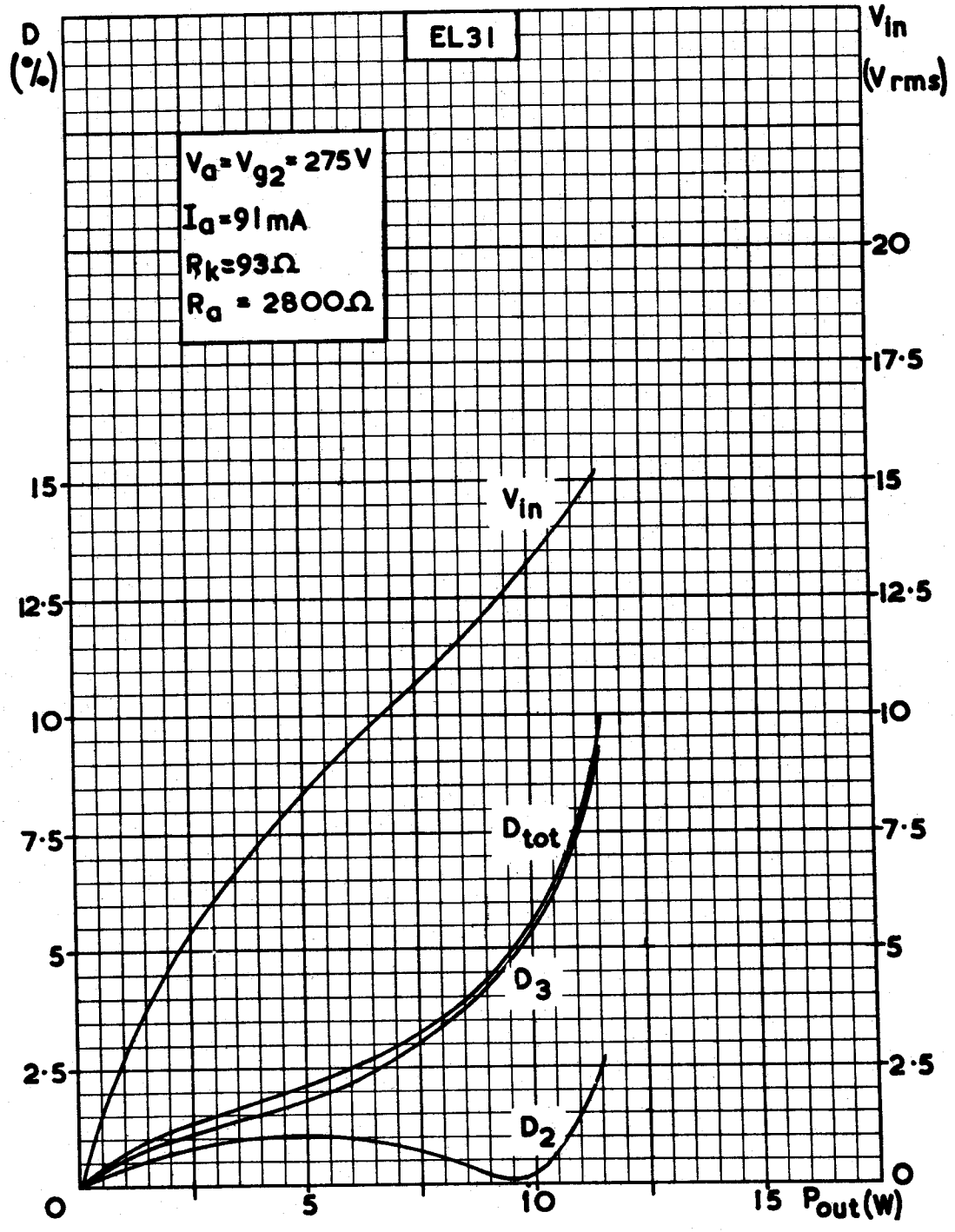


Fig. 4. Distortion curve for single valve at $V_a = V_{g2} = 275$ V. with simple feedback.

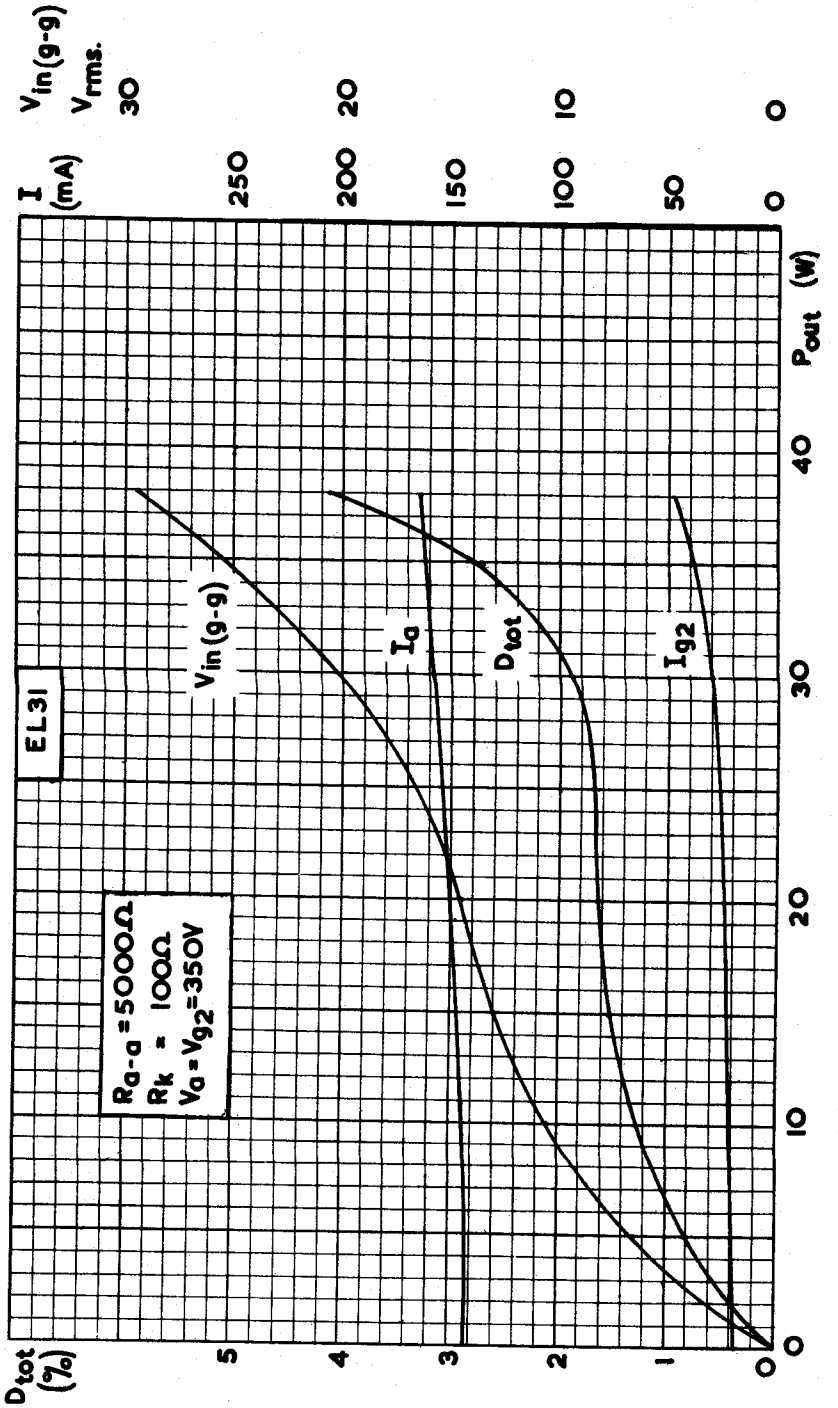


Fig. 5. Push-pull operating conditions for $V_a = V_{g2} = 350$ V. with self bias.

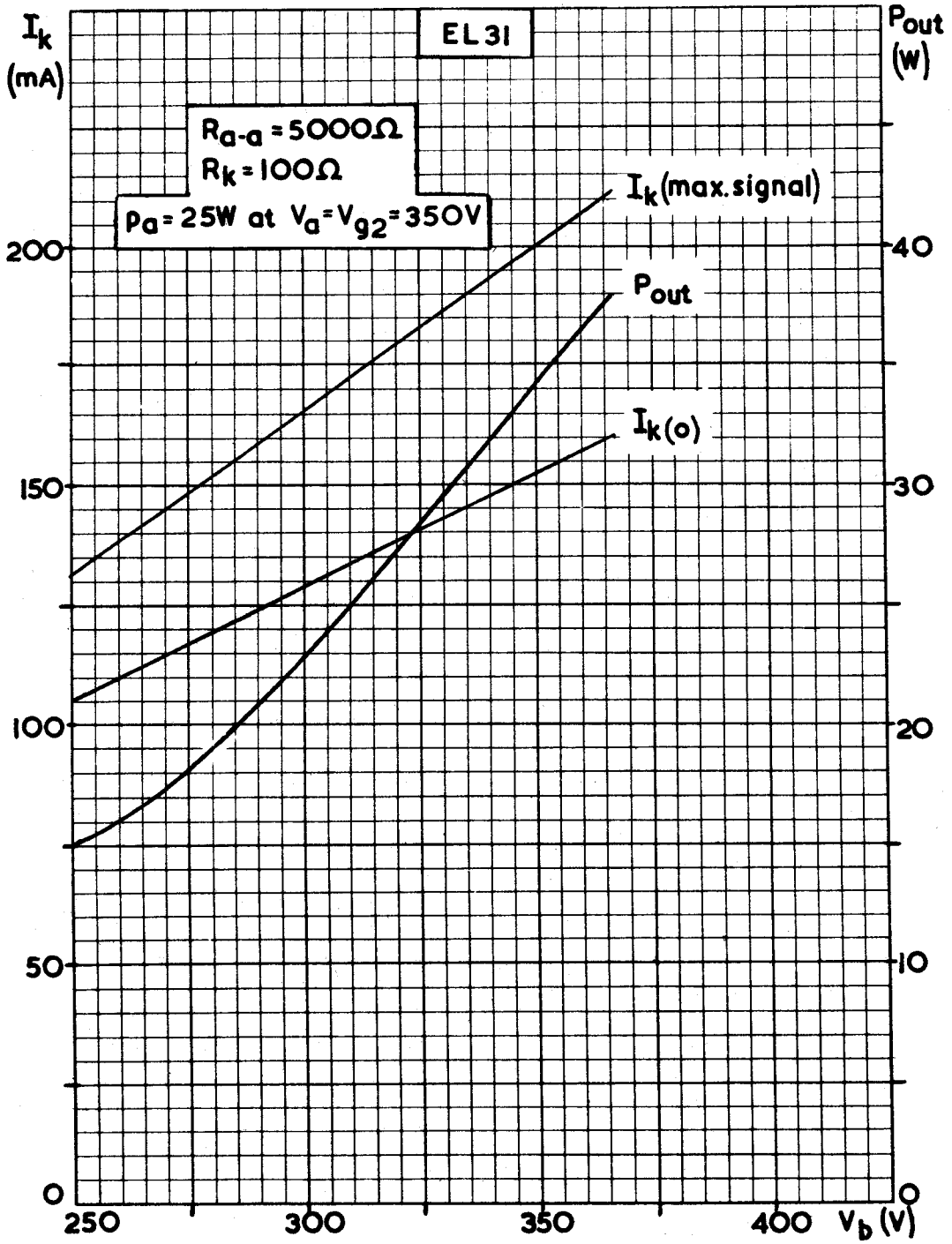


Fig. 6. Push-pull operating conditions with self bias and HT supply having poor regulation. ($V_b = 367$ V).

To enable the optimum conditions to be obtained with a power supply having poor regulation the above figures are shown graphically fig. 6.

4.2 p_a = 25 watts at $V_a = V_{g2}$ = 375V (Vb = 393V).
R_k = 122 Ω
R_{a-a} = 6000 Ω

V_b V	$I_{a(o)}$ mA	$I_{g2(o)}$ mA	I_a (max. sig) mA	I_{g2} (max. sig) mA	V_{in} (g-g) Vrms	P_{out} W	D_{tot} %
393	2 x 67	2 x 8.8	2 x 75	2 x 24.5	30	37.5	5.0
375	2 x 63	2 x 8.2	2 x 71	2 x 22.5	28.2	33	5.0
350	2 x 59	2 x 7.7	2 x 66	2 x 21.0	26.4	28.5	5.0
325	2 x 54	2 x 7.0	2 x 61	2 x 18.5	24.6	24	5.0
300	2 x 50	2 x 6.3	2 x 56	2 x 17.0	22.6	20	5.0
275	2 x 45	2 x 5.7	2 x 51	2 x 15.0	20.6	16.5	5.0

The distortion curve shown in Fig.7 was taken under this condition with $V_a = V_{g2}$ = 375 (V_b = 393V). These results are shown graphically in Fig. 8.

4.3 p_a = 25 watts at $V_a = V_{g2}$ = 400V (V_b = 420V)
R_k = 145 Ω
R_{a-a} = 7000 Ω

V_b V	$I_{a(o)}$ mA	$I_{g2(o)}$ mA	I_a (max. sig) mA	I_{g2} (max. sig) mA	V_{in} (g1-g1) Vrms	P_{out} W	D_{tot} %
420	2 x 63	2 x 8.3	2 x 69	2 x 24	31	37	5.0
400	2 x 59	2 x 7.8	2 x 65	2 x 22.5	29.4	33	5.0
375	2 x 55	2 x 7.2	2 x 61	2 x 21	28	29	5.0
350	2 x 51	2 x 6.6	2 x 57	2 x 19	26	25	5.0
325	2 x 47	2 x 6.2	2 x 53	2 x 17	24	20.8	5.0
300	2 x 44	2 x 5.1	2 x 48	2 x 16	22.2	17.7	5.0

The distortion curve shown in Fig.9 was taken under this condition with $V_a = V_{g2}$ = 400V (V_b = 420V). The above figures are shown plotted in Fig. 10.

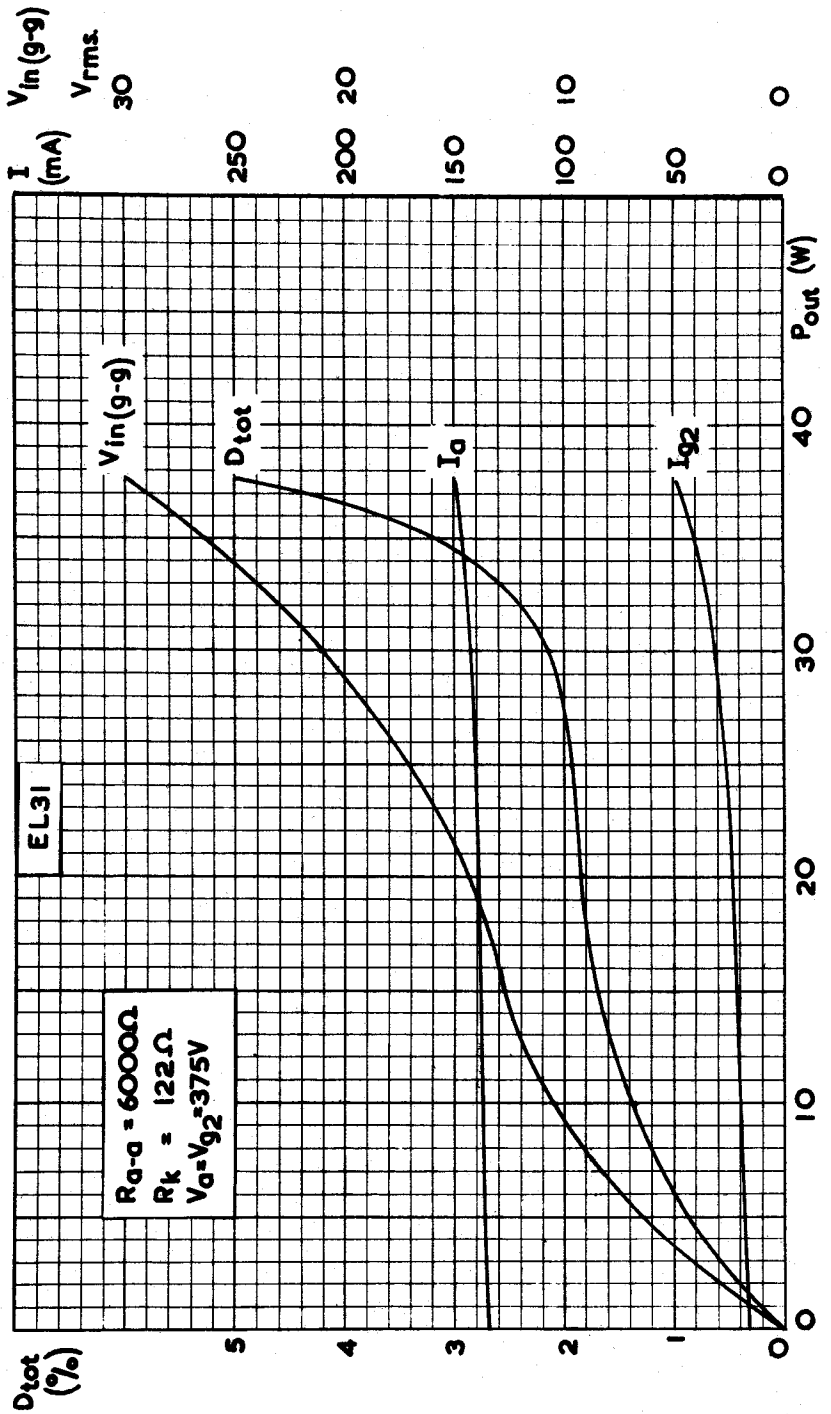


Fig. 7. Push-pull operating conditions for $V_a = V_{g2} = 375$ V. with self bias.

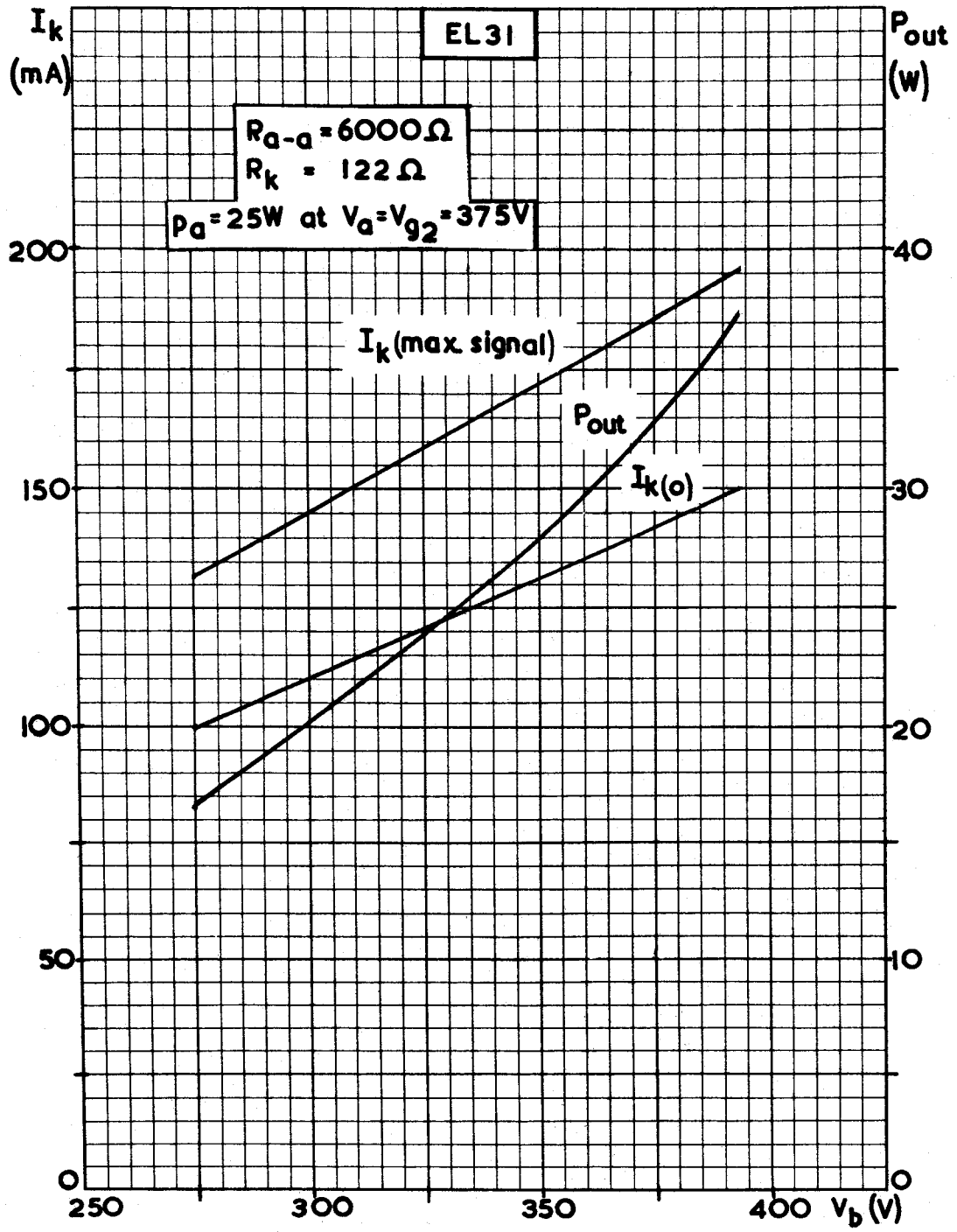


Fig. 8. Push-pull operating conditions with self bias and HT supply having poor regulation. (V_b = 393 V).

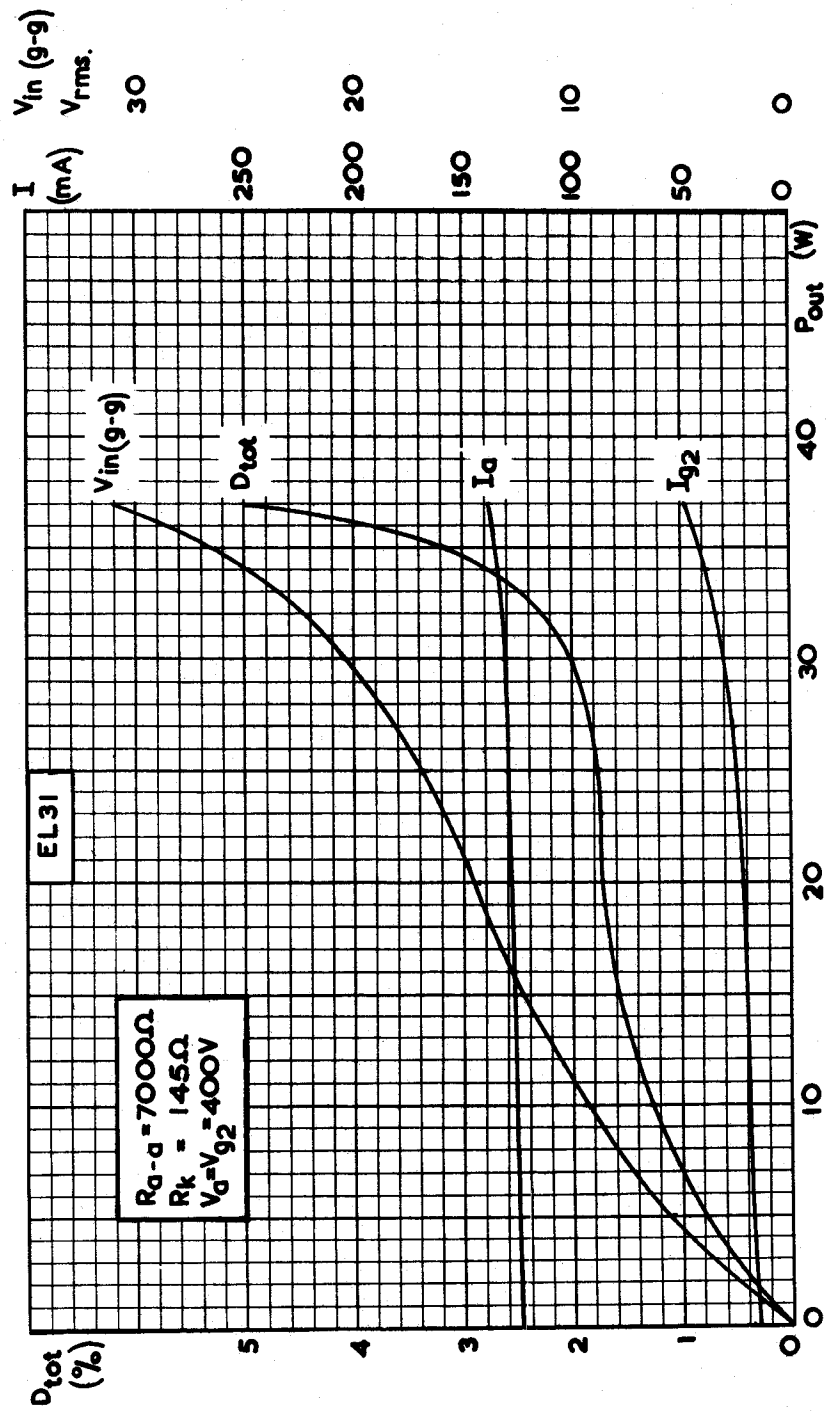


Fig. 9. Push-pull operating conditions for $V_a = V_{g2} = 400$ V. with self bias.

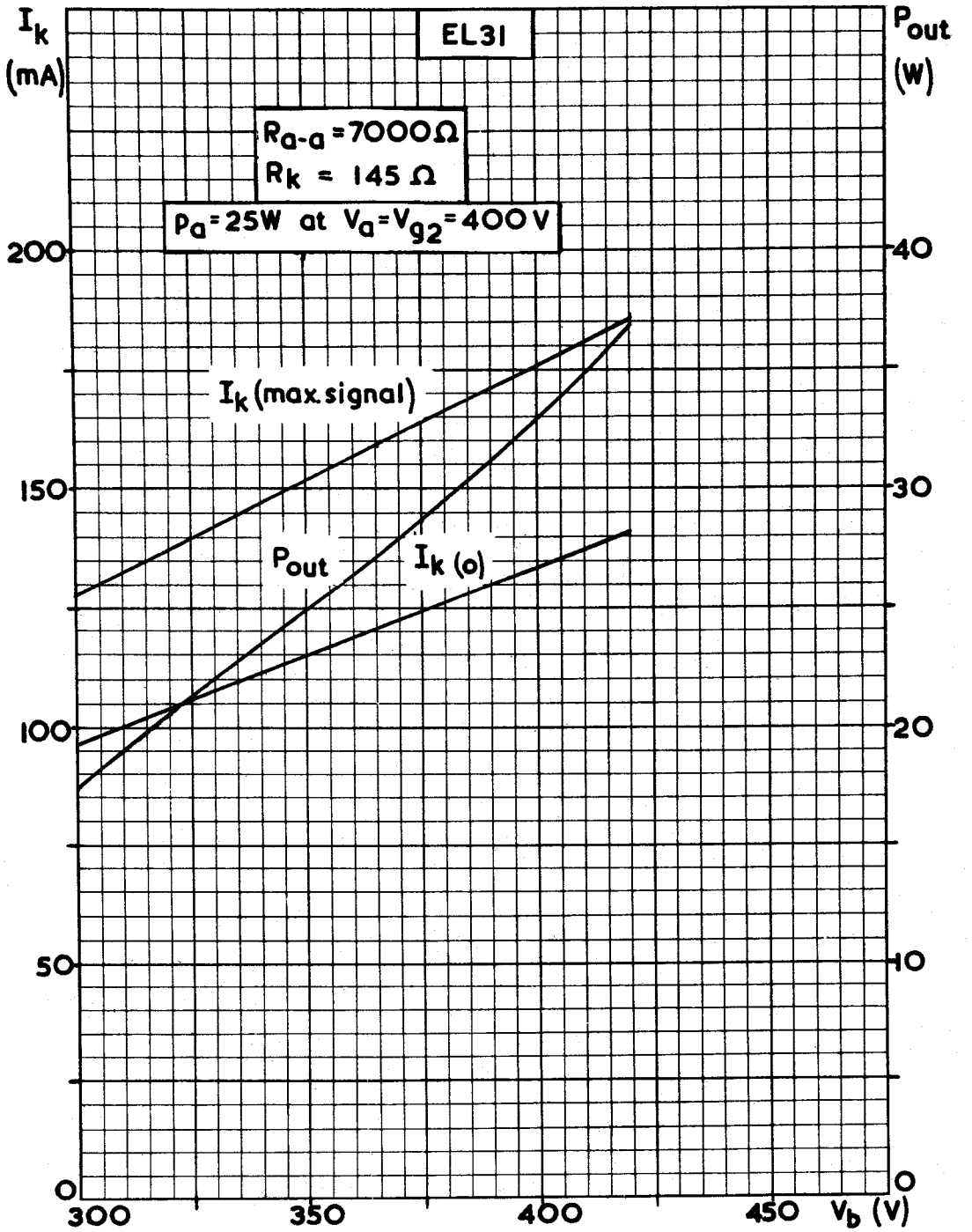


Fig. 10. Push-pull operating conditions with self bias and HT supply having poor regulation. (V_b = 420 V).

5. PUSH PULL OPERATION WITH RC FILTERING FOR SCREEN

The following data is given in view of the modern tendency to dispense with smoothing chokes in the H.T. smoothing circuit. Under such conditions, in order to keep the ripple voltage (approx. 10 volts max.) and the ripple current within the safe limits of the average electrolytic capacitor, it is necessary to use a combination of two 16μF capacitors in parallel. This permits the anodes of the output valves to be fed from the reservoir capacitor and the screen grids and pre-amplifier supplies via an RC filter.

A filter resistor of 1000 ohms is recommended which, together with another 16μF capacitor, provides sufficient smoothing. This results in the cheapest possible reliable smoothing consistent with good performance.

NOTE. The use of lower values of input capacitance and over-running them as far as ripple current is concerned is not recommended.

The following figures were taken under the above mentioned conditions with self bias, the output power being limited by grid current or 5% distortion.

5.1 p_a = 25 watts at V_a = 375 V. (V_b = 392 V)
R_k = 114 ohms.
R_{g2} = 1000 ohms.
R_{a-a} = 6000 ohms.

V_b V	$I_{a(o)}$ mA	$I_{g2(o)}$ mA	I_a (max. sig) mA	I_{g2} (max. sig) mA	V_{in} (g-g) Vrms	P_{out} W	D_{tot} %
392	2 x 67	2 x 8.6	2 x 75	2 x 21	28.4	36.5	5.0
375	2 x 64	2 x 8.2	2 x 70	2 x 20	27.2	33.0	5.0
350	2 x 59	2 x 7.5	2 x 65	2 x 18.5	25.6	28.0	5.0
325	2 x 55	2 x 6.9	2 x 60	2 x 16.8	24.0	24.0	5.0
300	2 x 50	2 x 6.3	2 x 55	2 x 14.3	21.4	19.7	4.5
275	2 x 46	2 x 5.7	2 x 51	2 x 13.2	19.6	16.5	4.4

The above figures are shown graphically in Figs. 11 and 12.

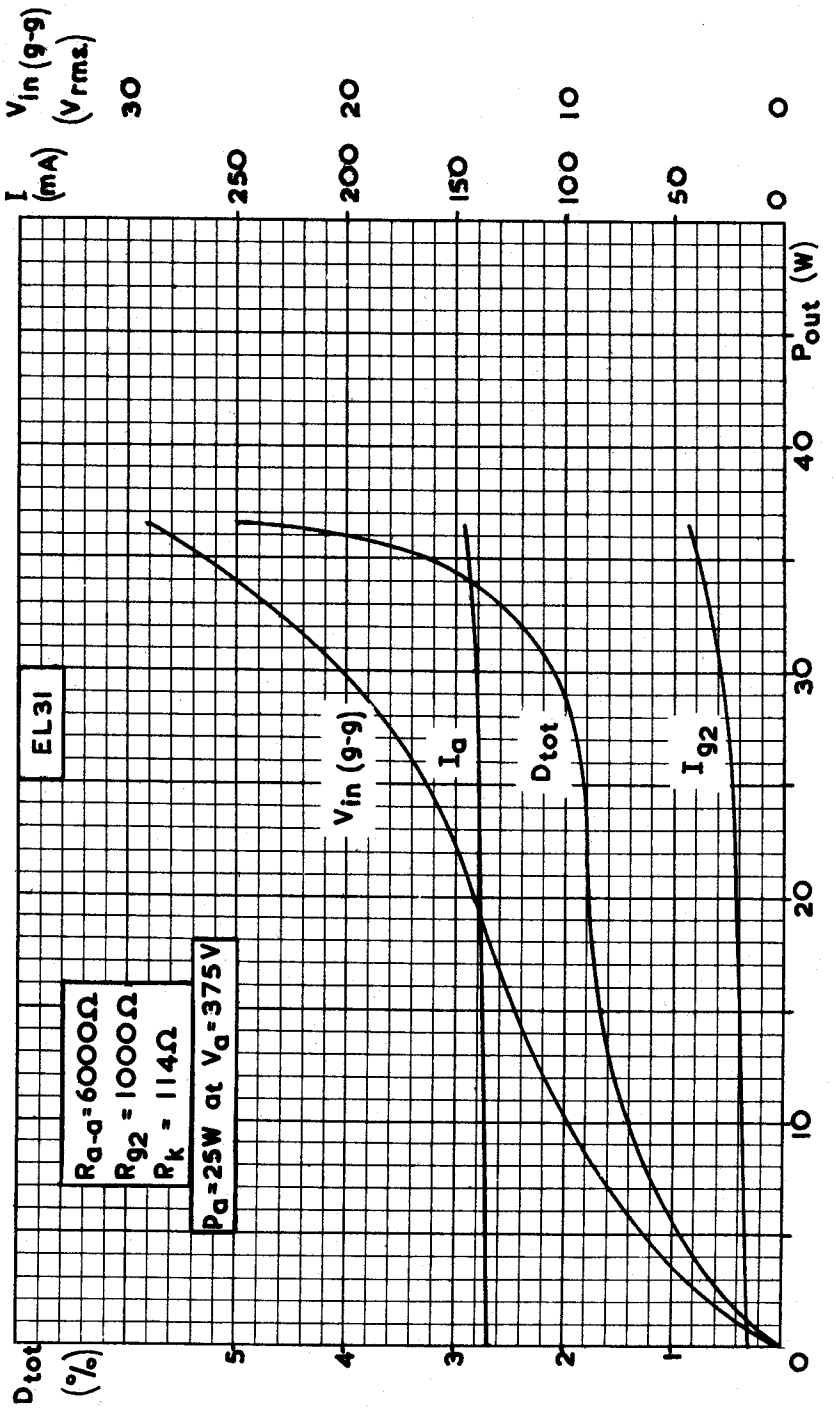


Fig. 11. Push-pull operating conditions with RC filtering for the screen and self bias. (p_a = 25W at V_a = 375 V).

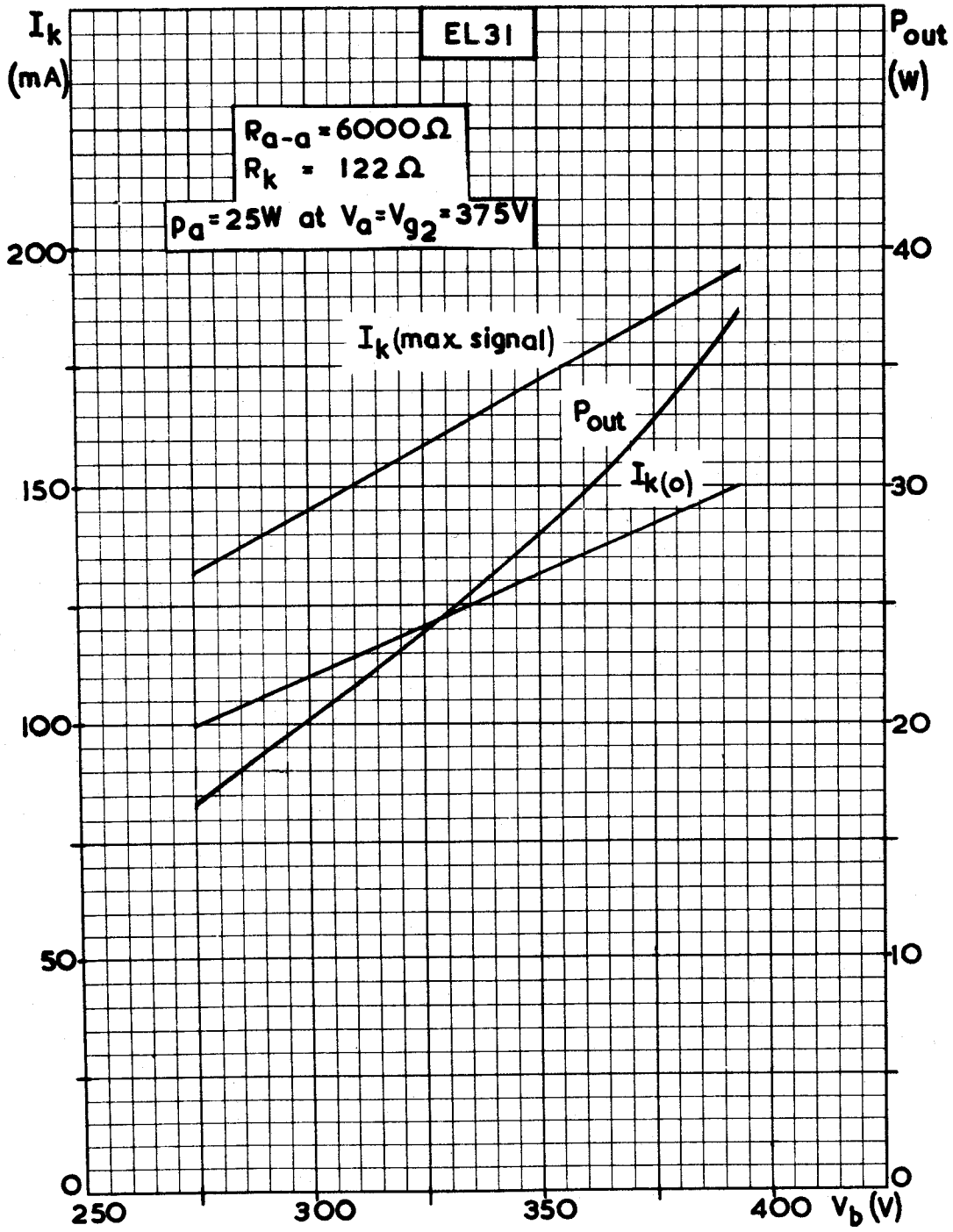


Fig. 12. Push-pull operating conditions with RC filtering for the screen, self bias, and HT supply having poor regulation. (V_b = 393 V).

5.2 p_a = 25 watts at V_a = 400 V. (V_b = 419 V)
R_k = 137 ohms.
R_{g2} = 1000 ohms.
R_{a-a} = 7000 ohms.

V_b V	$I_{a(o)}$ mA	$I_{g2(o)}$ mA	I_a (max. sig) mA	I_{g2} (max. sig) mA	V_{in} (g-g) Vrms	P_{out} W	D_{tot} %
419	2 x 63	2 x 8.2	2 x 67	2 x 21.3	30	36	5.0
400	2 x 60	2 x 7.9	2 x 64	2 x 20.3	28.6	33	5.0
375	2 x 55	2 x 7.2	2 x 60	2 x 18.3	26.8	29	5.0
350	2 x 52	2 x 6.7	2 x 56	2 x 17	25.4	25	5.0
325	2 x 48	2 x 6.1	2 x 52	2 x 15.9	24	21.4	5.0
300	2 x 44	2 x 5.5	2 x 48	2 x 14.5	22	17.7	5.0

The above figures are shown graphically in Figs. 13 and 14.

6. PUSH PULL OPERATION WITH FIXED BIAS

If the H.T. Voltage is decreased when fixed bias is employed the operating conditions approach Class C and distortion becomes intolerable. The no-signal conditions are therefore limited to a fixed point.

6.1 Push-pull operation at Equal Voltages on Anode and Screen

The output figures were measured at the start of grid current.

$V_a = V_{g2}$ = 400 V $I_{a(o)}$ = 2 x 40 mA
R_{a-a} = 4000 ohms V_{g1} = -23V

$V_a = V_{g2}$ V	$I_{a(o)}$ mA	$I_{g2(o)}$ mA	I_a (max. sig) mA	I_{g2} (max. sig) mA	V_{in} (g-g) Vrms	P_{out} W	D_{tot} %
400	2 x 40	2 x 5.2	2 x 110	2 x 26.8	31.4	55	3.5
375			2 x 99	2 x 23.8	31.4	44	3.5
350			2 x 88	2 x 19.3	31.4	36	5.4

Curves for this condition are shown in Figs. 15 and 16.

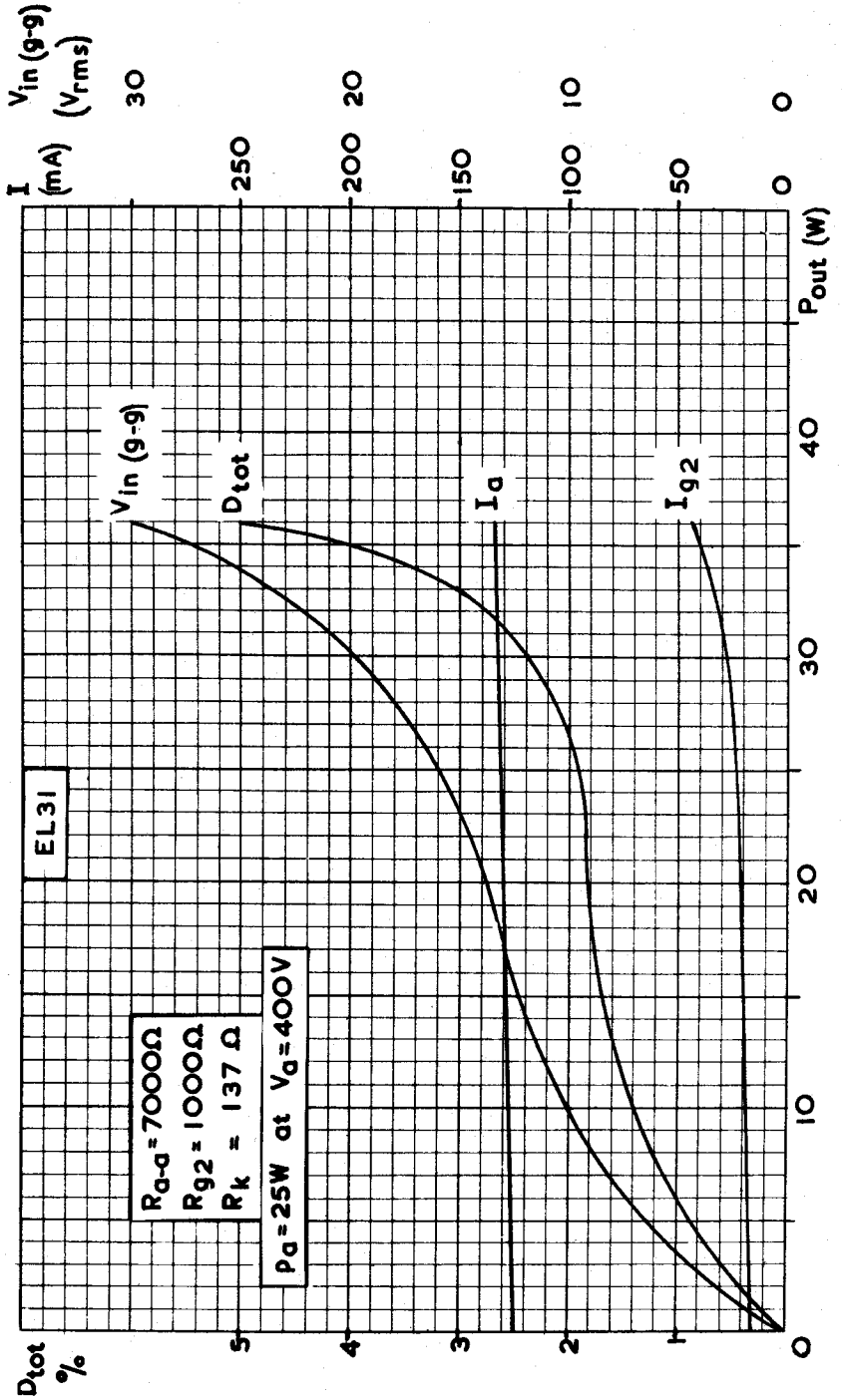


Fig. 13. Push-pull operating conditions with RC filtering for the screen and self bias. (p_a = 25W at V_a = 400 V).

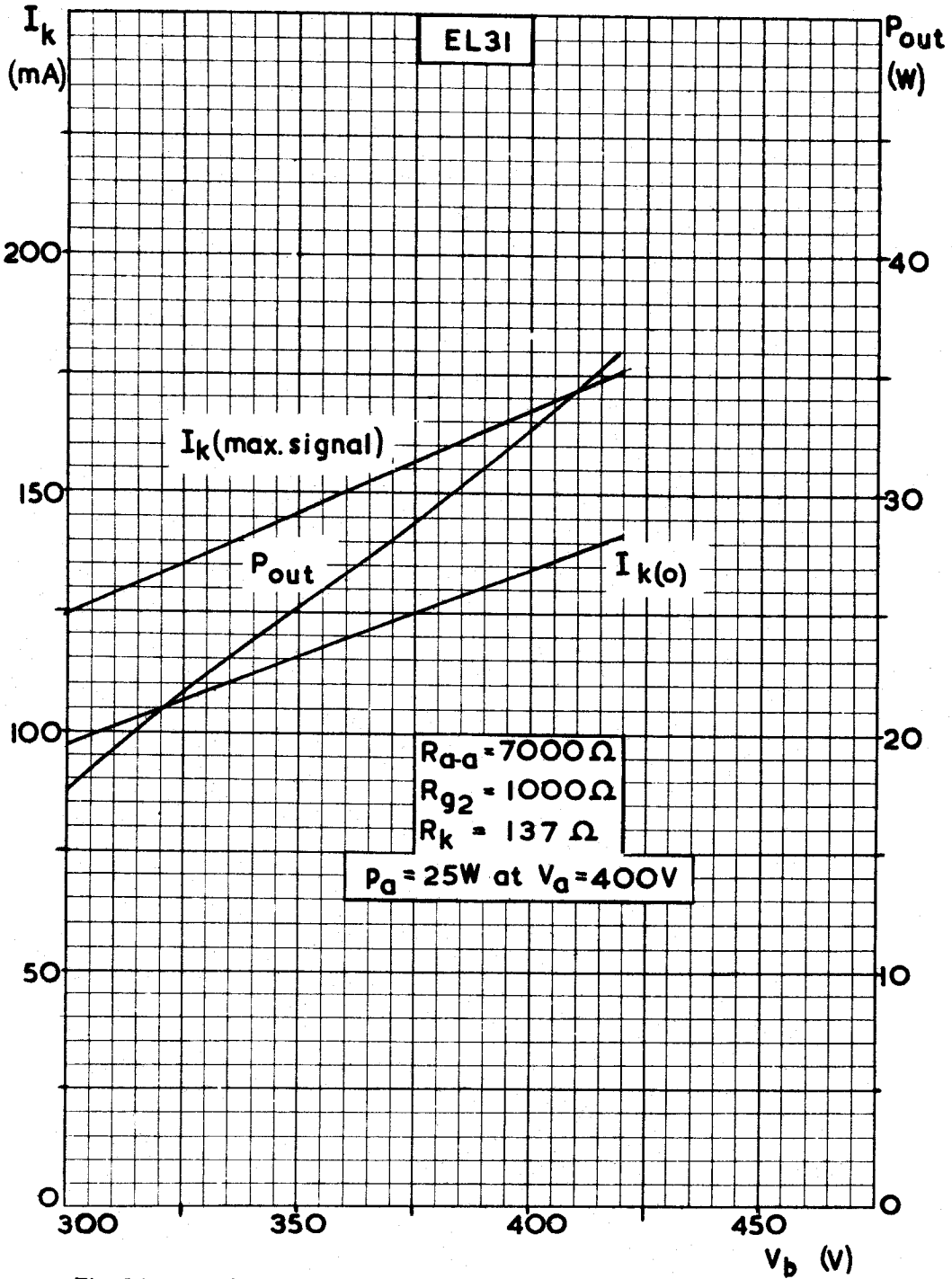


Fig. 14. Push-pull operating conditions with RC filtering for the screen, self bias, and HT supply having poor regulation. (V_b = 419 V).

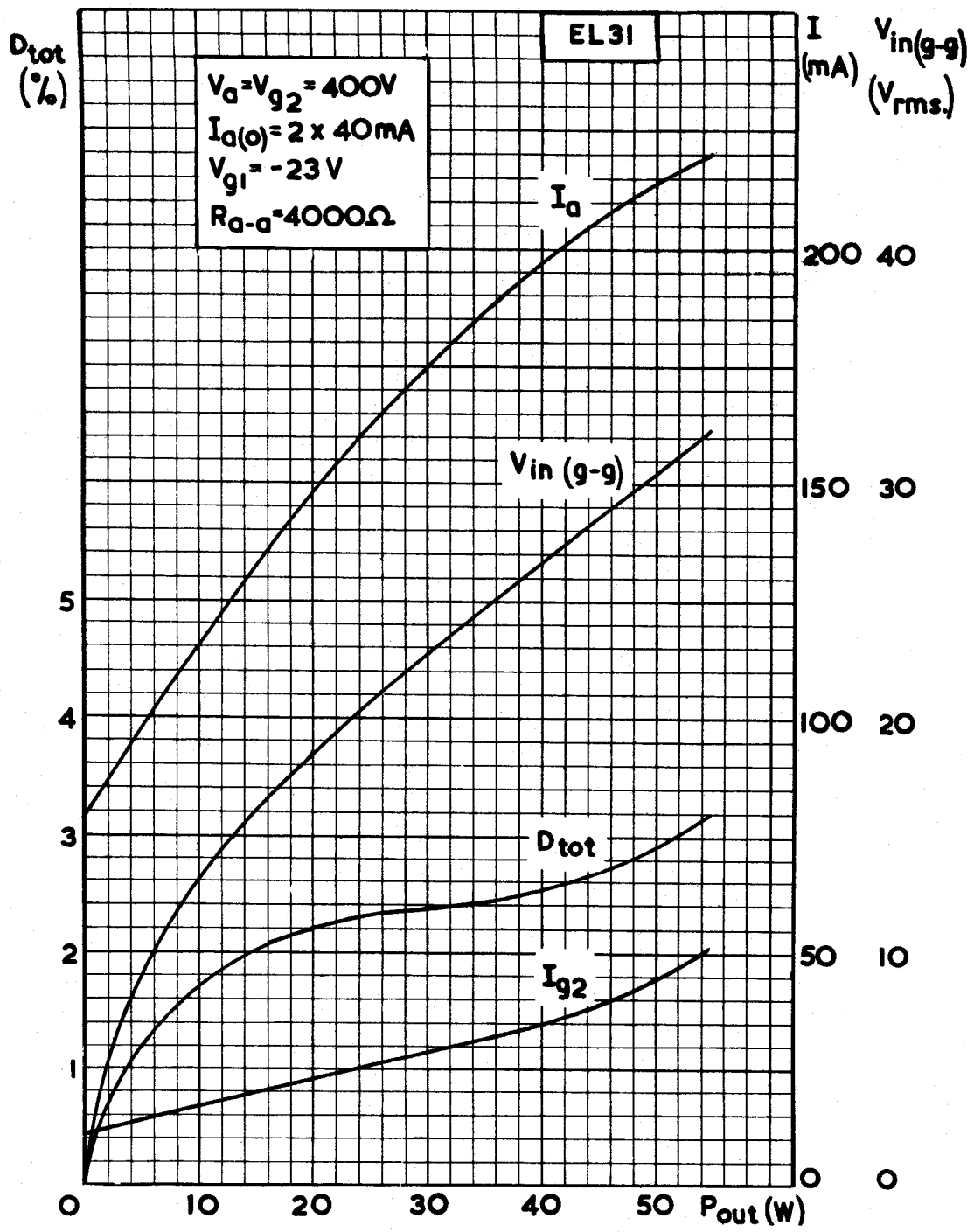


Fig. 15. Push-pull operating conditions for $V_a = V_{g2} = 400$ V. with fixed bias.

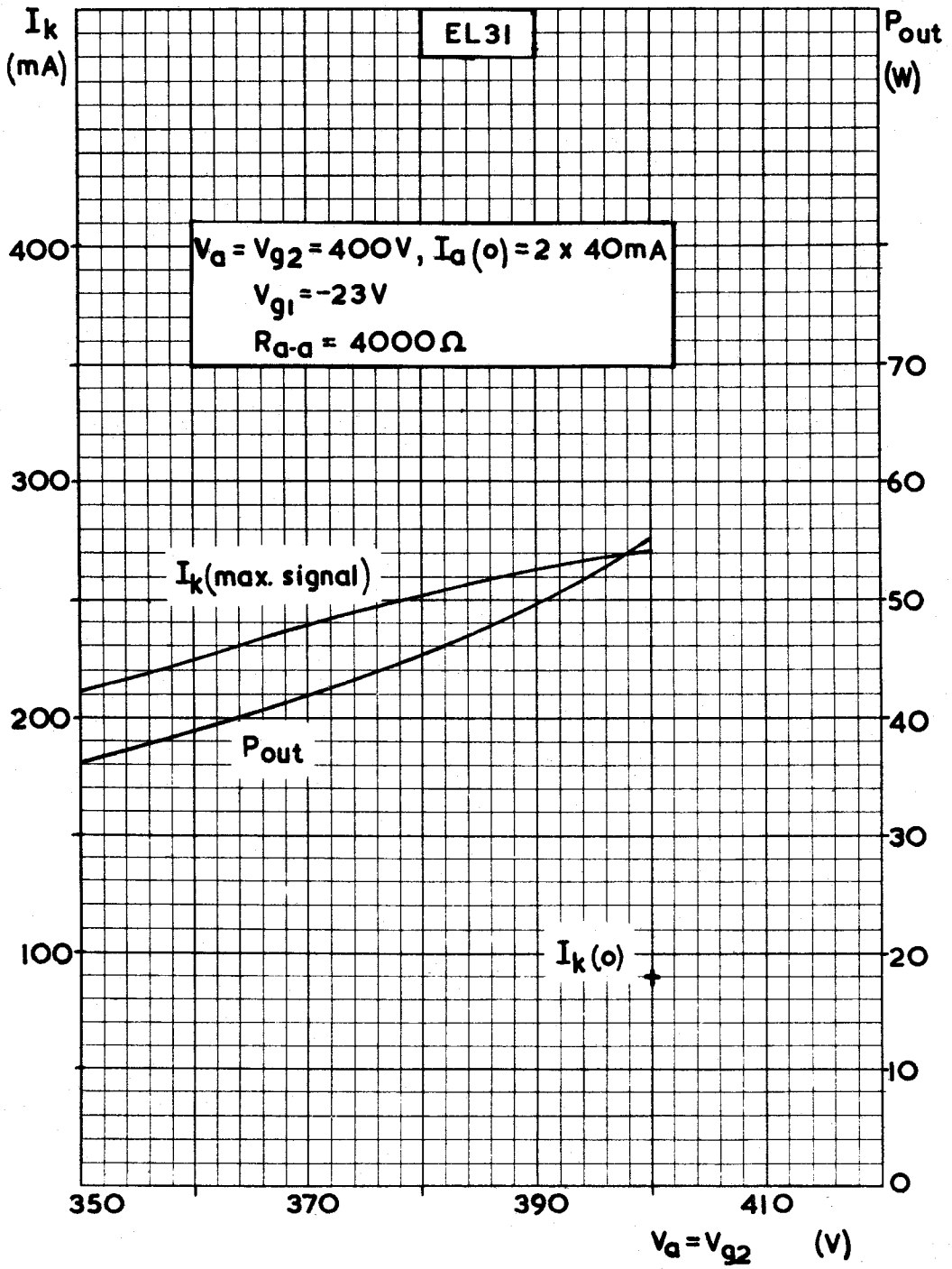


Fig. 16. Push-pull operating conditions with fixed bias and HT supply having poor regulation. ($V_b = 400$ V).

6.2 Push-pull operation at Unequal Voltages on Anode and Screen

Under this condition, when the regulation curve of the anode and screen power supplies are plotted against the respective curves of anode and screen current the lower of the two values of output power should be taken as the obtainable output.

V_a = 600V
V_{g2} = 400V
$I_{a(o)}$ = 2 x 30 mA
V_{g1} = -25.2V
R_{a-a} = 7500 ohms

V_a V	V_{g2} V	$I_{a(o)}$ mA	$I_{g2(o)}$ mA	I_a (max. sig) mA	I_{g2} (max. sig) mA	V_{in} g-g Vrms	P_{out} W	D_{tot} %
600	400	2 x 30	2 x 3.4	2 x 103	2 x 28.5	34.6	84	5.0
562	375			2 x 89	2 x 23	34.6	67	5.2
525	350			2 x 79	2 x 20	34.6	54	7.6

These figures are shown graphically in Figs. 17, 18 and 19.

6.3

V_a = 800 V
V_{g2} = 400 V
$I_{a(o)}$ = 2 x 30 mA
V_{g1} = - 26 V
R_{a-a} = 10,000 ohms

V_a V	V_{g2} V	$I_{a(o)}$ mA	$I_{g2(o)}$ mA	I_a (max. sig) mA	I_{g2} (max. sig) mA	V_{in} g-g Vrms	P_{out} W	D_{tot} %
800	400	2 x 30	2 x 3.1	2 x 107	2 x 28.5	36	120	5.0
750	375			2 x 92	2 x 22.5	36	94	5.5
700	350			2 x 80	2 x 17.5	36	75	8.4

These figures are shown graphically in Figs. 20, 21 and 22.

It is essential in this last application that meters are included in the anode circuits because a small decrease in grid bias will cause the anode dissipation to be exceeded. For speech amplification the no-signal anode current could be reduced to 2 x 20 mA in order to effect a greater economy in H.T. Current.

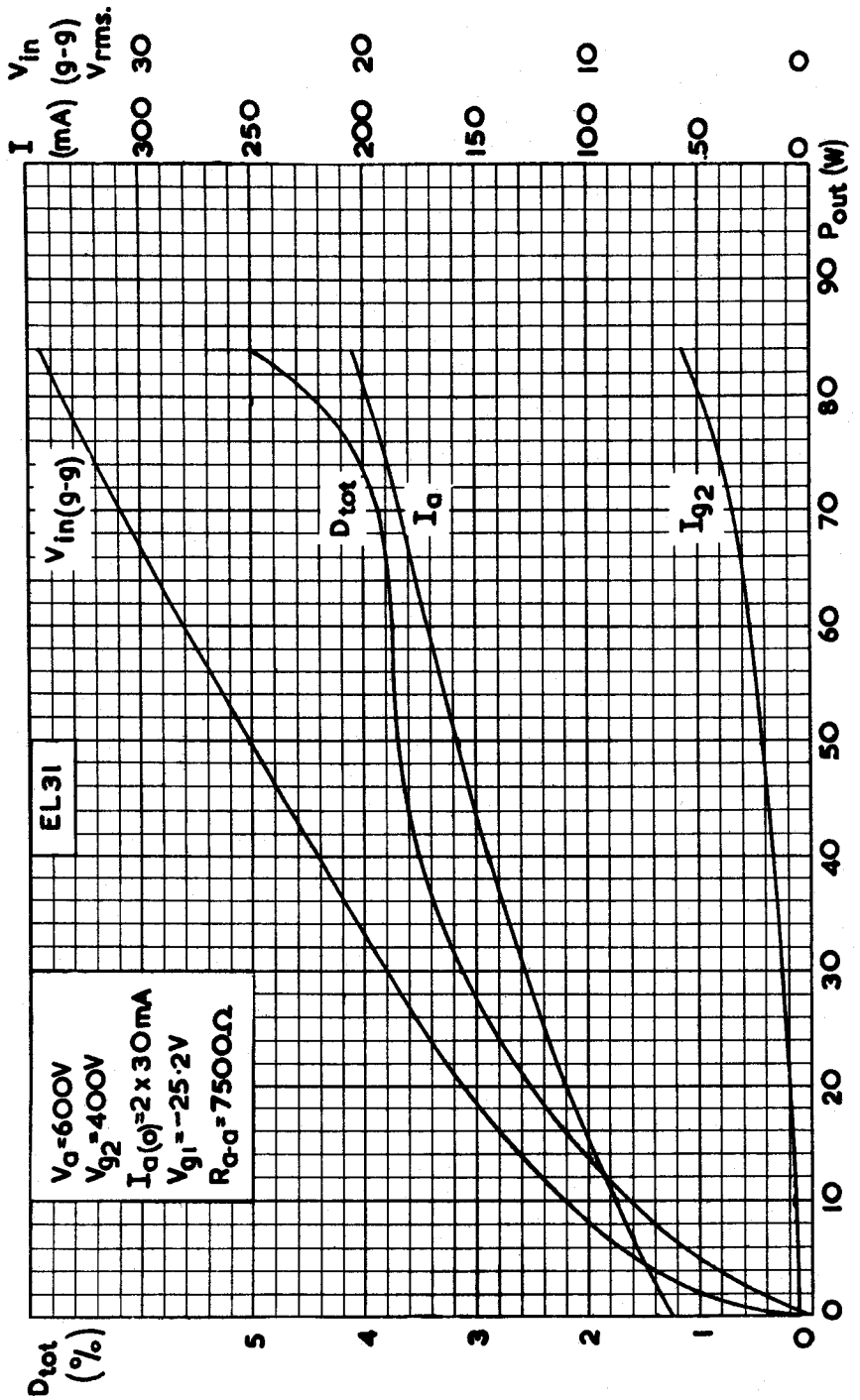


Fig.17. Push-pull operating conditions for V_a = 600 V. V_{g2} = 400 V. with fixed bias.

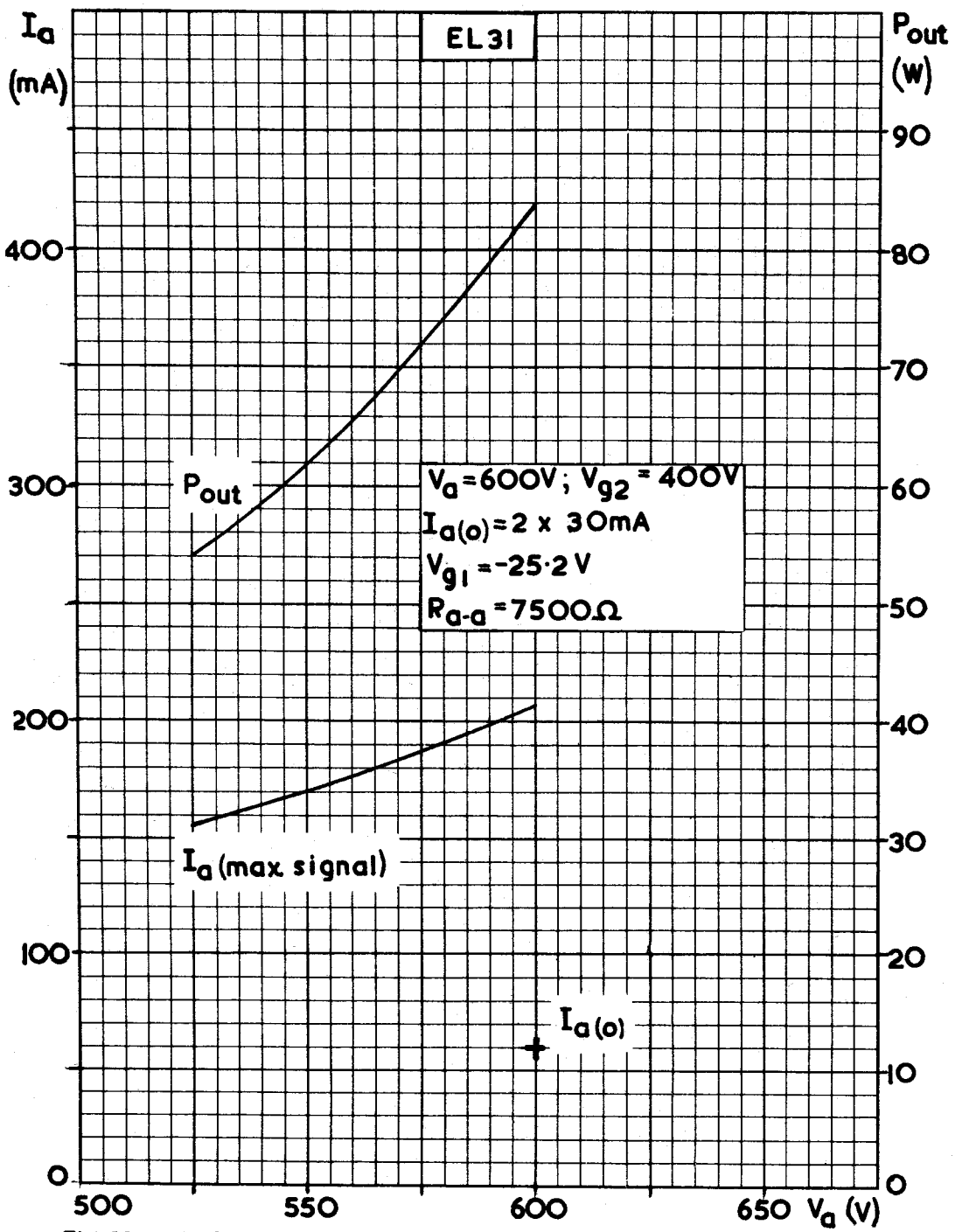


Fig. 18. Push-pull operating conditions with fixed bias and anode supply having poor regulation. ($V_{a(b)}$ = 600 V).

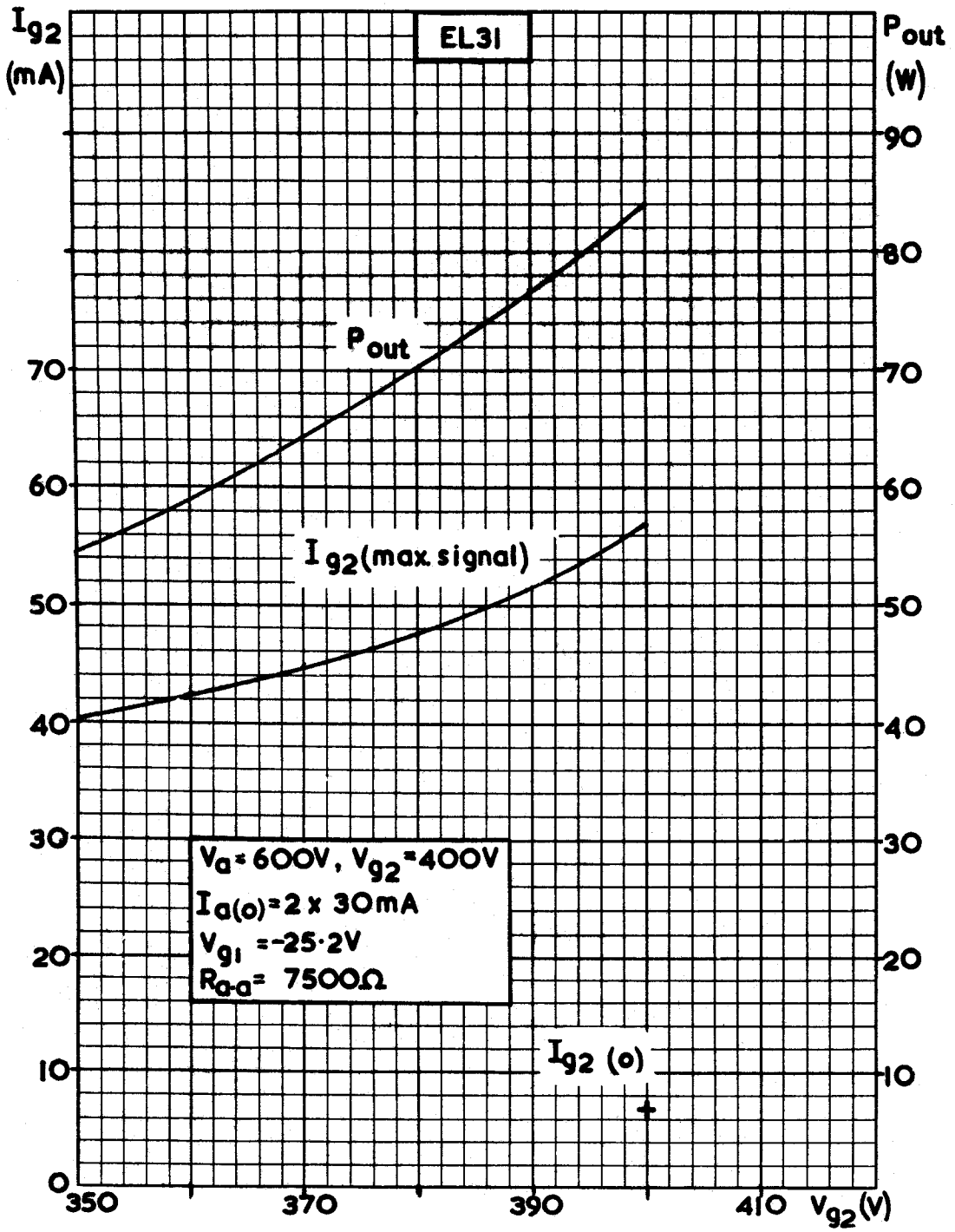


Fig. 19. Push-pull operating conditions with fixed bias and screen supply having poor regulation. ($V_{g2(b)}$ = 400 V. at V_a = 600 V).

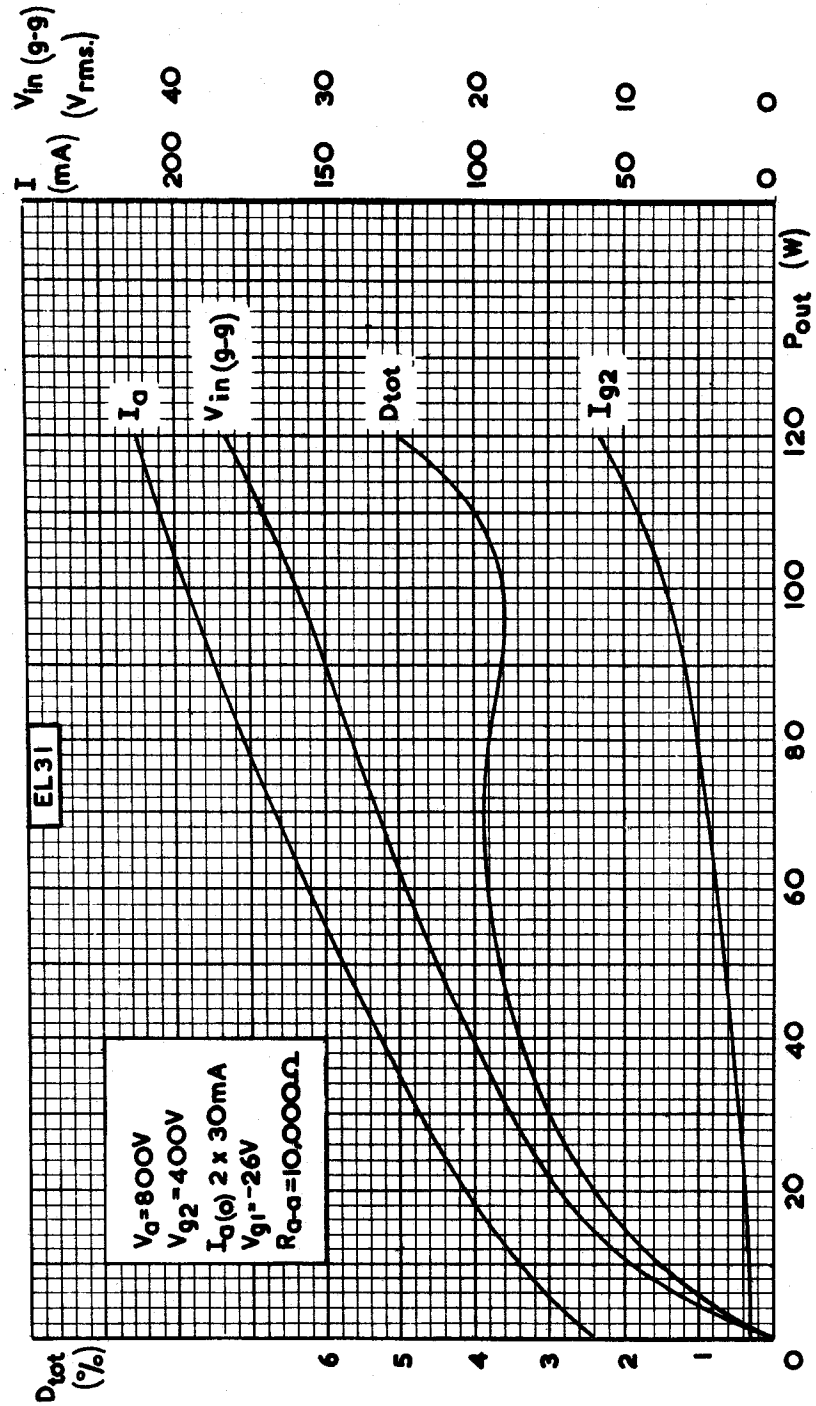


Fig. 20. Push-pull operating conditions for V_a = 800 V. V_{g2} = 400 V. with fixed bias.

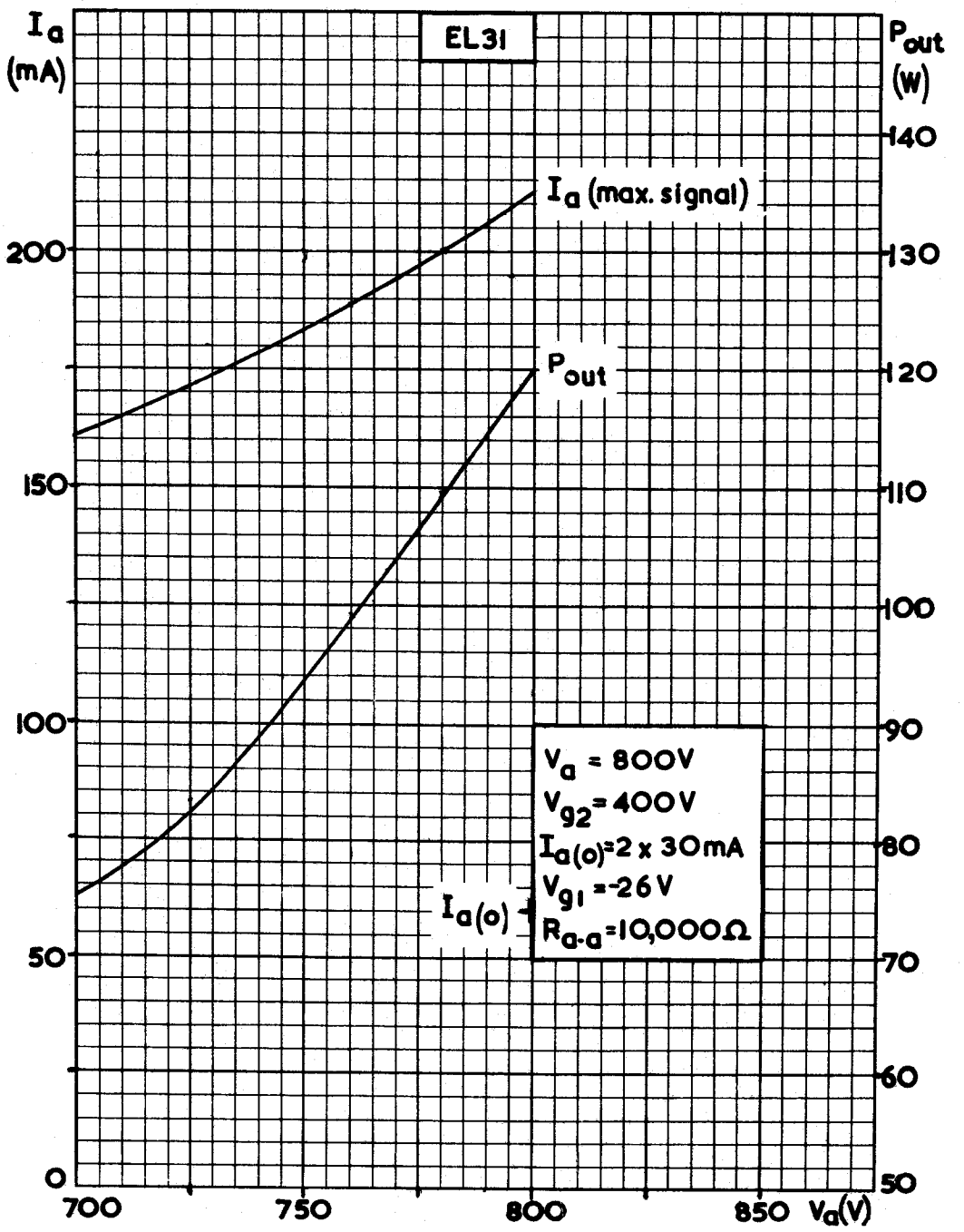


Fig. 21. Push-pull operating conditions with fixed bias and anode supply having poor regulation. ($V_{a(b)}$ = 800 V).

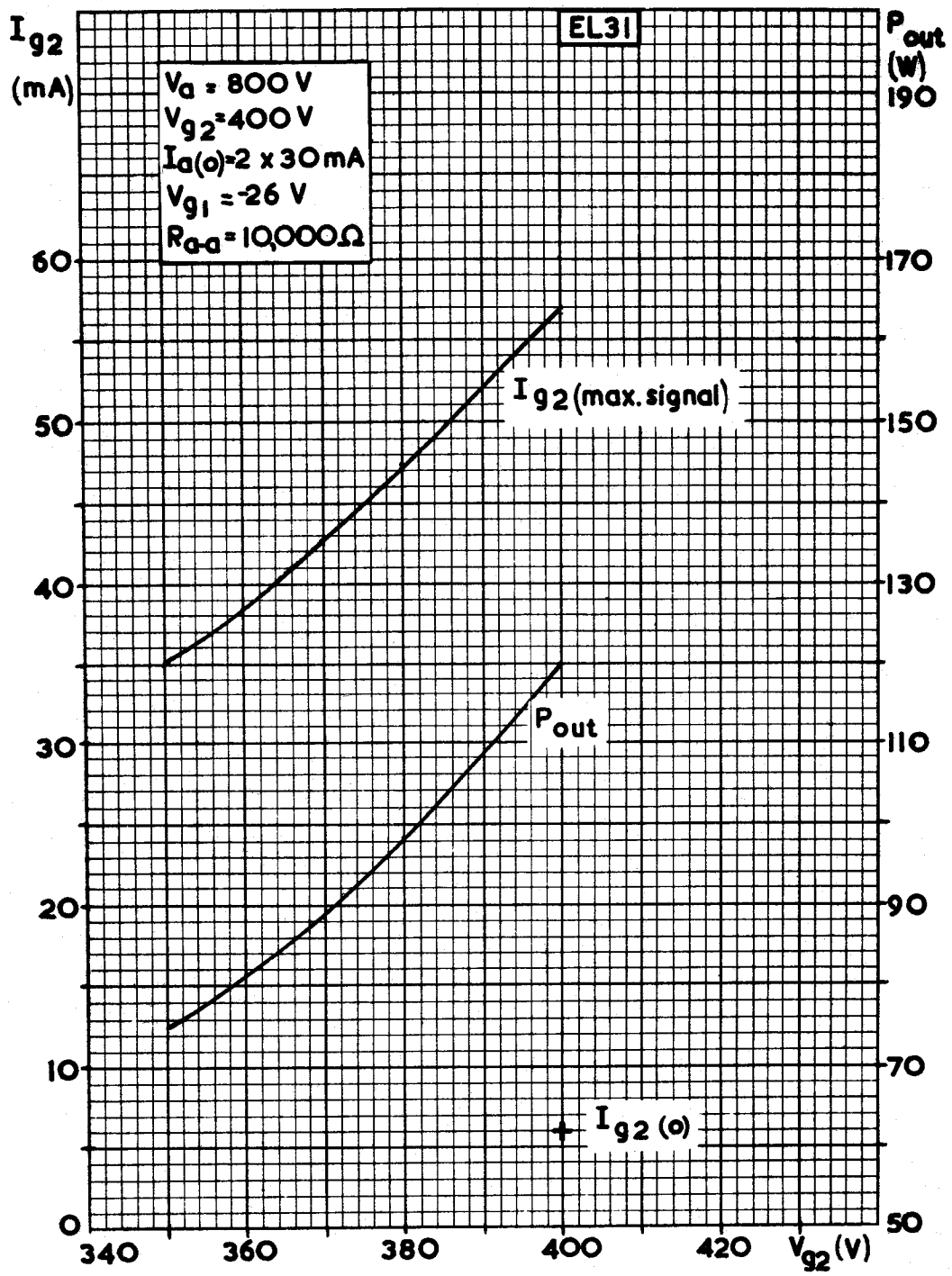


Fig. 22. Push-pull operating conditions with fixed bias and screen supply having poor regulation. ($V_{g2(b)}$ = 400 V. at V_a = 800 V).

7. GENERAL NOTES

7.1 Prevention of Parasitic Oscillation

In order to prevent parasitic oscillation in the output stage it is advisable to include resistors of the values stated below in the screen grid and control grid leads, as close to the valve holder as possible.

Screen grid circuit	47 ohms ½ watt.
Control grid circuit	1000 ohms ½ watt.

7.2 Full drive values of I_a and I_{g2}

All the measurements given in this publication were taken with a sinusiodal input voltage. Under normal conditions of speech and music input, the full drive valves of I_a and I_{g2} will be smaller.

7.3 Screen dissipation

The EL31Ø in push-pull stages is intended for speech and music amplification, and it is unwise to drive the valves fully with a continuous sine wave. In applications where there is a risk of over-running the screens, as for instance in amplifiers which are often over-loaded or which are occasionally mis-matched, a common limiting resistance of 2000 ohms in the lead to the two screens is a suitable precaution.

As, however, this would result in an appreciable loss in the maximum available power output, a better solution is to connect a 200-230 V 25 watt electric lamp in series with the screens. At the low screen currents which normally occur, the resistance of such a lamp is low, but increases rapidly with increasing current. In this manner the screens are protected against overloads at the cost of only about 10% loss in maximum power output.

7.4 Output Power

The figures quoted for output power in the previous paragraphs are for the power delivered by the valve or valves into the output transformer. The power obtained in a load connected in the secondary circuit of the transformer will be slightly smaller owing to losses in the transformer.

OUTPUT PENTODE

EL32

Output pentode with 200mA. heater for use in A.C., D.C./A.C. or car radio receivers.

HEATER

This valve is suitable for DC/AC operation.

V_h	6.3	V
I_h	0.2	A

OPERATING CONDITIONS AS CLASS 'A' AMPLIFIER

V_a	250	V
V_{g2}	250	V
V_{g1}	-18	V
I_a	32	mA
I_{g2}	5	mA
g_m	2.8	mA/V
r_a	70,000	ohms
R_a	8,000	ohms
W_{out}	3.6	W
$V_{in(rms)}$	10	V
D_{tot}	10	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

V_a	200	250	V
V_{g2}	200	250	V
R_k	300	310	ohms
I_{ao}	2x21	2x27.5	mA
I_a max	2x24.5	2x32	mA
I_{g2o}	2x3.85	2x4.4	mA
I_{g2} max.	2x6.1	2x8.0	mA
R_a (anode to anode)	9,000	8,000	ohms
W_{out}	5.1	7.0	W
D_{tot}	1.6	1.5	%

OPERATING CONDITIONS AS TRIODE

V_a	200	200	250	250	V
V_{g1}	-19	-14	-27	-20	V
I_a	15	30	15	30	mA
g_m	2.1	3.2	1.7	2.6	mA/V
r_a	3,300	2,400	4,100	3,100	ohms
μ	7	8	7	8	

EL32

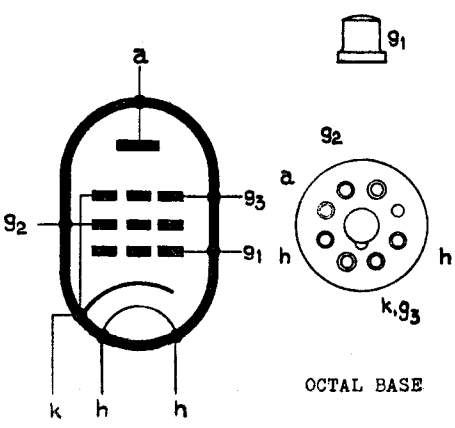
OUTPUT PENTODE

Output pentode with 200mA. heater for use in A.C., D.C./A.C. or car radio receivers.

LIMITING VALUES

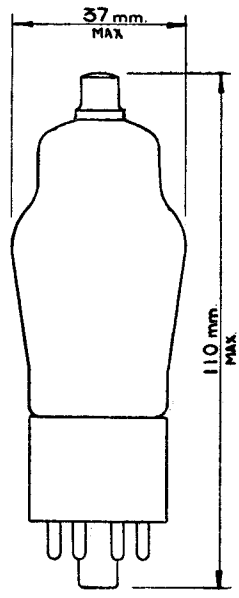
$V_{a(b)}$ max.	550	V
V_a max.	250	V
w_a max.	8	W
I_k max.	45	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
w_{g2} max.	1.6	W
V_{g1} max. (I_{g1}=0.3uA)	-1.3	V
R_{h-k} max.	5,000	ohms
R_{g1} max.(Self bias)	1	megohm
R_{g1} max.(Fixed bias)	0.6	megohm
V_{h-k} max.	50	V

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



OCTAL BASE

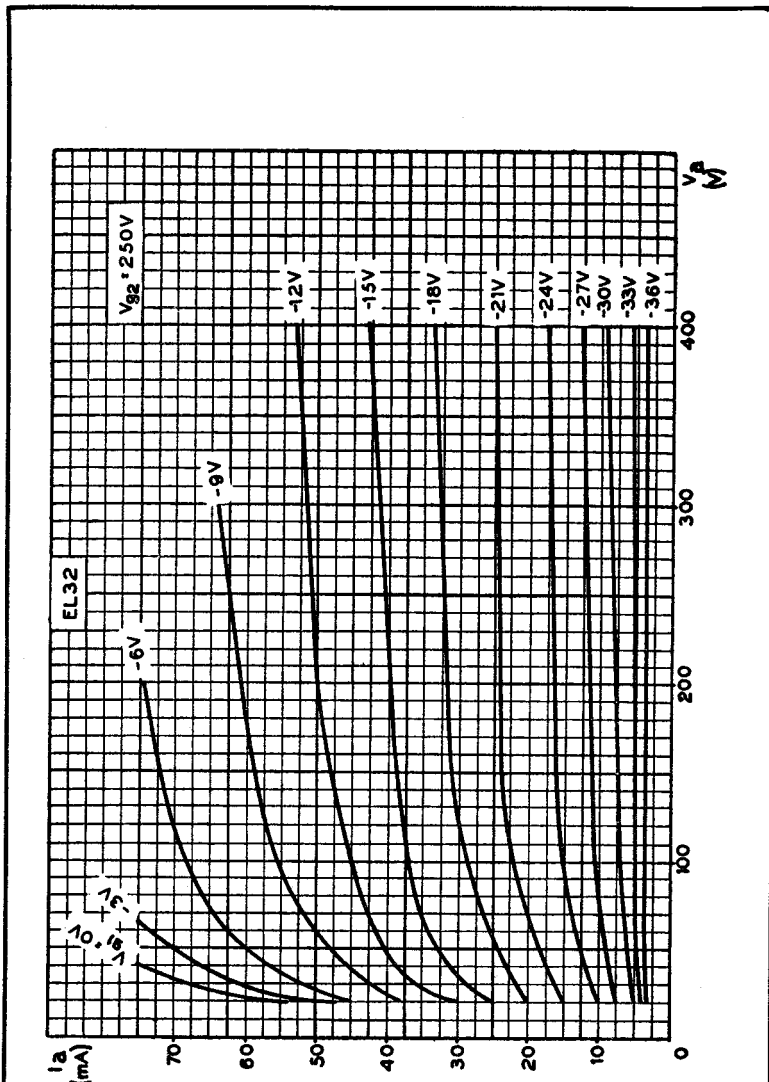
DIMENSIONS



OUTPUT PENTODE

EL32

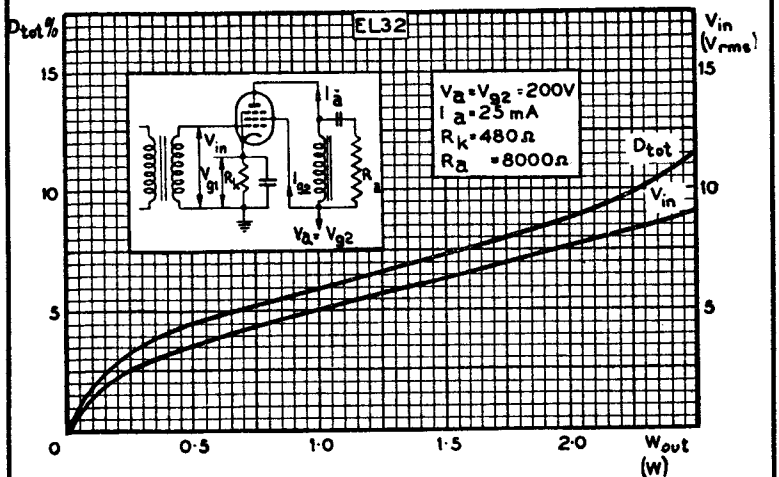
Output pentode with 200mA. heater for use in A.C., D.C./A.C. or car radio receivers.

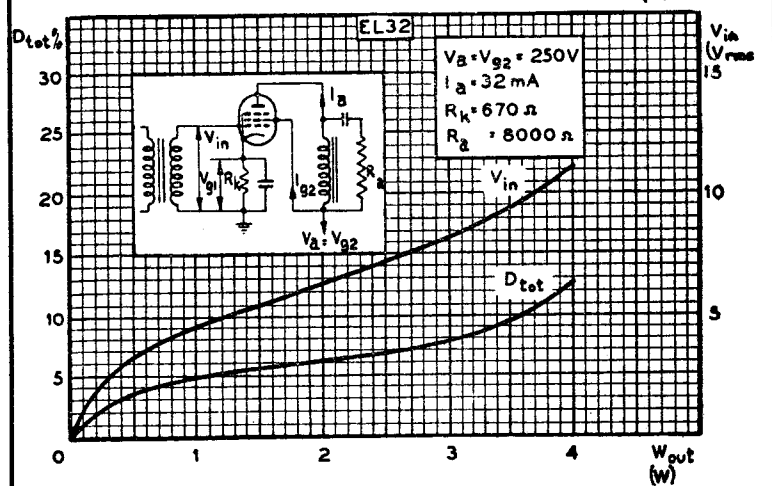


EL32

OUTPUT PENTODE

Output pentode with 200mA. heater for use in A.C., D.C./A.C. or car radio receivers.

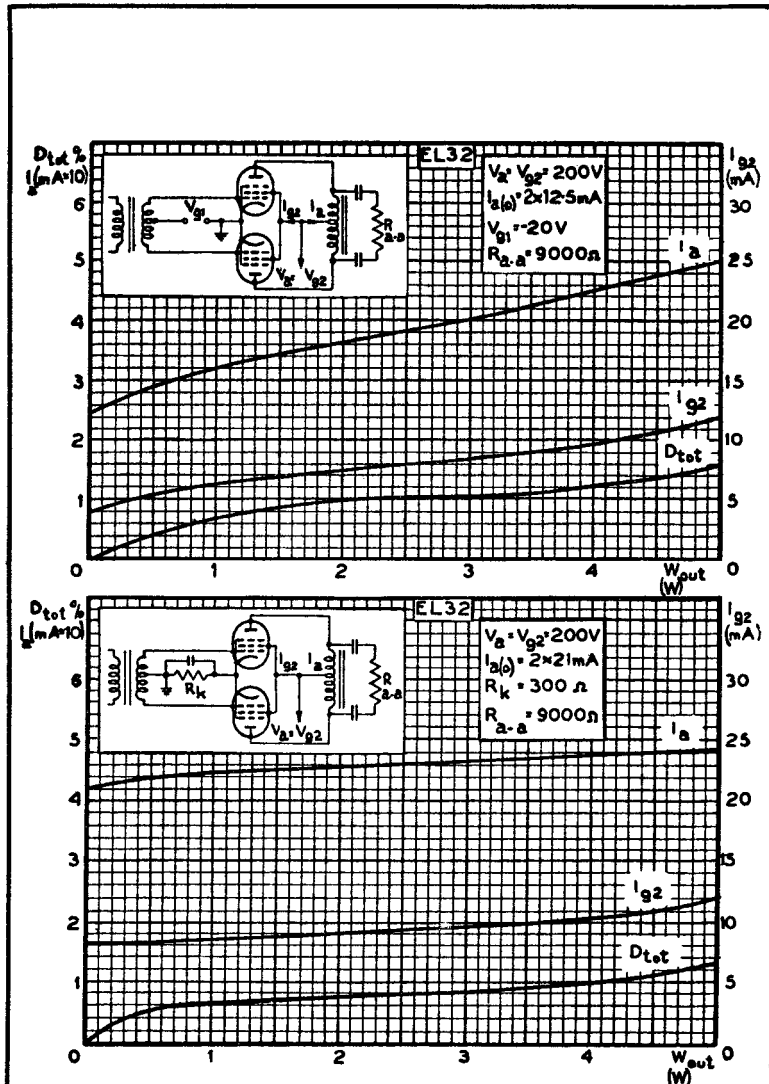




OUTPUT PENTODE

EL32

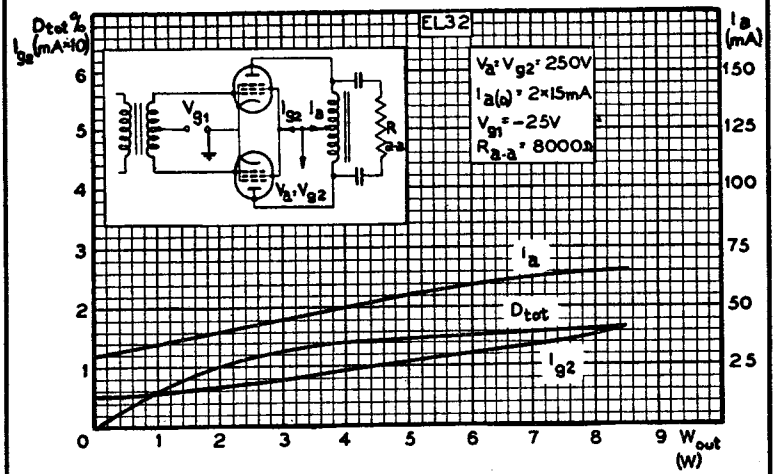
Output pentode with 200mA. heater for use in A.C., D.C./A.C. or car radio receivers.

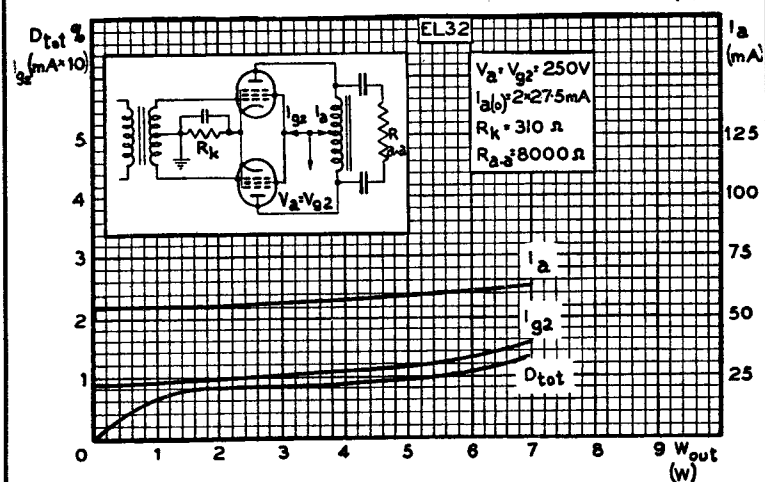


EL32

OUTPUT PENTODE

Output pentode with 200mA. heater for use in A.C., D.C./A.C. or car radio receivers.

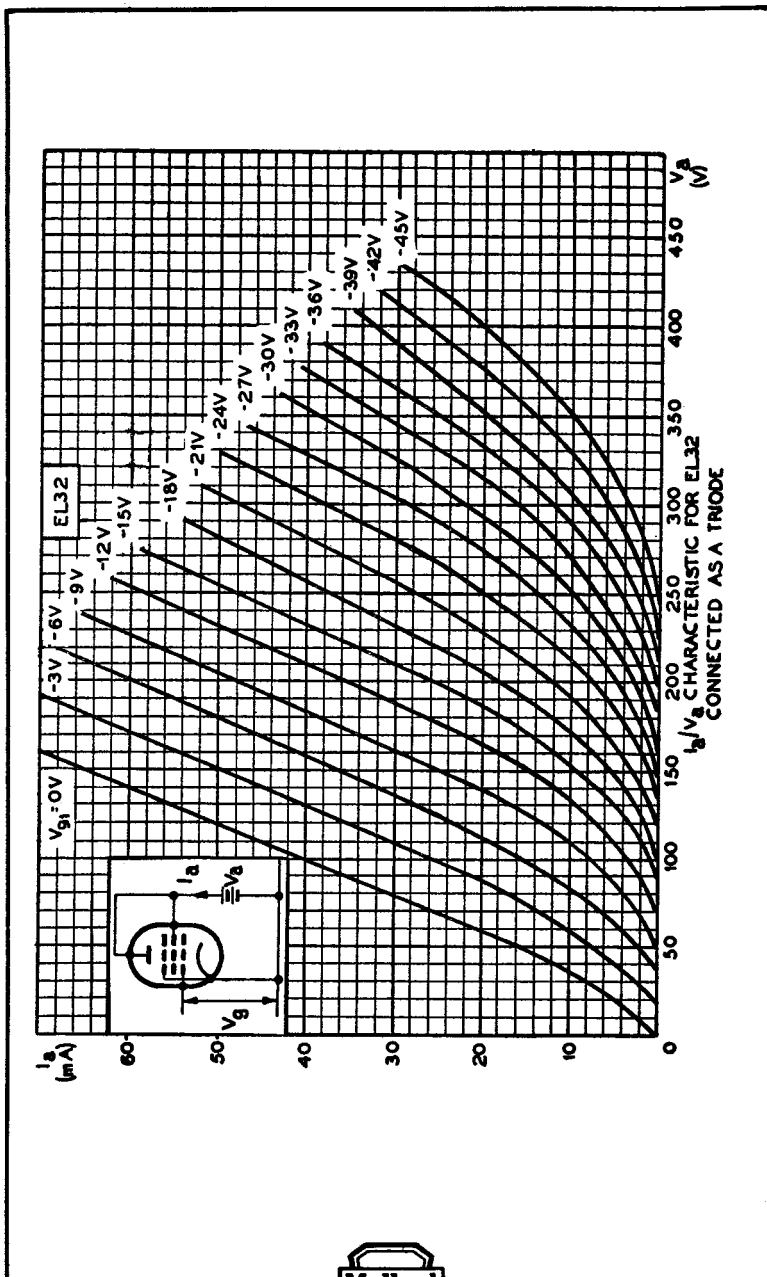




OUTPUT PENTODE

EL32

Output pentode with 200mA. heater for use in A.C., D.C./A.C. or car radio receivers.

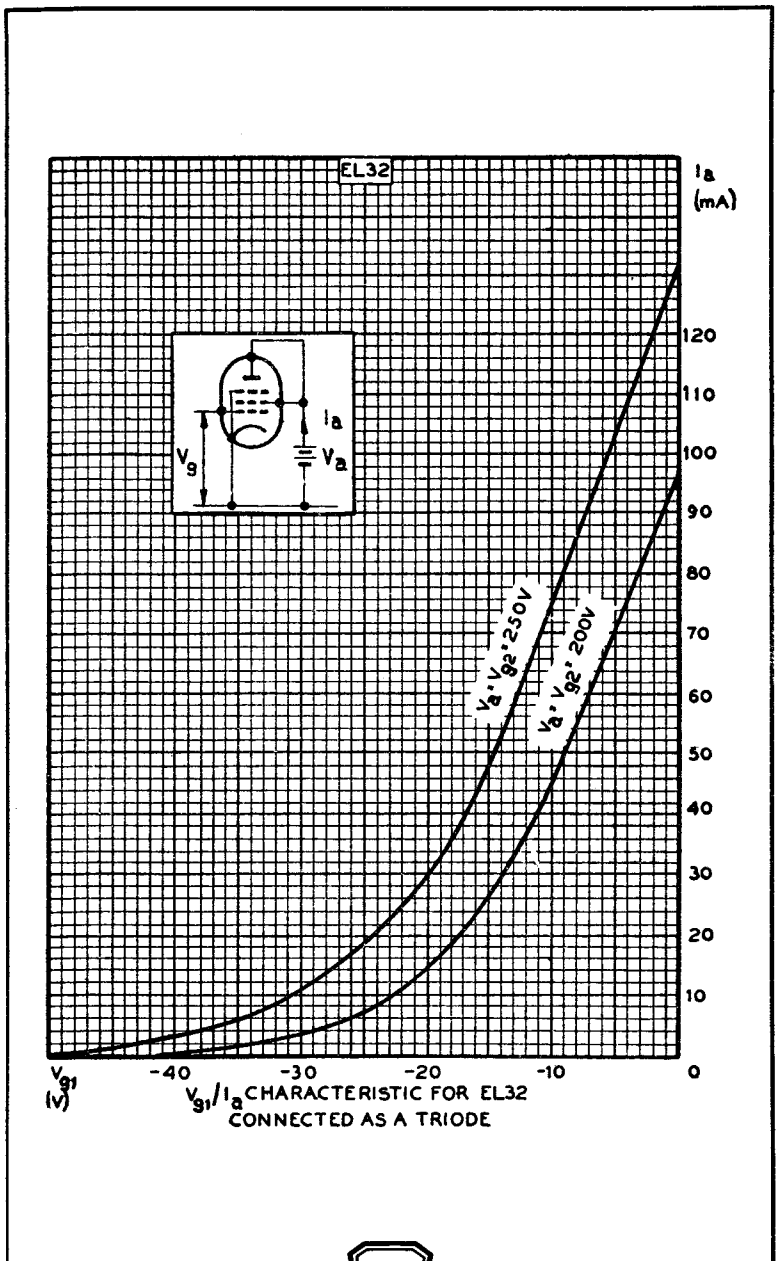


Mullard

EL32

OUTPUT PENTODE

Output pentode with 200mA. heater for use in A.C., D.C./A.C. or car radio receivers.



V_{g1}/I_a CHARACTERISTIC FOR EL32 CONNECTED AS A TRIODE

OUTPUT PENTODE

EL34

Output pentode rated for 25W anode dissipation, intended for use in a.c. mains operated equipment.

HEATER

V_h	6.3	V
I_h	1.5	A

CAPACITANCES

C_{out}	8.4	pF
C_{in}	15.2	pF
C_{a-g1}	<1.0	pF
C_{g1-h}	<1.0	pF
C_{h-k}	11	pF

CHARACTERISTICS

Pentode connection

V_a	250	V
V_{g2}	250	V
V_{g3}	0	V
I_a	100	mA
I_{g2}	15	mA
V_{g1}	−12.2	V
g_m	11	mA/V
r_a	15	kΩ
μ_{g1-g2}	11	
V_{g1} max. (I_{g1} = +0.3μA)	−1.3	V

Triode connection (g_2 connected to a)

V_a	250	V
I_a	70	mA
V_{g1}	−15.5	V
g_m	11.5	mA/V
r_a	910	Ω
μ	10.5	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Pentode connection

V_a	250	300	V
V_{g2}	250	300	V
V_{g3}	0	0	V
R_k	106	190	Ω
R_a	2.0	3.5	kΩ
I_a	100	83	mA
I_{g2}	15	13	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	500	450	mV
$V_{in(r.m.s.)}$	8.0	8.2	V
*P_{out}	11	11	W
*D_{tot}	10	10	%

*P_{out} and D_{tot} are measured at fixed bias and therefore represent the power output available during the reproduction of speech and music. When a sustained sine wave is applied to the control-grid the bias across the cathode resistor will readjust itself as a result of the increased anode and screen-grid currents. This will result in a reduction in power output of approximately 10%.

EL34

OUTPUT PENTODE

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Distributed load conditions for maximum output (screen-grid tapping at 20% of primary turns)

V_b	450	V
R_{g2} (per valve)	1.0	kΩ
R_k (per valve)	500	Ω
R_{a-a}	7.0	kΩ
$I_{a(o)}$	2×55	mA←
$I_{g2(o)}$	2×9.0	mA←
$V_{in(g1-g1)r.m.s.}$	55.2	V
P_{out}	40	W
D_{tot}	4.5	%
$I_{a(max.\ sig.)}$	2×74	mA
$I_{g2(max.\ sig.)}$	2×9.0	mA

Distributed load conditions for minimum distortion (with screen-grid tapping at 43% of primary turns)

V_b	430	430	V
R_{g2} (per valve)	1.0	1.0	kΩ
R_k (per valve)	470	470	Ω
R_{a-a}	6.0	6.0	kΩ
$I_{a(o)}$	2×62.5	2×62.5	mA
$I_{g2(o)}$	2×10	2×10	mA
$V_{in(g1-g1)r.m.s.}$	35	50	V
P_{out}	20	34	W
D_{tot}	0.35	2.5	%
$I_{a\ (max.\ sig.)}$	2×65	2×70	mA
$I_{g2(max.\ sig.)}$	2×10.2	2×14	mA

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Fixed bias

V_b	375	400	V
V_{g3}	0	0	V
*R_{g2}	600	800	Ω
V_{g1}	−33	−36	V
R_{a-a}	3.5	3.5	kΩ
$I_{a(o)}$	2×30	2×30	mA
$I_{g2(o)}$	2×4.7	2×4.5	mA
$V_{in(g1-g1)r.m.s.}$	46.7	50	V
P_{out}	48	54	W
D_{tot}	2.8	1.6	%
$I_{a(max.\ sig.)}$	2×107.5	2×110.5	mA
$I_{g2\ (max.\ sig.)}$	2×23.5	2×23	mA

*Screen-grid resistor common to both valves.

Cathode bias

V_b	375	450	V
V_{g3}	0	0	V
*R_{g2}	0.47	1.0	kΩ
R_k (per valve)	260	465	Ω
R_{a-a}	3.5	6.5	kΩ
$I_{a(o)}$	2×75	2×60	mA
$I_{g2(o)}$	2×12.5	2×10	mA
$V_{in(g1-g1)r.m.s.}$	40	54	V
P_{out}	35	40	W
D_{tot}	1.7	5.1	%
$I_{a(max.\ sig.)}$	2×94	2×71.5	mA
$I_{g2(max.\ sig.)}$	2×19.5	2×22	mA

*Screen-grid resistor common to both valves.

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Triode connection (g_2 connected to a, g_3 to k) with separate cathode bias resistors.

With R_k bypassed

V_b	430	V
V_a	400	V
V_{g3}	0	V
R_k (per valve)	440	Ω
R_{a-a}	5.0	kΩ
$I_{a(o)}$	2×70	mA
$V_{in(g1-g1)r.m.s.}$	48	V
P_{out}	19	W
D_{tot}	1.8	%
$I_{a(max.\ sig.)}$	2×75	mA

With R_k unbypassed

V_b	430	V
V_a	400	V
V_{g3}	0	V
R_k (per valve)	440	Ω
R_{a-a}	10	kΩ
$I_{a(o)}$	2×70	mA
$V_{in(g1-g1)r.m.s.}$	48	V
P_{out}	14	W
D_{tot}	0.4	%
$I_{a(max.\ sig.)}$	2×73	mA

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL WITH CONTINUOUS SINE WAVE DRIVE

Fixed bias

V_b	375	400	V
V_{g3}	0	0	V
R_{g2}	1.0	1.5	kΩ
V_{g1}	−32	−35.5	V
R_{a-a}	3.5	3.5	kΩ
$I_{a(o)}$	2 × 30	2 × 30	mA
$I_{g2(o)}$	2 × 4.4	2 × 4.4	mA
$V_{in(g1-g1)r.m.s.}$	45	50	V
P_{out}	42	51	W
D_{tot}	3.0	1.8	%
$I_{a(max.\ sig.)}$	2 × 98	2 × 106	mA
$I_{g2(max.\ sig.)}$	2 × 19	2 × 21	mA

Cathode bias

Any of the cathode bias conditions published in this data sheet are suitable for continuous sine wave drive.

DESIGN CENTRE RATINGS

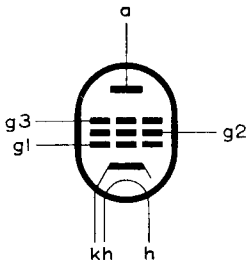
$V_{a(b)}$ max.	2.0	kV
V_a max.	800	V
p_a max.	25	W
$V_{g2(b)}$ max.	800	V
V_{g2} max.	500	V
p_{g2} max.	8.0	W
I_k max.	150	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

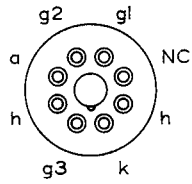
Triode connected

V_a max.	600	V
p_{a+g2} max. (V_a = 500V)	30	W
p_{a+g2} max. (V_a = 600V)	15	W

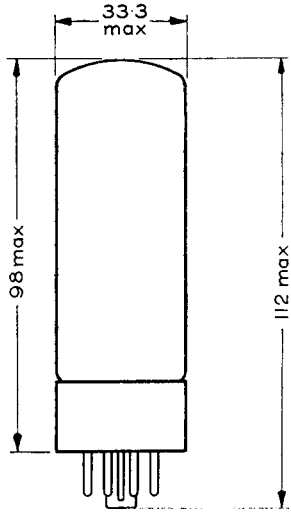
EL34

6299

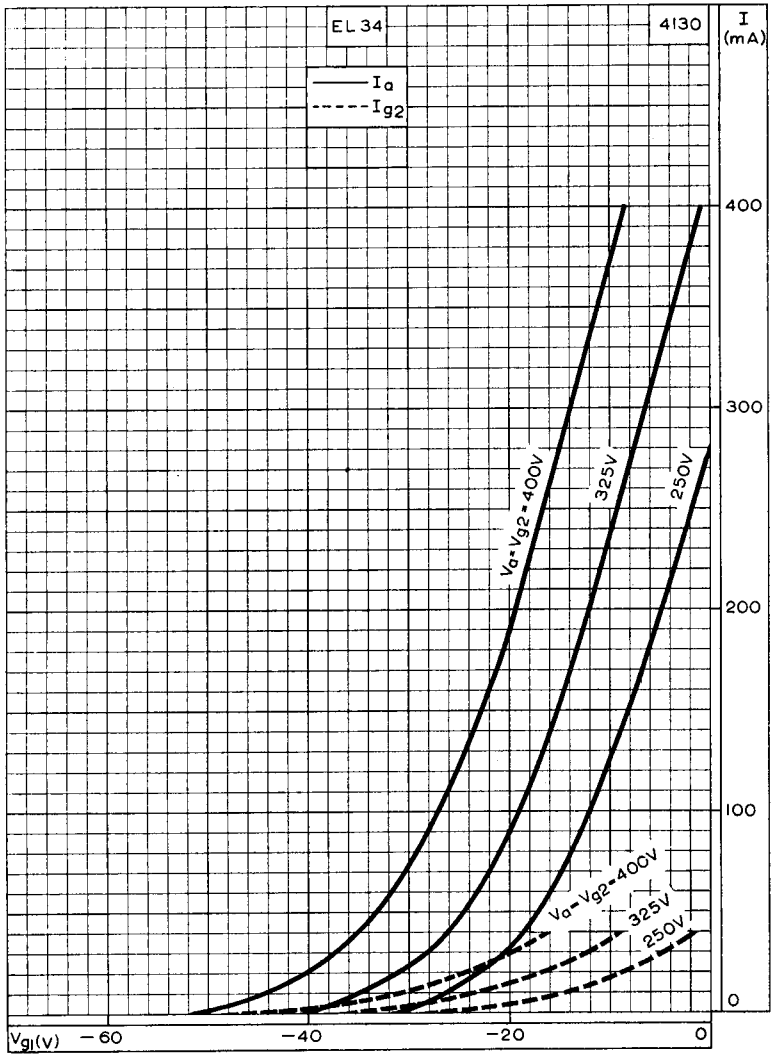




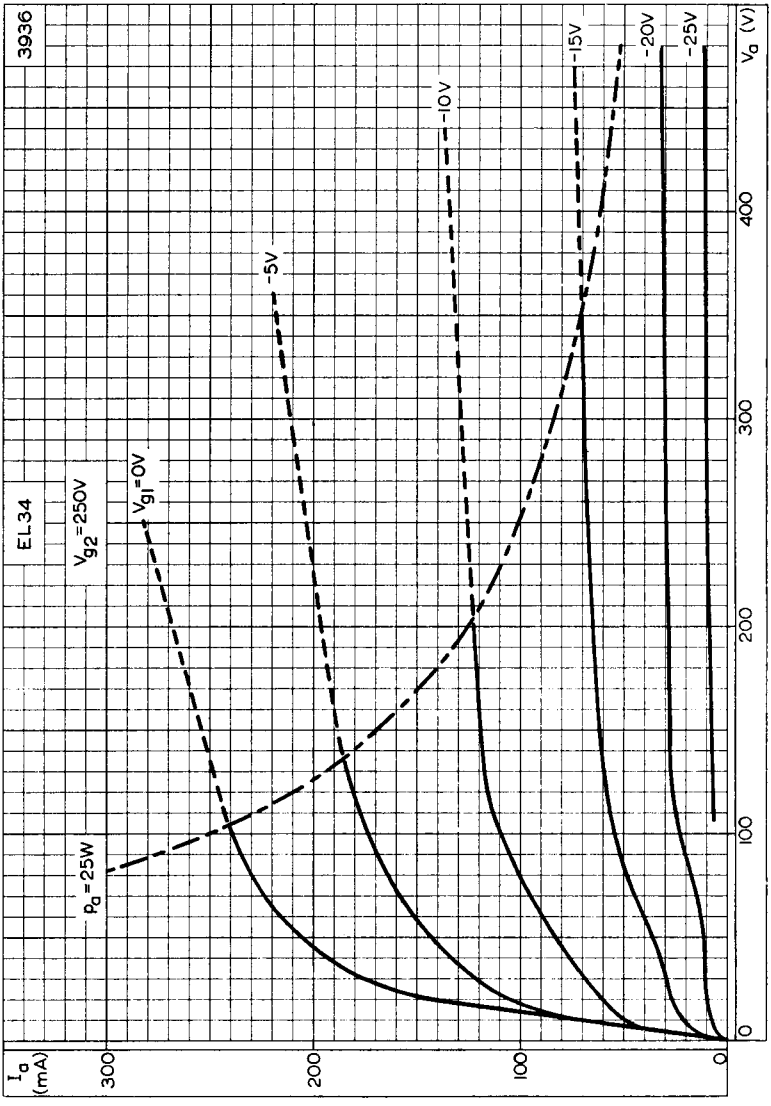
Octal Base



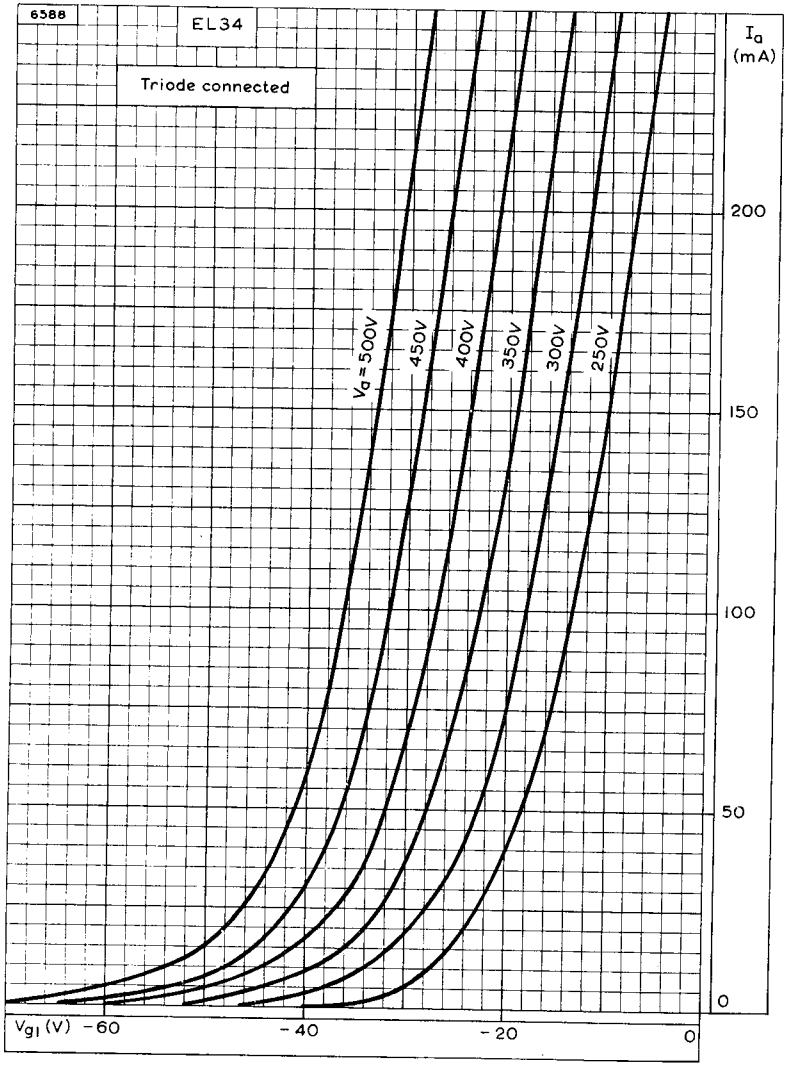
All dimensions in mm



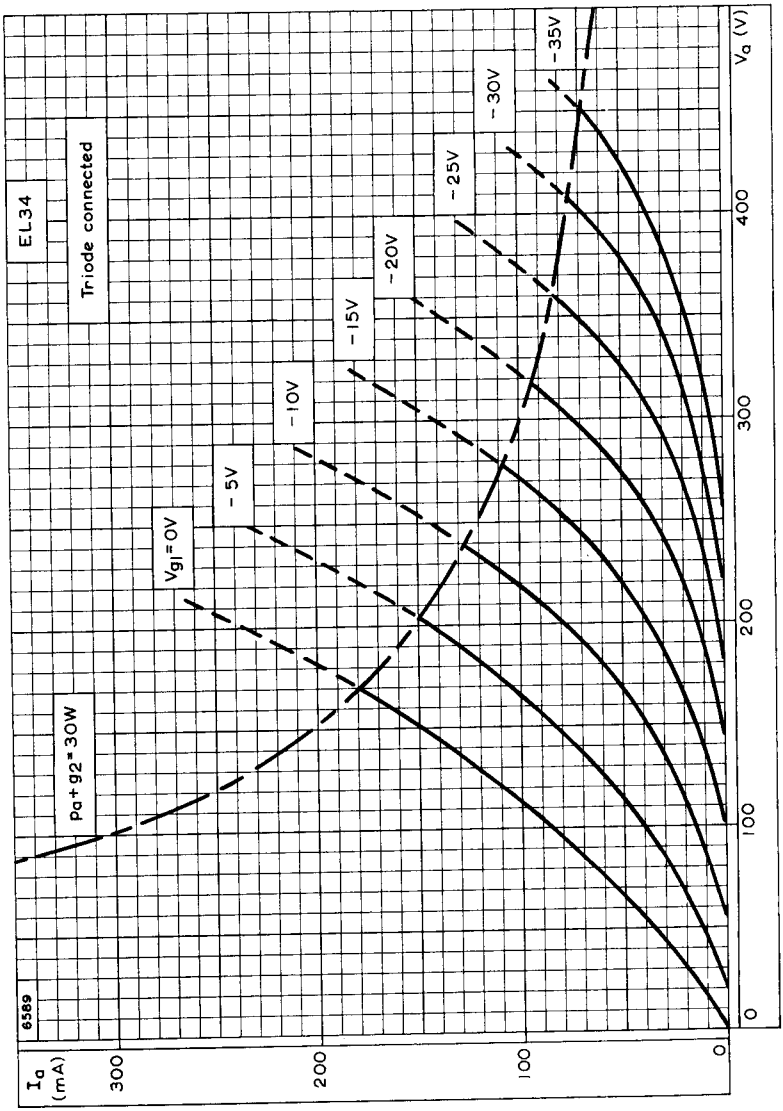
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS



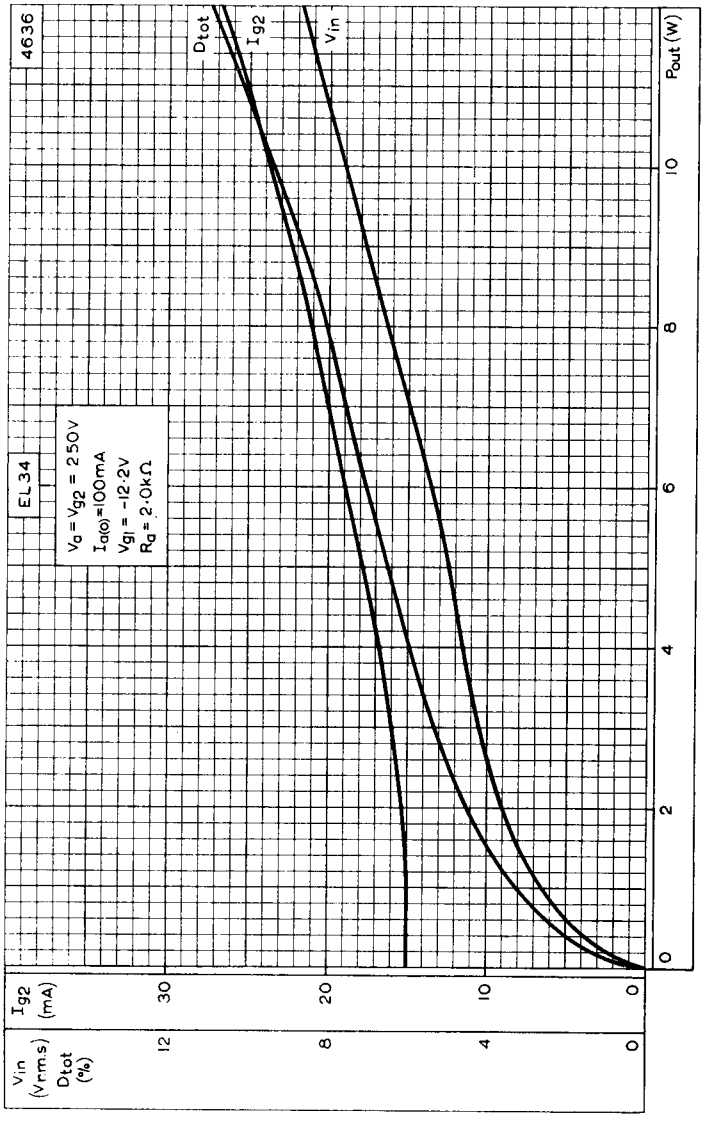
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



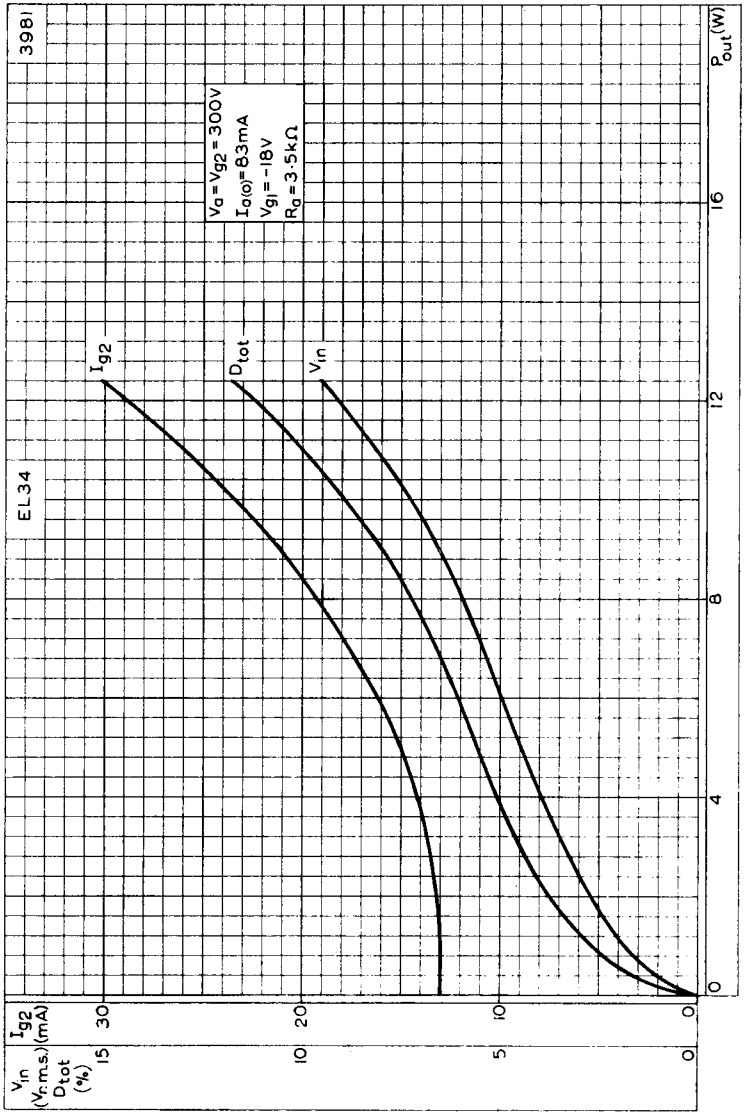
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED

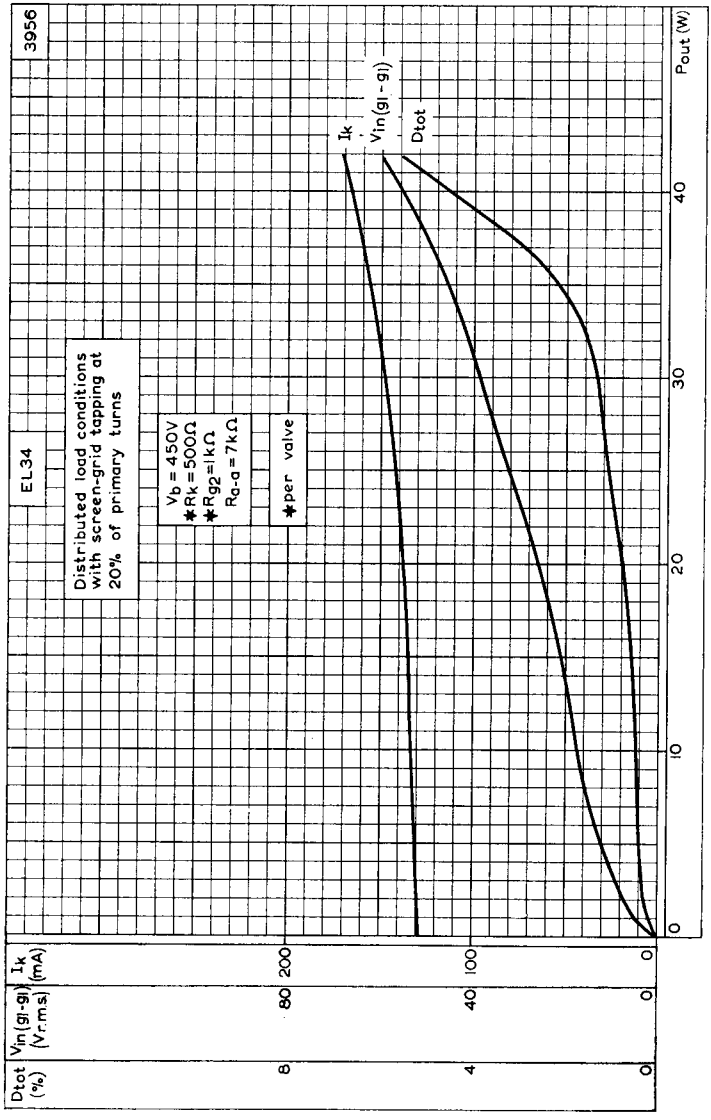


PERFORMANCE OF EL34 WHEN USED AS A SINGLE VALVE CLASS 'A' AMPLIFIER. V_a = 250V

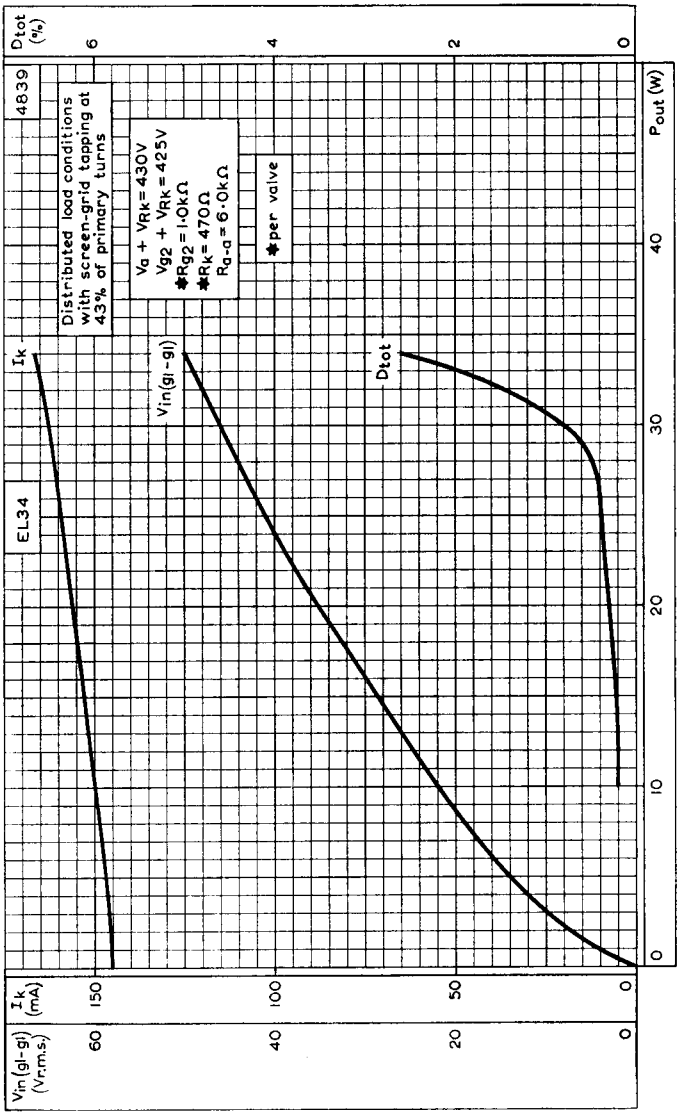


PERFORMANCE OF EL34 WHEN USED AS A SINGLE VALVE CLASS 'A' AMPLIFIER. V_a = 300V

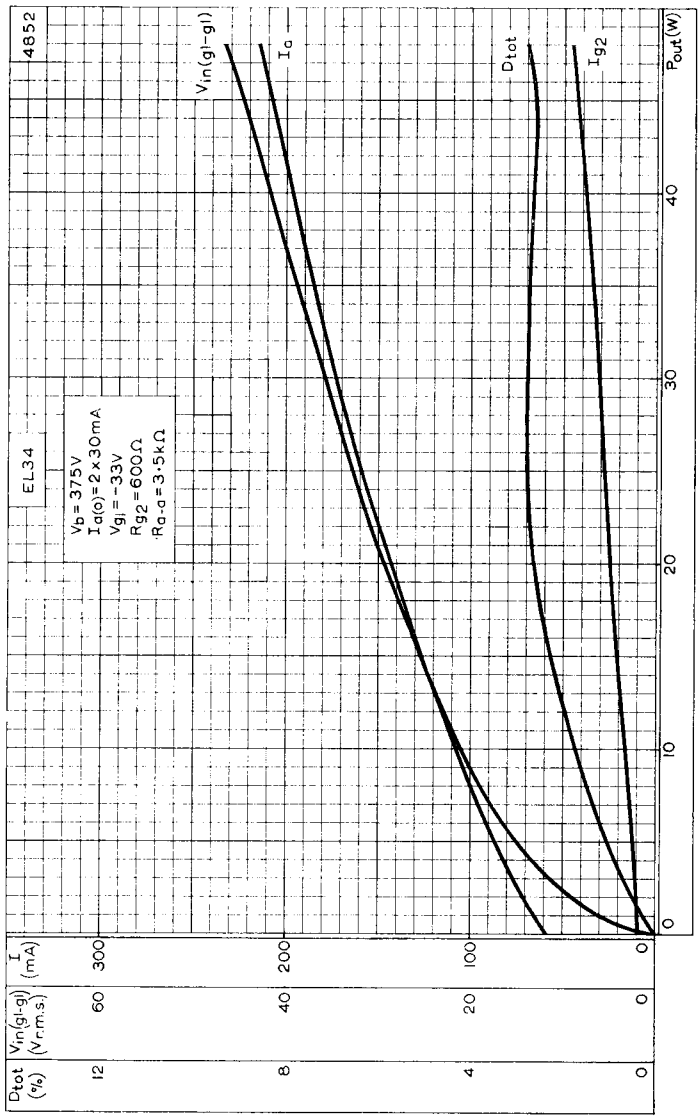
EL34



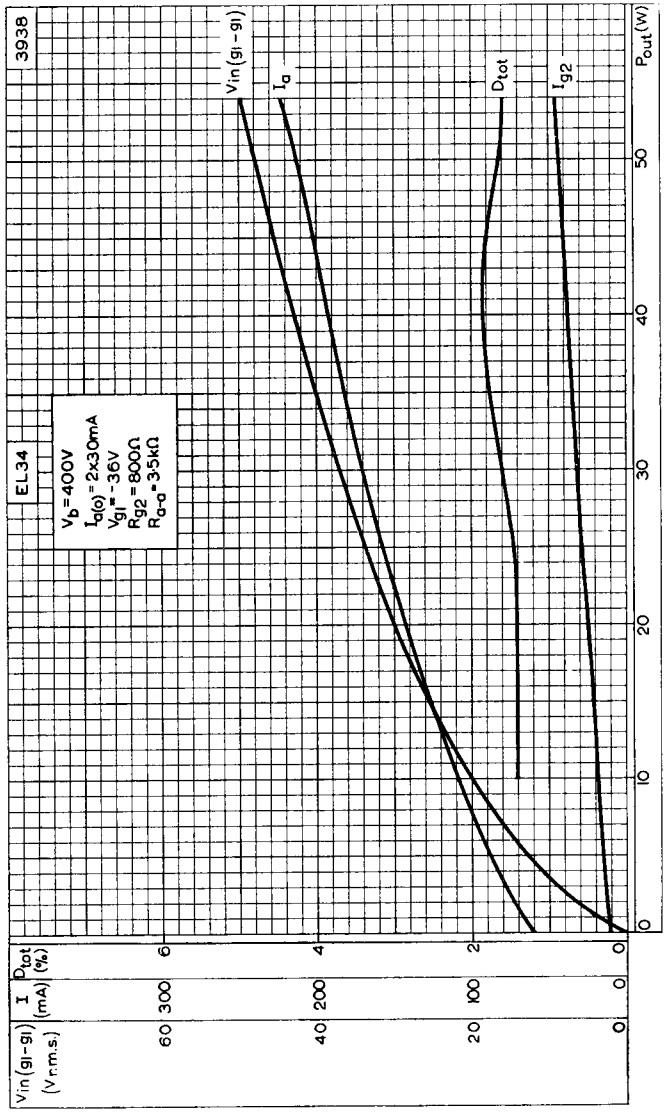
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS



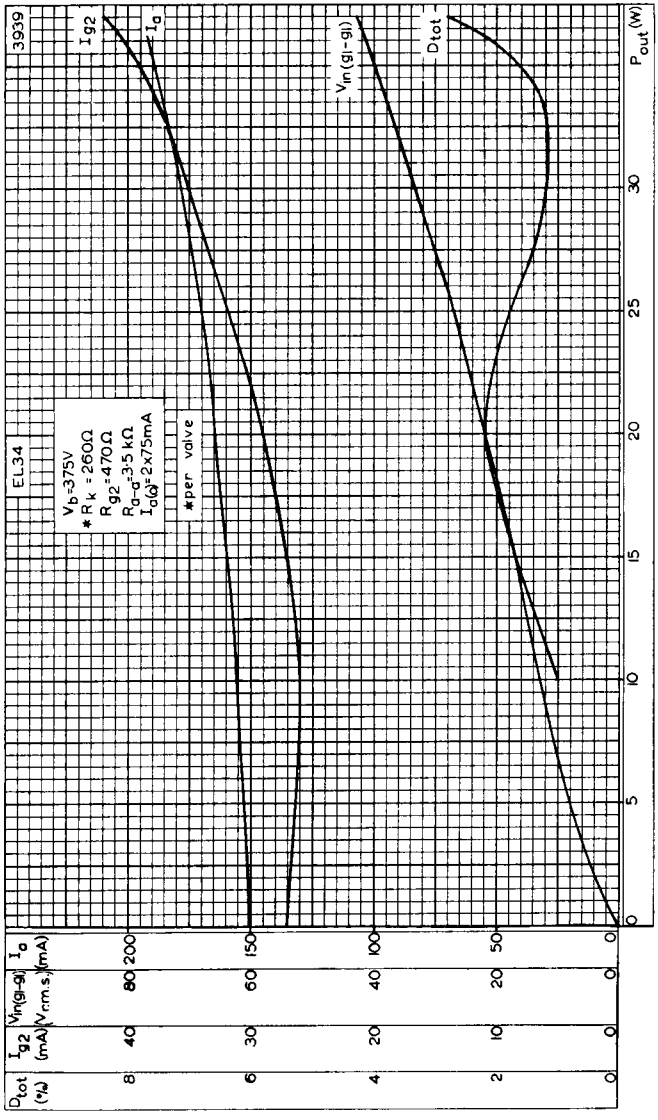
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS



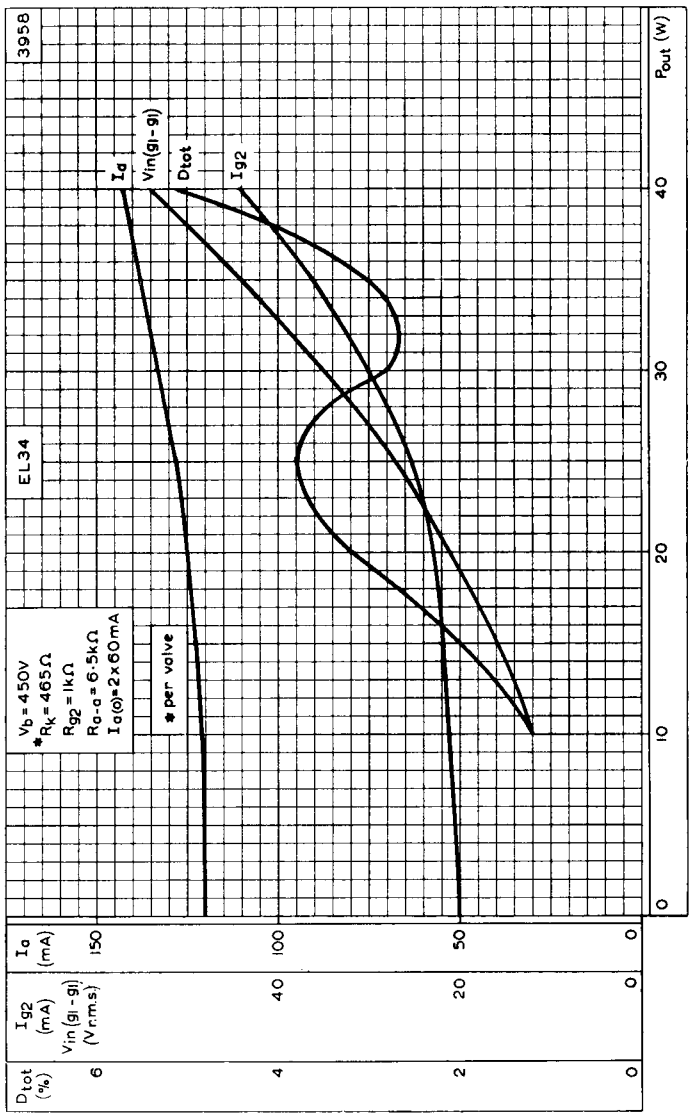
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH FIXED BIAS
V_b = 375V



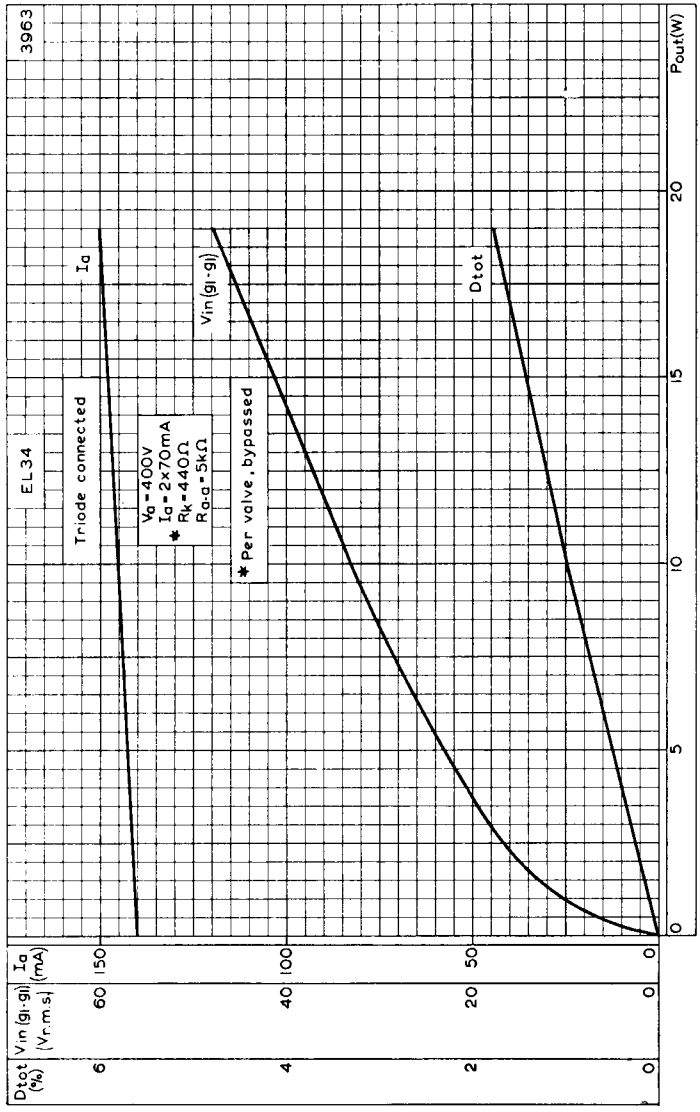
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH FIXED BIAS
V_b = 400V



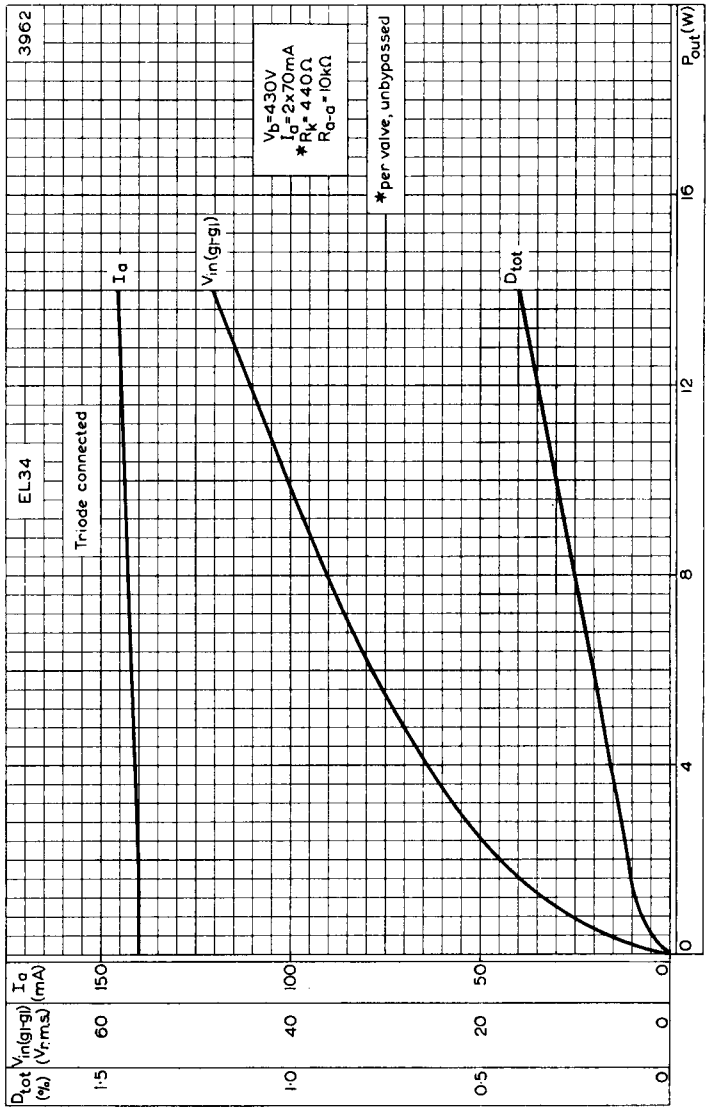
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH CATHODE BIAS
V_b = 375V



PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH CATHODE BIAS
$V_b = 450V$



PERFORMANCE OF TWO EL34 IN PUSH-PULL WHEN TRIODE CONNECTED AND THE CATHODE BYPASSED



PERFORMANCE OF TWO EL34 IN PUSH-PULL WHEN TRIODE CONNECTED AND THE CATHODE UNBYPASSED

OUTPUT PENTODE

EL360

Output pentode for use in radar scanning, series regulator and similar applications and in pulse modulator applications.

HEATER

V_h	6.3	V
I_h	1.27	A

CAPACITANCES

c_{out}	7.7	pF
c_{in}	17.5	pF
c_{a-g1}	<1.1	pF

CHARACTERISTICS

Pentode connection

V_a	100	250	V
V_{g2}	100	250	V
V_{g1}	−6.3	−46	V
I_a	120	48	mA
I_{g2}	8.3	5.5	mA
g_m	16.5	6.9	mA/V
r_a	3.7	13.5	kΩ
μ_{g1-g2}	6.0	5.0	

Triode connection (g_2 connected to a)

V_a	100	V
I_a	100	mA
V_{g1}	−8.0	V
g_m	14.5	mA/V
r_a	380	Ω
μ	5.5	

EL360

OUTPUT PENTODE

DESIGN CENTRE RATINGS (unless otherwise stated)

Scanning, low voltage series regulator, and similar applications

$V_{a(b)}$ max.	1.0	kV
$v_{a(pk)}$ max.	7.0	kV
$-v_{a(pk)}$ max. (p_a = 15W)	1.0	kV
$-v_{a(pk)}$ max. (p_a = 10W)	1.5	kV
V_a max.	800	V
$V_{g2(b)}$ max.	800	V
V_{g2} max.	400	V
$-v_{g1(pk)}$ max.	1.0	kV
p_a max.	15	W
p_{g2} max.	5.0	W
V_{a+g2} max.	400	V
p_{a+g2} max.	18	W
I_k max.	200	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	200	V

High voltage series regulator applications

$V_{a(b)}$ max.	4.0	kV
$V_{g2(b)}$ max.	550	V
V_a max.	2.0	kV
V_{g2} max.	400	V
p_a max.	6.0	W
p_{g2} max.	2.0	W
I_k max.	5.0	mA

Pulse modulator applications

V_a max. (absolute)	5.0	kV
p_a max.	10	W
*$i_{k(pulse)}$ max. (absolute)	4.0	A
V_{g2} max.	550	V
p_{g2} max.	3.0	W
$-V_{g1}$ max.	300	V
$+v_{g1(pulse)}$ max.	60	V

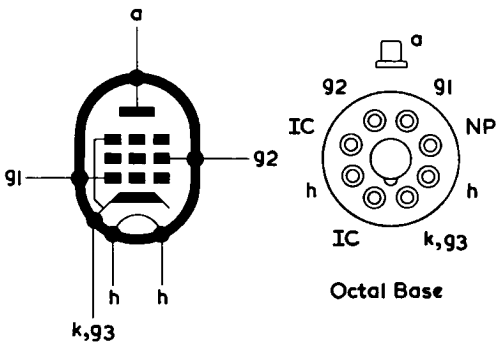
*Max. pulse duration 1μs, duty factor 0.001

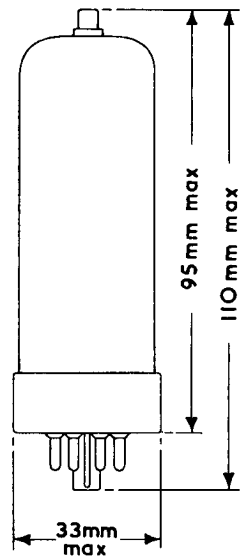
OUTPUT PENTODE

EL360

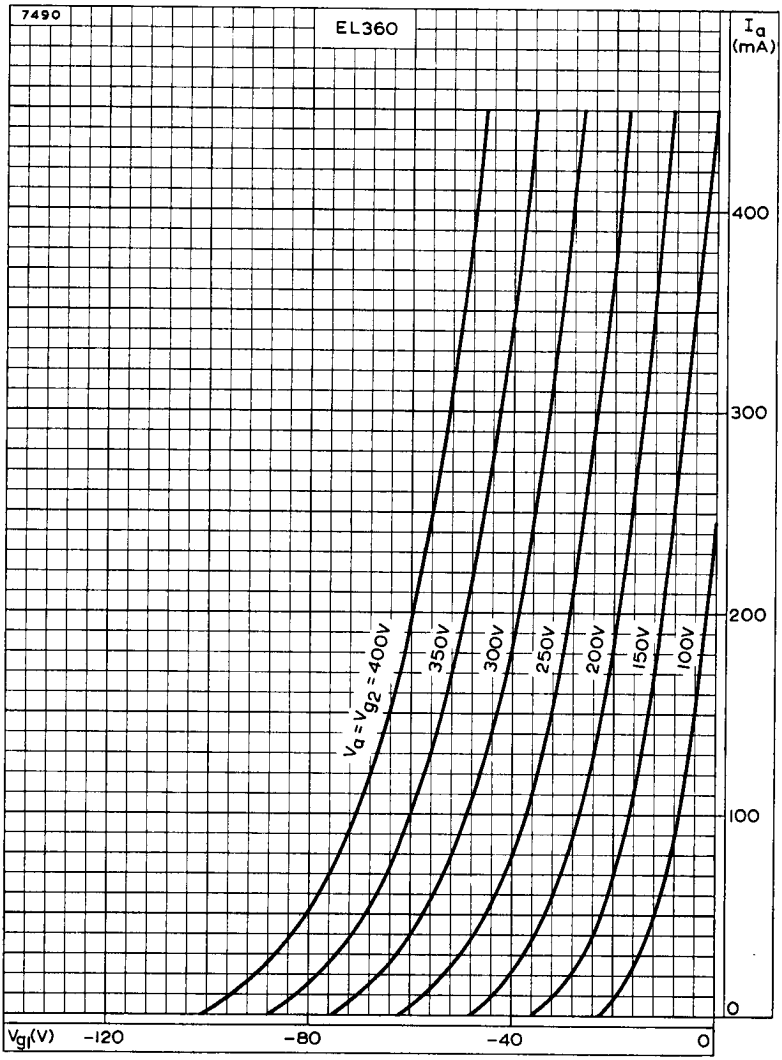
Output pentode for use in radar scanning, series regulator and similar applications and in pulse modulator applications.

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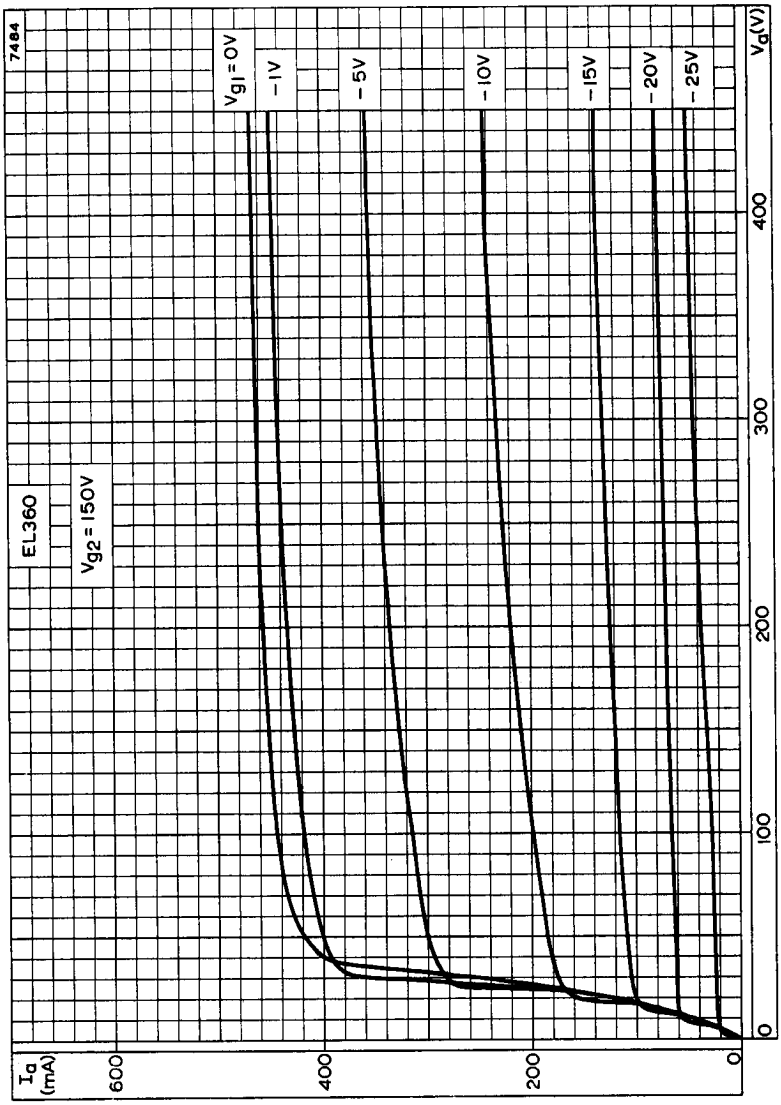




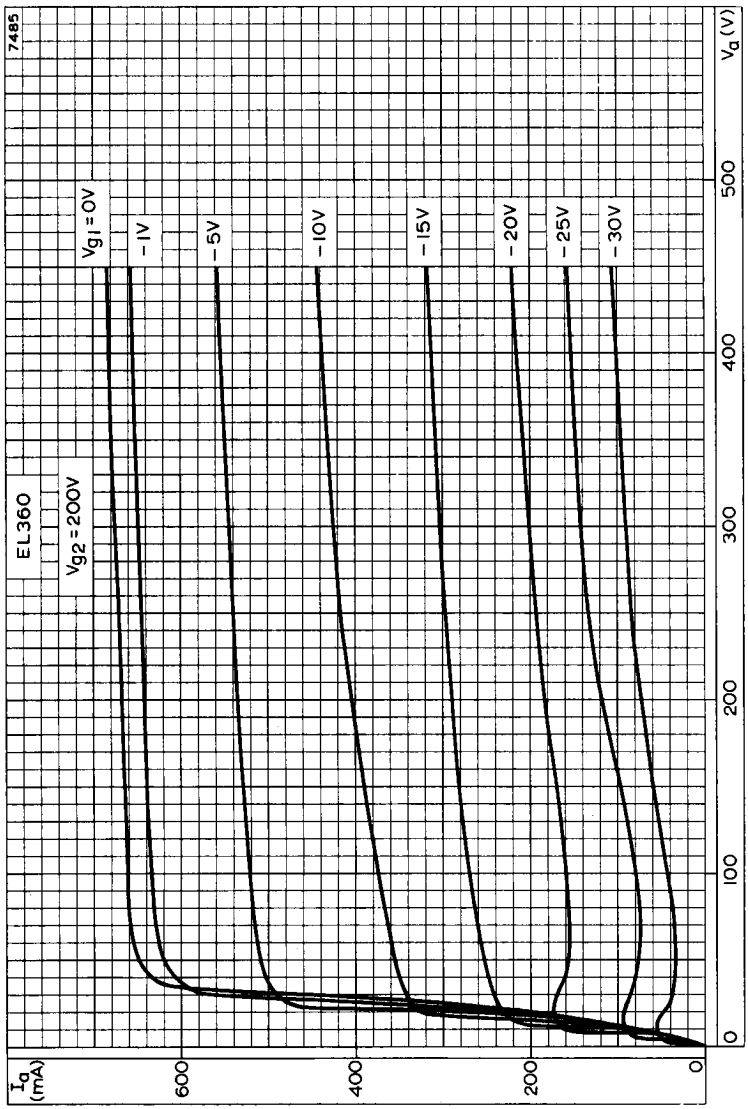
EL360



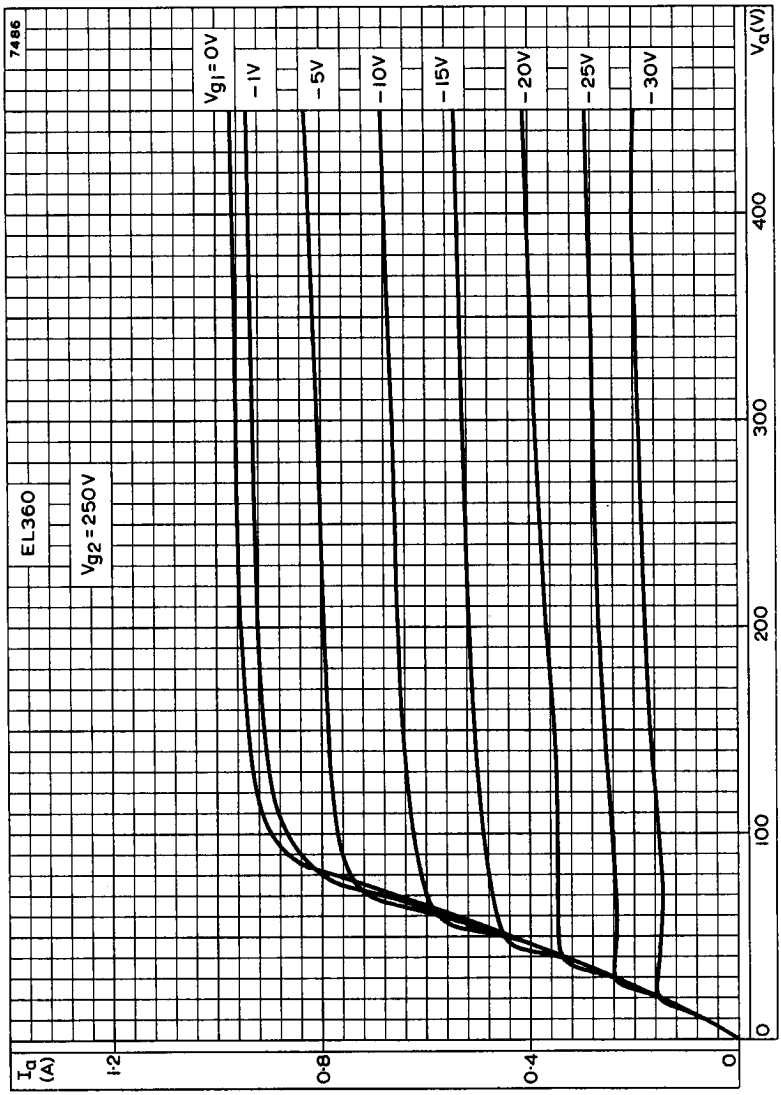
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V

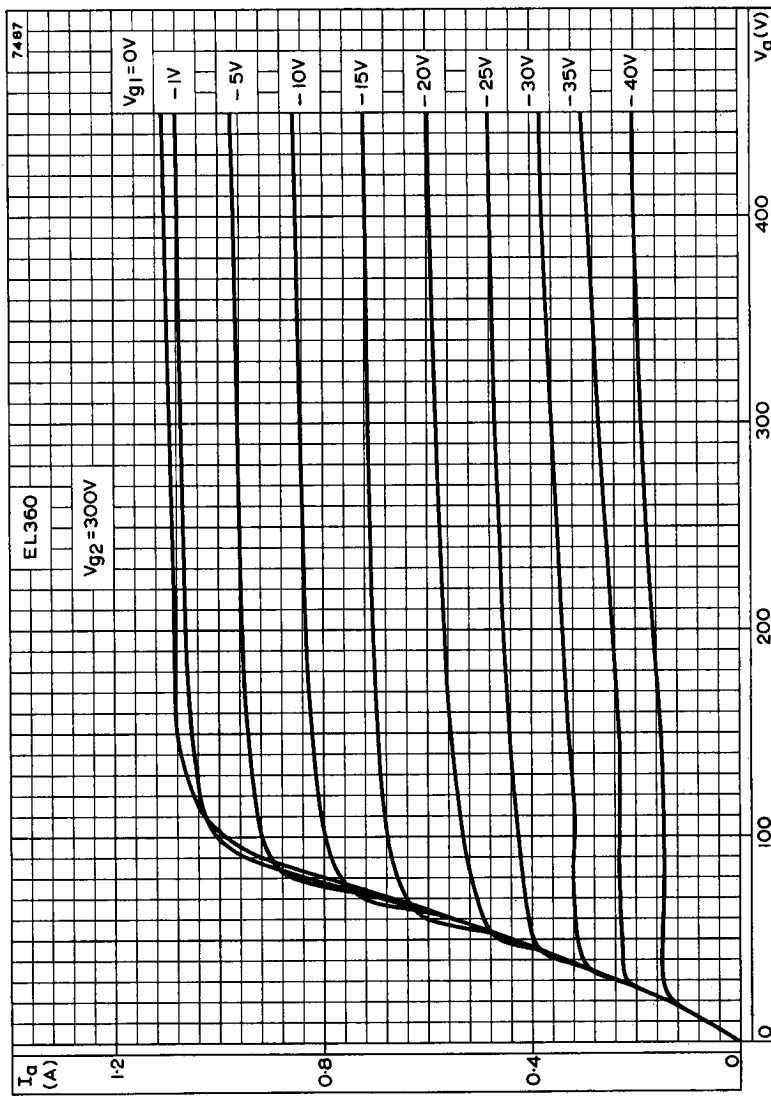


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

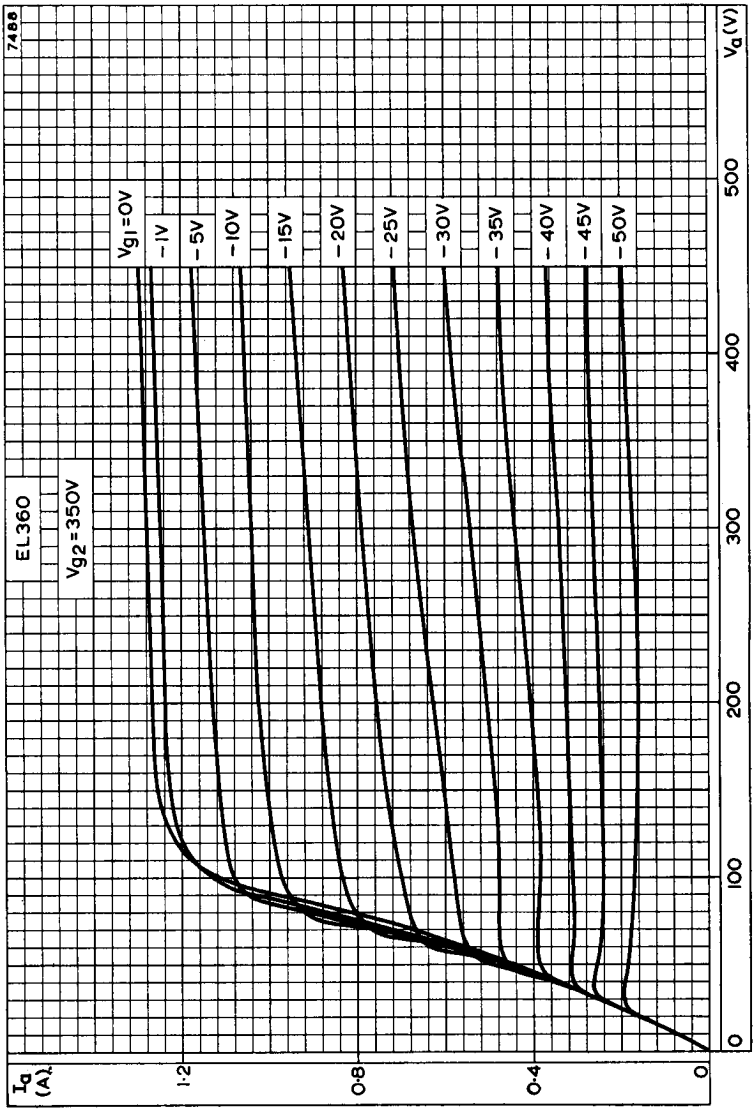


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

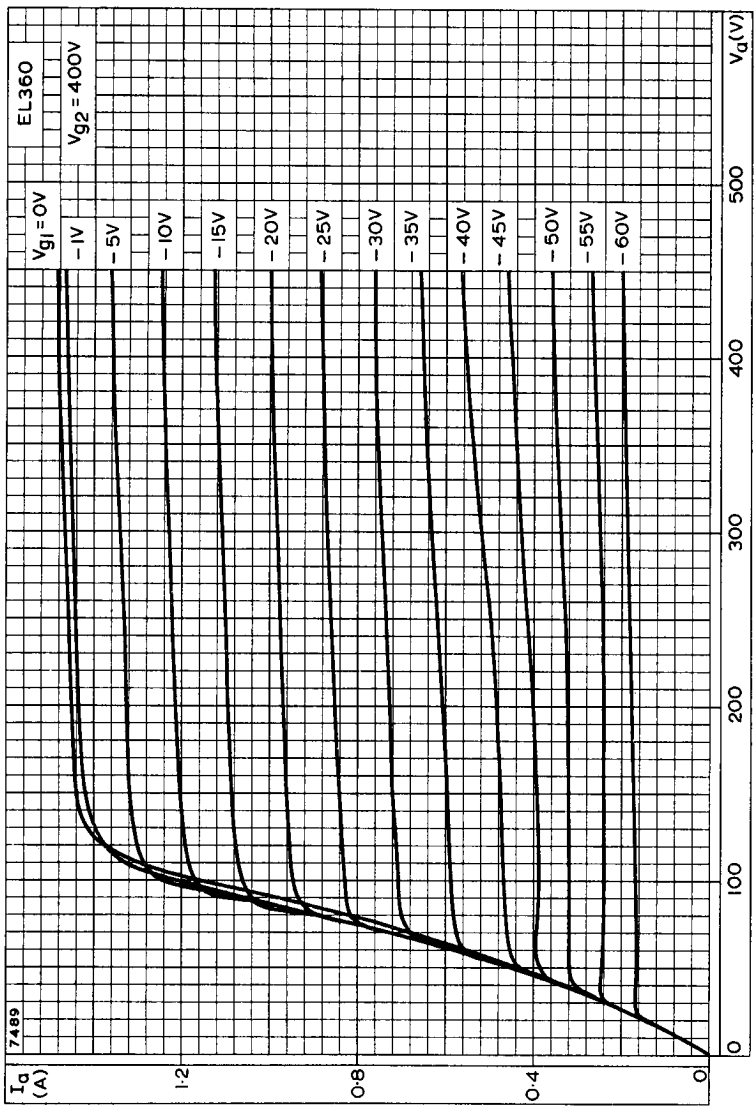
EL360



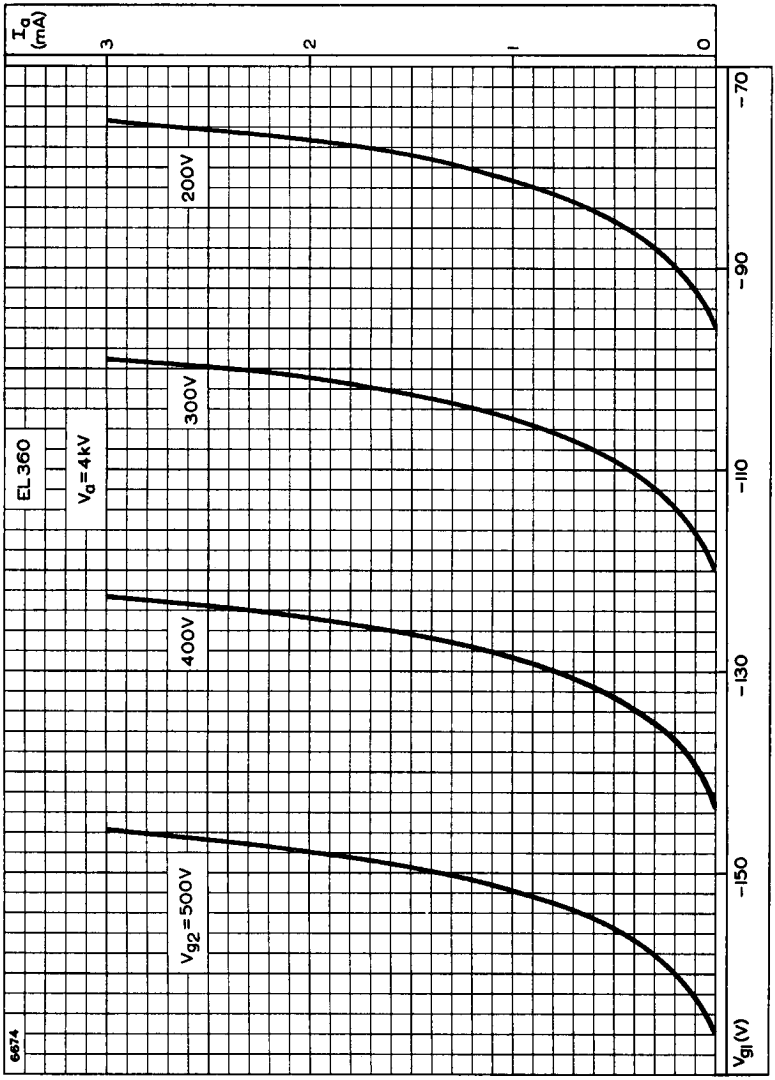
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V



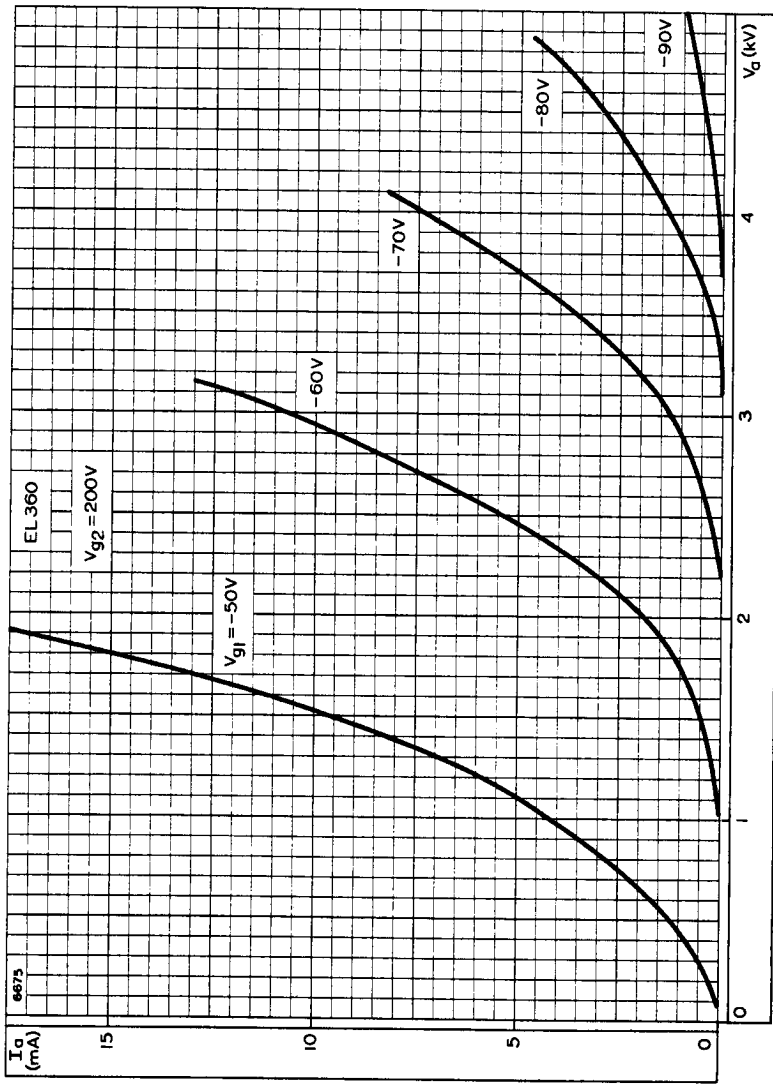
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 350V



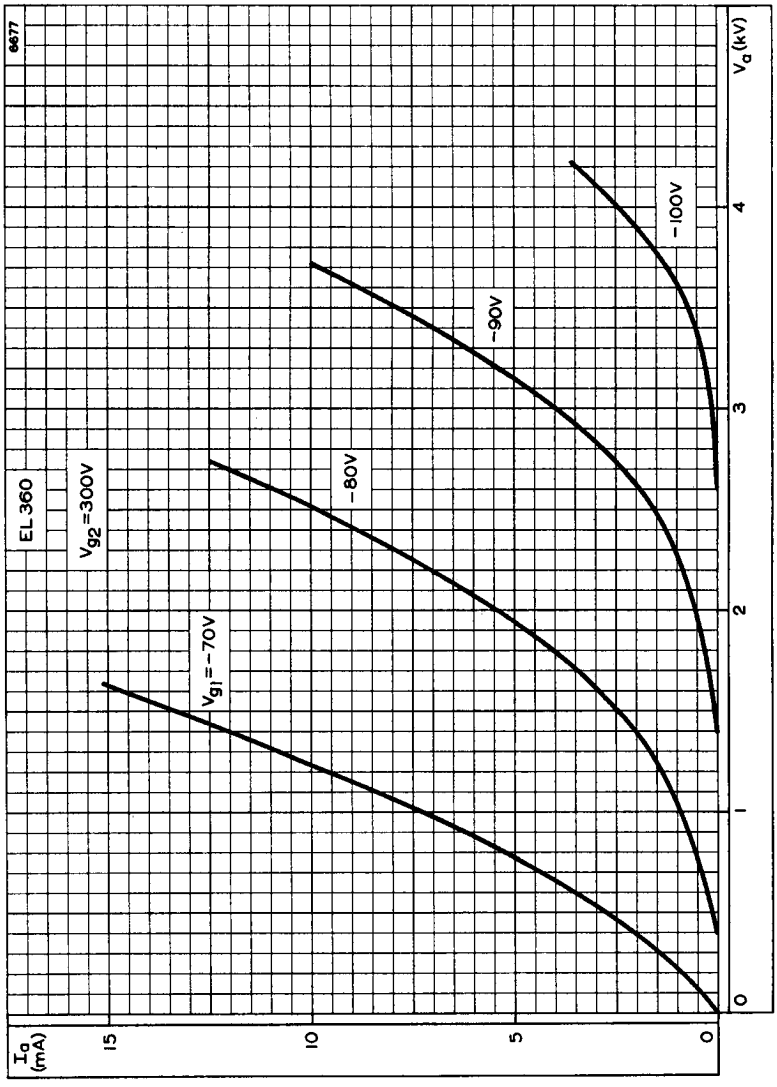
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 400V



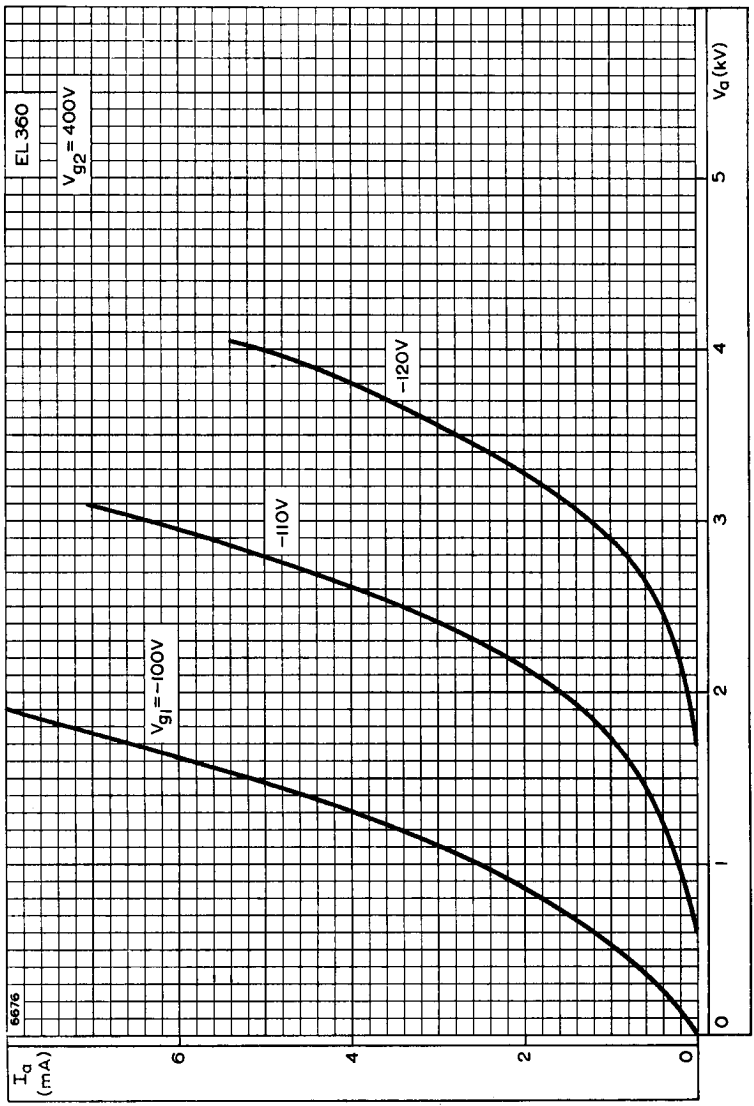
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER. V_a = 4kV



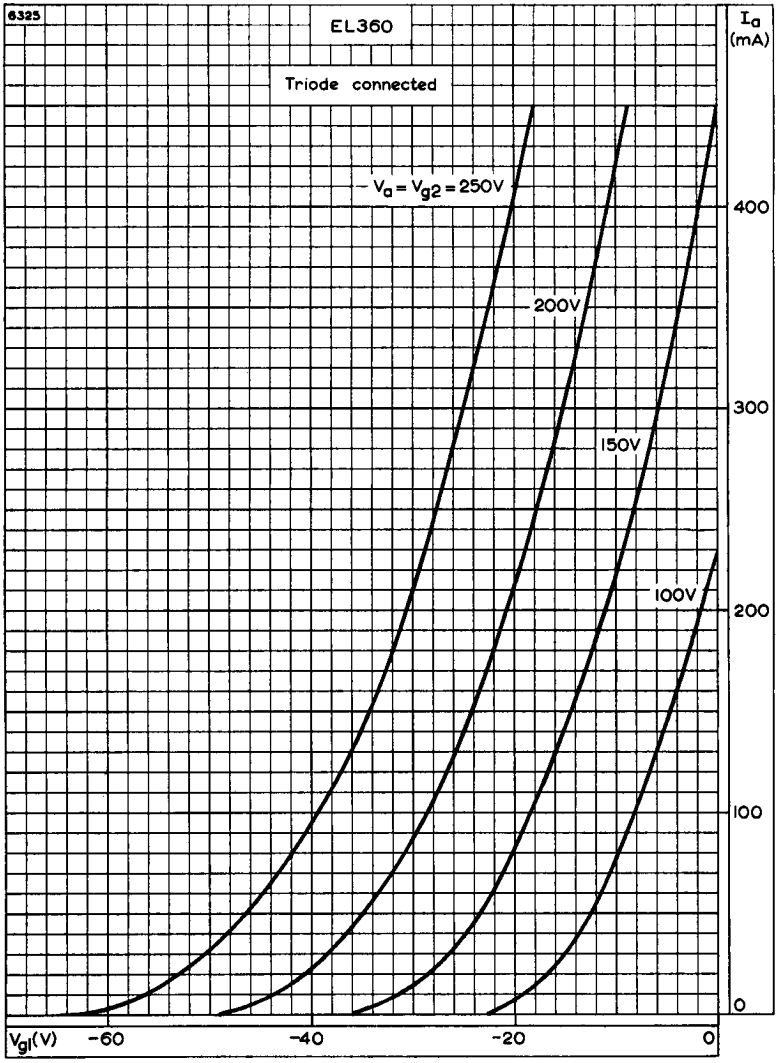
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE UP TO 5kV WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE UP TO 4kV WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V

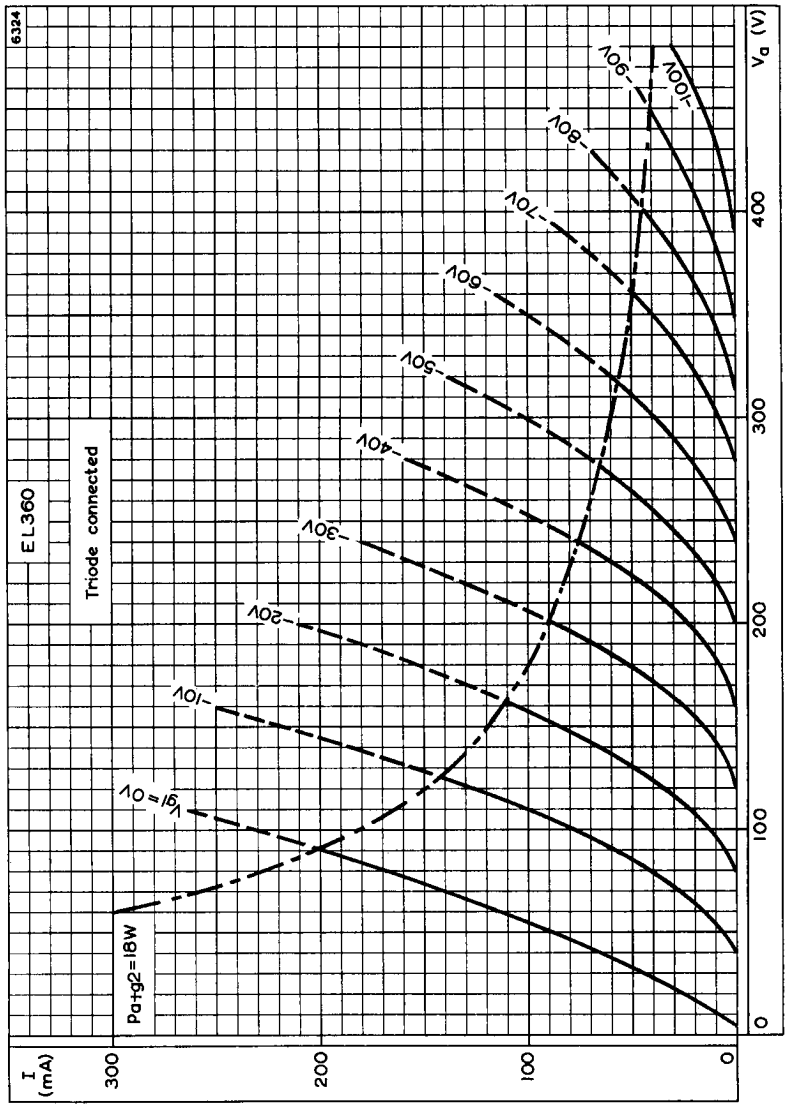


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE UP TO 4kV WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 400V

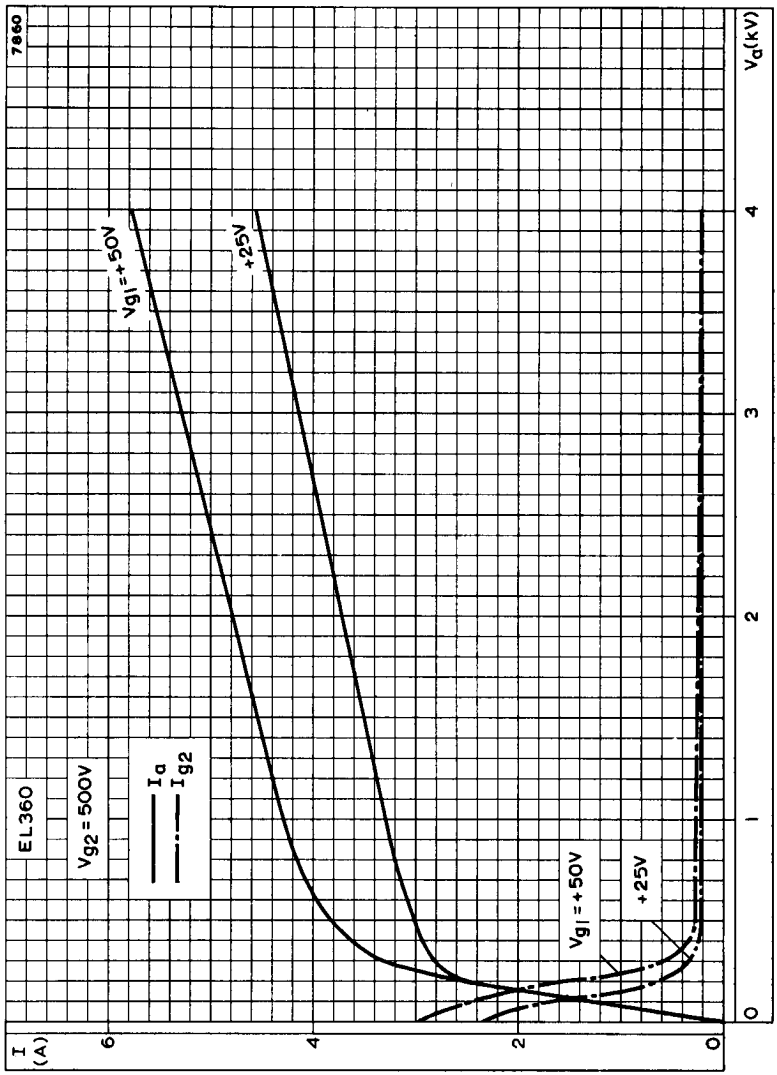


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER WHEN TRIODE CONNECTED

EL360

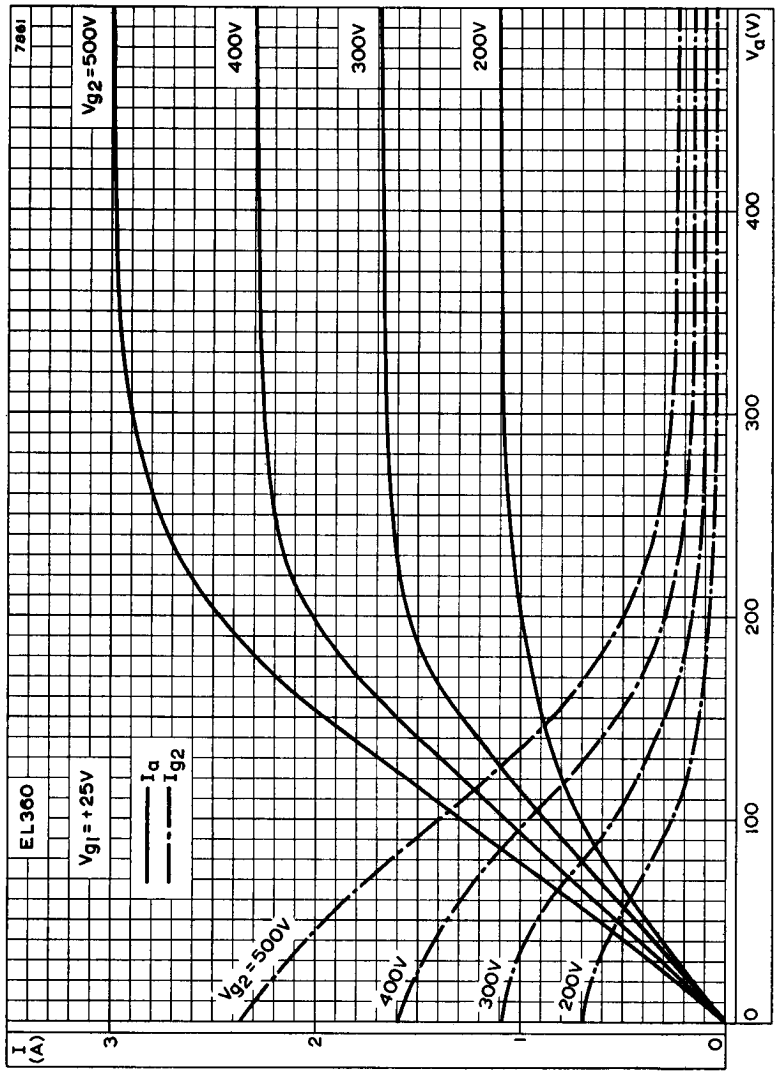


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED

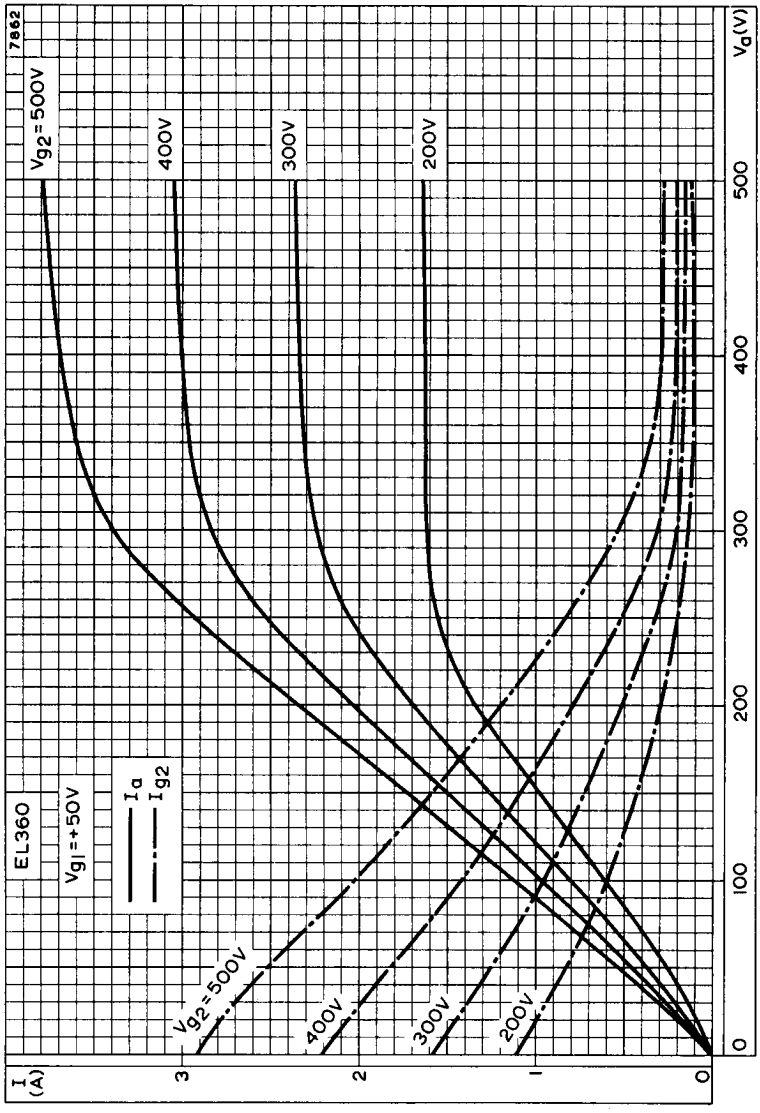


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

EL360

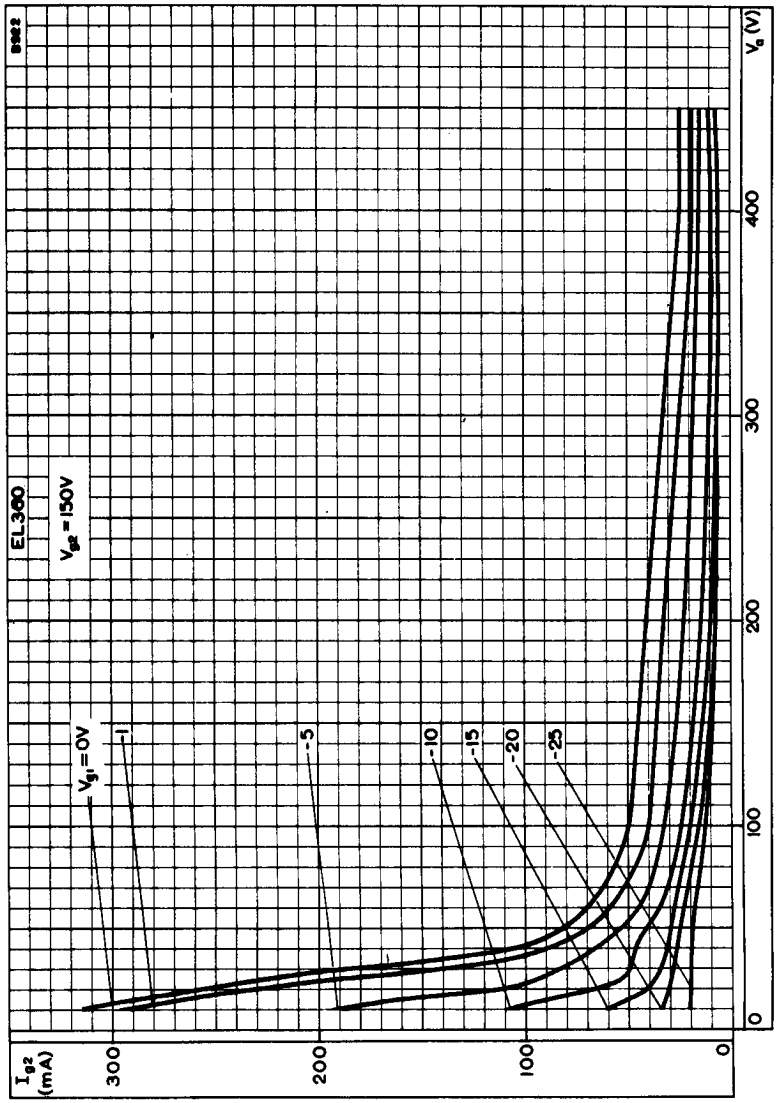


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER. V_{g1} = +25V

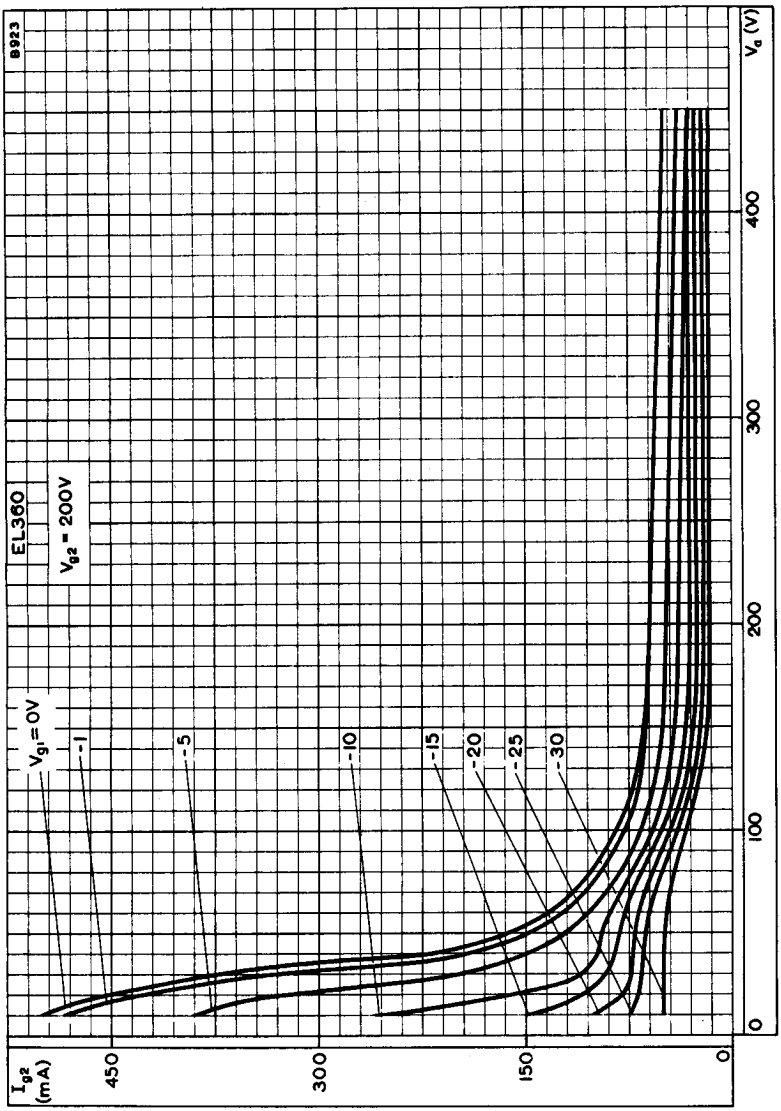


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER. $V_{g1} = +50V$

EL360

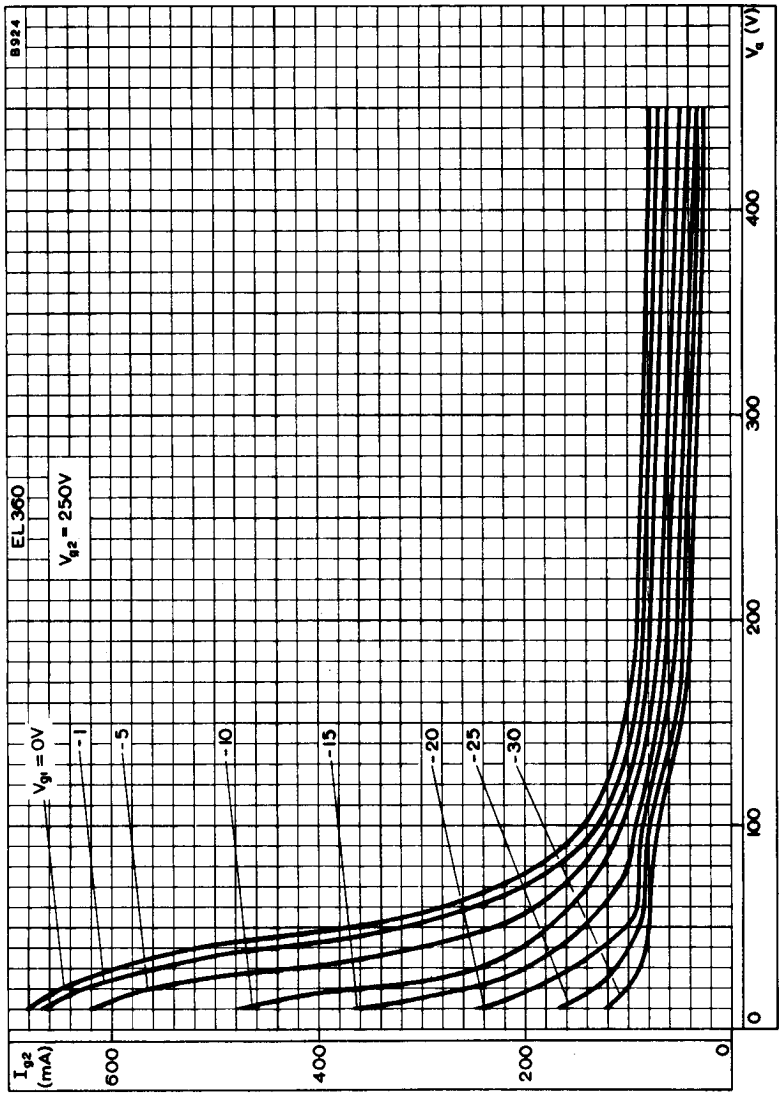


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 150V$

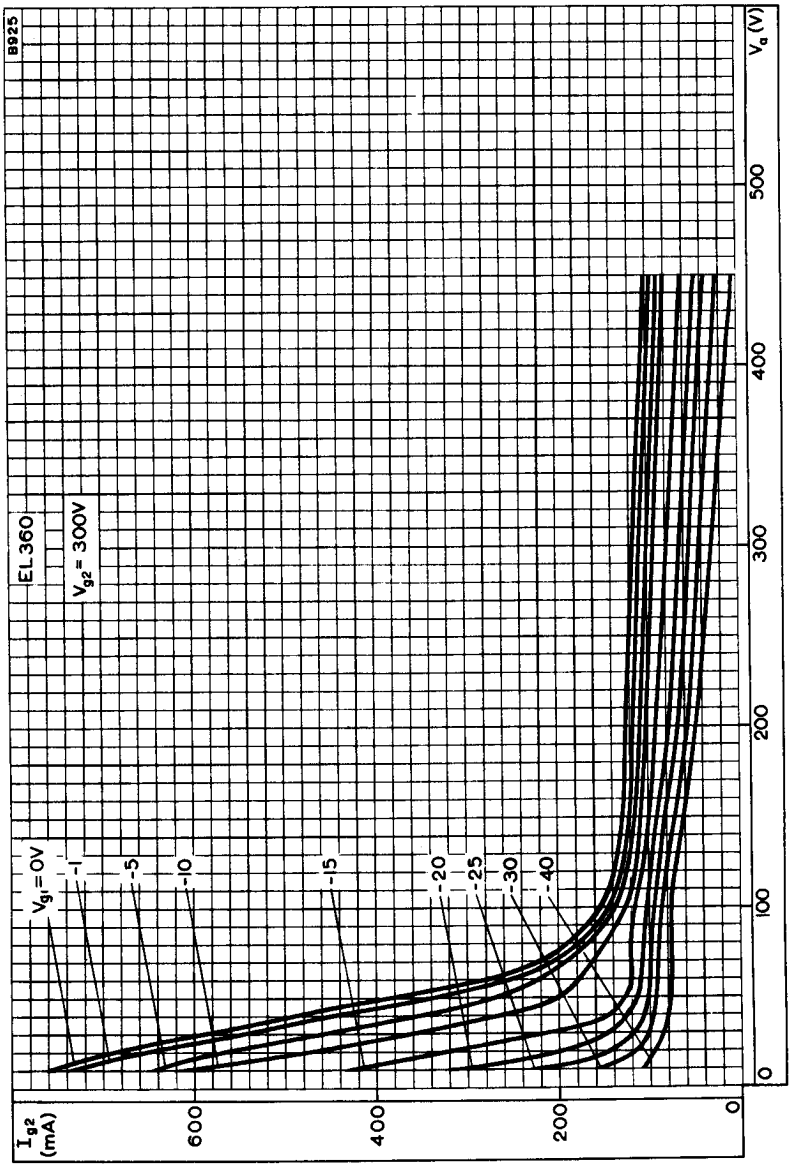


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

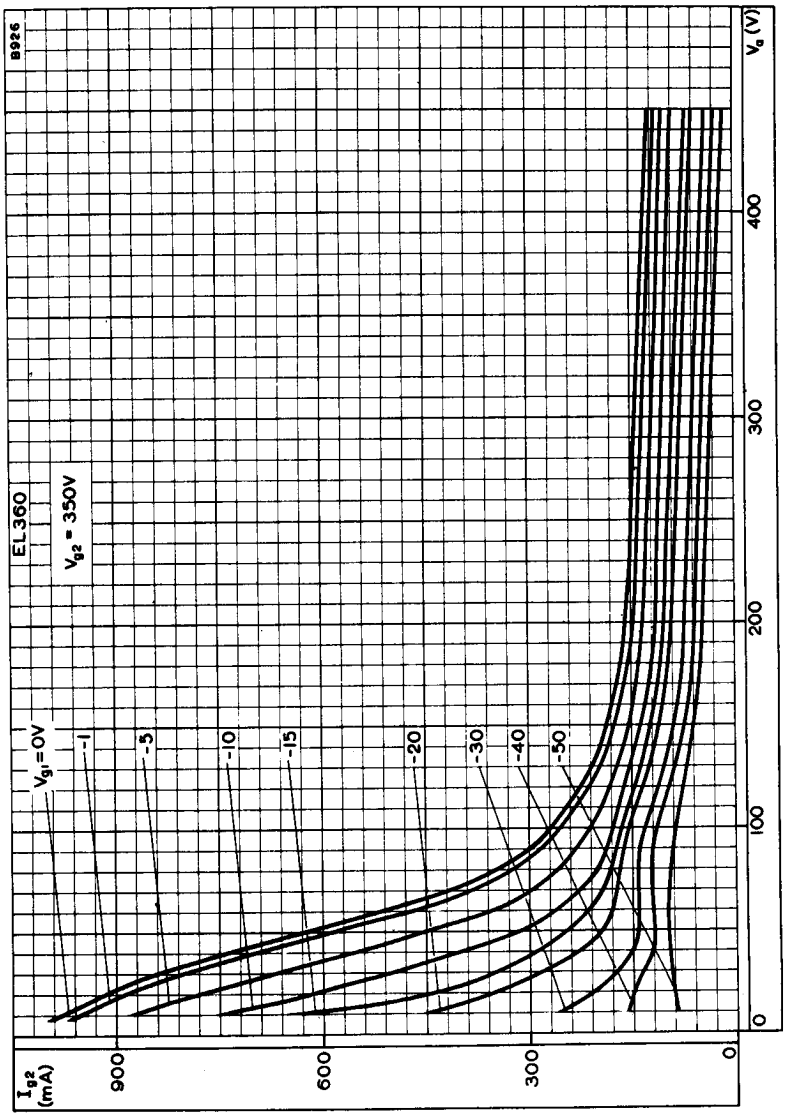
EL360



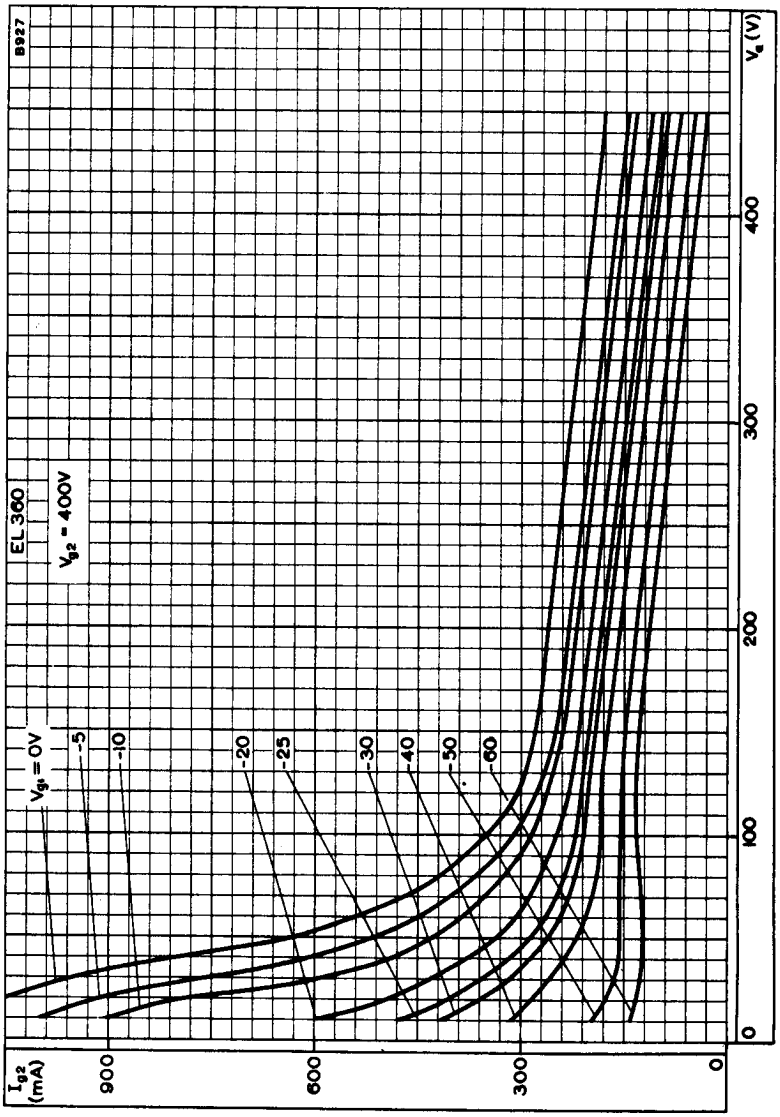
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 350V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 400V

OUTPUT PENTODE

EL37

25-watt pentode, particularly suitable for use in push-pull combination for outputs up to 69W, or as drivers for large power triode push-pull output stage.

HEATER

V_h	6.3	V
I_h	1.4	A

CAPACITANCES

c_{out}	9.0	pF
c_{in}	17.5	pF
c_{a-g1}	1.0	pF

OPERATING CONDITIONS AS PENTODE

V_a	250	V
V_{g2}	250	V
V_{g1}	−13.5	V
I_a	100	mA
I_{g2}	13.5	mA
R_k	120	Ω
g_m	11	mA/V
r_a	13.5	kΩ
μ_{g1-g2}	10	
R_a	2.5	kΩ
$V_{in\ (r.m.s.)}$ (P_{out} = 50mW)	0.45	V
P_{out} (D_{tot} = 10%)	10.5	W
$V_{in\ (r.m.s.)}$ (start of I_{g1})	10.8	V
D_{tot} (start of I_{g1})	13.5	%
P_{out} (start of I_{g1})	11.5	W

OPERATING CONDITIONS — TWO VALVES IN PUSH-PULL

(Self Bias)

V_a	250	325	V
V_{g2}	250	325	V
$I_{a(0)}$	2×59	2×77	mA
I_a (max. sig.)	2×68	2×90	mA
$I_{g2(0)}$	2×7.5	2×9.75	mA
I_{g2} (max. sig.)	2×18	2×30	mA
R_k	130	130	Ω
R_{a-a}	4.0	4.0	kΩ
P_{out}	20	35	W
$V_{in\ (g1-g1)\ (r.m.s.)}$	29	43	V
D_{tot}	2.25	4.4	%

EL37

OUTPUT PENTODE

25-watt pentode, particularly suitable for use in push-pull combination for outputs up to 69W, or as drivers for large power triode push-pull output stage.

OPERATING CONDITIONS — TWO VALVES IN PUSH-PULL (Fixed Bias)

V_a	350	400	V
V_{g2}	350	400	V
$I_{a(0)}$	2×40	2×50	mA
I_a (max. sig.)	2×118	2×138	mA
$I_{g2(0)}$	2×5	2×6	mA
I_{g2} (max. sig.)	2×29	2×36	mA
V_{g1}	−31	−36	V
R_{a-a}	3.25	3.25	kΩ
P_{out}	46	69	W
$V_{in\ (g1-g1)\ (r.m.s.)}$	43.4	49	W
D_{tot}	2.8	2.5	%

OPERATING CONDITIONS AS SINGLE VALVE, TRIODE CONNECTED

(Grid 2 connected to anode by 100 Ω resistor)

V_a	300	400	V
I_a	50	37.5	mA
V_{g1}	−26	−39	V
g_m	6.5	4.5	mA/V
μ	9.0	9.0	
r_a	1.4	2.0	kΩ

OPERATING CONDITIONS AS PUSH-PULL PAIR, TRIODE CONNECTED (Self Bias)

V_b	350	435	V
V_a	320	400	V
$I_{a+g2(0)}$	2×56	2×70	mA
I_{a+g2} (max. sig.)	2×64	2×80	mA
p_{a+g2}	2×18	2×28	W
R_k	245	245	Ω
R_{a-a}	4.0	4.0	kΩ
$V_{in\ (r.m.s.)}$	2×21.5	2×27.2	V
P_{out}	12.5	20.6	W
D_{tot}	4.1	4.3	%

LIMITING VALUES — PENTODE CONNECTED

$V_{a(b)}$ max.	800	V
V_a max.	400	V
$V_{g2(b)}$ max.	800	V
V_{g2} max.	400	V
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
V_{h-k} max.	75	V
R_{h-k} max.	5.0	kΩ

OUTPUT PENTODE

EL37

25-watt pentode, particularly suitable for use in push-pull combination for outputs up to 69W, or as drivers for large power triode push-pull output stage.

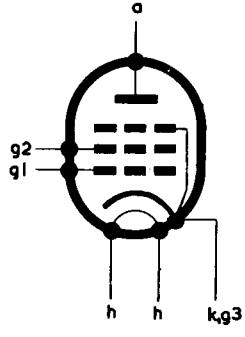
R_{g1-k} max. (cathode bias)	500	k Ω
R_{g1-k} max. (fixed bias)	100	k Ω
p_a max.	25	W
p_{g2} max.	6.0	W
I_k max.	200	mA

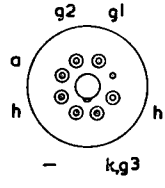
LIMITING VALUES — TRIODE CONNECTED (NORMAL APPLICATIONS)

V_{a+g2} max.	400	V
p_{a+g2} max.	28	W

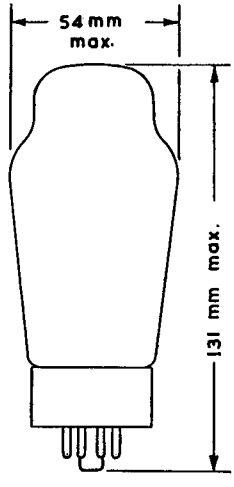
LIMITING VALUES — TRIODE CONNECTED (IN CATHODE-COUPLED PUSH-PULL DRIVER STAGE FOR LARGE POWER TRIODES)

V_{a+g2} max.	500	V
p_{a+g2} max.	12.5	W





OCTAL BASE

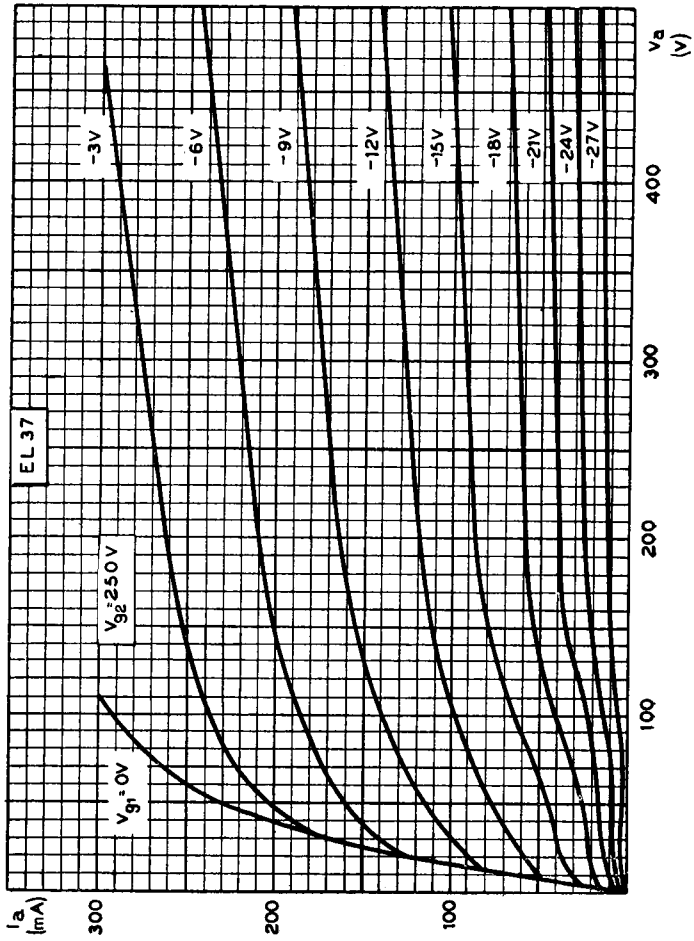


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EL37

OUTPUT PENTODE

25-watt pentode, particularly suitable for use in push-pull combination for outputs up to 69W, or as drivers for large power triode push-pull output stage.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE OF 250 V

OUTPUT PENTODE

EL38

Output pentode primarily intended for use as line time base output valve in A.C. television receivers.

HEATER

V_h	6.3	V
I_h	1.4	A

CAPACITANCES

c_{in}	18	μμF
c_{out}	8.0	μμF ←
c_{a-g1}	<1.2	μμF

CHARACTERISTICS

V_a	275	V
V_{g2}	275	V
I_a	91	mA
I_{g2}	11	mA
V_{g1}	−9	V
g_m	14	mA/V
μ_{g1-g2}	16.5	
r_a	20	kΩ

OPERATION AS LINE OUTPUT PENTODE

Circuit Design

To allow for valve spread and for deterioration during life the line output stage should be designed around the following values :—

V_a	90	V
V_{g2}	275	V
I_a	150	mA

For the average new valve the following figures will apply:—

V_a	90	V
V_{g2}	275	V
V_{g1}	−1	V
I_a	225	mA

Typical Circuit (See circuit on page 3)

	V_b	300	V
For EL38	I_a	64	mA
	I_{g2}	18	mA
	R_k	120	Ω
For EBC33	I_a	0.8	mA

N.B.—Above figures measured under synchronised conditions.

LIMITING VALUES

$V_{a\ (b)}$ max.	1.2	kV
V_a max.	800	V
$v_{a\ (pk)}$ max.	8	kV
$V_{g2\ (b)}$ max.	800	V
V_{g2} max.	400	V
p_a max.	25	W
p_{g2} max.	8	W
I_k max.	200	mA
V_{g1} max. (I_{g1} = +0.3 μA)	−1.3	V
R_{g1-k} max. (p_a <25W)	500	kΩ
R_{g1-k} max. (p_a <9 W)	800	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

EL38

OUTPUT PENTODE

Output pentode primarily intended for use as line time base output valve in A.C. television receivers.

CIRCUIT VALUES (see circuit on page 3)

Resistors

	Value	Wattage	Tolerance
R_1	47 kΩ	¼ W	20%
R_2	330 kΩ	¼ W	10%
R_3	50 kΩ	1 W	Potentiometer
R_4	680 Ω	¼ W	10%
R_5	820 kΩ	¼ W	20%
R_6	120 Ω	1 W	20%
R_7	500 Ω	4 W	Potentiometer
R_8	2.2 kΩ	¼ W	20%
R_9	2.5 kΩ	4 W	Potentiometer
R_{10}	2.7 kΩ	4 W	20%
R_{11}	100 Ω	¼ W	20%

Capacitors

	Value	Tolerance	Wkg. Voltage
C_1	0.1 μF	20%	350 V
C_2	0.0022 μF	20%	350 V
C_3	0.01 μF	10%	350 V
C_4	0.001 μF	10%	350 V
C_5	0.004–0.006 μF	—	500 V

Transformers

T1 Ratio 1 : 3 (step-up into grid circuit)
T2 Ratio 4 : 1 primary inductance ≮1 H

Deflector Coils

Resistance 3 Ω
Inductance 6.5 mH

To provide full scan for 9″ picture tube (V_{a_2}=7kV) with peak to peak current swing of 500 mA.

Notes

(i) Synchronising pulses may be applied negatively to the anode or positively to the grid of the EBC33.

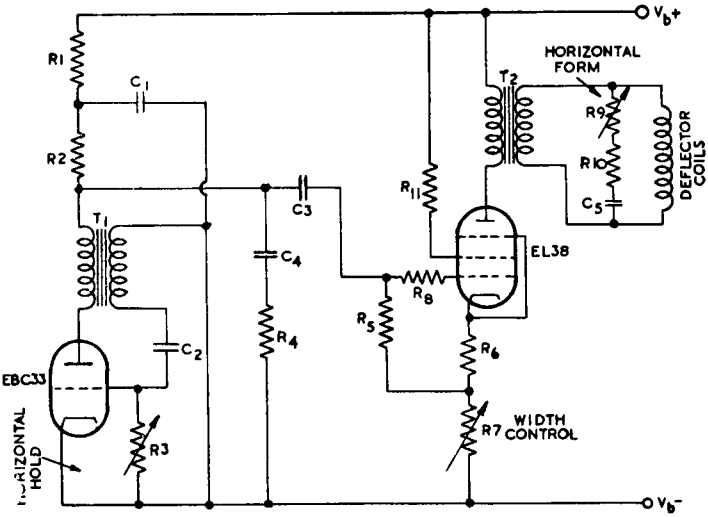
(ii) The decoupling components (R_1 C_1) in the anode circuit of the EBC33 are necessary only if there is ripple on the H.T. line.

(iii) All potentiometers should be linear components to provide smooth control.

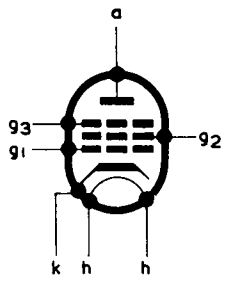
OUTPUT PENTODE

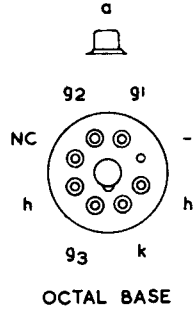
EL38

Output pentode primarily intended for use as line time base output valve in A.C. television receivers.

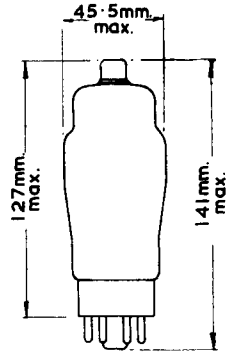


LINE TIME BASE CIRCUIT





OCTAL BASE

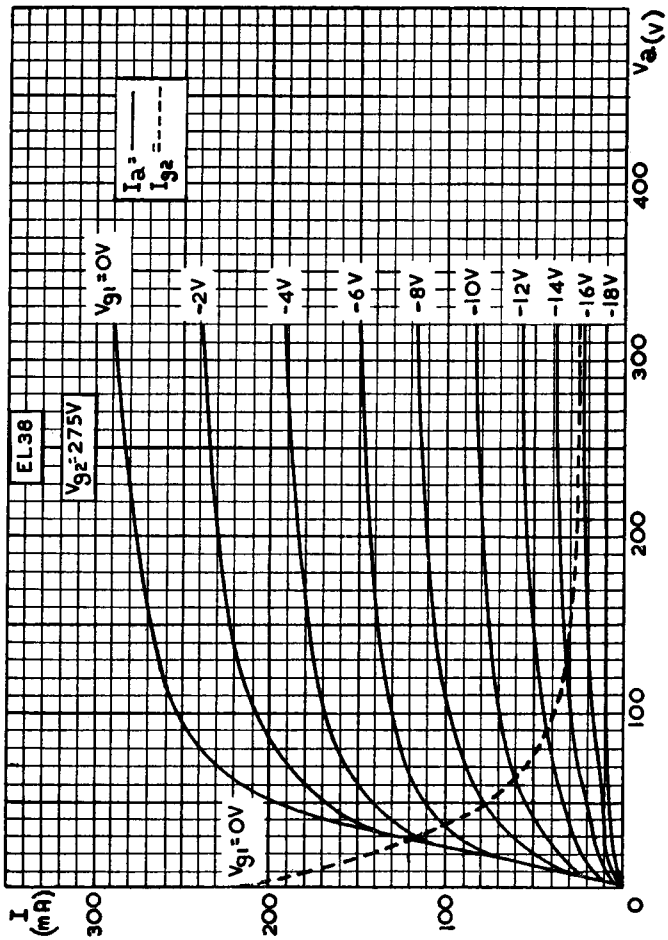


732

EL38

OUTPUT PENTODE

Output pentode primarily intended for use as line time base output valve in A.C. television receivers.



ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

OUTPUT PENTODE

EL41

Output pentode rated for 9W anode dissipation, primarily intended for use in A.C. mains operated equipment.

HEATER

V_h	6.3	V
I_h	0.7	A

MOUNTING POSITION

Any

CAPACITANCES

C_{out}	7.8	pF
C_{in}	10.2	pF
C_{a-g1}	<1.0	pF
C_{g1-h}	<0.15	pF

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
I_a	36	mA
I_{g2}	5.2	mA
V_{g1}	–7	V
g_m	10	mA/V
r_a	40	kΩ
μ_{g1-g2}	22	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Pentode connection

V_a	250	V
V_{g2}	250	V
V_{g1}	–7	V
R_k	170	Ω
I_a	36	mA
I_{g2}	5.2	mA
R_a	7	kΩ
$V_{in\ (r.m.s.)}$ (P_{out}=50mW)	0.32	V
P_{out} (D_{tot}=10%)	4.2	W
$V_{in\ (r.m.s.)}$ (D_{tot}=10%)	3.7	V
P_{out} (η=50%)	4.5	W
$V_{in\ (r.m.s.)}$ (P_{out}=4.5W)	4.0	V
D_{tot} (P_{out}=4.5W)	11.5	%

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Triode connection (g_2 connected to a)

V_a	250	V
R_k	250	Ω
R_a	3.5	kΩ
I_a	33	mA
P_{out}	1.55	W
$V_{in\ (r.m.s.)}$	6	V
D_{tot}	8	%

EL41

OUTPUT PENTODE

Output pentode rated for 9W anode dissipation, primarily intended for use in A.C. mains operated equipment.

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Pentode connection

V_a	250	300	V
V_{g_2}	250	300	V
$I_{a(o)}$	2×25	2×30	mA
I_a (max. sig.)	2×30	2×36	mA
$I_{g2(o)}$	2×3.5	2×4	mA
I_{g_2} (max. sig.)	2×8	2×9.5	mA
R_k	140	140	Ω
R_{a-a}	9	9	kΩ
P_{out}	9	13	W
$V_{in\ (g-g)\ (r.m.s.)}$	14	17	V
D_{tot}	2.5	2.5	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Triode connection (g_2 connected to a)

V_a	250	300	V
$I_{a\ (o)}$	2×27.5	2×33	mA
R_k	150	150	Ω
R_{a-a}	10	10	kΩ
P_{out}	2.5	4	W
$V_{in\ (g-g)\ (r.m.s.)}$	5.4	6.7	V
D_{tot}	1	1	%

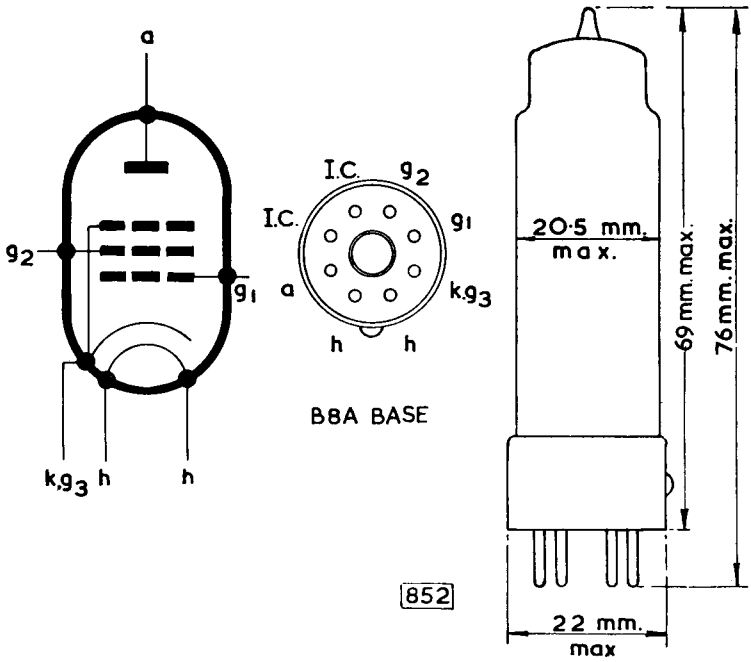
LIMITING VALUES

$V_{a\ (b)}$ max.	550	V
V_a max.	300	V
p_a max.	9	W
$V_{g_2\ (b)}$ max.	550	V
V_{g_2} max.	300	V
p_{g_2} (zero sig.) max.	1.4	W
p_{g_2} (max. sig.) max.	3.3	W
I_k max.	55	mA
V_{g_1} max. (I_{g_1} = +0.3μA)	−1.3	V
R_{g_1-k} max.	1	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ

OUTPUT PENTODE

EL41

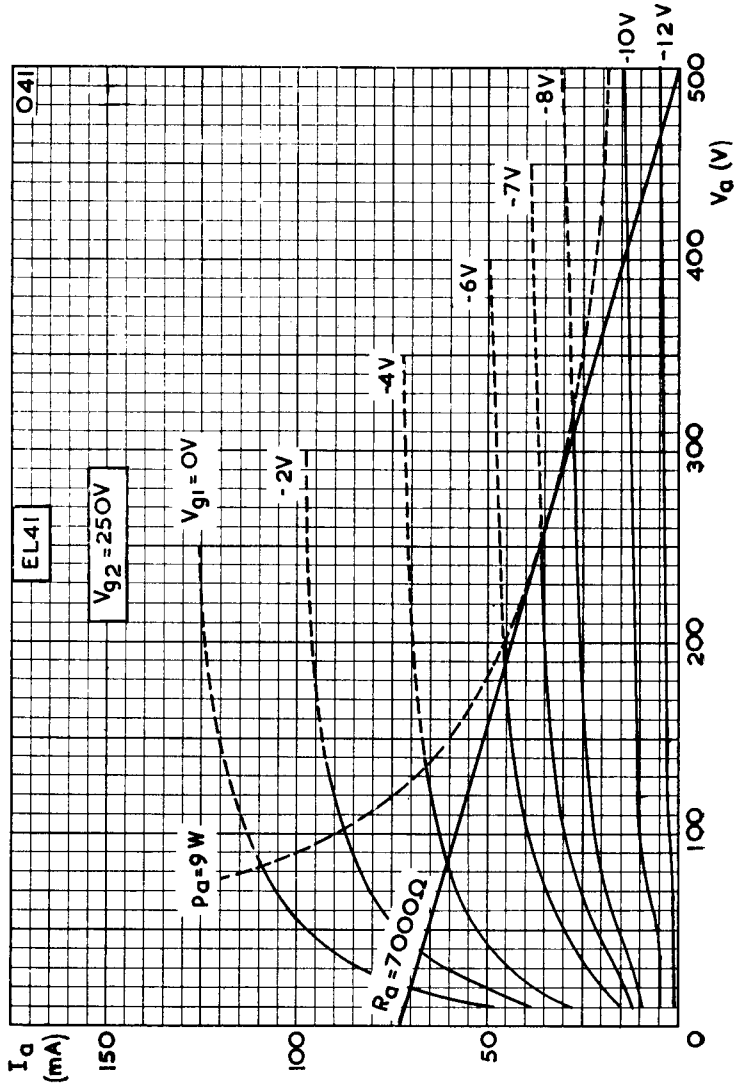
Output pentode rated for 9W anode dissipation, primarily intended for use in A.C. mains operated equipment.



EL41

OUTPUT PENTODE

Output pentode rated for 9W anode dissipation, primarily intended for use in A.C. mains operated equipment.



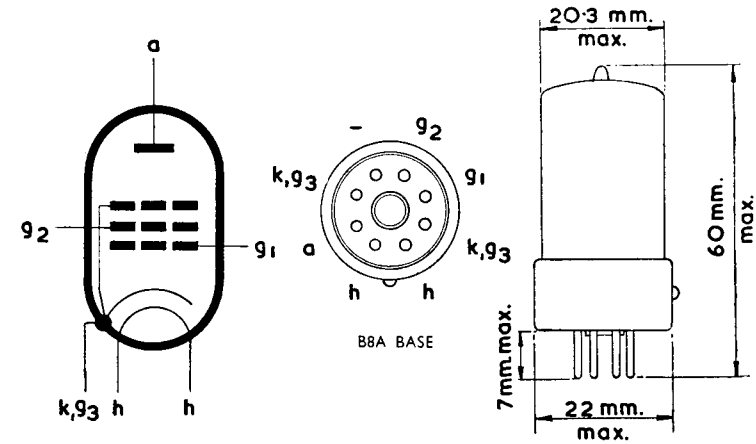
ANODE CURRENT PLOTTED AGAINST ANODE VOLTS

OUTPUT PENTODE

Output pentode with an anode dissipation of 6W, suitable for use in car radio receivers.

EL42

The limiting values, characteristics and audio performance of the EL42 and EL85 are identical. The basing and dimensions of the EL42 are shown below.



SUBMINIATURE OUTPUT PENTODE

EL71

Audio output pentode.

HEATER

V_h	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

c_{a-g1}	<0.2	pF
c_{in}	6.5	pF
c_{out}	7.5	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
I_a	30	mA
I_{g2}	1.2	mA
g_m	4.2	mA/V
r_a	15	kΩ
V_{g1}	–8.3	V
V_{g1} (I_a = 10μA)	–40	V

TYPICAL OPERATING CONDITIONS

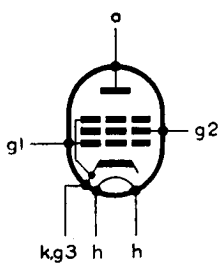
$V_{a\ c}$	110	V
$V_{g2\ c}$	110	V
I_a	30	mA
I_{g2}	1.2	mA
R_k	270	Ω
R_a	3.0	kΩ
$V_{in(r.m.s.)}$	6.4	V
P_{out}	1.0	W
D_{tot}	10	%

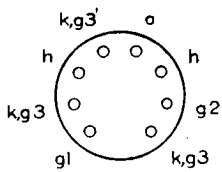
LIMITING VALUES (absolute ratings)

$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	4.0	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	1.0	W
$-V_{g1}$ max.	55	V
I_k max.	50	mA
$V_{h\ k}$ max.	200	V

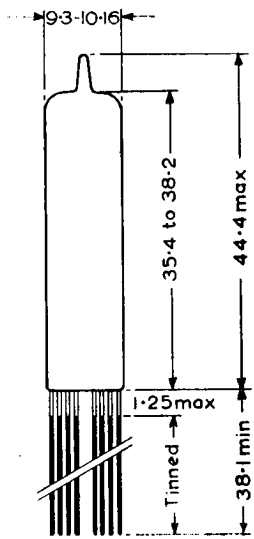
EL71

SUBMINIATURE OUTPUT PENTODE





B8D/F Base



[5326]

All dimensions in mm

OUTPUT PENTODE

EL81

Output pentode suitable for use in the line time base of television receivers or as a series regulator valve in stabilised power supply units.

HEATER

V_h	6.3	V
I_h	1.05	A

CAPACITANCES (measured without external shield)

Pentode connected

c_{in}	14.7	pF
c_{out}	6.0	pF
c_{a-g1}	<0.8	pF
c_{a-k}	<0.1	pF
c_{g1-h}	<0.2	pF

Triode connected

c_{in}	8.7	pF
c_{out}	11.4	pF
c_{a-g1}	6.6	pF

CHARACTERISTICS

Pentode connected

V_a	250	V
V_{g3}	0	V
V_{g2}	250	V
V_{g1}	−38.5	V
I_a	32	mA
I_{g2}	2.4	mA
g_m	4.6	mA/V
r_a	15	kΩ
μ_{g1-g2}	5.1	

Triode connected (g_2 connected to a, g_3 connected to k)

V_a	250	V
V_{g1}	−38	V
I_a	40	mA
g_m	5.5	mA/V
r_a	1.0	kΩ
μ	5.5	

EL81

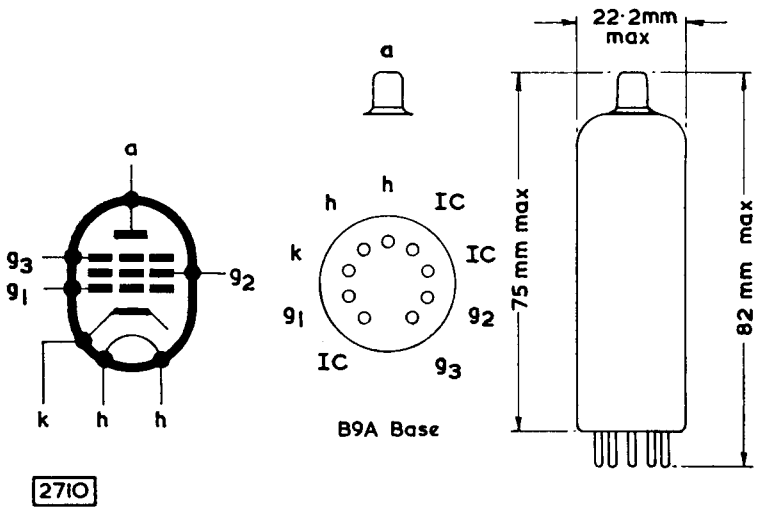
OUTPUT PENTODE

Output pentode suitable for use in the line time base of television receivers or as a series regulator valve in stabilised power supply units.

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
*$V_{a(pk)}$ max.	7.0	kV
p_a max.	8.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	4.5	W
p_{a+g2} max.	10	W
I_k max.	180	mA
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	185	°C

*Max. pulse duration 18% of one cycle, with a maximum of 18μs



VIDEO OUTPUT PENTODE

EL821

Video output pentode having a high mutual conductance, particularly suitable for use in high definition television equipment.

HEATER

V_h	6.3	V
I_h	750	mA

CAPACITANCES (measured without an external shield)

c_{in}	14	pF
c_{out}	5.0	pF
c_{a-g1}	<250	mpF
c_{h-k}	7.0	pF

CHARACTERISTICS

V_a	250	250	V
V_{g1}	0	0	V
V_{g2}	200	250	V
V_{g1}	–2.5	–4.5	V
I_a	40	40	mA
I_{g2}	6.5	6.0	mA
g_m	13	11	mA/V
r_a	60	50	kΩ
μ_{g1-g2}	26	26	
*T_{bulb}	203	205	°C

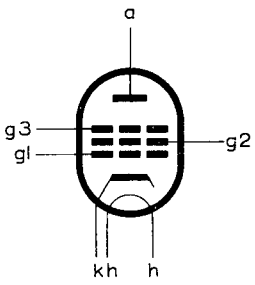
*At 20°C ambient, in free air at normal atmospheric pressure and without external screening can.

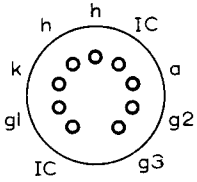
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	275	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max.	2.5	W
I_k max.	60	mA
R_{g1-k} max. (cathode bias)	220	kΩ
R_{g1-k} max. (fixed bias)	100	kΩ
V_{h-k} max.	90	V
T_{bulb} max.	250	°C

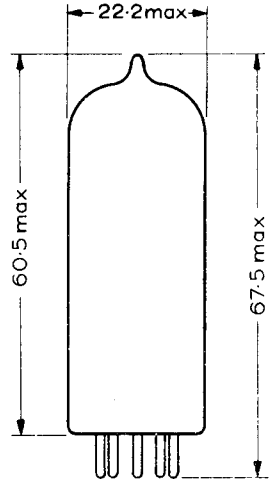
EL821

VIDEO OUTPUT PENTODE





B9A Base



All dimensions in mm

6396

VIDEO OUTPUT PENTODE

EL822

Video output pentode having a high mutual conductance.

HEATER

V_h	6.3	V
I_h	750	mA

CAPACITANCES (unshielded)

C_{in}	12	pF
C_{out}	6.0	pF
C_{a-g1}	<0.1	pF

CHARACTERISTICS

Pentode connection

V_a	250	250	250	V
V_{g3}	0	0	0	V
V_{g2}	150	200	250	V
V_{g1}	−2.5	−5.0	−7.0	V
I_a	40	37.5	42.5	mA
I_{g2}	5.0	4.8	4.8	mA
g_m	13	12.2	12.5	mA/V
μ_{g1-g2}	23	23	23	
r_a	100	90	90	kΩ
T_{bulb}	190	200	220	°C

Triode connection (g_2 connected to a)

V_a	150	V
I_a	45	mA
V_{g1}	−2.5	V
g_m	14.6	mA/V
r_a	1.56	kΩ
μ	23	

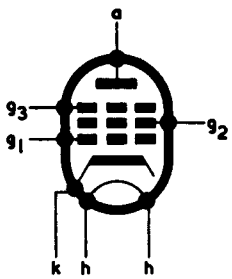
EL822

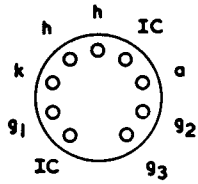
VIDEO OUTPUT PENTODE

DESIGN CENTRE RATINGS

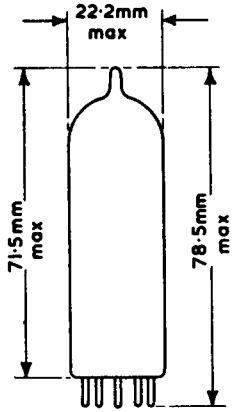
$V_{a(b)}$ max.	550	V
V_a max.	275	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max.	2.5	W
I_k max.	60	mA
R_{g1-k} max.	100	kΩ
V_{h-k} max.	90	V
T_{bulb} max.	220	°C

3310





B9A Base



OUTPUT PENTODE

EL84

Output pentode rated for 12W anode dissipation, primarily intended for use in a.c. mains operated equipment.

HEATER

V_h	6.3	V
I_h	760	mA

CAPACITANCES

c_{in}	10.8	pF
c_{out}	6.5	pF
c_{a-g1}	<500	mpF
c_{g1-h}	<250	mpF

CHARACTERISTICS

Pentode connection

V_a	250	V
V_{g2}	250	V
I_a	48	mA
I_{g2}	5.5	mA
V_{g1}	−7.3	V
g_m	11.3	mA/V
r_a	38	kΩ
μ_{g1-g2}	19	

Triode connection (g_2 connected to a)

V_a	250	V
I_a	34	mA
V_{g1}	−9.0	V
g_m	10	mA/V
r_a	2.0	kΩ
μ	19.5	

OPERATING CONDITIONS AS SINGLE VALVE AMPLIFIER

Pentode connection

V_a	250	250	V
V_{g2}	250	250	V
R_a	5.2	4.5	kΩ
V_{g1}	−7.3	−7.3	V
I_a	48	48	mA
I_{g2}	5.5	5.5	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	300	300	mV
$V_{in(r.m.s.)}$ (D_{tot} = 10%)	4.3	4.4	V
P_{out} (D_{tot} = 10%)	5.7	5.7	W
D_3	9.5	8.0	%
D_2	2.0	5.0	%

Triode connection (g_2 connected to a)

V_a	250	V
R_a	3.5	kΩ
V_{g1}	−9.0	V
$I_{a(o)}$	34	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	1.0	V
$V_{in(r.m.s.)}$	6.0	V
P_{out}	1.5	W
D_{tot}	6.0	%
$I_{a(max.sig.)}$	39	mA

EL84

OUTPUT PENTODE

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Pentode connection

V_a	250	300	V
V_{g2}	250	300	V
R_k (per valve)	270	270	Ω
R_{a-a}	8.0	8.0	kΩ
$I_{a(o)}$	2×31	2×36	mA
$I_{g2(o)}$	2×3.5	2×4.0	mA
$V_{in(g1-g1)}$ r.m.s.	16	20	V
P_{out}	11	17	W
D_{tot}	3.0	4.0	%
$I_{a(max.sig.)}$	2×37.5	2×46	mA
$I_{g2(max.sig.)}$	2×7.5	2×11	mA

Distributed load conditions for maximum output (screen-grid tapping at 20% of primary turns)

V_a	300	300	V
V_{g2}	300	300	V
R_k (per valve)	390+47	270	Ω
R_{a-a}	6.0	8.0	kΩ
$I_{k(o)}$	2×28	2×40	mA
$V_{in(g1-g1)}$r.m.s.	17	18.3	V
P_{out}	14.4	15.4	W
D_{tot}	0.85	1.17	%
$I_{k(max.sig.)}$	2×55	2×48.5	mA

Distributed load conditions for minimum distortion (screen-grid tapping at 43% of primary turns)

V_a	300	300	V
V_{g2}	300	300	V
R_k (per valve)	390+47	270	Ω
R_{a-a}	6.0	8.0	kΩ
$I_{k(o)}$	2×28	2×40	mA
$V_{in(g1-g1)}$r.m.s.	16.8	16	V
P_{out}	10.1	11	W
D_{tot}	0.72	0.7	%
$I_{k(max.sig.)}$	2×47	2×45	mA

Triode connection (g_2 connected to a)

V_a	250	300	V
R_k (per valve)	560	560	Ω
R_{a-a}	10	10	kΩ
$I_{a(o)}$	2×20	2×24	mA
$V_{in(g1-g1)}$r.m.s.	16.5	20	V
P_{out}	3.4	5.2	W
D_{tot}	2.5	2.5	%
$I_{a(max.sig.)}$	2×21.5	2×26	mA

OPERATING CONDITIONS WITH CONTINUOUS SINE WAVE DRIVE

Single valve

V_a	250	250	V
$V_{g2(b)}$	250	250	V
*R_{g2}	4.7(±10%)	3.9(±10%)	kΩ
R_k	130	130	Ω
R_a	5.25	4.5	kΩ
$I_{a(o)}$	44	44	mA
$I_{g2(o)}$	5.1	5.2	mA
$V_{in(r.m.s.)}$	4.4	4.65	V
P_{out}	5.4	5.6	W
D_{tot}	12.5	13.9	%
$I_{a(max.sig.)}$	40	42	mA
$I_{g2(max.sig.)}$	8.6	8.4	mA
p_{g2}	1.8	1.8	W

*Decoupled by 8μF capacitor.

Two valves in push-pull

V_a	300	V
$V_{g2(b)}$	300	V
*R_{g2}	1.8(±10%)	kΩ
R_k (per valve)	270	Ω
R_{a-a}	8.0	kΩ
$I_{a(o)}$	2×35	mA
$I_{g2(o)}$	2×4.0	mA
$V_{in(g1-g1)r.m.s.}$	17.4	V
P_{out}	15	W
D_{tot}	3.4	%
$I_{a(max.sig.)}$	2×42	mA
$I_{g2(max.sig.)}$	2×7.0	mA
p_{g2}	1.93	W

*Screen-grid resistor common to both valves.

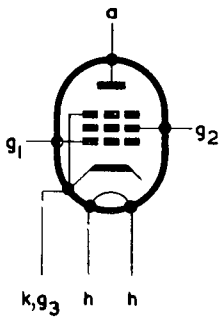
LIMITING VALUES

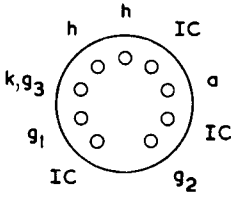
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	2.0	W
I_k max.	65	mA
$-V_g$ max.	100	V
R_{g1-k} max.	300	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

EL84

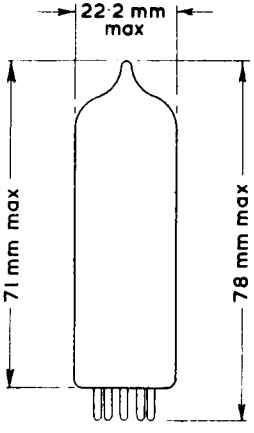
OUTPUT PENTODE

2834

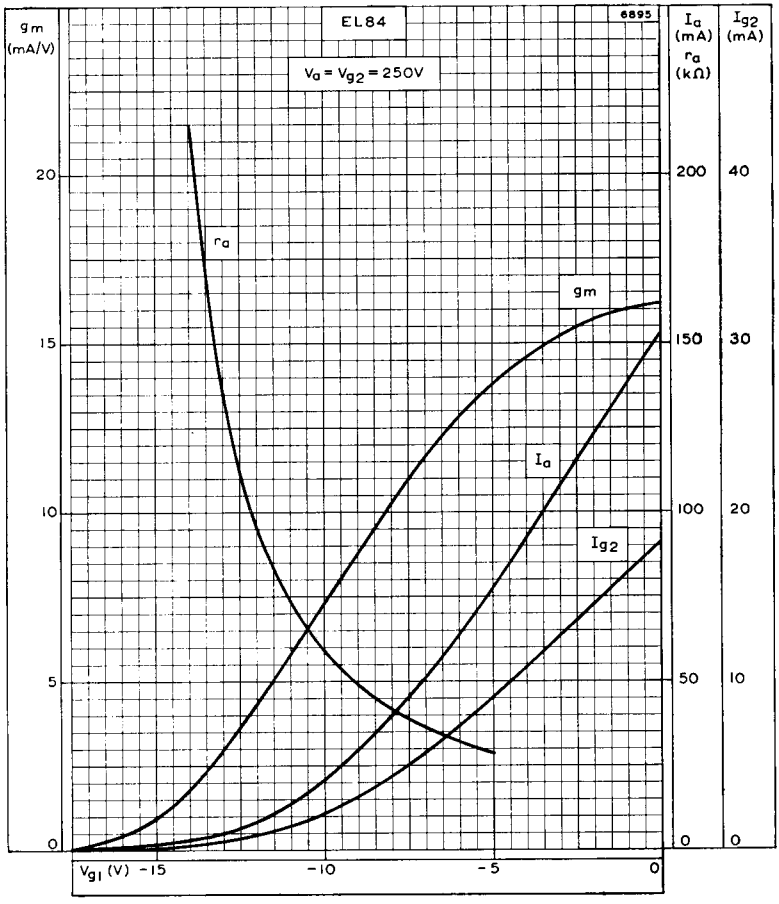




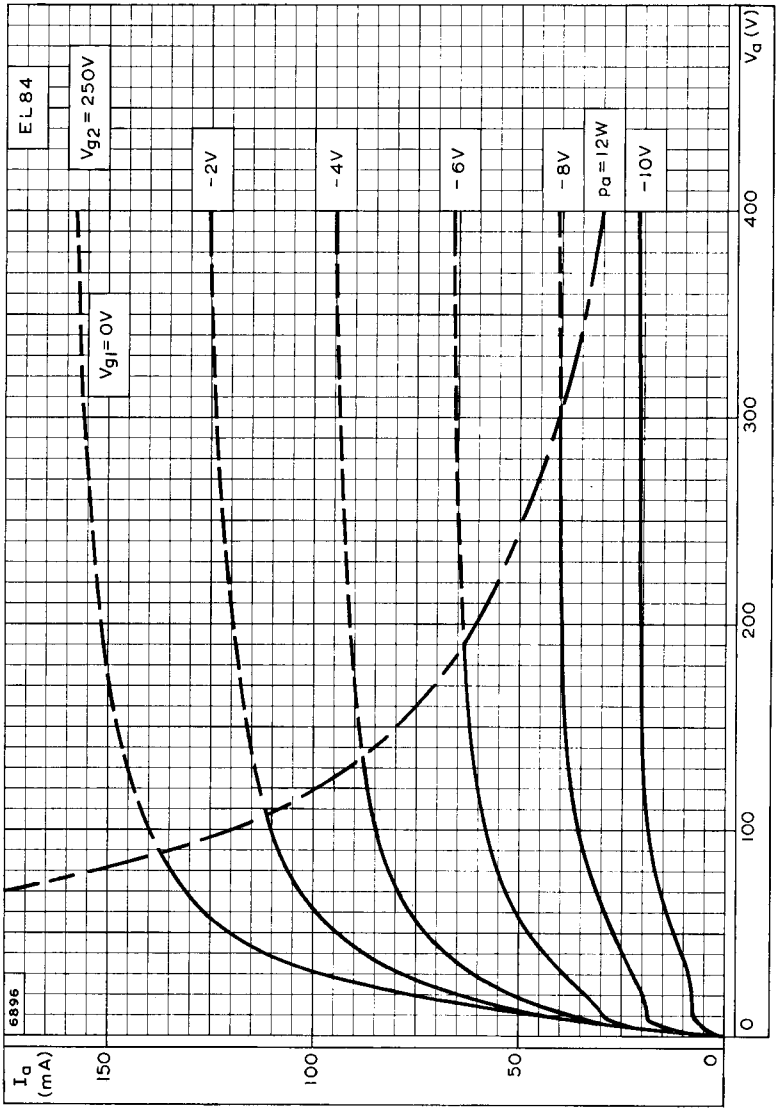
B9A Base



EL84

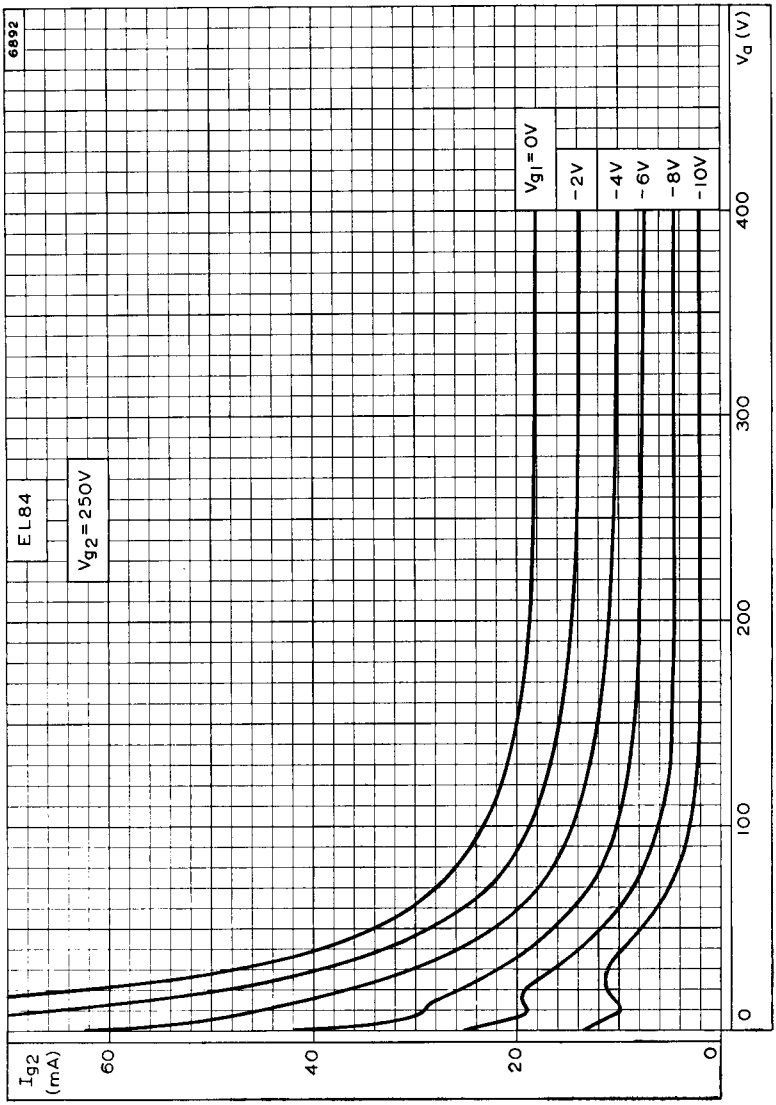


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

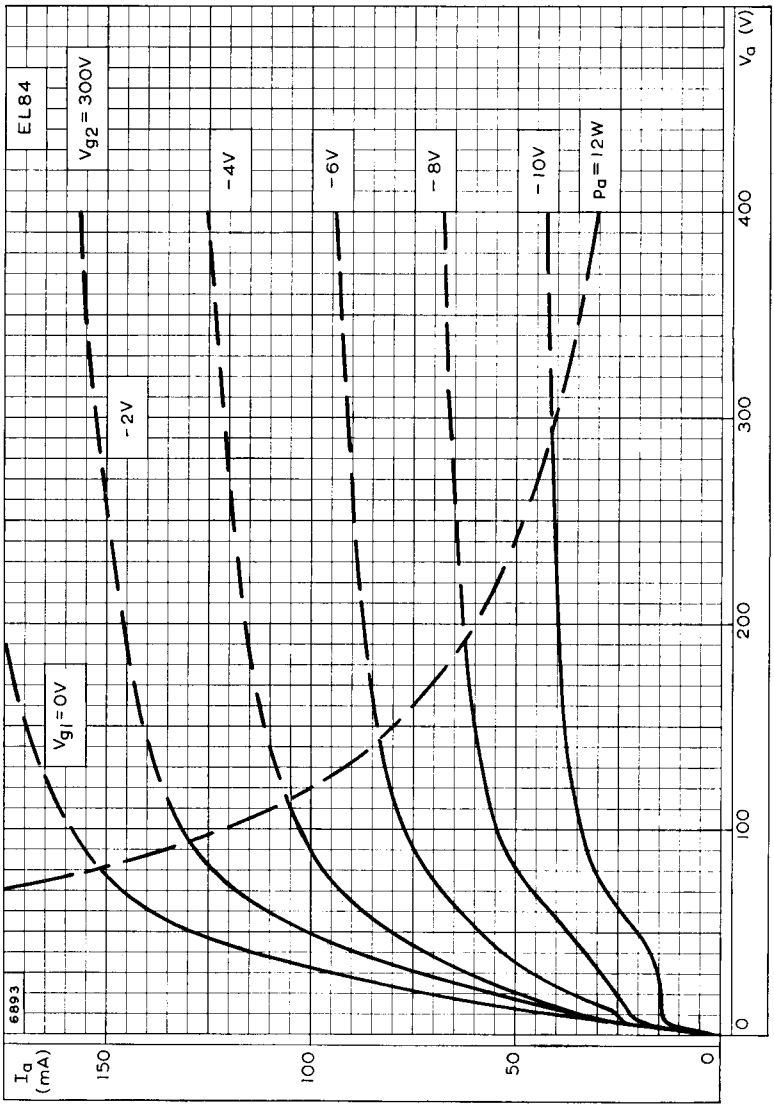
EL84



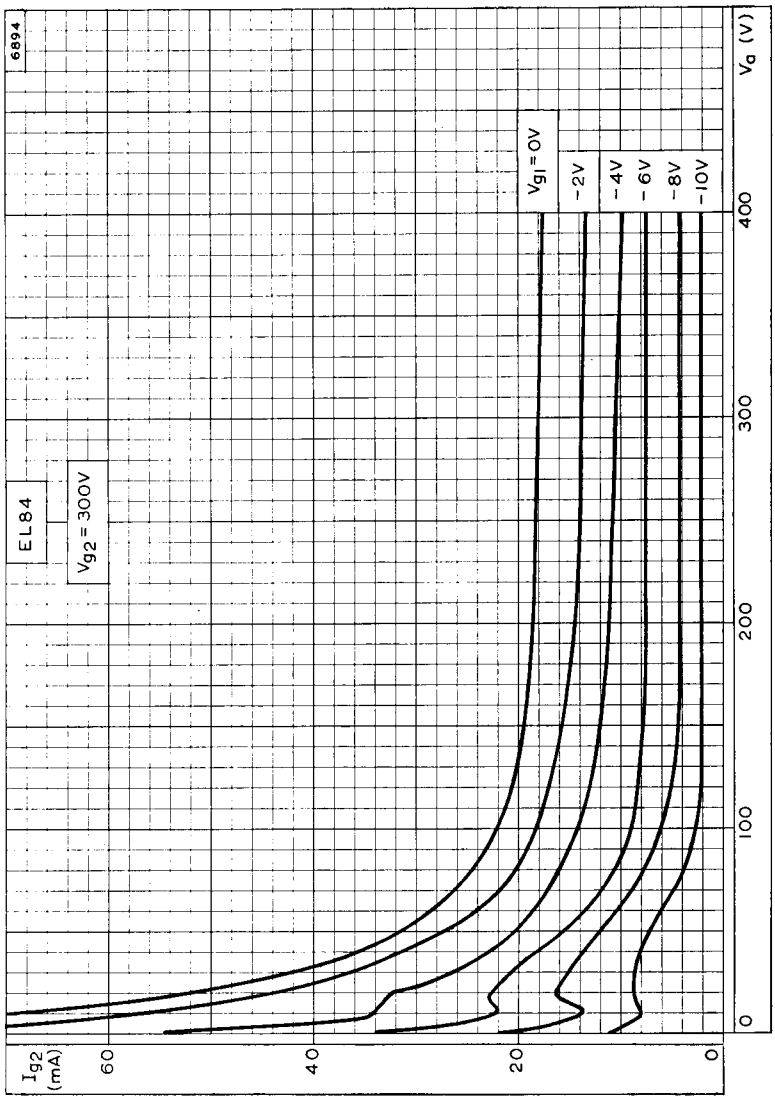
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

EL84

OUTPUT PENTODE



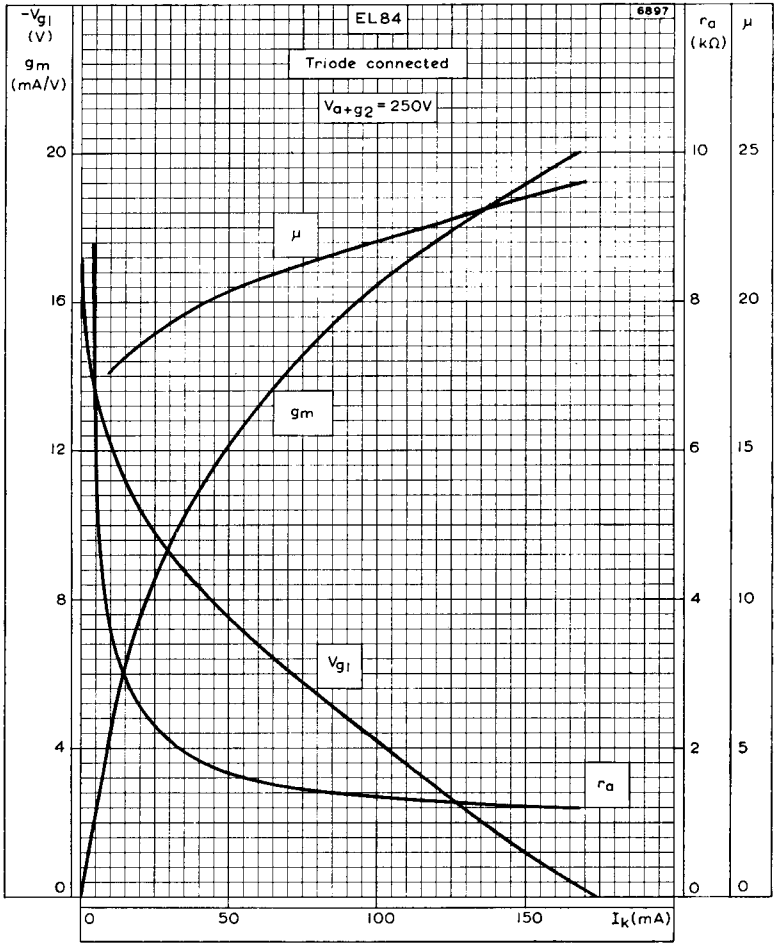
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V



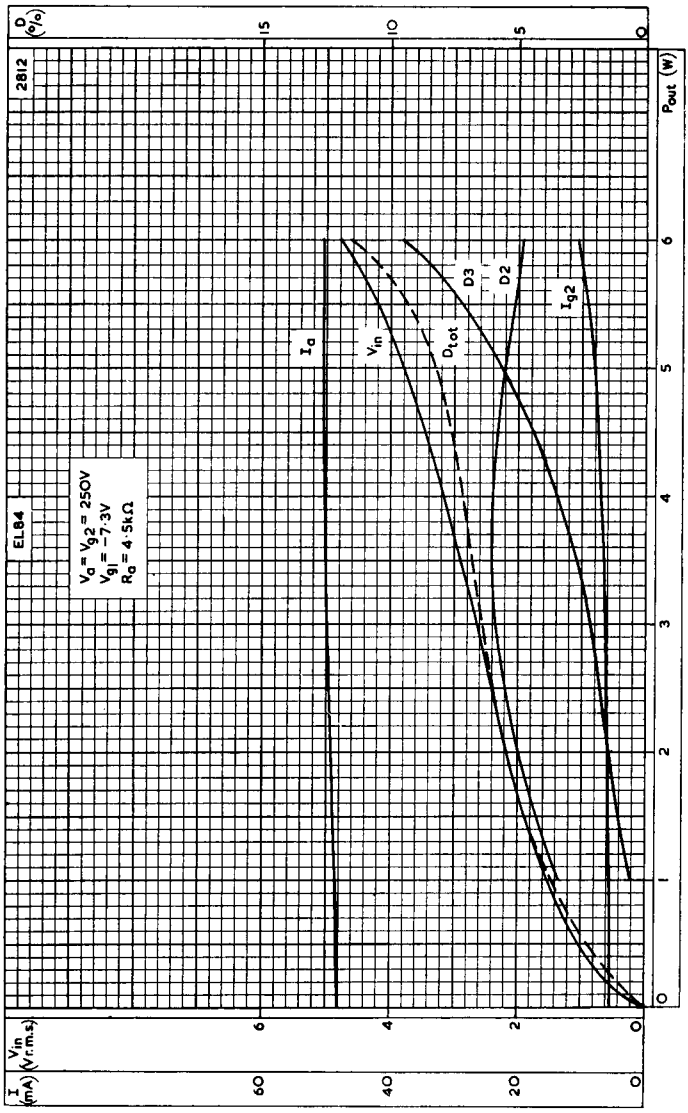
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V

EL84

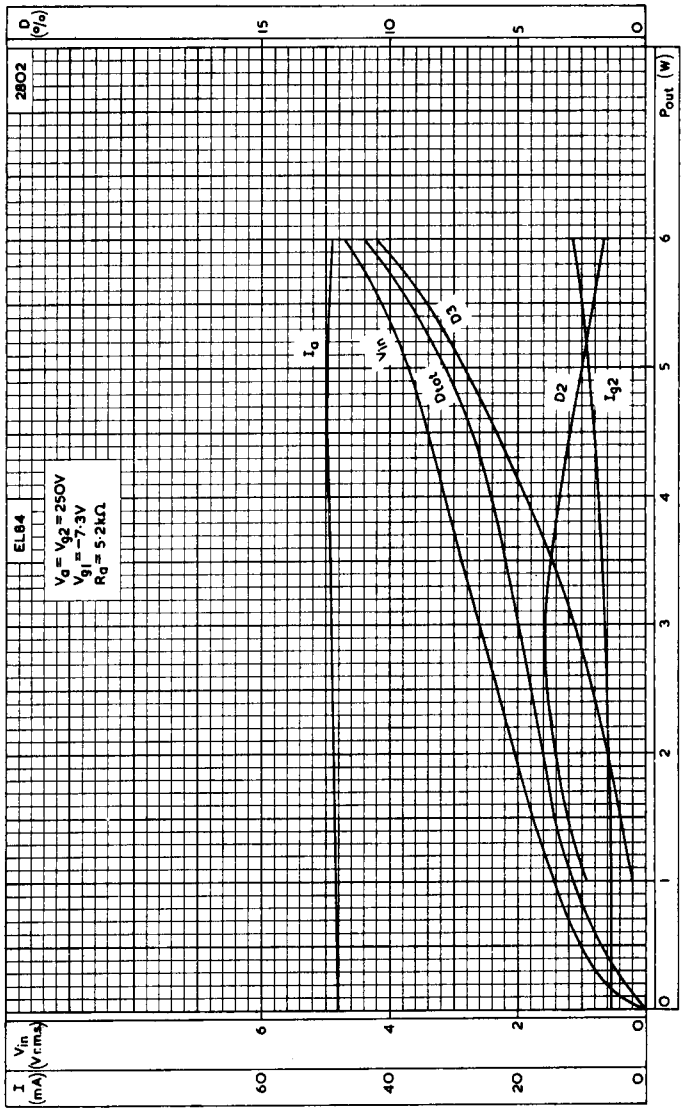
OUTPUT PENTODE



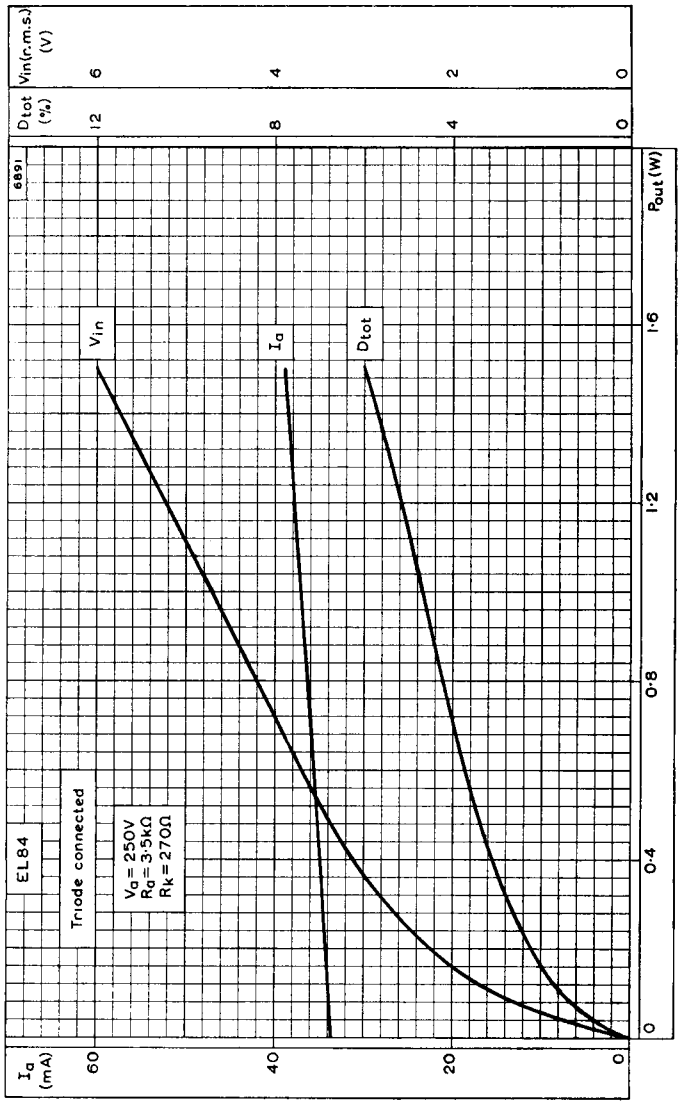
CONTROL-GRID VOLTAGE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CATHODE CURRENT WHEN TRIODE CONNECTED



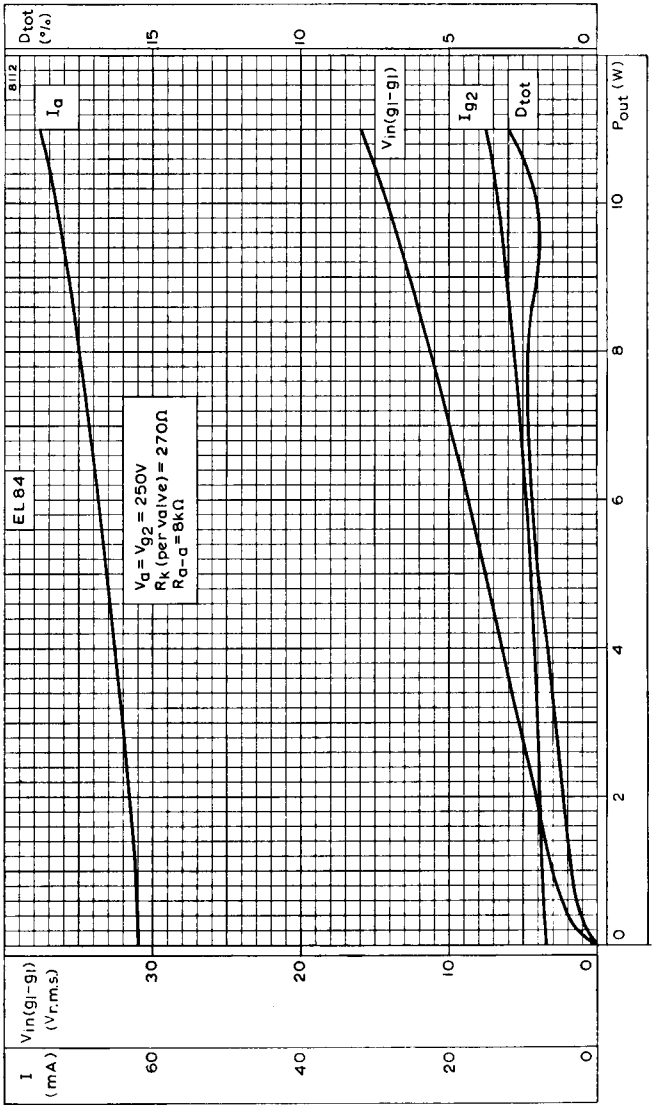
PERFORMANCE OF EL84 WHEN USED AS A SINGLE VALVE AMPLIFIER WITH A LOAD OF 4.5kΩ



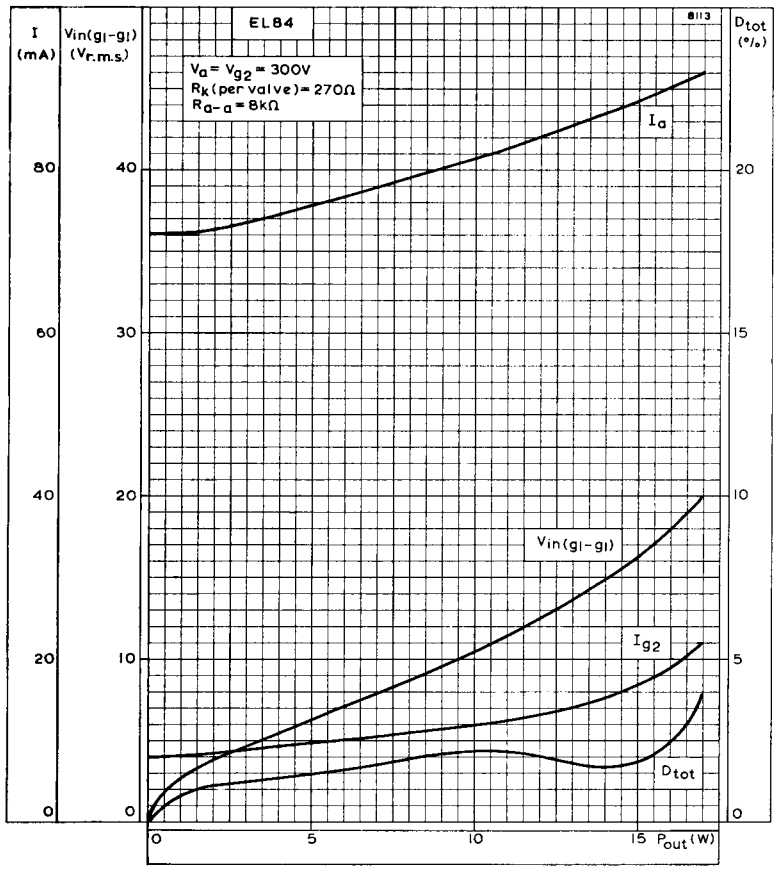
PERFORMANCE OF EL84 WHEN USED AS A SINGLE VALVE AMPLIFIER WITH A LOAD OF 5.2kΩ



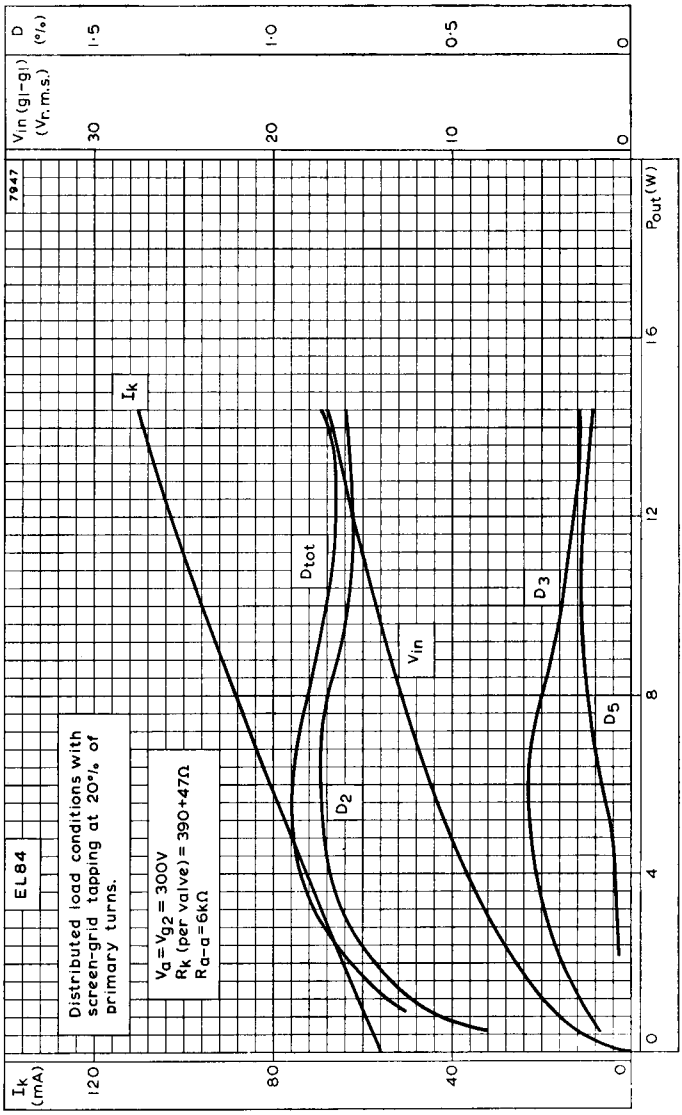
PERFORMANCE OF EL84 TRIODE CONNECTED AS A SINGLE VALVE AMPLIFIER



PERFORMANCE OF TWO EL84 IN PUSH-PULL
$V_a = V_{g2} = 250V$

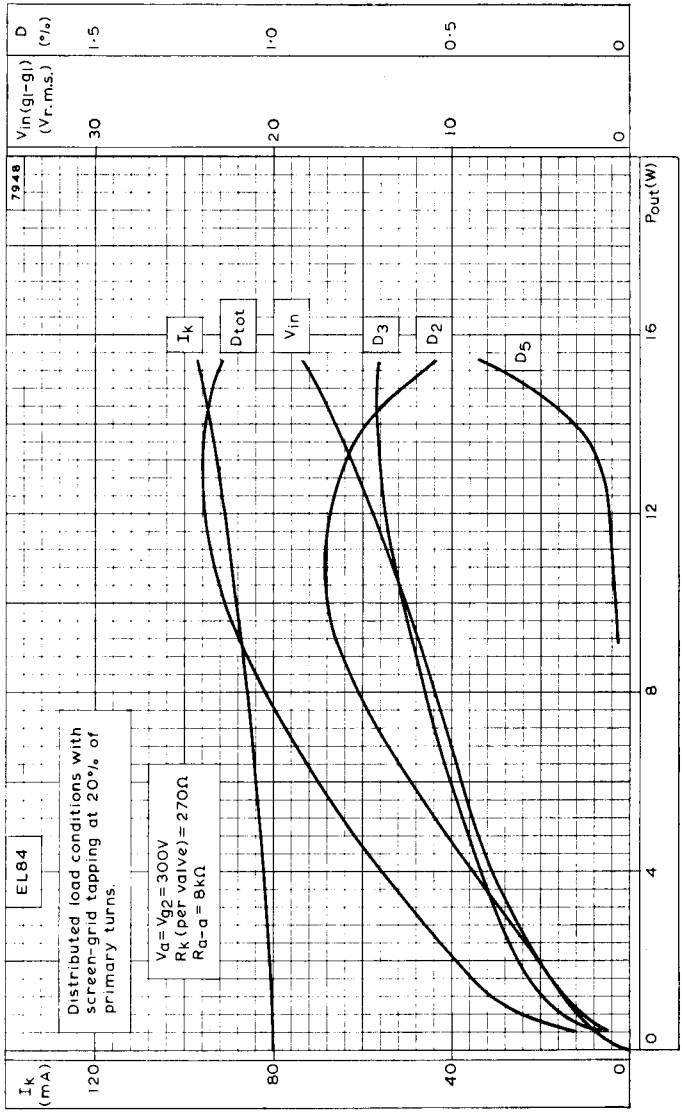


PERFORMANCE OF TWO EL84 IN PUSH-PULL
$V_a = V_{g2} = 300V$

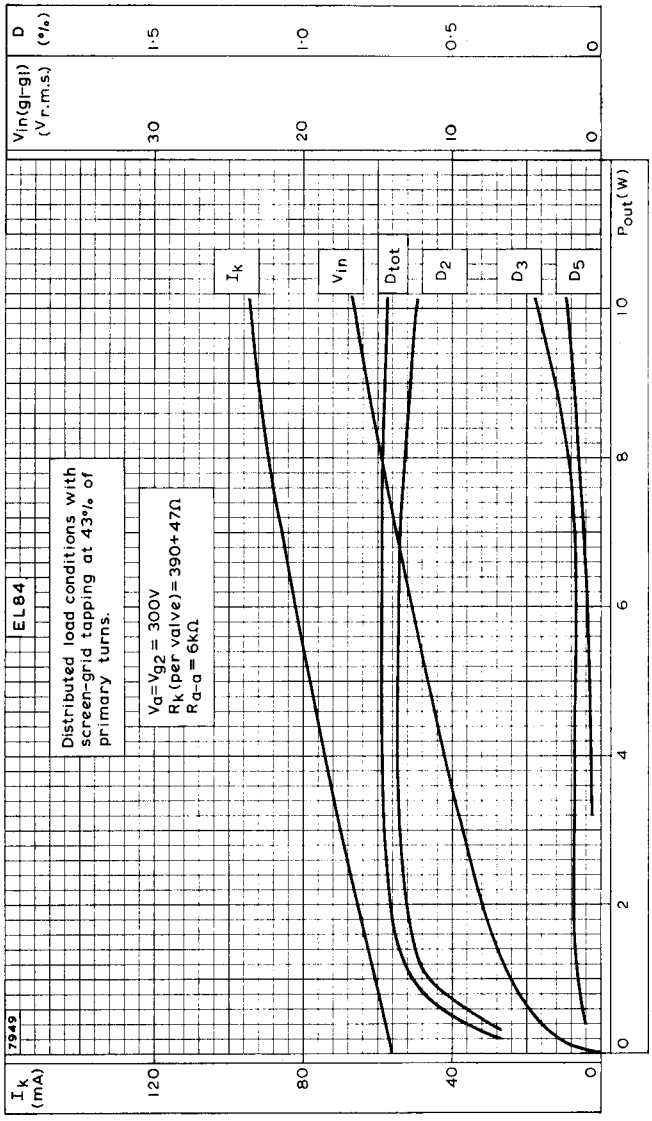


PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS. $R_{a-a} = 6k\Omega$

EL84

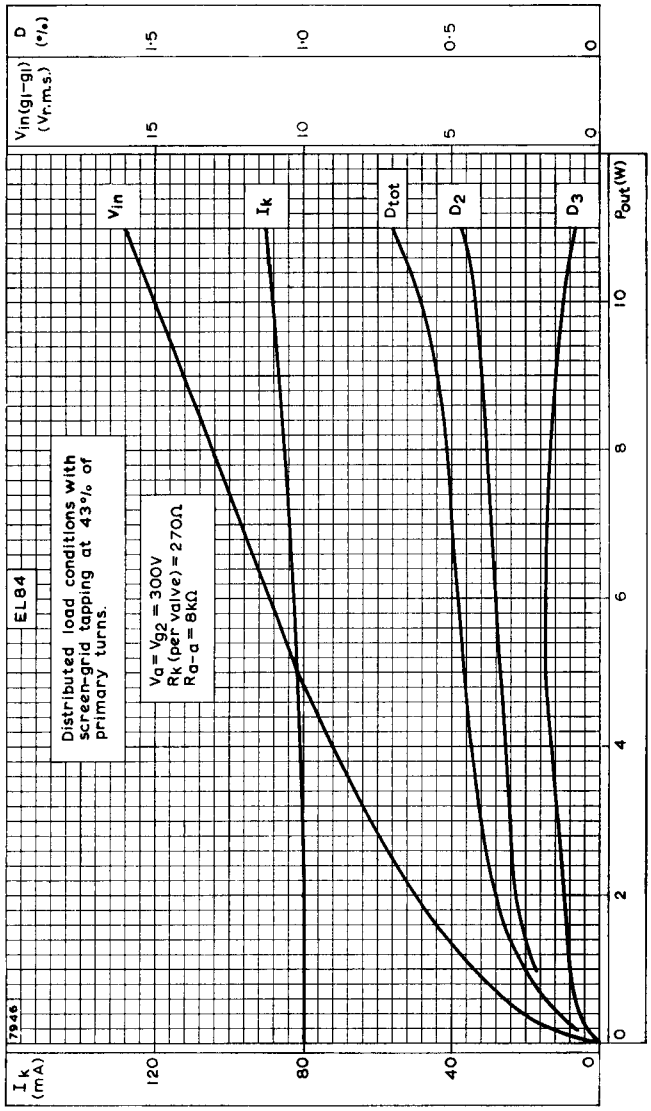


PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS. $R_{a-a} = 8k\Omega$

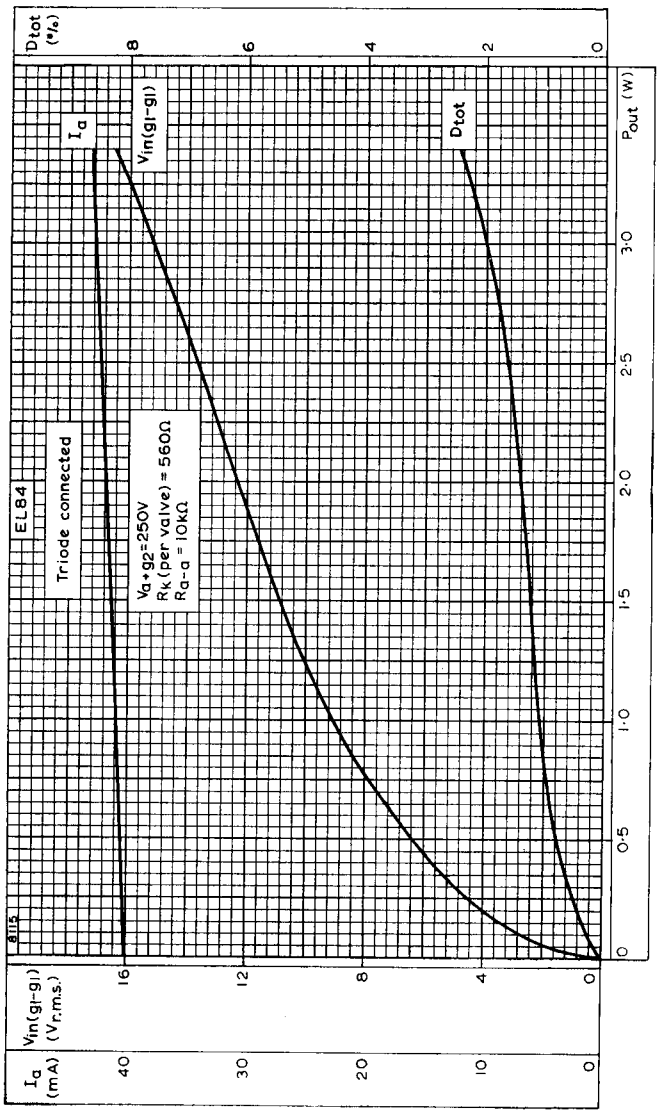


PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS. $R_{a-a} = 6k\Omega$

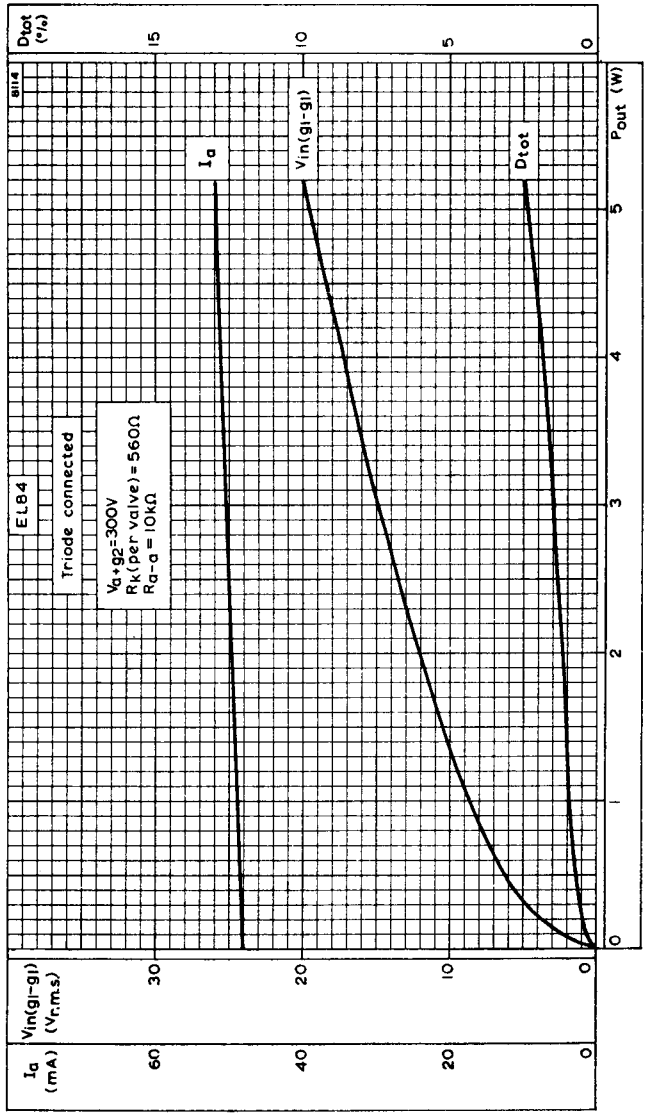
EL84



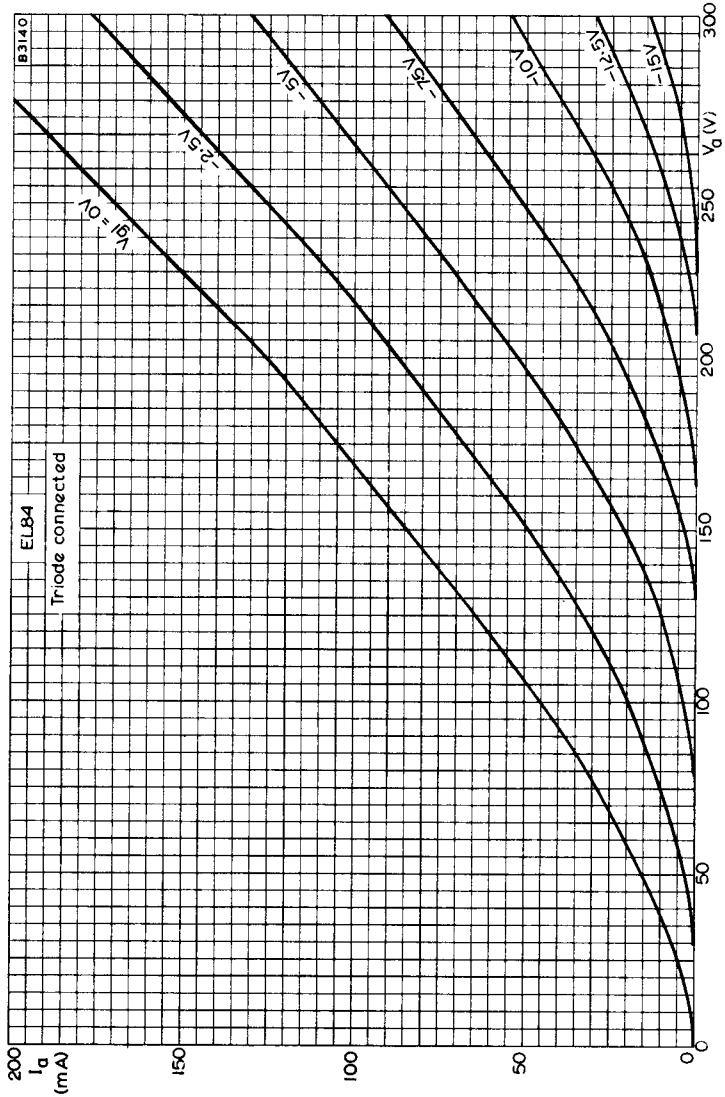
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS. $R_{a-a} = 8k\Omega$



PERFORMANCE OF TWO EL84 TRIODE CONNECTED IN PUSH-PULL.
$V_{a+g2} = 250V$



PERFORMANCE OF TWO EL84 TRIODE CONNECTED IN PUSH-PULL.
$V_{a-g2} = 300V$



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED

OUTPUT PENTODE

EL85

Output pentode rated for 6W anode dissipation intended for use in mobile equipment as a r.f. amplifier at frequencies up to 120Mc/s or as an a.f. output valve.

HEATER

V_h	6.3	V
I_h	200	mA

CAPACITANCES

c_{a-g1}	<0.2	pF
c_{in}	4.3	pF
c_{out}	5.1	pF

CHARACTERISTICS

V_a	200	225	250	V
V_{g2}	200	225	250	V
I_a	22.5	26	24	mA
I_{g2}	3.6	4.1	4.1	mA
V_{g1}	−9.4	−10.8	−13.5	V
g_m	3.2	3.2	3.1	mA/V
r_a	90	90	100	kΩ
μ_{g1-g2}	11	11	11	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

V_a	200	225	250	V
V_{g2}	200	225	250	V
R_k	360	360	470	Ω
V_{g1}	−9.4	−10.8	−13.5	V
I_a	22.5	26	24	mA
I_{g2}	3.6	4.1	4.1	mA
R_a	9.0	9.0	11	kΩ
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	800	800	700	mV
P_{out}	2.0	2.6	2.55	W
$V_{in(r.m.s.)}$	6.4	7.2	7.5	V
D_{tot}	10	10	10	%

OPERATING CONDITIONS FOR TWO VALVES IN CLASS "AB" PUSH-PULL (Cathode bias)

V_a	200	250	V
V_{g2}	200	250	V
$I_{a(o)}$	2×16	2×20	mA
I_a (max. sig.)	2×17.5	2×22.1	mA
$I_{g2(o)}$	2×2.9	2×3.3	mA
I_{g2} (max. sig.)	2×4.4	2×7.1	mA
*R_k	310	310	Ω
R_{a-a}	12	12	kΩ
P_{out}	4.0	6.8	W
$V_{in(g1-g1)r.m.s.}$	19	24.4	V
D_{tot}	4.5	5.4	%

*Common cathode bias resistor.

EL85

OUTPUT PENTODE

Output pentode rated for 6W anode dissipation intended for use in mobile equipment as a r.f. amplifier at frequencies up to 120Mc/s or as an a.f. output valve.

OPERATING CONDITIONS FOR TWO VALVES IN CLASS "B" PUSH-PULL (Fixed bias)

V_a	200	250	V
V_{g2}	200	250	V
V_{g1}	−17.5	−23	V
$I_{a(o)}$	2×5.0	2×5.0	mA
I_a (max. sig.)	2×15	2×19	mA
$I_{g2(o)}$	2×0.8	2×0.9	mA
I_{g2} (max. sig.)	2×5.0	2×7.3	mA
R_{a-a}	16	16	kΩ
P_{out}	3.9	6.8	W
$V_{in(g1-g1)r.m.s.}$	24.4	32	V
D_{tot}	3.5	4.3	%

P_{out} and D_{tot} are measured with fixed bias and therefore represent the power output available during the reproduction of speech and music. When a sustained sine wave is applied to the control-grid the bias across the cathode resistor will readjust itself as a result of the increased anode and screen-grid currents. This will result in approximately 10% reduction in power output.

R.F. OPERATING CONDITIONS FOR SINGLE VALVE, CLASS "C"

R.F. amplifier

f	50	100	Mc/s
V_a	300	300	V
V_{g2}	175	175	V
V_{g1}	−30	−30	V
I_a	19.8	20.2	mA
I_{g2}	4.1	3.9	mA
I_{g1}	1.1	0.9	mA
P_{load}	3.8	3.1	W
η_{load}	64	51	%

Frequency doubler

f_{out}	50	100	Mc/s
V_a	300	300	V
V_{g2}	175	175	V
V_{g1}	−60	−60	V
I_a	19.8	20.3	mA
I_{g2}	3.7	3.5	mA
I_{g1}	1.5	1.2	mA
P_{load}	2.7	2.0	W
η_{load}	45	33	%

Frequency trebler

f_{out}	50	100	Mc/s
V_a	300	300	V
V_{g2}	175	175	V
V_{g1}	−100	−100	V
I_a	19.6	20	mA
I_{g2}	3.6	3.4	mA
I_{g1}	1.8	1.6	mA
P_{load}	2.1	1.7	W
η_{load}	36	28	%

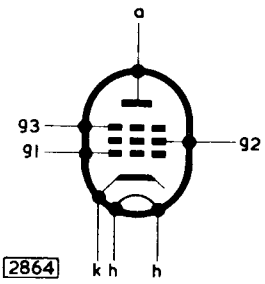
OUTPUT PENTODE

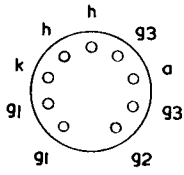
EL85

Output pentode rated for 6W anode dissipation intended for use in mobile equipment as a r.f. amplifier at frequencies up to 120Mc/s or as an a.f. output valve.

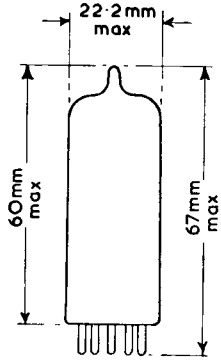
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	6.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max. (zero sig.)	1.0	W
p_{g2} max. (max. sig. speech and music)	2.0	W
$-V_{g1}$ max.	100	V
$-v_{g1(pk)}$ max.	250	V
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
I_k max. (a.f. operation)	35	mA
I_k max. (r.f. operation)	25	mA
R_{g1-k} max.	2.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ





B9A Base

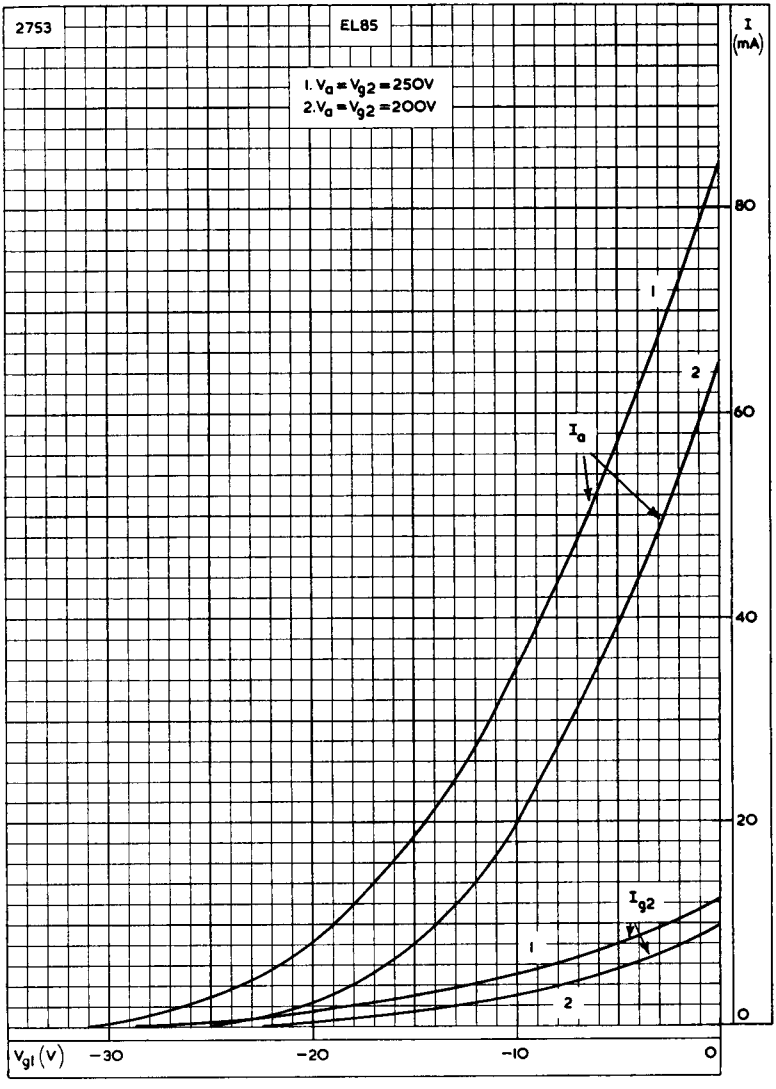


FOR R.F. APPLICATIONS IT IS RECOMMENDED THAT PINS 1 AND 2 SHOULD BE STRAPPED TOGETHER AND PINS 6 AND 8 BE CONNECTED SEPARATELY TO THE CHASSIS

EL85

OUTPUT PENTODE

Output pentode rated for 6W anode dissipation intended for use in mobile equipment as a r.f. amplifier at frequencies up to 120Mc/s or as an a.f. output valve.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE

OUTPUT PENTODE

EL86

Low impedance output pentode suitable for use in single-ended push-pull output stages and series regulators.

HEATER

V_h	6.3	V
I_h	760	mA

CAPACITANCES (measured without an external shield)

c_{in}	13	pF
c_{out}	6.8	pF
c_{a-g1}	<600	mpF
c_{h-g1}	<250	mpF

CHARACTERISTICS

Pentode connection

V_a	100	170	V
V_{g2}	100	170	V
V_{g1}	−5.0	−12.5	V
I_a	57	70	mA
I_{g2}	3	3.5	mA
g_m	13	11	mA/V
μ_{g1-g2}	9	8	
r_a	23	26	kΩ
V_{g1} max.		−1.3	V

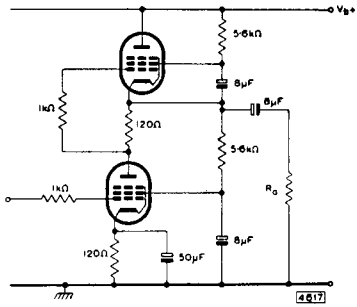
Triode connection (g_2 connected to a)

V_a	100	170	V
V_{g1}	−5.0	−12.5	V
I_a	60	74	mA
g_m	14	12	mA/V
μ	9	8	
r_a	645	665	Ω

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

$V_{a(b)}$	200	V
$V_{g2(b)}$	200	V
R_k	215	Ω
R_a	2.5	kΩ
R_{g2} (unbypassed)	470	Ω
I_a	64	mA
$I_{g2(o)}$	3.2	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	520	mV
$V_{in(r.m.s.)}$	7.0	V
P_{out}	5.3	W
D_{tot}	10	%
I_{g2} (max. sig.)	11.4	mA

OPERATING CONDITIONS FOR TWO VALVES IN SINGLE ENDED PUSH-PULL



V_b	300	V
R_a	1.0	kΩ
$I_{b(o)}$	66	mA
I_b (max. sig.)	64	mA
$V_{in(r.m.s.)}$	5.4	V
P_{out}	4.5	W
D_{tot}	9.3	%

OPERATING CONDITIONS FOR TWO VALVES IN CLASS 'AB' PUSH-PULL

Speech and music

V_{a-k}	250	V
V_{g2-k}	200	V
R_k (per valve)	300	Ω
R_{a-a}	5.5	kΩ
$I_{a(o)}$	2×50	mA
I_a (max. sig.)	2×55	mA
$I_{g2(o)}$	2×2.0	mA
I_{g2} (max. sig.)	2×13	mA
$V_{in(g1-g1)r.m.s.}$	26	V
P_{out}	18.5	W
D_{tot}	4.5	%

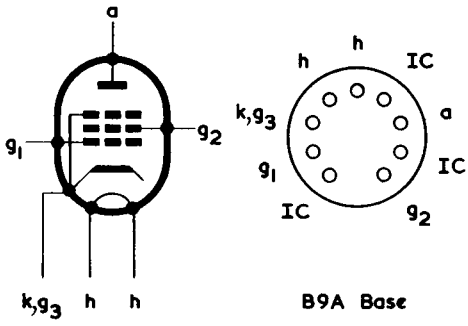
Continuous sine wave drive

V_{a-e}	190	220	250	V
$V_{g2(b)}$	190	220	250	V
R_k (per valve)	220	270	390	Ω
R_{g2} (common)	330	1000	1800	Ω
$I_{a(o)}$	2×61	2×59	2×51	mA
$I_{g2(o)}$	2×2.8	2×2.7	2×2.4	mA
R_{a-a}	2.6	3.0	3.5	kΩ
P_{out}	13.3	15.7	17.4	W
$V_{in(g1-g1)r.m.s.}$	24	29	39	V
D_{tot}	2.3	3.3	4.2	%
I_a (max. sig.)	2×69	2×69	2×64	mA
I_{g2} (max. sig.)	2×10	2×9.7	2×8.7	mA
$V_{in(g1-g1)r.m.s.}$ (P_{out} = 50mW)	930	920	960	mV

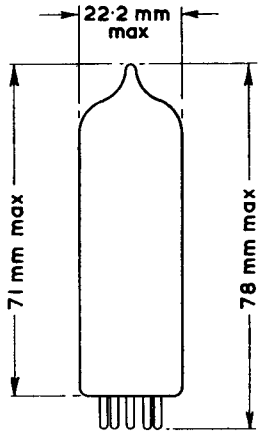
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
V_{a+g2} max.	250	V
p_a max.	12	W
p_{a+g2} max.	13	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.75	W
I_k max.	100	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

2834



B9A Base



MINIATURE OUTPUT PENTODE

EL91

Miniature output pentode for use in single or push-pull output stages of miniature equipment.

HEATER

V_h	6.3	V
I_h	0.2	A
Heating Time	12	secs approx.

CAPACITANCES

c_{in}	4.2	μμF
c_{out}	3.2	μμF
c_{a-g}	<0.5	μμF

OPERATING CONDITIONS - SINGLE VALVE CLASS A

V_a	250	V
V_{g2}	250	V
I_a	16	mA
I_{g2}	2.4	mA
g_m	2.6	mA/V
μ_{g1-g2}	12	-
r_a	130,000	Ω
R_k	680	Ω
R_a	16,000	Ω
V_{in}	5.3	V.rms
W_{out}	1.4	W
Dtot	10	%

OPERATING CONDITIONS - PUSH-PULL SELF BIAS.

V_a	250	V
V_{g2}	250	V
$I_{a(o)}$	2x11	mA
$I_{g2(o)}$	2x1.6	mA
R_k	600	Ω
R_{a-a}	24,000	Ω
V_{in} (W_{out}=50mW)	2x0.8	V.rms
$I_{a(max.sig.)}$	2x12.8	mA
$I_{g2(max.sig)}$	2x4.1	mA
V_{in}	2x12	V.rms
W_{out}	4.0	W
Dtot	3.2	%

EL91

MINIATURE OUTPUT PENTODE

Miniature output pentode for use in single or push-pull output stages of miniature equipment.

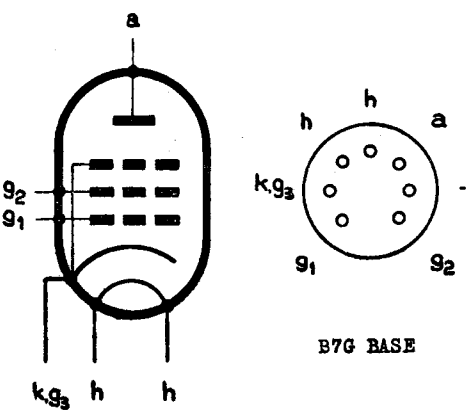
OPERATING CONDITIONS - PUSH-PULL FIXED BIAS

V_a	250	V
V_{g2}	250	V
V_{g1}	-19	V
$I_{a(o)}$	2x5	mA
$I_{g2(o)}$	2x0.65	mA
R_{a-a}	20,000	Ω
V_{in} (W_{out}=50mW)	2x1.5	V.rms
I_a (max.sig.)	2x16	mA
I_{g2} (max.sig.)	2x4.5	mA
V_{in}	2x13	V.rms
W_{out} (start of Ig1)	4.8	W
D_{tot} (start of Ig1)	3.3	%

LIMITING VALUES

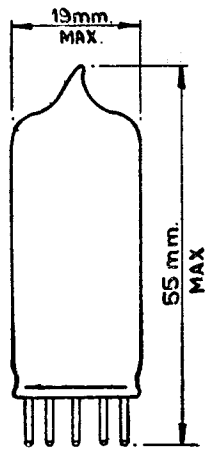
V_a max.	250	V
V_{g2} max.	250	V
w_a max.	4.0	W
w_{g2} max.	0.6	W
I_k max.	25	mA
V_{h-k} max.	50	V
Rgl max(cathode bias)	0.7	MΩ

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



B7G BASE

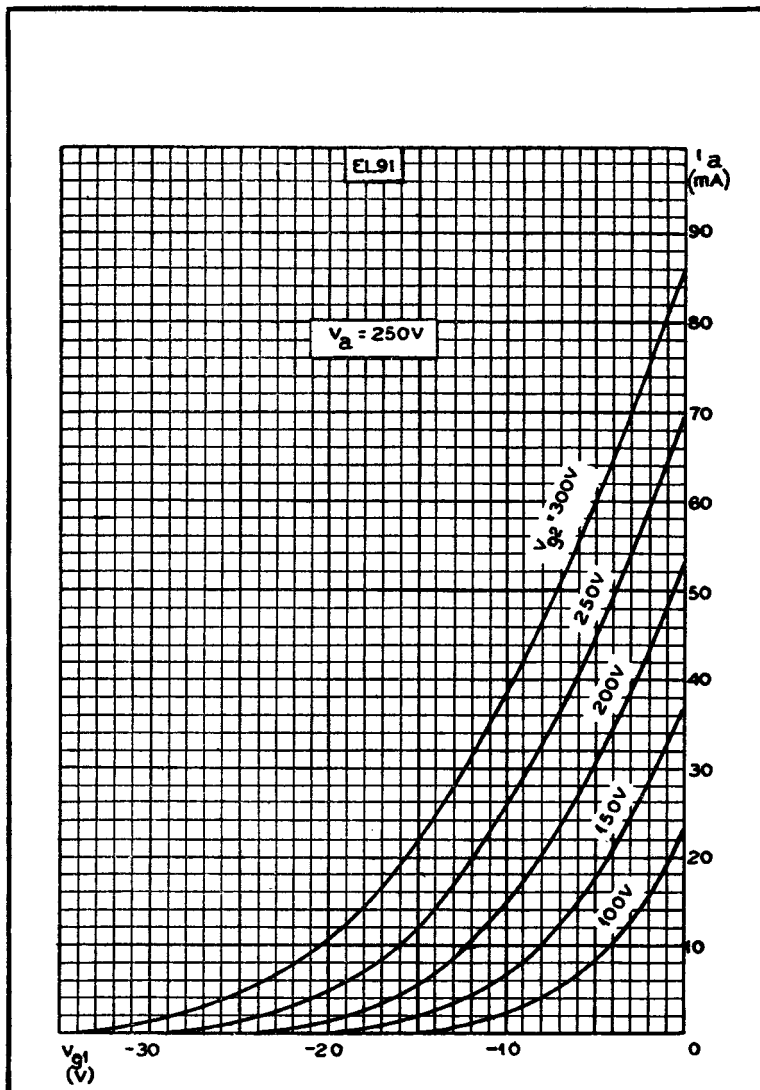
DIMENSIONS



MINIATURE OUTPUT PENTODE

EL91

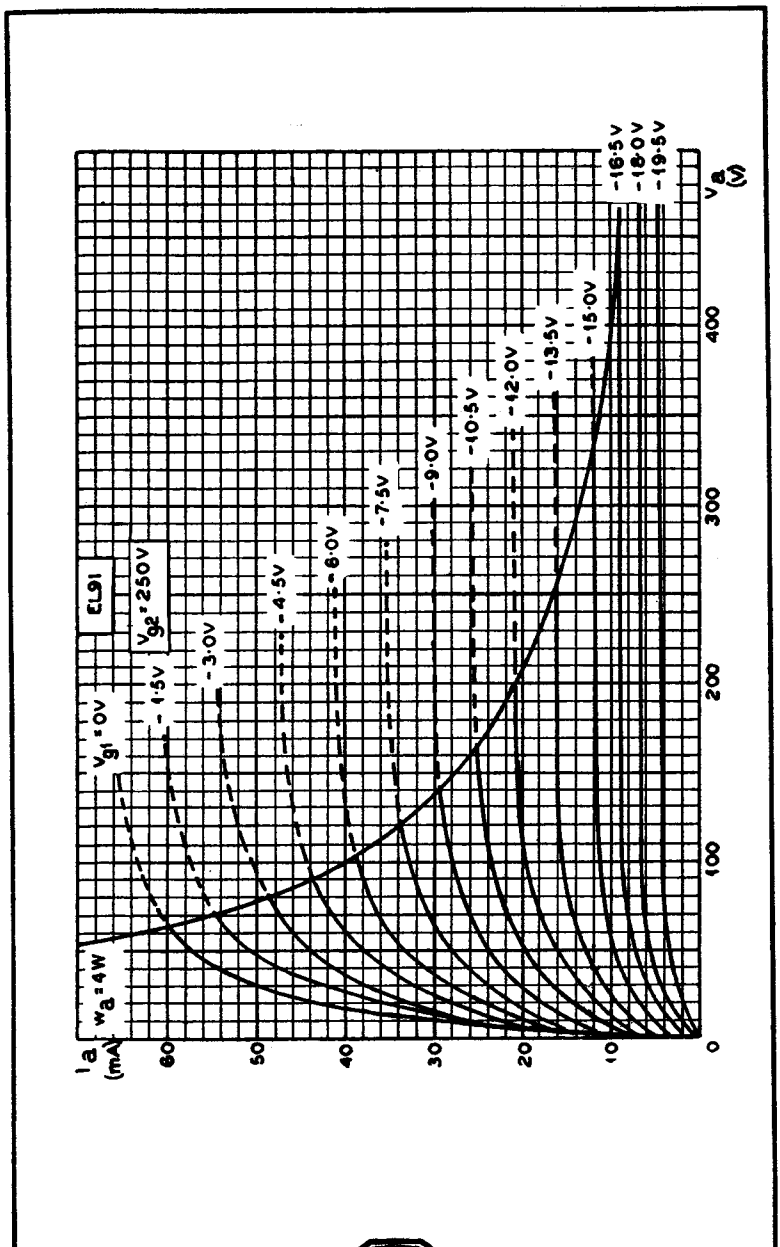
Miniature output pentode for use in single or push-pull output stages of miniature equipment.



EL91

MINIATURE OUTPUT PENTODE

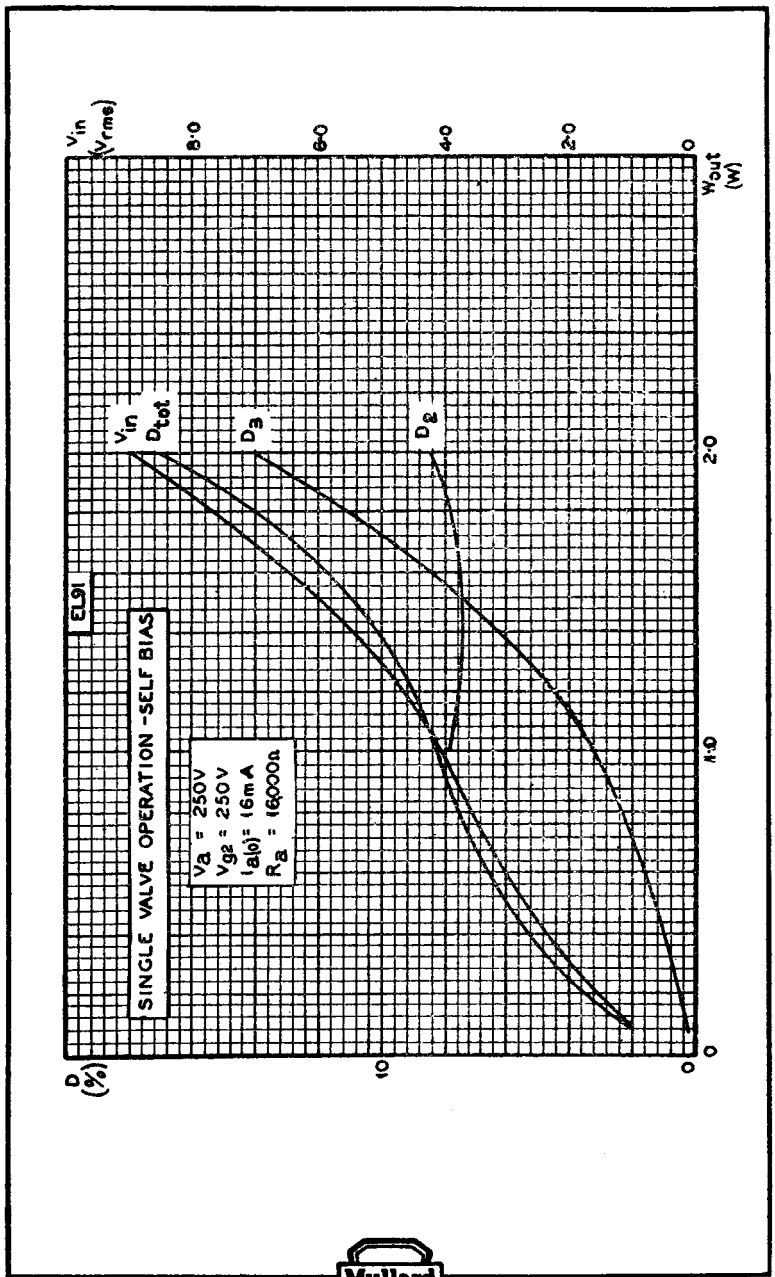
Miniature output pentode for use in single or push-pull output stages of miniature equipment.



MINIATURE OUTPUT PENTODE

EL91

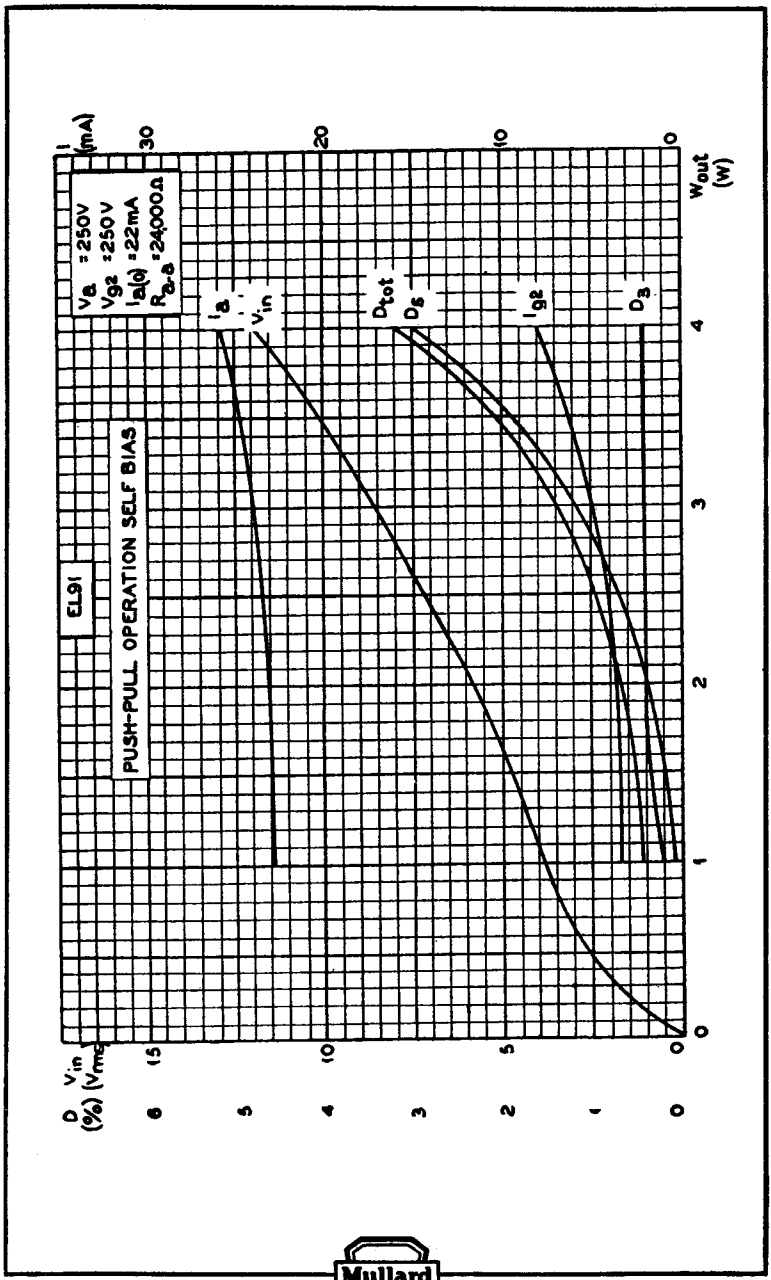
Miniature output pentode for use in single or push-pull output stages of miniature equipment.



EL91

MINIATURE OUTPUT PENTODE

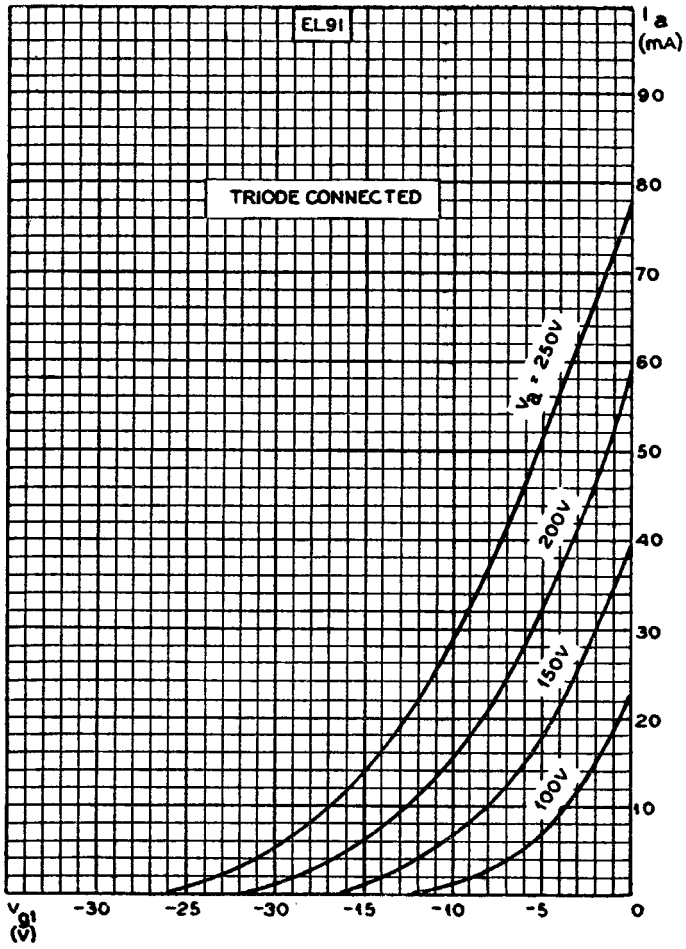
Miniature output pentode for use in single or push-pull output stages of miniature equipment.



MINIATURE OUTPUT PENTODE

EL91

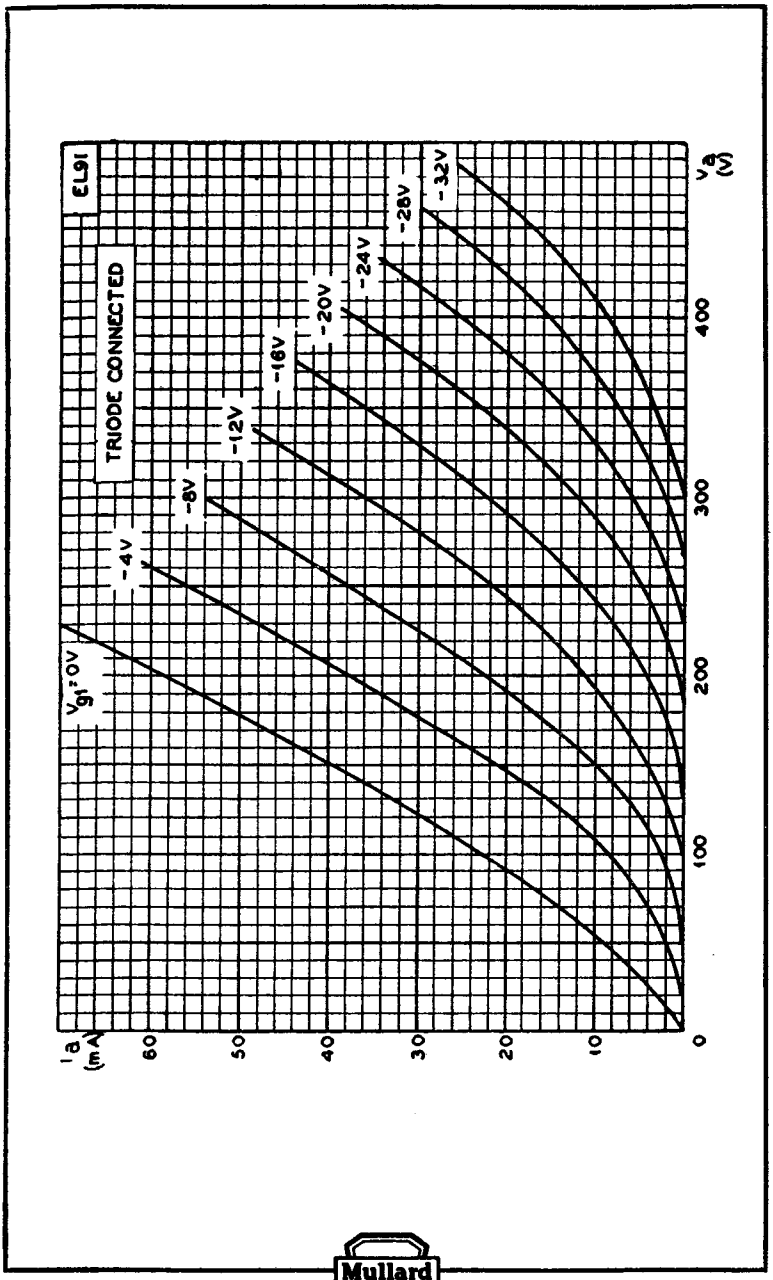
Miniature output pentode for use in single or push-pull output stages of miniature equipment.



EL91

MINIATURE OUTPUT PENTODE

Miniature output pentode for use in single or push-pull output stages of miniature equipment.



Mullard

ELECTRON BEAM INDICATOR

EM34

Electron beam tube for use as tuning indicator in radio receivers or as nul indicator in test equipment.

HEATER

This valve is suitable for DC/AC operation.

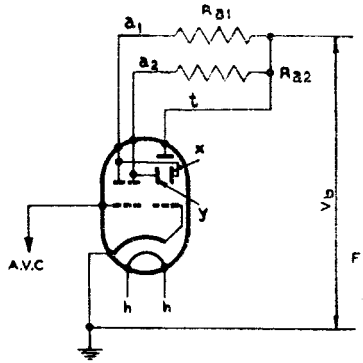
V_h	6.3	V
I_h	0.2	A

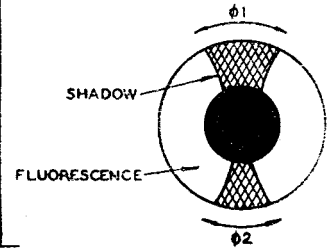
OPERATING CONDITIONS

V_b	200	250	V
R_{a1}	1	1	megohm
R_{a2}	1	1	megohm
I_t	0.55	0.75	mA
V_g(ϕ1 max.)(1)	0	0	V
V_g(ϕ2 max.)(2)	0	0	V
V_g(ϕ1 min.)(5)	-4.2	-5.0	V
V_g(ϕ2 min.)(6)	-12.5	-16.0	V

(1) and (2) Max. angle of the shadows produced by the deflector plates x', x" and y',y" respectively.

(5) and (6) Min. angle (5°) of the shadows produced by the deflector plates x', x" and y', y" respectively.





EM34

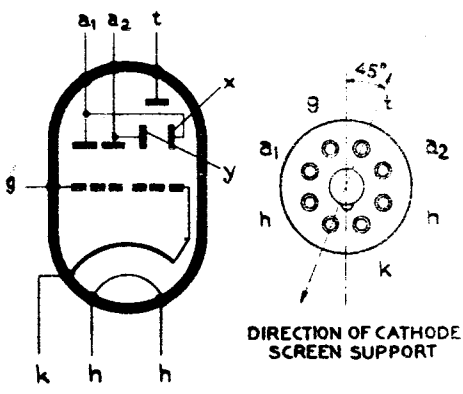
ELECTRON BEAM INDICATOR

Electron beam tube for use as tuning indicator in radio receivers or as nul indicator in test equipment.

LIMITING VALUES

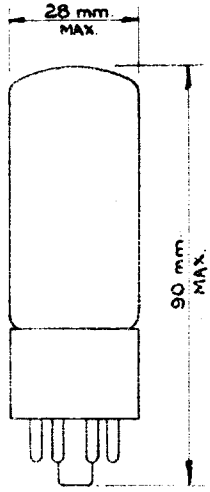
$V_{a1(b)}$ max.	550	V
V_{a1} max.	275	V
$V_{a2(b)}$ max.	550	V
V_{a2} max.	275	V
$V_{t(b)}$ max.	550	V
V_{t} max.	275	V
V_{h-k} max.	100	V
R_{h-k} max.	20,000	ohms
R_{g-k} max.	3	megohms

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



OCTAL BASE

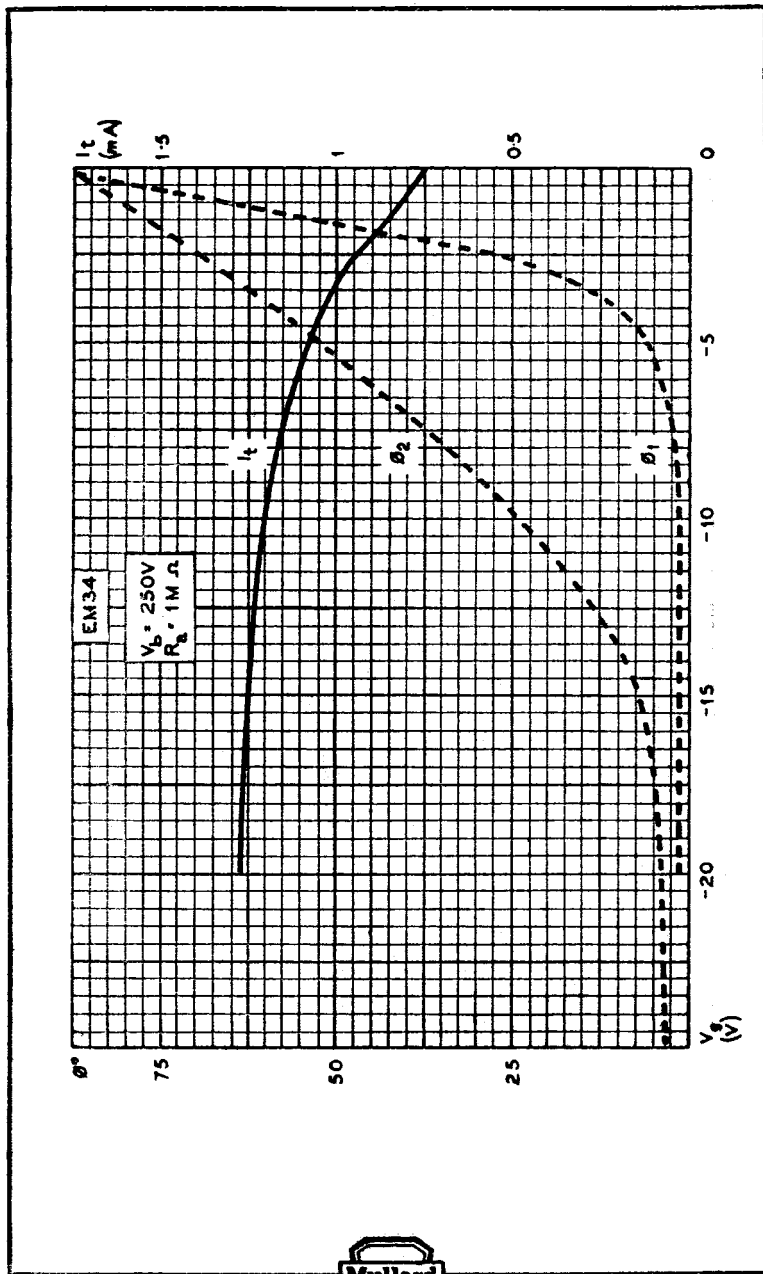
DIMENSIONS



ELECTRON BEAM INDICATOR

EM34

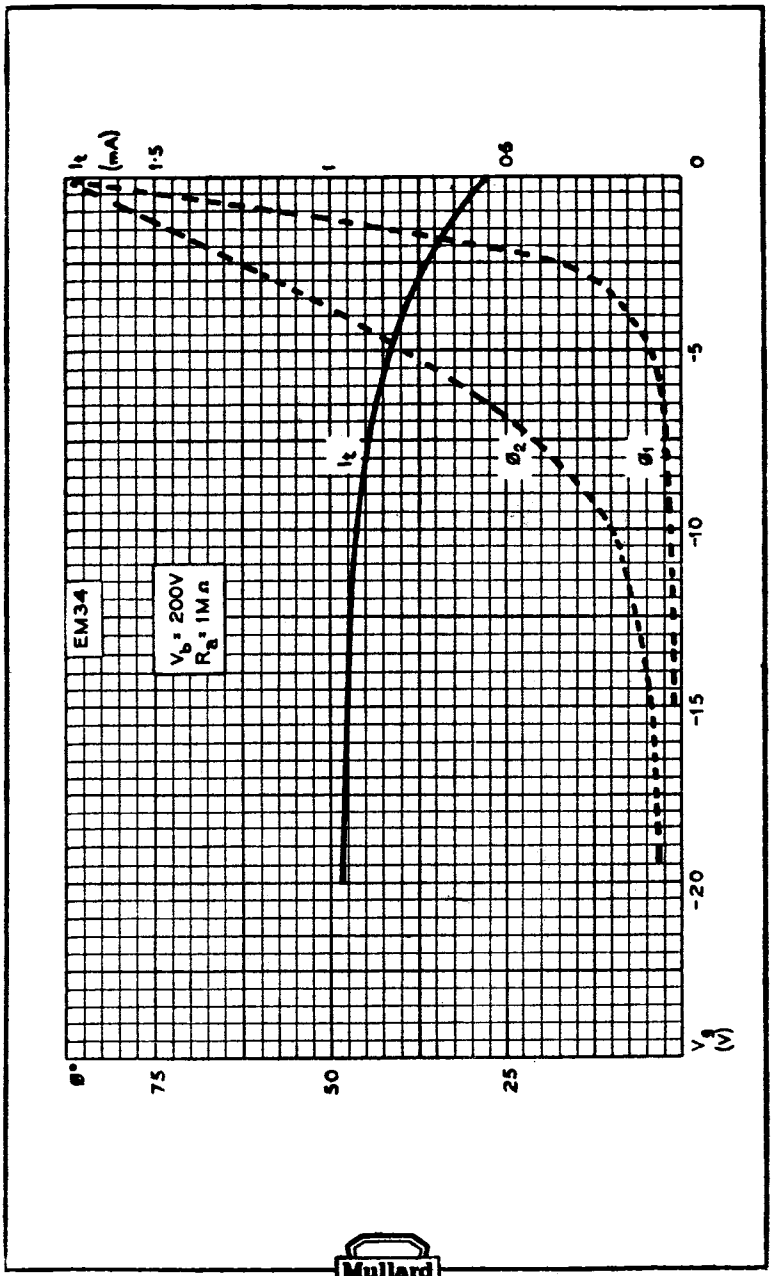
Electron beam tube for use as tuning indicator in radio receivers or as nul indicator in test equipment.



EM34

ELECTRON BEAM INDICATOR

Electron beam tube for use as tuning indicator in radio receivers or as nul indicator in test equipment.



TETRODE THYRATRON

EN32

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS, preceding this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	1.3	kV
Forward	650	V
Max. cathode current		
Peak	2.0	A
Average (max. averaging time 15s)	300	mA
Surge (fault protection max. duration 0.1s)	10	A
Max. negative control-grid voltage		
Before conduction	250	V
During conduction	10	V
Max. average positive control-grid current for anode voltage more positive than –10V (averaging time 1 cycle)	20	mA
Max. control-grid resistance		
$I_a < 200mA$	10	MΩ
$I_a > 200mA$	2.0	MΩ
Max. negative shield-grid voltage		
Before conduction	100	V
During conduction	10	V
Max. average positive shield-grid current for anode voltage more positive than –10V (averaging time 1 cycle)	20	mA
Max. screen-grid resistor	1.0	MΩ
Max. peak heater-cathode voltage		
Cathode negative	25	V
Cathode positive	100	V
Min. valve heating time (for $i_{k(pk)}$ max = 2.0A)	20	s
Ambient temperature limits	–75 to +90	°C

Note—Where circuit conditions permit, the shield-grid should be connected directly to the cathode.

EN32

TETRODE THYRATRON

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

CHARACTERISTICS

Electrical

Heater voltage	6.3	V
Heater current at 6.3V	950	mA
Capacitances		
Anode to grid	0.25	pF
Anode to cathode	0.06	pF
Grid to cathode	0.2	pF
Anode to shield-grid	3.0	pF
Control ratio		
g_2 to k and $R_{g1}=0\Omega$	275	
g_1 to k and $R_{g2}=0\Omega$	370	
Anode voltage drop	10	V
Recovery (deionisation) time		
$V_a=650V$, $i_{a(pk)}=2A$, $R_{g1}=100k\Omega$		
$V_{g1}=-100V$	240	μs
$V_{g1}=-50V$	1.0	ms

Mechanical

Type of cooling	Convection
Mounting position	Any

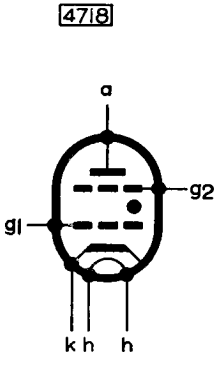
CONTROL CHARACTERISTIC (See page 5).

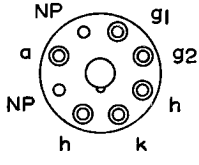
The curves given indicate the spread in characteristics due to:

(a) Variations in characteristics due to changes in heater voltage.

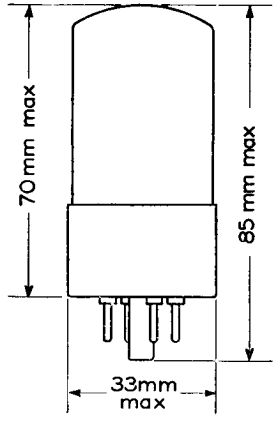
(b) Variations in characteristics during life.

(c) Variation in grid resistor.





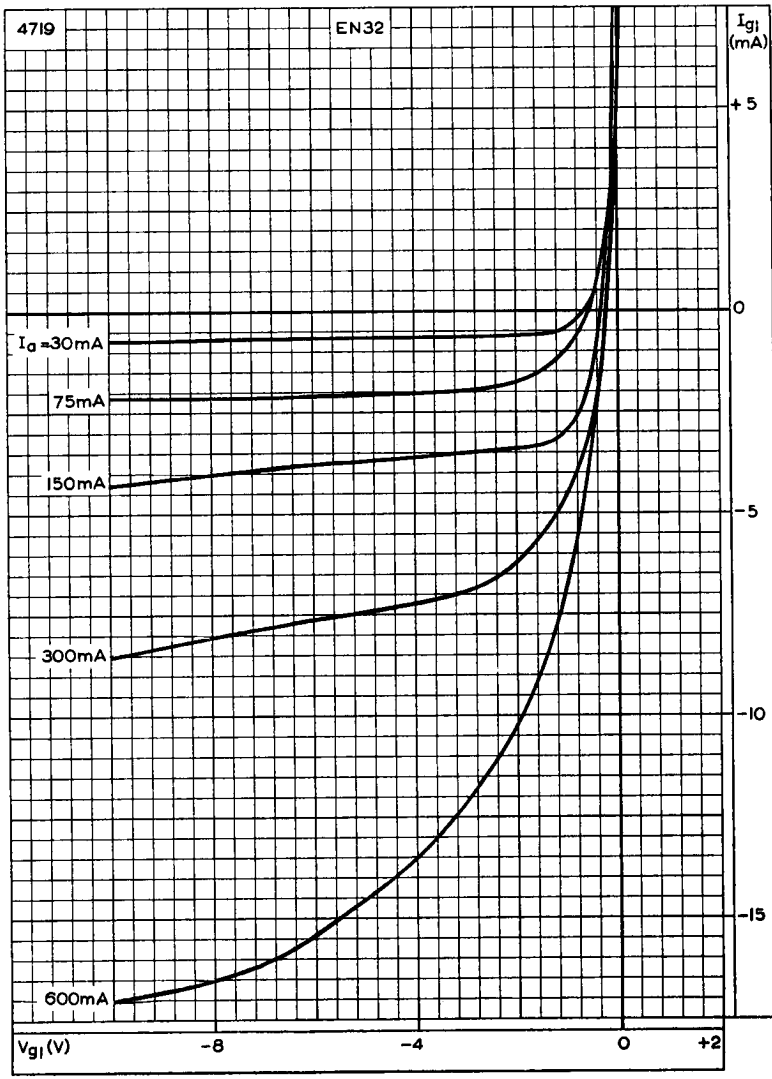
Octal Base



TETRODE THYRATRON

EN32

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

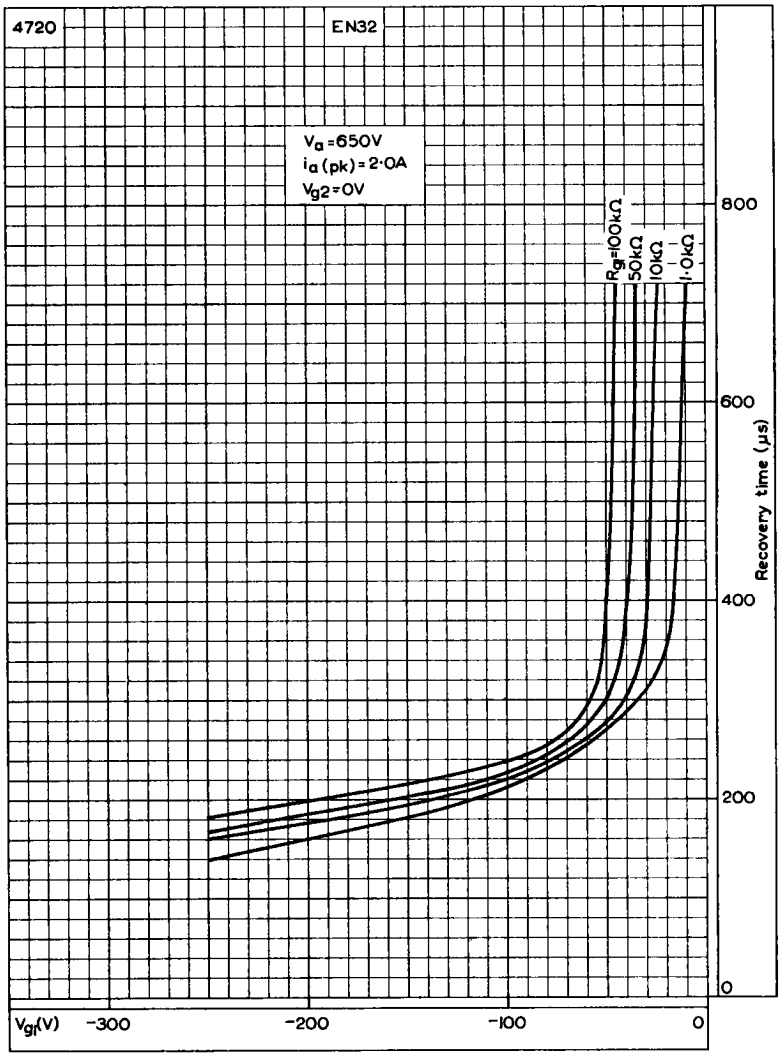


GRID ION CURRENT CHARACTERISTICS

EN32

TETRODE THYRATRON

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

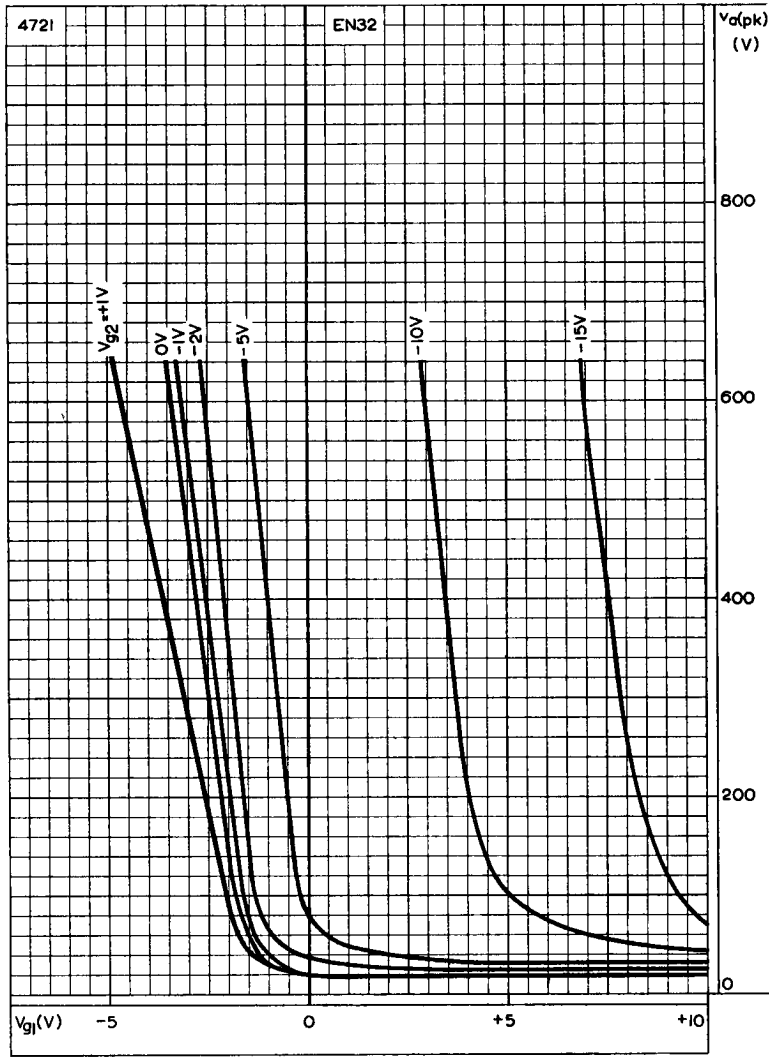


RECOVERY TIME PLOTTED AGAINST CONTROL-GRID VOLTAGE

TETRODE THYRATRON

EN32

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

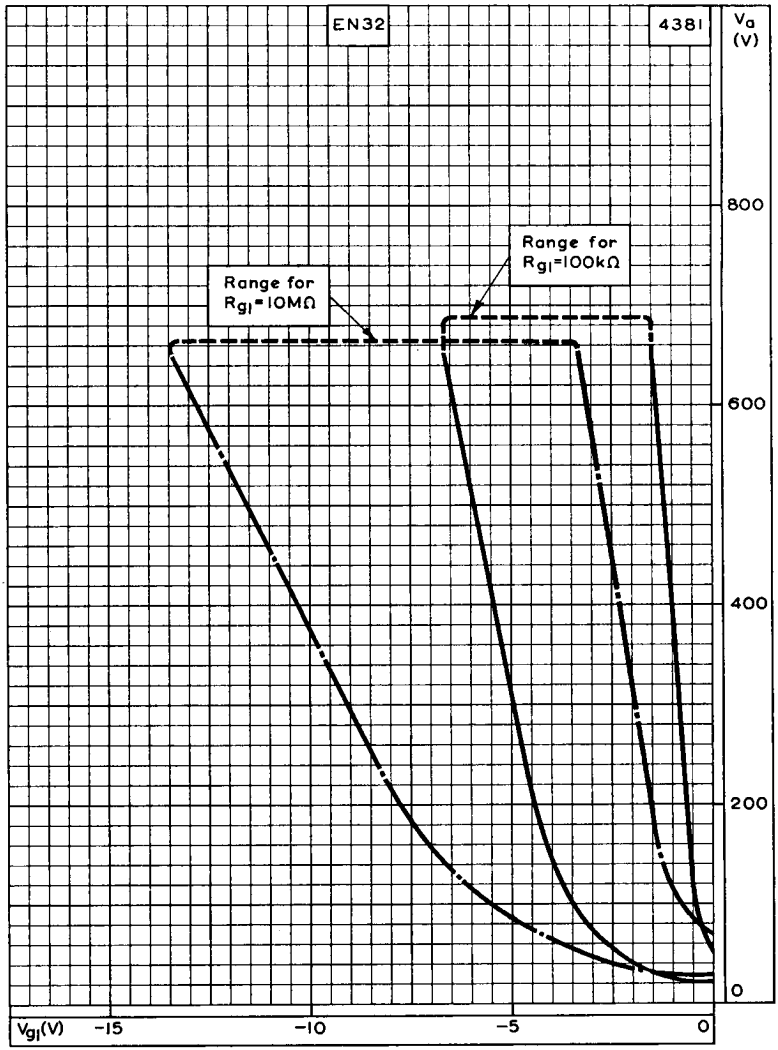


CONTROL CHARACTERISTIC (see page 2)

EN32

TETRODE THYRATRON

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.



OPERATING RANGE OF CRITICAL GRID VOLTAGE

SUBMINIATURE TETRODE THYRATRON

EN70

Subminiature tetrode inert gas-filled thyratron with negative control characteristic.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	500	V
Forward	500	V
Max. cathode current		
Peak	100	mA
Average (max. averaging time 15s)	20	mA
Max. negative control-grid voltage		
Before conduction	200	V
During conduction	10	V
Max. average positive control-grid current for anode voltage more positive than −10V (averaging time 1 cycle)	700	μA
Max. peak positive control-grid current during the time that the anode voltage is more positive than −10V	2.0	mA
Max. peak positive control-grid current during the time that the anode voltage is more negative than −10V	30	μA
Max. control-grid resistor	10	MΩ
*(Recommended min. control-grid resistor 100kΩ)		
Max. negative shield-grid voltage		
Before conduction	100	V
During conduction	5.0	V
Max. average positive shield-grid current for anode voltage more positive than −10V (averaging time 1 cycle)	700	μA
**Max. shield-grid resistor	1.0	MΩ
Max. peak heater to cathode voltage		
Cathode negative	25	V
Cathode positive	100	V
Heater voltage limits	5.7 to 6.9	V
Min. valve heating time	10	s
Max. operating frequency	100	c/s
Ambient temperature limits	−55 to +70	°C

*It is not desirable that the control-grid should be positive when the anode is more negative than −10V, but where this condition is unavoidable the control-grid resistor may need to be greater than the recommended minimum value.

**Where circuit conditions permit, the shield-grid should be connected directly to the cathode.

PRELIMINARY

EN70

SUBMINIATURE TETRODE THYRATRON

CHARACTERISTICS

Electrical

Heater voltage	6.3	V
Heater current at 6.3V		
Average	150	mA
Maximum	165	mA
Anode to control-grid capacitance	0.08	pF
Input capacitance	1.1	pF
Output capacitance	1.2	pF
Ionisation time (approx.)	0.5	μs
Anode voltage drop	11	V
Critical control-grid current at $V_a = 350V_{r.m.s.}$	0.2	μA

Mechanical

Type of cooling	Convection
Mounting position	Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

Max. net weight	0.1	oz
	3.0	g

TYPICAL OPERATING CONDITIONS

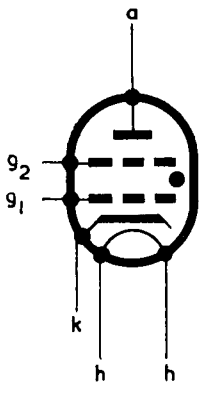
Heater voltage	6.3	V
R.M.S. anode voltage	150	V
Shield-grid voltage	0	V
R.M.S. control-grid voltage (180° out of phase with anode voltage)	5.0	V
*Peak control-grid signal voltage	5.0	V
Control-grid circuit resistance	1.0	MΩ
Anode circuit resistance	3.75	kΩ

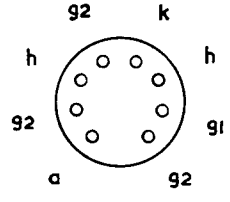
*The frequency of the signal is high compared with 50c/s

SUBMINIATURE TETRODE THYRATRON

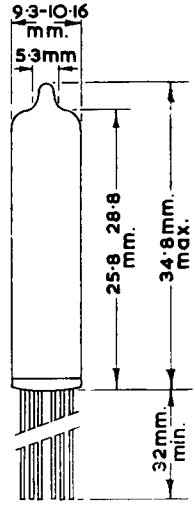
EN70

Subminiature tetrode inert gas-filled thyratron with negative control characteristic.





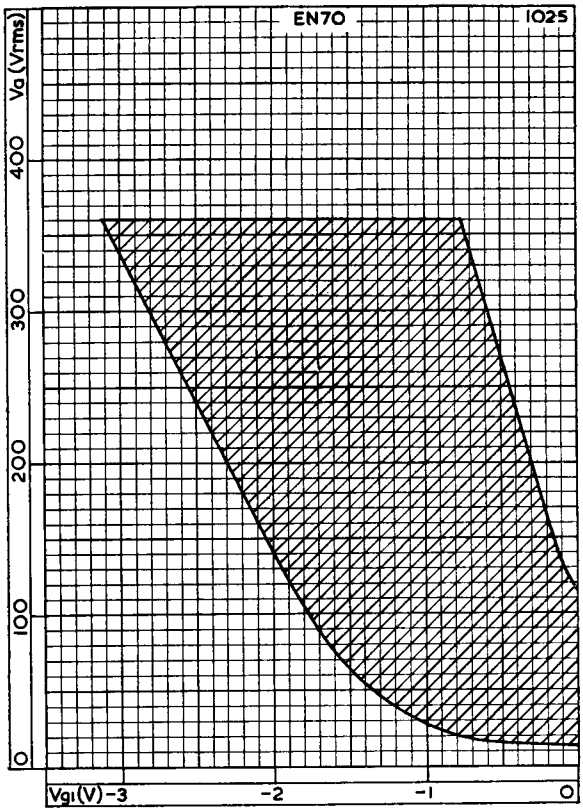
B8D BASE
(10mm. subminiature)



EN70

SUBMINIATURE TETRODE THYRATRON

Subminiature tetrode inert gas-filled thyratron with negative control characteristic.

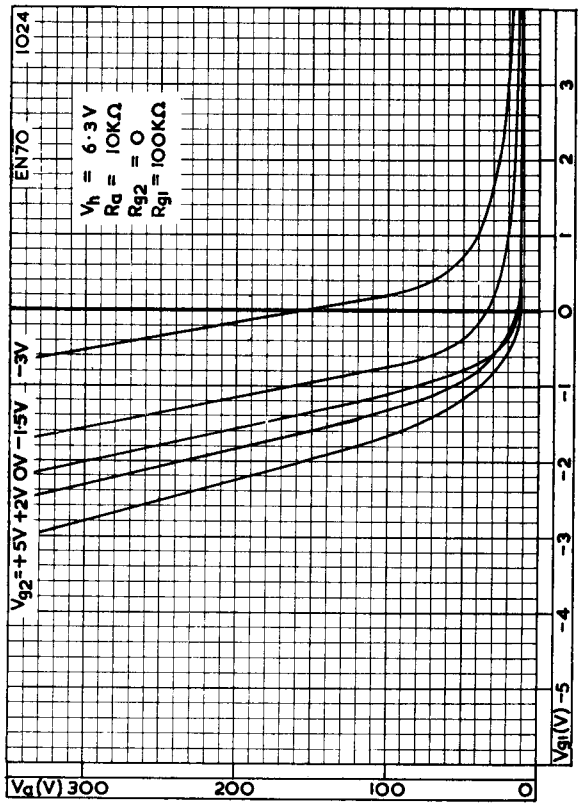


CONTROL CHARACTERISTIC

SUBMINIATURE TETRODE THYRATRON

EN70

Subminiature tetrode inert gas-filled thyratron with negative control characteristic.

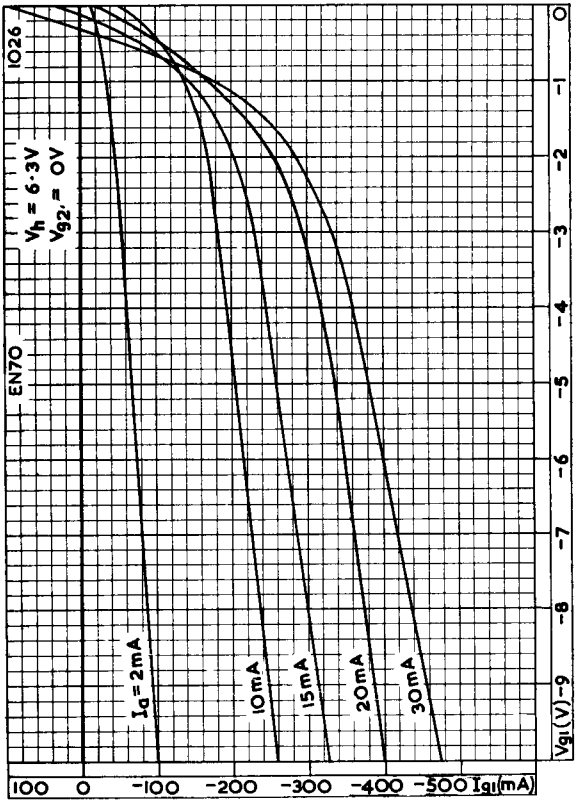


SPREAD OF CONTROL CHARACTERISTIC

EN70

SUBMINIATURE TETRODE THYRATRON

Subminiature tetrode inert gas-filled thyratron with negative control characteristic.



GRID ION CURRENT CHARACTERISTIC

TETRODE THYRATRON

EN91

(2D21)

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for use in relay or grid-controlled rectifier circuits.

This data sheet should be read in conjunction with "DEFINITIONS AND OPERATIONAL RECOMMENDATIONS—THYRATRONS", preceding this section of the Handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	1.3	kV
Forward	650	V
Max. cathode current		
Peak	500	mA
Average (Max. averaging time 30 secs.)	100	mA
Surge (Fault protection max. duration 0.1 secs.)	10	A
Max. negative control-grid voltage		
Before conduction	100	V
During conduction	10	V
Max. average positive control-grid current for anode voltage more positive than –10 V (averaging time 1 cycle)	10	mA
Max. peak positive control-grid current during the time that the anode voltage is more positive than –10 V	50	mA
*Max. peak positive control-grid current during the time that the anode voltage is more negative than –10 V	30	μA
Max. control-grid resistor *(Recommended min. control-grid resistor 0.1 MΩ)	10	MΩ
Max. negative shield-grid voltage		
Before conduction	100	V
During conduction	10	V
Max. average positive shield-grid current for anode voltage more positive than –10 V (averaging time 1 cycle)	10	mA
**Max. shield-grid resistor	1.0	MΩ
Max. peak heater-cathode voltage		
Heater positive	25	V
Heater negative	100	V
Heater voltage limits	5.7 to 6.9	V
Min. valve heating time	10	s
Max. operating frequency	500	c/s
Ambient temperature limits	–75 to +90	°C

*It is not desirable that the control-grid should be positive when the anode is more negative than –10 V, but where this condition is unavoidable the control-grid resistor may need to be greater than the recommended minimum value.

**Where circuit conditions permit, the shield-grid should be connected directly to the cathode.

EN91

(2D21)

TETRODE THYRATRON

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for use in relay or grid-controlled rectifier circuits.

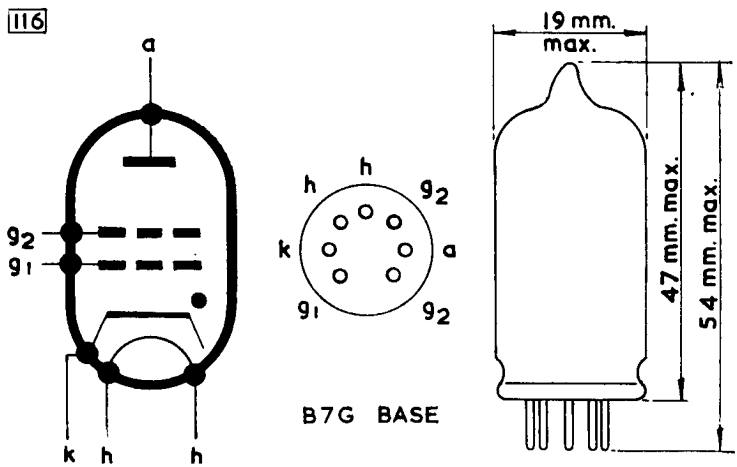
CHARACTERISTICS

Electrical

Heater voltage	6.3	V
Heater current at 6.3 V		
Average	0.60	A
Maximum	0.66	A
Anode to control-grid capacitance	0.03	μμF
Control-grid to cathode and shield-grid capacitance	2.5	μμF
Deionisation time (approx.)		
(a) V_{g1}=−100 V, I_a=100 mA	35	μs
(b) V_{g1}= −10 V, I_a=100 mA	75	μs
Ionisation time (approx.)	0.5	μs
Anode voltage drop	8	V
Critical grid current at V_a=460 V r.m.s.	0.5	μA

Mechanical

Type of cooling	Convection	
Mounting position	Any	
Max. net weight	0.5	oz.
	14	g

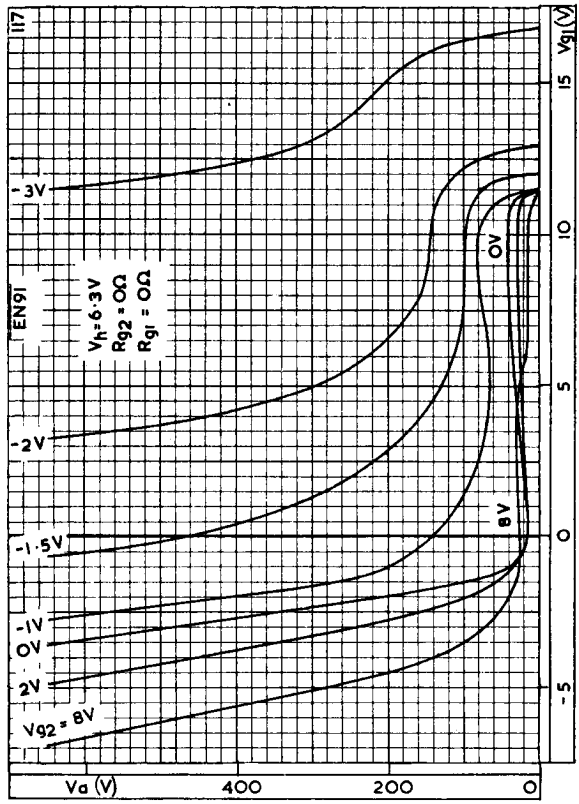


TETRODE THYRATRON

EN91

(2D21)

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for use in relay or grid-controlled rectifier circuits.



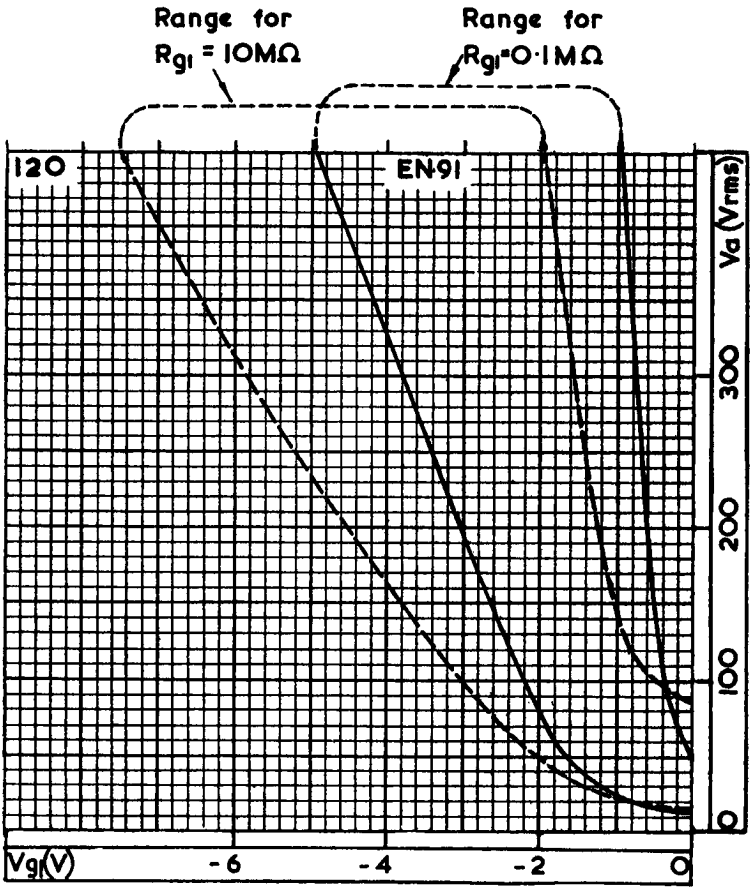
CONTROL CHARACTERISTIC

EN91

(2D21)

TETRODE THYRATRON

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for use in relay or grid-controlled rectifier circuits.



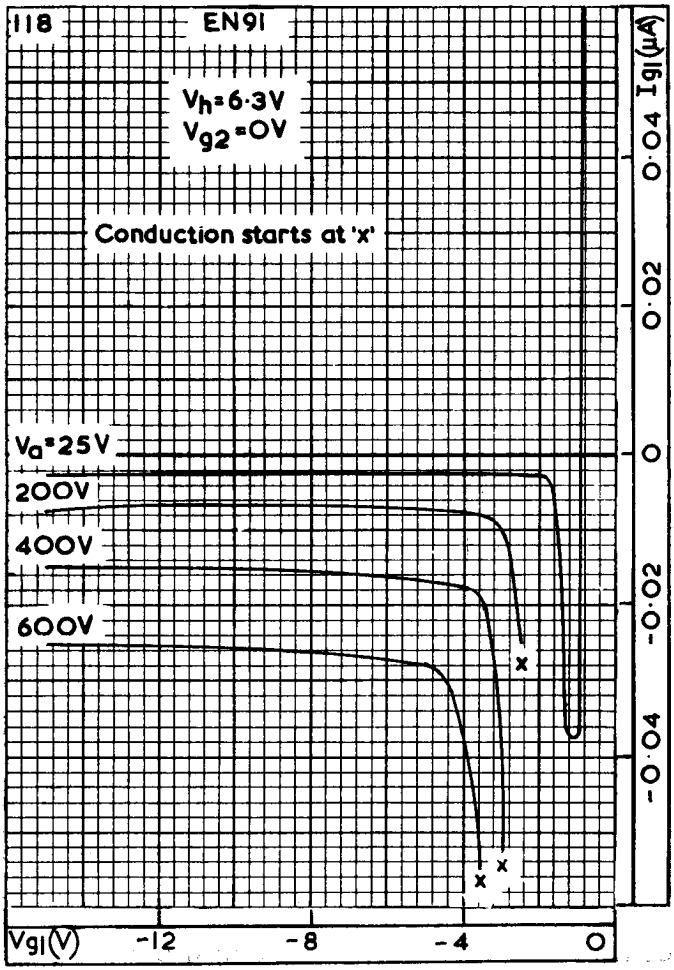
OPERATING RANGE OF CRITICAL GRID VOLTAGE

TETRODE THYRATRON

EN91

(2D21)

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for use in relay or grid-controlled rectifier circuits.



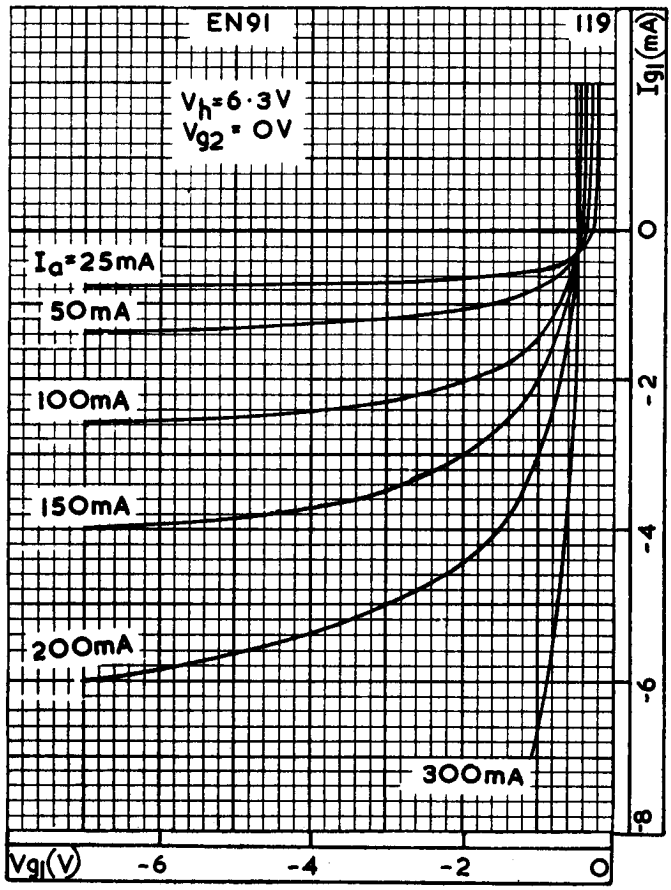
CONTROL-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE BEFORE CONDUCTION

EN91

(2D21)

TETRODE THYRATRON

Tetrode inert gas-filled thyratron with negative control characteristic. Primarily designed for use in relay or grid-controlled rectifier circuits.



CONTROL-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE DURING CONDUCTION

TETRODE THYRATRON

EN92

25mA tetrode inert gas-filled thyratron with negative control characteristic. Primarily intended for industrial control applications.

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS which precede this section of the handbook.

PRELIMINARY DATA

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	500	V
Forward	500	V
Max. cathode current		
Peak	100	mA
Average (max. averaging time = 30s)	25	mA
Surge (fault protection, max. duration 0.1s)	2.0	A
Max. negative control-grid voltage		
Before conduction	100	V
During conduction	10	V
Max. positive control-grid current for anode voltage more positive than –10V		
Peak	25	mA
Average (averaging time 1 cycle)	5.0	mA
Max. peak positive control-grid current for anode voltage more negative than –10V	30	μA
Max. control-grid resistor		
Grid-controlled rectifier service	10	MΩ
Stand-by service	100	kΩ
~~Recommended minimum control-grid resistor~~	~~5~~	~~kΩ~~
Max. negative shield-grid voltage		
Before conduction	50	V
During conduction	10	V
Max. average positive screen-grid current for anode voltage more positive than –10V	5.0	mA
Max. peak heater-to-cathode voltage		
Cathode negative	25	V
Cathode positive	100	V
Min. valve heating time	10	s
Ambient temperature limits	–55 to +90	°C

Note: Where circuit conditions permit the shield-grid should be connected directly to the cathode.

EN92

TETRODE THYRATRON

CHARACTERISTICS

Electrical

Heater voltage	6.3	V
Heater current at 6.3V	150	mA
Capacitances		
C_{a-g1}	0.03	pF
C_{in}	2.0	pF
C_{out}	1.5	pF
Control ratio		
g_1 to k, with $R_{g2} = 0\Omega$	250	
g_2 to k, with $R_{g1} = 0\Omega$	15	
Anode voltage drop	10	V
Recovery (deionisation) time (20μs pulse) $V_a = 500V$, $i_{k(pk)} = 100mA$. $R_{g1} = 50k\Omega$ $V_{g1} = -50V$	40	μs
Critical grid current at $V_a = 350V$ r.m.s.	0.5	μA

Mechanical

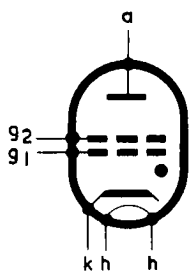
Type of cooling	Convection
Mounting position	Any

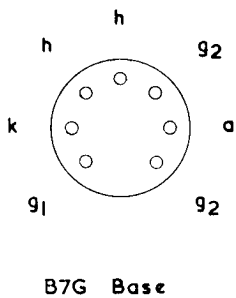
CONTROL CHARACTERISTIC (see page C4)

The curves given indicate the spread in characteristics due to:

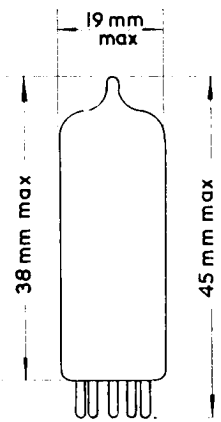
(a) Variations in characteristics due to changes in heater voltage.
(b) Variations in characteristics during life.
(c) Variation in grid resistor.

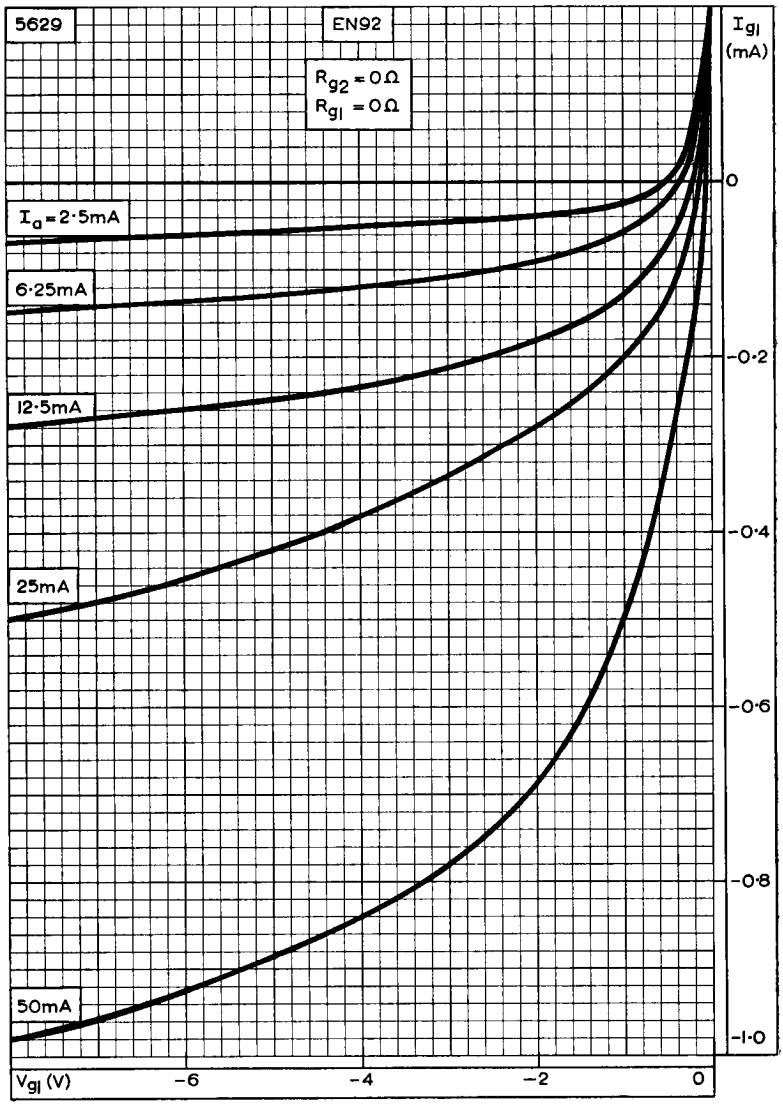
3539



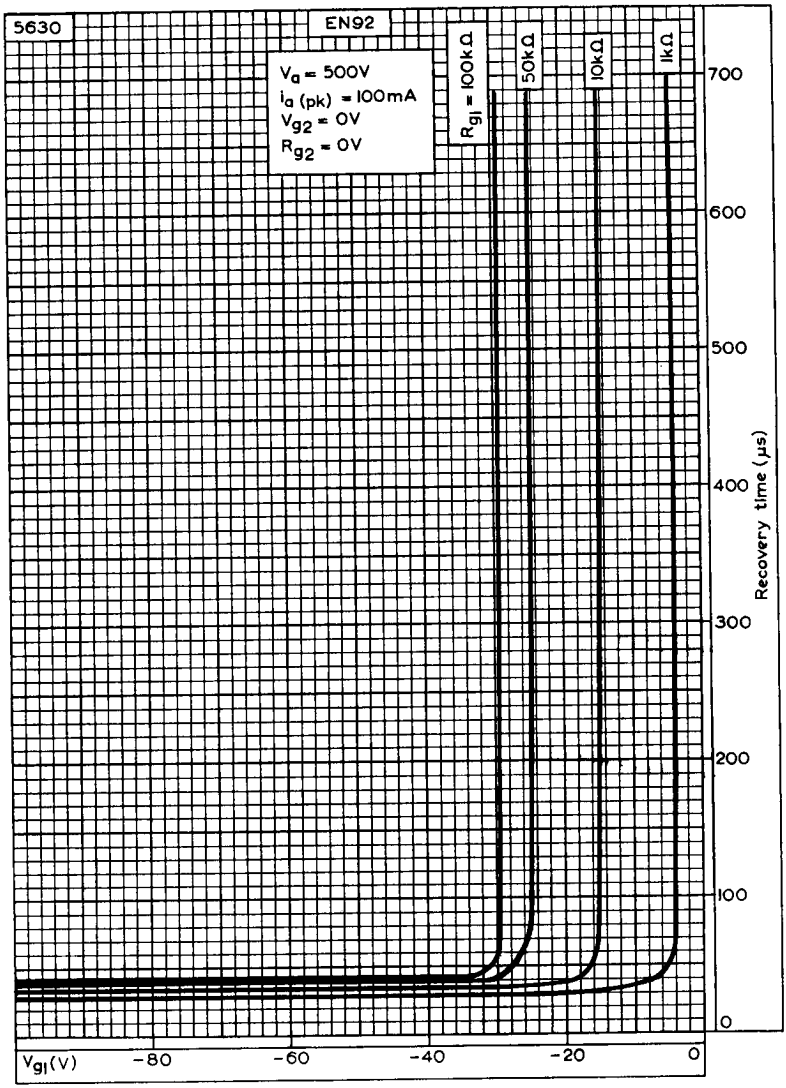


B7G Base

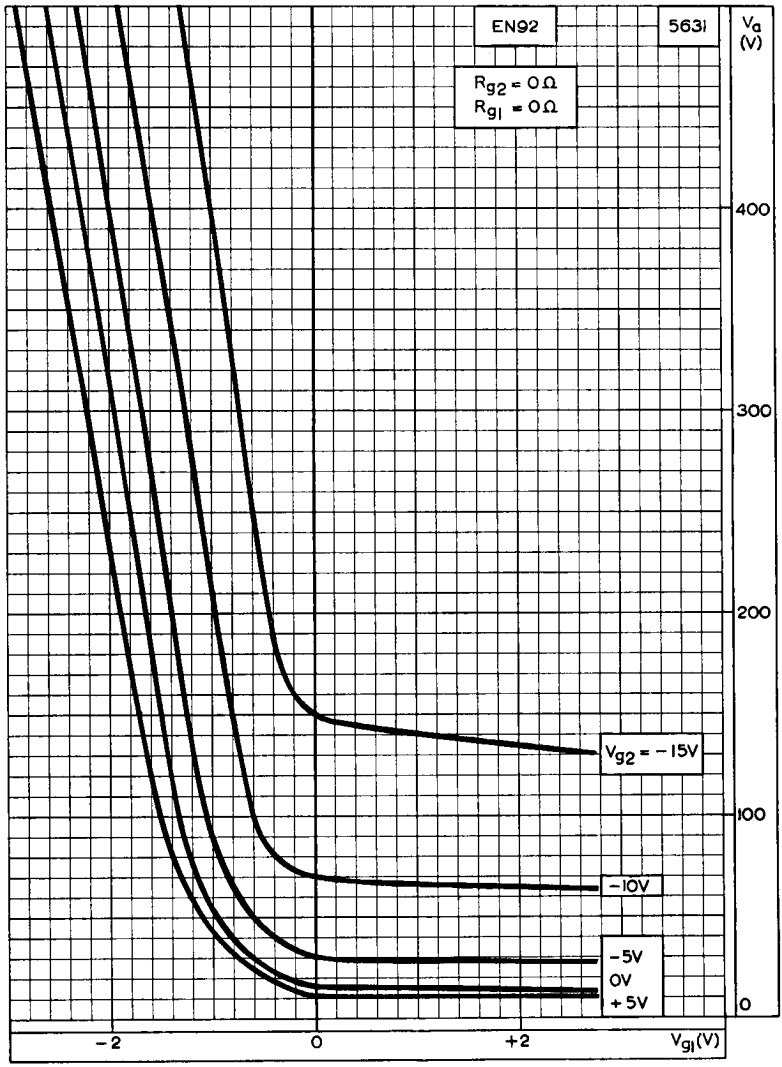




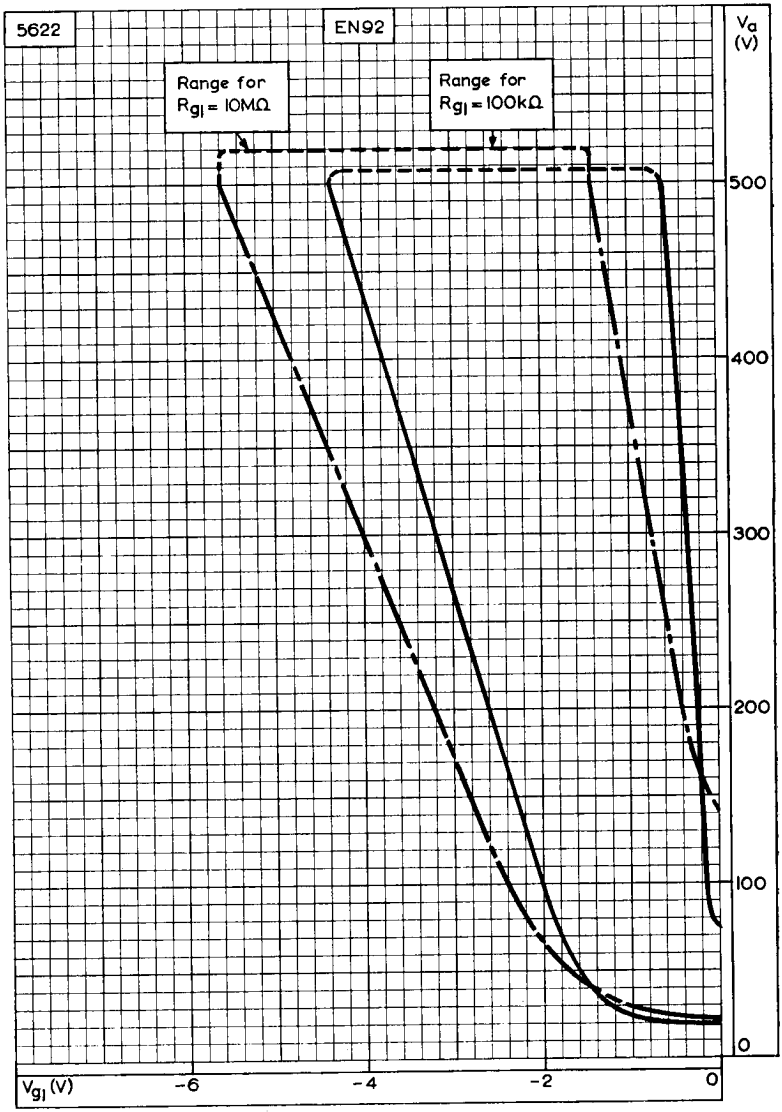
GRID ION CURRENT CHARACTERISTICS



RECOVERY TIME PLOTTED AGAINST CONTROL-GRID VOLTAGE



CONTROL CHARACTERISTICS



OPERATING RANGE OF CRITICAL GRID VOLTAGE

(See Page D2)

MINIATURE HALF WAVE RECTIFIER

EY51

Indirectly-heated miniature rectifier of low cathode consumption, with wired-in connections. Suitable for use as E.H.T. rectifier in television equipment or as probe rectifier in test equipment.

Preliminary Data

GENERAL

The EY.51 is a miniature high voltage rectifier with "wire in" connections. Its low heater wattage renders it suitable for use in television equipment when the EHT supply is derived either from the time base flyback, or from a small power oscillator.

HEATER

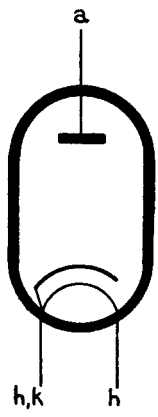
V_h	6.3	V
I_h	80	mA

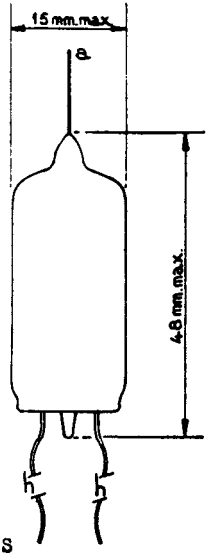
LIMITING VALUES FOR 50-150 c/s OPERATION

$V_{out\ max}$	5	kV
$I_{out\ max}$	0.5	mA

LIMITING VALUES FOR 1 kc/s PULSE OPERATION

$V_{out\ max}$	9	kV
$I_{out\ max}$	100	μA





DIMENSIONS AND CONNECTIONS

SUBMINIATURE HALF-WAVE RECTIFIER

EY70

Indirectly heated half-wave rectifier.

HEATER

V_h	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

LIMITING VALUES

P.I.V. max.	850	V
$V_{a(r.m.s.)}$ max.	250	V
I_a max.	45	mA
$i_{a(pk)}$ max.	270	mA
$v_{h-k(pk)}$ max.	425	V

TYPICAL OPERATING CONDITIONS

Half-wave operation—single valve

$V_{a(r.m.s.)}$		235	V
$R_{l(tm)}$ min.		270	Ω
I_{out}		45	mA
V_{out}	C = 20 μF	216	V
	C = 8 μF	207	V
	C = 4 μF	190	V

Full-wave operation—two valves

Capacitor input

$V_{a(r.m.s.)}$	250	V
$R_{l(tm)}$ min. (per anode)	300	Ω
C	4.0	μF
I_{out}	90	mA
V_{out}	207	V

Choke input

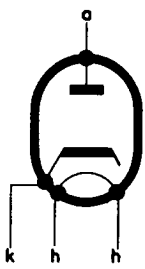
$V_{a(r.m.s.)}$	300	V
L min.	5.0	H
I_{out}	90	mA
V_{out}	240	V

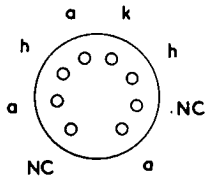
MAINTENANCE TYPE

EY70

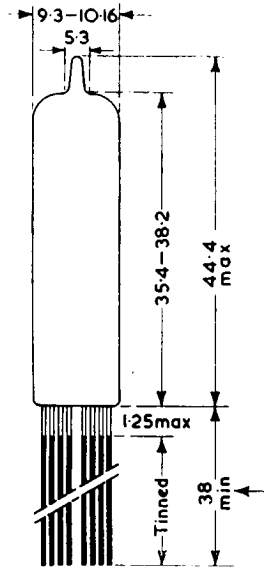
SUBMINIATURE HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier.





B8D/F Base



3392

All dimensions in mm

HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

PRELIMINARY DATA

HEATER

V_h	6.3	V
I_h	1.0	A

LIMITING VALUES

P.I.V. max.	2.0	kV
$i_{a(pk)}$ max.	0.9	A
V_{h-k} max. (heater negative)	650	V←

Capacitor Input

I_{out} max.	(V_a=500 $V_{r.m.s.}$)	150	mA
	(V_a=625 $V_{r.m.s.}$)	125	mA
C max.		24	μF
R_{l1m} min.	($V_a \leq$ 500 $V_{r.m.s.}$)	150	Ω
	($V_a >$ 500 $V_{r.m.s.}$)	250	Ω

Choke Input

I_{out} max.	(V_a=700 $V_{r.m.s.}$)	175	mA
L min.		5	H

CHARACTERISTICS

Anode voltage drop (I_{out}=150 mA)	22	V

TYPICAL OPERATION OF TWO VALVES AS FULL-WAVE RECTIFIER

CAPACITOR INPUT

$V_{in(r.m.s.)}$	500–0–500	625–0–625	V
R_{l1m} (per anode)	150	250	Ω
*C (50 c/s)	16	16	μF
I_{out}	300	250	mA
V_{out}	500	635	V

* For 1,600 c/s operation the same I/V relation would be obtained using a capacitor of 0.5 μF.

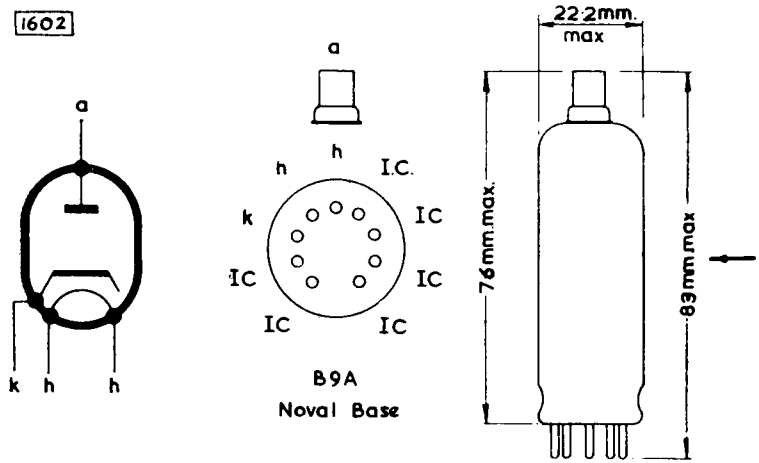
CHOKE INPUT

$V_{in(r.m.s.)}$	700–0–700	V
L	5	H
I_{out}	350	mA
V_{out}	550	V

EY84

HALF-WAVE RECTIFIER

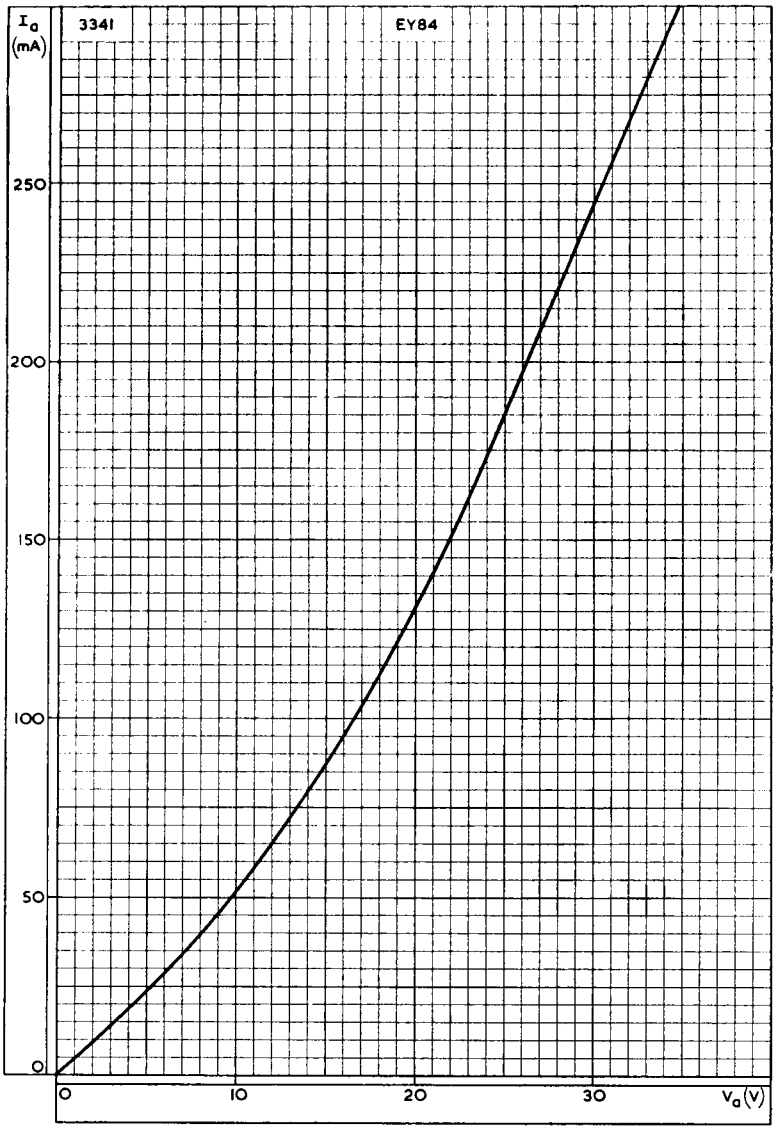
Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.



HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

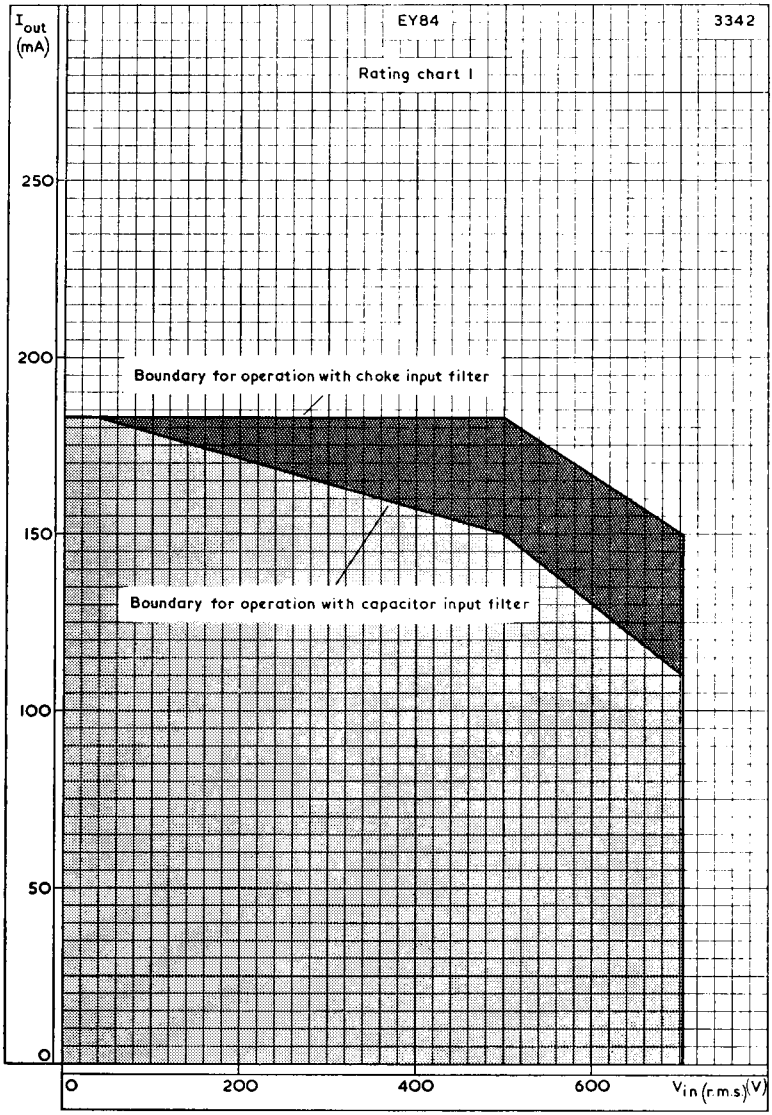


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

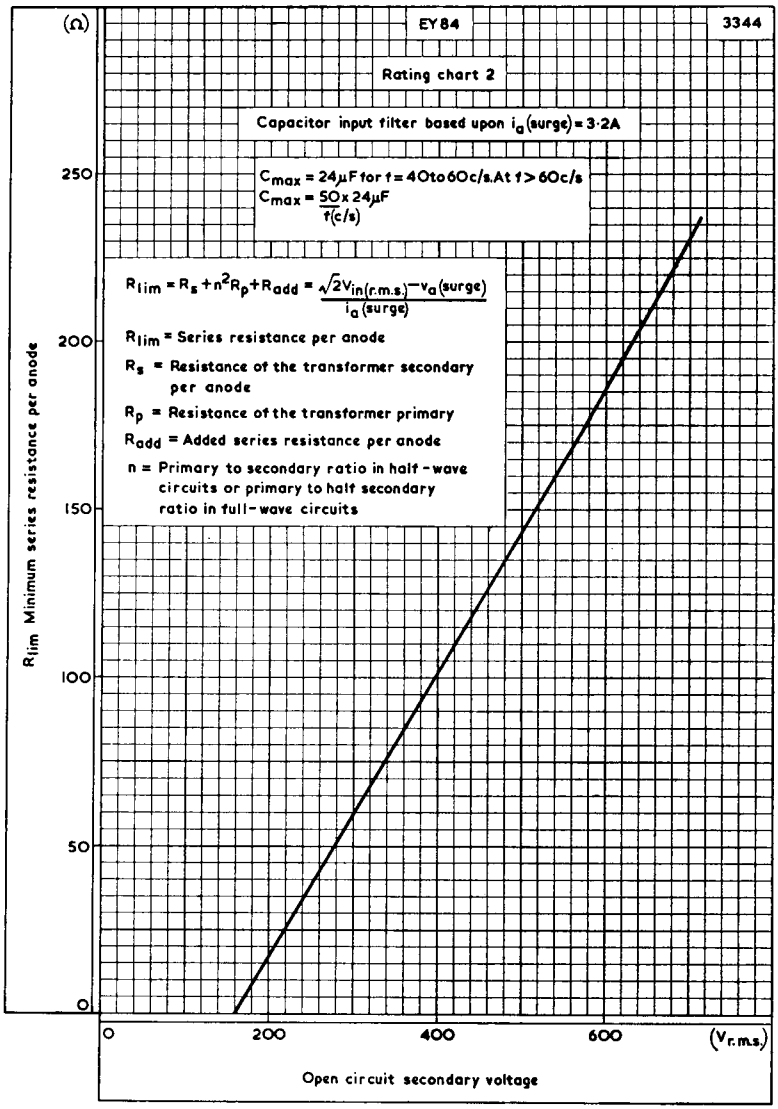


BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER

HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

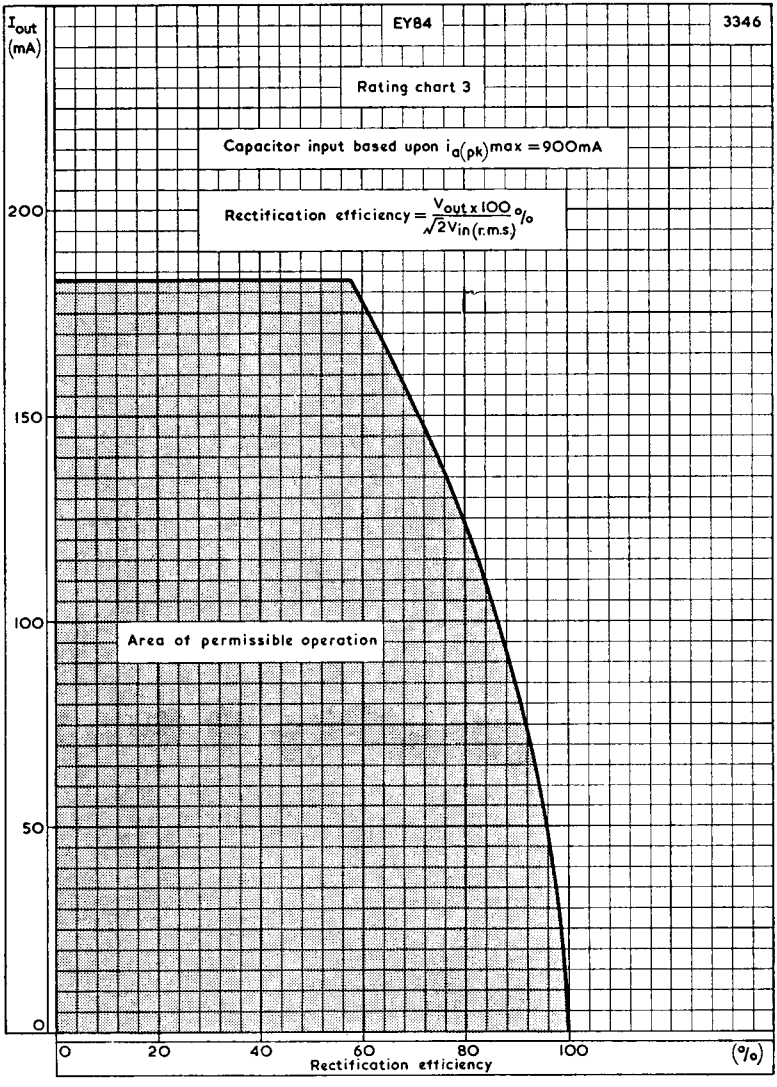


MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST OPEN CIRCUIT SECONDARY VOLTAGE

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

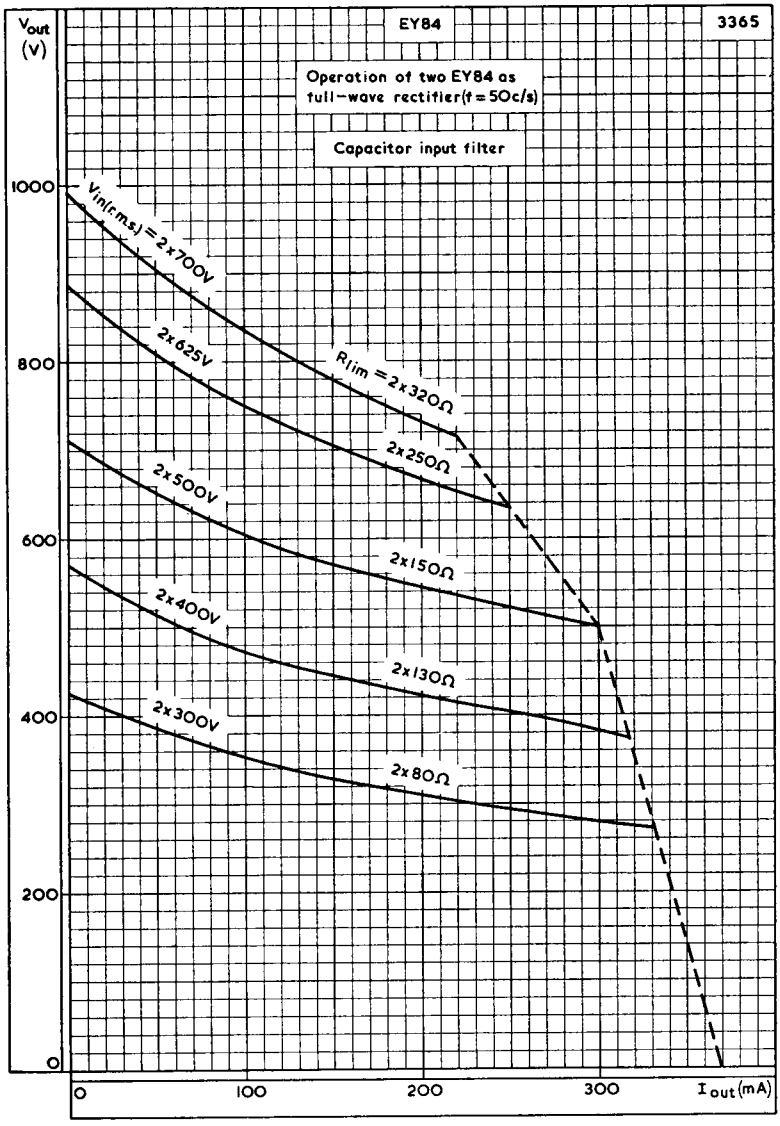


OUTPUT CURRENT PLOTTED AGAINST RECTIFICATION EFFICIENCY

HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

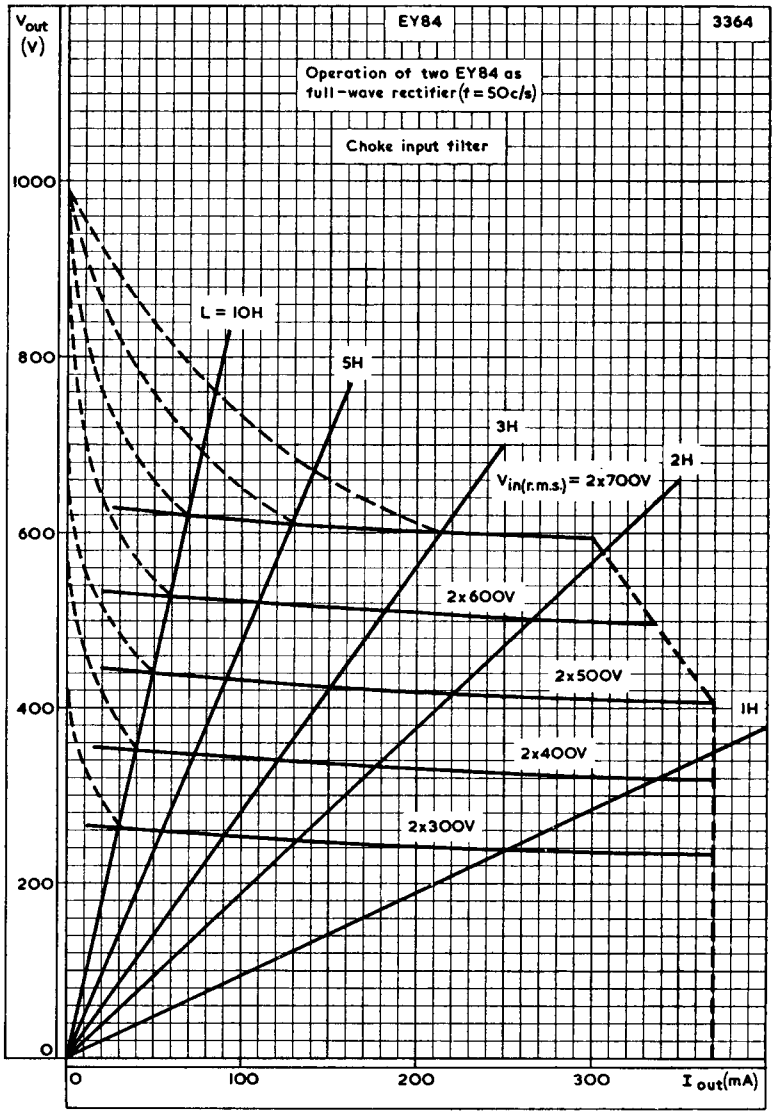


CAPACITOR INPUT FILTER REGULATION CURVES

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.



CHOKE INPUT FILTER REGULATION CURVES

MINIATURE HALF WAVE RECTIFIER

EY91

Indirectly-heated miniature rectifier for use in miniature equipment.

HEATER

V_h	6.3	V
I_h	0.42	A
Heating Time	20	secs approx.

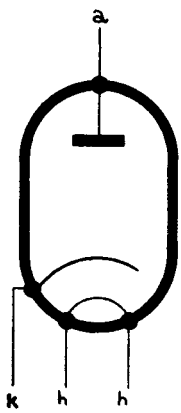
TYPICAL OPERATING CONDITIONS

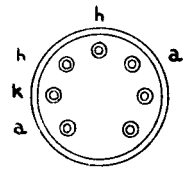
V_a (V.rms)	Reservoir Capacitance C(uF)	Limiting Resistance (Ω)
250	32	100
	16	50
	8	0
200	32	70
	16	30

LIMITING VALUES

V_a max.	250	V.rms
I_{out} max.	75	mA
V_{h-k} max.	300	V
C max.	32	uF

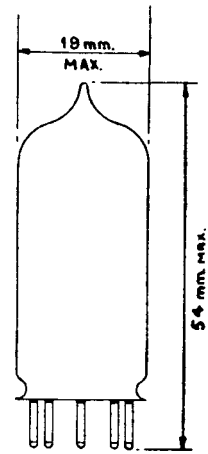
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS.





B7G BASE

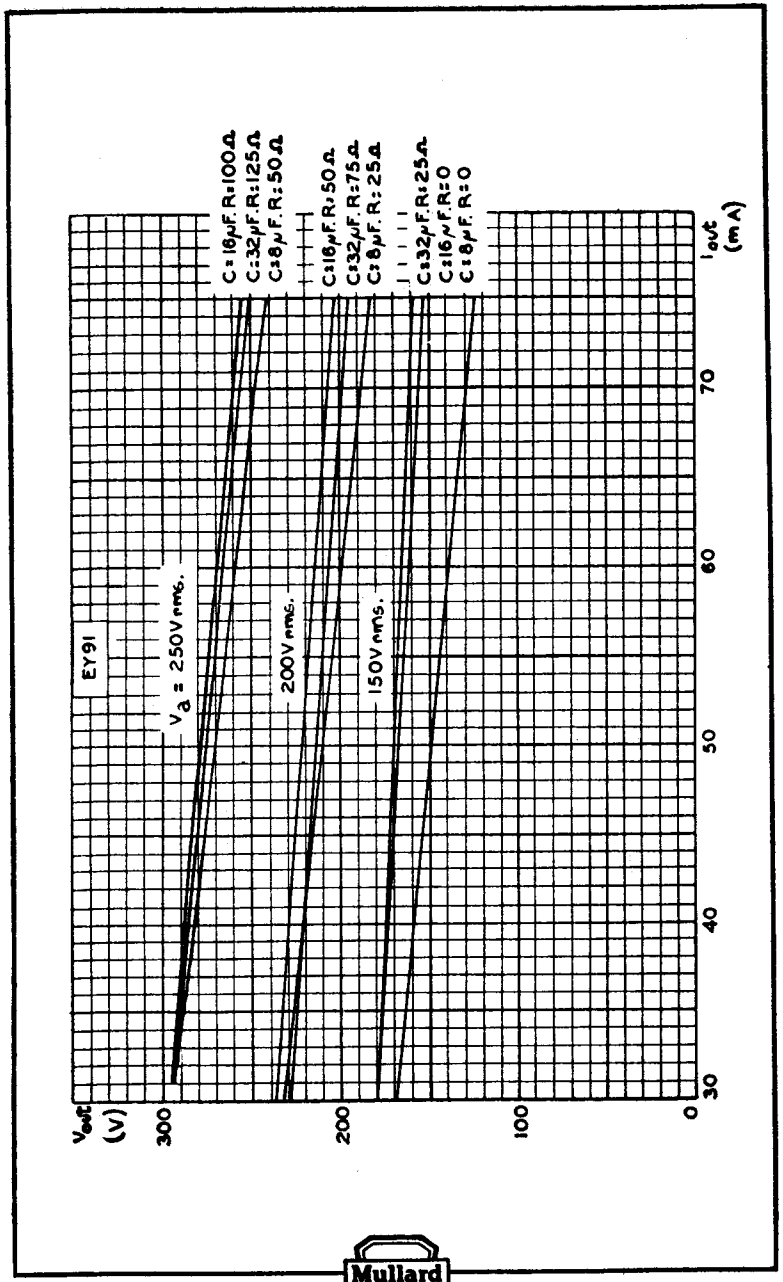
DIMENSIONS



EY91

MINIATURE HALF WAVE RECTIFIER

Indirectly-heated miniature rectifier for use in miniature equipment.



FULL WAVE RECTIFIER

EZ35

Indirectly-heated power rectifier with 6.3 V heater for use in A.C. mains-operated equipment.

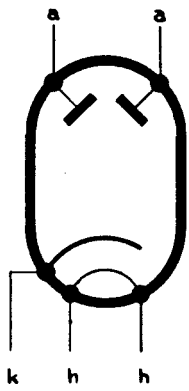
HEATER

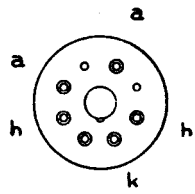
V_h	6.3	V
I_h	0.6	A

OPERATING CONDITIONS

Max. anode voltage	2 x 325	V_{rms}
Max. rectified current	70	mA
Max. voltage, heater to cathode	450	V_{pk}
Max. capacitance of reservoir condenser	16	µF
Min. value of limiting resistance in series with each anode, when reservoir capacitance is 16 µF	350	ohms

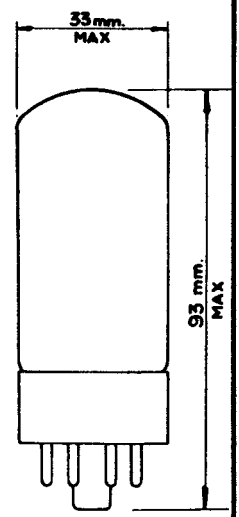
ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS





OCTAL BASE

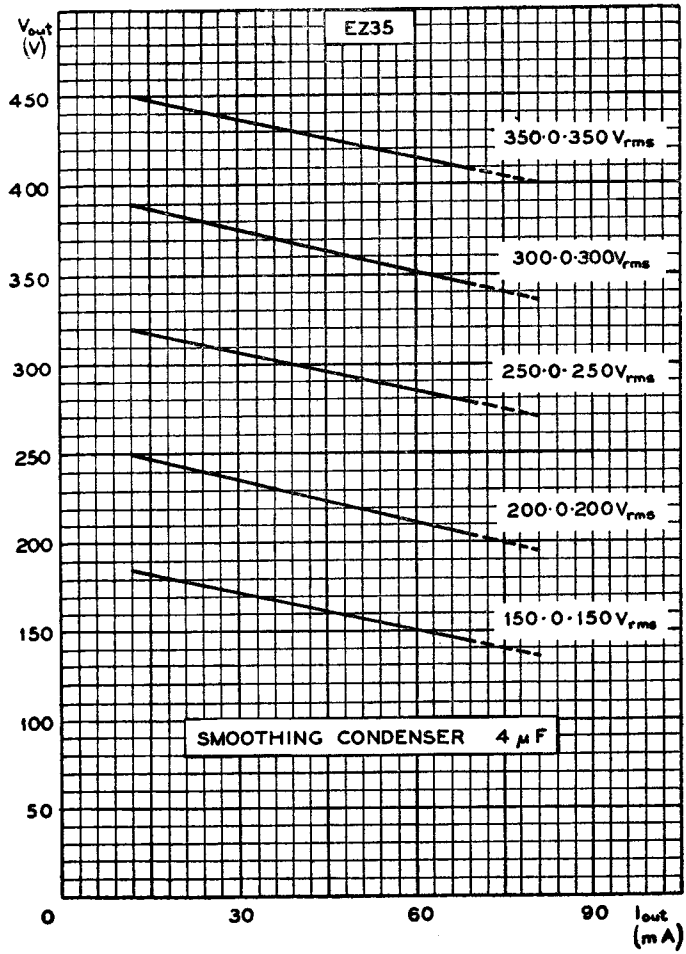
DIMENSIONS



EZ35

FULL WAVE RECTIFIER

Indirectly-heated power rectifier with 6.3 V heater for use in A.C. mains-operated equipment.



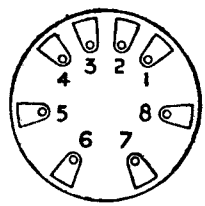
Mullard
OCTODE FREQUENCY CHANGER FC13

The FC13 is an indirectly heated Octode frequency changer for use in D.C./A.C. mains superheterodyne receivers.

DIMENSIONS

Overall length ... ... 118 mm. Overall diameter ... ... 47 mm.

CONNECTIONS



Viewed from underside of Valve base.

Contact No. 1 Metallising
„ 2 Heater
„ 3 Heater
„ 4 Cathode and Suppressor Grid (G6)
„ 5 Oscillator Anode (G2)
„ 6 Oscillator Grid (G1)
„ 7 Screen Grid (G3+5)
„ 8 Anode
Top Cap—Control Grid (G4)

OPERATING DATA AND NOTES

For heater characteristics, operating data, and characteristic curves, see Type FC13C. Except for dimensions and base connections, Types FC13 and FC13C are identical.

Mullard
OCTODE FREQUENCY CHANGER

FC13C

The FC13C is an octode frequency changer for use in D.C./A.C. mains superheterodyne receivers

HEATER CHARACTERISTICS

Heater Voltage	... ...	Vf=13·0 volts	
Heater Current	... ...	If=0·2 amp	
Heating Time—60 secs.			

DIMENSIONS

Overall Length	... =135 mm.
Overall Diameter	... = 47 mm.
Bulb Finish—Metallised	

OPERATING CHARACTERISTICS

Maximum Anode Voltage	Va_{max}	=	200 volts
Maximum Oscillator Anode Voltage	$Vg2_{max}$	=	90 volts
Maximum Screen Voltages	$Vg3+5_{max}$	=	90 volts
Normal Anode Voltage	Va_w	=	200 volts
Normal Oscillator Anode Voltage	$Vg2_w$	=	90 volts
Normal Screen Voltage	$Vg3+5_w$	=	70 volts
Anode Current (Vg4—1·5)	Ia_w	=	1·6 mA
Oscillator Anode Current	$Ig2_w$	=	2·0 mA
Screen Current	$Ig3+5_w$	=	3·8 mA
Control Grid Voltage	$-Vg4_w$	=	1·5 volts
Conversion Conductance (Ia=1·6 mA) ...	Sc_w	=	0·6 mA/V
Maximum Resistance in Grid Circuit	$Rg4_{max}$	=	2·0 megohms
Cathode Bias Resistance	Rk	=	250 ohms
Normal Heterodyne Voltage (Peak)	Vhet	=	12 volts

CAPACITIES

Anode-Control Grid	Cag4	=<0.1 μμF
Input	Cg4	= 9·0 μμF
Output	Ca	= 12·5 μμF
Oscillator Grid	Cg1	= 9·4 μμF
Oscillator Anode	Cg2	= 6·1 μμF
Oscillator Grid-Control Grid	Cg1g4	=<0·35 μμF
Oscillator Anode-Control Grid	Cg2g4	=<0·25 μμF

GRID CURRENT

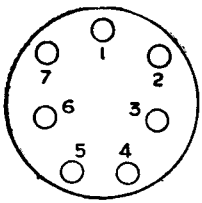
At: Va=200, Vg2, 3+5=70, Vhet 12 Peak, Grid current (G4) reaches a value of 1·0 μA between the grid voltage range of −0·1 to −0·75.

FC13C

Mullard

OCTODE FREQUENCY CHANGER

CONNECTIONS



Viewed from free end of pins.

Pin No. 1 Oscillator Anode (G2)
„ 2 Oscillator Grid (G1)
„ 3 Screen Grids (G3+5)
„ 4 Heater
„ 5 Heater
„ 6 Cathode, Metallising
„ 7 Anode
Top Cap—Control Grid (G4)

CIRCUIT DETAILS

For details of the circuit, see the circuit diagram printed on the FC4 data sheet.

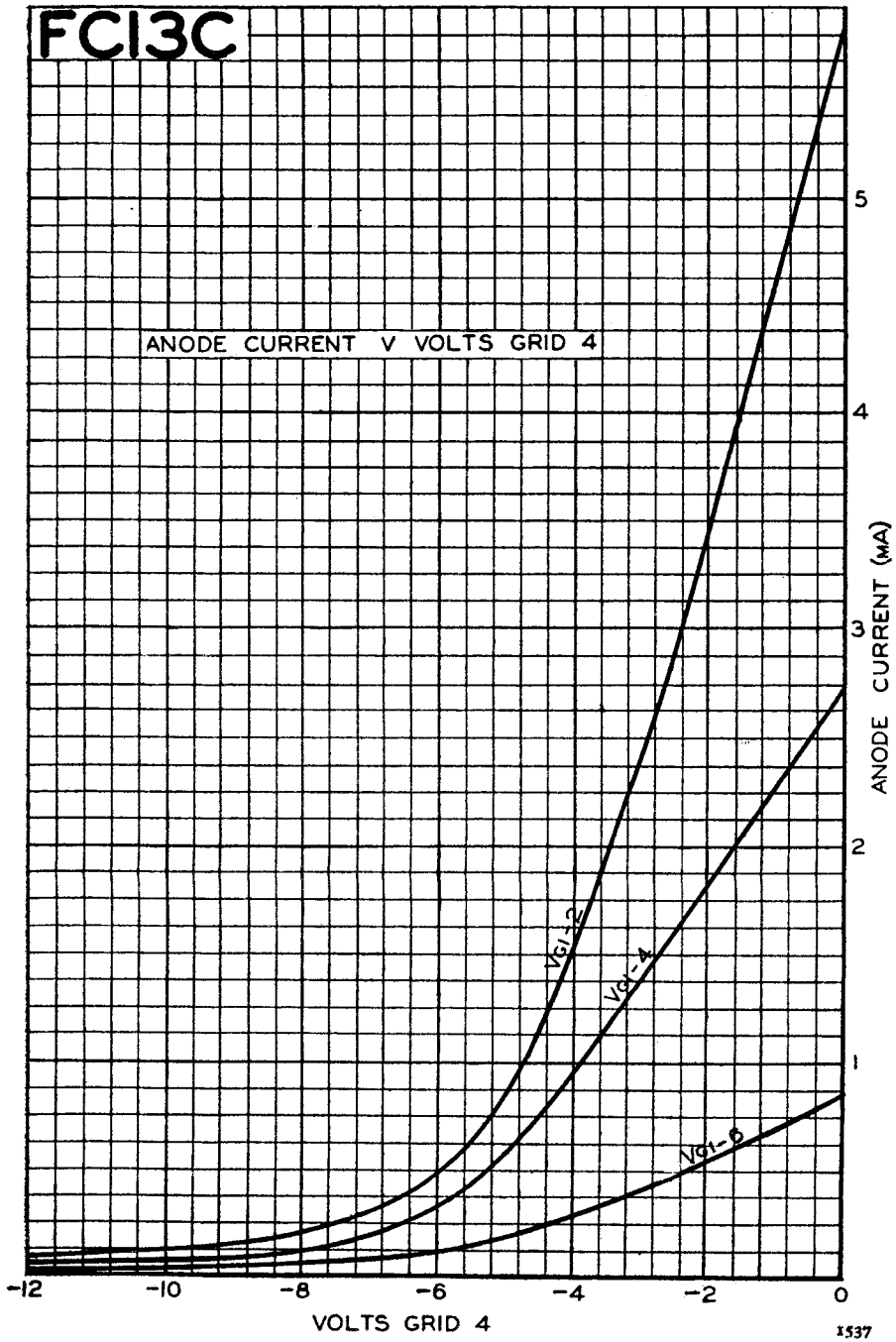
DYNAMIC CHARACTERISTICS

For the dynamic characteristics of this Valve refer to type FC4.

Mullard

OCTODE FREQUENCY CHANGER

FC13C



FULL WAVE RECTIFIER

FW4-500

Directly-heated power rectifier for outputs up to 500 V at 250mA.

HEATER

V_f	4.0	V
I_f	3.0	A

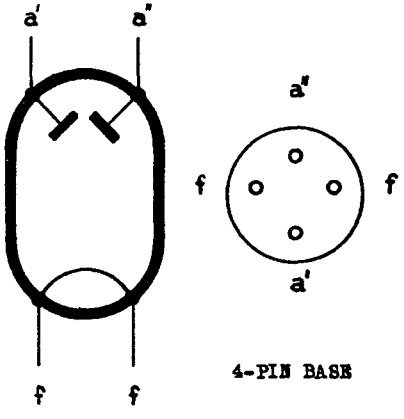
TYPICAL OPERATING CONDITIONS

Anode Voltage V.rms.	Capacitance of Reservoir Condenser (μF)	Minimum Value of Series Protective Resistance. (ohms)
2x500	16	200
2x350	32	150

LIMITING VALUES

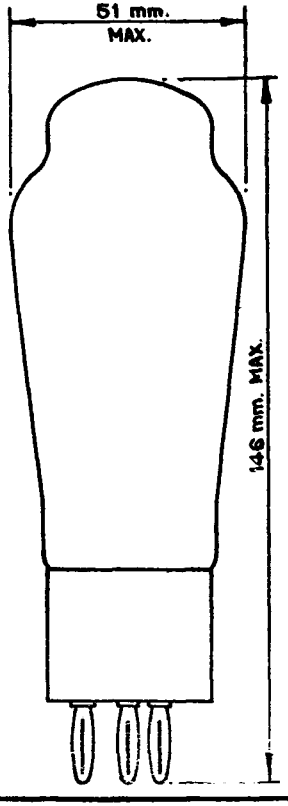
Max. Anode Voltage (rms)	2x500	V.rms
Max. Rectified Current	250	mA
Max. Peak Inverse Voltage	1600	V

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



4-PIN BASE

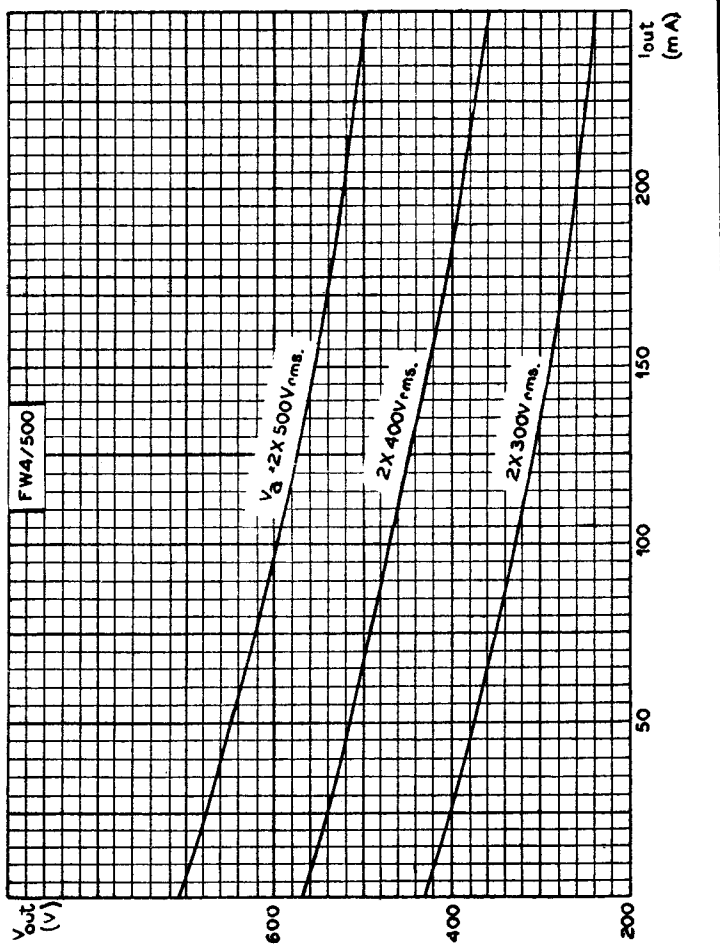
DIMENSIONS



FW4-500

FULL WAVE RECTIFIER

Directly-heated power rectifier for outputs up to 500 V at 250mA.



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FULL WAVE RECTIFIER

FW4-800

Directly-heated power rectifier for outputs up to 800V at 125mA.

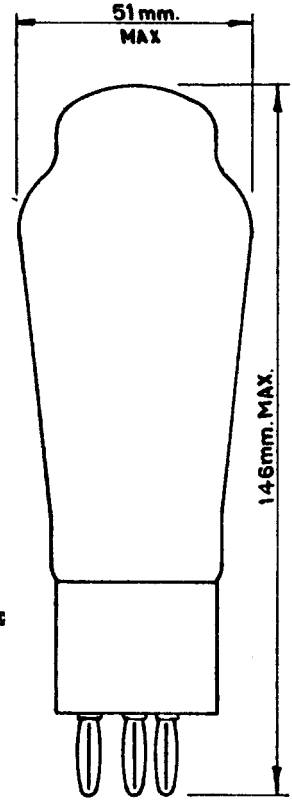
FILAMENT

V_f	4.0	V
I_f	3.0	A

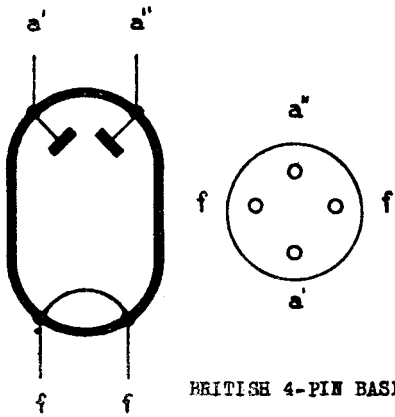
LIMITING VALUES

Max. Anode Voltage	2x850	V.rms
Max. Rectified Current.	125	mA
Max. Reservoir Capacitance	4	μF
Min. Value of Series Protective Resistance (per anode)	150	Ω

DIMENSIONS



ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS.

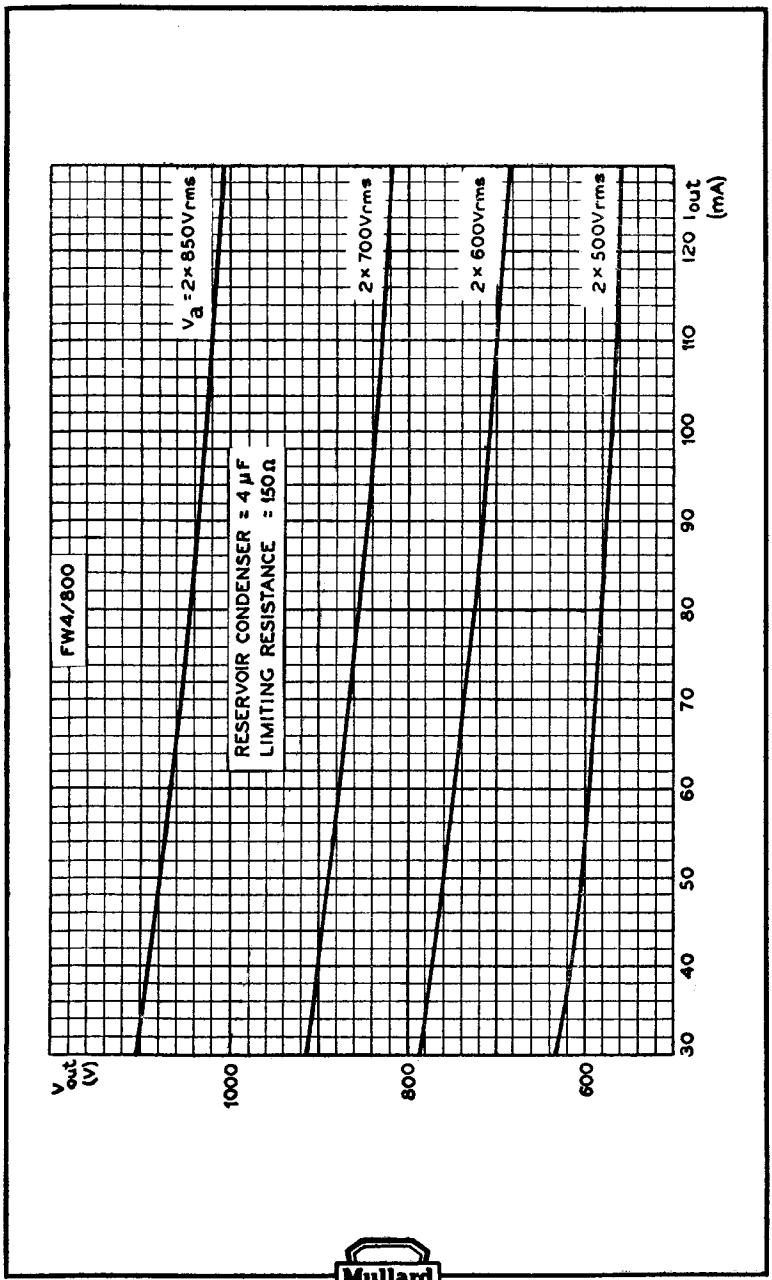


BRITISH 4-PIN BASE

FW4-800

FULL WAVE RECTIFIER

Directly-heated power rectifier for outputs up to 800V at 125mA.



Mullard

Mullard
GAS TRIODE

GT4A

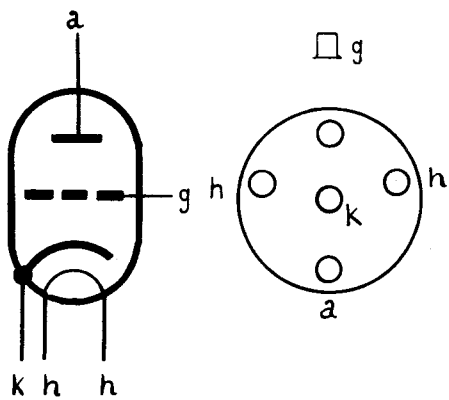
Heater	Vf	=	4.0 V
	If	=	1.2 V

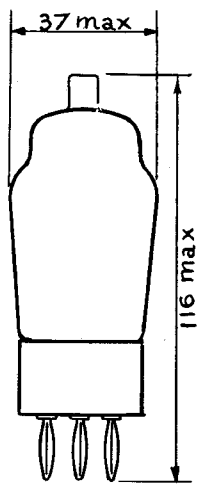
Capacities	Cak	=	3.1 uuF
	Cgk	=	3.4 uuF
	Cag	=	2.7 uuF

Operating Conditions

V max (peak) between any two electrodes	350	V
Va max (peak)	300	V
Ia max (peak)	300	mA
Ia max (average)	3	mA
Rg min	1,000	Ω/V
Rg max	0.5mΩ/V	
Gas Voltage Drop	17	V
Control Ratio	20	
V fk max	100	V

Arrangement of electrodes and base connections

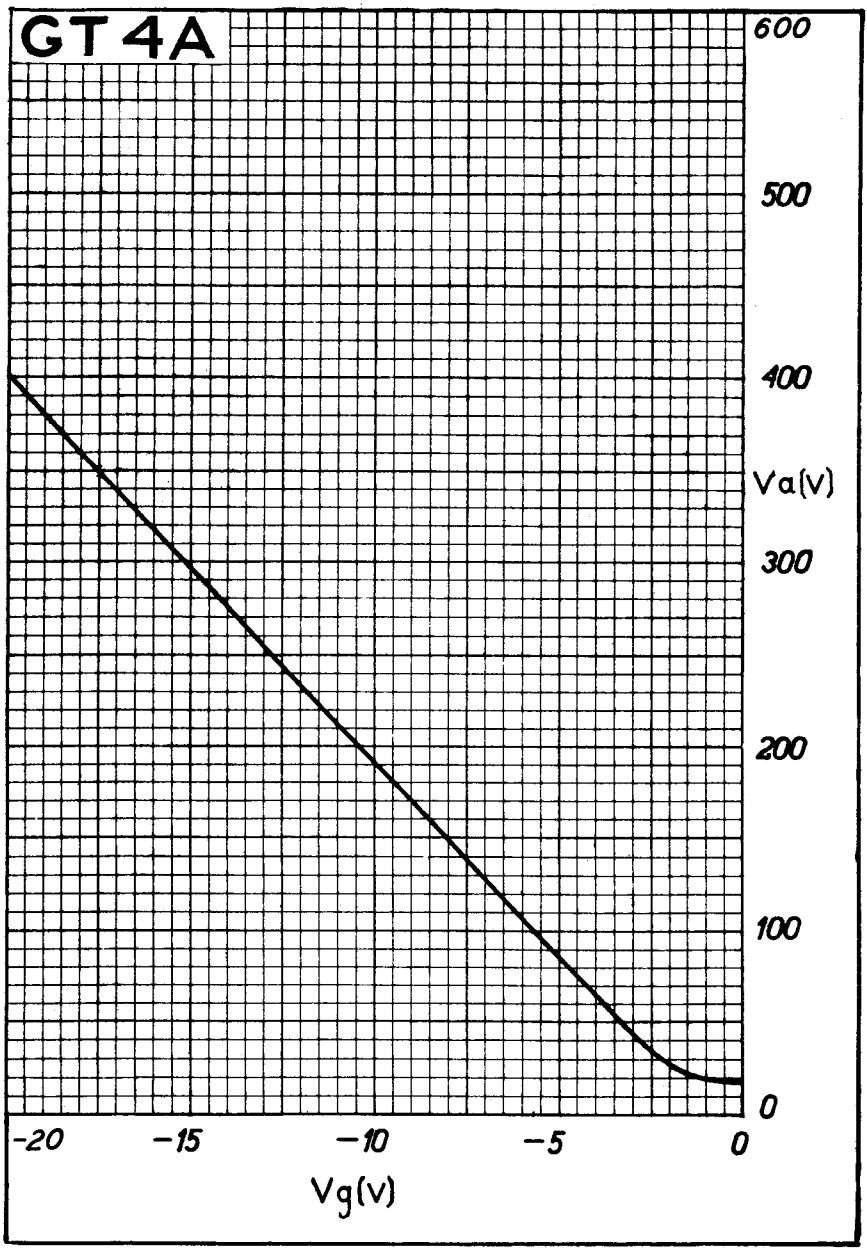




GT4A

GT4A

Mullard
GAS TRIODE



1539/2

Mullard
GAS TRIODE

GT4H

TENTATIVE DATA.

This valve has identical characteristics to the EC50 (q.v.) except for:-

Heater	Vf	=	4.0 V
	If	=	2.4 A
	Heating Time	=	15 secs.

FULL-WAVE RECTIFIER

GZ30

Indirectly-heated full-wave rectifier with 5-volt heater.

HEATER

V_h	5.0	V
I_h	2.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	375	mA
I_{out} max.	125	mA
C max.	50	μF
L min.	5	H

TYPICAL OPERATING CONDITIONS

Capacitor Input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	C (μF)	R_{11m} min. (per anode) (Ω)	V_{out} (V)
2×250	125	8	190	242
2×300	125	8	260	292
2×350	125	8	300	344
2×250	125	50	240	236
2×300	125	50	310	282
2×350	125	50	380	327

Choke Input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	V_{out} (V)
2×250	125	10	205
2×300	125	10	249
2×350	125	10	295
2×400	125	10	340
2×450	125	10	384
2×500	125	10	429

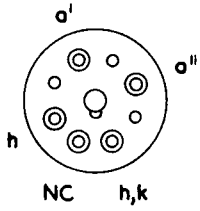
GZ30

FULL-WAVE RECTIFIER

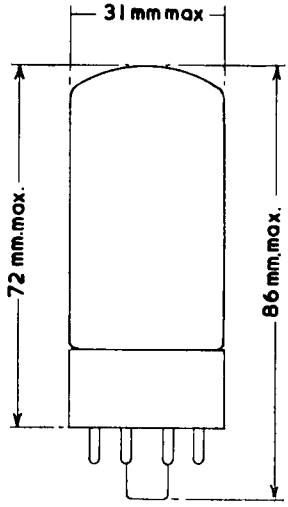
Indirectly-heated full-wave rectifier with 5-volt heater.

1332





Octal Base.



FULL-WAVE RECTIFIER

GZ33

Indirectly heated full-wave rectifier with 5-volt heater.

HEATER

V_h	5.0	V
I_h	3.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	750	mA
i_a surge max.	2.5	A

Capacitor input

$V_{a(r.m.s.)}$ max.	500	V
I_{out} max.	250	mA
C max.	60	μF

Choke input

$V_{a(r.m.s.)}$ max.	500	V
I_{out} max.	300	mA
L min.	10	H

TYPICAL OPERATING CONDITIONS

Capacitor input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	C (μF)	R_{11m}. min. (per anode) (Ω)	V_{out} (V)
2×300	250	8	140	271
2×400	250	8	200	375
2×500	250	8	250	479
2×300	250	60	140	289
2×400	250	60	200	388
2×500	250	60	250	493

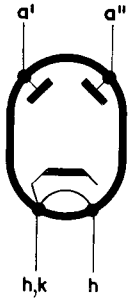
Choke input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	V_{out} (V)
2×300	300	10	242
2×400	300	10	332
2×500	300	10	421

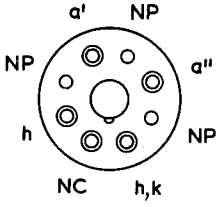
GZ33

FULL-WAVE RECTIFIER

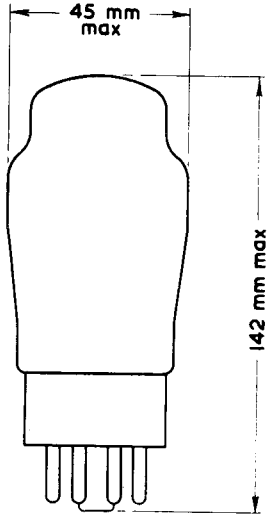
Indirectly heated full-wave rectifier with 5-volt heater.



3361



Octal Base



FULL-WAVE RECTIFIER

GZ34

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

HEATER

V_h	5.0	V
I_h	1.9	A

LIMITING VALUES

P.I.V. max.						1.5	kV
$i_{a(pk)}$ max.						750	mA
C max.						60	μF
$V_{a(r.m.s.)}$	2×300	2×350	2×400	2×450	2×500	2×550	V
Capacitor input							
I_{out} max.	250	250	250	250	200	160	mA
R_{llm} min. (per anode)	50	75	100	125	150	175	Ω
Choke input							
I_{out} max.	250	250	250	250	250	225	mA
R_{llm} min. (per anode)	0	0	0	0	0	0	Ω

TYPICAL OPERATING CONDITIONS

Capacitor input

$V_{a(r.m.s.)}$	I_{out}	C	R_{llm} (per anode)	V_{out}
(V)	(mA)	(μF)	(Ω)	(V)
2×300	250	60	75	330
2×350	250	60	100	380
2×400	250	60	125	430
2×450	250	60	150	480
2×500	200	60	175	560
2×550	160	60	200	640

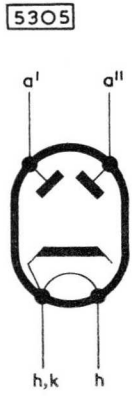
Choke input

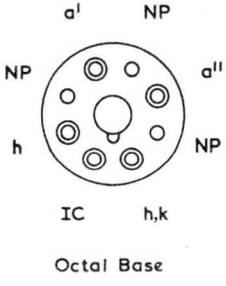
$V_{a(r.m.s.)}$	I_{out}	L	R_{llm} (per anode)	V_{out}
(V)	(mA)	(H)	(Ω)	(V)
2×300	250	10	0	250
2×350	250	10	0	290
2×400	250	10	0	330
2×450	250	10	0	375
2×500	250	10	0	420
2×550	225	10	0	465

GZ34

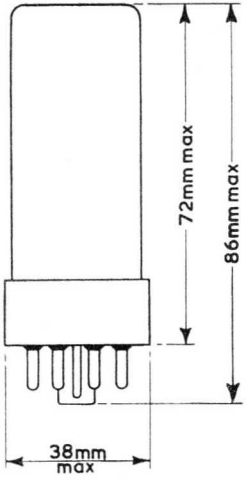
FULL-WAVE RECTIFIER

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.





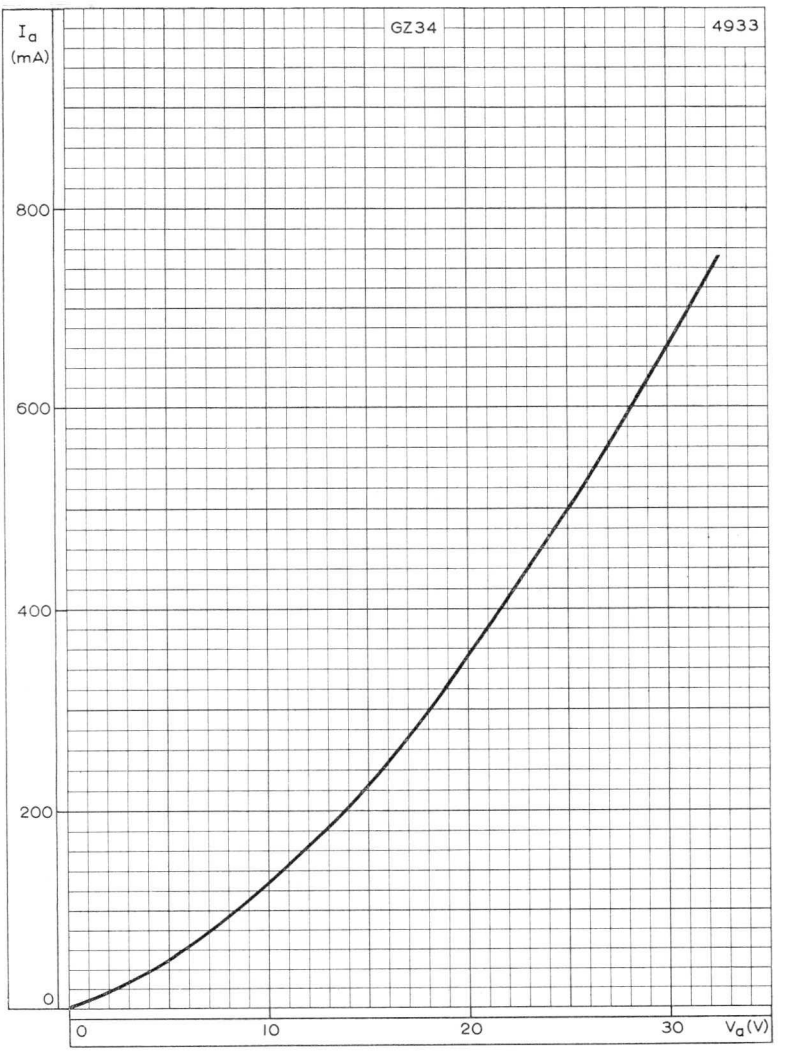
Octal Base



FULL-WAVE RECTIFIER

GZ34

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

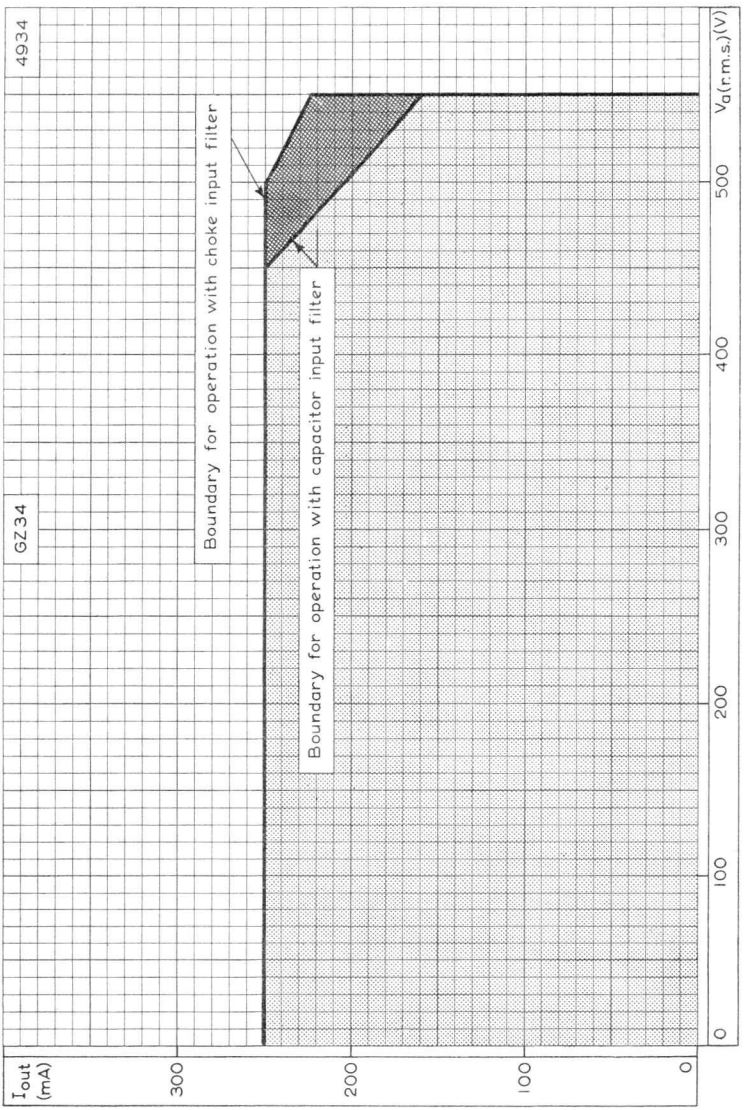


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

GZ34

FULL-WAVE RECTIFIER

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

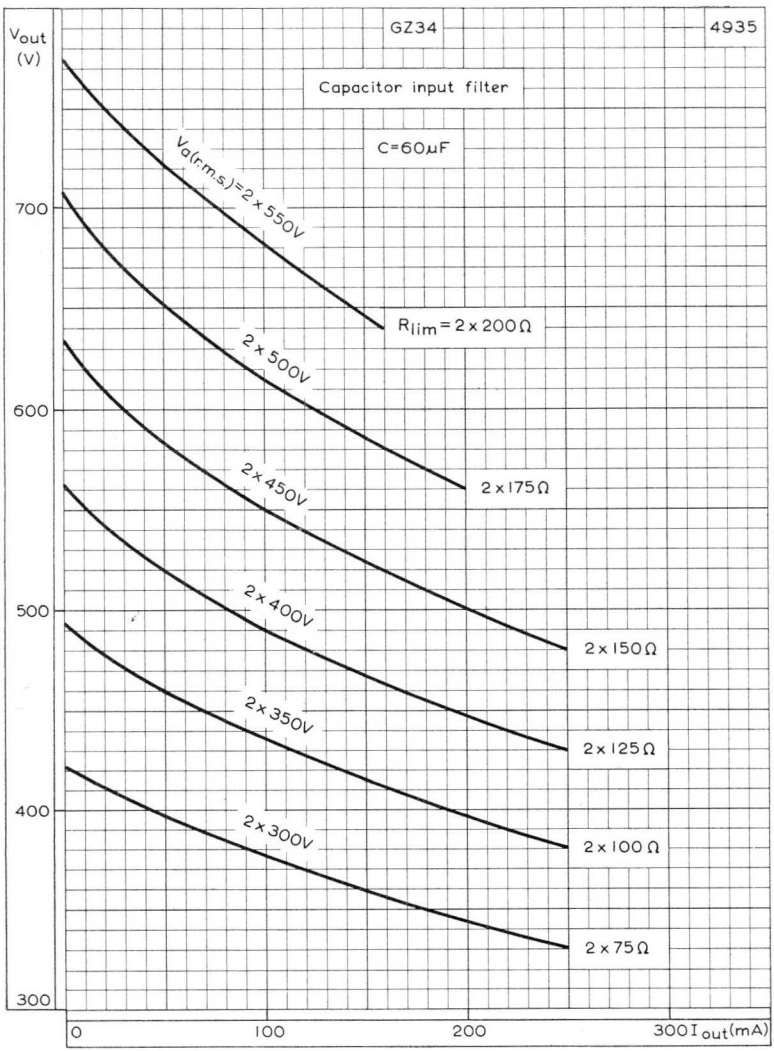


BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER

FULL-WAVE RECTIFIER

GZ34

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

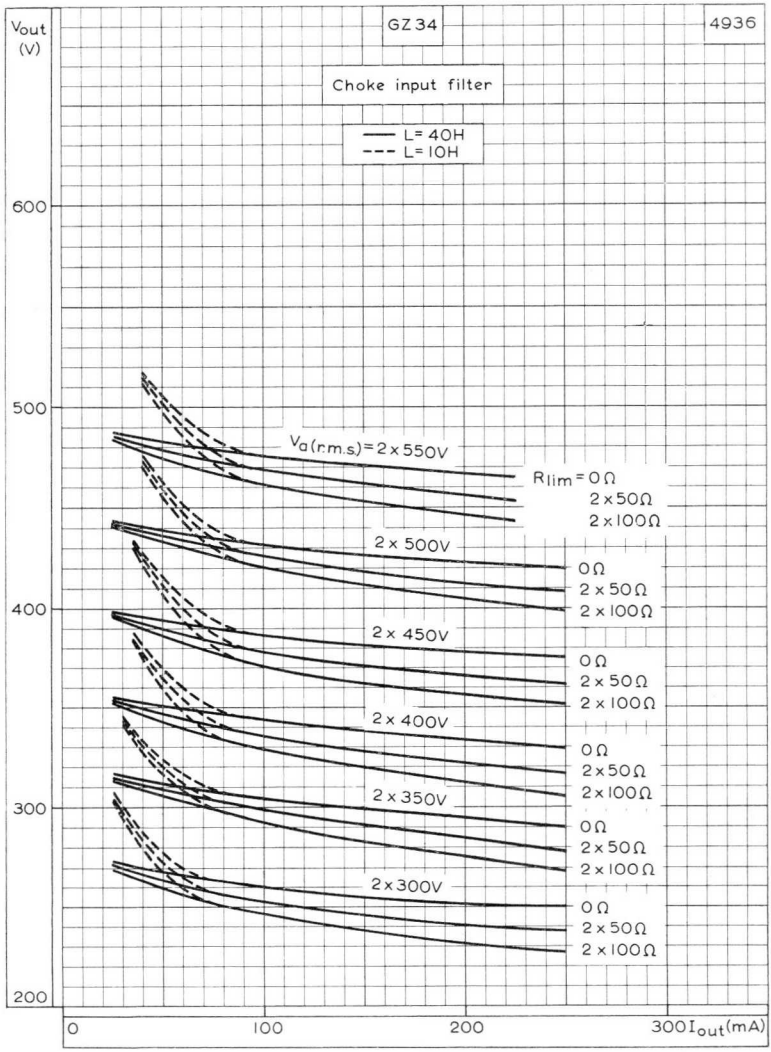


CAPACITOR INPUT FILTER REGULATION CURVES

GZ34

FULL-WAVE RECTIFIER

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.



CHOKE INPUT FILTER REGULATION CURVES

Mullard
MEDIUM IMPEDANCE TRIODE

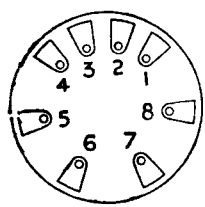
HL13

The HL13 is an indirectly heated medium impedance Triode for use in D.C./A.C. mains receivers.

DIMENSIONS

Overall length ... ... 101 mm. Overall diameter ... ... 44 mm.

CONNECTIONS



Viewed from underside of Valve base.

Contact No. 1 Metallising
" 2 Heater
" 3 Heater
" 4 Cathode
" 5 —
" 6 —
" 7 —
" 8 Anode
Top Cap—Control Grid (G1)

OPERATING DATA AND NOTES

For heater characteristics, operating data, and characteristic curves, see Type HL13C. Except for dimensions and base connections, Types HL13 and HL13C are identical.

Mullard
MEDIUM IMPEDANCE TRIODE HL13C

The HL13c is a medium impedance triode for use as detector or L.F. amplifier in D.C./A.C. mains receivers.

HEATER CHARACTERISTICS

Heater Volts	... ...	Vf=13·0 volts.	
Heater Current	... ...	If=0·2 amp.	
Heating Time—60 seconds			

DIMENSIONS

Overall Length	... =120 mm.
Overall Diameter	... = 43 mm.
Bulb Finish—Metallised	

OPERATING CHARACTERISTICS

Anode Voltage	... ...	Va_w	= 200 volts
Anode Current	... ...	Ia_w	= 5·0 mA
Grid Voltage	... ...	$-Vg_w$	= 3·7 volts
Mutual Conductance	... ...	S_w	= 3·3 mA/V
Amplification Factor	... ...	G_w	= 40
Anode Impedance	... ...	Ri_w	= 12,000 ohms
Cathode Bias Resistor	... ...	Rk	= 740 ohms

OPERATING CHARACTERISTICS AS R.C. AMPLIFIER

Line Voltage	... ...	Va	= 200 volts
Anode Current	... ...	Ia	= 0·65 mA
Grid Voltage	... ...	$-Vg$	= 2·6 volts
Optimum Load	... ...	Ra	=160,000 ohms
Cathode Bias Resistor	... ...	Rk	= 4,000 ohms
Amplification Factor	... ...	G	= 30·0
Maximum Output Voltage (D=5% 2nd H.)	...	Vo	= 36·0 volts

CAPACITIES

Anode-Control Grid	... ...	Cag1	= 3·1 $\mu\mu$F
Grid-Cathode	... ...	Cgk	= 3·9 $\mu\mu$F
Anode-Cathode	... ...	Cak	= 4·6 $\mu\mu$F

LIMITS

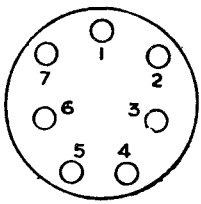
Maximum Anode Voltage	... ...	Va_{max}	= 200 volts
Maximum Anode Dissipation	... ...	Wa_{max}	= 2·0 watts
Maximum Cathode Current	... ...	Ik_{max}	= 10 mA
Maximum Resistance in Grid Circuit	... ...	$Rg1A_{max}$	= 1·5 megohms
Maximum Voltage between Heater and Cathode		Vfk_{max}	= 125 volts
Maximum Resistance between Heater & Cathode		Rfk_{max}	= 20,000 ohms
Range of grid voltage for 1 μA grid current	...	Vg1	=−0·5 to−1·0 v.

HL13C

Mullard

MEDIUM IMPEDANCE TRIODE

CONNECTIONS

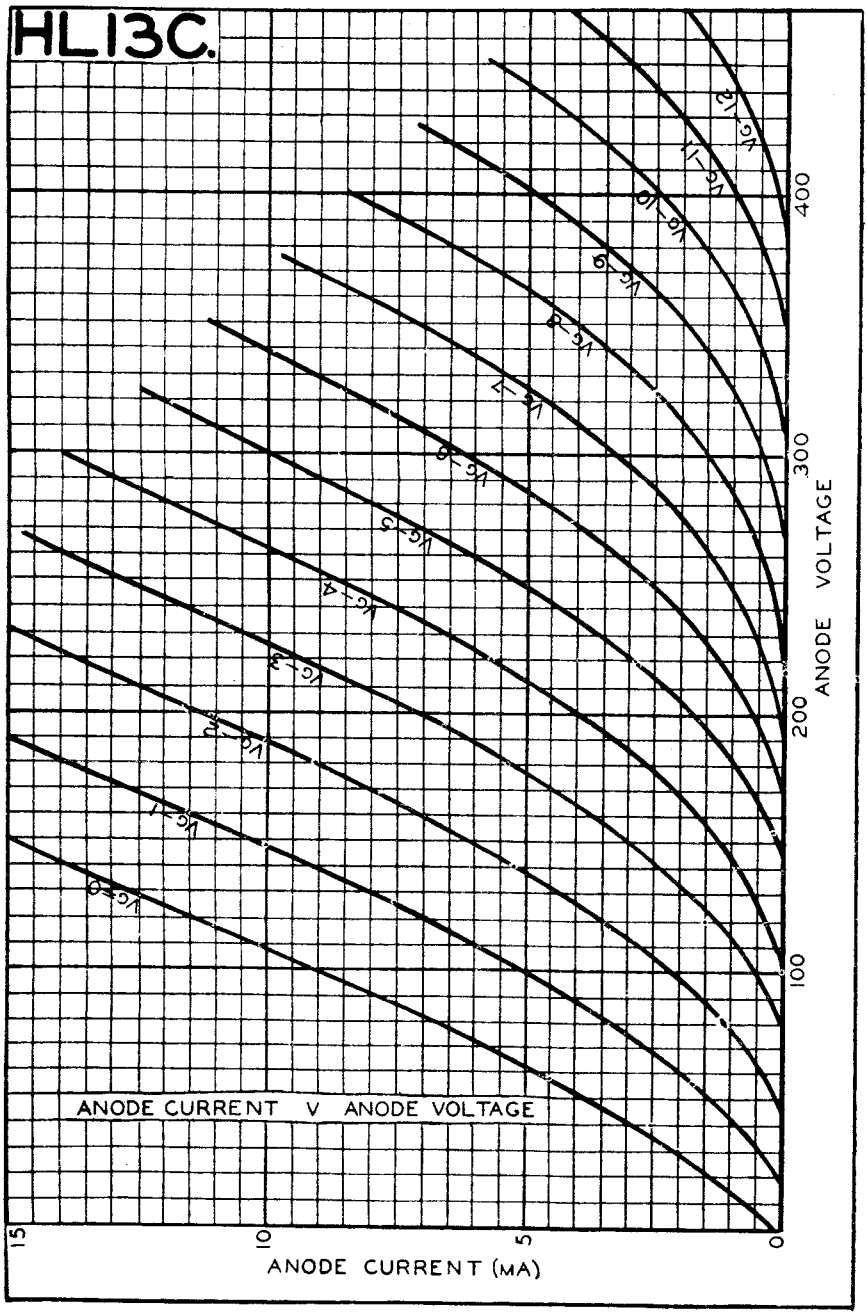


Pin No. 1 Metallisation
" 2 —
" 3 —
" 4 Heater
" 5 Heater
" 6 Cathode
" 7 Anode
Top Cap—Control Grid.

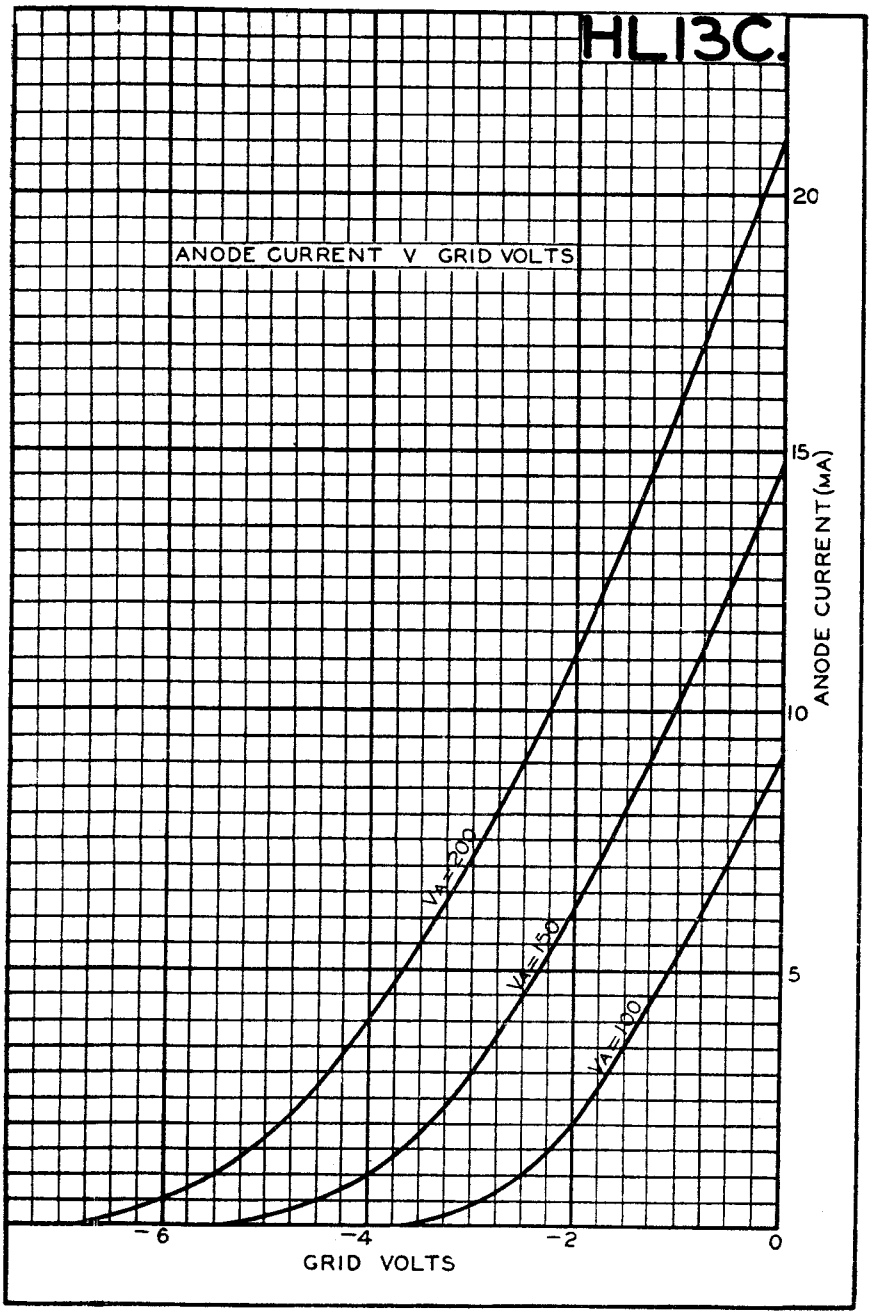
Viewed from free end of pins.

HL13C

Mullard
MEDIUM IMPEDANCE TRIODE



Mullard
MEDIUM IMPEDANCE TRIODE HL13C



Mullard
HIGH VOLTAGE RECTIFIER HVR1

The HVR1 is a directly heated high voltage half-wave rectifier for use in apparatus employing Cathode Ray Tubes.

FILAMENT CHARACTERISTICS

Filament Voltage ...	...	Vf=2·0 volts
Filament Current ...	...	If=0·29 amp

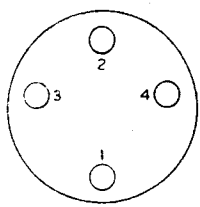
DIMENSIONS

Overall Length	...	=132 mm.
Overall Diameter...		= 46 mm.

OPERATING DATA

Maximum Anode Voltage (R.M.S.)	... ...	Va_{max}	= 6,000 volts
Maximum Rectified Current (continuous)	...	Ia_{max}	= 5·0 mA
Maximum Peak Inverse Voltage	... ...		= 15,000 volts

CONNECTIONS

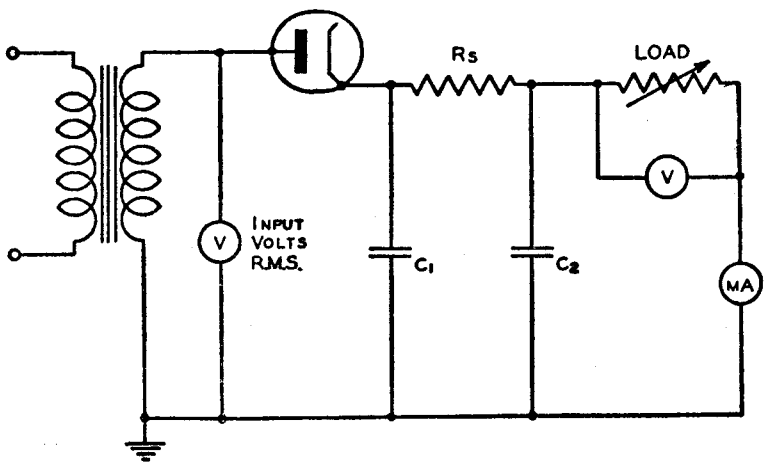


Viewed from end of pins.

Pin No. 1 —
„ 2 —
„ 3 Filament
„ 4 Filament
Top Cap—Anode

OPERATING NOTES

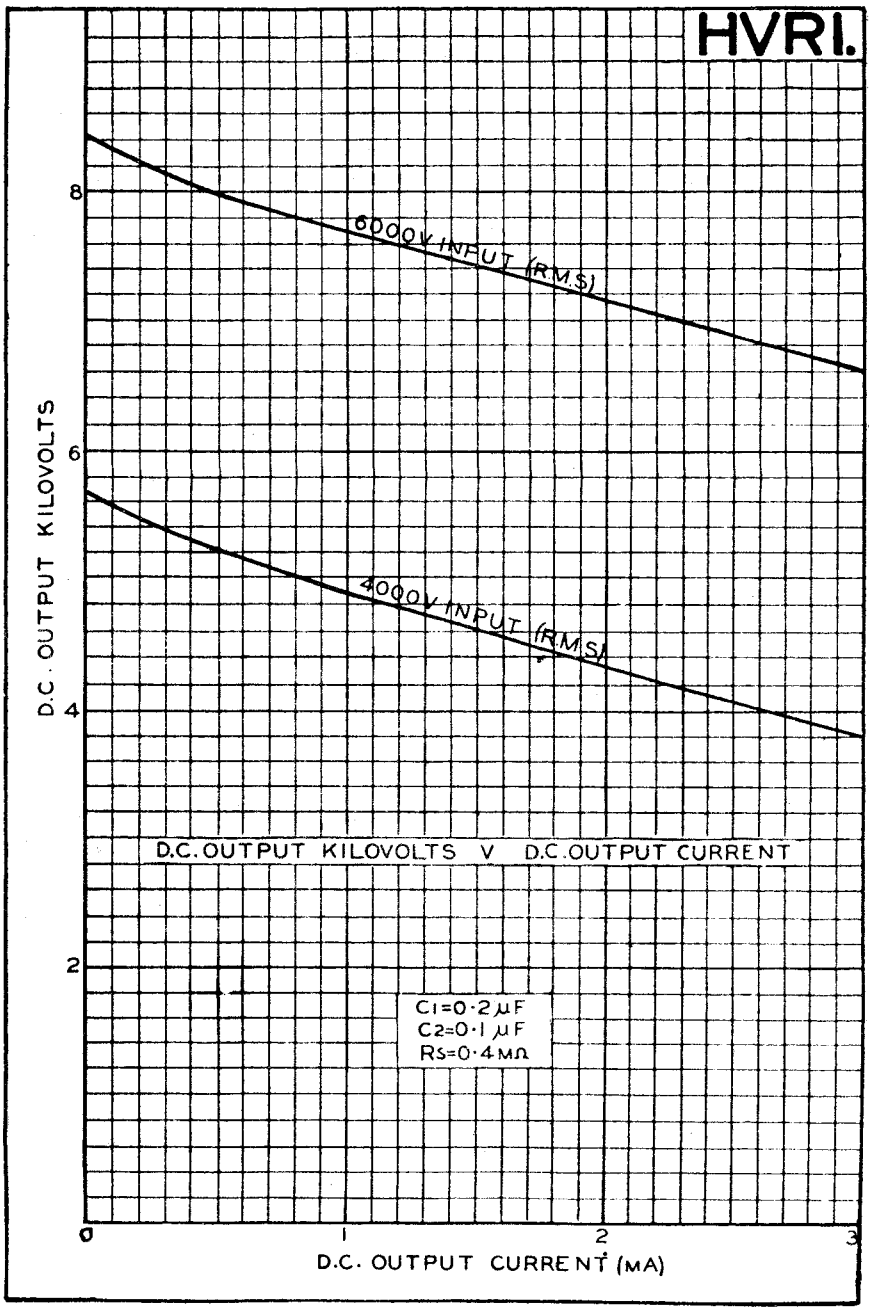
A typical method of operating is shown below, the constants on the curves refer to this circuit.



HVR1

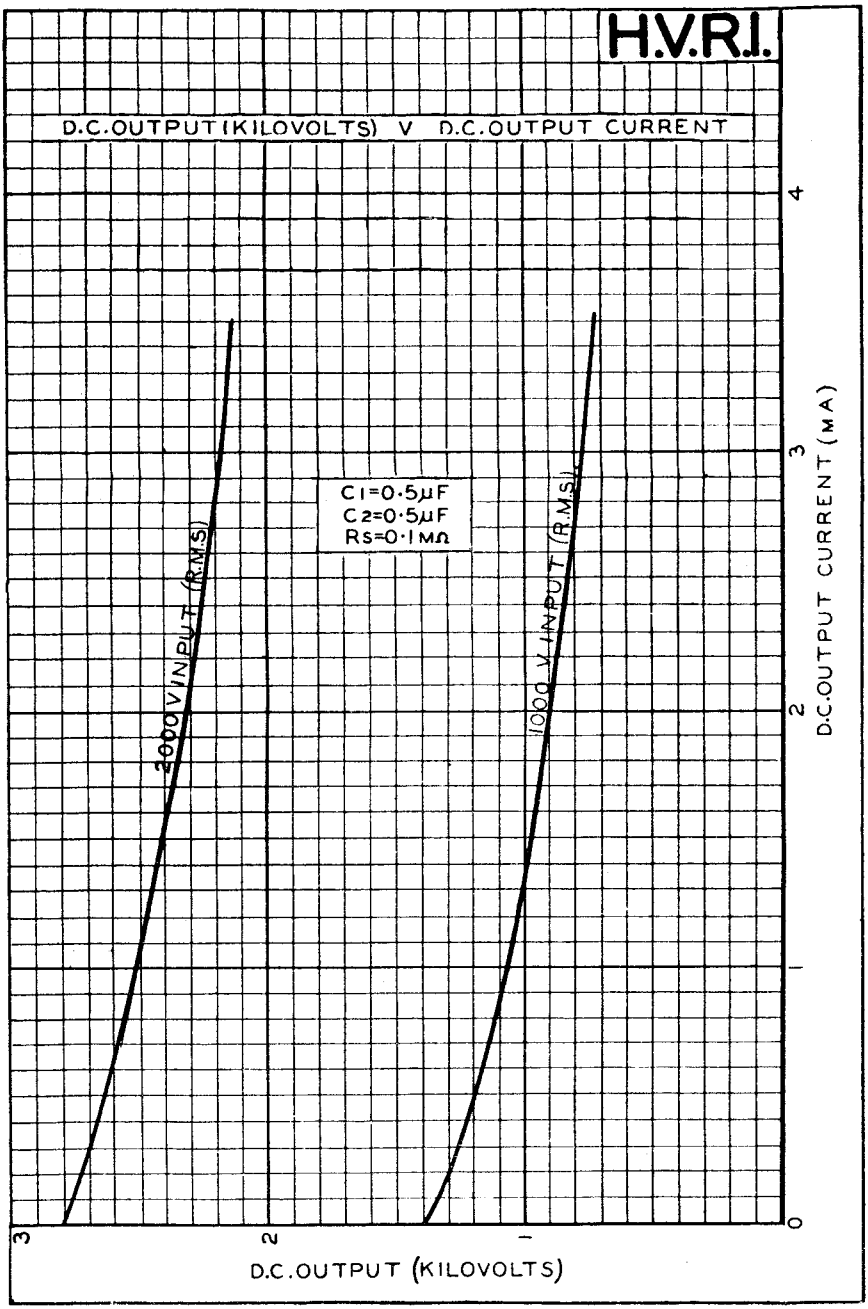
Mullard

HIGH VOLTAGE RECTIFIER



Mullard
HIGH VOLTAGE RECTIFIER

HVR1



Mullard
HIGH VOLTAGE RECTIFIER HVR2

The HVR2 is an indirectly heated high-voltage half-wave rectifier for use in apparatus employing Cathode Ray Tubes.

HEATER CHARACTERISTICS

Heater Voltage	... ...	Vf=4·0 volts
Heater Current	... ...	If=0·65 amp
		Heating Time—40 seconds

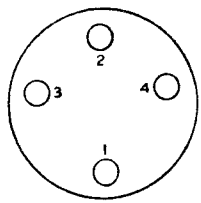
DIMENSIONS

Overall Length ...	=130 mm
Overall Diameter	= 46 mm.

OPERATING DATA

Maximum Anode Voltage (R.M.S.) ...	... Va_{max}	= 6,000 volts
Maximum Rectified Current (Continuous)	... Ia_{max}	= 3·0 mA
Maximum Peak Inverse Voltage ...	...	= 20,000 volts

CONNECTIONS

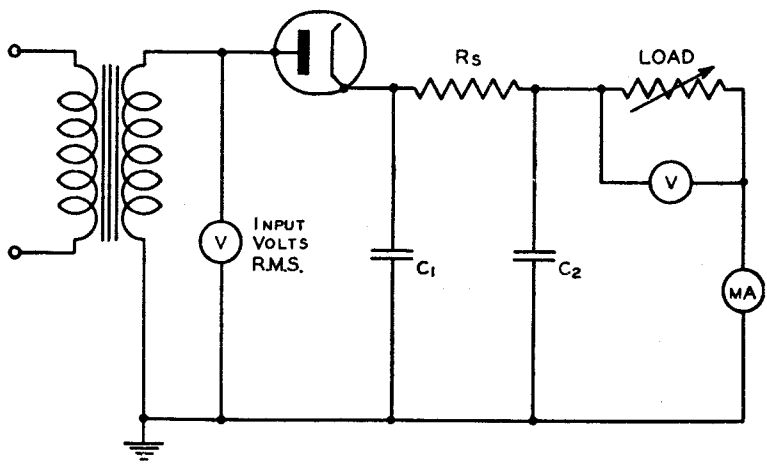


Viewed from free end of pins

Pin No. 1 —
„ 2 —
„ 3 Heater { Cathode internally connected
„ 4 Heater
Top Cap—Anode

OPERATING NOTES

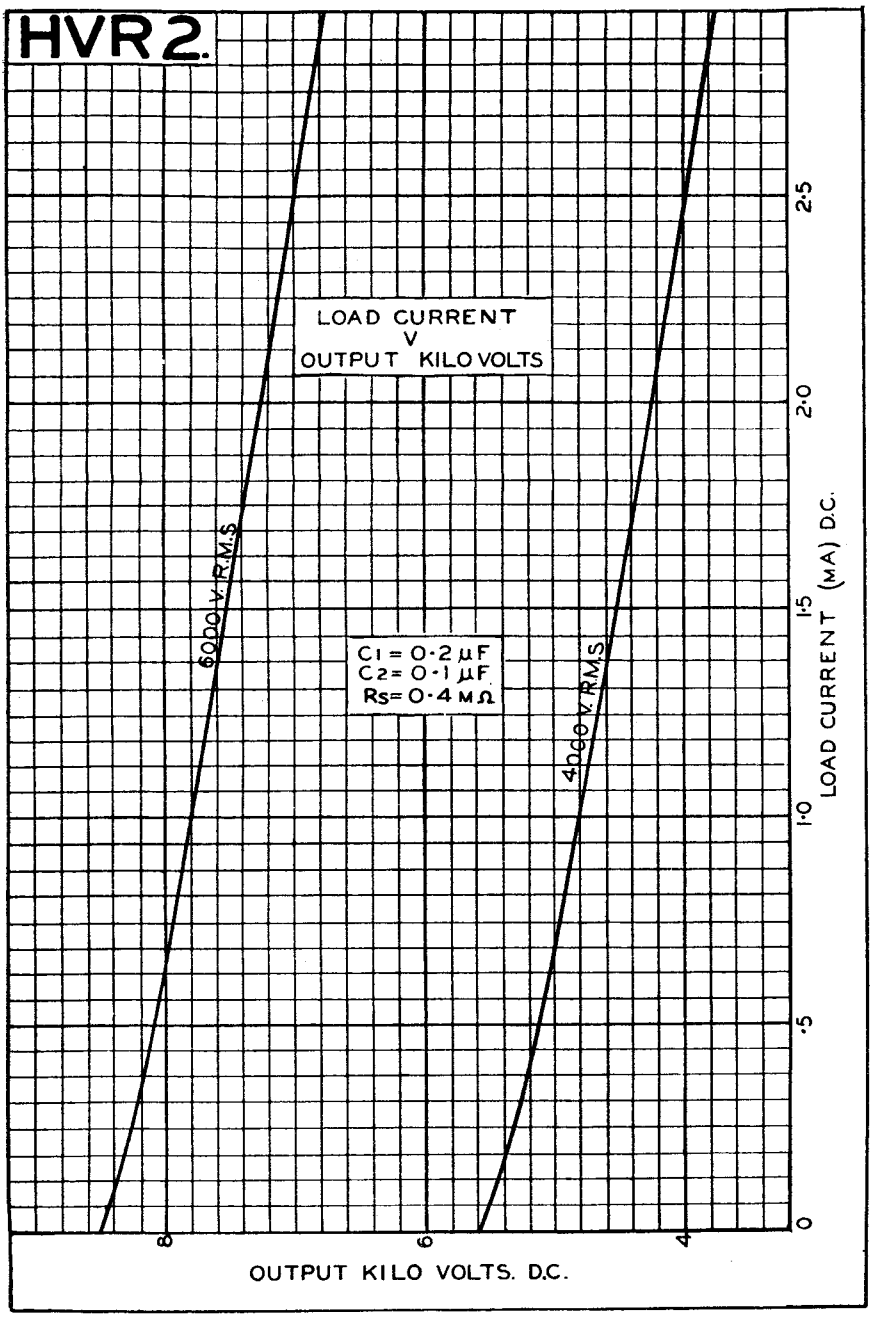
A typical method of operating is shown below, the constants on the curves refer to this circuit.



HVR2

Mullard

HIGH VOLTAGE RECTIFIER



FULL WAVE RECTIFIER

IW4-500

Indirectly-heated power rectifier for outputs up to 500V at 125mA.

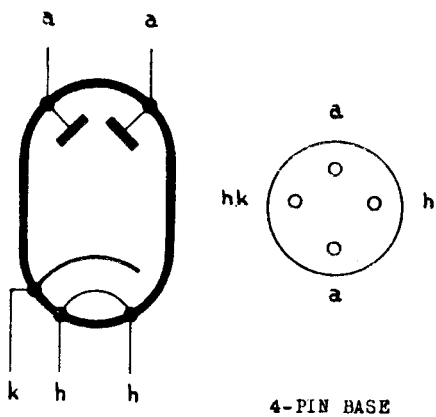
HEATER

V_h	4.0	V
I_h	2.5	A

LIMITING VALUES

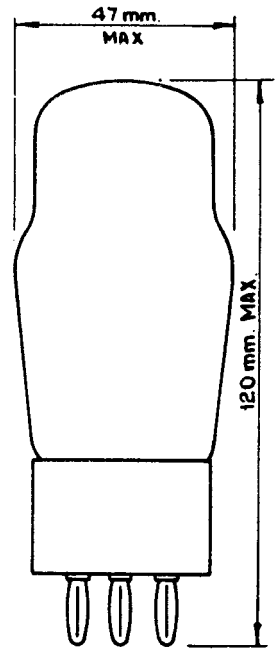
V_a max.	2x500	V.rms
I_{out} max.	120	mA
Max.reservoir capacitance	16	µF
Min.limiting resistance (per anode).	150	Ω

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS.



4-PIN BASE

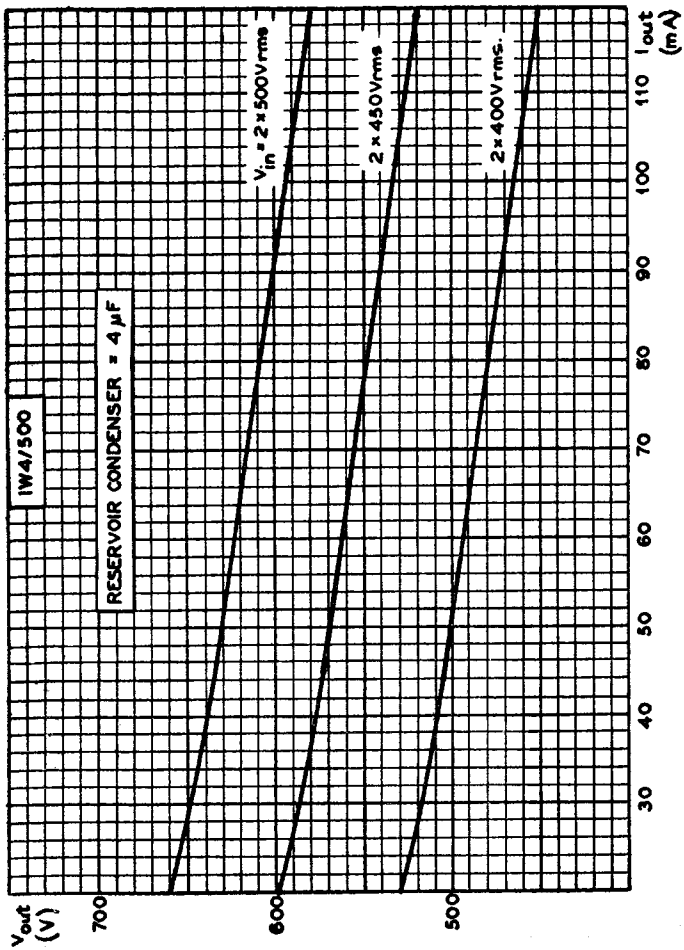
DIMENSIONS



IW4-500

FULL WAVE RECTIFIER

Indirectly-heated power rectifier for outputs up to 500V at 125mA.



Mullard

MAGNETRON

JP8-02B

PRELIMINARY DATA

QUICK REFERENCE DATA

Forced-air cooled fixed frequency 'X' band pulsed magnetron. with high duty ratio. Suitable for airborne doppler navigation equipment.

Frequency	8.80	Gc/s
Power output (pulsed)	25	W
Construction		Packaged

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

CHARACTERISTICS

	Min.		*Max.*	
Frequency				
Fixed within the band	8.77	to	8.83	Gc/s
Pulse voltage (I_{pulse} = 150mA)	750		850	V
R.F. pulse power output (I_{pulse} = 150mA)	17		—	W
Frequency pulling factor (v.s.w.r. = 1.5)	—		15	Mc/s
Frequency pushing factor	—		0.125	Mc/s per mA
Frequency temperature coefficient	—		−0.25	Mc/s per °C
Input capacitance	—		9.0	pF

CATHODE

Indirectly heated

V_h	6.3	V
I_h	1.2	A

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

TYPICAL OPERATION

Heater voltage (running)	5.5	4.5	V
Pulse duration	4.0	4.0	μs
Pulse repetition frequency	100,000	100,000	p/s
Duty cycle	0.2	0.4	
Pulse current	150	150	mA
Pulse voltage	800	800	V
R.F. pulse output power	25	25	W
Mean input current	60	60	mA
Mean input power	48	48	W
Mean r.f. output power	10	10	W
Frequency pulling factor (v.s.w.r. = 1.5)	12	12	Mc/s
Rate of rise of pulse voltage	4.0	4.0	kV/μs

JP8-02B

MAGNETRON

COOLING

It is necessary to direct a flow of cooling air between the radiator fins, in order to keep the temperature below the permitted maximum.

ABSOLUTE MAXIMUM RATINGS

	Min.	*Max.*	
Pulse current	110	180	mA
Pulse duration	—	5.0	μs
Duty cycle	—	0.5	
Mean input power	—	60	W
Rate of rise of voltage pulse	—	5.0	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	140	°C

END OF LIFE PERFORMANCE

R.F. pulse power output (I_{pulse} = 150mA) 15 W

	Min.		*Max.*	
Frequency				
Within the band	8.77	to	8.83	Gc/s
Pulse voltage (I_{pulse} = 150mA)	750		850	V

MOUNTING POSITION

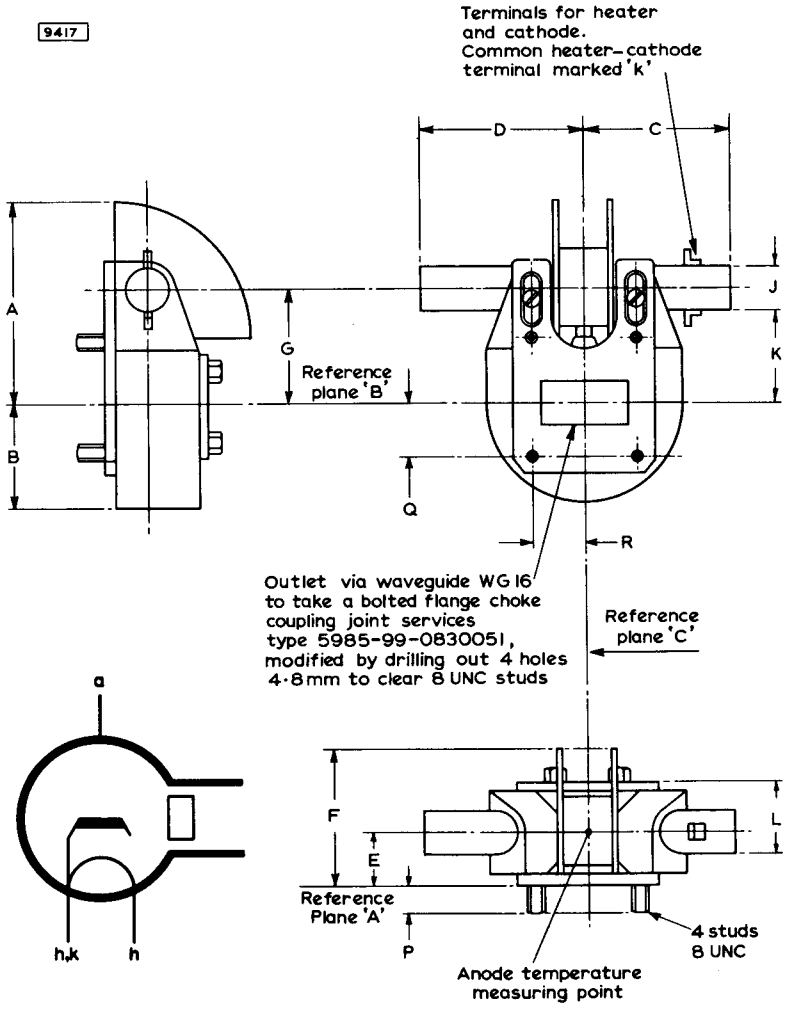
Any

PHYSICAL DATA

Weight of magnetron	1.0	lb
	454	g
Weight of magnetron in carton	2 lb 4 oz	
	1.02	kg
Dimensions of storage carton	5.0 × 7.25 × 7.25	in
	127 × 184 × 184	mm

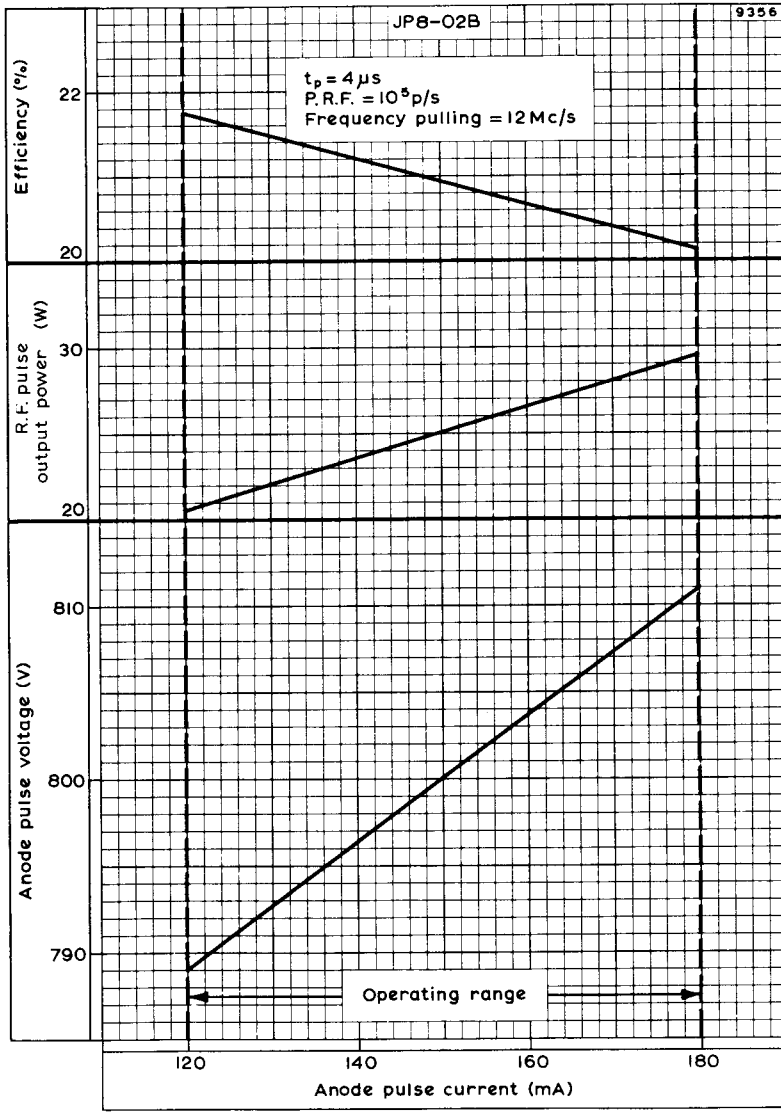
DIMENSIONS

	Inches	Millimetres	
A	2.36	60	max
B	1.26	32	max
C	1.73	44	max
D	1.73	44	max
E	1.53 ± 0.02	13.5 ± 0.5	
F	1.77	45	max
G	1.22 ± 0.08	31 ± 2	
J	0.51	13	max
K	1.14	29	max
L	0.79	20	max
P	0.32 ± 0.04	8 ± 1	
Q	0.64	16.2	
R	0.61	15.5	



ANODE CONNECTION IS TERMINATED AT THE BASE PLATE

JP8-02B



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT

DOUBLE-RESONATOR KLYSTRON

KB9-150W

Frequency: *'X' band, mechanically tunable.*
Power output: *180W min at 10Gc/s.*
Construction: *Double resonator, water-cooled.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES which precede this section of the handbook.

FREQUENCY RANGE

8.6 to 10 Gc/s

Mechanical tuning is effected by two calibrated controls.

CATHODE

Indirectly heated

V_h	6.3	V
I_h	800	mA

Heating time. The heater voltage should be applied at least 3 minutes before the application of h.t. voltage.

MOUNTING POSITION

Any

Two 2BA holes are provided in the resonator block to facilitate mounting and to prevent the whole weight of the valve being placed on the waveguide flange.

COOLING

Maximum temperature of outlet water	40	°C

Two water jackets are used, one surrounding the two resonators, the other the collector. When the two jackets are connected in series to a common water supply the inlet must be on the collector side. Rate of flow should be $>$1/2 gal/min and $<$1 gal/min.

LIMITING VALUES (absolute ratings)

Maximum collector and resonators voltage	10	kV
Maximum collector and resonators dissipation	2.0	kW
Maximum collector current	250	mA
Maximum negative grid voltage	250	V
Maximum positive grid voltage	20	V
Maximum standing wave ratio	1.5	

KB9-150W

DOUBLE-RESONATOR KLYSTRON

TYPICAL OPERATION

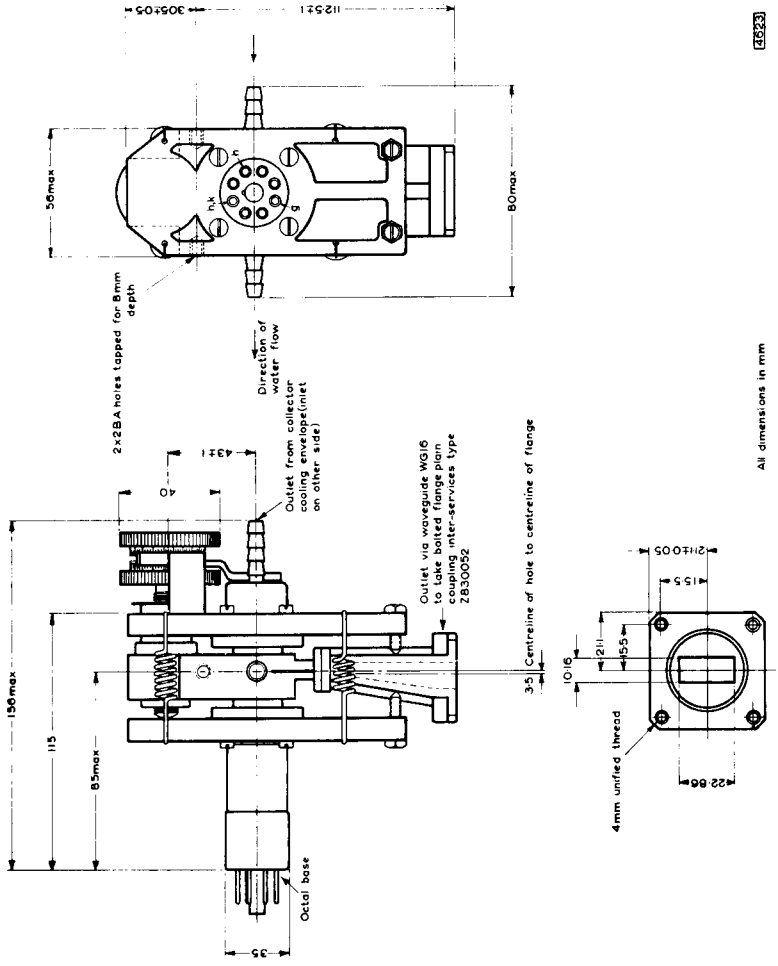
Principal Mode (Mode A)				
Frequency	8.6	9.3	10	Gc/s
Resonators/collector voltage	5.5	7.3	9.2	kV
Grid Voltage	−50	−50	−50	V
Collector current	96	145	200	mA
Power input	0.53	1.1	1.8	kW
Resonators/collector dissipation	0.488	0.958	1.63	kW
Average power output	40	100	210	W
Power output	>30	>80	>180	W
Mode B				
Frequency			9.3	Gc/s
Resonators/collector voltage			4.3	kV
Grid voltage			−50	V
Collector current			65	mA
Power input			280	W
Resonators/collector dissipation			262	W
Power output			>18	W

OPERATING NOTES

1. To ensure good frequency and amplitude stability the resonators and collector voltages should be taken from a stabilised supply; the voltage variation should not exceed ±10V (i.e. approximately 0.1%) if a frequency stability of 1 : 100,000 is to be maintained.
2. For the safety of personnel it is advisable to operate with the positive pole of the h.t. supply earthed.
3. For mobile applications anti-vibration mounting is recommended, to avoid undesirable amplitude or phase modulation.
4. The tube must be shielded from strong external magnetic fields.
5. The number of mechanical tuning operations extending below about 9Gc/s or above 9.5Gc/s should be limited to 100, to avoid damage to the flexible diaphragm; between these frequencies there need be no limitations.

WEIGHT

Valve only	5 lb 3 oz 2.35 kg
Shipping weight	9 lb 11 oz 4.4 kg
Dimensions of packing	197 × 203 × 248 mm 7.75 × 8.0 × 9.75 in


4623
All dimensions in mm
58max
80max
2x28A holes tapped for 8mm depth
Direction of water flow
Outlet from collector cooling envelope(inlet on other side)
Outlet via waveguide WG16 to take bolted flange plain coupling inter-services type 2830052
Centreline of hole to centreline of flange
150max
115
85max
Octal base
35
4mm unified thread
22·86

KLYSTRON

Frequency: *7Gc/s. band. Mechanical tuning.*
Power output: *50mW minimum.*
Construction: *All metal, coaxial output probe.*
Application: *Local oscillator, signal generator.*

KS7-85

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and REFLEX KLYSTRONS which precede this section of the handbook.

CHARACTERISTICS

	Min.	*Max.*	
Mechanical tuning range	6.5	7.5	Gc/s
Electronic tuning range, between half power points at any frequency in the mechanical tuning range	25	—	Mc/s
Power output at 7Gc/s ± 20Mc/s (principal mode)	85	—	mW
Power output at any other frequency in the band	50	—	mW
Reflector voltage for maximum power output at 7Gc/s ± 20Mc/s	−100	−175	V
Reflector voltage range, inclusive of electronic tuning range	−60	−215	V
Frequency change with temperature	—	500	kc/s per °C

CATHODE

Indirectly heated

V_h	6.3	V
I_h	500	mA

OPERATING CONDITIONS IN SPECIFIED MOUNT

f	7.0	Gc/s
$V_{resonator}$	300	V
$I_{resonator}$	24	mA
$V_{reflector}$	−140	V
$I_{reflector}$	1.0	μA
Electronic tuning range between half power points	38	Mc/s
P_{out}	100	mW

COOLING

Natural

ABSOLUTE RATINGS

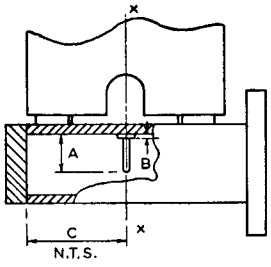
$V_{resonator}$ max.	350	V
$I_{resonator}$ max.	37	mA
$V_{reflector}$ max.	−1.0 to −400	V
V_{h-k} max.	−150	V
$T_{amb\ (shell)}$ max.	110	°C
$T_{coaxial\ line}$ max.	90	°C

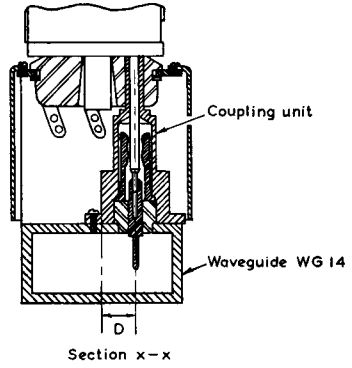
OPERATING NOTE

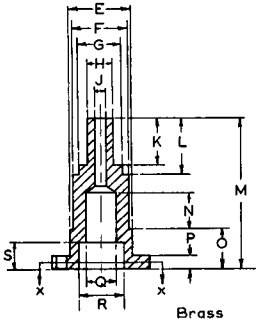
The prescribed tuning range is covered by five turns of the mechanical tuning screw.

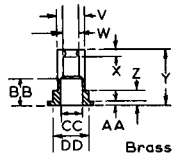
	Inches	*Millimetres*
A	0.370±0.005	9.398±0.127
B	0.045	1.143
C	0.315	8.001
D	0.333	8.458
E	0.5625	14.287
F	0.5	12.7
G	0.390	9.90
H	0.25	6.350
J	0.145	3.683
K	0.475	12.065
L	0.568	14.427
M	1.5	38.1
N	0.5	12.7
O	0.375	9.525
P	0.125	3.175
Q	0.314	7.976
R	0.468	11.887
S	0.250	6.350
T	0.375	9.525
U	1.000	25.4
V	0.281	7.137
W	0.15	3.81
X	0.1	2.54
Y	0.53	13.462
Z	0.125	3.175
AA	0.020	0.508
BB	0.250	6.350
CC	0.250	6.350
DD	0.312	7.925
EE	0.136	3.454
FF	0.015×0.313	0.381×7.950
GG	0.438	11.131
HH	0.468	11.887
JJ	0.230	5.842
KK	0.292	7.417
LL	0.062	1.575
MM	0.375	9.525
NN	0.088	2.235
OO	0.750	19.05
PP	0.325	8.255
QQ	0.040	1.016
RR	0.040×0.186	1.016×4.724
SS	0.010×0.180	0.254×4.572
TT	0.095	2.413

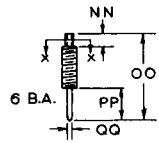
6308

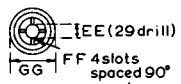

x
A
B
C
N.T.S.
x

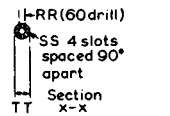

Coupling unit
Waveguide WG 14
D
Section x–x

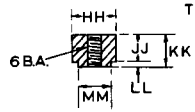

E
F
G
H
J
K
L
M
N
P
Q
R
S
x
x
Brass

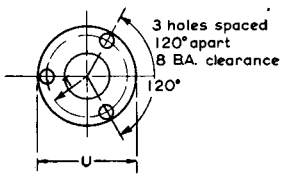

V
W
X
Z
Y
BB
CC
AA
DD
Brass

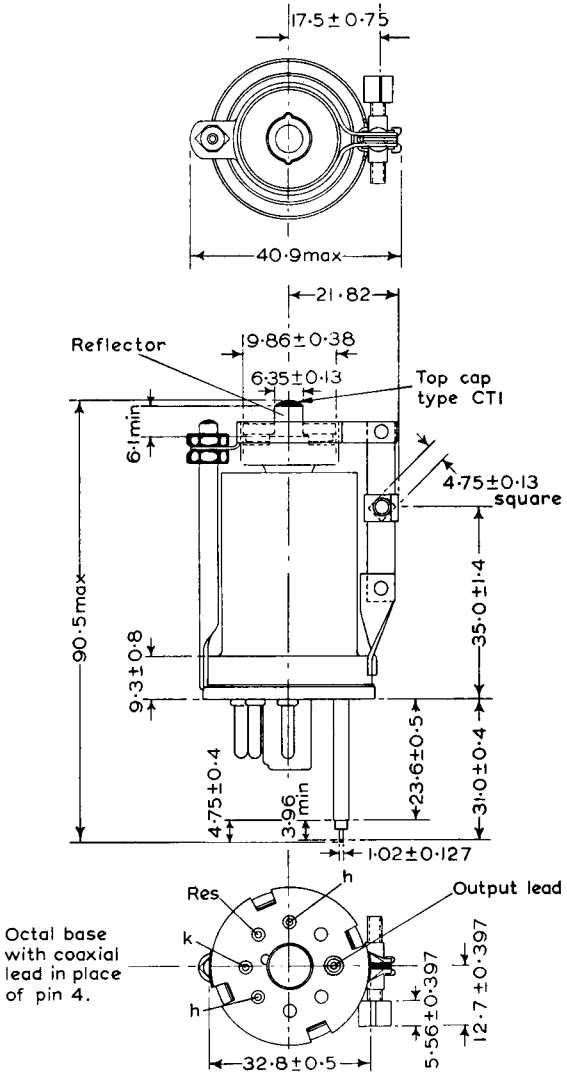

NN
X
X
OO
6 B.A.
PP
QQ


EE(29drill)
FF 4slots spaced 90° apart.
GG


RR(60drill)
SS 4 slots spaced 90° apart
Section x–x
TT


HH
6B.A.
JJ
KK
MM
LL
Polystyrene


3 holes spaced 120° apart 8 BA. clearance
120°
U



6331

All dimensions in mm

FORWARD WAVE AMPLIFIER

LA9-3

Application: *Broadband low power amplifier.*
Frequency: *'X' band.*
Construction: *Unpackaged.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and FORWARD WAVE AMPLIFIERS which precede this section of the handbook.

CHARACTERISTICS

	Min.		*Max.*	
Frequency band	7.0	to	11.5	Gc/s
Gain (low power level)—over frequency band	20		—	dB
*Noise factor	—		25	dB
Saturation power output	4.0		—	mW
Attenuation (at I_k = 0mA)	40		—	dB
Input match in recommended mount —broadband (v.s.w.r.)	—		3.5	
Output match in recommended mount —broadband (v.s.w.r.)	—		3.5	

CATHODE

Indirectly heated

V_h	6.3	V
I_h	500	mA
t_{hk}	5.0	min

TYPICAL OPERATION

As an input amplifier using a periodic permanent magnet system of approved design.

f	9.0	Gc/s
$V_{collector}$	1.4	kV
V_{helix}	1.3	kV
V_{g3}	135	V
V_{g2}	155	V
V_{g1}	–85	V
$I_{collector}$	550	μA
Gain	30	dB
*Noise factor	20	dB
Power output	50	μW
Input match in recommended mount (v.s.w.r.)	3.0	
Output match in recommended mount (v.s.w.r.)	3.0	

*Using a solenoid of approved design, up to 5dB improvement in noise factor can be obtained.

MAINTENANCE TYPE

LA9-3

FORWARD WAVE AMPLIFIER

ABSOLUTE MAXIMUM RATINGS

$V_{collector}$ max.	1.55	kV
$I_{collector}$ max.	600	μA
$p_{collector}$ max.	900	mW
V_{helix} max.	1.45	kV
I_{helix} max.	50	μA
V_{g3} max.	400	V
I_{g3} max.	10	μA
V_{g2} max.	200	V
I_{g2} max.	10	μA
$-V_{g1}$ max.	100	V
I_{g1} max.	10	μA
$P_{in(signal)}$ max.	500	mW
V_{h-k} max.	50	V

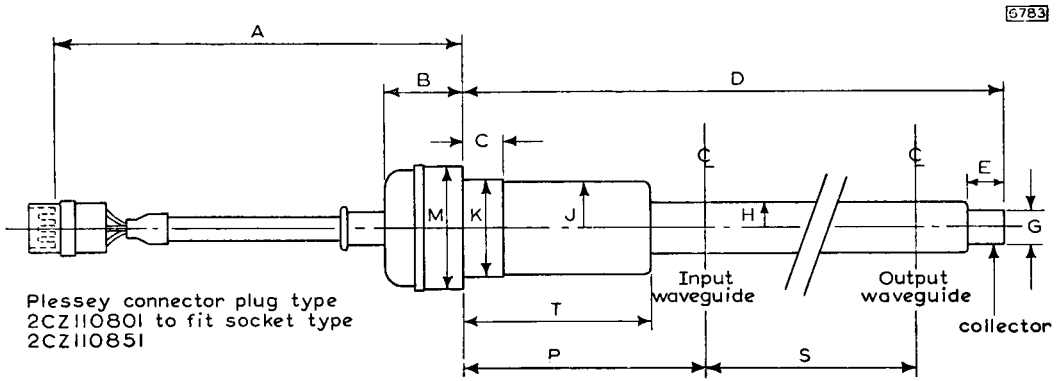
MOUNTING POSITION

Any

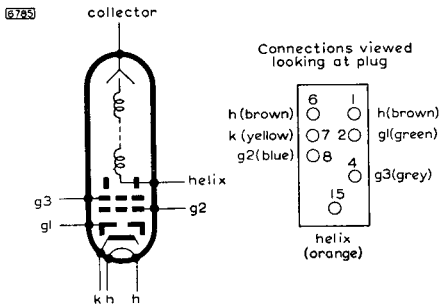
ACCESSORIES

Mount	Permanent magnet	P9L-1
	Solenoid	S9L-1

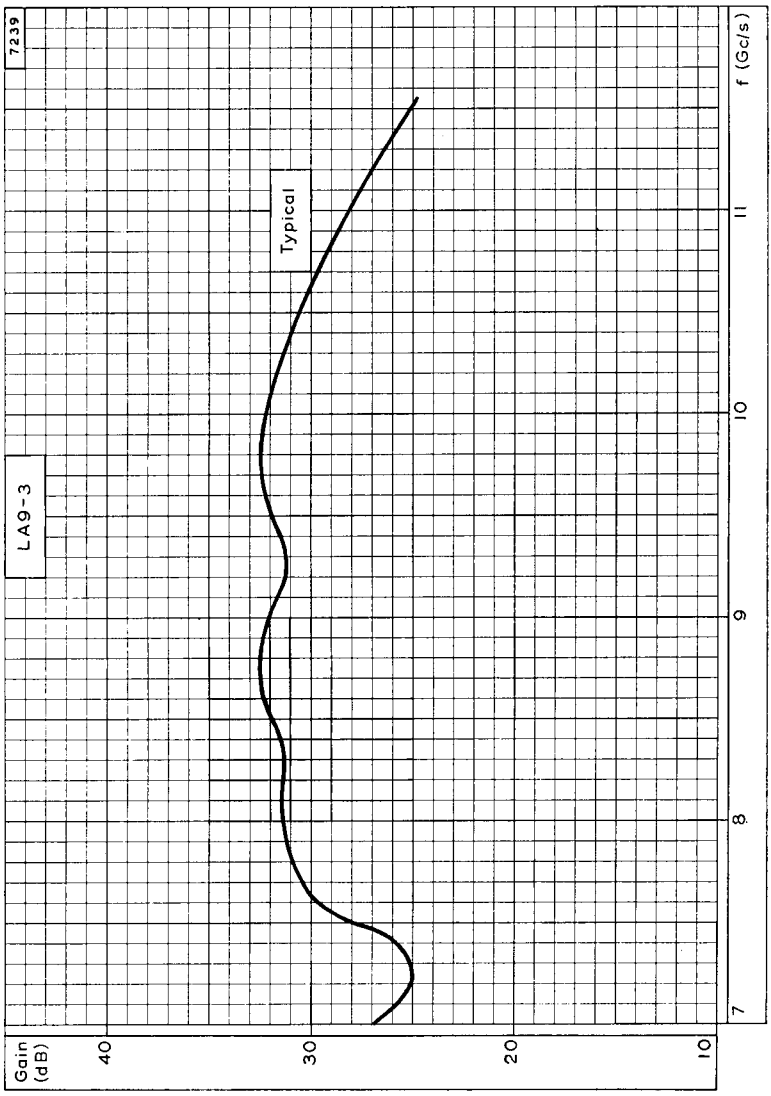
LA9-3



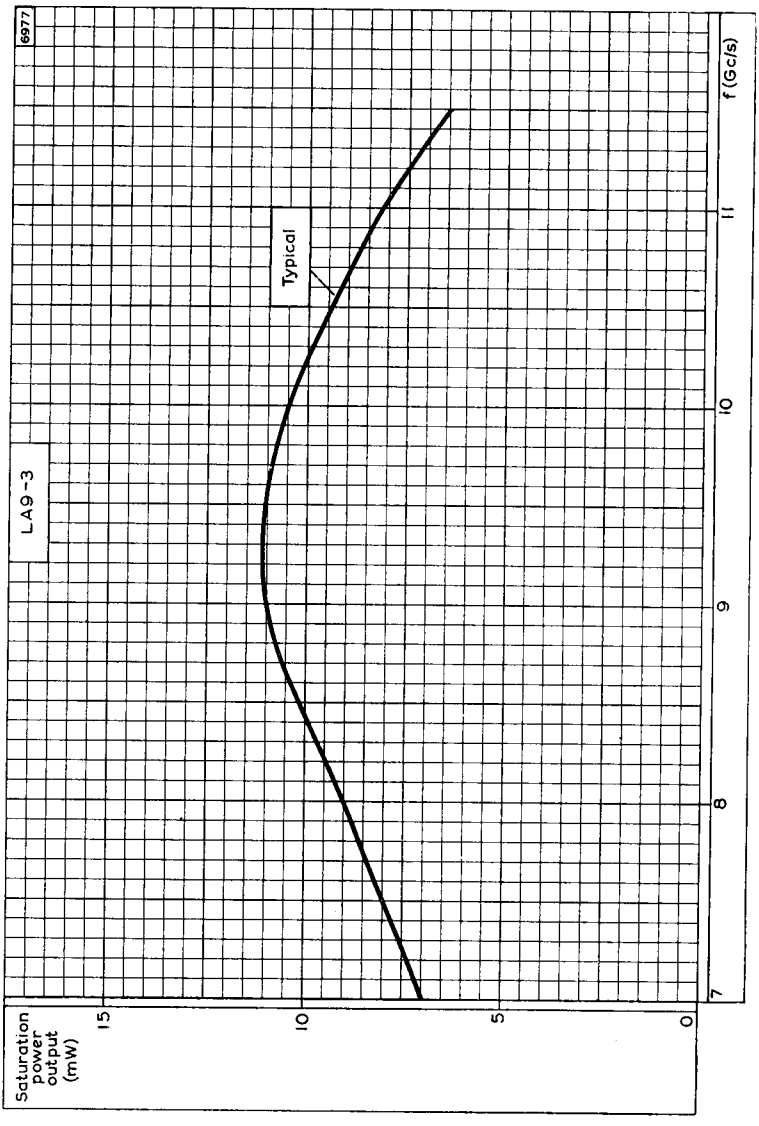
Waveguide dimensions 0.900×0.079 inches, 22.86×2.00 millimetres



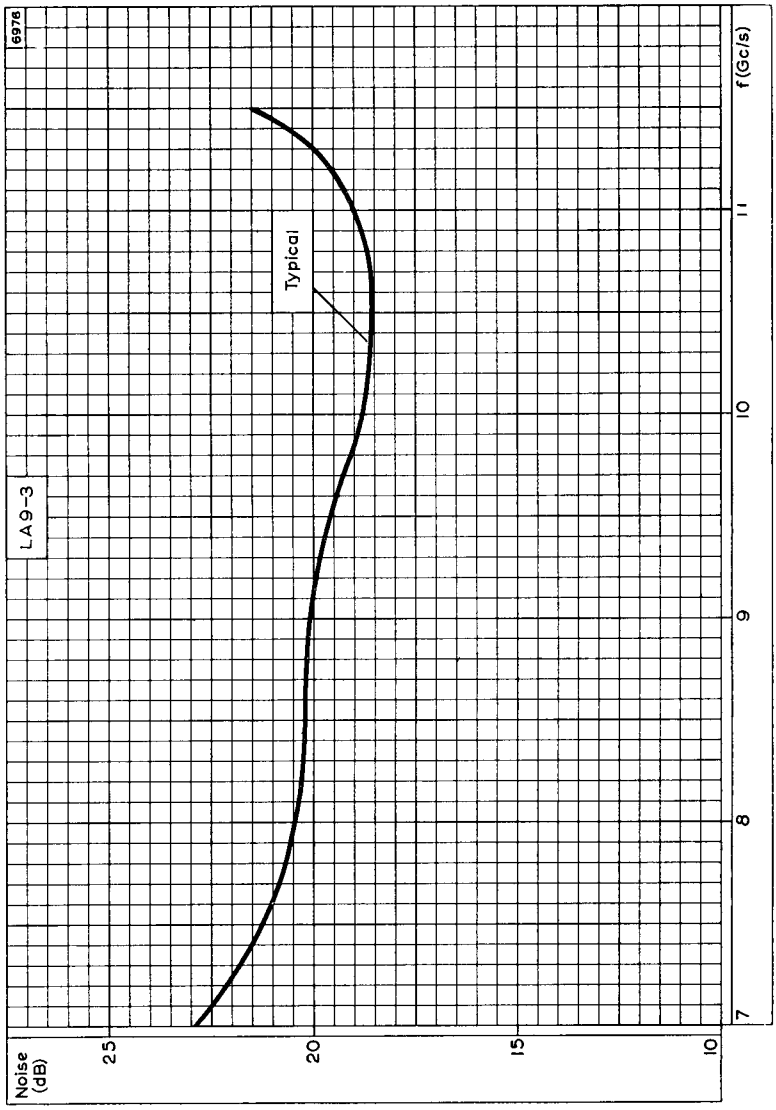
	Inches	*Millimetres*	
A	4.331	110	min.
B	1.299	33	max.
C	0.650	16.5	max.
D	12.638	316	max.
E	0.394	10	
G	0.167 ± 0.002	5.0 ± 0.05	
H	0.125	3.17	max.
J	0.472	12	max.
K	1.063	27	max.
M	1.260	32	max.
P	2.835 ± 0.008	72 ± 0.2	
S	8.150 ± 0.004	207 ± 0.1	
T	2.126	54	max.



TYPICAL GAIN PLOTTED AGAINST FREQUENCY



SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



TYPICAL NOISE FACTOR PLOTTED AGAINST FREQUENCY USING A PERMANENT-MAGNET MOUNT

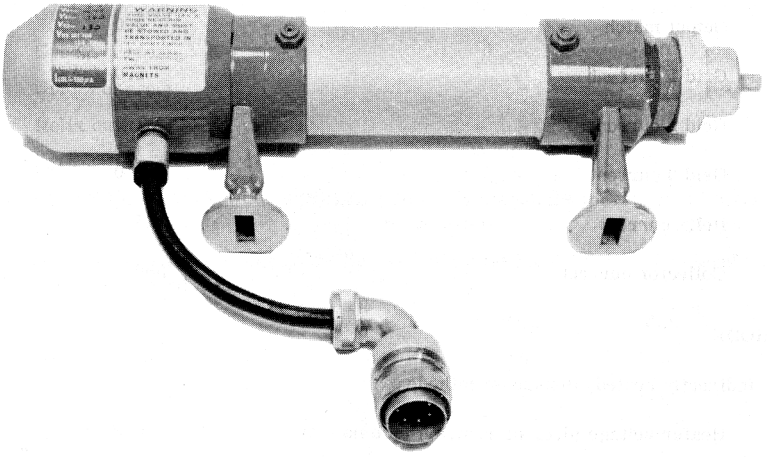
RADAR
TRAVELLING-WAVE TUBE

LA9-3B

QUICK REFERENCE DATA		
Forward wave amplifier for general purpose use.		
Frequency range	7.0 to 11.5	GHz
Power output	10	mW
Gain	30	dB
Construction		Packaged
Output connections		Waveguide WR90

Services type: **CV6087**

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



TYPICAL OPERATION

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	-100	V
Grid 2 voltage	150	V
Grid 3 voltage	100	V
Helix voltage	1.3	kV
Collector voltage	1.4	kV
Operating frequency	9.0	GHz

Typical performance

Gain	30	dB
Power output (saturated)	10	mW
Power output (working)	50	μW
Noise factor	22	dB
Input match	2.0	
Output match	2.0	
Grid 1 current	1.0	μA
Grid 2 current	1.0	μA
Grid 3 current	1.0	μA
Helix current	15	μA
Collector current	550	μA

CATHODE

Indirectly heated, dispenser cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.5 to 0.7	A
Pre-heating time (minimum) (see note 2)	500	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
Grid 1 voltage	-100	V
*Grid 2 voltage range	0 to 250	V
*Grid 3 voltage range	0 to 400	V
*Helix voltage range	1.15 to 1.45	kV
Collector voltage	helix voltage +100V	
Collector current	550	μA
Frequency range (see note 3)	7.0 to 11.5	GHz

*Specified on data sheet enclosed with tube.

Limits and characteristics

	Min.	Max.	
Gain	20	35	dB
Noise factor	-	24	dB
Power output	3.0	-	mW
Grid 1 current	-	10	μA
Grid 2 current	-	10	μA
Grid 3 current	-	10	μA
Helix current	-	50	μA
Attenuation (see note 4)			

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

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

	Min.	Max.	
Grid 1 voltage	-200	0	V
Grid 2 voltage	-	450	V
Grid 3 voltage	-	450	V
Helix voltage	-	1.6	kV
Helix current	-	100	μA
Collector voltage	-	1.7	kV
Collector current	-	600	μA

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage	-100	-70	V
Grid 1 current	-	10	μA
Grid 2 voltage	0	200	V
Grid 2 current	-	10	μA
Grid 3 voltage	0	250	V
Grid 3 current	-	10	μA
Helix voltage	1.15	1.45	kV
Helix current	-	60	μA
Collector voltage (see note 5)			
Collector current	-	550	μA

MOUNTING POSITION

Any. The barrel of the mount must be protected from strong magnetic fields such as from isolators and should be several centimetres from steel plates.

COOLING

Horizontally or vertically mounted — natural

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification	-10	+65	^{o}C

PHYSICAL DATA

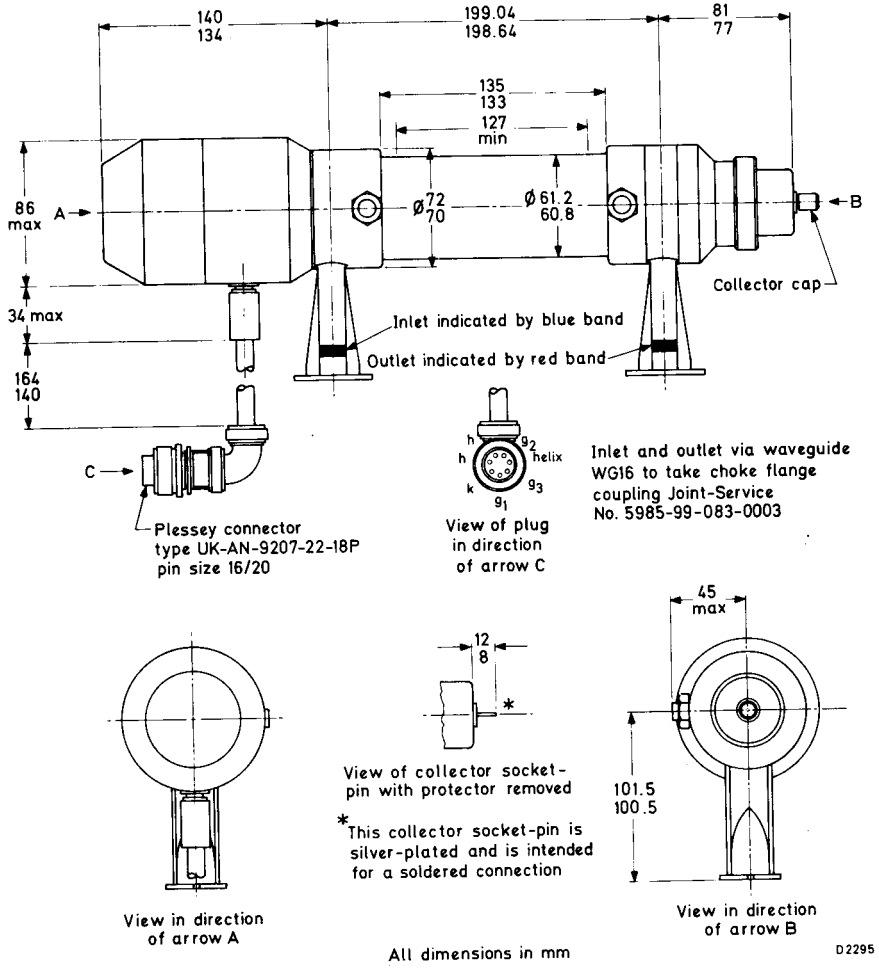
Packaged tube

	kg	lb
Weight	3.4	7.5
Weight in inner storage pack	3.9	8.5
Weight in transit carton (1 tube per carton)	58.5	129
	mm	in
Dimensions of inner storage pack	525 × 232 × 243	20.7 × 9.2 × 9.6
Dimensions of transit carton	900 × 560 × 600	35.4 × 22.3 × 23.5

NOTES

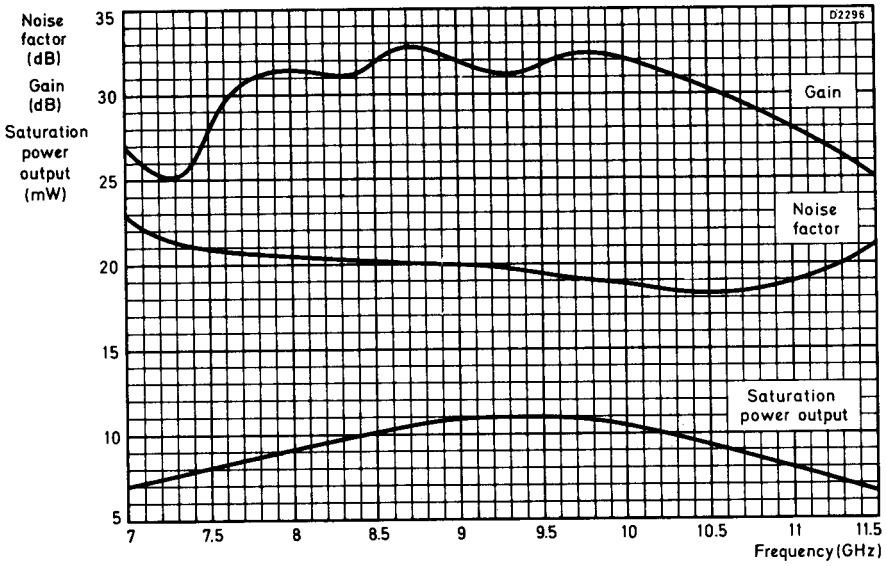
1. The absolute variation of heater voltage should be less than ±5%. When operated on d.c. the heater must be negative with respect to cathode.
2. The pre-heating time for a new tube must be at least 10 minutes.
3. The tube is tested at the centre and the extremes of the frequency range.
4. With electrode voltages not applied minimum attenuation is 40dB.
5. The collector voltage must be 100V greater than helix voltage. A stabilised supply is unnecessary.

OUTLINE DRAWING OF LA9-3B



CONVERSION TABLE
(Rounded outwards)

mm	in
12/8	0.472/0.315
34 max.	1.34 max.
45 max.	1.77 max.
Ø61.2/60.8	Ø2.409/2.394
Ø72/70	Ø2.835/2.756
81/77	3.189/3.031
86 max.	3.39 max.
101.5/100.5	3.996/3.957
127 min.	5.00 min.
135/133	5.315/5.236
140/134	5.512/5.276
164/140	6.456/5.512
199.04/198.64	7.836/7.820



TYPICAL SATURATION POWER OUTPUT, GAIN AND NOISE FACTOR PLOTTED AGAINST FREQUENCY

FORWARD WAVE AMPLIFIER

LA16-2

Application: *Low power amplifier, broadband.*
Frequency: *'J' band.*
Construction: *Unpackaged.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and FORWARD WAVE AMPLIFIERS which precede this section of the handbook.

CHARACTERISTICS

	Min.	*Max.*	
Frequency band	11.5	18	Gc/s
Gain (low power level)—over frequency band	20	—	dB
*Noise factor	—	28	dB
Saturation power output	1.0	—	mW
Attenuation (at I_k = 0mA)	40	—	dB

CATHODE

Indirectly heated

V_h	8.5	V
I_h	400	mA

TYPICAL OPERATION

As an input amplifier using a periodic permanent magnet system of approved design.

f	15	Gc/s
$V_{collector}$	1.7	kV
V_{helix}	1.6	kV
V_{g3}	150	V
V_{g2}	350	V
V_{g1}	–120	V
$I_{collector}$	450	μA
Gain	32	dB
*Noise factor	23	dB
Power output	10	μW

*Using a solenoid of approved design, up to 6dB improvement in noise factor can be obtained.

MAINTENANCE TYPE

LA16-2 FORWARD WAVE AMPLIFIER

ABSOLUTE MAXIMUM RATINGS

$V_{collector}$ max.	1.85	kV
$I_{collector}$ max.	500	μA
$p_{collector}$ max.	800	mW
V_{helix} max.	1.75	kV
I_{helix} max.	60	μA
V_{g3} max.	200	V
I_{g3} max.	20	μA
V_{g2} max.	450	V
I_{g2} max.	20	μA
$-V_{g1}$ max.	150	V
I_{g1} max.	10	μA
$P_{in\ (signal)}$ max.	300	mW
V_{h-k} max.	50	V

MOUNTING POSITION

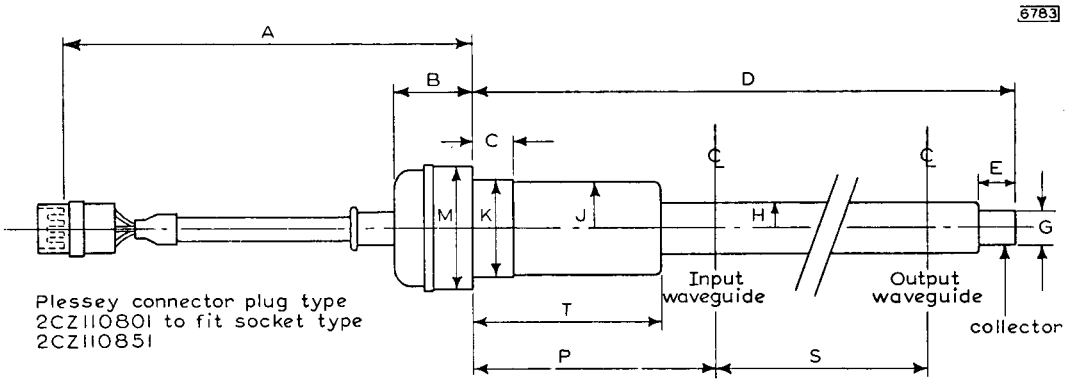
Any

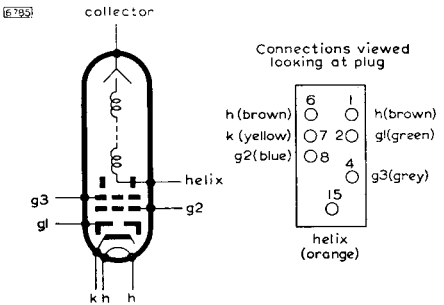
ACCESSORIES

Mount	Permanent magnet	P16L–1
	Solenoid	S16L–1

FORWARD WAVE AMPLIFIER

LA16-2

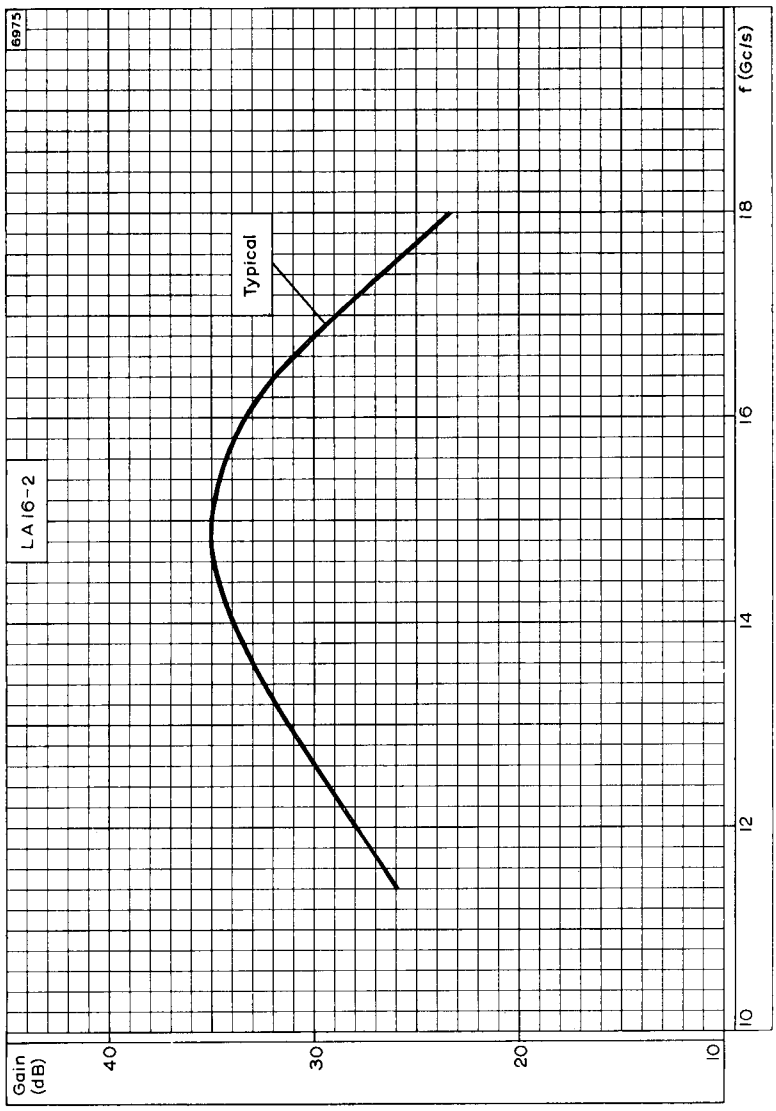




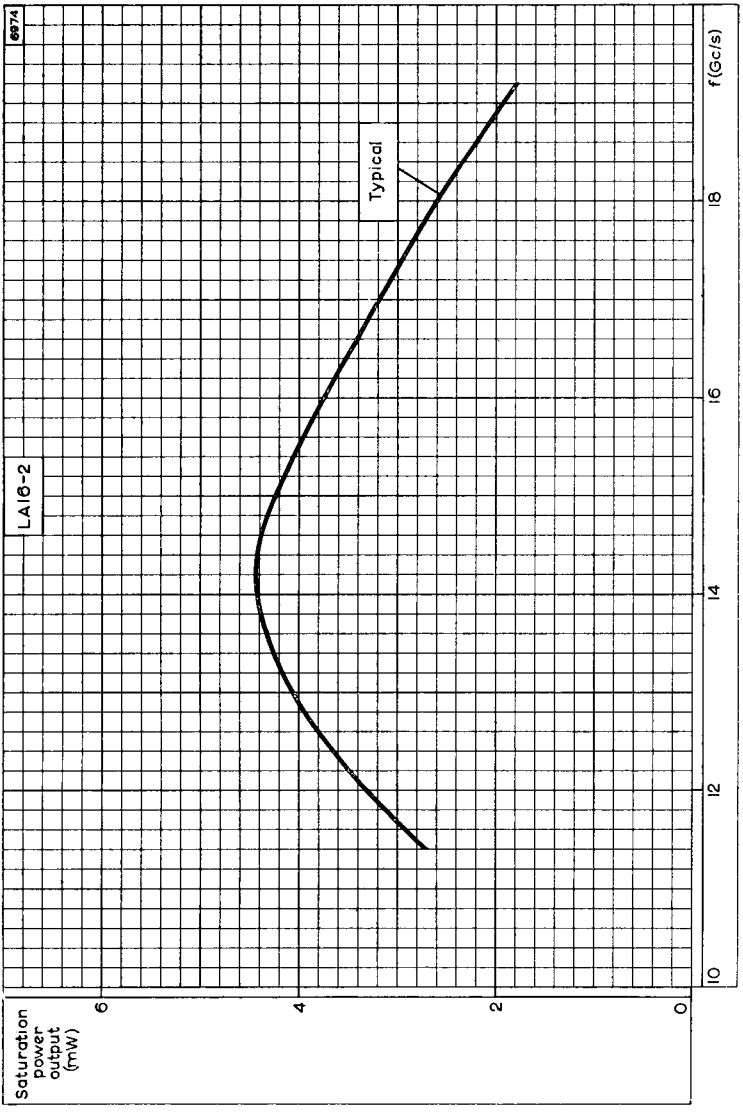
Waveguide dimensions 0.622 × 0.311 in., 15.78 × 7.90 mm.

	Inches	*Millimetres*	
A	4.409 ± 0.197	112 ± 5	
B	1.299	33	max.
C	0.650	16.5	max.
D	12.756 ± 0.118	324 ± 3	
E	0.394	10	min.
G	0.081	2.05	max.
H	0.108	2.75	max.
J	0.5	12.7	max.
K	1.063	27	max.
M	1.259	32	max.
P	2.614 ± 0.008	66.5 ± 0.2	
S	8.130 ± 0.004	206.5 ± 0.1	
T	2.283	58	max.

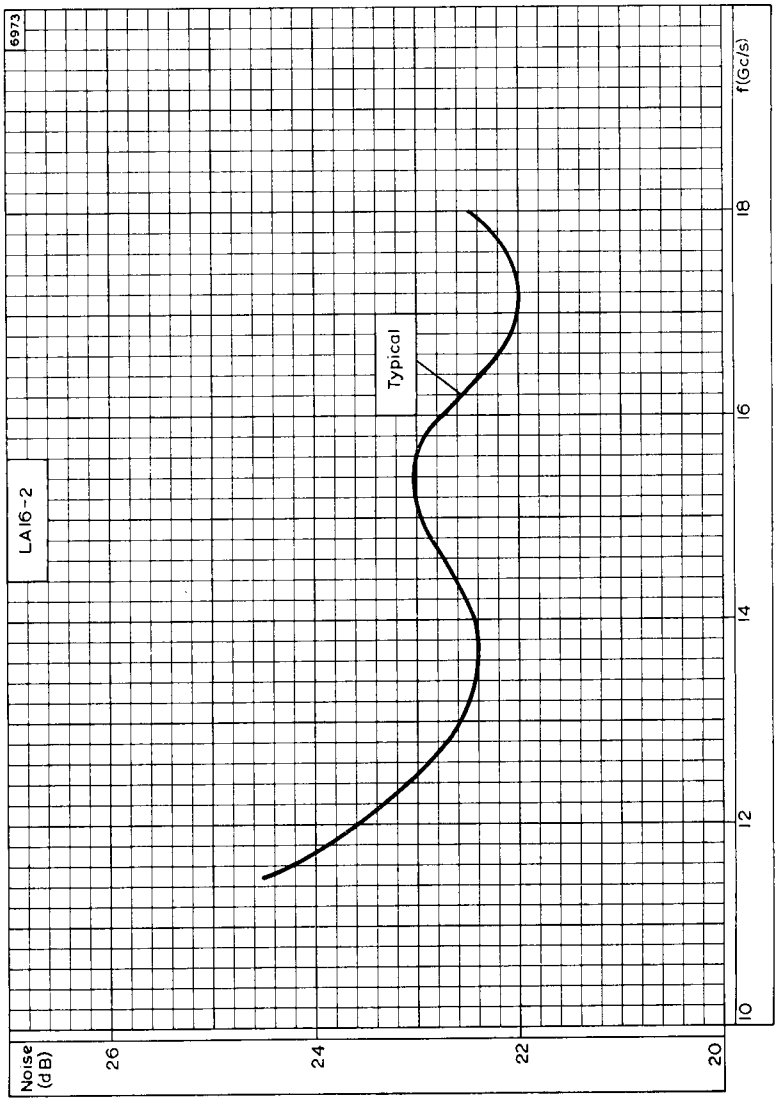
LA16-2



TYPICAL GAIN PLOTTED AGAINST FREQUENCY



SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



TYPICAL NOISE FACTOR PLOTTED AGAINST FREQUENCY USING A PERMANENT-MAGNET MOUNT

FORWARD WAVE AMPLIFIER

LA16-2C

Application: *Low power amplifier, broadband.*
Frequency: *J-band.*
Construction: *Packaged, periodic permanent magnet focussed.*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and FORWARD WAVE AMPLIFIERS which precede this section of the handbook

CHARACTERISTICS

	Min.	*Max.*	
Frequency band	11.5	18	Gc/s
Gain (low power level)—over frequency band	20	—	dB
Noise factor	—	28	dB
Saturation power output	1.0	—	mW
Attenuation (at I_k = 0mA)	40	—	dB

CATHODE

Indirectly heated

V_h	8.5	V
I_h	400	mA

OPERATING CONDITIONS

f	15	Gc/s
$V_{collector}$	1.7	kV
V_{helix}	1.6	kV
V_{g3}	150	V
V_{g2}	350	V
V_{g1}	−120	V
$I_{collector}$	450	μA
Gain	32	dB
Noise factor	23	dB
Power output	10	μW

LA16-2C FORWARD WAVE AMPLIFIER

ABSOLUTE MAXIMUM RATINGS

$V_{collector}$ max.	1.85	kV
$I_{collector}$ max.	500	μA
$P_{collector}$ max.	800	mW
V_{helix} max.	1.75	kV
I_{helix} max.	60	μA
V_{g3} max.	200	V
I_{g3} max.	20	μA
V_{g2} max.	450	V
I_{g2} max.	20	μA
$-V_{g1}$ max.	150	V
I_{g1} max.	10	μA
$P_{in\ (signal)}$ max.	300	mW
V_{h-k} max.	50	V

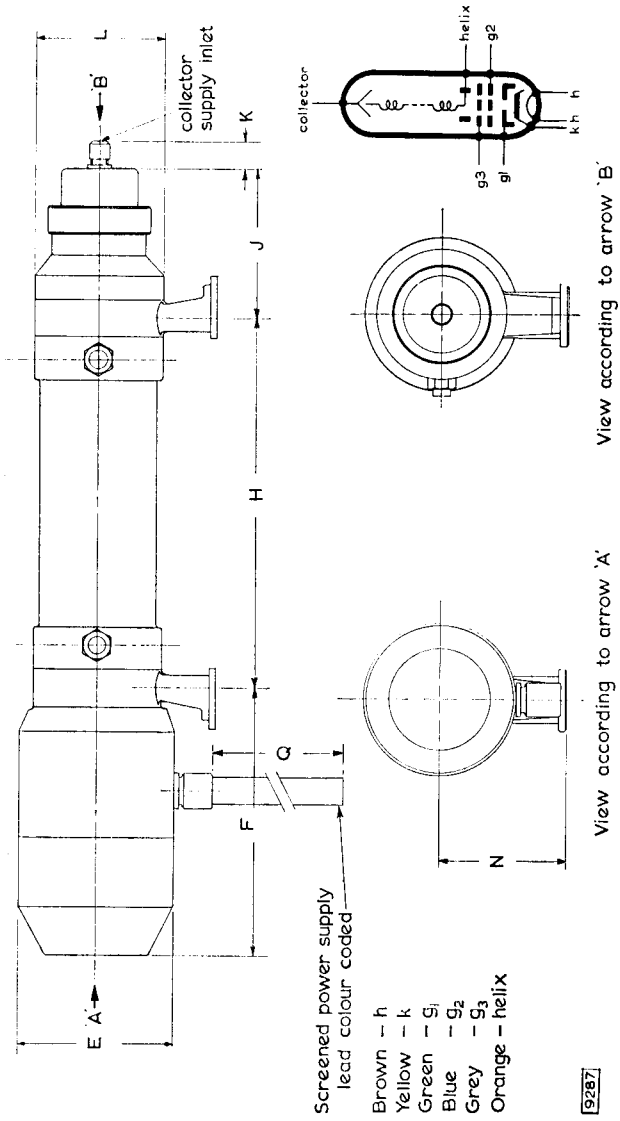
MOUNTING POSITION

Any

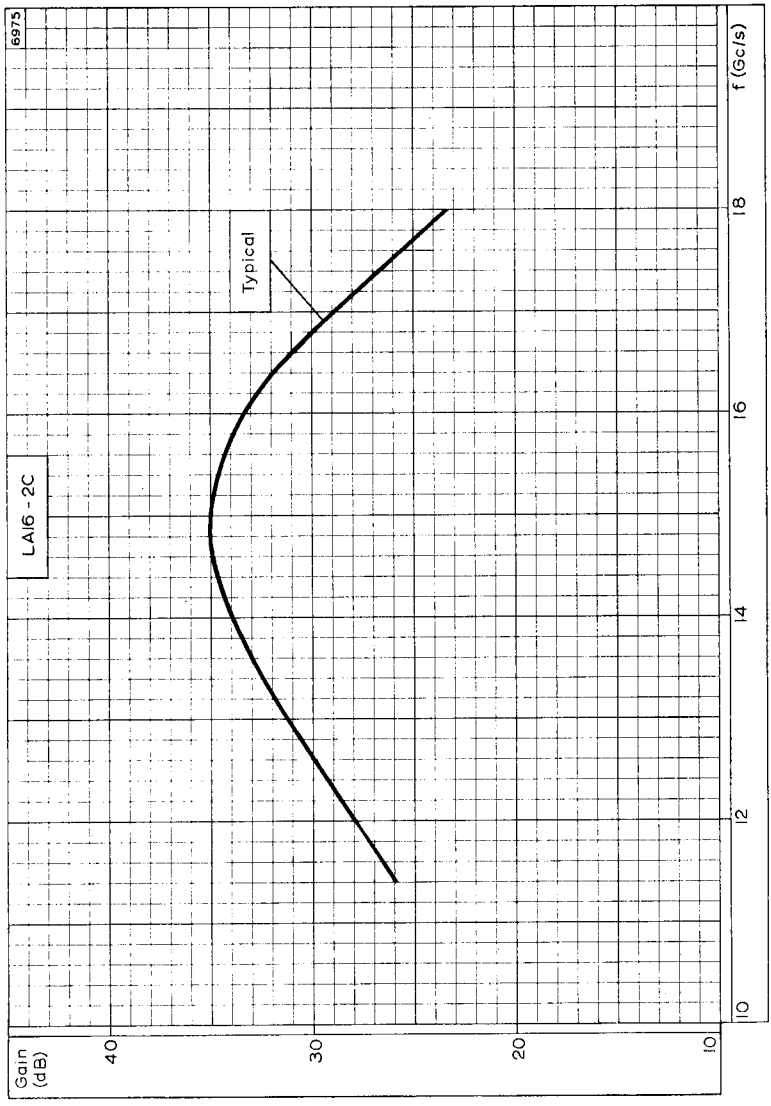
DIMENSIONS

	Inches	*Millimetres*
E	2.39	86 max.
F	5.39 ± 0.12	137 ± 3
H	7.828 ± 0.008	198.84 ± 0.2
J	3.11 ± 0.08	79 ± 2
K	0.47	12
L	2.80	71 dia.
N	3.976 ± 0.020	101 ± 0.5
Q	12	305

LA16-2C


L
B
collector supply inlet
K
J
H
Q
F
E
A
Screened power supply lead colour coded
Brown – h
Yellow – k
Green – g_1
Blue – g_2
Grey – g_3
Orange – helix
collector
helix
g2
h
k
g3
g1
N
View according to arrow 'A'
View according to arrow 'B'
9287

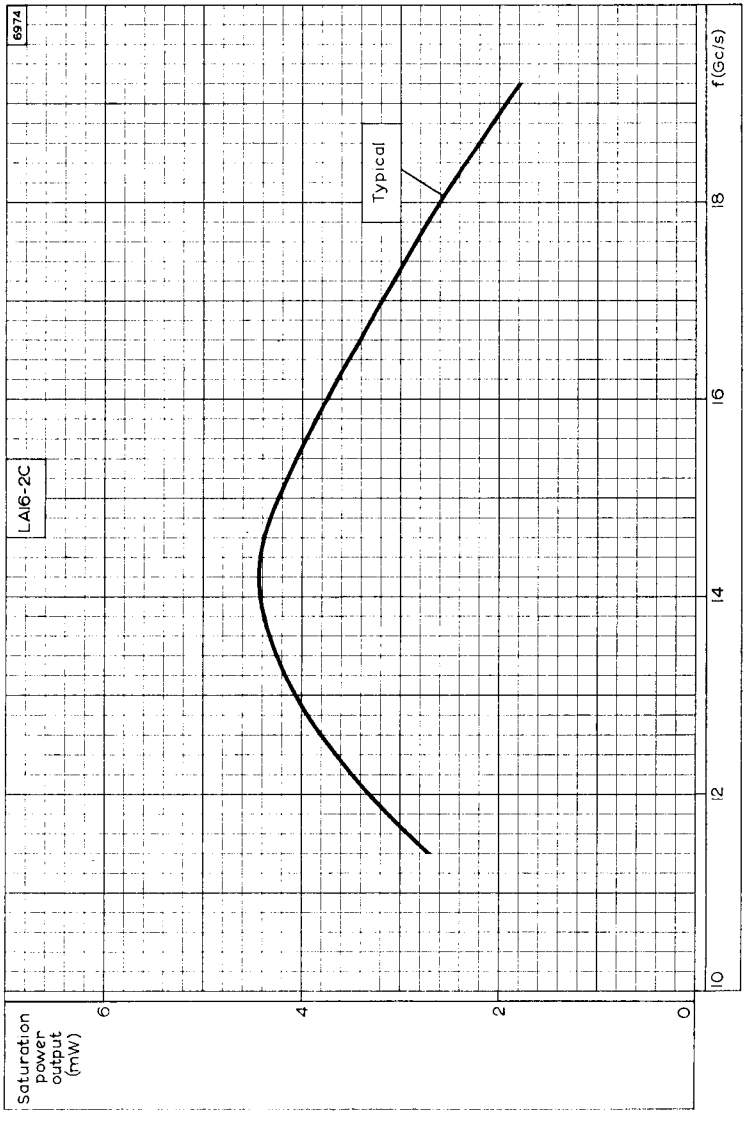
LA16-2C



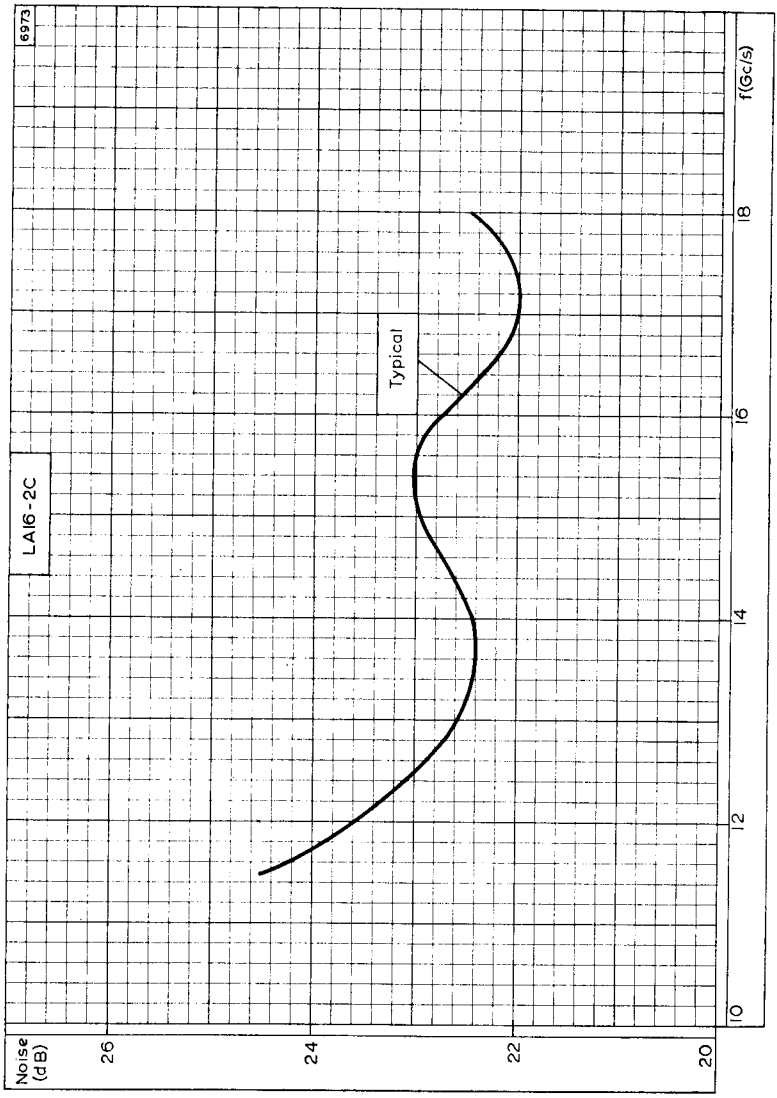
TYPICAL GAIN PLOTTED AGAINST FREQUENCY

LA16-2C

FORWARD WAVE AMPLIFIER



SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



TYPICAL NOISE FACTOR PLOTTED AGAINST FREQUENCY

FLASH TUBE

LSD2

Micro-second Flash Tube for high-speed photography.

MULLARD LSD2

GENERAL

The LSD2 is a cold cathode gas-filled discharge tube giving a high intensity luminous flash of extremely short duration suitable for high speed photography. It is intended for single flash operation at intervals of not less than 1 minute. The effective duration of the photographic flash is of the order of 1 micro-second, the exact duration being ultimately determined by the self-inductance of the discharge capacitor and its associated leads. This inductance should, therefore, be kept as low as possible.

LIMITING VALUES

Maximum energy dissipation within tube	35 joules
Effective duration of photographic flash	1 μ sec
Anode breakdown voltage	10,000 V
Minimum anode voltage	5,000 V
Recommended working anode voltage	7,500 V
Minimum peak trigger voltage (from spark-coil)	5,000 V

DISCHARGE CAPACITOR

Owing to the extremely high peak current associated with micro-second discharges, the losses in the capacitors and leads are such that it is unlikely that more than 60% of the capacitor energy will be dissipated in the flash tube. It is therefore permissable to use a 1uF capacitor at 10KV or a 2μF capacitor at 7.5KV corresponding to 50 joules and 56 joules respectively in the capacitor.

COLOUR OF DISCHARGE

Bluish white of high actinic value.

DELAY TIME

(a) Internal - from triggering impulse breakdown to production of luminous flash:-

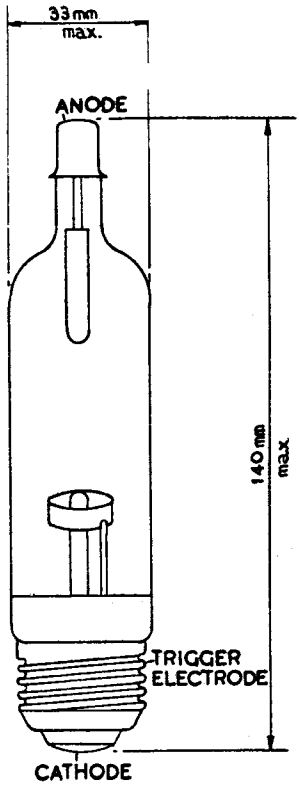
at V_a = 10,000 V	1 μ sec
at V_a = 7,500 V	3 μ sec

(b) External - dependent upon triggering circuit.

LSD2

FLASH TUBE

Micro-second Flash Tube for high-speed photography.



CAP - STANDARD EDISON SCREW

Mullard
TELEVISION TUBE

M46-12

Cathode Ray Tube for Television Reception.

12-INCH SCREEN

HEATER CHARACTERISTICS

Heater Voltage	Vf	=	4·0 volts
Heater Current	If	=	1·2 amps

OPERATING CHARACTERISTICS

Second Anode Voltage	Va2	=	4,000-5,000 volts
First Anode Voltage	Va1	=	250 volts
*Grid Voltage	−Vg	=	0-60 volts
Cathode internally connected to Heater— Electromagnetic Deflection Sensitivity ...	$Y=\frac{13L}{\sqrt{Va2}}$		mm. per Gauss.

(Where L is the length of deflection zone in millimetres and Va2 the second anode voltage.)

Ampere turns for focusing coil ... ... = 500 A.T.

INPUT CAPACITY

Grid to all other Electrodes ... ... Cg = 6·0 $\mu\mu$F

FLUORESCENT COLOUR

White

DEFLECTION

Double Electromagnetic

LIMITS

Maximum Second Anode Voltage	$Va2_{max}$	=	6,000 volts
Maximum First Anode Voltage	$Va1_{max}$	=	250 volts

* The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

M46-12

Mullard
TELEVISION TUBE

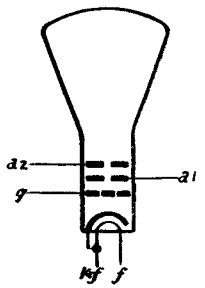
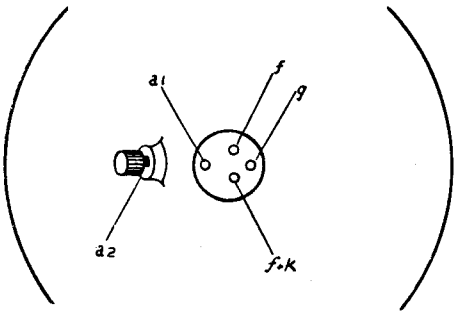


FIG 1



BOTTOM VIEW OF TUBE

FIG 2

DIMENSIONS IN M/M

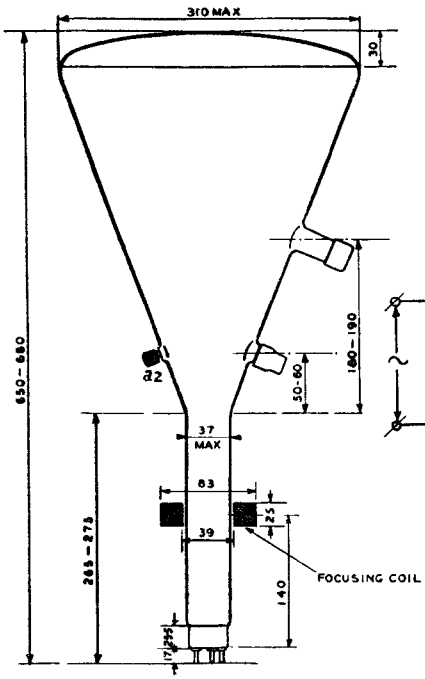


FIG 3

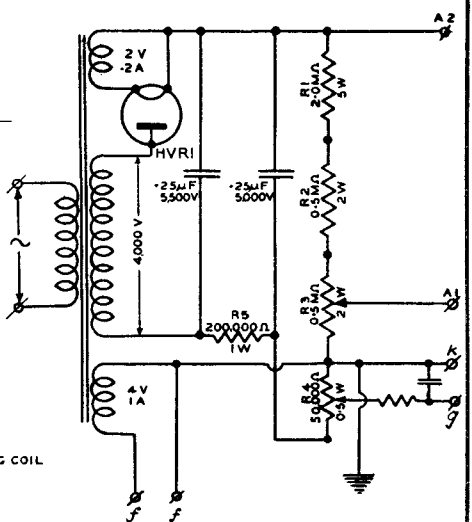


FIG 4

Mullard
TELEVISION TUBE M46-15

Cathode Ray Tube for Television Reception

15-INCH SCREEN

HEATER CHARACTERISTICS

Heater Voltage	Vf	= 4·0 volts
Heater Current	If	= 1·2 amps

OPERATING CHARACTERISTICS

Second Anode Voltage	Va2	= 4,000-5,000 volts
First Anode Voltage	Va1	= 250 volts
*Grid Voltage	− Vg	= 0-60 volts

Cathode internally connected to Heater—
Electromagnetic Deflection Sensitivity ... $Y = \frac{16L}{\sqrt{Va2}}$ mm. per Gauss.

(Where L is the length of deflection zone in millimetres and Va2 the second anode voltage.)

Ampere turns for focusing coil ... ... = 500 A.T.

INPUT CAPACITY

Grid to all other Electrodes ... ... Cg = 6·0 $\mu\mu$F

FLUORESCENT COLOUR

White.

DEFLECTION

Double Electromagnetic

LIMITS

Maximum Second Anode Voltage	$Va2_{max}$	= 6,000 volts
Maximum First Anode Voltage	$Va1_{max}$	= 250 volts

* The Grid Voltage should be adjusted to give the required light intensity. The voltage should never become positive or damage to the tube will result.

M46-15

Mullard
TELEVISION TUBE

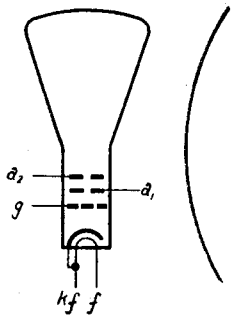
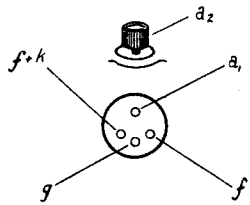


FIG. 1.



BOTTOM VIEW OF TUBE

FIG. 2.

DIMENSIONS IN M/M

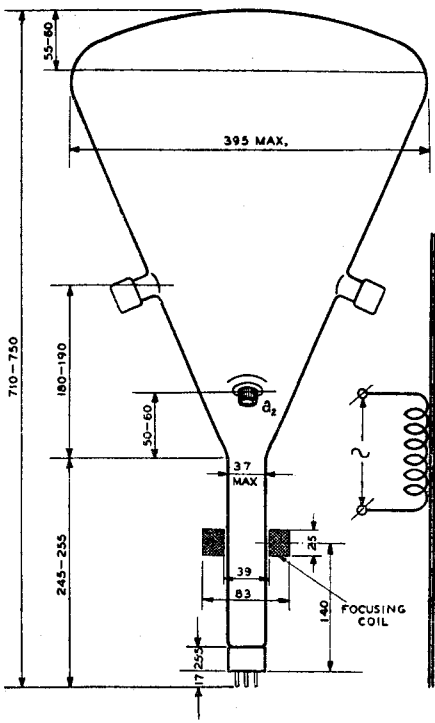


FIG 3

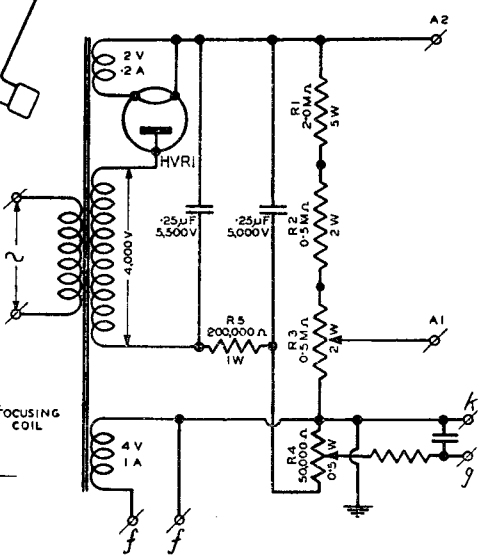
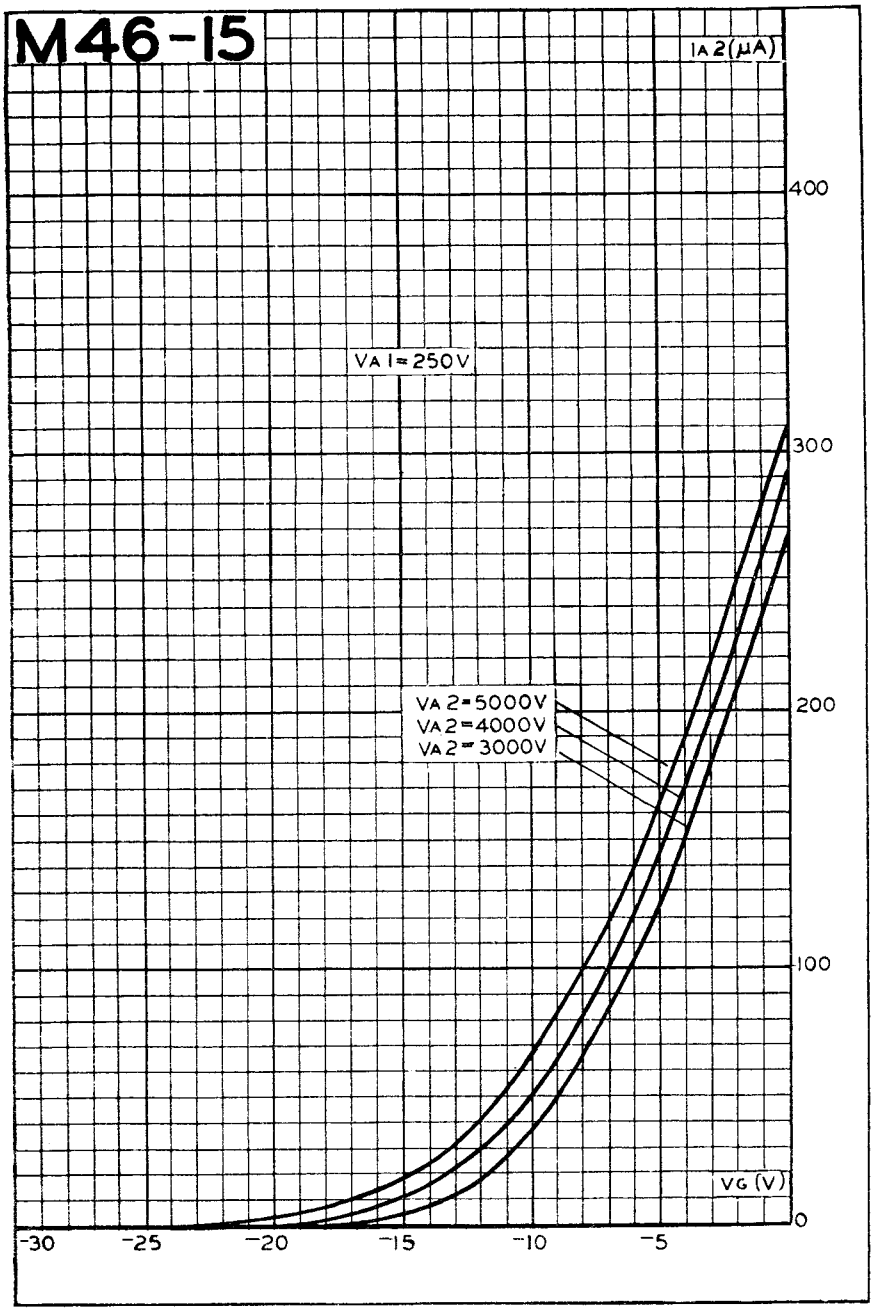


FIG 4

Mullard
TELEVISION TUBE

M46-15



T1837

SPECIAL QUALITY DOUBLE DIODE

M8079

Special quality miniature double diode with separate cathodes and internal screening between sections for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

V_h[1]	6.3	V
I_h	300	mA

CAPACITANCES[2] (measured with an external shield)

$C_{a'-k'+h+s+S}$	3.2	pF
$C_{a''-k''+h+s+S}$	3.2	pF
$C_{k'-a'+h+s+S}$	3.9	pF
$C_{k''-a''+h+s+S}$	3.9	pF
$C_{a'-a''}$	<26	mpF

LIMITING VALUES[4] (absolute ratings) each section

P.I.V. max.	460	V
I_a max.	10	mA
$i_{a(pk)}$ max.	60	mA
$V_{h\ k}$ max.	360	V
$V_{in(r.m.s.)}$ max.	165	V
R_{Hm} min. (per anode)	600	Ω
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

M8079

SPECIAL QUALITY DOUBLE DIODE

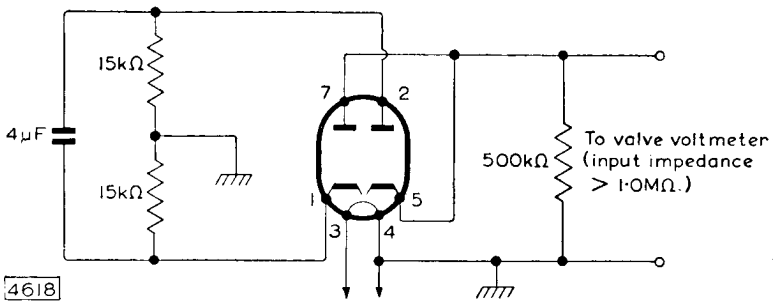
TEST CONDITIONS (unless otherwise specified)

V_h (V)	$V_{a(r.m.s.)}$ (V)	R_{load} (kΩ)	C (μF)
6.3	165	11	8.0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest, screen-rest measured at –300V	0.25	—	100	—	—	—	—	MΩ
GROUP B								
Heater current	0.65	—	275	325	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	5.0	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	5.0	—	—	—	μA
Output current	0.65	18	16	—	—	—	—	mA
Emission V_a = 10V	0.65	—	40	—	—	—	—	mA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_a = 0V$, $R_a = 40k\Omega$	2.5	—	2.0	20	—	—	—	μA
Anode current difference between sections $V_a = 0V$, $R_a = 40k\Omega$	2.5	—	—	5.0	—	—	—	μA
Change in emission $V_h = 5.7V$, $V_a = 7.0V$	2.5	—	—	15	—	—	—	%
Hum $V_h = 7.0V$ Tested in circuit shown below	2.5	—	—	10	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	



GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
$C_{a'-a''}$	—	—	—	26	—	—	—	mpF
$C_{a'-k'+h+s+\ddagger}$	—	—	2.4	4.0	—	—	—	pF
$C_{a''-k''+h+s+\ddagger}$	—	—	2.4	4.0	—	—	—	pF
$C_{k'-a'+h+s+\ddagger}$	—	—	2.5	5.0	—	—	—	pF←
$C_{k''-a''+h+s+\ddagger}$	—	—	2.5	5.0	—	—	—	pF←

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
Microphonic noise measured at the cathode with both sections in parallel. 50c/s, 2.0g min. peak acceleration, R_k = 4.7kΩ, I_a = 20mA	2.5	—	—	5.0	—	—	—	mV (r.m.s.)
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
Microphonic noise (conditions as above)	—	—	—	5.0	—	—	—	mV (r.m.s.)

GROUP F

Intermittent life test

The valve is connected in a full-wave rectifier circuit with a load resistor of 11kΩ and a reservoir capacitor of 8μF. The supply impedance is adjusted so that the peak anode current is not less than 60mA for a nominal valve, the total output current being approximately 18mA.

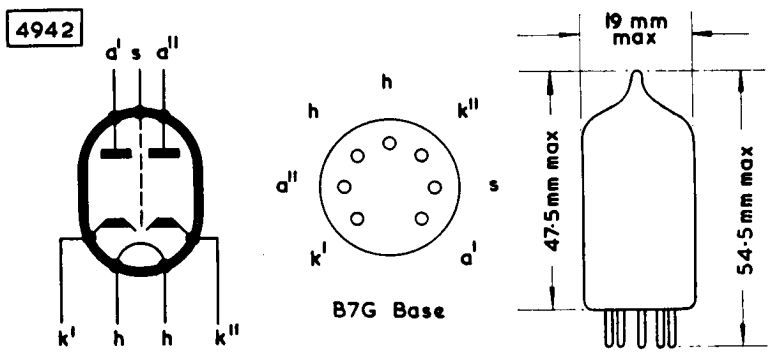
The cathode to heater voltage is provided by the output voltage in series with 117Vr.m.s.

Intermittent life test end points		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	275	325	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	10	μA
	1000 hours	4.0	—	10	μA
Emission $V_a = 10V$	500 hours	2.5	35	—	mA
	1000 hours	4.0	30	—	mA
Sub-group (b)					
Change in emission $V_h = 5.7V$, $V_a = 7.0V$	500 hours	4.0	—	20	%
Anode current $V_a = 0V$, $R_a = 40k\Omega$	500 hours	4.0	1.0	20	μA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	50	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

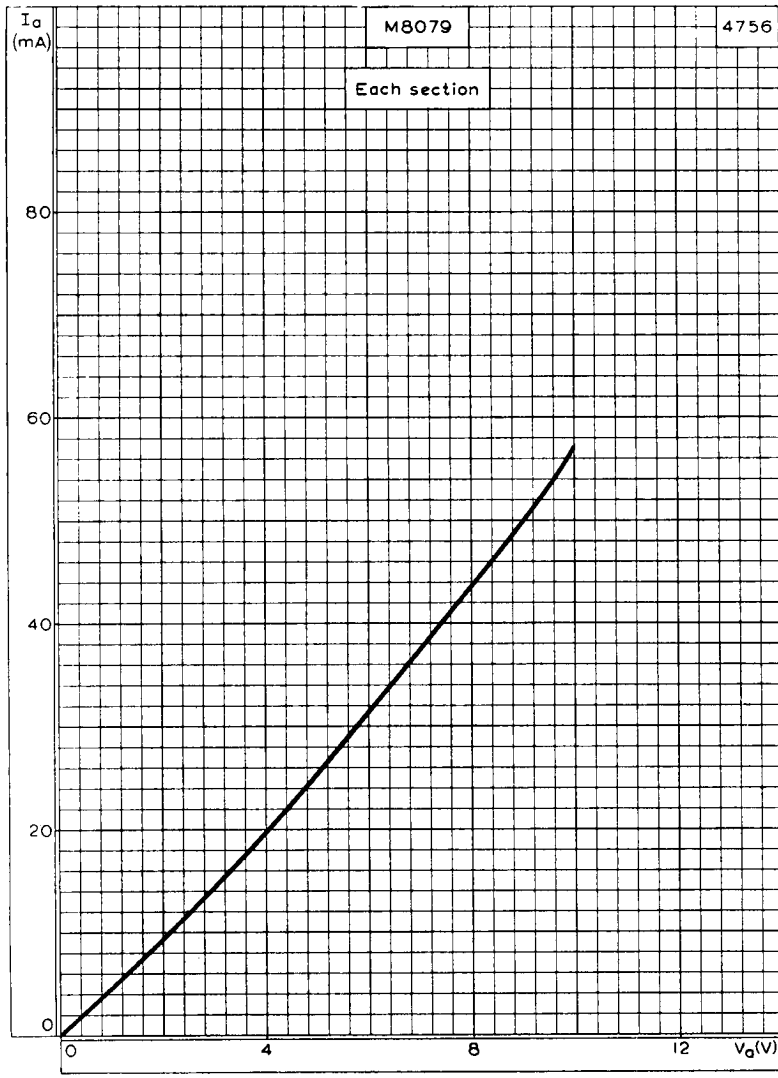
GROUP G

Valves are held for 28 days and retested for Inoperatives[14]	0.5	—	—	

M8079 SPECIAL QUALITY DOUBLE DIODE



The bulb and base dimensions of this valve are in accordance with BS448, Section B7G



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SPECIAL QUALITY R.F. POWER TRIODE

M8080

Special quality power triode for use as an r.f. power amplifier or oscillator in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	150	mA

CAPACITANCES[2] (measured without an external shield)

c_{in}	1.5	pF
c_{out}	1.2	pF
c_{a-g}	1.4	pF

CHARACTERISTICS[3]

V_a	250	V
I_a	10.5	mA
V_g	–8.5	V
g_m	2.2	mA/V
μ	17	
r_a	7.7	kΩ
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

f max.	150	Mc/s
$V_{a(b)}$ max.	550	V
V_a max.	330	V
p_a max.	3.8	W
$-V_g$ max.	110	V
I_g max.	5.5	mA
I_k max.	21	mA
R_{g-k} max. (cathode bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	250	kΩ
V_{h-k} max.	150	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	170	°C

M8080

SPECIAL QUALITY
R.F. POWER TRIODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_g (V)	R_k (Ω)	V_{h-k} (V)
6.3	250	–8.5	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest measured at –300V	0.25	—	100	—	—	—	—	MΩ
g-rest measured at –100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current, R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	138	162	—	—	—	mA
Heater cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	3.0	—	μA
Anode current	0.65	10.5	6.5	14.5	—	—	—	mA
	—	—	—	—	9.0	12	1.22	mA
Mutual conductance	0.65	2.2	1.75	2.65	—	—	—	mA/V
	—	—	—	—	2.0	2.4	0.157	mA/V
Group qaulity level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. V_g = −30V	2.5	—	—	50	—	—	—	μA
Reverse grid current. V_h = 6.9V, V_{a-e} = 250V V_{g-e} = 0V, R_k = 810Ω	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration, V_b = 250V, R_a = 2kΩ, V_{g-e} = 0V, R_k = 810Ω, C_k = 1000μF	2.5	—	—	7.0	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages; pin 2 connected to pin 7	6.5	—	—	—	—	—	—	
C_{in}	—	—	1.35	2.25	—	—	—	pF
C_{out}	—	—	0.98	1.62	—	—	—	pF
C_{a-g}	—	—	1.2	2.0	—	—	—	pF
Mutual conductance. V_a = 100V, V_g = 0V	6.5	3.25	2.5	4.0	—	—	—	mA/V
	—	—	—	—	2.82	3.68	0.33	mA/V
Change of mutual conductance. V_a = 100V, V_g = 0V, V_h = 5.7V	6.5	—	—	15	—	—	—	%
Amplification factor	6.5	17	15.5	18.5	—	—	—	
	—	—	—	—	16.15	17.85	0.66	
Power oscillation. V_a = 300V, R_g = 8.5kΩ, f = 150Mc/s	4.0	—	1.8	—	—	—	—	W

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170±5c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current $R_g$max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.6	2.65	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	15	—	—	—	mV (r.m.s.)
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current $R_g$max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.6	2.65	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	15	—	—	—	mV (r.m.s.)

TESTS

GROUP F

Stability life test[14]

Running conditions. V_{a-c} = 250V, R_k = 500Ω, V_{h-k} = 150V (cathode negative)

Stability life test end point

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

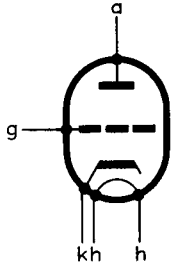
Running conditions. V_{a-c} = 250V, R_k = 500Ω, V_{h-k} = 150V (cathode negative)

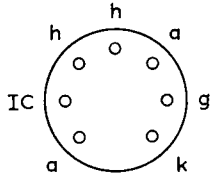
Intermittent life test end points

		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	138	162	mA
Heater to cathode leakage current V_{h-k} = ±100V	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse grid current. R_g max. = 500kΩ	500 hours	2.5	—	0.5	μA
	1000 hours	4.0	—	0.5	μA
Mutual conductance	500 hours	2.5	1.6	2.65	mA/V
	1000 hours	4.0	1.5	2.65	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Anode current	500 hours	4.0	5.5	14.5	mA
	1000 hours	6.5	5.0	14.5	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

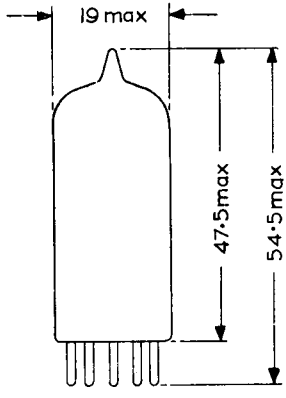
GROUP G	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for				
Inoperatives[16]	0.5	—	—	
Reverse grid current. R_g max. = 500kΩ	0.5	—	0.5	μA

5606





B7G Base



All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448 Section B7G.

SPECIAL QUALITY V.H.F. DOUBLE TRIODE

M8081

Special quality double triode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	450	mA

CAPACITANCES[2] (measured without an external shield)

*c_{a-g}	1.6	pF
*c_{in}	2.1	pF
$c_{out'}$	450	mpF
$c_{out''}$	350	mpF
c_{h-k}	4.0	pF

*Each section

CHARACTERISTICS[3] (each section)

V_a	100	V
I_a	9.0	mA
*V_g	–0.9	V
g_m	5.6	mA/V
μ	38	
r_a	6.8	kΩ
R_k	0	Ω

* Fixed bias operation is not recommended

LIMITING VALUES[4] (absolute ratings)

f max.	250	Mc/s
$V_{a(b)}$ max.	550	V
V_a max.	330	V
p_a max.	2×1.6	W
I_k max.	25	mA
$-V_g$ max.	110	V
I_g max.	2×4.5	mA
V_{h-k} max.	100	V
$R_{g\ k}$ max. (cathode resistor bias)	500	kΩ
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g-e} (V)	R_k (Ω)	C_k (μF)
6.3	100	0	50	1000

Voltages are applied simultaneously to both sections. The measurements apply to each section, unless otherwise stated.

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest, measured at –300V	0.25	—	100	—	—	—	—	MΩ
g-rest, measured at –100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current								
$R_g$max. = 1MΩ, V_{a-e} = 250V,								
R_k = 500Ω both sections strapped	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	420	480	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V cathode negative	—	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive	—	—	—	10	—	—	—	μA
Anode current	0.65	—	6.5	11.5	—	—	—	mA
Mutual conductance	0.65	—	4.0	7.5	—	—	—	mA/V
Anode current V_{g-e} = –30V, V_{a-e} = 250V	0.65	—	—	75	—	—	—	μA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Microphonic noise at the anode at 50c/s and 2.0g min. peak acceleration, both sections connected in parallel, $V_b = 250V$, $R_a = 2k\Omega$, $R_k = 1.5k\Omega$, $R_{g'} = R_{g''} = 0\Omega$.	2.5	—	—	15	—	—	—	mV (r.m.s.)

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	1.4	2.8	—	—	—	pF
$C_{out'}$	—	—	250	650	—	—	—	mpF
$C_{out''}$	—	—	250	550	—	—	—	mpF
C_{a-g}	—	—	1.2	1.8	—	—	—	pF
C_{h-k}	—	—	3.3	7.5	—	—	—	pF
Amplification factor	6.5	—	28	48	—	—	—	
Reverse grid current. $V_h = 7.0V$, $R_g = 1M\Omega$ both sections connected in parallel	6.5	—	—	1.0	—	—	—	μA

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 2g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current as in group A	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	3.5	7.5	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	35	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current as in group A	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	3.5	7.5	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	35	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	

GROUP F

Stability life test[14]

Running conditions: $V_{a-e} = 125V$, $R_k = 50\Omega$, $V_{h-k} = 180V$ (cathode negative)

Stability life test end points

Change in mutual conductance after 1 hour	1.0	—	—	15	—	—	—	%

Intermittent life test

Running conditions: $V_{a-e} = 125V$, $R_k = 50\Omega$, $V_{h-k} = 180V$ (cathode negative)

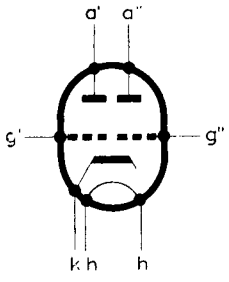
Intermittent life test end points

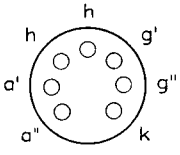
		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	420	480	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse grid current as in group A	500 hours	2.5	—	0.75	μA
	1000 hours	4.0	—	1.0	μA
Mutual conductance	500 hours	2.5	3.5	7.5	mA/V
	1000 hours	4.0	3.25	7.5	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

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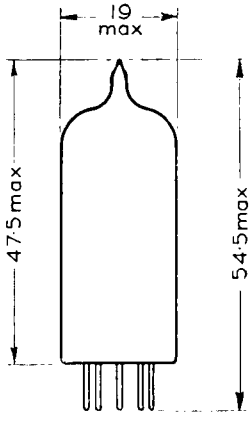
SPECIAL QUALITY V.H.F. DOUBLE TRIODE

GROUP G	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse grid current as in group A.	0.5	—	0.75	μA





B7G Base



4749

All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, Section B7G

SPECIAL QUALITY OUTPUT PENTODE

M8082

Special quality output pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

CAPACITANCES[2] (measured with an external shield)

c_{in}	3.8	pF
c_{out}	6.5	pF
c_{a-g1}	<300	mpF

CHARACTERISTICS[3]

V_a	250	V
V_{g2}	250	V
I_a	16	mA
I_{g2}	2.3	mA
g_m	2.5	mA/V
r_a	130	kΩ
$\mu_{g1\ g2}$	12	
R_k	0	Ω
V_{g1}	-13.5	V

ABSOLUTE MAXIMUM RATINGS[4]

f max.	100	Mc/s
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	4.75	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max.	800	mW
$-V_{g1}$ max.	110	V
V_{g1-g2} max.	300	V
I_{g1} max.	3.3	mA
I_k max.	23	mA
R_{g1-k} max. (fixed bias)	220	kΩ
V_{h-k} max.	150	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	180	°C

M8082

SPECIAL QUALITY OUTPUT PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	$V_{a(b)}$ (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	R_{g1} (Ω)	C_k (μF)
6.3	250	250	0	740	0	1000

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation a-rest, g_2-rest measured at –300V g_1-rest measured at –100V	0.25	—	100	—	—	—	—	MΩ
Reverse control-grid current R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	184	216	—	—	—	mA
Heater to cathode leakage current V_{h-k} = 100V cathode alternately positive and negative	0.65	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive		—	—	—	—	3.0	—	μA
Anode current	0.65	15	12	18	—	—	—	mA
	—	—	—	—	13.9	16.1	0.86	mA
Screen-grid current	0.65	2.0	1.3	2.7	—	—	—	mA
	—	—	—	—	1.74	2.26	0.2	mA
Mutual conductance	0.65	2.55	1.95	3.15	—	—	—	mA/V
	—	—	—	—	2.33	2.77	0.17	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_{g1-e} = -50V$	2.5	—	—	50	—	—	—	μA
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse control-grid current. $V_h = 6.9V$, $V_{a-e} = 300V$, $V_{g2-e} = 235V$	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s 2.0g min. peak acceleration, $V_{a(b)} = 250V$, $R_a = 2k\Omega$, $V_{g2-e} = 250V$.	2.5	—	—	15	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	3.5	5.0	—	—	—	pF
C_{out}	—	—	5.8	7.2	—	—	—	pF
C_{a-g1}	—	—	—	300	—	—	—	mpF
Amplification factor (μ_{g1-g2})	6.5	—	10	14	—	—	—	

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on, 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s, for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse control-grid current R_{g1} max = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.8	3.2	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse control-grid current R_{g1} max = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.8	3.2	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	

GROUP F

Stability life test[14]

Running conditions. $R_{g1} = 100k\Omega \pm 20\%$, $R_k = 740\Omega \pm 10\%$, $V_{h-k} = 150V$ (cathode negative)

Stability life test end point

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

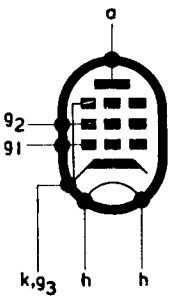
Running conditions. $R_{g1} = 100k\Omega \pm 20\%$, $R_k = 740\Omega \pm 10\%$, $V_{h-k} = 150V$ (cathode negative)

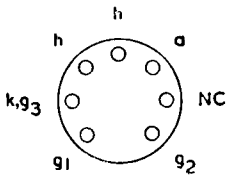
Intermittent life test end points

		A.Q.L.[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	184	216	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	30	μA
	1000 hours	4.0	—	30	μA
Reverse control-grid current. R_{g1} max = 500kΩ	500 hours	2.5	—	1.0	μA
	1000 hours	4.0	—	1.0	μA
Mutual conductance	500 hours	2.5	1.7	3.2	mA/V
	1000 hours	4.0	1.6	3.2	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

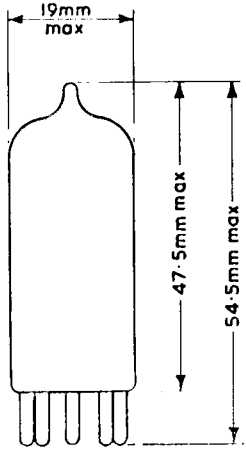
	A.Q.L.[5] (%)	Min.	Max.	
Dynamic life test 100 hours				
Running conditions as a trebler. V_b = 300V, decoupling resistor = 1.0kΩ I_a+I_{g2} = 20mA, I_{g1} = 1.6mA, f = 70 to 75Mc/s P_{out} = 900mW				
Dynamic life test end point				
Change in P_{out}	—	—	20	%
GROUP G				
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse control-grid current. R_{g1} max. = 500kΩ	0.5	—	0.75	μA

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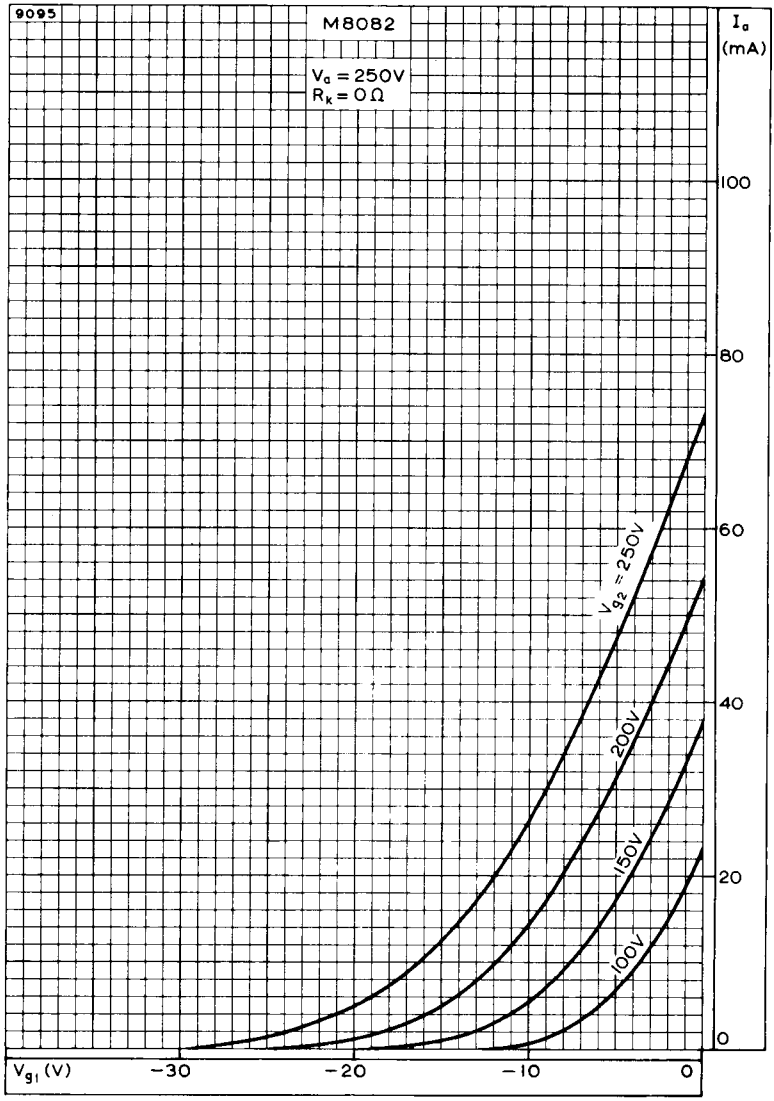


B7G Base



The bulb and base dimensions of this valve are in accordance with BS448, Section B7G

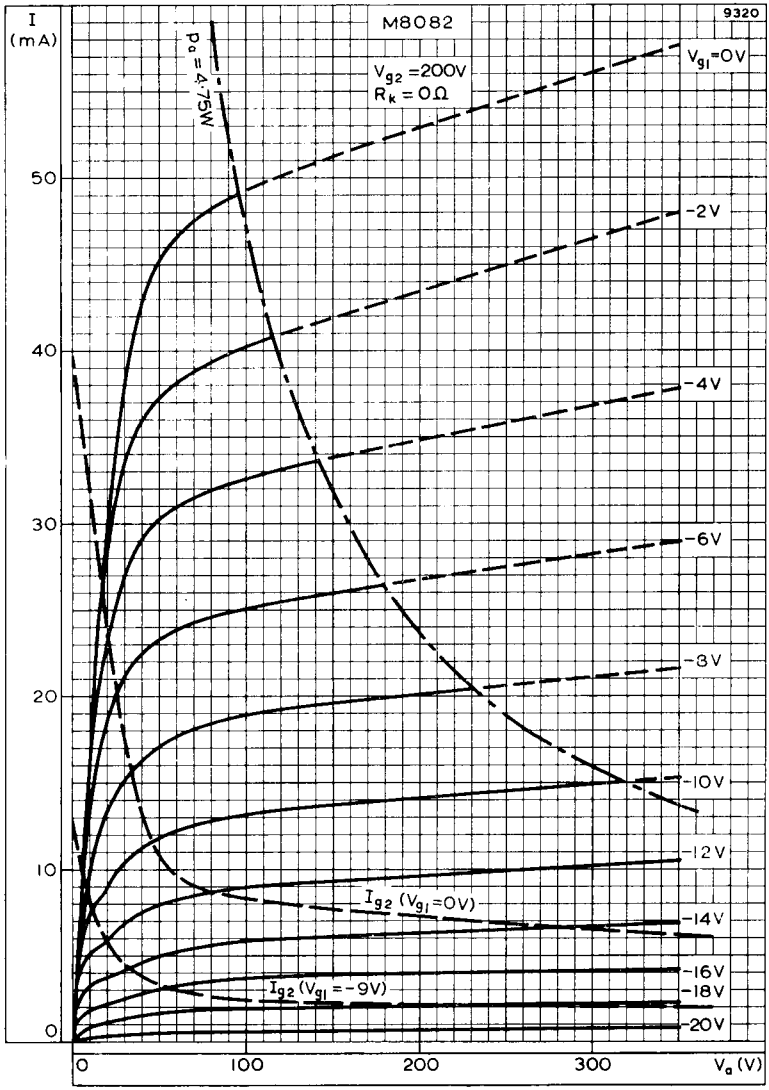
M8082



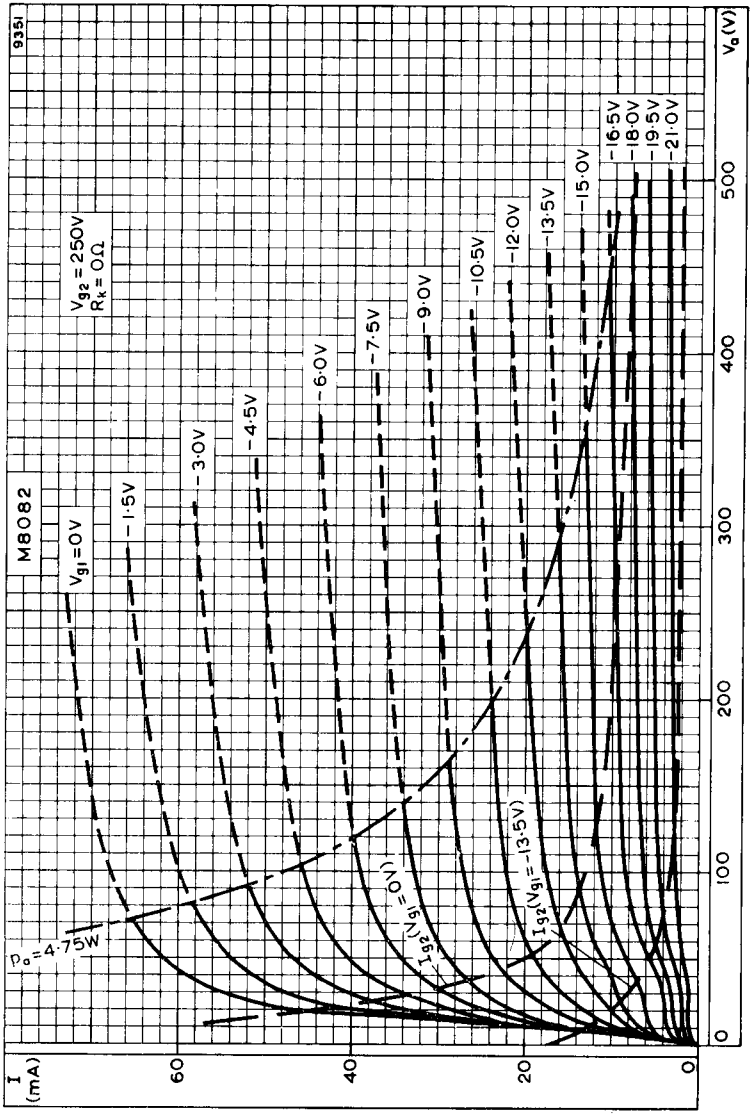
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V

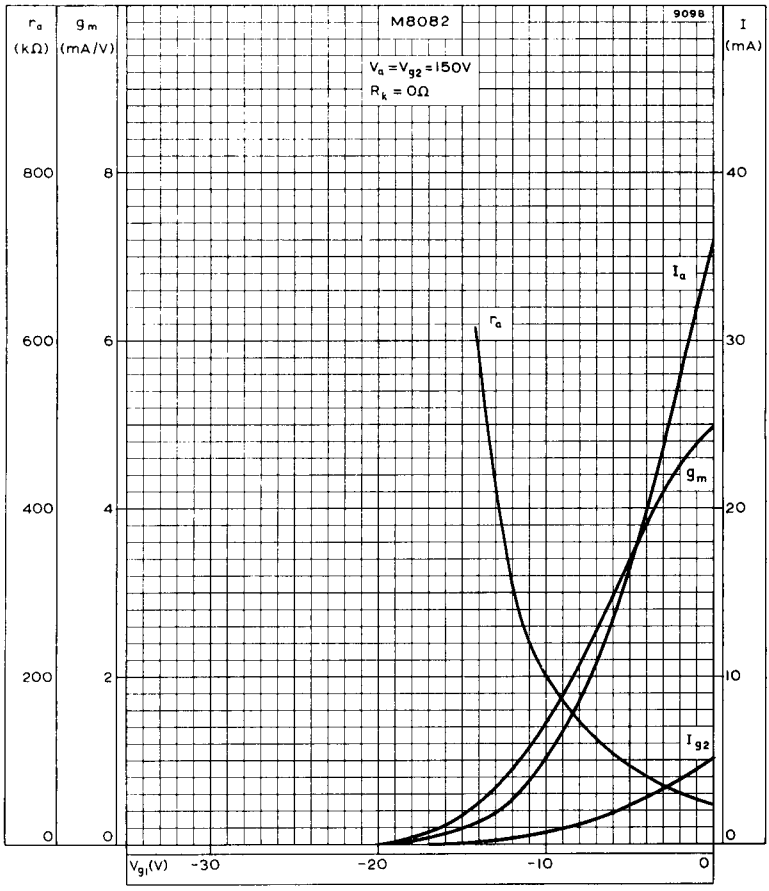


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

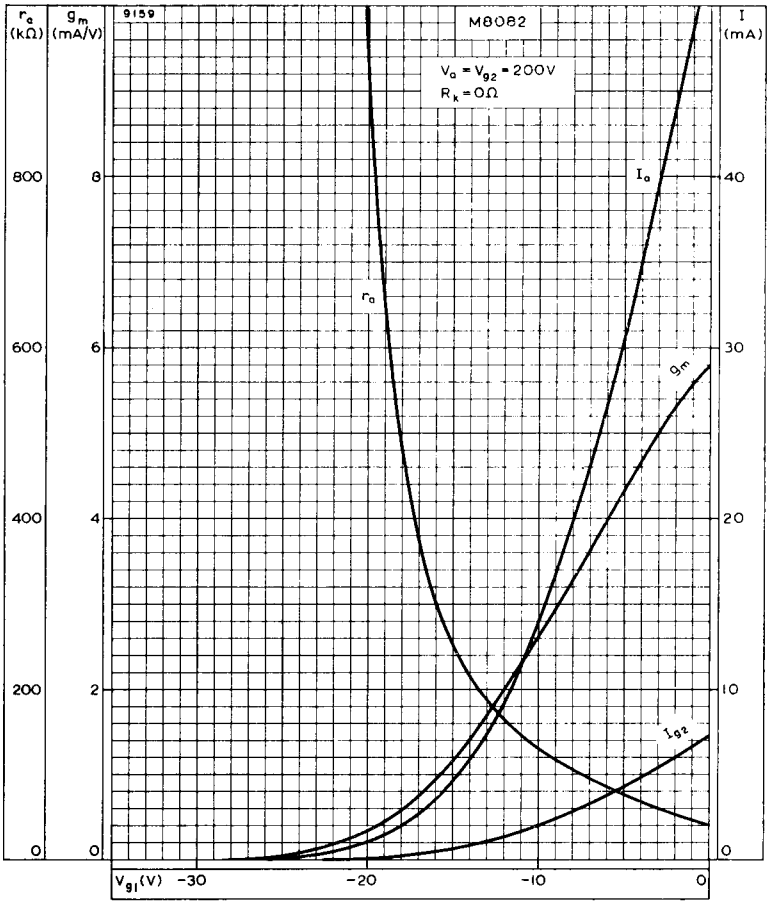


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

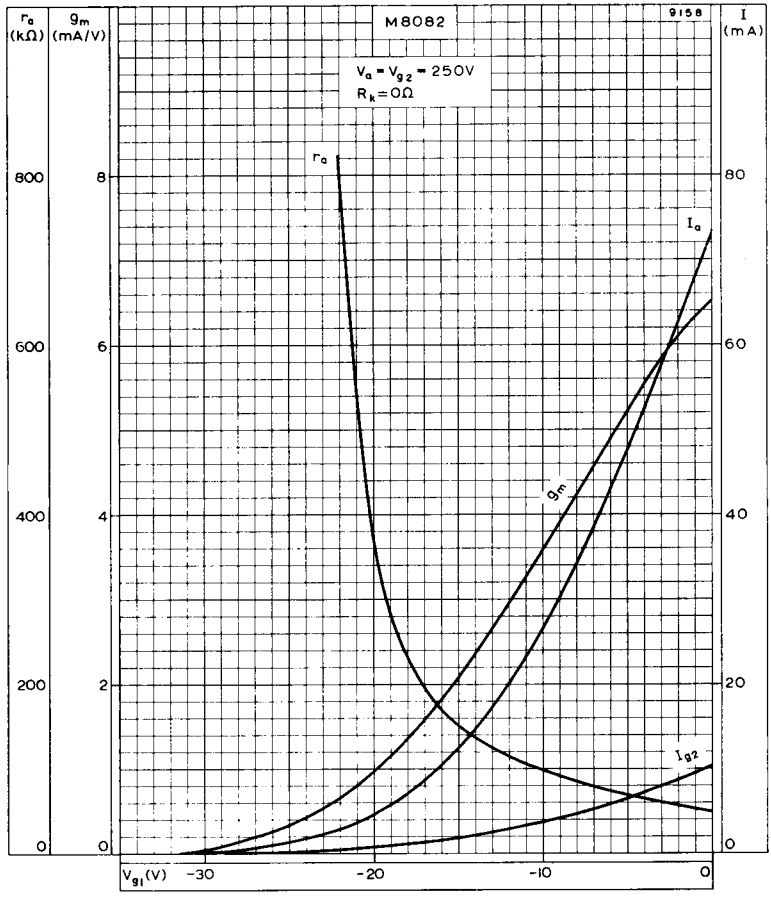
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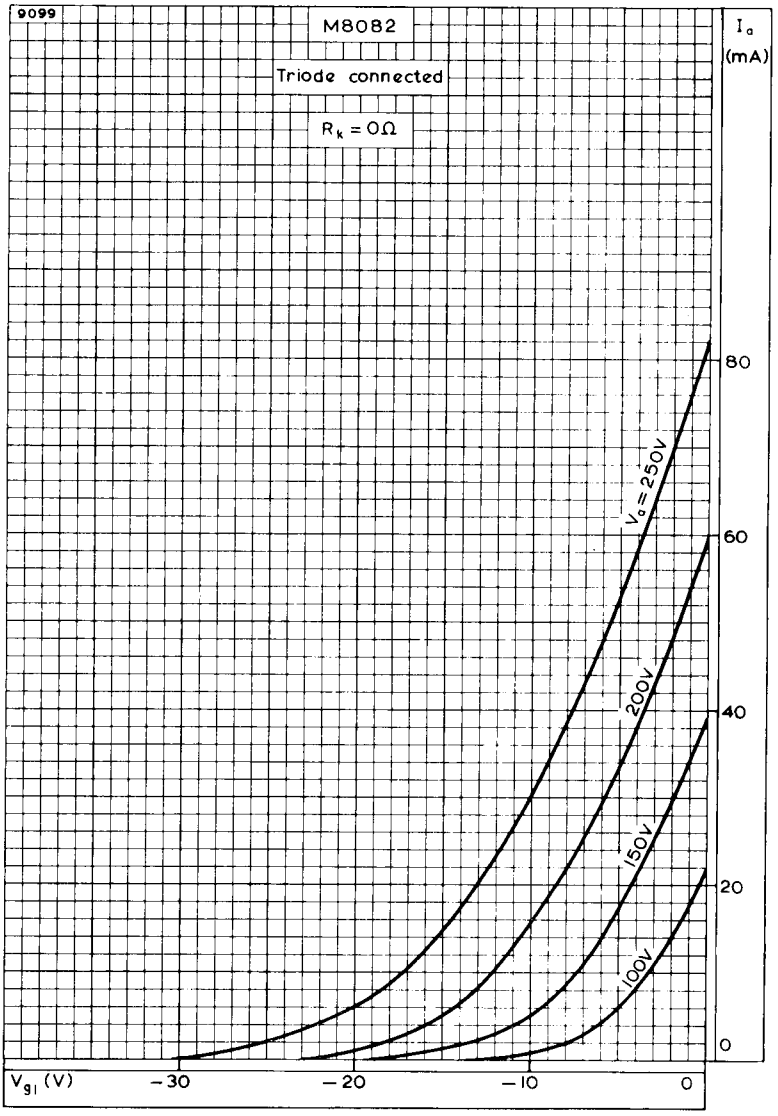
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_{a} = V_{g2} = 200V$

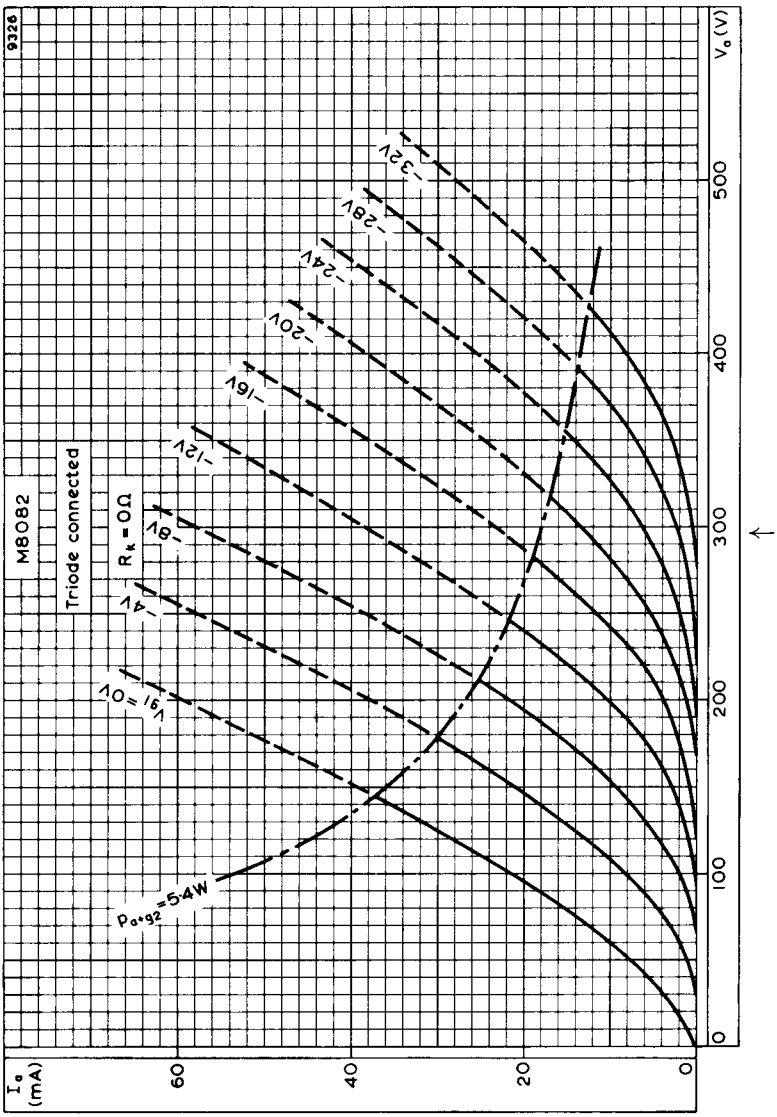


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 250V$



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED

M8082



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED

SPECIAL QUALITY R.F. PENTODE

M8083

Special quality r.f. pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES[2] (measured with an external shield)

c_{in}	7.1	pF ←
c_{out}	3.4	pF ←
c_{a-g1}	<10	mpF

CHARACTERISTICS[3]

V_a	250	V
V_{g3}	0	V
V_{g2}	250	V
I_a	10	mA
I_{g2}	2.6	mA
V_{g1}	−2.0	V
g_m	7.6	mA/V
r_a	>500	kΩ
μ_{g1-g2}	70	
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	450	V ←
V_{g2} max.	300	V
p_{g2} max.	900	mW
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
R_{g1-k} max.	500	kΩ ←
V_{h-k} max.	150	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	200	°C

M8083

SPECIAL QUALITY R.F. PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g3-k} (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	R_{g1} (Ω)	C_k (μF)
6.3	250	0	250	0	160	0	1000

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation a-rest, g_2-rest measured at −300V g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse control-grid current R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	275	325	—	—	—	mA
Heater to cathode leakage current V_{h-k} = 100V cathode negative	0.65	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive	0.65	—	—	10	—	—	—	μA
	—	—	—	—	—	2.0	—	μA
Anode current	0.65	9.85	7.5	12.2	—	—	—	mA
	—	—	—	—	8.7	11	0.91	mA
Screen-grid current	0.65	2.6	1.8	3.4	—	—	—	mA
	—	—	—	—	—	3.0	—	mA
Mutual conductance	0.65	7.6	6.0	9.25	—	—	—	mA/V ←
	—	—	—	—	6.81	8.43	0.63	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_{g1-e} = -8.0V$	2.5	—	—	100	—	—	—	μA
Reverse control-grid current. $V_{g1-e} = -50V$	2.5	—	—	1.0	—	—	—	μA
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse control-grid current. $V_h = 6.9V$, $V_{a-e} = 300V$, $V_{g2-e} = 300V$, $R_k = 250\Omega$	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.0g min. peak acceleration. $V_b = 250V$, $R_a = 2k\Omega$, $R_k = 0\Omega$, $V_{g1} = -2V$	2.5	—	—	15	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	6.5	8.7	—	—	—	pF
c_{out}	—	—	2.75	3.75	—	—	—	pF
c_{a-g1}	—	—	—	10	—	—	—	mpF
Grid 3 cut-off voltage $V_{g1-e} = -3.5V$, $I_a = 50\mu A$	6.5	—	-70	-120	—	—	—	V
Amplification factor (μ_{g1-g2})	—	—	60	89	—	—	—	

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s, for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse control-grid current. R_{g1} max = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	5.5	9.25	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse control-grid current. R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	5.5	9.25	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	

GROUP F

Stability life test[14]

Running conditions. $R_{g1} = 100k\Omega \pm 20\%$, $R_k = 180\Omega \pm 10\%$, $V_{h-k} = 100V$ (cathode negative)

Stability life test end point

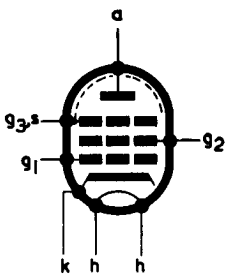
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

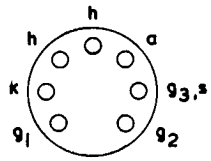
Intermittent life test		*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	275	325	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse coutrol-grid current. R_{g1} max = 500kΩ	500 hours	2.5	—	0.75	μA
	1000 hours	4.0	—	1.0	μA
Mutual conductance	500 hours	2.5	5.2	9.25	mA/V
	1000 hours	4.0	4.9	9.25	mA/V
Average change in mutual conductance	500 hours	—	—	10	%
Sub-group (b)					
Anode current	500 hours	4.0	6.8	12.2	mA
	1000 hours	6.5	5.25	—	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

M8083 SPECIAL QUALITY R.F. PENTODE

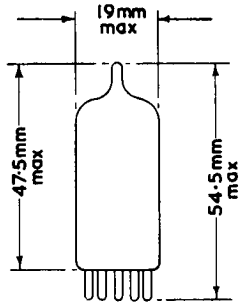
GROUP G	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for				
Inoperatives[16]	0.5	—	—	
Reverse control-grid current. R_{g1}max = 500kΩ	0.5	—	0.75	μA

3594

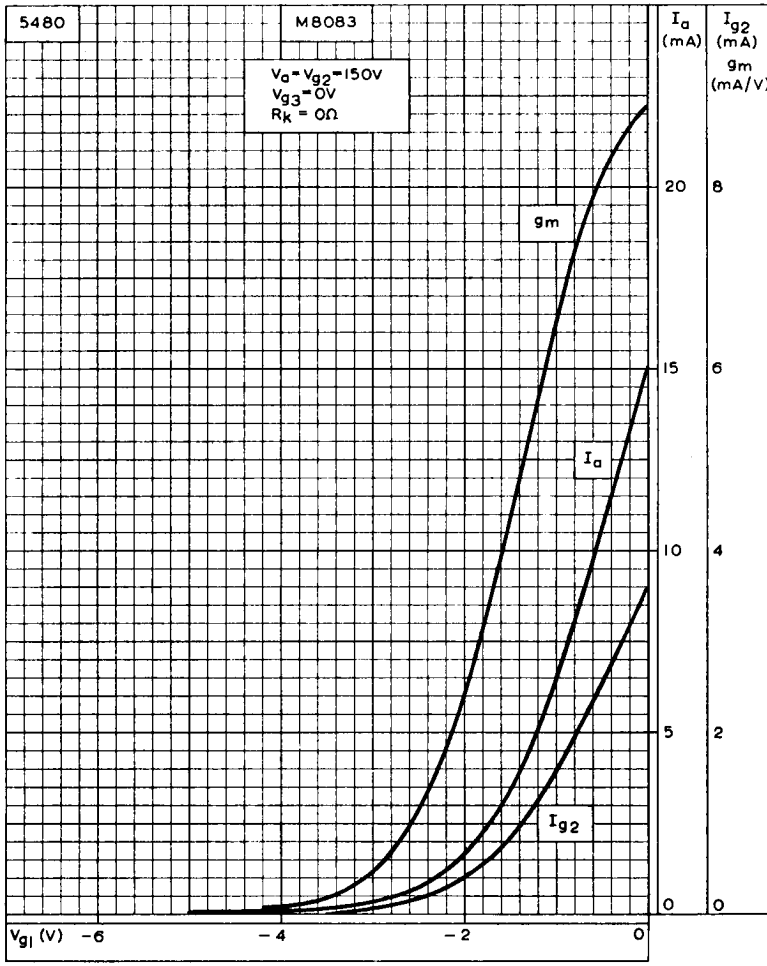




B7G Base



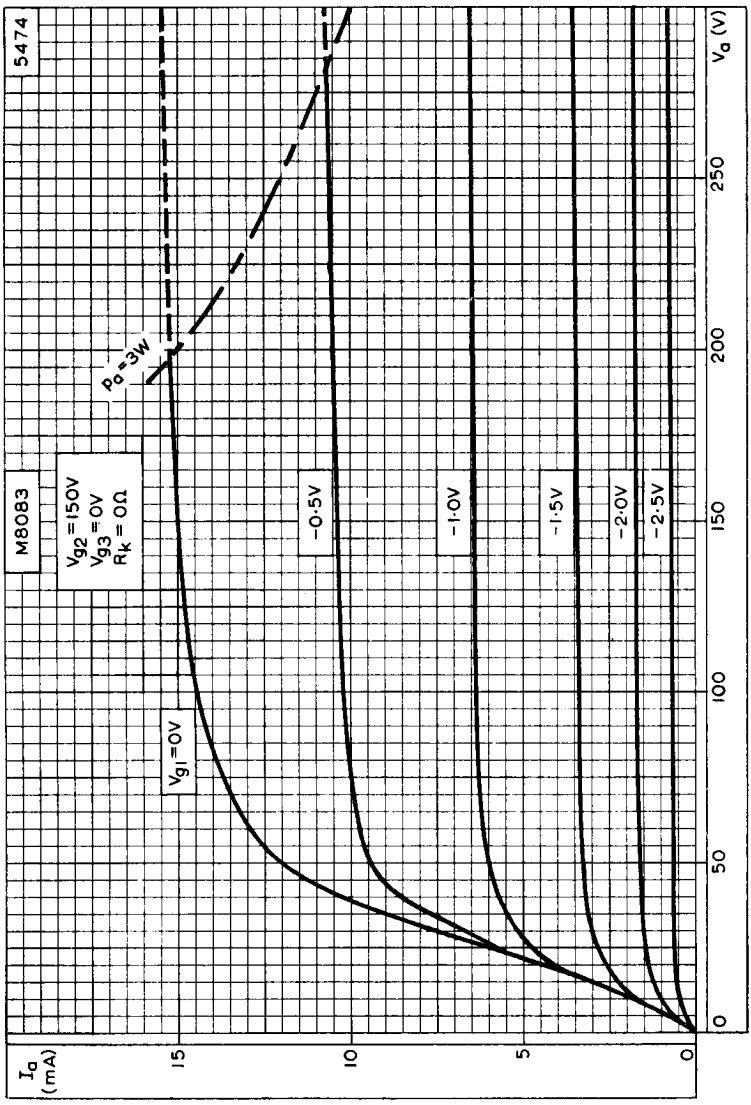
The bulb and base dimensions of this valve are in accordance with BS448, Section B7G



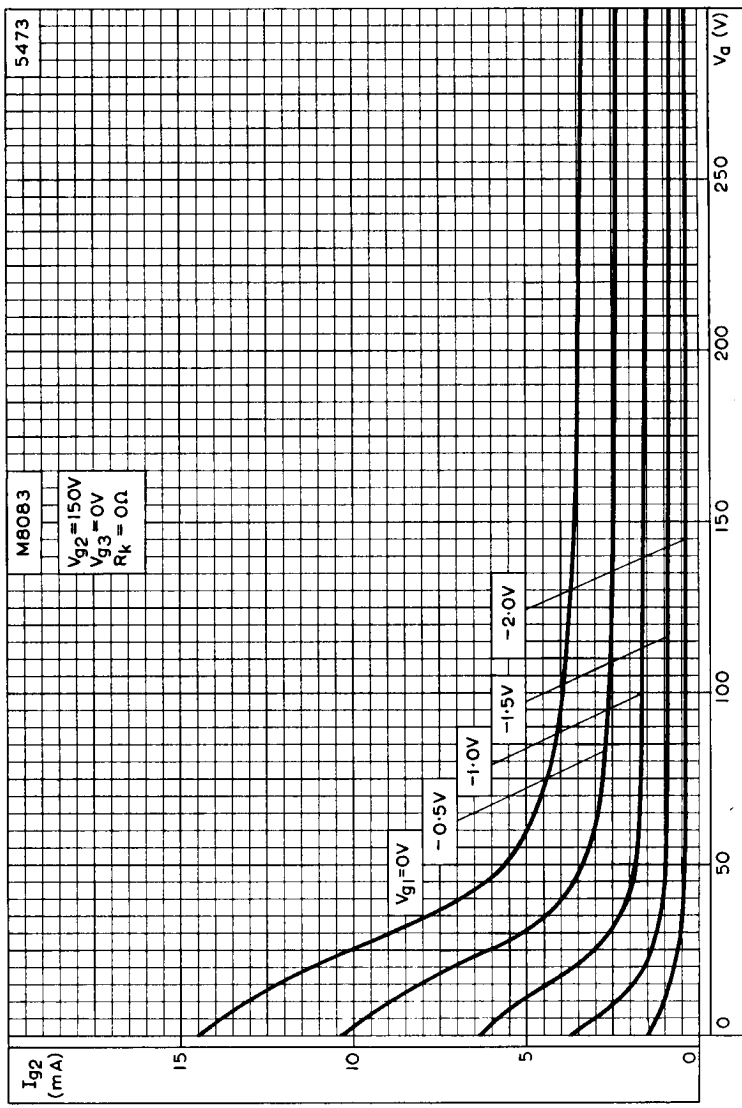
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 150V$

M8083

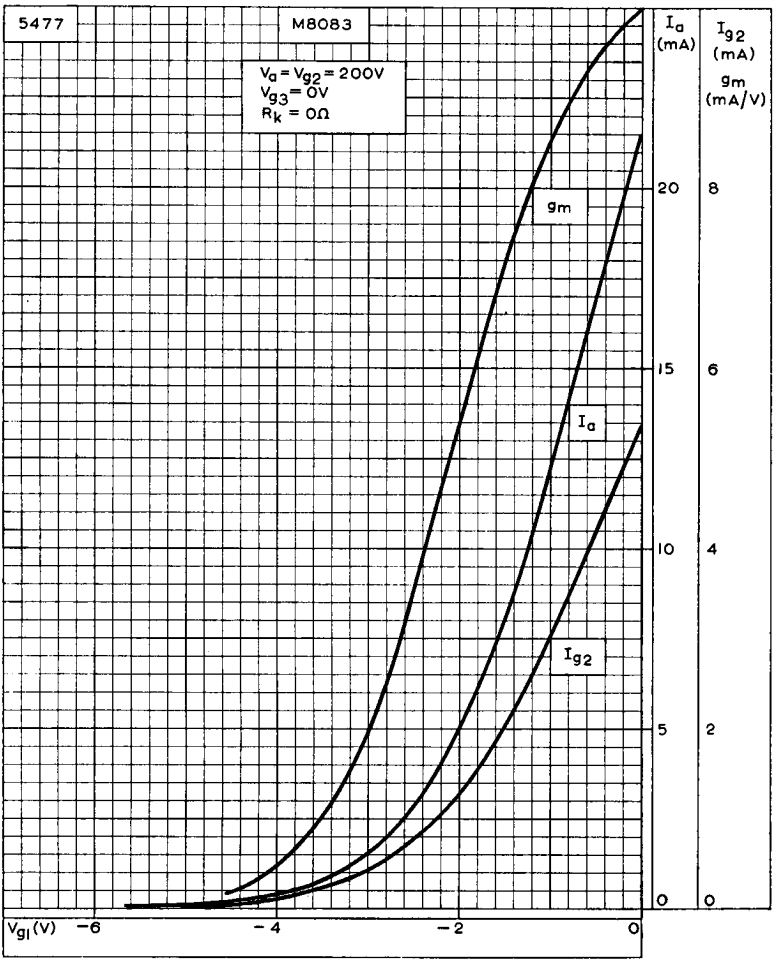
SPECIAL QUALITY R.F. PENTODE



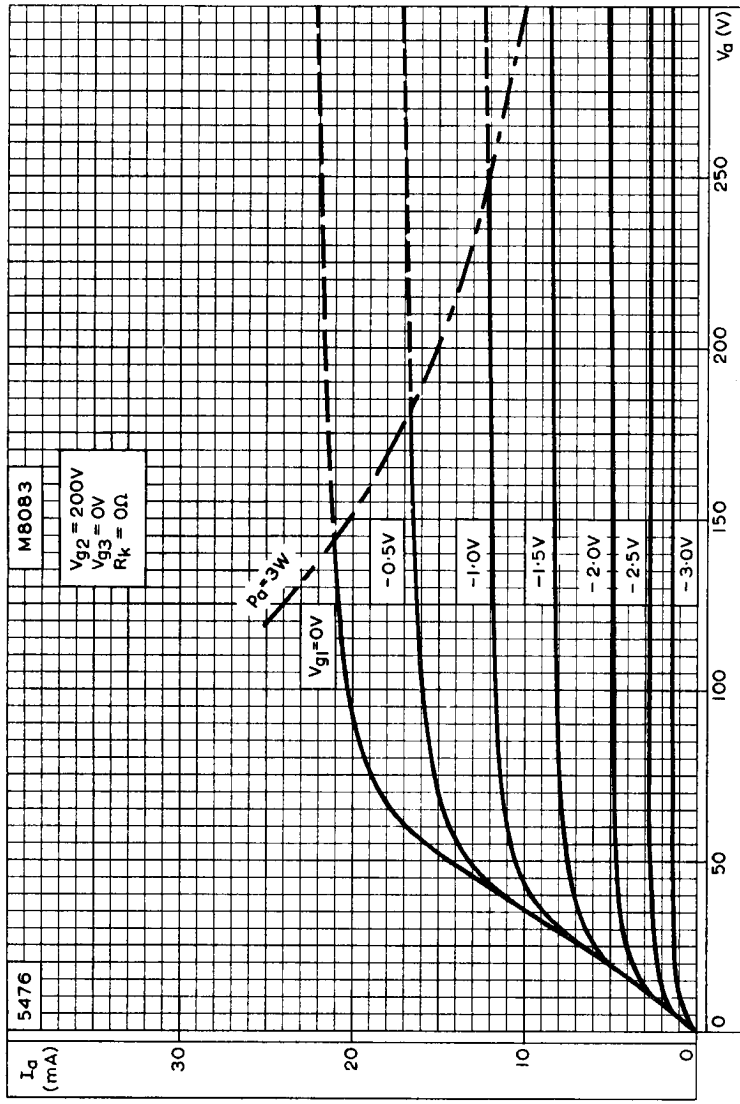
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



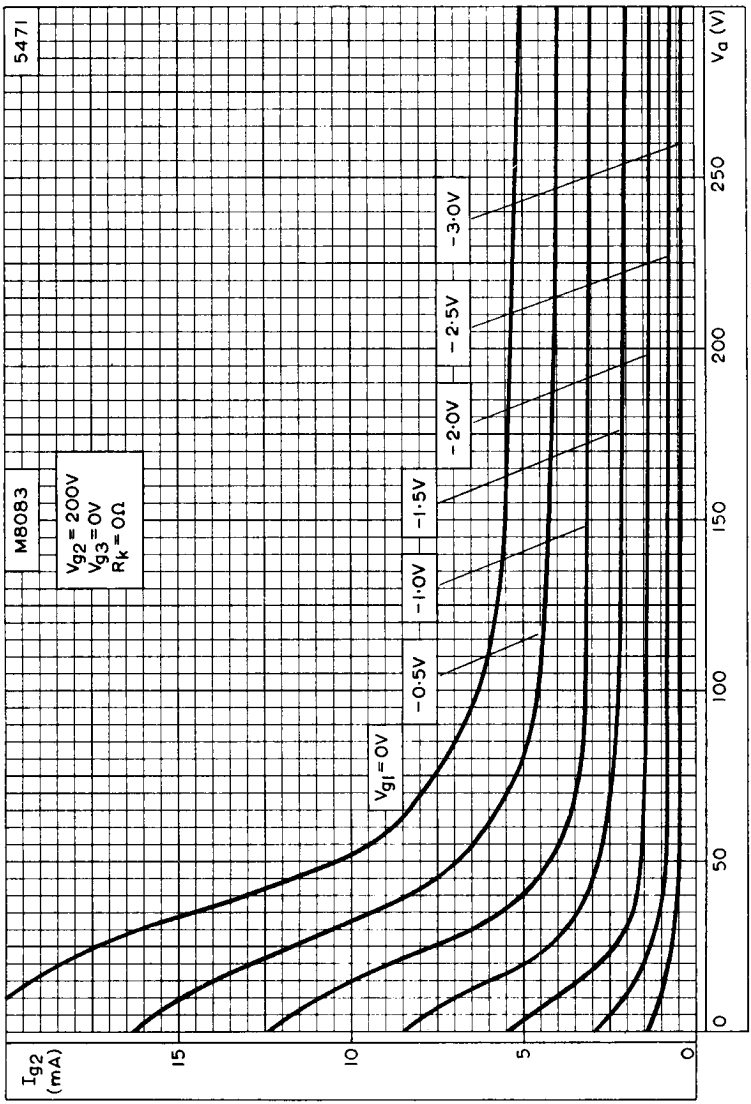
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 200V$



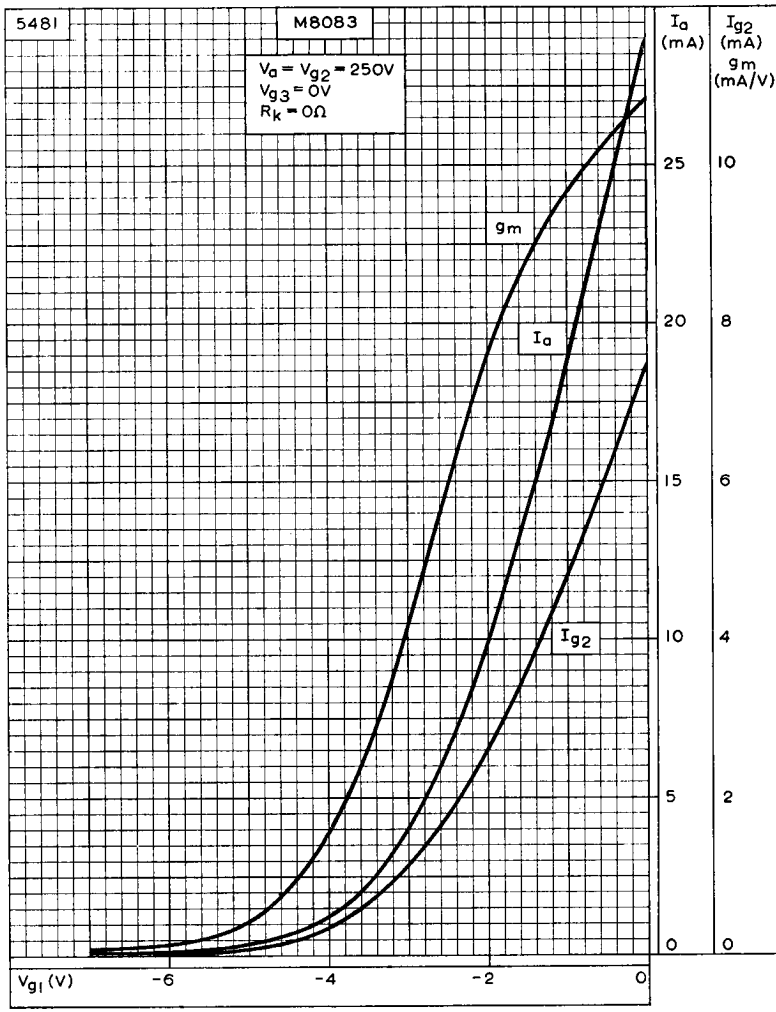
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

M8083

SPECIAL QUALITY R.F. PENTODE



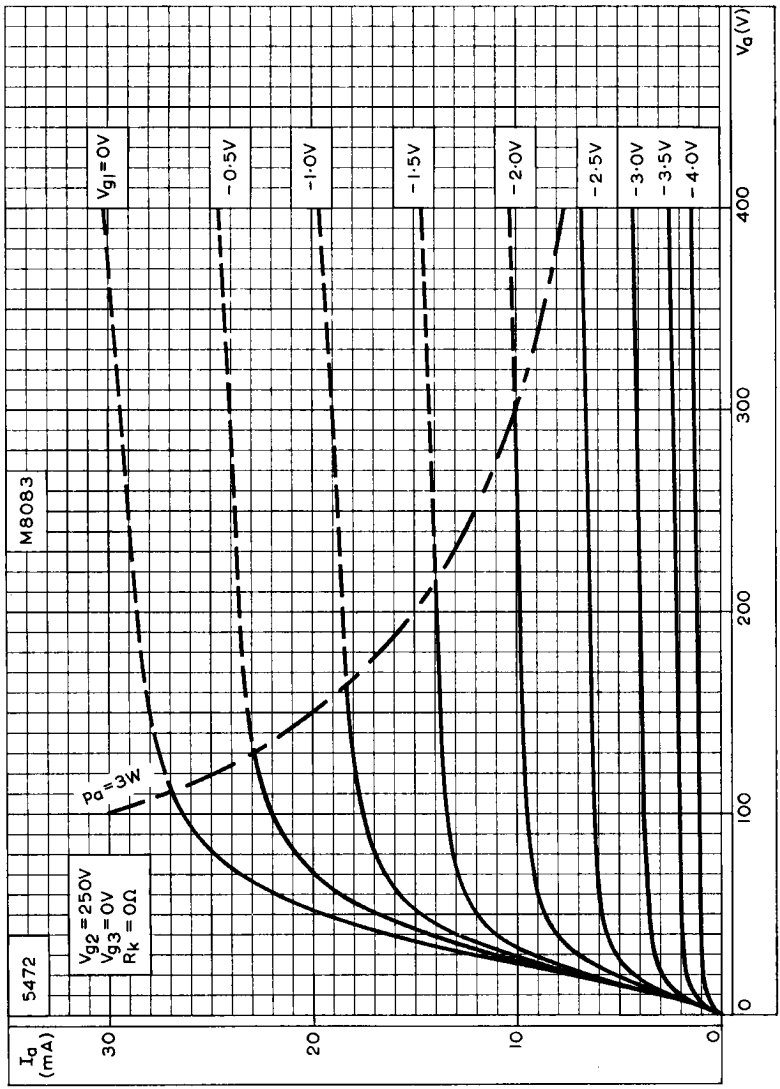
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V



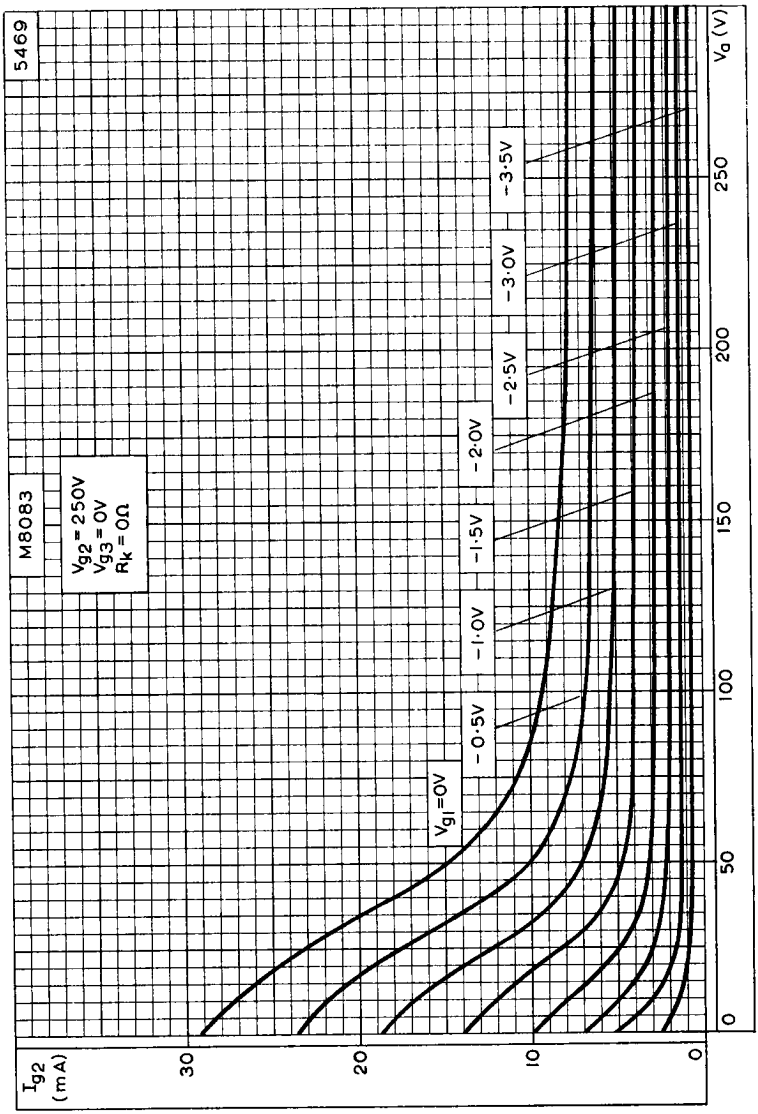
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 250V$

M8083

SPECIAL QUALITY R.F. PENTODE



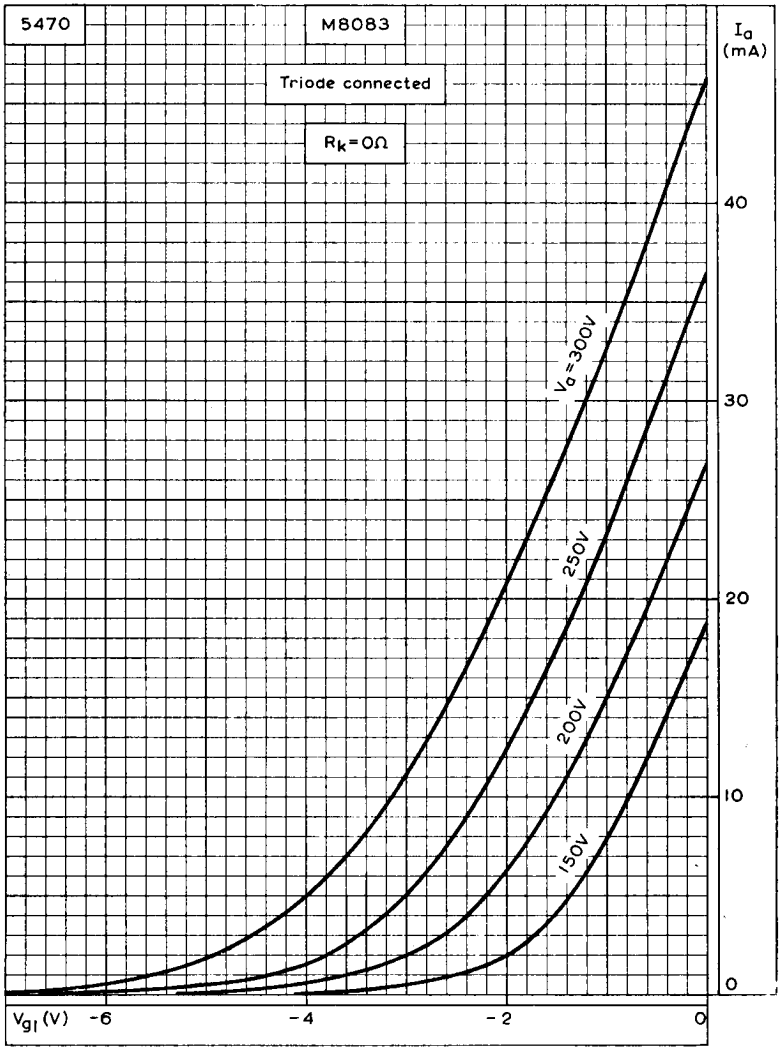
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V



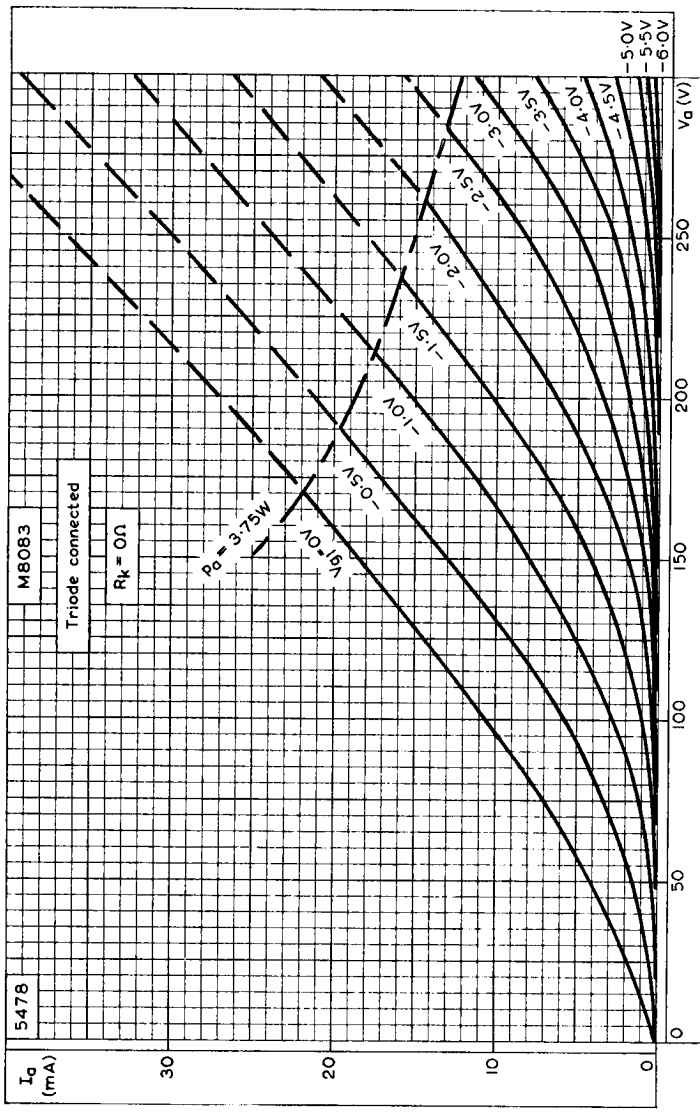
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

M8083

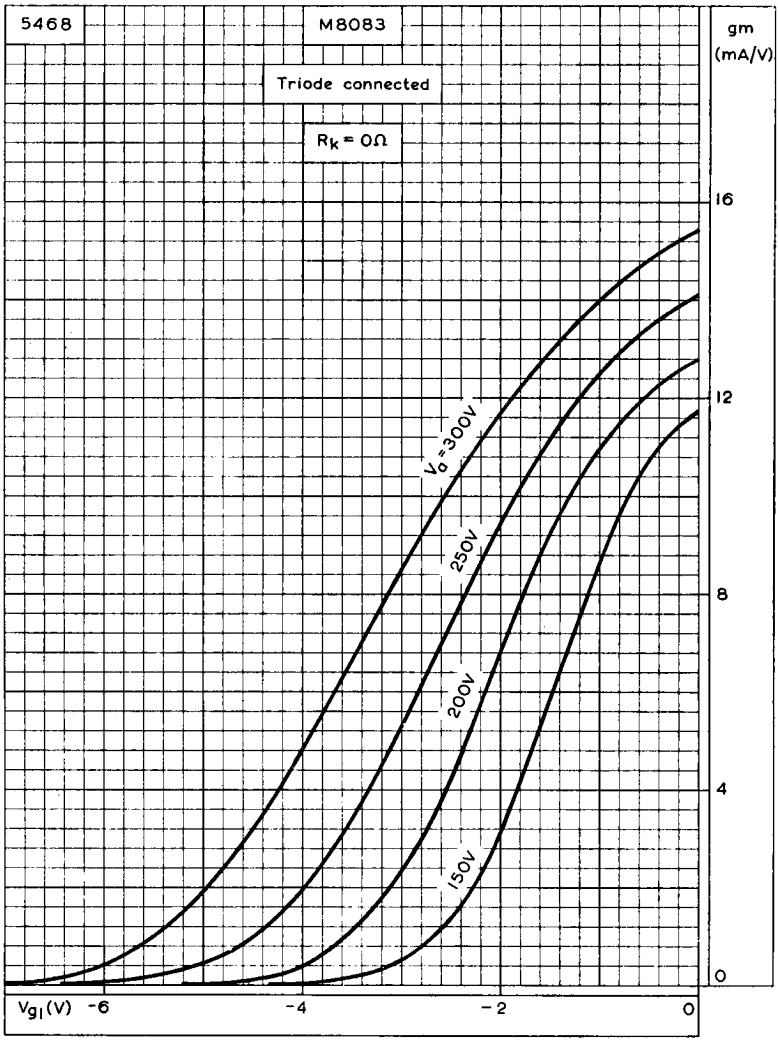
SPECIAL QUALITY R.F. PENTODE



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED



MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED

SPECIAL QUALITY HALF-WAVE RECTIFIER

M8091

Special quality half-wave rectifier primarily intended for operation at high altitudes in equipment where mechanical vibration and shocks are unavoidable.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	1.15	A

MOUNTING POSITION

Any

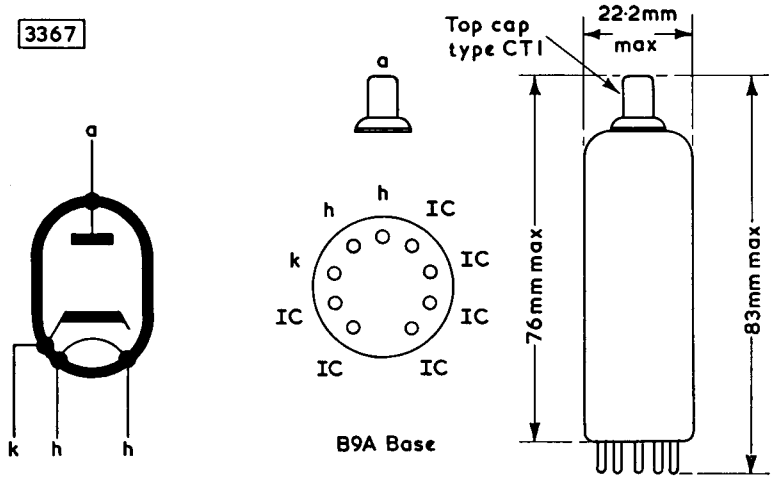
LIMITING VALUES[4] (absolute ratings)

P.I.V. max.	2.0	kV
$i_{a(pk)}$ max.	900	mA
V_{h-k} max.	650	V
Maximum altitude for full P.I.V. rating	60,000	ft
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

TYPICAL OPERATION OF TWO M8091 AS FULL-WAVE RECTIFIER

Capacitor input

$V_{in(r.m.s.)}$	2 × 500	2 × 625	V
R_{lim} min. (per anode)	150	250	Ω
C max.	16	16	μF
I_{out} max.	300	250	mA



M8091

SPECIAL QUALITY
HALF-WAVE RECTIFIER

TEST CONDITIONS (unless otherwise specified)

V_h (V)	$V_{in(r.m.s.)}$ (V)	R_{load} (kΩ)	C (μF)
6.3	625	5	8

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	
GROUP A					
Voltage breakdown	0.25	—	—	—	
GROUP B					
Heater current	0.65	—	0.9	1.4	A
Heater to cathode leakage current. V_{h-k} = 330V (cathode positive)	0.65	—	—	150	μA
Anode voltage. I_a = 150mA	0.65	—	18	26	V
Output current	0.65	—	120	—	mA
Group quality level[10]	1.0	—	—	—	
GROUP C					
Output current. $V_{in(r.m.s.)}$ = 500V, R_{load} = 3kΩ	2.5	—	145	—	mA
†Hot switch	2.5	—	—	—	
†Hot switch. f = 1.5 to 2.4kc/s C reduced to suit frequency	6.5	—	—	—	

†The anode voltage is switched on and off six times and no arcing must occur within the valve.

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	

GROUP E

Fatigue[14]

V_h = 7.0V, 1 minute on 3 minutes off. No other voltages applied, minimum peak acceleration = 5g, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes.

Post fatigue tests

Heater to cathode leakage current. V_{h-k} = 330V (cathode positive)	2.5	—	—	200	μA
Output current	2.5	—	120	—	mA

Shock[15]

No applied voltages, 500g.

Post shock tests

Heater to cathode leakage current. V_{h-k} = 330V (cathode positive)	2.5	—	—	200	μA
Output current	2.5	—	120	—	mA
Voltage breakdown	2.5	—	—	—	
Group quality level[10]	6.5	—	—	—	

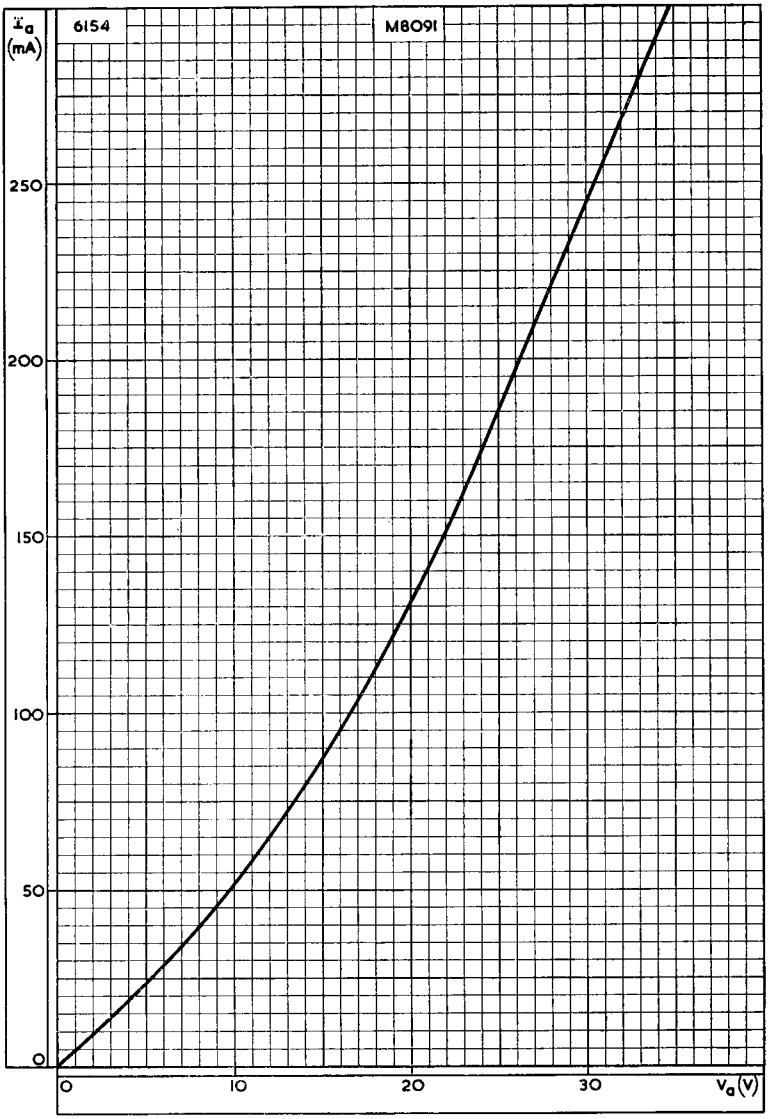
GROUP F

	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	
Life[14]					
Running conditions. $V_{in(r.m.s.)}$ = 500V, R_{load} = 3kΩ V_{h-k} = V_{out} + 150V r.m.s., C = 8μF					
Stability life test end point					
Change in anode voltage after 1 hour. I_a = 150mA	1.0	—	—	10	%
Intermittent life test					
Running conditions. $V_{in(r.m.s.)}$ = 500V, R_{load} = 3kΩ V_{h-k} = V_{out} + 150V r.m.s., C = 8μF					
Intermittent life test end points		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16] .. .. 500 hours		2.5	—	—	
Inoperatives[16] .. .. 1000 hours		4.0	—	—	
Heater current .. .. 500 hours		2.5	0.9	1.4	A
Heater to cathode leakage current. V_{h-k} = 300V (cathode positive) 500 hours		2.5	—	150	μA
Heater to cathode leakage current. V_{h-k} = 300V (cathode positive) 1000 hours		4.0	—	150	μA
Sub-group (b)					
Output current .. .. 500 hours		4.0	120	—	mA
Output current .. .. 1000 hours		6.5	120	—	mA
Group quality level[10] .. .. 500 hours		6.5	—	—	
Group quality level[10] .. .. 1000 hours		10	—	—	

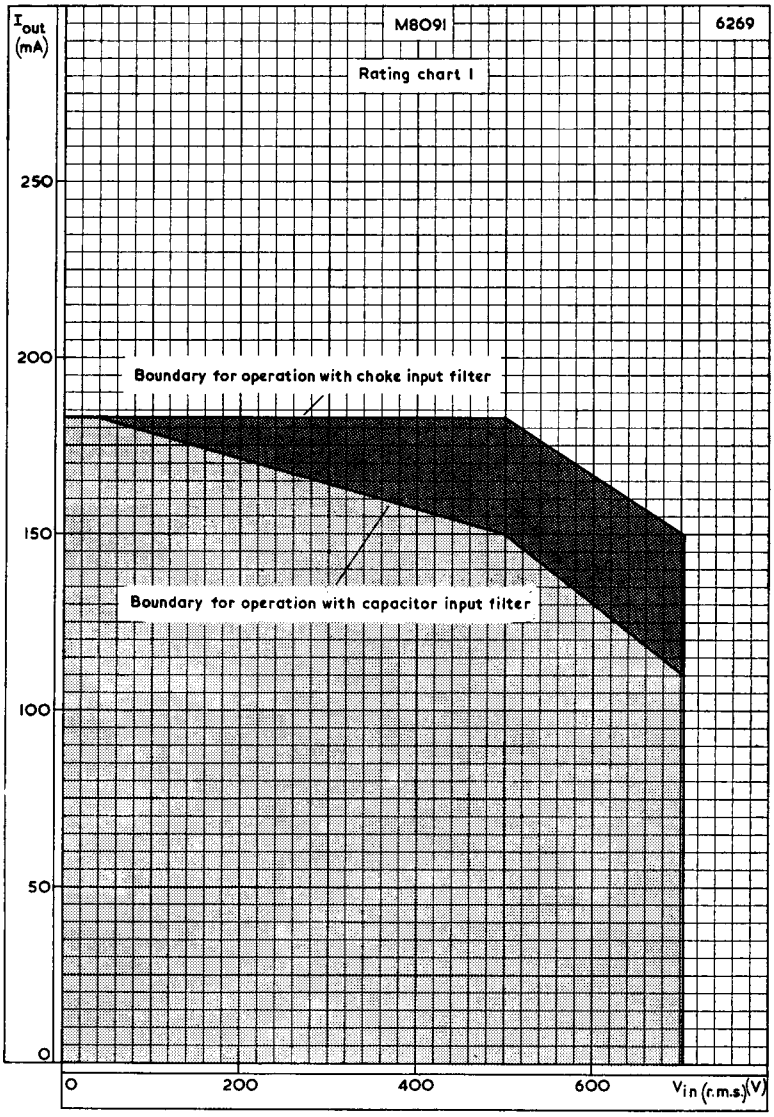
GROUP G

Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	

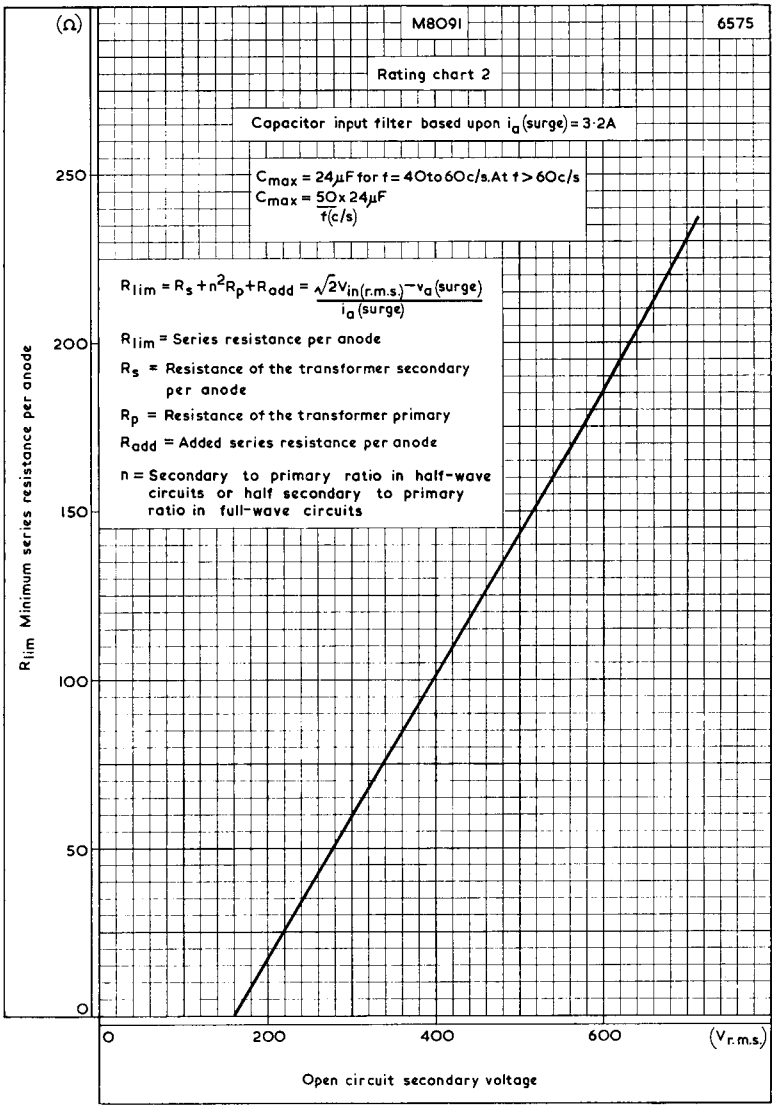
M8091



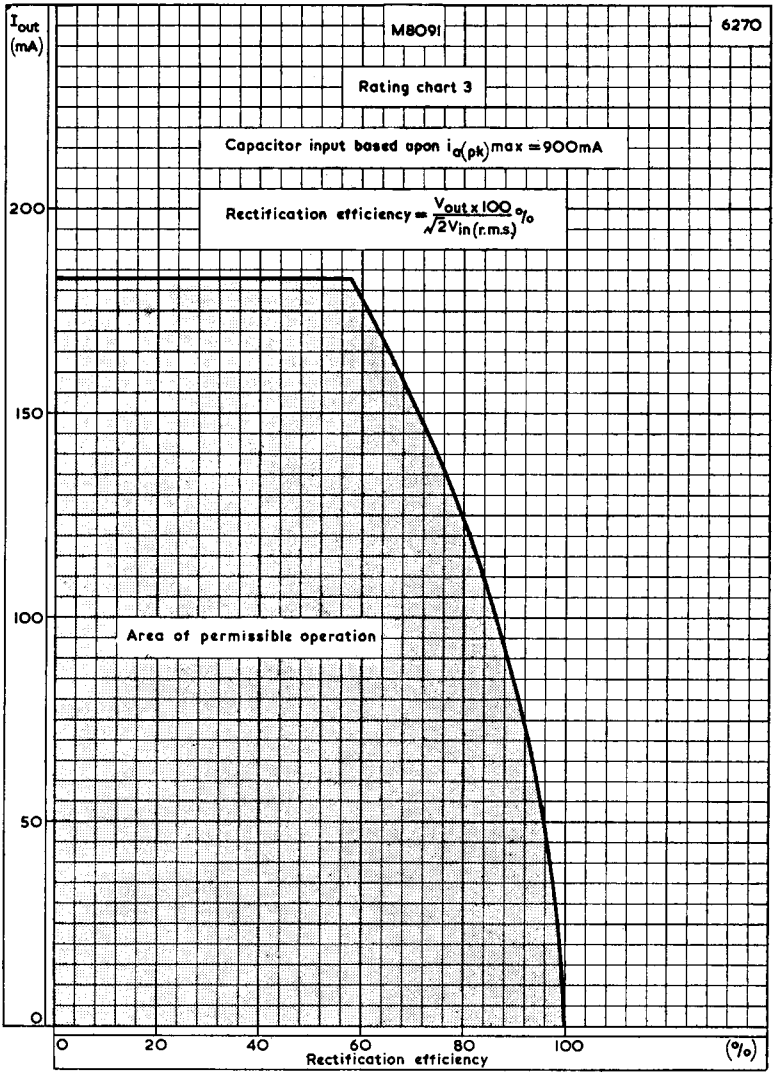
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



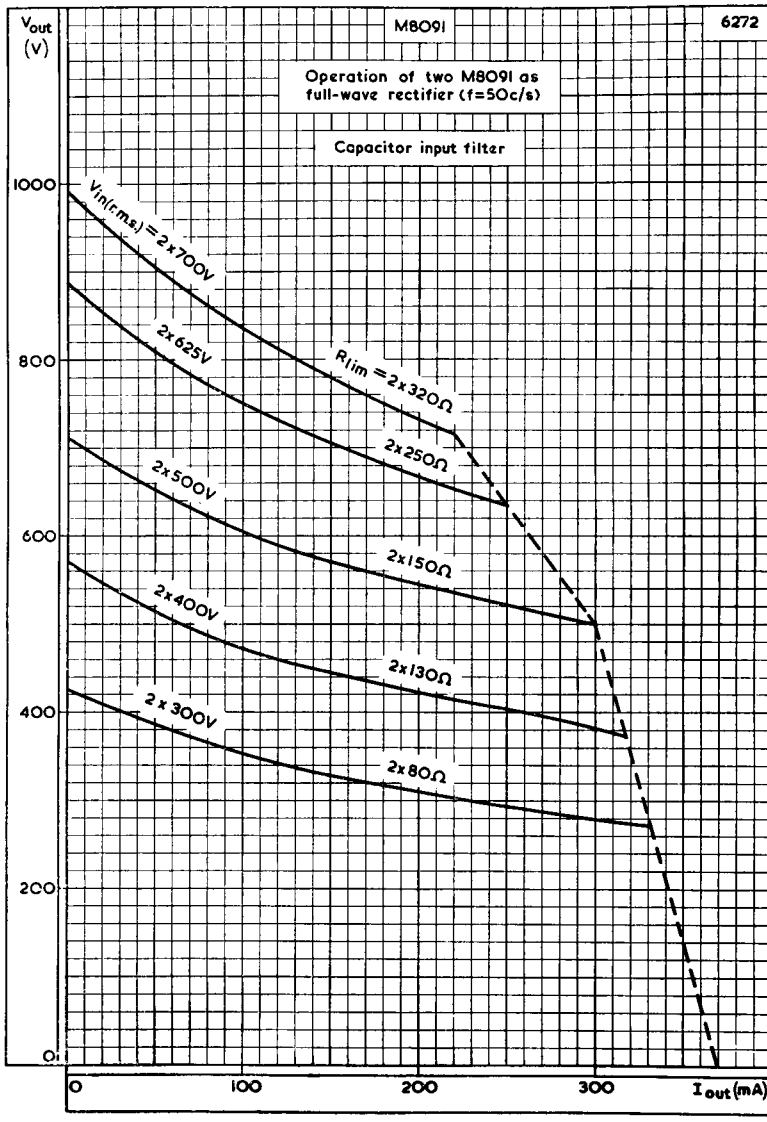
BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER



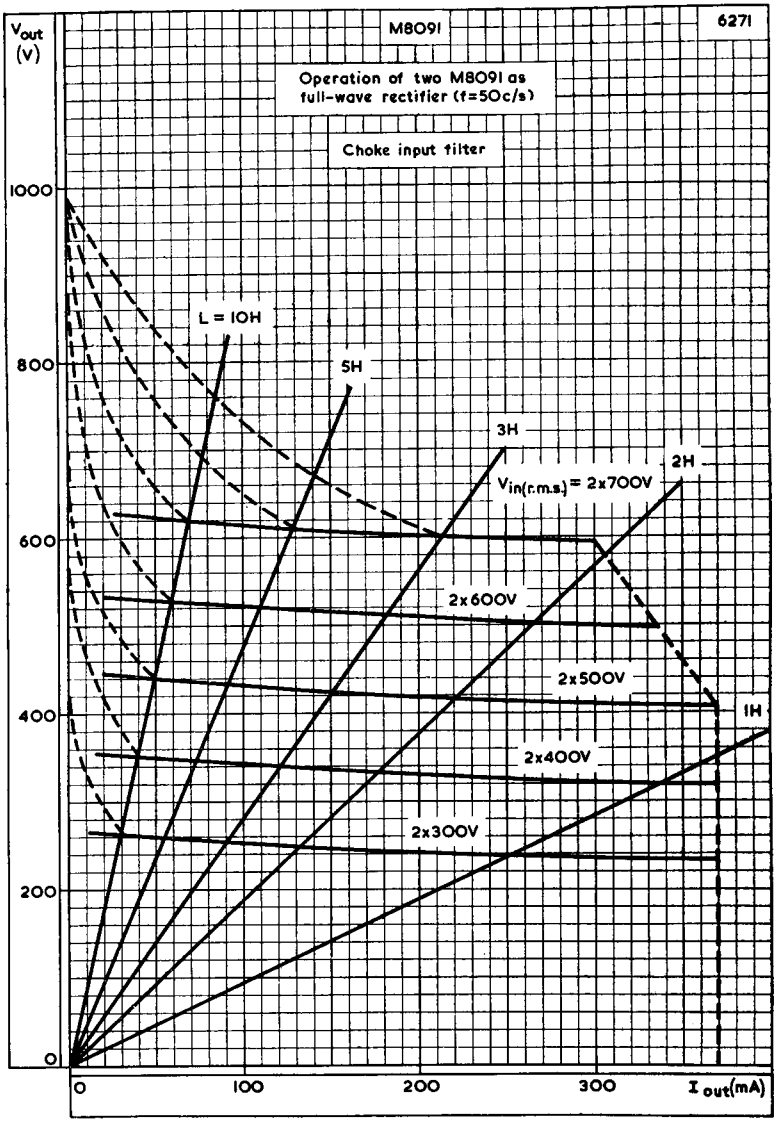
MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST OPEN CIRCUIT SECONDARY VOLTAGE



OUTPUT CURRENT PLOTTED AGAINST RECTIFICATION EFFICIENCY



CAPACITOR INPUT FILTER REGULATION CURVES



CHOKE INPUT FILTER REGULATION CURVES

SPECIAL QUALITY V.H.F. POWER TETRODE

M8096

Special quality r.f. beam power tetrode for use at frequencies up to 175Mc/s in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.0	V
I_h	750	mA

CAPACITANCES[2] (measured without an external shield)

c_{a-g1}	<300	mpF
c_{in}	9.5	pF
c_{out}	4.5	pF

CHARACTERISTICS[3]

V_a	250	V
V_{bp}	0	V
V_{g2}	250	V
V_{g1}	–7.5	V
I_a	45	mA
I_{g2}	4.5	mA
g_m	7.0	mA/V
μ_{g1-g2}	16	
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

f max.	175	Mc/s
$V_{a(b)}$ max.	500	V
V_a max.	300	V
$V_{g2(b)}$ max.	500	V
V_{g2} max.	250	V
$-V_{g1}$ max.	125	V
p_a max.	12	W
p_{g2} max.	2.0	W
I_k max.	60	mA
$i_{k(pk)}$ max.	550	mA
V_{h-k} max.	100	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	250	°C

M8096

SPECIAL QUALITY
V.H.F. POWER TETRODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{bp} (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.0	250	0	250	−7.5	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest, g_2-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid-current								
R_{g1} max. = 100kΩ	0.25	—	—	2.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	690	810	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	20	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	20	—	—	—	μA
†Anode current	0.65	45	33	57	—	—	—	mA
	—	—	—	—	39	51	4.6	mA
Screen-grid current	0.65	—	—	7.0	—	—	—	mA
Mutual conductance	0.65	7.0	5.6	9.0	—	—	—	mA/V
	—	—	—	—	6.3	7.7	0.54	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

When V_{g1} is applied in turn to pins 8 and 9,

†no change in anode current should result.

GROUP C

Anode current. $V_{g1} = -15V$	2.5	—	—	15	—	—	—	mA
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration, $V_b = 250V$, $R_a = 2.0k\Omega$, $V_g = -15V$.	2.5	—	—	250	—	—	—	mV (r.m.s.)
Amplification factor (μ_{g1-g2})	2.5	—	13	20	—	—	—	
*Beam plate continuity test. $V_{bp} = 250V$	2.5	—	—	—	—	—	—	
Group quality level[10]	6.5	—	—	—	—	—	—	

*The anode and screen-grid currents should change from the values obtained in group B

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{a-g}	—	—	—	300	—	—	—	mpF
C_{in}	—	—	7.9	11.1	—	—	—	pF
C_{out}	—	—	3.0	6.0	—	—	—	pF
Reverse grid current. $V_h = 6.6V$, $V_a = 300V$, $V_{g2} = 250V$, $I_a = 40mA$	6.5	—	—	2.5	—	—	—	μA
Power oscillation. $V_{a(b)} = 300V$, $I_a = 50mA$, $R_{g1} = 16k\Omega$, f = 135Mc/s	6.5	—	1.5	—	—	—	—	W
Reverse screen-grid current. $V_a = 0V$, $I_{g2} = 10mA$, $V_{g2} = 170V_{r.m.s.}$	6.5	—	—	500	—	—	—	μA
*Peak cathode current. $v_{a(pk)} = v_{g1(pk)} = v_{bp(pk)} = 200V$	6.5	—	4.5	—	—	—	—	A

*The voltage waveform should be a half-sine wave. P.R.F. = 50p/s., t_p max. = 12.5μs.

	A.Q.L.[5]	Individuals[6]			Lot average[7]		Lot standard deviation[8]	
	(%)	Bogey[9]	Min.	Max.	Min.	Max.	Max.	
GROUP E								
Fatigue[14]								
V_h = 6.6V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	40	—	—	—	μA
Reverse grid current. R_{g1} max. = 100kΩ	2.5	—	—	5.0	—	—	—	μA
Power oscillation as in group D	2.5	—	1.0	—	—	—	—	W
Microphonic noise as in group C	2.5	—	—	500	—	—	—	mV (r.m.s.)
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	40	—	—	—	μA
Reverse grid current. R_{g1} max. = 100kΩ	2.5	—	—	5.0	—	—	—	μA
Power oscillation as in group D	2.5	—	1.0	—	—	—	—	W
Microphonic noise as in group C	2.5	—	—	500	—	—	—	mV (r.m.s.)

GROUP F

Stability life test[14]

Running conditions. $R_{g1} = 100k\Omega \pm 20\%$, $R_k = 150\Omega \pm 10\%$, $V_{h-k} = 100V$ (cathode negative), $C_k = 1000\mu F$

Stability life test end points

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

Running conditions. $R_{g1} = 100k\Omega \pm 20\%$, $R_k = 150\Omega \pm 10\%$, $V_{h-k} = 100V$ (cathode negative) $C_k = 1000\mu F$

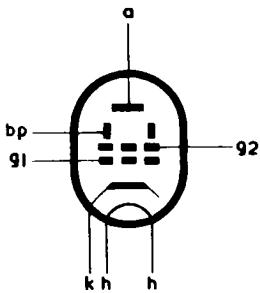
Intermittent life test end points

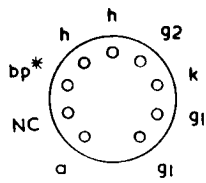
				A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)							
Inoperatives[16]	500 hours			2.5	—	—	
	1000 hours			4.0	—	—	
Heater current	500 hours			2.5	640	810	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours			2.5	—	30	μA
	1000 hours			4.0	—	40	μA
Reverse grid current. R_{g1} max. = 100kΩ	500 hours			2.5	—	3.0	μA
	1000 hours			4.0	—	4.0	μA
Mutual conductance	500 hours			2.5	4.8	—	mA/V
	1000 hours			4.0	4.5	—	mA/V
Average change in mutual conductance	500 hours			—	—	15	%
Sub-group (b)							
Anode current	500 hours			4.0	28	57	mA
	1000 hours			6.5	25	—	mA
Insulation as in group A	500 hours			4.0	50	—	MΩ
	1000 hours			6.5	30	—	MΩ
Power oscillation as in group D	500 hours			4.0	1.0	—	W
	1000 hours			6.5	0.8	—	W
Group quality level[10]	500 hours			6.5	—	—	
	1000 hours			10	—	—	

M8096

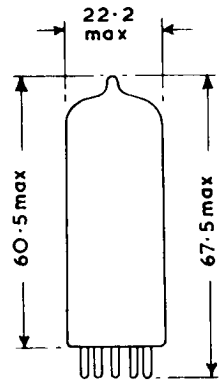
SPECIAL QUALITY V.H.F. POWER TETRODE

GROUP G	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse grid current. R_{g1} max. = 100kΩ	0.5	—	2.5	μA





B9A Base



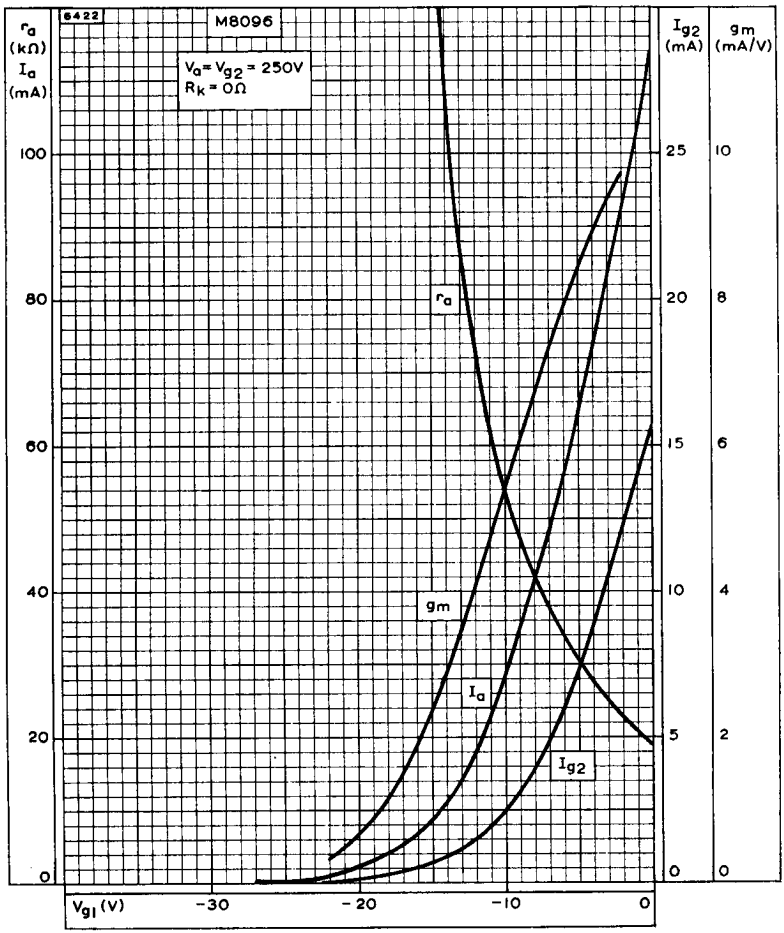
All dimensions in mm

* Connect contact 3 to contact 7 at socket. Contacts 8 and 9 should be connected to external circuit with leads of equal length.

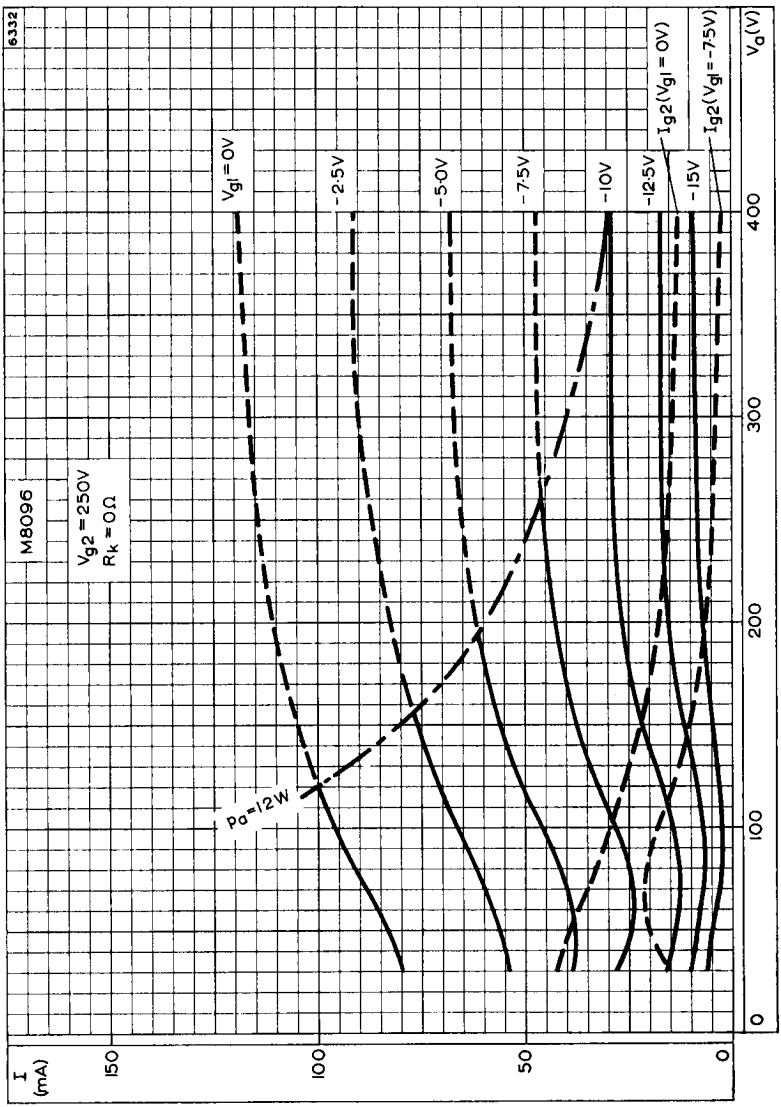
6309

The bulb and base dimensions of this valve are in accordance with BS448, Section B9A

M8096



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY VOLTAGE REFERENCE TUBE

M8098

Special quality 85V gas-filled voltage reference tube for use in equipment where mechanical vibration and shocks are unavoidable.

PRELIMINARY DATA

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VOLTAGE STABILISER & REFERENCE TUBES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

LIMITING VALUES[1] (absolute ratings)

*Minimum voltage necessary for ignition	115	V
Burning current		
Maximum	10	mA
Minimum	1.0	mA
Maximum negative anode voltage	75	V
Ambient temperature limits	−55 to +90	°C

*This value covers operation in daylight and complete darkness.

PREFERRED OPERATING CONDITION

Burning current	6.0	mA

CHARACTERISTICS

Measured at preferred operating condition and $T_{ambient}$ = 25°C

Maintaining voltage (variation from tube to tube)	83 to 87	V
Incremental resistance		
Average	300	Ω
Maximum	450	Ω
Maximum increase in maintaining voltage as current is varied from 1 to 10mA	4.0	V
*Maximum percentage variation of maintaining voltage over first 1000 hours of life	0.5	%
Typical percentage drift of maintaining voltage per 1000 hours after 1300 hours	0.1	%

*After the initial warming-up period of 3 minutes

Discontinuities of the I_a/V_a characteristic

Typical voltage jumps over current range 4 to 10mA	5.0	mV
Maximum voltage jumps over current range 1 to 10mA	100	mV

SHORT-TERM STABILITY

Maximum short-term variation of maintaining voltage for any 8 hour period after the first 100 hours life will be better than 0.01% provided there is an initial warming-up period of 3 minutes.

Maximum short-term (100 hours max.) variation of maintaining voltage after the first 300 hours of life is 0.1%.

In order to avoid voltage variations due to temperature fluctuations it will in general be sufficient to draught shield the tube.

M8098

SPECIAL QUALITY VOLTAGE REFERENCE TUBE

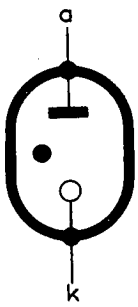
OPERATING NOTES

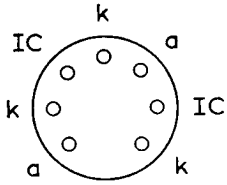
A steady maintaining voltage is reached within 3 minutes.

The greatest constancy of maintaining voltage is obtained if the tube is operated at the preferred current.

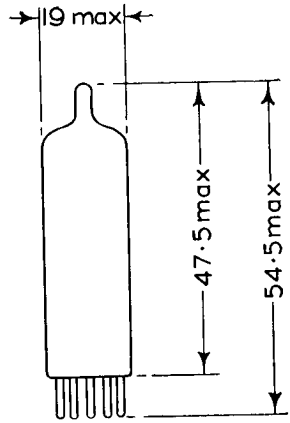
The noise generated by the tube over a frequency band of 30 to 10,000c/s is of the order of 60μV, which is equivalent to the noise generated by a resistor of approximately 22MΩ at a temperature of 300°K. The noise is evenly distributed over the frequency range.

4401





B7G Base



All dimensions in mm

The bulb and base dimensions of this tube are in accordance with BS448, Section B7G.

TEST CONDITIONS (unless otherwise specified)

R_{lim} (kΩ)	$I_{burning}$ (mA)
5.0	6.0

After initial warming-up period of 3 minutes at burning current of 6mA.

TESTS	A.Q.L.[2] (%)	Individuals[3] Min.	Max.	
GROUP A				
Ignition voltage. Illumination 5 to 50 ft. cd.	†	—	115	mV
Maintaining voltage	†	83	87	V
Change in maintaining voltage for burning current change from 5.8 to 6.2mA	†	—	180	mV
Voltage jumps. Burning current varies from 1 to 10mA. $R_a = 500\Omega$	†	—	100	mV (pk–pk)
Oscillation. Burning current varies from 1 to 10mA. $R_a = 500\Omega$	†	—	5	mV (pk–pk)
Microphonic noise. $R_a = 500\Omega$	†	—	15	mV (pk–pk)
Leakage current. Supply voltage = 55V, $R_a = 1M\Omega$	†	—	5	μA

†This test is carried out on a 100% basis.

GROUP B				
Ignition voltage in darkness, after 24 hours in darkness	2.5	—	115	V
Change in maintaining voltage for burning current change from 1 to 10mA	2.5	—	4.0	V

TESTS	A.Q.L.[2] (%)	Individuals[3] Min.	Max.	
GROUP C				
Glass strain test [8A]. No applied voltage	6.5	—	—	
Base strain test [9]. No applied voltage	6.5	—	—	
Resonance search				
Vibrated at 2g over frequency range specified.				
25 to 500c/s	2.5	—	5	mV (r.m.s.)
500 to 2500c/s	2.5	—	15	mV (r.m.s.)
Fatigue[11]				
No applied voltage, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes				
Post fatigue tests				
Change in maintaining voltage	2.5	—	±0.7	V
Microphonic noise as in Group A	2.5	—	30	mV (pk–pk)
Sub-group quality level[7]	4.0	—	—	
Shock[12]				
No applied voltage, 500g				
Post shock tests				
Change in maintaining voltage	2.5	—	±0.7	V
Microphonic noise as in Group A	2.5	—	30	mV (pk–pk)
Sub-group quality level[7]	4.0	—	—	

GROUP D

Life test[11]

Burning current = 6mA continuous

Life test end points. 1000 hours

Inoperatives[13]	2.5	—	—		
Ignition voltage	2.5	—	115	V	
Change in maintaining voltage	2.5	—	±0.4	V	
Change in maintaining voltage for burning current change from 5.8 to 6.2mA	2.5	—	180	mV	

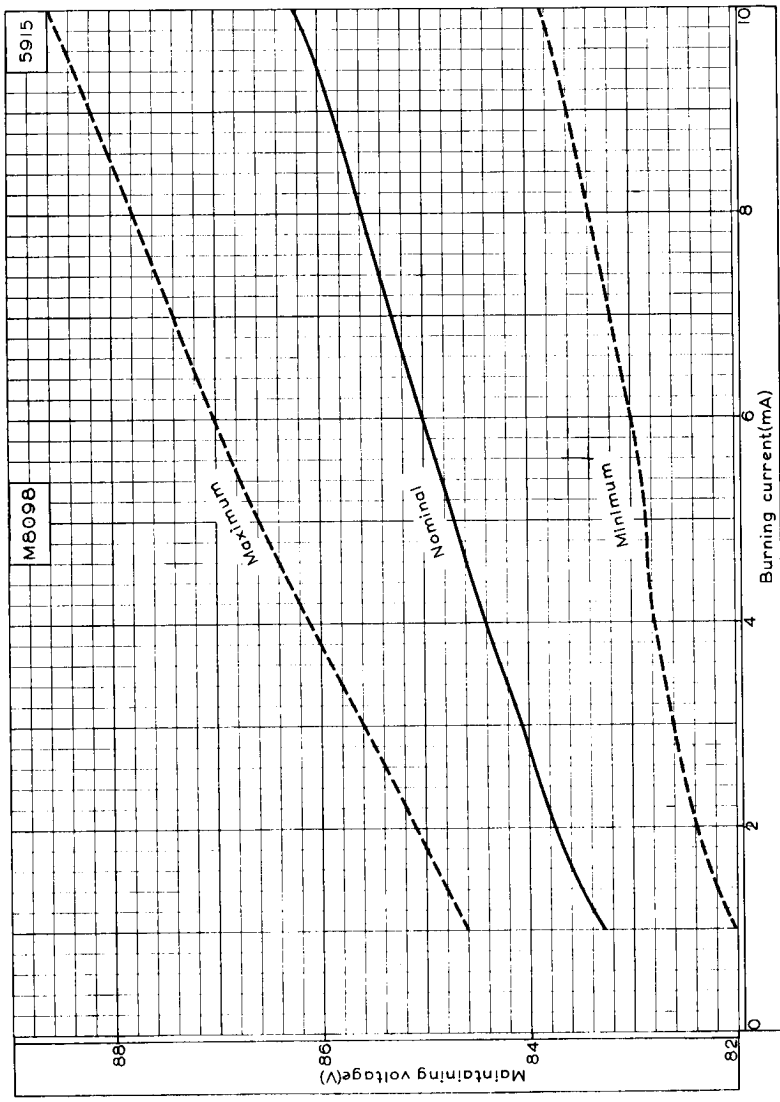
GROUP E

Tubes are held for 28 days and retested for

Inoperatives[13]	0.5	—	—		
Ignition voltage	0.5	—	115	V	
Maintaining voltage	0.5	83	87	V	
Change in maintaining voltage for burning current change from 5.8 to 6.2mA	0.5	—	180	mV	

SPECIAL QUALITY VOLTAGE REFERENCE TUBE

M8098



MAINTAINING VOLTAGE PLOTTED AGAINST BURNING CURRENT

SPECIAL QUALITY V.H.F. PENTODE

M8100

Special quality low noise, high slope r.f. pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES – SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	175	mA

CAPACITANCES[2] (measured with an external shield)

c_{a-g1}	<20	mpF
c_{in}	4.0	pF
c_{out}	3.1	pF

CHARACTERISTICS[3]

V_a	120	180	V
V_{g2}	120	120	V
I_a	7.5	7.7	mA
I_{g2}	2.5	2.4	mA
V_{g1}	–2.0	–2.0	V
g_m	5.0	5.1	mA/V
r_a	250	400	kΩ
μ_{g1-g2}	35	35	
R_k	0	0	Ω

ABSOLUTE MAXIMUM RATINGS[4]

f max.	400	Mc/s
$V_{a(b)}$ max.	400	V
V_a max.	200	V
p_a max.	1.65	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	550	mW
$-V_{g1}$ max.	55	V
I_{g1} max.	4.0	mA
R_{g1-k} max.	3.0	MΩ
I_k max.	20	mA
V_{h-k} max.	130	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.3	120	120	−2.0	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest, g_2-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current								
R_{g1} max. = 500kΩ	0.25	—	—	0.1	—	—	—	μA
GROUP B								
Heater current	0.65	—	160	190	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	—	—	μA
Anode current	0.65	7.5	5.0	11	—	—	—	mA
	—	—	—	—	6.5	8.5	0.87	mA
Screen-grid current	0.65	2.5	0.8	4.0	—	—	—	mA
	—	—	—	—	1.8	3.2	0.52	mA
Mutual conductance	0.65	5.0	4.0	6.25	—	—	—	mA/V
	—	—	—	—	4.525	5.475	0.357	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_{g1} = -10V$	2.5	—	—	200	—	—	—	μA
Anode current. $V_{g1} = -5.5V$	2.5	—	5.0	—	—	—	—	μA
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse grid current. $V_h = 7.0V$, $R_{g1} = 100k\Omega$	2.5	—	—	0.5	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.0g min. peak acceleration, $V_b = 135V$, $R_a = 2k\Omega$, $R_{g2} = 10k\Omega$, $C_{g2} = 2\mu F$, $R_{g1} = 100k\Omega$	2.5	—	—	45	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

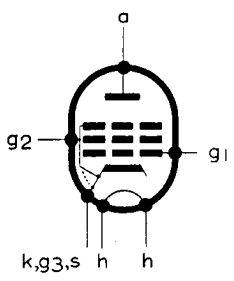
GROUP D

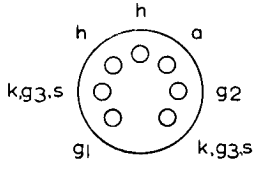
Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	3.4	4.6	—	—	—	pF
C_{out}	—	—	2.45	3.25	—	—	—	pF
C_{a-g1}	—	—	—	20	—	—	—	mpF
Noise factor	4.0	—	—	2.5	—	—	—	dB

TESTS	A.Q.L.[5]	Individuals[6]			Lot average[7]		Lot standard deviation[8]	
GROUP E	(%)	Bogey[9]	Min.	Max.	Min.	Max.	Max.	
Fatigue[14]								
V_h = 6.3V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s, for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current.								
V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current.								
R_{g1} max. = 500kΩ	2.5	—	—	0.2	—	—	—	μA
Mutual conductance	2.5	—	3.5	—	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	90	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current.								
V_{h-k} = ±100V	2.5	—	—	30	—	—	—	μA
Reverse grid current.								
R_{g1} max. = 500kΩ	2.5	—	—	0.2	—	—	—	μA
Mutual conductance	2.5	—	3.5	—	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	90	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
GROUP F								
Stability life test[14]								
Running conditions. V_a = 150V, V_{g2} = 125V, R_{g1} = 100kΩ, R_k = 130Ω, V_{h-k} = 135V (cathode negative).								

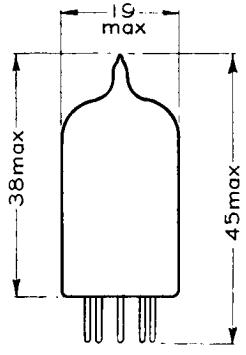
Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Intermittent life test								
Running conditions. $V_a = 150V$, $V_{g2} = 125V$, $R_{g1} = 100k\Omega$, $R_k = 130\Omega$, $V_{h-k} = 135V$ (cathode negative).								
Intermittent life test end points					A.Q.L.[5] (%)	*Min.*	*Max.*	
Sub-group (a)								
Inoperatives[16]				500 hours	2.5	—	—	
				1000 hours	4.0	—	—	
Heater current				500 hours	2.5	160	190	mA
				1000 hours	4.0	160	190	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$				500 hours	2.5	—	10	μA
				1000 hours	4.0	—	10	μA
Reverse grid current. R_{g1} max. = 500kΩ				500 hours	2.5	—	0.1	μA
				1000 hours	4.0	—	0.1	μA
Mutual conductance				500 hours	2.5	3.75	6.25	mA/V
				1000 hours	4.0	3.5	6.25	mA/V
Average change in mutual conductance				500 hours	—	—	15	%
Sub-group (b)								
Anode current				500 hours	4.0	4.5	11	mA
				1000 hours	6.5	4.0	11	mA
Insulation as in group A				500 hours	4.0	50	—	MΩ
				1000 hours	6.5	30	—	MΩ
Noise factor				500 hours	4.0	—	2.7	dB
				1000 hours	6.5	—	2.8	dB
Group quality level[10]				500 hours	6.5	—	—	
				1000 hours	10	—	—	
GROUP G								
Valves are held for 28 days and retested for								
Inoperatives[16]					0.5	—	—	
Reverse grid current. R_{g1} max. = 500kΩ					0.5	—	0.15	μA

M8100 SPECIAL QUALITY V.H.F. PENTODE





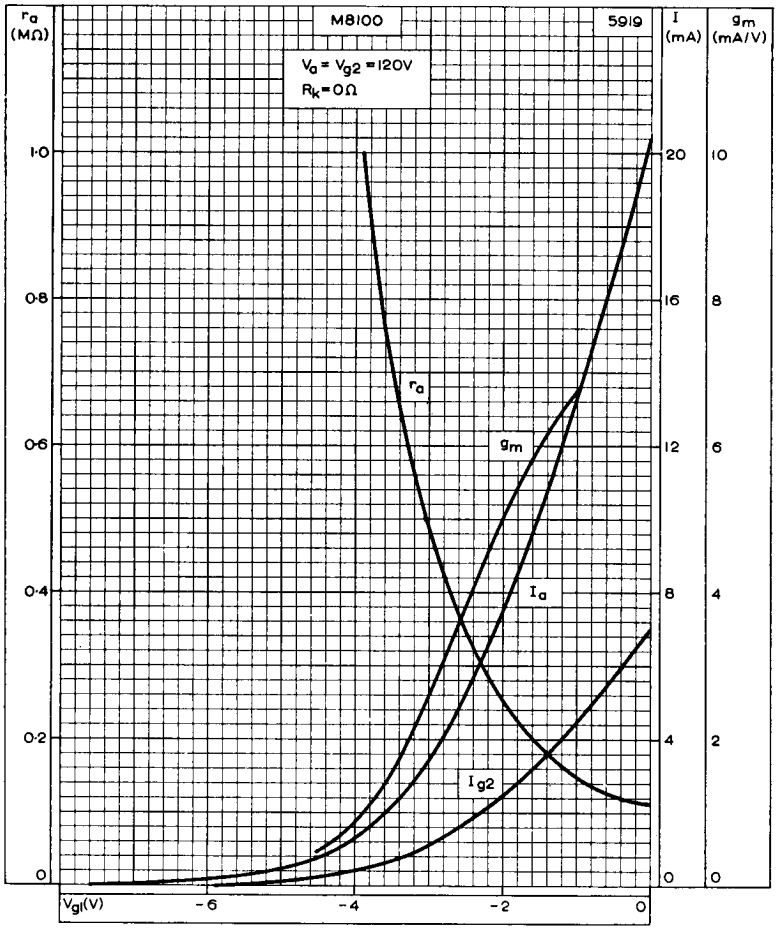
B7G Base



4748

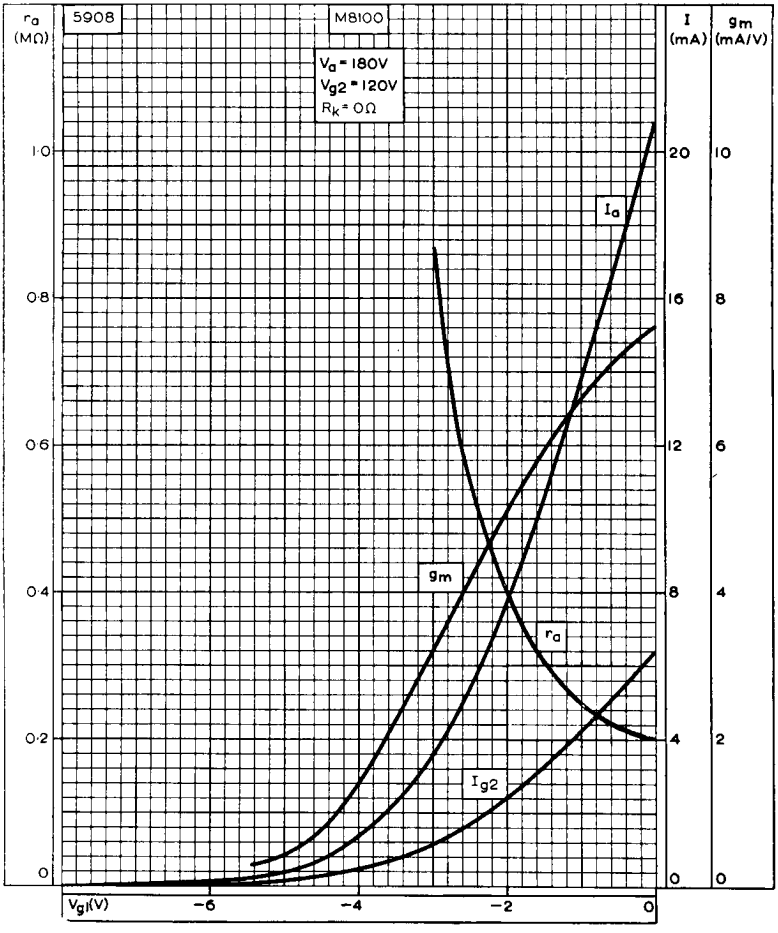
All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, Section B7G

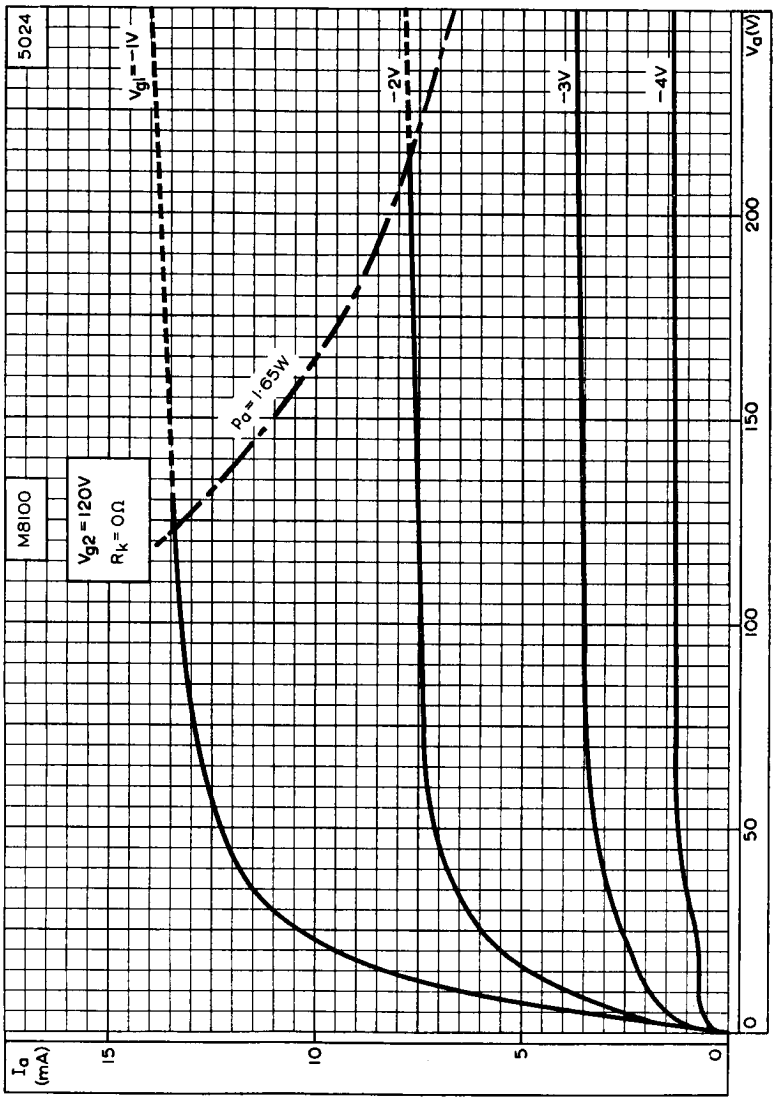


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = 120V$

M8100 SPECIAL QUALITY V.H.F. PENTODE

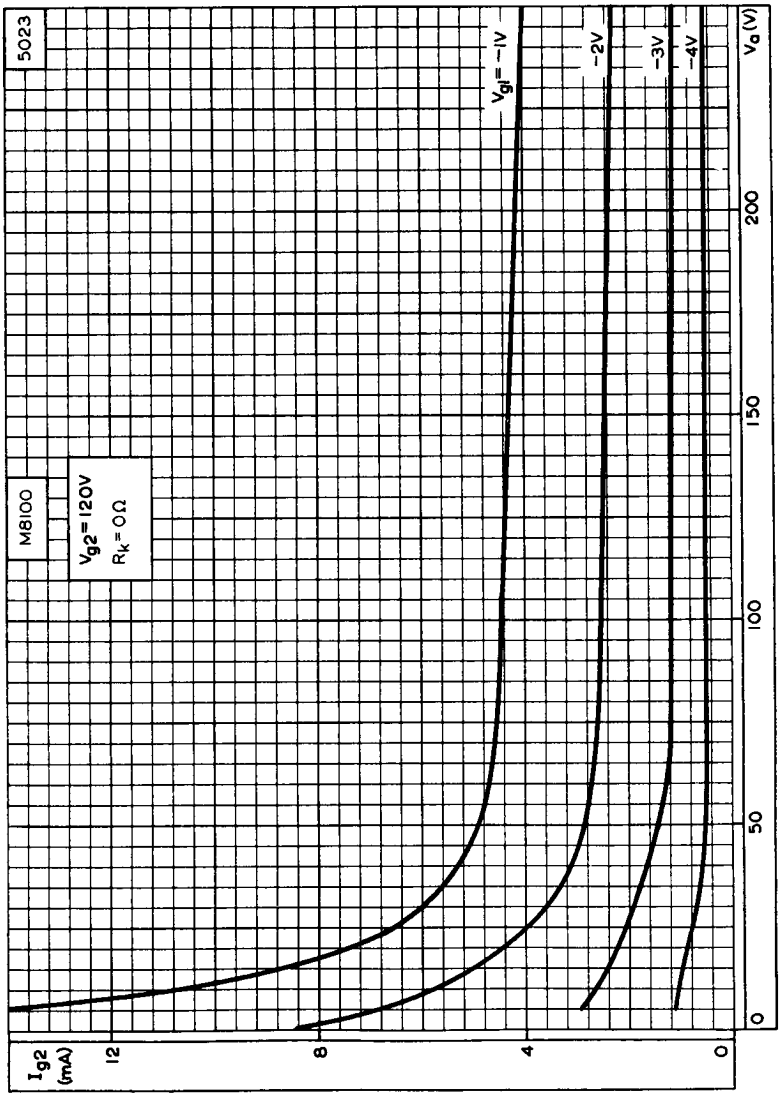


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
V_a = 180V

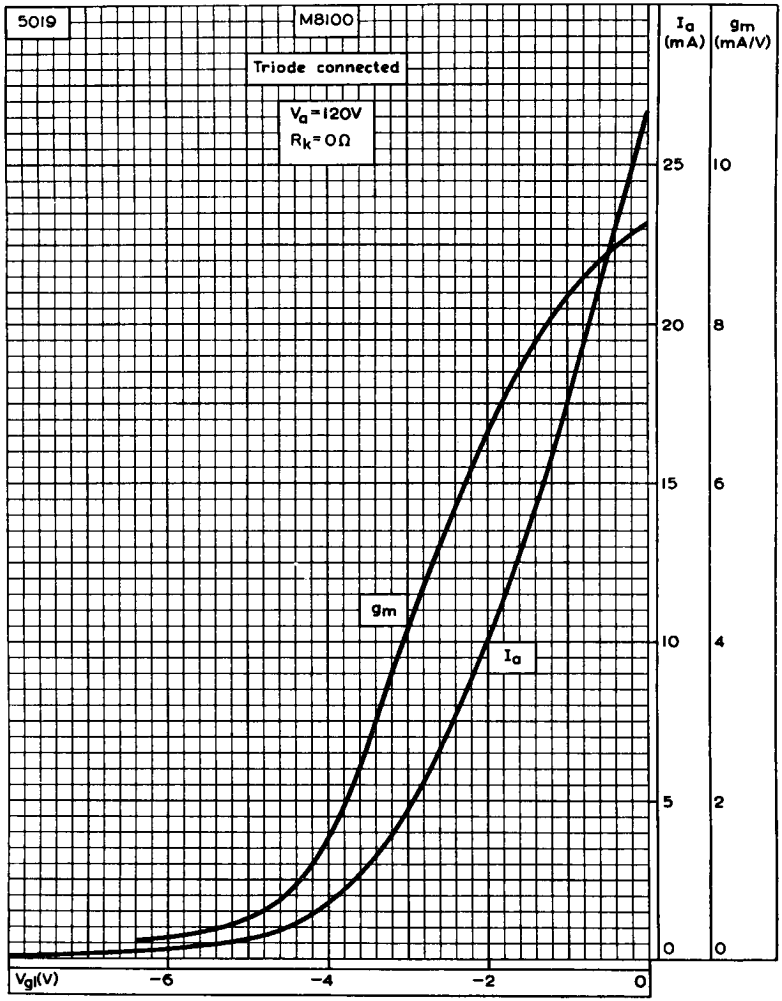


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.

M8100 SPECIAL QUALITY V.H.F. PENTODE

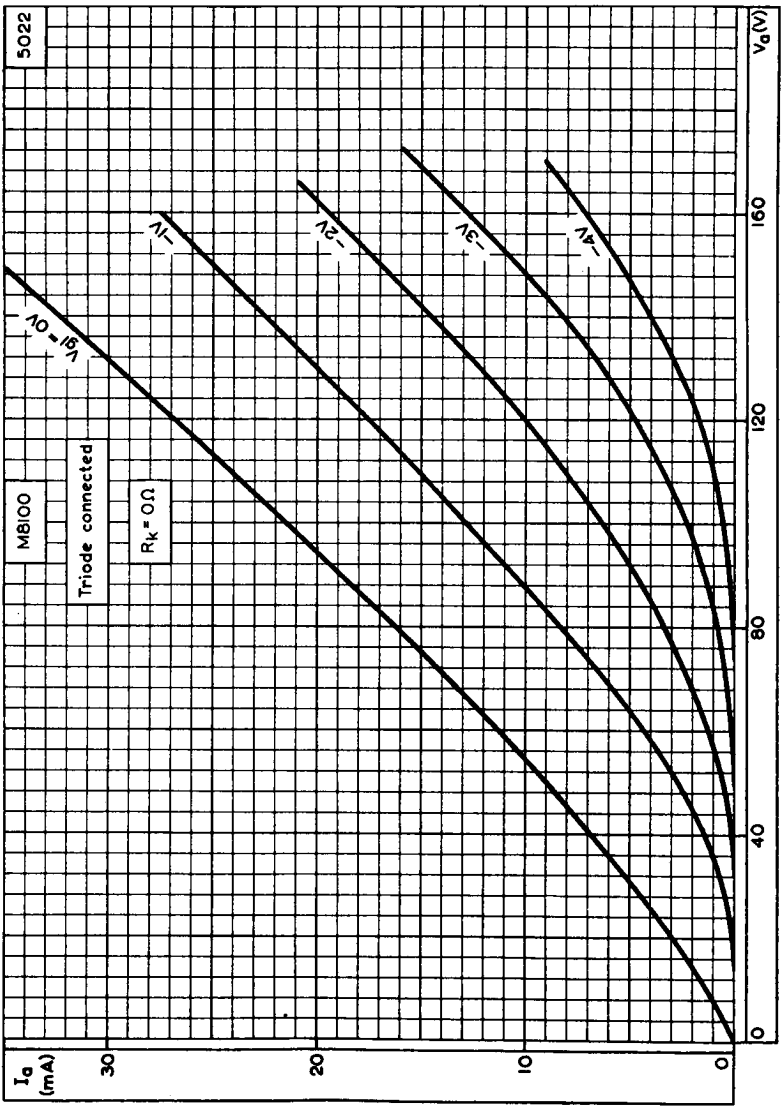


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.



ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE, WHEN TRIODE CONNECTED.

M8100 SPECIAL QUALITY V.H.F. PENTODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED.

SPECIAL QUALITY VOLTAGE REFERENCE TUBE

M8142

Special quality 85V gas-filled voltage reference tube with flying leads, for use in equipment where mechanical vibration and shocks are unavoidable.

PRELIMINARY DATA

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VOLTAGE STABILISER & REFERENCE TUBES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

LIMITING VALUES[1] (absolute ratings)

*Minimum voltage necessary for ignition	115	V
Burning current		
Maximum	10	mA
Minimum	1.0	mA
Maximum negative anode voltage	75	V
Ambient temperature limits	−55 to + 90	°C

*This value covers operation in daylight and complete darkness.

PREFERRED OPERATING CONDITION

Burning current	6.0	mA

CHARACTERISTICS

Measured at preferred operating condition and $T_{ambient}$ = 25°C

Maintaining voltage (variation from tube to tube)	83 to 87	V
Incremental resistance		
Average	300	Ω
Maximum	450	Ω
Maximum increase in maintaining voltage as current is varied from 1 to 10mA	4.0	V
*Maximum percentage variation of maintaining voltage over first 1000 hours of life	0.5	%
Typical percentage drift of maintaining voltage per 1000 hours after 1300 hours	0.1	%

*After the initial warming-up period of 3 minutes

Discontinuities of the I_a/V_a characteristic

Typical voltage jumps over current range 4 to 10mA	5.0	mV
Maximum voltage jumps over current range 1 to 10mA	100	mV

SHORT-TERM STABILITY

Maximum short-term variation of maintaining voltage for any 8 hour period after the first 100 hours life will be better than 0.01% provided there is an initial warming-up period of 3 minutes.

Maximum short-term (100 hours max.) variation of maintaining voltage after the first 300 hours of life is 0.1%.

In order to avoid voltage variations due to temperature fluctuations it will in general be sufficient to draught shield the tube.

M8142

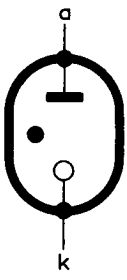
SPECIAL QUALITY VOLTAGE REFERENCE TUBE

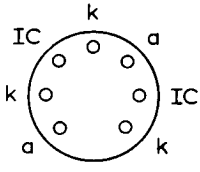
OPERATING NOTES

A steady maintaining voltage is reached within 3 minutes.

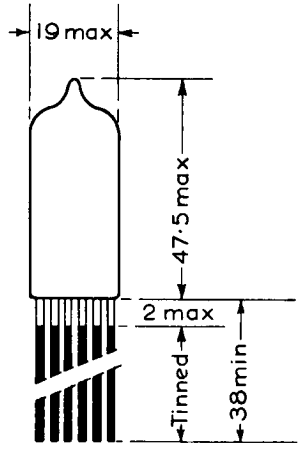
The greatest constancy of maintaining voltage is obtained if the tube is operated at the preferred current.

The noise generated by the tube over a frequency band of 30 to 10,000c/s is of the order of 60μV, which is equivalent to the noise generated by a resistor of approximately 22MΩ at a temperature of 300°K. The noise is evenly distributed over the frequency range.





B7G/F Base



5806

All dimensions in mm

The bulb dimensions of this tube are in accordance with BS448, Section B7G

Note.—Direct soldered connections to the leads of the tube must be at least 5mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

TEST CONDITIONS (unless otherwise specified)

R_{lim} (kΩ)	$I_{burning}$ (mA)
5.0	6.0

After initial warming-up period of 3 minutes at burning current of 6mA.

TESTS	A.Q.L.[2] (%)	Individuals[3] Min.	Max.	
GROUP A				
Ignition voltage. Illumination 5 to 50 ft. cd.	†	—	115	V
Maintaining voltage	†	83	87	V
Change in maintaining voltage for burning current change from 5.8 to 6.2mA	†	—	180	mV
Voltage jumps. Burning current varies from 1 to 10mA. $R_a = 500\Omega$	†	—	100	mV (pk–pk)
Oscillation. Burning current varies from 1 to 10mA. $R_a = 500\Omega$	†	—	5	mV (pk–pk)
Microphonic noise. $R_a = 500\Omega$	†	—	15	mV (pk–pk)
Leakage current. Supply voltage = 55V, $R_a = 1M\Omega$	†	—	5	μA

†This test is carried out on a 100% basis.

GROUP B				
Ignition voltage in darkness, after 24 hours in darkness	2.5	—	115	V
Change in maintaining voltage for burning current change from 1 to 10mA	2.5	—	4.0	V

TESTS	A.Q.L.[2] (%)	Individuals[3] Min.	Individuals[3] Max.	
GROUP C				
Glass strain test [8A]. No applied voltage	6.5	—	—	
Lead fragility test [10A]. No applied voltage	6.5	—	—	
Resonance search				
Vibrated at 2g over frequency range specified.				
25 to 500c/s	2.5	—	5	mV (r.m.s.)
500 to 2500 c/s	2.5	—	15	mV (r.m.s.)
Fatigue[11]				
No applied voltage, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes				
Post fatigue tests				
Change in maintaining voltage	2.5	—	±0.7	V
Microphonic noise as in Group A	2.5	—	30	mV (pk–pk)
Sub-group quality level[7]	4.0	—	—	
Shock[12]				
No applied voltage, 500g				
Post shock tests				
Change in maintaining voltage	2.5	—	±0.7	V
Microphonic noise as in Group A	2.5	—	30	mV (pk–pk)
Sub-group quality level[7]	4.0	—	—	

GROUP D

Life test[11]

Burning current = 6mA continuous

Life test end points. 1000 hours

Inoperatives[13]	2.5	—	—		
Ignition voltage	2.5	—	115	V	
Change in maintaining voltage	2.5	—	±0.4	V	
Change in maintaining voltage for burning current change from 5.8 to 6.2mA	2.5	—	180	mV	

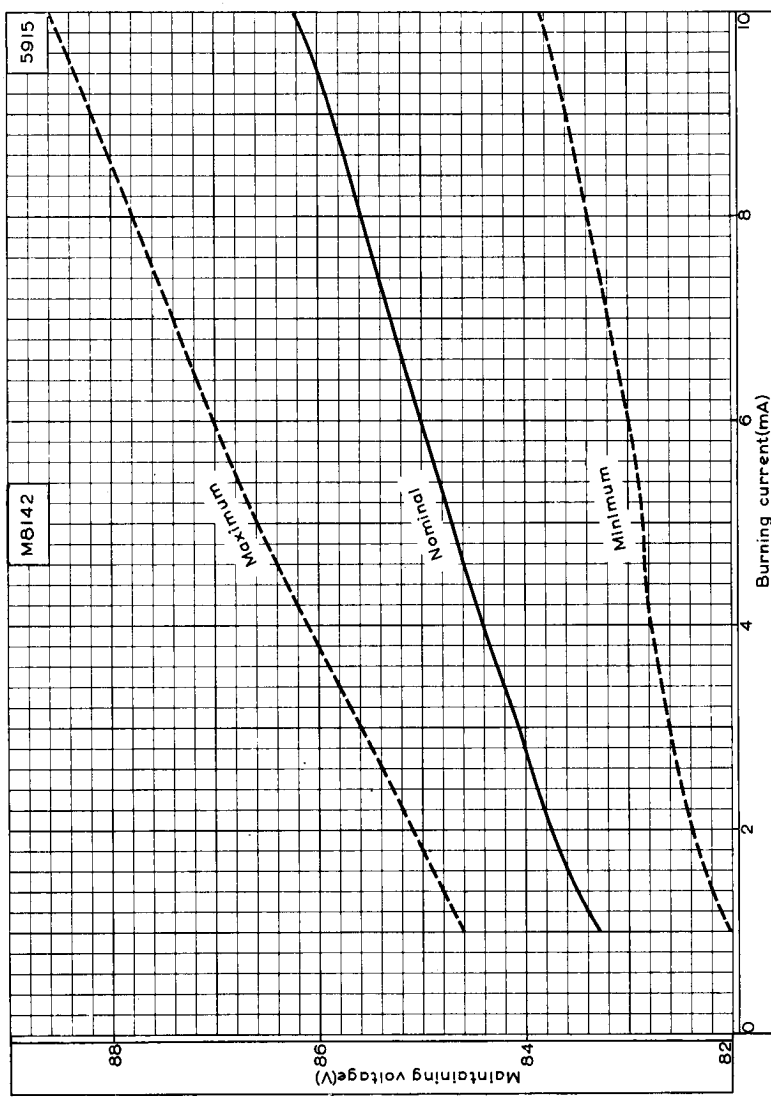
GROUP E

Tubes are held for 28 days and retested for

Inoperatives[13]	0.5	—	—		
Ignition voltage	0.5	—	115	V	
Maintaining voltage	0.5	83	87	V	
Change in maintaining voltage for burning current change from 5.8 to 6.2mA	0.5	—	180	mV	

SPECIAL QUALITY VOLTAGE REFERENCE TUBE

M8142



MAINTAINING VOLTAGE PLOTTED AGAINST BURNING CURRENT

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

M8161

Special quality variable-mu r.f. pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

CAPACITANCES[2]

	Unshielded	*Shielded*	
c_{in}	4.8	5.0	pF
c_{out}	6.3	6.5	pF
c_{a-g1}	<15	<10	mpF
c_{h-k}	2.3	2.3	pF

CHARACTERISTICS[3]

V_a	200	V
V_{g2}	200	V
V_{g3}	0	V
I_a	8.25	mA
I_{g2}	2.1	mA
V_{g1}	−2.5	V
g_m	2.45	mA/V
r_a	900	kΩ
μ_{g1-g2}	30	
R_k	0	Ω
V_{g1} (for 100 : 1 reduction in g_m)	−27	V

ABSOLUTE MAXIMUM RATINGS[4]

$V_{a(b)}$ max.	500	V
V_a max.	300	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	300	V
p_{g2} max.	700	mW
$-V_g$ max.	55	V
I_k max.	14	mA
R_{g1-k} max. (cathode bias)	500	kΩ
R_{g1-k} max. (fixed bias)	100	kΩ
V_{h-k} max.	150	V
Maximum fatigue (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	200	°C

M8161

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{g3} (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.3	200	0	200	−2.5	0	0

TESTS

	A.Q.L.[5]	Individuals[6]			Lot average[7]		Lot standard deviation[8]	
GROUP A	(%)	Bogey[9]	Min.	Max.	Min.	Max.	Max.	
Insulation								
a-rest, g_2-rest, g_3-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current								
R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	184	216	—	—	—	mA
Heater-to-cathode leakage current								
V_{h-k} = 100V cathode positive, cathode negative	0.65	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive	—	—	—	—	—	3.0	—	μA
Anode current	0.65	8.25	6.0	10.5	—	—	—	mA
	—	—	—	—	7.6	8.9	0.77	mA
Screen-grid current	0.65	—	1.2	3.0	—	—	—	mA
	—	—	—	—	—	2.4	—	mA
Mutual conductance	0.65	2.45	1.8	3.1	—	—	—	mA/V
	—	—	—	—	2.25	2.65	0.23	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Mutual conductance. V_{g1} = –26V	2.5	—	4.0	60	—	—	—	μA/V
Reverse grid current. V_{g1} = –50V	2.5	—	—	1.0	—	—	—	μA
Change in mutual conductance. V_h = 5.7V	2.5	—	—	15	—	—	—	%
Reverse grid current. V_h = 6.9V, V_{a-e} = 300V, V_{g2-e} = 200V, R_k = 240Ω	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration, $V_{a(b)}$ = 200V, R_a = 2.0kΩ	2.5	—	—	15	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.8	5.2	—	—	—	pF
c_{out}	—	—	5.0	7.4	—	—	—	pF ←
c_{a-g1}	—	—	—	10	—	—	—	mpF
Grid 3 cut-off voltage. V_{g1} = –7.0V, I_a = 50μA	6.5	—	–55	–125	—	—	—	V
Amplification factor (μ_{g1-g2})	6.5	—	23	39	—	—	—	

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170 ± 5c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater-to-cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current. R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.6	3.1	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater-to-cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current. R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.6	3.1	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)

GROUP F

Stability life test[14]

Running conditions. $R_{g1} = 100k\Omega$, $V_a = 250V$, $V_{h-k} = 135V$ (cathode negative), $R_k = 160\Omega$, $V_{g1-e} = 0V$

Stability life test end point

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

Running conditions. $R_{g1} = 100k\Omega$, $V_a = 250V$, $V_{h-k} = 135V$ (cathode negative), $R_k = 160\Omega$

Intermittent life test end points

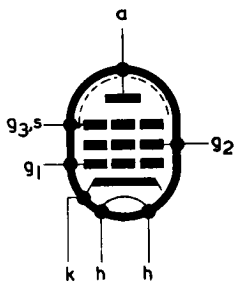
		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	184	216	mA
Heater-to-cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	30	μA
Reverse grid current. R_{g1} max. = 500kΩ	500 hours	2.5	—	0.75	μA
	1000 hours	4.0	—	1.0	μA
Mutual conductance	500 hours	2.5	1.6	3.1	mA/V
	1000 hours	4.0	1.5	3.1	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

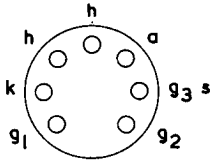
M8161

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

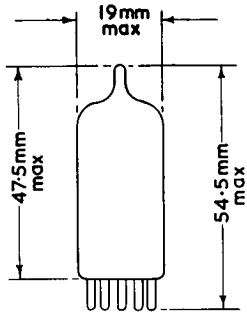
	A.Q.L.[5] (%)	Min.	Max.	
GROUP G				
Valves are held for 28 days and retested for				
Inoperatives[16]	0.5	—	—	
Reverse grid current. R_{g1} max. = 500kΩ	0.5	—	0.75	μA

3594

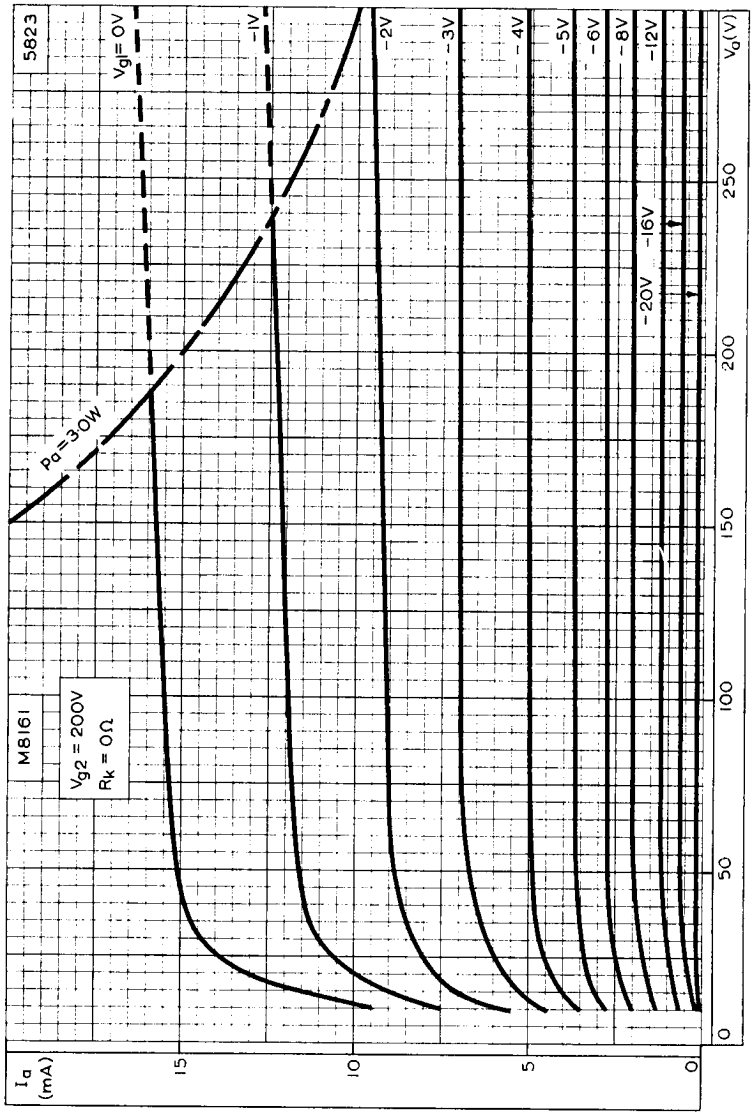




B7G Base



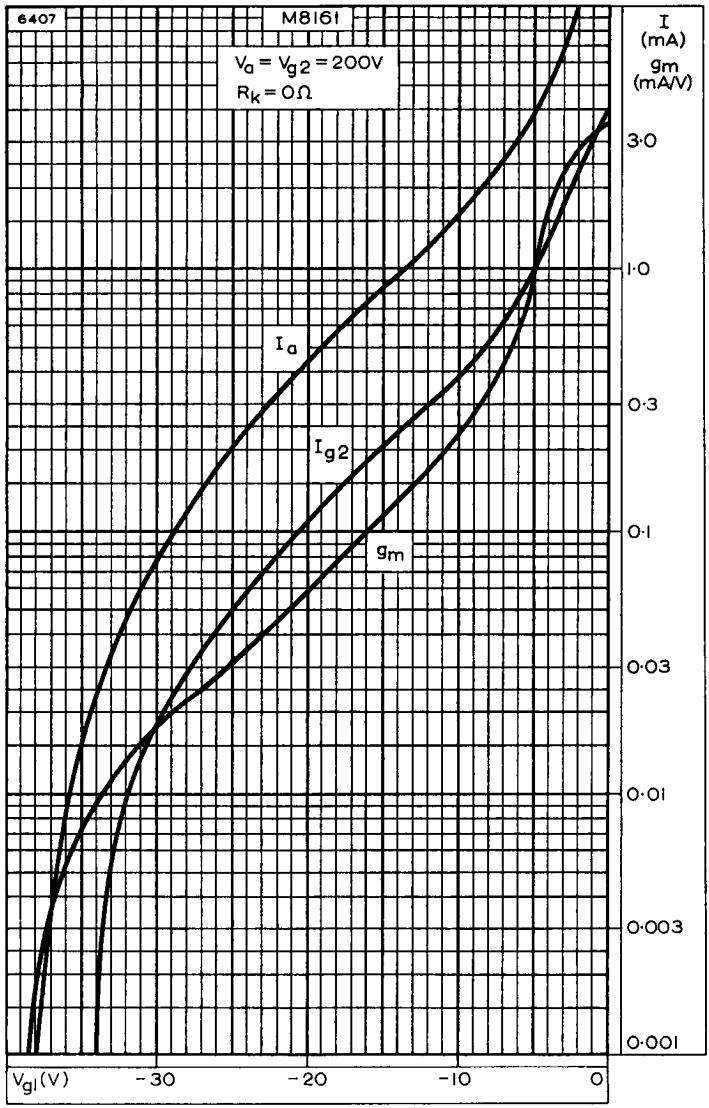
The bulb and base dimensions of this valve are in accordance with BS448 Section B7G



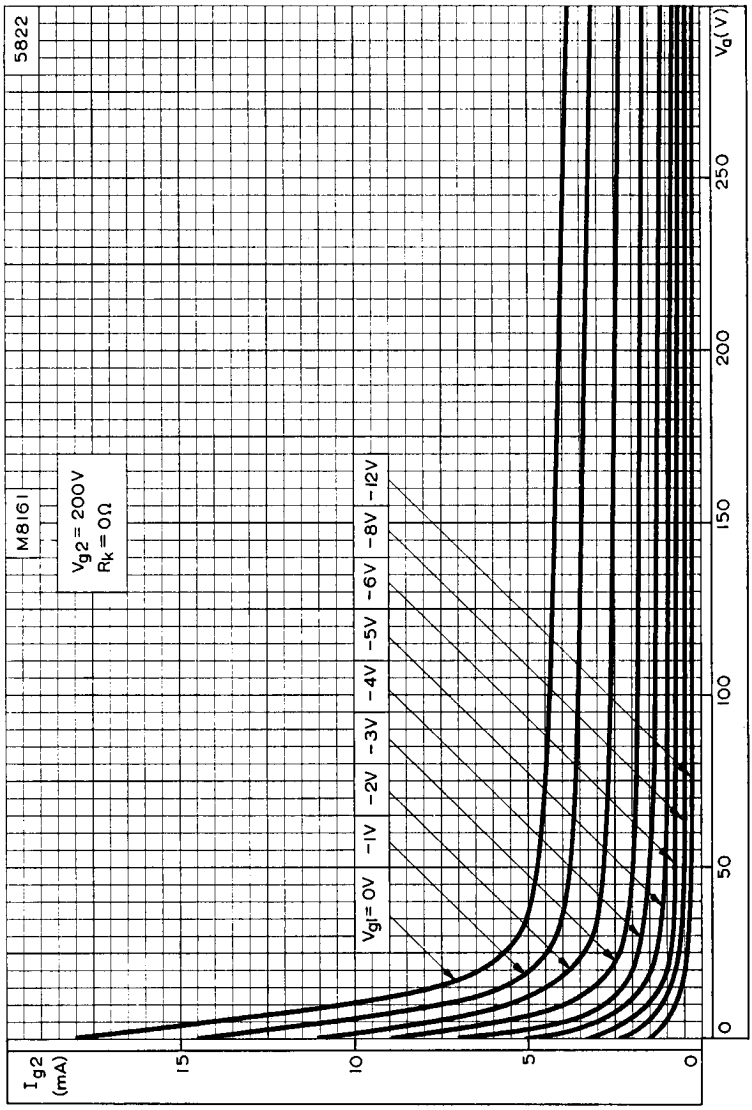
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V.

M8161

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

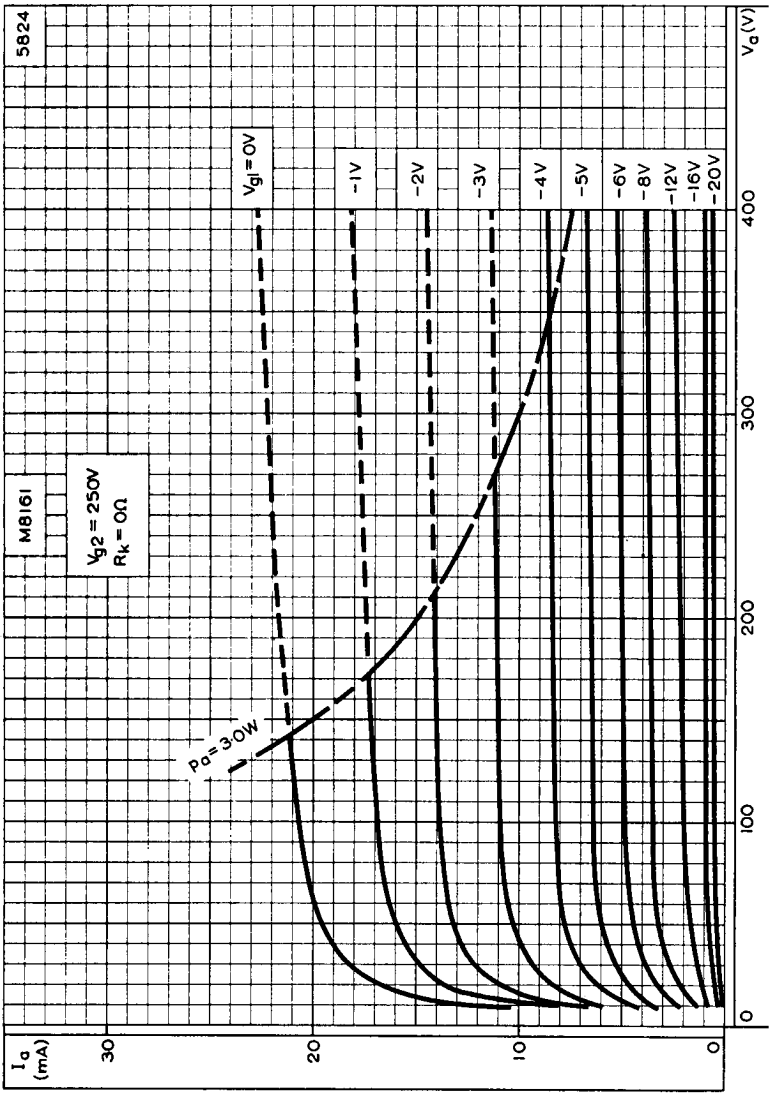


ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 200V$.

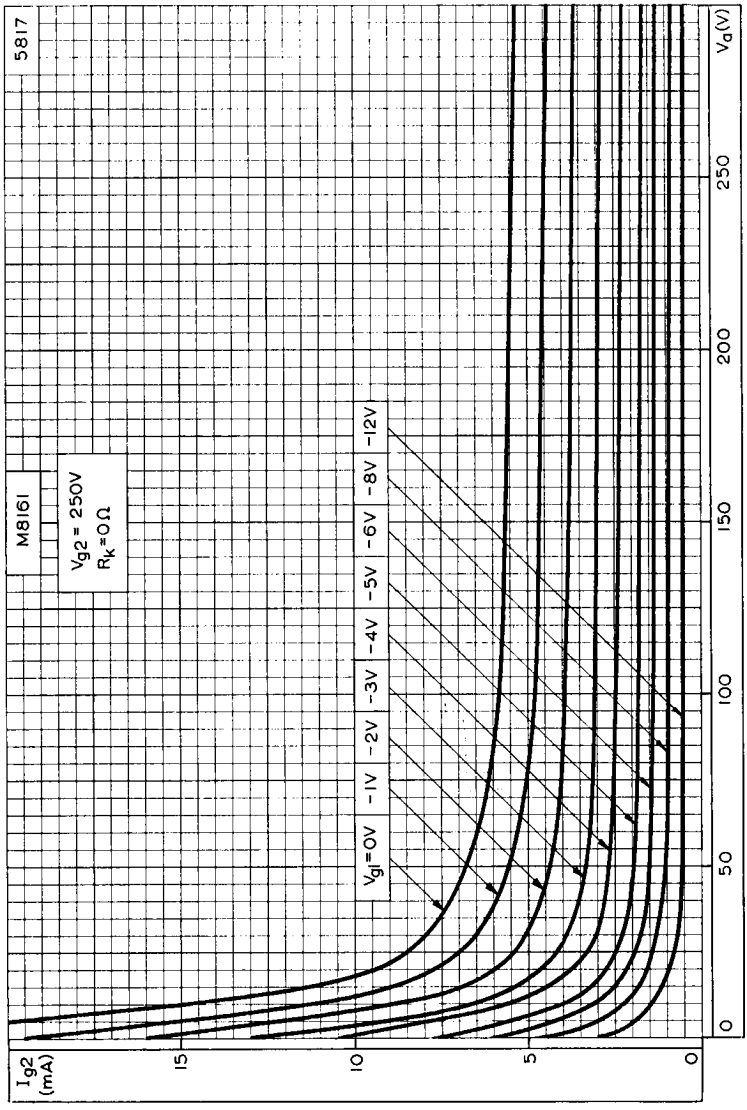


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V.

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE



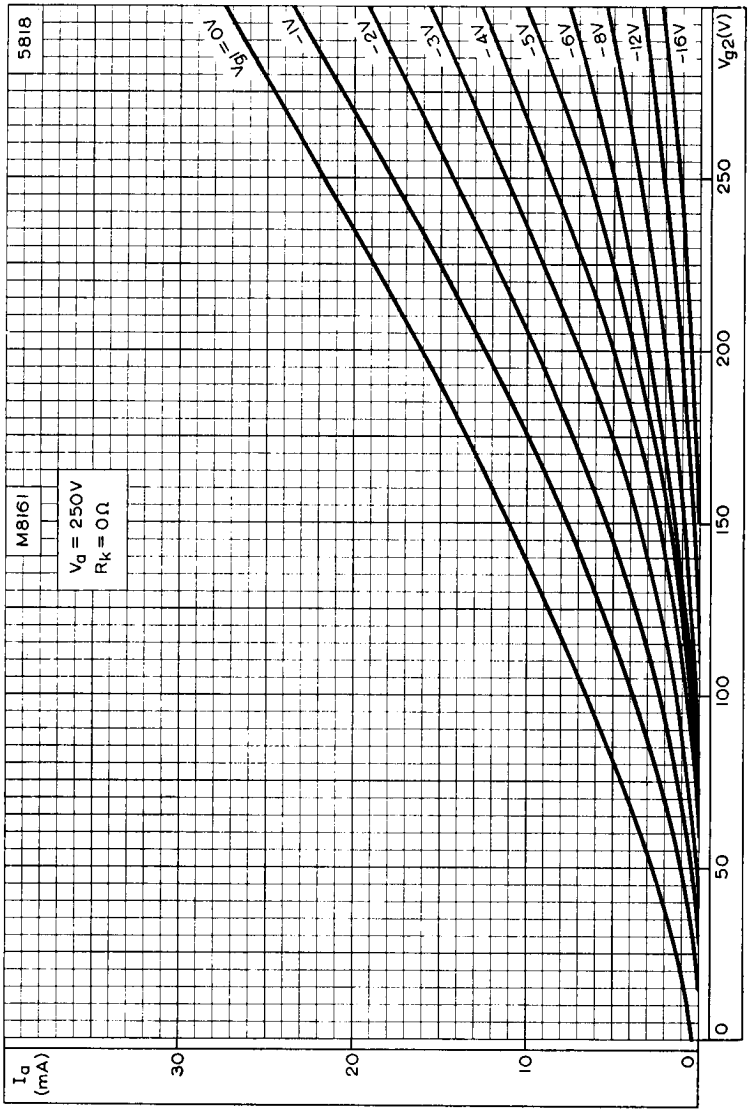
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V.



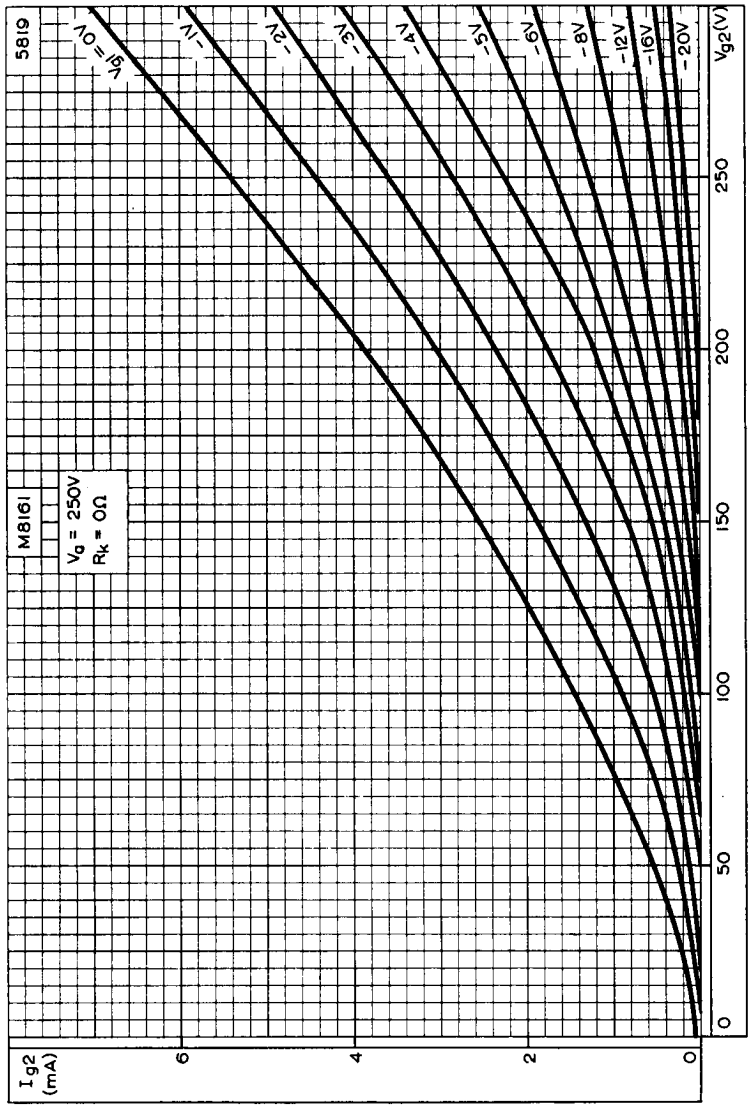
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V.

M8161

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE



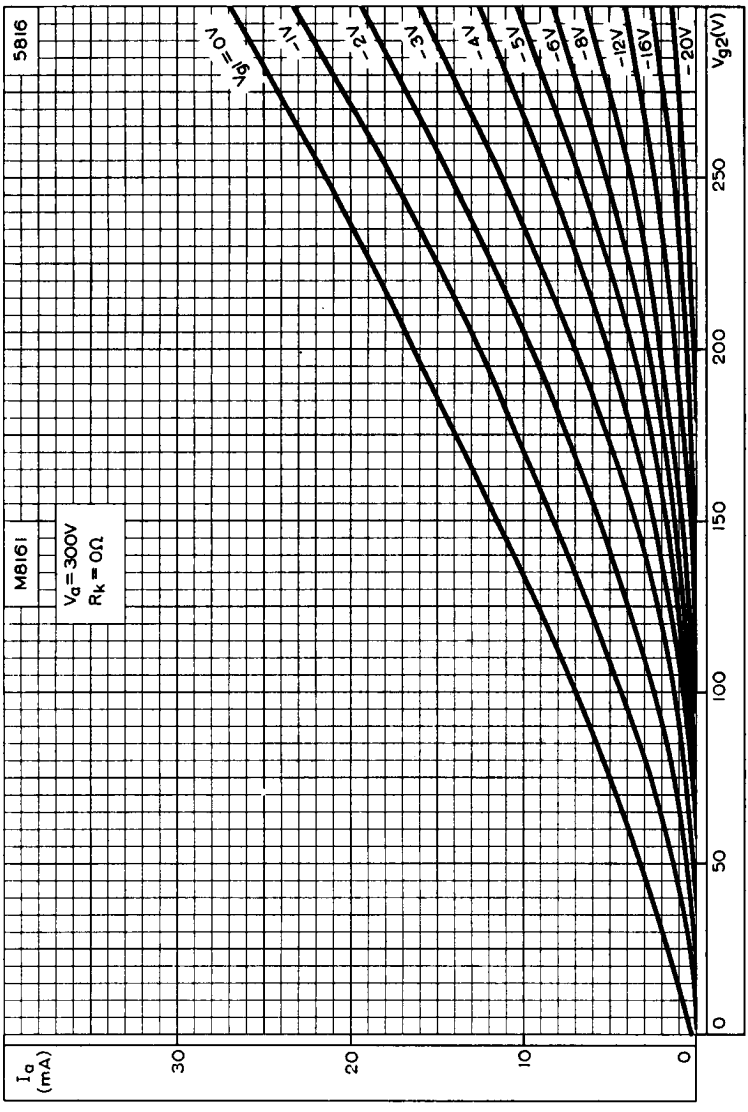
ANODE CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_a = 250V.



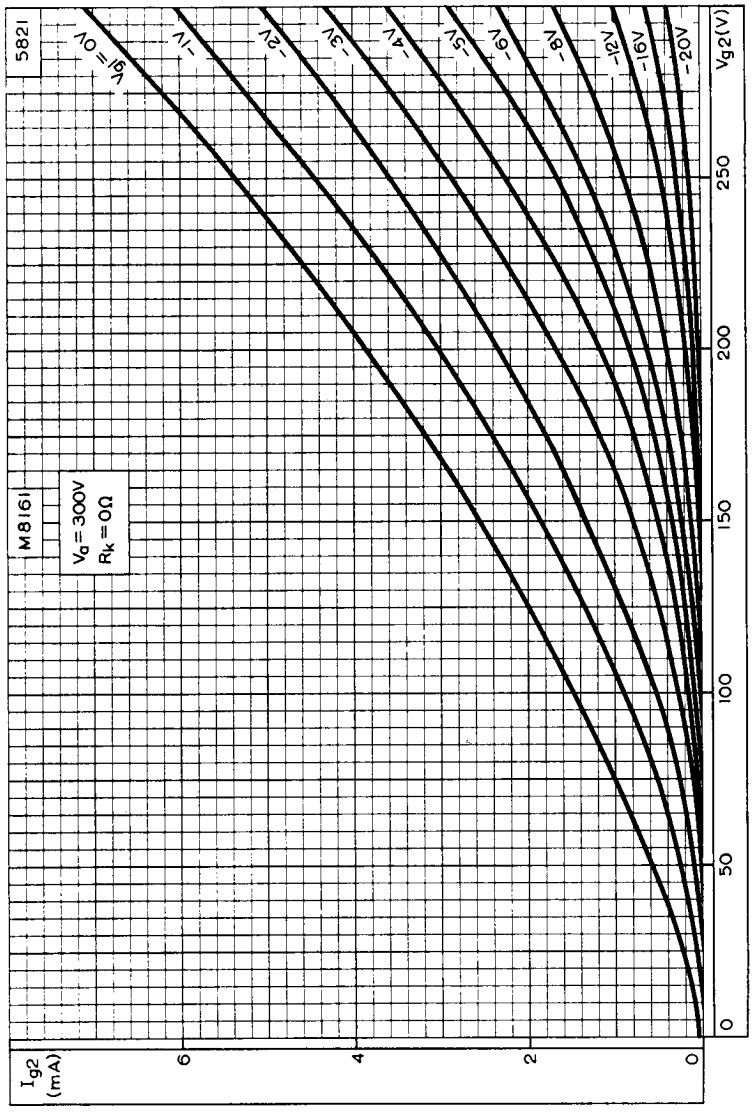
SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_a = 250V.

M8161

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

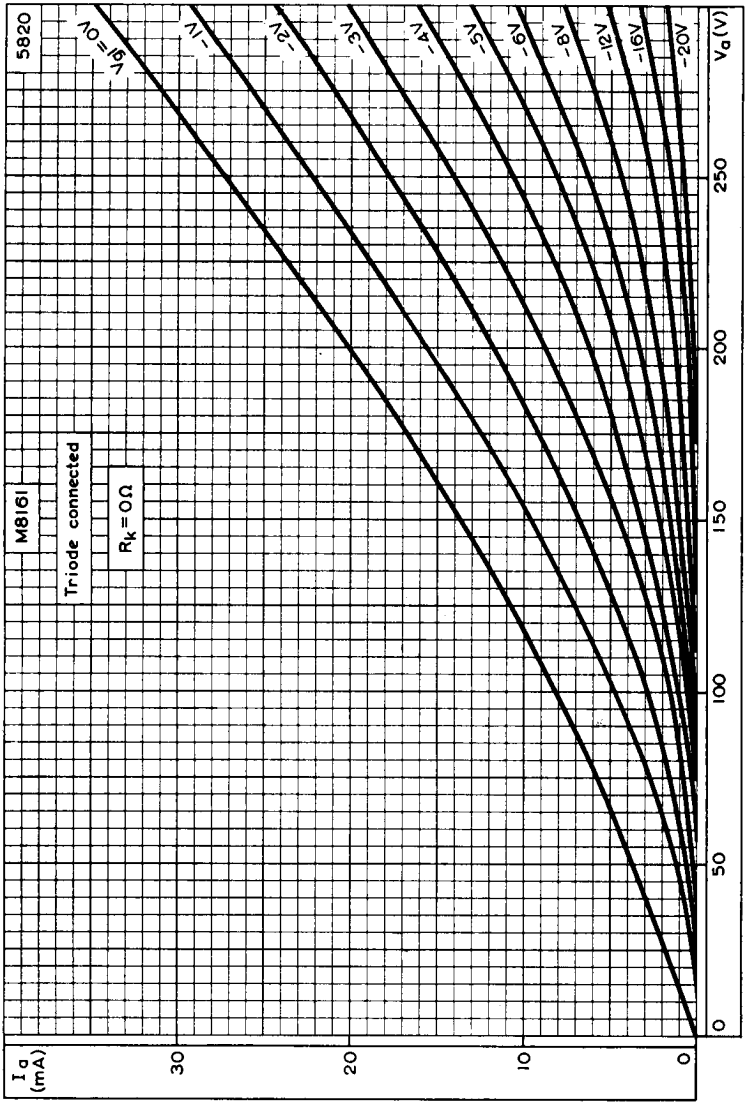


ANODE CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_a = 300V.



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_a = 300V.

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, WHEN TRIODE CONNECTED.

SPECIAL QUALITY SUBMINIATURE VOLTAGE REFERENCE TUBE

M8190

Special quality 85V subminiature gas-filled voltage reference tube.

PRELIMINARY DATA

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VOLTAGE STABILISER & REFERENCE TUBES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

LIMITING VALUES[1] (absolute ratings)

*Minimum voltage necessary for ignition	125	V
Burning current		
Maximum	3.5	mA
Minimum	0.5	mA
Maximum negative anode voltage	75	V
Minimum ambient temperature	−55	°C
Maximum bulb temperature	+90	°C

*This value covers operation in daylight and complete darkness.

PREFERRED OPERATING CONDITION

Burning current	2.0	mA

CHARACTERISTICS

Measured at preferred operating condition and $T_{ambient}$ = 25°C

Maintaining voltage (variation from tube to tube)	84 to 88	V
Maximum maintaining voltage difference over current range 0.5 to 3.5mA	3.0	V
Maximum incremental resistance	1.0	kΩ
Variation of maintaining voltage during the first 1000 hours of life		
Maximum	±1.0	%
Typical	±0.5	%

OPERATING NOTES

A steady maintaining voltage is reached within 3 min.

The greatest constancy of maintaining voltage is obtained if the tube is operated at the preferred current.

M8190

SPECIAL QUALITY SUBMINIATURE VOLTAGE REFERENCE TUBE

TEST CONDITIONS (unless otherwise specified)

$R_{lim.}$ (kΩ)	$I_{burning}$ (mA)
30	2.0

After initial warming-up period of 3 minutes at burning current of 2.0mA

TESTS	A.Q.L.[2] (%)	Individuals[3] Min.	Max.	
GROUP A				
Ignition voltage	†	—	125	V
Maintaining voltage	†	84	88	V
Change in maintaining voltage for burning current change from 1.9 to 2.1mA	†	—	0.2	V
Voltage jumps. Burning current varies from 1.2 to 3.5mA	†	—	25	mV (pk–pk)
Oscillation. Burning current varies from 1.2 to 3.5mA	†	—	15	mV (pk–pk)
Microphonic noise	†	—	25	mV (pk–pk)
†This test is carried out on a 100% basis.				
GROUP B				
Ignition voltage in darkness after 24 hours in darkness	2.5	—	125	V
Leakage current. Supply voltage = 50V R_a = 1MΩ	2.5	—	15	μA
Change in maintaining voltage for burning current change from 0.5 to 3.5mA	2.5	—	3.0	V
Maintaining voltage at burning current of 3.5mA	2.5	—	89	V
Group quality level[7]	6.5	—	—	
GROUP C				
Glass strain test [8A]. No applied voltage	6.5	—	—	
Lead fragility test [10A]. No applied voltage	6.5	—	—	
Resonance search				
Vibrated at 2g over frequency range specified.				
25 to 500c/s	2.5	—	5.0	mV (r.m.s.)
500 to 2500c/s	2.5	—	15	mV (r.m.s.)

Fatigue[11]

No applied voltage, 5g min. peak acceleration, f = 170±5c/s for 33 hours in each of 3 mutually perpendicular planes

Post fatigue tests

Change in maintaining voltage	2.5	—	±0.8	V
Microphonic noise	2.5	—	50	mV (pk–pk)
Sub-group quality level[7]	4.0	—	—	

Shock[12]

No applied voltage, 750g

Post shock tests

Change in maintaining voltage	2.5	—	±0.8	V
Microphonic noise	2.5	—	50	mV (pk–pk)
Sub-group quality level[7]	4.0	—	—	

GROUP D

Life test[11]

Burning current = 2mA continuous

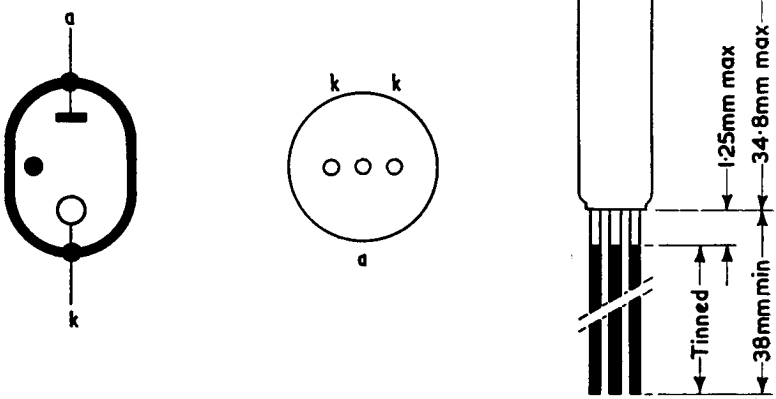
Life test end points. 1000 hours

Ignition voltage	2.5	—	125	V
Change in maintaining voltage from 0 to 300 hours	2.5	—	±0.4	V
Change in maintaining voltage from 0 to 1000 hours	2.5	—	±0.8	V
Change in maintaining voltage for burning current change from 1.9 to 2.1mA	2.5	—	+0.2	V
Group quality level[7]	6.5	—	—	

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SPECIAL QUALITY SUBMINIATURE VOLTAGE REFERENCE TUBE

5807



The bulb dimensions of this tube are in accordance with BS448, Section B8D.

Note.—Direct soldered connections to the leads of the tube must be at least 5mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

SPECIAL QUALITY VOLTAGE AMPLIFYING PENTODE

M8195

Special quality low noise low hum pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	200	mA

CAPACITANCES[2] (measured without an external shield)

c_{a-g1}	<50	mpF
c_{in}	3.8	pF
c_{out}	5.1	pF

CHARACTERISTICS[3]

V_a	250	V
V_{g3}	0	V
V_{g2}	140	V
I_a	3.0	mA
I_{g2}	550	μA
g_m	2.0	mA/V
r_a	2.5	MΩ
μ_{g1-g2}	38	
V_{g1}	−2.0	V
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	200	V
p_{g2} max.	200	mW
I_k max.	6.0	mA
R_{g1-k} max. (p_a>200mW)	3.0	MΩ
R_{g1-k} max. (p_a<200mW)	10	MΩ
V_{h-k} max.	100	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

M8195

SPECIAL QUALITY VOLTAGE AMPLIFYING PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{g3} (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.3	250	0	140	−2.0	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest, g_2-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current, R_{g1} max. = 500kΩ	0.25	—	—	0.4	—	—	—	μA
GROUP B								
Heater current	0.65	—	185	215	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	2.0	—	μA
Anode current	0.65	3.0	2.15	3.85	—	—	—	mA
	—	—	—	—	2.69	3.31	0.28	mA
Screen-grid current	0.65	—	—	850	—	—	—	μA
Mutual conductance	0.65	2.0	1.55	2.45	—	—	—	mA/V
	—	—	—	—	1.83	2.17	0.13	mA/V
Microphony. V_b = 200V, R_a = 100kΩ, R_{g2} = 680kΩ, R_{g1} = 470kΩ, R_k = 1.2kΩ, C_k = 100μF, C_{g2} = 0.1μF. Impact = 50g, at rt. angles to the axis. Control grid voltage (r.m.s.)	0.65	—	—	3.5	—	—	—	mV (pk–pk)

Grid hum. $V_b = 200V$, $R_a = 100k\Omega$, $R_{g2} = 680k\Omega$, $R_{g1} = 470k\Omega$, $R_k = 1.2k\Omega$, $C_k = 100\mu F$, $C_{g2} = 0.1\mu F$. Pins 4 and 5 earthed alternately. Hum referred to the grid	0.65	—	—	8.0	—	—	—	μV
Cathode hum. $V_b = 200V$, $R_a = 100k\Omega$, $R_{g2} = 680k\Omega$, $R_{g1} = 470\Omega$, $R_k = 1.2k\Omega$, $C_{g2} = 0.1\mu F$. Pins 4 and 5 earthed alternately. Hum referred to the grid	0.65	—	—	60	—	—	—	μV
Hiss. $V_h = 6.3V$ d.c., $V_b = 200V$, $R_a = 100k\Omega$, $R_{g2} = 680k\Omega$, $R_{g1} = 470k\Omega$, $R_k = 1.2k\Omega$, $C_{g2} = 0.1\mu F$, $C_k = 100\mu F$. Hiss referred to the grid	0.65	—	—	5.0	—	—	—	μV
Group quality level[10]	2.5	—	—	—	—	—	—	
GROUP C								
Anode current, $V_{g1} = -7.0V$, $R_a = 1.0M\Omega$	2.5	—	—	40	—	—	—	μA
Change in mutual conductance, $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse grid current, $V_h = 6.9V$	2.5	—	—	1.0	—	—	—	μA
Group quality level[10]	6.5	—	—	—	—	—	—	
GROUP D								
Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances[2] (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{a-g1}	—	—	—	50	—	—	—	mpF
C_{in}	—	—	3.4	4.3	—	—	—	pF ←
C_{out}	—	—	4.5	5.8	—	—	—	pF
Amplification factor (μ_{g1-g2})	6.5	—	34	42	—	—	—	

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SPECIAL QUALITY
VOLTAGE AMPLIFYING PENTODE

TESTS	A.Q.L.[5] (%)	Individuals Bogey[9]	Individuals Min.	Individuals Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170 ±5c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current, R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.0	—	—	—	—	mA/V
Microphonic noise as in group B	2.5	—	—	1.0	—	—	—	V (pk–pk)
Cathode hum as in group B	2.5	—	—	120	—	—	—	μV
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current V_{h-k} = ±100V	2.5	—	—	20	—	—	—	μA
Reverse grid current, R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.0	—	—	—	—	mA/V
Microphonic noise as in group B	2.5	—	—	1.0	—	—	—	V (pk–pk)
Cathode hum as in group B	2.5	—	—	120	—	—	—	μV
Sub-group quality level[10]	6.5	—	—	—	—	—	—	

GROUP F

Intermittent life test

Running conditions, $V_{a-e} = 300V$,
$V_{g2-e} = 200V$, $R_k = 820\Omega$,
$V_{h-k} = 100V$ (cathode negative)

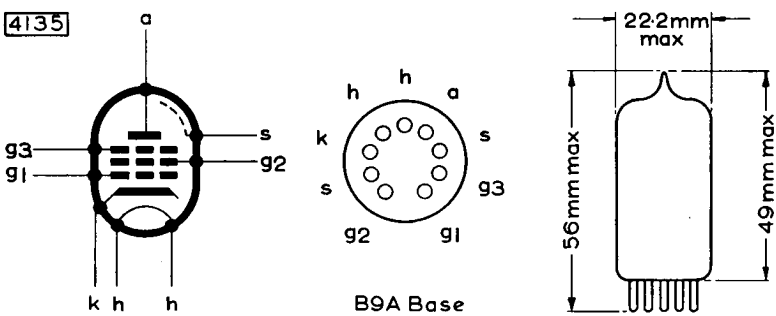
Intermittent life test end points

		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	185	215	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse grid current. R_{g1} max. = 500kΩ	500 hours	2.5	—	0.4	μA
	1000 hours	4.0	—	0.5	μA
Mutual conductance	500 hours	2.5	1.2	—	mA/V
	1000 hours	4.0	1.0	—	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Anode current	500 hours	4.0	2.0	3.85	mA
	1000 hours	6.5	1.5	3.85	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
Cathode hum as in group B	500 hours	4.0	—	120	μV
	1000 hours	6.5	—	250	μV
Hiss as in group B	500 hours	4.0	—	10	μV
	1000 hours	6.5	—	15	μV
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

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SPECIAL QUALITY VOLTAGE AMPLIFYING PENTODE

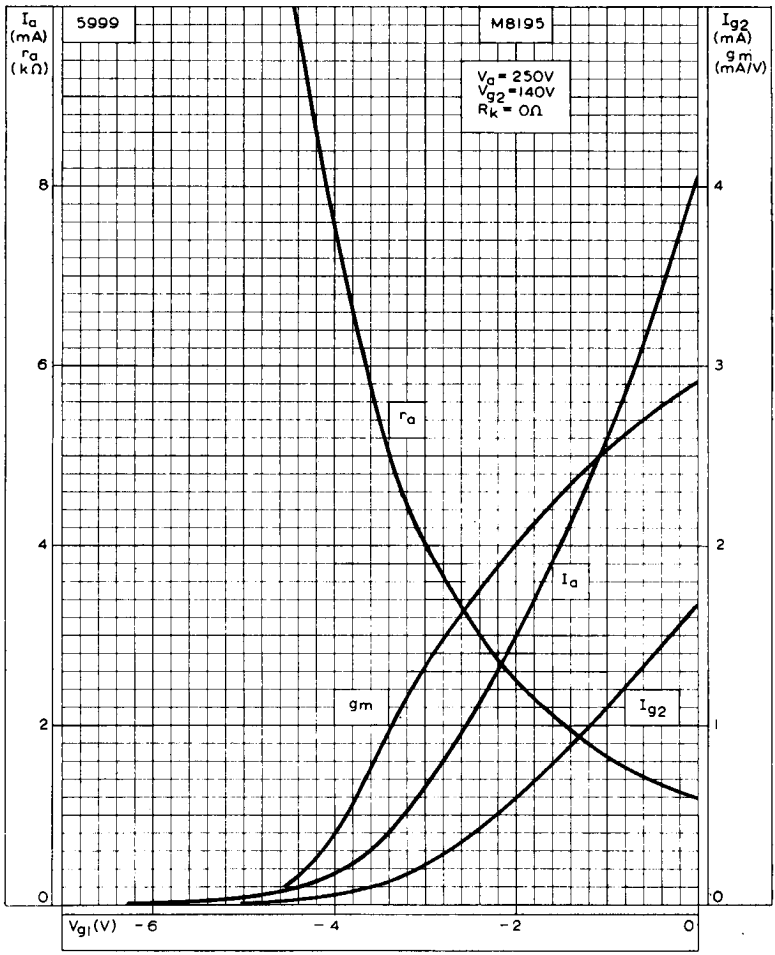
	A.Q.L.[5] (%)	Min.	Max.	
GROUP G				
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse grid current R_{g1} max. = 500kΩ	0.5	—	0.4	μA



The bulb and base dimensions of this valve are in accordance with BS448, Section B9A.

SPECIAL QUALITY
VOLTAGE AMPLIFYING PENTODE

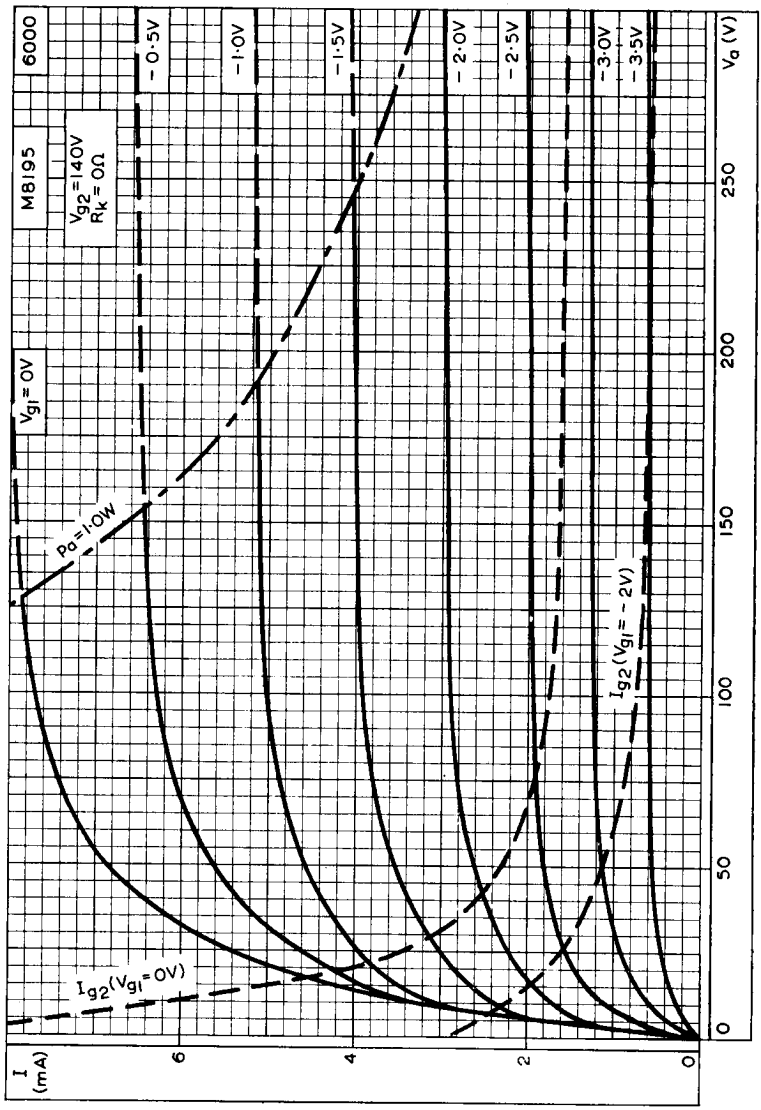
M8195



ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

M8195

SPECIAL QUALITY VOLTAGE AMPLIFYING PENTODE



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY PENTODE

M8196

Special quality dual control pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	175	mA

MOUNTING POSITION

Any

CAPACITANCES[2] (measured with an external shield)

c_{a-g1}	<20	mpF
c_{in}	4.2	pF
c_{out}	3.2	pF

CHARACTERISTICS[3]

V_a	120	120	V
V_{g2}	120	120	V
V_{g3}	−3.0	0	V
I_a	3.5	5.1	mA
I_{g2}	4.8	3.5	mA
V_{g1}	−2.0	−2.0	V
$g_{m(g1-a)}$	2.0	3.2	mA/V
$g_{m(g3-a)}$	660	450	μA/V
r_a	—	150	kΩ
$V_{g1}(I_a = 100\mu A)$	—	<−7.5	V
$V_{g3}(I_a = 20\mu A)$	−10	<−15	V
R_k	0	0	Ω

ABSOLUTE MAXIMUM RATINGS[4]

$V_{a(b)}$ max.	400	V
V_a max.	200	V
V_{g3} max.	30	V
$-V_{g3}$ max.	55	V
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_a max.	1.65	W
p_{g2} max.	550	mW
R_{g1-k} max.	4.0	MΩ←
I_k max.	20	mA
V_{h-k} max.	100	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	450	g
T_{bulb} max.	165	°C

M8196

SPECIAL QUALITY PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{g3} (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.3	120	0	120	–2.0	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	175	160	190	—	—	—	mA
	—	—	—	—	168	182	4.87	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	10	—	—	—	μA
Reverse grid current, $R_{g1} = 100k\Omega$	0.65	—	0	0.1	—	—	—	μA
Anode current	0.65	5.2	2.5	9.0	—	—	—	mA
	—	—	—	—	4.2	6.2	0.8	mA
Mutual conductance	0.65	3.2	2.5	4.5	—	—	—	mA/V
	—	—	—	—	2.9	3.5	0.26	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	
GROUP B								
Insulation								
a-rest, measured at –300V	2.5	—	100	—	—	—	—	MΩ
g_1-rest, measured at –100V		—	100	—	—	—	—	MΩ
g_3-rest, measured at –300V		—	100	—	—	—	—	MΩ

Anode current								
V_{g1} = –3V, V_{g3} = –10V	2.5	—	—	200	—	—	—	μA
V_{g1} = –3V, V_{g3} = –6V	2.5	—	5.0	—	—	—	—	μA
V_{g1} = –8V	2.5	—	—	200	—	—	—	μA
V_{g1} = –6V	2.5	—	5.0	—	—	—	—	μA
Screen-grid current	2.5	—	1.5	5.5	—	—	—	mA
Change in mutual conductance, V_h = 5.7V	2.5	—	—	15	—	—	—	%
Reverse grid current								
V_h = 7.5V, V_{g1} = –10V, R_{g1} = 100kΩ	2.5	—	0	1.0	—	—	—	μA
†R.F. noise at anode, V_{g1} = 0V, R_k = 200Ω, V_{sig} = 15mV, C_k = 0.2μF	2.5	—	—	—	—	—		
Vibration, 2.5g min. peak acceleration, f = 50c/s, R_a = 10kΩ	6.5	—	—	150	—	—	—	mV
Mutual conductance (g_{3-a}), V_{g3} = –3V	6.5	—	0.35	1.05	—	—	—	mA/V
Mutual conductance (g_{1-a}), V_{g3} = –5V	6.5	—	0.7	1.7	—	—	—	mA/V
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
C_{in}	—	—	3.5	4.5	—	—	—	pF
C_{out}	—	—	2.6	3.4	—	—	—	pF
C_{a-g1}	—	—	—	20	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55 ± 5mm Hg Voltage = 500$V_{r.m.s.}$. No other applied voltages.	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min. peak acceleration, $V_{a(b)}$ = $V_{g2(b)}$ = 200V, R_a = 100kΩ, R_{g2} = 500kΩ, C_{g2} = 2μF, V_{g1} = 0V, R_k = 1kΩ, C_k = 1000μF, $V_{g(sig)}$ = 175mV	2.5	—	—	—	—	—	—	

†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP C								
Base strain test[12]	—	—	—	—	—	—	—	
Glass strain test[11B]. No applied voltages	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltage applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	—	—	—	30	—	—	—	μA
Mutual conductance	—	—	2.2	—	—	—	—	mA/V
Reverse grid current, R_{g1} = 100kΩ	—	—	0	0.4	—	—	—	μA
Vibration as in group B	—	—	—	300	—	—	—	mV
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
V_{h-k} = 100V, No other applied voltages, 500g.								
Post shock tests								
Heater-to-cathode leakage current V_{h-k} = ±100V	—	—	—	30	—	—	—	μA
Mutual conductance	—	—	2.2	—	—	—	—	mA/V
Reverse grid current, R_{g1} = 100kΩ	—	—	0	0.4	—	—	—	μA
Vibration as in group B	—	—	—	300	—	—	—	mV

GROUP D

Heater cycling life test

V_h = 7.5V 1 minute on 4 minutes off
V_{h-k} = 135V. No other applied voltages

Heater cycling life test end point

Heater to cathode leakage current V_{h-k} = ±100V	—	—	—	20	—	—	—	μA

Stability life test[14]

Running conditions. R_{g1} = 100kΩ, R_k = 130Ω, V_{a-e} = 180V, V_{g2-e} = 125V, V_{g1-e} = 0V, V_{h-k} = 135V, $T_{ambient}$ = Room temperature.

Stability life test end points

Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%

Intermittent life test

Running conditions. R_{g1} = 100kΩ, R_k = 130Ω, V_{a-e} = 180V, V_{g2-e} = 125V, V_{g1-e} = 0V, V_{h-k} = 135V, T_{bulb} min. = 165°C.

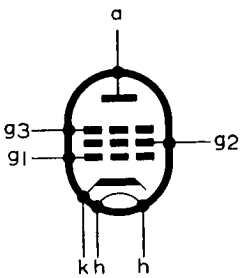
Intermittent life test end points

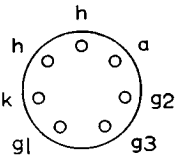
		A.Q.L.[5] (%)	Min.	Max.	
Inoperatives[6]	500 hours	—	—	—	
	1000 hours	—	—	—	
Heater current	500 hours	4.0	160	190	mA
	1000 hours	6.5	160	190	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	500 hours	4.0	—	10	μA
	1000 hours	6.5	—	10	μA
Reverse grid current, R_{g1} = 100kΩ	500 hours	4.0	0	0.1	μA
	1000 hours	6.5	0	0.1	μA
Change in mutual conductance (individuals)	500 hours	4.0	—	20	%
	1000 hours	6.5	—	25	%
Change in mutual conductance, V_h = 5.7V	500 hours	6.5	—	15	%
Insulation as in group B	500 hours	6.5	50	—	MΩ
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group quality level[10]	500 hours	10	—	—	
	1000 hours	15	—	—	

M8196

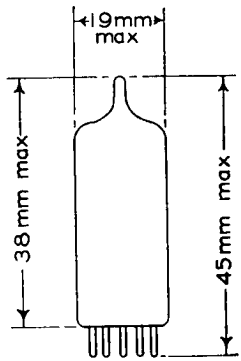
SPECIAL QUALITY PENTODE

4491

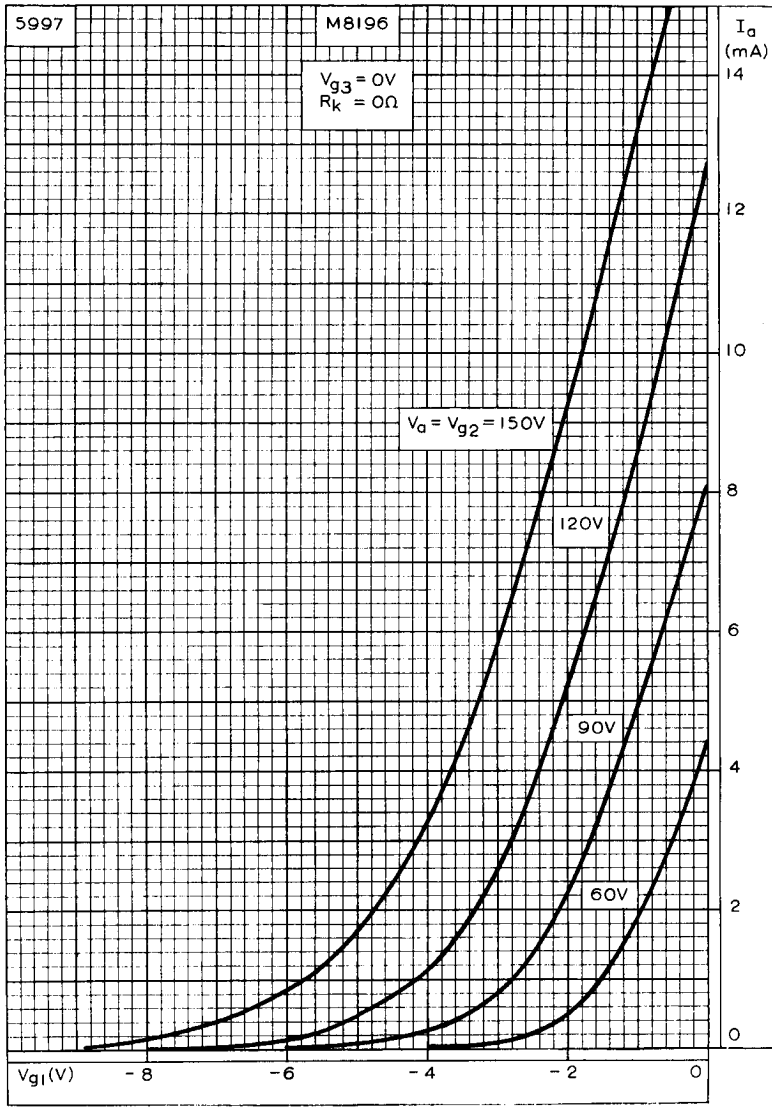




B7G Base



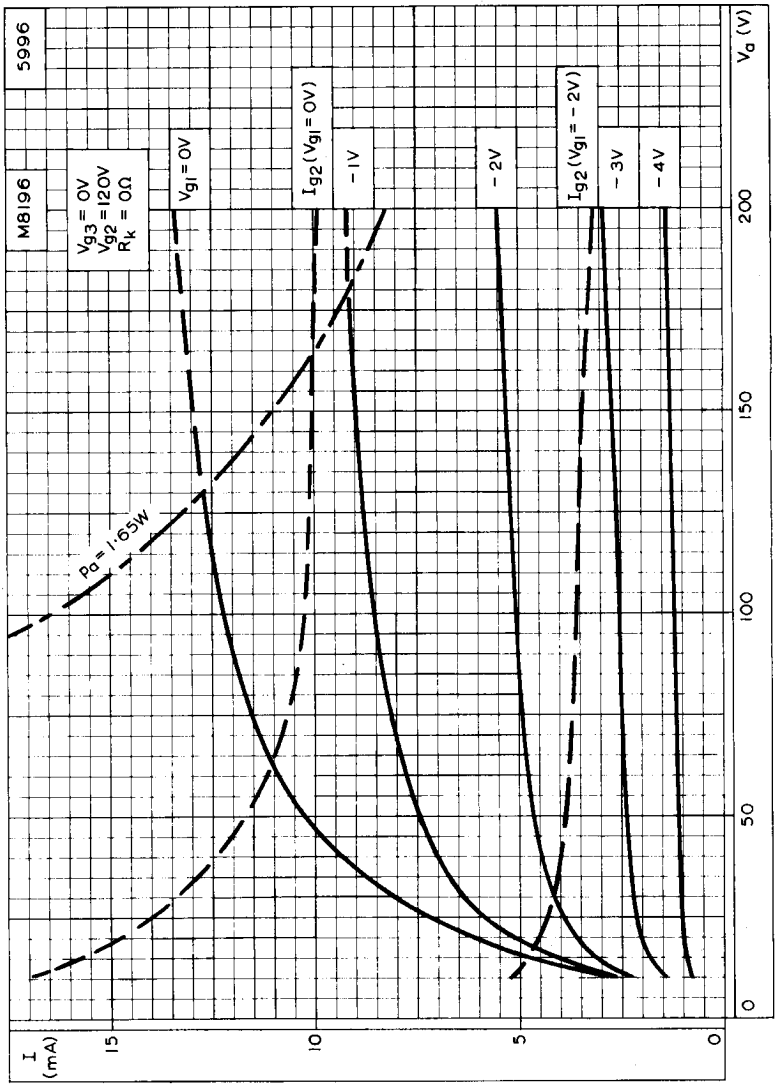
The bulb and base dimensions of this valve are in accordance with BS448, Section B7G.



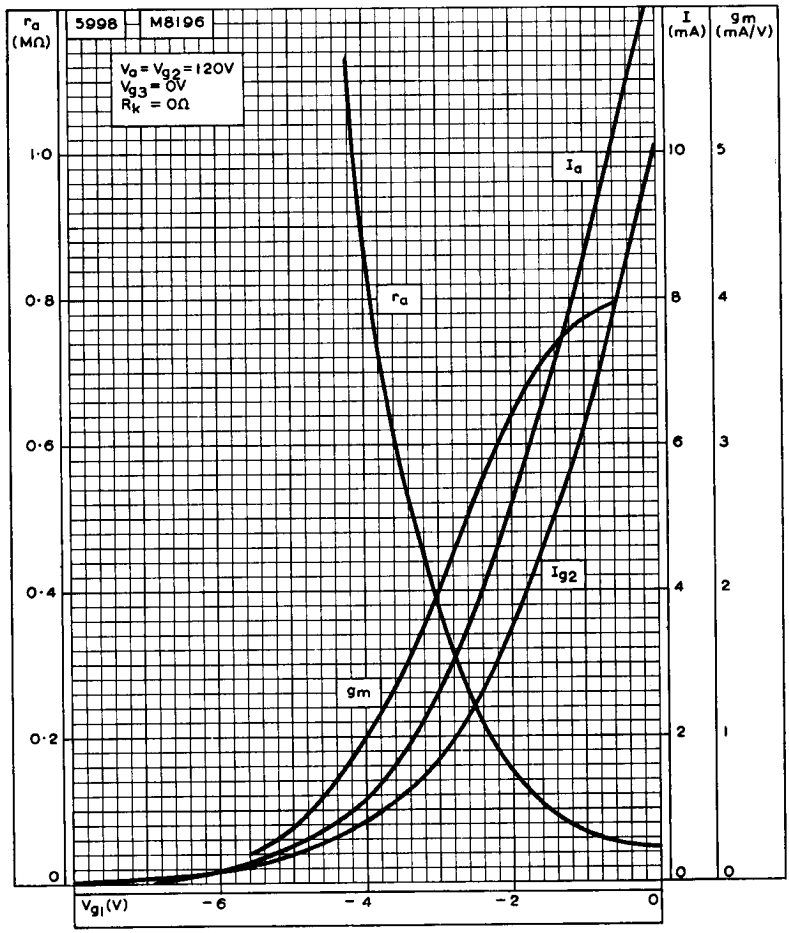
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETER

M8196

SPECIAL QUALITY PENTODE



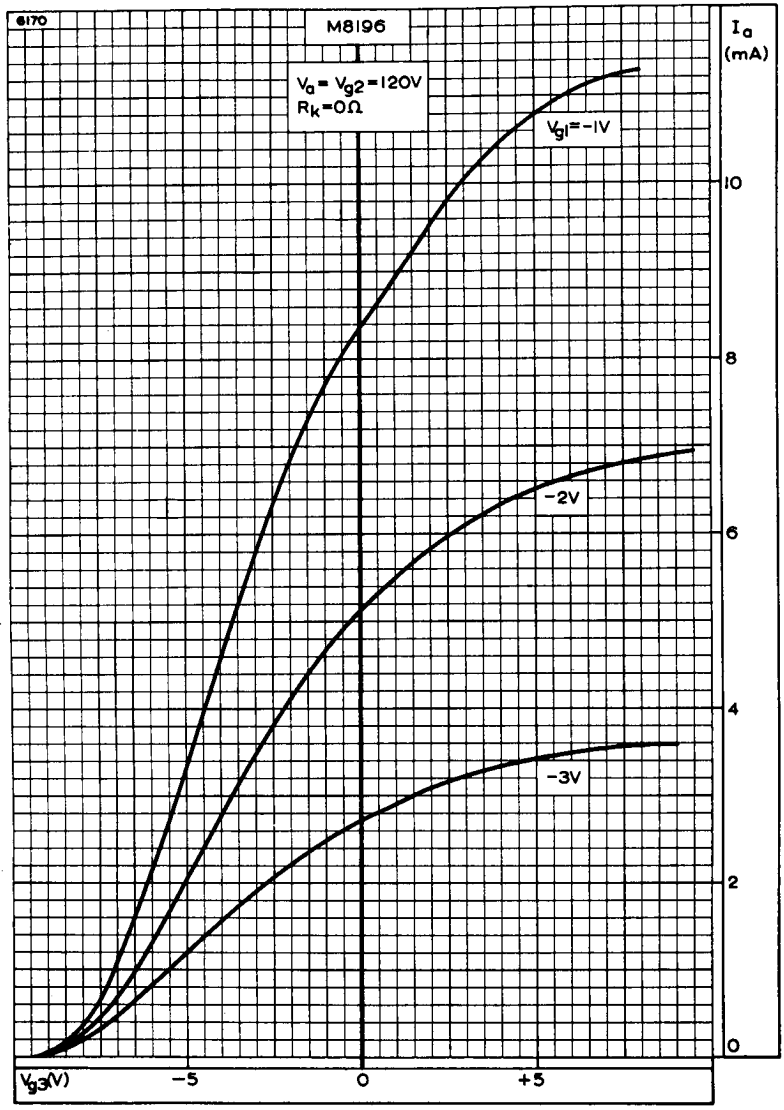
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



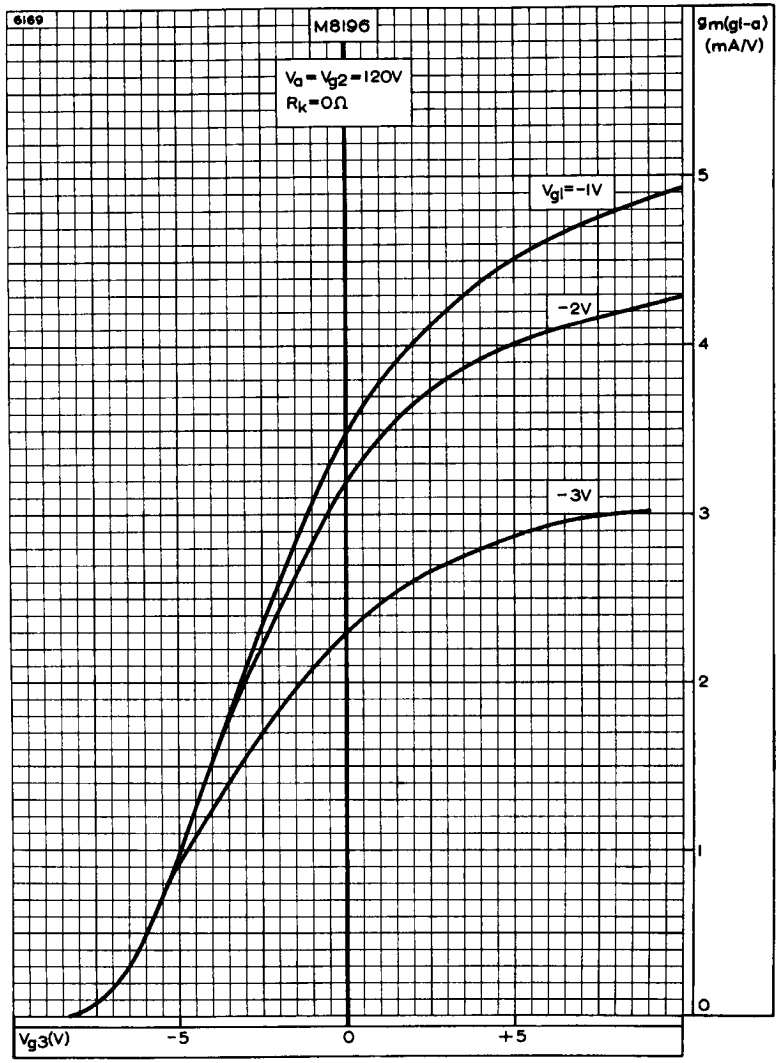
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

M8196

SPECIAL QUALITY PENTODE



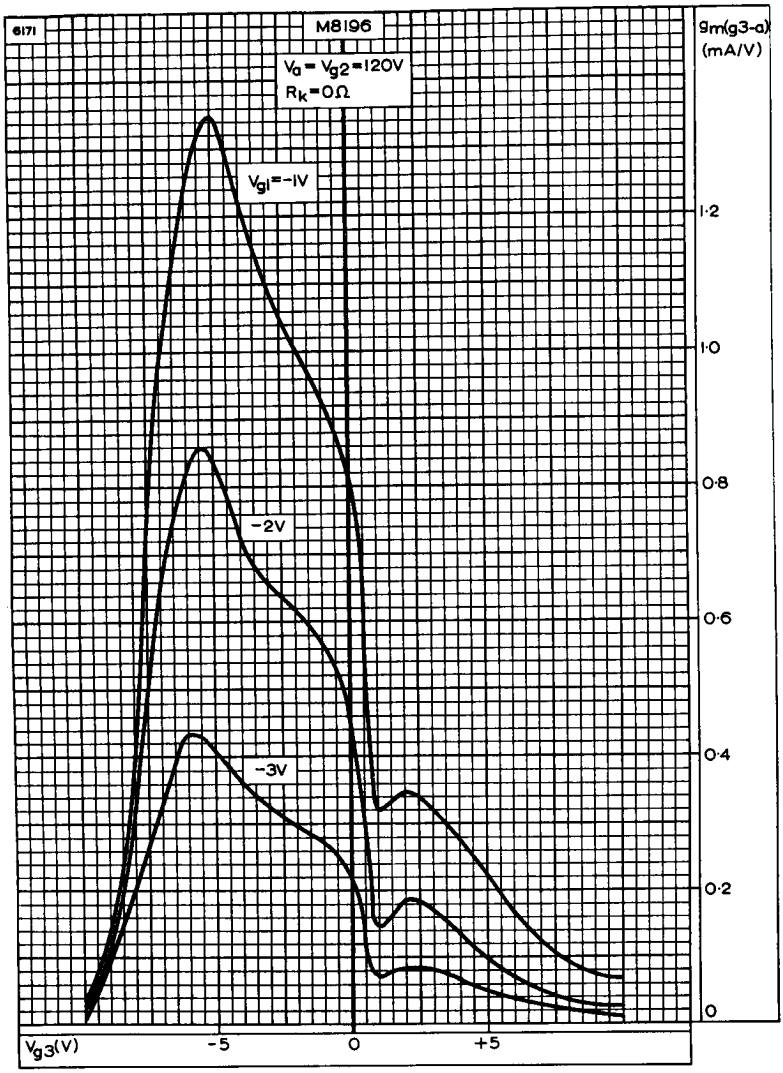
ANODE CURRENT PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



MUTUAL CONDUCTANCE (g_{1-a}) PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

M8196

SPECIAL QUALITY PENTODE



MUTUAL CONDUCTANCE (g_{3-a}) PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY TETRODE THYRATRON

M8204

100mA special quality tetrode xenon thyratron with negative control characteristic for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

PRELIMINARY DATA

This data should be read in conjunction with the GENERAL NOTES – SPECIAL QUALITY THYRATRONS preceding this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

LIMITING VALUES[3] (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

	Relay service and grid-controlled rectifier	*Pulse modulator service*	
*Max. anode supply voltage	—	500	V
Max. peak anode voltage			
Inverse	1300	100	V
Forward	650	500	V
Max. cathode current			
Peak	0.5	10	A
Average (max. averaging time 30s)	100	10	mA
Surge (fault protection max. duration 0.1s)	10	10	A
Max. negative control-grid voltage			
Before conduction	100	100	V
During conduction	10	10	V
Max. average positive control-grid current for anode voltage more positive than –10V (averaging time 30s)	10	—	mA
Max. peak positive control-grid current during the time that the anode voltage is more positive than –10V	50	20	mA
Max. peak positive control-grid current during the time that the anode voltage is more negative than –10V	30	—	μA
Max. control-grid resistor	10	0.5	MΩ
Recommended min. control-grid resistor	100	—	kΩ
Max. negative shield-grid voltage			
Before conduction	100	50	V
During conduction	10	10	V

M8204

SPECIAL QUALITY TETRODE THYRATRON

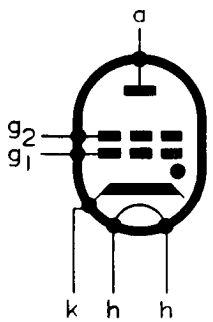
Max. average positive shield-grid current for anode voltage more positive than −10V (averaging time 30s)	10	—	mA
Max. shield-grid resistor	—	25	kΩ
Max. peak heater to cathode voltage			
Cathode negative	25	0	V
Cathode positive	100	0	V
Heater voltage	6.3V ± 10%	6.3V $^{+10}_{-5}$%	
Min. valve heating time	20	20	s
Ambient temperature limits	−75 to +90	−75 to +90	°C
Max. pulse duration	—	5.0	μs
*Max. pulse repetition frequency	—	500	c/s
Max. duty cycle	—	0.001	
Max. rate of rise of current pulse	—	100	A/μs

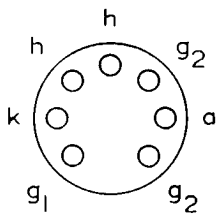
*After completion of a pulse a 20μs delay is required before a positive voltage of more than 10V is applied to the anode.

CAPACITANCES[a]

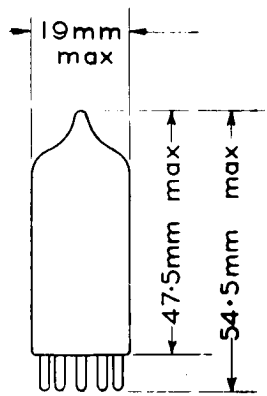
Anode to control-grid	—	0.03	pF
Control-grid to cathode and shield-grid	—	2.5	pF

4087





B7G Base



The bulb and base dimensions of this valve are in accordance with BS 448, Section B7G

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{g2} (V)
6.3	0

TESTS GROUP A	A.Q.L.[4] (%)	*individuals*[5] Bogey[8]	Min.	Max.	*Lot average*[6] Min.	Max.	
Heater current	0.65	600	540	660	—	—	mA
	—	—	—	—	567	633	mA
Heater to cathode leakage current							
V_{h-k} = 25V cathode negative	0.65	—	—	15	—	—	μA
V_{h-k} = 100V cathode positive	0.65	—	—	15	—	—	μA
*Grid 1 voltage V_a = 460V r.m.s., R_{g1} = 100kΩ, R_a = 3.0kΩ	0.65	−3.7	−2.9	−4.5	—	—	V
	—	—	—	—	−3.4	−4.0	V
*Grid 1 voltage V_a = 460V r.m.s., R_{g1} = 10MΩ, R_a = 3.0kΩ	0.65	−4.2	—	−5.6	—	—	V
*Anode voltage V_{g1} = 0V, R_{g1} = 100kΩ, R_a = 1.0kΩ	0.65	22	—	38	—	—	V
	—	—	—	—	—	33	V
Anode voltage V_h = 0V, V_{g1} = −100V, R_a = 1.0kΩ							
No breakdown must occur	0.65	—	650	—	—	—	V
Operation. $I_{load\ (pulse)}$	0.65	—	16	—	—	—	A

Measured at $V_{a(b)}$ = 500V, $v_{a(pk)}$ = 1.0kV,
$v_{g1(pk)}$ = 100V, V_{g1} = −50V, R_{g1} = 10kΩ,
R_{g2} = 25kΩ.
p.r.f. = 500pps, $t_p = 2 \pm 0.2\mu s$.
Modulator line impedance Z_o = 25Ω.
Load resistance = 20Ω, Min. P.I.V. = 100V.
Pulse rise time = 0.2μs max.
Pulse fall time = 0.4μs max.

	A.Q.L[4] (%)	Individuals[5] Bogey[8]	Individuals[5] Min.	Individuals[5] Max.	Lot average[6] Min.	Lot average[6] Max.	
Pulse emission $V_h = 6.3V$, $V_a = V_{g2} = V_{g1} = 180 \pm 9V$, min. P.I.V. = 100V, $t_p = 5 \pm 0.25\mu s$, pulse rise time = 0.5μs max., pulse fall time = 1.0μs max., p.r.f. = 100 ± 5pps. Pulse applied across valve and 10Ω resistor in series.							
Voltage measured across valve	0.65	—	—	76	—	—	V
	—	—	—	—	—	65	V
Group quality level[9]	1.0	—	—	—	—	—	
*Adjust voltage to initiate conduction							
GROUP B							
Inoperatives[14]	0.4	—	—	—	—	—	
GROUP C							
Insulation g_2–a measured at $V_{a-g2} = \pm 380V$	2.5	—	760	—	—	—	MΩ
*Anode voltage. $V_h = 5.7V$, $V_{g1} = 0V$, $R_{g1} = 100k\Omega$, $R_a = 1.0k\Omega$	2.5	—	—	50	—	—	V
	—	—	—	—	—	45	V
*Grid 1 voltage. $V_h = 7.0V$, $V_a = 460V$ r.m.s., $R_{g1} = 10M\Omega$, $R_a = 3.0k\Omega$ (Following special pre-heat condition)	6.5	−4.6	—	−6.4	—	—	V
*Grid 2 voltage. $V_a = 150V$ r.m.s., $R_a = 1.0k\Omega$, $R_{g1} = 2.5k\Omega$ V_{g1} supply in phase with V_a supply, V_{g2} in antiphase: r.m.s. voltage	6.5	2.45	1.85	3.05	—	—	V
Vibration. No applied voltages. Vibrate for 60s at 25c/s 2.5g then repeat Group B test	6.5	—	—	—	—	—	
*Adjust voltage to initiate conduction							

GROUP D

Shock[13]

No applied voltages, 750g.

Post shock tests

Heater to cathode leakage current								
V_{h-k} = 25V cathode negative	—	—	—	40	—	—	μA
V_{h-k} = 100V cathode positive	—	—	—	40	—	—	μA
Anode voltage as in Group A (V_{g1}=0V)	—	—	—	50	—	—	V
Pulse emission as in Group A	—	—	—	76	—	—	V
Grid 1 voltage as in Group A (R_{g1}=100kΩ)	—	—	-2.9	-4.5	—	—	V
Sub-group quality level [9]	20						

Fatigue[14]

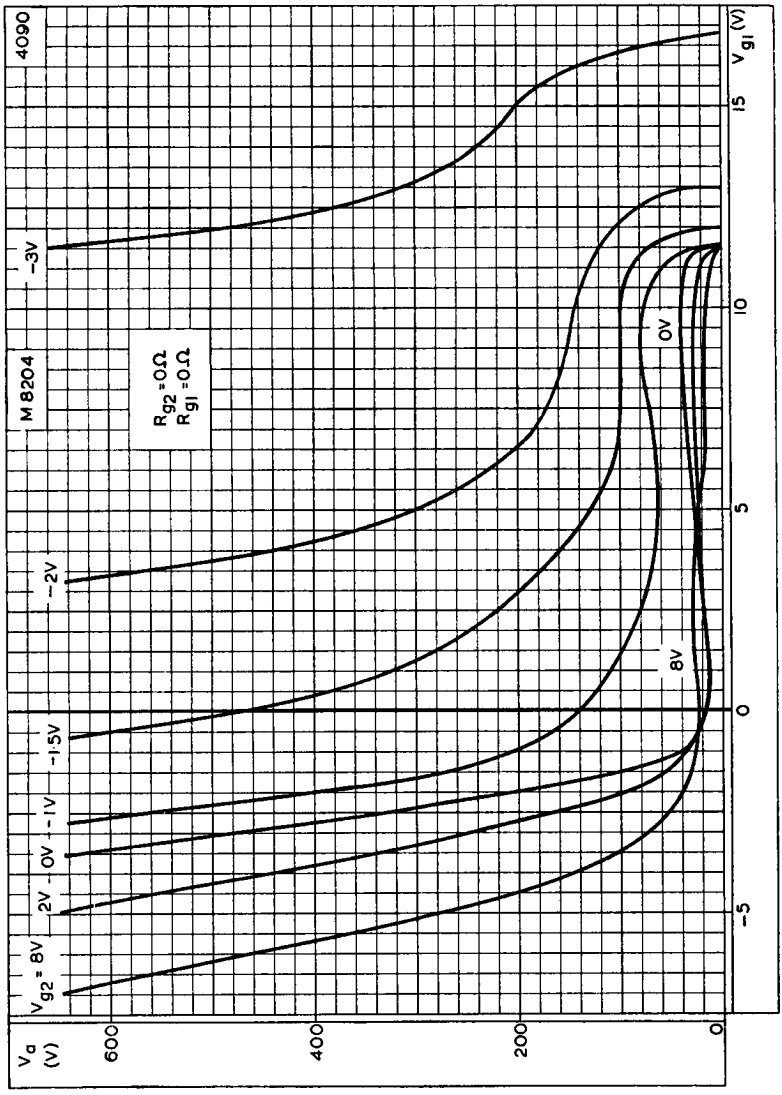
V_h = 6.3V, no other applied voltages, 2.5g acceleration, f = 25±2c/s for 32 hours in each of three mutually perpendicular planes

Post fatigue tests

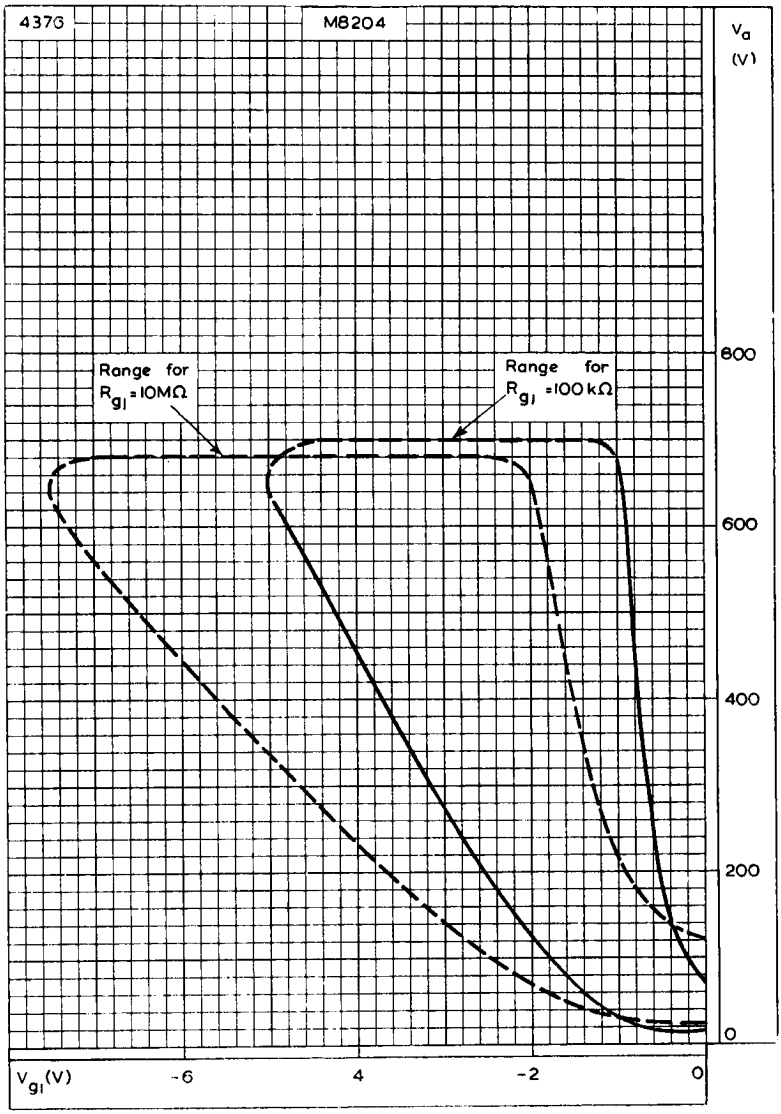
Heater to cathode leakage current								
V_{h-k} = 25V cathode negative	—	—	—	40	—	—	μA
V_{h-k} = 100V cathode positive	—	—	—	40	—	—	μA
Anode voltage as in Group A (V_{g1}=0V)	—	—	—	50	—	—	V
Pulse emission as in Group A	—	—	—	76	—	—	V
Grid 1 voltage as in Group A (R_{g1}=100kΩ)	—	—	-2.9	-4.5	—	—	V
Sub-group quality level [9]	20	—	—	—	—	—	
Base strain test[11]	6.5	—	—	—	—	—	

GROUP E	A.Q.L.[4] (%)	Individuals[5] Min.	Individuals[5] Max.	
Heater cycling life test V_h = 7.5V, 1 minute on, 1 minute off, 2000 cycles. V_{h-k} = 100V cathode positive. No other applied voltages	1.0	—	—	
Heater cycling life test end points				
Heater to cathode leakage current				
V_{h-k} = 25V cathode negative	—	—	20	μA
V_{h-k} = 100V cathode positive	—	—	20	μA
Intermittent life[12]				
Running conditions as grid controlled rectifier 500 hours				
V_a = 460Vr.m.s., I_k = 80mA (d.c.) R_{g1} = 50kΩ,				
$i_{k(pk)}$ = 0.5A, Cathode heating time = 20^{+0}_{-1}s				
Room temperature				
Intermittent life test end points				
Inoperatives[14]				
Heater to cathode leakage current				
V_{h-k} = 25V cathode negative	—	—	20	μA
V_{h-k} = 100V cathode positive	—	—	20	μA
Anode voltage as in Group A (V_{g1} = 0V)	—	—	50	V
Pulse emission as in Group A	—	—	100	V
Insulation g_2-a as in Group C	—	380	—	MΩ
Continuous life, 200 hours' duration[12]				
Adjust $v_{a(pk)}$ for $I_{load\ pulse}$ = 20A initially				
Running conditions, pulse modulator service				
$V_{a(b)}$ = 250V, $v_{a(pk)}$ = 500V, $v_{g1(pk)}$ = 100V,				
V_{g1} = −50V, V_{g2} = 0V, R_{g1} = 10kΩ, R_{g2} = 25kΩ,				
p.r.f. = 1000pps., modulator line impedance				
Z_o = 12.5Ω, load resistance = 7.5Ω. t_p = 2±0.2μs				
Life test end points				
$I_{load\ pulse}$	—	16	—	A
Average life	—	180	—	hrs
Pulse emission as in Group A	—	—	100	V

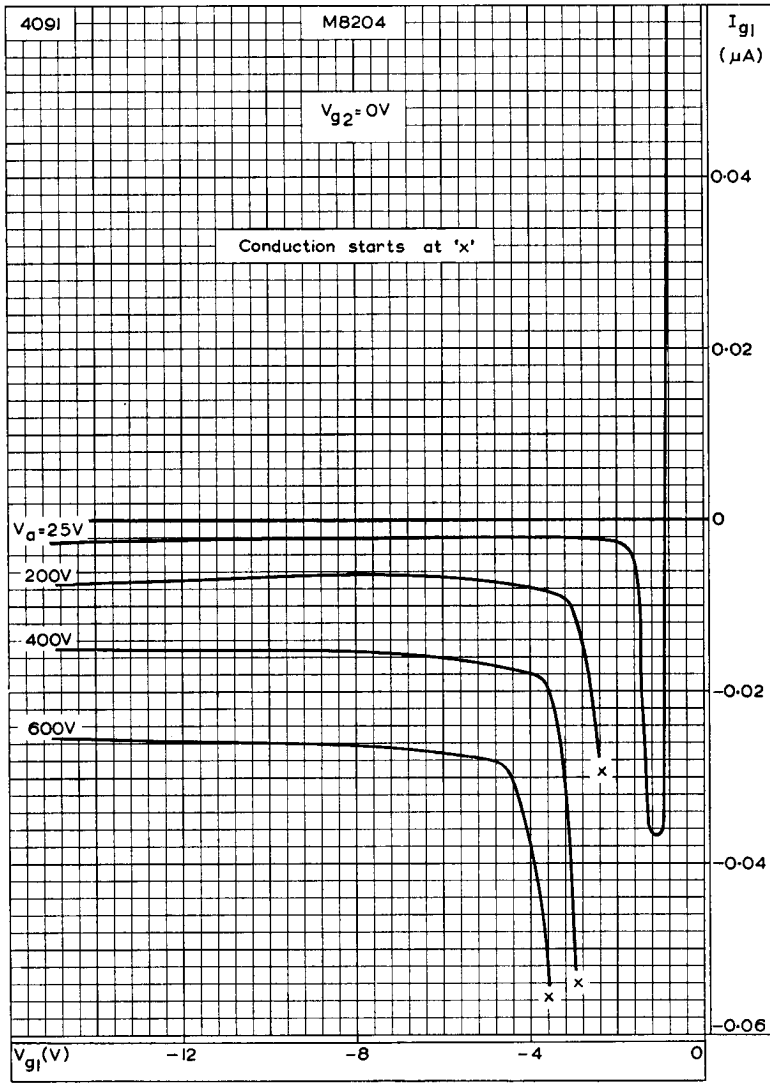
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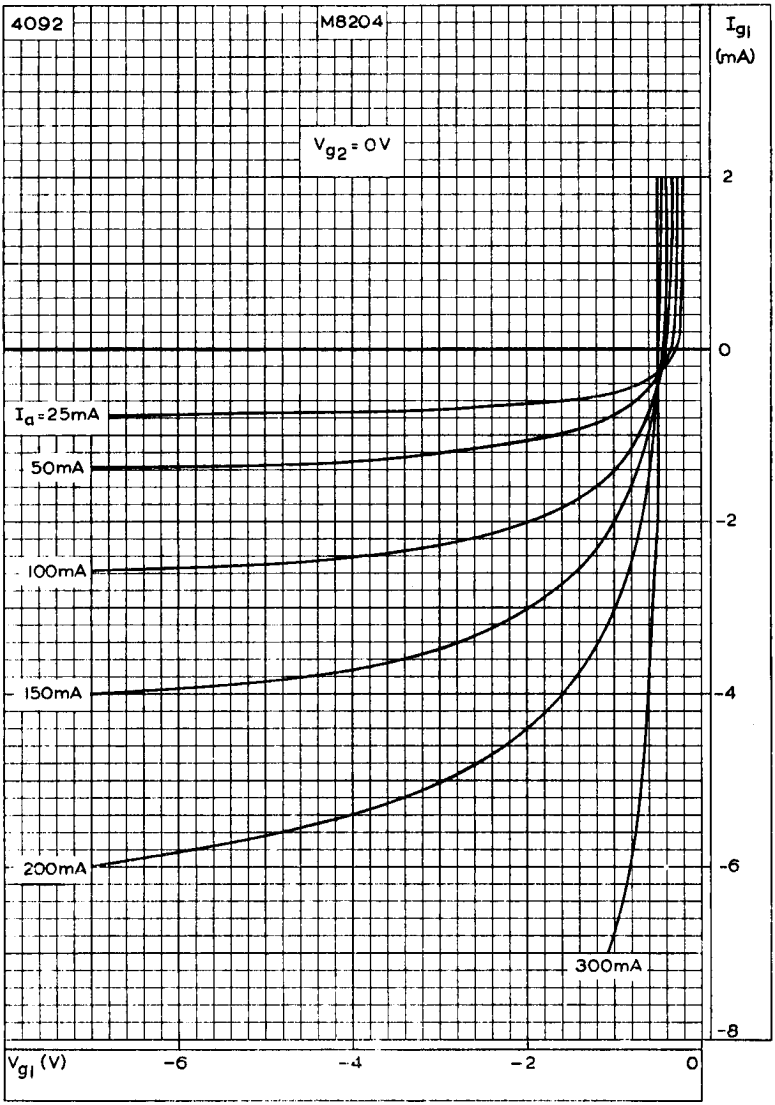
CONTROL CHARACTERISTIC



OPERATING RANGE OF CRITICAL CONTROL-GRID VOLTAGE



CONTROL-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE BEFORE CONDUCTION



CONTROL-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE DURING CONDUCTION

SPECIAL QUALITY DOUBLE DIODE

M8212

Special quality double diode with separate cathodes and internal screening between sections for use in equipment where mechanical vibrations and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to specific note.

HEATER

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

V_h[1]	6.3	V
I_h	300	mA

CAPACITANCES[2] (measured with an external shield)

$c_{a'-k'+h+s+S}$	3.2	pF
$c_{a''-k''+h+s+S}$	3.2	pF
$c_{k'-a'+h+s+S}$	3.9	pF
$c_{k''-a''+h+s+S}$	3.9	pF
$c_{a'-a''}$	<26	mpF

LIMITING VALUES[4] (absolute ratings) each section

P.I.V. max.	360	V
I_a max.	10	mA
$i_{a(pk)}$ max.	60	mA
$i_{a(surge)}$ max.	350	mA
V_{h-k} max.	360	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

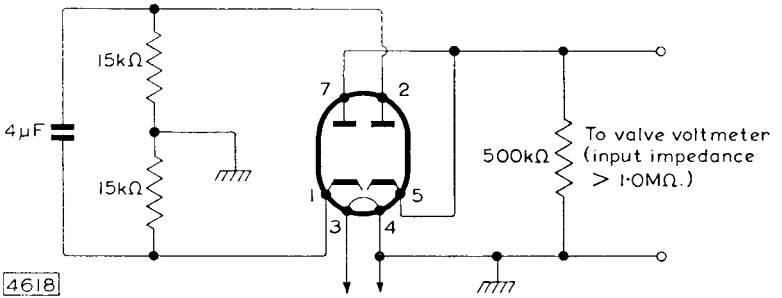
TEST CONDITIONS (unless otherwise specified)

V_h (V)	$V_{a(r.m.s.)}$ (V)	R_{load} (kΩ)	C (μF)
6.3	165	11	8.0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest, screen-rest measured at –300V	0.25	—	100	—	—	—	—	MΩ
GROUP B								
Heater current	0.65	—	275	325	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	5.0	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	5.0	—	—	—	μA
Output current	0.65	18	16	—	—	—	—	mA
Emission V_a = 10V	0.65	—	40	—	—	—	—	mA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. V_a = 0V, R_a = 40kΩ	2.5	—	2.0	20	—	—	—	μA
Anode current difference between sections V_a = 0V, R_a = 40kΩ	2.5	—	—	5.0	—	—	—	μA
Change in emission V_h = 5.7V, V_a = 7.0V	2.5	—	—	15	—	—	—	%
Hum V_h = 7.0V Tested in circuit shown below	2.5	—	—	10	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	



GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
$C_{a'-a''}$	—	—	—	26	—	—	—	mpF
$C_{a'-k'+h+s+S}$	—	—	2.4	4.0	—	—	—	pF
$C_{a''-k''+h+s+S}$	—	—	2.4	4.0	—	—	—	pF
$C_{k'-a'+h+s+S}$	—	—	2.5	5.0	—	—	—	pF ←
$C_{k''-a''+h+s+S}$	—	—	2.5	5.0	—	—	—	pF ←

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. V_{h-k} = ±100V	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
Group quality level[10]	6.5	—	—	—	—	—	—	
GROUP F								
Intermittent life test								
The valve is connected in a full wave rectifier circuit with a load resistor of 11kΩ and a reservoir capacitor of 8μF. The supply impedance is adjusted so that the peak anode current is not less than 60mA for a nominal valve, the total output current being approximately 18mA. The cathode to heater voltage is provided by the output voltage in series with 117Vr.m.s.								

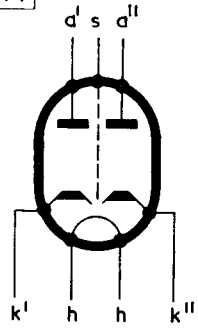
		A.Q.L.[5] (%)	Min.	Max.	
Intermittent life test end points					
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	275	325	mA
	1000 hours	4.0	275	325	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	10	μA
	1000 hours	4.0	—	10	μA
Emission $V_a = 10V$	500 hours	2.5	35	—	mA
	1000 hours	6.5	30	—	mA
Sub-group (b)					
Change in emission $V_h = 5.7V$, $V_a = 7.0V$	500 hours	4.0	—	20	%
Anode current $V_a = 0V$, $R_a = 40k\Omega$	500 hours	4.0	1.0	20	μA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	50	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

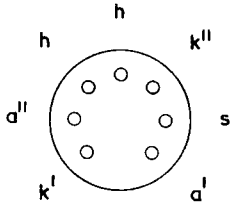
GROUP G

Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	

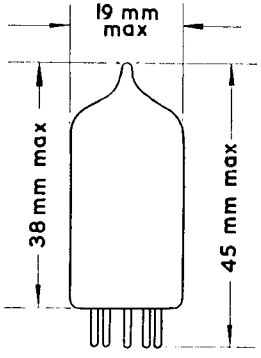
M8212 SPECIAL QUALITY DOUBLE DIODE

3577

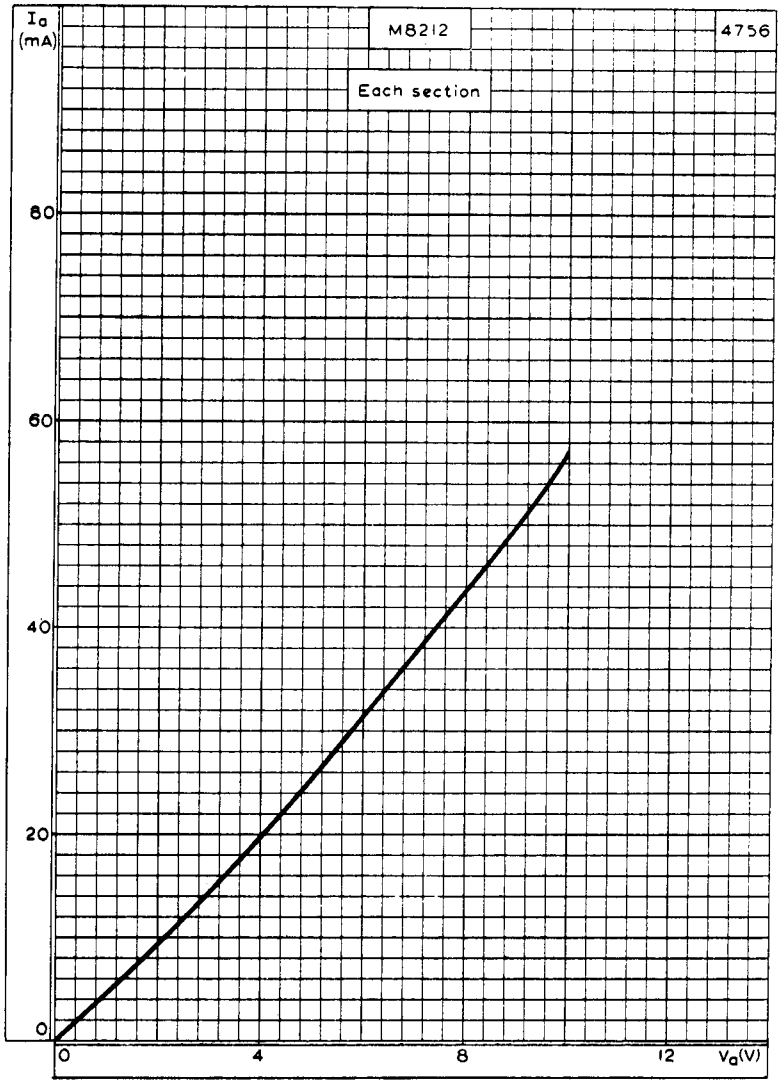




B7G Base



The bulb and base dimensions of this valve are in accordance with BS448, Section B7G



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SPECIAL QUALITY STABILISING TUBE

M8223

Special quality 150V gas-filled voltage stabiliser for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

PRELIMINARY DATA

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VOLTAGE STABILISER & REFERENCE TUBES preceding this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

LIMITING VALUES[1] (absolute ratings)

†Minimum voltage necessary for immediate ignition		
In some ambient light (50ft.cd.)	165	V
In complete darkness	225	V
Burning current		
Maximum	30	mA
Minimum	5.0	mA
Maximum starting current	75	mA
Maximum negative anode voltage	125	V
Minimum ambient temperature	−55	°C
Maximum bulb temperature	150	°C

†These values cover life.

CHARACTERISTICS

Maximum maintaining voltage at 30mA (all tubes over life)	158	V
Minimum maintaining voltage at 5.0mA (all tubes over life)	142	V
Difference between maintaining voltages at 30mA and 5.0mA (individual tube)		
Maximum	5.0	V
Typical	3.0	V
Typical variation of maintaining voltage at 20mA during 500 hours life at T_{bulb} = 150°C	±2.0	%

M8223

SPECIAL QUALITY STABILISING TUBE

TESTS	A.Q.L.[2] (%)	Individuals[3] Bogey[6]	Individuals[3] Min.	Individuals[3] Max.	Lot average[4] Min.	Lot average[4] Max.	Lot standard deviation[5] Max.	
GROUP A								
Ignition voltage. Illumination 5 to 50ft.cd.	0.65	—	—	165	—	—	—	V
Maintaining voltage								
Burning current = 30mA	0.65	150	—	156	—	—	—	V
	—	—	—	—	—	152	2.1	V
Burning current = 5.0mA..	0.65	149	143	—	—	—	—	V
	—	—	—	—	147	—	2.1	V
Change in maintaining voltage for burning current change from 5.0 to 30mA ..	0.65	—	—	5.0	—	—	—	V
Group quality level[7]	1.0	—	—	—	—	—	—	
GROUP B								
Continuity and short	0.4	—	—	—	—	—	—	
*Microphonic noise. Burning current = 30mA	2.5	—	—	5.0	—	—	—	mV
Oscillation. V_{sig} = 100mV, burning current change from 5.0 to 30mA	2.5	—	—	—	—	—	—	
Ignition voltage in complete darkness, after 24 hours in darkness	6.5	—	—	225	—	—	—	V
Leakage current. V_a = 50V, R_a = 3.0kΩ ..	6.5	—	—	5.0	—	—	—	μA

*The tube is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

GROUP C

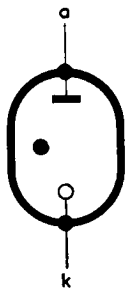
Glass strain[8A]. No applied voltage ..	2.5	—	—	—	—	—	—	
Fatigue[11]								
No applied voltage, 2.5g min. peak acceleration f = 25±2c/s for 32 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Ignition voltage as in Group A	—	—	—	165	—	—	—	V
Maintaining voltage								
Burning current = 30mA	—	—	—	158	—	—	—	V
Burning current = 5.0mA	—	—	142	—	—	—	—	V
Change in maintaining voltage for burning current change from 5.0 to 30mA ..	—	—	—	5.0	—	—	—	V
Sub-group quality level[7]	6.5	—	—	—	—	—	—	
Shock[12]								
No applied voltage, 500g								
Post shock tests								
Ignition voltage as in Group A	—	—	—	165	—	—	—	V
Maintaining voltage								
Burning current = 30mA	—	—	—	158	—	—	—	V
Burning current = 5.0mA	—	—	142	—	—	—	—	V
Change in maintaining voltage for burning current change from 5.0 to 30mA ..	—	—	—	5.0	—	—	—	V
Sub-group quality level[7]	20	—	—	—	—	—	—	

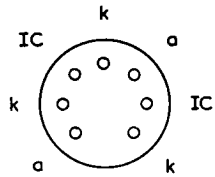
	A.Q.L.[2] (%)	Individuals[3] Bogey[6]	Min.	Max.	Lot average[4] Min.	Max.	Lot standard deviation[5] Max.	
GROUP D								
Intermittent life test								
Burning current = 20mA								
T_{bulb} min = 150°C								
Intermittent life test end point 500 hours								
Change in maintaining voltage for current change from 5.0 to 30mA	—	—	—	8.0	—	—	—	V
Maintaining voltage								
Burning current = 30mA	—	—	—	158	—	—	—	V
Burning current = 5.0mA	—	—	142	—	—	—	—	V
Ignition voltage as in Group A	—	—	—	165	—	—	—	V
Change in maintaining voltage								
Burning current = 30mA	—	—	—	—	—	2.0	—	%
Burning current = 5.0mA	—	—	—	—	—	2.0	—	%
GROUP E								
Valves are held for 28 days and tested for								
Inoperatives	0.5	—	—	—	—	—	—	—

SPECIAL QUALITY STABILISING TUBE

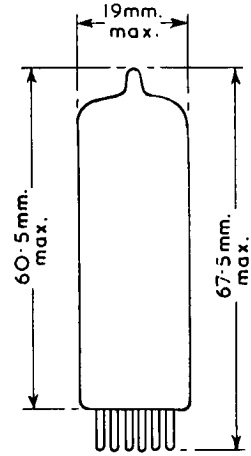
M8223

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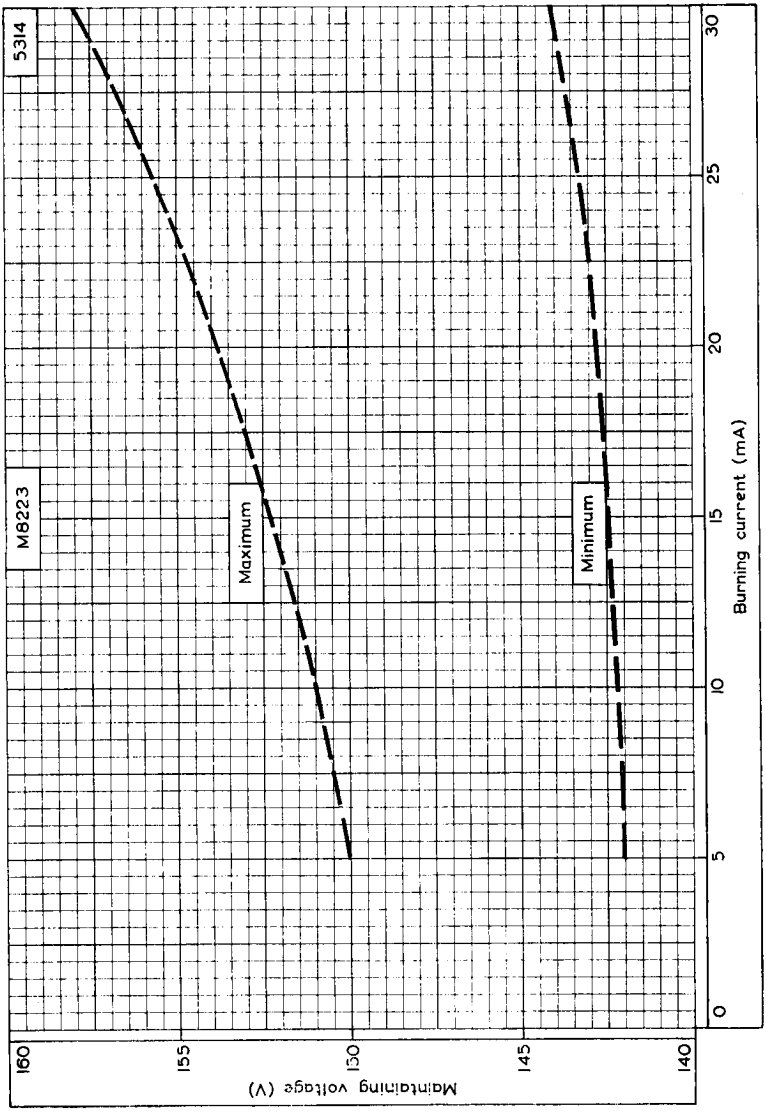
B7G Base.



The bulb and base dimensions of this tube are in accordance with BS448 Section B7G

M8223

SPECIAL QUALITY STABILISING TUBE



MAXIMUM DEVIATION OF CHARACTERISTIC (ALL TUBES OVER LIFE)

SPECIAL QUALITY STABILISING TUBE

M8224

Special quality 108V gas-filled voltage stabiliser for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

PRELIMINARY DATA

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VOLTAGE STABILISER AND REFERENCE TUBES preceding this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

LIMITING VALUES[1] (absolute ratings)

†Minimum voltage necessary for immediate ignition		
In some ambient light (50 ft.cd.)	133	V
In complete darkness	210	V
Burning current		
Maximum	30	mA
Minimum	5.0	mA
Maximum starting current	75	mA
Maximum negative anode voltage	75	V
Minimum ambient temperature	−55	°C
Maximum bulb temperature	150	°C

†These valves cover life.

CHARACTERISTICS

Maximum maintaining voltage at 30mA (all tubes over life)	113	V
Minimum maintaining voltage at 5.0mA (all tubes over life)	103	V
Difference between maintaining voltages at 30mA and 5.0mA (individual tube)		
Maximum	4.0	V
Typical	1.5	V
Typical variation of maintaining voltage at 20mA during 500 hours life at T_{bulb}=150°C	±2.0	%

M8224

SPECIAL QUALITY STABILISING TUBE

TESTS	A.Q.L.[2] (%)	Individuals[3] Bogey[6]	Min.	Max.	Lot average[4] Min.	Max.	Lot standard deviation[5] Max.	
GROUP A								
Ignition voltage. Illumination 5 to 50ft.cd.	0.65	—	—	130	—	—	—	V
Maintaining voltage								
Burning current = 30mA	0.65	108.5	—	111	—	—	—	V
	—	—	—	—	—	109.5	0.87	V
Burning current = 5.0mA	0.65	101.5	105	—	—	—	—	V
	—	—	—	—	106.5	—	0.87	V
Change in maintaining voltage for burning current change from 5.0 to 30mA ..	0.65	—	—	3.0	—	—	—	V
Group quality level[7]	1.0	—	—	—	—	—	—	
GROUP B								
Continuity and short	0.4	—	—	—	—	—	—	
*Microphonic noise. Burning current = 30mA	2.5	—	—	5.0	—	—	—	mV
Oscillation. V_{sig}=100mV, burning current change from 5.0 to 30mA	2.5	—	—	—	—	—	—	
Ignition voltage in complete darkness, after 24 hours in darkness	6.5	—	—	210	—	—	—	V
Leakage current. V_a = 50V, R_a = 3.0kΩ	6.5	—	—	5.0	—	—	—	μA

*The tube is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

GROUP C									
Glass strain[8A]. No applied voltage ..	2.5	—	—	—	—	—	—		
Fatigue[11]									
No applied voltage, 2.5g min. peak acceleration f = 25±2c/s for 32 hours in each of 3 mutually perpendicular planes.									
Post fatigue tests									
Ignition voltage as in Group A	—	—	—	133	—	—	—	V	
Maintaining voltage									
Burning current = 30mA	—	—	—	113	—	—	—	V	
Burning current = 5.0mA	—	—	103	—	—	—	—	V	
Change in maintaining voltage for burning current change from 5.0 to 30mA ..	—	—	—	4.0	—	—	—	V	
Sub-group quality level[7]	6.5	—	—	—	—	—	—		
Shock[12]									
No applied voltage, 500g									
Post shock tests									
Ignition voltage as in Group A	—	—	—	133	—	—	—	V	
Maintaining voltage									
Burning current = 30mA	—	—	—	113	—	—	—	V	
Burning current = 5.0mA	—	—	103	—	—	—	—	V	
Change in maintaining voltage for burning current change from 5.0 to 30mA ..	—	—	—	4.0	—	—	—	V	
Sub-group quality level[7]	20	—	—	—	—	—	—		

M8224

SPECIAL QUALITY
STABILISING TUBE

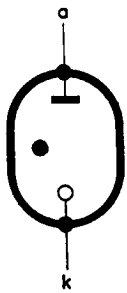
GROUP D	A.Q.L.[2] (%)	Individuals[3] Bogey[6]	Min.	Max.	Lot average[4] Min.	Max.	Lot standard deviation[5] Max.	
Intermittent life test								
Burning current = 20mA								
T_{bulb} min = 150°C								
Intermittent life test end points 500 hours								
Change in maintaining voltage for current change from 5.0 to 30mA	—	—	—	4.0	—	—	—	V
Maintaining voltage								
Burning current = 30mA	—	—	—	113	—	—	—	V
Burning current = 5.0mA	—	—	103	—	—	—	—	V
Ignition voltage as in Group A	—	—	—	133	—	—	—	V
Change in maintaining voltage								
Burning current = 30mA	—	—	—	—	—	2.0	—	%
Burning current = 5.0mA	—	—	—	—	—	2.0	—	%

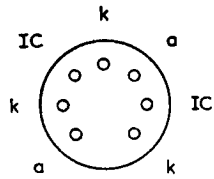
GROUP E								
Valves are held for 28 days and tested for Inoperatives	0.5	—	—	—	—	—	—	

SPECIAL QUALITY STABILISING TUBE

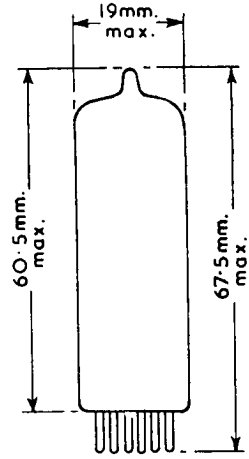
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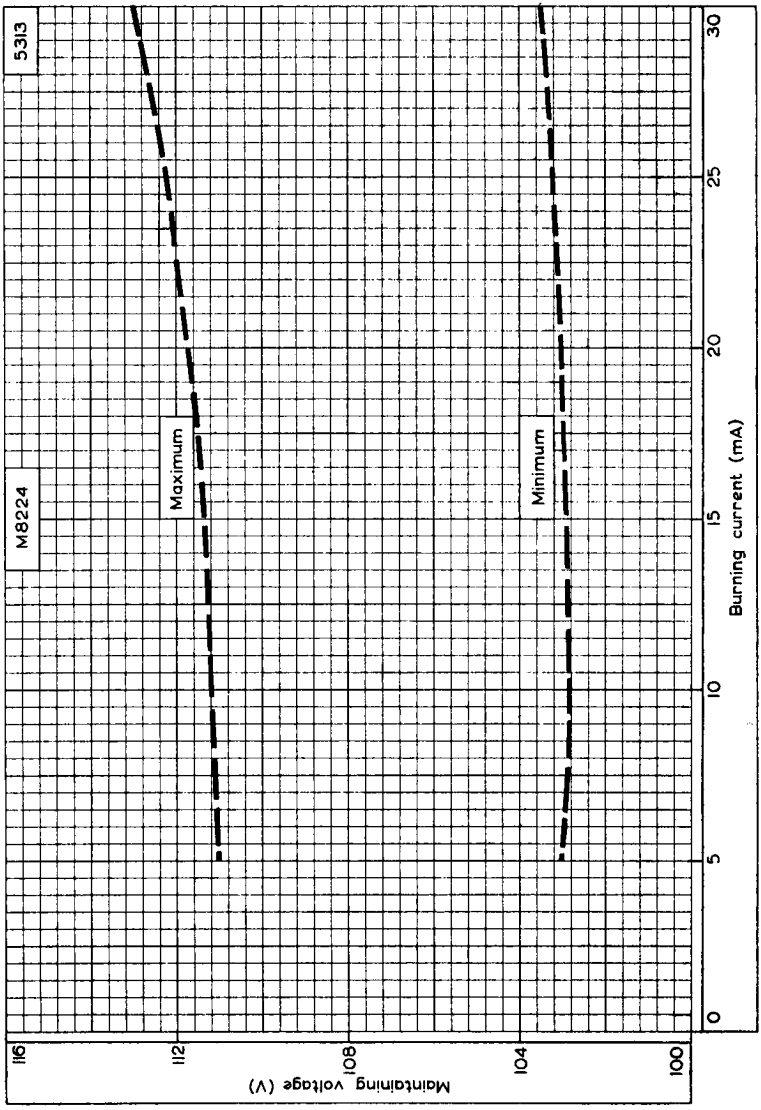




B7G Base.



The bulb and base dimensions of this tube are in accordance with BS448 Section B7G



MAXIMUM DEVIATION OF CHARACTERISTIC (ALL TUBES OVER LIFE)

SPECIAL QUALITY U.H.F. TRIODE

M8248

Special quality triode for use as a grounded grid amplifier in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

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

V_h[1]	6.3	V
I_h	400	mA

CAPACITANCES[2] (measured with external shield)

c_{a-k}	80	mpF
c_{a-k} max.	150	mpF
c_{h-k}	3.8	pF
c_{a-g}	2.8	pF
$c_{k-g+h+sh}$	8.8	pF
$c_{a-g+h+sh}$	4.0	pF

CHARACTERISTICS[3]

V_a	150	V
I_a	13.5	mA
V_g	–1.35	V
g_m	13.5	mA/V
r_a	3.7	kΩ
μ	50	
R_k	0	Ω
V_g ($I_a \leqslant 60\mu A$)	–15	V

ABSOLUTE MAXIMUM RATINGS[4]

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	2.7	W
$+V_g$ max.	0	V
$-V_g$ max.	55	V
I_k max.	20	mA
I_g max.	3.5	mA
R_{g-k} max.	250	kΩ
V_{h-k} max.	90	V
Maximum acceleration (continuous operation)	50	g
Maximum shock (short duration)	500	g
T_{bulb} max.	120	°C

M8248

SPECIAL QUALITY U.H.F. TRIODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g1-e} (V)	R_k (Ω)	C_k (μF)
6.3	150	0	100	1000

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	400	375	425	—	—	—	mA
Heater-cathode leakage current V_{h-k} ±100V	0.65	—	—	10	—	—	—	μA
Reverse grid current V_{a-e} 175V, R_k 150Ω, R_{g1} 250kΩ	0.65	—	—	0.5	—	—	—	μA
Anode current	0.65	13.5	9.0	18.0	—	—	—	mA
	—	—	—	—	11.8	15.2	1.35	mA
Anode current $V_g = -15V$, $R_k = 0Ω$	0.65	—	—	60	—	—	—	μA
Mutual conductance	0.65	13.5	11.0	16.0	—	—	—	mA/V
	—	—	—	—	12.6	14.4	0.73	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

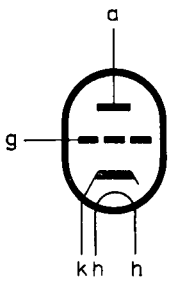
GROUP B

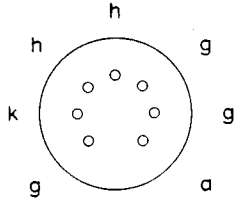
Insulation								
a-rest measured at –300V g-rest measured at –100V	2.5	— —	200 200	—	—	—	—	MΩ MΩ
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Amplification factor	6.5	—	40	65	—	—	—	
Capacitances[2] (shielded). No applied voltages	6.5							
c_{a-k} shield to earth		—	—	150	—	—	—	mpF
c_{h-k} shield to earth		—	2.5	5.0	—	—	—	pF
c_{a-g} shield to earth		—	2.3	3.3	—	—	—	pF
c_{k-g+h} shield to grid		—	8.0	11.0	—	—	—	pF
c_{a-g+h} shield to grid		—	—	5.0	—	—	—	pF
Low pressure voltage breakdown pressure 55±5mm Hg, voltage 500V o.c. No other applied voltages	6.5	—	—	—	—	—	—	
Microphone noise at the anode at 50c/s, 2.0g minimum peak acceleration, $R_a = 2000\Omega$	6.5	—	—	200	—	—	—	mV (r.m.s.)

TESTS	A.Q.L.[5]	Individuals[6]			Lot average[7]		Lot standard deviation[8]	
GROUP C	(%)	Bogey[9]	Min.	Max.	Min.	Max.	Max.	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g minimum peak acceleration, fixed frequency. f = 25c/s min., 60c/s max. for 32 hours in each of 3 mutually perpendicular planes.								
Post Fatigue Tests								
Heater to cathode leakage current V_{h-k} ± 100V	6.5	—	—	20	—	—	—	μA
Change in mutual conductance		—	—	20	—	—	—	%
Reverse grid current		—	—	1.0	—	—	—	μA
Microphonic noise as in Group B		—	—	300	—	—	—	mV (r.m.s.)
Shock[15]								
V_{h-k} = 100V (cathode negative) V_g = −1.5V d.c. R_g = 100kΩ, 500g.								
Post Shock Tests								
Heater-cathode leakage current V_{h-k} ± 100V	20	—	—	20	—	—	—	μA
Change in mutual conductance		—	—	20	—	—	—	%
Reverse grid current		—	—	1.0	—	—	—	μA
Microphonic noise as in Group B		—	—	300	—	—	—	mV (r.m.s.)
Base strain[12]. No applied voltages	—	—	—	—	—	—	—	
Glass strain[11A]. No applied voltages	2.5	—	—	—	—	—	—	
GROUP D								
Heater cycling life test V_h = 7.0V. V_{h-k} + 100V d.c. 1 minute on 4 minutes off. No other voltages.								

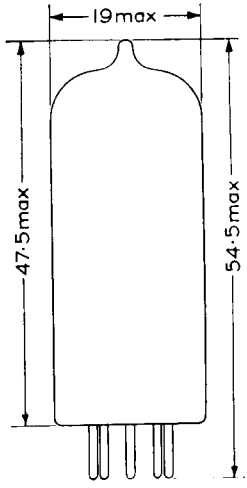
Heater cycling life end points								
Heater to cathode leakage								
$V_{h-k} \pm 100V$ d.c.	1.0	—	—	20	—	—	—	μA
Insulation as in Group B	2.5	—	30	—	—	—	—	MΩ
Stability life test[14]								
Running conditions, $V_{h-k}+100V$ d.c. $R_g = 250$ kΩ								
$T_{ambient}$ = Room temperature.								
Stability life end point								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions. $V_{h-k}+100V$ d.c. $R_g = 250k\Omega$								
$T_{ambient}$ = room temperature								
Survival rate end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	10	—	—	—	—	mA/V
Intermittent life test								
Running conditions								
$V_{h-k}+100V$ d.c. $R_g = 250k\Omega$								
T_{bulb} min. = 120°C								
Intermittent life test end points (500 hours)								
Inoperatives[16]	2.5							
Heater current	2.5	—	370	460	—	—	—	mA
Reverse grid current	2.5	—	—	2.0	—	—	—	μA
Change in mutual conductance. $V_h = 5.7V$	4.0	—	—	15	—	—	—	%
Change in mutual conductance (individuals)	2.5	—	—	20	—	—	—	%
Heater to cathode leakage								
$V_{h-k} = \pm 100V$ d.c.	2.5	—	—	20	—	—	—	μA
Insulation as in Group B	2.5	—	100	—	—	—	—	MΩ
Average change in mutual conductance	—	—	—	10	—	—	—	%
Sub-group quality level[19]	10.0							

M8248 SPECIAL QUALITY U.H.F. TRIODE





B7G Base



All dimensions in mm

7824

RADAR TUBE

Direct viewing radar tube with 9-in. diameter flat-faced metal-backed screen primarily intended for use in P.P.I. applications.

MB22-75
MF22-75

The only difference between the MB22-75 and the MF22-75 is in the screen properties (see appropriate section of data).

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES included in this section of the handbook.

HEATER

Indirectly heated

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

CAPACITANCES

C_{g-all}	<10	pF
C_{k-all}	<10	pF

SCREEN

Metal-backed

Max. picture diameter		200	mm
	MB22-75	*MF22-75*	
Fluorescent colour	blue	orange—with orange afterglow	
Persistence	short	long	

FOCUSING

Magnetic

DEFLECTION

Double magnetic

MOUNTING POSITION

Any, except vertical with screen downwards and the axis of the tube making an angle of less than 20° with the vertical.

TYPICAL OPERATING CONDITIONS

V_a	15	kV
V_g for cut-off	−60 to −140	V
†Recommended distance of centre of magnetic length of focus unit from reference line	117	mm

†See appropriate section of 'General operational recommendations—cathode ray tubes'.

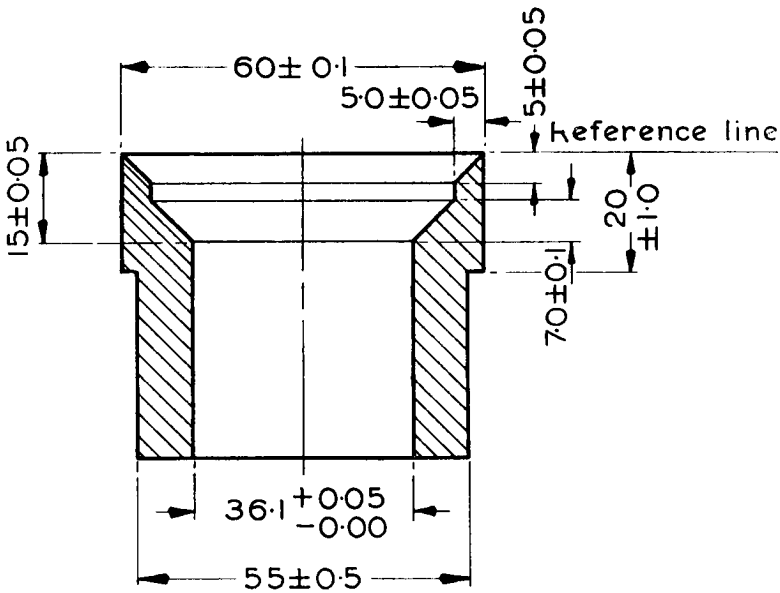
MB22-75
MF22-75

RADAR TUBE

LIMITING VALUES (absolute ratings)

V_{a} max.	15.5	kV
V_{a} min.	9.0	kV
$-V_{g}$ max.	200	V
*I_{k} max.	150	μA
V_{h-k} max.	150	V
R_{g-k} max.	1.5	MΩ
R_{h-k} max.	1.0	MΩ

*The MF22-75 has a magnesium fluoride screen which is liable to burn if a stationary or slowly moving spot is used even with low values of mean beam current.

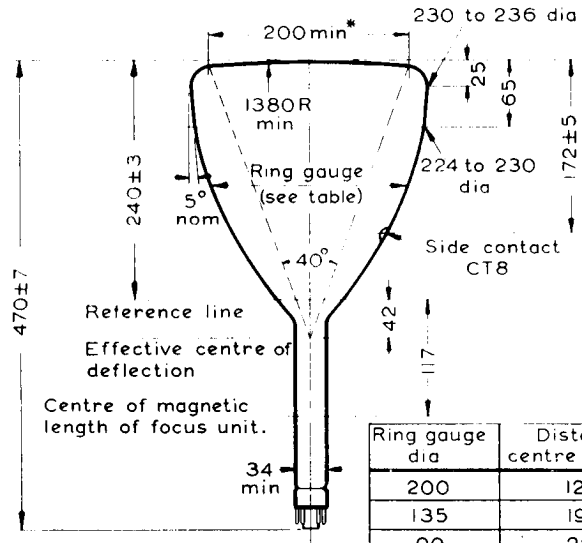


All dimensions in mm

5614

REFERENCE LINE GAUGE

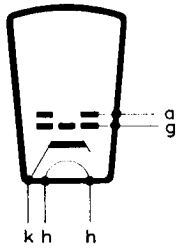
MB22-75
MF22-75

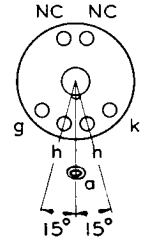


Ring gauge dia	Distance from centre of tube face
200	123±20
135	190±15(Note)
90	222±10

Note: The 135 dia gauge may have a chord of 30mm cut from the gauge face to a depth of 10mm to avoid the anode side contact.

*Diameter of useful screen area.

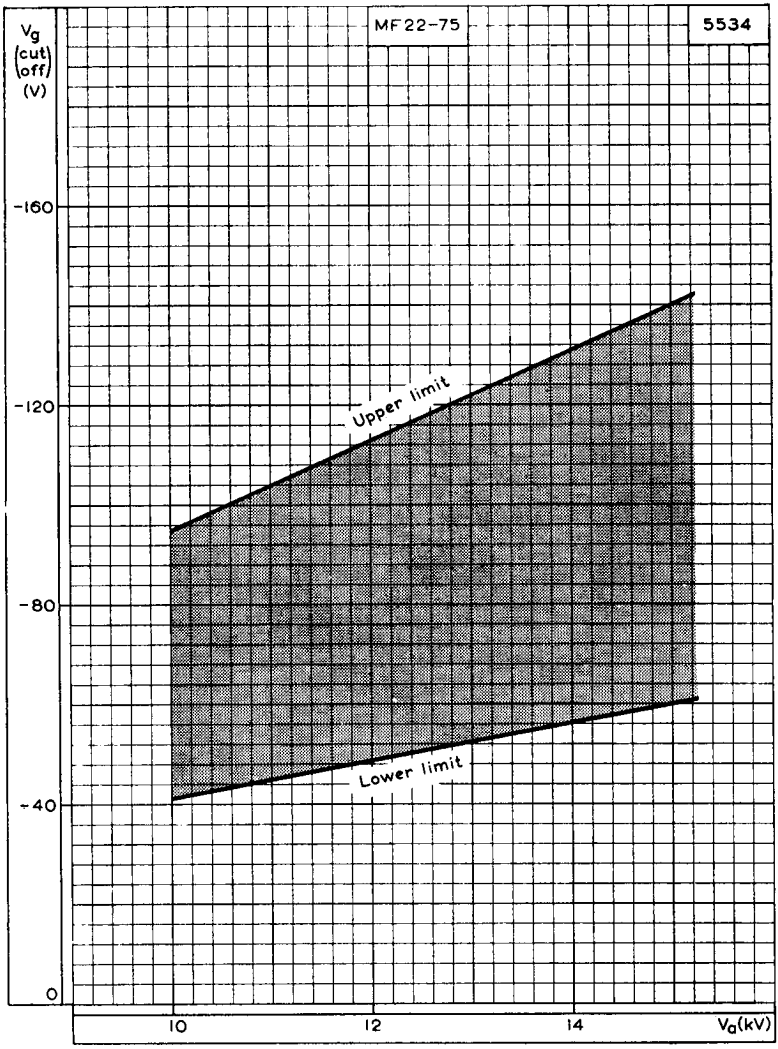




B12A Base

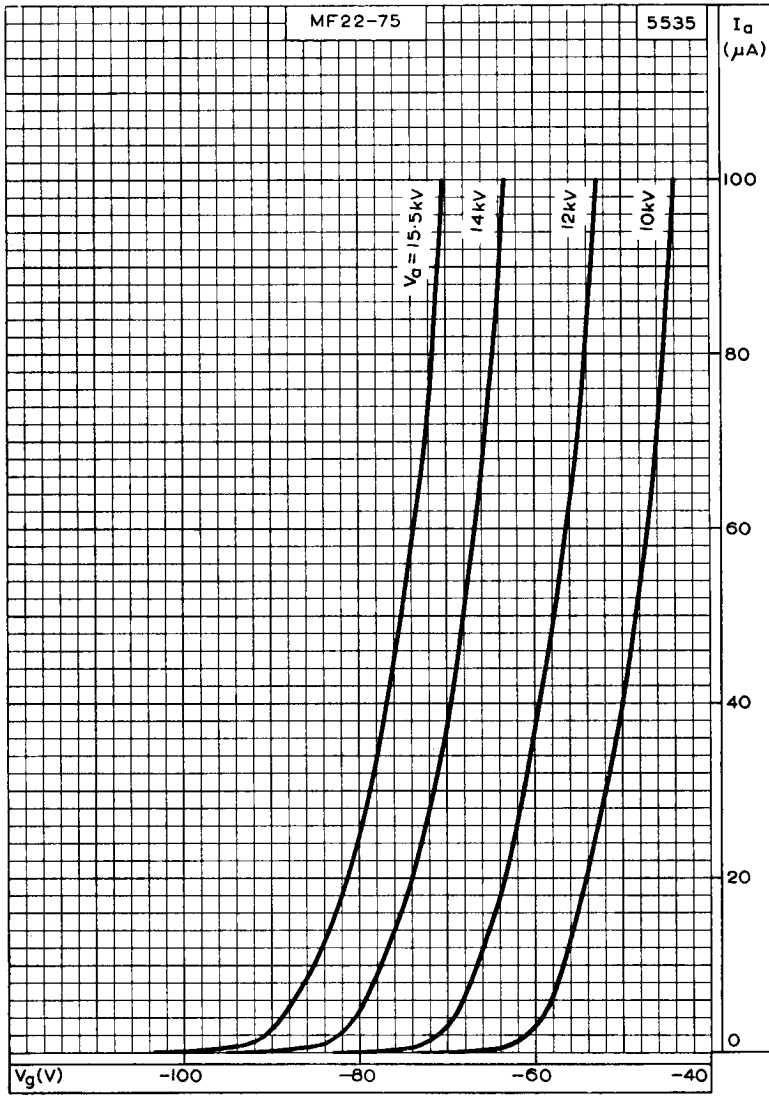
5610

All dimensions in mm



LIMITS OF GRID CUT-OFF VOLTAGE FOR FINAL ANODE VOLTAGES FROM 10 TO 15kV

MB22-75
MF22-75



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

ELECTROMETER PENTODE

Pentode suitable for use in high resistance circuits for applications such as pH meters, photocell units and valve voltmeters.

ME1400

HEATER

V_h	4.5±5%	V
I_h	160	mA

MOUNTING POSITION

Any

CAPACITANCES

c_{a-g1}	<20	mpF
c_{in}	5.5	pF
c_{out}	8.5	pF

CHARACTERISTICS

Pentode connected

Measured at V_h = 4.5V, $V_a = V_{g2}$ = 45V and I_a = 80μA

	Min.	*Av.*	*Max.*	
I_h	150	160	170	mA
V_{g1}	–1.6	–2.0	–2.4	V
g_m	160	240	320	μA/V
I_{g2}	—	20	—	μA
I_{g1}	—	-5.0×10^{-12}	-10^{-11}	A
r_a	—	>5.0	—	MΩ
*V_{g1} (crossover)	—	–0.8	–1.3	V

Triode connected (g_2 connected to a, g_3 connected to k)

Measured at V_h = 4.5V, V_a = 45V and I_a = 100μA

	Min.	*Av.*	*Max.*	
I_h	150	160	170	mA
V_{g1}	–1.6	–2.0	–2.4	V
g_m	200	300	400	μA/V
I_{g1}	—	-5.0×10^{-12}	-10^{-11}	A
r_a	—	65	—	kΩ
μ	—	20	—	
*V_{g1} (crossover)	—	–0.8	–1.3	V

*'Crossover' is the point at which the polarity of the grid current is reversed.

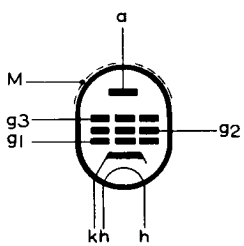
LIMITING VALUES

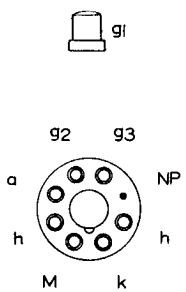
V_a max.	90	V
V_{g2} max.	90	V
I_k max.	1.0	mA
V_{h-k} max.	10	V

ME1400

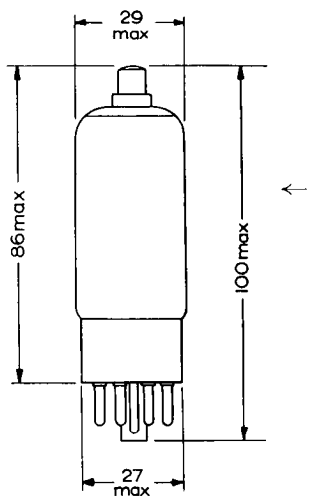
ELECTROMETER PENTODE

6709



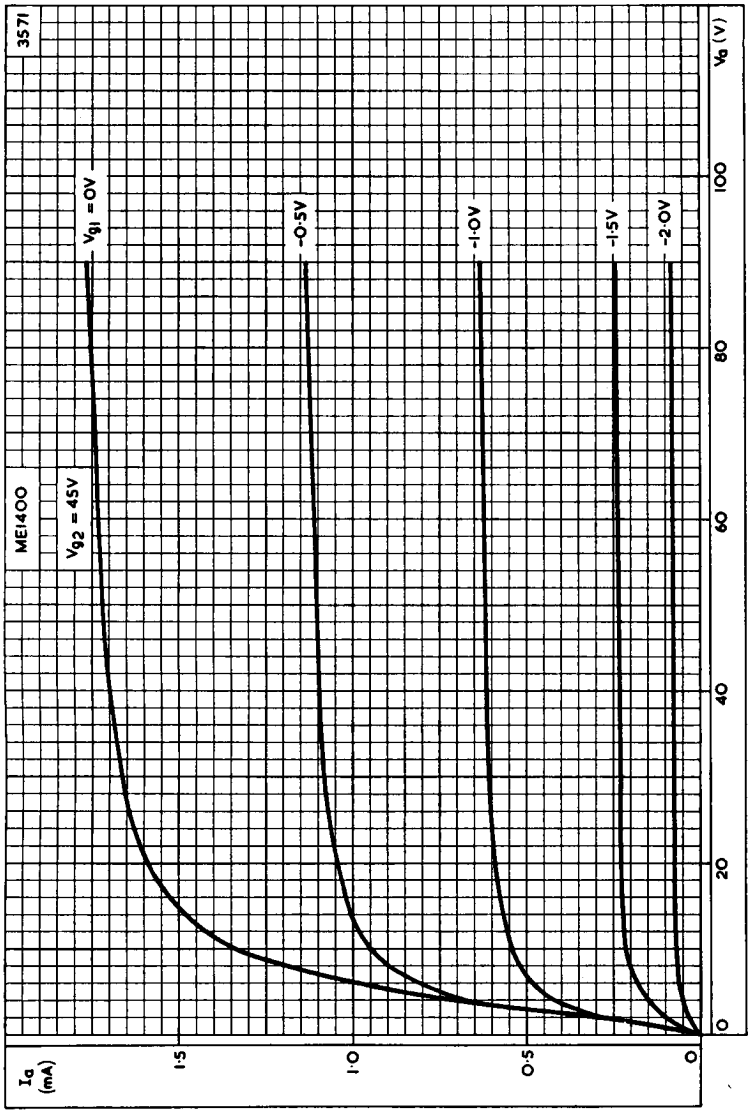


Octal base



All dimensions in mm

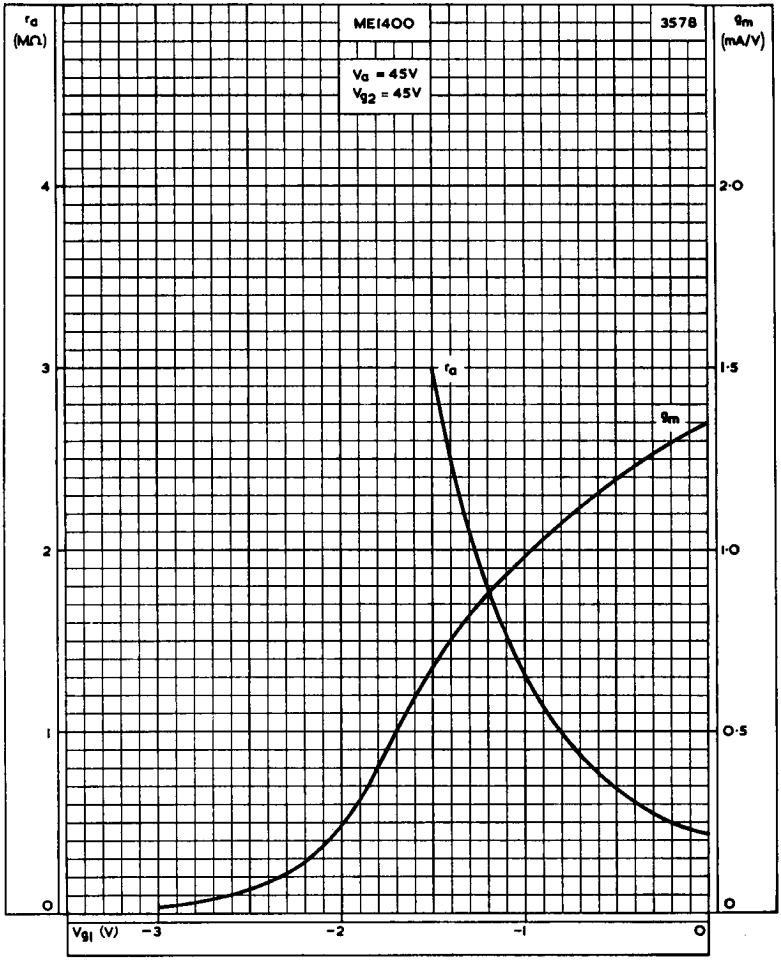
ME1400



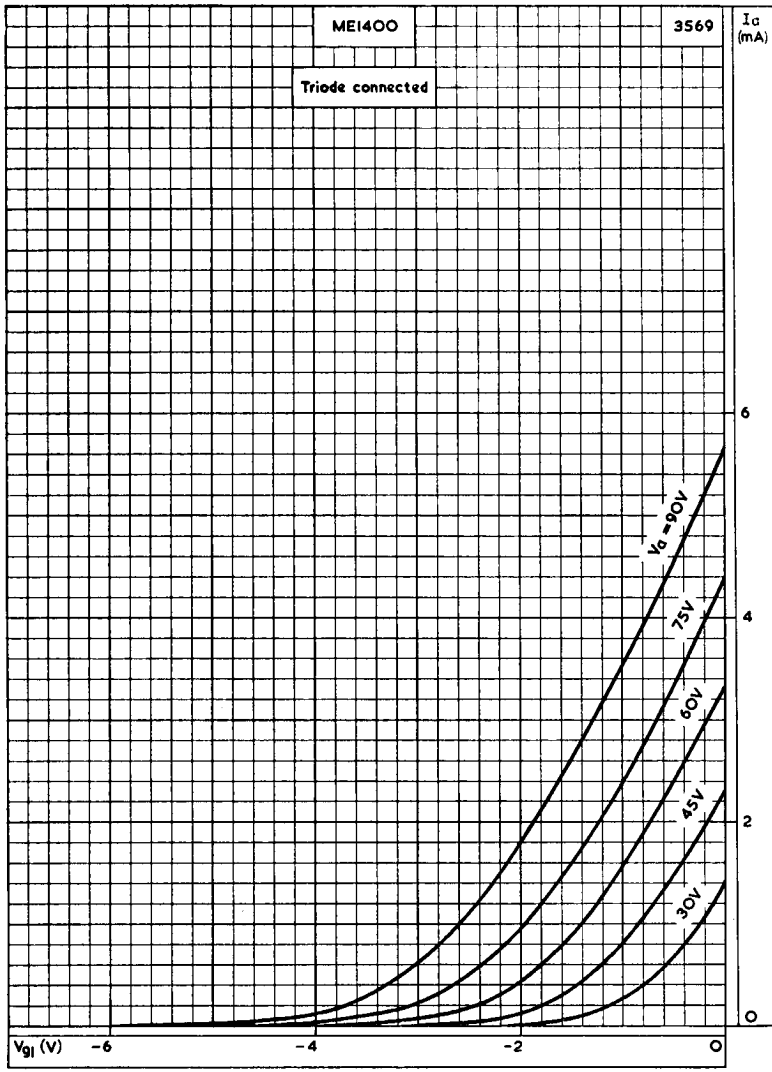
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 45V

ME1400

ELECTROMETER PENTODE



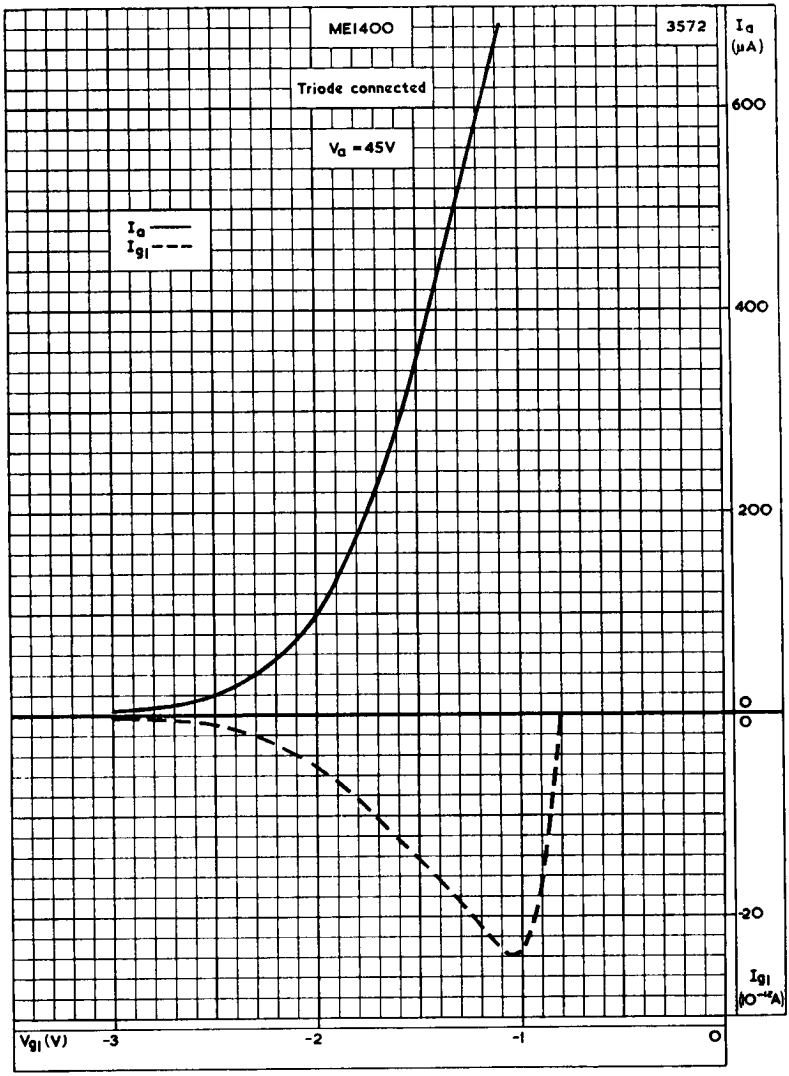
ANODE IMPEDANCE AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 45V$



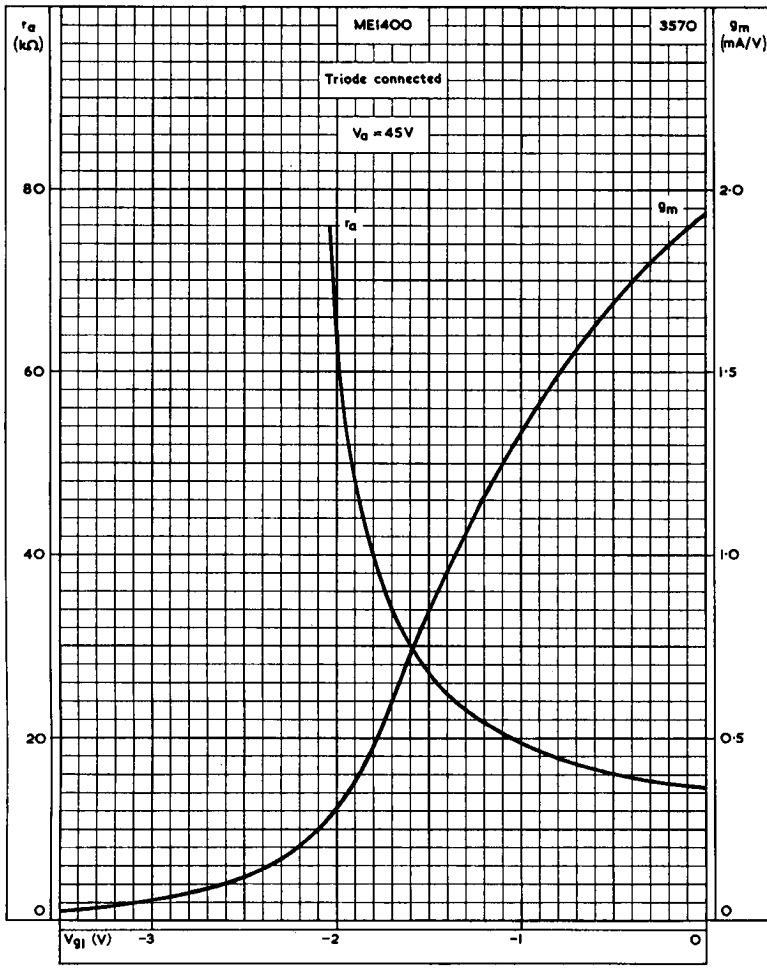
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER. TRIODE CONNECTED

ME1400

ELECTROMETER PENTODE



ANODE AND CONTROL-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. TRIODE CONNECTED. V_a = 45V



ANODE IMPEDANCE AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. TRIODE CONNECTED. V_a = 45V

SUBMINIATURE ELECTROMETER TRIODE

ME1401

Subminiature electrometer triode with a grid current of 10^{-13}A.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	13	mA

MOUNTING POSITION

Any

CAPACITANCES

C_{a-g}	2.0	pF
C_{g-f}	0.6	pF
C_{a-f}	0.8	pF

CHARACTERISTICS (All voltages are with respect to the negative end of the filament)

Measured at $V_f = 1.25V$, $V_a = 9V$, $I_a = 100\mu A$

	Min.	*Av.*	*Max.*	
V_g	−2.0	−2.5	−3.75	V
g_m	70	80	90	μA/V
μ	1.7	2.0	2.7	
*I_g	—	-8.5×10^{-14}	-12.5×10^{-14}	A
†V_g (crossover)	—	−1.3	−1.6	V
†I_a (crossover)	160	—	—	μA

*The quoted grid current characteristics will only be obtained if the tube is operated in complete darkness.

†'Crossover' is the point at which the polarity of the grid current is reversed.

LIMITING VALUES

V_a max.	25	V
I_a max.	250	μA
V_f limits	1.1 to 1.5	V

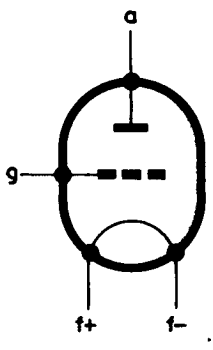
OPERATING NOTES

1. In order to avoid excessive drift the filament voltage must be applied before the anode voltage.
2. To avoid contamination of the glass, the valve should not be removed from its protective envelope until it is fitted into the equipment.
3. Direct soldered connections to the leads of this valve must be at least 13mm from the seal, and any bending of the valve leads must be at least 1.5mm from the seal.

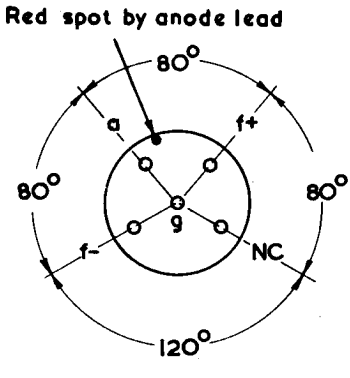
ME1401

SUBMINIATURE ELECTROMETER TRIODE

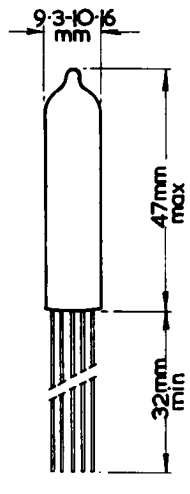
Subminiature electrometer triode with a grid current of 10^{-13}A.



4377



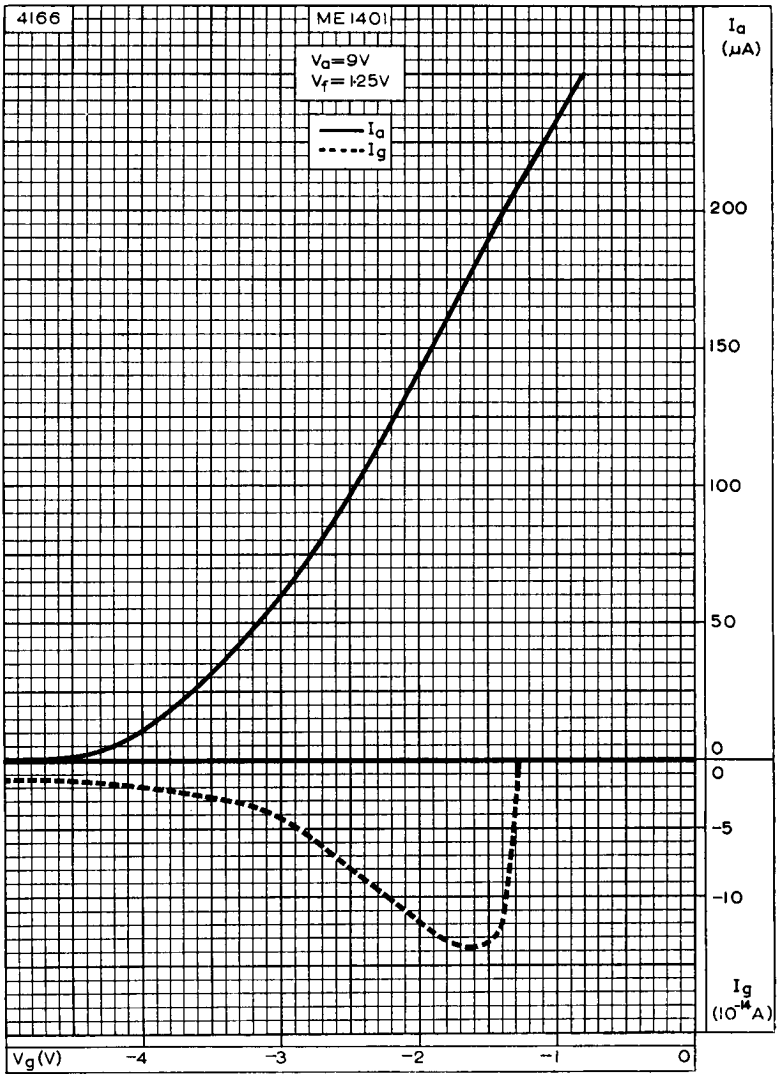
B5J/F Base



SUBMINIATURE ELECTROMETER TRIODE

ME1401

Subminiature electrometer triode with a grid current of 10^{-13}A.

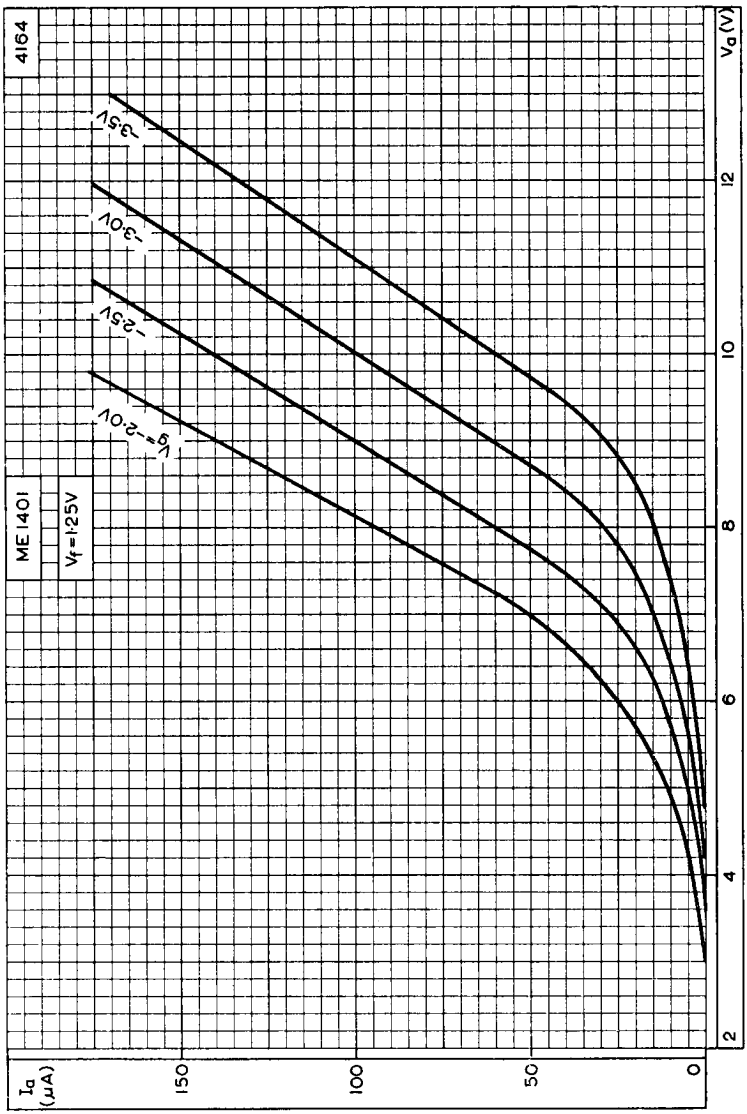


ANODE AND GRID CURRENTS PLOTTED AGAINST GRID VOLTAGE

ME1401

SUBMINIATURE ELECTROMETER TRIODE

Subminiature electrometer triode with a grid current of 10^{-18}A.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

SUBMINIATURE ELECTROMETER TETRODE

ME1402

Subminiature electrometer tetrode with a grid current of 3×10^{-15}A.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	13	mA

MOUNTING POSITION

Any

CAPACITANCES

C_{a-g}	2.5	pF
C_{in}	0.3	pF
C_{out}	0.8	pF

CHARACTERISTICS (All voltages are with respect to the negative end of the filament)

Measured at $V_f = 1.25V$, $V_a = 4.5V$, $I_a = 20\mu A$, $I_{g1} = 250\mu A$ g_2 is the control-grid, g_1 being used as an accelerator grid.

	Min.	*Av.*	*Max.*	
V_{g1}	2.0	3.0	4.0	V
V_{g2}	−2.0	−3.2	−4.5	V
$g_{m(g2-a)}$	10	17	24	μA/V
$\mu_{(g2-a)}$	0.7	1.2	1.4	
*I_{g2}	—	-2.5×10^{-15}	-6.0×10^{-15}	A
†V_{g2} (crossover)	—	−1.75	—	V

*The quoted grid current characteristics will only be obtained if the tube is operated in complete darkness.

†'Crossover' is the point at which the polarity of the grid current (I_{g2}) is reversed.

LIMITING VALUES

V_a max.	10	V
I_k max.	300	μA ←
V_f limits	1.1 to 1.5	V

OPERATING NOTES

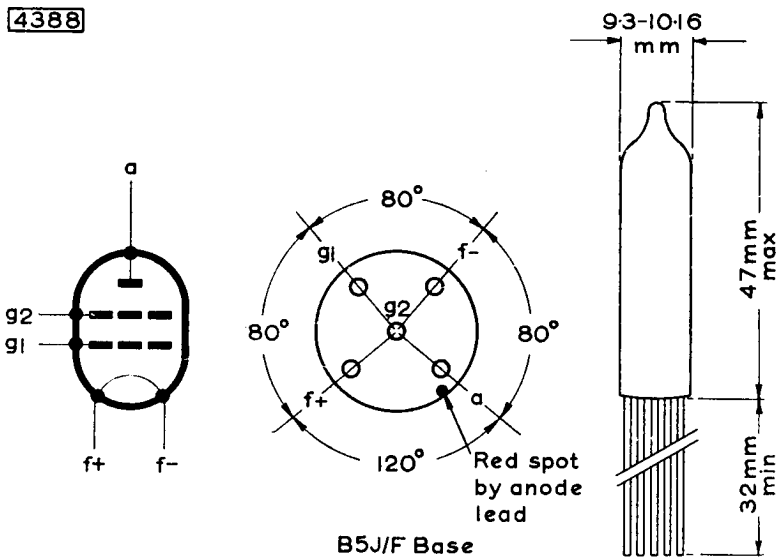
1. In order to avoid excessive drift of characteristics the filament voltage must be applied before the anode voltage.
2. To avoid contamination of the glass, the valve should not be removed from its protective envelope until it is fitted into the equipment.
3. Direct soldered connections to the leads of the valve must be at least 13mm from the seal and any bending of the leads must be at least 1.5mm from the seal.

ME1402

SUBMINIATURE ELECTROMETER TETRODE

Subminiature electrometer tetrode with a grid current of 3×10^{-15}A.

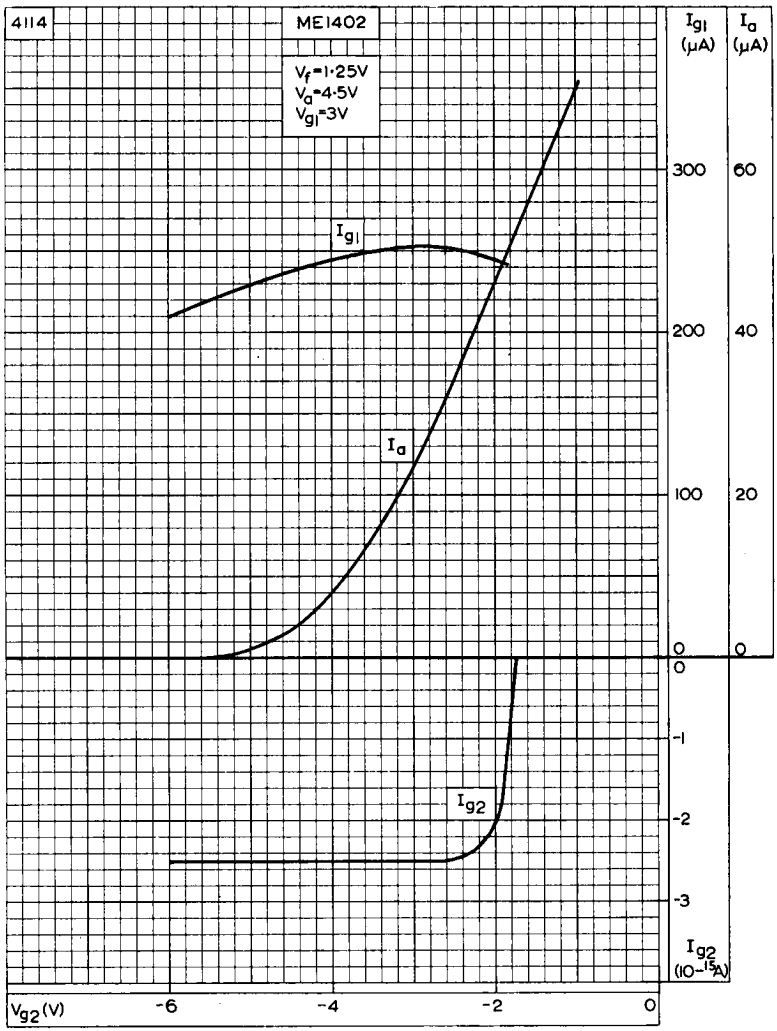
4388



SUBMINIATURE ELECTROMETER TETRODE

ME1402

Subminiature electrometer tetrode with a grid current of 3×10^{-15}A.

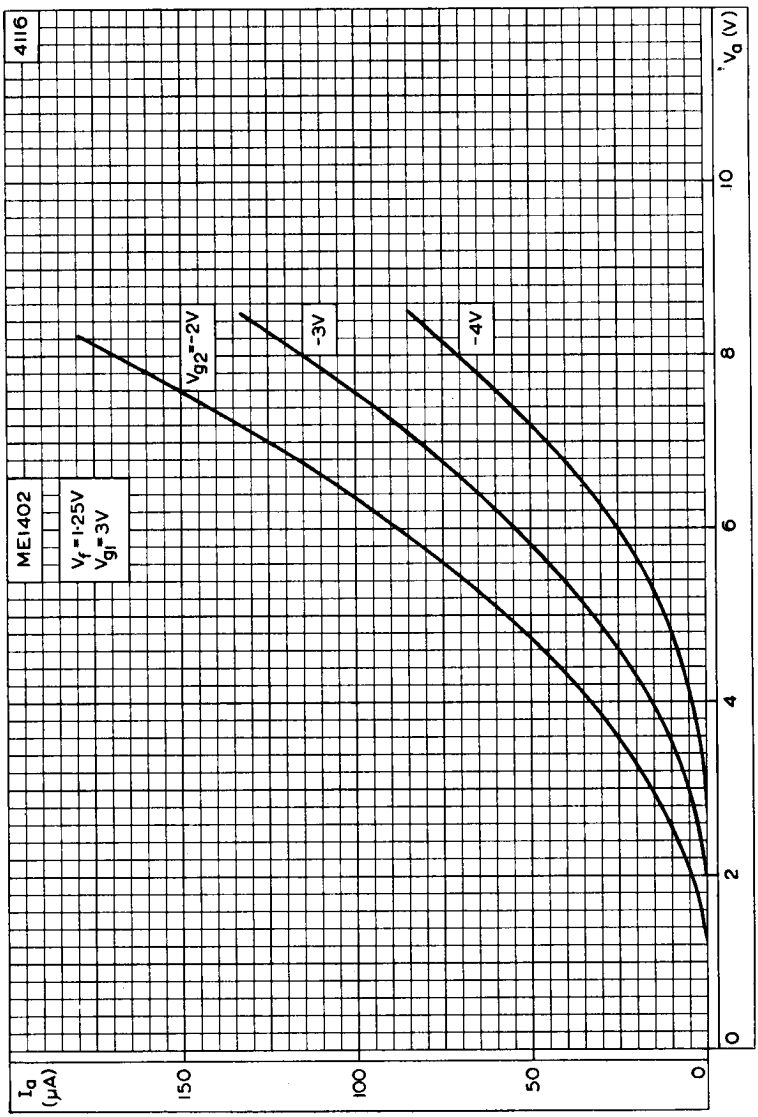


ANODE, ACCELERATOR GRID (g_1) AND CONTROL-GRID (g_2) CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE

ME1402

SUBMINIATURE ELECTROMETER TETRODE

Subminiature electrometer tetrode with a grid current of 3×10^{-15}A.

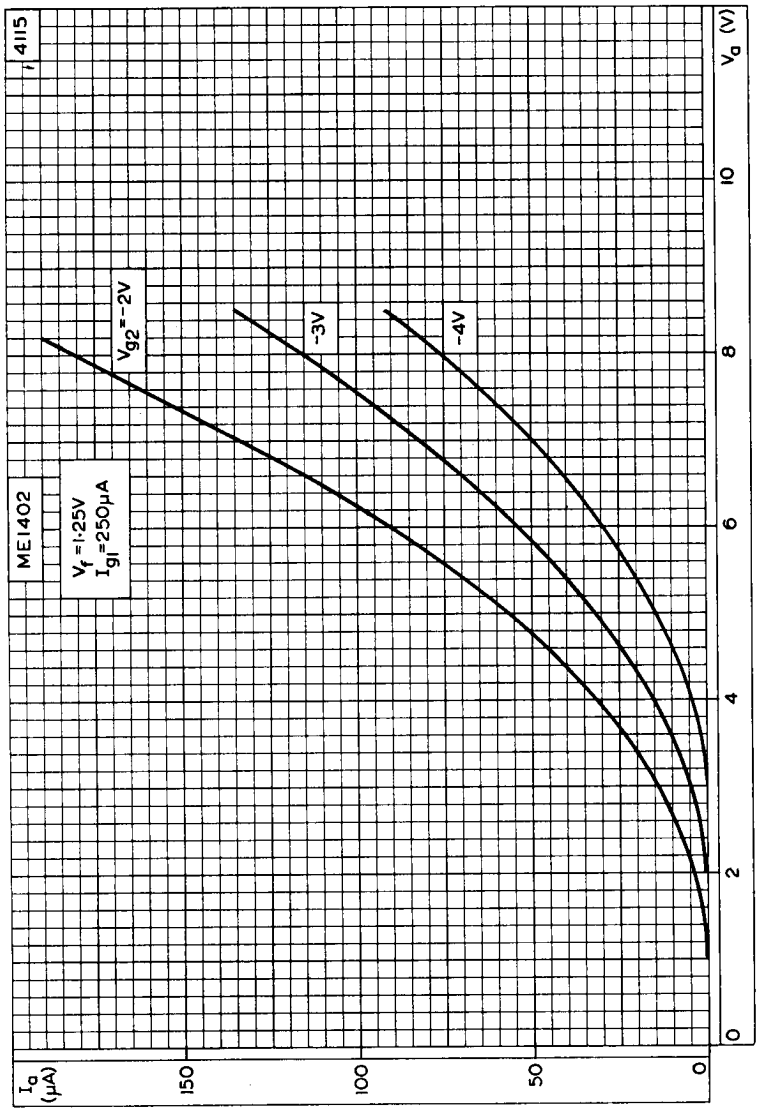


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_2) VOLTAGE AS PARAMETER AT ACCELERATOR GRID (g_1) VOLTAGE OF 3V

SUBMINIATURE ELECTROMETER TETRODE

ME1402

Subminiature electrometer tetrode with a grid current of 3×10^{-15}A.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_2) VOLTAGE AS PARAMETER AT ACCELERATOR GRID (g_1) CURRENT OF 250μA

SUBMINIATURE ELECTROMETER PENTODE

ME1403

Subminiature electrometer pentode with a grid current of 3×10^{-15}A.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	8.2	mA

MOUNTING POSITION

Any

CAPACITANCES

C_{a-g1}	0.2	pF
C_{in}	3.0	pF
C_{out}	4.0	pF

CHARACTERISTICS (All voltages are with respect to the negative end of the filament)

Measured at $V_f = 1.25V$, $V_a = 10V$, $I_a = 5.0\mu A$, $V_{g1} = -2.5V$

	Min.	*Av.*	*Max.*	
V_{g2}	5.0	6.5	7.5	V
g_m	8.0	10.5	15	μA/V
r_a	—	10.5	—	MΩ
$\mu_{(g1-a)}$	80	110	—	
*I_{g1}	—	-3.0×10^{-15}	-8.0×10^{-15}	A
I_{g2}	1.5	2.2	3.0	μA
†V_{g1}(crossover)	—	−1.15	—	V

*The quoted grid current characteristics will only be obtained if the tube is operated in complete darkness.

†'Crossover' is the point at which the polarity of the grid current is reversed (measured at $V_f = 1.25V$, $V_a = 10V$, V_{g2} = the value which gives $I_a = 5\mu A$ when $V_{g1} = -2.5V$)

LIMITING VALUES

V_a max.	45	V
V_{g2} max.	45	V
I_k max.	180	μA
V_f limits	1.1 to 1.5	V

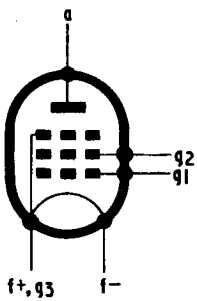
OPERATING NOTES

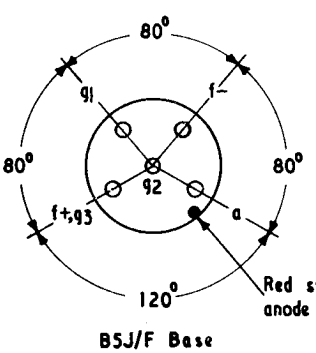
1. In order to avoid excessive drift of characteristics the filament voltage must be applied before the anode voltage.
2. To avoid contamination of the glass, the valve should not be removed from its protective envelope until it is fitted into the equipment.
3. Direct soldered connections to the leads of the valve must be at least 13mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

ME1403

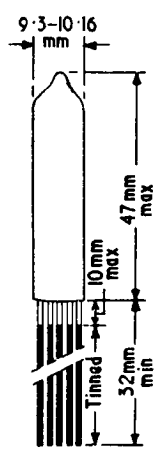
SUBMINIATURE ELECTROMETER PENTODE

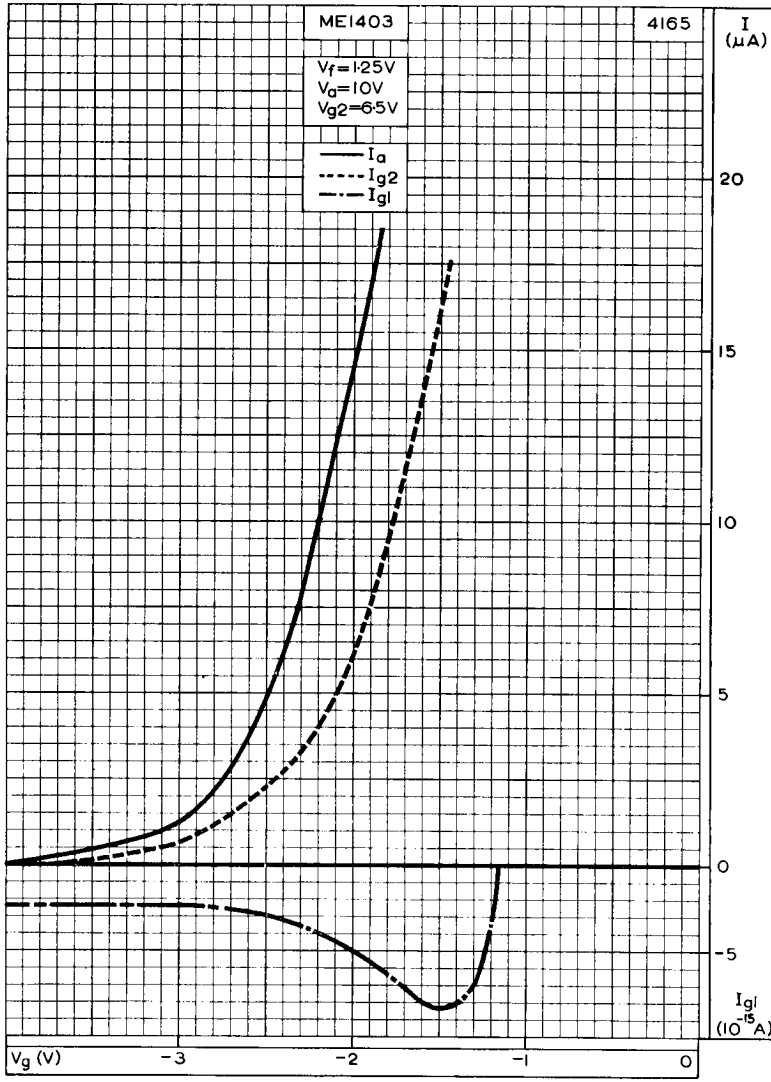
5525





B5J/F Base

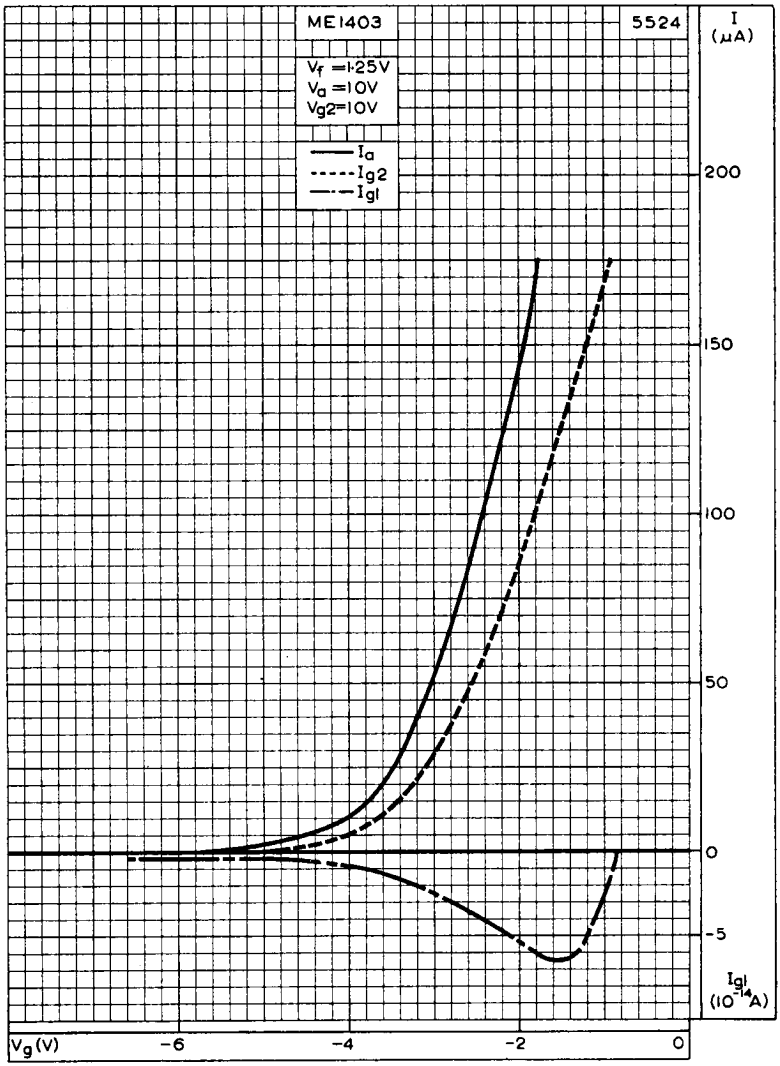




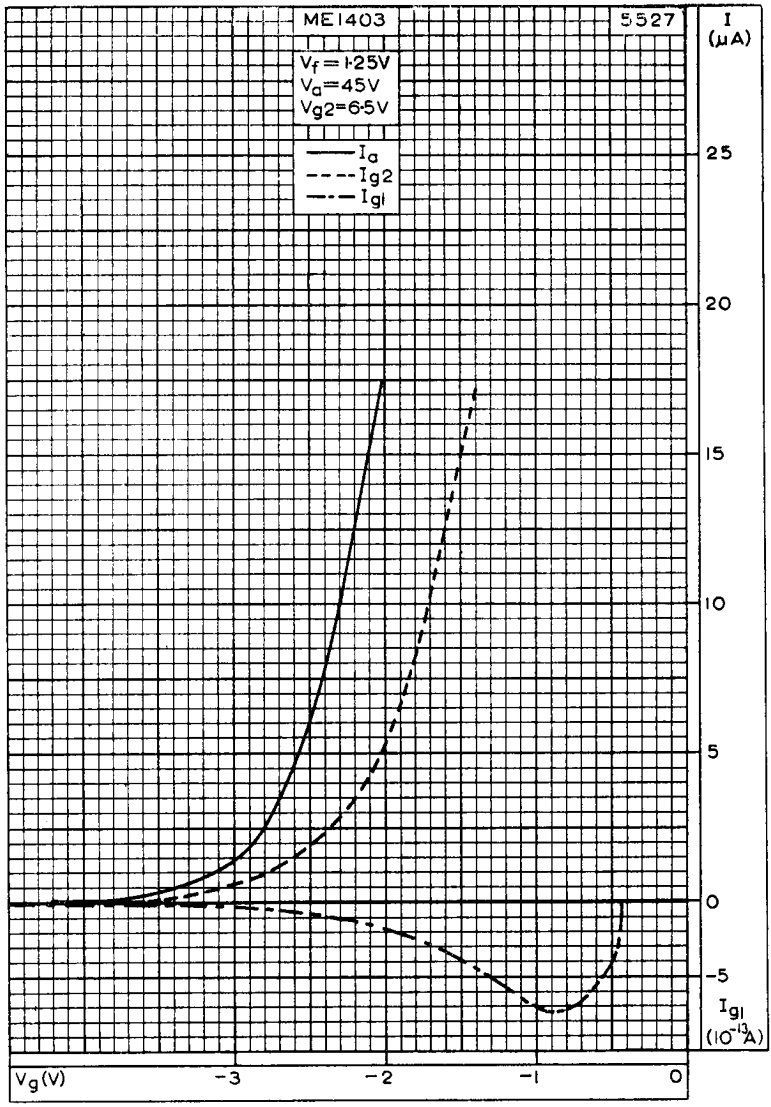
ANODE, SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = 10V$, $V_{g2} = 6.5V$

ME1403

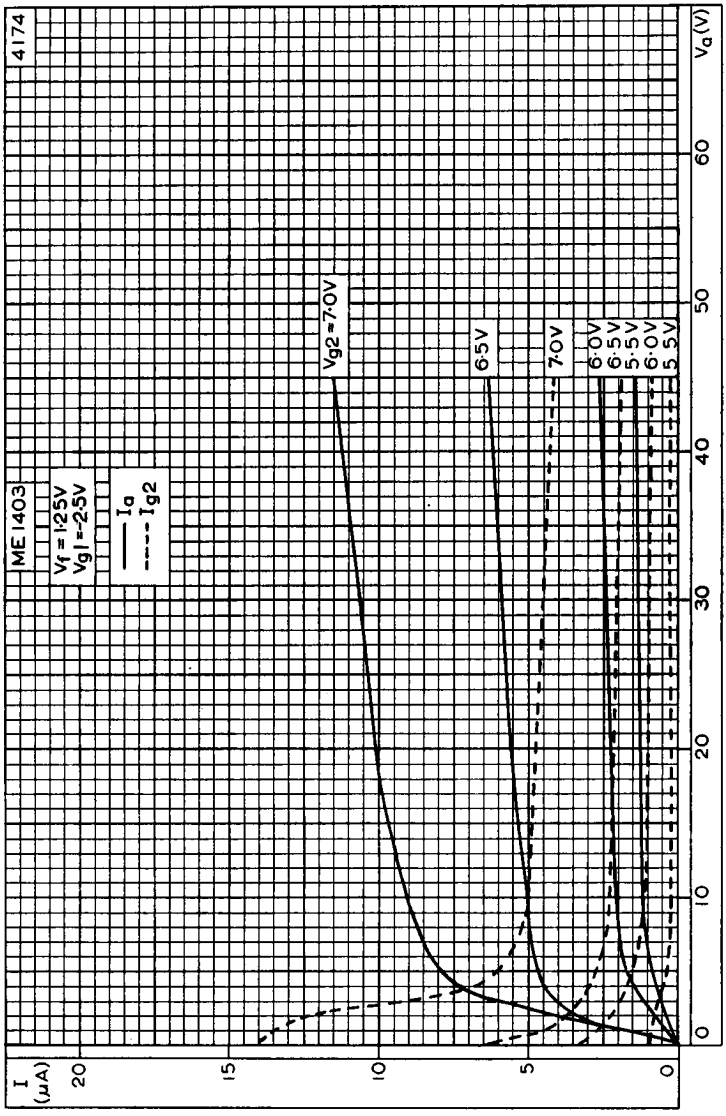
SUBMINIATURE ELECTROMETER PENTODE



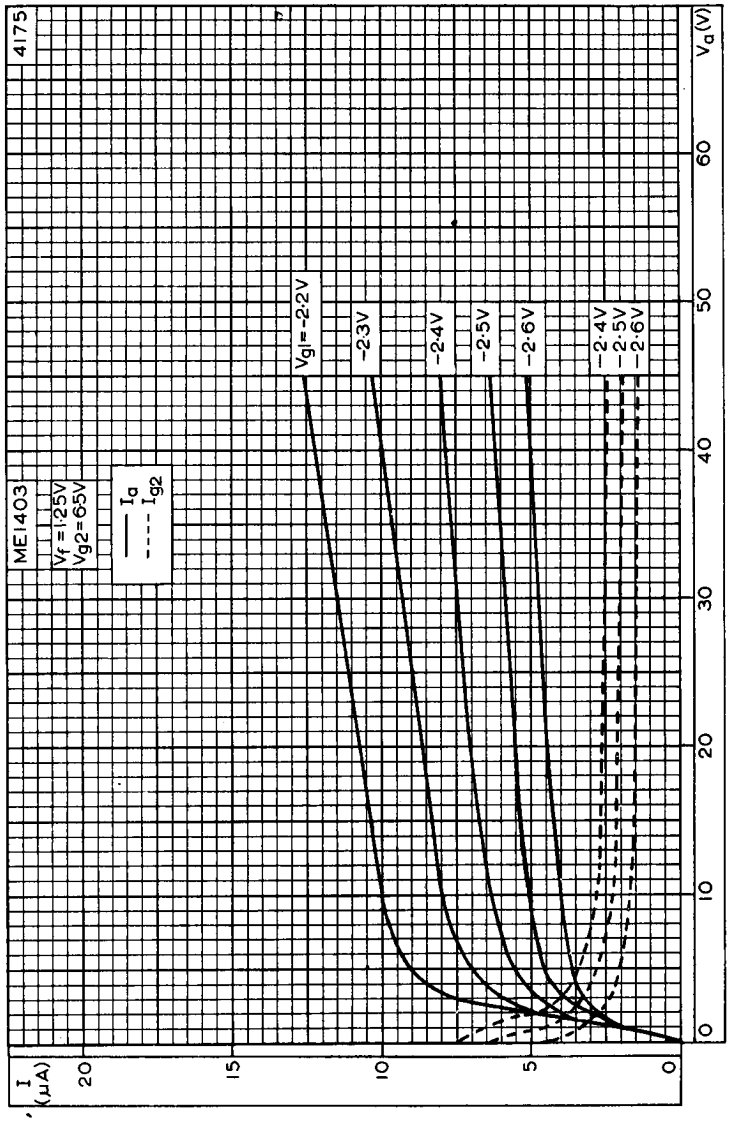
ANODE, SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = 10V$, $V_{g2} = 10V$



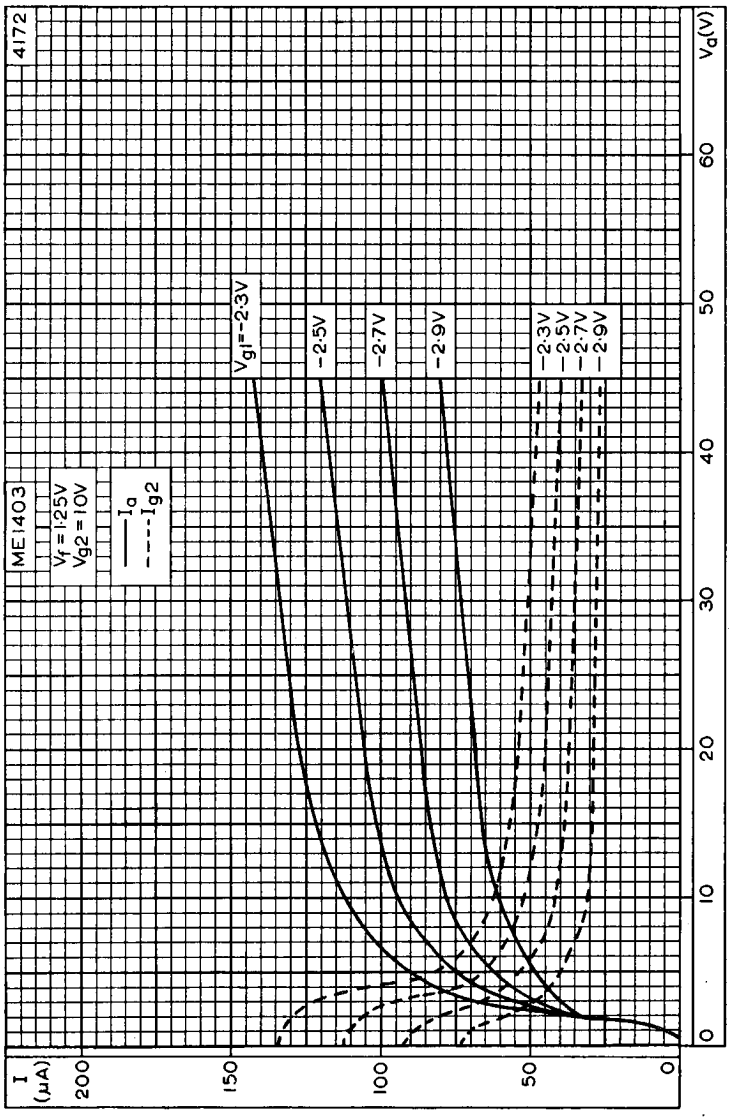
ANODE, SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = 45V$, $V_{g2} = 6.5V$



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 6.5V$



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 10V

SUBMINIATURE ELECTROMETER TRIODE

ME1404

Subminiature electrometer triode for linear and logarithmic use with a controlled logarithmic relationship between positive grid current and anode current, and a grid current of 2×10^{-13}A.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	14	mA

CAPACITANCES

C_{a-g}	2.0	pF
C_{in}	0.5	pF
C_{out}	0.8	pF

CHARACTERISTICS (for linear operation with all voltages measured with respect to the negative end of the filament)

Measured at $V_f = 1.25V$, $V_a = 9.0V$, $I_a = 100\mu A$

	Minimum	*Typical*	*Maximum*	
V_g	−2.0	−2.7	−3.75	V
g_m	60	80	90	μA/V
μ	1.6	2.0	2.7	
I_g	—	-1.6×10^{-13}	-10×10^{-13}	A
†V_g (crossover)	—	−1.4	−1.7	V
†I_a (crossover)	145	—	—	μA

†'Crossover', measured at $V_a = 9.0V$, is the point at which the polarity of the grid current is reversed.

LIMITING VALUES

V_a max.	25	V
I_a max.	250	μA
V_f limits	1.1 to 1.5	V

Notes for operation with logarithmic characteristic

This valve has a controlled linear relationship between the anode current and the logarithm of the positive grid current. This relationship holds good over a range of at least three decades of positive grid current i.e. from 3×10^{-12}A to 3×10^{-9}A. Conditions can be established such that this change in grid current always produces a fall in anode current of 50μA.

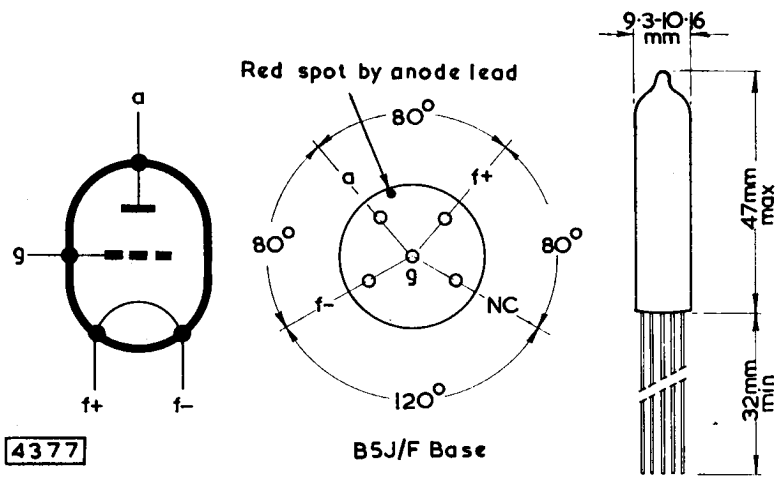
With a positive grid current of 3×10^{-9}A, the anode voltage should be set to some value (nominal 4.4V) such that when the grid current is reduced to 3×10^{-12}A the anode current falls by 50μA. It will be found that the anode voltage lies in the approx. range 3 to 6V, whilst the initial anode current is in the range 65 to 100μA.

ME1404

SUBMINIATURE ELECTROMETER TRIODE

OPERATING NOTES

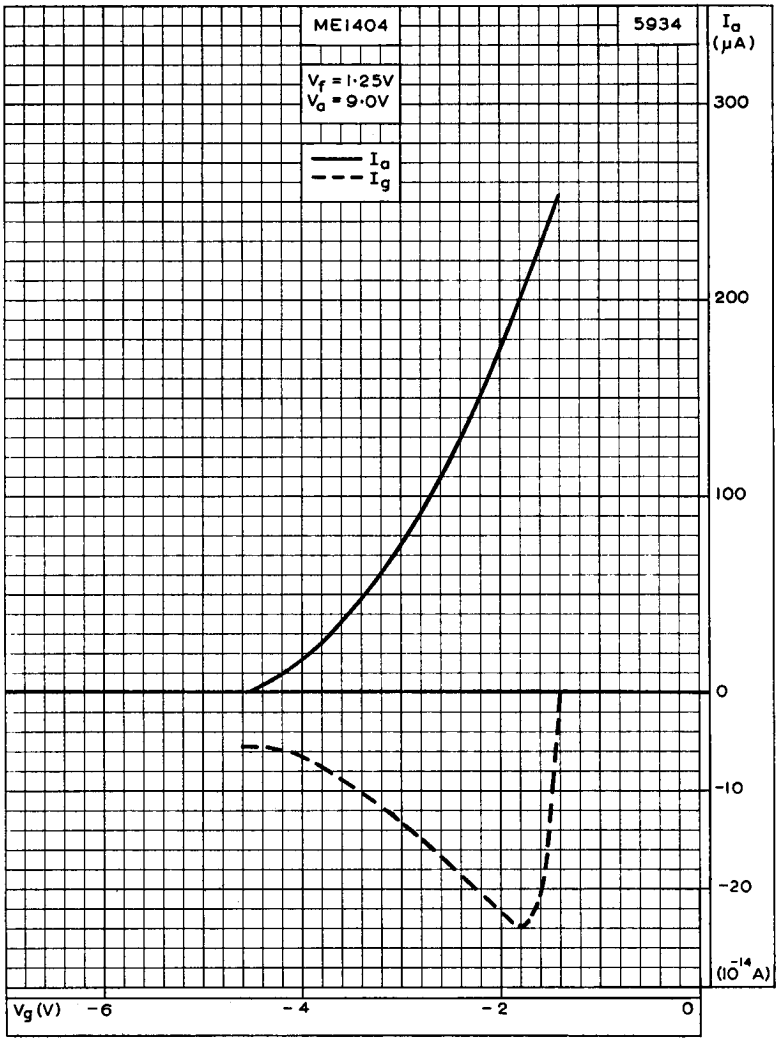
1. In order to avoid excessive drift of characteristics the filament voltage must be applied before the anode voltage.
2. To avoid contamination of the glass the valve should not be removed from its protective envelope until it is fitted into the equipment. Great care should be taken not to handle the valve within 13mm of the base.
3. Direct soldered connections to the leads of the valve must be at least 13mm from the seal and any bending of the leads must be 1.5mm from the seal.
4. To prevent photoemission from the grid, the valve should be operated in darkness or at a low ambient light level.



4377

B5J/F Base

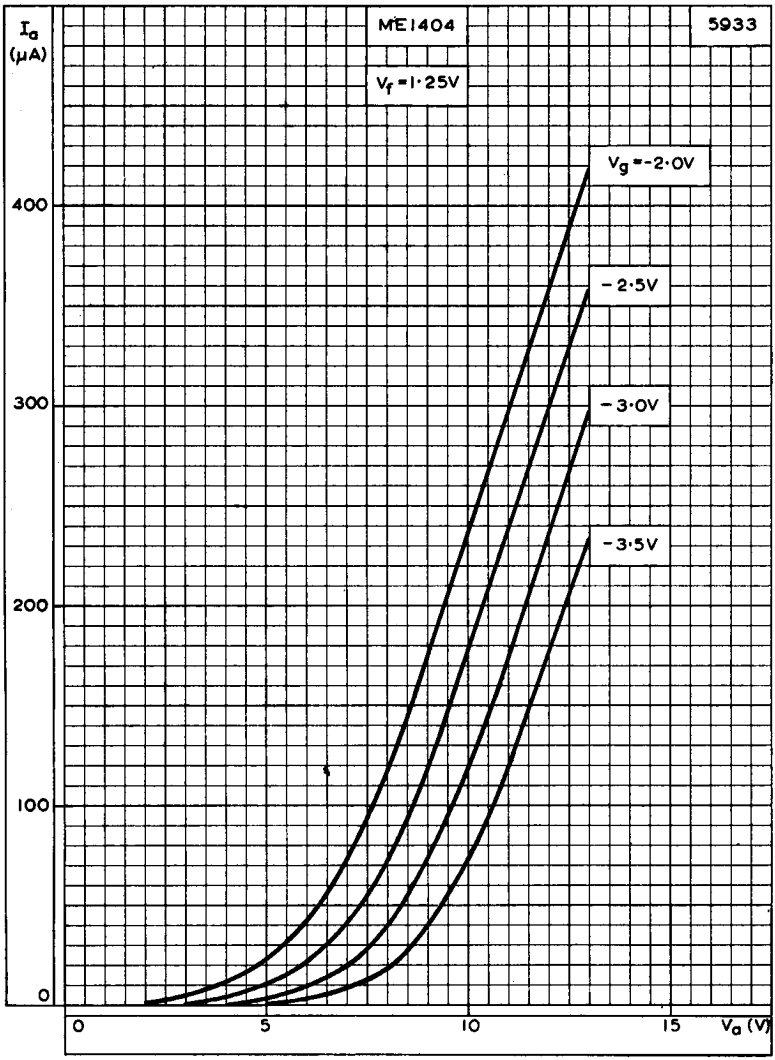
ME1404



ANODE AND GRID CURRENTS PLOTTED AGAINST GRID VOLTAGE

ME1404

SUBMINIATURE ELECTROMETER TRIODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

SUBMINIATURE ELECTROMETER PENTODE

ME1406

Low cost subminiature electrometer pentode with a grid current of 3×10^{-14}A←

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	8.2	mA

MOUNTING POSITION Any

CAPACITANCES

c_{a-g1}	0.2	pF
c_{in}	3.0	pF
c_{out}	4.0	pF

CHARACTERISTICS (measured at $V_f = 1.25V$, $V_a = 10V$, $I_a = 5.0\mu A$, $V_{g1} = -2.5V$)

All voltages are measured with respect to the negative end of the filament

	Min.	Av.	Max.	
V_{g2}	5.0	6.5	7.5	V
g_m	8.0	10.5	15	μA/V
r_a	-	10.5	-	MΩ
μ_{g1-a}	80	110	-	
*I_{g1}	-	-3×10^{-14}	-5×10^{-14}	A←
I_{g2}	1.5	2.2	3.0	μA
**$V_{g1(crossover)}$	-	-1.0	-	V←

*The quoted grid current characteristics will only be obtained if the tube is operated in complete darkness.

**'Crossover' is the point at which the polarity of the grid current is reversed (measured at $V_f = 1.25V$, $V_a = 10V$, V_{g2} = the value which gives $I_a = 5\mu A$ when $V_{g1} = -2.5V$).

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_a max.	45	V
V_{g2} max.	45	V
I_k max.	180	μA
V_f max.	1.5	V
V_f min.	1.1	V

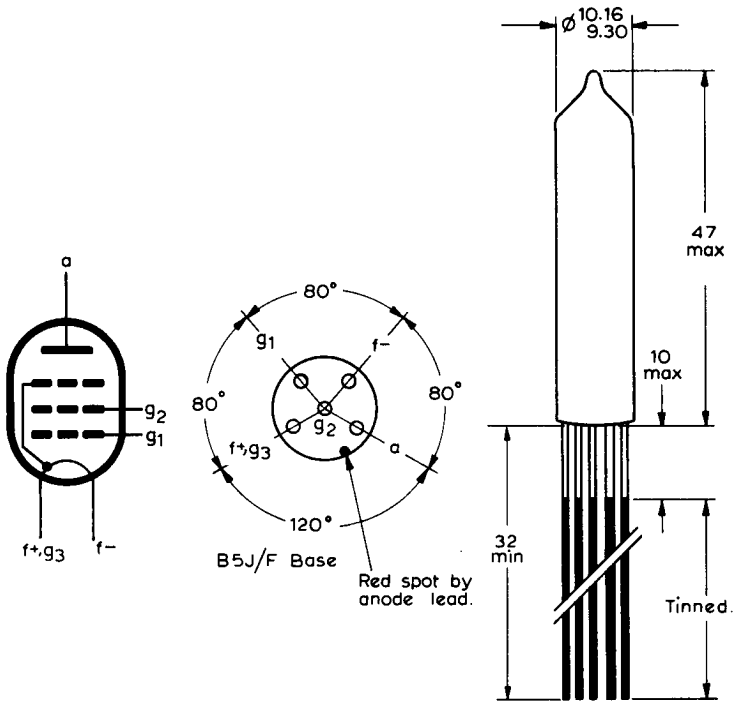
OPERATING NOTES

1. In order to avoid excessive drift of characteristics the filament voltage must be applied before the anode voltage.

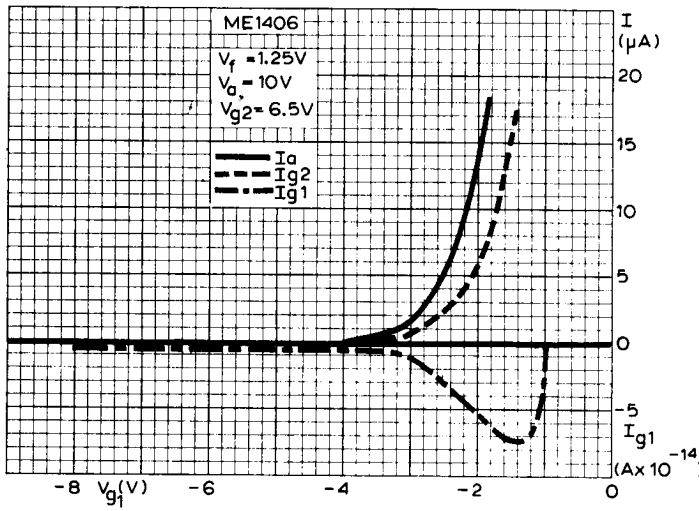
2. To avoid contamination of the glass, the valve should not be removed from its protective envelope until it is fitted into the equipment.

3. Direct soldered connections to the leads of the valve must be at least 13mm from the seals and any bending of the leads must be at least 1.5mm from the seals.

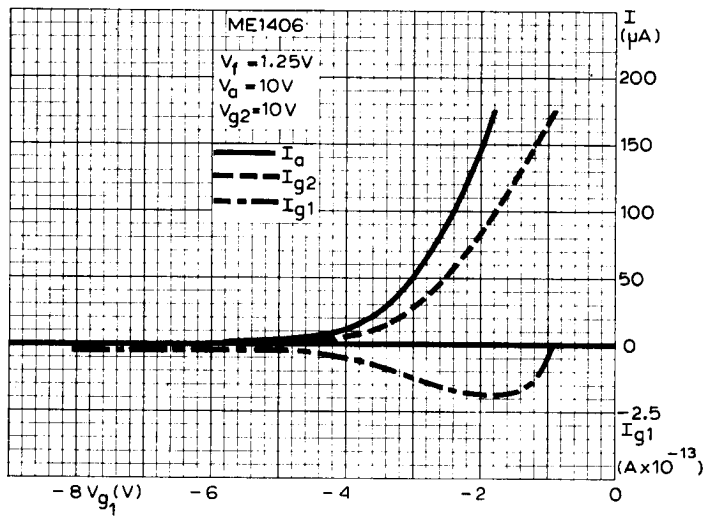
Outline drawing
ME1406



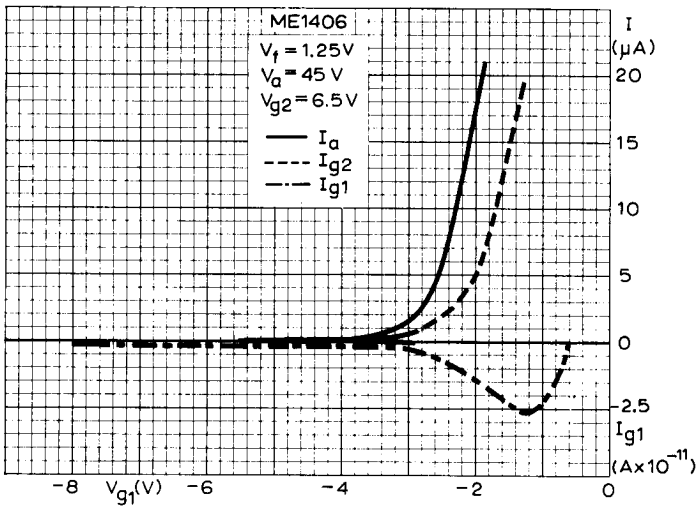
All dimensions in mm



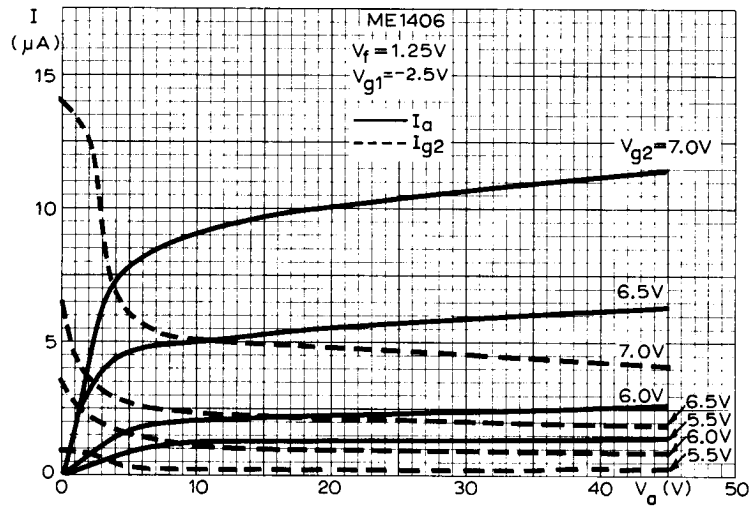
ANODE, SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. V_a = 10V, V_{g2} = 6.5V



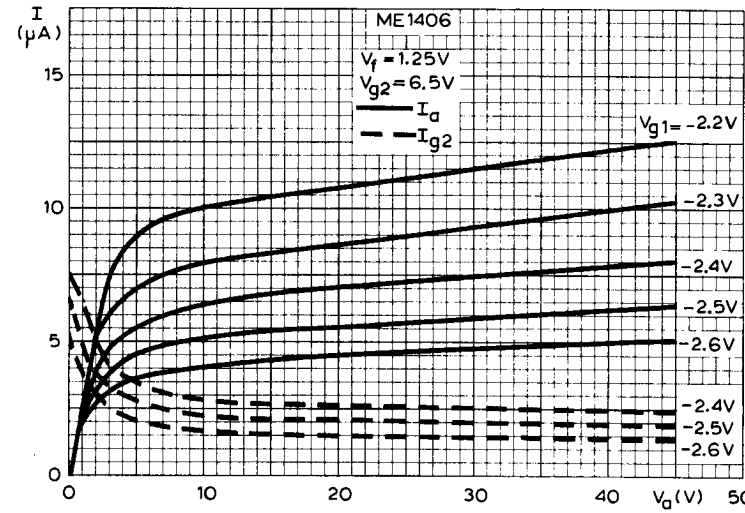
ANODE, SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. V_a = 10V, V_{g2} = 10V



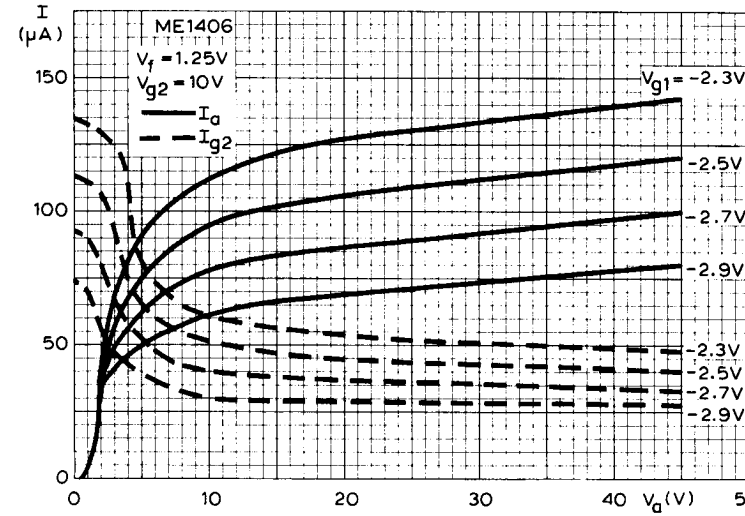
ANODE, SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. V_a = 45V, V_{g2} = 6.5V



ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 6.5V



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 10V.

RADAR TUBE

MF31-95

Direct viewing radar tube with 12-in. diameter flat-faced metal-backed long persistence screen. Primarily intended for use in p.p.i. applications.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES, included in this volume of the handbook.

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{g-all}	≈8.0	pF
c_{k-all}	≈8.0	pF

SCREEN

Metal-backed		
Fluorescent colour	orange—with orange afterglow	
Persistence	long	
Min. useful screen diameter	265	mm

FOCUSING

Magnetic

DEFLECTION

Double magnetic

MOUNTING POSITION

Any, except with the screen downwards and the axis of the tube making an angle of less than 20° with the vertical.

TYPICAL OPERATING CONDITIONS

V_{a2}	10	kV
*V_{a1}	800	V
V_g for cut-off	−50 to −115	V
*Recommended distance of centre of magnetic length of focus unit from reference line	98	mm

*See appropriate section of 'General Operational Recommendations—Cathode Ray Tubes'.

LIMITING VALUES (absolute ratings)

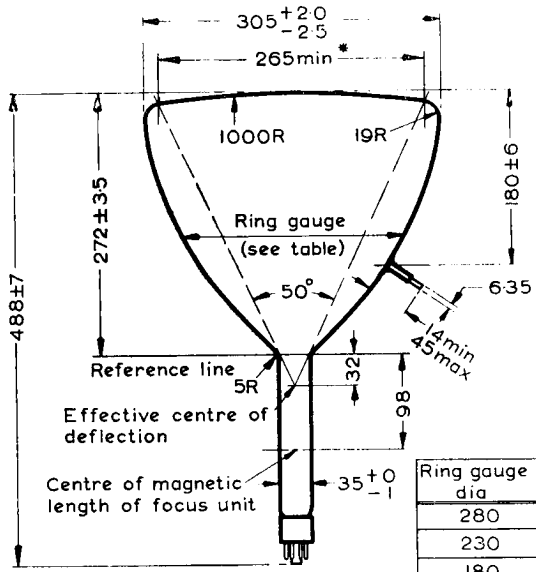
V_{a2} max.	12	kV
V_{a2} min.	8.0	kV
V_{a1} max.	850	V
V_{a1} min.	250	V
$-V_g$ max.	200	V
†I_k max.	150	μA
V_{h-k} max.	150	V
R_{g-k} max.	1.5	MΩ
R_{h-k} max.	1.0	MΩ

†This tube has a magnesium fluoride screen which is liable to burn if a stationary or slowly moving spot is used, even with low values of mean beam current.

MF31-95

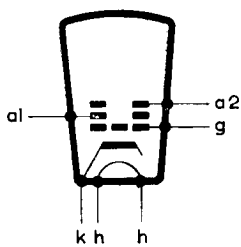
RADAR TUBE

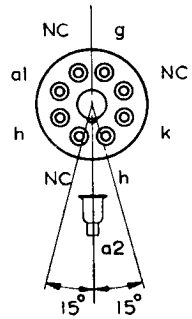
5618



Ring gauge dia	Distance from centre of tube face
280	93±10
230	150±9
180	191±8
130	222±7
80	249±6
36·1	272±3·5

*Diameter of useful screen area

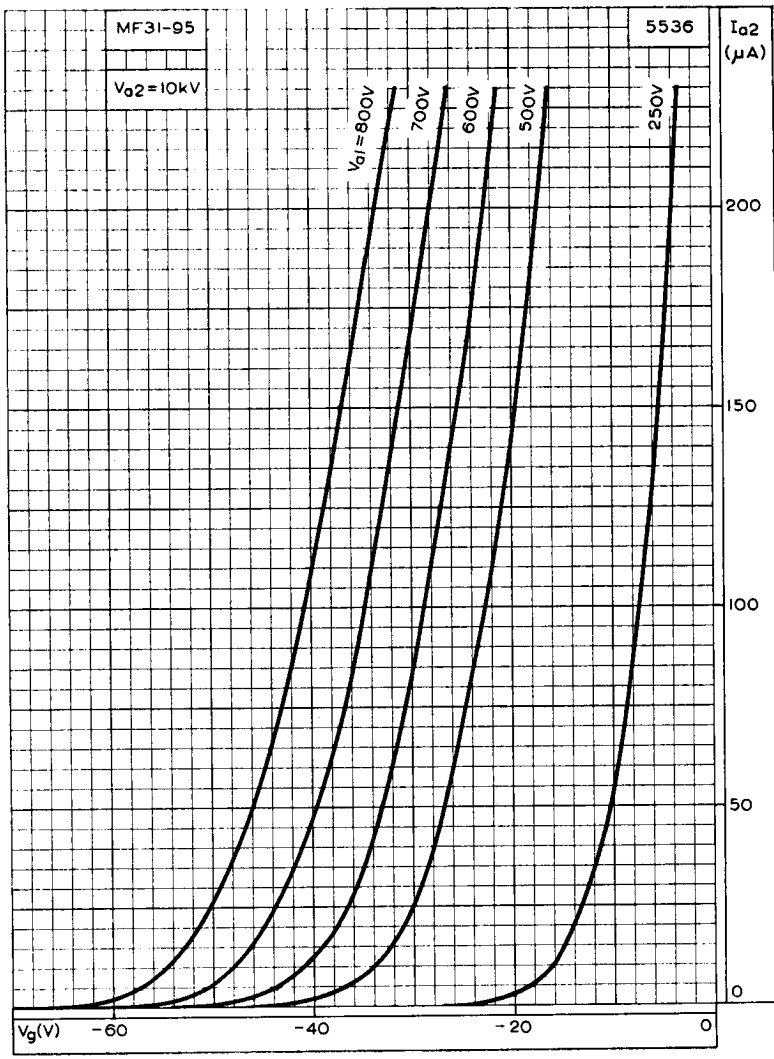




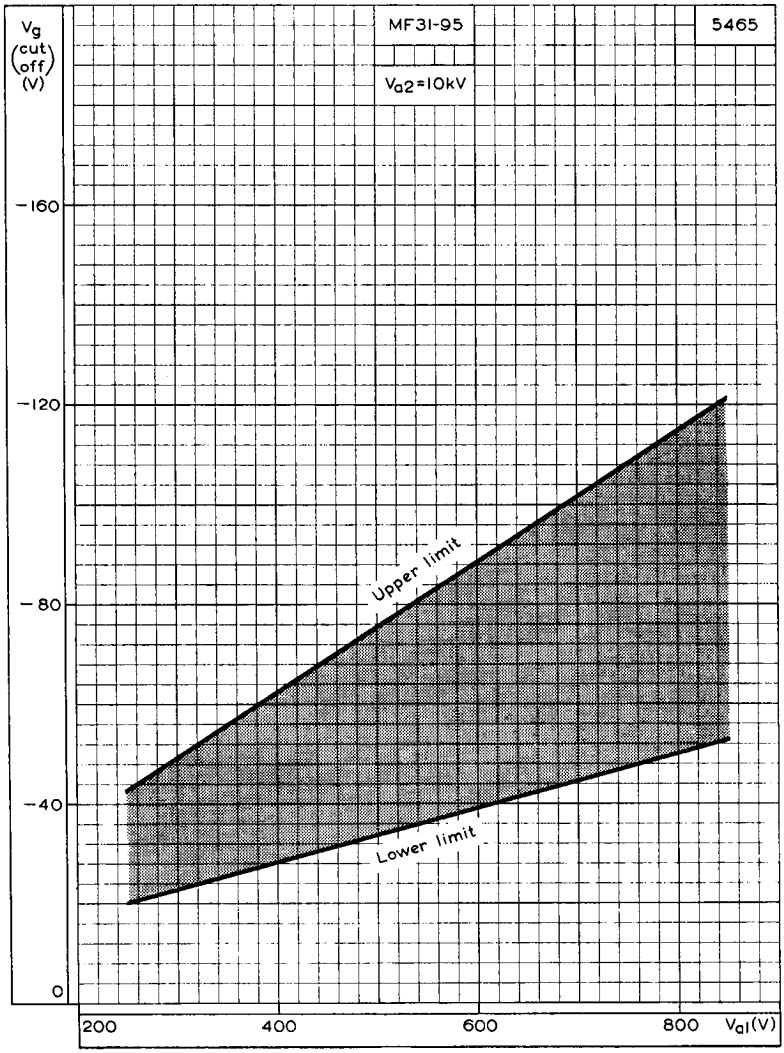
All dimensions in mm

Octal base

MF31-95



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE



LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES FROM 250V TO 850V.

RADAR TUBE

MM13-10

Direct-viewing high brightness radar tube with 5-in. diameter metal-backed double layer screen and external lacquered coating.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS — CATHODE RAY TUBES which precede this section of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

CAPACITANCES

C_{g-all}	<9.0	pF
C_{k-all}	<7.0	pF
C_{a-M}	500 to 1500	pF

SCREEN

Metal-backed		
Double layer		
Fluorescent colour	blue with green-yellow afterglow	
Useful screen diameter	100	mm

PERSISTENCE

Blue fluorescence of short persistence followed by green-yellow phosphorescence of long persistence.

FOCUSING

Magnetic

DEFLECTION

Double magnetic	
Deflection angle (approx.)	40°

MOUNTING POSITION

Any, except with the screen downward and the axis of the tube making an angle less than 20° with the vertical.

OPERATING CONDITIONS

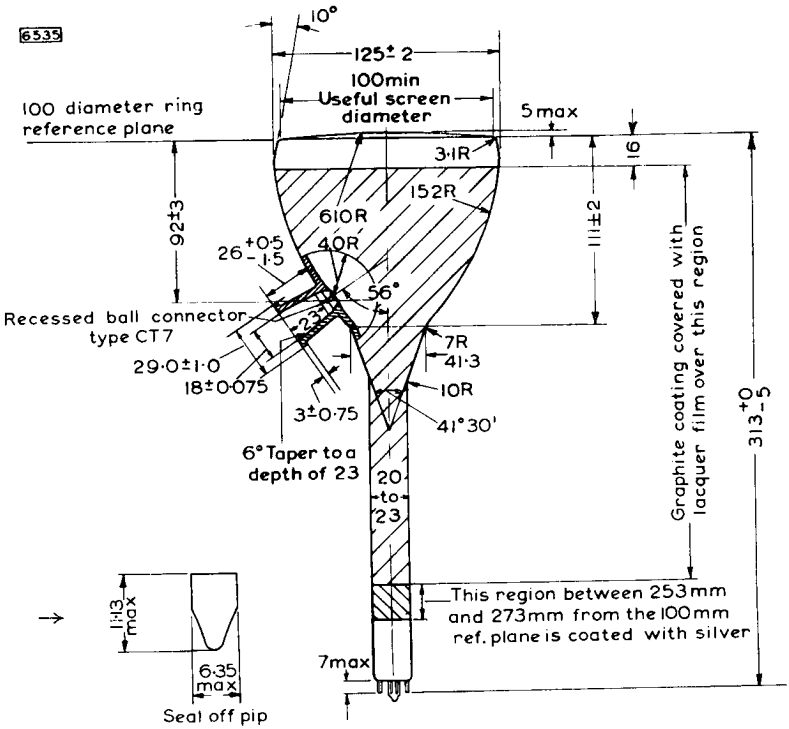
V_a	22	kV
V_g for cut-off	−50 to −100	V

LIMITING VALUES (absolute ratings)

V_a max.	27	kV
V_a min.	18	kV
$-V_g$ max.	150	V
$+V_g$ max.	0	V
$+V_{g(pk)}$ max.	2.0	V
I_k max.	200	μA
R_{g-k} max.	1.5	MΩ
V_{h-k} max. (cathode positive)	300	V
V_{h-k} max. (cathode negative)	90	V

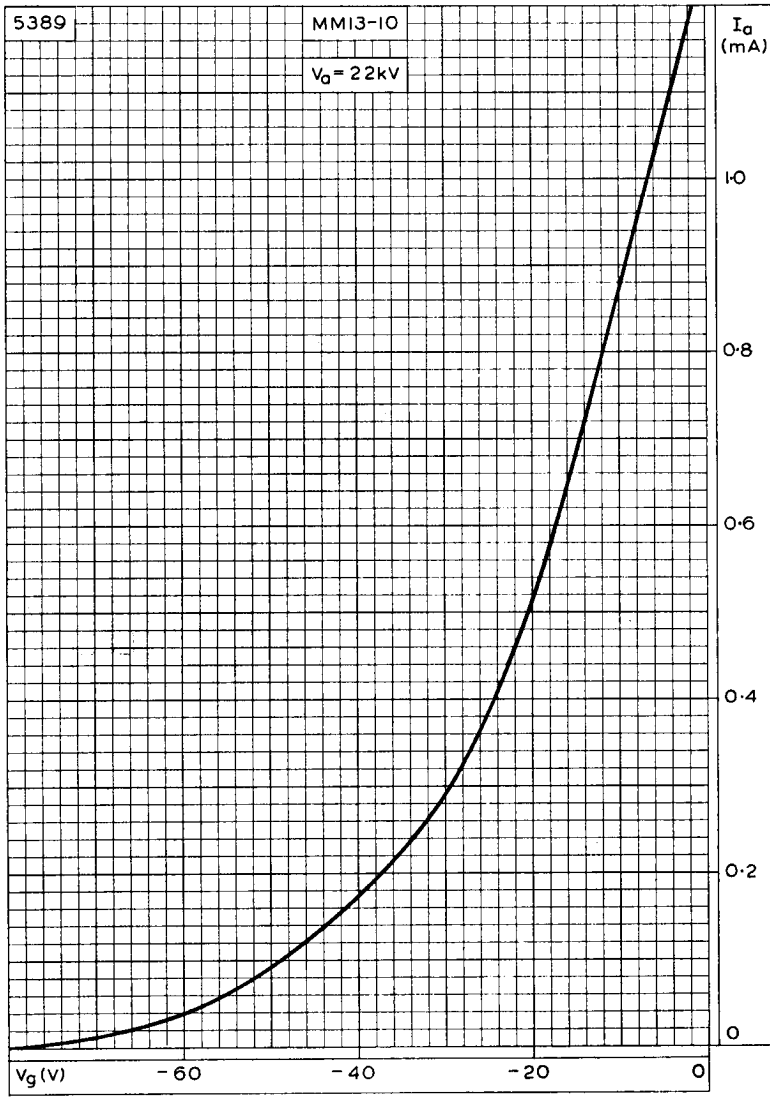
WARNING

At $V_a = 27kV$ and $I_a = 200\mu A$, the level of 'X' radiation expected may be of the order of 10 mr/hr, and adequate shielding must be provided.

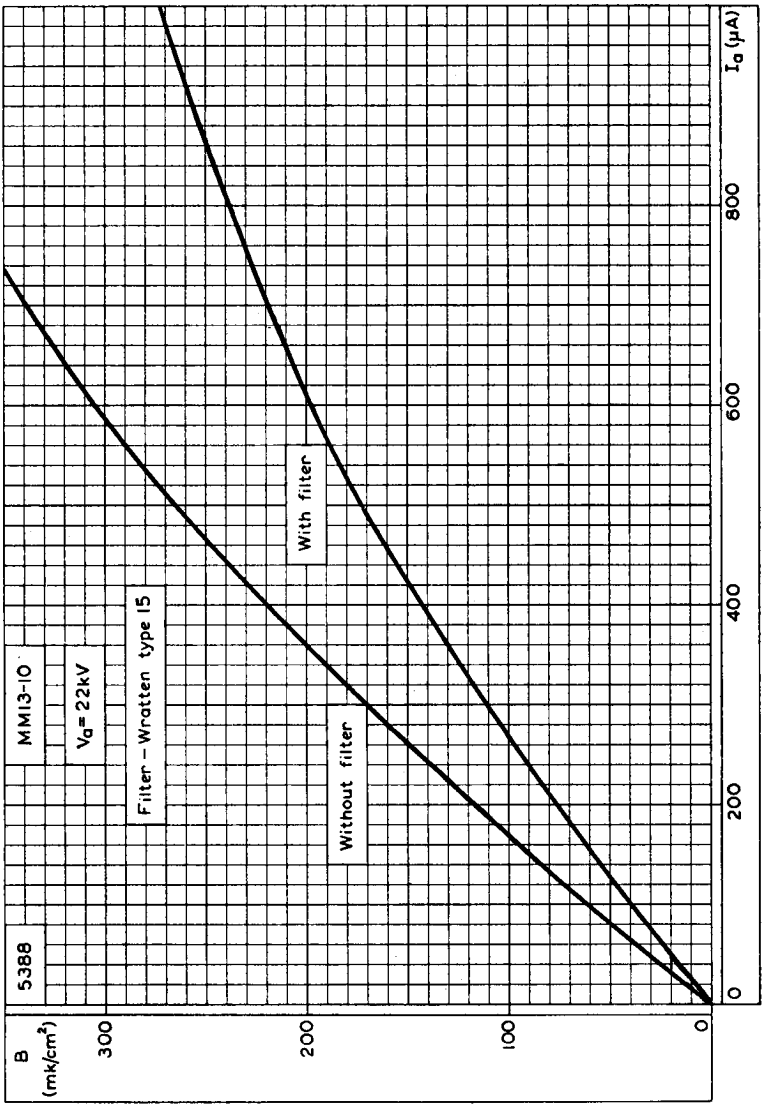


All dimensions in mm

MM13-10



FINAL ANODE CURRENT FLOTTED AGAINST GRID VOLTAGE



LIGHT OUTPUT PLOTTED AGAINST FINAL ANODE CURRENT
(1mk/cm²=2.9 e.f.c.=2.9ft lambert)

Mullard
TELEVISION PROJECTION TUBE

MS11-1

CATHODE RAY TUBE FOR TELEVISION RECEPTION
4 - Inch Screen.

Heater	Vf	=	4.0 V
	If	=	1.0 A
Capacity	Cg	=	10.0 uuF

Fluorescent Colour - Green

Deflection - Double Electromagnetic

Operating Conditions

Va2	20,000	25,000 V
Va1	300	500 V
-Vg	0 - 150	0-150 V

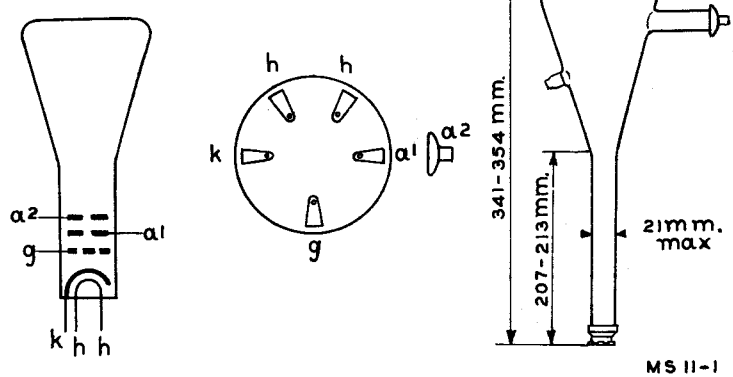
With centre of deflection coils 160 m.m. from the screen, the deflection sensitivity is 0.034L m.m. per gauss.

L = length of the electron path through the field of the deflection coil (m.m.)

Limiting Values

Va2 max	25,000 V
Va1 max	500 V
Ia2 max (Vg = 0 V).....	2.0 mA

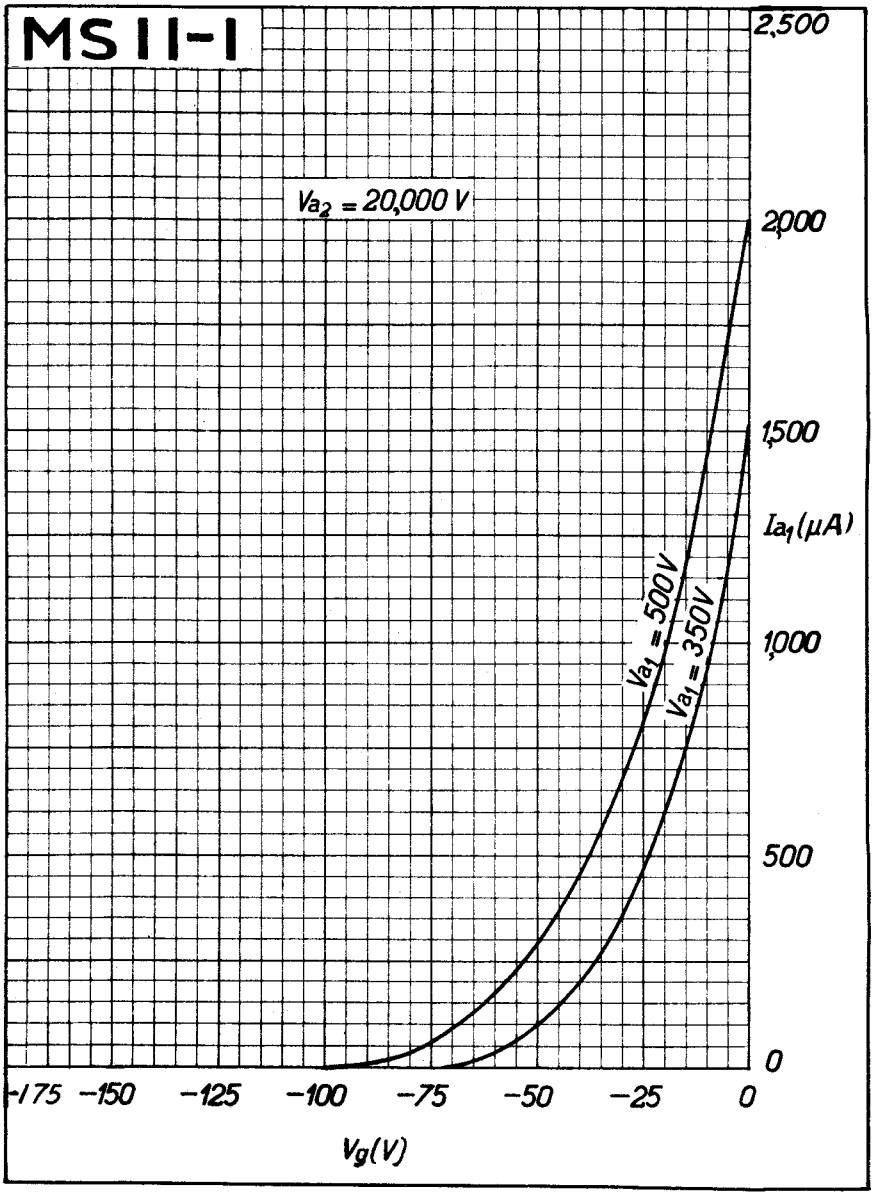
Arrangement of electrodes and base connections.



MS11-1

Mullard

TELEVISION PROJECTION TUBE



1439/2

Mullard
PICTURE TUBE

MW18-2

PICTURE TUBE FOR TELEVISION RECEPTION

7 - Inch Screen

Heater		Vf =	2.0 V
		If =	1.2 A
Capacity	Cg approx.	=	6.0 uuF
Fluorescent Colour	White		
Deflection	Double magnetic		

Operating Conditions

Va	.....	4,000 V
Vg	.....	-43 V

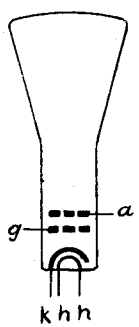
With centre of deflection coils 206 m.m. from the screen, the deflection sensitivity is 0·096 Lmm. per gauss.

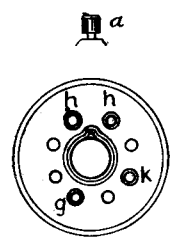
L = length of the electron path through the field of the deflection coil (m.m.)

Limiting Values

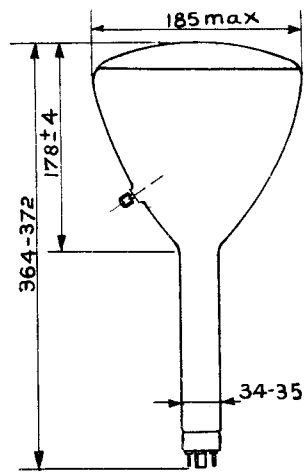
Va max	.....	5,000 V
Ia max	.....	0.1 mA

Arrangement of electrodes and base connections.





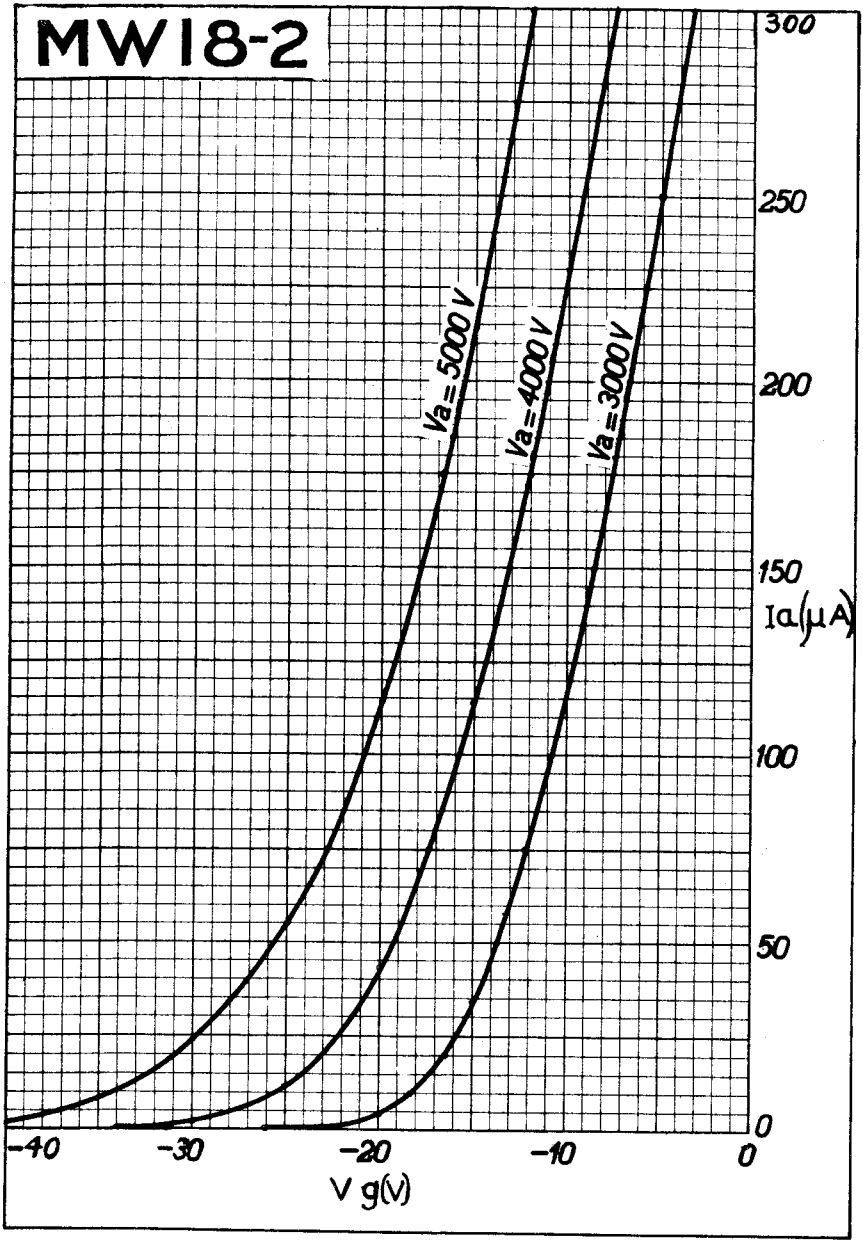
DIMENSIONS IN mm



MW 18-2

MW18-2

Mullard
PICTURE TUBE



1739/2

Mullard
PICTURE TUBE

MW22-1

PICTURE TUBE FOR TELEVISION RECEPTION

9 - Inch Screen.

Heater	Vf	=	4.0 V
	If	=	1.0 A
Capacity	Cg	=	13.0 uuF

Fluorescent Colour - White

Deflection - Double Electromagnetic

→Operating Conditions

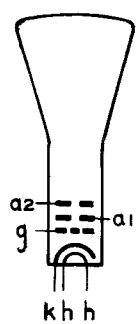
Va2	5000	5000 V
Va1	125	250 V
-Vg	0-50	0-100 V

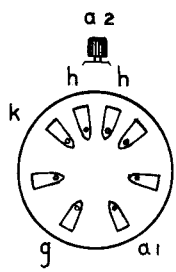
→ With centre of deflection coils 203 mm. from the screen, the deflection sensitivity is 0.09L mm. per gauss.

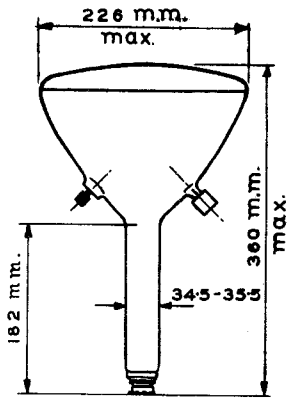
L = length of the electron path through the field of the deflection coil (mm.)

Limiting Values

Va2 max	5000	V
Va1 max	250	V
Ia2 max	100	uA ←
Screen dissipation (peak)	10	mW/cm^2 ←
Screen dissipation (continuous)	2	mW/cm^2 ←

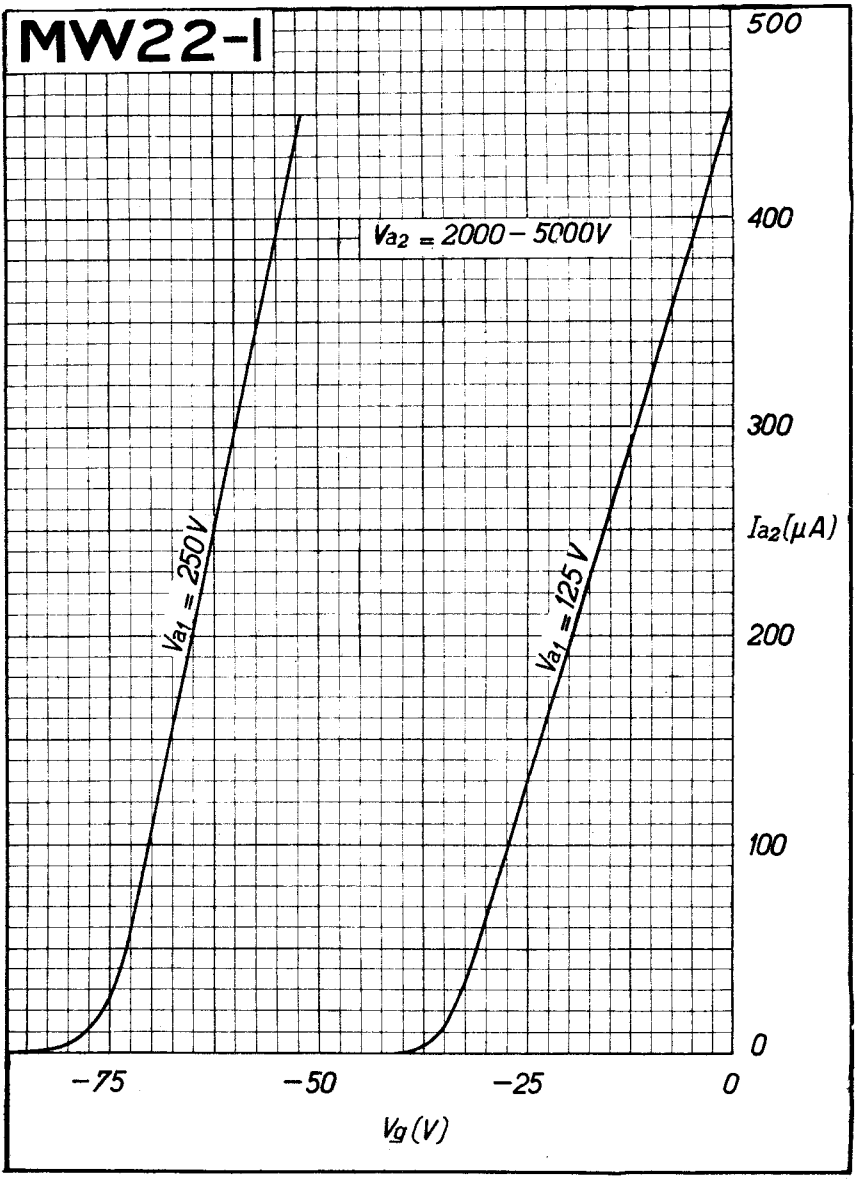






MW22-1

Mullard
PICTURE TUBE



1439/2

Mullard
PICTURE TUBE

MW22-3

PICTURE TUBE FOR TELEVISION RECEPTION

9 - Inch Screen

Heater	Vf	=	2.0 V
	If	=	1.2 A
Capacity	Cg approx.	=	6.0 uuF ←
Fluorescent Colour	White		
Deflection	Double Magnetic		

Operating Conditions

Va	5000	V ←
Vg	0-55	V ←

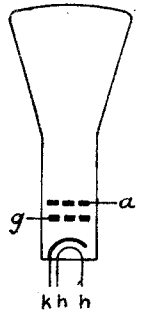
→ With centre of deflection coils 203 mm. from the screen, the deflection sensitivity is 0·09 Lmm. per gauss.

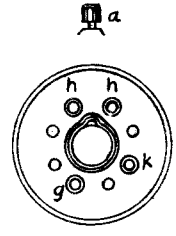
L = length of the electron path through the field of the deflection coil (mm.)

Limiting Values

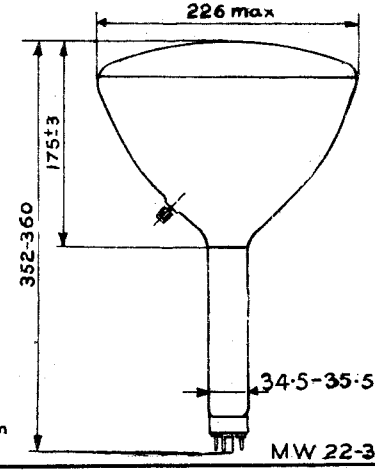
Va max	5000	V
Ia max	0.1	mA
Screen dissipation (peak)	10	mW/cm^2 ←
Screen dissipation (continuous)	2	mW/cm^2 ←

Arrangement of electrodes and base connections.



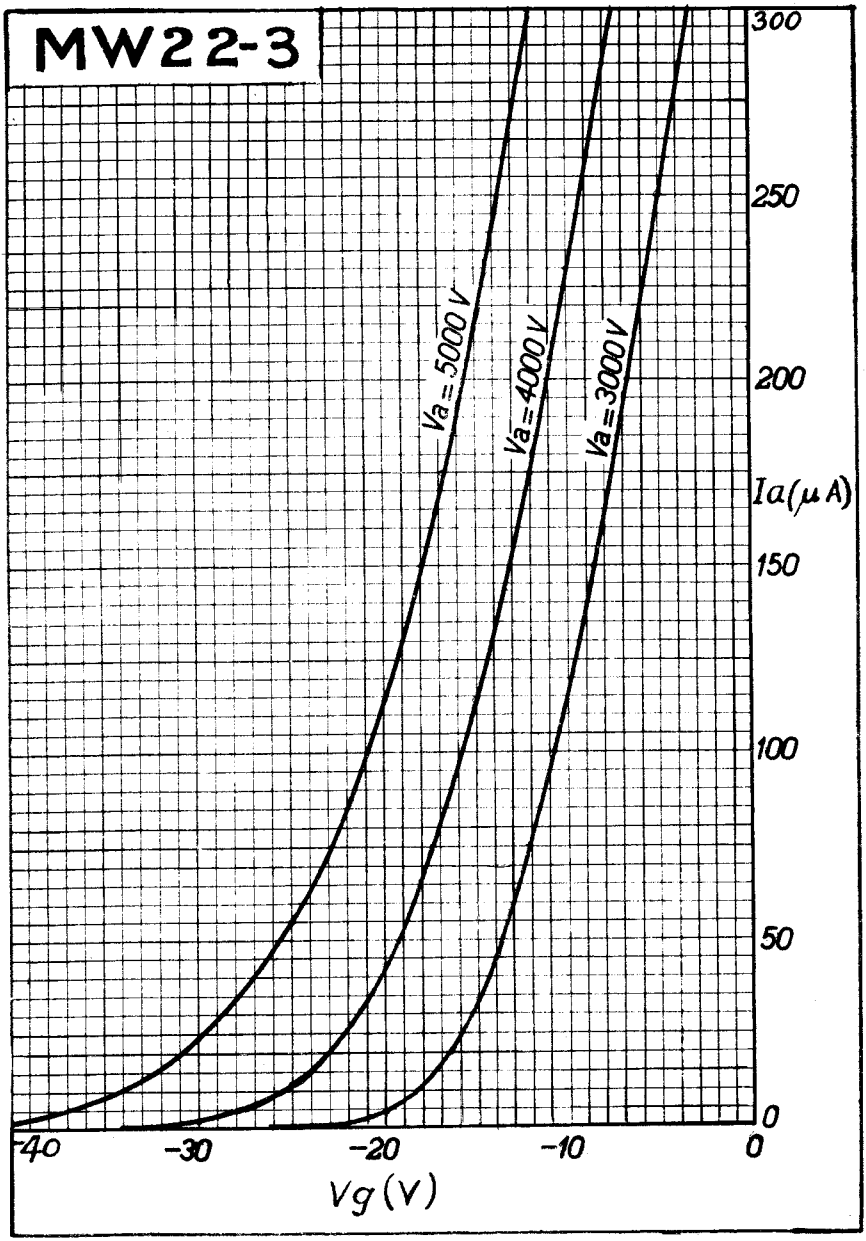


DIMENSIONS IN mm



MW22-3

Mullard
PICTURE TUBE



1939/E

Mullard
PICTURE TUBE

MW22-5

PICTURE TUBE FOR TELEVISION RECEPTION

9 - Inch Screen.

Heater	Vf	=	6.3 V
	If	=	0.65 A
Capacity	Cg	=	12.0 uuF←

Fluorescent Colour - White

Deflection - Double electromagnetic

→Operating Conditions

Va2	5000	5000	V
Va1	125	250	V
-Vg	0-50	0-100	V

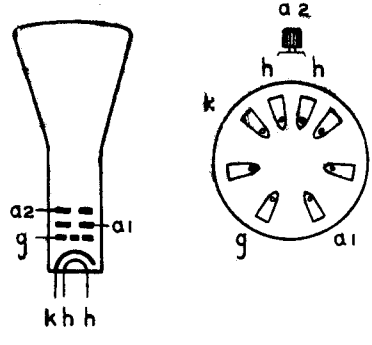
→ With centre of deflection coils 216 mm. from the screen, the deflection sensitivity is 0.09L mm. per gauss.

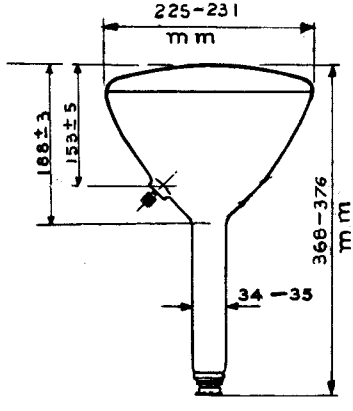
L = length of the electron path through the field of the deflection coil (mm.)

Limiting Values

Va2 max	5000	V
Va1 max	250	V
Ia2 max	100	uA←
Screen dissipation (peak)	10	mW/cm^2←
Screen dissipation (continuous)	2	mW/cm^2←

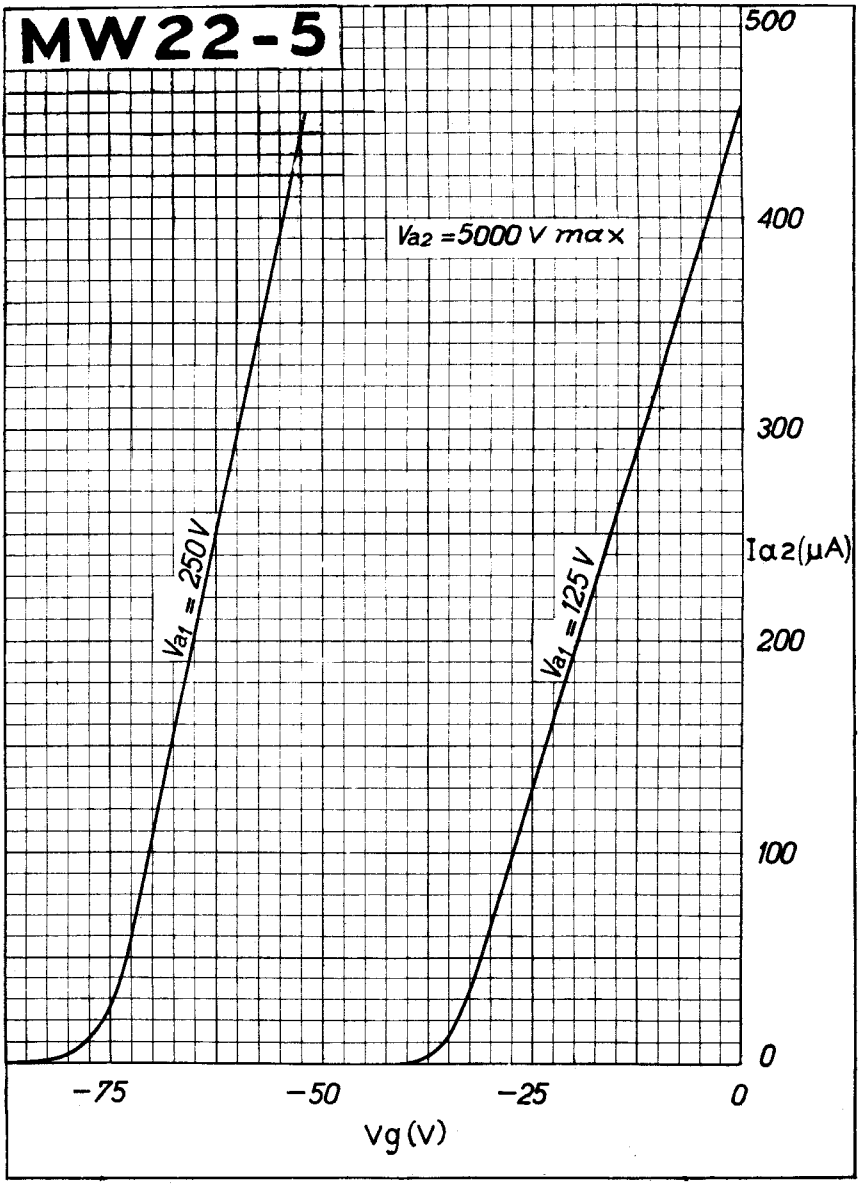
Arrangement of electrodes and base connections





MW22-5

Mullard
PICTURE TUBE



1939/2

Mullard
PICTURE TUBE

MW31-3

PICTURE TUBE FOR TELEVISION RECEPTION

12 - Inch Screen

Heater	Vf	=	6.3	V
	If	=	0.65	A ←
Capacity	Cg	=	13.0	uuF

Fluorescent Colour - White

Deflection - Double Electromagnetic

→ Operating Conditions

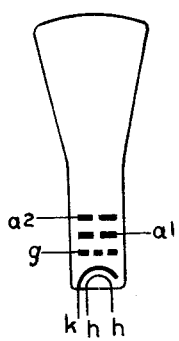
Va2	5000	5000	V
Va1	125	250	V
-Vg	0-50	0-100	V

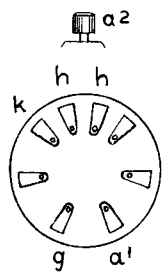
→ With centre of deflection coils 305 mm. from the screen, the deflection sensitivity is 0.12L mm. per gauss.

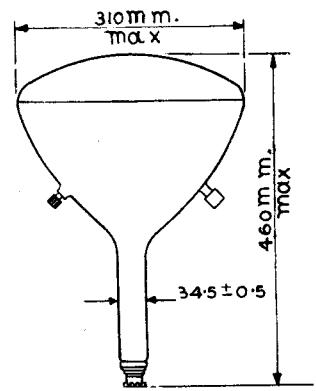
L = length of the electron path through the field of the deflection coil (mm.)

Limiting Values

Va2 max	5000	V
Va1 max	250	V
Ia2 max	100	uA ←
Screen dissipation (peak)	10	mW/cm² ←
Screen dissipation (continuous)	2	mW/cm² ←

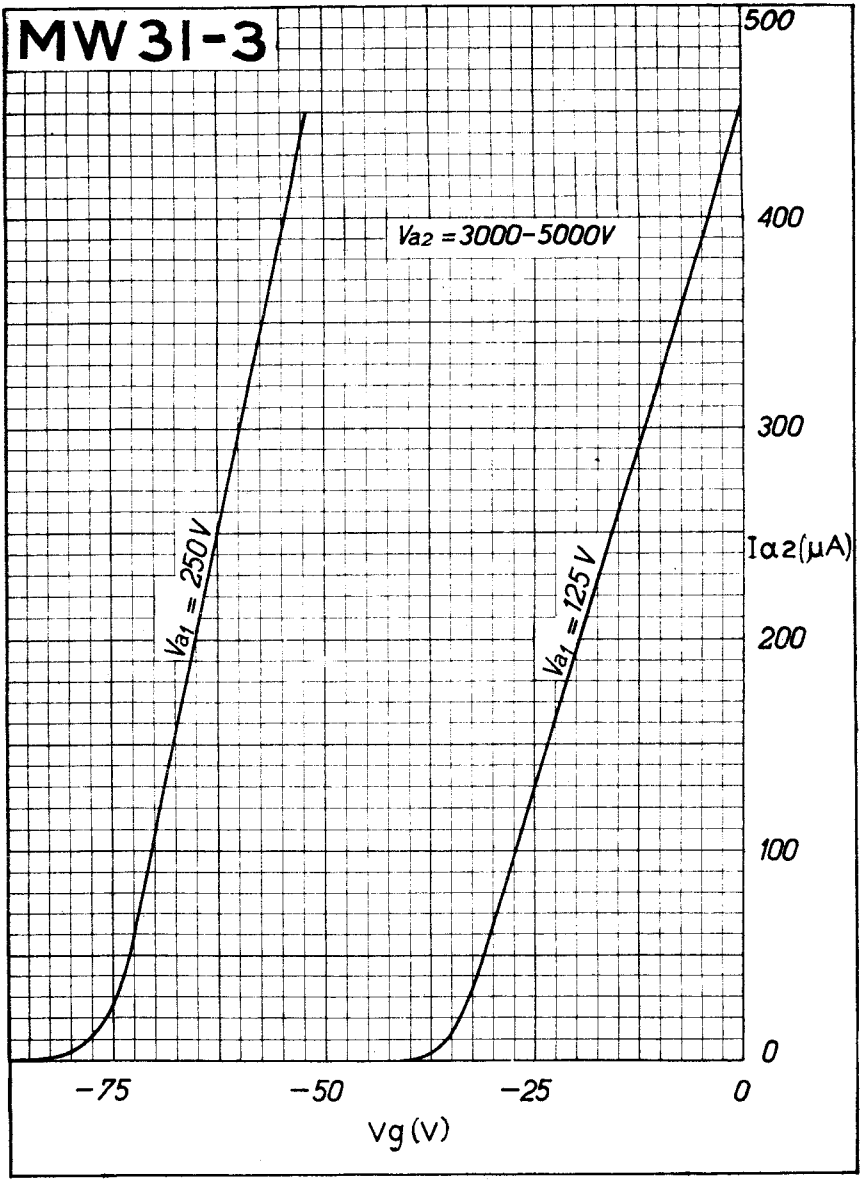






MW31-3

Mullard
PICTURE TUBE



1639/2

Mullard
PICTURE TUBE

MW31-6

PICTURE TUBE FOR TELEVISION RECEPTION

12 - Inch Screen

Heater	Vf	=	6.3 V
	If	=	0.6 A
Capacity	Cg	=	12.0 uuF ←

Fluorescent Colour - White

Deflection - Double Electromagnetic

→ Operating Conditions

Va2	5000	5000	V
Va1	125	250	V
-Vg	0-50	0-100	V

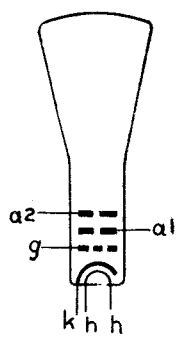
→ With centre of deflection coils 305 mm. from the screen, the deflection sensitivity is 0.12L mm. per gauss.

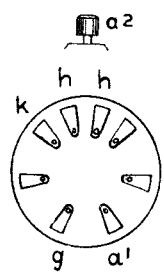
L = length of the electron path through the field of the deflection coil (mm.)

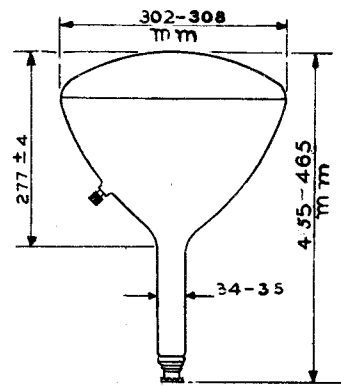
Limiting Values

Va2 max	5000	V
Va1 max	250	V
Ia2 max	100	uA ←
Screen dissipation (peak)	10	mW/cm² ←
Screen dissipation (continuous)	2	mW/cm² ←

Arrangement of electrodes and base connections.

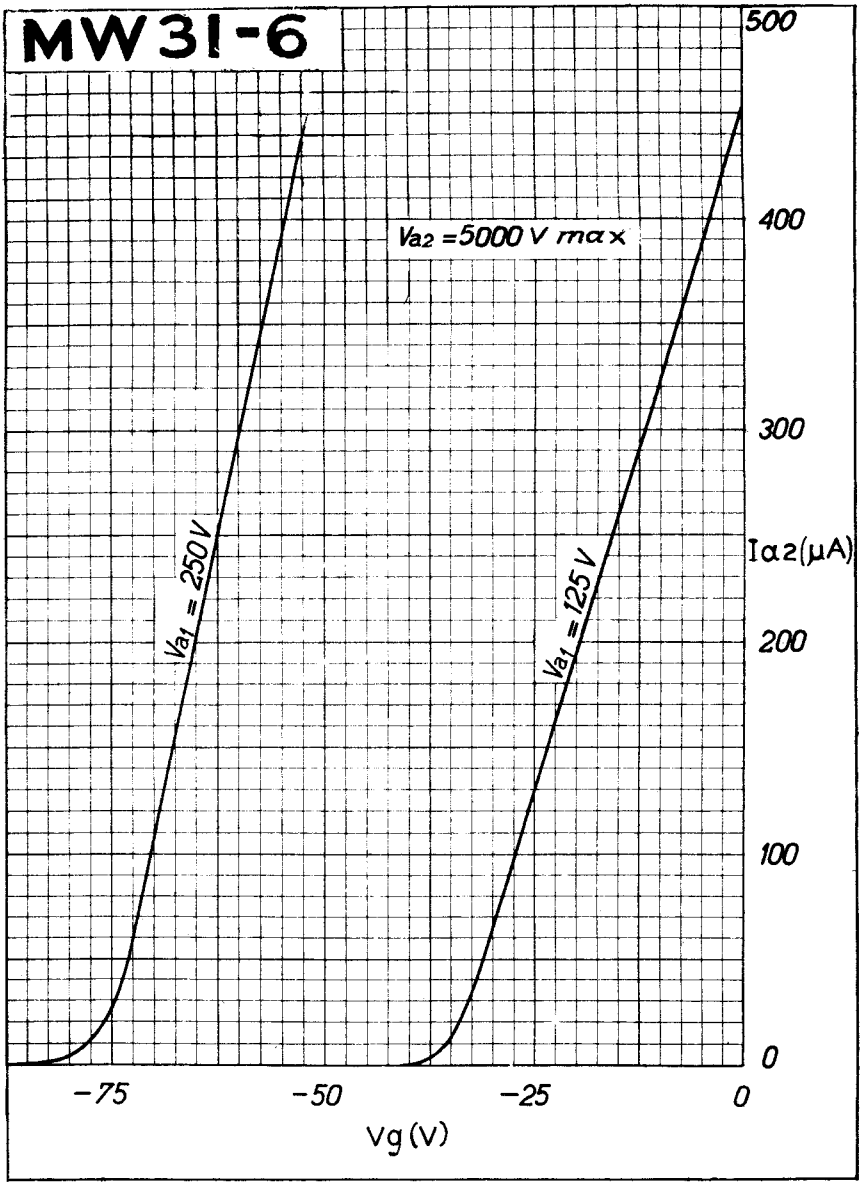






MW31-6

Mullard
PICTURE TUBE



1939/2

Mullard
PICTURE TUBE

MW39-3

PICTURE TUBE FOR TELEVISION RECEPTION

15 - Inch Screen

Heater	Vf	=	6.3 V
	If	=	0.65 A
Capacity	Cg	=	13.0 uuF

Fluorescent Colour - White

Deflection - Double Electromagnetic

Operating Conditions

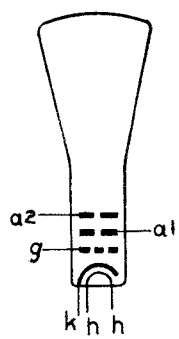
Va2	6000	6000	V
Va1	125	250	V
-Vg	0-50	0-100	V

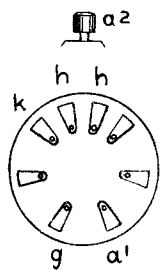
With centre of deflection coils 349 mm. from the screen, the deflection sensitivity is 0.13 L mm. per gauss.

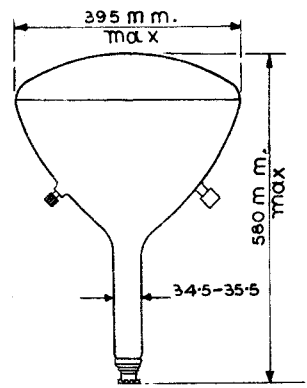
L = length of the electron path through the field of the deflection coil (mm).

Limiting Values

Va2 max	6000	V
Va1 max	250	V
Ia2 max	100	uA
Screen dissipation (peak)	10	mW/cm^2
Screen dissipation (continuous)	2	mW/cm^2



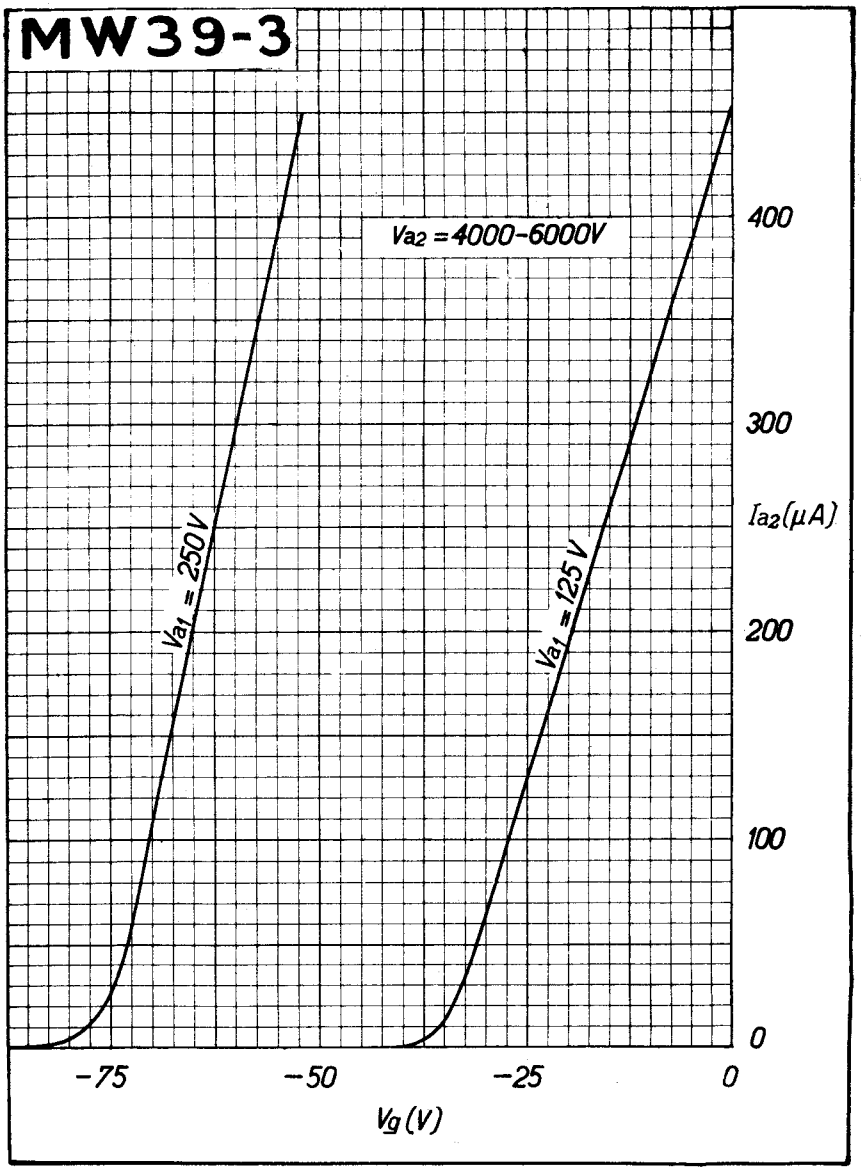




MW39-3

MW39-3

Mullard
PICTURE TUBE



1439/2

TELEVISION MONITOR TUBE

MW22-22

Direct viewing television tube with 9-in. diameter metal-backed screen. Primarily intended for use as a television studio monitor tube.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – CATHODE RAY TUBES, included in this volume of the handbook.

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note (applies to series operation only)—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

CAPACITANCES

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

SCREEN

Metal-backed		
Fluorescent colour	White	
Useful screen diameter	214	mm

FOCUSING

Magnetic

DEFLECTION

Double magnetic

MOUNTING POSITION

Any, except vertical with screen downward and the axis of the tube making an angle of less than 20° with the vertical.

TYPICAL OPERATING CONDITIONS

V_{a_2}	9.0	kV
V_{a_1}	300	V
*V_g for cut-off	–30 to –70	V

MW22-22

TELEVISION MONITOR TUBE

Direct viewing television tube with 9-in. diameter metal-backed screen. Primarily intended for use as a television studio monitor tube.

LIMITING VALUES (Absolute ratings)

**V_{a_2} max.	14	kV ←
V_{a_2} min.	7.0	kV
V_{a_1} max.	410	V
V_{a_1} min.	200	V
*$-V_g$ max.	150	V
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
††$v_{h-k(pk)}$ max. (cathode positive)	410	V
R_{g-k} max.	1.5	MΩ ←
Z_{g-k} max. (f = 50 c/s)	500	kΩ ←
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a_2} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

††During a warming-up period not exceeding 45 sec.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ, where Z_k is the 50c/s impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1MΩ.

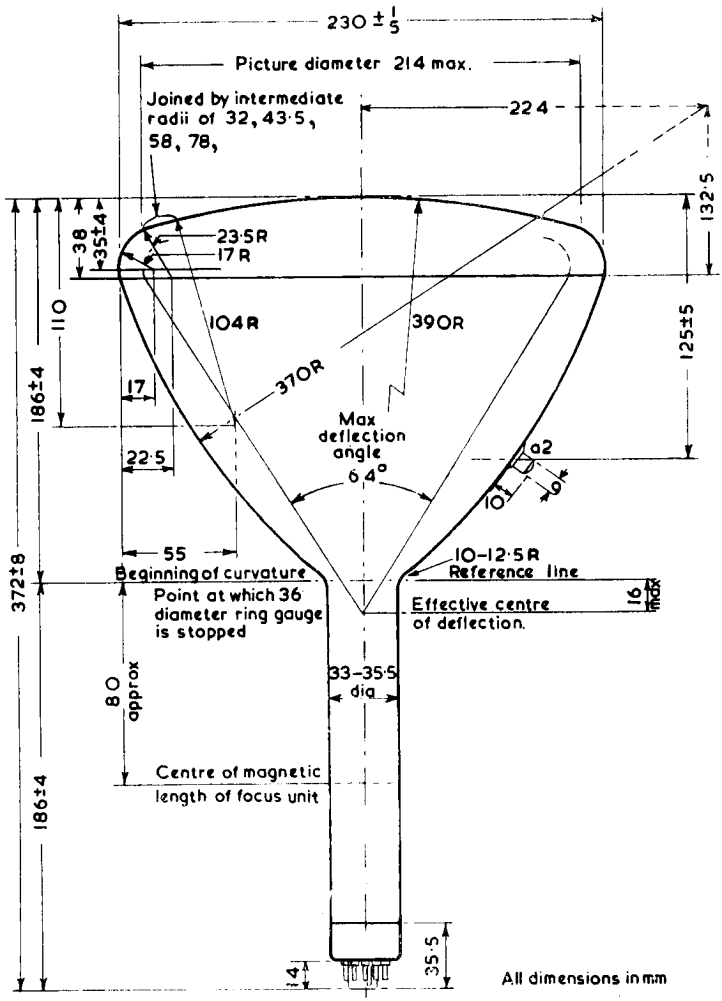
WEIGHT

Tube alone { 2 kg / 4lb 6 oz

TELEVISION MONITOR TUBE

MW22-22

Direct viewing television tube with 9-in. diameter metal-backed screen. Primarily intended for use as a television studio monitor tube.



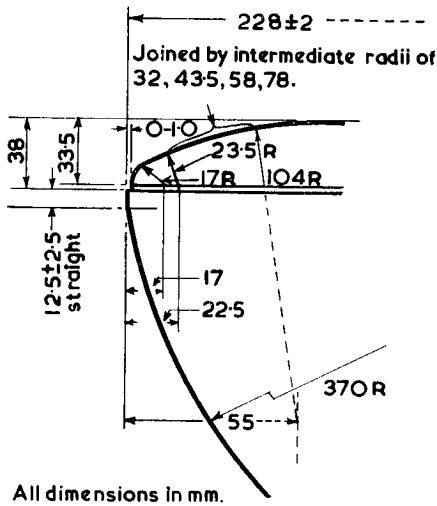
This drawing shows the blown bulb. Some tubes are made with a pressed bulb. A detailed drawing showing the points of difference of the pressed bulb is given on page 4. The base connections are also shown on that page. 2512

MW22-22

TELEVISION MONITOR TUBE

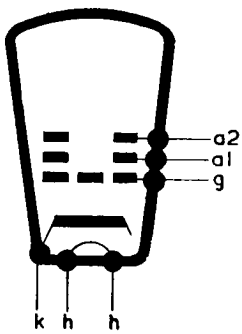
Direct viewing television tube with 9-in. diameter metal-backed screen. Primarily intended for use as a television studio monitor tube.

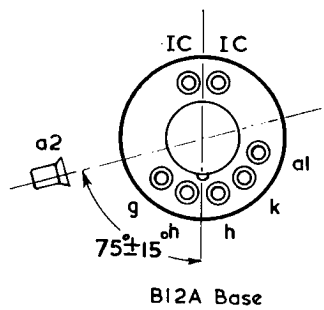
2513



All dimensions in mm.

The pressed bulb has the same dimensions as the blown bulb (page 3) apart from the differences shown in the detailed drawing above.



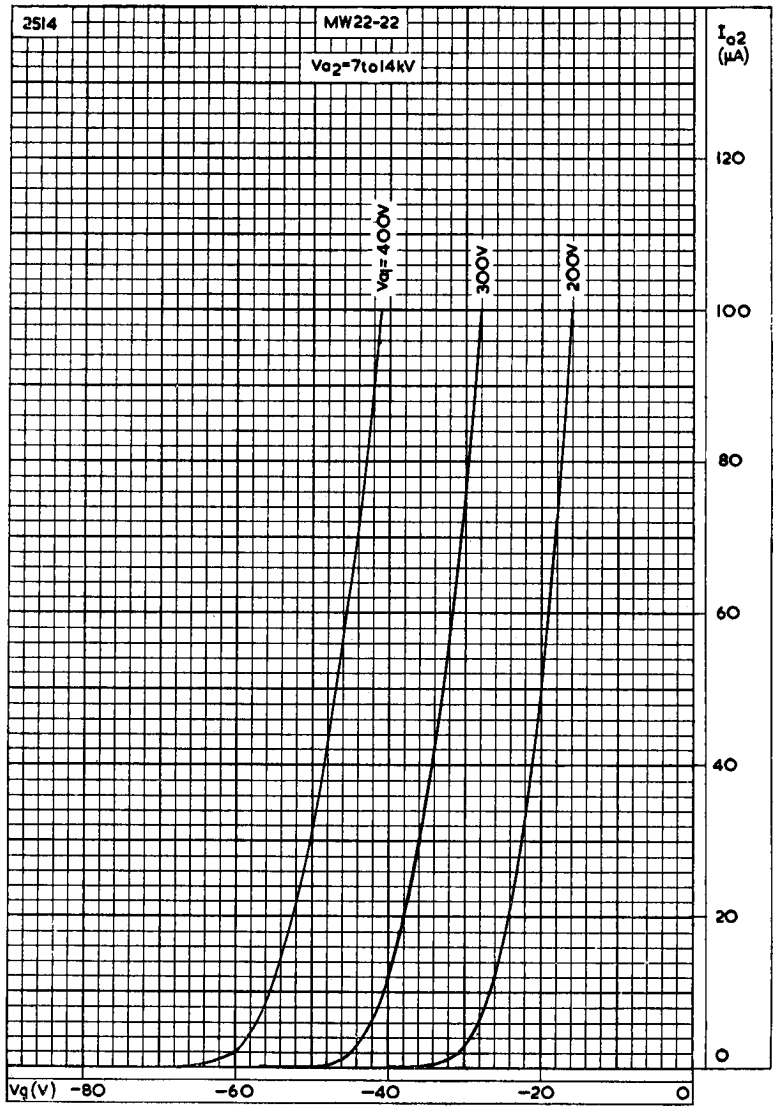


B12A Base

TELEVISION MONITOR TUBE

MW22-22

Direct viewing television tube with 9-in. diameter metal-backed screen. Primarily intended for use as a television studio monitor tube.

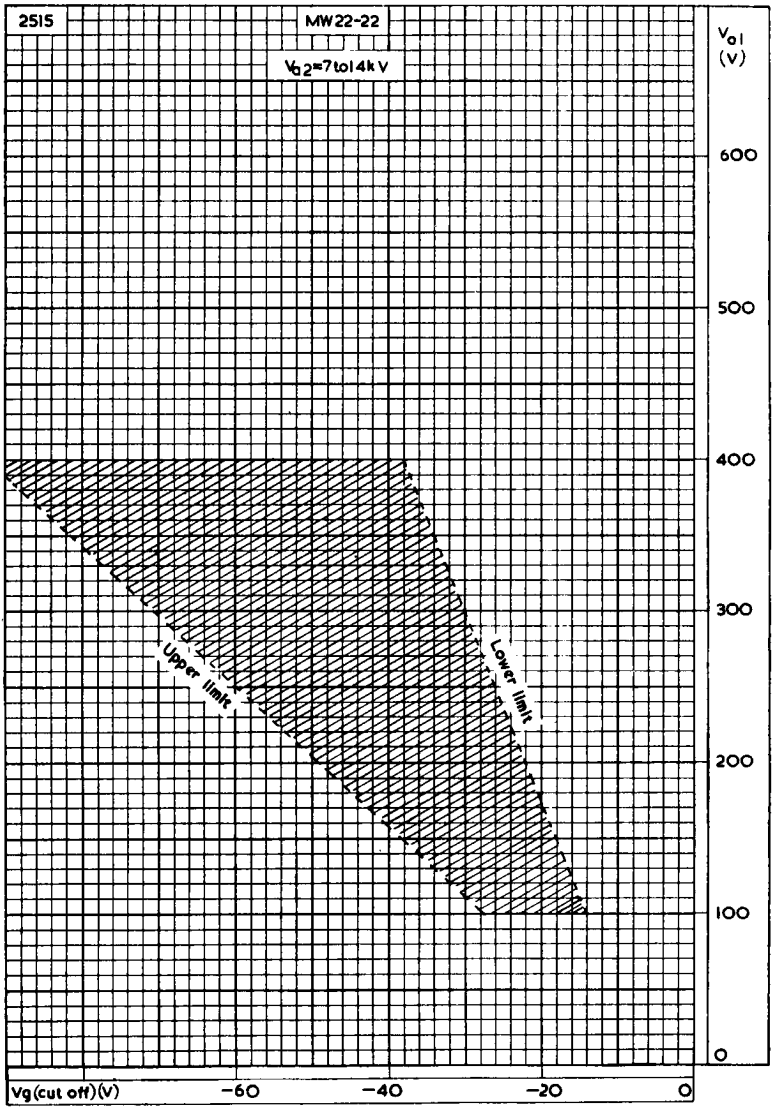


FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

MW22-22

TELEVISION MONITOR TUBE

Direct viewing television tube with 9-in. diameter metal-backed screen. Primarily intended for use as a television studio monitor tube.

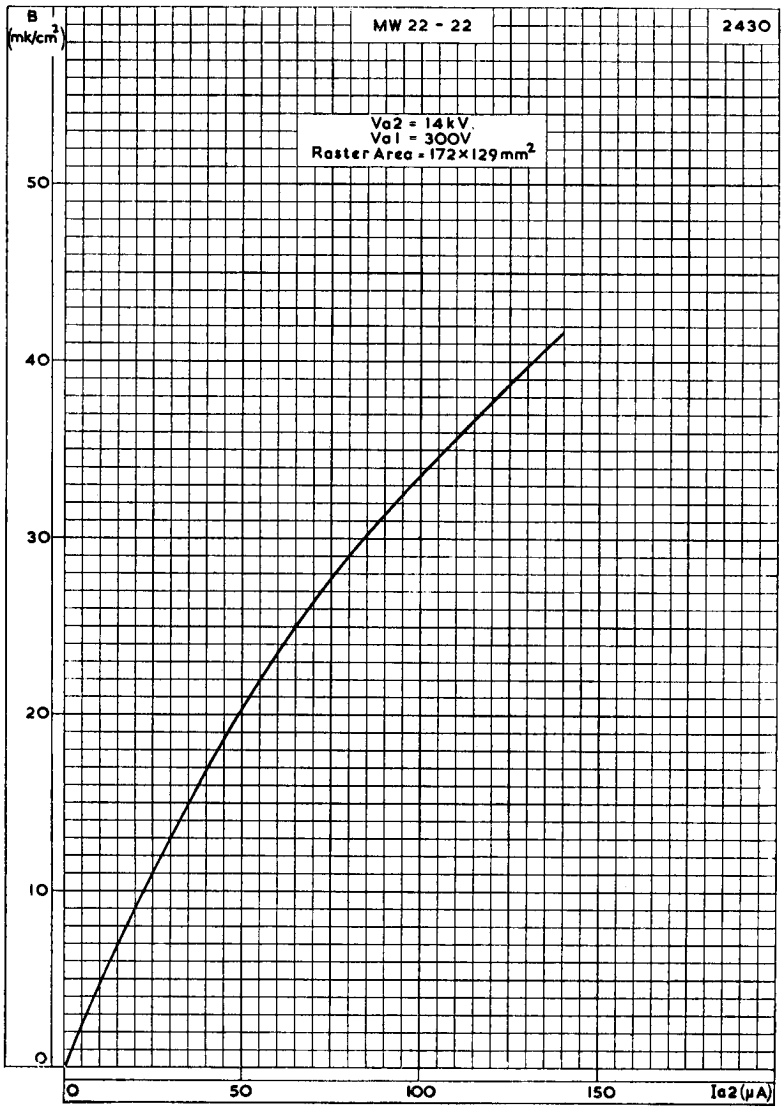


LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES FROM 100 TO 400V

TELEVISION MONITOR TUBE

MW22-22

Direct viewing television tube with 9-in. diameter metal-backed screen. Primarily intended for use as a television studio monitor tube.



LIGHT OUTPUT PLOTTED AGAINST FINAL ANODE CURRENT

(1mk/cm² = 2.9e.f.c. = 2.9ft. – lambert)

TELEVISION MONITOR TUBE

MW43-67

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. Primarily intended for use as a television studio monitor tube.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES, included in this volume of the handbook.

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note (applies to series operation only). The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

CAPACITANCES

C_{g-all}	<8	pF
C_{k-all}	<8	pF
C_{a2-M}	1100	pF

SCREEN

Metal-backed		
Fluorescent colour	White	
Light transmission	66	%
Useful screen area	See drawing on p. 3	

FOCUSING

Magnetic

DEFLECTION

Double magnetic

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'

MOUNTING POSITION

Any, except vertical with screen downward and the axis of the tube making an angle of less than 20° with the vertical.
The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle having a diameter of 55mm which is centred upon the perpendicular from the centre of the face.

MW43-67

TELEVISION MONITOR TUBE

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. Primarily intended for use as a television studio monitor tube.

TYPICAL OPERATING CONDITIONS

V_{a_2}	14	kV
V_{a_1}	300	V
*V_g for cut-off	−30 to −70	V
Recommended distance of centre of magnetic length of focus unit from reference line	100	mm

LIMITING VALUES (Absolute ratings)

**V_{a_2} max.	15	kV
V_{a_2} min.	9.0	kV
V_{a_1} max.	500	V
V_{a_1} min.	250	V
*$-V_g$ max.	150	V
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
††$v_{h-k(pk)}$ max. (cathode positive)	410	V
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50c/s)	500	kΩ
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the equipment on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a_2} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

††During a warming-up period not exceeding 45 sec.

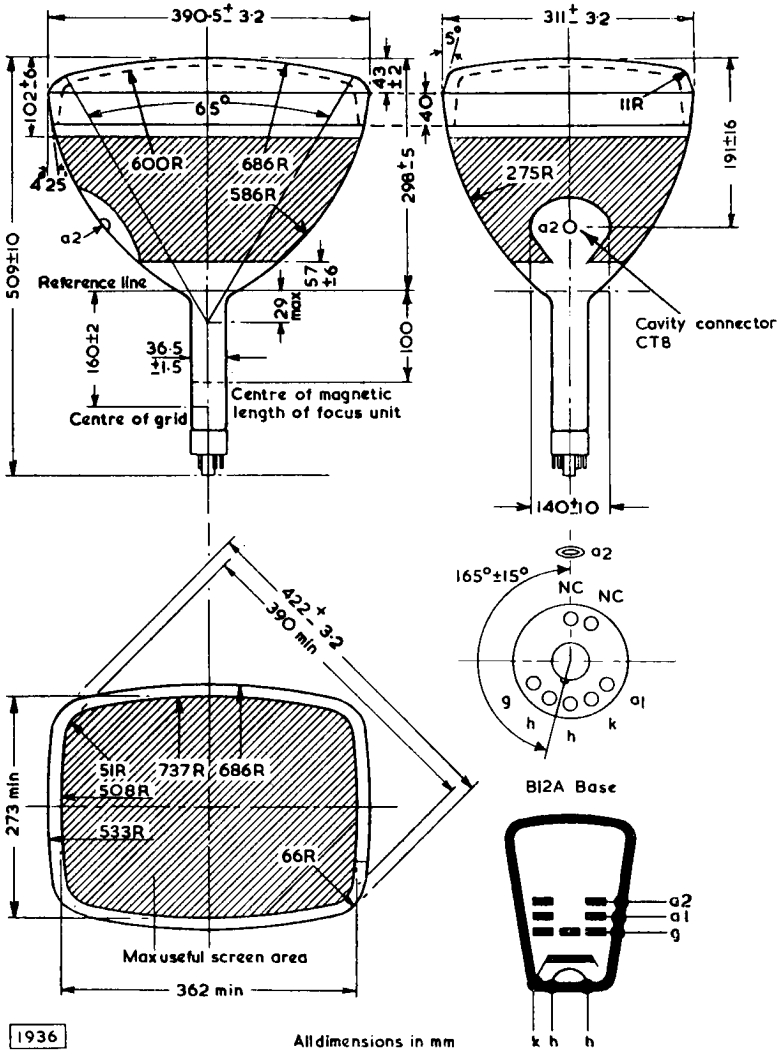
§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ, where Z_k is the 50c/s impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1MΩ.

WEIGHT Tube alone { 7.7 kg / 17 lb

TELEVISION MONITOR TUBE

MW43-67

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. Primarily intended for use as a television studio monitor tube.

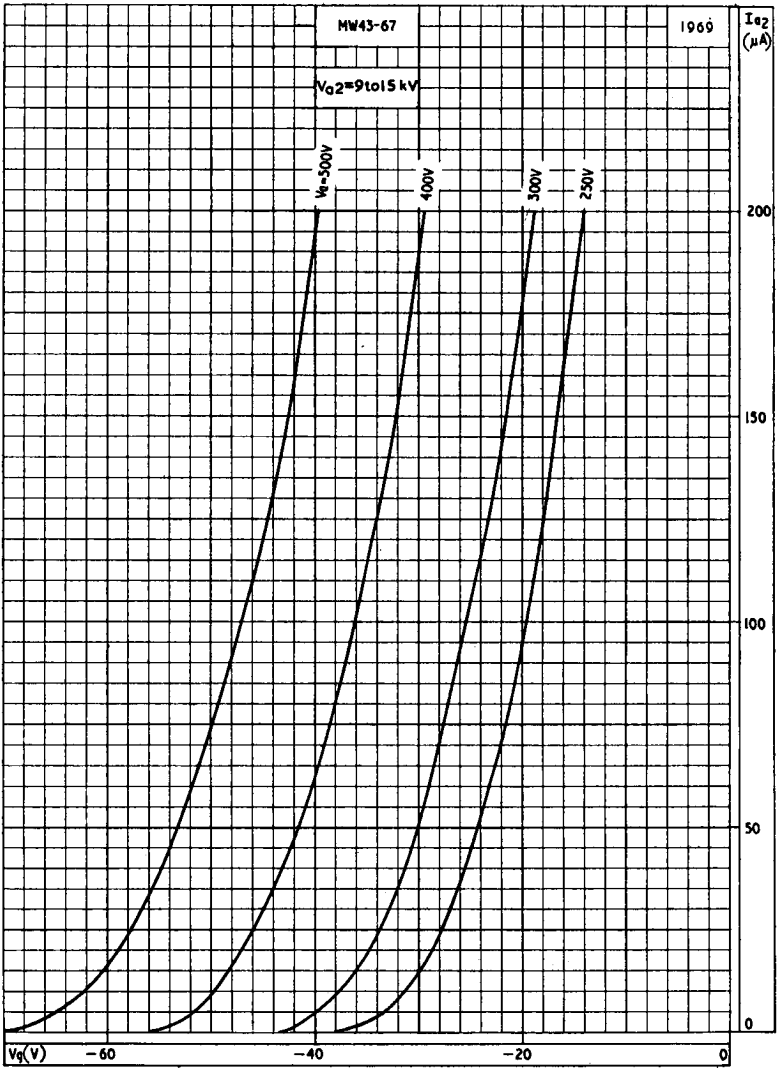


The indicated radius of faceplate curvature is not an exact but an average value.

MW43-67

TELEVISION MONITOR TUBE

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. Primarily intended for use as a television studio monitor tube.

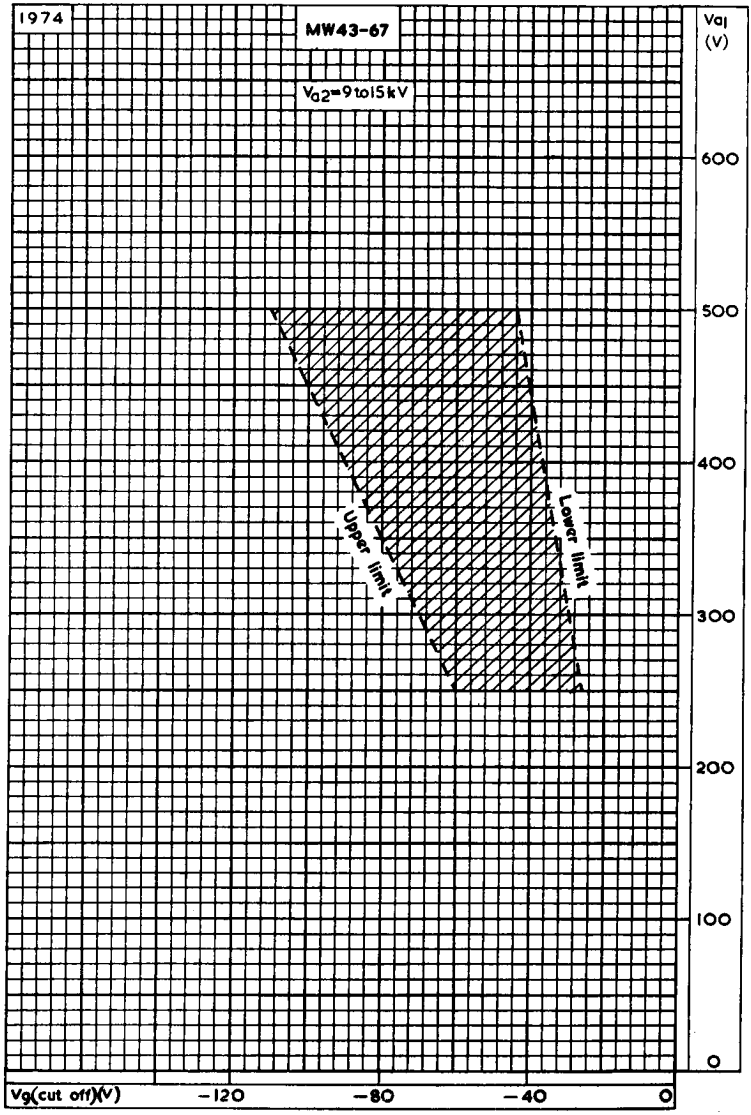


FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

TELEVISION MONITOR TUBE

MW43-67

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. Primarily intended for use as a television studio monitor tube.

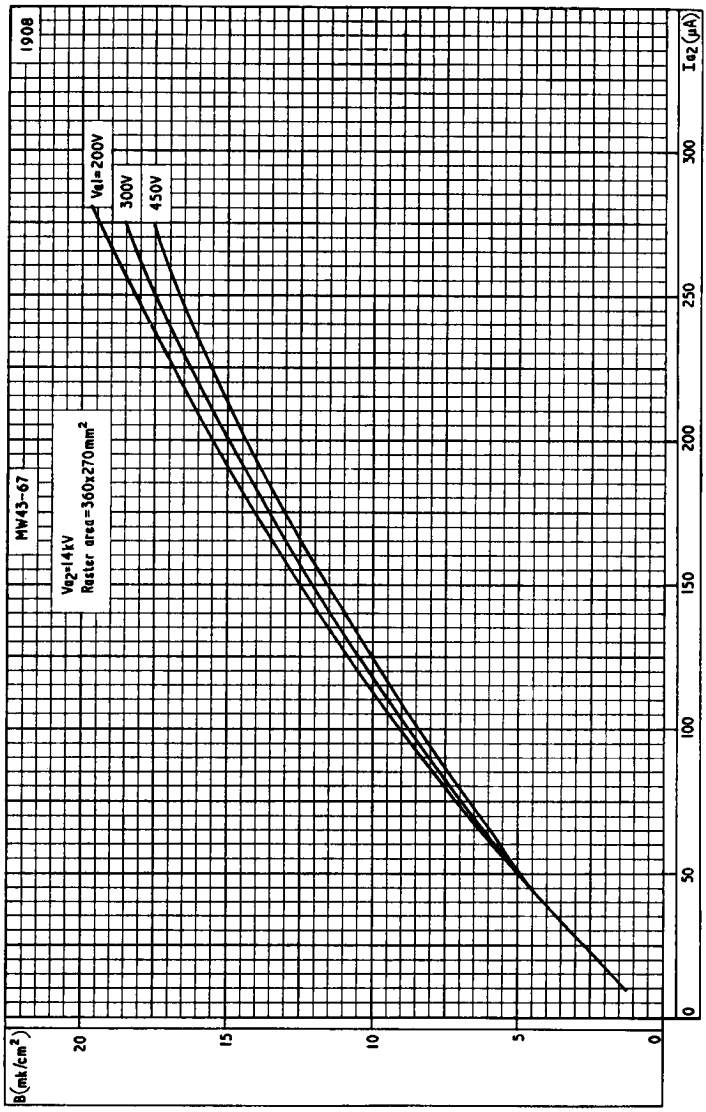


LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES FROM 250 TO 500V

MW43-67

TELEVISION MONITOR TUBE

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. Primarily intended for use as a television studio monitor tube.



LIGHT OUTPUT PLOTTED AGAINST FINAL ANODE CURRENT FOR VARIOUS FIRST ANODE VOLTAGES

(1mk/cm² = 2.9 e.f.c. = 2.9ft.-lambert)

TELEVISION TUBE

MW43-69Z

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. This tube has magnetic focusing and 70° magnetic deflection.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS — CATHODE RAY TUBES

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note: (applies to series operation only). The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

CAPACITANCES

C_{g-all}	<8	pF
C_{k-all}	<6	pF
$C_{k+a2-all}$	<11	pF
C_{a3-M}	1100	pF

SCREEN

Metal-backed		
Fluorescent colour	White	
Light transmission	66	%
Useful screen area	See drawing on p. 3	

FOCUSING

Magnetic

DEFLECTION

Double magnetic

ION TRAP

This tube does not use an external ion trap magnet. When used as a replacement for ion trap types, the ion trap magnet and any lead connected to it should be discarded.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'.

MOUNTING POSITION

Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle having a diameter of 55mm which is centred upon the perpendicular from the centre of the face.

PREFOCUSING

The spot size and uniformity of focus depend upon V_{a_2}. At V_{a_2} zero or negative with respect to cathode the spot size at the centre of the screen and the width of the electron beam are such that optimum uniformity of focus is obtained over the whole screen. If V_{a_2} is increased, the spot size at the centre of the screen is reduced but the width of the electron beam is increased, resulting in inferior focus at the edges of the screen.
With increased V_{a_2}, the power of the external focusing magnet has to be increased.

TYPICAL OPERATING CONDITIONS

V_{a_3}	14	kV
V_{a_2}	0	V
V_{a_1}	300	V
*V_g for cut-off	−40 to −86	V

LIMITING VALUES (Design centre ratings)

**V_{a_3} max.	16	kV
V_{a_3} min.	10	kV
V_{a_2} max.	410	V
V_{a_2} min.	−100	V
V_{a_1} max.	410	V
V_{a_1} min.	200	V
*$-V_g$ max.	150	V
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
††$V_{h-k(pk)}$ max. (cathode positive)	410	V
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50Hz)	500	kΩ
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ
Max. a_2 supply source impedance	1.5	MΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a_2} and I_t (average value for the whole screen) must not exceed 6W.

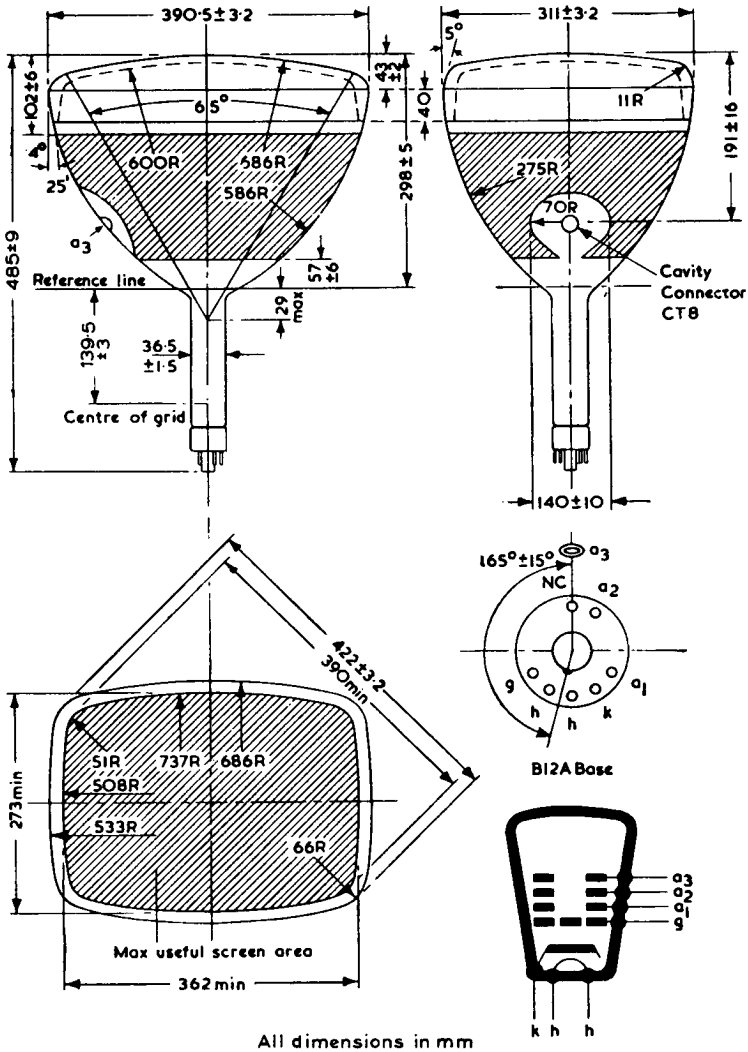
†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

††During a warming-up period not exceeding 45 sec.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50Hz impedance between earth and the cathode.
When the heater is supplied from a separate transformer R_{h-k} max is 1.0MΩ.

WEIGHT Tube alone { 7.5 kg / 17 lb

MW43-69Z



All dimensions in mm

The indicated radius of faceplate curvature is not an exact but an average value.

TELEVISION TUBE

MW43-80Z

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. This tube has magnetic focusing and 90° magnetic deflection.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes'.

Note (applies to series operation only)—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

CAPACITANCES

C_{g-all}	<8.0	pF
C_{k-all}	<5.0	pF
$C_{k+a2-all}$	<11	pF
C_{a3-M}	1200	pF

SCREEN

Metal backed		
Fluorescent colour	white	
Light transmission	70	%
Useful screen area	see drawing on page D4	

FOCUSING

Magnetic

DEFLECTION

Double magnetic

For timebase designs the following spreads in the useful screen area should be considered.

Picture height		
Maximum	284	mm
Minimum	273	mm
Picture width		
Maximum	369	mm
Minimum	362	mm
Picture diagonal		
Maximum	400	mm
Minimum	390	mm

The spread in the cone length can be obtained from the outline drawing.

MW43-80Z

TELEVISION TUBE

ION TRAP

This tube does not use an external ion trap magnet. When used as a replacement for ion trap types, the ion trap magnet and any lead connected to it should be discarded.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'.

MOUNTING POSITION

Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle having a diameter of 55mm which is centred upon the perpendicular from the centre of the face.

PREFOCUSING

The spot size and uniformity of focus depend upon V_{a2}. At V_{a2} zero or negative with respect to cathode the spot size at the centre of the screen and the width of the electron beam are such that optimum uniformity of focus is obtained over the whole screen. If V_{a2} is increased, the spot size at the centre of the screen is reduced but the width of the electron beam is increased, resulting in inferior focus at the edges of the screen.

With increased V_{a2}, the power of the external focusing magnet has to be increased.

OPERATING CONDITIONS

V_{a3}	14	kV
V_{a2}	0	V
V_{a1}	300	V
V_g for visual extinction of focused raster	−40 to −86	V

LIMITING VALUES (design centre ratings)

**V_{a3} max.	16	kV
V_{a3} min.	10	kV
V_{a2} max.	410	V
V_{a2} min.	−100	V
V_{a1} max.	410	V
V_{a1} min.	200	V
*$-V_g$ max.	150	V
†V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-c} max. (f = 50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ
Max. a_1 supply source impedance	1.5	MΩ
Max. a_2 supply source impedance	1.5	MΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a3} and I_t (average value for the whole screen) must not exceed 6W.

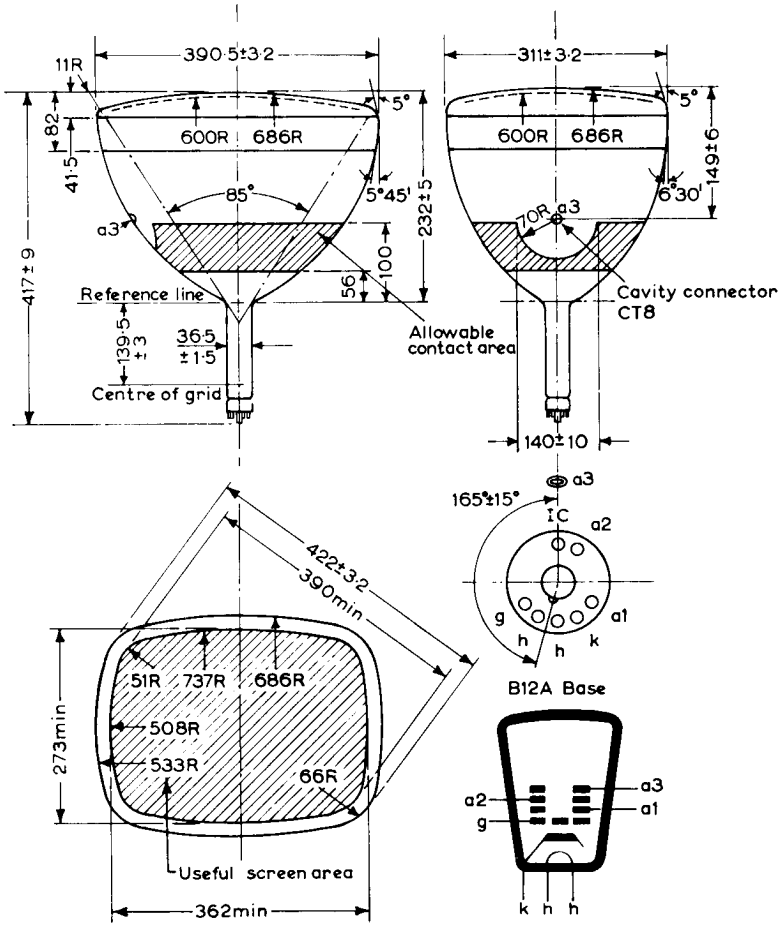
†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).
During a warming-up period not exceeding 45s $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WEIGHT

Tube alone	6.4 14	kg lb

MW43-80Z

TELEVISION TUBE



All dimensions in mm

POWER TRIODE

MY3-275

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT Thoriated tungsten

V_f	14	V
I_f	6.5	A

MOUNTING POSITION

Vertical, base down or up.

CAPACITANCES

c_{in}	11.5	pF
c_{out}	7.0	pF
c_{a-g}	18	pF

CHARACTERISTICS (measured at $V_a = 2.0kV$, $I_a = 160mA$)

g_m	8.5	mA/V
μ	16	
r_a	1.9	kΩ

COOLING Natural

LIMITING VALUES

V_a max.	3.0	kV
p_a max.	275	W
I_k max.	500	mA
$i_{k(pk)}$ max.	2.0	A
I_g max.	75	mA

OPERATION OF TWO MY3-275 IN PUSH-PULL AS CLASS 'B' AMPLIFIER OR MODULATOR DRIVEN BY TWO EL34 IN DIRECT-COUPLED CATHODE FOLLOWER CIRCUIT (See circuit diagram on page 3)

Typical operating conditions for two MY3-275

V_a	2.0	2.5	3.0	kV
V_g	−112	−145	−175	V
$I_{a(o)}$	2×60	2×60	2×60	mA
I_a (max. sig.)	2×405	2×335	2×280	mA
I_g	2×26	2×22	2×18	mA
$V_{in(g-g)r.m.s.}$	342	369	396	V
p_a	2×210	2×202	2×190	W
P_{out}	1.2	1.27	1.3	kW
R_{a-a}	6.0	9.4	13.8	kW
η	74	75.7	77.4	%
D_{tot}	3.0	3.0	3.0	%

MY3-275

POWER TRIODE

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.

Typical operating conditions for two EL34

V_{b1}	−415	−445	−475	V
V_{b2}	350	350	350	V
V_{g1}	−165	−200	−235	V
$I_{a(o)}$	2×20	2×20	2×20	mA
I_a (max. sig.)	2×46	2×42	2×38	mA
$V_{in(g1-g1)r.m.s.}$	380	410	440	V

NOTES

1. The regulation of the power supply V_{b1} is not critical, and a capacitance input filter may be used. V_{b2} however, should have good regulation, preferably using a choke input filter.

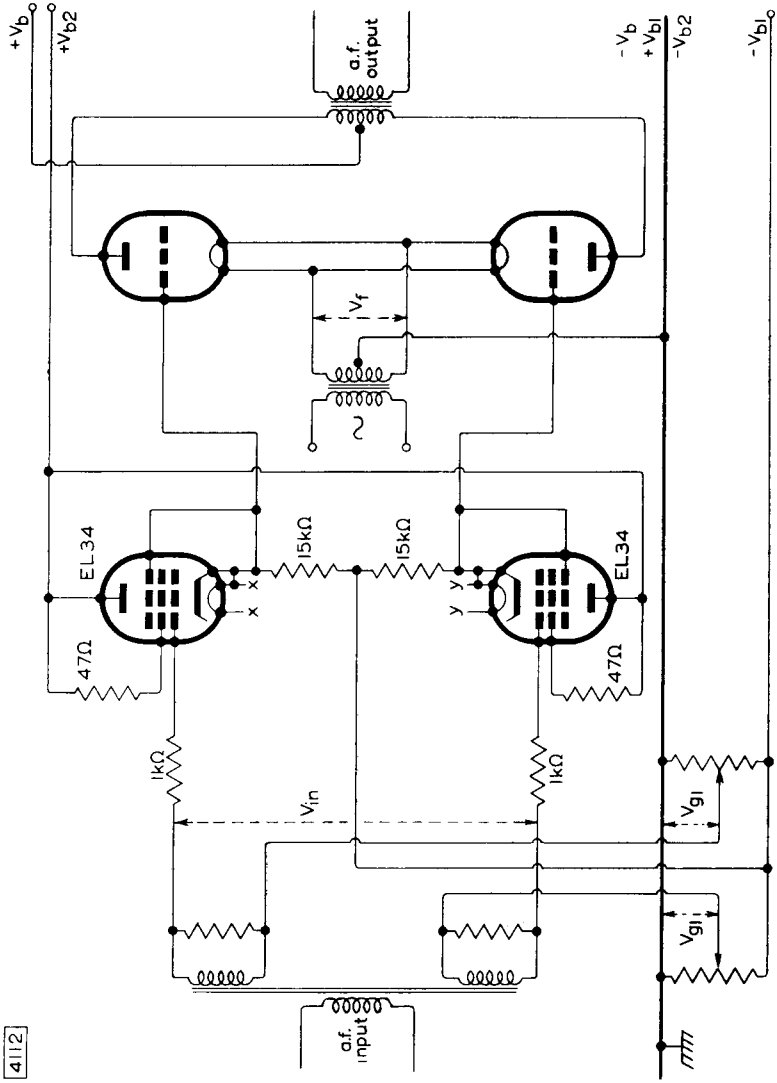
2. With no signal input, the bias potentiometers should be adjusted to set the anode currents of the corresponding output valves at the specified no-signal values. The correct driver conditions will then be automatically secured by the specified values of components and supply voltages.

WEIGHT 770 g / 1.7 lb

POWER TRIODE

MY3-275

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.

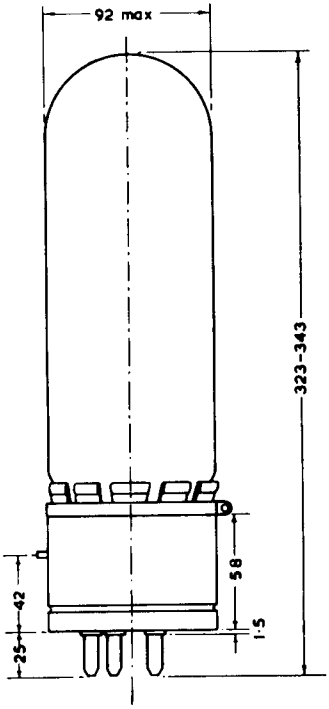


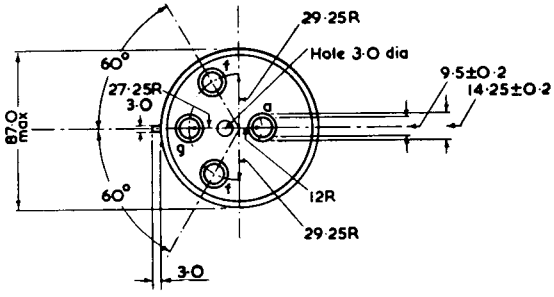
The heaters 'x x' and 'y y' must be supplied from separate windings on the mains transformer

MY3-275

POWER TRIODE

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.





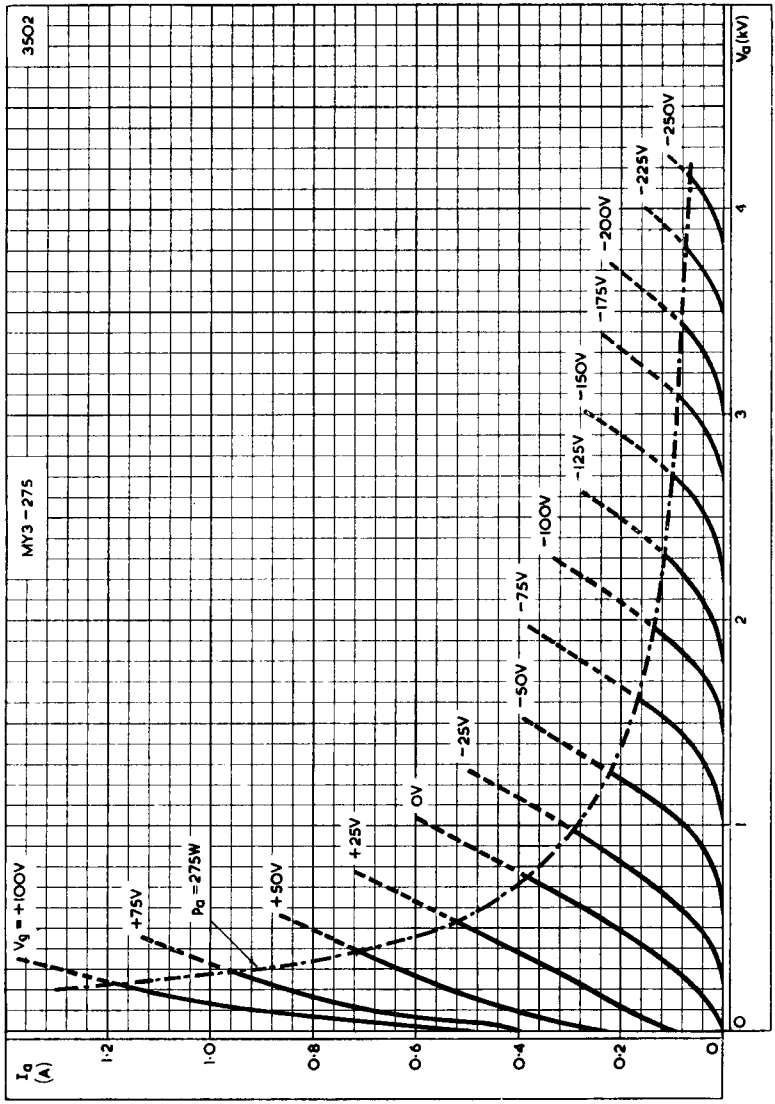
All dimensions in mm

3498

POWER TRIODE

MY3-275

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.

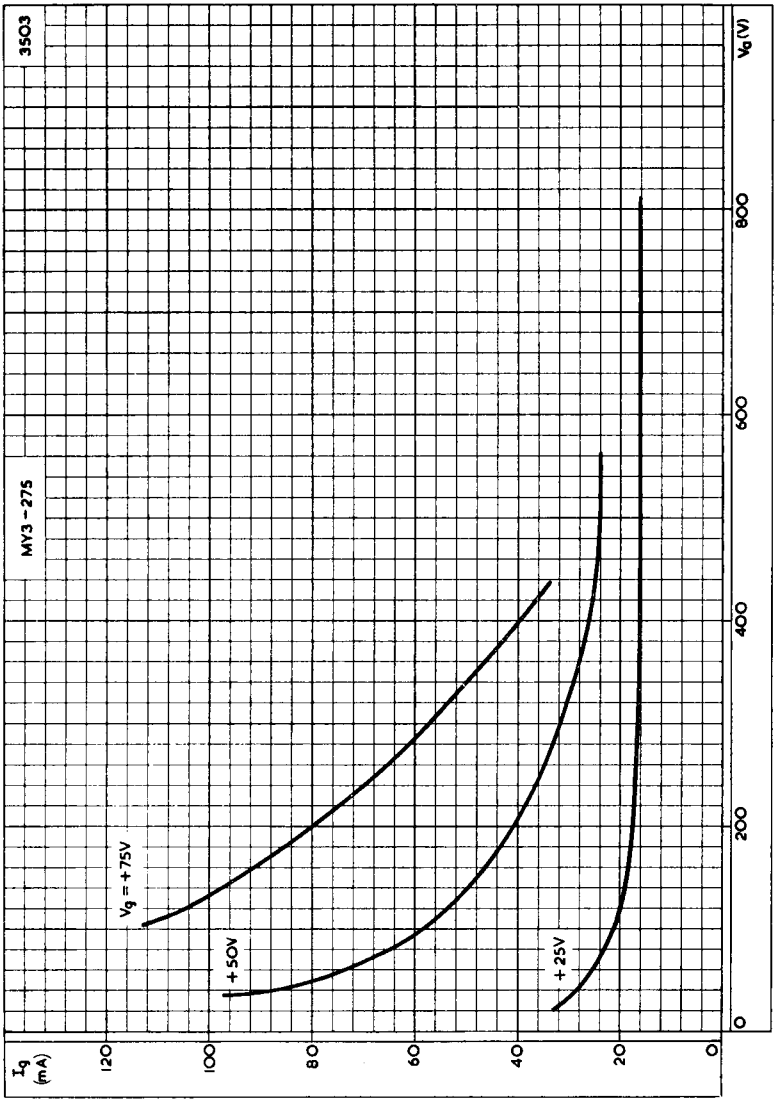


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

MY3-275

POWER TRIODE

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.

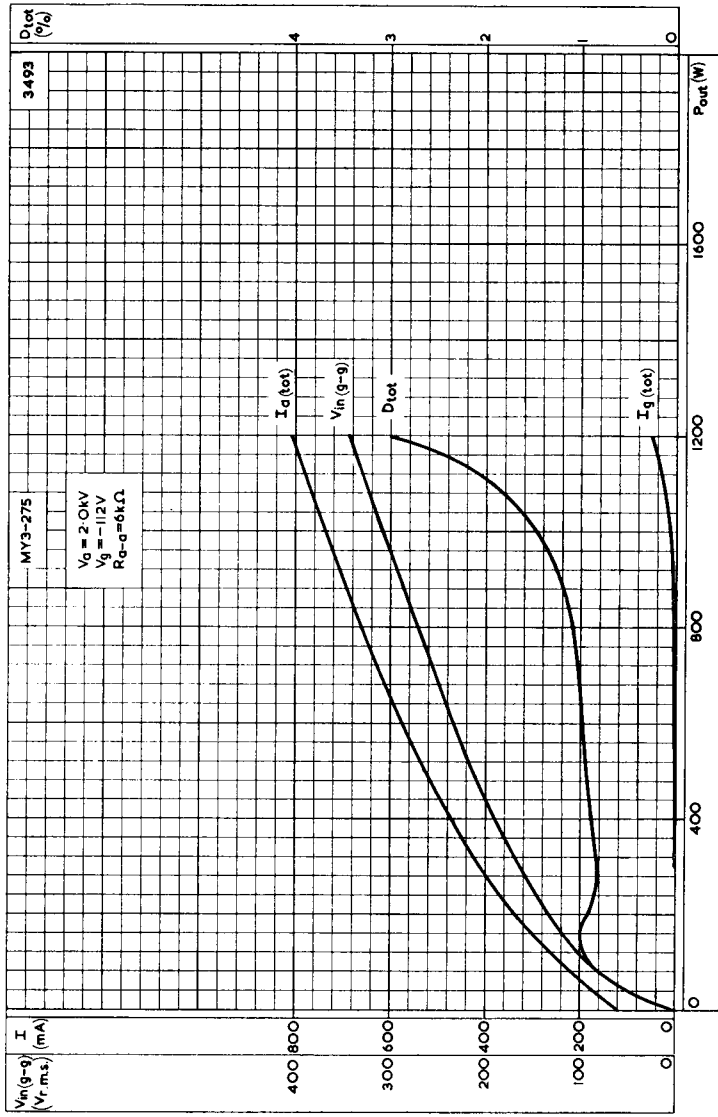


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

POWER TRIODE

MY3-275

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.

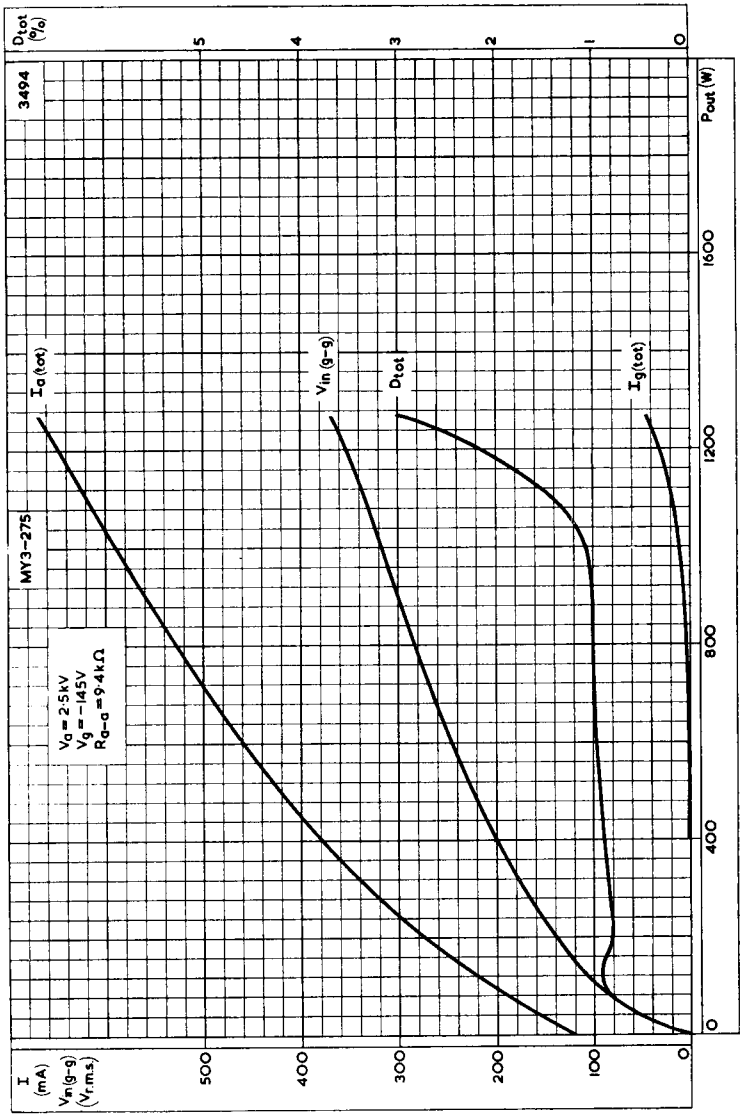


PERFORMANCE OF TWO VALVES AS CLASS 'B' A.F. AMPLIFIER OR MODULATOR. $V_a = 2.0kV$

MY3-275

POWER TRIODE

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.

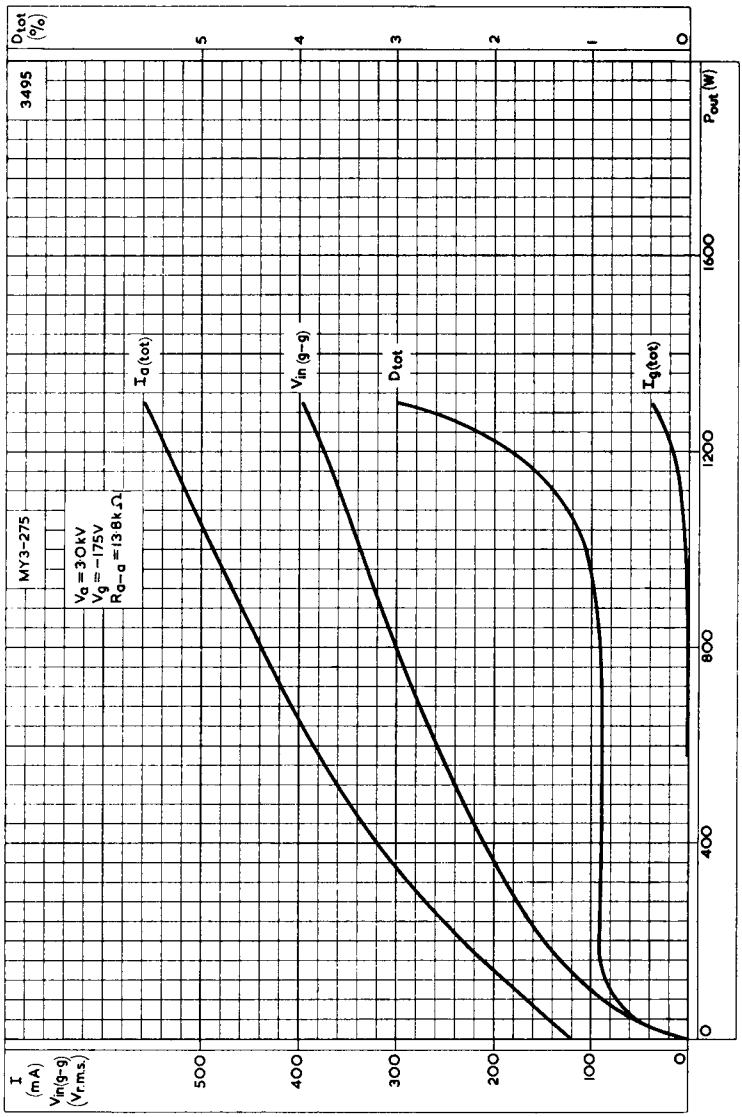


PERFORMANCE OF TWO VALVES AS CLASS 'B' A.F. AMPLIFIER OR MODULATOR. $V_a = 2.5kV$

POWER TRIODE

MY3-275

Directly heated triode rated for a maximum anode dissipation of 275W primarily intended for use in the output stage of a.f. amplifiers or modulators.



PERFORMANCE OF TWO VALVES AS CLASS 'B' A.F. AMPLIFIER OR MODULATOR. $V_a = 3.0kV$

POWER TRIODE

MZ2-200

Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.

This data sheet should be read in conjunction with "Operating Notes, Part 1—Power Valves" included in this volume of the Handbook.

CATHODE Oxide coated, for use on a.c. or d.c.

V_f	14.0	V
I_f	2.2	A

CAPACITANCES

c_{g-f}	16.0	μμF
c_{a-f}	5.6	μμF
c_{a-g}	16.2	μμF

CHARACTERISTICS At V_a = 2.0 kV; I_a = 180 mA.

g_m	7.2	mA/V
μ	15	
r_a	2,085	Ω

LIMITING VALUES

V_a max.	2.4	kV
p_a max.	275	W
I_k max.	400	mA
I_g max.	40	mA

OPERATING CONDITIONS AS CLASS AB2 PUSH-PULL AMPLIFIER USING DIRECT-COUPLED CATHODE-FOLLOWER DRIVER STAGE WITH TWO EL37 PENTODES AS DRIVERS

Operating Conditions for Two MZ2-200

V_a	1.5	1.75	2.0	2.25	kV
$I_{a(0)}$	2×60	2×60	2×60	2×60	mA
I_a (max. sig.)	2×363	2×364	2×363	2×365	mA
I_g	2×37.5	2×36	2×36	2×36	mA
R_{a-a}	4.7	5.65	6.6	7.6	kΩ
P_{out}	746	897	1,048	1,213	W
D_{tot}	3.1	3.0	2.9	2.9	%

MAINTENANCE TYPE

MZ2-200

POWER TRIODE

Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.

Corresponding Operating Conditions for Driver Stage (see circuit diagram)

V_{b1}	−375	−400	−425	−450	V
V_{b2}	350	350	350	350	V
V_{g1}	−136	−156	−176	−196	V
$I_{a(0)}$	2×19.5	2×19.8	2×20.5	2×20.5	mA
I_a (max. sig.)	2×57	2×56	2×56.5	2×56.5	mA
$V_{in\ (r.m.s.)}$	2×179	2×192	2×207	2×223	V

Notes—1. V_{in} for MZ2–200 is approximately $0.9 \times V_{in}$ (driver).

2. The regulation of the power supply V_{b1} is not critical, and a capacitance input filter may be used. V_{b2} however, should have good regulation, preferably using a choke input filter.

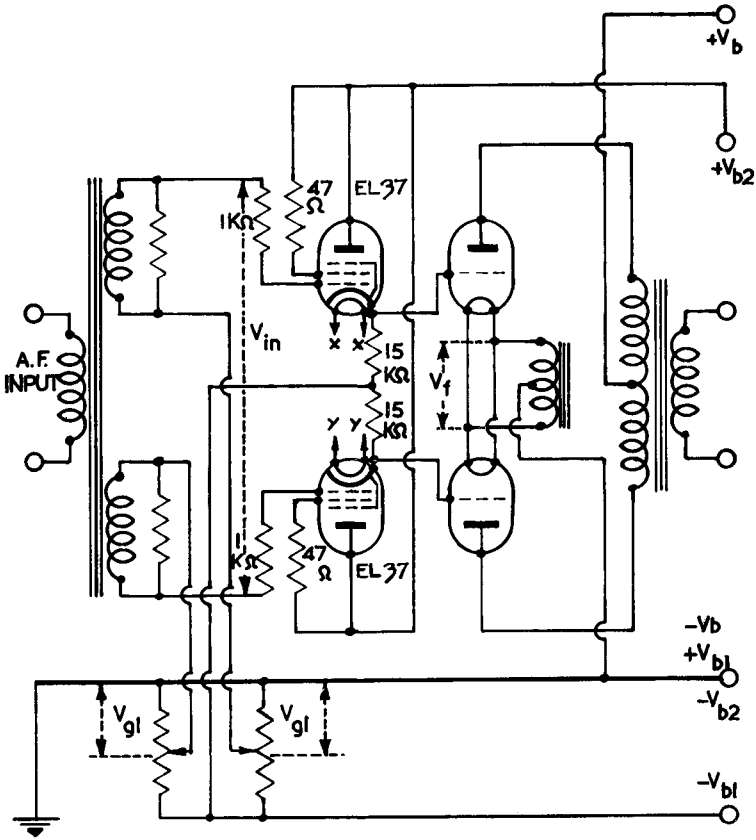
3. With no signal input, the bias potientiometers should be adjusted to set the anode currents of the corresponding output valves at the specified no-signal values. The correct driver conditions will then be automatically secured by the specified values of components and supply voltages.

WEIGHT Valve only { 2 lb. 5 oz. / 1.04 kg.

POWER TRIODE

MZ2-200

Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



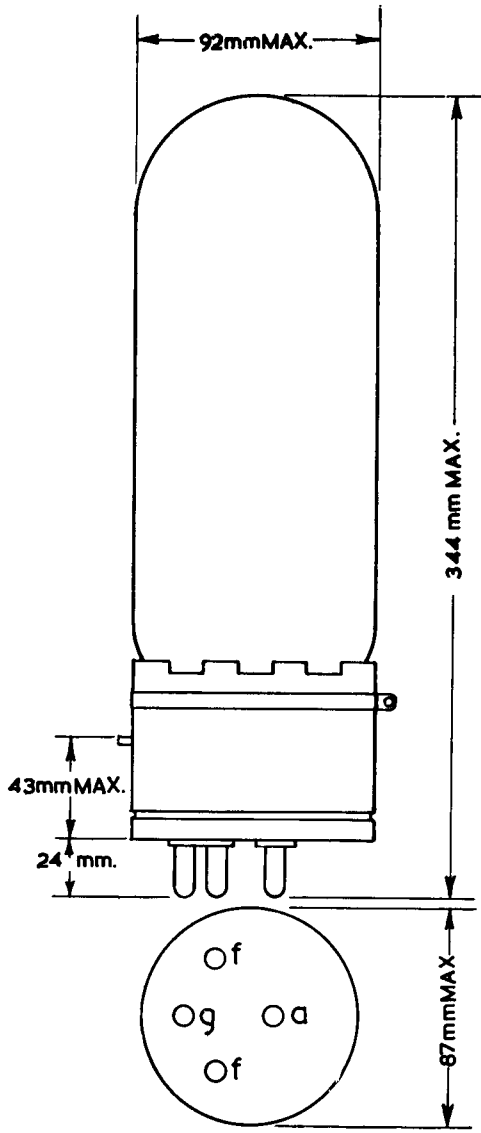
CIRCUIT DIAGRAM FOR OUTPUT STAGE WITH DIRECT-COUPLED DRIVER STAGE.

The heaters "x x" & "y y" must be supplied from separate windings on the mains transformer.

MZ2-200

POWER TRIODE

Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.

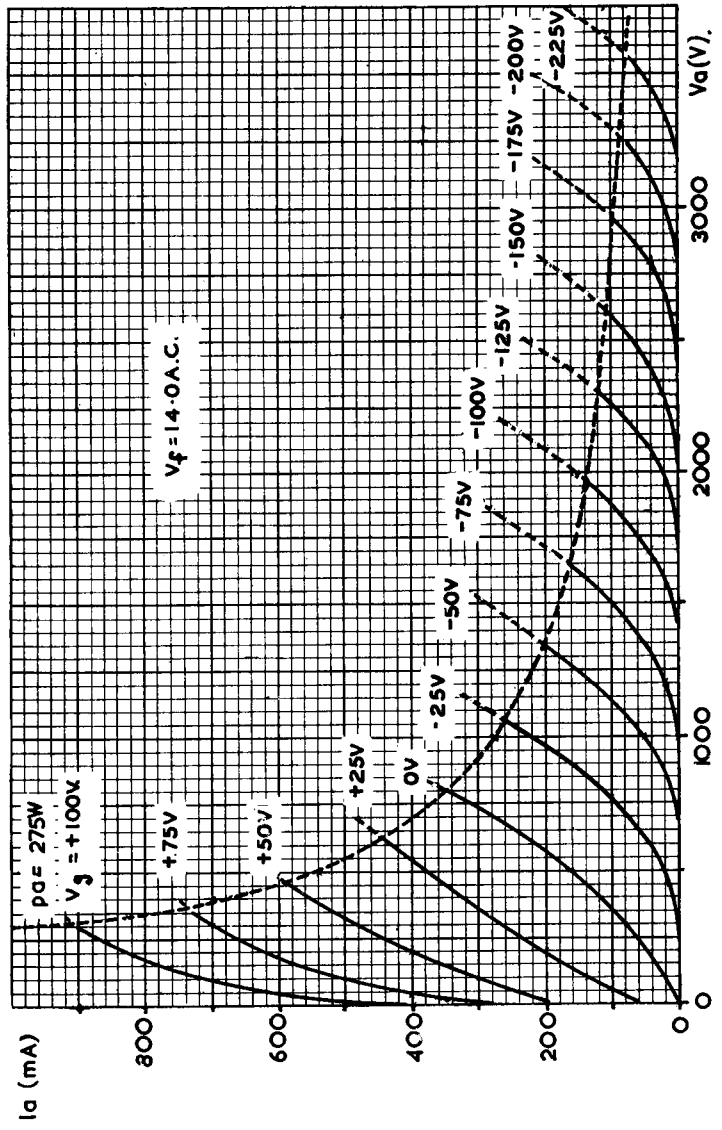


BASE : Large 4-pin bayonet base holder, Type MVH16, available from Mullard Ltd.

POWER TRIODE

MZ2-200

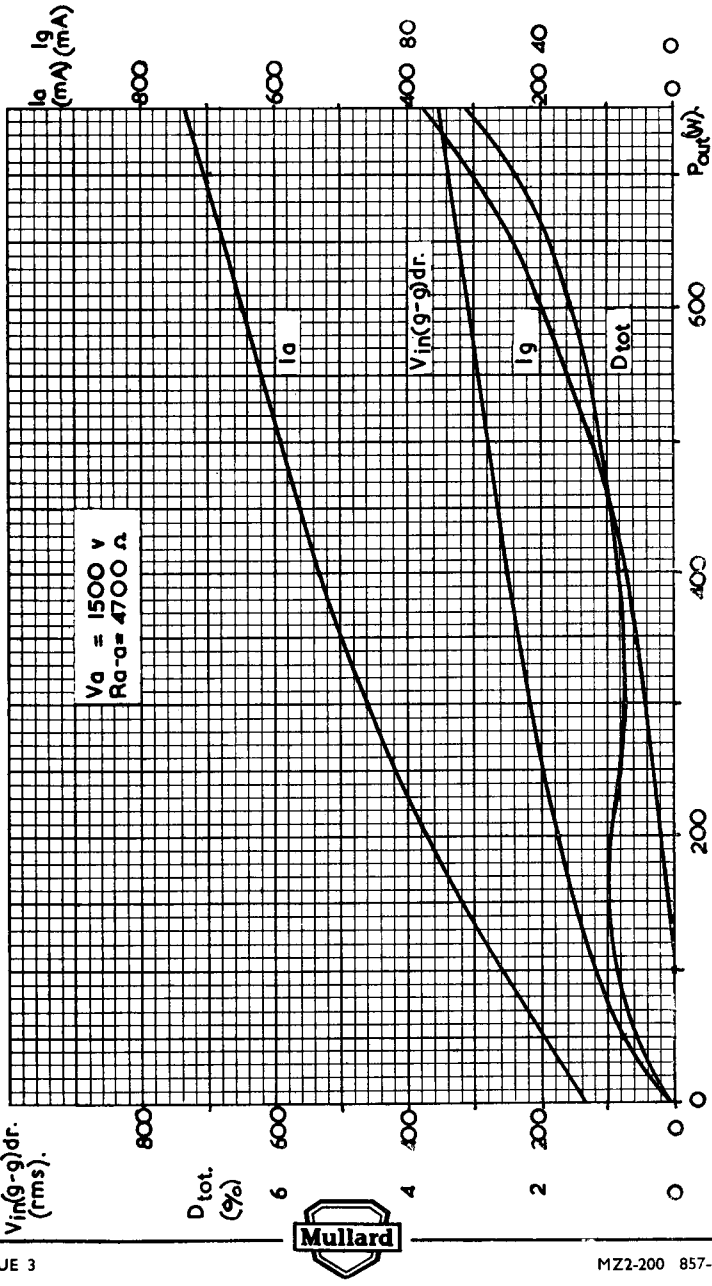
Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



MZ2-200

POWER TRIODE

Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.

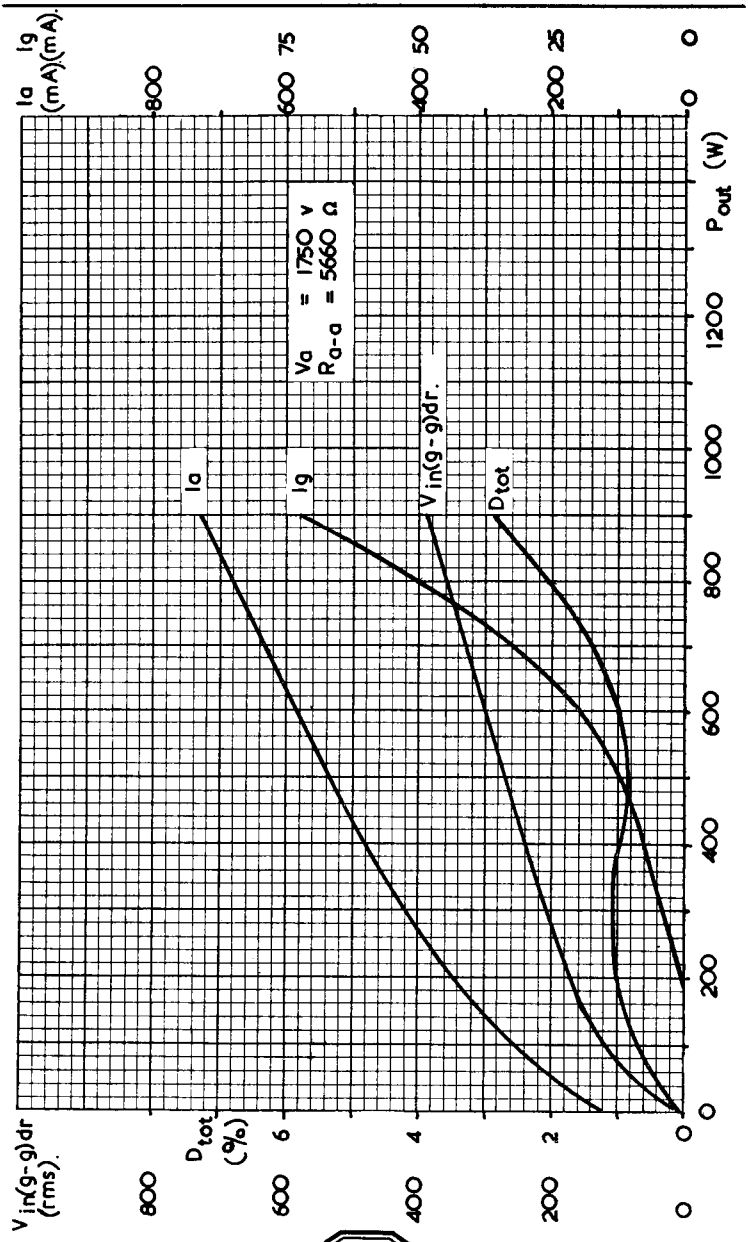


Mullard

POWER TRIODE

MZ2-200

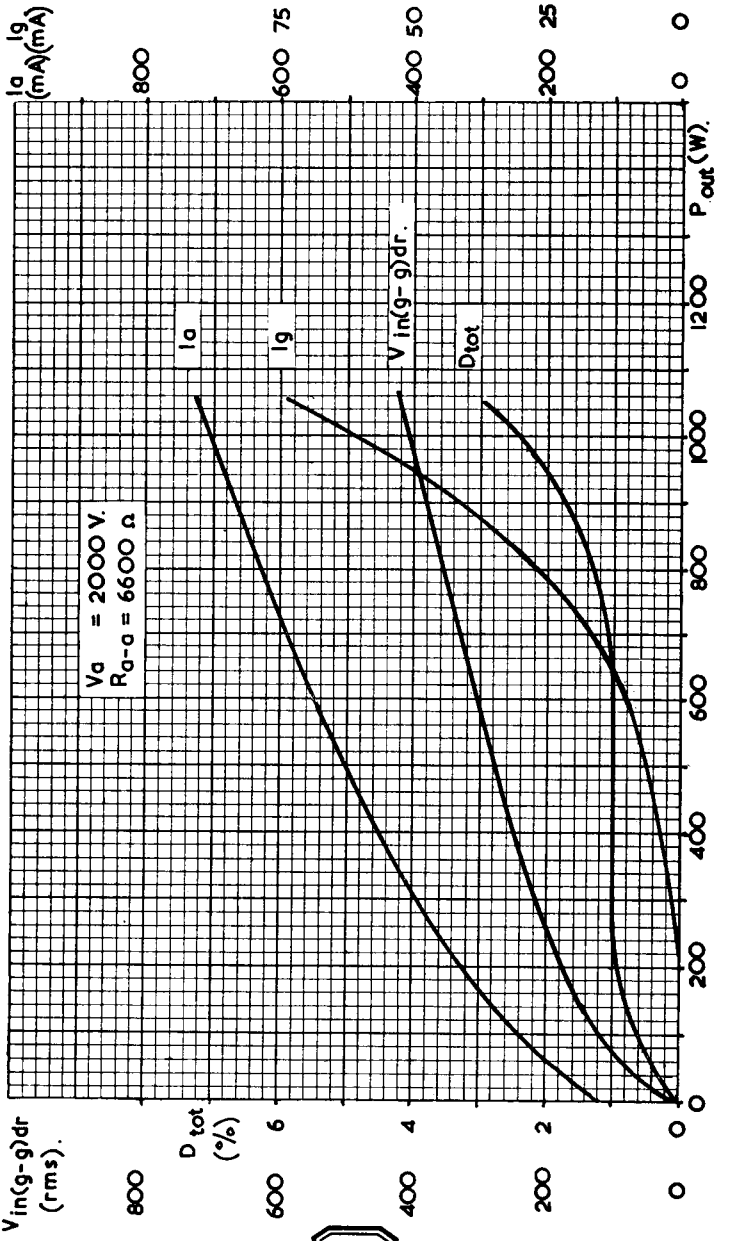
Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



MZ2-200

POWER TRIODE

Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.

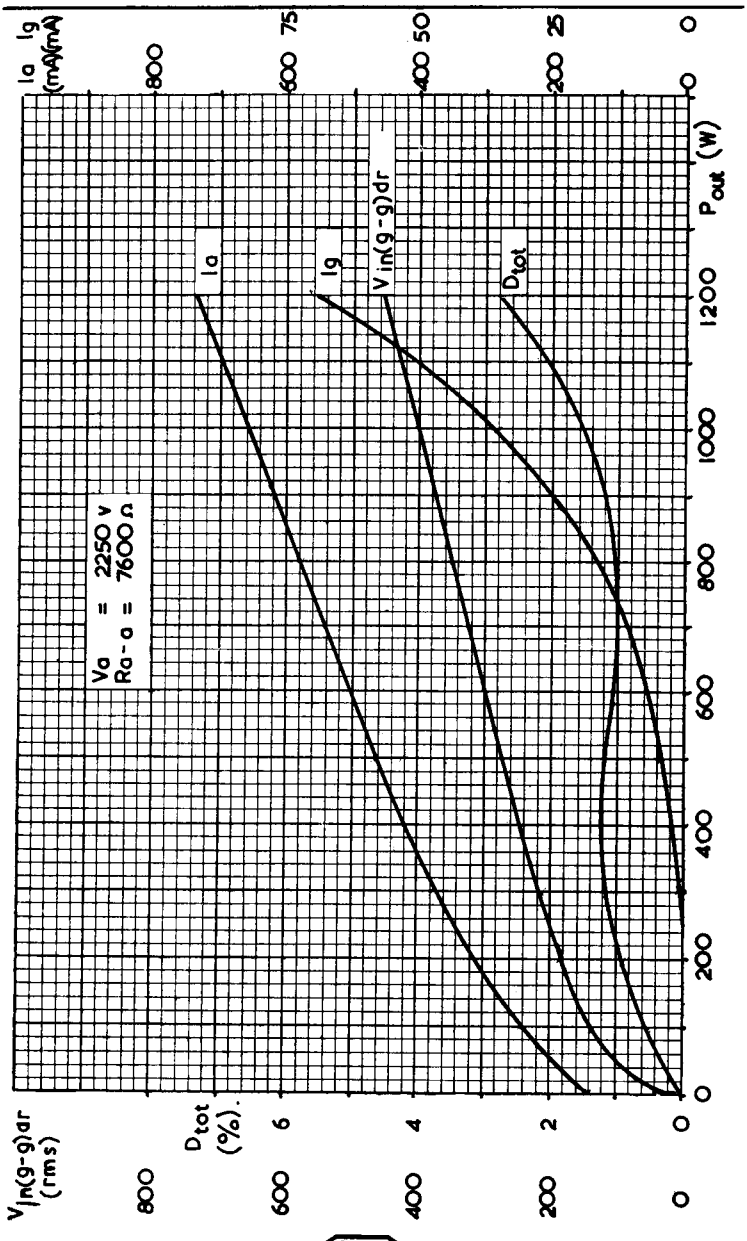


Mullard

POWER TRIODE

MZ2-200

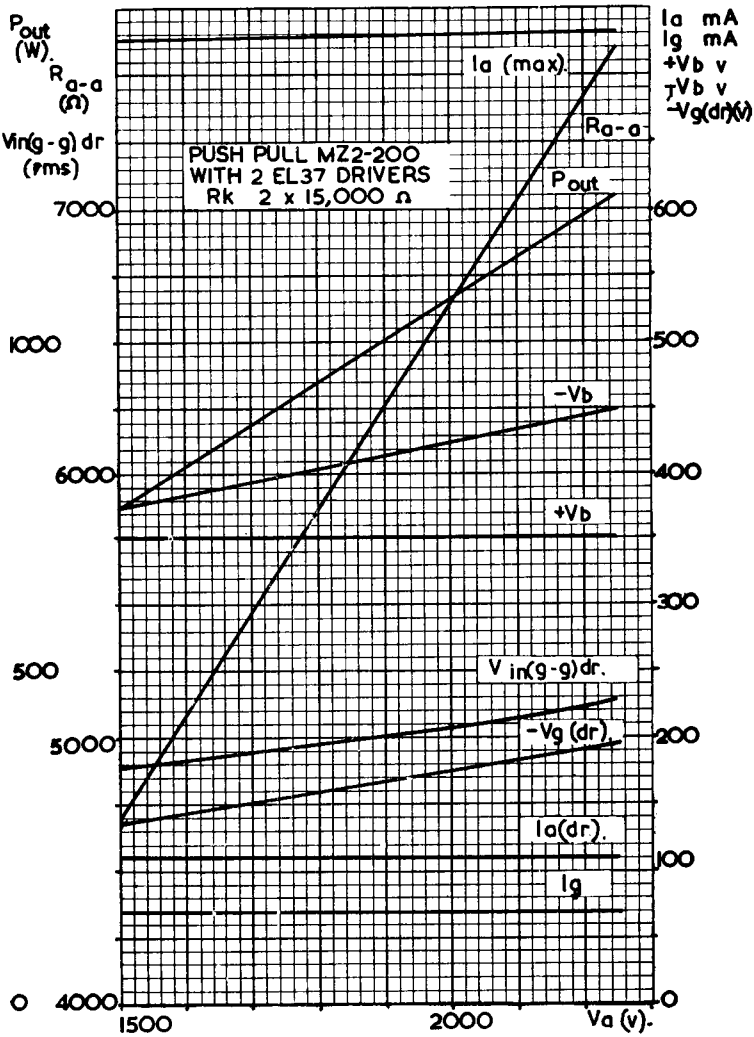
Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



MZ2-200

POWER TRIODE

Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



R.F. DOUBLE TRIODE

Variable-mu frame grid double triode primarily intended for use as a cascode amplifier at frequencies up to 220Mc/s in television receivers with series connected heaters.

PCC89

HEATER

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

I_h	300	mA
V_h	7.5	V←

CAPACITANCES (measured with an external shield)

$c_{a'-a''}$	<15	mpF
$c_{g'-a''}$	<5	mpF

Grounded cathode section

$c_{a'-g'}$	1.9	pF
$c_{g'-k'+h+g''+s}$	3.8	pF
$c_{a'-k'+h+g''+s}$	2.5	pF
$c_{g'-h}$	<300	mpF

Grounded grid section

$c_{a''-g''}$	4.1	pF
$c_{a''-k''}$	<200	mpF
$c_{k''-g''+h+s}$	6.3	pF
$c_{a''-g''+h+s}$	4.5	pF
$c_{k''-h}$	2.9	pF

CHARACTERISTICS (each section)

V_a	90	V
I_a	15	mA
V_g	–1.2	V
g_m	12.3	mA/V
r_a	2.9	kΩ
μ	36	

PCC89

R.F. DOUBLE TRIODE

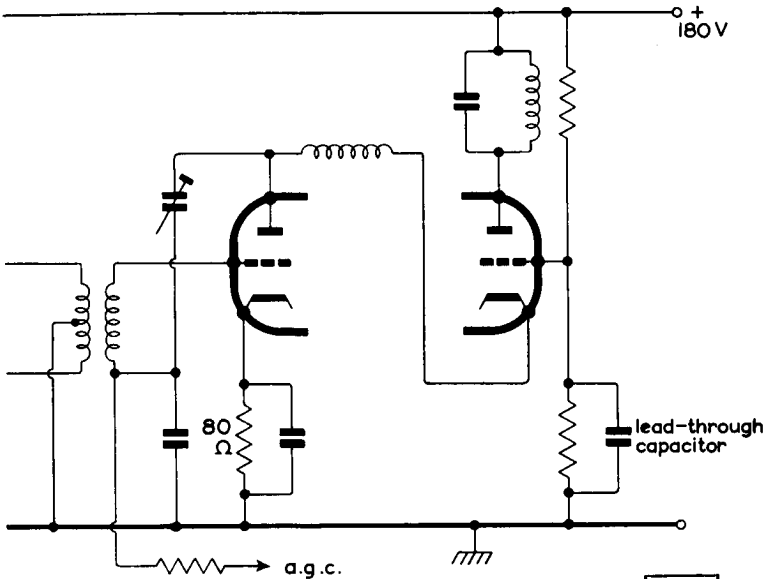


Fig.1

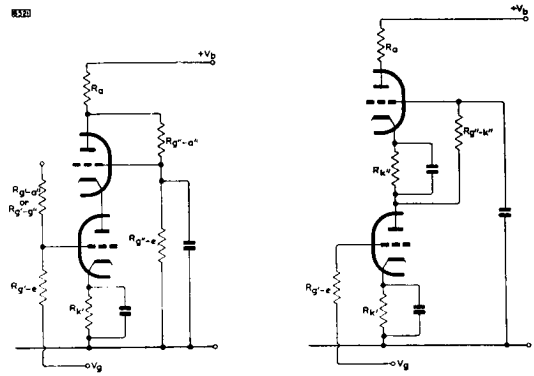
5283

CHARACTERISTICS (cascode—see Fig. 1)

V_b	180	V
I_a	15	mA
g_m	12	mA/V
*$V_{g'}$	−9.0	V
Noise factor	5.5	dB

*For 100 : 1 reduction in cascode slope.

PCC89



OPERATING CONDITIONS

Condition		1	2	3	4	
Circuit		A	A	A	A	
V_b		190	190	190	190	V
$R_{a"}$		1.5	3.3	3.9	3.9	kΩ
$R_{g"-a"}$		100	100	100	100	kΩ
$R_{g"-e}$		100	100	100	100	kΩ
$R_{g'-e}$		—	470	470	470	kΩ
$R_{g'-g"}$		—	—	22	15	MΩ
$R_{k'}$		68	0	0	0	Ω
I_a		15	14.8	14.7	14.9	mA
g_m		13	14.4	14.7	14.8	mA/V
V_g for 100 : 1 reduction in g_m		−9.3	−9.0	−11	−12	V

Condition	5	6	7	8	9	
Circuit	A	A	A	B	B	
V_b	190	190	190	190	190	V
$R_{a"}$	3.9	3.9	4.7	1.5	3.3	kΩ
$R_{g"-a"}$	100	100	100	—	—	kΩ
$R_{g"-e}$	100	100	100	—	—	kΩ
$R_{g"-k"}$	—	—	—	—	470	kΩ
$R_{k"}$	0	0	0	68	0	Ω
$R_{g'-e}$	470	470	470	470	470	kΩ
$R_{g'-g"}$	—	10	—	—	—	MΩ
$R_{g'-a"}$	22	—	15	—	—	MΩ
$R_{k'}$	0	0	0	68	0	Ω
I_a	15	15.1	14	15	14.4	mA
g_m	14.9	15	14.7	13	14.3	mA/V
V_g for 100 : 1 reduction in g_m	−12.5	−13.5	−15	−16.5	−16	V

The gain/slope ratio depends upon the circuit and will differ at high and low frequencies.

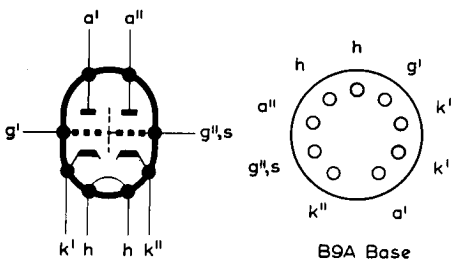
PCC89

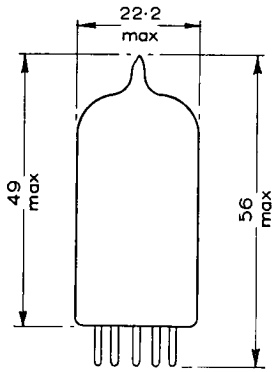
R.F. DOUBLE TRIODE

LIMITING VALUES (each section, unless otherwise stated)

V_a max.	130	V
p_a max.	1.8	W
I_k max.	18	mA ←
$-V_g$ max.	50	V
$R_{g'-k'}$ max.	1.0	MΩ
$R_{g''-k''}$ max.	500	kΩ
$V_{h-k''}$ max. (cathode positive)	200	V ←
R_{h-k} max.	20	kΩ

To fulfil hum requirements, $V_{h-k'}$ must be less than $50V_{r.m.s.}$

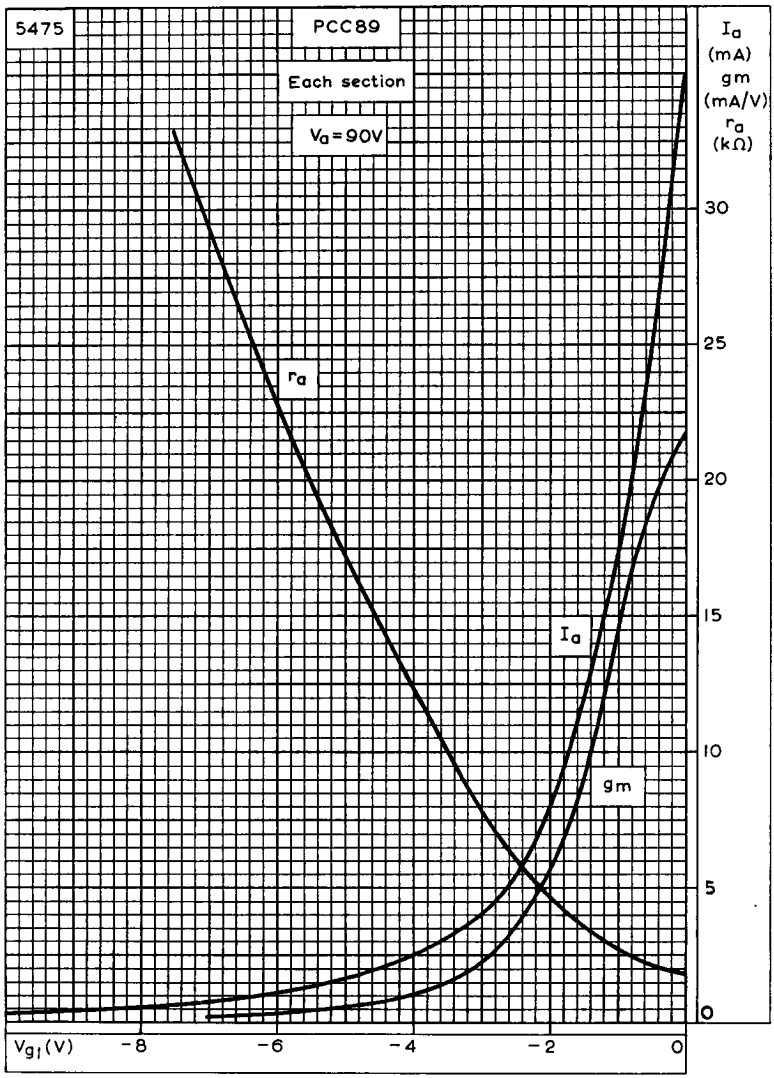




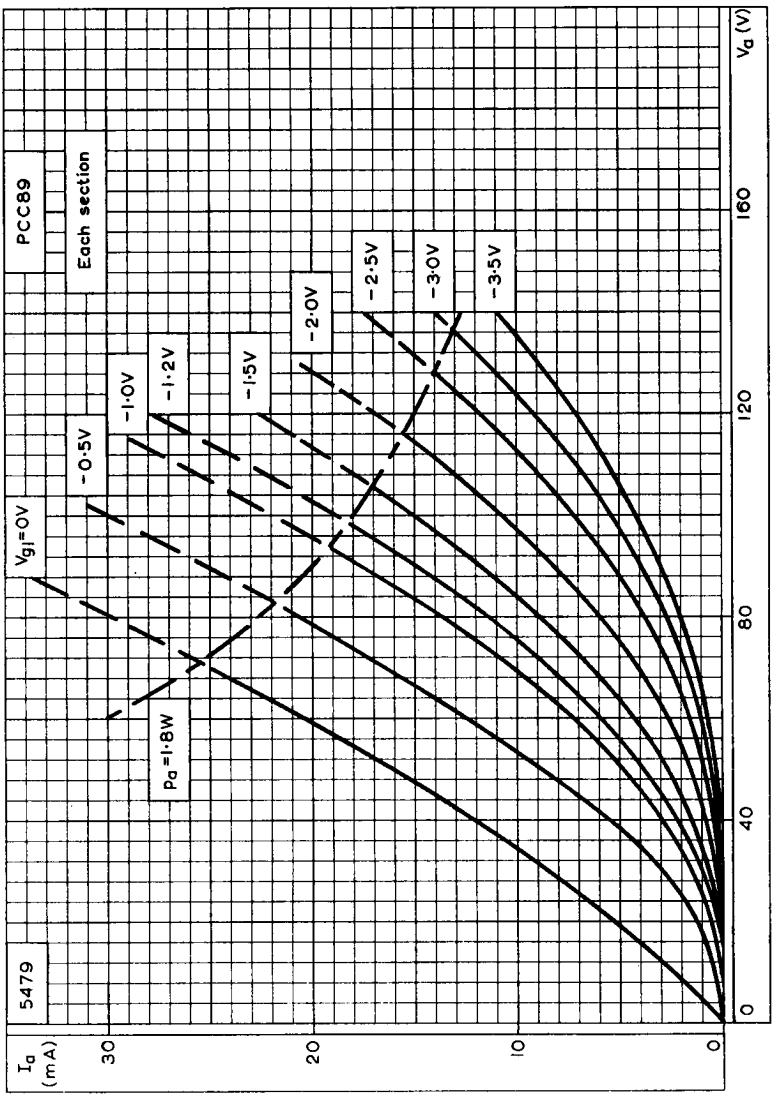
4473

All dimensions in mm

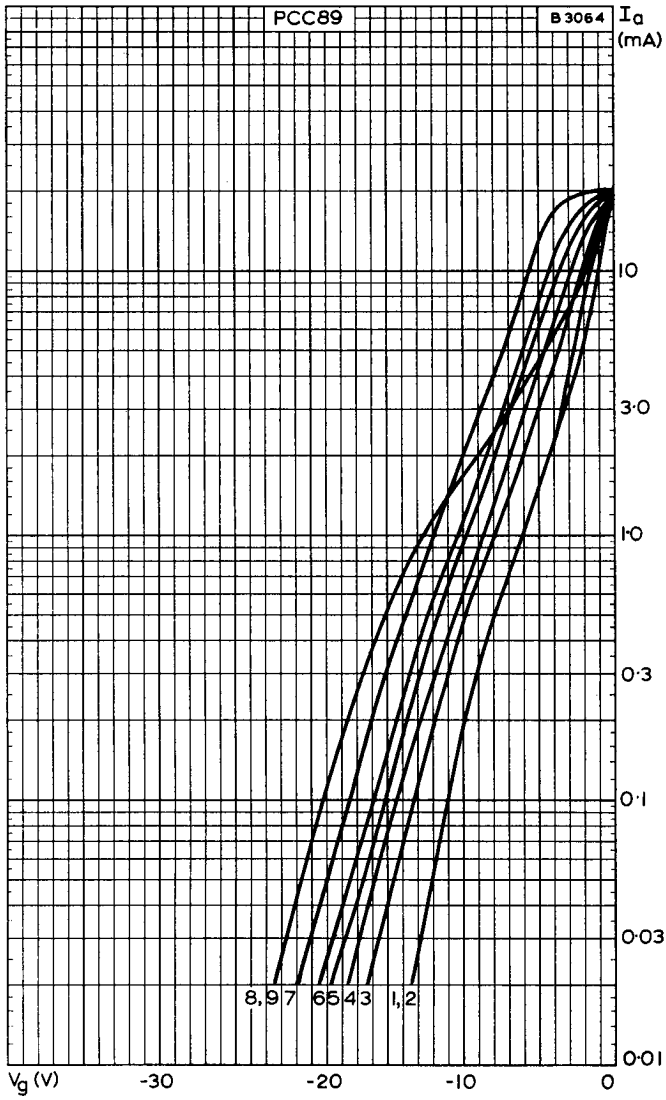
The triode on pins 6, 7, 8 and 9 should have the grounded cathode connection, and that on pins 1, 2 and 3 should have the grounded grid connection. It is recommended that pins 7 and 8 be strapped.



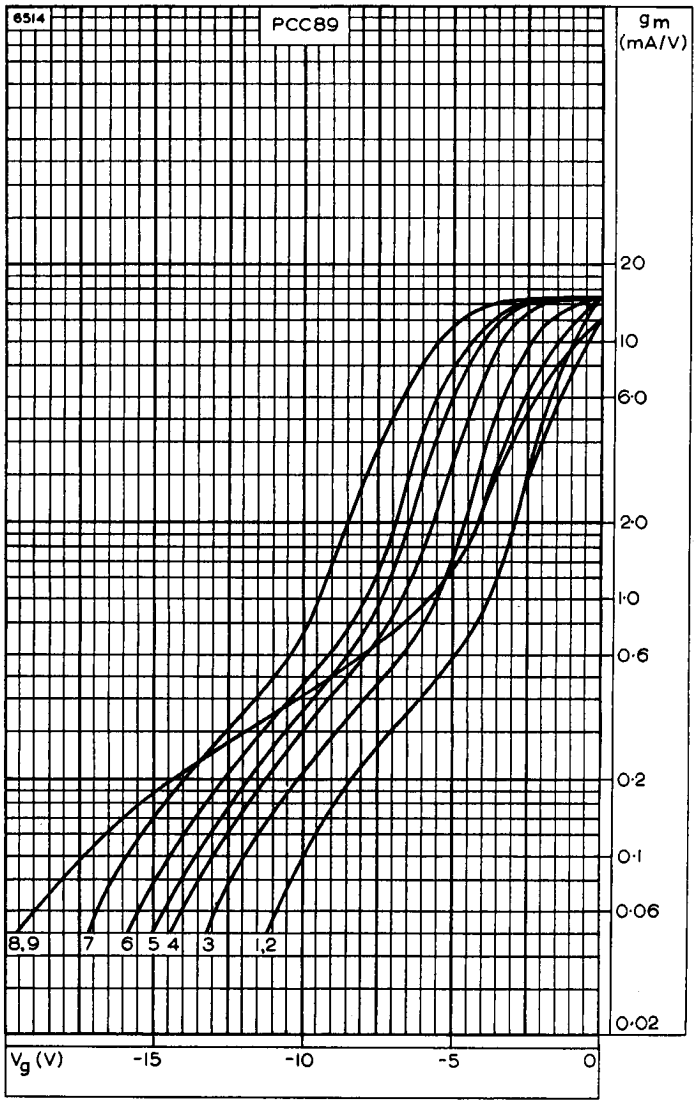
ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE UNDER CONDITIONS 1 to 9 (See page D3)



MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE UNDER CONDITIONS 1 to 9 (See page D3)

TRIODE PENTODE

PCF806

Combined triode and high slope frame grid r.f. pentode for use as a frequency changer at frequencies up to 220Mc/s in television tuners.

HEATER

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

I_h	300	mA
V_h	8.0	V

CAPACITANCES (measured without an external shield)

C_{ap-at}	<30	mpF
C_{ap-gt}	<10	mpF
C_{g1-at}	<10	mpF
C_{g1-gt}	<10	mpF

Pentode section

C_{a-g1}	12	mpF
C_{g1-g2}	1.6	pF ←
C_{in}	6.0	pF
C_{out}	3.3	pF ←

Triode section

C_{g-k+h}	2.2	pF ←
C_{a-k+h}	1.2	pF ←
C_{a-g}	2.0	pF

CHARACTERISTICS

Pentode section

V_a	170	V
V_{g2}	150	V
I_a	10	mA
I_{g2}	3.3	mA
g_m	12	mA/V
r_a	>350	kΩ
μ_{g1-g2}	70	
V_{g1}	−1.2	V
R_{eq}	1.0	kΩ

Triode section

V_a	100	V
I_a	14	mA
g_m	5.5	mA/V
μ	17	
V_g	−3.0	V

OPERATING CONDITIONS AS A FREQUENCY CHANGER

Pentode section

V_b	190	V
$V_{g2(b)}$	190	V
R_{g2}	18	kΩ
R_{g1}	100	kΩ
I_a	8.5	mA
I_{g2}	2.7	mA
$V_{osc(r.m.s.)}$	2.3	V
g_c	4.5	mA/V

DESIGN CENTRE RATINGS

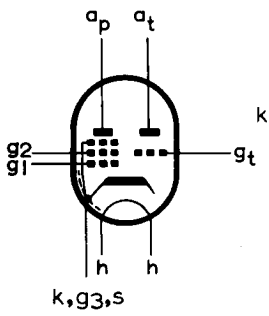
Pentode section

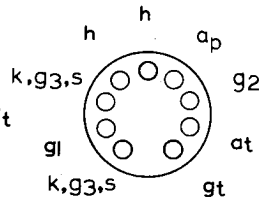
V_a max.	250	V
p_a max.	2.0	W
V_{g2} max.	150	V
p_{g2} max.	500	mW
I_k max.	18	mA
R_{g1-k} max.	250	kΩ

Triode section

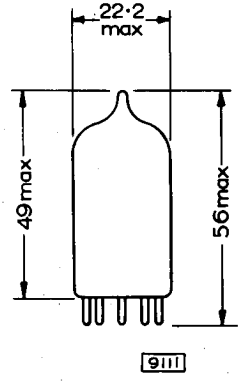
V_a max.	125	V
p_a max.	1.5	W
I_k max.	15	mA
R_{g-k} max.	500	kΩ
*V_{h-k} max.	100	V

*To fulfil hum requirements on a.m. sound, it will be necessary for V_{h-k} to be less than $50V_{r.m.s.}$



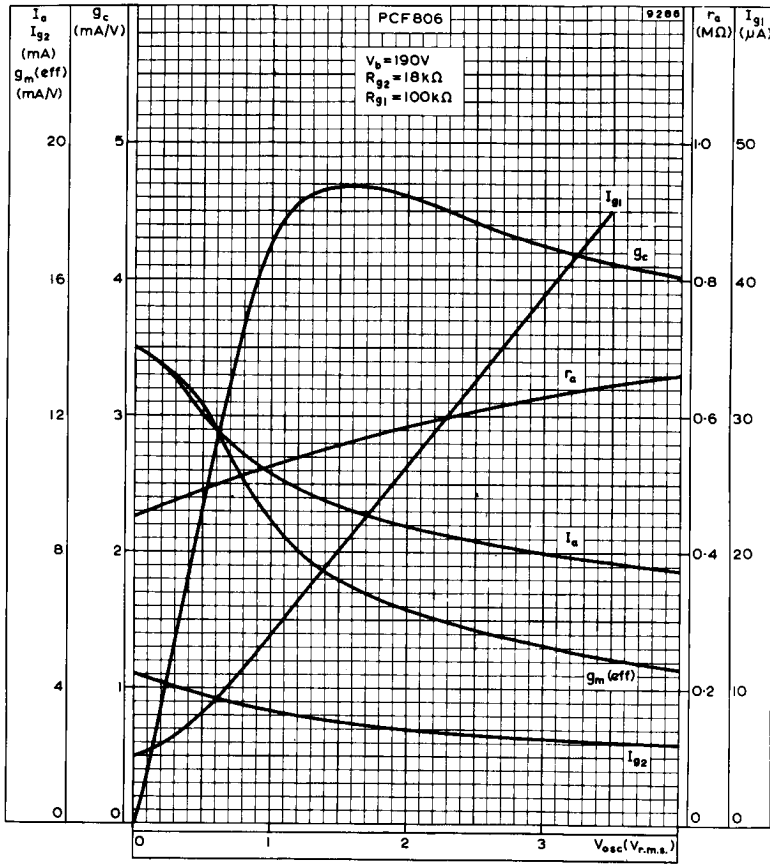


B9A Base
All dimensions in mm

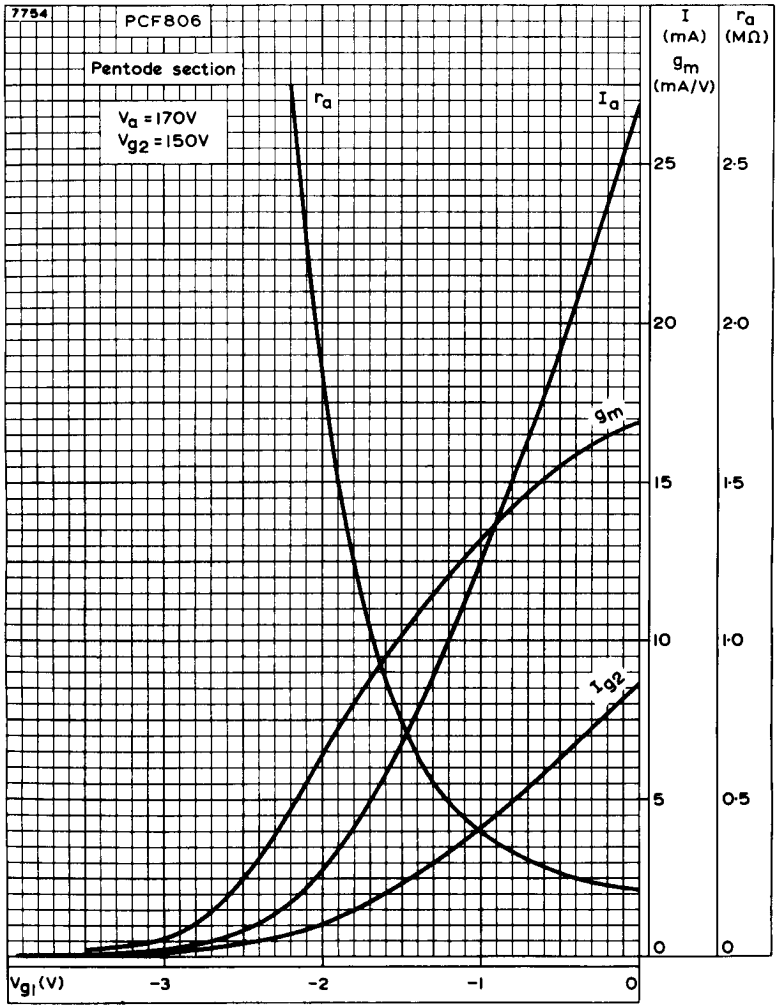


9111

PCF806

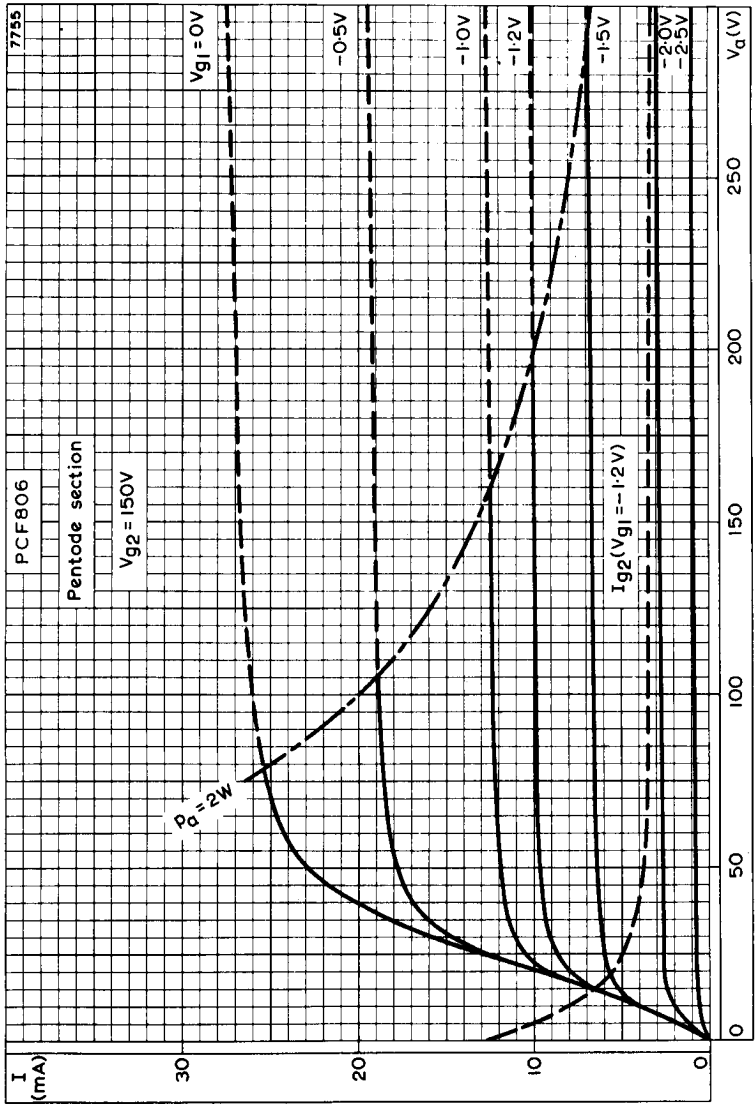


PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER

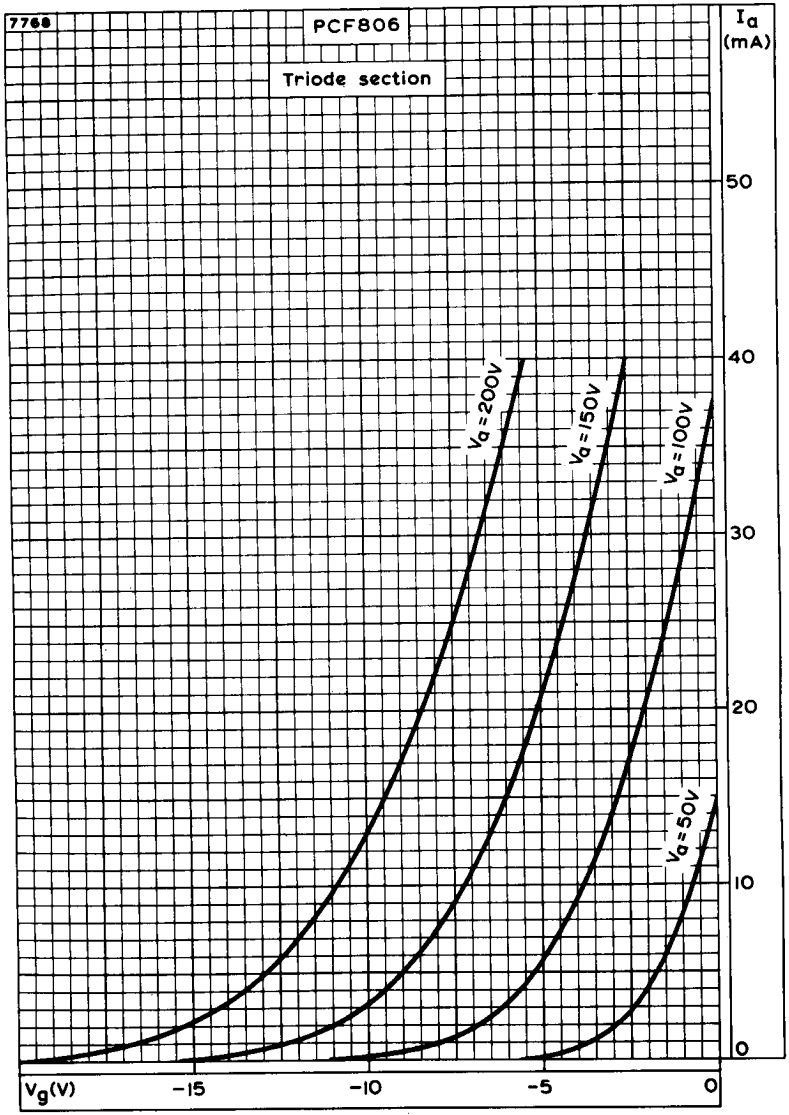


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. PENTODE SECTION

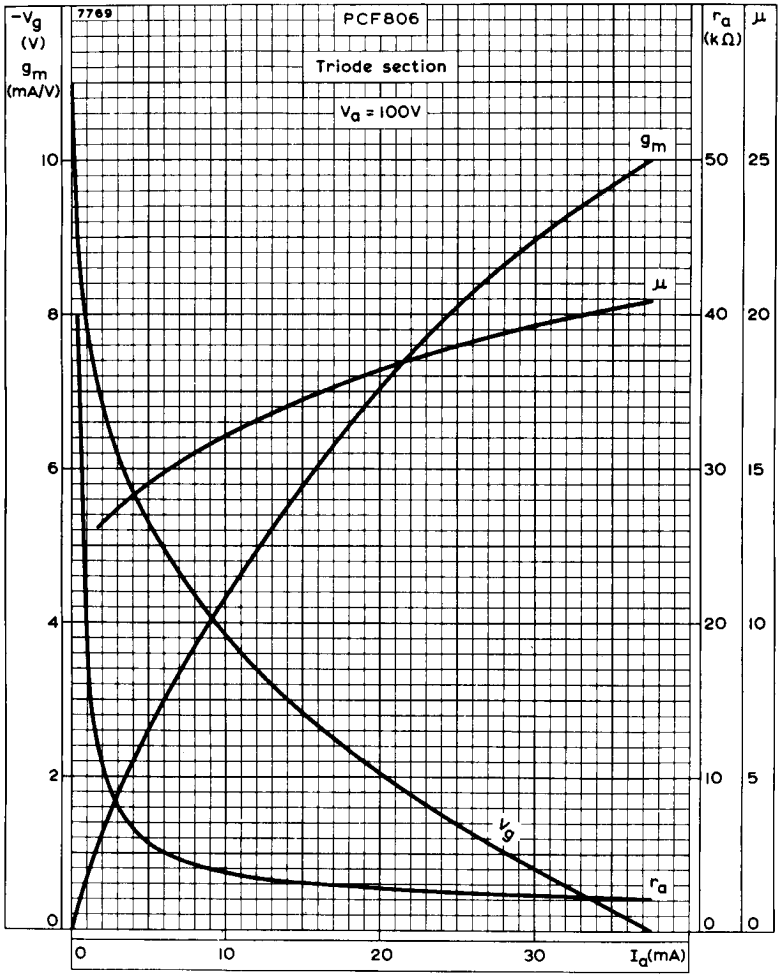
PCF806



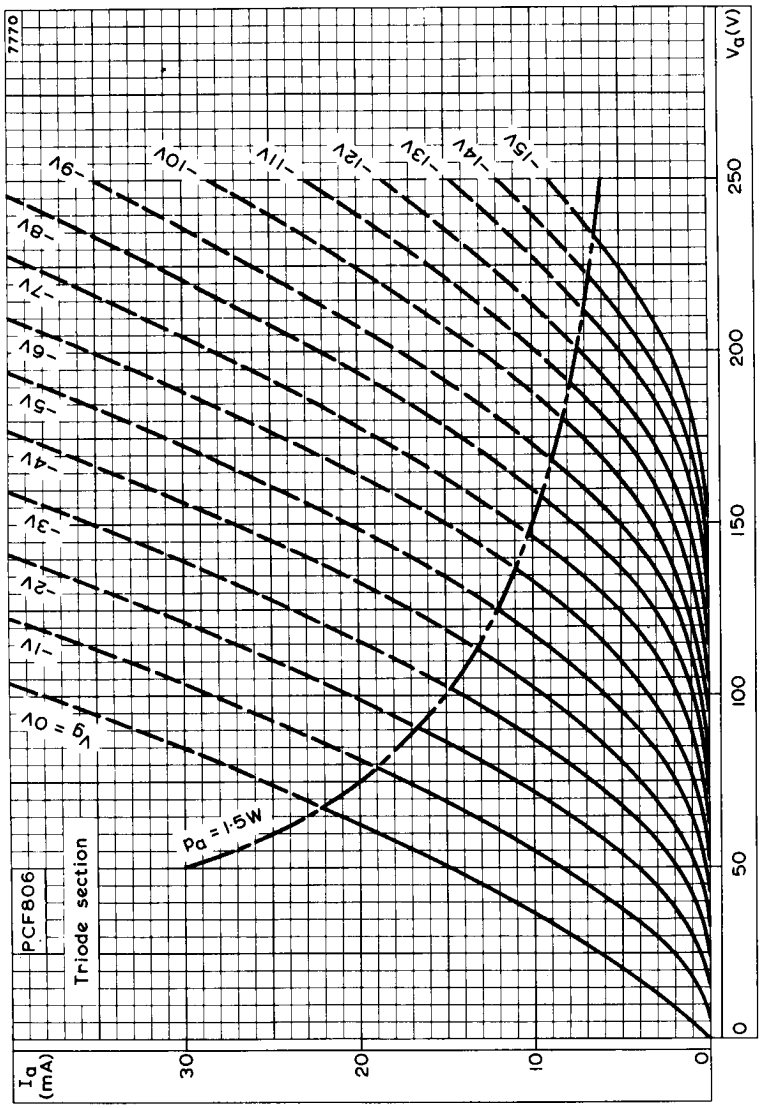
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION



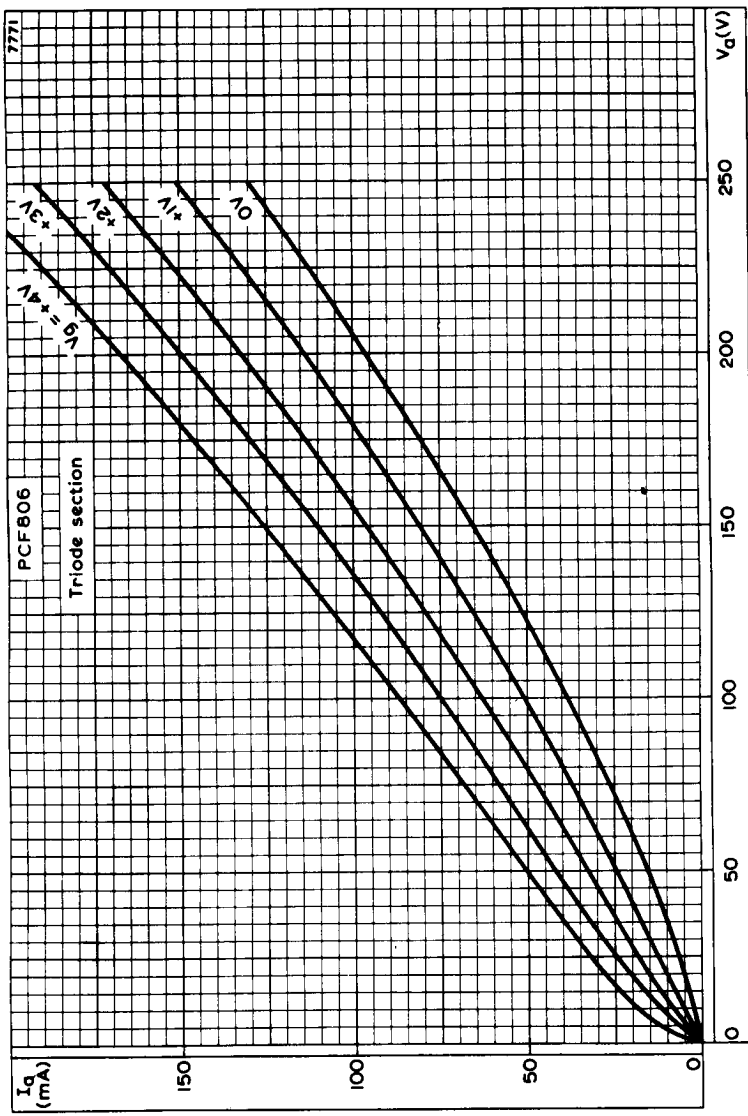
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE FOR VARIOUS VALUES OF ANODE VOLTAGE. TRIODE SECTION



GRID VOLTAGE, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND AMPLIFICATION FACTOR PLOTTED AGAINST ANODE CURRENT. TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER. TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH POSITIVE GRID VOLTAGE AS PARAMETER. TRIODE SECTION

TRIODE PENTODE

PCL83

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

HEATER

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

I_h	300	mA
V_h	12.6	V

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{at-gp}	<0.1	pF
c_{at-ap}	<1.6	pF
c_{gt-gp}	<0.03	pF
c_{gt-ap}	<0.05	pF

Pentode Section

c_{a-g1}	<0.2	pF
c_{in}	5.7	pF
c_{out}	4.7	pF
c_{g1-h}	0.4	pF

Triode Section

c_{a-g}	1.6	pF
c_{a-k+h}	0.35	pF
c_{g-k+h}	2.0	pF
c_{g-h}	0.1	pF

CHARACTERISTICS

Pentode Section

V_a	170	V
V_{g2}	170	V
I_a	30	mA
I_{g2}	5.0	mA
V_{g1}	−9.5	V
g_m	5.5	mA/V
r_a	53	kΩ
μ_{g1-g2}	10	

Triode Section

V_a	250	V
I_a	10.5	mA
V_g	−8.5	V
g_m	2.2	mA/V
r_a	7.7	kΩ
μ	17	

PCL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

PENTODE SECTION AS FRAME OUTPUT VALVE

Circuit design

To allow for valve spread and deterioration during life the frame output circuit should be designed around the following values.

V_a	70	70	V
V_{g2}	170	200	V
$i_{a(pk)}$	54	64	mA

For an average new valve the following figures will apply.

V_a	70	70	V
V_{g2}	170	200	V
$i_{a(pk)}$	81	96	mA

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single Valve Class 'A'

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−9.5	−13	V
$I_{a(o)}$	30	27	mA
$I_{g2(o)}$	4.8	4.4	mA
R_a	5.5	7.5	kΩ
$V_{in(r.m.s.)}$	5.0	5.2	V
P_{out}	2.2	2.5	W
D_{tot}	10	10.5	%

Two Valves in Class 'AB' Push-Pull

V_a	170	200	V
V_{g2}	170	200	V
R_k	180	220	Ω
$I_{a(o)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g2(o)}$	2×3.8	2×3.9	mA
I_{g2} (max. sig.)	2×6.25	2×8.5	mA
R_{a-a}	6.5	7.5	kΩ
$V_{in(g1-g1)\ r.m.s.}$	17	23.5	V
P_{out}	5.0	7.2	W
D_{tot}	3.6	4.2	%

TRIODE SECTION AS A.F. VOLTAGE AMPLFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	R_{g1}* (kΩ)
170	100	1.07	2.7	14	21	330
200	100	1.17	3.3	13.5	26.5	330

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV

V_{out} measured for a total harmonic distortion of 5%

*Grid resistor of following valve.

TRIODE PENTODE

PCL83

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

LIMITING VALUES

Pentode Section

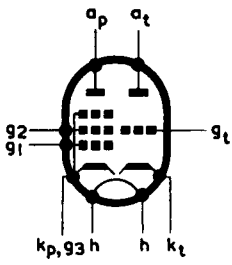
$V_{a(b)}$ max.	550	V
V_a max.	250	V
$+v_{a(pk)}$ max.	2.0	kV
$-v_{a(pk)}$ max.	500	V
p_a max.	5.4	W
$V_{g2(b)}$ max.	550	V
V_{g_2} max.	250	V
p_{g_2} max.	1.2	W
p_{g_2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g1-k} max. (self bias)	500	kΩ
R_{g1-k} max. (fixed bias)	250	kΩ
R_{g1-k} max. (timebase operation)	2.2	MΩ
V_{h-k} max. (d.c. heater negative with respect to cathode or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. heater positive with respect to cathode)	150	V

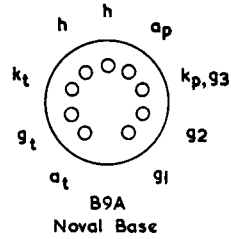
Triode Section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	20	mA
*$i_{k(pk)}$ max.	250	mA
$-v_{g1(pk)}$ max.	350	V
R_{g1-k} max.	1.0	MΩ
V_{h-k} max. (d.c. heater negative with respect to cathode or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. heater positive with respect to cathode)	150	V

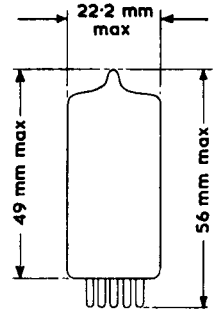
*Max. pulse duration 400μsec.

2224





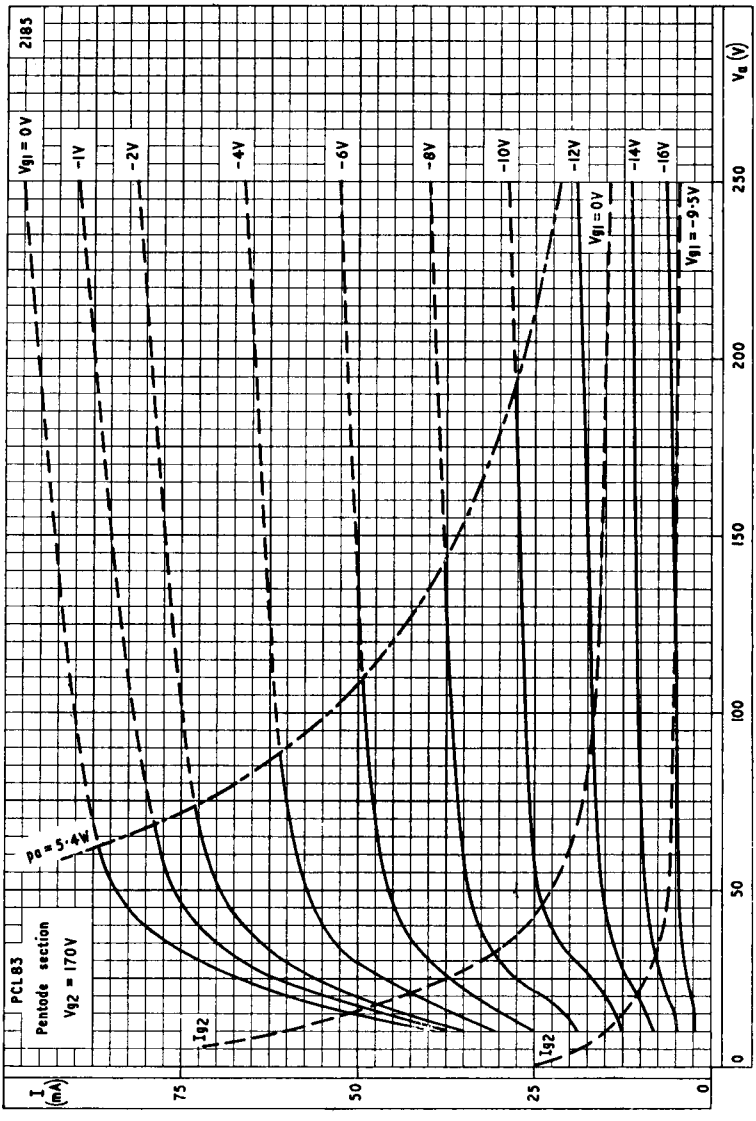
B9A
Noval Base



PCL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2}=170V

Mullard
OUTPUT PENTODE

Pen4VA

The Pen4VA is an indirectly heated pentode capable of giving a large output in A.C. mains receivers.

HEATER CHARACTERISTICS

Heater Volts ... ... Vf=4·0 volts
Heater Current ... ... If=1·35 amps
Heating Time—40 secs.

DIMENSIONS

Overall Length ... =137 mm.
Overall Diameter... = 50 mm.
Bulb Finish—Clear

OPERATING DATA

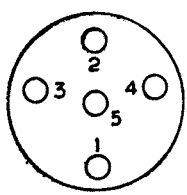
Anode Voltage	Va	= 250 volts
Auxiliary Grid Voltage	Vg2	= 250 volts
Anode Current	Ia	= 36 mA
Auxiliary Grid Current	Ig2	= 3 mA
Mutual Conductance	S_W	= 2·8 mA/V
Anode Impedance	Ri	= 40,000 ohms
Optimum Load	Ra	= 6,000 ohms
Audio Output (D=10% Total)	W_O	= 3·8 watts
Cathode Bias Resistance	Rk	= 500 ohms

LIMITS

Maximum Anode Voltage	Va_{max}	= 250 volts
Maximum Anode Dissipation	Wa_{max}	= 9 watts
Maximum Cathode Current	Ik_{max}	= 50 mA
Maximum Auxiliary Grid Voltage	$Vg2_{max}$	= 250 volts
Maximum Auxiliary Grid Dissipation	$Wg2_{max}$	= 1·5 watts
Maximum Resistance in Grid Circuit (with auto bias)	$Rg1a_{max}$	= 0·7 megohm
Maximum Resistance in Grid Circuit (with fixed bias)	$Rg1f_{max}$	= 0·3 megohm
Maximum Voltage Heater-Cathode	Vfk_{max}	= 50 volts

CONNECTIONS

For Valves Capped in 5-pin B.V.A. Base



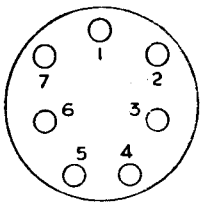
Viewed from free end of pins.

Pin No. 1 Anode
„ 2 Control Grid (G1)
„ 3 Heater
„ 4 Heater
„ 5 Cathode
Side Terminal—Aux. Grid (G2)

Pen4VA

Mullard
OUTPUT PENTODE

CONNECTIONS
For Valves Capped in 7-pin B.V.A. Base

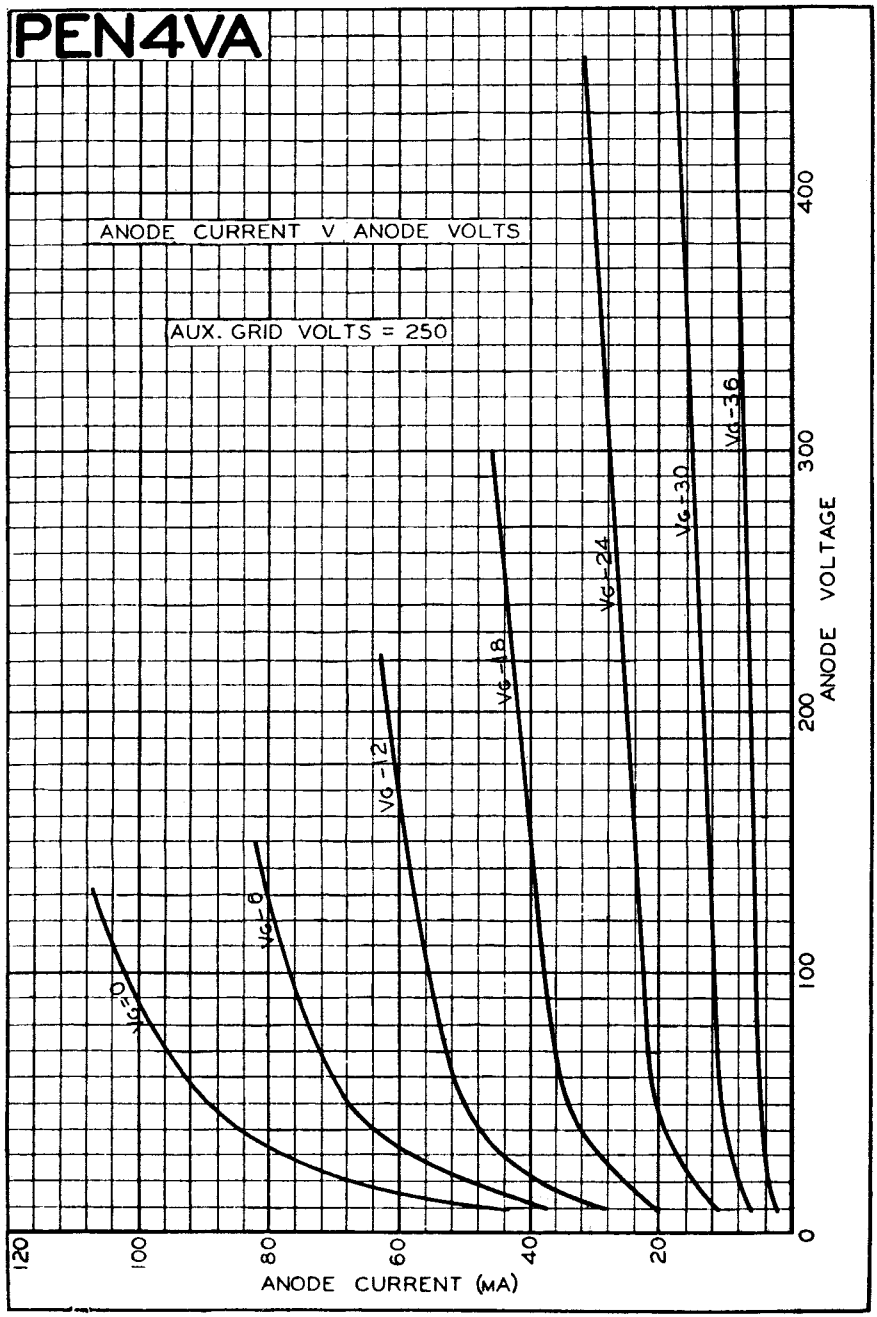


Viewed from free end of pins.

Pin No. 1 —
„ 2 Control Grid (G1)
„ 3 Auxiliary Grid (G2)
„ 4 Heater
„ 5 Heater
„ 6 Cathode
„ 7 Anode

Mullard
OUTPUT PENTODE

Pen4VA



Mullard
OUTPUT PENTODE

Pen4VB

The Pen4VB is a high-sensitivity output pentode for use in A.C. mains receivers. The cathode is slow-heating, but otherwise the characteristics of this valve are identical with the Mullard PenA4.

For operating characteristics, and static and dynamic curves, refer to data sheets for the PenA4.

Mullard
OUTPUT PENTODE

Pen26

The Pen26 is an indirectly heated output pentode for series heater connection in D.C./A.C. receivers.

HEATER CHARACTERISTICS

Heater Volts	Vf=24·0 volts	
Heater Current	If =0·2 amp	
Heating Time—60 seconds		

DIMENSIONS

Overall Length ...	=123 mm.
Overall Diameter	= 46 mm.
Bulb Finish—Clear	

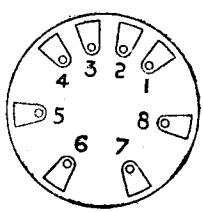
OPERATING DATA

Normal Anode Voltage	Va_w	= 200 volts
Normal Auxiliary Grid Voltage	$Vg2_w$	= 100 volts
Normal Anode Current (−$Vg1_w$=19 V) ...	Ia_w	= 40 mA
Auxiliary Grid Current	Ig2	= 5·0 mA
Normal Control Grid Voltage	−Vg1	= 19 volts
Mutual Conductance	S_w	= 3·1 mA/V
Optimum Load (Va=Vg2=250 V)	Ra	= 5,000 ohms
Audio Output (D=10% Total)	W_o	= 3·0 watts
Input Signal Volts (R.M.S.)	$Vg1_{eff}$	= 8·8 volts
Cathode Bias Resistance	Rk	= 420 ohms

LIMITS

Maximum Anode Voltage	Va_{max}	= 200 volts
Maximum Anode Dissipation	Wa_{max}	= 8 watts
Maximum Cathode Current	Ik_{max}	= 70 mA
Maximum Auxiliary Grid Voltage	$Vg2_{max}$	= 100 volts
Maximum Auxiliary Grid Dissipation	$Wg2_{max}$	= 1·0 watt
Maximum Resistance in Grid Circuit (with Auto Bias)	$Rg1a_{max}$	= 1·0 megohm
Maximum Resistance Heater to Cathode ...	Rfk_{max}	= 5,000 ohms
Maximum Voltage Heater to Cathode	Vfk_{max}	= 175 volts
Range of Grid Voltage for 1 μA Grid Current ...	Vg1	= −0·4 to −1·1 volts

CONNECTIONS

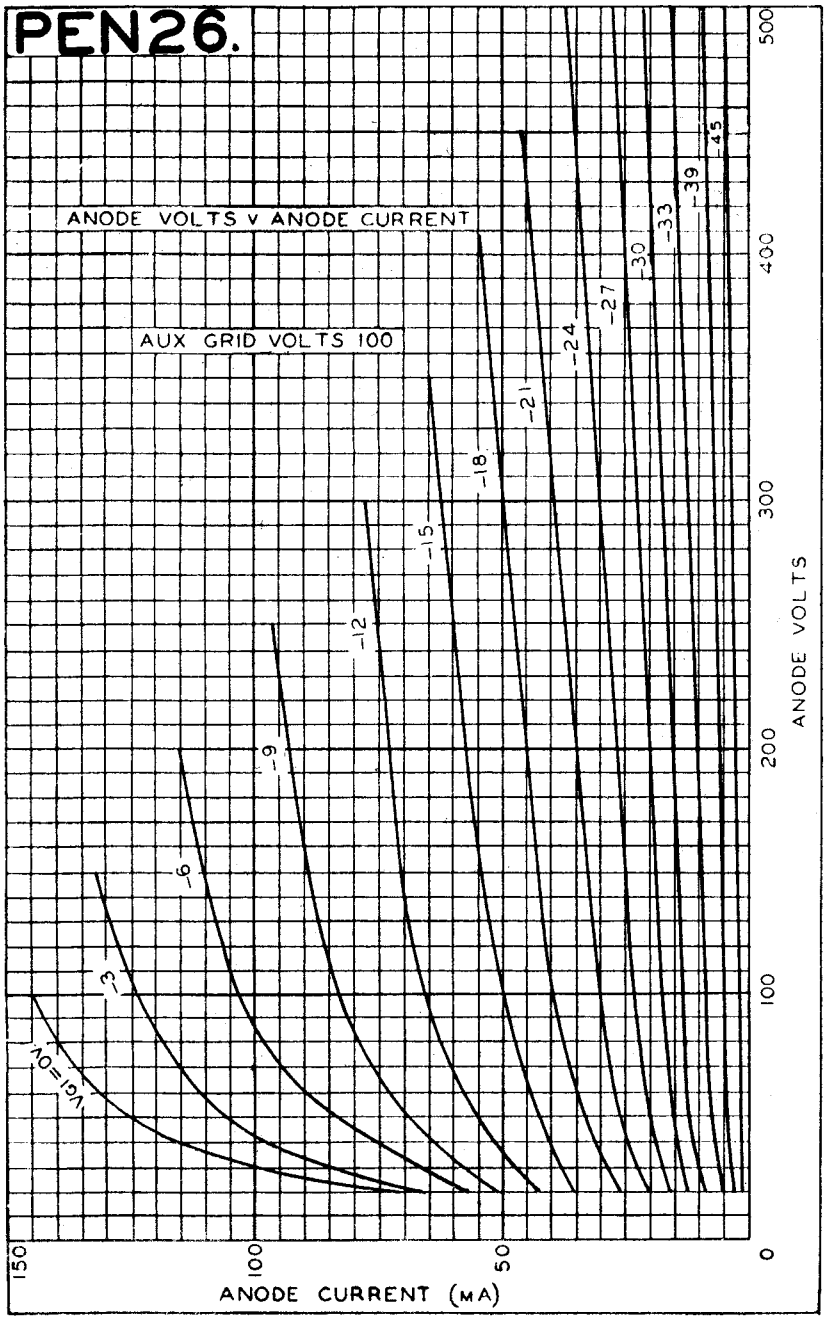


Viewed from underside of valve base.

Contact No. 1 —
" 2 Heater
" 3 Heater
" 4 Cathode
" 5 —
" 6 —
" 7 Auxiliary Grid (G2)
" 8 Anode
Top Cap—Control Grid (G1)

Pen26

Mullard
OUTPUT PENTODE



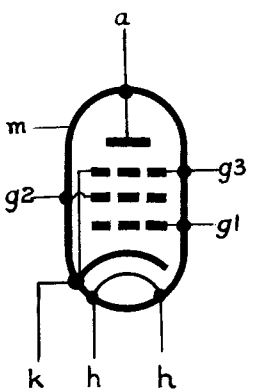
Mullard
OUTPUT PENTODE

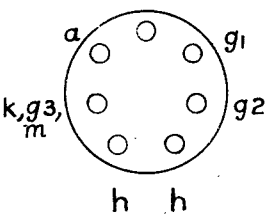
PEN 36 C

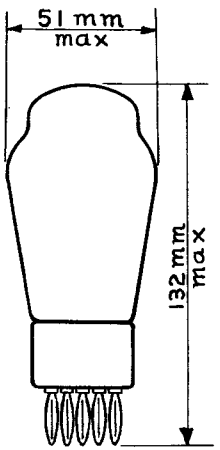
Heater (This valve is suitable for D.C./A.C. operation)	Vf =	33.0 V
	If =	0.2 A

For operating data and characteristic curves refer to valve type CL4. The valves have different dimensions, and the CL4 has a top cap and an 8 side contact base, whereas the Pen36C has no top cap and a 7 pin base. Except for these differences the two valves are identical.

Arrangement of electrodes and base connections.







Mullard
DOUBLE DIODE OUTPUT PENTODE PEN40DD

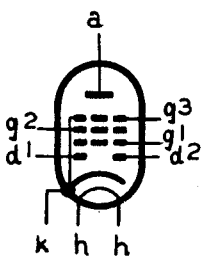
Heater	Vf	= 44 V
	If	= 0.2 A

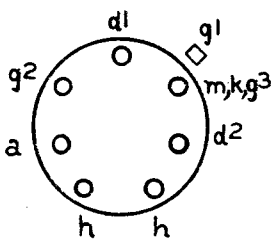
Capacities		
Cdd'		0.25 µµF
Cdk	=	3.1 µµF
Cd'k	=	3.2 µµF
Cda	=	0.2 µµF
Cd'a	=	0.2 µµF
Cdgl	=	0.08 µµF
Cd'gl	=	0.08 µµF
Cagl		1.0 µµF
Cak	=	8.4 µµF
Cglk	=	9.8 µµF

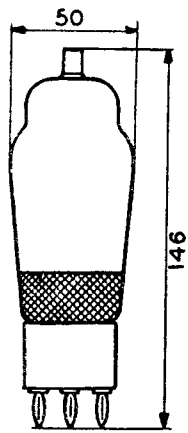
Operating Conditions as Class A Amplifier

Va	200 V
Vg2	200 V
Ia	45 mA
-Vgl	8.5 V
Ig2	6 mA
Sw	8 mA/V
Ri	35,000 Ω
Wo	4 W
Ra	4,500 Ω
Vgleff	5 V
Vgleff (50 mW)	0.5 V
dtot	10 %
Rk	170 Ω

Arrangement or electrodes and base connections







PEN 40DD

PEN40DD

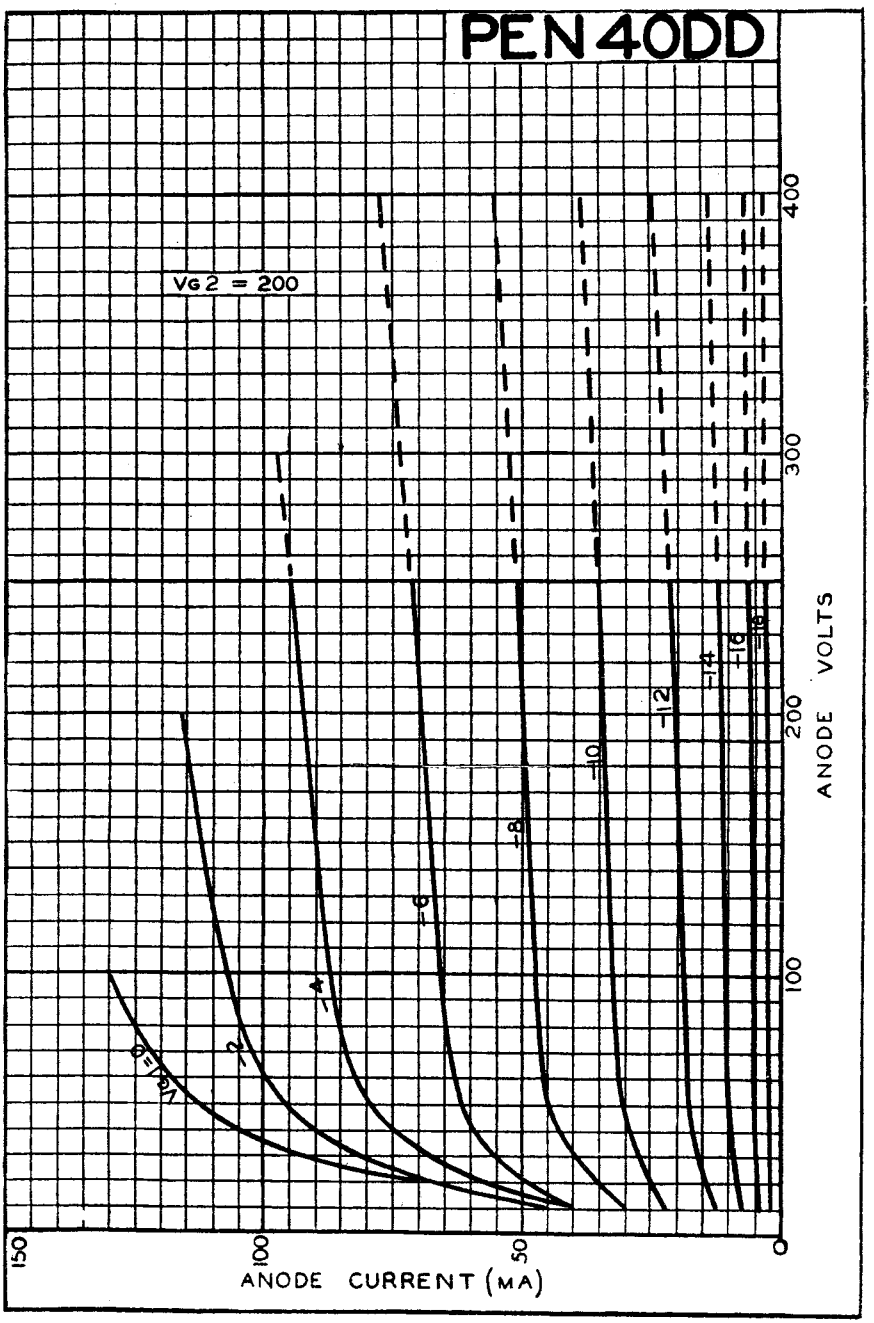
Mullard

DOUBLE DIODE OUTPUT PENTODE

Limiting Values

Va max.	250 V
Wa max.	9 W
Ik max.	70 mA
Vg2 max.	250 V
Wg2 max.	2 W
Rgla max.	1.0 MΩ
Vfk max.	175 V
Rfk max.	5,000 Ω
Vd max.	200 V
Id max.	0.8 mA
Vgl (Igl = 1.0 uA)	-0.3 to -0.8 V

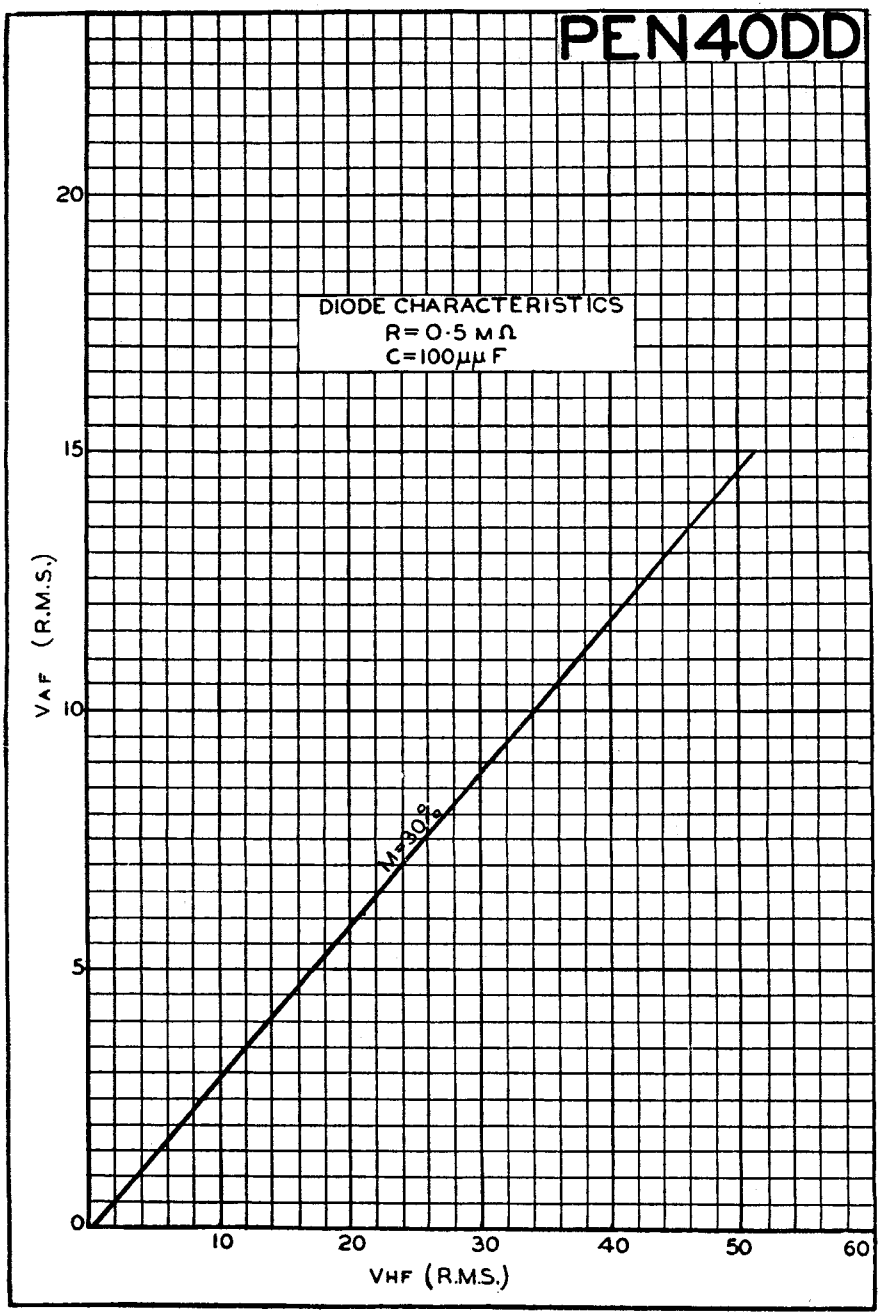
Mullard
DOUBLE DIODE OUTPUT PENTODE PEN40DD



PEN40DD

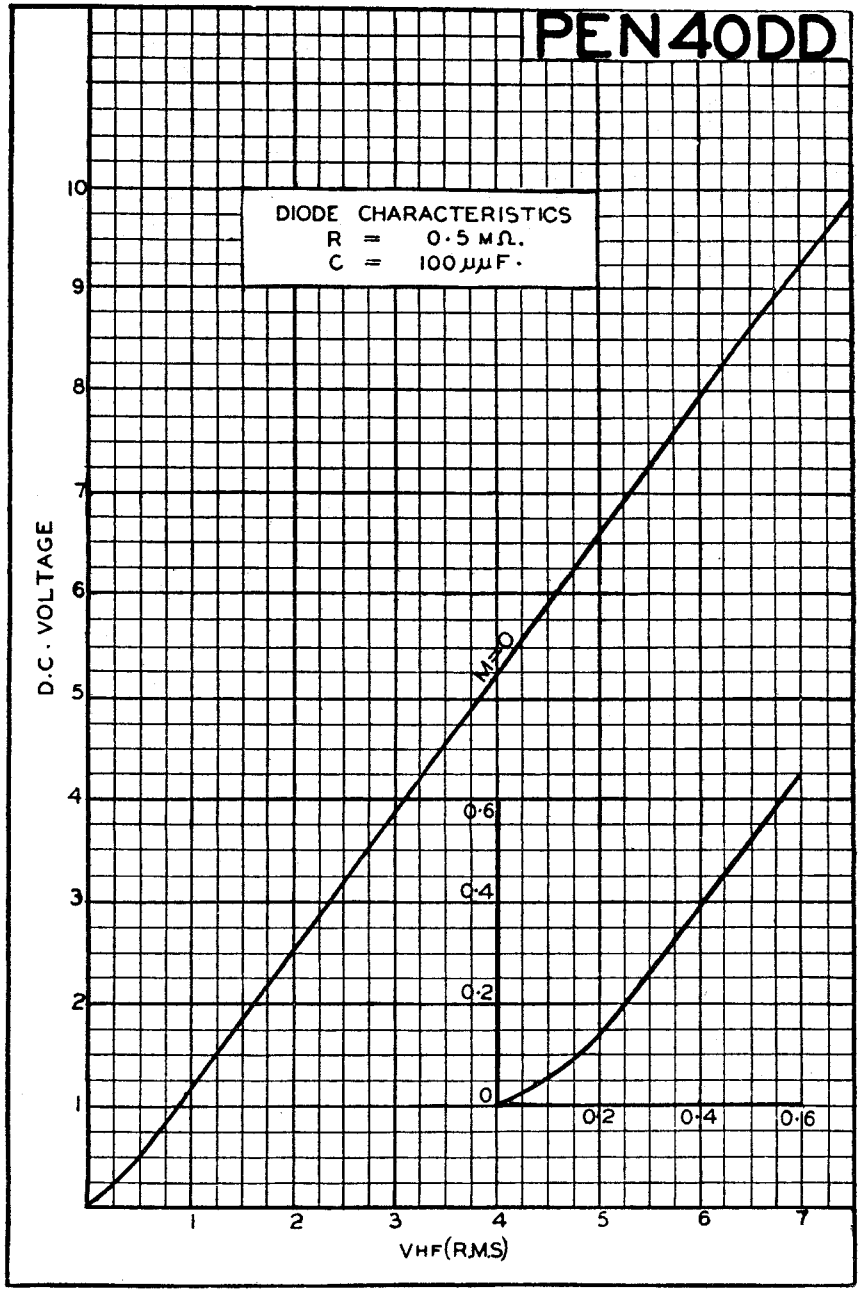
Mullard

DOUBLE DIODE OUTPUT PENTODE



Mullard

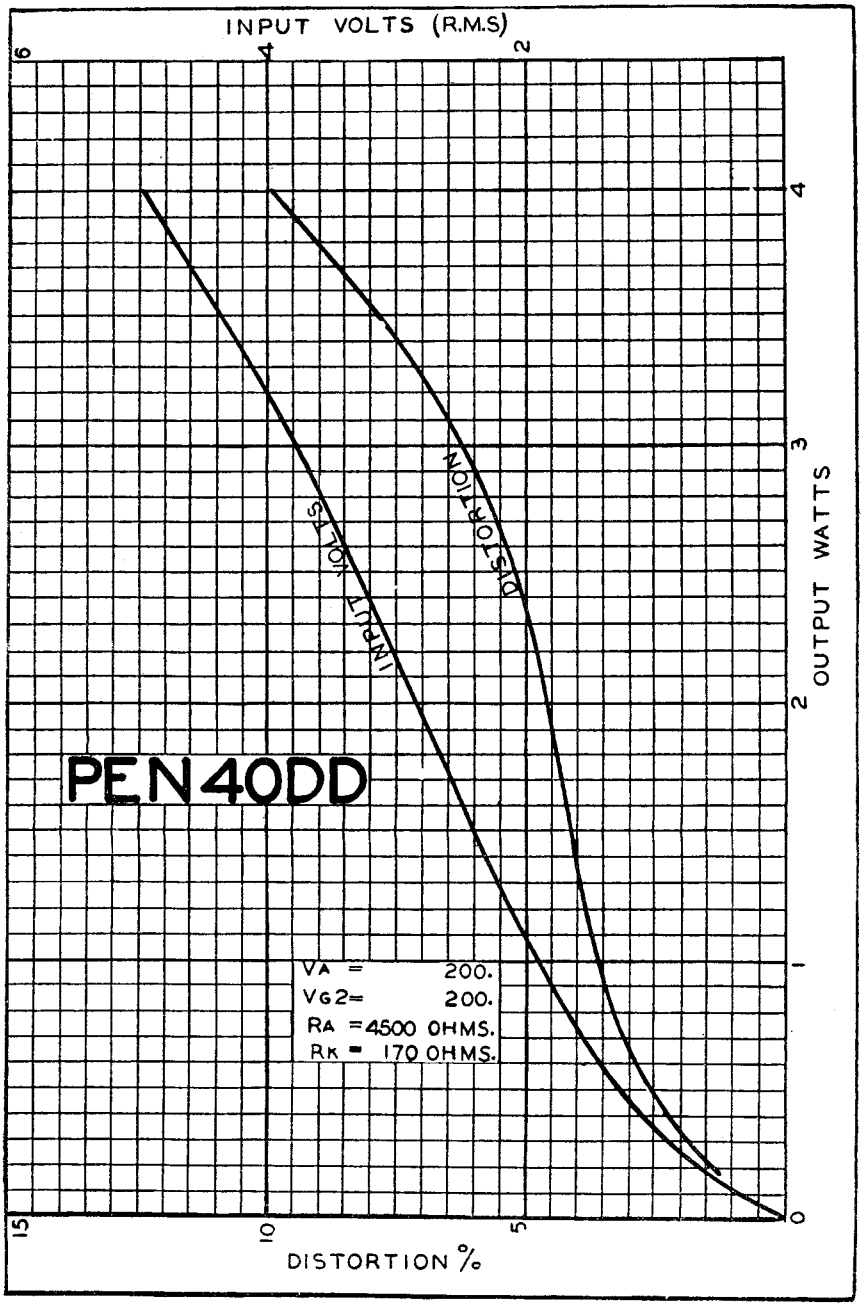
DOUBLE DIODE OUTPUT PENTODE PEN40DD



PEN40DD

Mullard

DOUBLE DIODE OUTPUT PENTODE



Mullard
OUTPUT PENTODE

PENA4

The PenA4 and Pen4VB are high sensitivity output pentodes for use in A.C. mains receivers having identical characteristics with the exception of heating time. The PenA4 is equipped with a quick-heating cathode, and should only be used with the IW4/350 rectifier

HEATER CHARACTERISTICS

Heater Voltage ... ... Vf=4·0 volts.
Heater Current ... ... If=1·95 amps.
Bulb Finish—Clear

DIMENSIONS

Overall Length ... =132 mm.
Overall Diameter... = 50 mm.

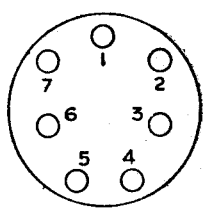
OPERATING CHARACTERISTICS

Maximum Anode Voltage	Va_{max}	= 250 volts
Maximum Auxiliary Grid Voltage	$Vg2_{max}$	= 250 volts
Normal Anode Voltage	Va_w	= 250 volts
Normal Auxiliary Grid Voltage	$Vg2_w$	= 250 volts
Anode Current ($Vg1_w$=−5·8)	Ia_w	= 36 mA
Auxiliary Grid Current	$Ig2_w$	= 5·0 mA
Control Grid Voltage (Ia_w=36 mA)	$-Vg1_w$	= 5·8 volts
Mutual Conductance (Ia_w=36 mA)	S_w	= 9·5 mA/V
Anode Impedance	Ri_w	= 50,000 ohms
Optimum Load	Ra	= 8,000 ohms
Output (D=10% 3rd H.)	Wo	= 3·8 watts
(D= 5% 3rd H.)	Wo	= 3·0 watts
Maximum Anode Dissipation	Wa_{max}	= 9·0 watts
Maximum Resistance in Grid Circuit	$Rg1_{max}$	= 1·0 megohm
Cathode Bias Resistor	Rk	= 145 ohms
Range of Grid Voltage for 1 μA grid current ...	Vg1	= −0·3 to −0·8 v.

CAPACITIES

Anode Control Grid	Cag1	= 1·0 μμF
Output	Ca	= 9·7 μμF
Input	Cg1	= 11·5 μμF

CONNECTIONS

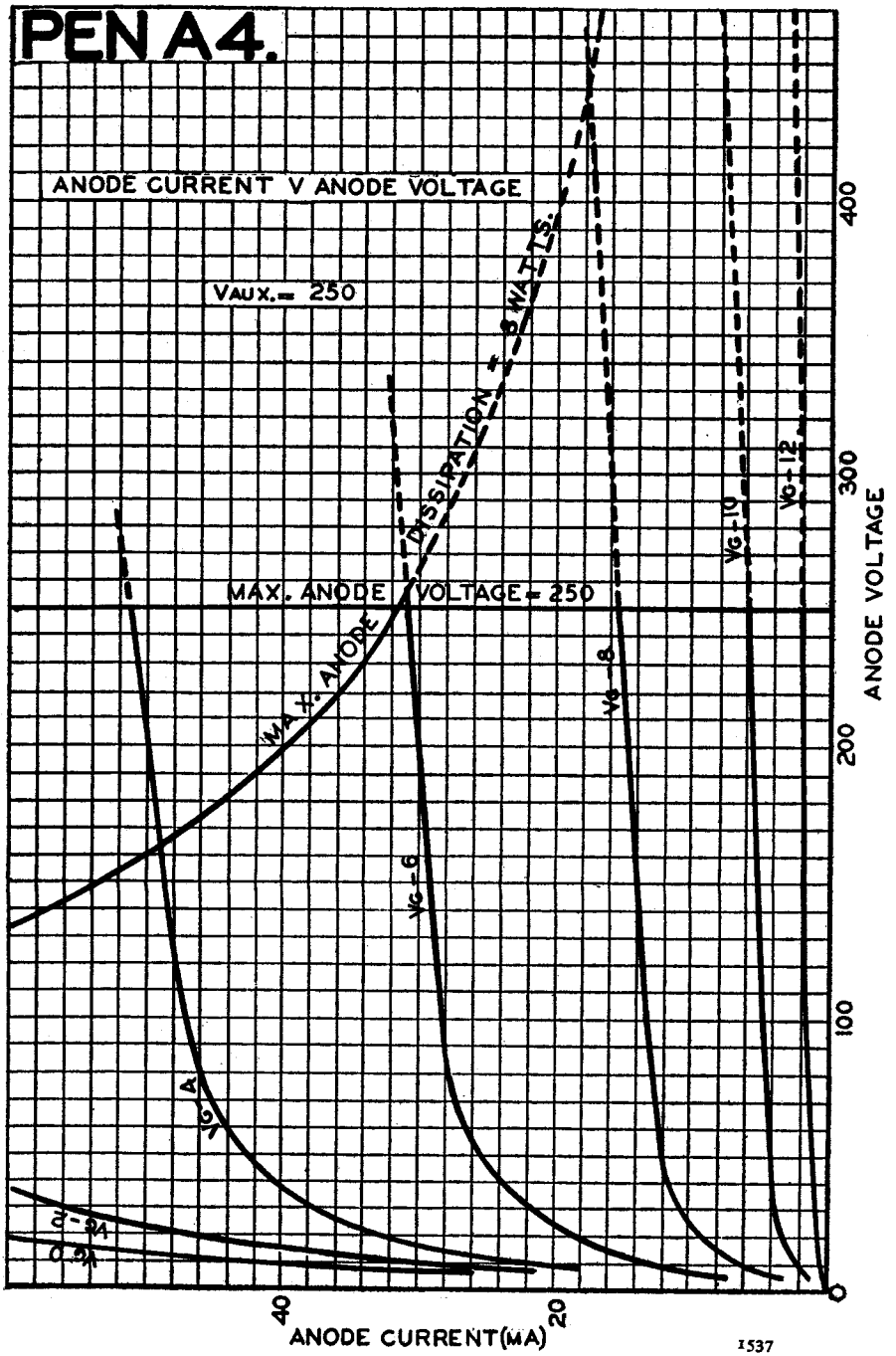


Viewed from free end of pins.

Pin No. 1 —
" 2 Control Grid (G1)
" 3 Auxiliary Grid (G2)
" 4 Heater
" 5 Heater
" 6 Cathode
" 7 Anode

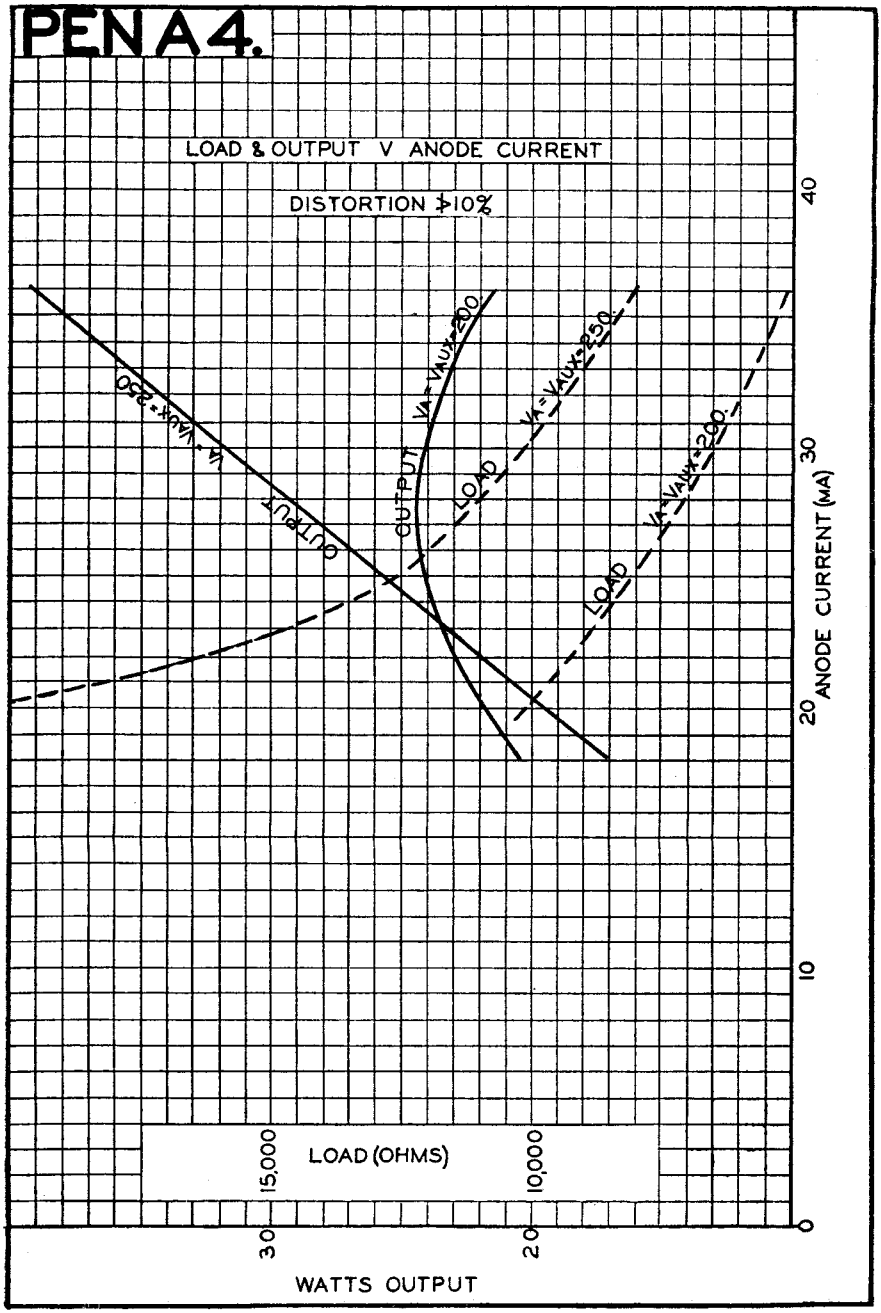
PENA4

Mullard
OUTPUT PENTODE



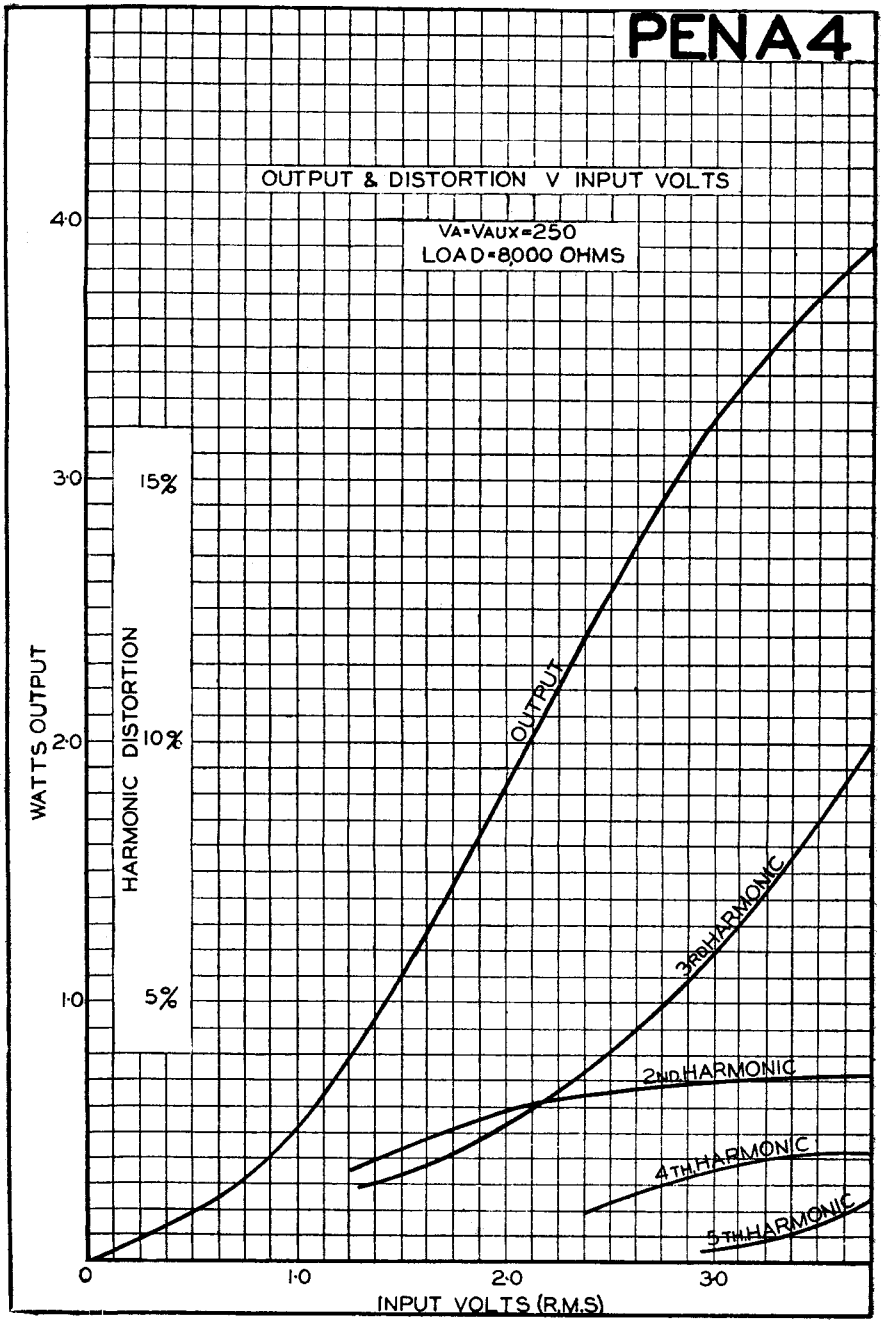
Mullard
OUTPUT PENTODE

PENA4



PENA4

Mullard
OUTPUT PENTODE



1537

OUTPUT PENTODE

PL33

High sensitivity output pentode with maximum anode dissipation of 9 watts, suitable for use in frame time base or audio output stage of D.C./A.C. television receivers.

HEATER

I_h	0.3	A
V_h	19	V

MOUNTING POSITION

Any

CAPACITANCE

C_{a-g1}	1.0	μμF

OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_a	175	200	225	V
V_{g2}	175	200	225	V
R_k	150	150	150	Ω
V_{g1}	−4	−4.65	−5.3	V
I_a	24	28	32	mA
I_{g2}	2.6	3.0	3.4	mA
g_m	8	8.6	9	mA/V
r_a	60	55	50	kΩ
μ_{g1-g2}	23	23	23	
R_a	7	7	7	kΩ
$V_{in\ (r.m.s.)}$ (D_{tot}=10%)	—	—	3.4	V
P_{out} (D_{tot}=10%)	—	—	3.3	W
$V_{in\ (r.m.s.)}$ (Start of I_{g1})	2.6	3.1	3.6	V
P_{out} (Start of I_{g1})	1.8	2.55	3.45	W
D_{tot} (Start of I_{g1})	8.8	10	11	%

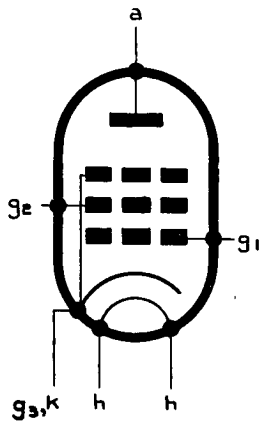
PL33

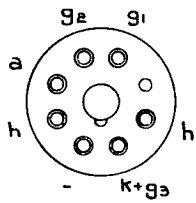
OUTPUT PENTODE

High sensitivity output pentode with maximum anode dissipation of 9 watts, suitable for use in frame time base or audio output stage of D.C./A.C. television receivers.

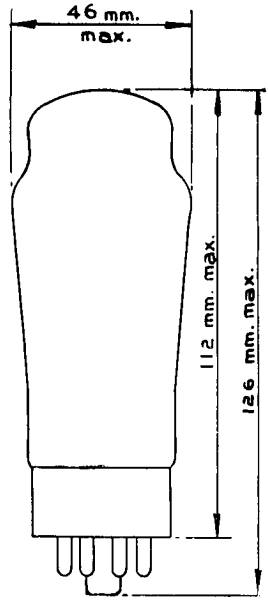
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	9	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max. (no sig.)	1.2	W
p_{g2} max. (max. sig.)	2.5	W
I_k max.	55	mA
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
R_{g1-k} max. (Self-bias)	1.0	MΩ
V_{h-k} max.	300	V
R_{h-k} max.	5.0	kΩ





OCTAL BASE



OUTPUT PENTODE

Output pentode primarily intended for use as line time base output valve in television receivers with series connected heaters.

PL38
PL38M

HEATER

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

I_h	300	mA
V_h	30	V

CAPACITANCES

	PL38M	PL38	
c_{in}	18	18	pF
c_{out}	9.5	6.5	pF
c_{a-g1}	<1.0	<1.2	pF

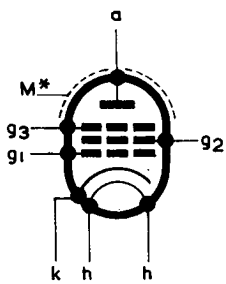
CHARACTERISTICS

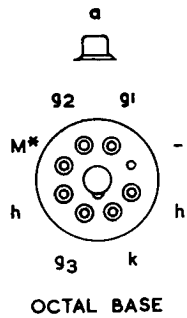
V_a	200	V
V_{g2}	200	V
V_{g1}	−5.5	V
I_a	75	mA
I_{g2}	9.0	mA
g_m	13.5	mA/V
r_a	20	kΩ
μ_{g1-g2}	16.5	

LIMITING VALUES

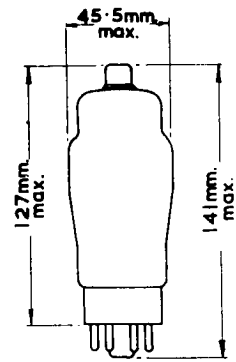
$V_{a(b)}$ max.	1.2	kV
V_a max.	800	V
$v_{a(pk)}$ max.	8.0	kV
$V_{g2(b)}$ max.	800	V
V_{g2} max.	400	V
p_a max.	25	W
p_{g2} max.	8.0	W
I_k max.	200	mA
V_{g1} max. (I_{g1} = +0.3μA)	−1.3	V
*R_{g1-k} max. (p_a < 25W)	500	kΩ
*R_{g1-k} max. (p_a < 9W)	800	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

*For self bias operation.





OCTAL BASE

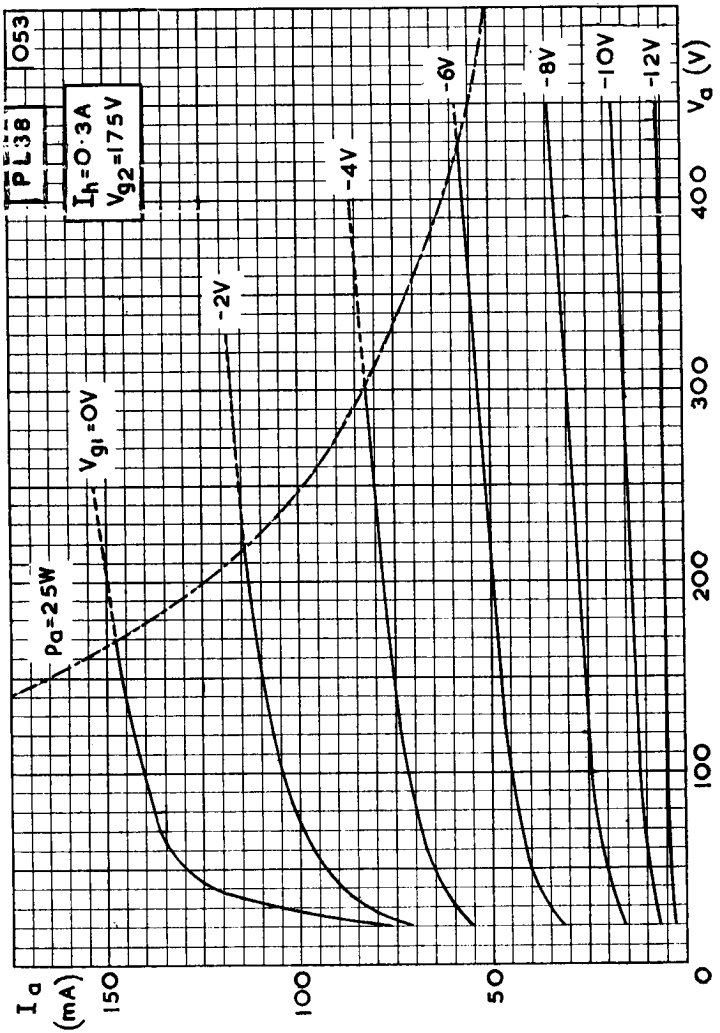


* External metallising on type PL38M only.

732

PL38
PL38M

OUTPUT PENTODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER AT V_{g2} 175V

LINE OUTPUT PENTODE PL81A

Line output pentode for use in portable television receivers.

HEATER

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

I_h	300	mA
V_h	21.5	V

CAPACITANCES

c_{in}	14	pF
c_{out}	6.0	pF
c_{a-g1}	<800	mpF
c_{g1-h}	<200	mpF
c_{a-k}	<100	mpF

CHARACTERISTICS

V_a	170	V
V_{g2}	170	V
V_{g1}	-24.5	V
I_a	45	mA
I_{g2}	2.2	mA
g_m	6.0	mA/V
r_a	11.5	kΩ
μ_{g1-g2}	4.9	

OPERATION AS LINE OUTPUT VALVE

Circuit design

Operation so that the anode potential of the output valve at the end of the scan is above the knee of the anode characteristic is recommended. An effective feedback stabilising circuit should be employed. A design chart is given on page C5.

Minimum values of R_{g2} required to prevent excessive screen-grid dissipation during the warming-up period.

V_b	170	200	230	V
R_{g2} min.	1.2	1.8	2.2	kΩ

High voltage cut-off

The minimum value of V_{g1} for cut-off during the fly-back period, when $v_{a(pk)}$ = 7.0kV, is -120V.

PEAK ANODE CURRENT DESIGN CHARTS

Stabilised timebases

The design chart shown on page C5 gives directly the values of peak anode current and end-of-scan anode voltage which should be used in designing a stabilised line timebase. The design chart is based on an h.t. line voltage of 200V, and a correction factor is included for other h.t. voltages.

Measurements

When measurements are made specifically for the purpose of comparison with the design chart, all the components comprising the timebase, including the valves, should be nominal. The h.t. line should also be nominal. In receivers designed for a range of declared values of mains voltage, measurements should be made at the nominal declared value of mains voltage producing the lowest nominal h.t. voltage. The timebase should be synchronised and the raster adjusted to nominal scan. The beam current drawn from the e.h.t. supply should be 300μA.

The use of the design chart does not exempt the designer from checking that the valve is operating within its limiting values.

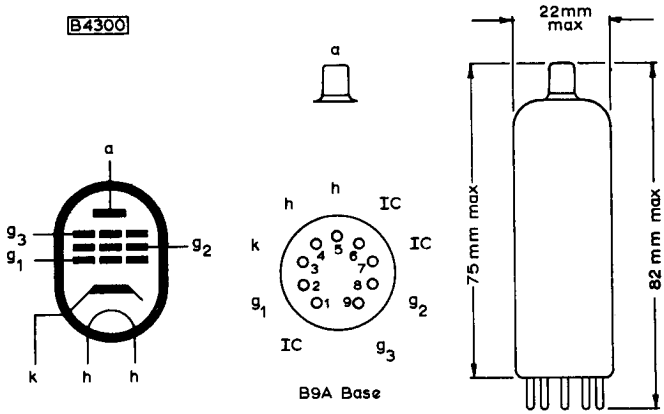
LINE OUTPUT PENTODE

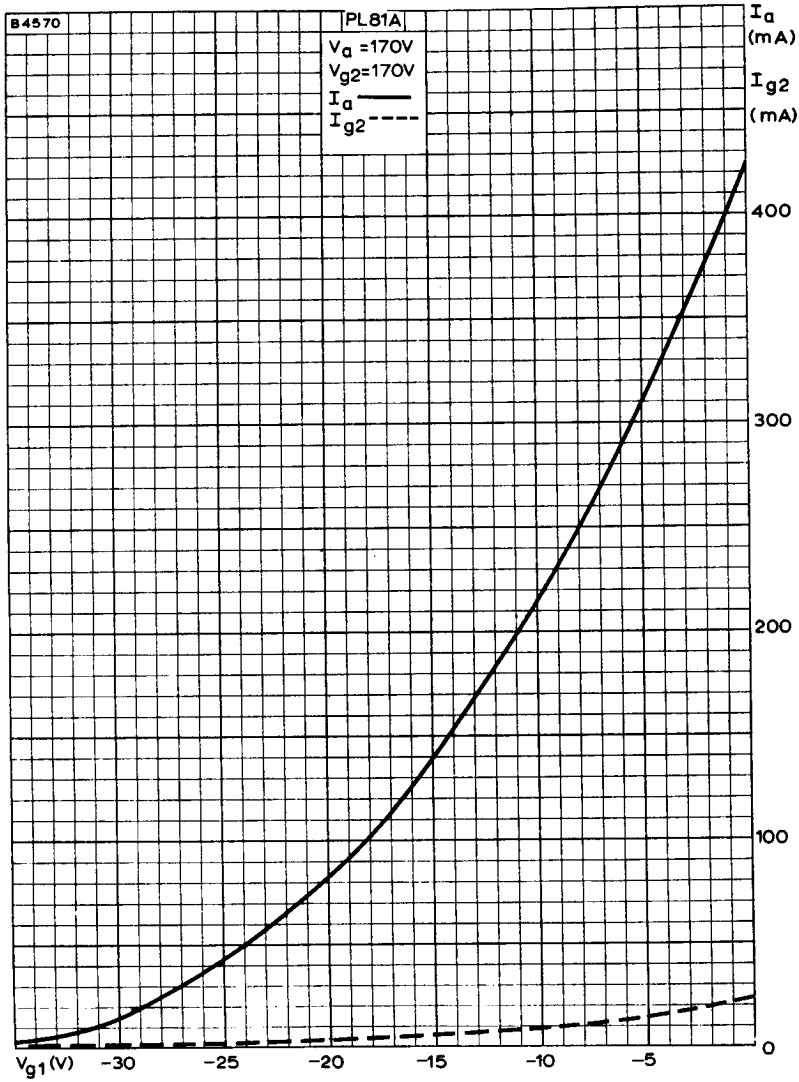
PL81A

RATINGS (DESIGN CENTRE SYSTEM)

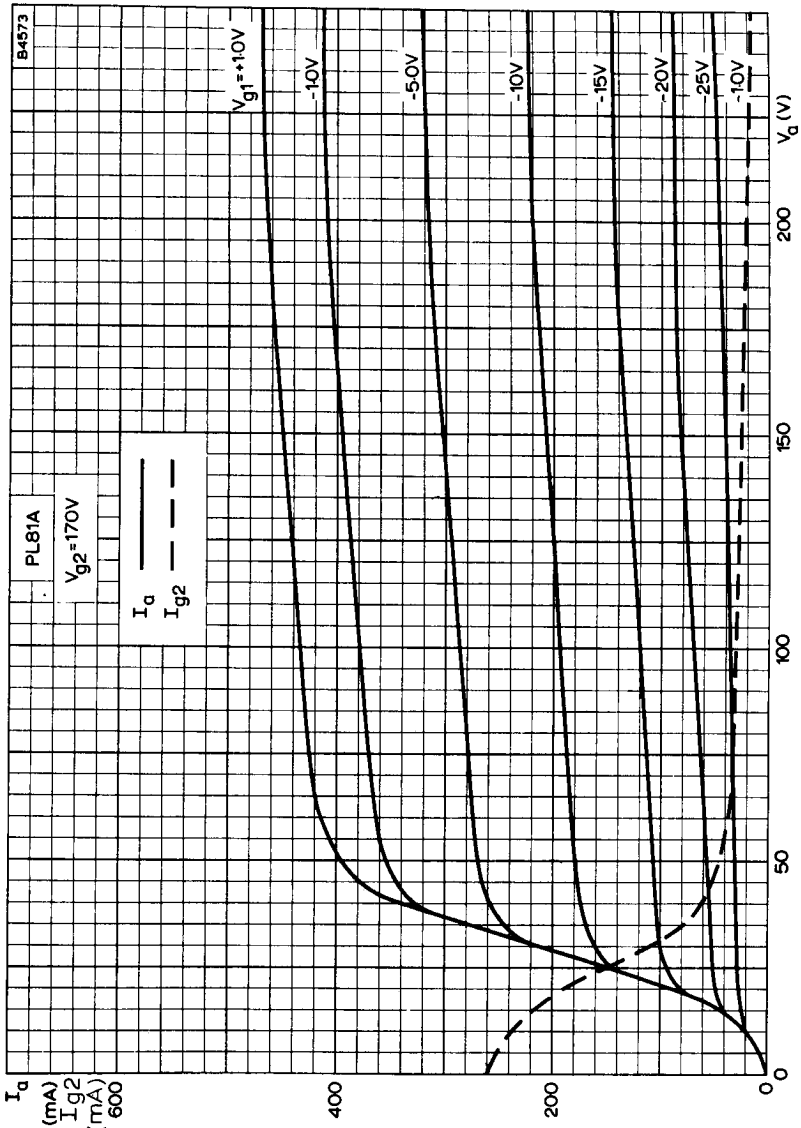
$V_{a(b)}$ max.	650	V
V_a	250	V
* $v_{a(pk)}$ max.	7.0	kV
p_a max.	see page C6	
$p_a + p_{g2}$	see page C6	
$V_{g2\ (b)}$ max.	550	V
V_{g2} max.	250	V
$v_{g1\ (pk)}$ max.	1.0	kV
p_{g2} max.	see page C6	
I_k max.	180	mA
R_{g1-k} max.	500	kΩ
R_{g1-k} max. (line timebase applications)	2.2	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max. (cathode negative)	200	V
V_{h-k} max. (cathode positive)	200	V
T_{bulb} max.	240	°C

*Maximum pulse duration 22% of one cycle with a maximum of 18μs.

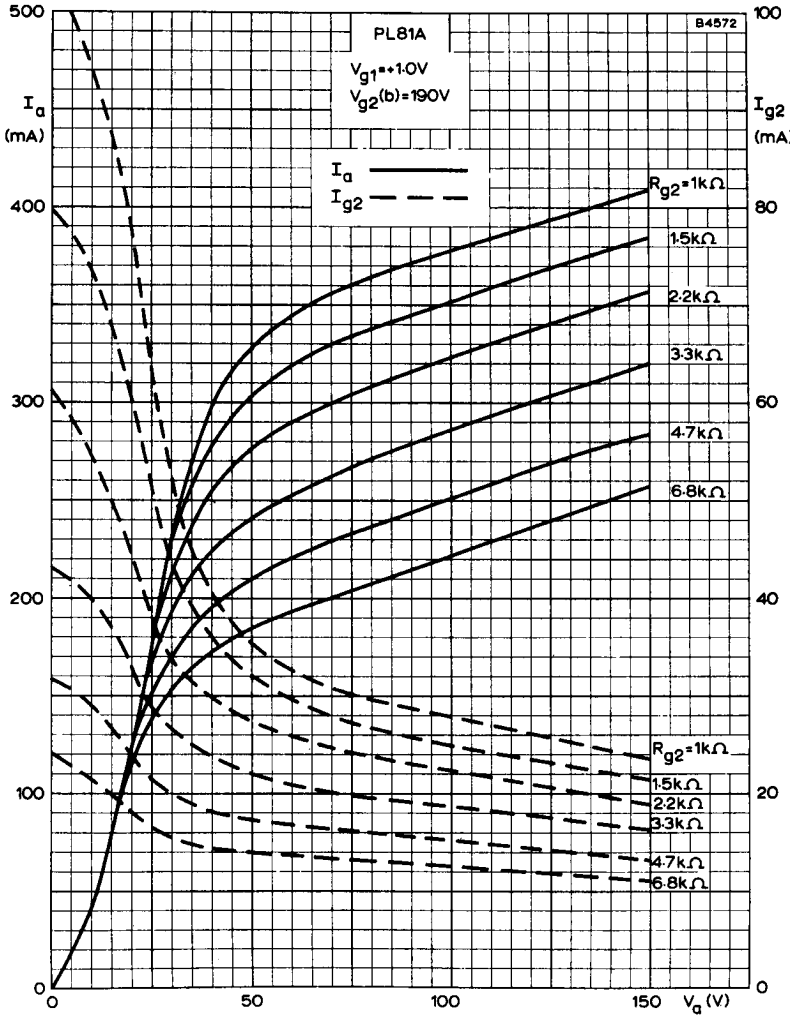




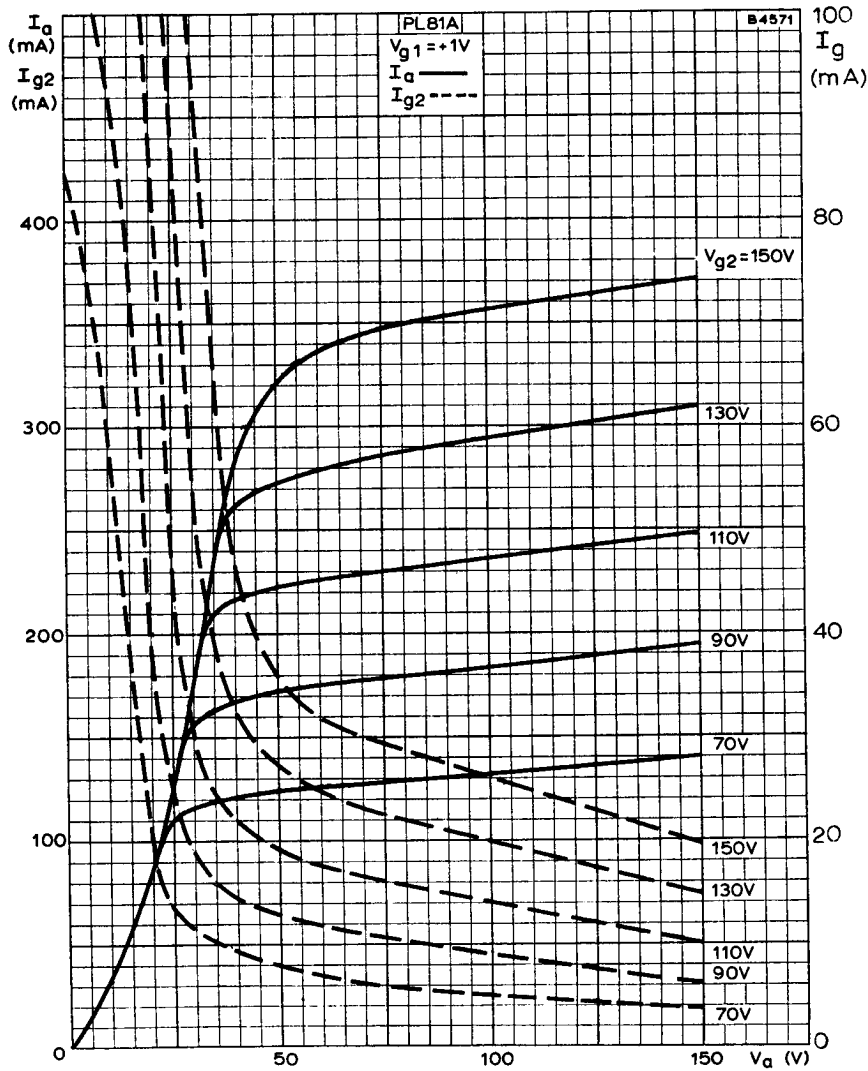
ANODE AND SCREEN CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE



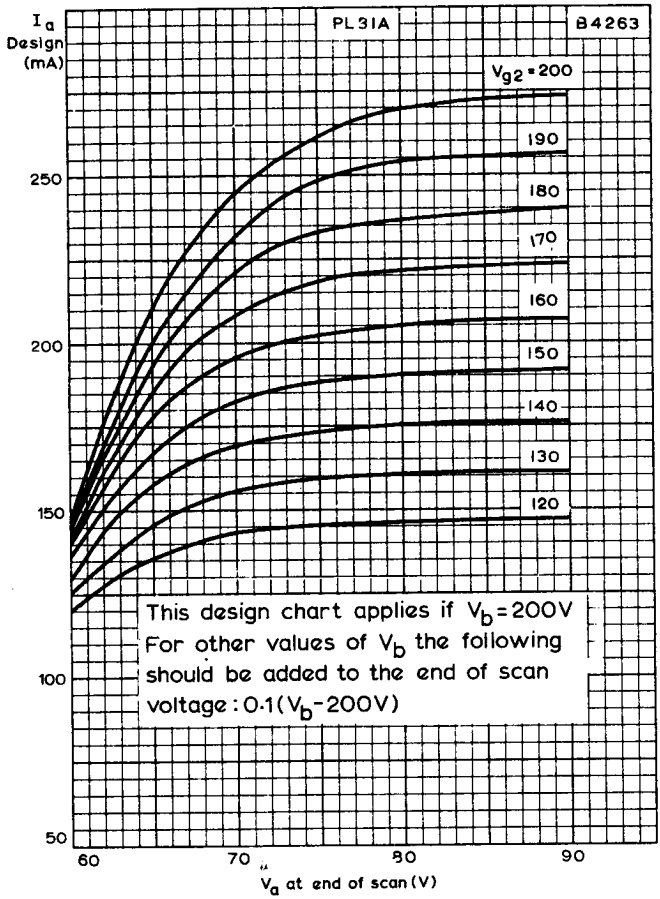
ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



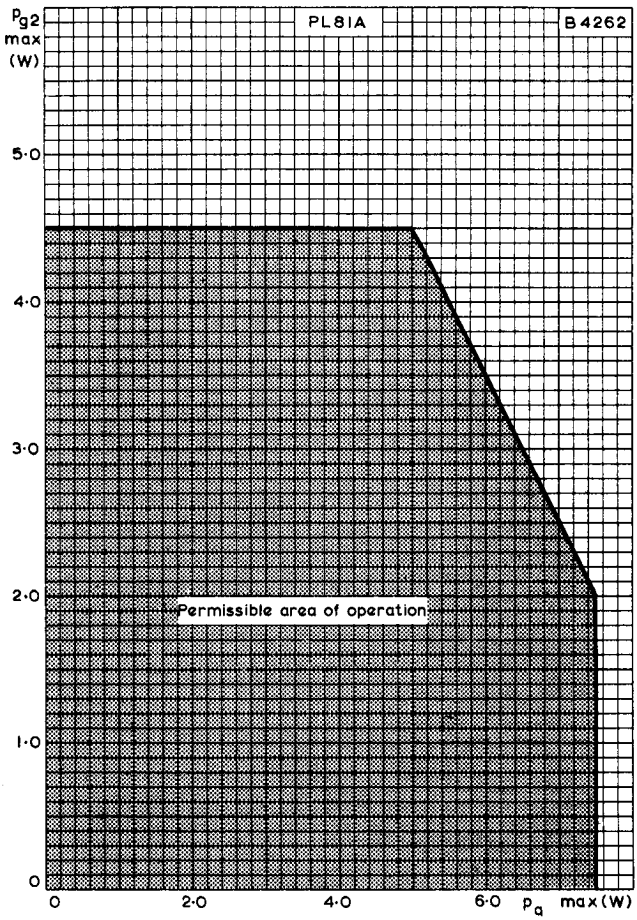
ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH SCREEN-GRID RESISTOR AS PARAMETER



ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE
WITH SCREEN-GRID VOLTAGE AS PARAMETER



DESIGN CHART FOR STABILISED TIMEBASES



DESIGN CENTRE RATINGS FOR p_a max. AND p_{g2} max.

HALF WAVE RECTIFIER

Indirectly heated half wave rectifier with 300mA heater for DC/AC operation.

PY31

HEATER

I_h	0.3	A
V_h	17	V

MOUNTING POSITION

Any

OPERATING CONDITIONS

$V_{a(r.m.s.)}$ (V)	C max. (μF)	R_{11m} min. (Ω)
250	60	175
250	32	125
250	16	75
250	8.0	0
170	60	100
170	32	75
170	16	30
127	60	0

LIMITING VALUES

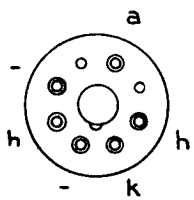
P.I.V. max.	1.0	kV
$V_{a(r.m.s.)}$ max.	250	V
I_a max.	125	mA
$v_{h-k(pk.)}$ max.	300	V
C max.	60	μF

PY31

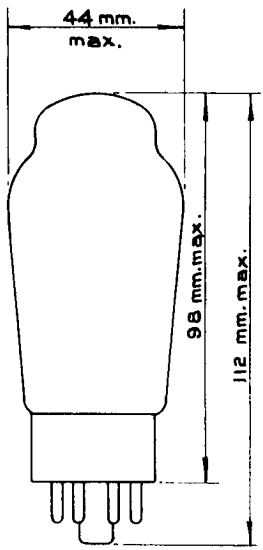
HALF WAVE RECTIFIER

Indirectly heated half wave rectifier with 300mA heater for DC/AC operation.





OCTAL BASE



HALF-WAVE RECTIFIER

PY32

Indirectly-heated half-wave rectifier with 300mA heater for use in television receivers with series connected heaters.

HEATER

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

I_h	300	mA
V_h	29	V

LIMITING VALUES

P.I.V. max.	700	V
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	325	mA ←
$i_{a(pk)}$ max.	2.1	A ←
$i_{a(surge)}$ max.	7.5	A
C max.	100	μF
*$v_{h-k(pk)}$ max. (cathode positive)	550	V

*Max. d.c. component = 250V. Max. a.c. component = $220V_{r.m.s.}$

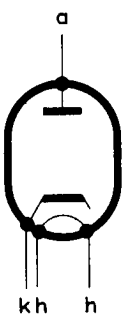
OPERATING CONDITIONS*

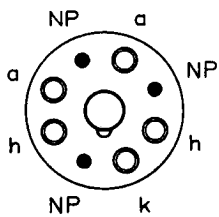
$V_{in(r.m.s.)}$	200	210	220	230	240	250	V
I_{out}	325	325	296	267	238	210	mA ←
C	100	100	100	100	100	100	μF
R_{lim} min.	23	25	27	29	31	33	Ω
V_{out}	182	194	212	230	248	264	V ←

*For television receivers, where a constant output voltage is required for different input voltages, the values of limiting resistor required can be obtained from the curves on pages C3 and C4.

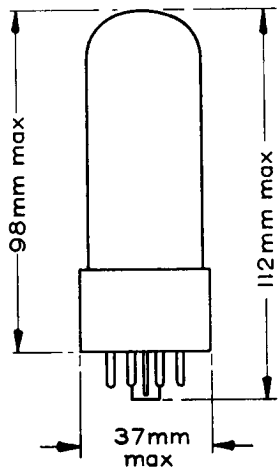
PY32

HALF-WAVE RECTIFIER





Octal Base



7575

HALF-WAVE RECTIFIER

Indirectly-heated half-wave rectifier with 300mA heater for use in television receivers with series connected heaters.

PY33

HEATER

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

I_h	300	mA
V_h	29	V

DESIGN CENTRE RATINGS

P.I.V. max.	700	V
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	325	mA
$i_{a(pk)}$ max.	2.6	A
$i_{a(surge)}$ max.	9.5	A
C max.	200	μF
*$v_{h-k(pk)}$ max. (cathode positive)	625	V

*Max. d.c. component=275V. Max. a.c. component=250$V_{r.m.s.}$

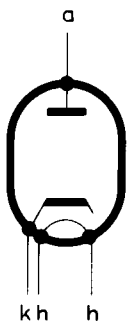
OPERATING CONDITIONS*

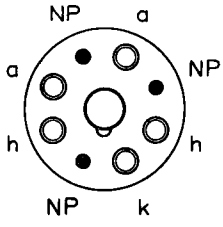
$V_{in(r.m.s.)}$	200	210	220	230	240	250	V
I_{out}	325	325	295	270	240	220	mA
C	200	200	200	200	200	200	μF
R_{lim} min.	15	17	19	21	23	25	Ω
V_{out}	209	219	234	249	264	280	V

*For television receivers, where a constant output voltage is required for different input voltages, the values of limiting resistor required can be obtained from the curves on pages C3 and C4.

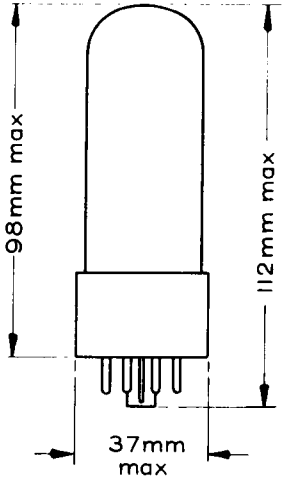
PY33

HALF-WAVE RECTIFIER





Octal Base



7575

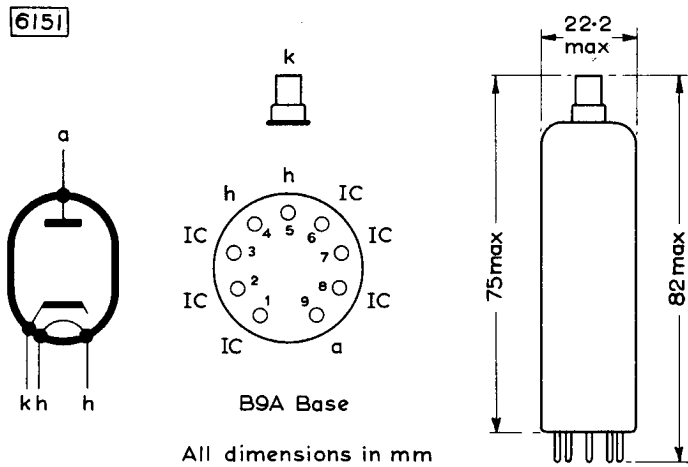
BOOSTER DIODE

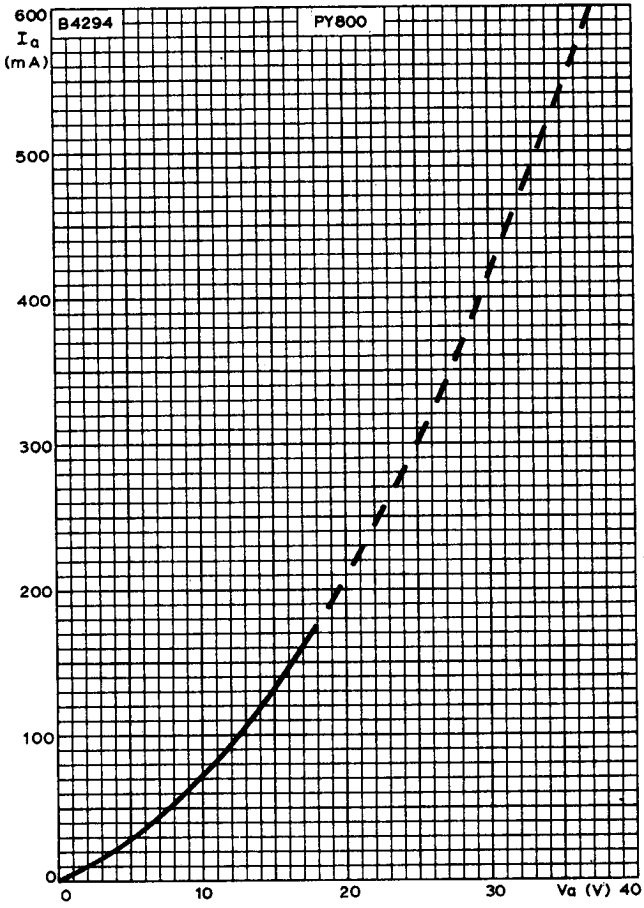
PY800

Booster diode for use in television receivers employing 110° deflection angle cathode ray tubes.

HEATER		
I_h	300	mA
V_h	19	V
CAPACITANCES		
c_{a-k}	6.0	pF ←
c_{h-k}	2.2	pF ←
LIMITING VALUES		
*P.I.V. max.	5.75	kV ←
i_a (pk) max.	450	mA ←
I_a (av) max.	175	mA ←
$*v_{h-k}$ (pk) max. (cathode positive)	6.0	kV ←

*Maximum pulse duration 22% of one cycle with a maximum of 18μs. ←





ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

INDIRECTLY HEATED RECTIFIER

PZ30

Indirectly heated rectifier with two separate half-wave sections, primarily intended for use as half-wave or voltage-doubling rectifier in d.c./a.c. television equipment.

HEATER

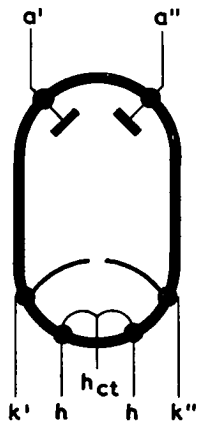
I_h	300	mA
V_h	52	V

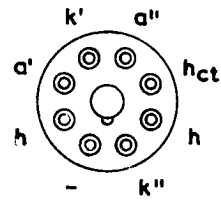
OPERATING CONDITIONS

	In half-wave circuit			In voltage doubler circuit		
$V_{a(r.m.s.)}$	200	220	240	220	240	V
I_{out}	400	400	400	200	200	mA
V_{out}	160	180	205	425	480	V
R_{11m} (each anode)	50	50	50	30	30	Ω
C	50	50	50	2×32	2×32	μF

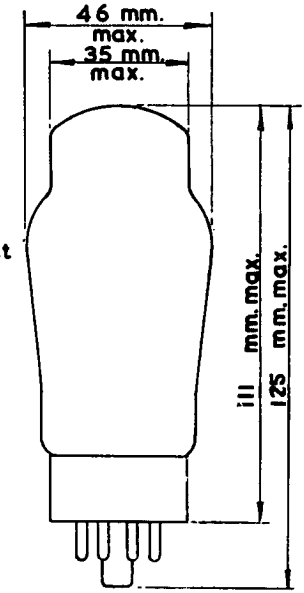
LIMITING VALUES

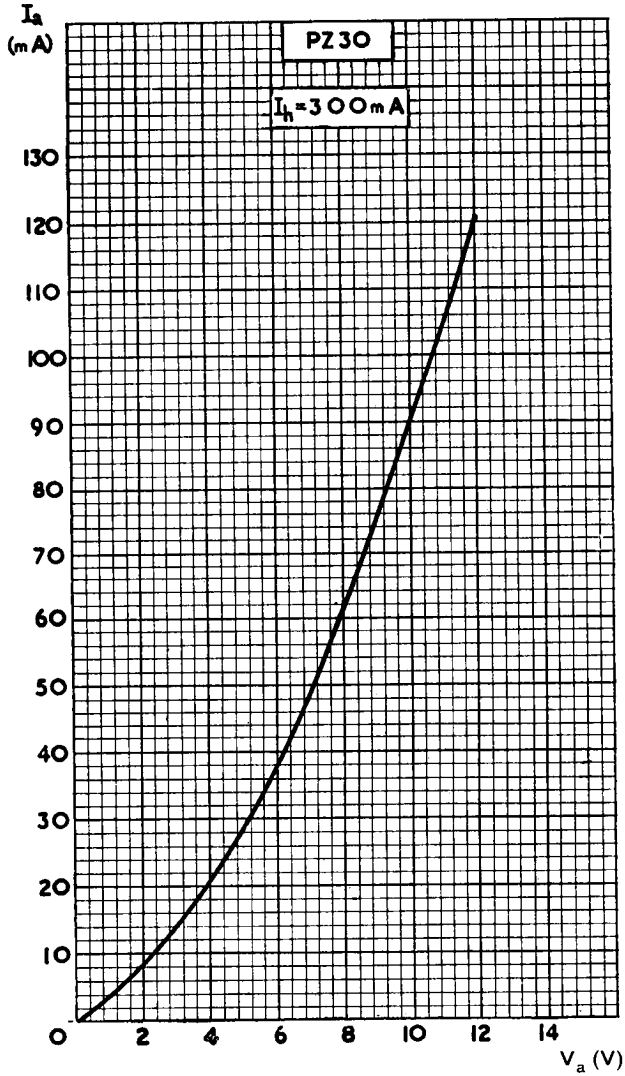
$V_{a(r.m.s.)}$ max.	240	V
I_a max. (each anode)	200	mA
$v_{h-k(pk)}$ max.	650	V
C max.	50	μF





OCTAL BASE





ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SINGLE SECTION

DOUBLE TETRODE PULSE MODULATOR

QQV5-P10

Double tetrode for pulsed applications having ratings of 5kV and 10A.

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this volume of the handbook.

CATHODE

Indirectly heated for series or parallel operation.

	Series	*Parallel*	
V_h	$12.6^{+10\%}_{-5\%}$	$6.3^{+10\%}_{-5\%}$	V
I_h	1.2	2.4	A

MOUNTING POSITION

Vertical—base up or down
Horizontal—anode pins in horizontal plane

CAPACITANCES (each section)

c_{g1-k}	14	pF
c_{a-k}	7.0	pF

CHARACTERISTICS (each section) measured at I_a=60mA

g_m	8.5	mA/V
μ_{g1-g2}	9.0	

COOLING Natural.

OPERATION AS PULSE MODULATOR

Limiting Values (Absolute ratings) Two sections in parallel.

V_a max.	5.0	kV
$v_{a(pulse)}$ max.	5.75	kV
V_{g2} max.	850	V
$-V_{g1}$ max.	225	V
$-v_{g1(pulse)}$ max.	600	V
$+v_{g1(pulse)}$ max.	250	V
$i_{a(pulse)}$ max.	See curve on p. 5	
$i_{g2(pulse)}$ max.	3.5	A
$i_{g1(pulse)}$ max.	4.0	A
p_a max.	15	W
$p_{in(mean)}$ max.	85	W
$p_{g2(mean)}$ max.	3.0	W
$p_{g1(mean)}$ max.	1.0	W
V_{h-k} max.	100	V

QQV5-P10

DOUBLE TETRODE PULSE MODULATOR

Double tetrode for pulsed applications having ratings of 5kV and 10A.

Typical Operating Conditions

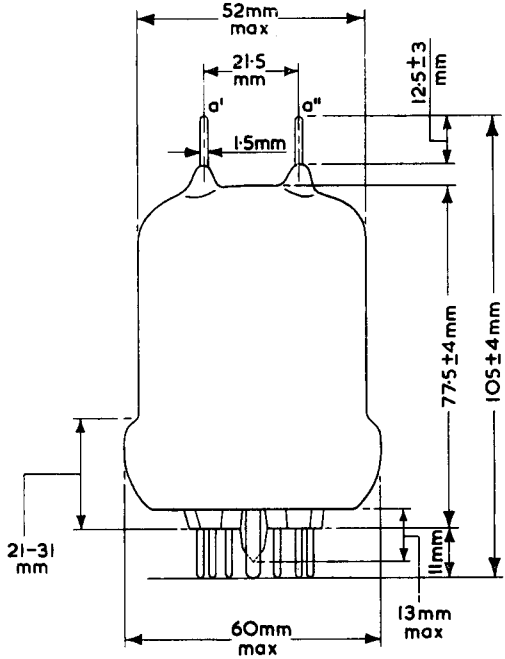
				*	
t_p	0.1	1.0	3.0	1.0	μs
P.R.F.	1200	1200	330	1000	p/s
D.F.	0.00012	0.0012	0.001	0.001	
V_a	4.5	4.5	4.5	5.0	kV
V_{g2}	800	800	800	850	V
V_{g1}	−200	−200	−200	−200	V
$v_{g1(pulse)}$	350	300	350	350	V
$i_{a(pulse)}$	9.0	8.0	9.0	10	A
I_a	1.1	9.6	9.0	10	mA
I_{g2}	0.25	1.5	2.0	2.0	mA
I_{g1}	0.125	0.625	1.0	1.0	mA
R_a	400	450	400	400	Ω

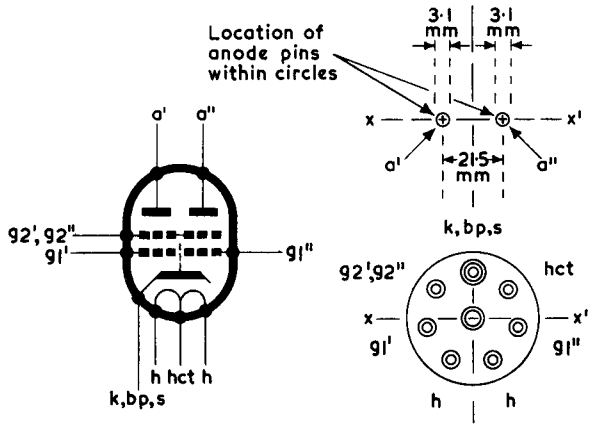
*This condition includes some of the absolute maximum ratings and therefore assumes protective conditions of operation.

DOUBLE TETRODE PULSE MODULATOR

QQV5-P10

Double tetrode for pulsed applications having ratings of 5kV and 10A.





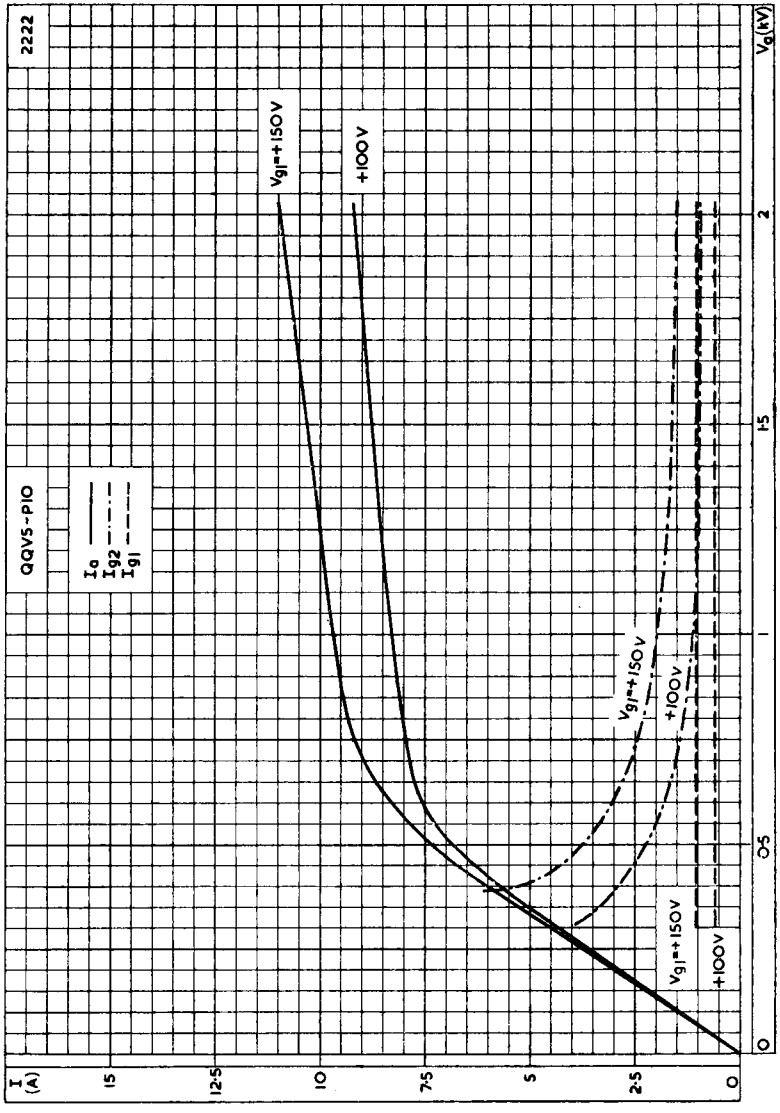
2297

B7A Base

QQV5-P10

DOUBLE TETRODE PULSE MODULATOR

Double tetrode for pulsed applications having ratings of 5kV and 10A.

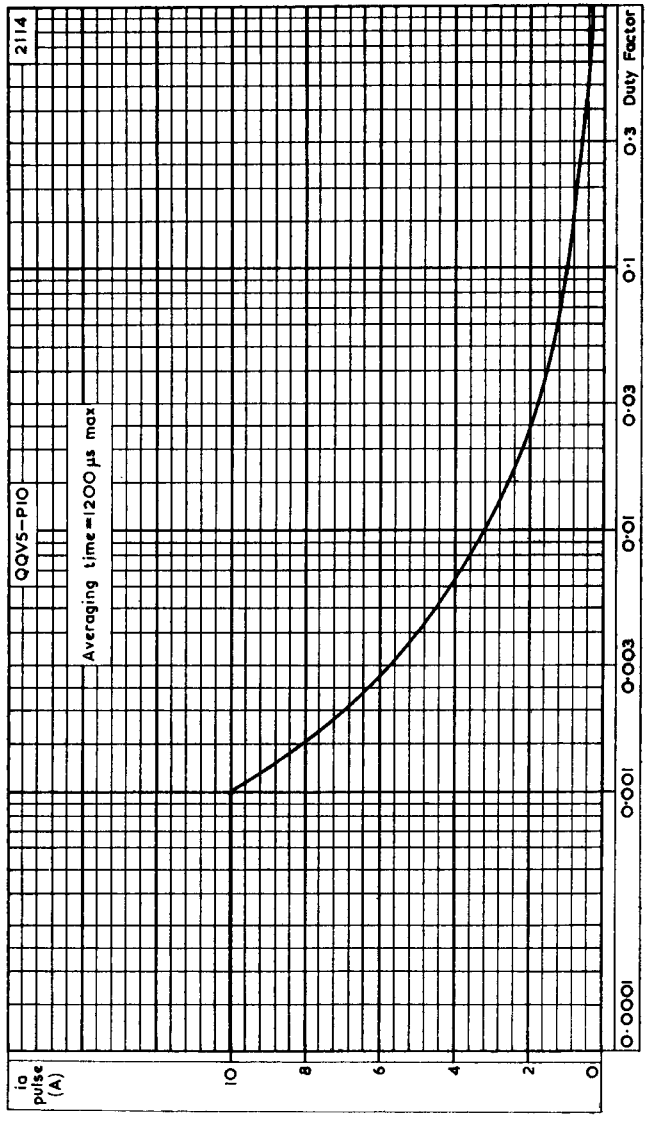


ANODE, SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE

DOUBLE TETRODE PULSE MODULATOR

QQV5-P10

Double tetrode for pulsed applications having ratings of 5kV and 10A.



MAXIMUM PULSE ANODE CURRENT PLOTTED AGAINST DUTY FACTOR

DOUBLE TETRODE PULSE MODULATOR

QQV5-P10

QUICK REFERENCE DATA

Double tetrode for pulsed applications

Performance

$i_{a(pulse)}$	10	A
V_a	5.0	kV
t_p	1.0	μs
$i_{a(pulse)}$ max.	10	A
V_a max.	5.0	kV

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES which precede this section of the handbook.

OPERATION AS PULSE MODULATOR

Design centre maximum operating conditions

				*	
t_p	0.1	1.0	3.0	1.0	μs
P.R.F.	1200	1200	330	1000	p/s
D.F.	0.00012	0.0012	0.001	0.001	
V_a	4.5	4.5	4.5	5.0	kV
V_{g2}	800	800	800	850	V
$-V_{g1}$	200	200	200	200	V
$v_{g1(pulse)}$	350	300	350	350	V
$i_{a(pulse)}$	9.0	8.0	9.0	10	A
I_a	1.1	9.6	9.0	10	mA
I_{g2}	0.25	1.5	2.0	2.0	mA
I_{g1}	0.125	0.625	1.0	1.0	mA
R_a	400	450	400	400	Ω

*This condition includes some of the absolute maximum ratings and therefore assumes protective conditions of operation.

ABSOLUTE MAXIMUM RATINGS
(Two sections in parallel)

V_a max.	5.0	kV
$v_{a(pulse)}$ max.	5.75	kV
V_{g2} max.	850	V
$-V_{g1}$ max.	225	V
$-v_{g1(pulse)}$ max.	600	V
$+v_{g1(pulse)}$ max.	250	V
$i_{a(pulse)}$ max.	See curve on page C2	
$i_{g2(pulse)}$ max.	3.5	A
$i_{g1(pulse)}$ max.	4.0	A
p_a max.	15	W
$p_{in(mean)}$ max.	85	W
$p_{g2(mean)}$ max.	3.0	W
$p_{g1(mean)}$ max.	1.0	W
V_{h-k} max.	100	V

CATHODE

Indirectly heated for series or parallel operation.

	Series	Parallel	
V_h	12.6	6.3	V
I_h	1.2	2.4	A

CAPACITANCES (each section)

c_{out}	7.0	pF
c_{in}	14.0	pF

CHARACTERISTICS (measured at I_a = 60mA)
(each section)

gm	8.5	mA/V
$\mu g1-g2$	9.0	

MOUNTING POSITION

Vertical - Base up or down.

Horizontal - Anode pins in horizontal plane.

DOUBLE TETRODE PULSE MODULATOR

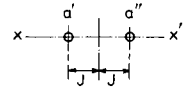
QQV5-P10

COOLING — Natural

PHYSICAL DATA

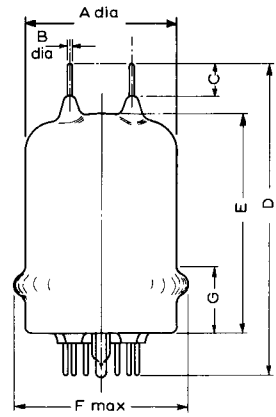
	oz	g
Weight of valve	4.00	110
Weight of valve and carton	9.25	270

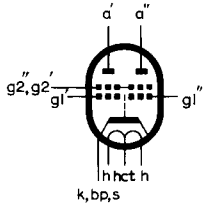
DIMENSIONS



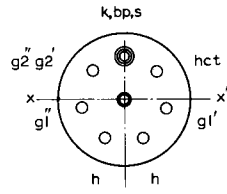
location of anode pins within circles of diameter "H"

A	2.00	50.80
B	0.056±0.004	1.42±0.10
C	0.500±0.125	12.70±3.18
D	4.121±0.191	104.68±4.86
E	3.062±0.187	77.78±4.74
F	2.376	60.35
G	1.031±0.188	26.19±4.77
H	0.120±0.001	3.05±0.025
J	0.424±0.001	10.77±0.025

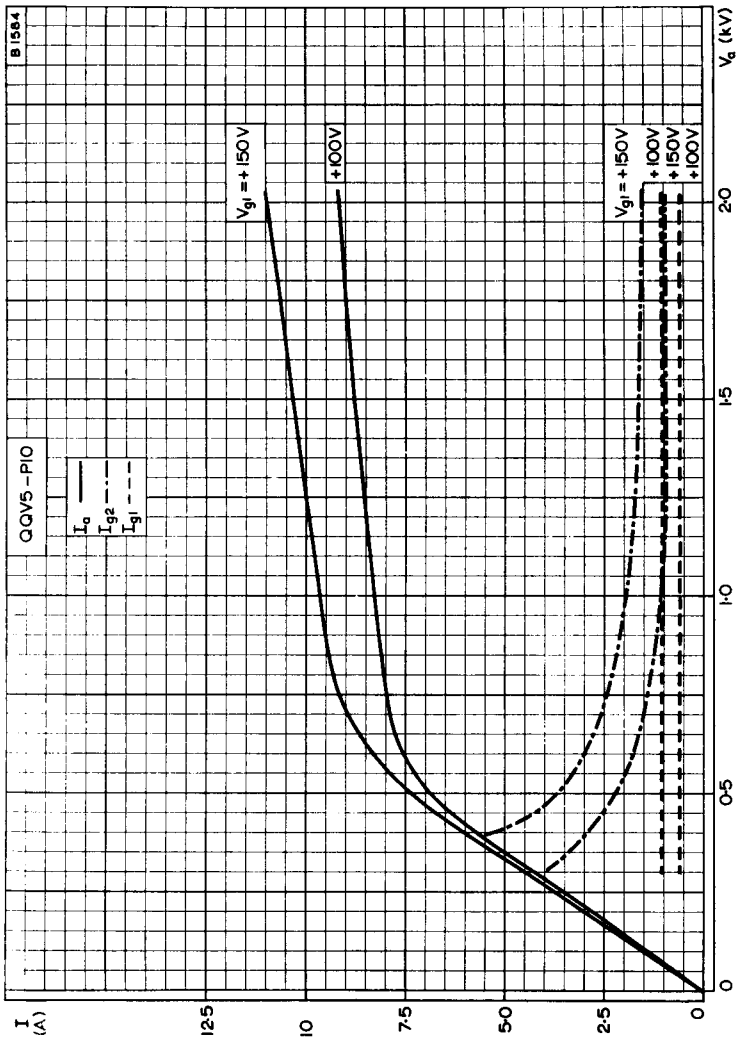




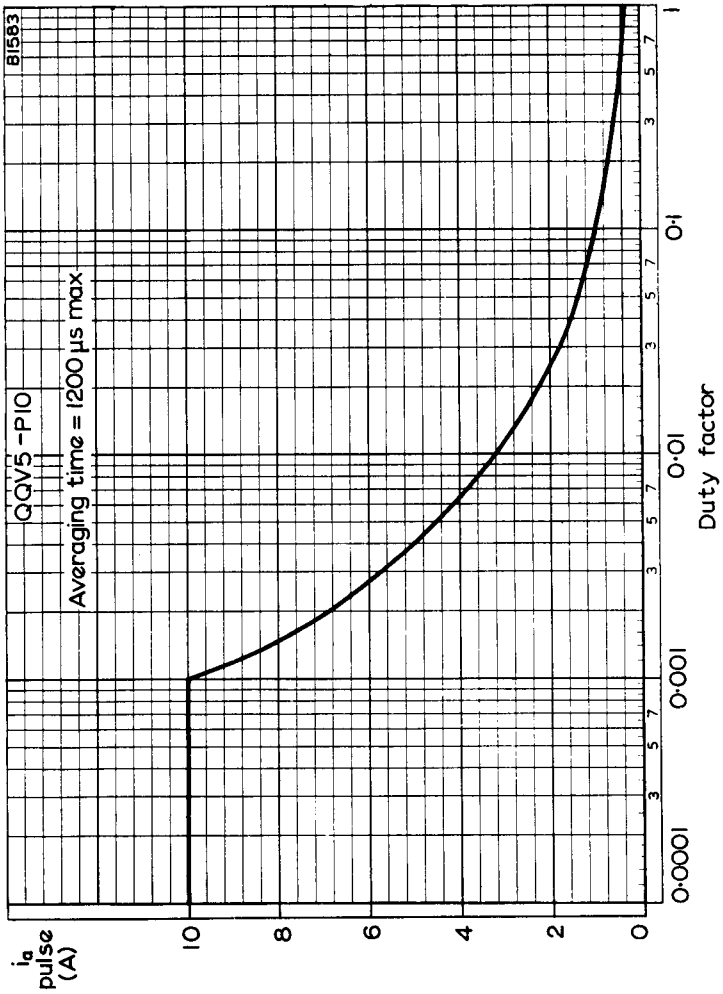
B 1585



B7A base



ANODE, SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE



MAXIMUM PULSE ANODE CURRENT PLOTTED AGAINST DUTY FACTOR

R.F. POWER DOUBLE TETRODE

QQV02-6

Application: R.F. amplifier or frequency multiplier.
Power output: 5.8W at 500Mc/s.
Frequency: 500Mc/s at full ratings.
Construction: All-glass, natural cooling.

This data sheet should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES which precede this section of the handbook.

CATHODE

Indirectly heated. The heater is centre-tapped and the two sections may be operated in series or parallel with one another.

	Series	*Parallel*	
*V_h	12.6	6.3	V
I_h	300	600	mA

*Emergency operation of the heater down to 5.7V (11.4V) and up to 7.0V (14V) is permissible.

MOUNTING POSITION

Any

For reasons of cooling and the performance of the valve at v.h.f. the use of a closed screening can is not permissible.

CAPACITANCES

*c_{a-g1} (each section)	< 160	mpF
c_{g1-all} (each section)	6.4	pF
c_{a-all} (each section)	1.6	pF
c_{out} (two sections in push-pull)	950	mpF
c_{in} (two sections in push-pull)	3.8	pF

*Internally neutralised for push-pull operation

CHARACTERISTICS (each section) measured at $V_a = V_{g2} = 150V$, $I_a = 25mA$

g_m	10.5	mA/V
μ_{g1-g2}	31	

COOLING

Radiation and convection

T_{bulb} max.	225	°C
T_{pin} max.	120	°C

QQV02-6 R.F. POWER DOUBLE TETRODE

CLASS "C" TELEGRAPHY OR F.M. TELEPHONY

Limiting values

f max.	500	Mc/s
V_a max.	250	V
p_a max.	2×3.0	W
I_a max.	2×45	mA
V_{g2} max.	200	V
p_{g2} max.	2×1.5	W
$-V_{g1}$ max.	50	V
p_{g1} max.	2×100	mW
I_{g1} max.	2×3.0	mA
V_{h-k} max.	100	V

Typical operation

f	500	Mc/s
V_a	180	V
V_{g2}	180	V
V_{g1}	−20	V
R_{g1-k} (each section)	27	kΩ
I_a	2×27.5	mA
I_{g2}	2×6.25	mA
I_{g1}	2×1.0	mA
$v_{in(g1-g1)pk}$	50	V
$P_{load(driver)}$	1.2	W
p_a	2×2.1	W
p_{g2}	2×1.13	W
P_{out}	5.8	W
P_{load} ($\eta_{transfer}$ = 77%)	4.5	W
η_a	58	%

CLASS "C" ANODE AND SCREEN-GRID MODULATION

Limiting values (carrier condition for use with a modulation factor of 1)

f max.	500	Mc/s
V_a max.	200	V
p_a max.	2×2.0	W
I_a max.	2×32	mA
V_{g2} max.	200	V
p_{g2} max.	2×1.0	W
$-V_{g1}$ max.	50	V
p_{g1} max.	2×100	mW
I_{g1} max.	2×3.0	mA
V_{h-k} max.	100	V

Typical operation

f	500	Mc/s
V_a	180	V
$V_{g2(b)}$	180	V
R_{g2}	100	Ω
V_{g1}	−25	V
R_{g1-k} (each section)	68	kΩ
I_a	2×20	mA
I_{g2}	2×4.75	mA
I_{g1}	2×0.4	mA
$v_{in\ (g1-g1)\ pk}$	55	V
$P_{load(driver)}$	1.0	W
p_a	2×1.5	W
p_{g2}	2×850	mW
P_{out}	4.2	W
P_{load} ($\eta_{transfer}$ = 71%)	3.5	W
η_a	58	%
For 100% modulation		
$v_{g2(pk)mod}$	175	V
P_{mod}	4.5	W

FREQUENCY MULTIPLIER

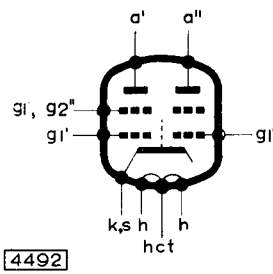
Limiting values

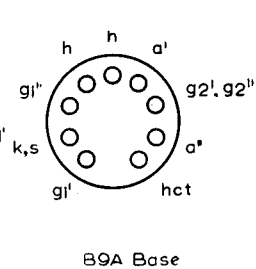
f max.	500	Mc/s
V_a max.	250	V
p_a max.	2×3.0	W
i_a max.	2×30	mA
V_{g2} max.	200	V
p_{g2}	2×1.5	W
$-V_{g1}$ max.	100	V
p_{g1} max.	2×100	mW
I_{g1} max.	2×3.0	mA
V_{h-k} max.	100	V

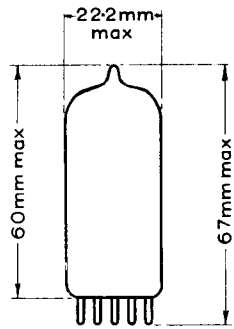
Typical operation

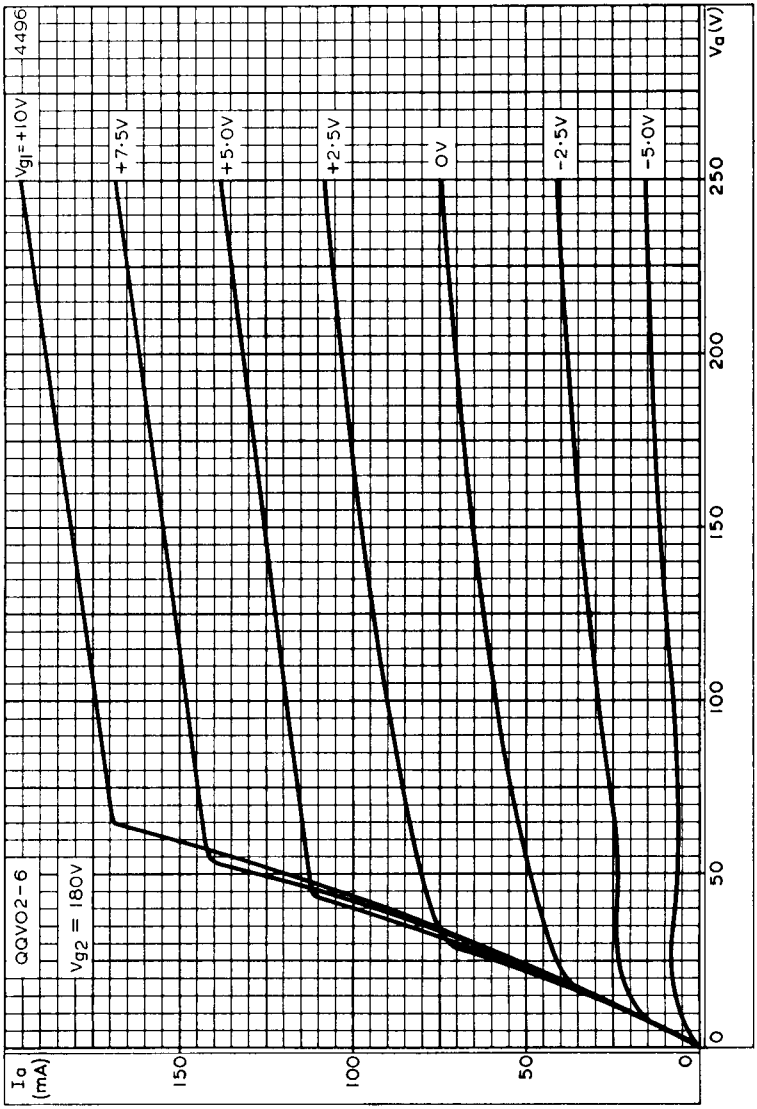
f_{in}	166.6	Mc/s
f_{out}	500	Mc/s
V_a	180	V
$V_{g2(b)}$	180	V
R_{g2}	1.2	kΩ
R_{g1-k} (each section)	82	kΩ
I_a	2×20	mA
I_{g2}	2×4.85	mA
I_{g1}	2×0.9	mA
$v_{in(g1-g1)pk}$	165	V
$P_{load(driver)}$	1.1	W
p_a	2×2.45	W
p_{g2}	2×830	mW
P_{out}	2.4	W
P_{load} ($\eta_{transfer}$ = 83%)	2.0	W
η_a	33	%

QQV02-6 R.F. POWER DOUBLE TETRODE

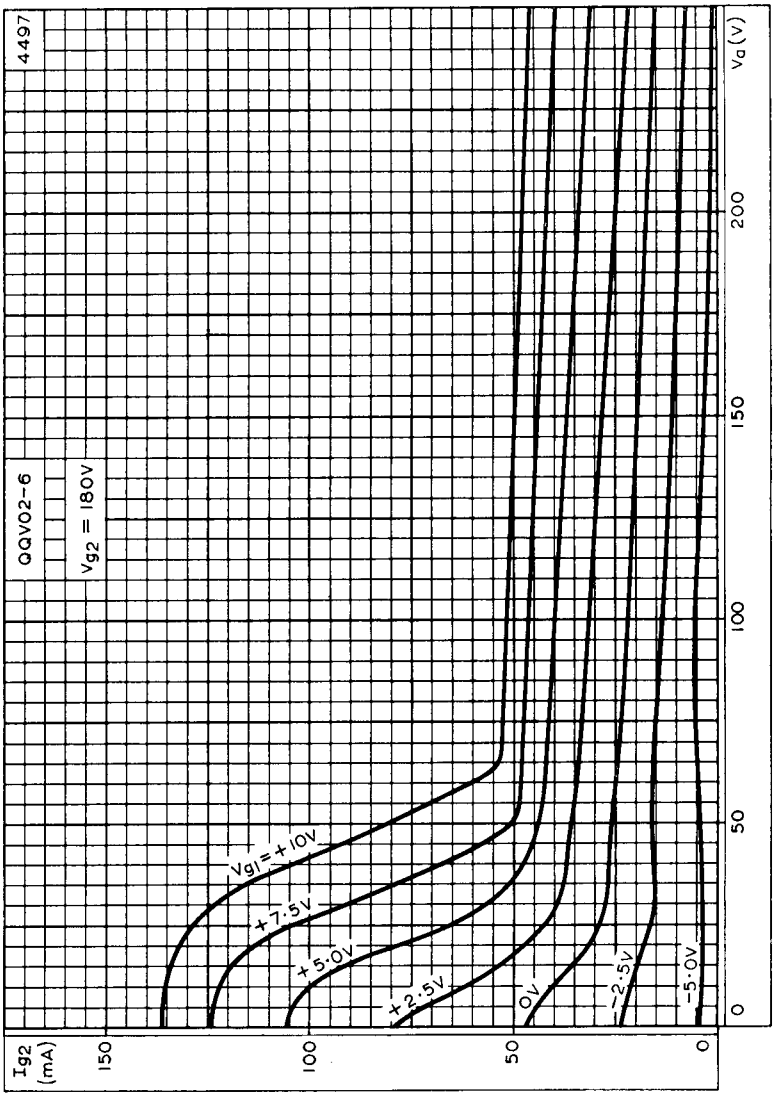




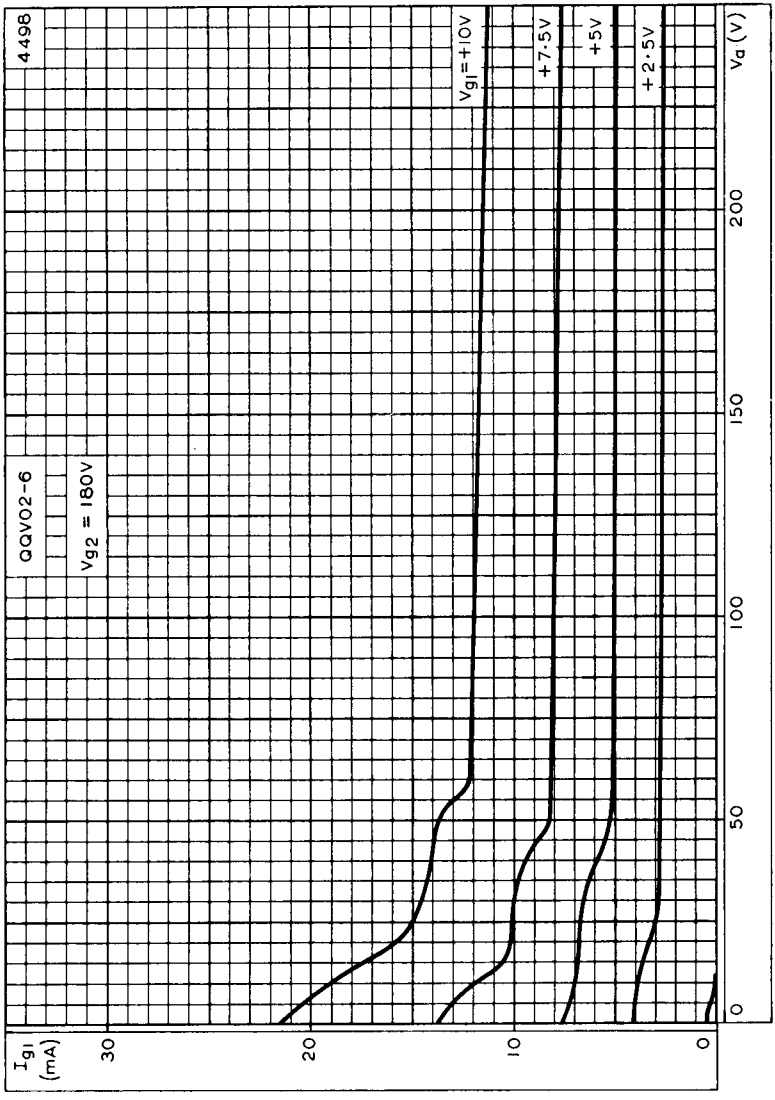




ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE, V_{g2} = 180V

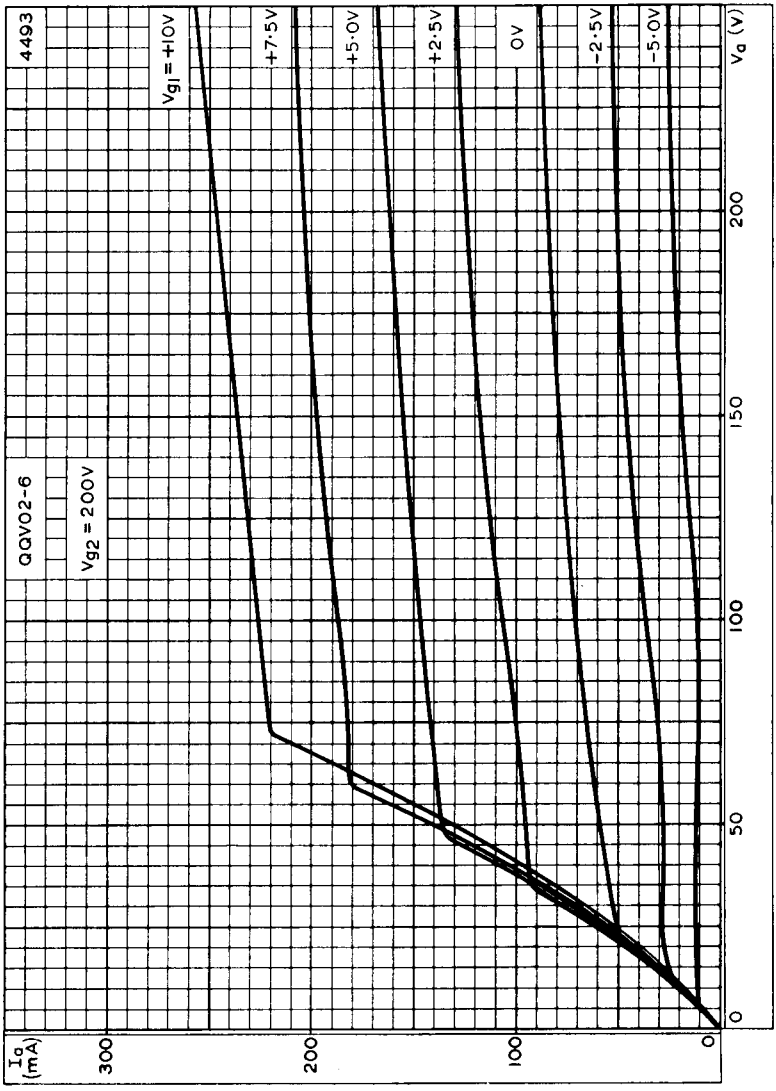


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE, V_{g2} = 180V

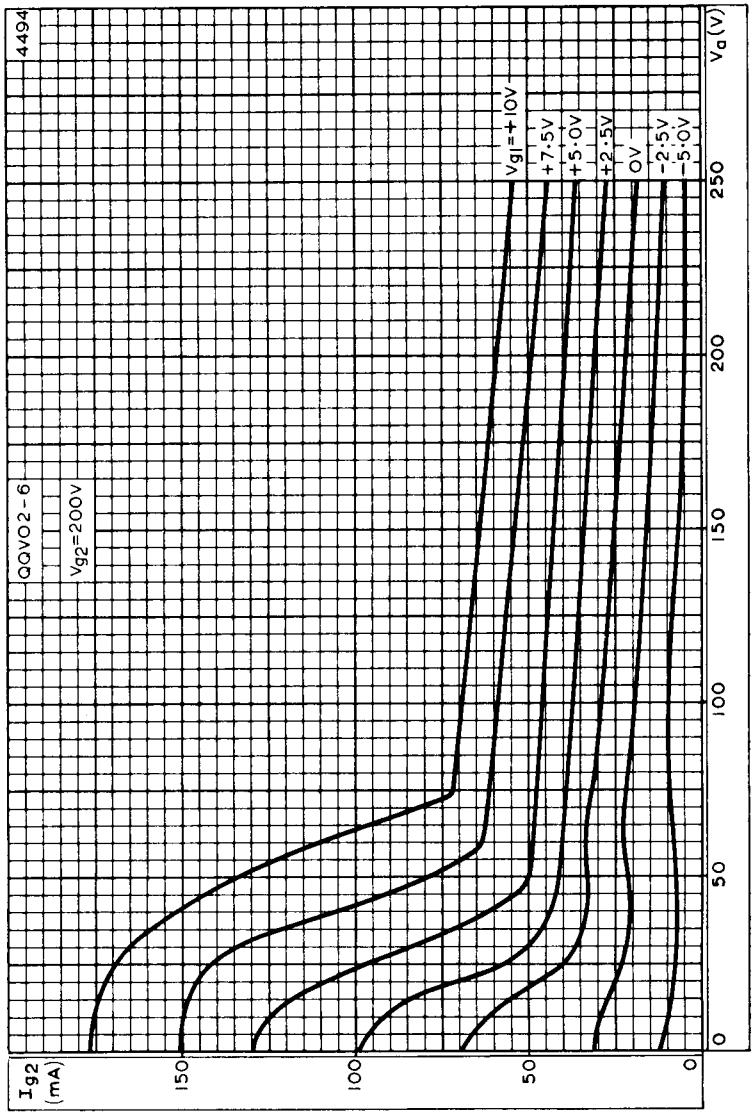


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE, $V_{g2}=180V$

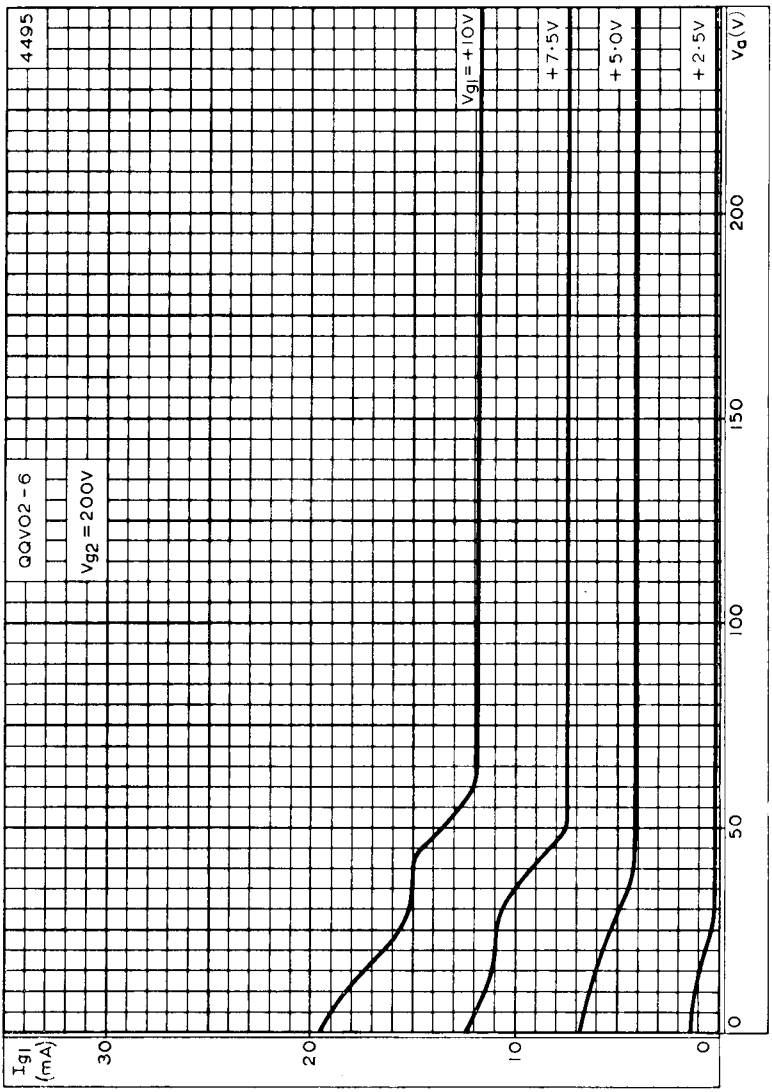
QQV02-6 R.F. POWER DOUBLE TETRODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE, V_{g2} = 200V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE, V_{g2}=200V



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE, V_{g2} = 200V

R.F. POWER DOUBLE TETRODE QQV03-10

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225 Mc/s.

CATHODE

Indirectly heated

	Series	*Parallel*	
*V_h	12.6	6.3	V
I_h	0.42	0.83	A
t_{h-k}		22	sec

*Emergency operation of the heater down to 5.3V (10.6V) and up to 7.8V (15.6V) is permissible.

MOUNTING POSITION

Any

When the valve is mounted in a horizontal position it is essential that pins 2 and 7 are placed in a vertical plane.

For reasons of cooling and the performance of the valve at v.h.f. the use of a closed screening can is not permissible.

CAPACITANCES

*c_{a-g1} (each section)	<0.1	pF
c_{g1-all} (each section)	6.2	pF
c_{a-all} (each section)	2.6	pF
c_{out} (two sections in push-pull)	1.5	pF
c_{in} (two sections in push-pull)	5.0	pF

*Internally neutralised for push-pull operation.

CHARACTERISTICS (each section) measured at I_a=30mA

g_m	3.3	mA/V
μ_{g1-g2}	7.5	

COOLING

Radiation and convection

T_{bulb} max.	225	°C
T_{pin} max.	120	°C

QQV03-10 R.F. POWER DOUBLE TETRODE

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225 Mc/s.

OPERATION AS SINGLE VALVE R.F. POWER AMPLIFIER OR OSCILLATOR (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	300	V
p_a max.	2×5.0	W
V_{g_2} max.	200	V
p_{g_2} max.	2×1.0	W
I_{g_1} max.	2×3.0	mA
p_{g_1} max.	200	mW
I_k max.	2×50	mA
$i_{k(pk)}$ max.	2×225	mA
$-V_{g_1}$ max.	150	V
V_{h-k} max.	100	V

Typical Operating Conditions

f	100	175	175	200	Mc/s
V_a	300	200	250	300	V
*V_{g_2}	175	150	175	175	V
*V_{g_1}	−40	−40	−40	−40	V
I_a	2×38	2×35	2×35	2×38	mA
I_{g_2}	2×2.5	2×1.5	2×1.5	2×1.5	mA
I_{g_1}	2×2.0	2×1.8	2×1.5	2×1.5	mA
$P_{load\ (driver)}$	250	500	400	500	mW
$v_{in(g_1-g_1)pk}$	110	115	105	110	V
p_a	2×3.4	2×3.0	2×3.0	2×4.5	W
P_{out}	16	8.5	11	14	W
P_{load}	14	7.0	8.5	10	W

*When V_{g_2} and/or V_{g_1} are obtained by means of resistors (R_{g_2} and R_{g_1}) the anode input power and therefore the output power is likely to vary considerably from valve to valve. For optimum operating conditions it will be necessary therefore to make R_{g_2} adjustable.

R.F. POWER DOUBLE TETRODE

QQV03-10

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225 Mc/s.

OPERATION AS SINGLE VALVE R.F. AMPLIFIER (CLASS "C" ANODE AND SCREEN-GRID MODULATION)

Limiting Values (carrier condition for use with modulation factor of 1) ←

V_a max.	250	V
p_a max.	2×3.3	W
V_{g2} max.	200	V
p_{g2} max.	2×650	mW
p_{g1} max.	2×200	mW
I_k max.	2×35	mA
$i_{k(pk)}$ max.	2×180	mA
$-V_{g1}$ max.	150	V
I_{g1} max.	2×3.0	mA
V_{h-k} max.	100	V

Typical Operating Conditions ←

f	175	Mc/s
V_a	200	V
V_{g2}	175	V
V_{g1}	−60	V
I_a	2×34	mA
I_{g2}	2×1.5	mA
I_{g1}	2×1.2	mA
$v_{in(g1-g1)pk}$	150	V
$P_{load\ (driver)}$	1.0	W
p_a	2×2.4	W
p_{out}	9.0	W
P_{load}	7.0	W
For 100% modulation		
*$v_{g2(pk)mod}$	125	V
P_{mod}	6.8	W

*Conveniently obtained from potential divider consisting of a 12kΩ and 39kΩ resistors across the secondary of the modulation transformer.

QQV03-10 R.F. POWER DOUBLE TETRODE

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225 Mc/s.

OPERATION AS A FREQUENCY TREBLER

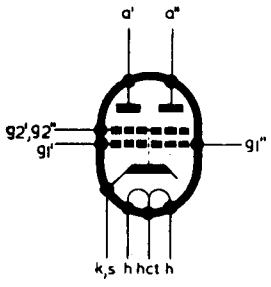
Limiting Values

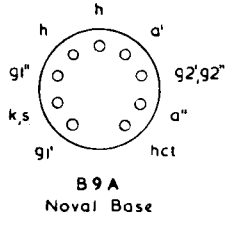
V_a max.	300	V
p_a max.	2×5.0	W
V_{g_2} max.	200	V
p_{g_2} max.	2×1.0	W
$-V_{g_1}$ max.	150	V
p_{g_1} max.	2×200	mW
I_{g_1} max.	2×2.0	mA
I_k max.	2×35	mA
$i_{k(pk)}$ max.	2×225	mA
V_{h-k} max.	100	V

Typical Operating Conditions

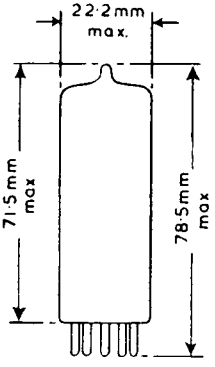
f_{out}	175	175	Mc/s
V_a	200	300	V
V_{g_2}	150	150	V
V_{g_1}	−100	−125	V
I_a	2×15	2×24	mA
I_{g_2}	2×0.5	2×1.3	mA
I_{g_1}	2×0.5	2×1.3	mA
$v_{in(g_1-g_1)pk}$	210	250	V
$P_{load\ (driver)}$	300	500	mW
p_a	2×2.0	2×4.5	W
P_{out}	2.0	5.5	W
P_{load}	1.5	3.5	W

1738





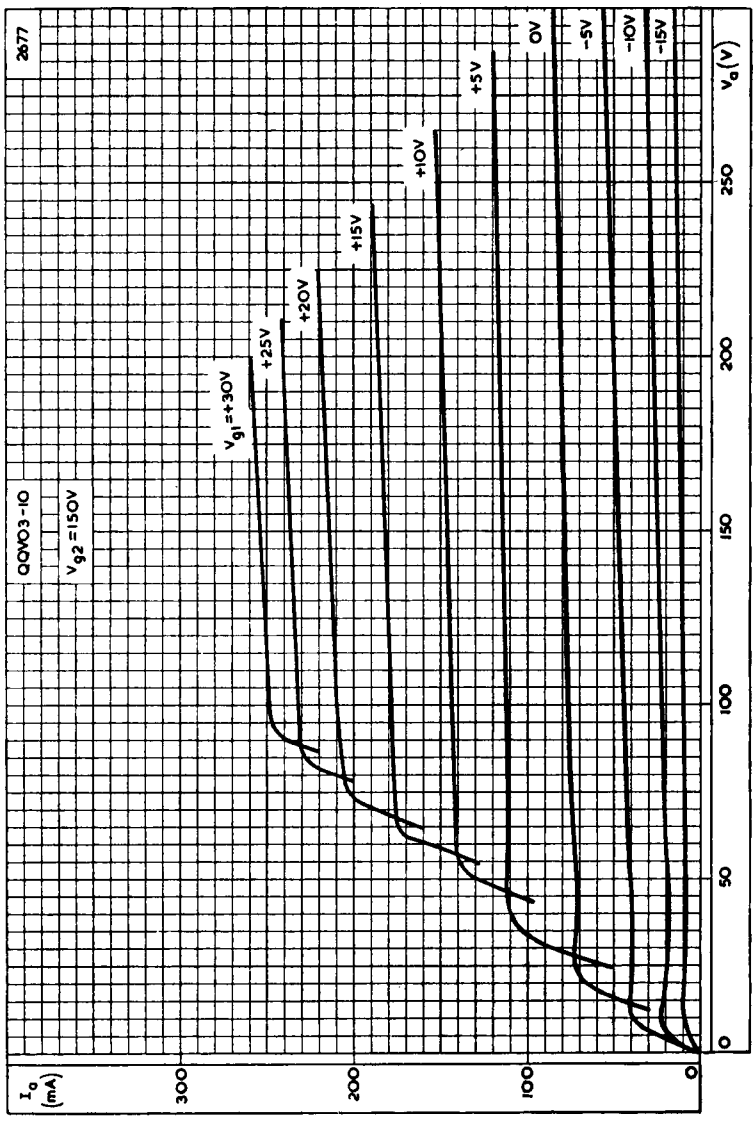
B9A
Noval Base



R.F. POWER DOUBLE TETRODE

QQV03-10

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.

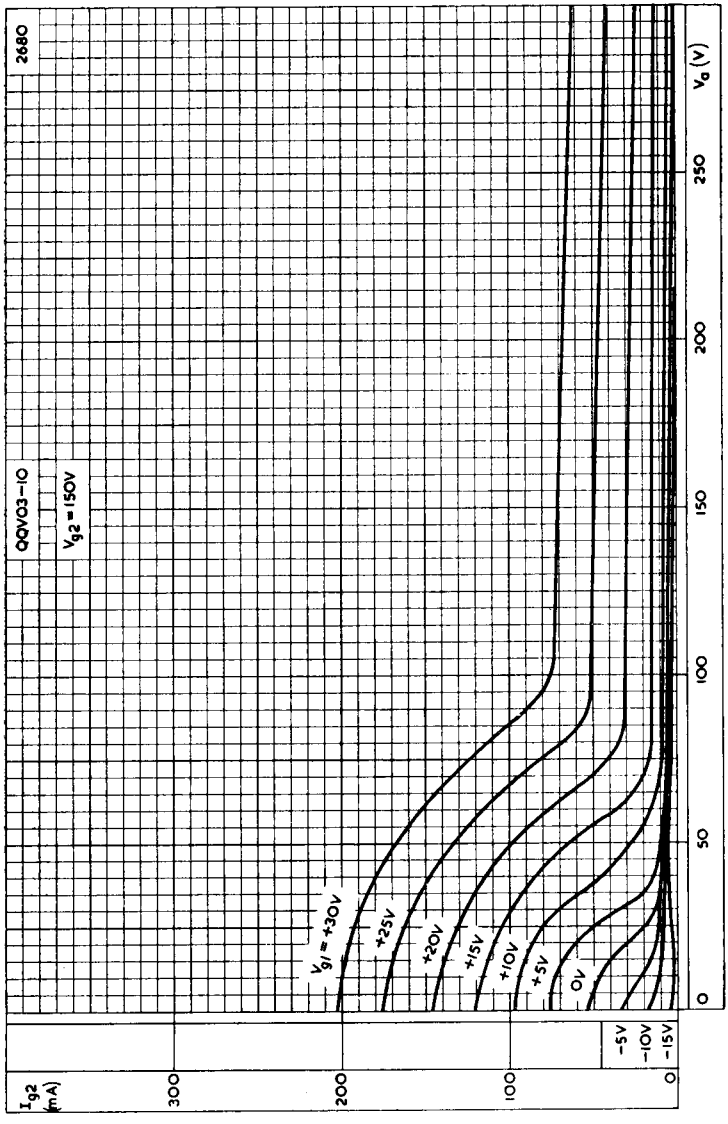


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g2}=150V

QQV03-10

R.F. POWER DOUBLE TETRODE

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.

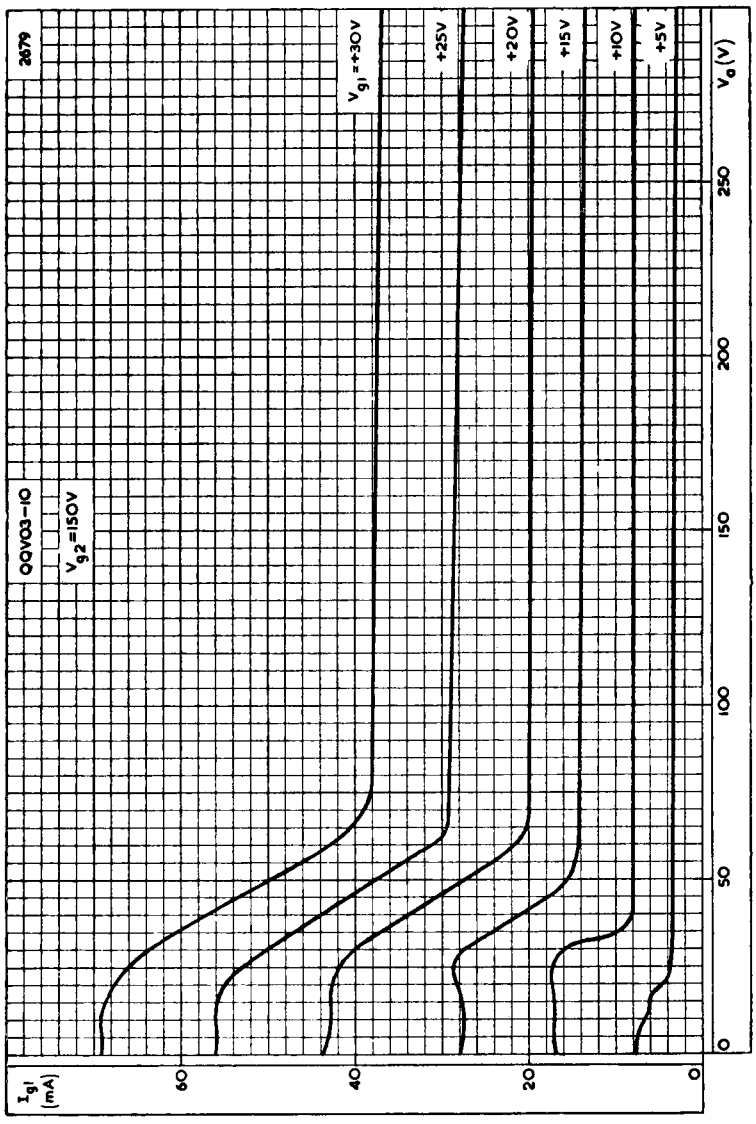


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g_2} = 150V

R.F. POWER DOUBLE TETRODE

QQV03-10

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
V_{g2}=150V

QQV03-10

R.F. POWER DOUBLE TETRODE

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.

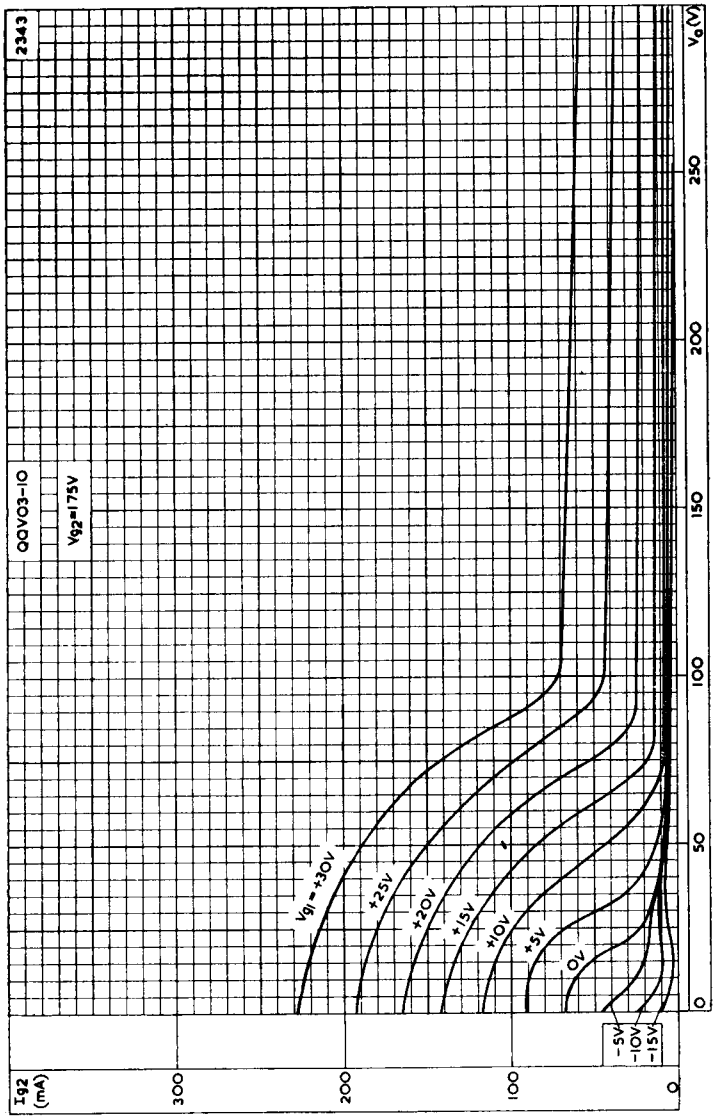


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g_2} = 175V

R.F. POWER DOUBLE TETRODE

QQV03-10

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.

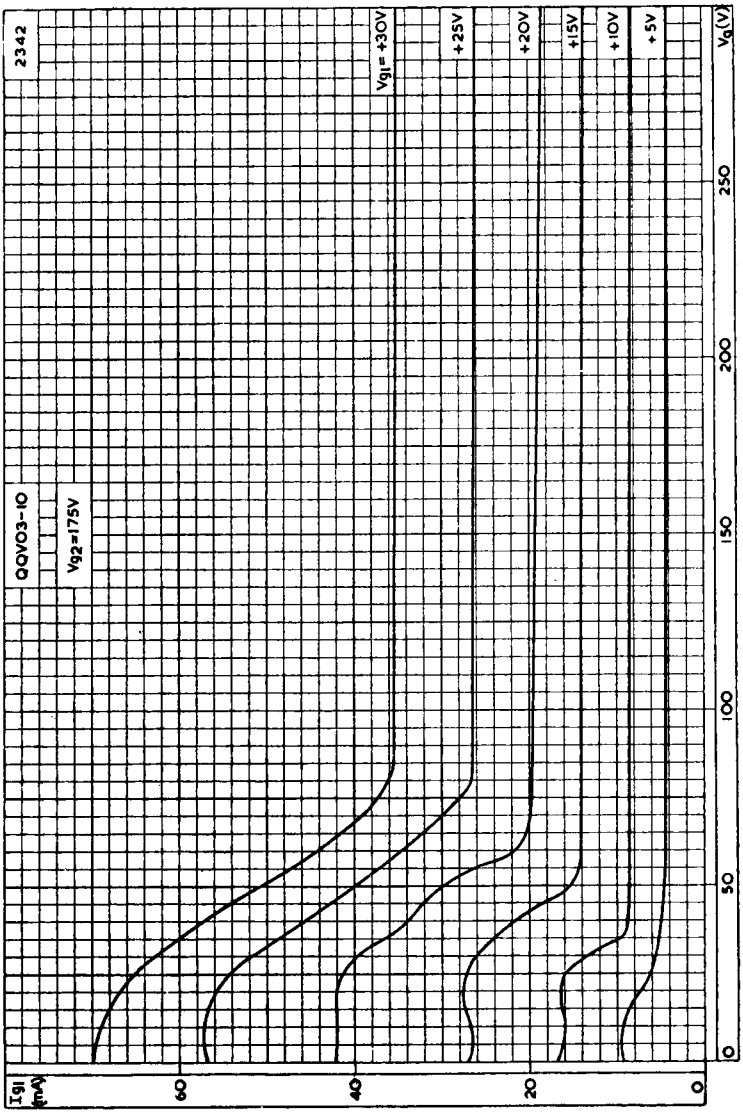


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g_2}=175V

QQV03-10

R.F. POWER DOUBLE TETRODE

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.

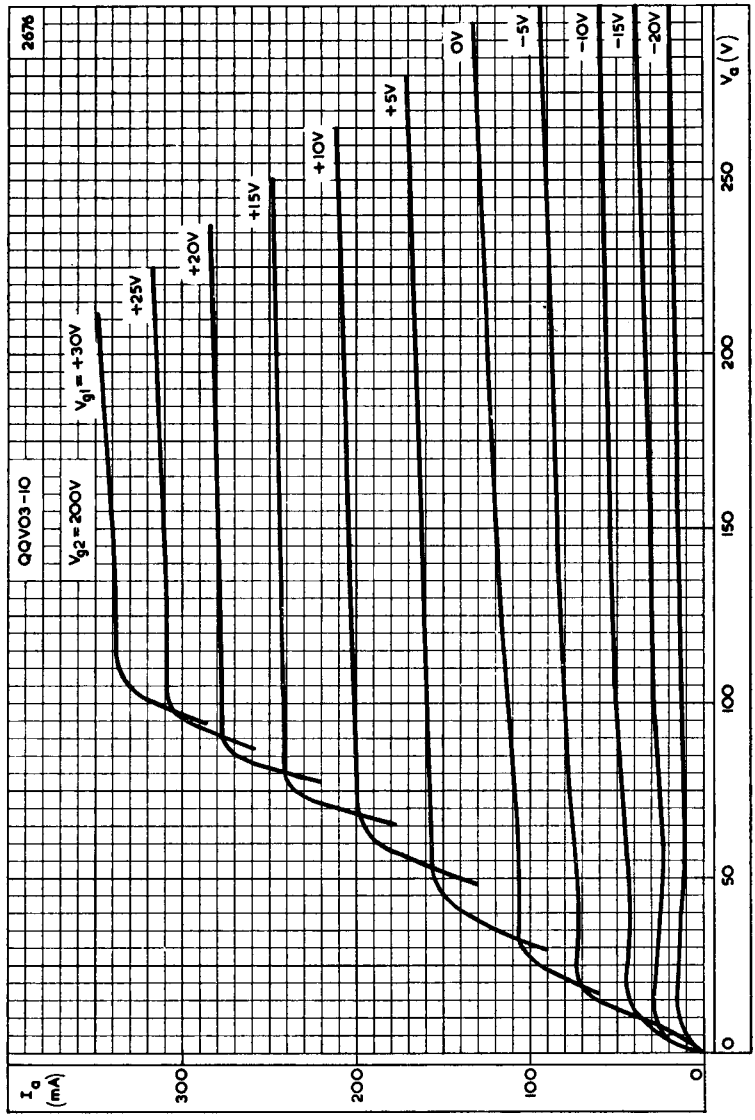


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
V_{g_2} = 175V

R.F. POWER DOUBLE TETRODE

QQV03-10

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.

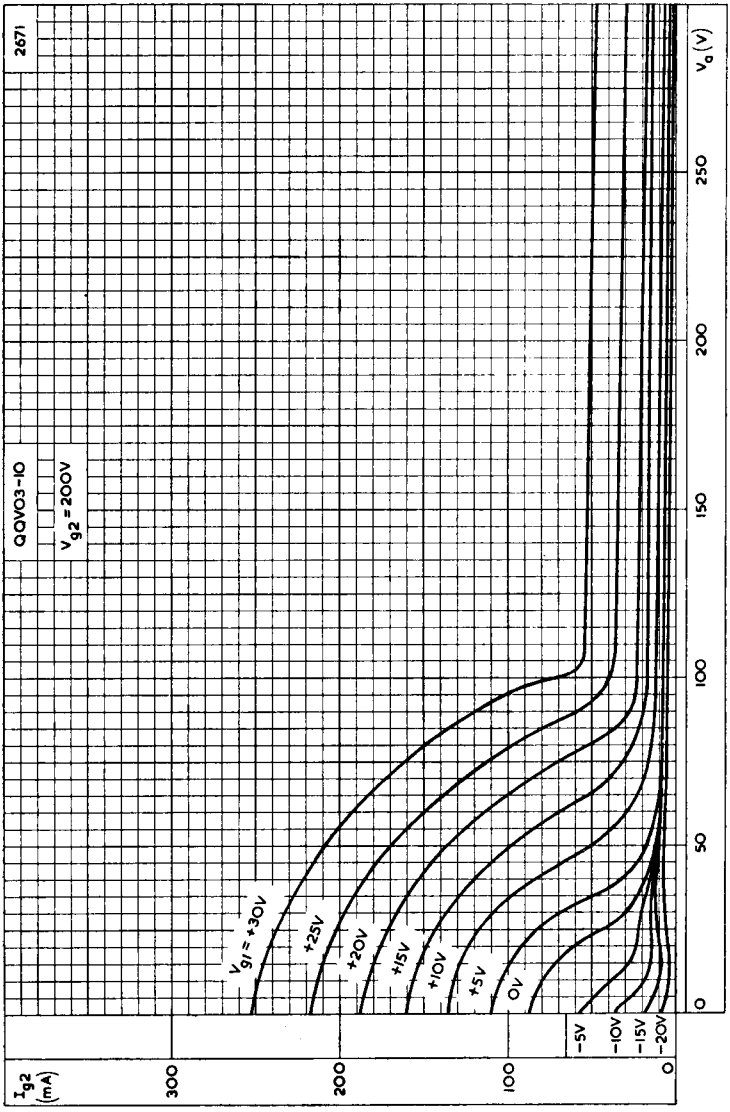


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g_2}=200V

QQV03-10

R.F. POWER DOUBLE TETRODE

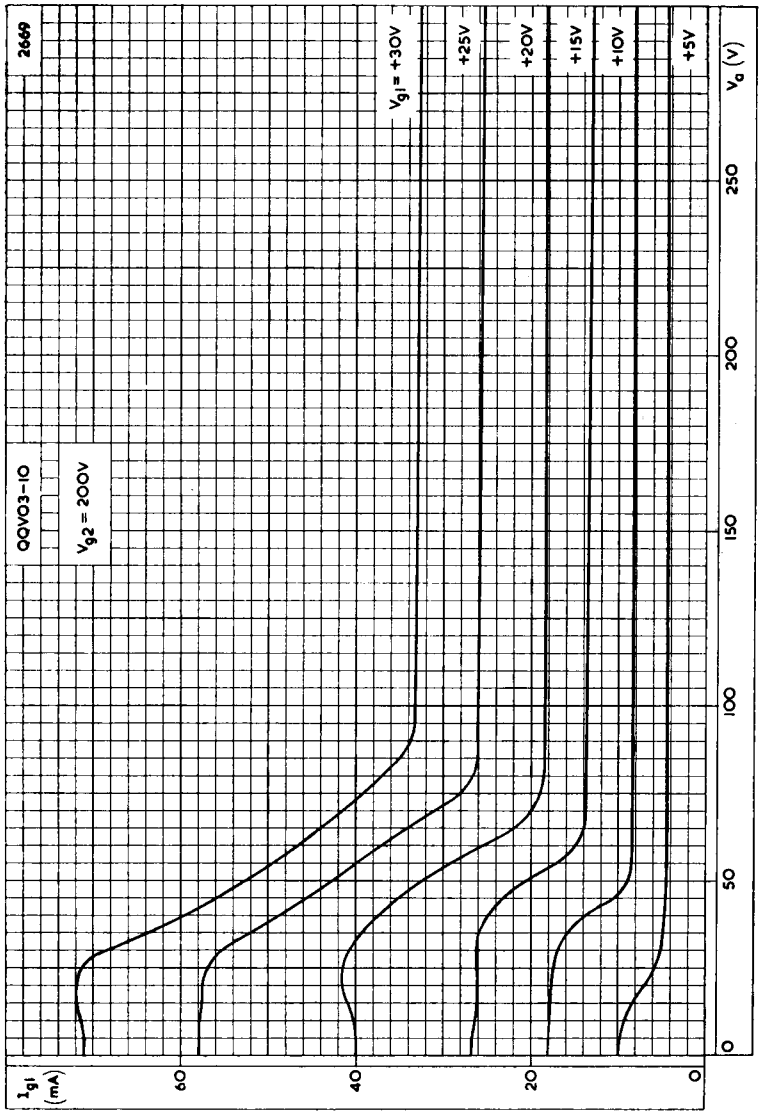
Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g2} = 200V

R.F. POWER DOUBLE TETRODE QQV03-10

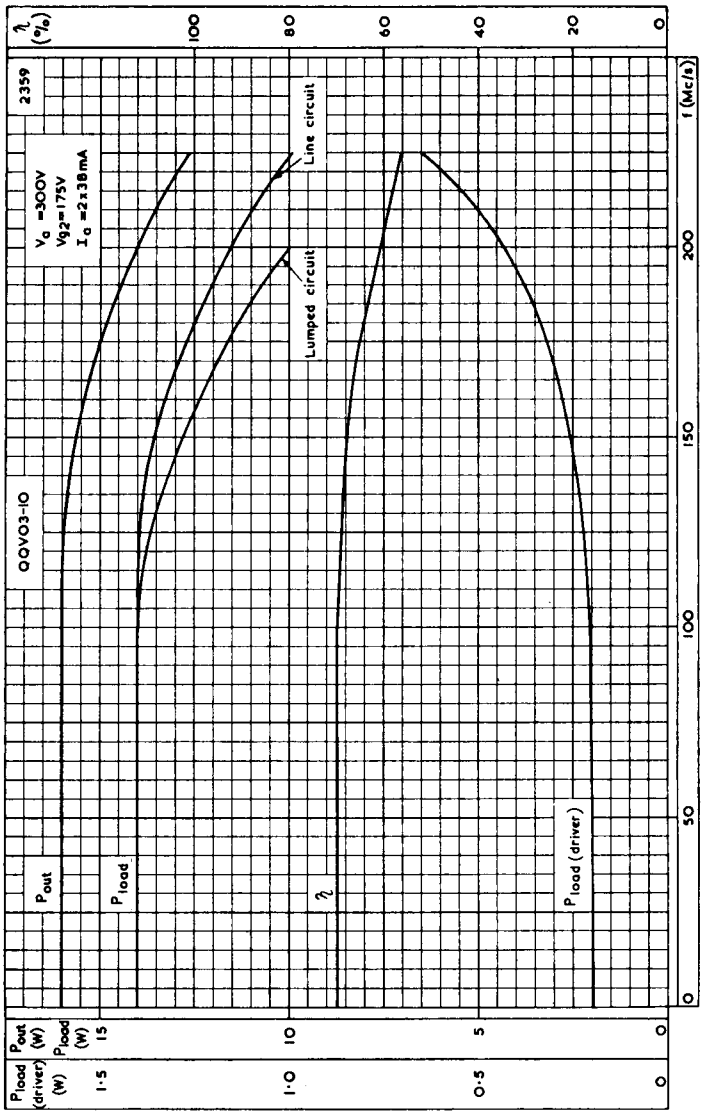
Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
V_{g2} = 200V

QQV03-10 R.F. POWER DOUBLE TETRODE

Miniature r.f. double tetrode rated to dissipate 5W at each anode and intended for use at frequencies up to 225Mc/s.



FREQUENCY CHARACTERISTICS. SINGLE VALVE CLASS "C" TELEGRAPHY

V.H.F. POWER DOUBLE TETRODE

QQV03-20A

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

CATHODE

Indirectly heated. The heater is centre-tapped and the two sections may be operated in series or parallel with one another.

	Series	*Parallel*	
V_h	12.6	6.3	V
I_h	0.65	1.3	A

MOUNTING POSITION

Fixed station operation	Vertical – base up or down
	Horizontal – anode pins in horizontal plane
Mobile operation	Vertical – base up or down

CAPACITANCES

*c_{a-g1} (each section)	0.04	pF
c_{g1-all} (each section)	7.5	pF
c_{a-all} (each section)	2.6	pF
c_{out} (two sections in push-pull)	1.6	pF
c_{in} (two sections in push-pull)	4.4	pF

*Internally neutralised for push-pull operation

CHARACTERISTICS (each section) measured at I_a = 20mA

g_m	2.5	mA/V
μ_{g1-g2}	8.0	

COOLING

Maximum base pin temperature	180	°C
Maximum bulb and anode seal temperature	200	°C

Anode connectors providing a high degree of heat transfer by radiation or by conduction should be used.

Natural cooling is sufficient with—

V_a = 600V at frequencies up to 150Mc/s

V_a = 500V at frequencies up to 200Mc/s

V_a = 300V at freuqencies up to 430Mc/s

Above these limits or with high ambient temperatures it may be necessary to direct a flow of air (up to 5cu.ft. per min.) on the top of the bulb to keep the seal temperature within the stated limit.

QQV03-20A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	See page 14	
p_a max.	2×10	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	300	V ←
p_{g2} max.	2×1.5	W
p_{g1} max.	2×0.5	W
I_{g1} max.	2×2.5	mA ←
I_k max.	2×55	mA
$i_{k(pk)}$ max.	2×260	mA
$-V_{g1}$ max.	75	V
R_{g1-k} max. per section (fixed bias)	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	kΩ
V_{h-k} max.	100	V

Typical operating conditions

f	200	200	200	200	Mc/s
V_a	200	300	400	600	V
V_{g2}	200	250	250	250	V
V_{g1}	−30	−40	−50	−60	V
I_a	2×50	2×50	2×50	2×50	mA
I_{g2}	2×4.0	2×4.5	2×4.0	2×4.0	mA
*I_{g1}	2×1.0	2×0.7	2×0.7	2×0.7	mA
$P_{load(driver)}$	<1.0	<1.0	1.0	1.5	W
p_a	2×3.5	2×4.5	2×5.0	2×6.0	W
P_{out}	13	21	30	48	W
η	65	70	75	80	%
P_{load}	11	18	25	39	W

f	400	400	400	600	Mc/s
V_a	200	300	400	400	V
V_{g2}	200	250	250	250	V
V_{g1}	−30	−40	−50	−50	V
I_a	2×50	2×50	2×50	2×50	mA
I_{g2}	2×3.0	2×2.5	2×2.5	2×2.5	mA
*I_{g1}	2×0.5	2×0.6	2×0.7	2×0.7	mA
$P_{load(driver)}$	1.0	1.5	2.0	6.0	W
p_a	2×4.5	2×6.5	2×7.5	2×10	W
P_{out}	11	17	25	20	W
η	55	57	63	50	%
P_{load}	9	14	20	15	W

*I_{g1} will vary between valves.

V.H.F. POWER DOUBLE TETRODE

QQV03-20A

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

OPERATING CONDITIONS AS ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY)

Limiting values (carrier conditions for modulation factor of 1)

V_a max.	See page 16	
p_a max.	2×6.7	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	300	V ←
p_{g2} max.	2×1.2	W ←
p_{g1} max.	2×0.5	W
I_{g1} max.	2×2.5	mA
I_k max.	2×50	mA
$i_{k(pk)}$ max.	2×400	mA
$-V_{g1}$ max.	100	V
V_{h-k} max.	100	V

Typical operating conditions for unmodulated carrier

f	200	200	200	400	Mc/s
V_a	300	500	600	300	V
V_{g2}	250	250	250	250	V
V_{g1}	−50	−80	−80	−50	V
I_a	2×40	2×40	2×40	2×40	mA
I_{g2}	2×4.0	2×4.0	2×4.0	2×3.0	mA
*I_{g1}	2×1.0	2×1.0	2×1.0	2×1.0	mA
$P_{load(driver)}$	1.5	3.0	3.0	2.5	W
p_a	2×3.5	2×4.0	2×5.0	2×4.5	W
P_{out}	17	31	38	15	W ←
η	71	78	79	63	%
P_{load}	14	24	32	12	W ←
For 100% modulation					
$v_{g2(pk)}$	185	185	185	185	V
P_{mod}	13	21	25	13	W ←

*I_{g1} will vary between valves

OPERATING CONDITIONS AS FREQUENCY TREBLER

Limiting values

V_a max.	600	V
p_a max.	2×10	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	300	V ←
p_{g2} max.	2×1.5	W
$-V_{g1}$ max.	200	V
I_{g1} max.	2×2.5	mA
p_{g1} max.	2×0.5	W
I_k max.	2×50	mA
$i_{k(pk)}$ max.	2×275	mA
R_{g1-k} max. per section (fixed bias)	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	kΩ
V_{h-k} max.	100	V

QQV03-20A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

Typical operating conditions

f_{out}	200	400	Mc/s
V_a	300	300	V
V_{g2}	250	250	V
V_{g1}	−175	−175	V
I_a	2×45	2×45	mA
I_{g2}	2×3.0	2×2.8	mA
I_{g1}	2×1.5	2×1.2	mA
$P_{load(driver)}$	4.0	5.0	W
p_a	2×8.5	2×9.5	W
P_{out}	10	8.0	W
η_j	37	30	%
P_{load}	8.0	6.0	W

OPERATING CONDITIONS AS A.F. POWER AMPLIFIER AND MODULATOR (CLASS "B")

Limiting values

V_a max.	600	V
p_a max.	2×10	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	300	V
p_{g2} max.	2×1.5	W
$-V_{g1}$ max.	75	V
p_{g1} max.	2×0.5	W
I_k max.	2×55	mA
$i_{k(pk)}$ max.	2×120	mA
R_{g1-k} max. per section (fixed bias)	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	kΩ
V_{h-k} max.	100	V

Typical operating conditions

V_a	300	500	V
V_{g2}	250	250	V
V_{g1}	−25	−26	V
$I_{a(o)}$	2×12.5	2×12.5	mA
I_a (max. sig.)	2×35	2×36.5	mA
$I_{g2(o)}$	2×0.6	2×0.35	mA
I_{g2} (max. sig.)	2×9.5	2×8.1	mA
$p_{a(o)}$	2×3.75	2×6.25	W
p_a (max. sig.)	2×3.9	2×6.5	W
P_{out}	13.2	23.5	W
R_{a-a}	11	20	kΩ
D_{tot}	3.5	3.5	%
$V_{in(g1-g1)r.m.s.}$	35	37	V

ACCESSORIES

Information on these items can be obtained from the Industrial Technical Service Dept., Mullard Ltd.,

WEIGHT

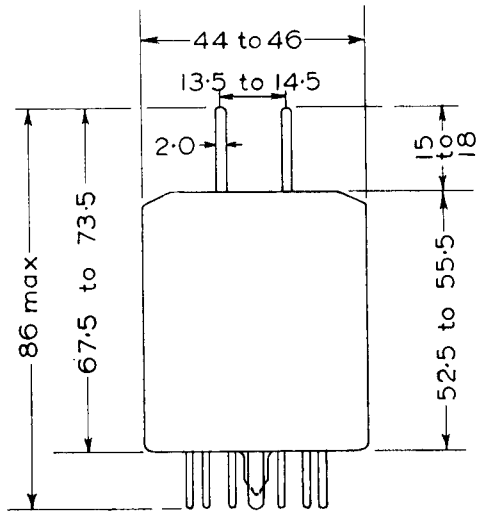
Valve only { 2.0 oz / 53 g

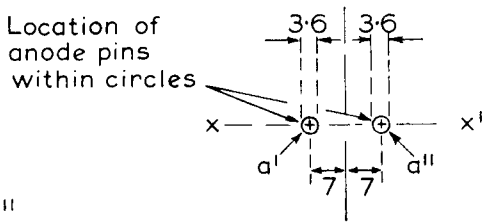
V.H.F. POWER DOUBLE TETRODE

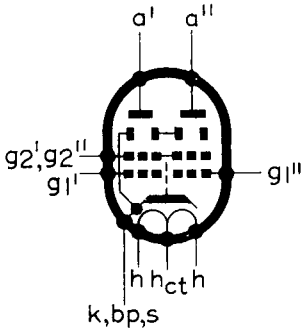
QQV03-20A

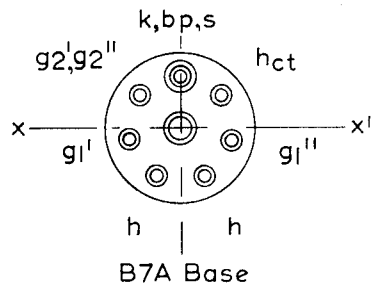
Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

4375







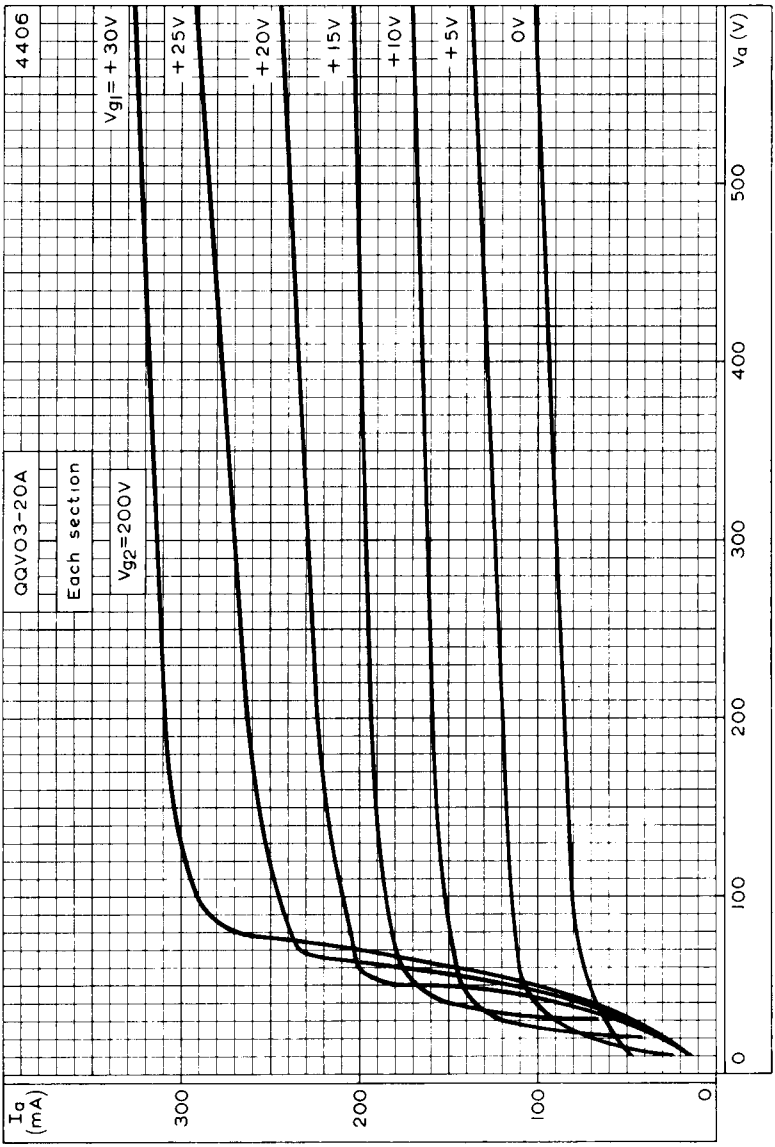


All dimensions in mm

QQV03-20A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

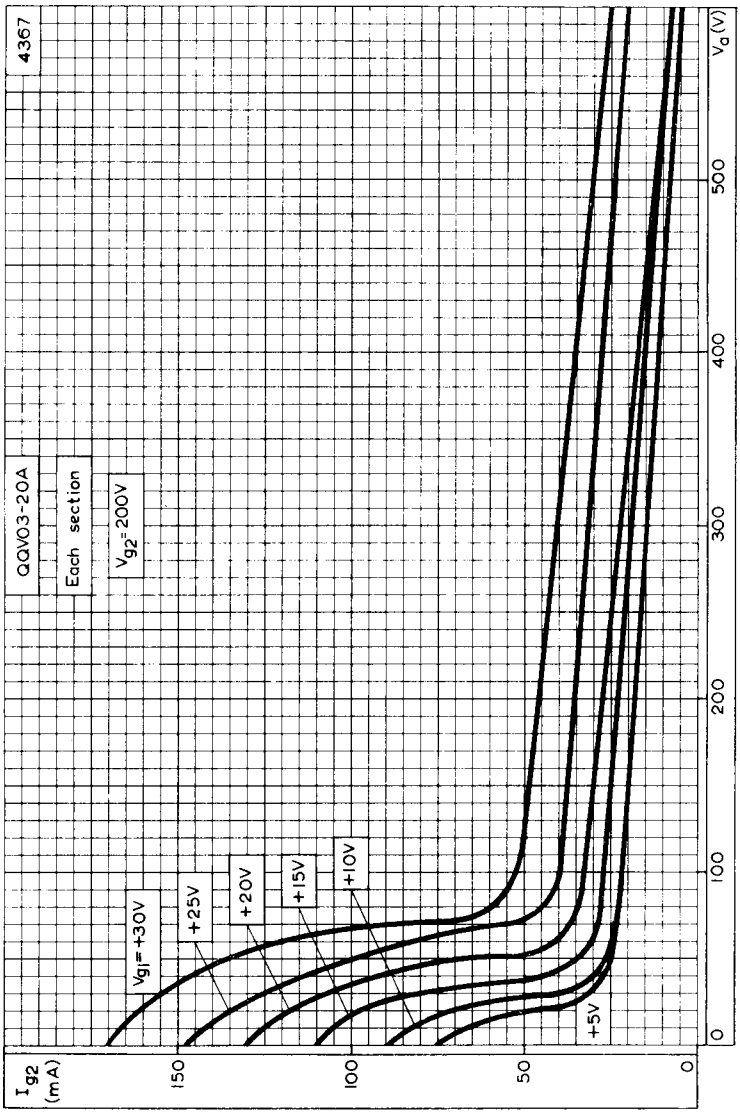


ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V

V.H.F. POWER DOUBLE TETRODE

QQV03-20A

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

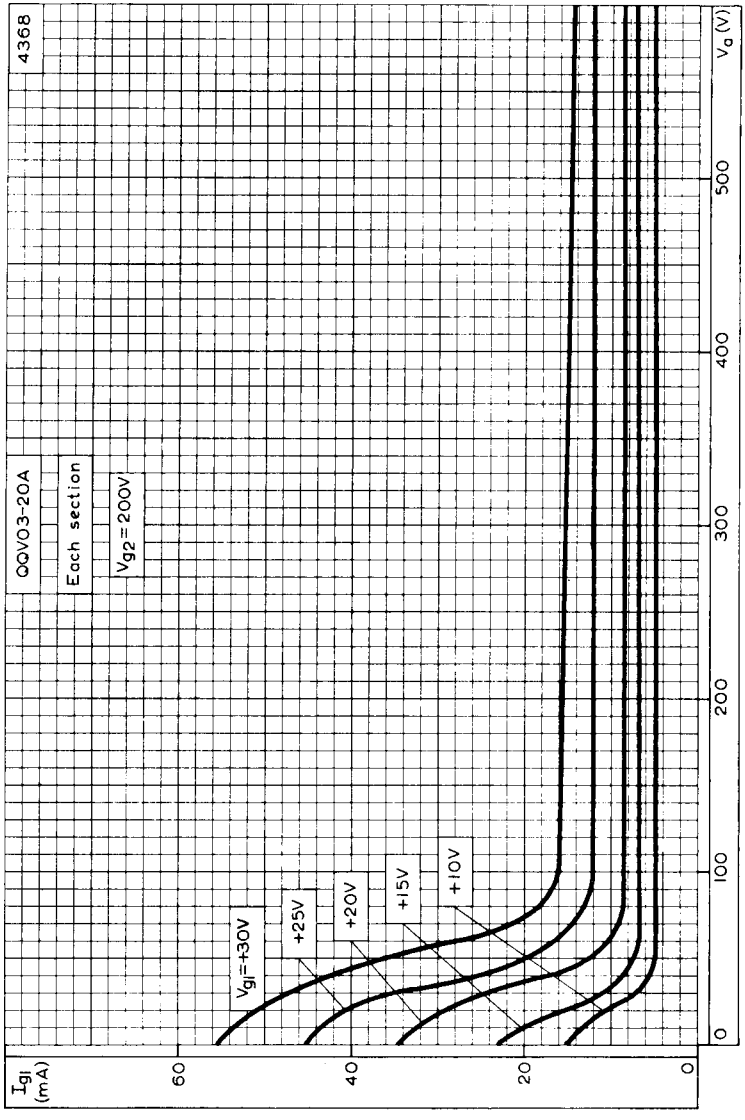


SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V

QQV03-20A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

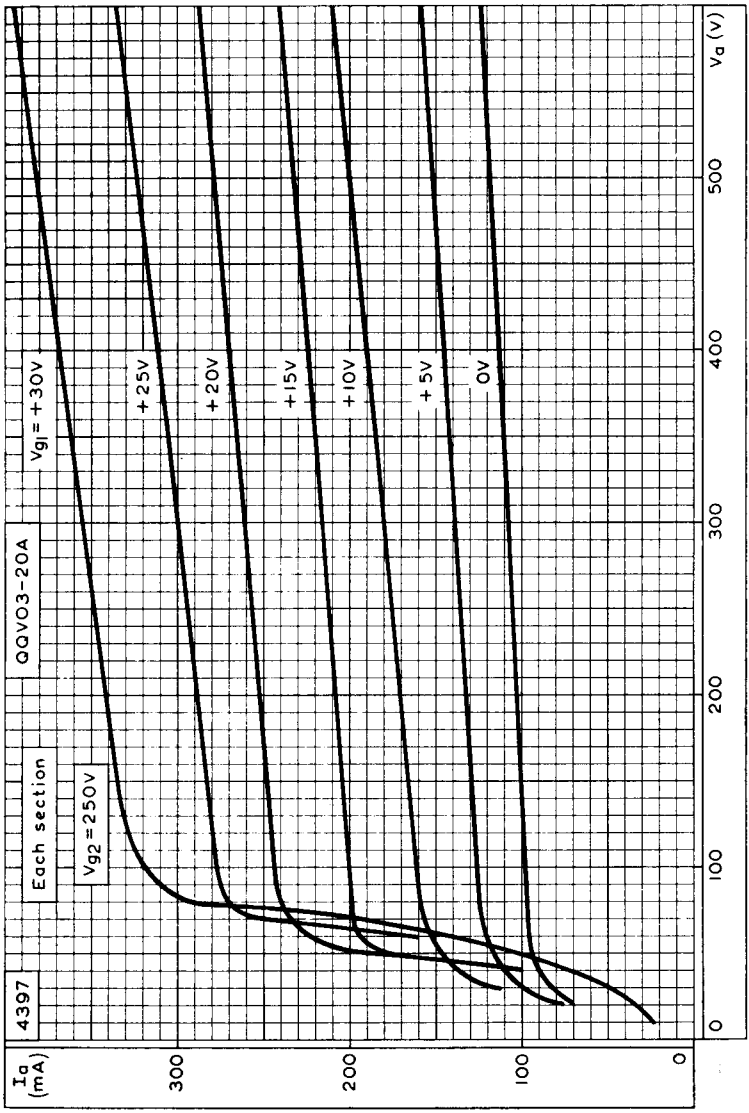


CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} 200V

V.H.F. POWER DOUBLE TETRODE

QQV03-20A

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

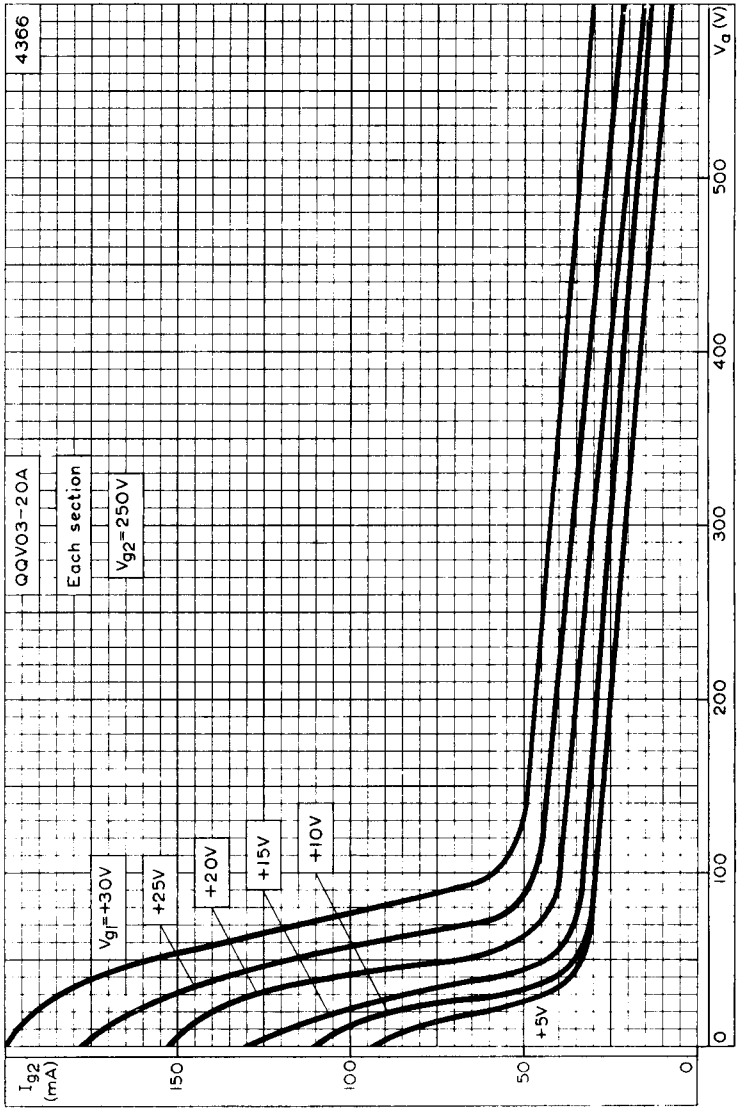


ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 250V

QQV03-20A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

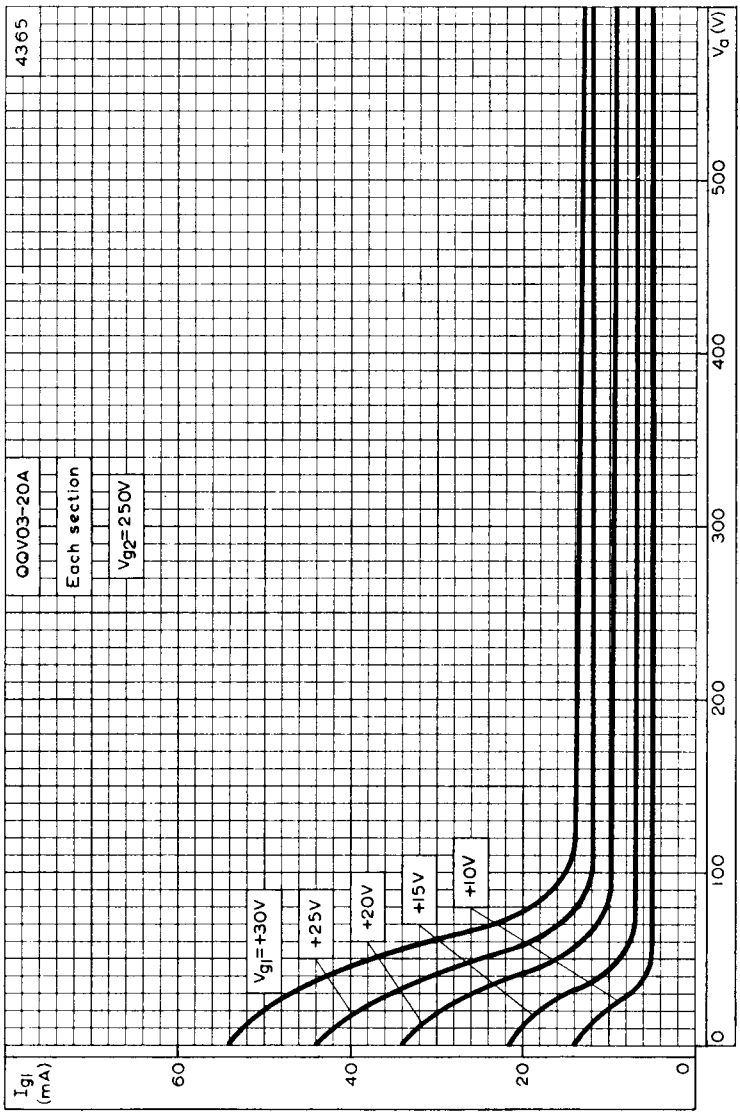


SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} 250V

V.H.F. POWER DOUBLE TETRODE

QQV03-20A

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

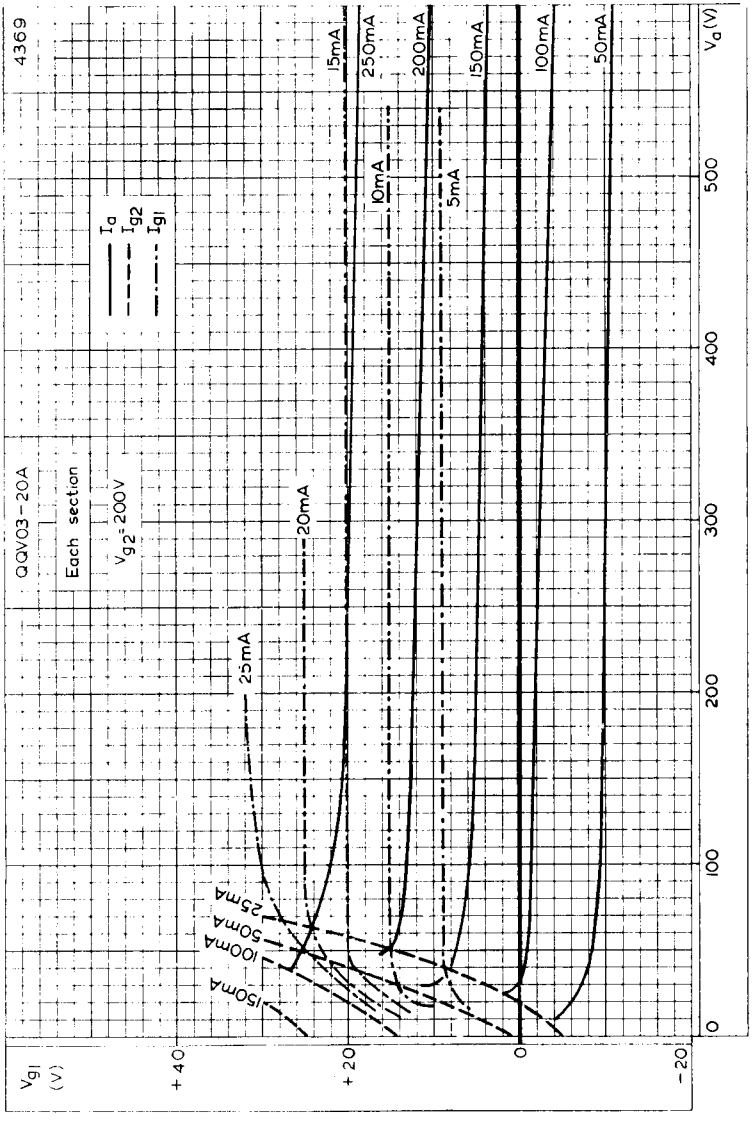


CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER
V_{g2} = 250V

QQV03-20A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

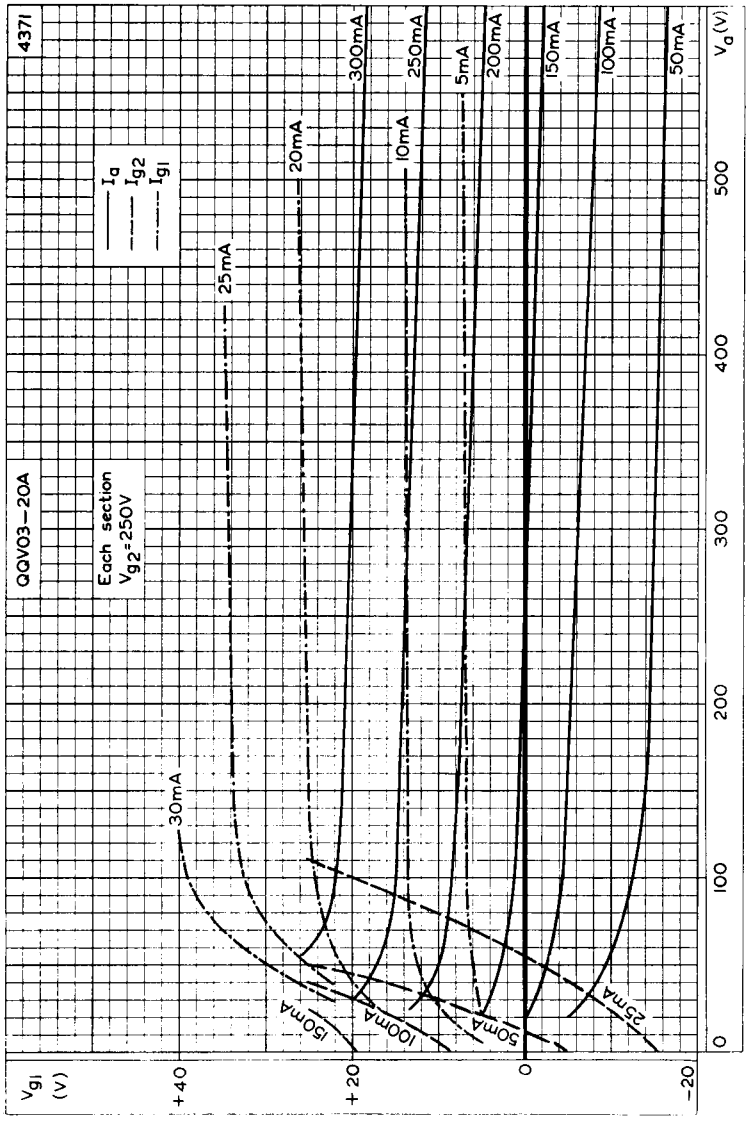


CONSTANT CURRENT CURVES FOR EACH SECTION V_{g2} = 200V

V.H.F. POWER DOUBLE TETRODE

QQV03-20A

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

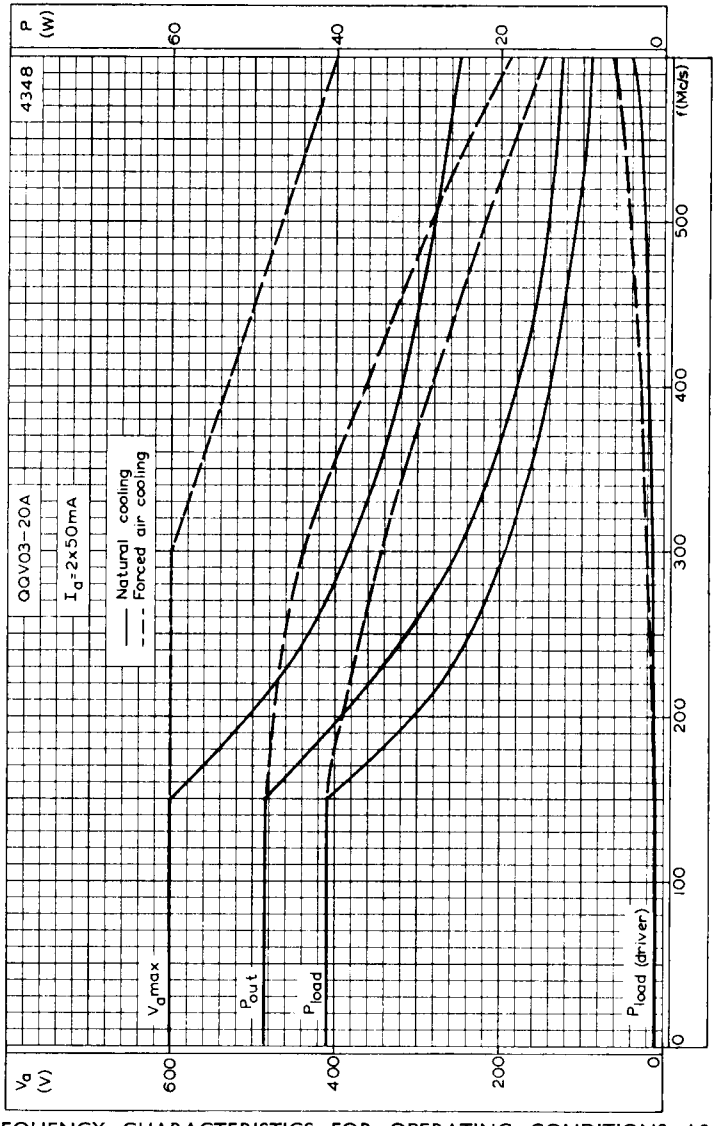


CONSTANT CURRENT CURVES FOR EACH SECTION V_{g2} = 250V

QQV03-20A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

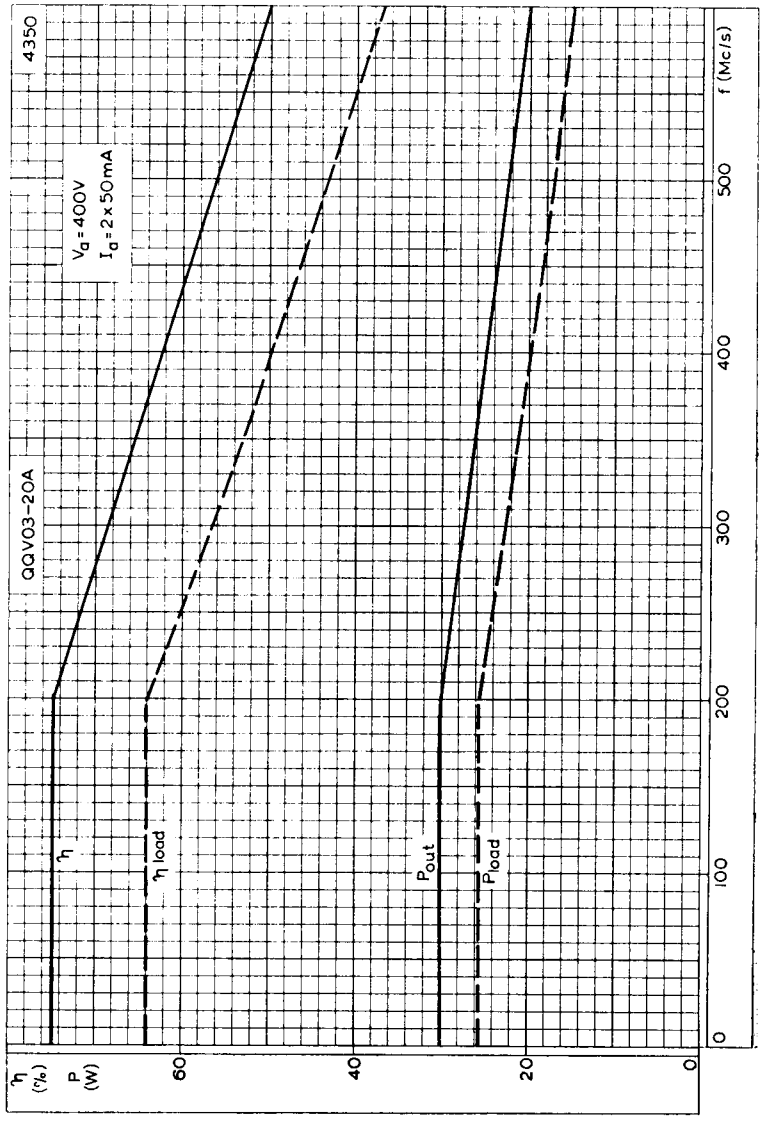


FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

V.H.F. POWER DOUBLE TETRODE

QQV03-20A

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

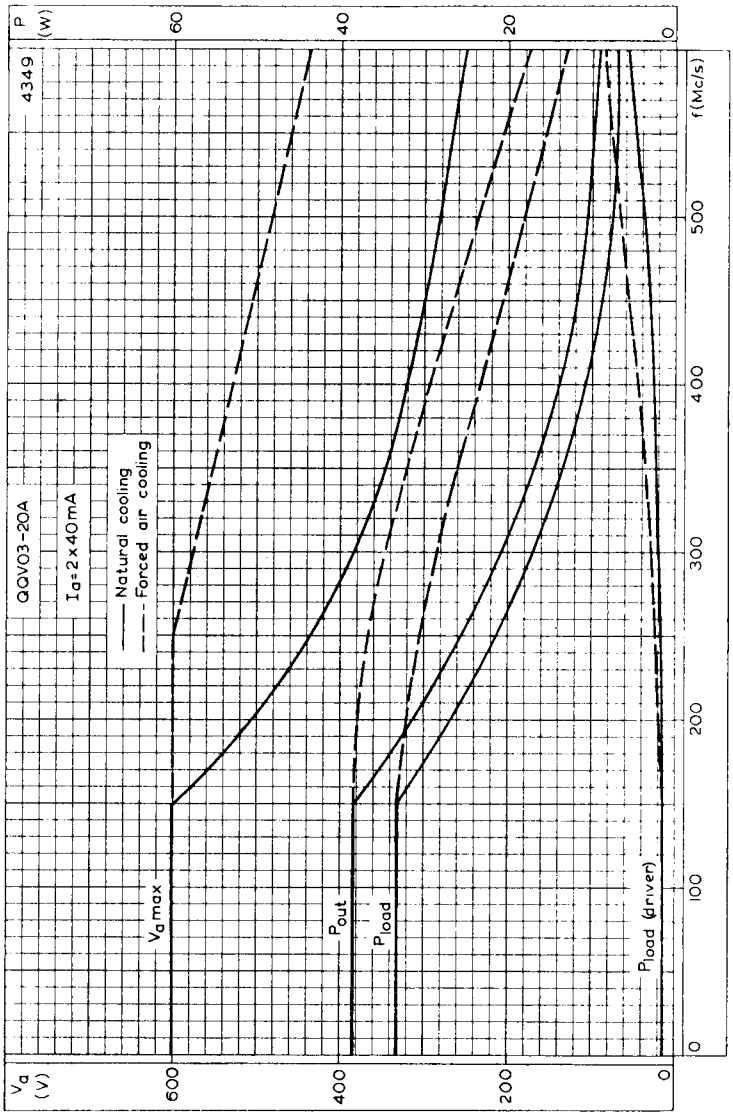


FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

QQV03-20A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s.

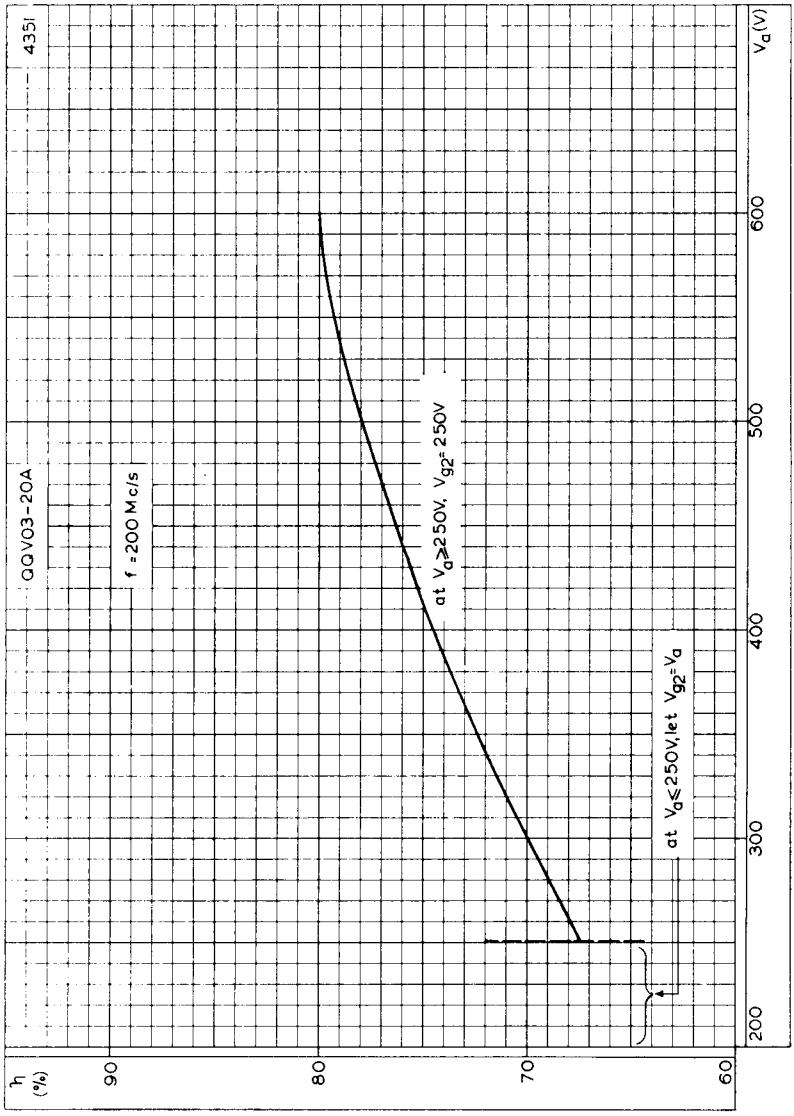


FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY)

V.H.F. POWER DOUBLE TETRODE

QQV03-20A

Beam power double tetrode rated to dissipate 10W at each anode and intended for use at frequencies up to 600Mc/s



ANODE EFFICIENCY PLOTTED AGAINST ANODE VOLTAGE FOR CLASS "C" PUSH-PULL TELEGRAPHY

U.H.F. POWER DOUBLE TETRODE

QQV03-20A

QUICK REFERENCE DATA

Natural or forced-air cooled beam power double tetrode. Intended for use as a U. H. F. power amplifier or frequency multiplier or A. F. power amplifier.

	Frequency Multiplier	Class 'C' Telephony Anode and Screen Modulated	Class 'C' Telegraphy or F. M. Telephony	
Performance				
f out	400	200	200	Mc/s
P out	8	38	48	W
f max.	600	600	600	Mc/s
Va max.	600	600	600	V
pa max.	2 x 10	2 x 6.7	2 x 10	W

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES which precede this section of the handbook.

OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Absolute maximum ratings

Va max.	600	V
pa max.	2 x 10	W
Vg2(b) max.	600	V
Vg2 max.	300	V
pg2 max.	2 x 1.5	W
pg1 max.	2 x 0.5	W
Ig1 max.	2 x 2.5	mA
Ik max.	2 x 55	mA
ik(pk) max.	2 x 260	mA
-Vg1 max.	75	V
Rg1-k max. per section (fixed bias)	50	kΩ
Rg1-k max. per section (automatic bias)	100	kΩ
Vh-k max.	100	V

Typical operating conditions

f	200	200	200	200	Mc/s
Va	200	300	400	600	V
Vg2	200	250	250	250	V
-Vg1	30	40	50	-60	V
Ia	2 x 50	2 x 50	2 x 50	2 x 50	mA
Ig2	2 x 4.0	2 x 4.5	2 x 4.0	2 x 4.0	mA
*Ig1	2 x 1.0	2 x 0.7	2 x 0.7	2 x 0.7	mA
Pload (driver)	<1.0	<1.0	1.0	1.5	W
pa	2 x 3.5	2 x 4.5	2 x 5.0	2 x 6.0	W
Pout	13	21	30	48	W
ηa	65	70	75	80	%
Pload	11	18	25	39	W

f	470	470	470	600	Mc/s←
Va	200	300	400	400	V
Vg2	200	250	250	250	V
Vg1	-30	-40	-50	-50	V
Ia	2 x 50	2 x 50	2 x 50	2 x 50	mA
Ig2	2 x 3.0	2 x 2.5	2 x 2.5	2 x 2.5	mA
*Ig1	2 x 0.5	2 x 0.6	2 x 0.7	2 x 0.7	mA
Pload (driver)	1.0	2.5	3.0	6.0	W←
pa	2 x 4.5	2 x 7.5	2 x 8.5	2 x 10	W←
Pout	11	15	23	20	W←
ηa	55	50	58	50	%←
Pload	9	13	18	15	W←

*Ig1 will vary between valves.

OPERATING CONDITIONS AS ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS 'C' TELEPHONY)

Carrier conditions for a modulation factor of 1.

Absolute maximum ratings

Va max.	600	V
pa max.	2 x 6.7	W
Vg2(b) max.	600	V
Vg2 max.	300	V
pg2 max.	2 x 1.2	W
pg1 max.	2 x 0.5	W
Ig1 max.	2 x 2.5	mA
Ik max.	2 x 50	mA
ik(pk) max.	2 x 400	mA
-Vg1 max.	100	V
Vh-k max.	100	V

f	200	200	470	Mc/s
Va	300	500	300	V
Vg2	250	250	250	V
-Vg1	50	80	50	V
Ia	2 x 40	2 x 40	2 x 40	mA
Ig2	2 x 4.0	2 x 4.0	2 x 3.0	mA
*Ig1	2 x 1.0	2 x 1.0	2 x 1.0	mA
Pload (driver)	1.5	3.0	3.5	W←
pa	2 x 3.5	2 x 4.0	2 x 5.5	W←
Pout	17	31	13	W←
ηa	71	78	50	%←
Pload	14	24	11	W←
For 100% modulation				
vg2(pk)	185	185	185	V
Pmod	13	21	13	W

*Ig1 will vary between valves.

OPERATING CONDITIONS AS FREQUENCY TREBLER

Absolute maximum ratings

Va max.	600	V
pa max.	2 x 10	W
Vg2(b) max.	600	V
Vg2 max.	300	V
pg2 max.	2 x 1.5	W
-Vg1 max.	200	V
Ig1 max.	2 x 2.5	mA
pg1 max.	2 x 0.5	W
Ik max.	2 x 50	mA
ik(pk) max.	2 x 275	mA
Rg1-k max. per section (fixed bias)	50	kΩ
Rg1-k max. per section (automatic bias)	100	kΩ
Vh-k max.	100	V

Typical operating conditions

f out	200	470	Mc/s←
Va	300	300	V
Vg2	250	250	V
Vg1	-175	-175	V
Ia	2 x 45	2 x 45	mA
Ig2	2 x 3.0	2 x 2.8	mA
Ig1	2 x 1.5	2 x 1.2	mA
Pload (driver)	4.0	5.0	W
pa	2 x 8.5	2 x 9.5	W
Pout	10	8.0	W
ηa	37	30	%
Pload	8.0	6.0	W

OPERATING CONDITIONS AS A.F. POWER AMPLIFIER AND MODULATOR (CLASS 'B')

Absolute maximum ratings

Va max.	600	V
pa max.	2 x 10	W
Vg2(b) max.	600	V
Vg2 max.	300	V
pg2 max.	2 x 1.5	W
-Vg1 max.	75	V
pg1 max.	2 x 0.5	W
Ik max.	2 x 55	mA
ik(pk) max.	2 x 120	mA
Rg1-k max. per section (fixed bias)	50	kΩ
Rg1-k max. per section (automatic bias)	100	kΩ
Vh-k max.	100	V

Typical operating conditions

Va	300	500	V
Vg2	250	250	V
-Vg1	25	26	V
Ia(o)	2 x 12.5	2 x 12.5	mA
Ia (max. sig.)	2 x 35	2 x 36.5	mA
Ig2(o)	2 x 0.6	2 x 0.35	mA
Ig2 (max. sig.)	2 x 9.5	2 x 8.1	mA
pa(o)	2 x 3.75	2 x 6.25	W
pa (max. sig.)	2 x 3.9	2 x 6.5	W
Pout	13.2	23.5	W
Ra-a	11	20	kΩ
Dtot	3.5	3.5	%
Vin(g1-g1) r.m.s.	35	37	V

CATHODE

Indirectly heated. The heater is centre-tapped and the two sections may be operated in series or parallel.

	Series	Parallel	
Vh	12.6	6.3	V
Ih	0.65	1.3	A

CAPACITANCES

*ca-g1	(each section)	0.04	pF
cg1-all	(each section)	6.25	pF
ca-all	(each section)	2.2	pF
cout	(two sections in push-pull)	1.3	pF
cin	(two sections in push-pull)	4.0	pF

*Internally neutralised for push-pull operation.

CHARACTERISTICS (each section) measured at Ia = 40mA

gm	2.5	mA/V
μg1-g2	8.0	

MOUNTING POSITION

Any

COOLING

Maximum base pin temperature	180	°C
Maximum bulb and anode seal temperature	250	°C

Anode connectors providing a high degree of heat transfer by radiation or by conduction should be used.

Natural cooling is sufficient with : -

Va = 600V at frequencies up to 150Mc/s
Va = 500V at frequencies up to 200Mc/s
Va = 300V at frequencies up to 430Mc/s

Above these limits or with high ambient temperatures it may be necessary to direct a flow of air (up to 5 cu. ft. per min.) on the top of the bulb to keep the seal temperature within the stated limit.

PHYSICAL DATA

Weight of valve only	2.0	oz
	53	g

ACCESSORIES

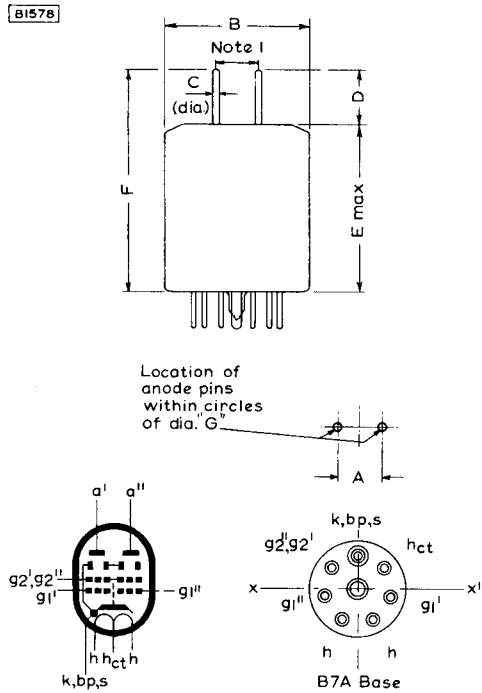
Socket	40202

DIMENSIONS

	Inches	Millimetres
A	0.551±0.001	14±0.03
B	1.772±0.039	45±1
C	0.079±0.004	2±0.1
D	0.650±0.059	16.5±1.5
E	2.165	55
F	2.677±0.118	68±3
G	0.098±0.001	2.5±0.03
H	0.118±0.004	3±0.1

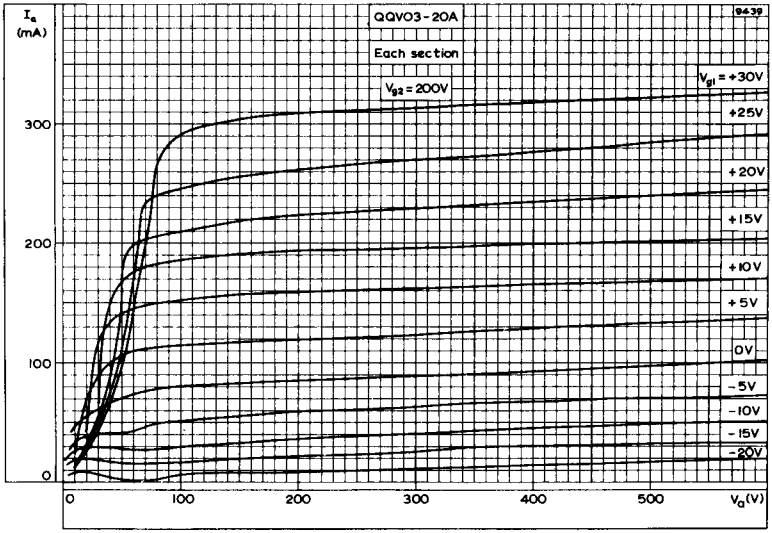
U.H.F. POWER DOUBLE TETRODE

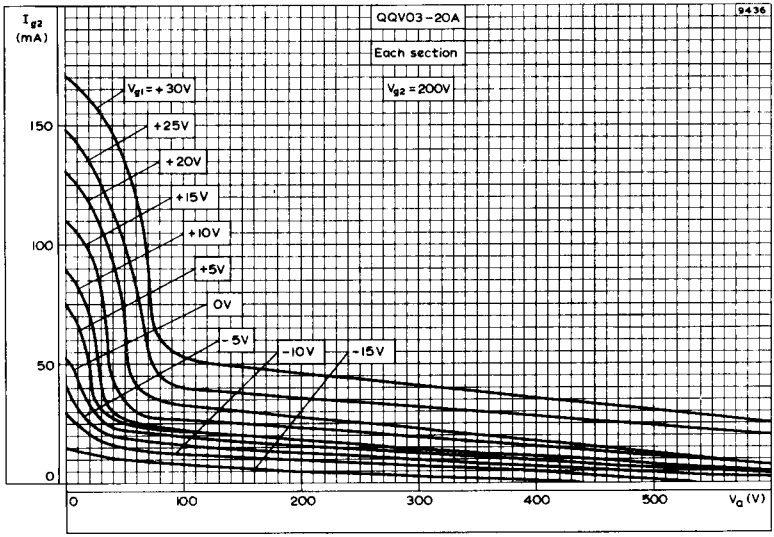
QQV03-20A



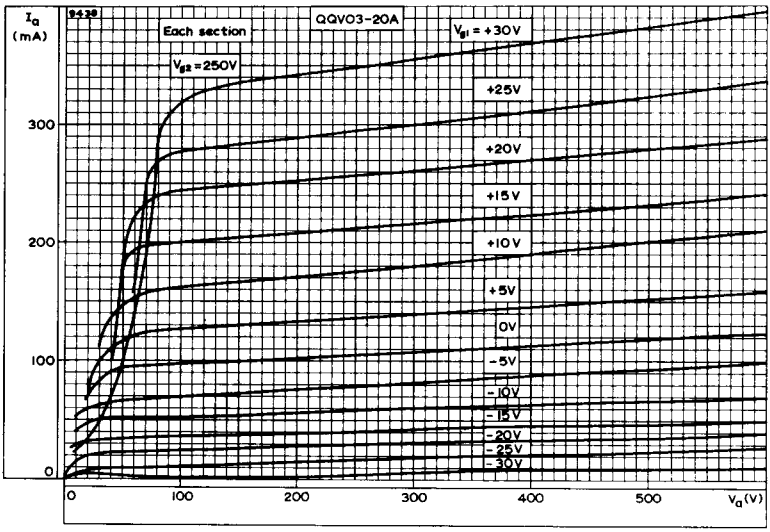
U.H.F. POWER DOUBLE TETRODE

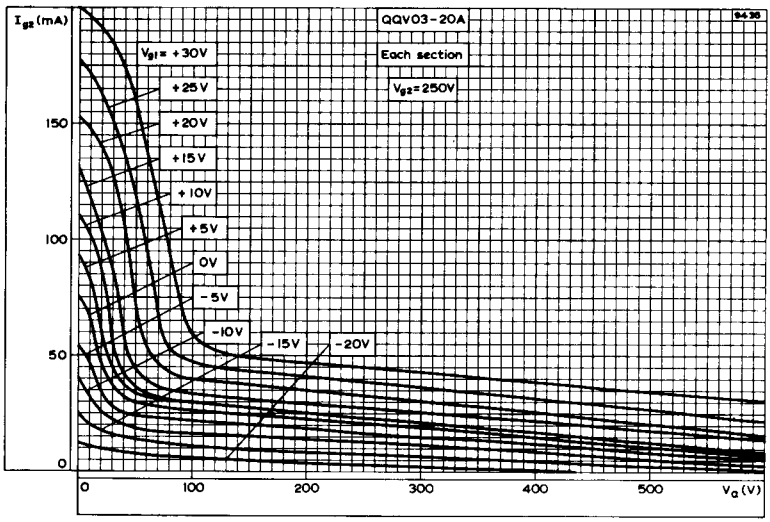
QQV03-20A



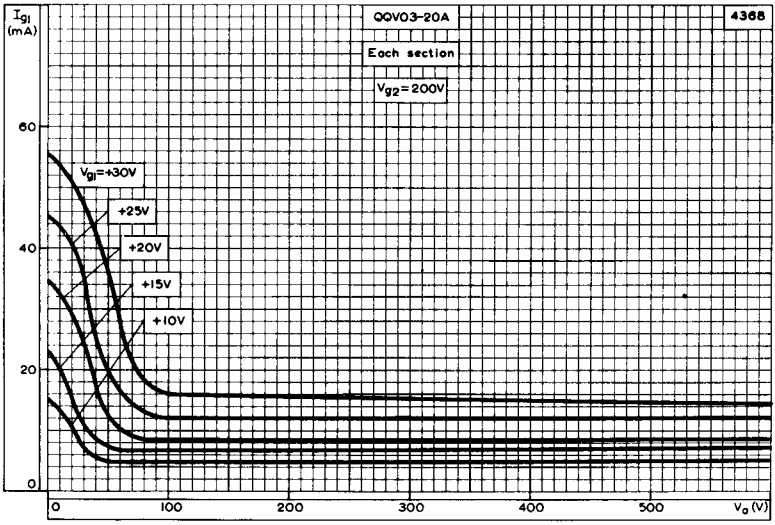


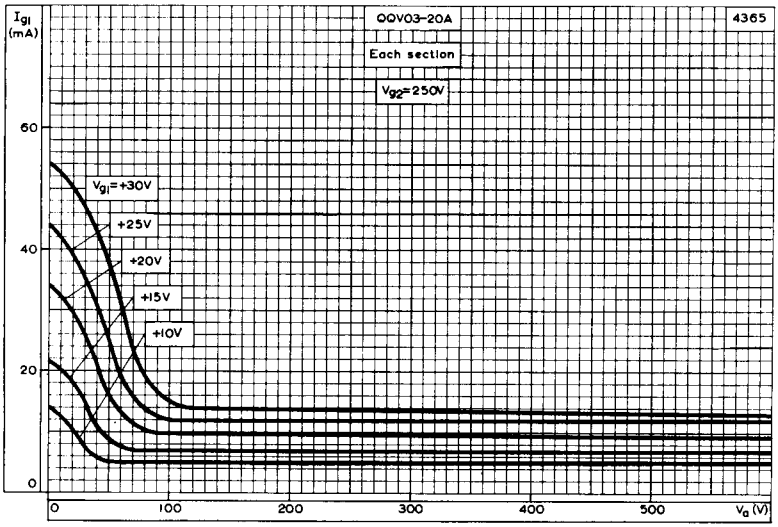
ANODE AND SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V.



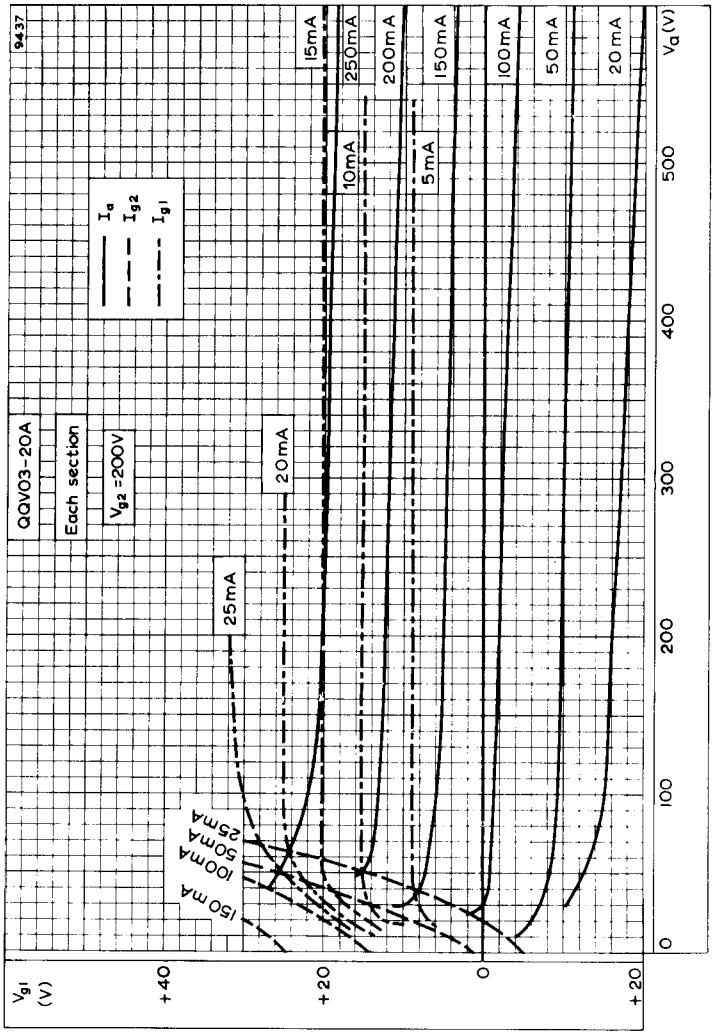


ANODE AND SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 250V.

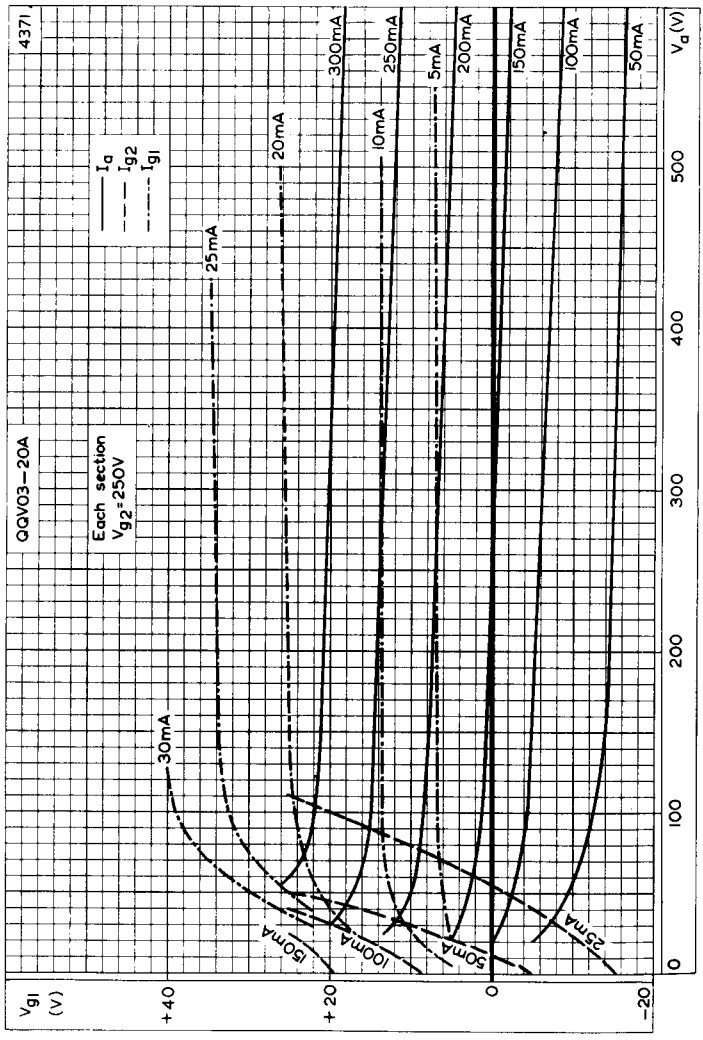




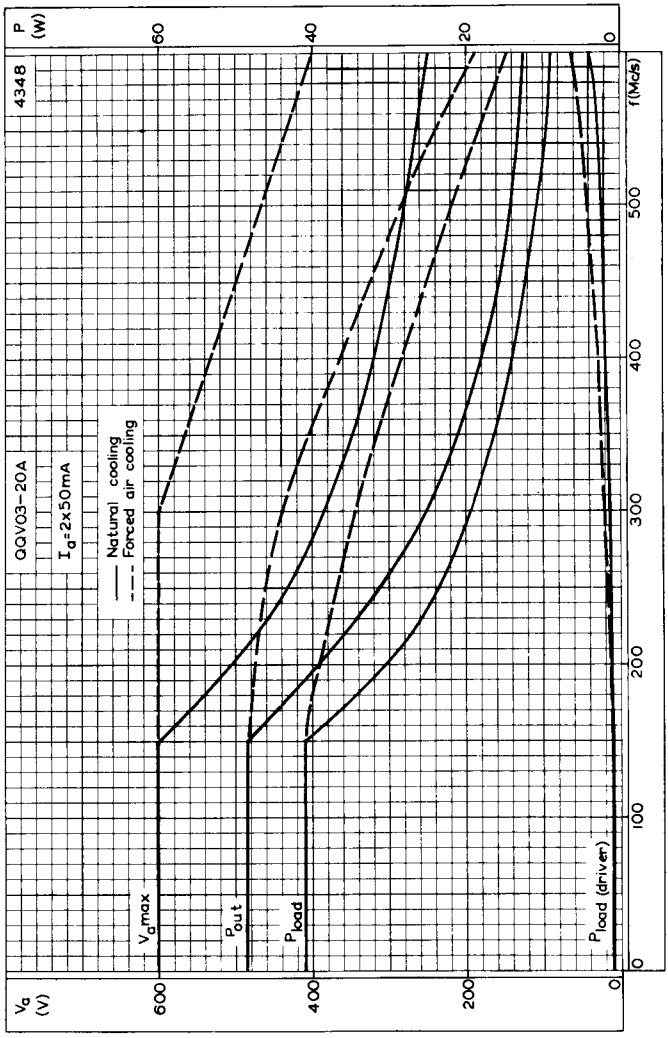
CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V AND V_{g2} = 250V.



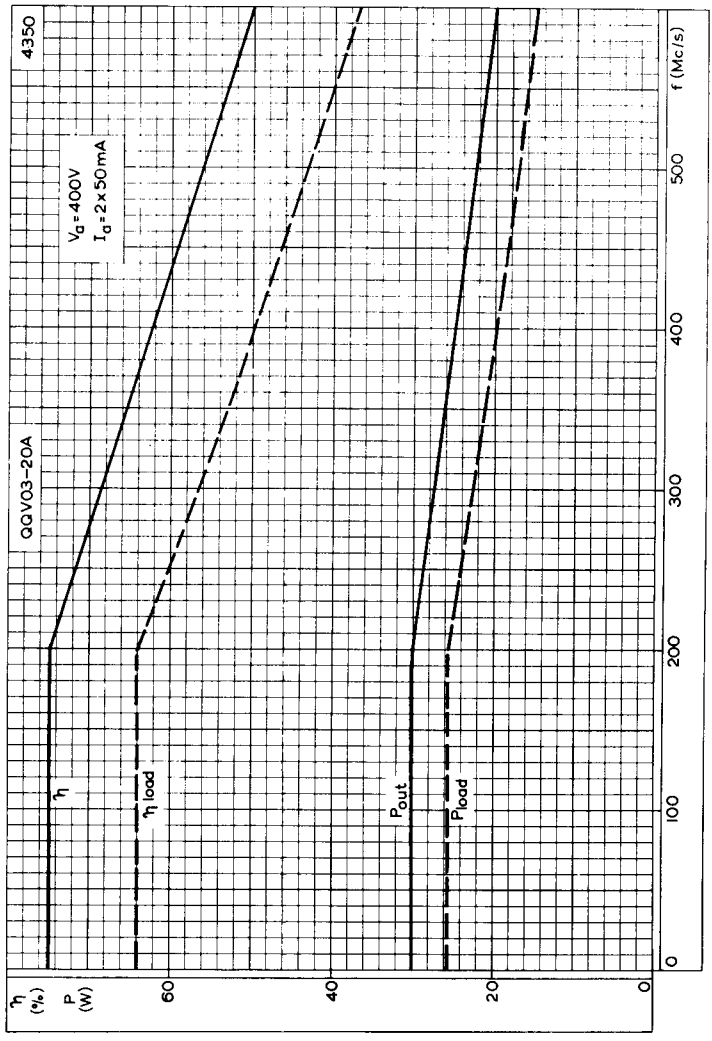
CONSTANT CURRENT CURVES FOR EACH SECTION V_{g2} = 200V.



CONSTANT CURRENT CURVES FOR EACH SECTION V_{g2} = 250V.



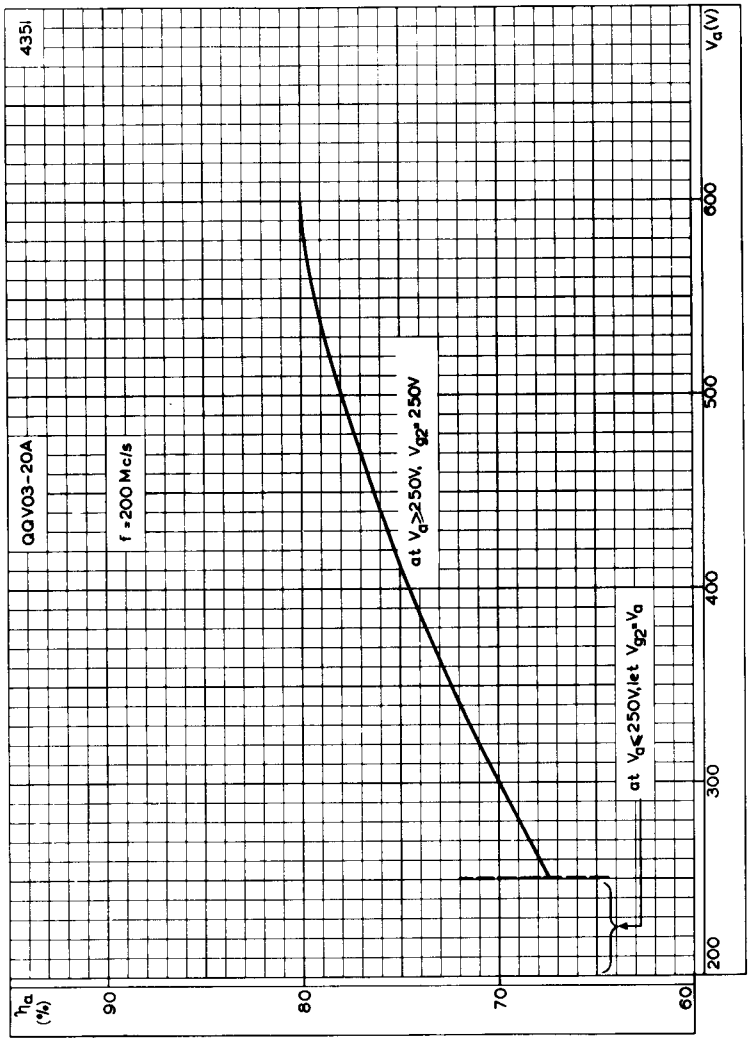
MAXIMUM OPERATING CONDITIONS FOR A PUSH-PULL R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)



FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY OR F.M. TELEGRAPHY)



MAXIMUM OPERATING CONDITIONS FOR AN ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS 'C' TELEPHONY)



ANODE EFFICIENCY PLOTTED AGAINST ANODE VOLTAGE FOR CLASS "C" PUSH-PULL TELEGRAPHY

U.H.F. POWER DOUBLE TETRODE

QQV03-25

QUICK REFERENCE DATA

Double tetrode intended for use as v.h.f. power amplifier or frequency multiplier.

	Frequency Multiplier	Class 'C' Telephony Anode and Screen Grid Modulation	Class 'C' Telegraphy or F.M. Telephony	
f	158/475	180	180	Mc/s
P_{out}	10	43	67	W
f max.	600	600	600	Mc/s
V_a max. (f<250Mc/s)	750	600	750	V
(f=600Mc/s)	600	400	500	V
p_a max.	2 x 12.5	2 x 8.3	2 x 12.5	W

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES.

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

f	180	180	180	470	600	Mc/s
P_{out}	35	56	67	38	22	W
P_{load}	31	48	57	31	17	W
η_a	73	78	80	63	47	%
V_a	400	600	700	500	400	V
I_a	2 x 60	2 x 60	2 x 60	2 x 60	2 x 59	mA
V_{g2}	250	250	250	250	250	V
I_{g2}	2 x 4.5	2 x 4.5	2 x 4.5	2 x 3.0	2 x 3.0	mA
$-V_{g1}$	50	60	65	55	50	V
I_{g1}	2 x 1.0	2 x 1.0	2 x 1.0	2 x 1.0	2 x 0.8	mA
P_{load} (driver)	1.2	1.8	2.0	3.0	6.0	W
p_a	2 x 6.5	2 x 8.0	2 x 8.5	2 x 11	2 x 12.5	W

CLASS 'C' TELEPHONY ANODE AND SCREEN-GRID MODULATION

Maximum operating conditions (Carrier conditions for 100% modulation)

f	180	180	180	180	470	Mc/s
P_{out}	19.5	26	35.5	43	17.5	W
P_{load}	16.5	21	29	37	14.5	W
η_a	68	71	74	75	60	%
V_a	300	400	500	600	300	V
I_a	2 x 48	2 x 41	2 x 48	2 x 48	2 x 48	mA
V_{g2}	250	250	250	250	250	V
I_{g2}	2 x 4.5	2 x 4.5	2 x 4.5	2 x 4.5	2 x 3.5	mA
$-V_{g1}$	50	65	75	80	50	V
I_{g1}	2 x 1.5	2 x 1.5	2 x 1.5	2 x 1.5	2 x 1.5	mA
$P_{load\ (driver)}$	2.0	2.5	3.0	3.5	3.0	W
p_a	2 x 4.75	2 x 3.5	2 x 6.25	2 x 7.25	2 x 5.75	W

For 100% modulation

P_{mod}	16.5	18.5	25	31	16.5	W
$v_{g2(pk)}$	185	185	185	185	185	V

FREQUENCY MULTIPLIER

Maximum operating conditions

f_{out}/f_{in}	180/60	475/158	Mc/s
P_{out}	15	10	W
P_{load}	12	8.0	W
η_a	38	27	%
V_a	400	300	V
I_a	2 x 50	3 x 50	mA
V_{g2}	250	250	V
I_{g2}	2 x 4.0	2 x 4.0	mA
$-V_{g1}$	175	175	V
I_{g1}	2 x 1.5	2 x 1.5	mA
$P_{load\ (driver)}$	4.0	6.0	W
p_a	2 x 12.5	2 x 10	W

U.H.F. POWER DOUBLE TETRODE

QQV03-25

ABSOLUTE MAXIMUM RATINGS

	Frequency Multiplier	Class 'C' Telephony	Class 'C' Telegraphy	
V_a max. (f<250Mc/s)	750	600	750	V
(f=600Mc/s)	600	400	500	V
V_{g2} max.	300	300	300	V
$-V_{g1}$ max.	200	200	200	V
I_k max.	2 x 60	2 x 50	2 x 66	mA
p_a max.	2 x 12.5	2 x 8.3	2 x 12.5	W
p_{g2} max.	2 x 1.5	2 x 1.2	2 x 1.5	W
I_{g1} max.	2 x 2.5	2 x 2.5	2 x 2.5	mA
p_{g1} max.	2 x 0.5	2 x 0.5	2 x 0.5	W
R_{g1-k} max. per section (fixed bias)	50	50	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	100	100	kΩ
V_{h-k} max.	100	100	100	V
$V_{g2(b)}$ max.	600	600	600	V

CATHODE

Indirectly heated. The heater is centre tapped and the two sections may be operated in series or parallel.

	Series	Parallel	
V_h	12.6	6.3	V
I_h	0.65	1.3	A

CAPACITANCES

* c_{a-g1} (each section	40	mpF
c_{g1-all} (each section)	7.5	pF
c_{a-all} (each section)	2.6	pF
c_{out} (two sections in push pull)	1.6	pF
c_{in} (two sections in push pull)	4.4	pF

* Internally neutralised for push-pull operation.

CHARACTERISTICS (each section) measured at I_a = 40mA

g_m	2.5	mA/V
μ_{g1-g2}	8.0	

MOUNTING POSITION

Any

COOLING

Radiation and convection cooled

Maximum temperatures

Base pin	180	°C
Bulb	250	°C
Anode seal	250	°C

Anode connectors providing a high degree of heat transfer by radiation or by conduction should be used.

Natural cooling is sufficient with:-

V_a = 600V at frequencies up to 150Mc/s
V_a = 500V at frequencies up to 200Mc/s
V_a = 300V at frequencies up to 430Mc/s

Above these limits or with high ambient temperatures it may be necessary to direct a flow of air (up to $5ft^3$/min, $0.15m^3$/min) on the top of the bulb to keep the seal temperature within the stated limit.

PHYSICAL DATA

	oz	g
Weight of valve	2.0	57

ACCESSORIES — socket 40202

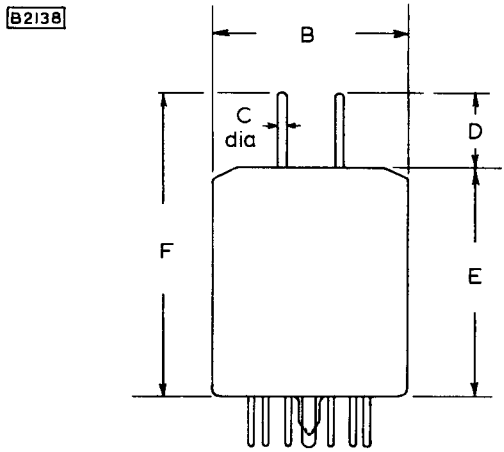
DIMENSIONS

	Inches	millimetres
B	1.772 ± 0.039	45 ± 1
C	0.079 ± 0.001	2.0 ± 0.01
D	0.650 ± 0.059	16.5 ± 1.5
E	2.165	55 max
F	2.874	73 max
G	0.098 ± 0.001	2.5 ± 0.03
H	0.551 ± 0.001	14 ± 0.03

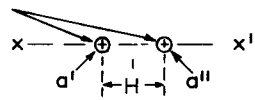
Inch dimensions are derived from original millimetre dimensions.

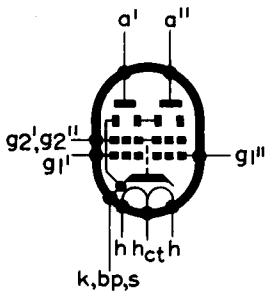
U.H.F. POWER DOUBLE TETRODE

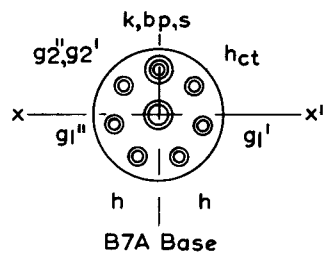
QQV03-25



Location of anode pins within circles of dia G.



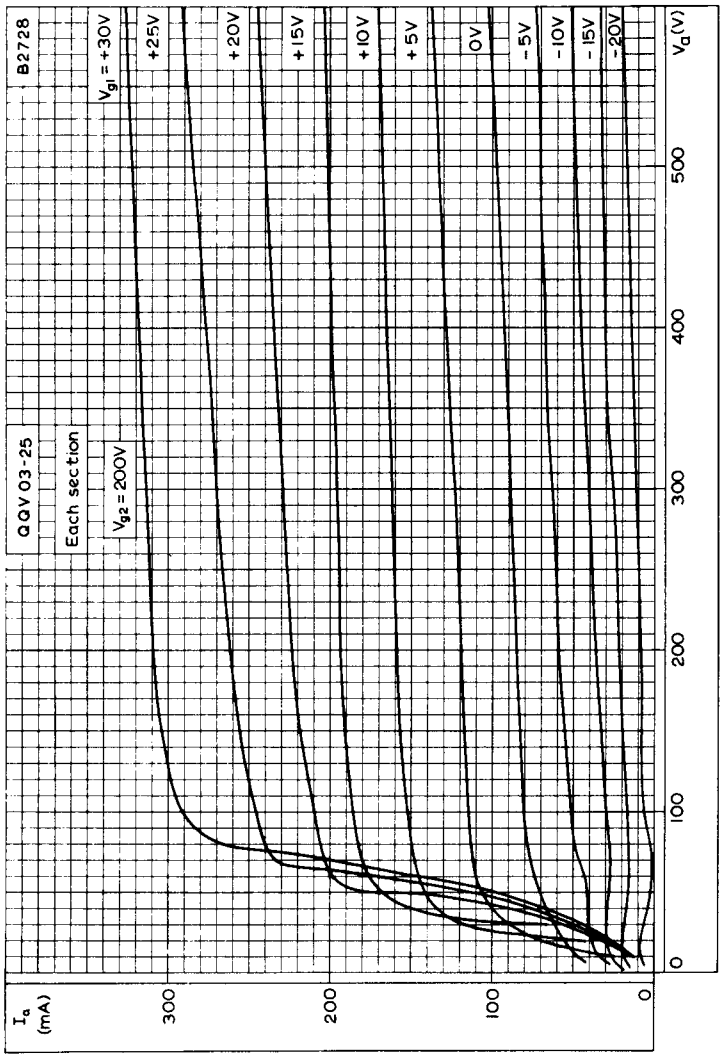




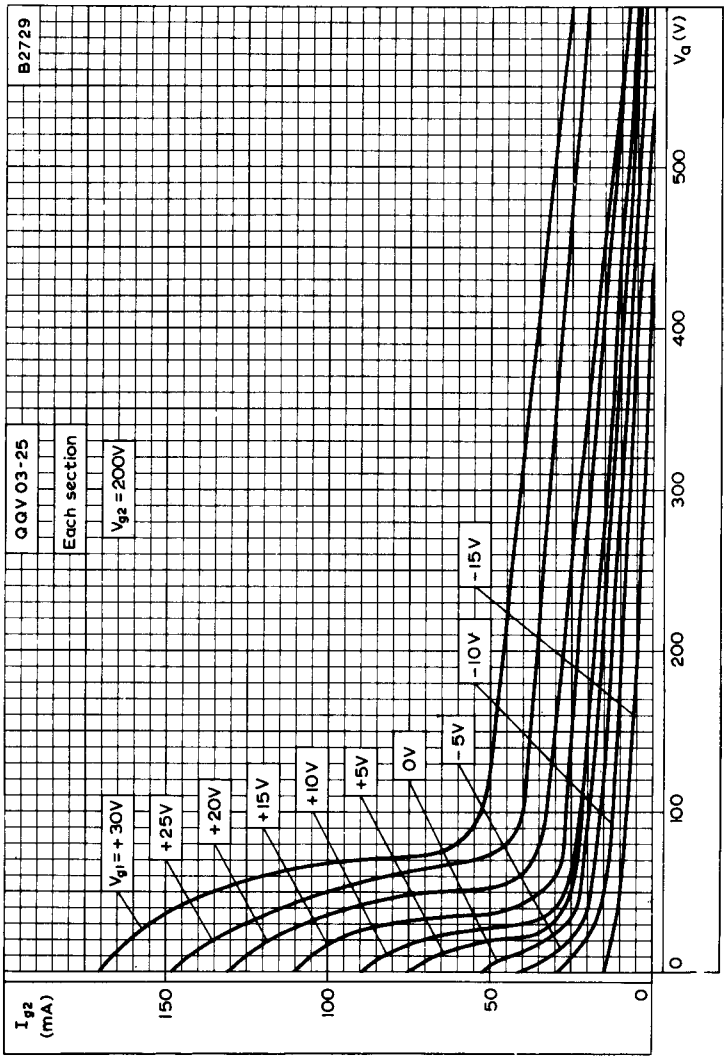
B7A Base

U.H.F. POWER DOUBLE TETRODE

QQV03-25



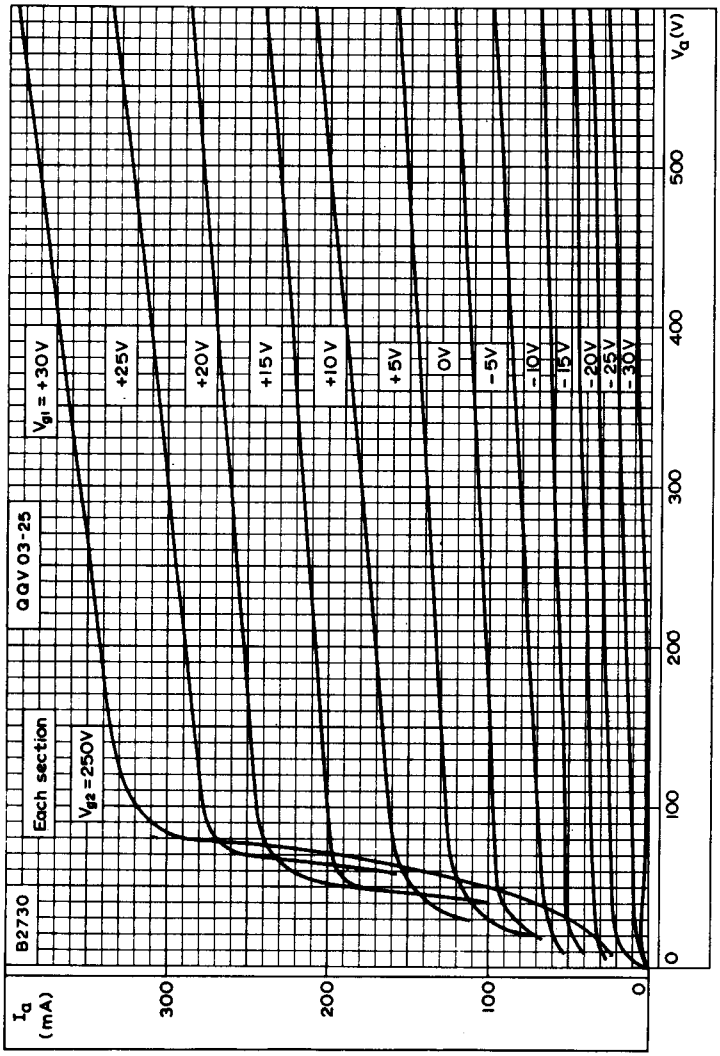
ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V



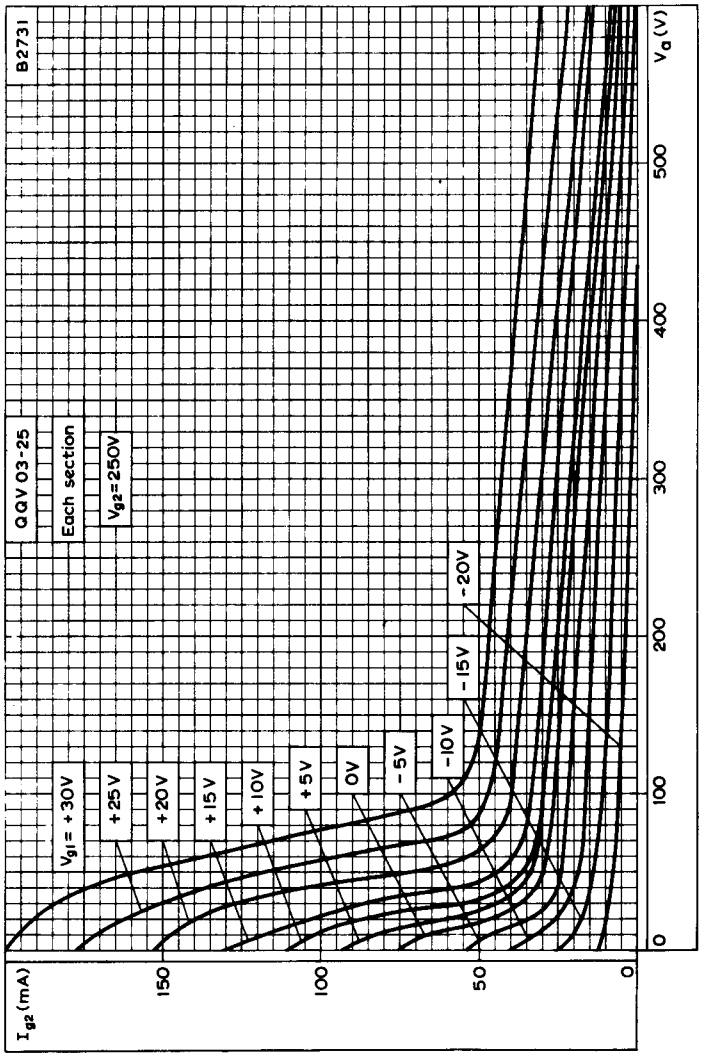
SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V

U.H.F. POWER DOUBLE TETRODE

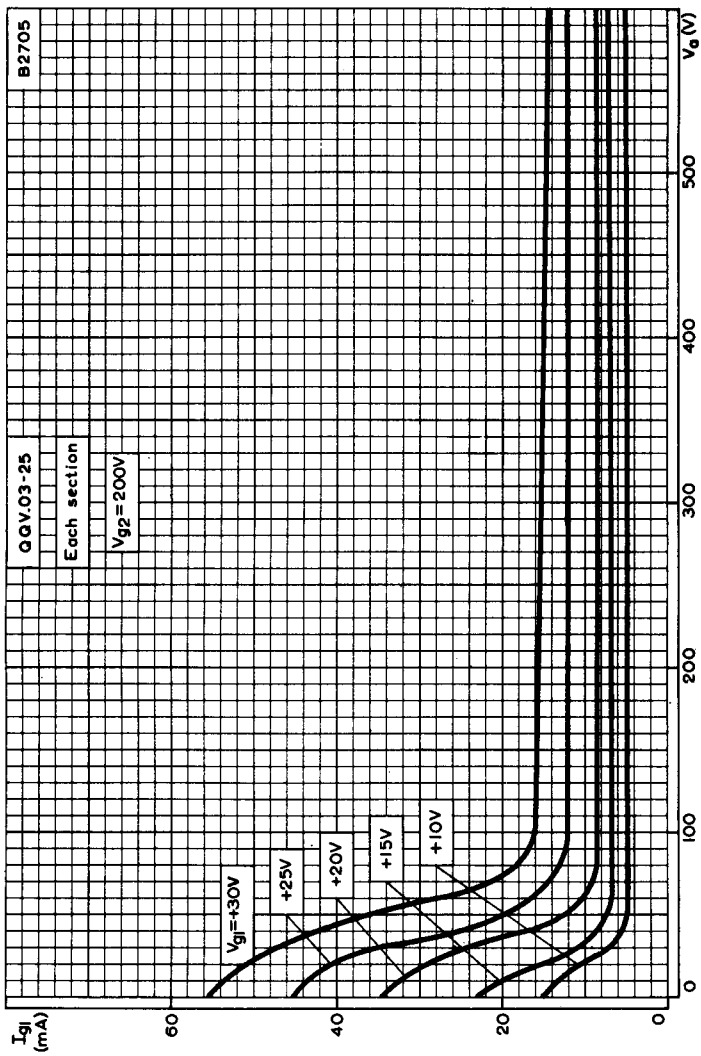
QQV03-25



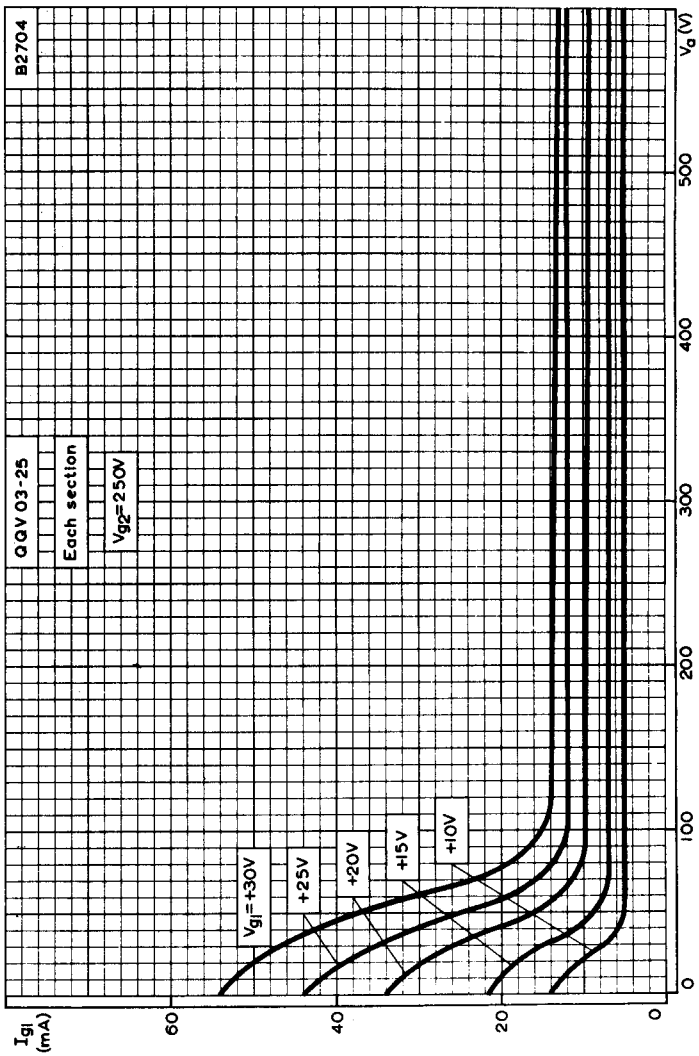
ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=250V



SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=250V



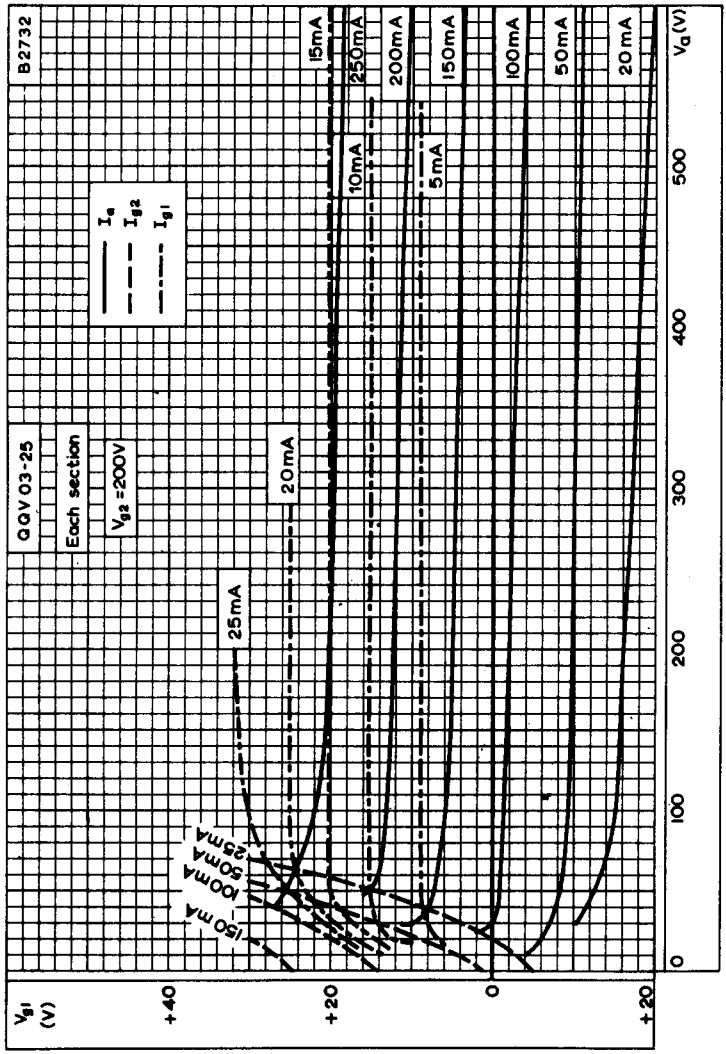
CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V



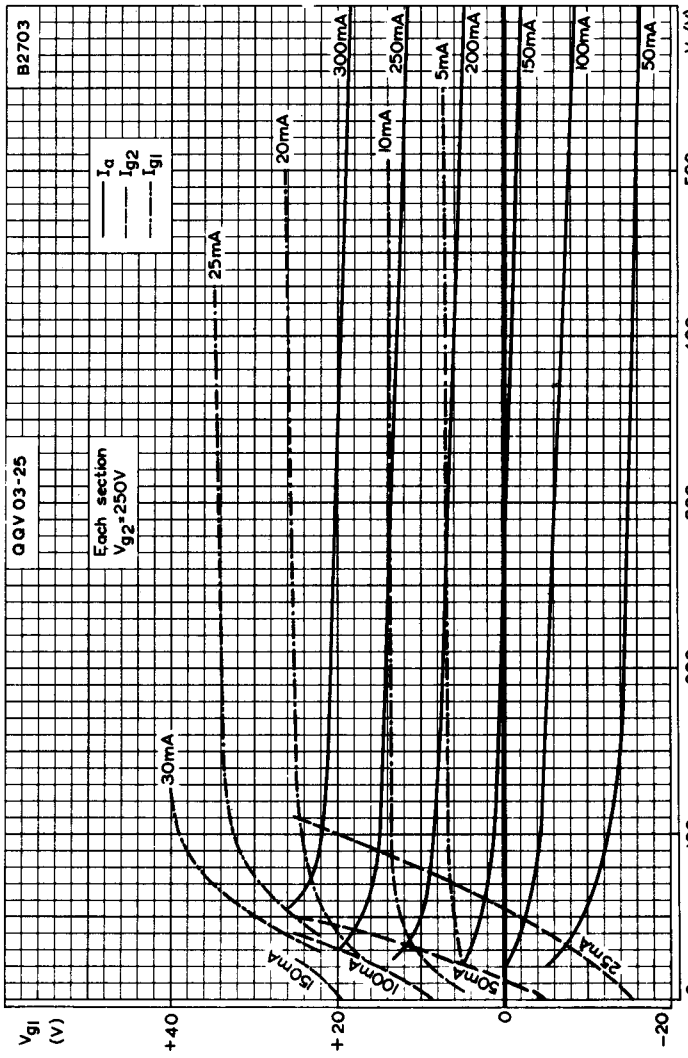
CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=250V

U.H.F. POWER DOUBLE TETRODE

QQV03-25



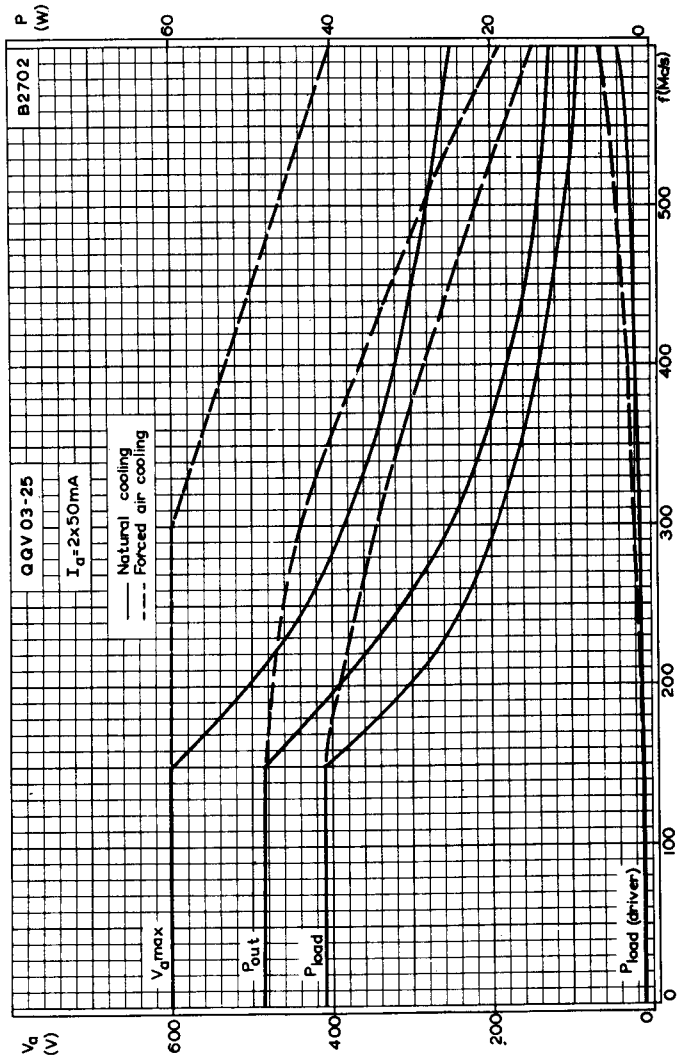
CONSTANT CURRENT CHARACTERISTICS FOR EACH SECTION V_{g2} = 200V



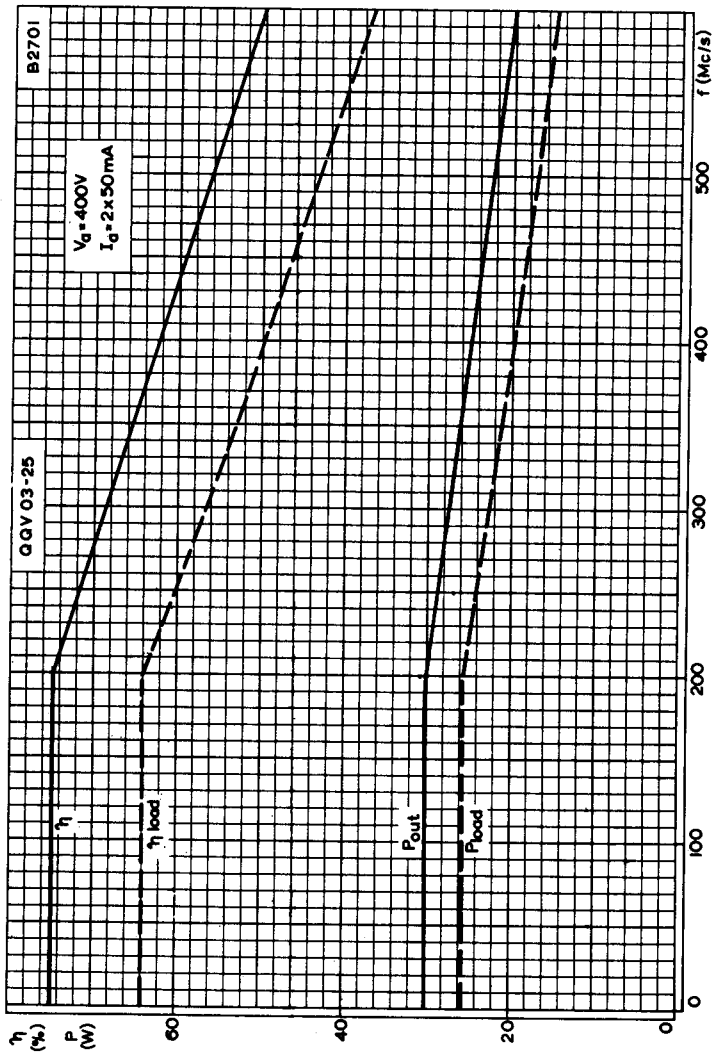
CONSTANT CURRENT CHARACTERISTICS FOR EACH SECTION V_{g2}=250V

U.H.F. POWER DOUBLE TETRODE

QQV03-25



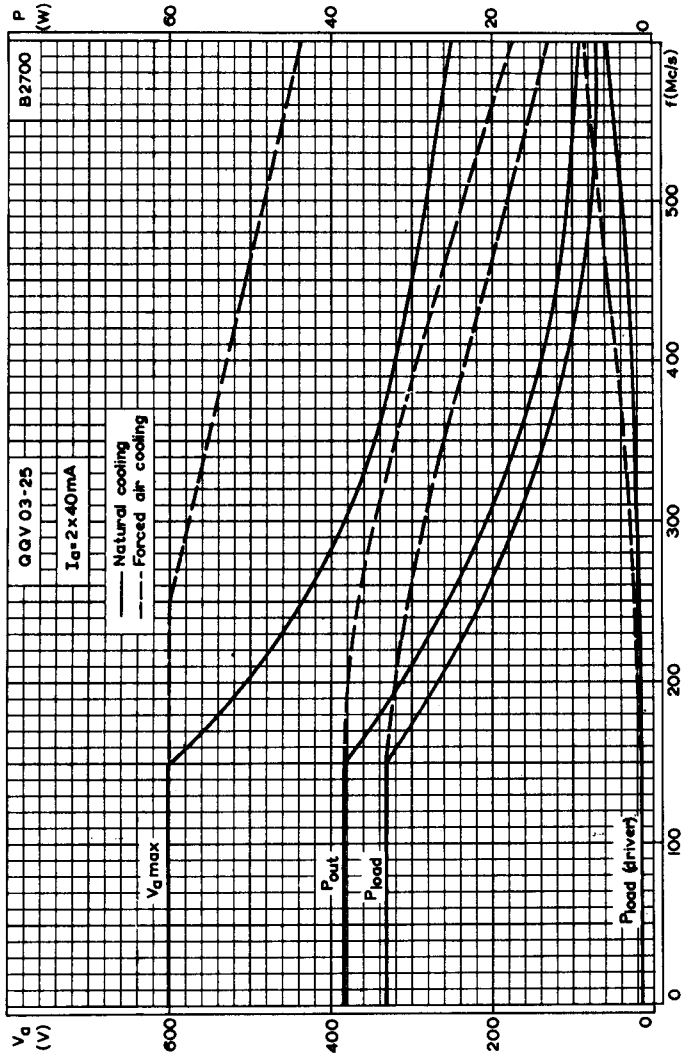
MAXIMUM OPERATING CONDITIONS FOR A PUSH-PULL R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY)



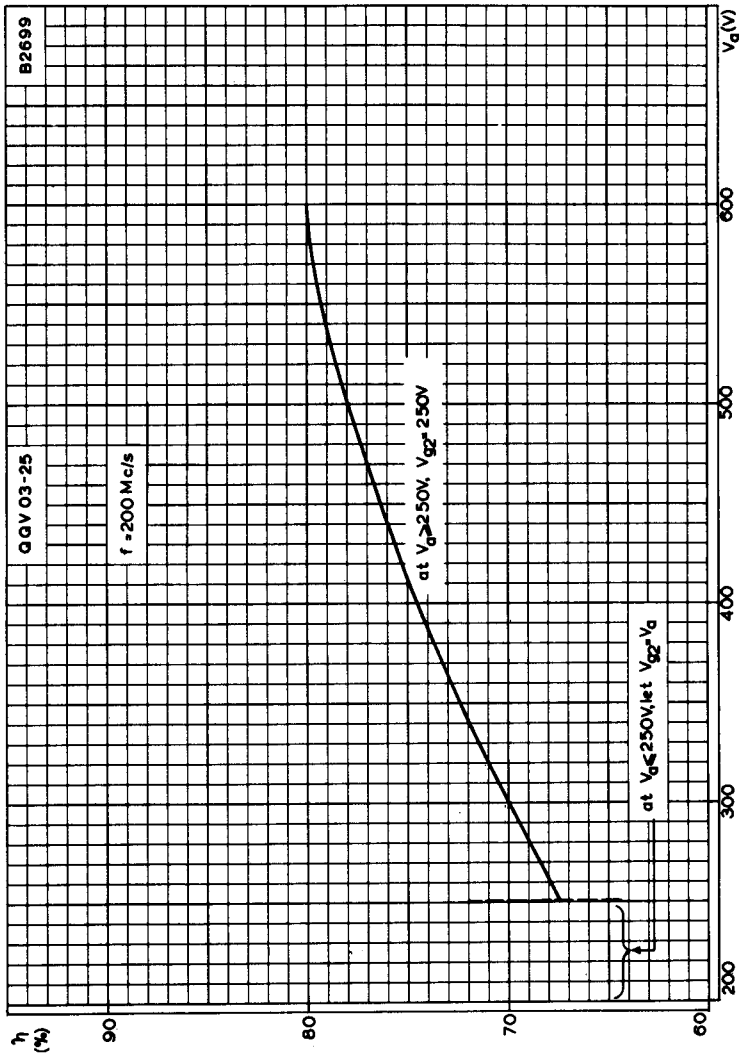
FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

U.H.F. POWER DOUBLE TETRODE

QQV03-25



MAXIMUM OPERATING CONDITIONS FOR AN ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS 'C' TELEPHONY)



ANODE EFFICIENCY PLOTTED AGAINST ANODE VOLTAGE FOR CLASS 'C' PUSH-PULL TELEGRAPHY

V.H.F. POWER DOUBLE TETRODE

QQV04-15

V.H.F. double tetrode rated for a maximum anode dissipation of 7.5W per section and suitable for use at frequencies up to 250Mc/s.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS — TRANSMITTING VALVES included in this volume of the handbook.

CATHODE Indirectly heated for series or parallel operation.

	Series	*Parallel*	
V_h	12.6	6.3	V
I_h	0.8	1.6	A

MOUNTING POSITION Any

CAPACITANCES (each section)

c_{a-g1}	<0.07	pF
c_{in}	8.0	pF
c_{out}	3.8	pF
*c_{g2-k} (approx.)	65	pF

*Including capacitor connected internally between g_2 and k.

CHARACTERISTICS (each section; measured at I_a = 30mA)

g_m	3.0	mA/V
μ_{g1-g2}	6.5	

COOLING Natural cooling

Maximum bulb temperature	200	°C
Maximum temperature of seals	180	°C

OPERATING CONDITIONS AS PUSH-PULL R.F. POWER AMPLIFIER OR OSCILLATOR (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting values (absolute ratings)

V_a max. (f = 200Mc/s)	750	V
V_a max. (f = 250Mc/s)	670	V
p_a max.	2×7.5	W
V_{g2} max.	250	V
p_{g2} max.	5.0	W
I_k max.	2×55	mA
$I_{k(pk)}$ max.	2×260	mA
V_{g1} max.	−175	V
I_{g1} max.	2×3.0	mA
R_{g1-k} max. (each section)	50	kΩ
V_{h-k} max.	100	V

MAINTENANCE TYPE

QQV04-15

V.H.F. POWER DOUBLE TETRODE

V.H.F. double tetrode rated for a maximum anode dissipation of 7.5W per section and suitable for use at frequencies up to 250Mc/s.

Typical operating conditions

f	200	200	250	Mc/s
V_a	500	750	500	V
V_{g2}	200	200	200	V
V_{g1}	−65	−65	−65	V
I_a	2×36	2×24	2×32	mA
I_{g2}	14	15	12	mA
I_{g1} (approx.)	2×1.3	2×1.4	2×0.9	mA
$v_{in(g1-g1)pk}$	150	150	140	V
$P_{load(driver)}$	500	600	800	mW
p_a	2×5.0	2×5.0	2×7.0	W
P_{out}	26	26	18	W
η	72	72	56	%
P_{load}	21	21	14.5	W

OPERATING CONDITIONS AS ANODE AND SCREEN-GRID MODULATED PUSH-PULL R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY)

Limiting values (carrier condition for modulation factor of 1) (absolute ratings)

V_a max. (f = 200Mc/s)	600	V
V_a max. (f = 250Mc/s)	530	V
p_a max.	2×5.0	W
V_{g2} max.	250	V
p_{g2} max.	3.4	W
I_k max.	2×50	mA
$i_{k(pk)}$ max.	2×400	mA
V_{g1} max.	−175	V
I_{g1} max.	2×3.0	mA
R_{g1-k} max. (each section)	50	kΩ
V_{h-k} max.	100	V

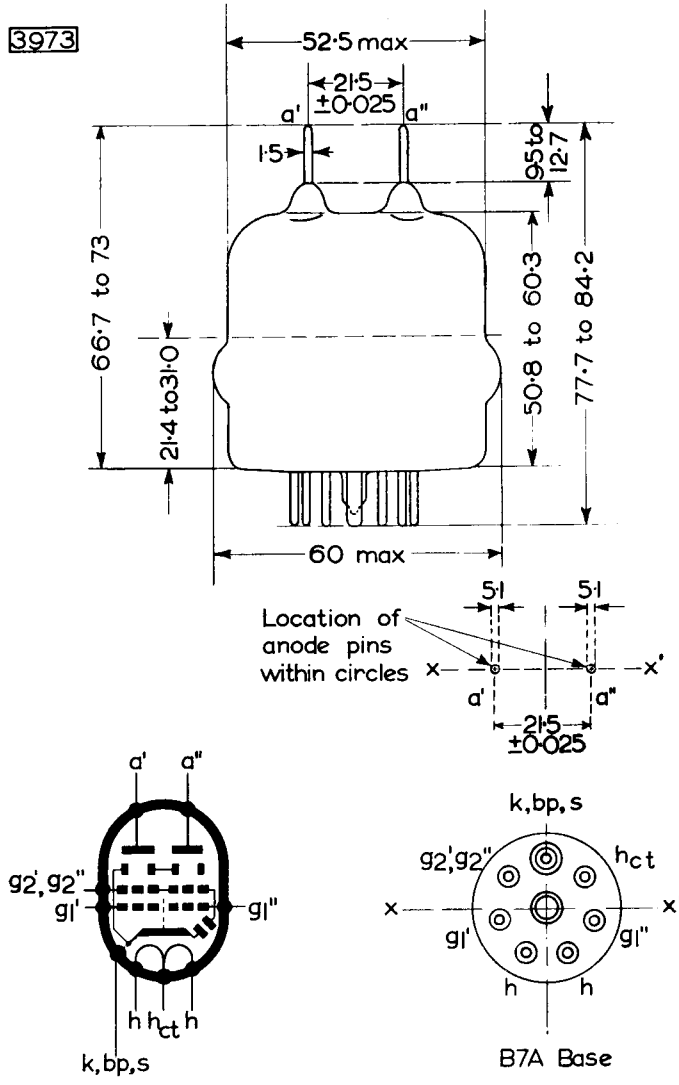
Typical operating conditions

f	200	200	Mc/s
V_a	425	600	V
V_{g2}	200	200	V
V_{g1}	−60	−65	V
I_a	2×26	2×18	mA
I_{g2}	16	16	mA
I_{g1} (approx.)	2×1.2	2×1.3	mA
$v_{in(g1-g1)}$ pk	140	150	V
$P_{load(driver)}$	500	500	mW
p_a	2×3.0	2×2.3	W
P_{out}	16	17	W
η	72	79	%
P_{load}	13	14	W
For 100% modulation			
P_{mod}	12.5	12.5	W
$v_{g2(pk)}$	140	140	V

V.H.F. POWER DOUBLE TETRODE

QQV04-15

V.H.F. double tetrode rated for a maximum anode dissipation of 7.5W per section and suitable for use at frequencies up to 250Mc/s.

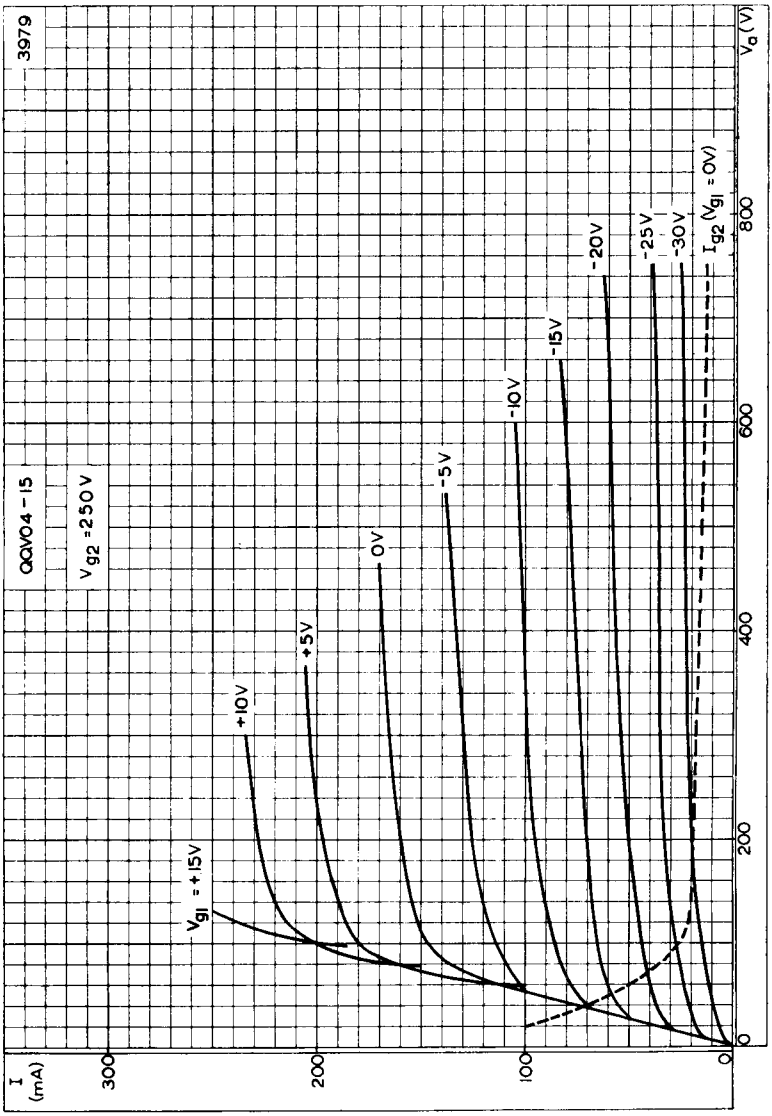


All dimensions in mm

QQV04-15

V.H.F. POWER DOUBLE TETRODE

V.H.F. double tetrode rated for a maximum anode dissipation of 7.5W per section and suitable for use at frequencies up to 250Mc/s.

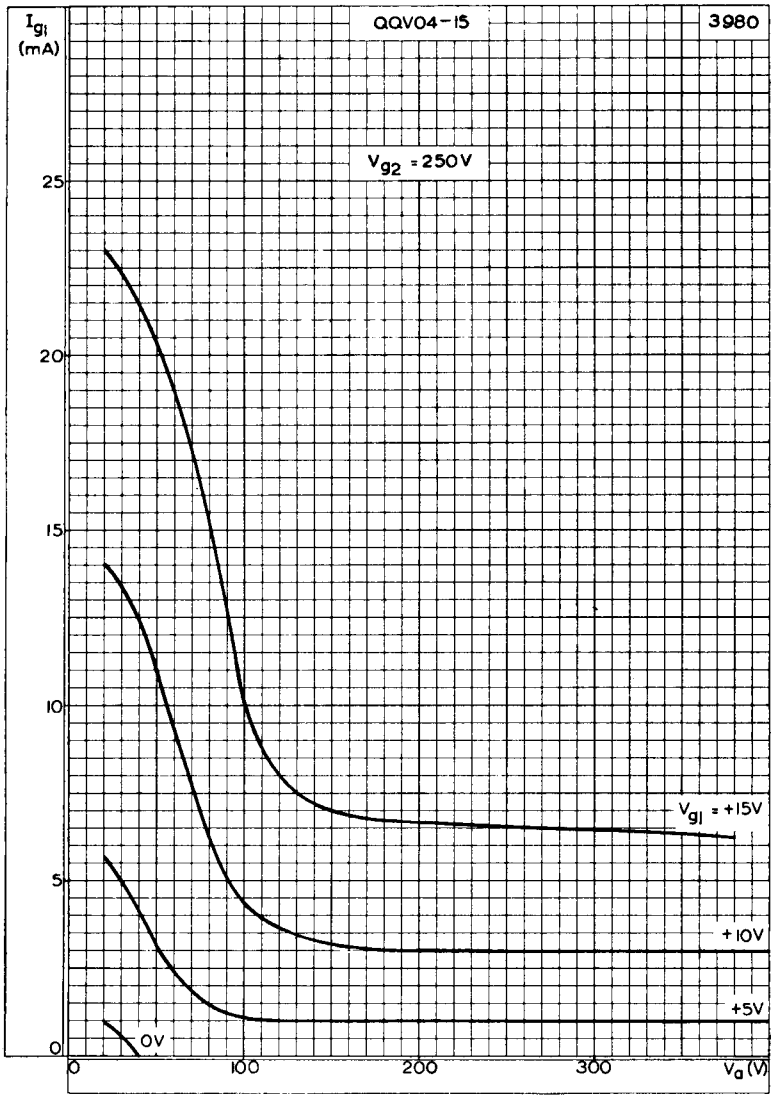


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

V.H.F. POWER DOUBLE TETRODE

QQV04-15

V.H.F. double tetrode rated for a maximum anode dissipation of 7.5W per section and suitable for use at frequencies up to 250Mc/s.



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

DOUBLE TETRODE

Application: U.H.F. amplifier, frequency trebler and oscillator.
Power output: 7W continuous rating.
Frequency: 960Mc/s at maximum ratings.
Construction: Glass, natural cooling.

QQV04-16

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES which precede this section of the handbook.

CATHODE

Indirectly heated, oxide coated. The heater is centre-tapped and the two sections may be operated in series or parallel.

	Series	*Parallel*	
*V_h	12.6	6.3	V
I_h	300	600	mA

*The heater has been designed to accept temporary fluctuations of ±10%.

MOUNTING POSITION

Any

CAPACITANCES

c_{a-g1} (each section)	145	mpF
c_{in} (two sections in push-pull)	4.5	pF
c_{out} (two sections in push-pull)	1.35	pF

CHARACTERISTICS (each section)

V_a	350	V
V_{g2}	250	V
I_a	25	mA
g_m	10.5	mA/V
μ_{g1-g2}	26	

COOLING

Radiation and convection

T_{bulb} max.	220	°C
T_{pins} max.	220	°C

WEIGHT

Valve only	1.2	oz
	35	g
Shipping weight	1.9	oz
	55	g

ACCESSORIES

Base socket assembly B8.700.71

QQV04-16

DOUBLE TETRODE

CLASS "C" TELEGRAPHY OR F.M. TELEPHONY

Limiting values (absolute ratings)	*C.C.S.*	*I.C.A.S.*	
f max.	960	960	Mc/s
V_a max.	400	400	V
I_a max.	2×45	2×50	mA
p_a max.	2×8.0	2×10	W
V_{g2} max.	225	225	V
p_{g2} max.	2×1.5	2×1.75	W
I_{g1} max.	2×4.0	2×5.0	mA
$-V_{g1}$ max	100	100	V

Operating conditions for push-pull amplifier			
f	960	960	Mc/s
V_a	250*	250	V
V_{g2}	160	170	V
V_{g1}	−15	−15	V
I_a	2×35	2×40	mA
I_{g2}	15	15	mA
I_{g1}	2×750	2×750	μA
$P_{load\ (driver)}$	1.4	1.4	W
p_a	2×5.4	2×5.4	W
P_{out}	7.0	8.0	W
η_a	40	40	%
P_{load}	4.0	5.0	W
$\eta_{transfer}$	57	62.5	%

*Adjust V_{g2} until $I_a = 2 \times 35$mA at P_{out} max.

PUSH-PULL FREQUENCY TREBLER

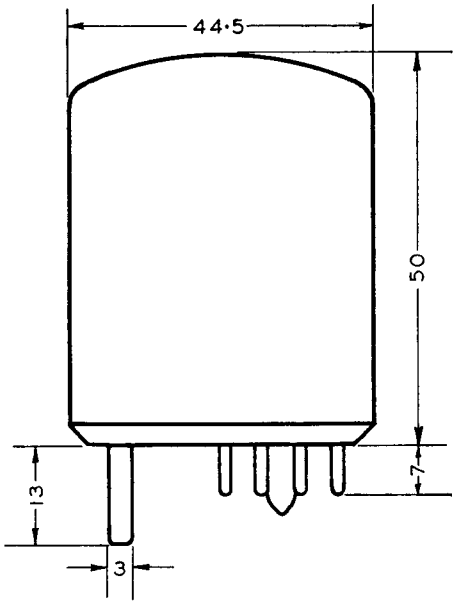
Limiting values (absolute ratings)	*C.C.S.*	*I.C.A.S.*	
f max.	960	960	Mc/s
V_a max.	400	400	V
I_a max.	2×40	2×40	mA
p_a max.	2×8.0	2×10	W
V_{g2} max.	225	250	V
p_{g2} max.	2×1.5	2×1.75	W
I_{g1} max.	2×4.0	2×5.0	mA
$-V_{g1}$ max.	100	100	V

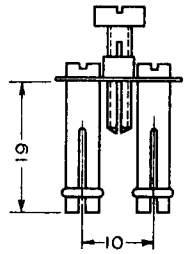
Operating conditions			
f_{out}	960	960	Mc/s
V_a	250	250	V
V_{g2}	150	170	V
I_a	2×37.5	2×40	mA
I_{g2}	15	16	mA
I_{g1}	2×2.25	2×2.25	mA
$P_{load\ (driver)}$	3.0	3.0	W
p_a	2×8.0	2×8.5	W
P_{out}	2.75	3.0	W
η_a	14.7	15	%
P_{load}	1.5	1.8	W
$\eta_{transfer}$	54	60	%

DIMENSIONS

Maximum overall length	63	mm
Maximum seated height	50	mm
Maximum diameter	44.5	mm

QQV04-16

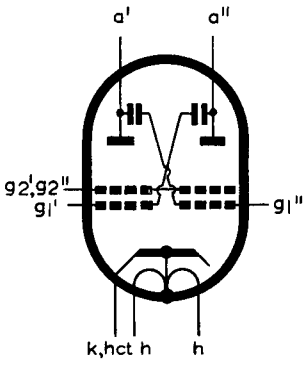




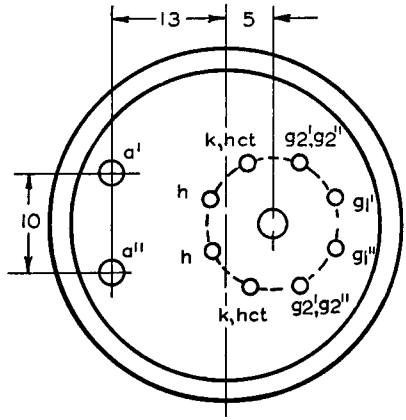
Typical anode connector at f = 960Mc/s

All dimensions in mm

6697



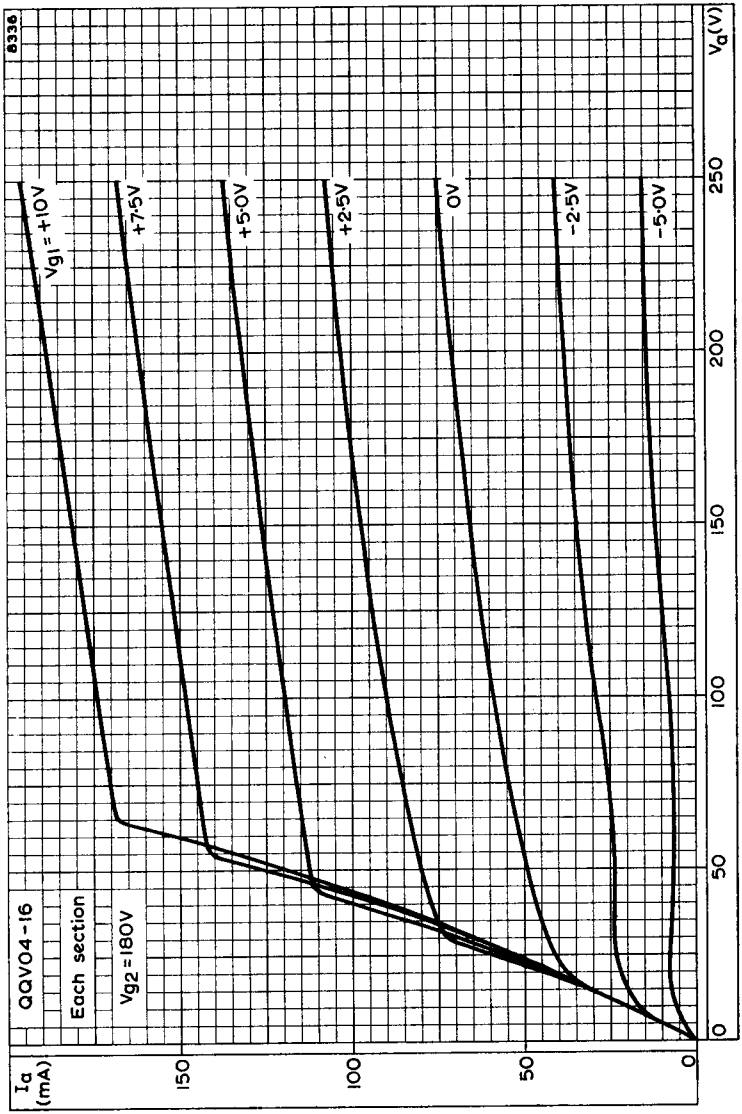
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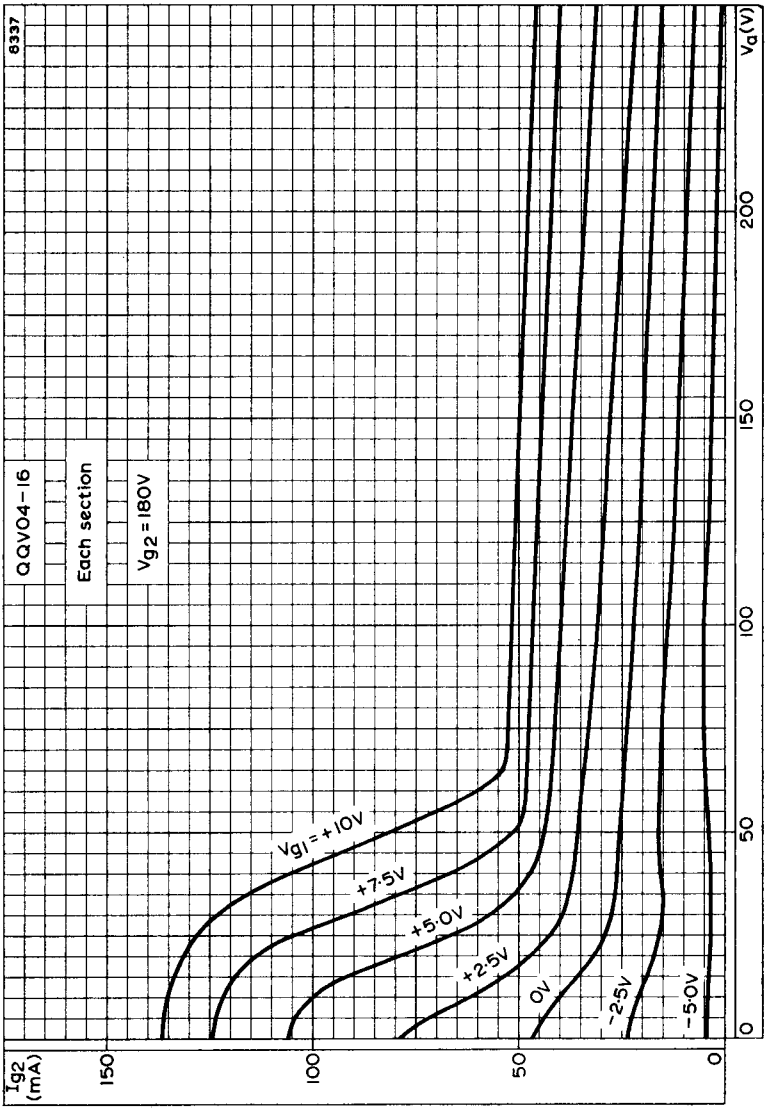
Loctal base with separate anode pins

All dimensions in mm

QQV04-16

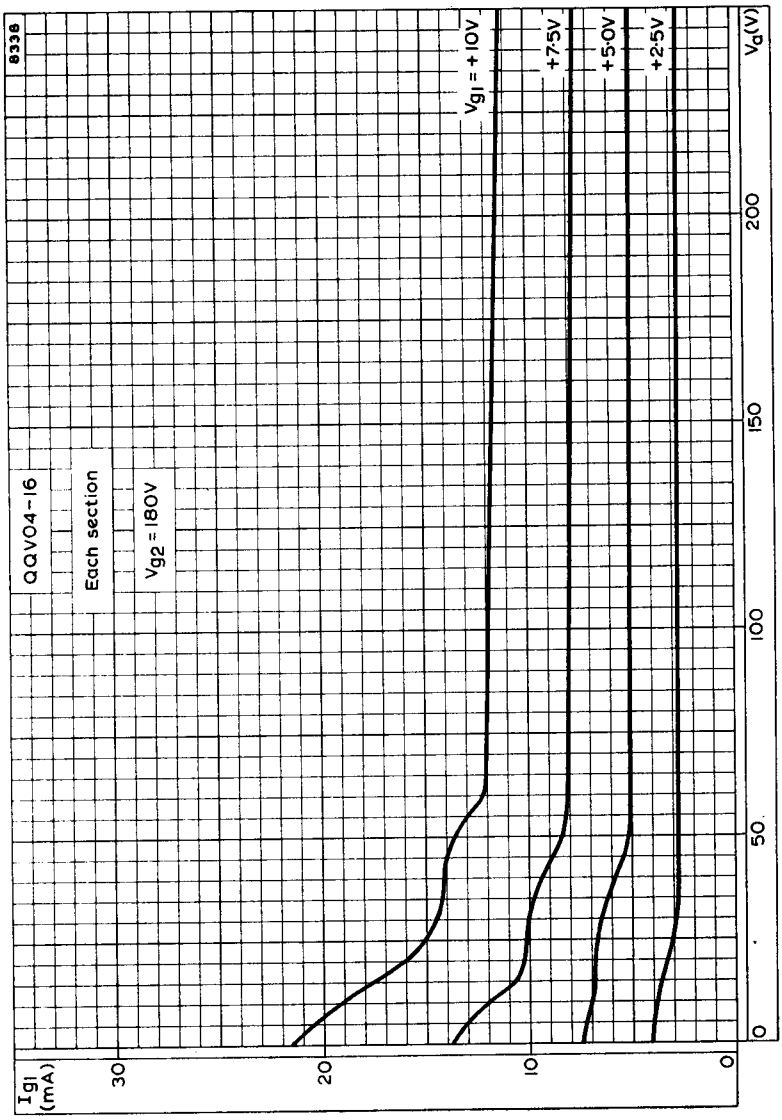


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 180V

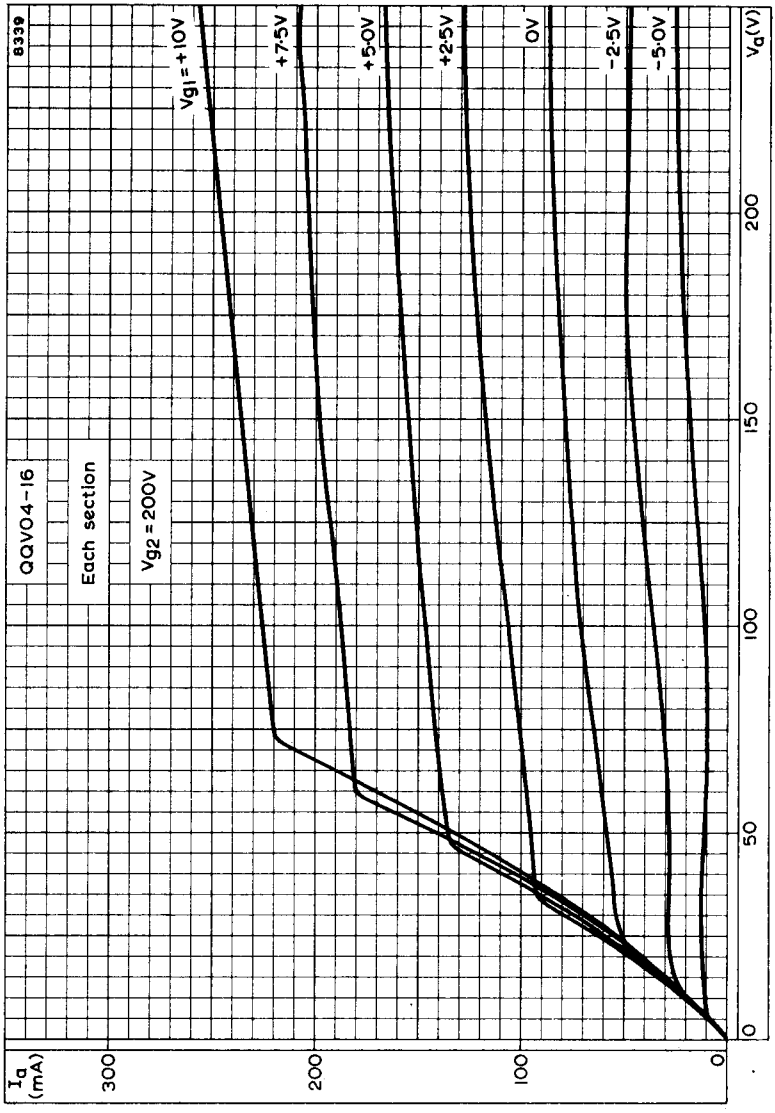


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 180V

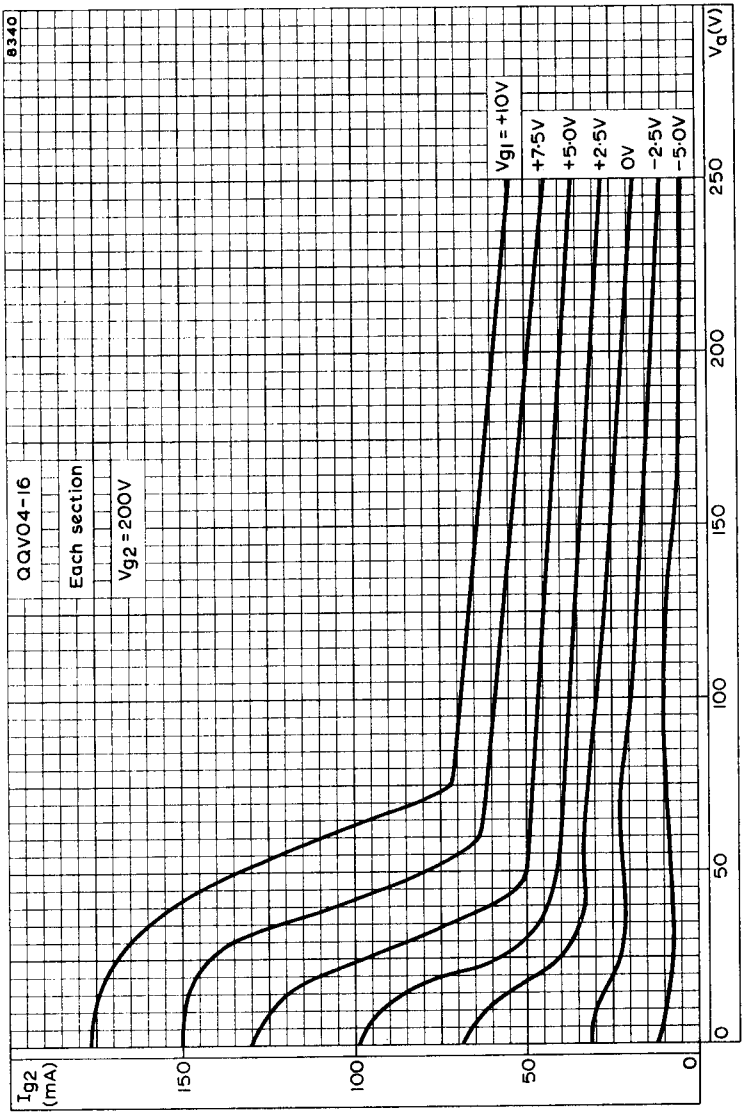
QQV04-16



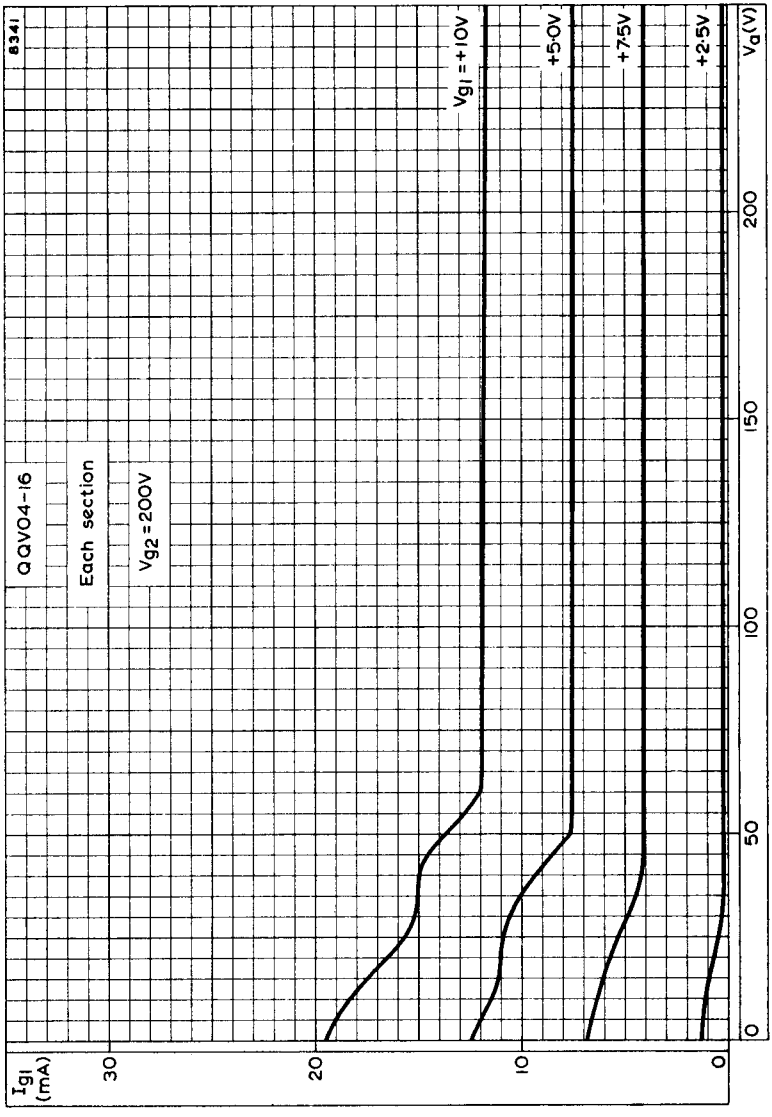
CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 180V



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

CATHODE

Indirectly heated. The heater is centre-tapped and the two sections may be operated in series or parallel with one another.

	Series	*Parallel*	
V_h	12.6	6.3	V
I_h	0.9	1.8	A

MOUNTING POSITION

Fixed station operation	Vertical – base up or down Horizontal – anode pins in horizontal plane
Mobile operation	Vertical – base up or down

CAPACITANCES

*c_{a-g1} (each section)	0.06	pF ←
c_{g1-all} (each section)	10.5	pF
c_{a-all} (each section)	3.2	pF
c_{out} (two sections in push-pull)	2.1	pF
c_{in} (two sections in push-pull)	6.7	pF

*Internally neutralised for push-pull operation

CHARACTERISTICS (each section) measured at I_a = 30mA

g_m	4.5	mA/V
μ_{g1-g2}	8.0	

COOLING

Max. base pin temperature	180	°C
Max. bulb and anode seal temperature	200	°C

Anode connectors providing a high degree of heat transfer by radiation or by conduction should be used.

Natural cooling is sufficient with –

V_a = 750V at frequencies up to 100Mc/s
V_a = 600V at frequencies up to 150Mc/s
V_a = 300V at frequencies up to 450Mc/s.

Above these limits or with high ambient temperatures it may be necessary to direct a flow of air (up to 5cu.ft. per min.) on the top of the bulb to keep the seal temperature within the stated limit.

QQV06-40A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500 Mc/s.

OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting values

V_a max.	See page 15	
p_a max.	2×20	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	300	V
p_{g2} max.	2×3.5	W
p_{g1} max.	2×1.0	W
I_{g1} max.	2×5.0	mA
I_k max.	2×120	mA
$i_{k(pk)}$ max.	2×700	mA
$-V_{g1}$ max.	100	V
R_{g1-k} max. per section (fixed bias)	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	kΩ
V_{h-k} max.	100	V

Typical operating conditions

f	200	200	400	400	Mc/s
V_a	400	600	400	540	V
V_{g2}	250	250	250	250	V
V_{g1}	−60	−80	−50	−55	V
I_a	2×100	2×100	2×100	2×100	mA
I_{g2}	2×8.0	2×9.0	2×5.0	2×7.0	mA
I_{g1}	2×3.0	2×3.5	2×2.0	2×1.5	mA
$P_{load(driver)}$	3.0	3.0	11	12	W
p_a	2×12	2×15	2×15	2×20	W
P_{out}	56	90	50	70	W
η_j	70	75	63	65	%
P_{load}	47	78	42	59	W

f	475	475	Mc/s
V_a	350	500	V
V_{g2}	250	250	V
V_{g1}	−45	−50	V
I_a	2×100	2×100	mA
I_{g2}	2×4.5	2×4.5	mA
I_{g1}	2×2.0	2×2.0	mA
$P_{load(driver)}$	10	12	W
p_a	2×15	2×20	W
P_{out}	40	60	W
η_j	57	60	%
P_{load}	33	51	W

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

OPERATING CONDITIONS AS ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY)

Limiting values (carrier condition for modulation factor of 1)

V_a max.	See page 17	
p_a max.	2×14	W
$V_{g2(b)}$ max.	600	V ←
V_{g2} max.	300	V ←
p_{g2} max.	2×2.3	W ←
$-V_{g1}$ max.	175	V ←
I_{g1} max.	2×5.0	mA
p_{g1} max.	2×1.0	W
I_k max.	2×120	mA
$i_{k(pk)}$ max.	2×1.0	A
R_{g1-k} max. per section (fixed bias)	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	kΩ
V_{h-k} max.	100	V

Typical operating conditions ←

f	60	200	200	250	Mc/s
V_a	600	400	600	600	V
V_{g2}	250	250	250	250	V
V_{g1}	−80	−70	−80	−80	V
I_a	2×75	2×75	2×75	2×75	mA
I_{g2}	2×10	2×9.0	2×9.0	2×9.0	mA
I_{g1}	2×4.0	2×2.0	2×2.0	2×1.5	mA
p_a	2×9.5	2×9.5	2×11.5	2×13	W
P_{out}	71	41	67	64	W
η	79	69	75	71	%
P_{load}	60	35	57	54	W
For 100% modulation					
P_{mod}	47	47	47	47	W
$v_{g2(pk)}$	185	185	185	185	V

f	400	475	Mc/s
V_a	400	400	V
V_{g2}	250	250	V
V_{g1}	−70	−70	V
I_a	2×75	2×75	mA
I_{g2}	2×8.0	2×7.5	mA
I_{g1}	2×1.5	2×1.5	mA
p_a	2×11.5	2×13	W
P_{out}	37	34	W
η	62	57	%
P_{load}	32	30	W
For 100% modulation			
P_{mod}	47	47	W
$v_{g2(pk)}$	185	185	V

QQV06-40A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

OPERATING CONDITIONS AS FREQUENCY TREBLER

Limiting values

V_a max.	750	V
p_a max.	2×20	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	300	V
p_{g2} max.	2×3.5	W
p_{g1} max.	2×1.0	W
I_k max.	2×100	mA
$i_{k(pk)}$ max.	2×700	mA
$-V_{g1}$ max.	175	V
R_{g1-k} max. per section (fixed bias)	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	kΩ
V_{h-k} max.	100	V

Typical operating conditions

f_{out}	150	150	230	Mc/s
V_a	400	500	400	V
V_{g2}	250	250	250	V
V_{g1}	−150	−150	−150	V
I_a	2×72	2×60	2×65	mA
I_{g2}	2×8.0	2×5.0	2×10	mA
I_{g1}	2×2.5	2×3.0	2×1.5	mA
$V_{in(g1-g1)pk}$	360	360	360	V
p_a	2×20	2×20	2×20	W
P_{out}	18	20	12	W
η_j	31	33	23	%
P_{load}	14.5	16	10	W

OPERATING CONDITIONS AS A.F. POWER AMPLIFIER AND MODULATOR (CLASS "B")

Limiting values

V_a max.	600	V
p_a max.	2×20	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	300	V
p_{g2} max.	2×3.5	W
p_{g1} max.	2×1.0	W
I_k max.	2×140	mA
$i_{k(pk)}$ max.	2×450	mA
R_{g1-k} max. per section (fixed bias)	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	kΩ
V_{h-k} max.	100	V

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

Typical operating conditions (without grid current)

V_a	300	450	600	V
V_{g2}	250	250	250	V
V_{g1}	−26	−27	−27	V
$I_{a(o)}$	2×20	2×20	2×20	mA
I_a (max. sig.)	2×56	2×58	2×62	mA
$I_{g2(o)}$	2×1.0	2×0.7	2×0.45	mA
I_{g2} (max. sig.)	2×14	2×13.5	2×11.5	mA
$V_{in(g1-g1)r.m.s.}$	36	38	39	V
P_a	2×5.6	2×8.5	2×12	W
R_{a-a}	6.5	10	12.5	kΩ
P_{out}	22.5	35	50	W
η	67	67.5	67.5	%
D_{tot}	2.9	3.1	2.4	%

Typical operating conditions (with grid current)

V_a	300	450	600	V
V_{g2}	250	250	250	V
V_{g1}	−25	−25	−25	V
$I_{a(o)}$	2×25	2×25	2×25	mA
I_a (max. sig.)	2×94	2×97	2×100	mA
$I_{g2(o)}$	2×1.4	2×0.95	2×0.7	mA
I_{g2} (max. sig.)	2×14	2×14	2×13	mA
I_{g1}	2×2.6	2×2.6	2×2.6	mA
$V_{in(g1-g1)r.m.s.}$	52	54	55	V
P_a	2×9.7	2×13.5	2×17	W
R_{a-a}	4.0	6.0	8.0	kΩ
P_{out}	37	60	86	W
η	65.5	69	71.5	%
D_{tot}	5.0	5.0	5.0	%

ACCESSORIES

Information on these items can be obtained from the Industrial Technical Service Dept., Mullard Ltd.

WEIGHT

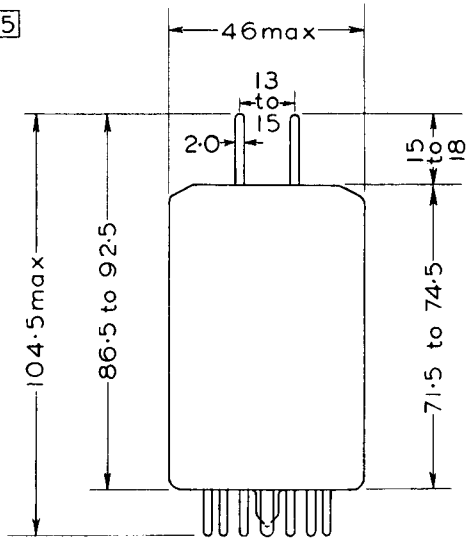
Valve only — 2.3 oz / 65 g

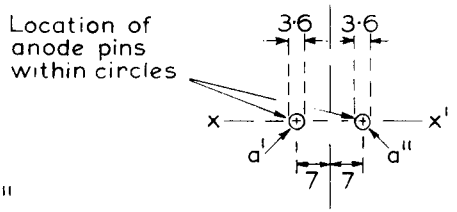
QQV06-40A

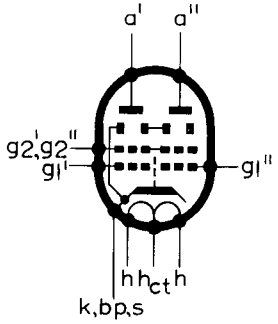
V.H.F. POWER DOUBLE TETRODE

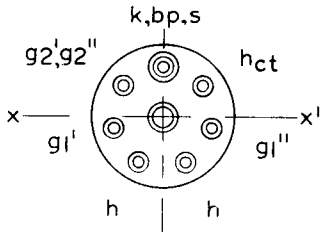
Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

4395









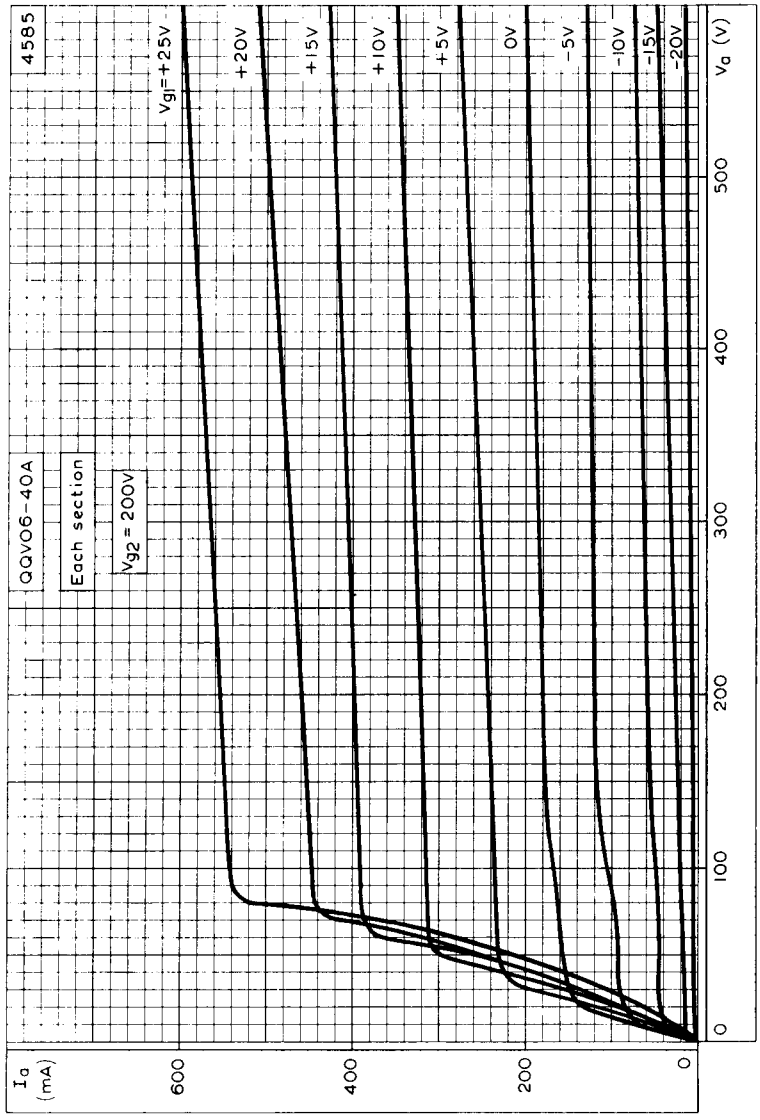
B7A Base

All dimensions in mm

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

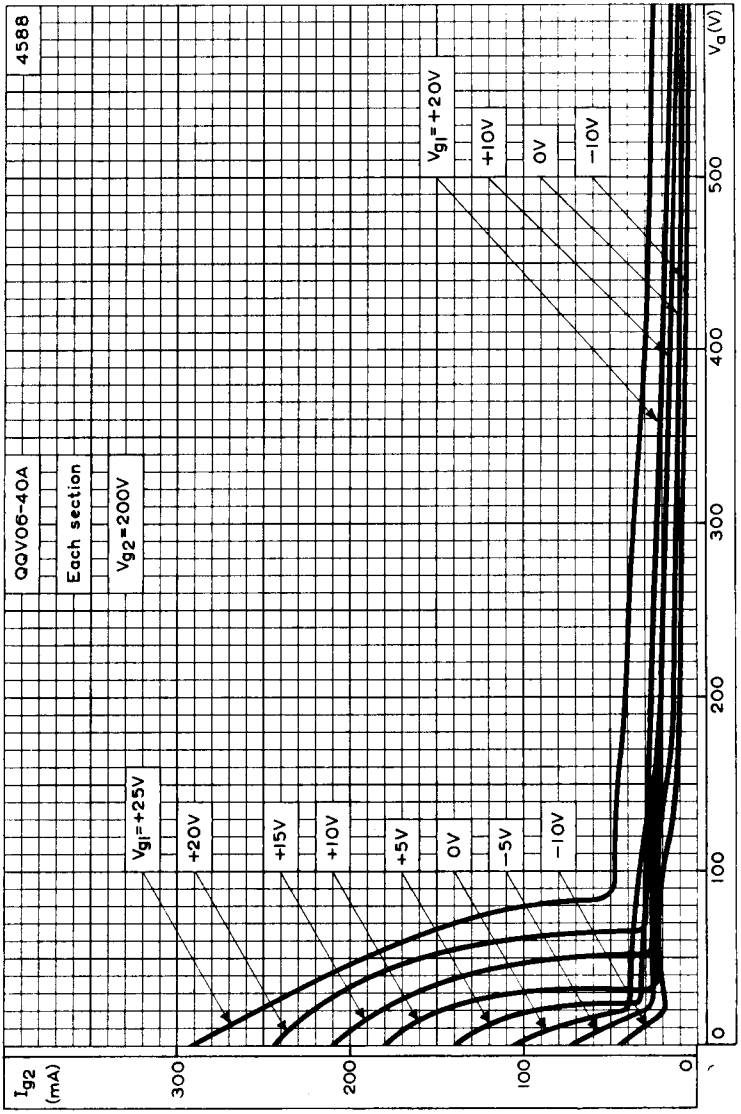


ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V

QQV06-40A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

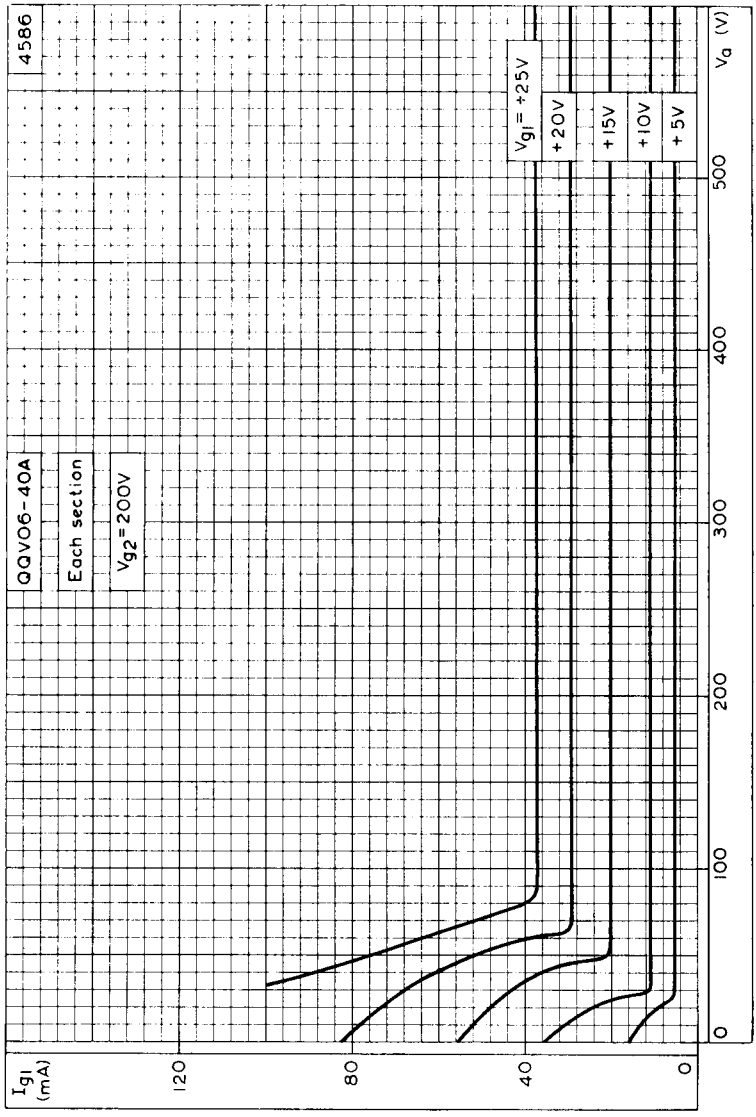


SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} 200V

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.



CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V

QQV06-40A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

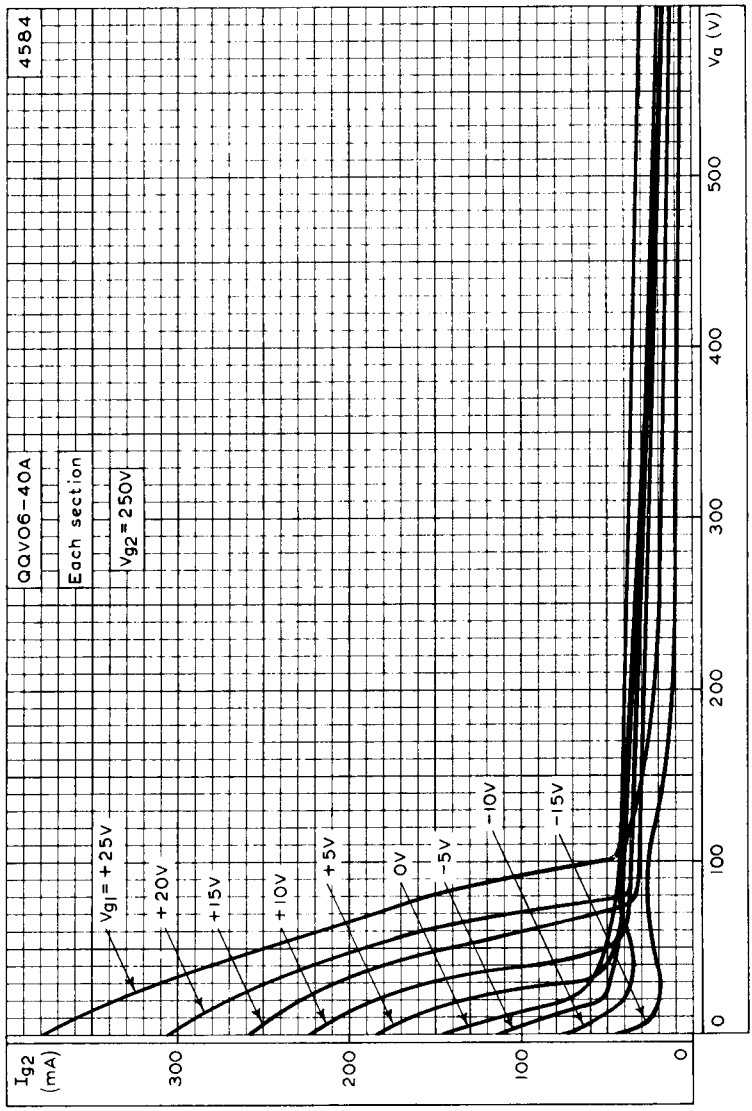


ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 250V

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

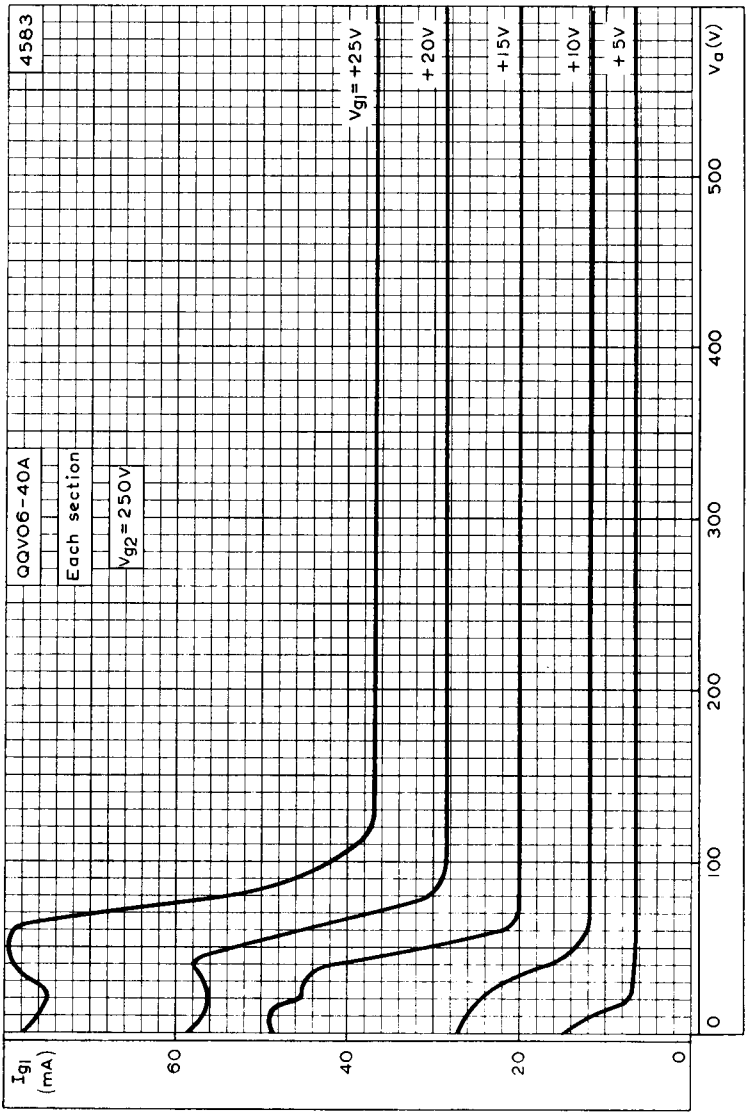


SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} — 250V

QQV06-40A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

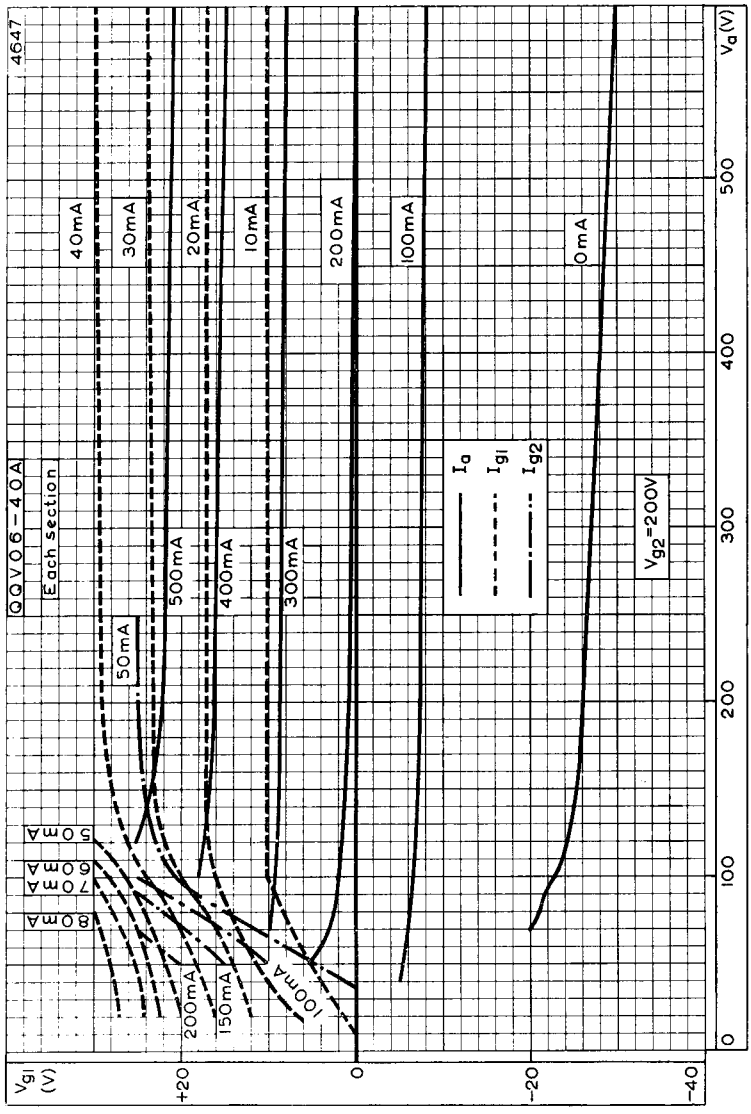


CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER
V_{g2} = 250V

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

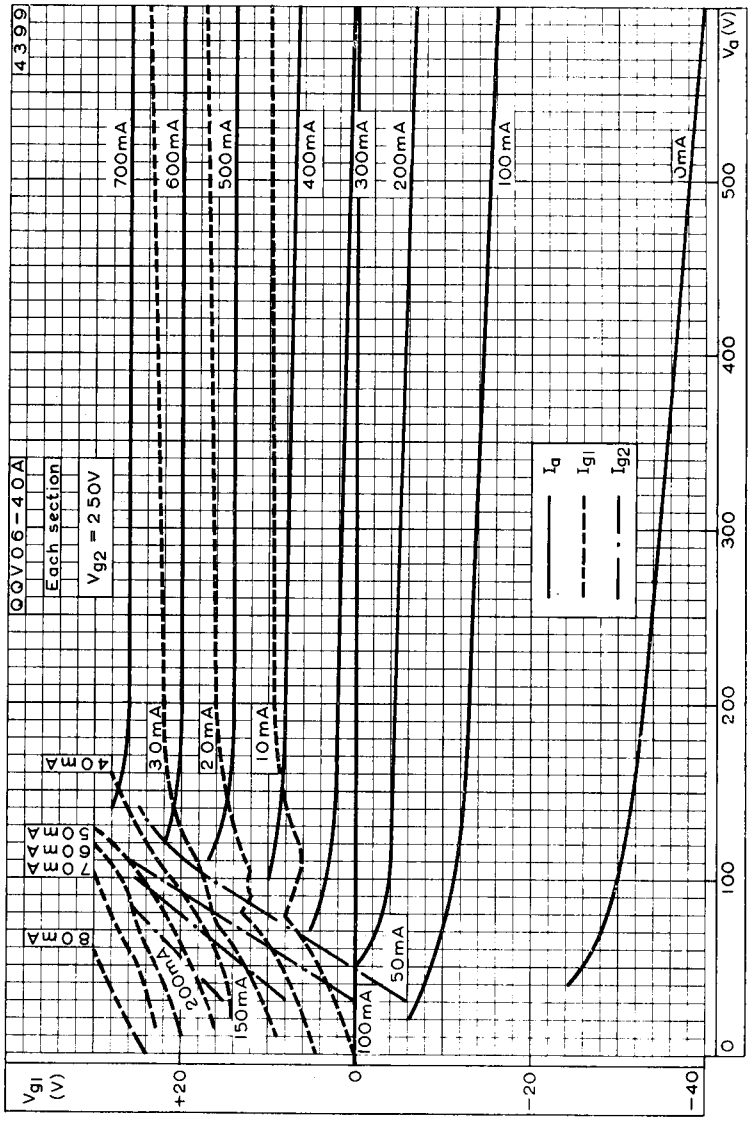


CONSTANT CURRENT CURVES FOR EACH SECTION V_{g2} = 200V

QQV06-40A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

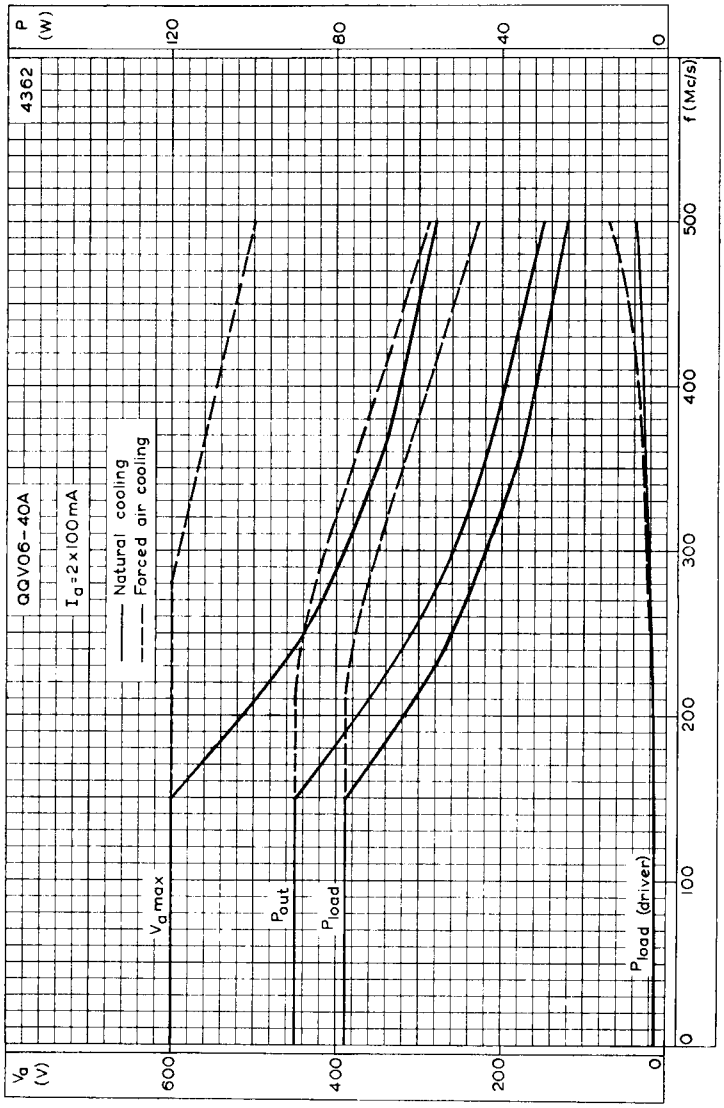


CONSTANT CURRENT CURVES FOR EACH SECTION V_{g2} 250V

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

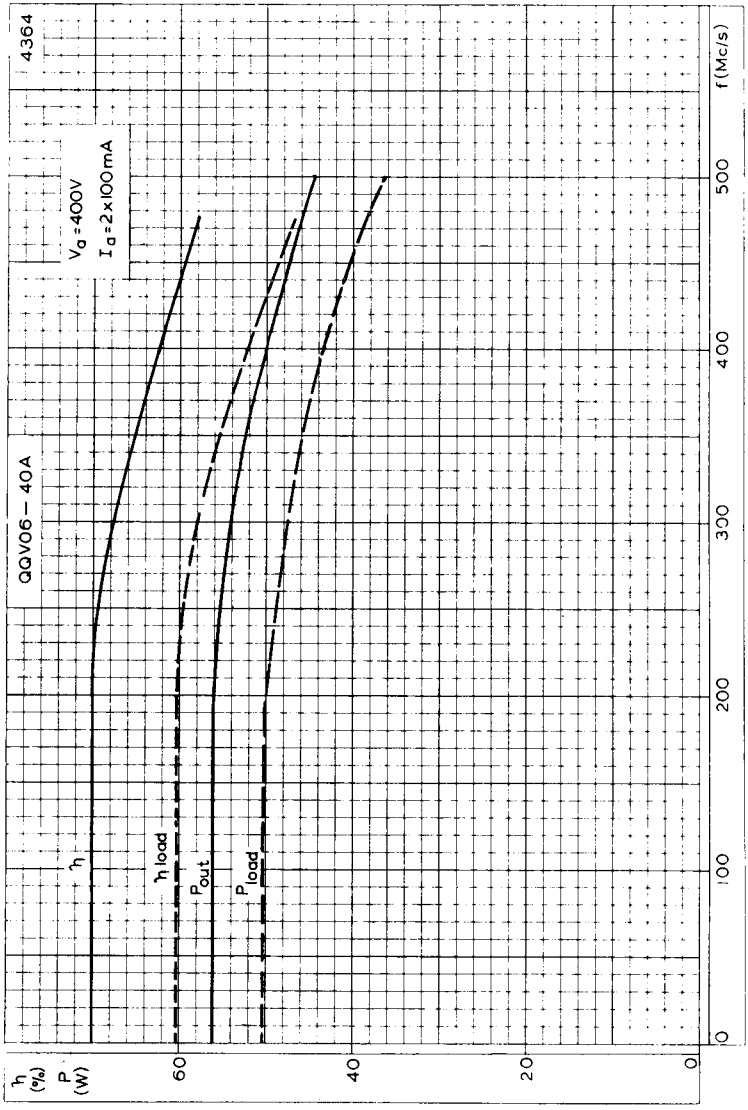


FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

QQV06-40A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

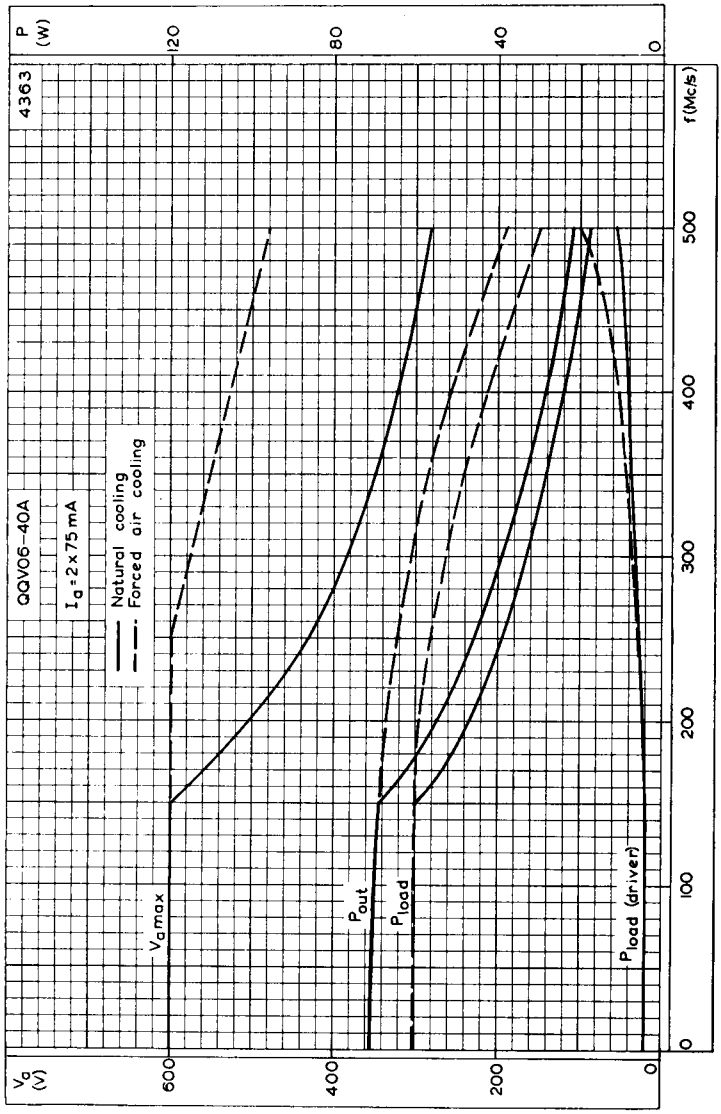


FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY)

V.H.F. POWER DOUBLE TETRODE

QQV06-40A

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.

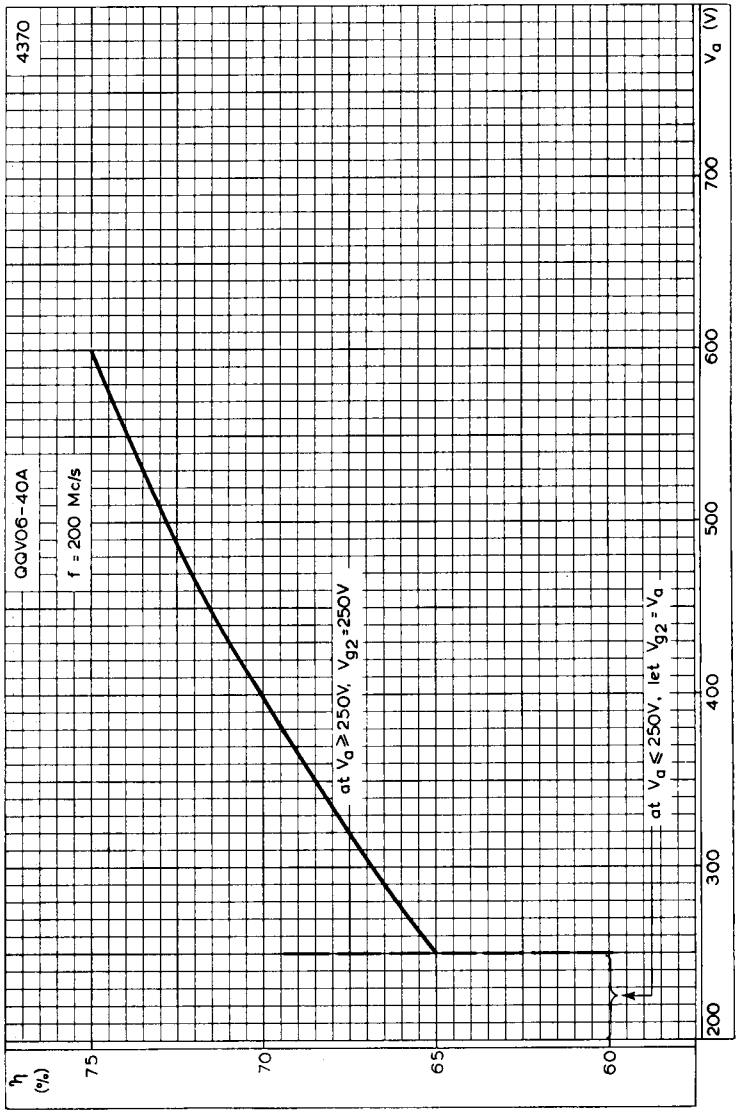


FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY)

QQV06-40A

V.H.F. POWER DOUBLE TETRODE

Beam power double tetrode rated for a maximum anode dissipation of 20W at each anode and intended for use at frequencies up to 500Mc/s.



ANODE EFFICIENCY PLOTTED AGAINST ANODE VOLTAGE FOR CLASS "C" PUSH-PULL TELEGRAPHY

R.F. POWER DOUBLE TETRODE

QQV07-40

Twin beam-tetrode rated to dissipate 20 W at each anode, and primarily intended for use as a Class "C" amplifier or oscillator at frequencies up to 250 Mc/s.

This data sheet should be read in conjunction with "Operating Notes. Part 1, Power Valves," included in this volume of the Handbook.

CATHODE

Indirectly heated for series or parallel operation.

	Series	Parallel	
V_h	12.6	6.3	V
I_h	1.25	2.5	A

MOUNTING POSITION

Vertical—base down.
Horizontal—plane of anodes vertical

CAPACITANCES (Each Section)

c_{in}	14.5	μμF
c_{out}	7.0	μμF
*c_{a-g1}	<0.12	μμF
c_{g2-k} (including internal by-pass capacitor)	65	μμF approx.

*With external shield up to flange seal

CHARACTERISTICS (Each Section) measured at I_a=60 mA; V_a=750 V; V_{g2}=225 V

g_m	8.5	mA/V
μ_{g1-g2}	9	

LIMITING VALUES

V_a max.	750	V
p_a max.	2×20	W
$v_{a\ (pk)}$ max.	2,500	V
$V_{g2(b)}$ max.	600	V
V_{g2} max.	225	V
p_{g2} max.	2×3.5	W
I_{g2} max.	2×17	mA
I_k max.	2×145	mA
$I_{k\ (pk)}$ max. (each section)	550	mA
V_{g1} max.	−175	V
I_{g1} max.	2×7.5	mA
$I_{g1\ (pk)}$ max. (each section)	30	mA
R_{g1-k} max. (each section)	30,000	Ω
V_{h-k} max.	100	V
**Max. bulb temp.	175	°C

Operating Frequency (Mc/s)	Max. Anode Voltage (V)	Max. Anode Input Power (W)
100	750	120
150	700	120
200	600	120
250	500	100

**Forced air cooling may be required to limit the bulb temperature to the figure quoted, at normal dissipations an air flow of approximately 5 cu. ft./min. is required.

SAMPLE COPY

QQV07-40

R.F. POWER DOUBLE TETRODE

Twin beam-tetrode rated to dissipate 20 W at each anode, and primarily intended for use as a Class "C" amplifier or oscillator at frequencies up to 250 Mc/s.

OPERATING CONDITIONS AS PUSH-PULL R.F. POWER AMPLIFIER OR OSCILLATOR—CLASS "C" TELEGRAPHY

V_a	500	750	V
*V_{g2}	200	200	V
R_{g2}	9,300	18,300	Ω
**V_{g1}	−45	−55	V
R_{g1-k}	3,750	4,600	Ω
R_k	160	270	Ω
I_a	2×120	2×80	mA
I_{g2}	2×16	2×15	mA
I_{g1}	2×6	2×6	mA approx.
$V_{in\ (pk)}$	2×62	2×70	V
P_{drive}	0.7	0.8	W approx.
P_{out}	83	87	W approx.

OPERATING CONDITIONS AS CLASS "C" ANODE MODULATED PUSH-PULL R.F. AMPLIFIER

V_a	425	600	V
*V_{g2}	200	200	V
R_{g2}	6,400	13,300	Ω
**V_{g1}	−60	−70	V
R_{g1-k}	5,500	5,800	Ω
I_a	2×106	2×75	mA
I_{g2}	2×18	2×15	mA
I_{g1}	2×5.5	2×6	mA approx.
$V_{in\ (pk)}$	2×77	2×86	V
P_{drive}	0.8	0.9	W approx.
P_{out}	63	70	W approx.

OPERATING CONDITIONS AS CLASS "C" GRID MODULATED PUSH-PULL R.F. POWER AMPLIFIER

V_a	500	750	V
V_{g2}	200	200	V
V_{g1}	−38	−55	V
I_a	2×60	2×40	mA
I_{g2}	2×5	2×2.5	mA
I_{g1}	2×1	0	mA approx.
$V_{in\ (pk)}$ (R.F.)	2×41	2×52	V
$V_{mod\ (pk)}$	17	15	V
P_{drive}	0.5	0.7	W approx.
P_{out}	23	24	W approx.

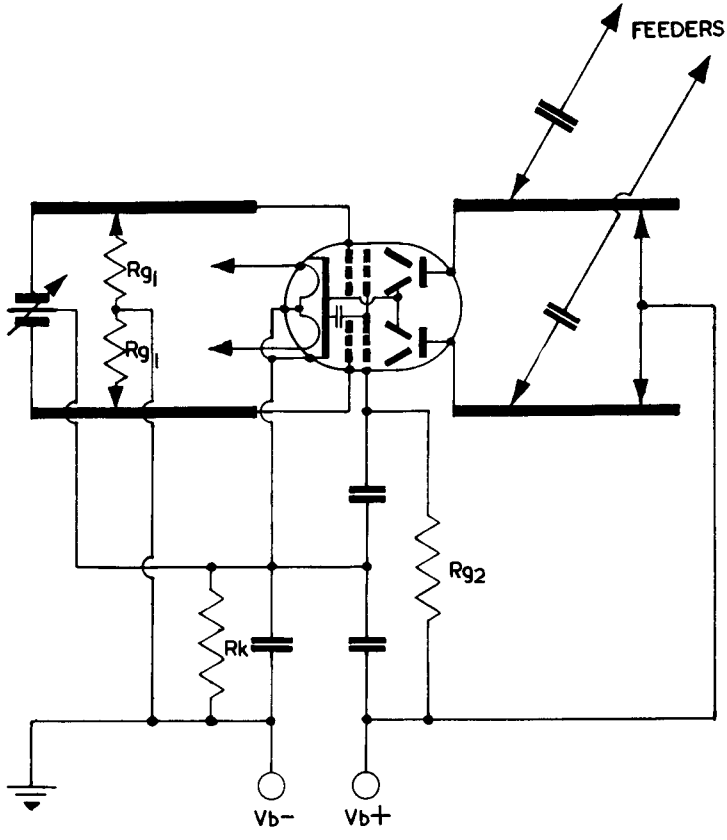
*May be obtained from a separate supply, or from the anode supply through series resistor (R_{g2}) of value shown, in which case provision must be made to ensure that $V_{g2(b)}$ does not exceed 600 V.

**May be obtained from a separate supply, or by a grid or cathode resistor of value shown, or by a combination of these methods.

R.F. POWER DOUBLE TETRODE

QQV07-40

Twin beam-tetrode rated to dissipate 20 W at each anode, and primarily intended for use as a Class "C" amplifier or oscillator at frequencies up to 250 Mc/s.

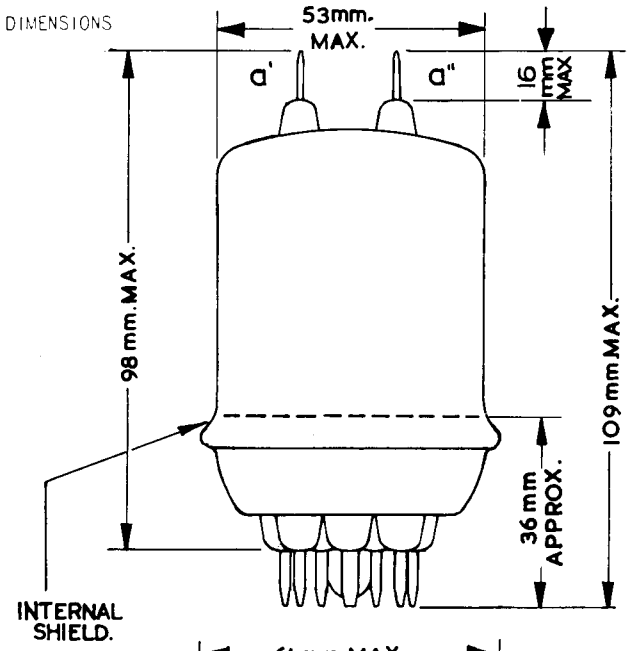


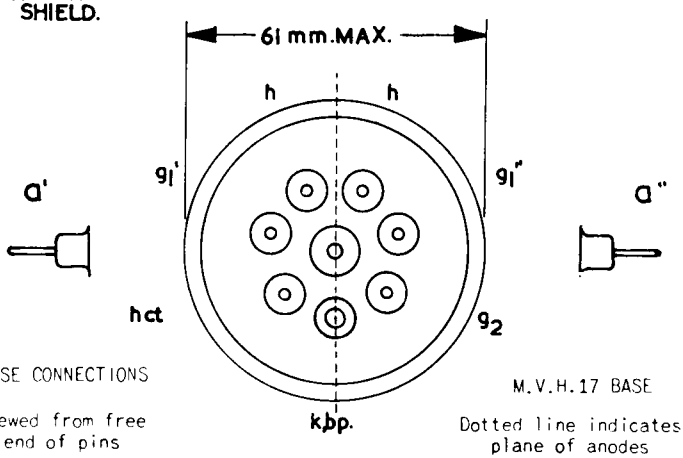
CIRCUIT DIAGRAM FOR QQV07-40 AS V.H.F. PUSH-PULL R.F. POWER AMPLIFIER

QQV07-40

R.F. POWER DOUBLE TETRODE

Twin beam-tetrode rated to dissipate 20 W at each anode, and primarily intended for use as a Class "C" amplifier or oscillator at frequencies up to 250 Mc/s.





BASE CONNECTIONS

Viewed from free end of pins

M.V.H.17 BASE

Dotted line indicates plane of anodes

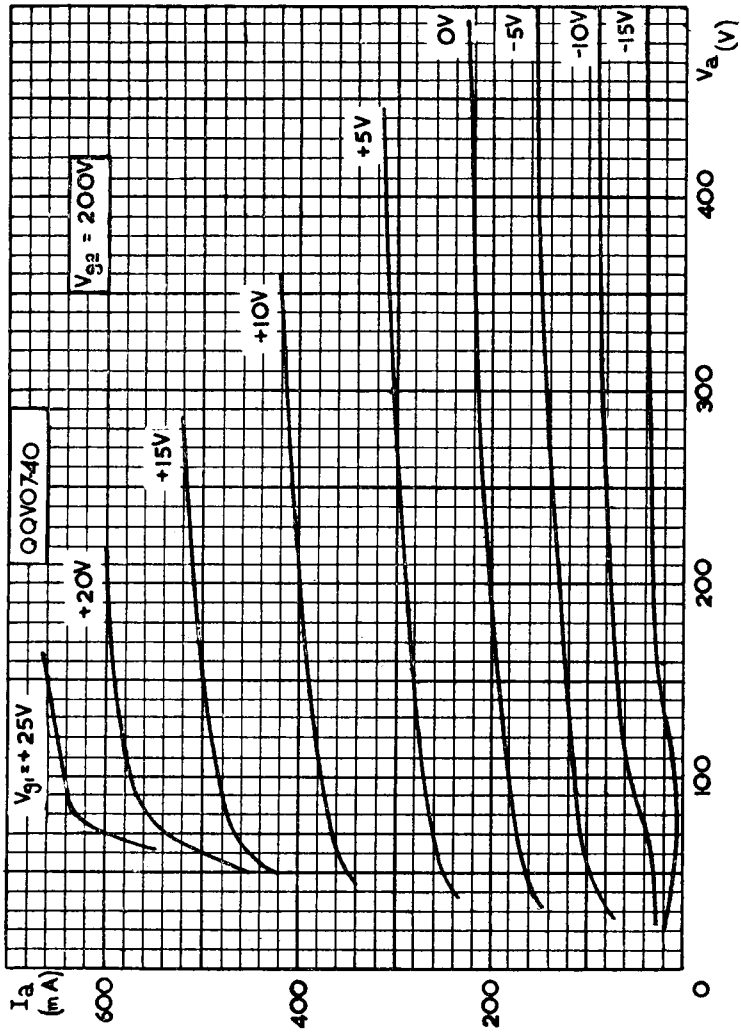
WEIGHT

Valve only 4 oz. (0.11 Kg.)
Valve and carton 9¼ oz. (0.27 Kg.)

R.F. POWER DOUBLE TETRODE

QQV07-40

Twin beam-tetrode rated to dissipate 20 W at each anode, and primarily intended for use as a Class "C" amplifier or oscillator at frequencies up to 250 Mc/s.

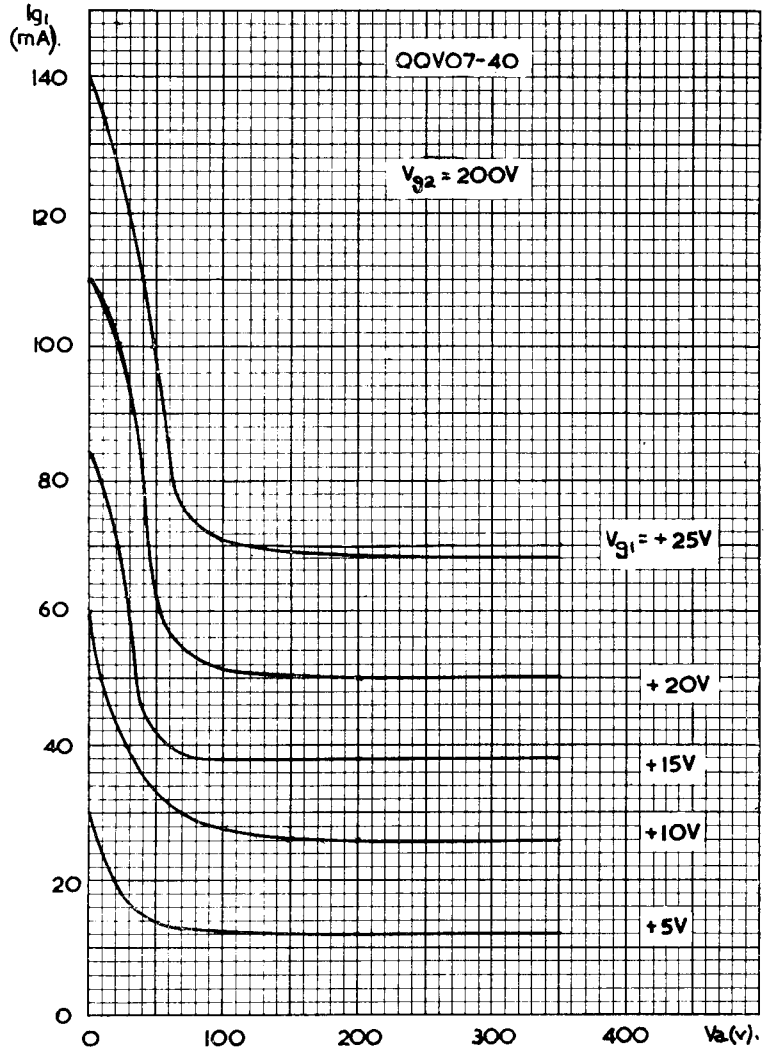


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

QQV07-40

R.F. POWER DOUBLE TETRODE

Twin beam-tetrode rated to dissipate 20 W at each anode, and primarily intended for use as a Class "C" amplifier or oscillator at frequencies up to 250 Mc/s.



CONTROL GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

U.H.F. POWER DOUBLE TETRODE

QQV07-50

QUICK REFERENCE DATA

Double tetrode intended for use as u.h.f. power amplifier or frequency multiplier.

	Frequency Multiplier	Class 'C' Telephony Anode and Screen Grid Modulation	Class 'C' Telegraphy or F.M. Telephony	
f	180/60	60	200	Mc/s
P_{out}	27	80	103	W
f max.	500	500	500	Mc/s
V_a max. (f<250Mc/s)	750	600	750	V
(f =500Mc/s)	600	480	600	V
p_a max.	2 x 25	2 x 16.7	2 x 25	W

To be read in conjunction with

GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

f	180	180	470	470	Mc/s
P_{out}	64	103	52	69	W
P_{load}	54	87	44	59	W
η_a	70	75	57	60	%
V_a	400	600	400	500	V
I_a	2 x 115	2 x 115	2 x 115	2 x 115	mA
V_{g2}	250	250	250	250	V
I_{g2}	2 x 7.0	2 x 8.0	2 x 5.0	2 x 4.0	mA
$-V_{g1}$	60	80	50	60	V
I_{g1}	2 x 3.0	2 x 4.0	2 x 3.0	2 x 3.0	mA
$P_{load\ (driver)}$	4.0	4.0	12	14	W
p_a	2 x 14	2 x 17.5	2 x 20	2 x 23	W

CLASS 'C' TELEPHONY ANODE AND SCREEN-GRID MODULATION

Maximum operating conditions (Carrier conditions for 100% modulation)

f	60	180	180	470	Mc/s
P_{out}	80	47	61	37	W
P_{load}	68	40	52	26	W
η_a	78	69	72	55	%
V_a	600	400	500	400	V
I_a	2 x 85	2 x 85	2 x 85	2 x 85	mA
V_{g2}	250	250	250	250	V
I_{g2}	2 x 10	2 x 9.0	2 x 10	2 x 8.0	mA
$-V_{g1}$	90	70	90	70	V
I_{g1}	2 x 4.0	2 x 3.0	2 x 4.0	2 x 2.0	mA
$P_{load\ (driver)}$					W
p_a	2 x 11	2 x 10.5	2 x 12	2 x 15.5	W
For 100% modulation					
P_{mod}	60	36	45	35	W
$v_{g2\ (pk)}$	185	185	185	185	V

FREQUENCY MULTIPLIER

Maximum operating conditions

f_{out}/f_{in}	180/60	180/60	475/158	Mc/s
P_{out}	19	27	20	W
P_{load}	16	22	16	W
η_a	30	35	28	%
V_a	400	600	450	V
I_a	2 x 80	2 x 64	2 x 78	mA
V_{g2}	250	250	250	V
I_{g2}	2 x 8.0	2 x 4.0	2 x 9.0	mA
$-V_{g1}$	150	175	150	V
I_{g1}	2 x 3.0	2 x 3.0	2 x 3.0	mA
$P_{load\ (driver)}$				W
p_a	2 x 22.5	2 x 25	2 x 25	W

U.H.F. POWER DOUBLE TETRODE

QQV07-50

ABSOLUTE MAXIMUM RATINGS

	Frequency Multiplier	Class 'C' Telephony	Class 'C' Telegraphy	
V_a max. (f<250Mc/s)	750	600	750	V
(f =500Mc/s)	600	480	600	V
V_{g2} max.	300	300	300	V
$-V_{g1}$ max.	175	175	175	V
I_k max.	2 x 130	2 x 130	2 x 150	mA
p_a max.	2 x 25	2 x 16.7	2 x 25	W
p_{g2} max.	2 x 3.5	2 x 2.3	2 x 3.5	W
I_{g1} max.	2 x 5.0	2 x 5.0	2 x 5.0	mA
p_{g1} max.	2 x 1.0	2 x 1.0	2 x 1.0	W
R_{g1-k} max. per section (fixed bias)	50	50	50	kΩ
R_{g1-k} max. per section (automatic bias)	100	100	100	kΩ
V_{h-k} max.	100	100	100	V
$V_{g2(b)}$ max.	600	600	600	V

CATHODE

Indirectly heated. The heater is centre-tapped and the two sections may be operated in series or parallel.

	Series	Parallel	
V_h	12.6	6.3	V
I_h	0.9	1.8	A

CAPACITANCES

* c_{a-g1} (each section)	60	mpF
c_{g1-all} (each section)	10.5	pF
c_{a-all} (each section)	3.2	pF
c_{out} (two sections in push-pull)	2.1	pF
c_{in} (two sections in push-pull)	6.7	pF

* Internally neutralised for push-pull operation.

CHARACTERISTICS (each section) measured at I_a = 30mA

g_m	4.5	mA/V
μ_{g1-g2}	8.0	

MOUNTING POSITION — Any

COOLING

Radiation and convection cooled

Maximum temperatures

Pins	180	°C
Seals	200	°C
Bulb	250	°C

Anode connectors providing a high degree of heat transfer by radiation or by conduction should be used.

Natural cooling is sufficient with:-

V_a = 750V at frequencies up to 100 Mc/s
V_a = 600V at frequencies up to 150 Mc/s
V_a = 300V at frequencies up to 450 Mc/s

Above these limits or with high ambient temperatures it may be necessary to direct a flow of air (up to 5ft^3/min, 0.15m^3/min) on the top of the bulb to keep the seal temperature within the stated limit.

PHYSICAL DATA

	oz	g
Weight of valve	2.0	57

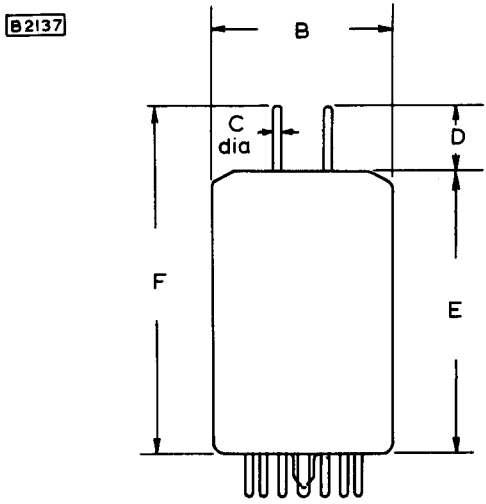
DIMENSIONS

	Inches	Millimetres
B	1.732 ± 0.079	44 ± 2
C	0.079 ± 0.001	2.0 ± 0.1
D	0.650 ± 0.059	16.5 ± 1.5
E	2.874 ± 0.059	73 ± 1.5
F	3.524 ± 0.118	89.5 ± 3.0
G	0.098 ± 0.001	2.5 ± 0.03
H	0.551 ± 0.001	14 ± 0.03

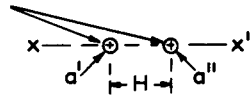
Inch dimensions are derived from original millimetre dimensions.

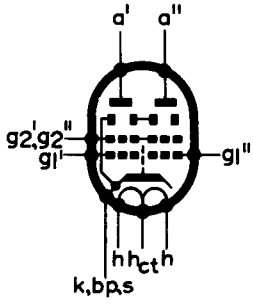
U.H.F. POWER DOUBLE TETRODE

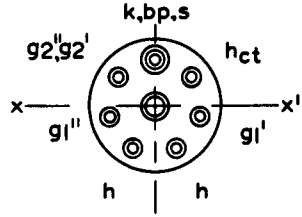
QQV07-50



Location of anode pins within circles of dia G.



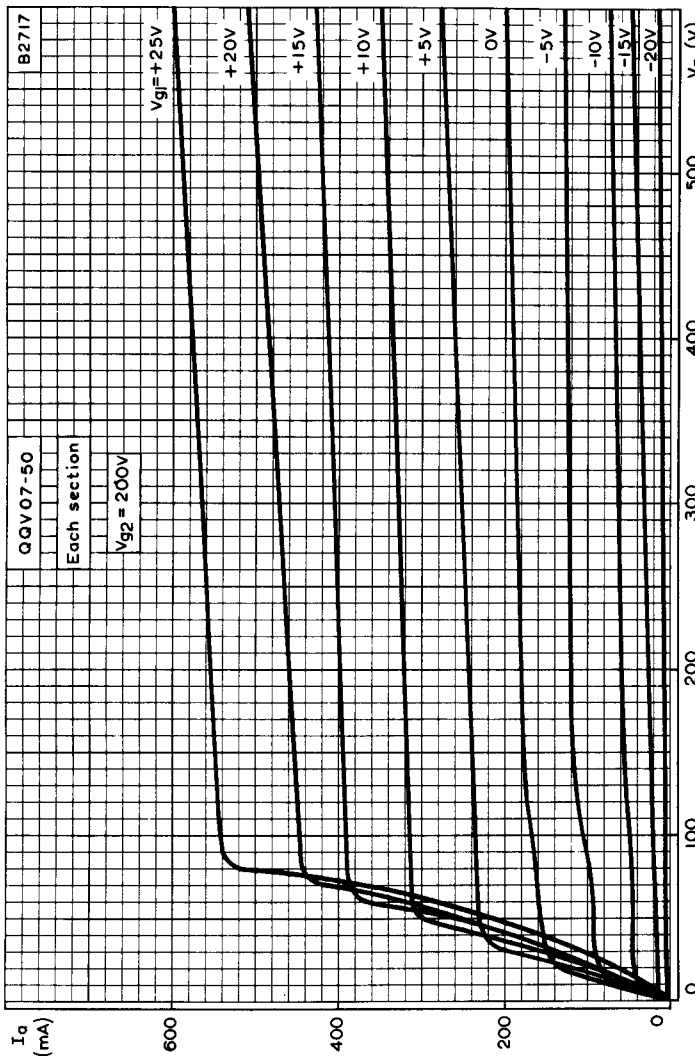




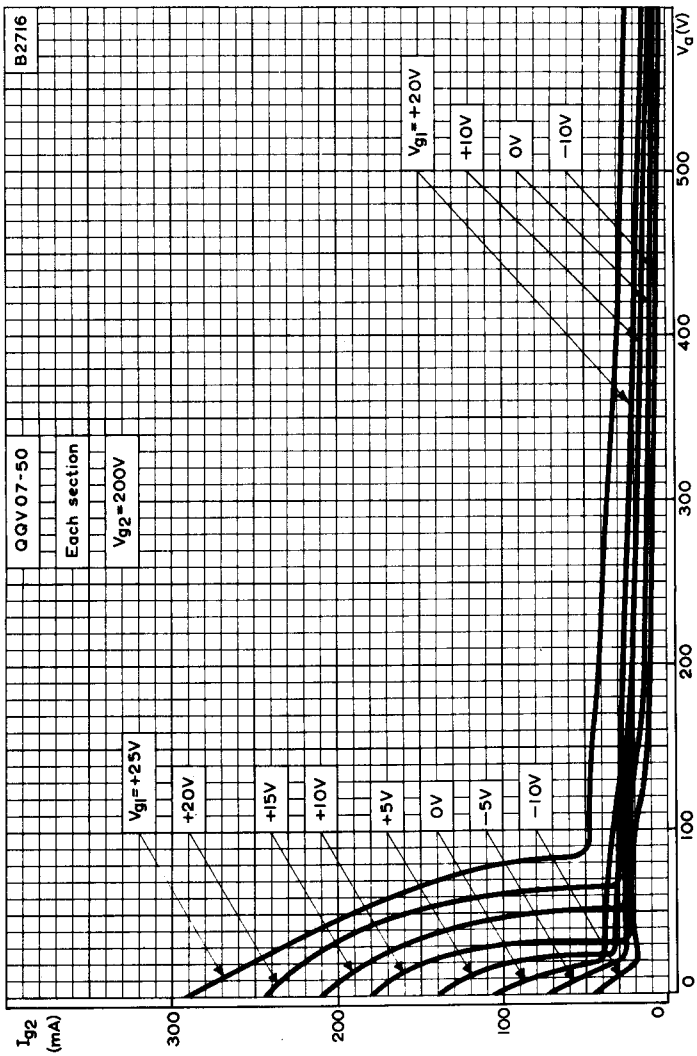
B7A Base

U.H.F. POWER DOUBLE TETRODE

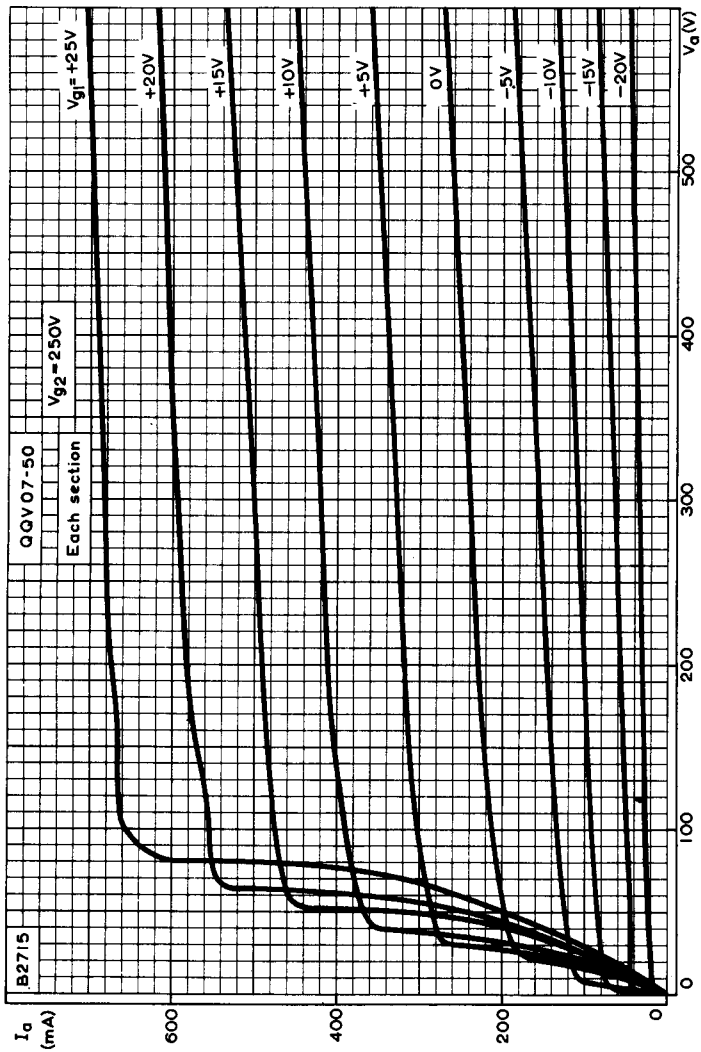
QQV07-50



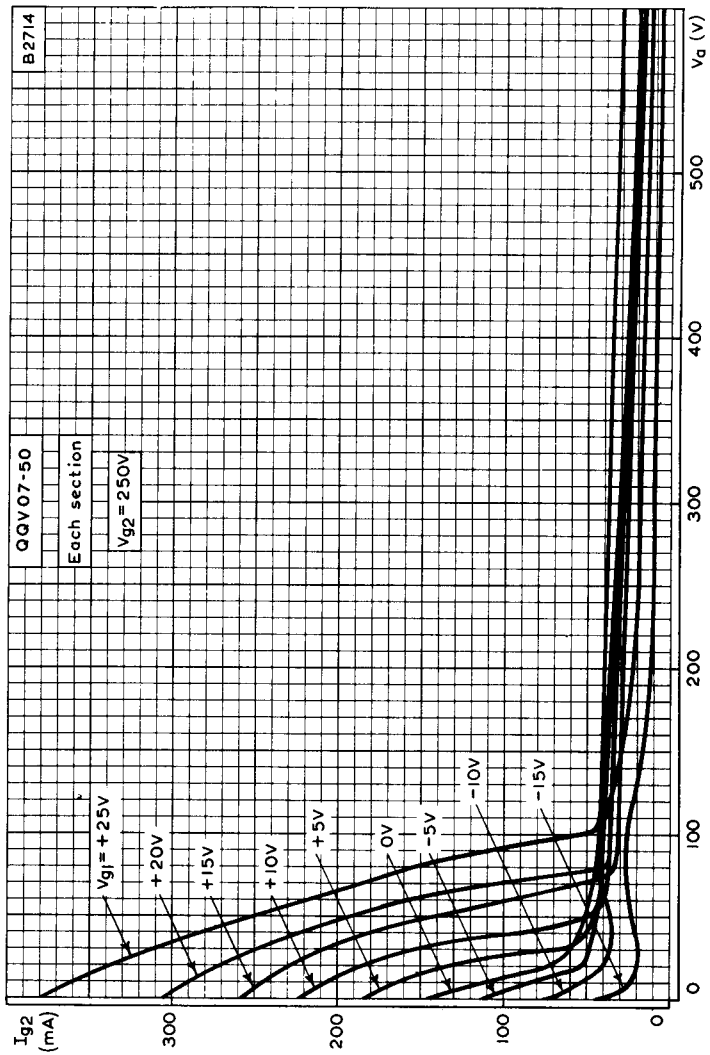
ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V



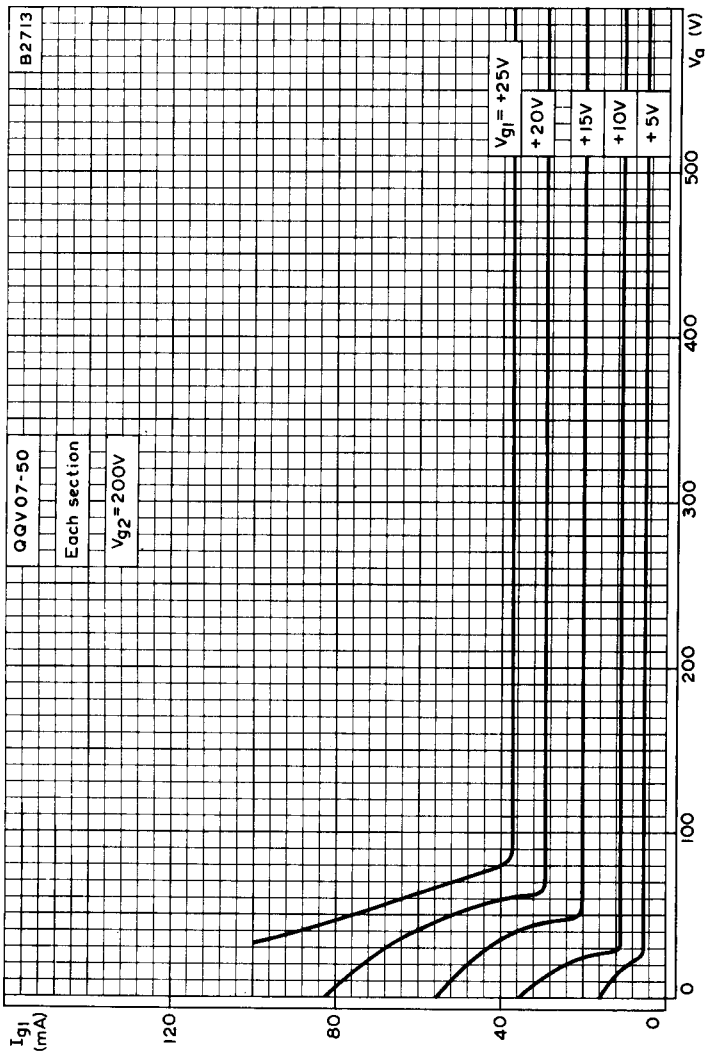
SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V



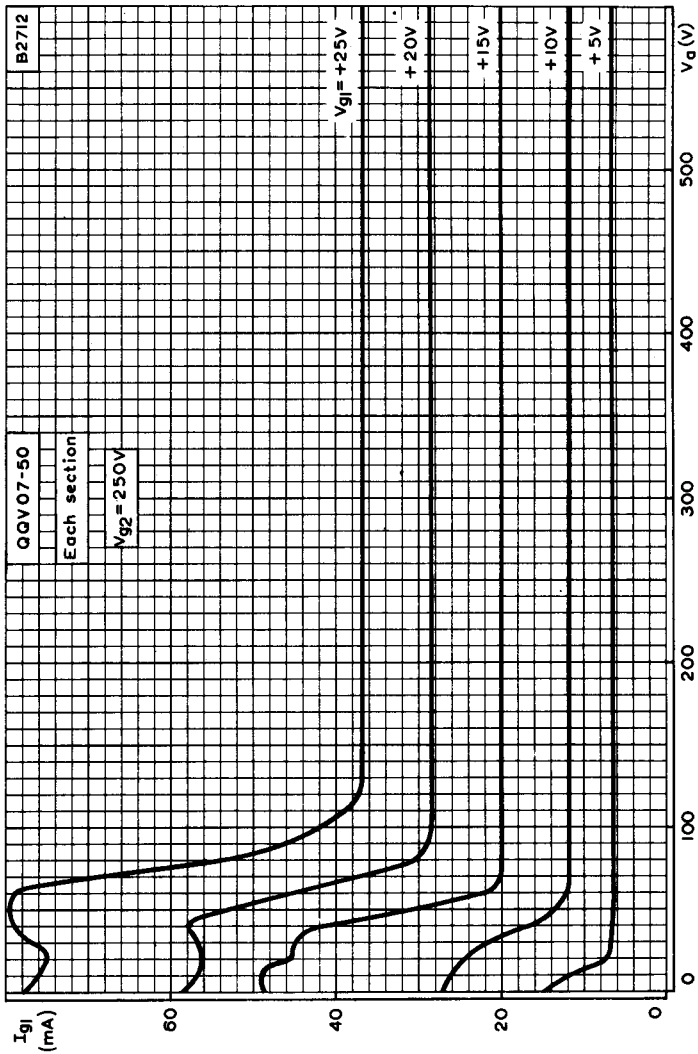
ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=250V



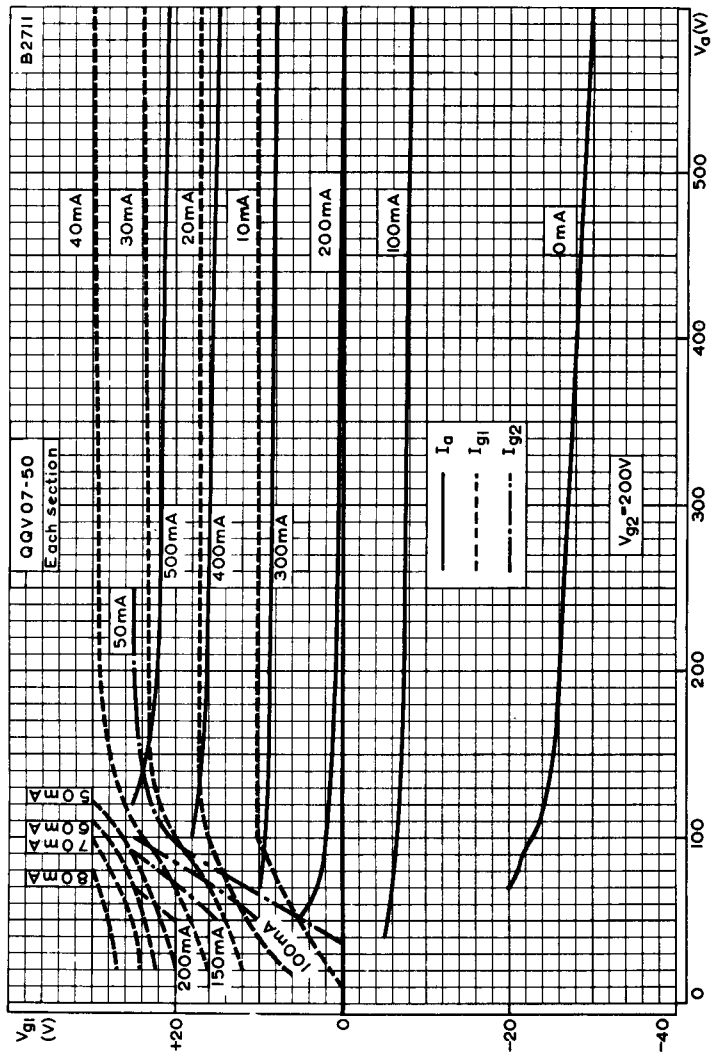
SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 250V



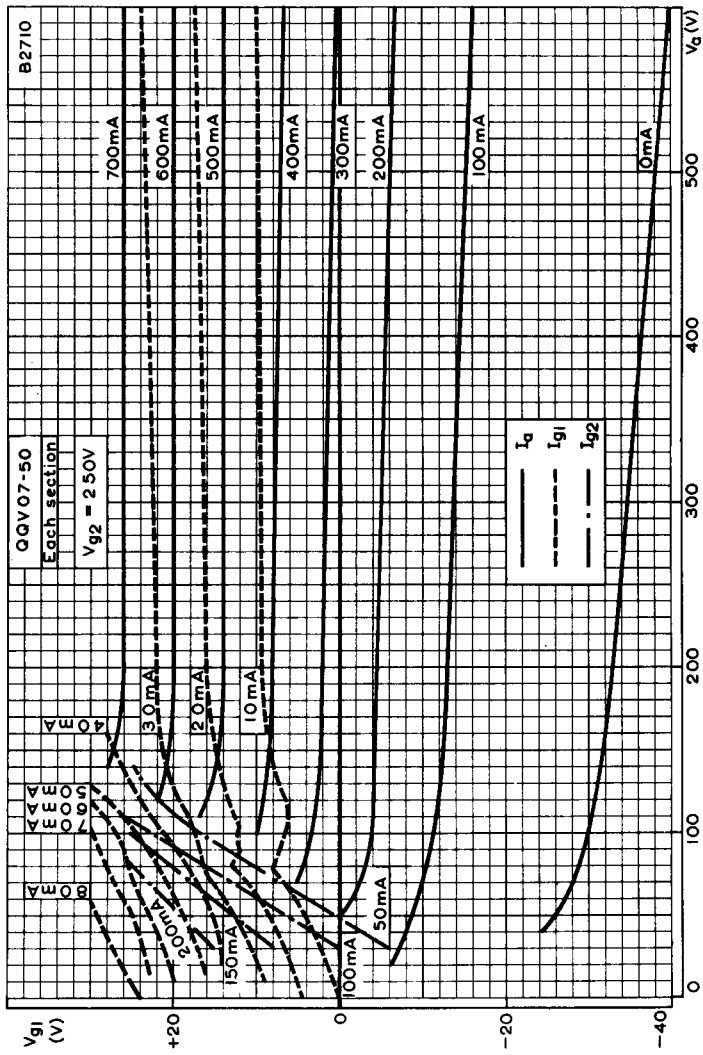
CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V



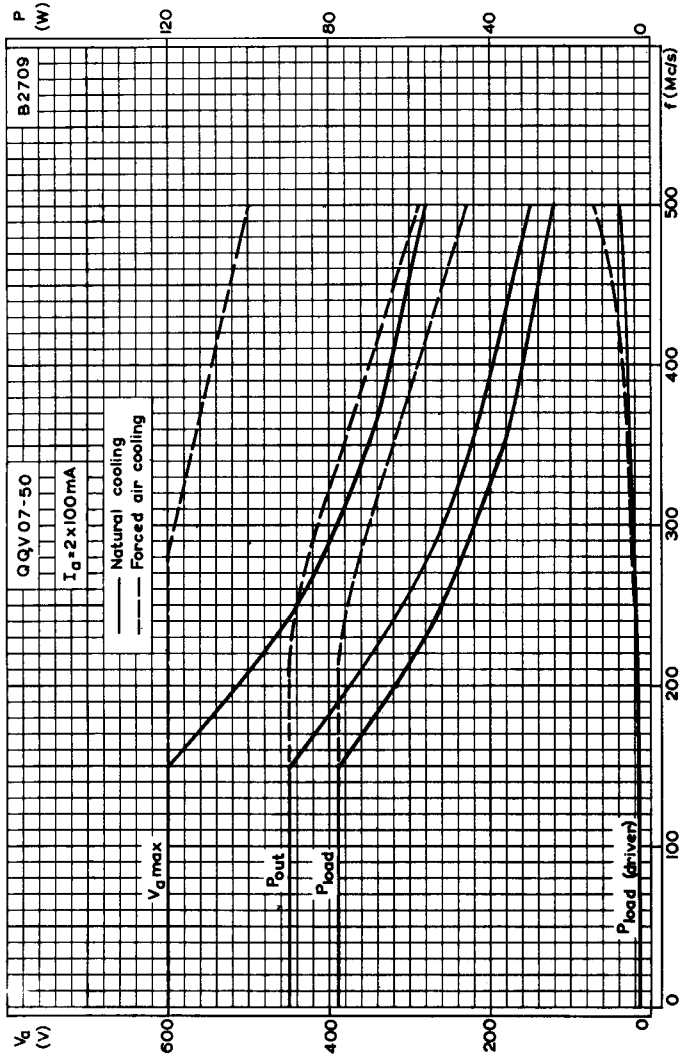
CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=250V



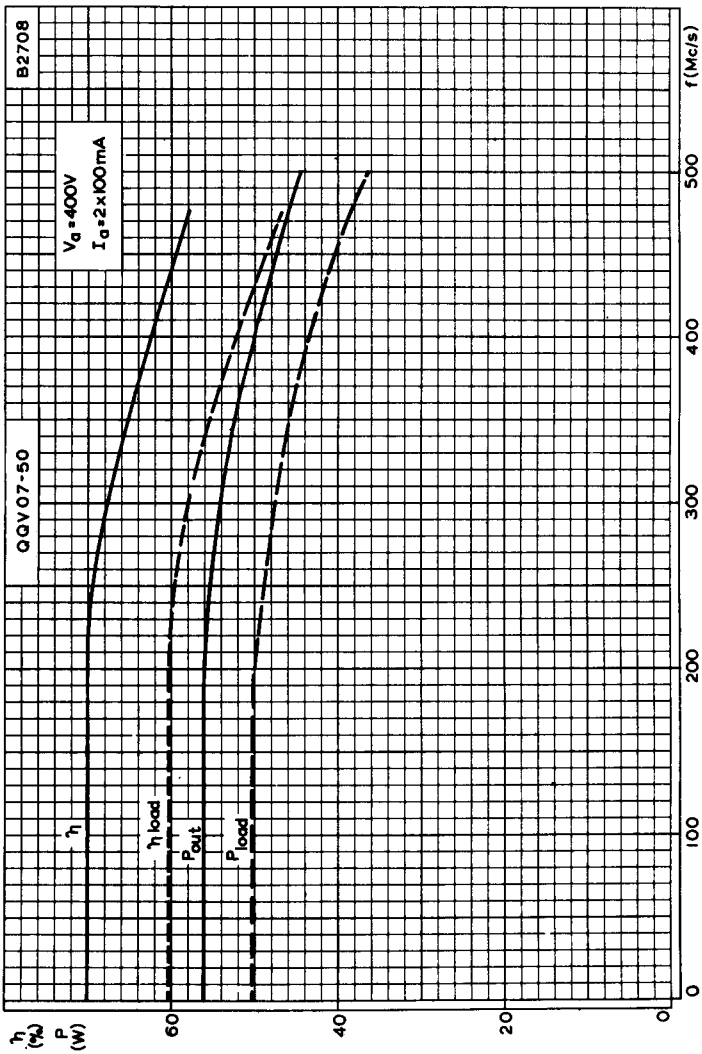
CONSTANT CURRENT CHARACTERISTICS FOR EACH SECTION V_{g2}=200V



CONSTANT CURRENT CHARACTERISTICS FOR EACH SECTION V_{g2} = 250V



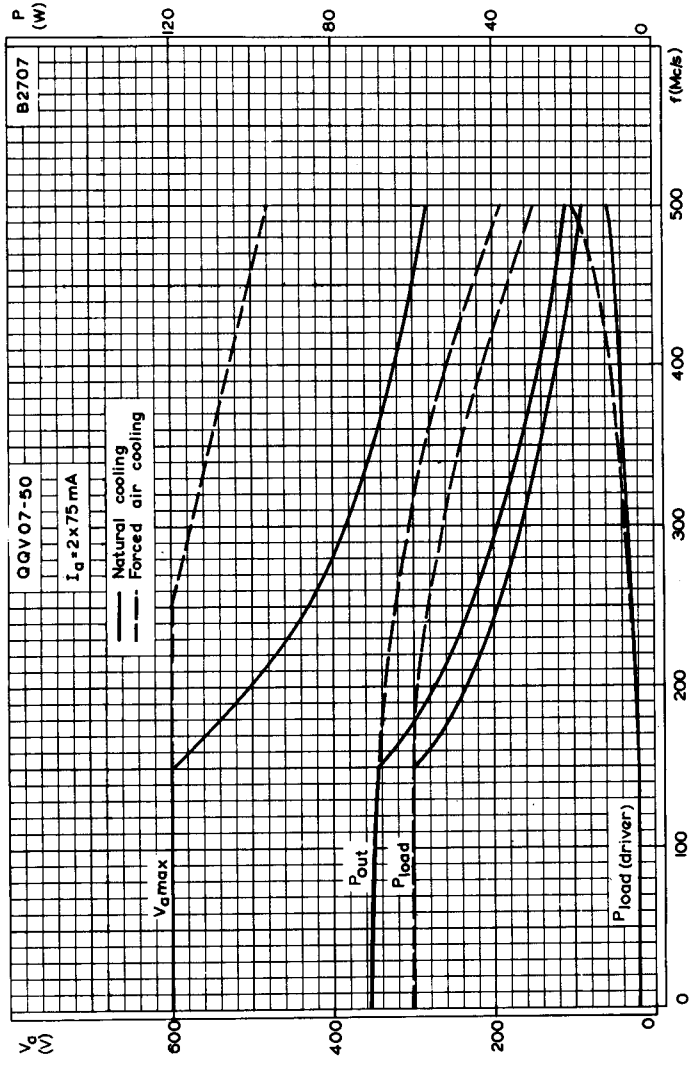
MAXIMUM OPERATING CONDITIONS FOR A PUSH-PULL R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY)



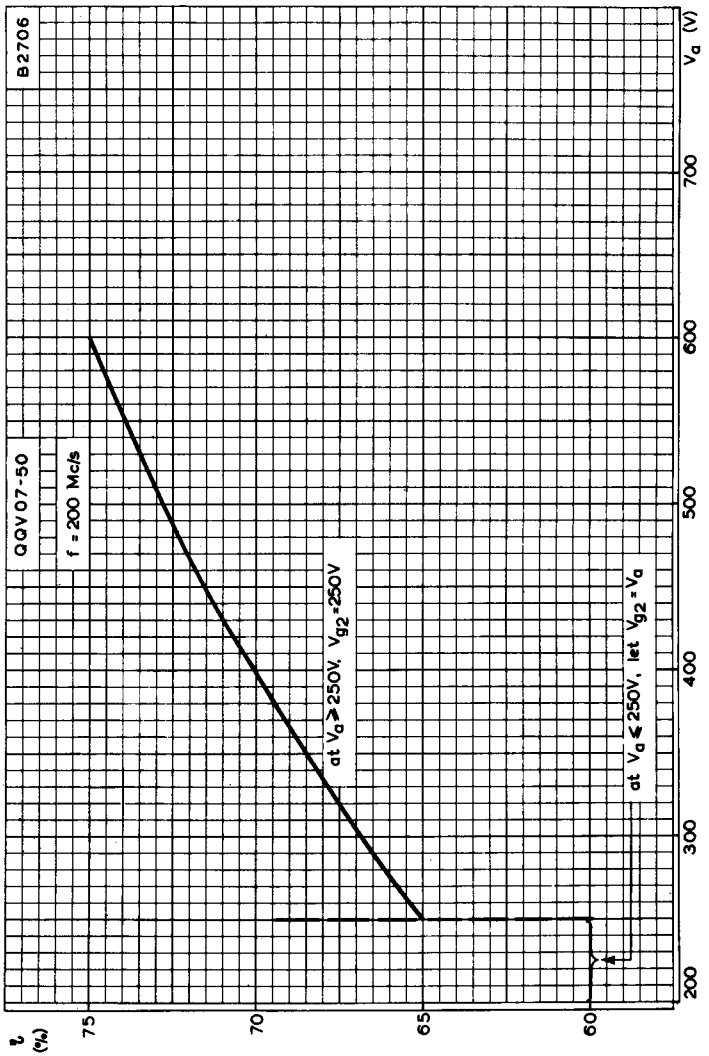
FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

U.H.F. POWER DOUBLE TETRODE

QQV07-50



MAXIMUM OPERATING CONDITIONS FOR AN ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS 'C' TELEPHONY)



ANODE EFFICIENCY PLOTTED AGAINST ANODE VOLTAGE FOR CLASS 'C' PUSH-PULL TELEGRAPHY

R.F. POWER DOUBLE TETRODE

A quick-heating, directly-heated double tetrode rated to dissipate 8 W at each anode and primarily intended for use in mobile equipment at frequencies up to 186 Mc/s.

QQZ04-15

This data sheet should be read in conjunction with "Operating Notes Part 1—Power Valves" included in this volume of the Handbook.

MAINTENANCE TYPE

FILAMENT

Directly heated. Oxide coated

V_f	6.3	V
I_f	0.68	A
Heating time	2	Secs

MOUNTING POSITION

Vertical, base up or down

CAPACITANCES

c_{g-f} (each section)	8.0	μμF
c_{a-f} (each section)	3.0	μμF
c_{a-g} (each section)	0.1	μμF
c_{in} (sections in push-pull)	5.5	μμF
c_{out} (sections in push-pull)	2.9	μμF

CHARACTERISTICS (each section) measured at I_a=20 mA

g_m	2.0	mA/V
$\mu_{g_1-g_2}$	9	

LIMITING VALUES

	Continuous operation	Intermittent operation	
V_a max.	400	400	V
p_a max.	2×6	2×8	W
I_a max.	2×30	2×40	mA
$V_{g2(b)}$ max.	400	400	V
V_{g_2} max.	250	250	V
p_{g_2} max.	2×2.0	2×2.5	W
I_{g_1} max.	2×5	2×5	mA
p_{g_1} max.	2×0.25	2×0.25	W
I_k max.	2×40	2×50	mA
$I_{k(pk)}$ max.	2×160	2×200	mA
V_{g_1} max.	−250	−250	V
R_{g_1-f}	500	500	kΩ
Max. temperature of pins	80	100	°C
Max. temperature of bulb	200	250	°C
Max. frequency at full ratings	186	186	Mc/s

QQZ04-15

R.F. POWER DOUBLE TETRODE

A quick-heating, directly-heated double tetrode rated to dissipate 8 W at each anode and primarily intended for use in mobile equipment at frequencies up to 186 Mc/s.

OPERATING CONDITIONS AS PUSH-PULL CLASS "C" R.F. AMPLIFIER OR OSCILLATOR

	Continuous operation		Intermittent operation		
f	186	186	186	186	Mc/s
V_a	250	400	250	400	V
V_{g2}	175	200	175	200	V
V_{g1}	−70	−80	−70	−80	V
I_a	2×30	2×30	2×40	2×40	mA
I_{g2}	2×4	2×4	2×5	2×5	mA
I_{g1}	2×1.5	2×1.5	2×1.75	2×1.75	mA
$v_{in\ (pk)}$	2×60	2×65	2×60	2×65	V
p_a	2×3	2×4.75	2×4	2×6.25	W
P_{out}	9	14.5	12	19.5	W
η_i	60	61	60	61	%
P_{load}†	7.7	12.4	10.2	16.5	W

†These figures assume a circuit efficiency of 85%

OPERATING CONDITIONS AS PUSH-PULL CLASS "C" FREQUENCY TREBLER

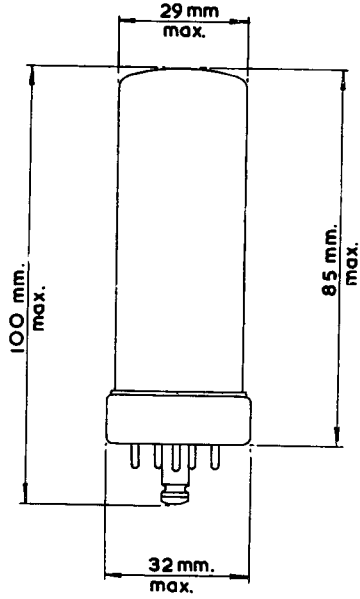
	f=62–186 Mc/s		f=33–100 Mc/s		
	Intermittent operation	Continuous operation	Intermittent operation	Continuous operation	
V_a	250	250	350	350	V
V_{g2}	200	200	200	200	V
V_{g1}	−180	−180	−180	−180	V
I_a	2×40	2×30	2×30	2×24	mA
I_{g2}	6	6	6	6	mA
I_{g1}	2×1.5	2×1.5	2×1.5	2×1.5	mA
P_{out}	5	3.75	6	4.8	W
P_{load}‡	3.5	3	5	3.8	W

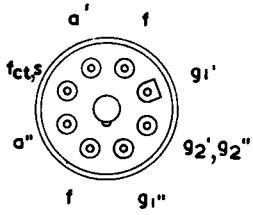
‡These figures assume normal circuit efficiencies

WEIGHT Value only 1½ oz. (0.042 Kg)

R.F. POWER DOUBLE TETRODE QQZ04-15

A quick-heating, directly-heated double tetrode rated to dissipate 8 W at each anode and primarily intended for use in mobile equipment at frequencies up to 186 Mc/s.





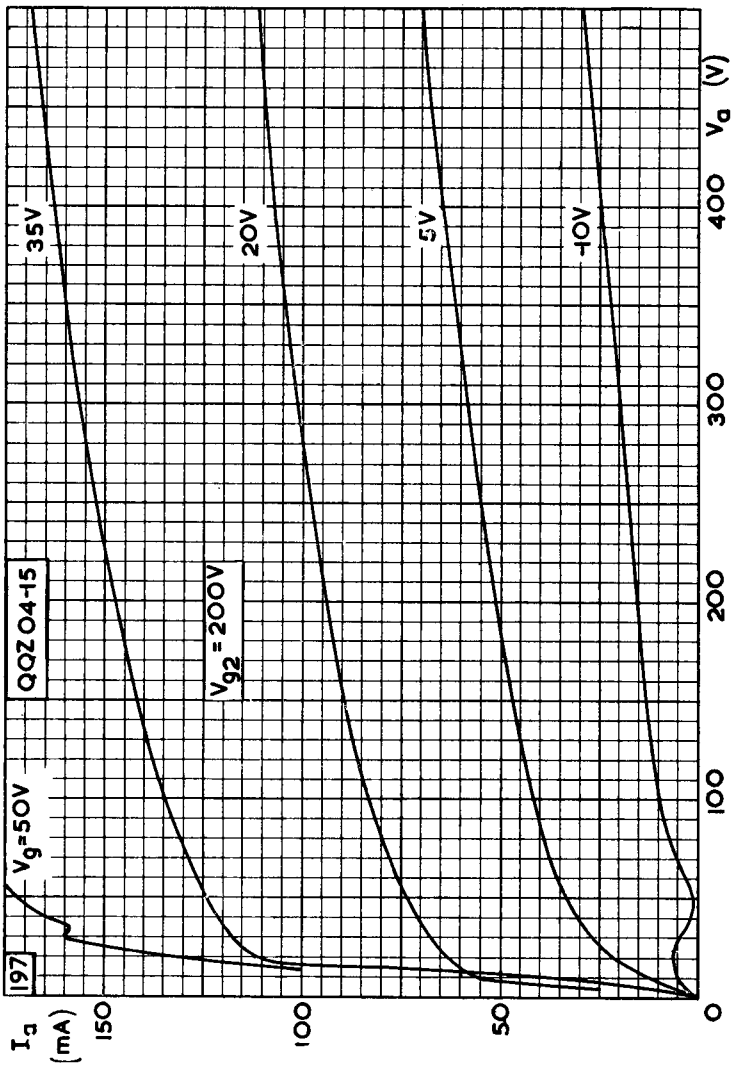
B8G BASE

170

QQZ04-15

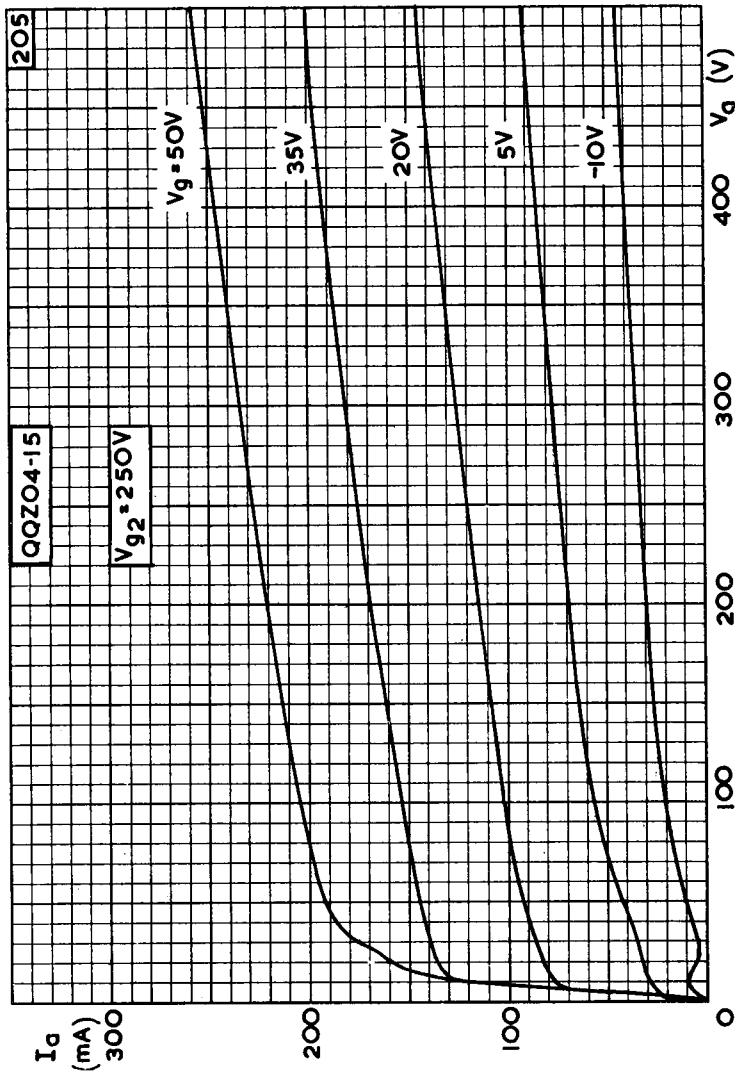
R.F. POWER DOUBLE TETRODE

A quick-heating, directly-heated double tetrode rated to dissipate 8 W at each anode and primarily intended for use in mobile equipment at frequencies up to 186 Mc/s.



R.F. POWER DOUBLE TETRODE QQZ04-15

A quick-heating, directly-heated double tetrode rated to dissipate 8 W at each anode and primarily intended for use in mobile equipment at frequencies up to 186 Mc/s.



PULSE TETRODE MODULATOR

QV20-P18

Tetrode for pulsed applications having ratings of 20kV and 18A.

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

HEATER

V_h	26	V
I_h	2.25	A
t_{h-k} (minimum delay before drawing cathode current)	3	min

MOUNTING POSITION

Any

CAPACITANCES

c_{a-g1} (measured without external shield)	0.3	pF
c_{in}	43	pF
c_{out}	9.0	pF

COOLING

Natural

T_{seals} max. 200 °C

An anode connector providing a high degree of heat transfer by radiation or by conduction must be used.

OPERATION AS PULSE MODULATOR

Limiting Values (Absolute ratings)

V_a max.	20	kV
$v_{a(pulse)}$ max.	25	kV
*V_{g2} max.	1.5	kV
**$-V_{g1}$ max.	1.0	kV
†† $v_{g1(pulse)}$ max.	300	V
$i_{a(pulse)}$ max.	18	A
$p_{a(mean)}$ max.	60	W
$p_{in(mean)}$ max.	360	W
$p_{g2(mean)}$ max.	8.0	W
Duty cycle max.	**	

*A screen-grid series protective resistor of 20kΩ minimum is required with a condenser connected between screen-grid and cathode.

**The maximum control-grid series resistance is 100kΩ.

††For $i_{a(pulse)} > 5A$ the duty cycle must not exceed 0.001, and the product of $i_{a(pulse)}$ and pulse duration shall not exceed 40. The valve must not be operated for longer than 5μsec in any 100μsec interval. For $i_{a(pulse)} < 5A$ the product of $i_{a(pulse)}$ and pulse duration of 40 is still applicable and the $p_{a(mean)}$ max. rating of 60W determines the maximum, permissible duty cycle.

QV20-P18

PULSE TETRODE MODULATOR

Tetrode for pulsed applications having ratings of 20kV and 18A.

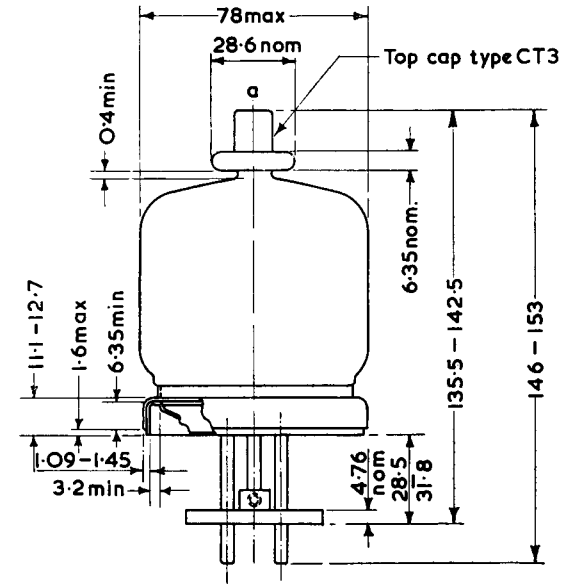
Typical Operating Conditions

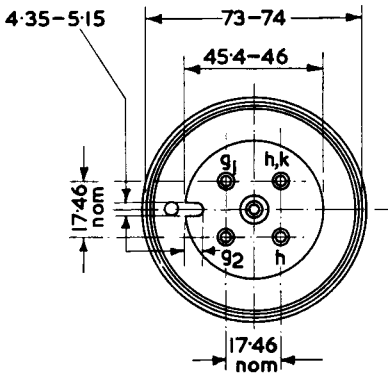
t_p	2	2	μsec
P.R.F.	500	500	p/s
V_a	15.8	20	kV
V_{g2}	1.25	1.25	kV
V_{g1}	−600	−600	V
$v_{g1(pulse)}$	700	700	V
$i_{a(pulse)}$	14	16	A
I_a	14	16	mA
$i_{g2(pulse)}$	4.0	3.0	A
I_{g2}	4.0	3.0	mA
$i_{g1(pulse)}$	1.1	1.1	A
I_{g1}	1.1	1.1	mA
$P_{in(pulse)}$	220	320	kW
R_a	1.0	1.2	kΩ
$P_{out(pulse)}$	210	305	kW
$V_{a(out)}$	15	19	kV

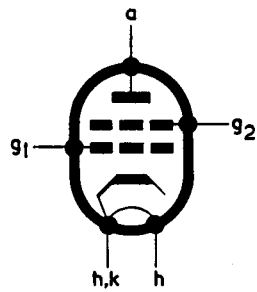
PULSE TETRODE MODULATOR

QV20-P18

Tetrode for pulsed applications having ratings of 20kV and 18A.





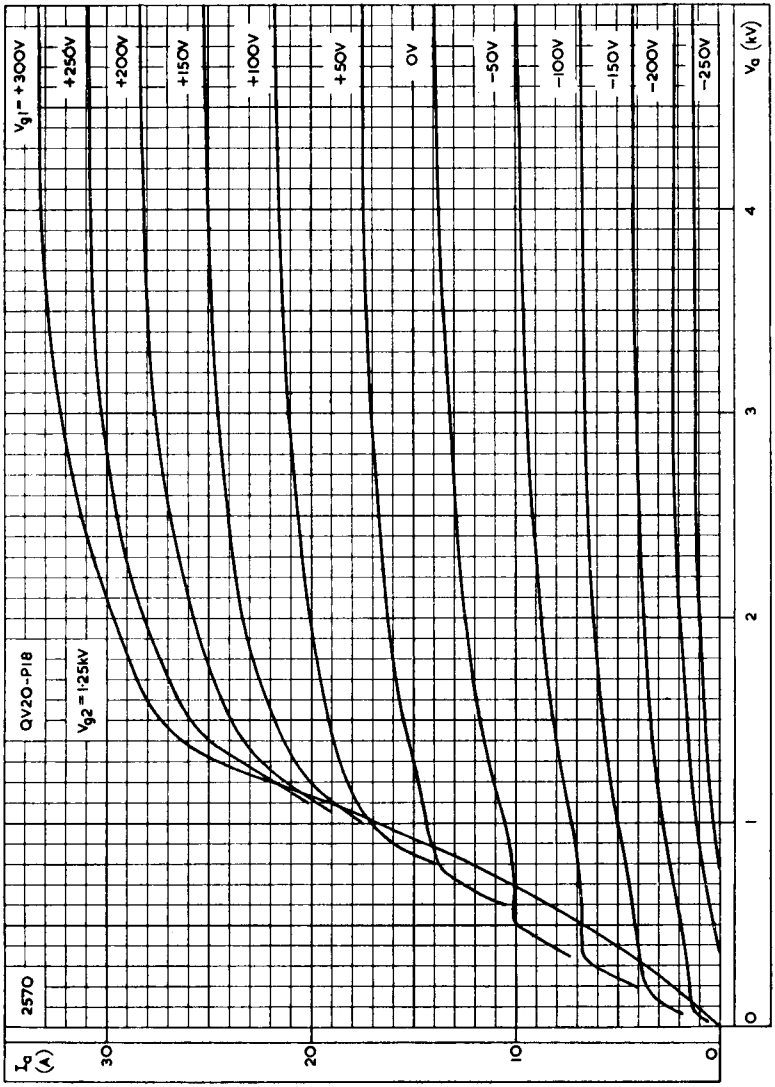


2610 B4A Base All dimensions in mm.

QV20-P18

PULSE TETRODE MODULATOR

Tetrode for pulsed applications having ratings of 20kV and 18A.

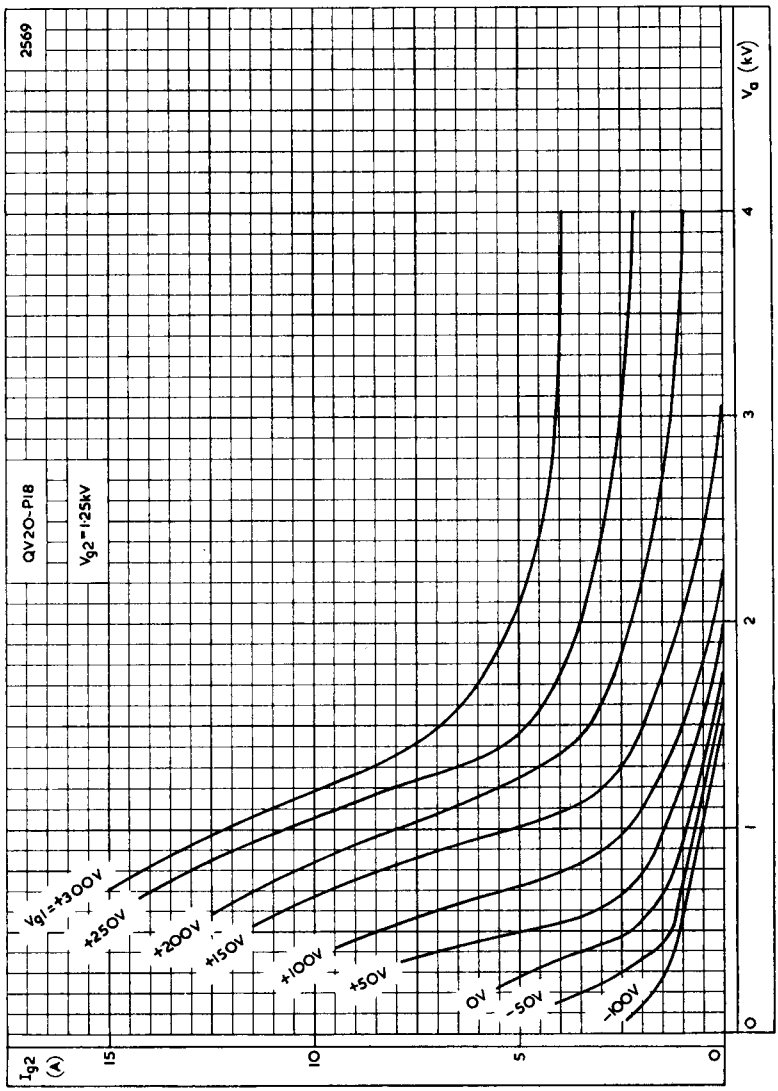


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

PULSE TETRODE MODULATOR

QV20-P18

Tetrode for pulsed applications having ratings of 20kV and 18A.

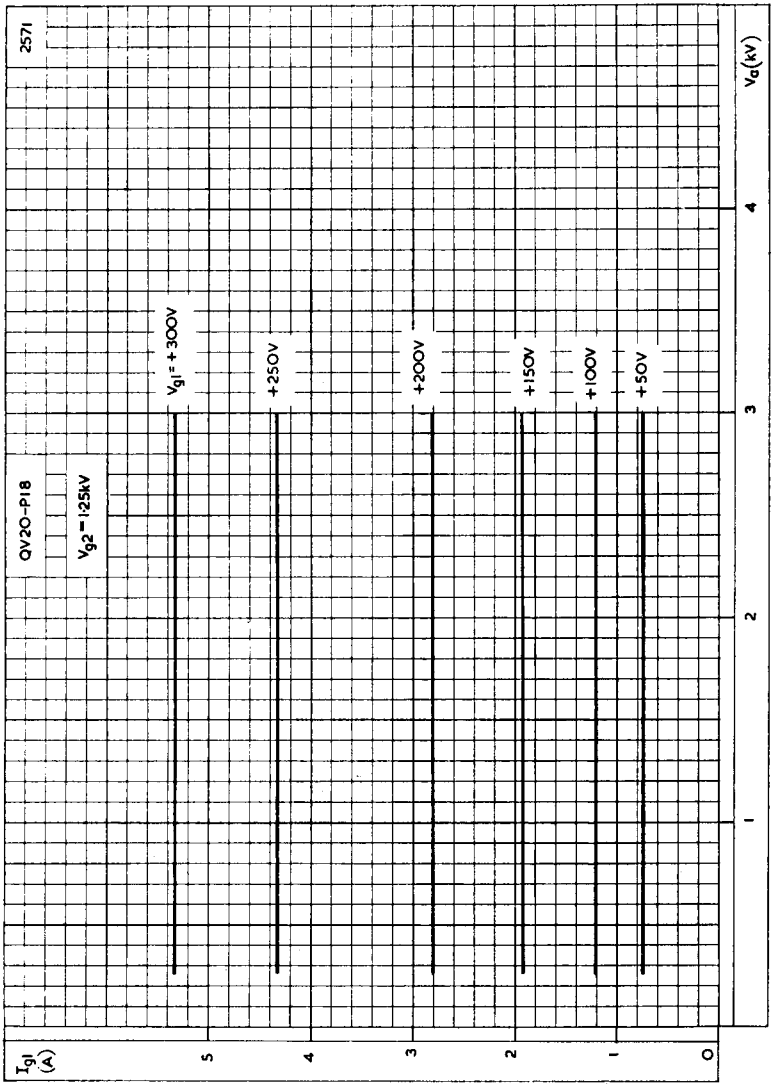


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

QV20-P18

PULSE TETRODE MODULATOR

Tetrode for pulsed applications having ratings of 20kV and 18A.



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

R.F. POWER TETRODE

QV04-7

Indirectly heated Beam Tetrode with aligned grid construction to minimise screen current. It is rated to dissipate a maximum of 7.5 watts at the anode, and is particularly suitable for use at frequencies up to 150 Mc/s., as an R.F. amplifier or as a frequency multiplier.

This data sheet should be read in conjunction with "Operating Notes, Part 1—Power Valves," included in this volume of the Handbook.

CATHODE

Indirectly heated.

V_h	6.3	V
I_h	0.6	A
Heating time	22	secs.

CAPACITANCES

c_{in}	8.0	$\mu\mu$F
c_{out}	5.4	$\mu\mu$F
c_{a-g1}	<0.1	$\mu\mu$F

CHARACTERISTICS at V_a=300 V; V_{g2}=250 V; I_a=25 mA.

g_m	1.9	mA/V
μ_{g1-g2}	5.6	
r_a	67	k Ω

LIMITING VALUES

V_a max.	400	V
V_{g2} max.	250	V
p_a max.	7.5	W
p_{g2} max.	2.0	W
I_k max.	50	mA
I_{g1} max.	6.0	mA

QV04-7

R.F. POWER TETRODE

Indirectly heated Beam Tetrode with aligned grid construction to minimise screen current. It is rated to dissipate a maximum of 7.5 watts at the anode, and is particularly suitable for use at frequencies up to 150 Mc/s., as an R.F. amplifier or as a frequency multiplier.

OPERATING CONDITIONS FOR SINGLE VALVE CLASS "C" R.F. AMPLIFIER

f	3	3	20	20	Mc/s
V_a	300	300	300	300	V
V_{g2}	150	250	150	250	V
V_{g1}	−35	−50	−30	−60	V
I_a	40	43	43.5	43.7	mA
I_{g2}	7.2	6.6	4.7	5.9	mA
I_{g1}	2.8	0.4	1.8	0.4	mA
$V_{in(pk)}$	58	60	48	67	V
P_a	4.9	4.8	5.8	5.2	W
P_{out}	7.1	8.1	7.3	7.9	W
η	59	62	56	60	%

f	60	60	150	150	Mc/s
V_a	300	300	300	300	V
V_{g2}	150	250	150	250	V
V_{g1}	−30	−50	−30	−50	V
I_a	44	44	44	46	mA
I_{g2}	4.5	6.0	4.5	4.0	mA
I_{g1}	1.9	0.4	1.5	0.4	mA
$V_{in(pk)}$	48	57	52	57	V
P_a	6.2	5.5	6.9	7.5	W
P_{out}	7.0	7.7	6.3	6.3	W
η	53	58	48	46	%

OPERATING CONDITIONS FOR TWO VALVES CLASS "C" R.F. AMPLIFIER

f	60	100	150	Mc/s
V_a	300	300	300	V
V_{g2}	250	250	250	V
V_{g1}	−60	−60	−50	V
I_a	2×43	2×44.4	2×46	mA
I_{g2}	2×6.7	2×5.3	2×4.0	mA
I_{g1}	2×0.5	2×0.4	2×0.4	mA
$V_{in(pk)}$	2×68	2×68	2×57	V
P_a	2×5.1	2×6.0	2×7.4	W
P_{out}	15.6	14.7	12.6	W
η	60	55	46	%

OPERATING CONDITIONS FOR SINGLE VALVE FREQUENCY DOUBLER

f_{out}	20	75	100	150	Mc/s
V_a	300	300	300	250	V
V_{g2}	250	250	200	200	V
V_{g1}	−80	−120	−120	−120	V
I_a	41	43.5	38.4	36.8	mA
I_{g2}	8.0	5.5	2.6	2.1	mA
I_{g1}	0.8	1.2	1.5	1.1	mA
$V_{in(pk)}$	81	124	120	144	V
P_a	6.8	7.4	7.1	6.9	W
P_{out}	5.6	5.6	4.4	2.3	W
η	45	44	38	25	%

R.F. POWER TETRODE

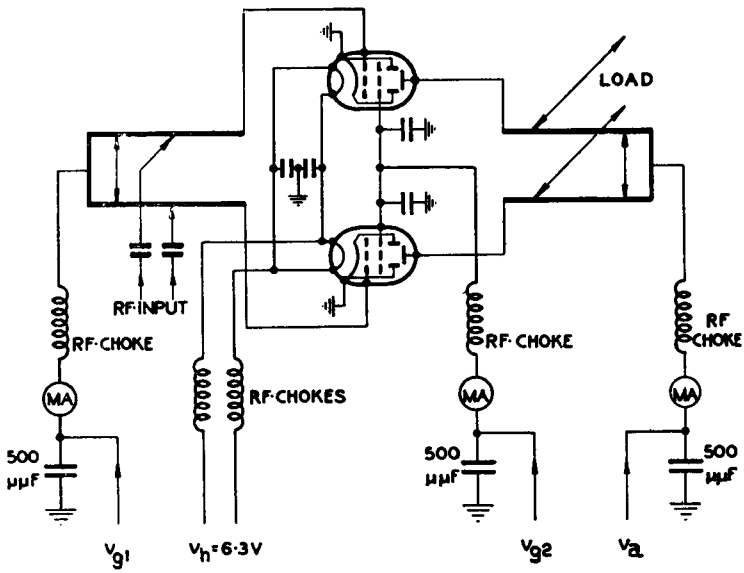
QV04-7

Indirectly heated Beam Tetrode with aligned grid construction to minimise screen current. It is rated to dissipate a maximum of 7.5 watts at the anode, and is particularly suitable for use at frequencies up to 150 Mc/s., as an R.F. amplifier or as a frequency multiplier.

OPERATING CONDITIONS AS FREQUENCY TREBLER

		Single Valve		Push-Pull	
f_{out}	20	75	100	150	Mc/s
V_a	300	300	275	225	V
V_{g2}	250	250	200	200	V
V_{g1}	−120	−140	−140	−140	V
I_a	35	34	36	2×36	mA
I_{g2}	4.2	2.8	2.5	2×2.5	mA
I_{g1}	0.6	0.6	1.5	2×1.3	mA
$V_{in(pk)}$	109	130	142	2×152	V
p_a	7.3	7.1	7.1	2×6.6	W
P_{out}	3.3	3.2	2.8	3.1	W
η	31	31	28	19	%

WEIGHT Valve only ; 1½ oz.



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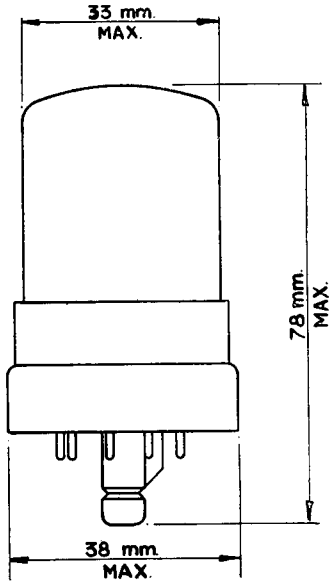
Parallel-line Push-pull R.F. Amplifier

QV04-7

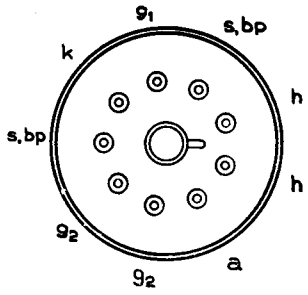
R.F. POWER TETRODE

Indirectly heated Beam Tetrode with aligned grid construction to minimise screen current. It is rated to dissipate a maximum of 7.5 watts at the anode, and is particularly suitable for use at frequencies up to 150 Mc/s., as an R.F. amplifier or as a frequency multiplier.

DIMENSIONS AND BASE CONNECTIONS



9-PIN PRESSED GLASS BASE TO FIT B9G VALVE HOLDER

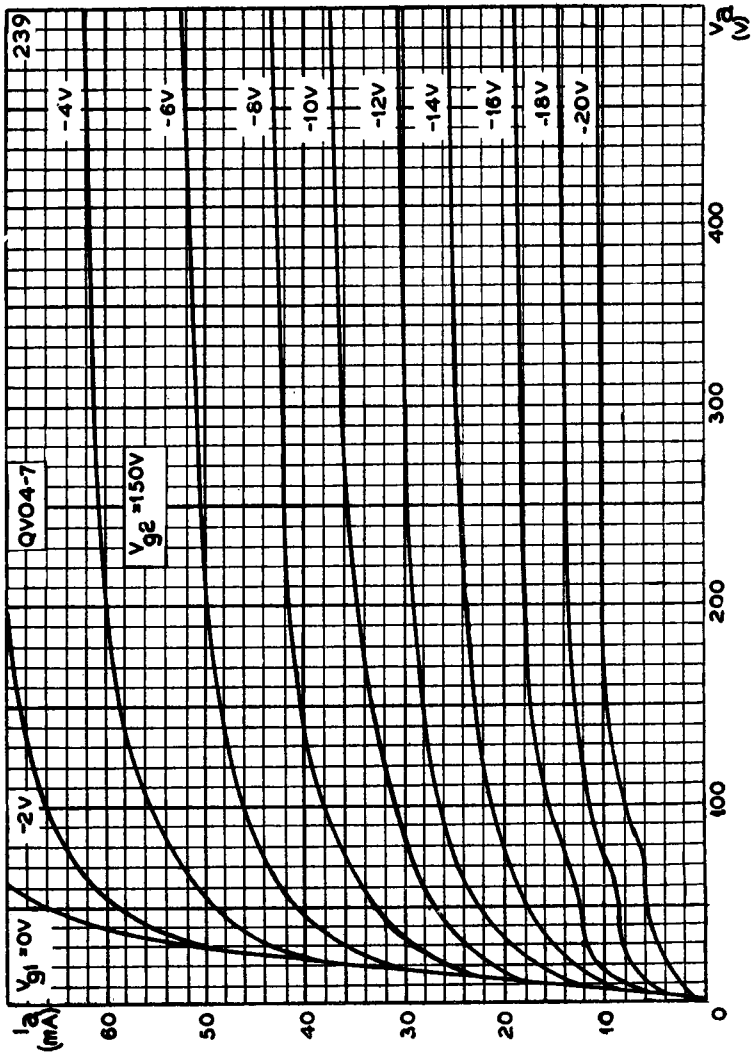


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R.F. POWER TETRODE

QV04-7

Indirectly heated Beam Tetrode with aligned grid construction to minimise screen current. It is rated to dissipate a maximum of 7.5 watts at the anode, and is particularly suitable for use at frequencies up to 150 Mc/s., as an R.F. amplifier or as a frequency multiplier.

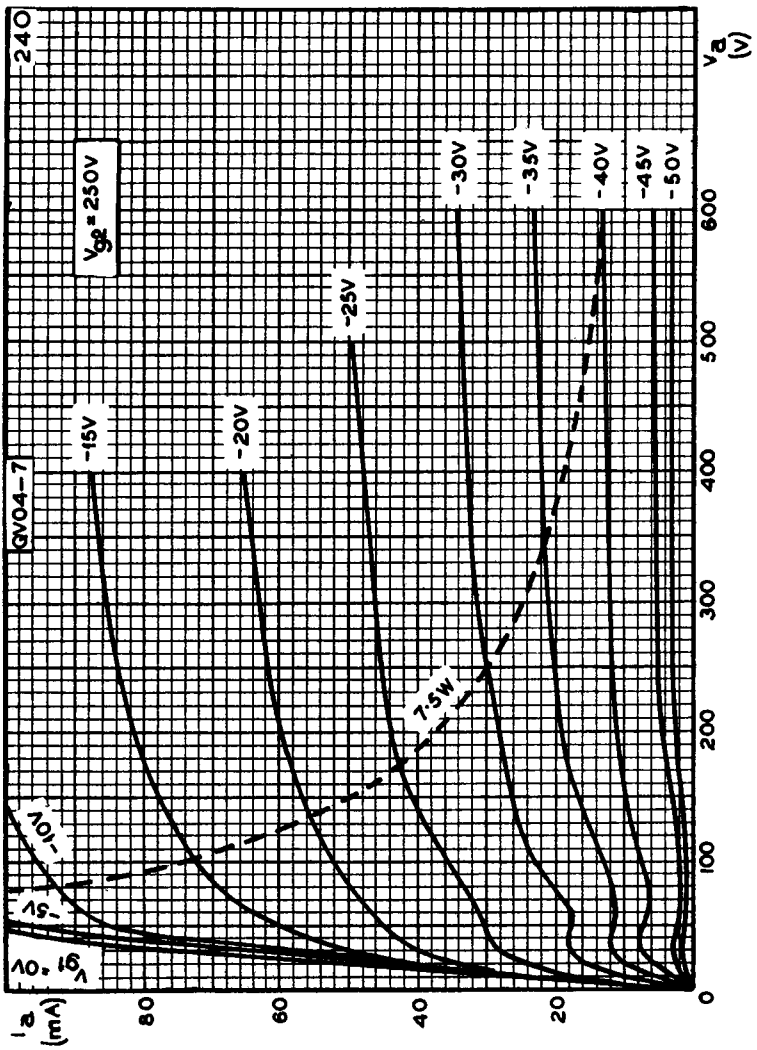


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE. $V_{g2}=150V$

QV04-7

R.F. POWER TETRODE

Indirectly heated Beam Tetrode with aligned grid construction to minimise screen current. It is rated to dissipate a maximum of 7.5 watts at the anode, and is particularly suitable for use at frequencies up to 150 Mc/s., as an R.F. amplifier or as a frequency multiplier.

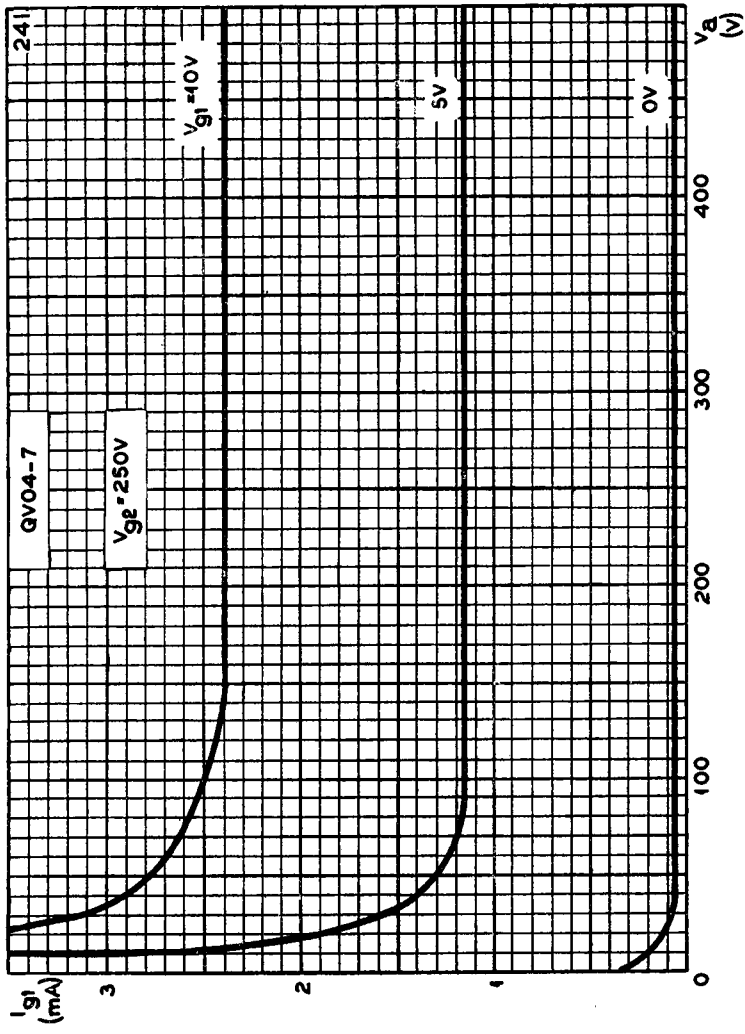


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE. V_{g2} = 250V

R.F. POWER TETRODE

Indirectly heated Beam Tetrode with aligned grid construction to minimise screen current. It is rated to dissipate a maximum of 7.5 watts at the anode, and is particularly suitable for use at frequencies up to 150 Mc/s., as an R.F. amplifier or as a frequency multiplier

QV04-7

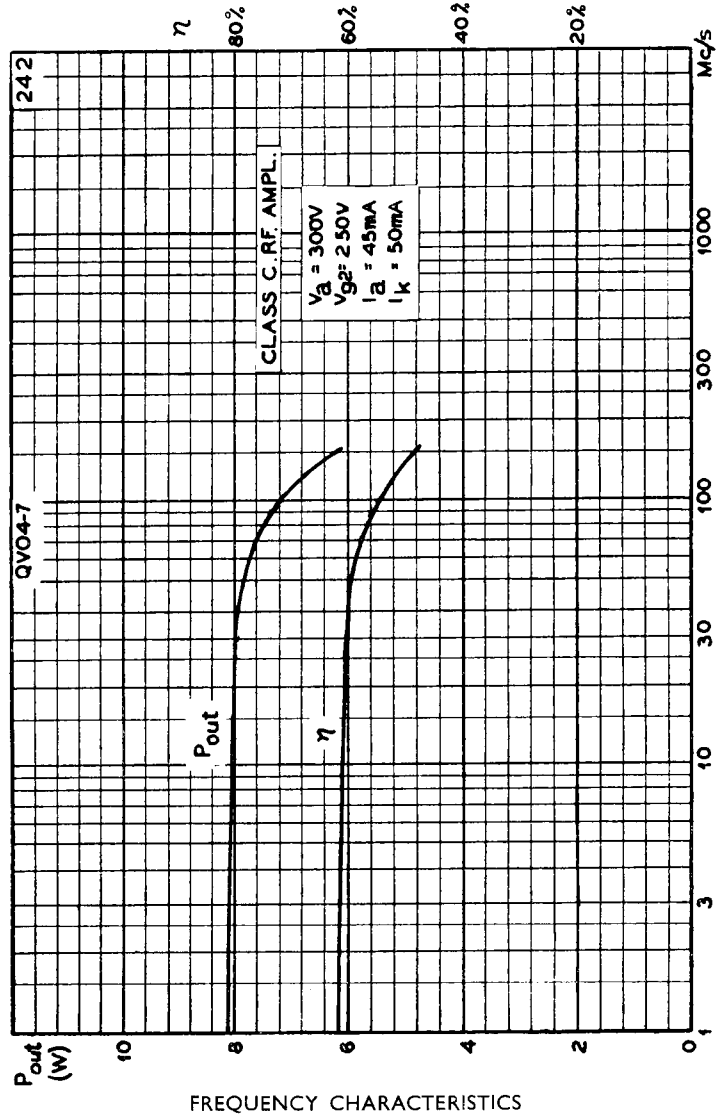


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE V_{g2}=250V

QV04-7

R.F. POWER TETRODE

Indirectly heated Beam Tetrode with aligned grid construction to minimise screen current. It is rated to dissipate a maximum of 7.5 watts at the anode, and is particularly suitable for use at frequencies up to 150 Mc/s, as an R.F. amplifier or as a frequency multiplier.



FREQUENCY CHARACTERISTICS

R.F. POWER TETRODE

QV04-7R

Special quality beam tetrode with aligned grid construction to minimise screen current and a maximum anode dissipation of 7.5W. Suitable for use at frequencies up to 150Mc/s as an r.f. amplifier or as a frequency multiplier.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this volume of the handbook.

CATHODE Indirectly heated

V_h	6.3	V
I_h	600	mA
Heating time	22	s

CAPACITANCES (measured without external shield)

c_{in}	8.2	pF
c_{out}	6.0	pF
c_{a-g1}	0.07	pF

CHARACTERISTICS at $V_a = 250V$, $V_{g2} = 135V$, $V_{g1} = 10V$, $I_a = 30mA$

g_m	3.0	mA/V

LIMITING VALUES (absolute ratings)

$V_{a(b)}$ max.	550	V
V_a max.	400	V
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_a max.	7.5	W
p_{g2} max.	1.75	W
I_k max.	55	mA
I_{g1} max.	6.0	mA
V_{h-k} max.	150	V
T_{bulb} max.	200	°C

EQUIPMENT DESIGN RANGE

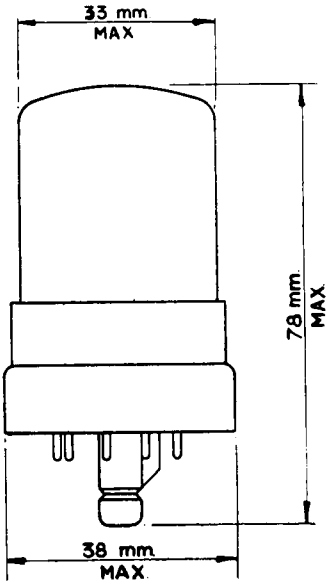
	Min.	Max.	
I_h ($V_h = 6.3V$)	540	660	mA
g_m ($V_a = 250V$, $V_{g2} = 135V$, $V_{g1} = -10V$, peak grid swing $\pm 1V$)	2.25	3.75	mA/V
I_a ($V_a = 250V$, $V_{g2} = 135V$, $V_{g1} = -10V$)	20	40	mA
*c_{in}	7.0	9.4	pF
*c_{out}	5.2	6.8	pF
*c_{a-g1}	—	0.09	pF

*Measured on 1Mc/s bridge with valve mounted in a fully shielded socket and no external screen.

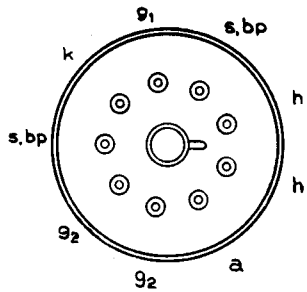
The operating conditions and curves are identical with those given for QV04-7.

QV04-7R

DIMENSIONS AND BASE CONNECTIONS



9-PIN PRESSED GLASS BASE TO FIT B9G VALVE HOLDER



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V.H.F. POWER TETRODE

QV03-12

R.F. beam power tetrode rated for a maximum anode dissipation of 12W and intended for use at frequencies up to 175 Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with "Operating Notes. Part 1—Power Valves" included in this volume of the Handbook.

CATHODE Indirectly heated.

V_h	6.0	V
I_h	0.75	A

MOUNTING POSITION Any

CAPACITANCES (Measured without external shield)

c_{a-g1}	<0.3	μμF
c_{in}	9.5	μμF
c_{out}	4.5	μμF

CHARACTERISTICS (Measured at I_a=45 mA)

g_m	7.0	mA/V
μ_{g1-g2}	16	

COOLING Natural cooling

Maximum bulb temperature	250	°C

OPERATING CONDITIONS AS ANODE AND SCREEN MODULATED R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY)

Limiting Values

V_a max.	250	V
p_a max.	8.0	W
V_{g2} max.	250	V
p_{g2} max.	1.5	W
I_k max.	60	mA
$i_{k(pk)}$ max.	550	mA
$-V_{g1}$ max.	125	V
I_{g1} max.	5.0	mA
R_{g1-k} max.	100	kΩ
$v_{h-k\ (pk)}$ max.	±100	V

QV03-12

V.H.F. POWER TETRODE

R.F. beam power tetrode rated for a maximum anode dissipation of 12W and intended for use at frequencies up to 175 Mc/s.

Typical Operating Conditions

f	<30	Mc/s
V_a	250	V
*V_{g2}	250	V
†V_{g1}	−39	V
I_a	40	mA
I_{g2}	5.5	mA
I_{g1} (approx.)	1.0	mA
$v_{in(pk)}$	47	V
P_{drive}	0.2	W
P_{out}	6.4	W
‡P_{load}	5.1	W

*Obtained preferably from a separate source modulated with the anode supply or from the modulated anode supply through a series resistor.

†May be obtained by grid resistor or from a combination of grid resistor with either fixed supply or cathode resistor.

‡With a circuit transfer efficiency of 80%.

OPERATING CONDITIONS AS R.F. POWER AMPLIFIER OR OSCILLATOR (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	300	V
p_a max.	12	W
V_{g2} max.	250	V
p_{g2} max.	2.0	W
I_k max.	70	mA
$i_{k(pk)}$ max.	350	mA
$-V_{g1}$ max.	125	V
I_{g1} max.	5.0	mA
R_{g1-k} max.	100	kΩ
$v_{h-k(pk)}$ max.	±100	V

Typical Operating Conditions

f	<30	<50	Mc/s
V_a	300	300	V
V_{g2}	250	250	V
*V_{g1}	−29	−60	V
R_{g1-k}	18	22	kΩ
$v_{in(pk)}$	38	80	V
I_a	50	50	mA
I_{g2}	6.5	5.0	mA
I_{g1}	1.5	3.0	mA
P_{drive}	0.15	0.4	W
P_{out}	10	8.0	W
†P_{load}	8.0	6.4	W

*May be obtained from a fixed supply or by the grid resistor shown.

†With a circuit transfer efficiency of 80%.

V.H.F. POWER TETRODE

QV03-12

R.F. beam power tetrode rated for a maximum anode dissipation of 12W and intended for use at frequencies up to 175 Mc/s.

OPERATING CONDITIONS AS FREQUENCY MULTIPLIER

Limiting Values

V_a max.	300	V
p_a max.	12	W
V_{g_2} max.	250	V
p_{g_2} max.	2.0	W
I_k max.	70	mA
$i_{k(pk)}$ max.	450	mA
$-V_{g_1}$ max.	125	V
I_{g_1} max.	5.0	mA
R_{g_1-k} max.	100	k Ω
$v_{h-k(pk)}$ max.	±100	V

TYPICAL OPERATING CONDITIONS AS A FREQUENCY MULTIPLIER

	Trebler	*Doubler*	
f_{out}	175	175	Mc/s
V_a	300	300	V
*V_{g_2}	238	250	V
R_{g_2}	12.5	12.5	k Ω
†V_{g_1}	−100	−75	V
R_{g_1-k}	100	75	k Ω
I_a	35	40	mA
I_{g_2}	5.0	4.0	mA
I_{g_1} (approx.)	1.0	1.0	mA
$v_{in(pk)}$	120	95	V
P_{drive}	0.6	0.6	W
P_{out}	2.8	3.6	W
‡P_{load}	1.5	2.0	W

*Obtained from anode supply voltage of 300 V through a series resistor of 12.5 kΩ.

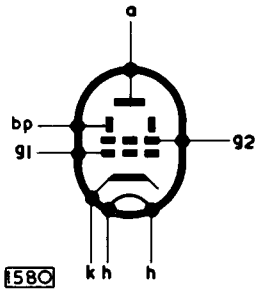
†May be obtained from a fixed supply or by the grid resistor shown.

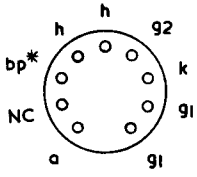
‡With a typical circuit arrangement.

QV03-12

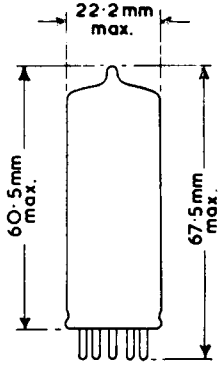
V.H.F. POWER TETRODE

R.F. beam power tetrode rated for a maximum anode dissipation of 12W and intended for use at frequencies up to 175 Mc/s.





B9A
Noval Base

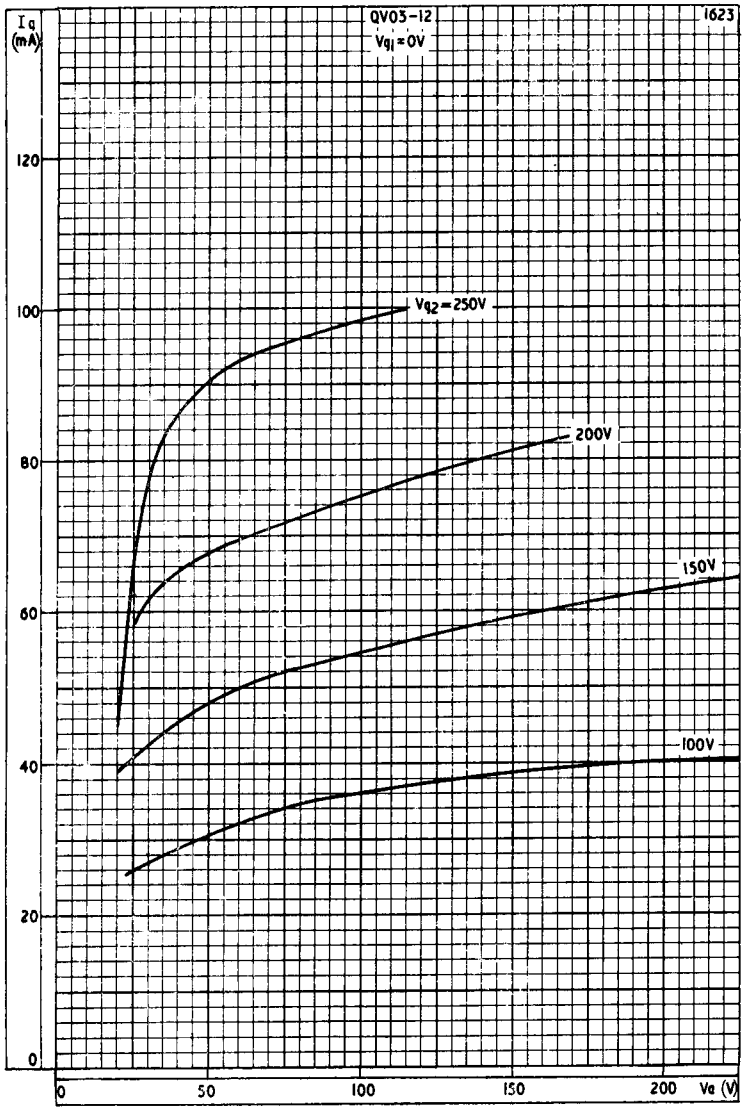


* Connect contact 3 to contact 7 at socket. Contacts 8 and 9 should be connected to external circuit with leads of equal length.

V.H.F. POWER TETRODE

QV03-12

R.F. beam power tetrode rated for a maximum anode dissipation of 12W and intended for use at frequencies up to 175 Mc/s.

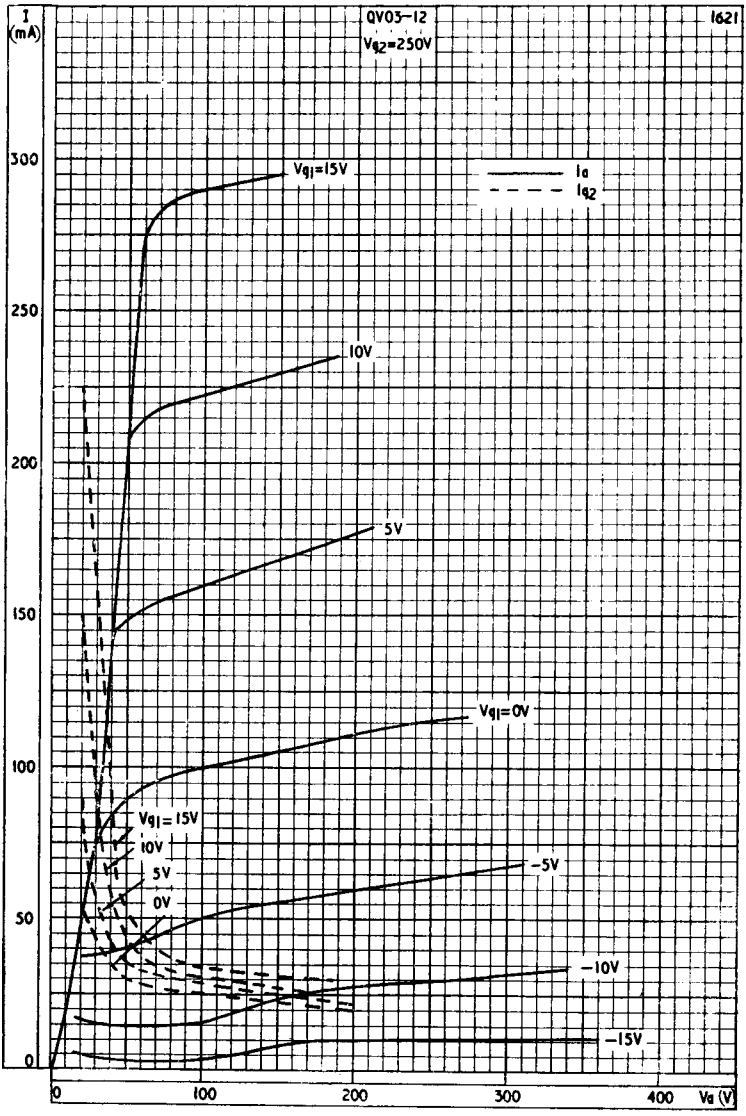


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR VARIOUS SCREEN-GRID VOLTAGES

QV03-12

V.H.F. POWER TETRODE

R.F. beam power tetrode rated for a maximum anode dissipation of 12W and intended for use at frequencies up to 175 Mc/s.

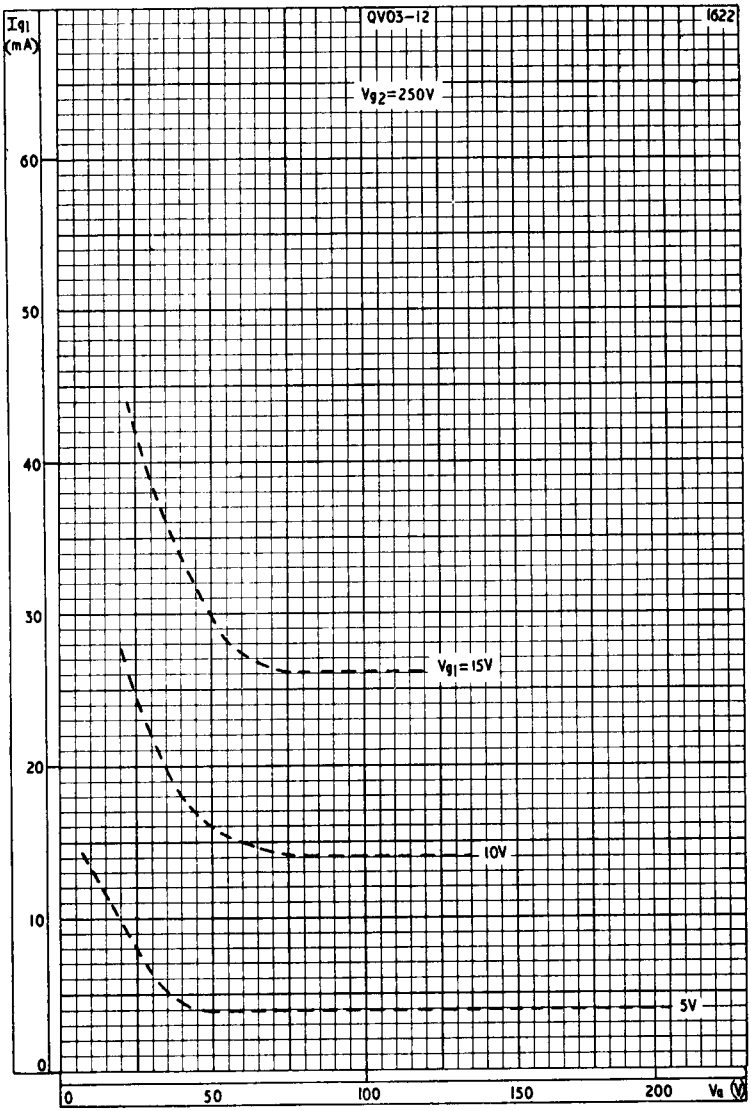


ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

V.H.F. POWER TETRODE

QV03-12

R.F. beam power tetrode rated for a maximum anode dissipation of 12W and intended for use at frequencies up to 175 Mc/s.



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

V.H.F. POWER TETRODE

QV03-12

Application: *V.H.F. power amplifier*
Power output: *10W*
Frequency: *175Mc/s at full ratings*
Construction: *Glass, natural cooling*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES which precede this section of the handbook.

CATHODE

Indirectly heated

V_h	6.0	V
I_h	750	mA

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

c_{a-g1}	<300	mpF
c_{in}	9.5	pF
c_{out}	4.5	pF

CHARACTERISTICS (measured at I_a = 45mA)

g_m	7.0	mA/V
μ_{g1-g2}	16	

COOLING

Natural cooling

T_{bulb} max.	250	°C

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Limiting values (absolute ratings)

V_a max.	300	V
p_a max.	12	W
V_{g2} max.	250	V
p_{g2} max.	2.0	W
$-V_{g1}$ max.	125	V
I_{g1} max.	5.0	mA
I_k max.	70	mA
$i_{k(pk)}$ max.	350	mA
R_{g1-k} max.	100	kΩ
$v_{h-k(pk)}$ max.	100	V

Operating conditions

f	<30	<50	Mc/s
V_a	300	300	V
V_{g2}	250	250	V
†V_{g1}	−29	−60	V
R_{g1-k}	18	22	kΩ
I_a	50	50	mA
I_{g2}	6.5	5.0	mA
I_{g1}	1.5	3.0	mA
$v_{in(pk)}$	38	80	V
P_{drive}	150	400	mW
P_{out}	10	8.0	W
P_{load}	8.0	6.4	W
$\eta_{transfer}$	80	80	%

†May be obtained by a fixed bias or by the grid resistor shown.

CLASS 'C' ANODE AND SCREEN-GRID MODULATION

Limiting values (absolute ratings)

V_a max.	250	V
p_a max.	8.0	W
V_{g2} max.	250	V
p_{g2} max.	1.5	W
$-V_{g1}$ max.	125	V
I_{g1} max.	5.0	mA
I_k max.	60	mA
$i_{k(pk)}$ max.	550	mA
R_{g1-k} max.	100	kΩ
$v_{h-k(pk)}$ max.	100	V

Operating conditions

f	<30	Mc/s
V_a	250	V
*V_{g2}	250	V
V_{g1}	−39	V
I_a	40	mA
I_{g2}	5.5	mA
I_{g1}	1.0	mA
$v_{in(pk)}$	47	V
P_{drive}	200	mW
P_{out}	6.4	W
P_{load}	5.1	W
$\eta_{transfer}$	80	%

*Obtained preferably from a separate modulated supply, or from the modulated anode supply.

CLASS 'C' FREQUENCY MULTIPLIER

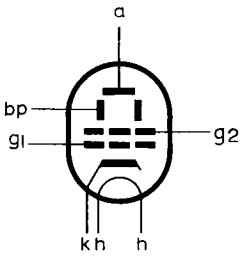
Limiting values (absolute ratings)

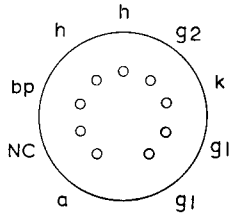
V_a max.	300	V
p_a max.	12	W
V_{g2} max.	250	V
p_{g2} max.	2.0	W
$-V_{g1}$ max.	125	V
I_{g1} max.	5.0	mA
I_k max.	70	mA
$i_{k(pk)}$ max.	450	mA
R_{g1-k} max.	100	kΩ
$v_{h-k(pk)}$ max.	100	V

QV03-12

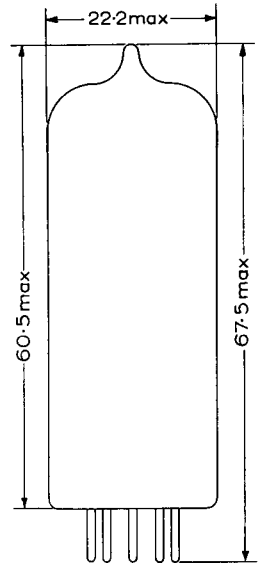
Operating conditions

	Doubler	*Trebler*	
f_{out}	175	175	Mc/s
V_a	300	300	V
V_{g2}	250	238	V
R_{g2}	12.5	12.5	kΩ
V_{g1}	−75	−100	V
R_{g1-k}	75	100	kΩ
I_a	40	35	mA
I_{g2}	4.0	5.0	mA
I_{g1}	1.0	1.0	mA
$V_{in(pk)}$	95	120	V
P_{drive}	600	600	mW
P_{out}	3.6	2.8	W
P_{load}	2.0	1.5	W
$\eta_{transfer}$	56	54	%





B9A Base

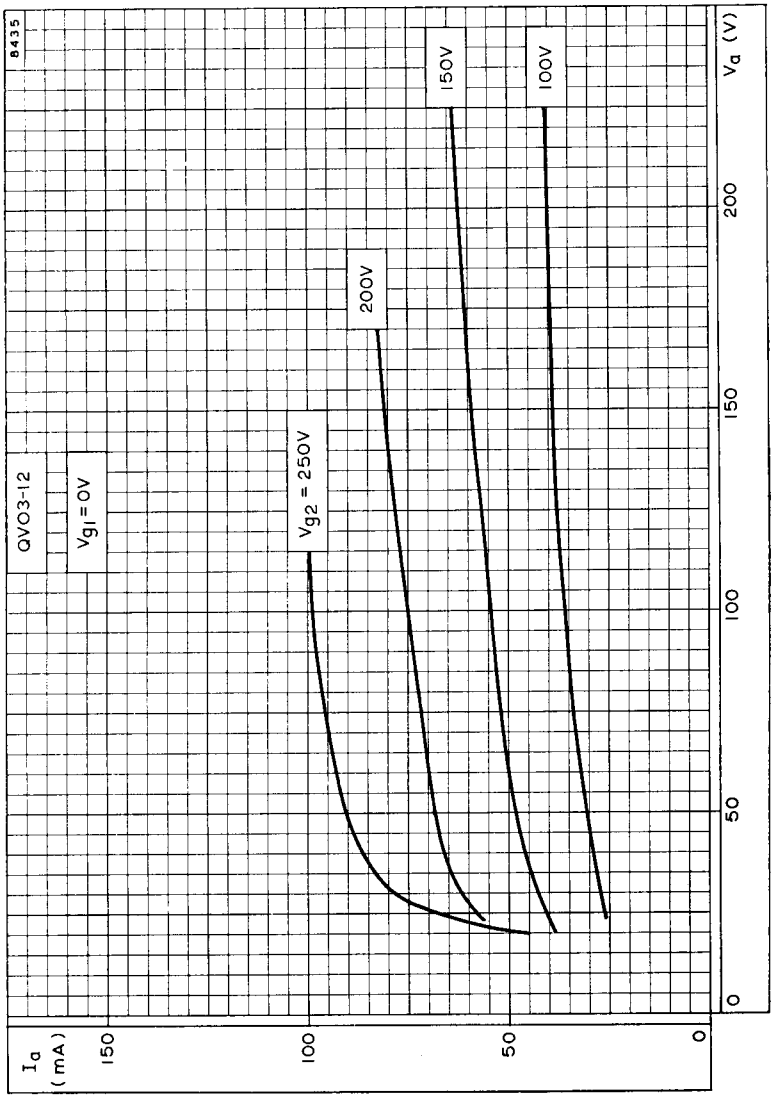


Contacts 3 and 7 should be connected together at the socket.
Contacts 8 and 9 should be connected to the external circuit with leads of equal length.

All dimensions in mm

8438

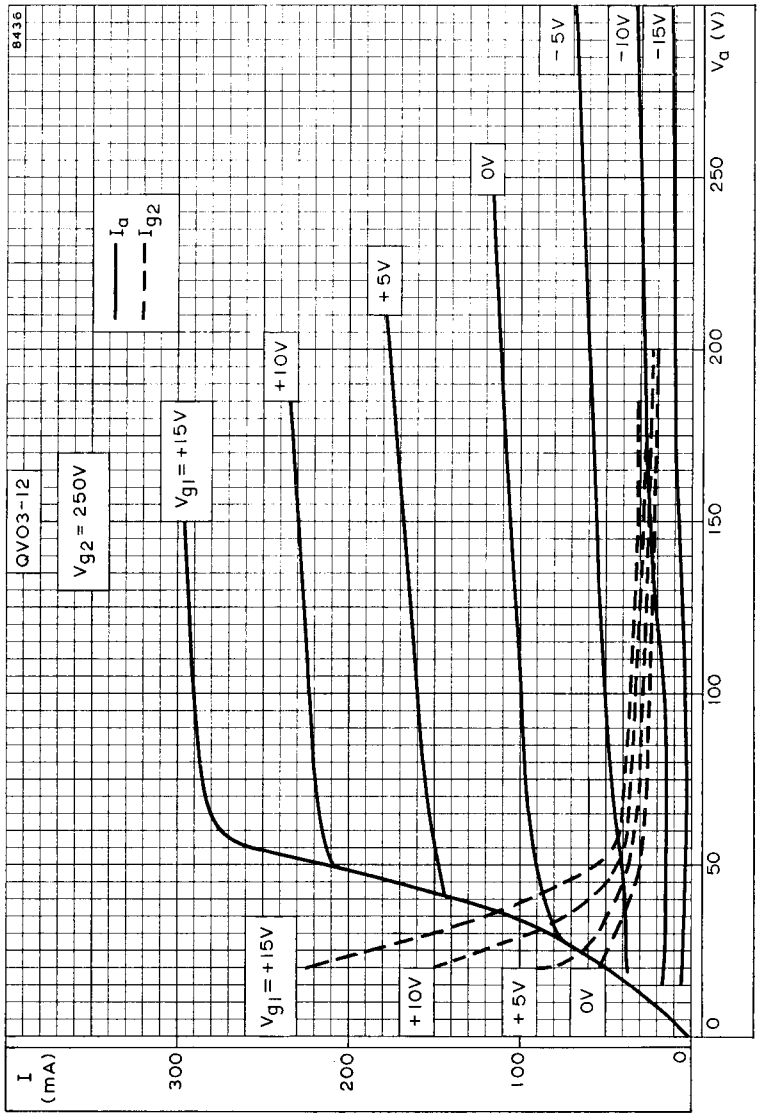
QV03-12



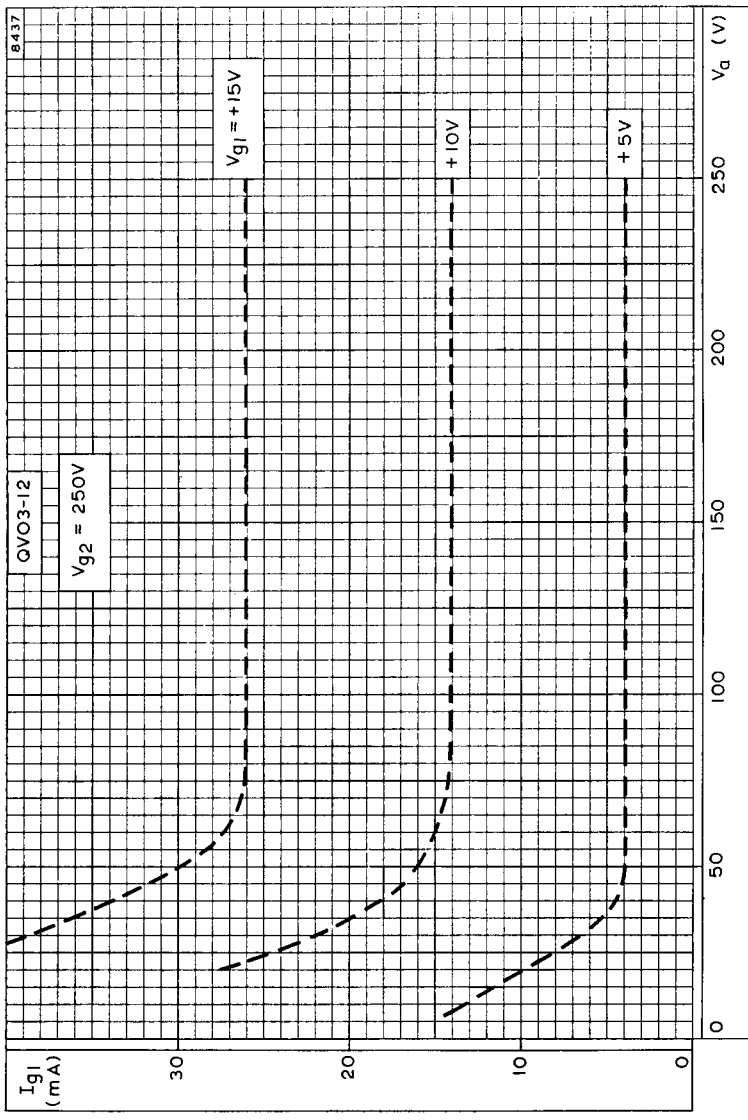
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR VARIOUS SCREEN-GRID VOLTAGES

QV03-12

V.H.F. POWER TETRODE



ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

R.F. POWER TETRODE

QV05-25

Indirectly heated beam tetrode, rated for a maximum anode dissipation of 25 watts, and suitable for use as an A.F. Amplifier or modulator, or as an R.F. Power Amplifier or oscillator.

This Data Sheet should be read in conjunction with "Operating Notes, Part I—Power Valves" included in this volume of the Handbook.

HEATER

V_h	6.3	V
I_h	0.9	A
Heating Time	15	secs.

MOUNTING POSITION

Any

CAPACITANCES

c_{in}	11	μμF
*c_{out}	7.0	μμF
c_{a-g1}	<0.2	μμF

*Measured with external shield

CHARACTERISTICS

At V_a = 600 V. V_{g2} = 300 V. I_a = 72 mA.

μ_{g1-g2}	8.0	
g_m	6.0	mA/V

LIMITING VALUES

V_a max.	600	V
$V_{a(pk)}$ max.	2,000	V
V_{g2} max.	300	V
V_{g1} max.	−200	V
I_k max.	150	mA
$i_{k(pk)}$ max.	400	mA
I_{g2} max.	10	mA
I_{g1} max.	5.0	mA
$i_{g1(pk)}$ max.	25	mA
p_a max.	25	W
p_{g2} max.	3.5	W
R_{g1-k} max.	25	kΩ
V_{h-k} max.	100	V

Operating Frequency (Mc/s.)	Max. anode voltage (V)	Max. anode input power (W)
60	600	60
75	500	50

MAINTENANCE ONLY

QV05-25

R.F. POWER TETRODE

Indirectly heated beam tetrode, rated for a maximum anode dissipation of 25 watts and suitable for use as an A.F. Amplifier or modulator, or as an R.F. Power Amplifier or oscillator.

OPERATING CONDITIONS

For Push-pull pair as Class "AB_2" A.F. power amplifier and modulator

V_a	400	500	600	V
V_{g2}	300	300	300	V
V_{g1}	−25	−25	−30	V
$I_{a(o)}$	2×50	2×50	2×30	mA
$I_{g2(o)}$	2×2.5	2×2.5	2×2.5	mA
$V_{in(pk)}$	2×39	2×39	2×39	V
I_a (max. sig.)	2×120	2×120	2×100	mA
I_{g2} (max. sig.)	2×5.0	2×5.0	2×5.0	mA
R_{a-a}	3.2	4.24	6.4	kΩ
*P_{drive} (max. sig.) approx.	0.2	0.2	0.1	W
P_{out} approx.	55	75	80	W

* The effective resistance of the grid circuit should be below 500 ohms, and the effective impedance should not exceed 700 ohms at the highest response frequency required.

OPERATING CONDITIONS

For single valve as R.F. amplifier Class B telephony

V_a	400	500	600	V
V_{g2}	250	250	250	V
V_{g1}	−25	−25	−25	V
I_a	75	75	62.5	mA
I_{g2}	4.0	4.0	3.0	mA
$V_{in(pk)}$	30	30	20	V
P_{drive} approx.	0.25	0.25	0.2	W
P_{out} approx.	9.0	12.5	12.5	W

OPERATING CONDITIONS

For single valve as R.F. amplifier Class C telephony anode modulated

V_a	325	400	475	V
*V_{g2}	225	225	225	V
R_{g2}	20	30	50	kΩ
**V_{g1}	−75	−80	−85	V
R_{g1-k}	25	22.8	21.3	kΩ
I_a	80	80	83	mA
I_{g2} approx.	5.0	5.75	5.0	mA
I_{g1}	3.0	3.5	4.0	mA
$V_{in(pk)}$	90	95	110	V
P_{drive} approx.	0.25	0.3	0.4	W
P_{out} approx.	17.5	22.5	27.5	W

* Preferably obtained from modulated anode supply through resistor (R_{g2}) of value shown.

** May be obtained either from separate supply, or by a grid resistor of value shown, or by a combination of these methods.

R.F. POWER TETRODE

QV05-25

Indirectly heated beam tetrode, rated for a maximum anode dissipation of 25 watts, and suitable for use as an A.F. Amplifier or modulator, or as an R.F. Power Amplifier or oscillator.

OPERATING CONDITIONS

For single valve as R.F. amplifier and oscillator Class C telegraphy

V_a	400	500	600	V
*V_{g2}	250	250	250	V
R_{g2}	20	42	50	k Ω
**V_{g1}	−45	−45	−45	V
R_{g1-k}	12.8	12.8	12.8	k Ω
R_k	410	410	410	Ω
I_a	100	100	100	mA
I_{g2}	7.5	6.0	7.0	mA
I_{g1} approx.	3.5	3.5	3.5	mA
$V_{in(pk)}$	65	65	65	V
P_{drive} approx.	0.2	0.2	0.2	W
P_{out} approx.	25	30	40	W

* May be obtained from a separate supply, or from a potentiometer, or from the anode supply through resistor (R_{g2}) of value shown.

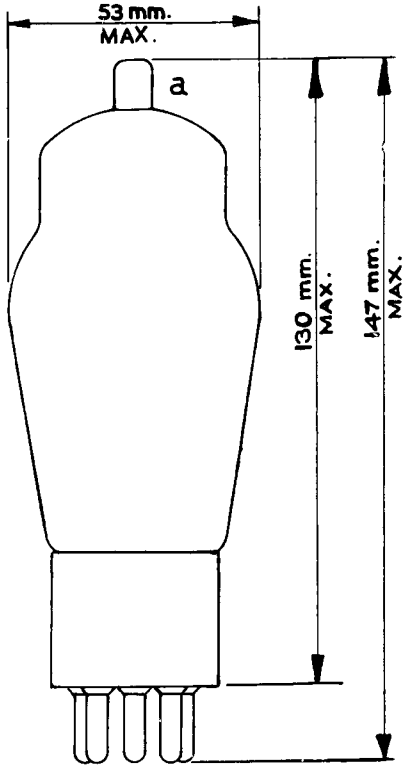
** May be obtained from a separate supply, or from a grid or cathode resistor of value shown, or by a combination of these methods.

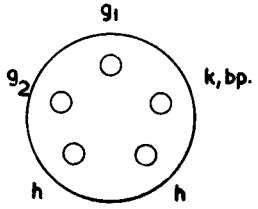
WEIGHT Valve only ; 2½ oz. (0.08 kg.)

QV05-25

R.F. POWER TETRODE

Indirectly heated beam tetrode, rated for a maximum anode dissipation of 25 watts, and suitable for use as an A.F. Amplifier or modulator, or as an R.F. Power Amplifier or oscillator.



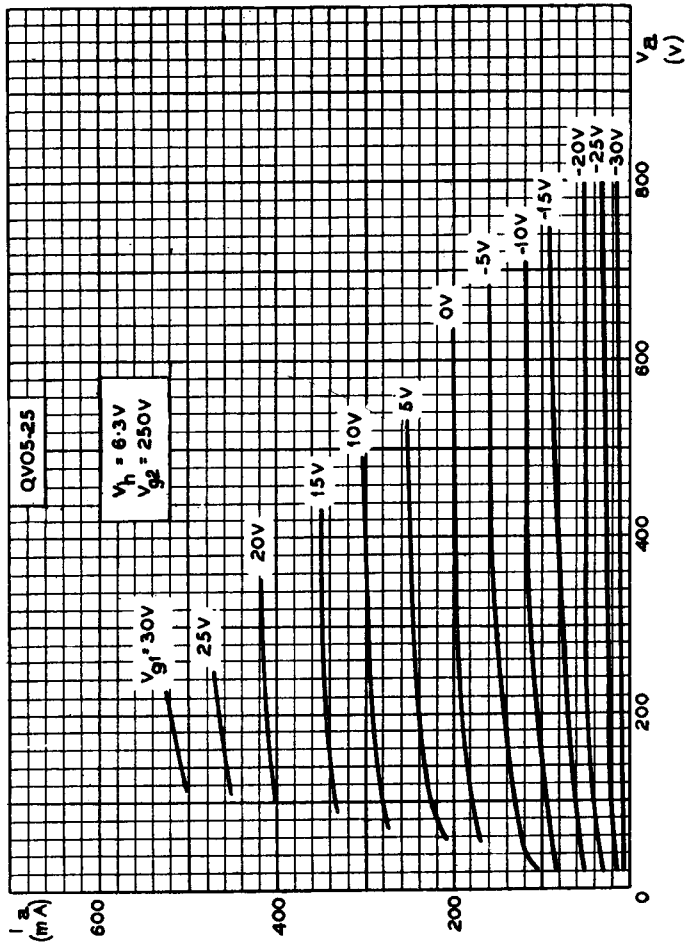


AMERICAN MEDIUM 5-PIN BASE

R.F. POWER TETRODE

QV05-25

Indirectly heated beam tetrode, rated for a maximum anode dissipation of 25 watts, and suitable for use as an A.F. Amplifier or modulator, or as an R.F. Power Amplifier or oscillator.

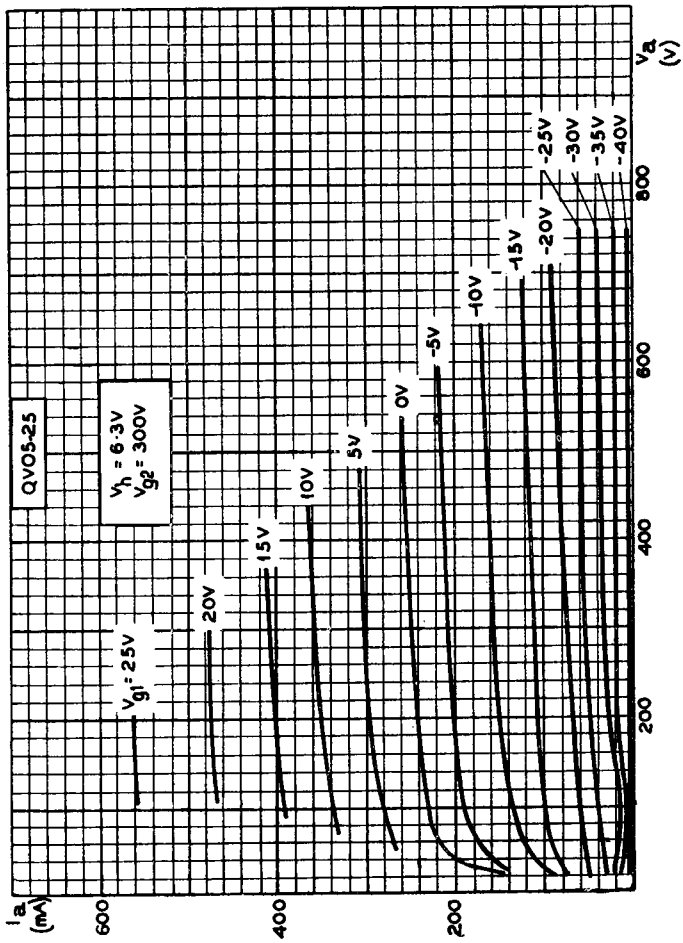


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
FOR SCREEN VOLTAGE = 250V

QV05-25

R.F. POWER TETRODE

Indirectly heated beam tetrode, rated for a maximum anode dissipation of 25 watts, and suitable for use as an A.F. Amplifier or modulator, or as an R.F. Power Amplifier or oscillator.

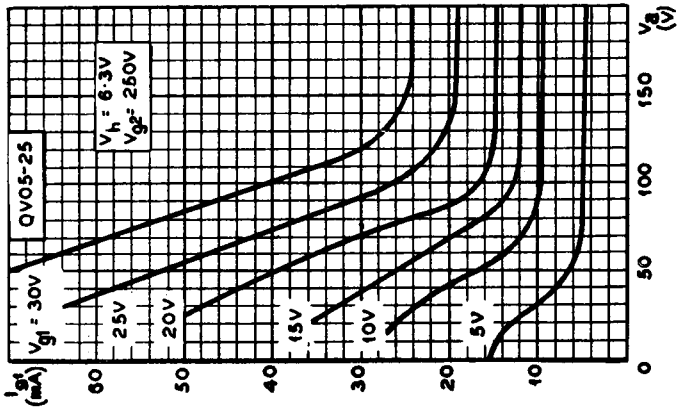


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
FOR SCREEN VOLTAGE = 300V

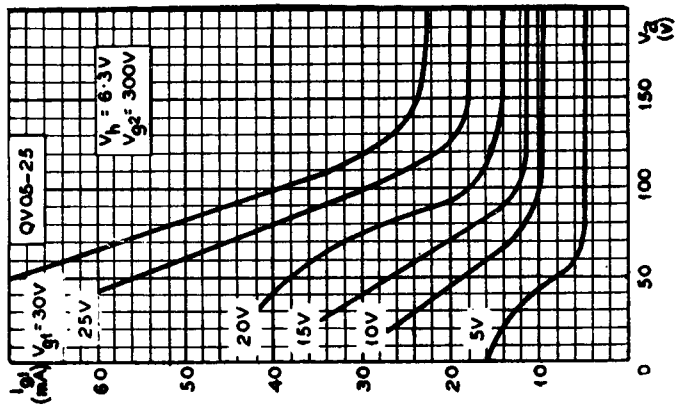
R.F. POWER TETRODE

QV05-25

Indirectly heated beam tetrode, rated for a maximum anode dissipation of 25 watts, and suitable for use as an A.F. Amplifier or modulator, or as an R.F. Power Amplifier or oscillator.



CONTROL GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN VOLTAGE = 250V

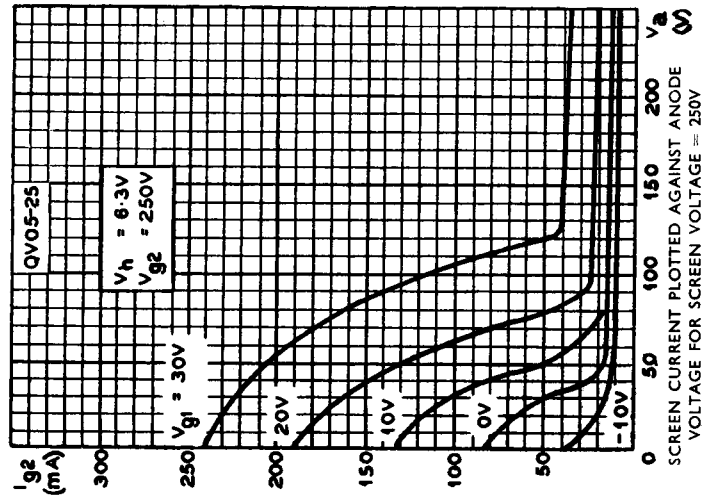


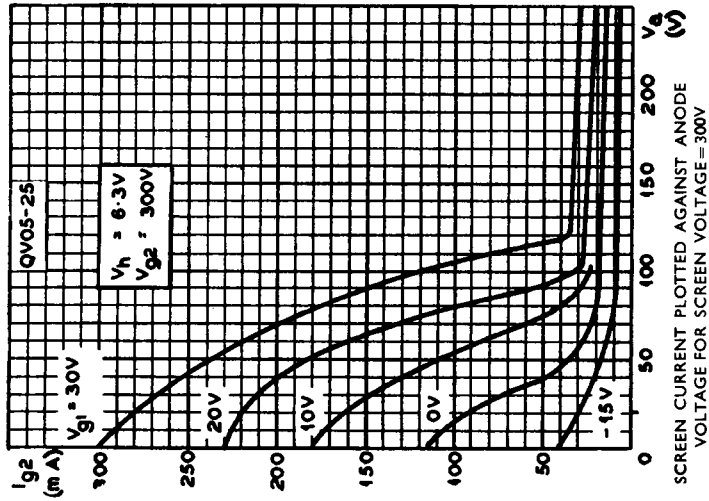
CONTROL GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN VOLTAGE = 300V

QV05-25

R.F. POWER TETRODE

Indirectly heated beam tetrode, rated for a maximum anode dissipation of 25 watts, and suitable for use as an A.F. Amplifier or modulator, or as an R.F. Power Amplifier or oscillator.





V.H.F. POWER TETRODE

QV06-20

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this volume of the handbook.

CATHODE Indirectly heated.

V_h	6.3	V
I_h	1.25	A

MOUNTING POSITION Any

CAPACITANCES (measured with the base sleeve connected to earth)

C_{a-g1}	<0.22	pF
C_{in}	13.5	pF
C_{out}	8.5	pF

CHARACTERISTICS (measured at $V_a = V_{g2} = 200V$: $I_a = 100mA$)

g_m	7.0	mA/V
μ_{g1-g2}	4.5	

COOLING

Natural cooling		
Maximum bulb temperature	220	°C

OPERATING CONDITIONS AS R.F. POWER AMPLIFIER OR OSCILLATOR (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	600	V
p_a max.	20	W
V_{g2} max.	250	V
p_{g2} max.	3.0	W
I_k max.	160	mA
$i_{k(pk)}$ max.	800	mA
V_{g1} max.	−150	V
I_{g1} max.	8.0	mA
*R_{g1-k} max.	30	kΩ
$v_{h-k(pk)}$ max.	±135	V

*At reduced input R_{g1-k} max. = 100kΩ

QV06-20

V.H.F. POWER TETRODE

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175 Mc/s.

Typical Operating Conditions

f	60	60	175	Mc/s
V_a	500	600	320	V
*V_{g2}	170	150	180	V
*V_{g1}	−66	−58	−51	V
I_a	135	112	140	mA
I_{g2}	10	10	10	mA←
I_{g1} (approx.)	5.0	5.0	4.0	mA←
$v_{in(pk)}$	84	73	64	V
$P_{load(driver)}$	0.6	0.6	5.0	W←
P_{out}	48	52	25	W
P_{load}	38	42	20	W

*When V_{g2} and/or V_{g1} are obtained by means of resistors (R_{g2} and R_{g1}) the anode input power and therefore the output power is likely to vary considerably from valve to valve. For optimum operating conditions it will be necessary therefore to make R_{g2} adjustable.

OPERATING CONDITIONS AS ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY)

Limiting Values (carrier condition for modulation factor of 1)

V_a max.	480	V
p_a max.	13.5	W
V_{g2} max.	250	V
p_{g2} max.	2.0	W
I_k max.	130	mA
$i_{k(pk)}$ max.	600	mA←
V_{g1} max.	−150	V
I_{g1} max.	9.0	mA←
*R_{g1-k} max.	30	kΩ
$v_{h-k(pk)}$ max.	± 135	V

*At reduced input R_{g1-k} max. = 100 k Ω.

V.H.F. POWER TETRODE

QV06-20

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

Typical Operating Conditions

f	<60	Mc/s
V_a	400	V
*V_{g2}	150	V
*V_{g1}	−87	V
I_a	112	mA
I_{g2}	12	mA ←
I_{g1}	6.0	mA ←
$v_{in(pk)}$	107	V
$P_{load(driver}$	1.2	W ←
P_{out}	32	W
P_{load}	26	W
For 100% modulation		←
P_{mod}	25	W
$v_{g2(pk)}$	110	V

*When V_{g2} and/or V_{g1} are obtained by means of resistors (R_{g2} and R_{g1}) the anode input power and therefore the output power is likely to vary considerably from valve to valve. For optimum operating conditions it will be necessary therefore to make R_{g2} adjustable.

OPERATING CONDITIONS AS A.F. POWER AMPLIFIER OR MODULATOR (CLASS "AB1")

Limiting Values

V_a max.	600	V
p_a max.	20	W
V_{g2} max.	250	V
p_{g2} max.	3.0	W
I_k max.	140	mA
$i_{k(pk)}$ max.	450	mA
†R_{g1-k} max. (fixed bias)	100	kΩ
$v_{h-k(pk)}$ max.	±135	V

†Under these conditions fixed bias is recommended and the control grid resistor should not exceed the specified value of 100kΩ For higher values of control-grid resistance cathode bias is required. Under no circumstances should the total d.c. control-grid resistor exceed 500kΩ.

QV06-20

V.H.F. POWER TETRODE

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

Typical Operating Conditions (for two valves)

V_a	400	500	600	V
*V_{g2}	190	185	190	V
†V_{g1}	−40	−40	−45	V
$I_{a(o)}$	2×31	2×28	2×13	mA
I_a (max. sig.)	2×114	2×107	2×100	mA
$I_{g2(o)}$	2×1.2	2×1.0	2×0.5	mA
I_{g2} (max. sig.)	2×12.5	2×12.5	2×11.5	mA
$V_{in(g1-g1)}$ r.m.s.	56	56	64	V
P_{out}	55	70	82	W
R_{a-a}	4.0	5.0	7.0	kΩ
D_{tot}	8.0	8.0	8.0	%

*Obtained preferably from a separate source or from the anode supply using a voltage divider.

†Under these conditions fixed bias is recommended and the control grid resistor should not exceed the specified value of 100 kΩ. For higher values of control-grid resistance cathode bias is required. Under no circumstances should the total d.c. control-grid resistor exceed 500kΩ.

OPERATING CONDITIONS AS A.F. POWER AMPLIFIER OR MODULATOR (CLASS "AB2")

Limiting Values

V_a max.	600	V
p_a max.	20	W
V_{g2} max.	250	V
p_{g2} max.	3.0	W
p_{g1} max.	1.0	W
I_k max.	135	mA
$i_{k(pk)}$ max.	450	mA
*R_{g1-k} max. (fixed bias)	30	kΩ
$v_{h-k(pk)}$ max.	±135	V

*At reduced input R_{g1-k} max. = 100kΩ.

V.H.F. POWER TETRODE

QV06-20

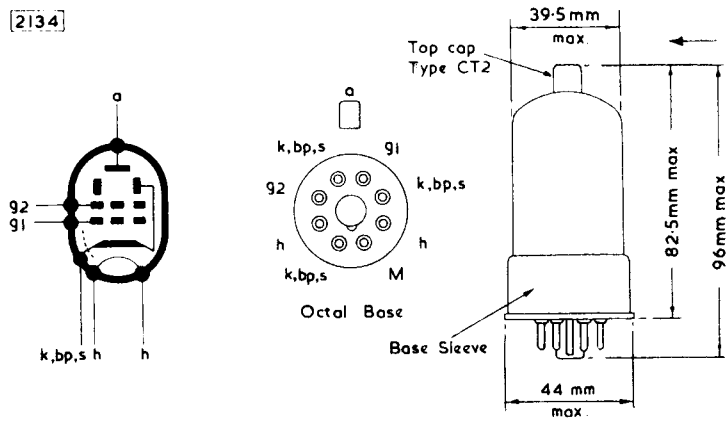
Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

Typical Operating Conditions (for two valves)

V_a	400	500	600	V
*V_{g2}	175	175	165	V
†V_{g1}	–41	–44	–44	V
$I_{a(o)}$	2×16	2×13	2×11	mA
I_a (max. sig.)	2×116	2×121	2×103	mA
$I_{g2(o)}$	2×0.5	2×0.3	2×0.3	mA
I_{g2} (max. sig.)	2×9.0	2×9.0	2×8.5	mA
I_{g1} (max. sig.)	2×0.8	2×1.0	2×0.5	mA
$V_{in(g1-g1)r.m.s.}$	66	72	68	V
P_{out}	62	83	90	W
R_{a-a}	3.7	4.6	6.8	kΩ
D_{tot}	9.0	9.0	9.0	%

*Obtained preferably from a separate source, or from the anode supply using a voltage divider.

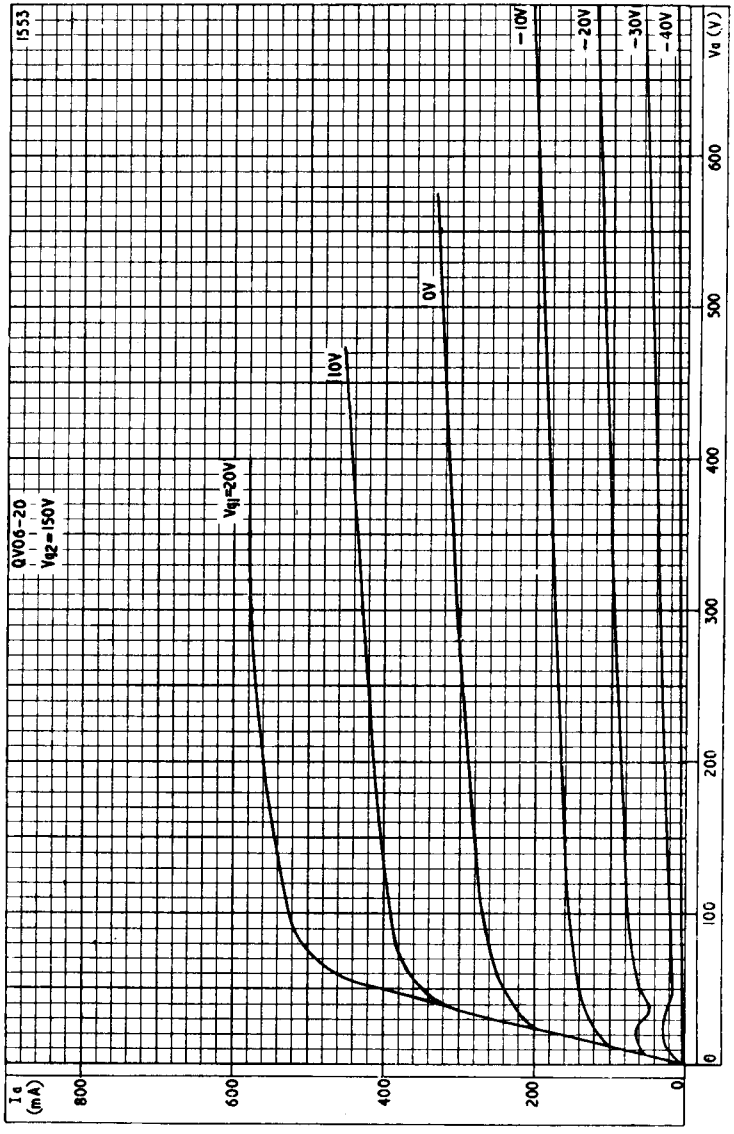
†Fixed bias is recommended.



QV06-20

V.H.F. POWER TETRODE

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

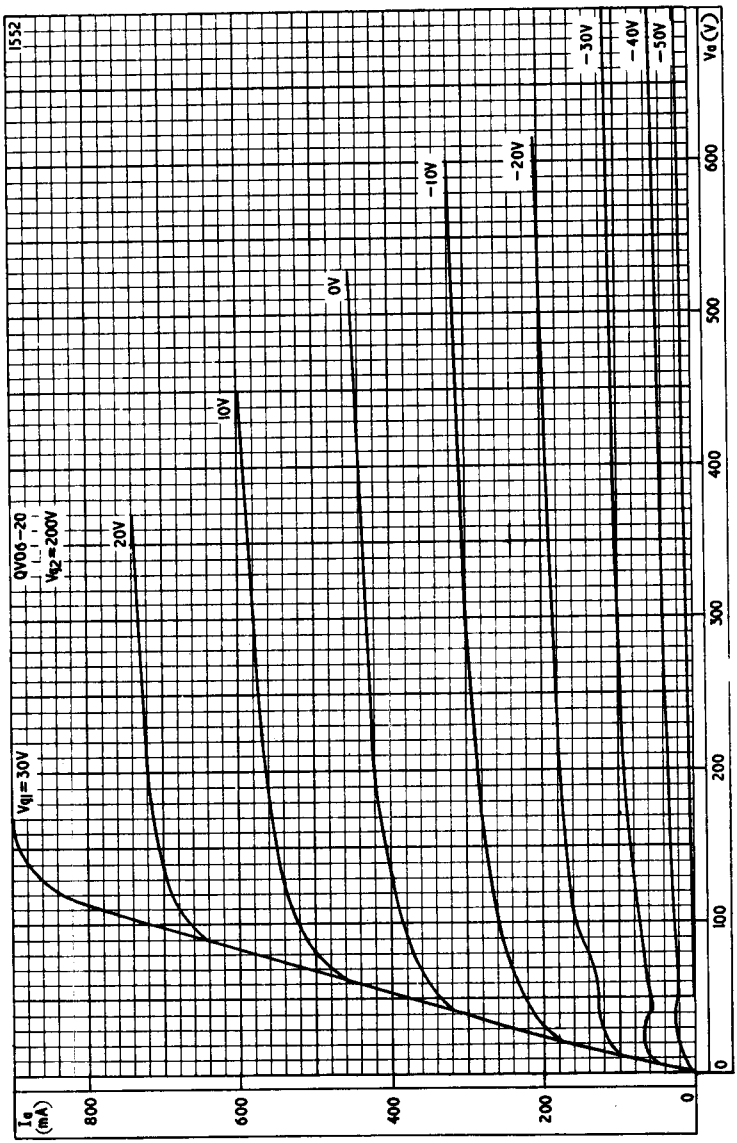


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE=150V

V.H.F. POWER TETRODE

QV06-20

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

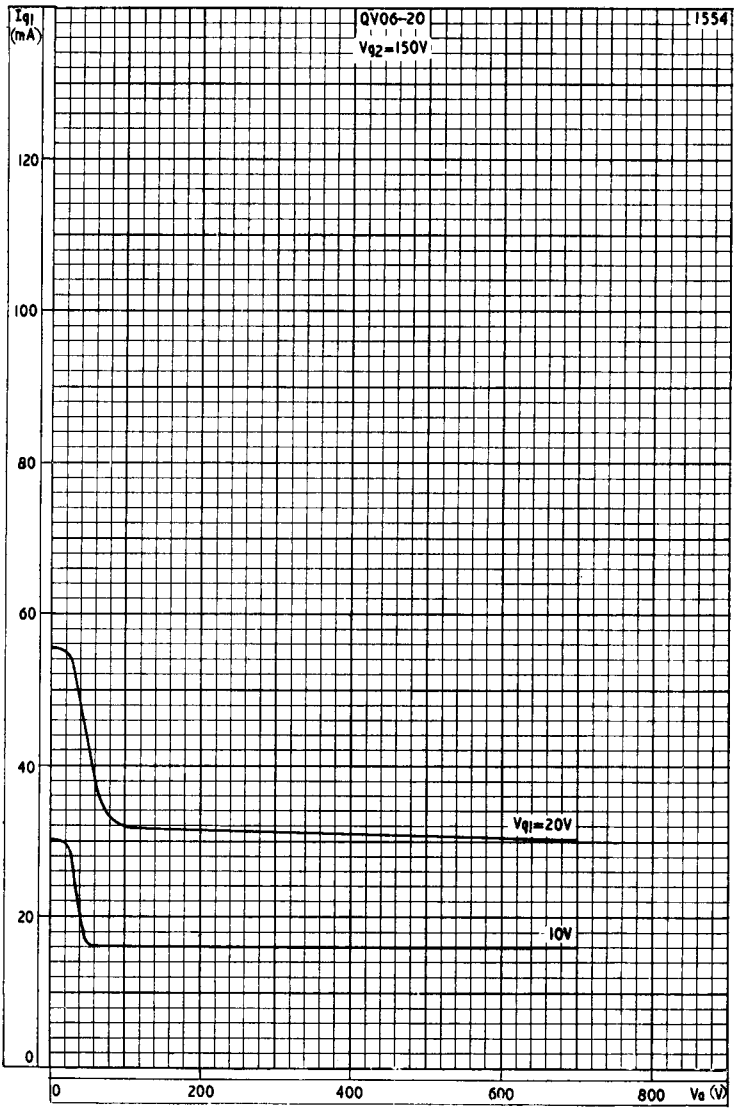


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE=200V

QV06-20

V.H.F. POWER TETRODE

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s

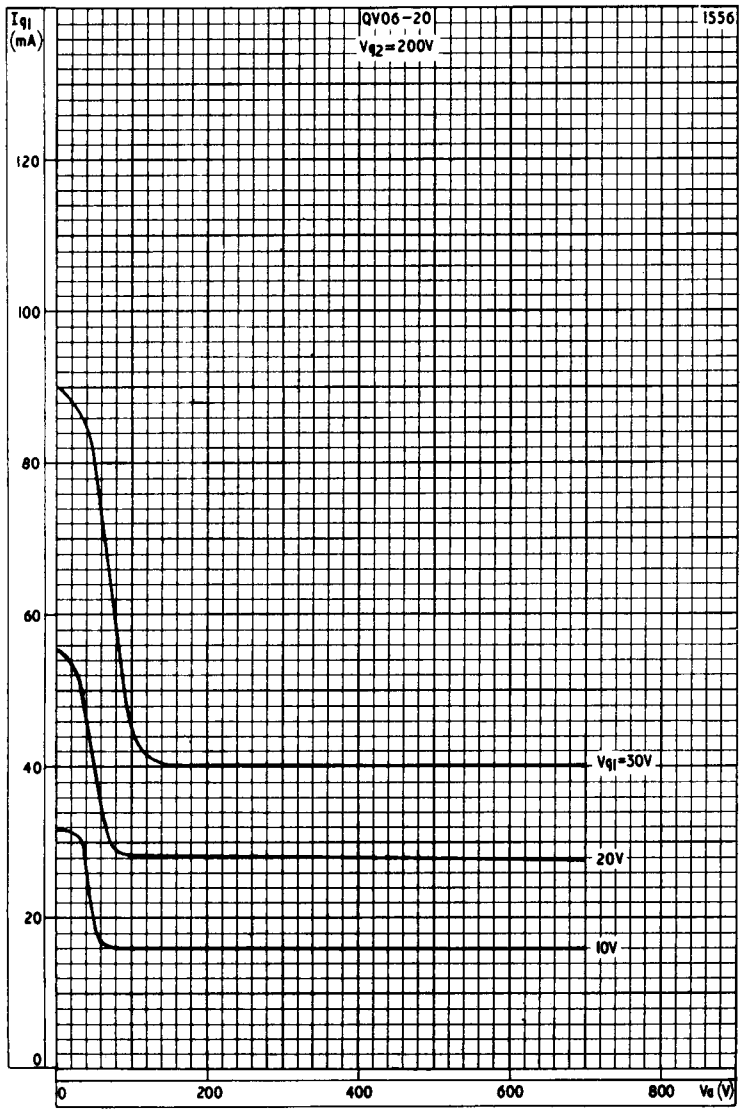


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE=150V

V.H.F. POWER TETRODE

QV06-20

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

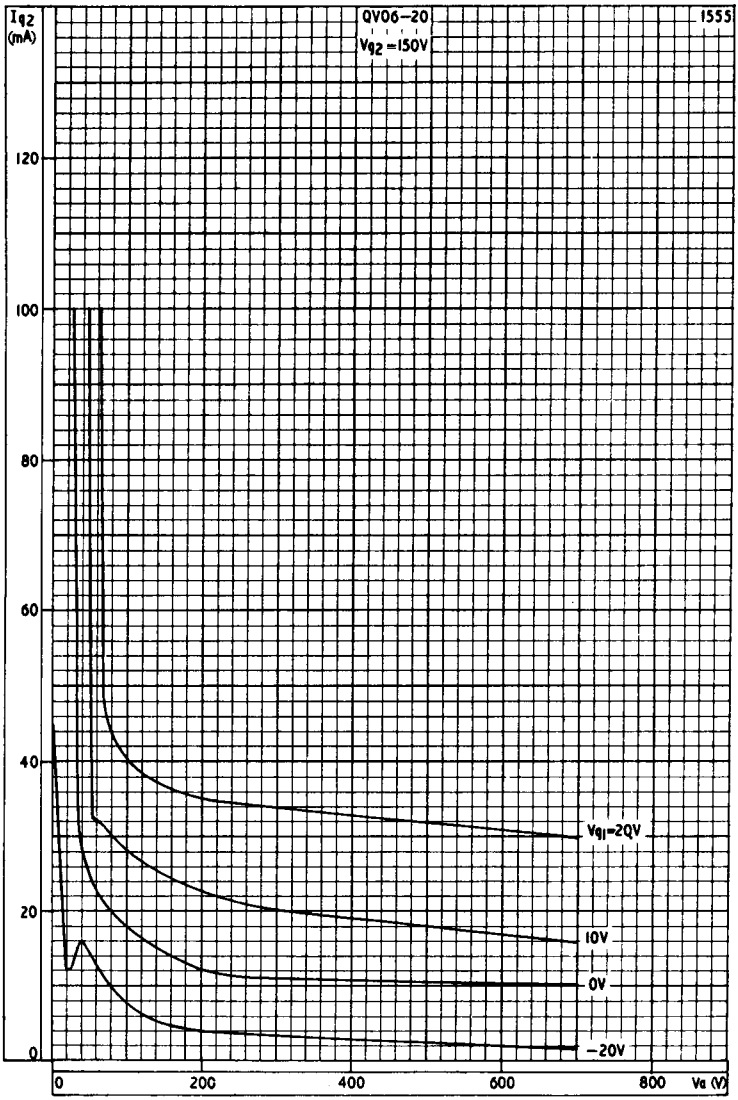


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE=200V

QV06-20

V.H.F. POWER TETRODE

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

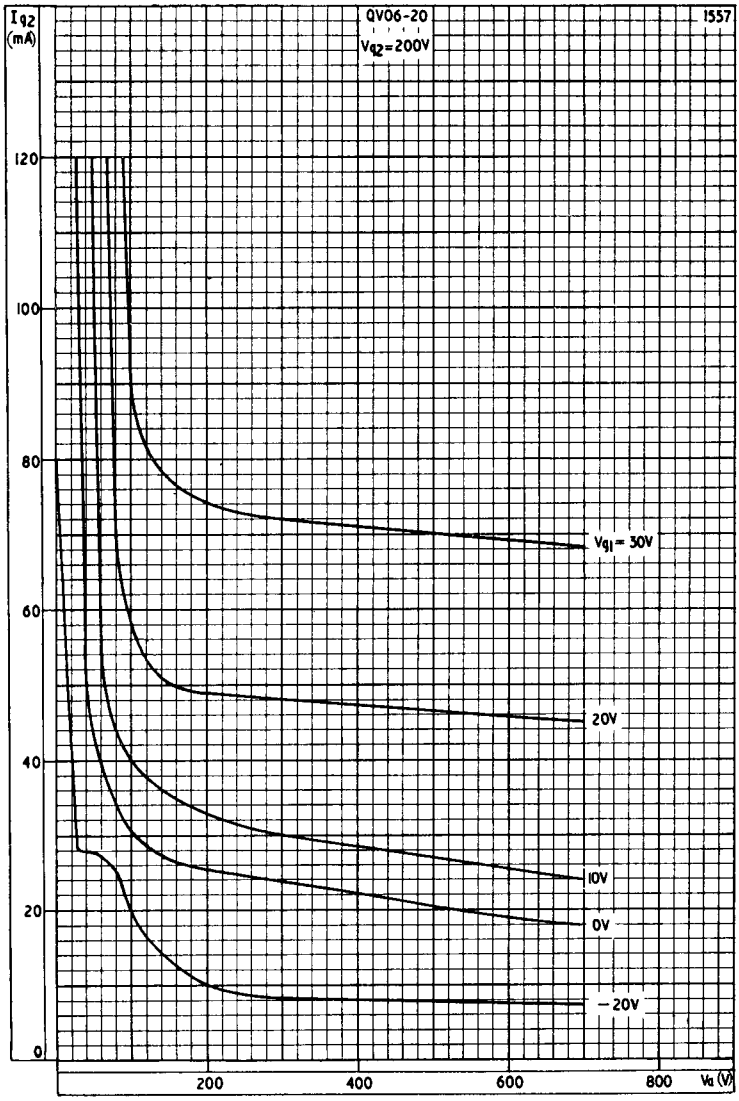


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE=150V

V.H.F. POWER TETRODE

QV06-20

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.

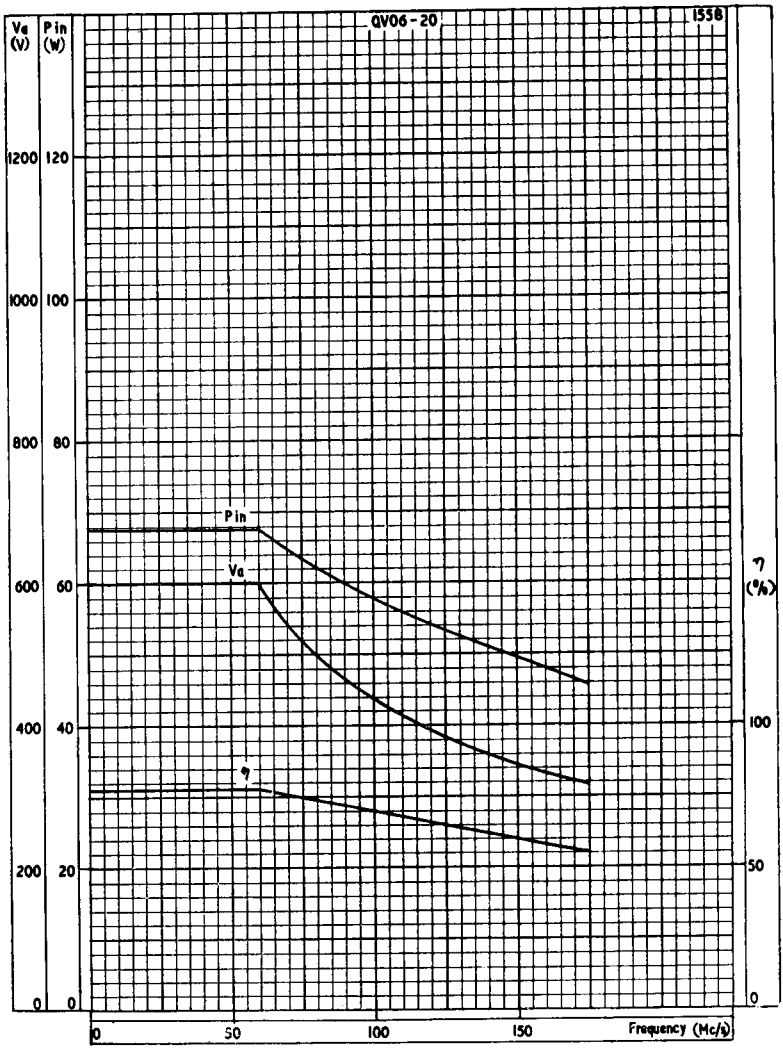


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE=200 V

QV06-20

V.H.F. POWER TETRODE

Beam power tetrode rated for a maximum anode dissipation of 20W and suitable for use at frequencies up to 175Mc/s.



FREQUENCY CHARACTERISTICS

U.H.F. POWER TETRODE

QV1-150A

Forced air-cooled power tetrode rated for a maximum anode dissipation of 150W and suitable for use at frequencies up to 500 Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with "Operating Notes, Part 1—Power Valves" included in this volume of the Handbook.

HEATER Indirectly heated.

V_h	6.0	V
I_h	2.6	A
Minimum heating time	30	secs

MOUNTING POSITION Any

CAPACITANCES (Measured without external shield)

c_{a-g1}	<0.06	μμF
c_{in}	15.5	μμF
c_{out}	4.5	μμF

CHARACTERISTICS (Measured at V_a=500 V, V_{g2}=250 V, I_a=200 mA)

μ_{g1-g2}	5.0	
g_m	12	mA/V

COOLING

Max. temperature of base and envelope seals 150 °C

Air cooling must start simultaneously with the application of heater voltage. A base must be used which directs air on to the base seals, past the screen-grid seal and glass envelope, and through the radiator.

A typical value of air flow for maximum anode dissipation is given in the following table.

Anode dissipation	Height above sea-level	Input temperature	Rate of flow of air	Pressure difference between inlet and outlet
P_a (W)	h (m)	T_{in} °C	(m^3/min)	(mm of H_2O)
150	0	20	0.22	15

QV1-150A

U.H.F. POWER TETRODE

Forced air-cooled power tetrode rated for a maximum anode dissipation of 150W and suitable for use at frequencies up to 500 Mc/s.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY, ANODE AND SCREEN-GRID MODULATION)

Limiting Values

f max.	500	Mc/s
V_a max.	1.0	kV
p_a max.	100	W
V_{g2} max.	300	V
p_{g2} max.	12	W
I_k max.	250	mA
$i_{k(pk)}$ max.	2.1	A
$-V_{g1}$ max.	250	V
p_{g1} max.	2.0	W
R_{g1-k} max.	25	k Ω

Typical Operating Conditions at f≦165 Mc/s.

V_a	400	600	800	1000	V
V_{g2}	250	250	250	250	V
V_{g1}	−90	−95	−100	−105	V
I_a	200	200	200	200	mA
I_{g2}	40	35	25	20	mA
I_{g1} (approx.)	7.0	8.0	10	15	mA
$V_{in(pk)}$	110	120	120	125	V
p_a	25	40	60	60	W
P_{drive}	1.0	1.0	1.5	2.0	W
P_{out}	55	80	100	140	W
*P_{load}	44	64	80	112	W
η	69	66	63	70	%
For 100% modulation					
$v_{g2(pk)\ mod.}$	140	150	160	170	V
$P_{mod.}$	40	60	80	100	W

*With a circuit transfer efficiency of 80%.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER OR OSCILLATOR (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

f max.	500	Mc/s
V_a max.	1.25	kV
p_a max.	150	W
V_{g2} max.	300	V
p_{g2} max.	12	W
I_k max.	250	mA
$i_{k(pk)}$ max.	1.25	A
$-V_{g1}$ max.	250	V
p_{g1} max.	2.0	W
R_{g1-k} max.	25	k Ω

U.H.F. POWER TETRODE

QV1-150A

Forced air-cooled power tetrode rated for a maximum anode dissipation of 150W and suitable for use at frequencies up to 500 Mc/s.

Typical Operating Conditions at f≦165 Mc/s.

V_a	600	750	1000	1250	V
V_{g_2}	250	250	250	250	V
V_{g_1}	–75	–80	–80	–90	V
I_a	200	200	200	200	mA
I_{g_2}	37	37	30	20	mA
I_{g_1} (approx.)	10	10	10	10	mA
$V_{in(pk)}$	90	95	95	105	V
*P_{drive}	1.0	1.0	1.0	1.2	W
p_a	35	40	50	55	W
P_{out}	85	110	150	195	W
†P_{load}	68	88	120	156	W
η_i	71	73	75	78	%

*Circuit losses not included.

†With a circuit transfer efficiency of 80%.

Typical Operating Conditions with Coaxial Cavity at f≦500 Mc/s.

V_a	600	800	1000	1250	V
V_{g_2}	250	250	250	280	V
V_{g_1}	–110	–110	–110	–115	V
I_a	170	200	200	200	mA
I_{g_2}	6.0	7.0	7.0	5.0	mA
I_{g_1} (approx.)	6.0	10	10	10	mA
p_a	52	65	80	110	W
*P_{drive}	15	20	25	30	W
P_{out}	50	95	120	140	W
†P_{load}	40	76	96	112	W
η_i	49	60	60	56	%

*Output of driver stage.

†With a circuit transfer efficiency of 80%.

OPERATING CONDITIONS AS R.F. POWER AMPLIFIER CLASS "B" FOR TELEVISION SERVICE (Negative modulation and positive synchronisation).

Limiting Values

f max.	220	Mc/s
V_a max.	1.25	kV
p_a max.	150	W
$I_{a(sync)}$ max.	335	mA
I_a max.	250	mA
V_{g_2} max.	400	V
p_{g_2} max	12	W
$-V_{g_1}$ max.	250	V
p_{g_1} max.	2.0	W

QV1-150A

U.H.F. POWER TETRODE

Forced air-cooled power tetrode rated for a maximum anode dissipation of 150W and suitable for use at frequencies up to 500 Mc/s.

Typical Operating Conditions

f	170–220	170–220	170–220	Mc/s
Bandwidth	5.0	5.0	5.0	Mc/s
V_a	750	1000	1250	V
V_{g2}	300	300	300	V
V_{g1}	–60	–65	–70	V
I_a (sync)	335	330	305	mA
I_a (black)	245	240	230	mA
I_{g2} (sync)	50	45	45	mA
I_{g2} (black)	20	15	10	mA
I_{g1} (sync)	15	20	25	mA
I_{g1} (black)	4.0	4.0	4.0	mA
$v_{in(pk)}$ (sync)	85	95	100	V
$v_{in(pk)}$ (black)	65	70	75	V
P_{drive} (sync)	7.0	8.0	9.0	W
P_{drive} (black)	4.25	4.7	5.5	W
P_{out} (sync)	135	200	250	W
P_{out} (black)	75	110	140	W

CIRCUIT NOTES

1. All four cathode connections must be used.
2. For low frequency operation the screen-grid connection is made to Pin 1. At higher frequencies the contact ring must be used for connecting the screen-grid.

WEIGHT

Valve only { 5.5 ozs / 150 g

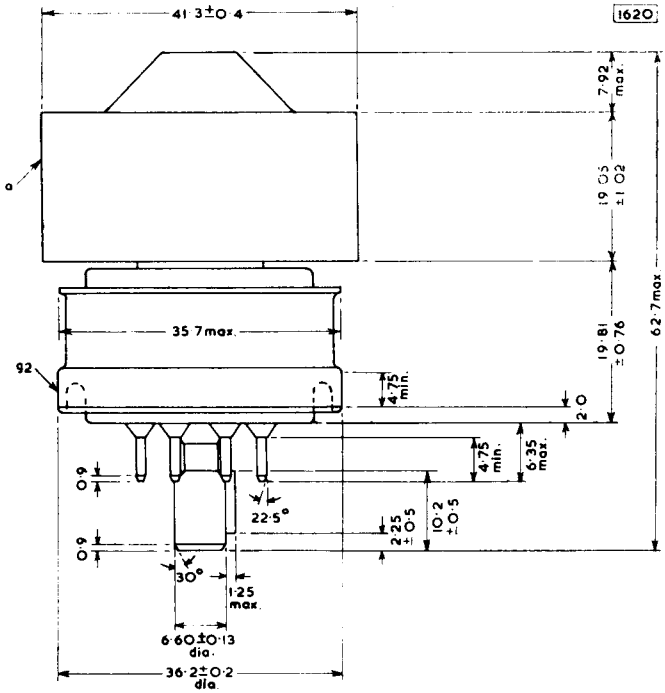
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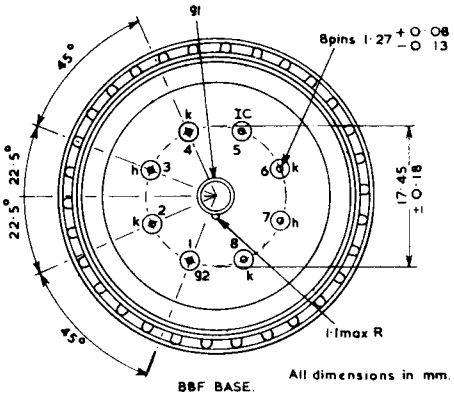
Information on these items can be obtained from the Industrial Technical Service Department, Mullard Ltd.

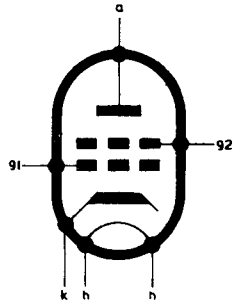
U.H.F. POWER TETRODE

QV1-150A

Forced air-cooled power tetrode rated for a maximum anode dissipation of 150W and suitable for use at frequencies up to 500 Mc/s.



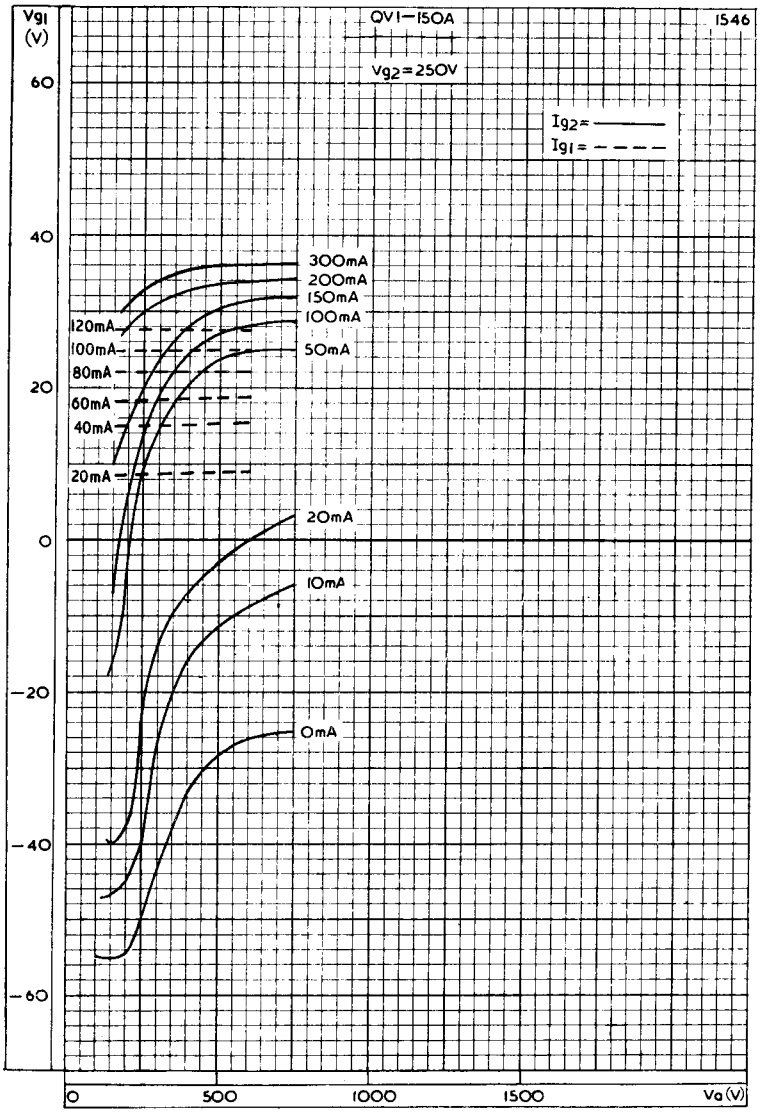




QV1-150A

U.H.F. POWER TETRODE

Forced air-cooled power tetrode rated for a maximum anode dissipation of 150W and suitable for use at frequencies up to 500 Mc/s.

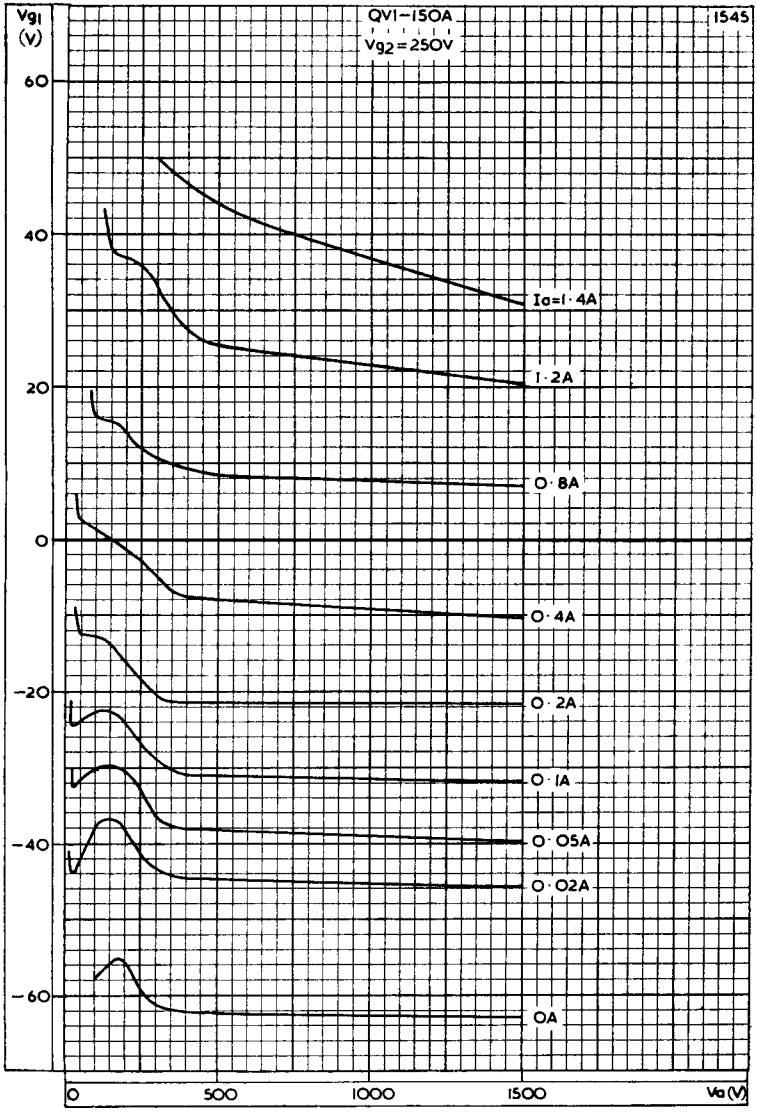


SCREEN-GRID AND CONTROL-GRID CONSTANT CURRENT CURVES

U.H.F. POWER TETRODE

QV1-150A

Forced air-cooled power tetrode rated for a maximum anode dissipation of 150W and suitable for use at frequencies up to 500 Mc/s.



CONSTANT ANODE CURRENT CURVES

U.H.F. POWER TETRODE

QV2-250B

Application: *U.H.F. amplifier*
Power output: *390W*
Frequency: *500Mc/s at full ratings*
Construction: *External anode, forced-air cooled*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS–TRANSMITTING VALVES which precede this section of the handbook.

CATHODE

Indirectly heated

V_h	6.0	V
I_h	2.6	A
Minimum heating time	30	s

MOUNTING POSITION

Any

CAPACITANCES

$C_{a\ g1}$	<60	mpF
C_{g1-k}	15.7	pF
C_{a-k}	4.5	pF

CHARACTERISTICS (measured at $V_a = 500V$, $V_{g2} = 250V$, $I_a = 200mA$)

μ_{g1-g2}	5.2	
g_m	12	mA/V

COOLING

Maximum temperature of anode core	250	°C
Maximum temperature of envelope seals	250	°C
Maximum temperature of base seals	175	°C

Air cooling must commence simultaneously with the application of heater voltage. A socket and air system chimney must be used to direct air on to the base seals, past the screen-grid seal and envelope, and through the radiator.

A typical value of air flow for maximum anode dissipation is given in the following table:

Anode dissipation	*Height above sea-level*	*Input temperature*	*Rate of flow of air*	*Pressure difference between inlet and outlet*
p_a (W)	h (m)	T_{in} (°C)	(m^3/min)	(mm of H_20)
250	0	20	0.11	6.4

QV2-250B

U.H.F. POWER TETRODE

CLASS 'C' TELEGRAPHY

Limiting values (absolute ratings)

f max.	500	Mc/s
V_a max.	2.0	kV
I_a max.	250	mA
V_{g2} max.	300	V
$-V_{g1}$ max.	250	V
p_a max.	250	W
p_{g2} max.	12	W
p_{g1} max.	2.0	W

Typical operation

f	175	175	175	175	500	Mc/s
V_a	0.5	1.0	1.5	2.0	2.0	kV
I_a	250	250	250	250	250	mA
V_{g2}	250	250	250	250	300	V
I_{g2}	45	38	21	19	10*	mA
V_{g1}	−90	−90	−90	−90	−90	V
I_{g1}	35	31	28	26	25*	mA
p_a	55	60	95	110	—	W
$v_{in(pk)}$	114	114	112	112	—	V
η_a	56	76	75	78	—	%
P_{out}	70	190	280	390	225*	W

*Measured values for a circuit having an efficiency of approximately 75%.

Note: When the valve is operated at maximum input as a class 'C' amplifier it is necessary to reduce the heater voltage according to the table below.

	≤300Mc/s	300 to 400Mc/s	400 to 500Mc/s
V_h	6.0V	5.75V	5.5V

CLASS 'C' ANODE AND SCREEN-GRID MODULATION

Limiting values (absolute ratings)

f max.	500	Mc/s
V_a max.	1.5	kV
I_a max.	200	mA
V_{g2} max.	300	V
$-V_{g1}$ max.	250	V
p_a max.	165	W
p_{g2} max.	12	W
p_{g1} max.	2.0	W

Typical operation

f	175	175	175	Mc/s
V_a	0.5	1.0	1.5	kV
I_a	200	200	200	mA
V_{g2}	250	250	250	V
I_{g2}	31	22	20	mA
V_{g1}	–100	–100	–100	V
I_{g1}	15	14	14	mA
p_a	40	55	65	W
p_{g2}	7.75	5.5	5.0	W
$v_{in(pk)}$	118	117	117	V
η_a	60	72.5	78	%
P_{out}	60	145	235	W
For 100% modulation				
P_{mod}	50	100	150	W

CLASS 'B' R.F. AMPLIFIER (S.S.B.)

Limiting values (absolute ratings)

f max.	500	Mc/s
V_a max.	2.0	kV
I_a max.	250	mA
V_{g2} max.	400	V
$-V_{g1}$ max.	250	V
p_a max.	250	W
p_{g2} max.	12	W

Typical operation (for two tone modulation)

The r.f. voltage is modulated by two sinusoidal a.f. signals of equal amplitude but different frequency.

f	175	175	175	Mc/s
V_a	1.0	1.5	2.0	kV
V_{g2}	315	300	300	V
V_{g1}	–44.5	–45	–47	V
R_{load}	1.85	2.9	4.2	kΩ
$I_{a(o)}$	100	75	75	mA
$I_{a(max.\ sig.)}$	180	165	160	mA
$I_{g2(o)}$	–4.0	–2.0	–1.0	mA
$I_{g2(max.\ sig.)}$	0	–5.0	–5.0	mA
I_{g1}	0	0	0	mA
$v_{in(pk)}$	44.5	45	47	V
$p_{a(max.\ sig.)}$	115	140	170	W
P_{out}	65	110	150	W
P.E.P.	130	220	300	W

QV2-250B

U.H.F. POWER TETRODE

CLASS 'AB' A.F. AMPLIFIER AND MODULATOR

Limiting values (absolute ratings)

V_a max.	2.0	kV
I_a max.	250	mA
V_{g2} max.	400	V
p_a max.	250	W
p_{g2} max.	12	W
p_{g1} max.	2.0	W
R_{g1-k} max.	100	kΩ

Typical operation (two valves)

V_a	1.0	1.5	2.0	kV
V_{g2}	350	350	350	V
V_{g1}	−55	−55	−55	V
$I_{a(o)}$	2×100	2×100	2×100	mA
$I_{a(max.\ sig.)}$	2×250	2×250	2×250	mA
$I_{g2(o)}$	2×0	2×0	2×0	mA
$I_{g2(max.\ sig.)}$	2×10	2×8.0	2×5.0	mA
$V_{in(g1\text{-}g1)\ r.m.s.}$	70.7	70.7	70.7	V
p_a	2×130	2×160	2×200	W
R_{a-a}	3.5	6.2	9.5	kΩ
η_a	48	57	60	%
P_{out}	240	430	600	W

CIRCUIT NOTES

1. All four cathode connections must be used.
2. For low frequency operation the screen-grid connection is made to pin 1. At radio frequencies the contact ring must be used for connecting the screen grid.

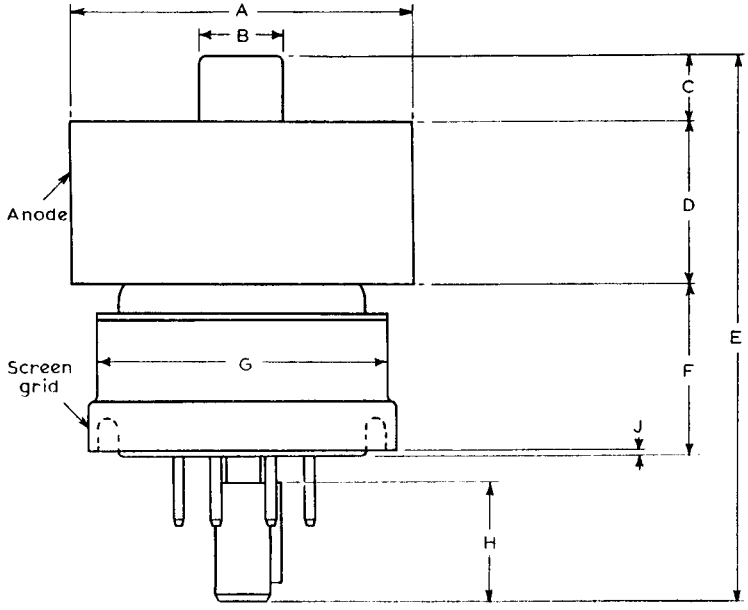
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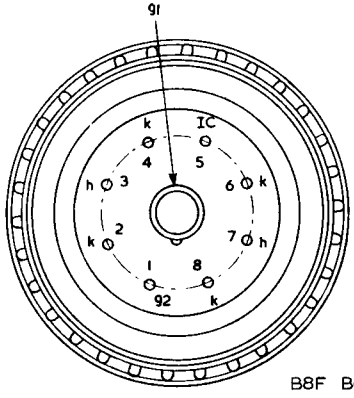
Valve only	4.3	oz
	120	g
Shipping weight	10.6	oz
	300	g

DIMENSIONS

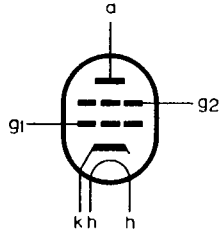
	Inches	*Millimetres*	
A	1.626±0.016	41.3±0.4	
B	0.566±0.007	14.375±0.175	
C	0.240	6.1	min.
D	0.768±0.040	19.05±1.01	
E	2.465	62.6	max.
F	0.780±0.026	19.71±0.66	
G	1.406	35.71	max.
H	0.388	9.85	max.
J	0.002	0.51	min.

QV2-250B



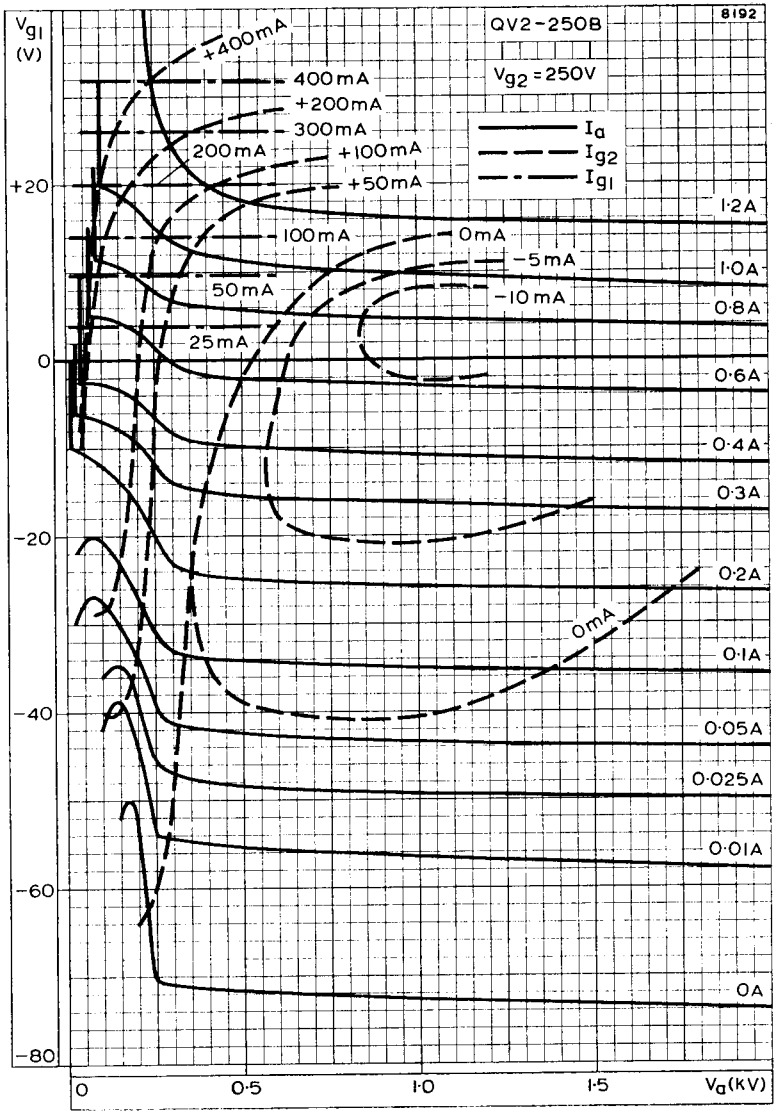


B8F Base



8193

QV2-250B



CONSTANT CURRENT CURVES

U.H.F. BEAM POWER TETRODE

QV2-250C

QUICK REFERENCE DATA

Forced-air cooled beam power tetrode suitable for use as power amplifier, oscillator, frequency multiplier and linear amplifier for s.s.b. applications. The QV2-250C is of ceramic construction.

	Class 'AB' Linear Amplifier for S.S.B. operation	Class 'C' Telephony Anode and Screen Grid Modulation	Class 'C' Telegraphy or F.M. Telephony		
f	175	175	175	500	Mc/s
P_{out}	*300	235	390	250	W
f max.	500	500		500	Mc/s
V_a max.	2.0	1.5		2.0	kV
p_a max.	250	165		250	W

*P.E.P_{out}

To be read in conjunction with

GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES

Maximum operating conditions

f	175		175		175		Mc/s
$P.E.P_{out}$	120		215		300		W
$P.E.P_{load}$	108		193		270		W
**d_3	30		29		28		dB
**d_5	35		36		35		dB
V_a	1.0		1.5		2.0		kV
V_{g2}	350		350		350		V
***$-V_{g1}$	55		55		55		V
$I_{a(o)}$	100		100		100		mA
$I_{g2(o)}$	0		0		0		mA
	Single tone	Double tone	Single tone	Double tone	Single tone	Double tone	
I_a	250	190	250	190	250	190	mA
I_{g2}	10	2.0	8.0	-1.0	5.0	2.0	mA
I_{g1}	0	-	0	-	0	-	mA
$v_{in(pk)}$	50	-	50	-	50	-	V
$P.E.P_{load}$ (driver)	1.0	1.0	1.0	1.0	1.0	1.0	W
p_a	130	-	160	-	200	-	W
η_a	48	32	57	38	60	40	%

**Third and fifth order intermodulation products. Maximum values encountered at any level of drive voltage referred to the amplitude of either of the two tones at that level.

***Adjust to give the desired value of $I_{a(o)}$.

U.H.F. BEAM POWER TETRODE

QV2-250C

CLASS 'AB' AUDIO AMPLIFIER OR MODULATOR

Maximum operating conditions for two valves in push-pull

P_{out}	240	430	600	W
R_{a-a}	3.5	6.2	9.5	kΩ
V_a	1.0	1.5	2.0	kV
V_{g2}	350	350	350	V
*$-V_{g1}$	55	55	55	V
$I_{a(o)}$	2 x 100	2 x 100	2 x 100	mA
$I_{g2(o)}$	0	0	0	mA
$I_{a(max.sig)}$	2 x 250	2 x 250	2 x 250	mA
$I_{g2(max.sig)}$	2 x 10	2 x 8.0	2 x 5.0	mA
I_{g1}	0	0	0	mA
$V_{in(g1-g1)\ pk}$	100	100	100	V
p_a	2 x 100	2 x 150	2 x 200	W
η_a	48	57	60	%

*Adjust to give the desired value of $I_{a(o)}$.

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions.

f	175	175	175	175	**500	Mc/s
P_{out}	70	190	280	390	250	W
P_{load}	60	160	240	330	225	W
η_a	56	76	75	80	50	%
V_a	0.5	1.0	1.5	2.0	2.0	kV
I_a	250	250	250	250	250	mA
V_{g2}	250	250	250	250	300	V
I_{g2}	45	38	21	19	10	mA
$-V_{g1}$	90	90	90	90	90	V
I_{g1}	35	31	28	26	25	mA
$V_{in\ (pk)}$	114	114	112	112	-	V
$P_{load\ (driver)}$	4.0	3.5	3.2	2.9	18	W
p_a	55	60	95	110	250	W
p_{g2}	12	11	9.0	7.5	-	W

**With coaxial cavity

CLASS 'C' TELEPHONY ANODE AND SCREEN-GRID MODULATION

Maximum operating conditions (Carrier conditions for 100% modulation)

f	175	175	175	Mc/s
P_{out}	60	140	235	W
P_{load}	51	120	200	W
η_a	60	70	78	%
V_a	0.5	1.0	1.5	kV
I_a	200	200	200	mA
V_{g2}	250	250	250	V
I_{g2}	31	22	20	mA
$-V_{g1}$	100	100	100	V
I_{g1}	15	14	14	mA
$v_{in(pk)}$	118	117	117	V
$P_{load\ (driver)}$	1.8	1.7	1.7	W
p_a	40	60	65	W
For 100% modulation				
P_{mod}	50	100	150	W

CLASS 'B' AMPLIFIER FOR TELEVISION SERVICE

Negative modulation, positive synchronisation

Maximum operating conditions

f	216	216	216	Mc/s
Bandwidth (-3dB)	5.0	5.0	5.0	Mc/s
P_{out} sync	160	300	440	W
P_{load} sync	140	260	385	W
V_a	1.0	1.5	2.0	kV
V_{g2}	350	350	350	V
$-V_{g1}$	60	65	70	V
$v_{in(pk)}$ sync	65	71	76	V
black	52	57	62	V
I_a sync	355	360	360	mA
black	250	250	250	mA
I_{g2} sync	27	29	29	mA
black	4.0	0	0	mA
I_{g1} sync	2.0	5.0	5.0	mA
black	0	0	0	mA
$P_{load\ (driver)}$ sync	0.4	1.2	1.2	W

U.H.F. BEAM POWER TETRODE

QV2-250C

ABSOLUTE MAXIMUM RATINGS

	Class 'AB' Amplifier for S.S.B.	Class 'AB' Amplifier	Class 'C' Telephony	Class 'C' Telegraphy or Television Service	
f max.	500	-	500	500	Mc/s
V_a max.	2.0	2.0	1.5	2.0	kV
V_{g2} max.	400	400	300	300	V
$-V_{g1}$ max.	250	250	250	250	V
I_k max.	265	265	285	340	mA
p_a max.	250	250	165	250	W
p_{g2} max.	12	12	12	12	W
I_{g1} max.	-	-	40	45	mA
p_{g1} max.	2.0	2.0	2.0	2.0	W
R_{g1-h}	25	100	25	25	kΩ
V_{h-k} max.	150	150	150	150	V

CATHODE

Indirectly heated, oxide coated

V_h	6.0	V
I_h (at V_h = 6.0V)	2.6	A
t_{hk} min.	30	s

The heater voltage should be reduced as follows:-

Up to 300Mc/s	6.0	V
300 to 400Mc/s	5.75	V
400 to 500Mc/s	5.5	V

CAPACITANCES

	g1, g2 earthed	k earthed	
c_{a-g1}	-	<60	mpF
c_{out}	4.5	4.5	pF
c_{in}	13	15.7	pF

CHARACTERISTICS

g_m (measured at V_a = 500V, V_{g2} = 250V, I_a = 200mA)	12	mA/V
μ_{g1-g2} (measured at V_{g2} = 300V, I_a = 50mA)	5.2	

MOUNTING POSITION — Any

COOLING

Forced-air

Maximum temperatures

Anode core and seals	250	°C

Air cooling must commence simultaneously with the application of heater voltage. A socket and air system chimney must be used to direct air on to the base seals, past the screen-grid seal and envelope, and through the radiator.

A typical value of air flow for maximum anode dissipation is given in the following table:

Anode dissipation	Height above sea-level	Inlet temperature	Rate of flow of air	Pressure difference between inlet and outlet
p_a	h	T_{in}		
(W)	(m)	(°C)	(m^3/min)	(mm of water)
250	0	20	0.11	6.4
			(ft^3/min)	(in of water)
			3.8	0.25

At higher altitudes or ambient temperatures the air flow required to maintain the temperature of the anode core and all seals within the permitted maximum must be increased.

PHYSICAL DATA

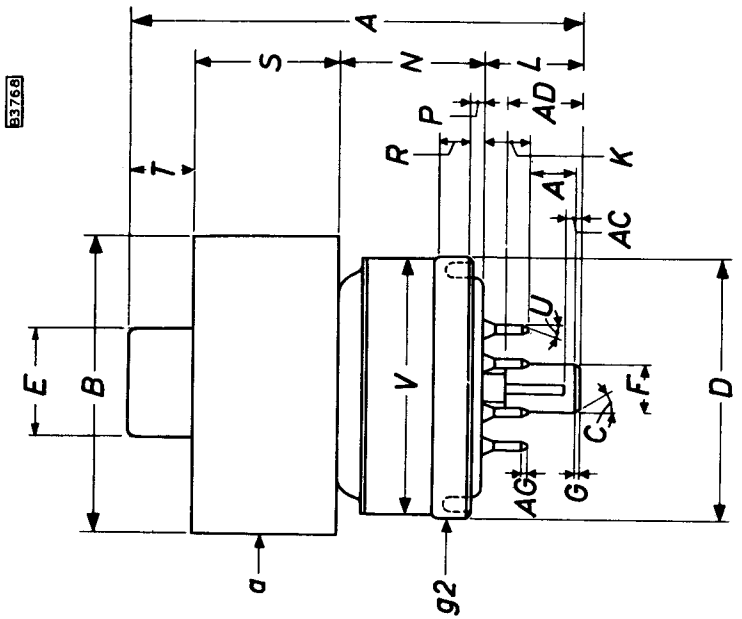
	oz	g
Weight of valve	4.2	120
Weight of valve and carton	10.6	300

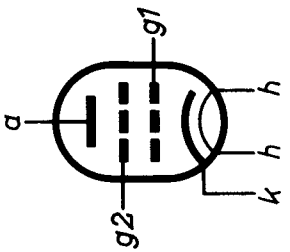
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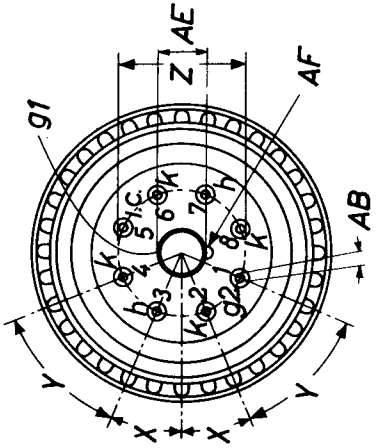
Air system socket (including air system chimney)	40222
Air system chimney	56 590 81/40

U.H.F. BEAM POWER TETRODE

QV2-250C







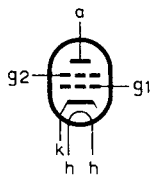
DIMENSIONS

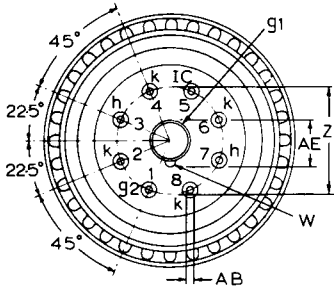
	Inches		Millimetres	
A	1.860 ± 0.049		47.245 ± 1.265	
B	1.624 ± 0.015		41.275 ± 0.375	dia.
C		30°		
D	1.424 ± 0.007		36.195 ± 0.195	dia.
E	0.568 ± 0.0068		14.375 ± 0.175	dia.
F	0.259 ± 0.0048		6.605 ± 0.125	dia.
G	0.031		0.79	typ.
H	0.340		8.65	min.
K	0.25		6.35	max.
L	0.534 ± 0.02		13.565 ± 0.505	
M	0.035		0.89	typ.
N	0.776 ± 0.026		19.71 ± 0.66	
P	0.020		0.51	typ.
R	0.187		4.75	min.
S	0.75 ± 0.039		19.05 ± 1.01	
T	0.240		6.10	typ.
U		22.5°		
V	1.405		35.7	dia.max.
W	0.043		1.09	rad.max.
X		22.5°		
Y		45°		
Z	0.688 ± 0.007		17.45 ± 0.17	dia.
AB	0.049 ± 0.003		1.245 ± 0.095	dia.
AC	0.088 ± 0.02		2.235 ± 0.505	
AD	0.461		11.58	max.
AE	0.302 ± 0.0048		7.695 ± 0.125	
AF	0.082 ± 0.003		2.085 ± 0.095	
AG	0.005		0.13	rad.min.

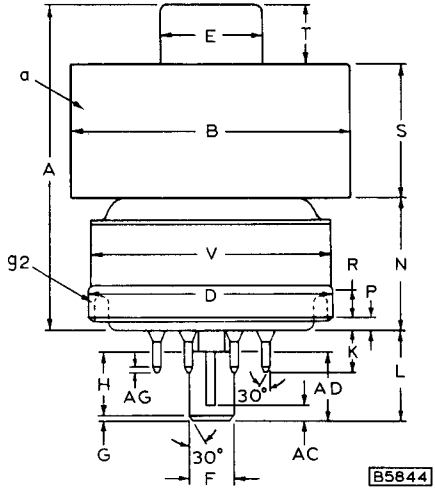
Inch dimensions derived from original millimetre dimensions

U.H.F. BEAM POWER TETRODE

QV2-250C





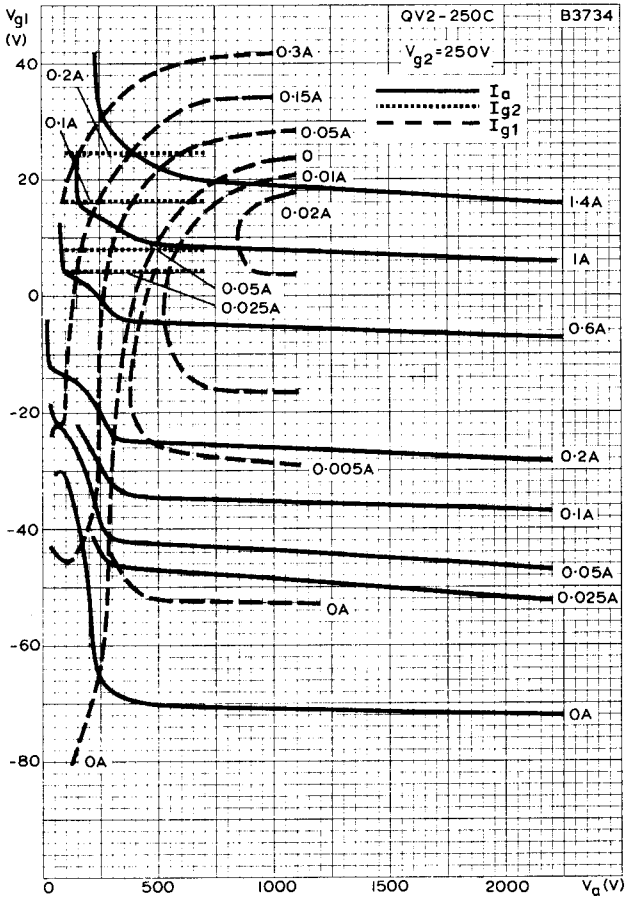


DIMENSIONS	Inches	Millimetres	
A	1.860 ± 0.050	47.25 ± 1.27	
B	1.625 ± 0.015	41.28 ± 0.38	dia.
D	1.425 ± 0.008	36.20 ± 0.02	dia.
E	$0.568^{+0.005}_{-0.009}$	$14.43^{+0.13}_{-0.23}$	dia.
F	0.260 ± 0.005	6.61 ± 0.13	dia.
G	0.031	0.79	
H	0.360	9.15	min.
K	0.250 ± 0.005	6.35 ± 0.12	
L	0.534 ± 0.020	13.56 ± 0.50	
N	0.780 ± 0.030	19.81 ± 0.76	
P	0.020	0.51	
R	0.187	4.75	min.
S	0.750 ± 0.040	19.05 ± 1.01	
T	$0.255^{+0.025}_{-0.015}$	$6.48^{+0.64}_{-0.38}$	
V	1.40	35.71	dia. max.
W	0.043	1.09	rad. max.
Z	0.687 ± 0.007	17.45 ± 0.17	dia.
AB	$0.050^{+0.003}_{-0.005}$	$1.27^{+0.08}_{-0.13}$	dia.
AC	0.088 ± 0.020	2.23 ± 0.50	
AD	0.456	11.58	max.
AE	0.303 ± 0.005	7.70 ± 0.13	
AG	0.005	0.13	rad. min.

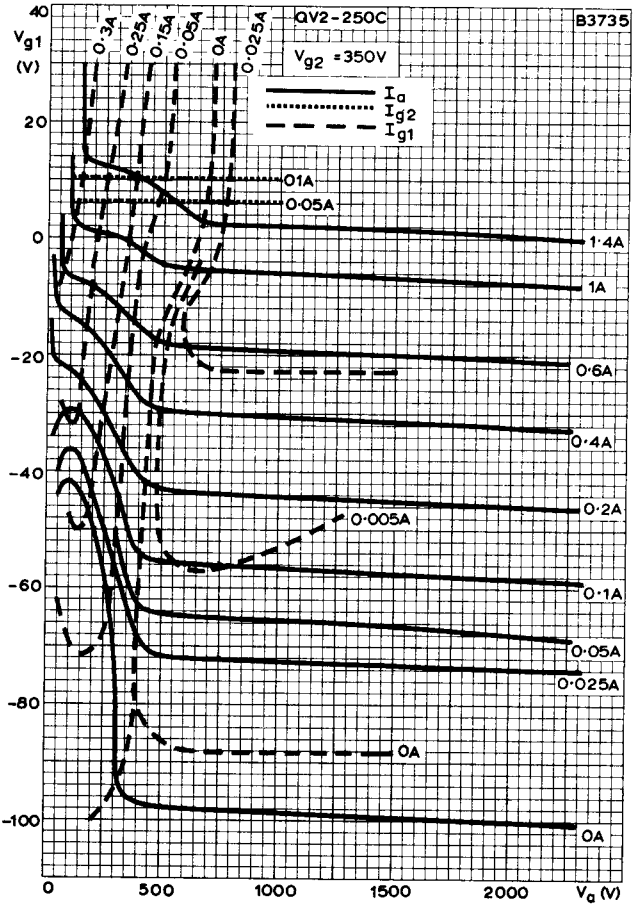
Millimetre dimensions derived from original inch dimensions

U.H.F. BEAM POWER TETRODE

QV2-250C



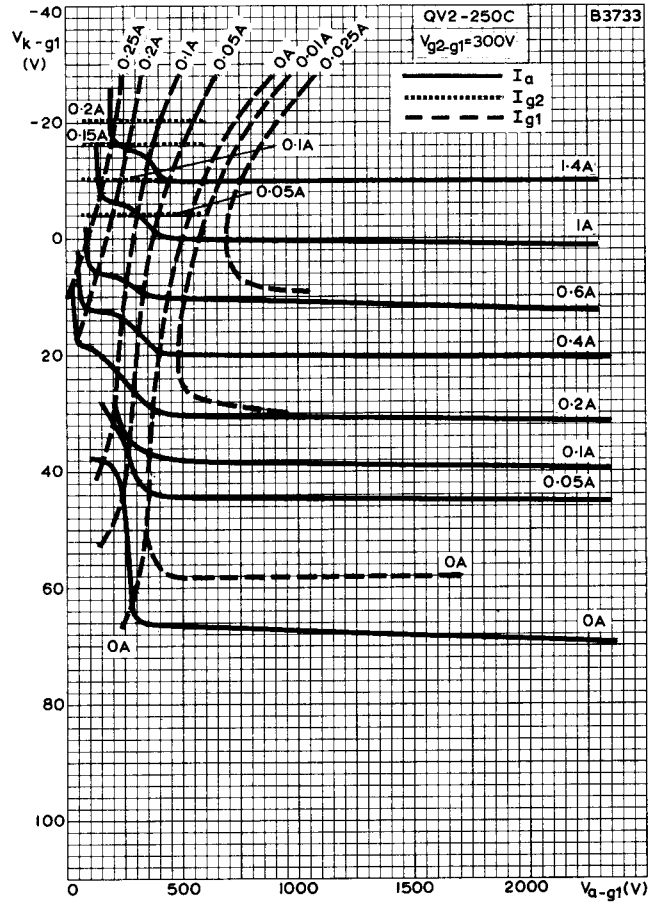
CONSTANT CURRENT CHARACTERISTICS. V_{g2} = 250V



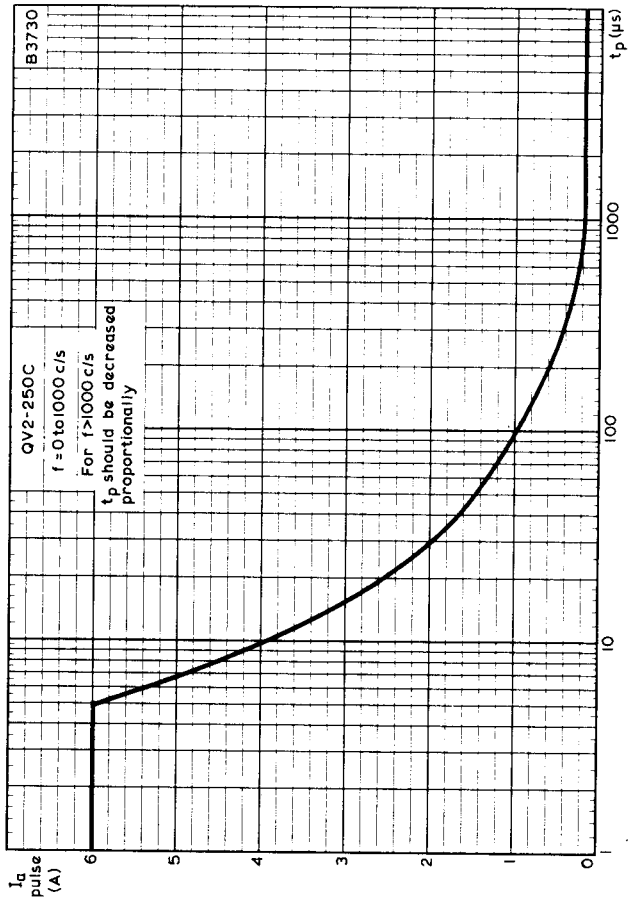
CONSTANT CURRENT CHARACTERISTICS. V_{g2} = 350V

U.H.F. BEAM POWER TETRODE

QV2-250C



CONSTANT CURRENT CHARACTERISTICS. Vg2-g1 = 300V
(COMMON GRID)



MAXIMUM PULSE ANODE CURRENT PLOTTED AGAINST PULSE TIME

TETRODE

QV08-100

Application: *R.F. amplifier, suitable for single side-band applications.*
Power output: *200W.*
Frequency: *30Mc/s at full ratings.*
Construction: *Glass, natural cooling.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

CATHODE

Indirectly heated

V_h	6.3	V
I_h	3.9	A

MOUNTING POSITION

Vertical, or horizontal with plane of anode vertical

CAPACITANCES

c_{a-g1}	<900	mpF
c_{g1-k}	30	pF
c_{a-k}	12.7	pF

CHARACTERISTICS (measured at $V_a = 750V$, $V_{g2} = 250V$, $I_a = 100mA$)

g_m	9.0	mA/V
μ_{g1-g2}	5.7	

COOLING

Natural cooling

T_{bulb} max.	300	°C
$T_{anode\ seal}$ max.	220	°C
T_{pins} max.	180	°C

WEIGHT

Valve only	8	oz
	220	g
Shipping weight	15	oz
	400	g

ACCESSORIES

Base socket	40211/01
Anode cap	40619

QV08-100

TETRODE

CLASS 'C' TELEGRAPHY

Limiting values (absolute ratings)

f max.	30	Mc/s
V_a max.	825	V
I_k max.	450	mA
$i_{k(pk)}$ max.	2.1	A
V_{g2} max.	300	V
$-V_{g1}$ max.	150	V
I_{g1} max.	30	mA
p_a max.	100	W
p_{g2} max.	12	W
R_{g1-k} max.	25	kΩ
V_{h-k} max.	125	V

Operating conditions

f	⩽30	Mc/s
V_a	750	V
I_a	385	mA
V_{g2}	250	V
I_{g2}	20	mA
V_{g1}	−90	V
I_{g1}	7.0	mA
p_a	85	W
$v_{in(pk)}$	120	V
$P_{load(driver)}$	2.5	W
η_a	70	%
P_{out}	200	W
P_{load} ($\eta_{transfer}$ = 85%)	170	W

CLASS 'C' ANODE AND SCREEN GRID MODULATION

Limiting values (absolute ratings)

Carrier condition for a modulation factor of 1

f max.	30	Mc/s
V_a max.	650	V
i_k max.	380	mA
$i_{k(pk)}$ max.	1.8	A
V_{g2} max.	300	V
$-V_{g1}$ max.	150	V
I_{g1} max.	30	mA
p_a max.	67	W
p_{g2} max.	10	W
R_{g1-k} max.	25	kΩ
V_{h-k} max.	125	V

Operating conditions

f	⩽30	Mc/s
V_a	600	V
I_a	300	mA
V_{g2}	250	V
I_{g2}	20	mA
V_{g1}	–100	V
I_{g1}	4.0	mA
p_a	50	W
p_{g2}	5.0	W
$v_{in(pk)}$	110	V
$P_{load(driver)}$	3.0	W
η_a	72	%
P_{out}	130	W
P_{load} ($\eta_{transfer}$ = 85%)	110	W

For 100% modulation

$P_{mod.}$	92	W
$v_{g2(pk)}$	220	V

CLASS 'B' R.F. AMPLIFIER (S.S.B.)

Limiting values (absolute ratings)

f max.	30	Mc/s
V_a max.	825	V
I_k max.	430	mA
V_{g2} max.	350	V
p_a max.	100	W
p_{g2} max.	12	W
R_{g1-k} max.	25	kΩ
V_{h-k} max.	125	V

Operating conditions (for two tone modulation)

The r.f. voltage is modulated by two sinusoidal a.f. signals of equal strength but different frequency.

f	⩽30	Mc/s
V_a	750	V
V_{g2}	310	V
*V_{g1}	−45	V
$I_{a(o)}$	130	mA
$I_{a\ (max.\ sig.)}$	270	mA
$I_{g2(o)}$	<5.0	mA
$I_{g2\ (max.\ sig.)}$ approx.	26	mA
I_{g1}	0	mA
†$V_{in(pk)}$	45	V
$P_{a\ (max.\ sig.)}$	90	W
$P_{g2\ (max.\ sig.)}$	8.0	W
η_a	55	%
P_{out} (two tone)	110	W
P.E.P.	220	W

*To be adjusted for $I_{a(o)}$ = 130mA

†To be adjusted for I_{g1} = 0mA

QV08-100

CLASS 'B' A.F. AMPLIFIER AND MODULATOR

Limiting values (absolute ratings)

V_a max.	825	V
I_k max.	430	mA
$i_{k(pk)}$ max.	600	mA
V_{g2} max.	300	V
$-V_{g1}$ max.	150	V
I_{g1} max.	30	mA
p_a max.	100	W
p_{g2} max.	12	W
R_{g1-k} max.	25	kΩ
V_{h-k} max.	125	V

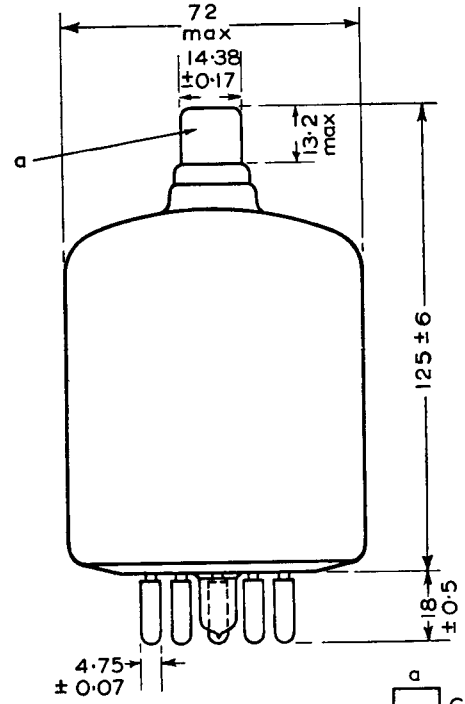
Operating conditions (two valves)

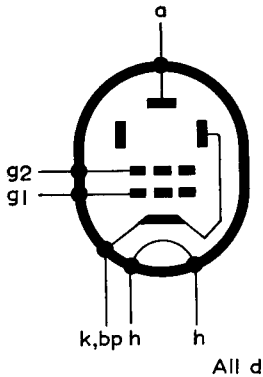
V_a	750	600	V
V_{g2}	250	250	V
V_{g1}	−45	−45	V
$I_{a(o)}$	2 × 45	2 × 25	mA
$I_{a\ (max.\ sig.)}$	2 × 280	2 × 235	mA
$I_{g2(o)}$	0	2 × 500	μA
$I_{g2\ (max.\ sig.)}$	2 × 40	2 × 24	mA
$I_{g1\ (max.\ sig.)}$	2 × 1.0	2 × 0.5	mA
$V_{in(g1-g1)r.m.s.}$	78	74	V
p_a	2 × 60	2 × 40	W
R_{a-a}	3.6	3.5	kΩ
η_a	71.5	71.5	%
P_{out}	300	200	W
D_{tot}	6.5	5.0	%

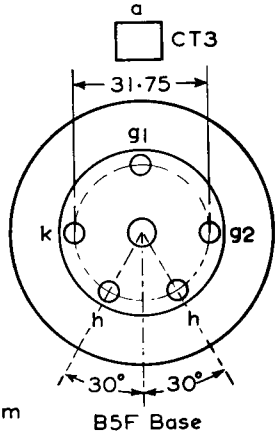
QV08-100

TETRODE

6298



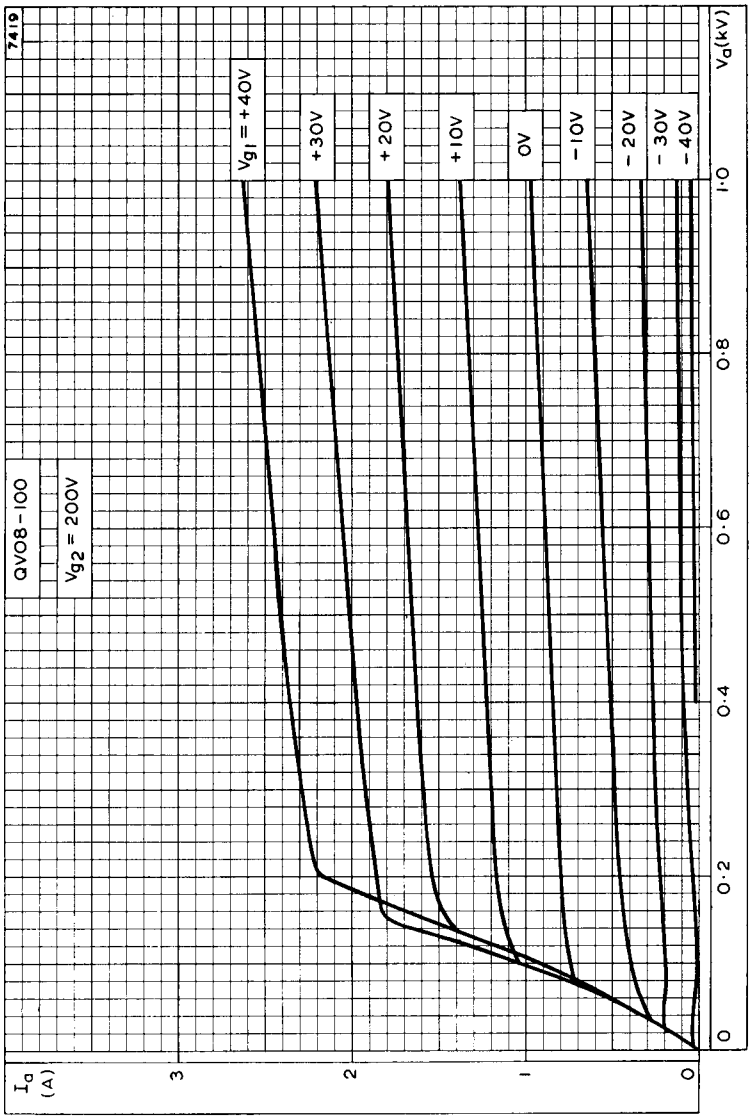




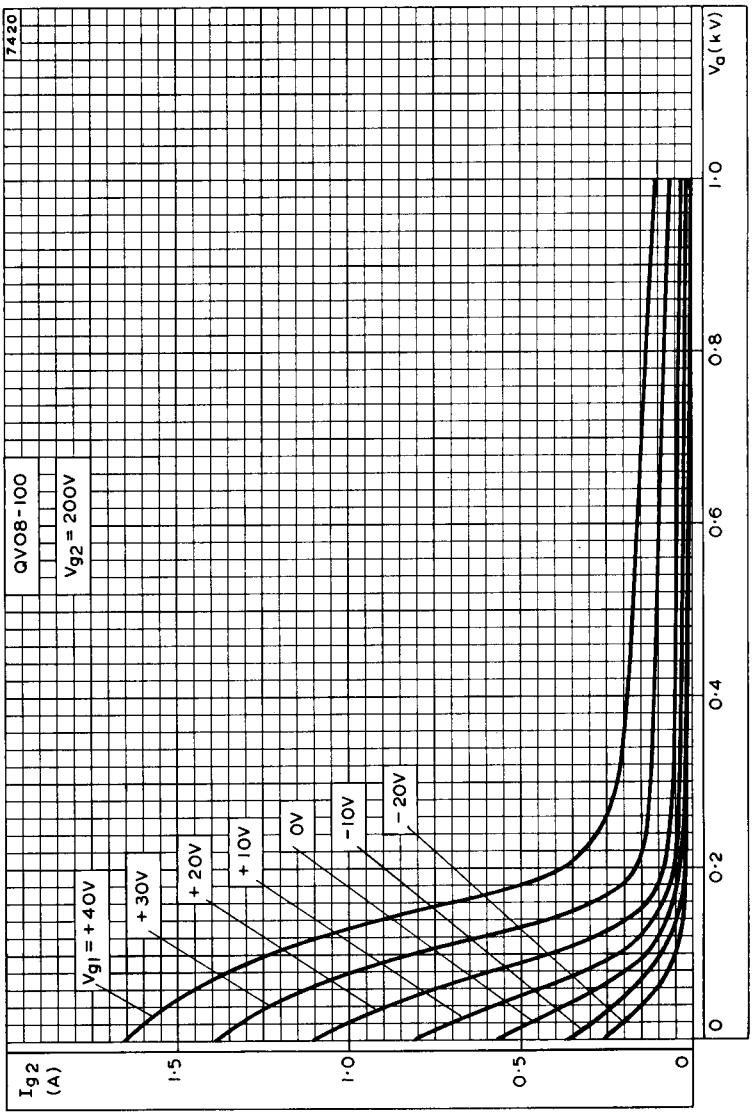
All dimensions in mm

B5F Base

QV08-100

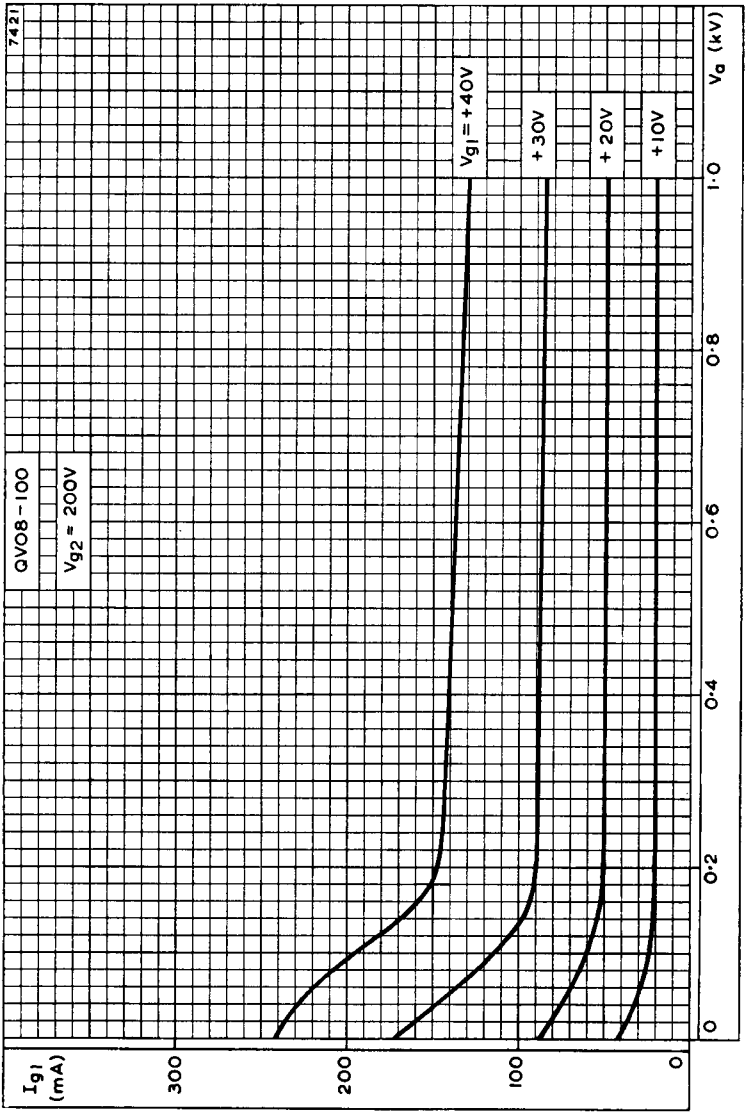


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

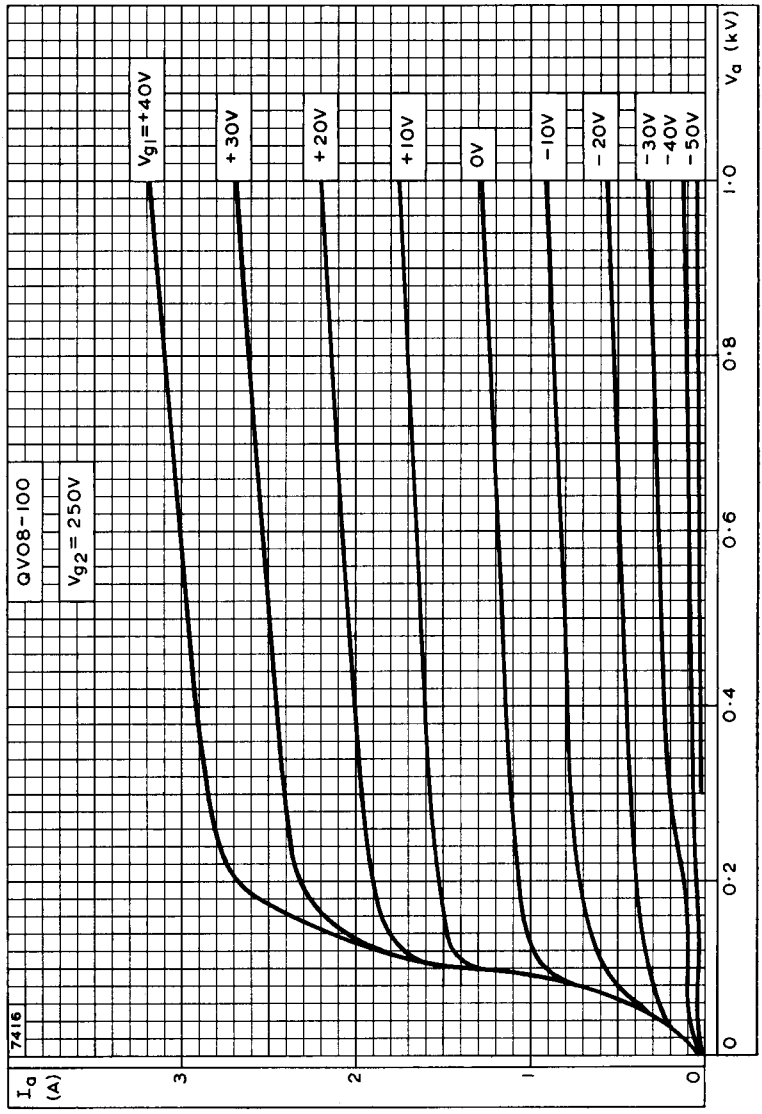


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

QV08-100

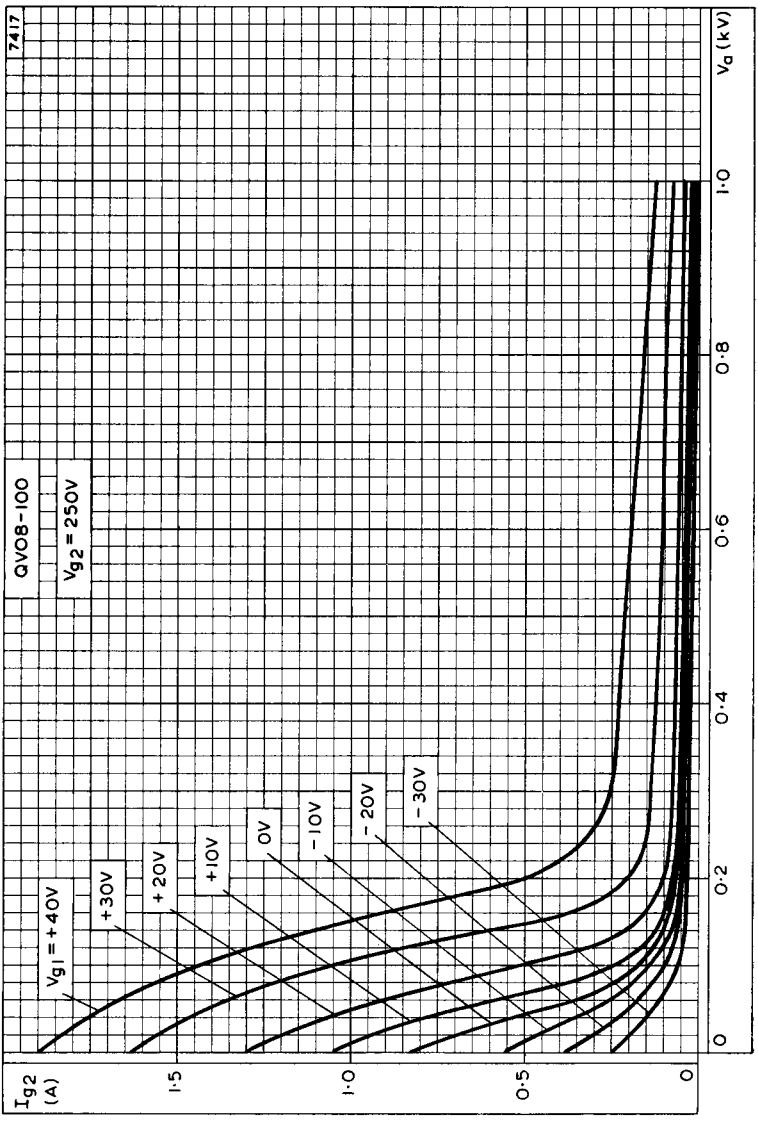


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V

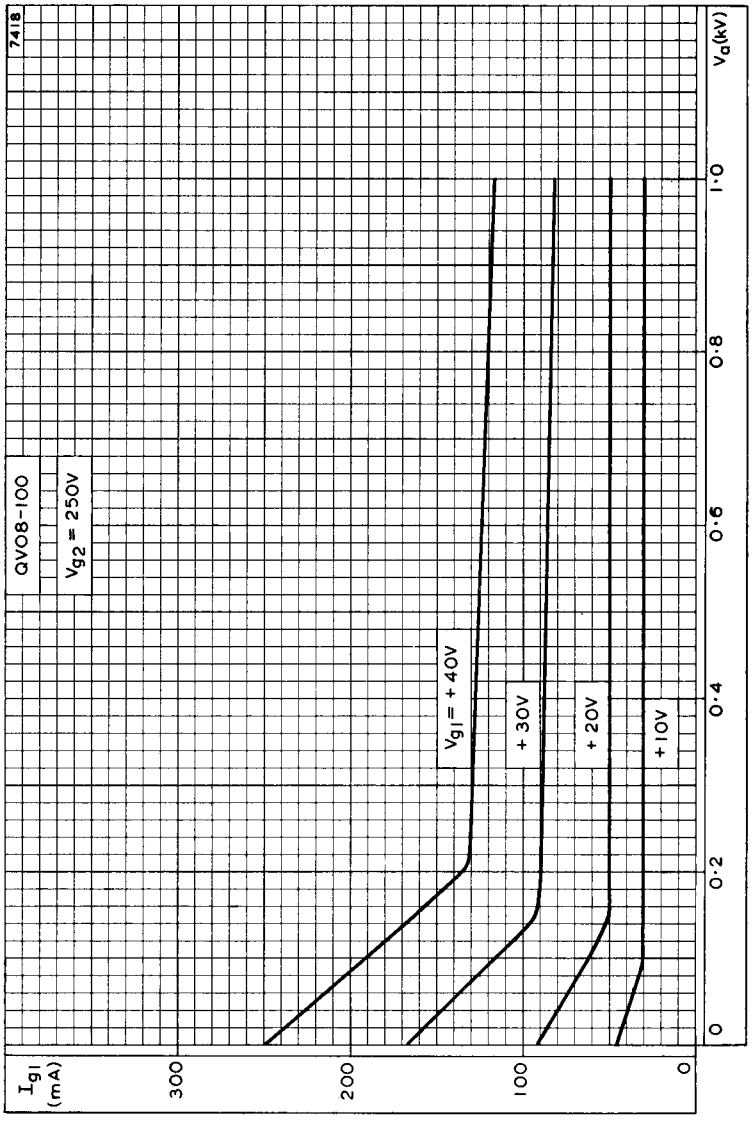


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

QV08-100

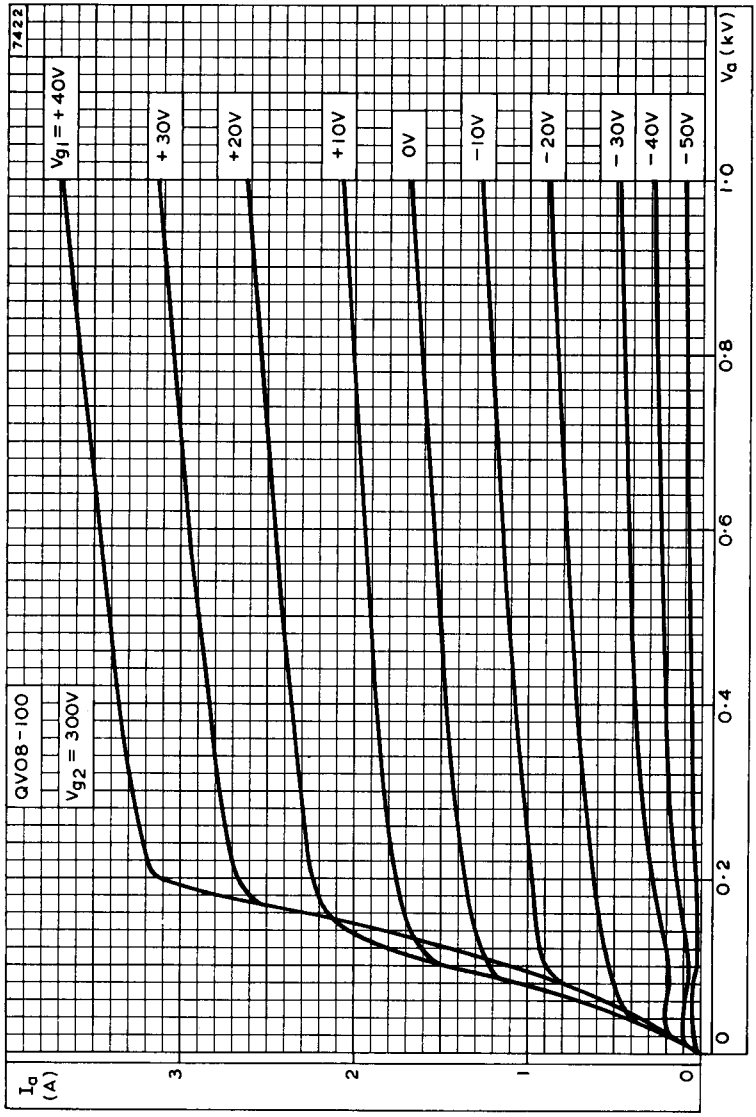


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

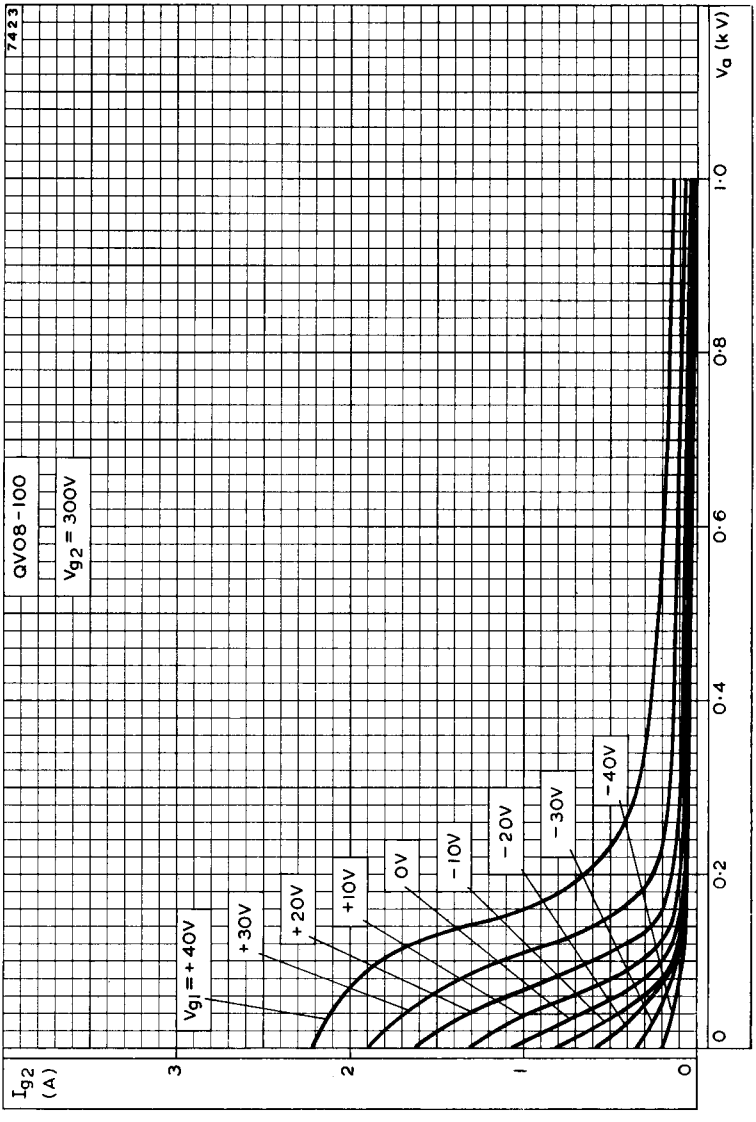


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

QV08-100

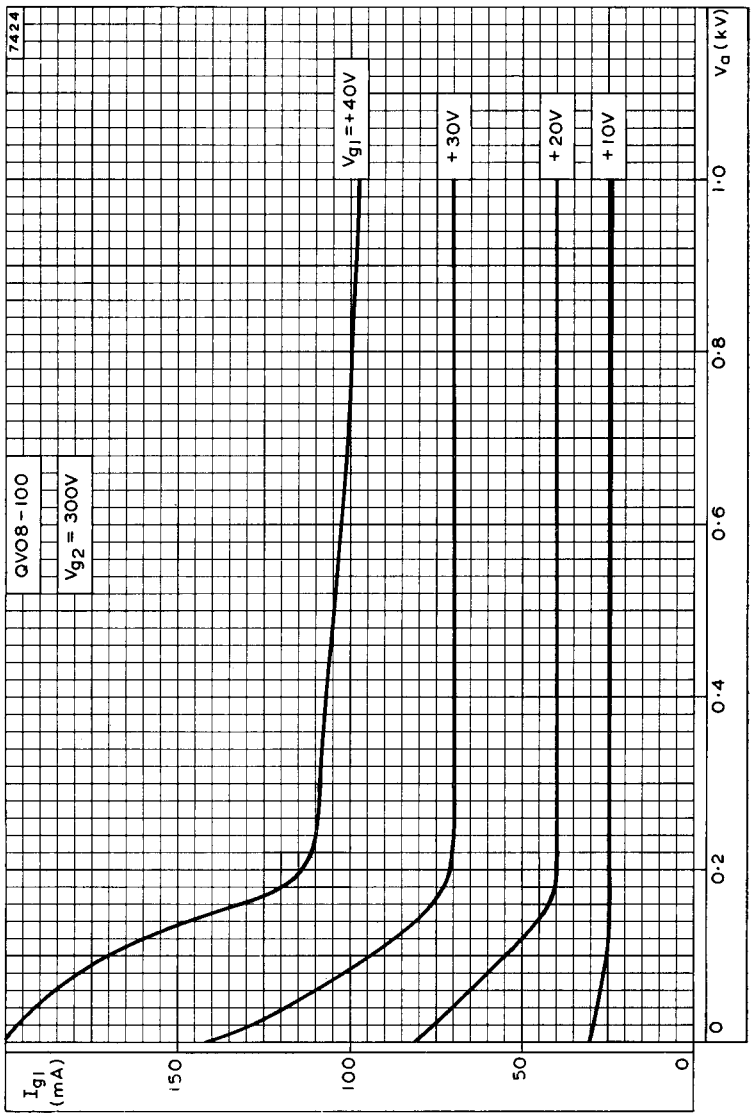


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V

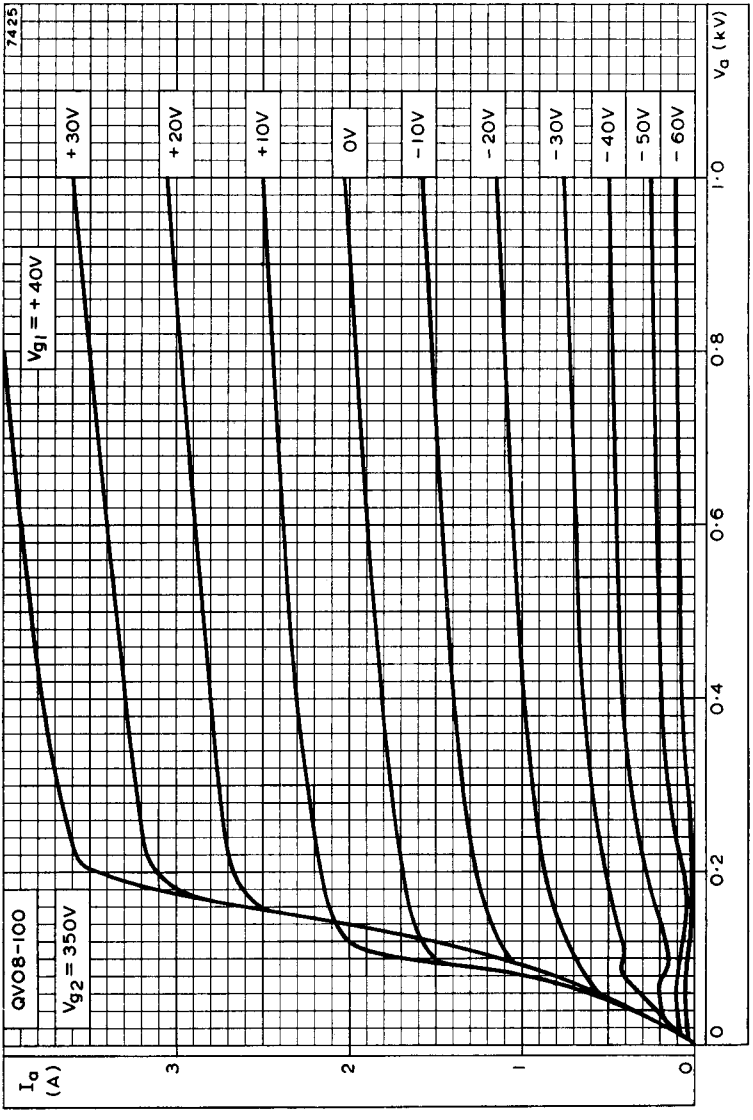


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V

QV08-100

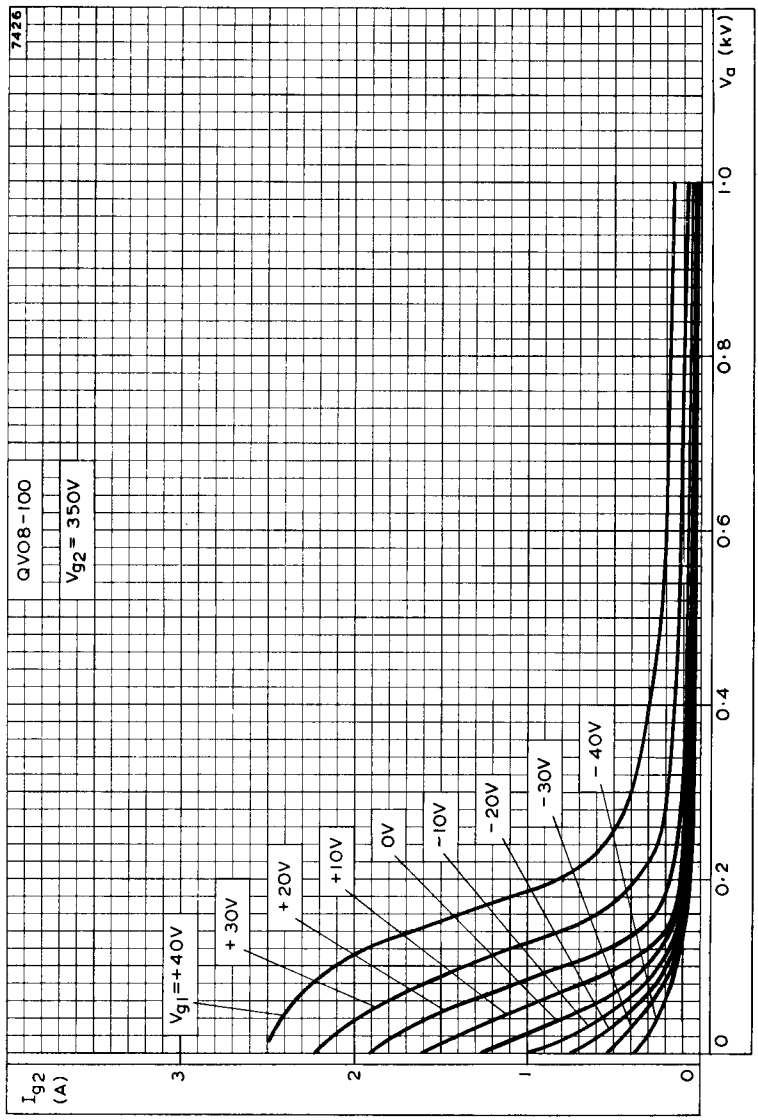


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V

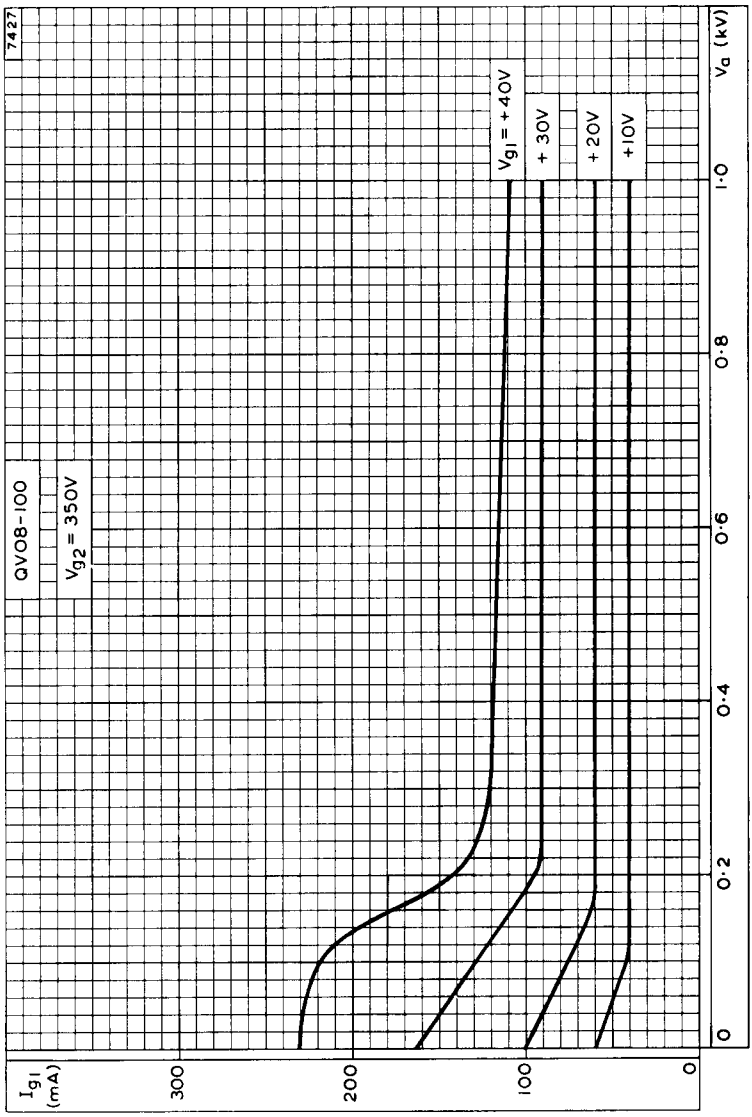


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 350V

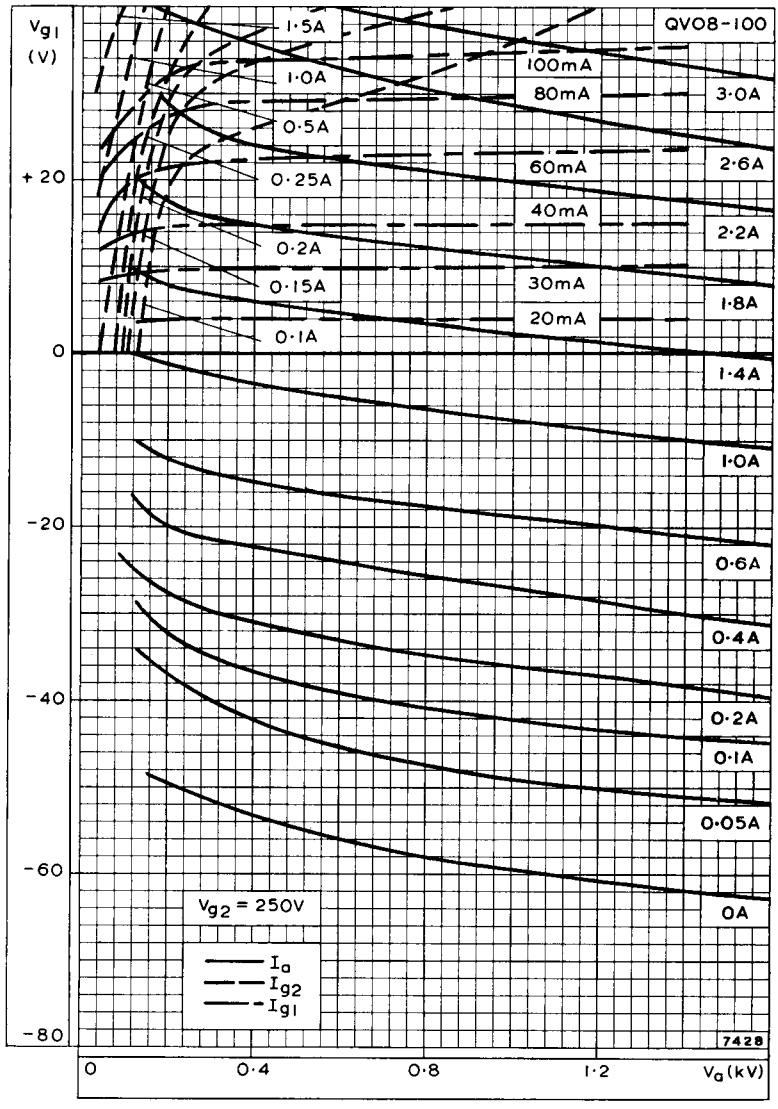
QV08-100



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 350V



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 350V



CONSTANT CURRENT CURVES

V.H.F. POWER TETRODE

QY3-65

All glass tetrode rated for a maximum anode dissipation of 65W and suitable for use at frequencies up to 250Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with "Operating Notes, Part 1—Power Valves" included in this volume of the Handbook.

FILAMENT Thoriated tungsten.

V_f	6.0	V
I_f	3.5	A

MOUNTING POSITION Vertical, base up or down.

CAPACITANCES

c_{in}	8.0	pF
c_{out}	2.1	pF
c_{a-g1}	0.08	pF

CHARACTERISTICS (measured at V_a=500V; V_{g2}=250V; I_a=125mA)

g_m	4.0	mA/V
μ_{g1-g2}	5.0	

COOLING

Max. temperature of anode seals and envelope 225 °C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the anode seal and the base of the valve when operated at frequencies above 50Mc/s. The air stream on to the base should be directed so that it passes over the envelope. Below 50Mc/s radiation cooling from the envelope is sufficient but an anode terminal connector of large surface area is necessary in order to keep the anode seal cool.

ACCESSORIES

Information on these items can be obtained from the Industrial Technical Service Dept., Mullard Ltd.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	3.0	kV
p_a max.	65	W
V_{g2} max.	400	V
p_{g2} max.	10	W
p_{g1} max.	5.0	W
I_k max.	230	mA
$i_{k(pk)}$ max.	1.2	A
$-V_{g1}$ max.	500	V
R_{g1-f} max.	25	kΩ

QY3-65

V.H.F. POWER TETRODE

All glass tetrode rated for a maximum anode dissipation of 65W and suitable for use at frequencies up to 250Mc/s.

Typical Operating Conditions

f	≦50	≦50	≦50	≦220	Mc/s
V_a	600	1500	3000	1500	V
V_{g2}	250	250	250	250	V
V_{g1}	−75	−85	−100	−85	V
I_a	150	150	115	117	mA
I_{g2}	40	40	22	35	mA
I_{g1}	18	18	10	20	mA
$v_{in\ (pk)}$	170	180	170	190	V
*P_{drive} (approx)	4.0	4.0	3.0	10	W
p_a	45	60	65	65	W
P_{out}	45	165	280	110	W
†P_{load}	36	130	224	88	W
η	50	73	81	63	%

*Includes typical fixed frequency grid circuit loss.

†With a circuit transfer efficiency of 80%.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY. ANODE AND SCREEN-GRID MODULATION)

Limiting Values (carrier condition)

V_a max.	2.5	kV
p_a max.	45	W
V_{g2} max.	400	V
p_{g2} max.	10	W
p_{g1} max.	5.0	W
I_k max.	190	mA
$i_{k(pk)}$ max.	1.0	A
$-V_{g1}$ max.	500	V
R_{g1-t} max.	25	kΩ

Typical Operating Conditions

f	≦50	≦50	≦50	≦220	Mc/s
V_a	600	1500	2500	1500	V
V_{g2}	250	250	250	250	V
V_{g1}	−120	−125	−135	−85	V
I_a	120	120	110	80	mA
I_{g2}	40	40	25	27	mA
$v_{in(pk)}$	215	220	215	185	V
I_{g1}	15	16	12	12	mA
*P_{drive}	4.0	4.5	3.5	10	W
p_a	27	40	45	45	W
P_{out}	45	140	230	75	W
†P_{load}	36	112	185	60	W
η	62	62	84	63	%
For 100% Modulation					
$v_{g2(pk)\ mod.}$	250	250	250	250	V
$P_{mod.}$	36	90	125	60	W

*Includes typical fixed frequency grid circuit loss.

†With a circuit transfer efficiency of 80%.

V.H.F. POWER TETRODE

QY3-65

All glass tetrode rated for a maximum anode dissipation of 65W and suitable for use at frequencies up to 250Mc/s.

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL AS CLASS "AB" A.F. POWER AMPLIFIER OR MODULATOR

Limiting Values (per valve)

V_a max.	3.0	kV
p_a max.	65	W
V_{g_2} max.	600	V
p_{g_2} max.	10	W
p_{g_1} max.	5.0	W
I_k max.	220	mA
$i_{k(pk)}$ max.	750	mA
R_{g_1-f} max.	250	k Ω

Typical Operating Conditions (Without I_{g_1})

V_a	1.0	1.5	1.75	kV
V_{g_2}	500	500	500	V
V_{g_1}	−100	−110	−115	V
$I_{a(o)}$	2×30	2×30	2×20	mA
I_a (max. sig.)	2×85	2×90	2×85	mA
I_{g_2} (max. sig.)	2×15	2×10	2×11.5	mA
$V_{in(g_1-g_1)(r.m.s.)}$	120	120	128	V
p_a	2×45	2×63	2×62	W
P_{out}	80	145	175	W
R_{a-a}	9.0	15	20	k Ω
η	47	54	59	%

Typical Operating Conditions (With I_{g_1})

V_a	600	1000	1500	1800	V
V_{g_2}	250	250	250	250	V
V_{g_1}	−40	−40	−45	−50	V
$I_{a(o)}$	2×30	2×30	2×30	2×25	mA
I_a (max. sig.)	2×150	2×150	2×125	2×110	mA
I_{g_2} (max. sig.)	2×40	2×30	2×20	2×15	mA
I_{g_1} (max. sig.)	2×15	2×14	2×10	2×9.0	mA
$V_{in(g_1-g_1)(r.m.s.)}$	170	148	141	127	V
P_{drive}	2×4.0	2×3.0	2×3.8	2×2.6	W
p_a	2×45	2×65	2×63	2×63	W
P_{out}	90	170	250	270	W
R_{a-a}	3.6	6.8	14	20	k Ω
η	50	57	67	68	%

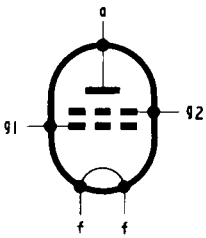
WEIGHT

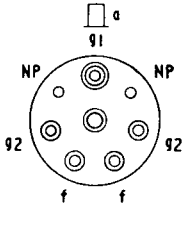
Valve only	3	oz
	85	g

QY3-65

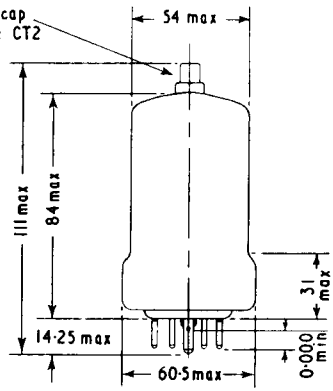
V.H.F. POWER TETRODE

All glass tetrode rated for a maximum anode dissipation of 65W and suitable for use at frequencies up to 250Mc/s.





B7A Base



1882

All dimensions in mm

V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

This data should be read in conjunction with " Operating Notes, Part 1—Power Valves " included in this volume of the Handbook.

FILAMENT Thoriated tungsten.

V_f	5.0	V
I_f	6.5	A

MOUNTING POSITION Vertical, base up or down.

CAPACITANCES

c_{in}	10.8	μμF
c_{out}	3.1	μμF
c_{a-g1}	0.05	μμF

CHARACTERISTICS (At V_a=2.5 kV, V_{g2}=350 V, I_a=40 mA)

g_m	2.2	mA/V
μ_{g1-g2}	6.2	

COOLING

Maximum temperature of anode seal	220	°C
Maximum temperature of base pins	180	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the anode seal and the base of the valve at frequencies above 50 Mc/s. The air stream on to the base should be directed so that it also passes over the envelope. Below 50 Mc/s, radiation cooling of the envelope is sufficient, but an anode terminal connector of large surface area is necessary in order to keep the anode seal cool.

OPERATION AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS " C " TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	3.0	kV
p_a max. (corresponding to an anode temperature of 850°C, *i.e.*, red heat)	125	W
I_k max.	300	mA
$i_{k(pk)}$ max.	1.6	A
V_{g2} max.	400	V
p_{g2} max.	20	W
p_{g1} max.	5.0	W
$-V_{g1}$ max.	500	V
I_{g1} max.	15	mA

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

Typical Operating Conditions at f ≤120 Mc/s.

V_a	2.0	2.5	3.0	kV
V_{g2}	350	350	350	V
V_{g1}	−100	−150	−150	V
I_a	200	200	167	mA
I_{g2}	50	40	30	mA
I_{g1}	9.0	9.0	6.5	mA
$v_{in(pk)}$	260	330	300	V
P_{drive}	2.4	3.0	2.0	W
p_a	125	125	125	W
p_{g2}	17.5	14	10.5	W
P_{out}	275	375	375	W
*P_{load}	220	300	300	W
η	69	75	75	%

* With a circuit transfer efficiency of 80%.

OPERATION AS SINGLE VALVE R.F. POWER AMPLIFIER (Class " B " Telephony)

Limiting Values

V_a max.	3.0	kV
p_a max. (corresponding to an anode temperature of 850°C, *i.e.*, red heat)	125	W
I_k max.	120	mA
$i_{k(pk)}$ max.	350	mA
V_{g2} max.	400	V
p_{g2} max.	14	W

Typical Operating Conditions at f ≤120 Mc/s.

V_a	2.0	2.5	3.0	kV
V_{g2}	350	350	350	V
V_{g1}	−50	−50	−50	V
I_a	83	70	60	mA
I_{g2}	1.5	1.0	1.0	mA
$v_{in(pk)}$	65	55	50	V
p_a	112	120	122	W
p_{g2}	0.52	0.35	0.35	W
P_{out}	54	55	58	W
*P_{load}	43	45	46	W
η	32.5	31.5	32	%
For 100% modulation				
I_{g1}	4.0	4.0	4.5	mA
P_{drive}	0.52	0.44	0.45	W

* With a circuit transfer efficiency of 80%.

V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

OPERATION AS SINGLE VALVE R.F. POWER AMPLIFIER CLASS "C" TELEPHONY (Anode and Screen Grid Modulated)

Limiting Values

V_a max.	2.5	kV
p_a max.	83	W
I_k max.	200	mA
$i_{k(pk)}$ max.	2.0	A
V_{g_2} max.	400	V
p_{g_2} max.	20	W
$-V_{g_1}$ max.	500	V
I_{g_1} max.	15	mA

Typical Operating Conditions at f ≤120 Mc/s.

V_a	2.0	2.5	kV
V_{g_2}	350	350	V
V_{g_1}	−220	−210	V
I_a	150	152	mA
I_{g_2}	33	30	mA
I_{g_1}	5.0	4.5	mA
P_{drive}	2.0	1.7	W
$v_{in(pk)}$	390	380	V
p_a	75	80	W
p_{g_2}	11.5	10.5	W
P_{out}	225	300	W
*P_{load}	180	240	W
η	75	79	%
For 100% modulation			
P_{mod}	150	190	W
$v_{g2(pk)\ mod.}$	300	300	V

* With a circuit transfer efficiency of 80%.

OPERATION OF TWO VALVES IN PUSH-PULL AS CLASS "B" A.F. POWER AMPLIFIER OR MODULATOR

Limiting Values

V_a max.	3.0	kV
p_a max. (corresponding to an anode temperature of 850°C, *i.e.*, red heat)	125	W
I_k max.	320	mA
$i_{k(pk)}$ max.	1.0	A
V_{g_2} max. ($I_{g_1}=0$)	600	V
V_{g_2} max. ($I_{g_1}>0$)	400	V
p_{g_2} max.	20	W
$-V_{g_1}$ max.	500	V
R_{g_1-k} max.	150	kΩ

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

Typical Operating Conditions (Without I_{g1})

V_a	1.5	2.0	2.5	kV
V_{g2}	600	600	600	V
V_{g1}	−94	−96	−97	V
$I_{a(o)}$	2×30	2×30	2×30	mA
I_a (max. sig.)	2×109	2×111	2×108	mA
I_{g2} (max. sig.)	2×13.5	2×12	2×13	mA
$V_{in(g-g)\ (r.m.s.)}$	130	132	134	V
p_a	2×78	2×92	2×95	W
P_{out}	170	260	345	W
R_{a-a}	12	17.6	25	kΩ
η	52	58.5	64	%
D_{tot}	3.5	3.6	4.0	%

Typical Operating Conditions (With I_{g1})

V_a	1.5	2.0	2.5	kV
V_{g2}	350	350	350	V
V_{g1}	−48	−50	−51	V
$I_{a\ (o)}$	2×30	2×30	2×30	mA
I_a (max. sig.)	2×225	2×197	2×151	mA
I_{g2} (max. sig.)	2×42	2×32	2×18	mA
I_{g1}	2×16	2×12	2×8.5	mA
$V_{in\ (g-g)\ (r.m.s.)}$	234	210	170	V
P_{drive}	2×2.4	2×1.6	2×0.9	W
p_a	2×114	2×120	2×103	W
P_{out}	455	550	550	W
R_{a-a}	7.2	12	20	kΩ
η	66.5	69.5	72.5	%
D_{tot}	5.0	5.0	5.0	%

CIRCUIT NOTES

1. The R.F circuit returns must be brought to the filament connection on Pin No. 1.

2. To ensure equal distribution of the currents through the seals the screen-grid leads should be strapped together at the valve holder and the circuit connections joined to the midpoint of the strap. This should not be allowed to impair the free flotation of individual contacts.

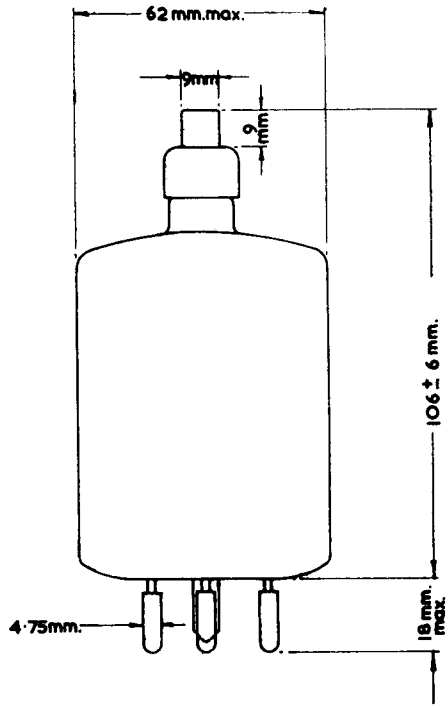
WEIGHT

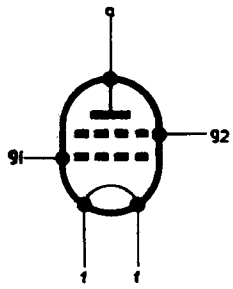
Valve only { 3.5 ozs / 100 g

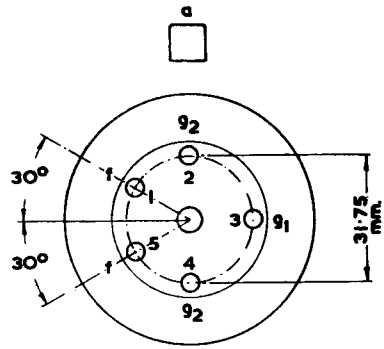
V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.





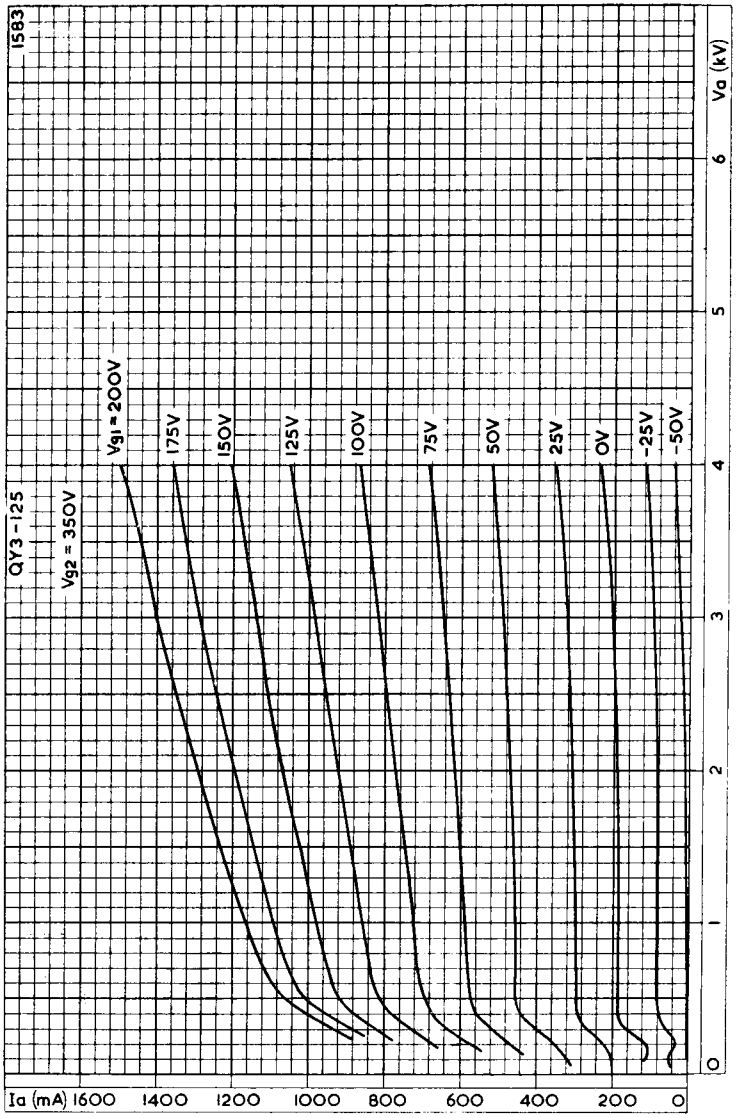


B5F Base. 1606

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

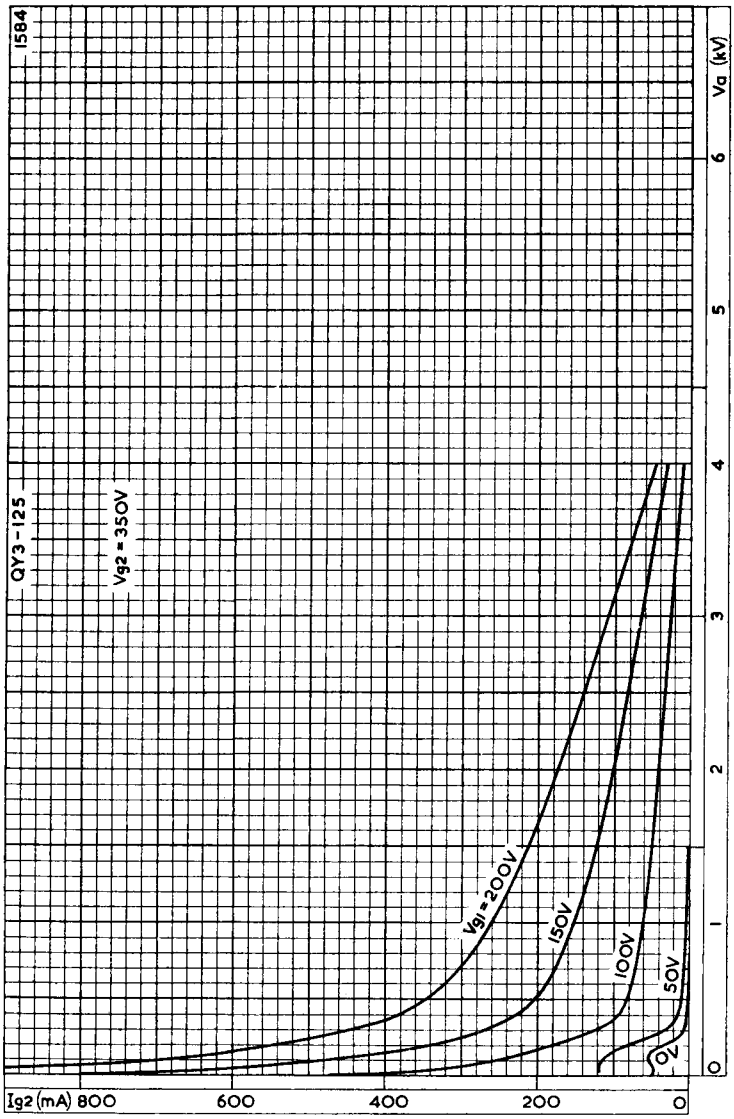


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE = 350 V

V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE = 350V

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

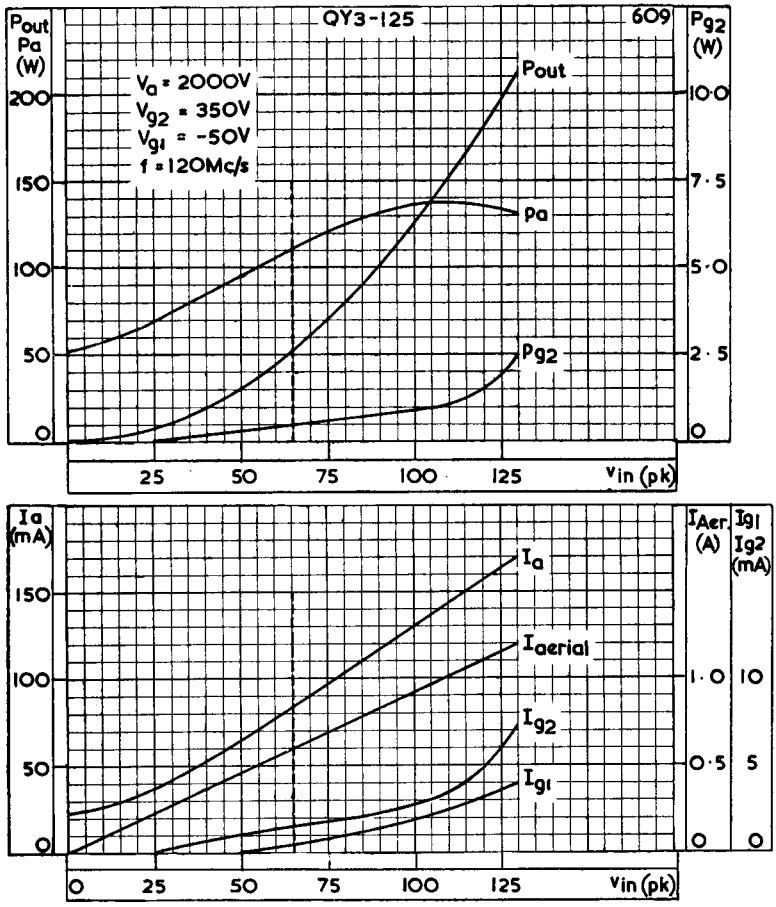


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE OF 350 V

V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

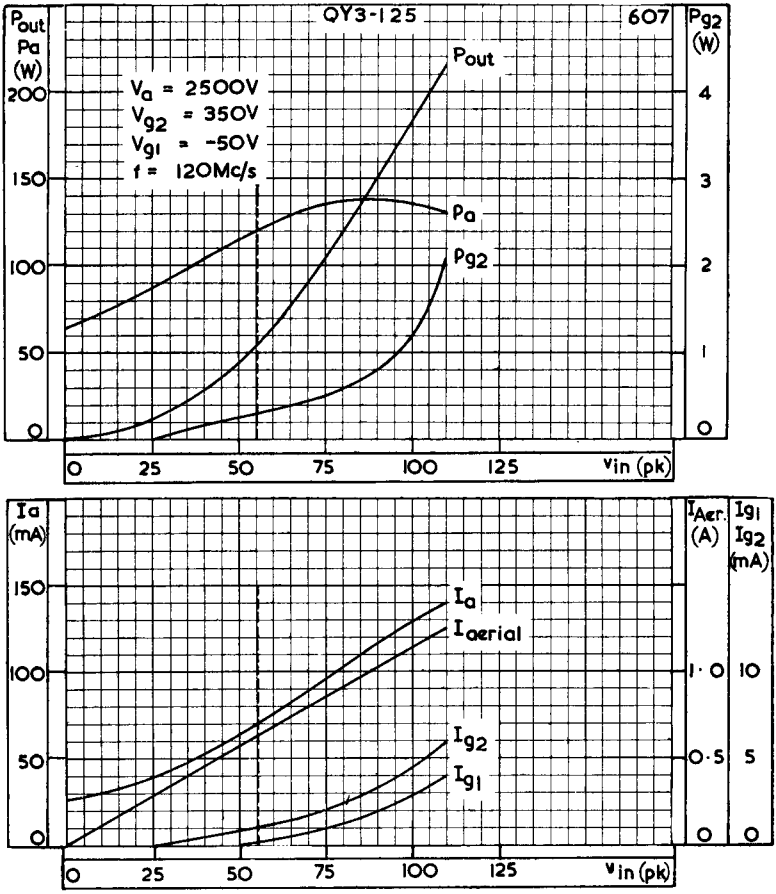


OPERATING CHARACTERISTICS FOR CLASS "B" TELEPHONY
AT V_a=2 kV

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

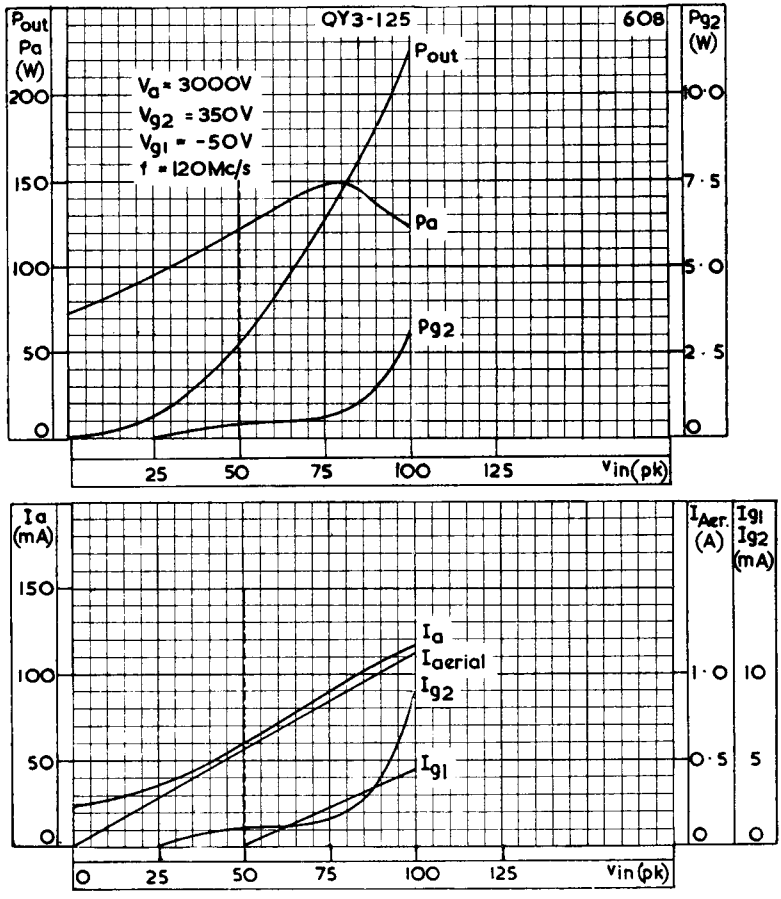


OPERATING CHARACTERISTICS FOR CLASS "B" TELEPHONY
AT V_a=2.5 kV

V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.



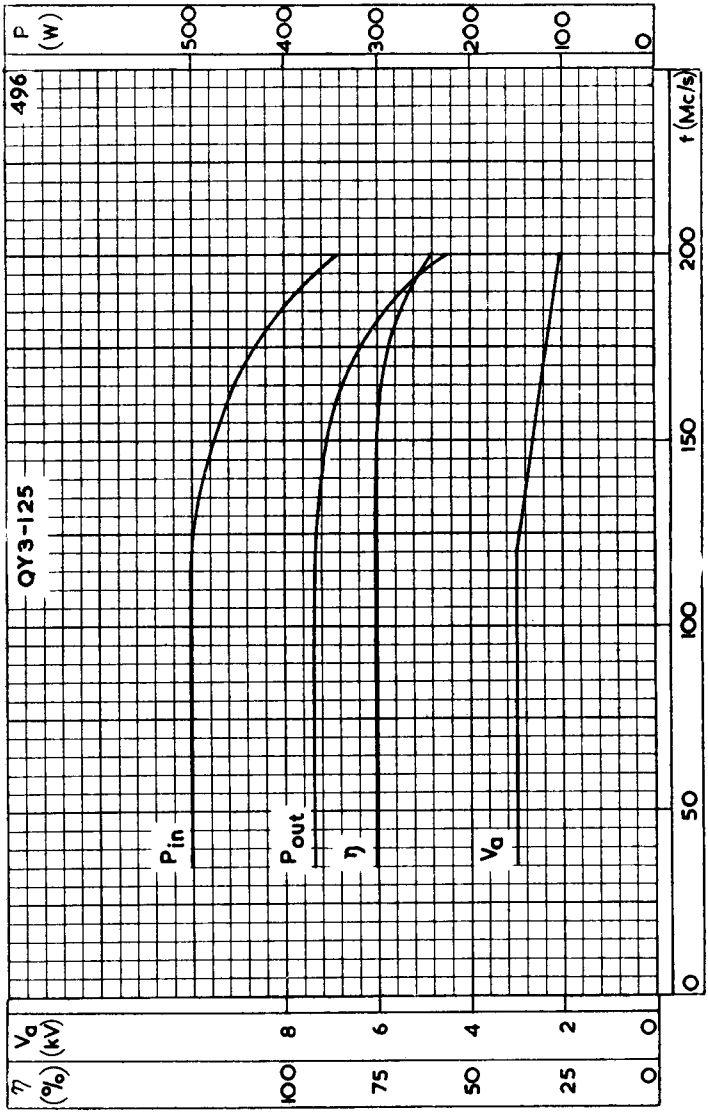
OPERATING CHARACTERISTICS FOR CLASS "B" TELEPHONY

AT $V_a = 3.0$ kV

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

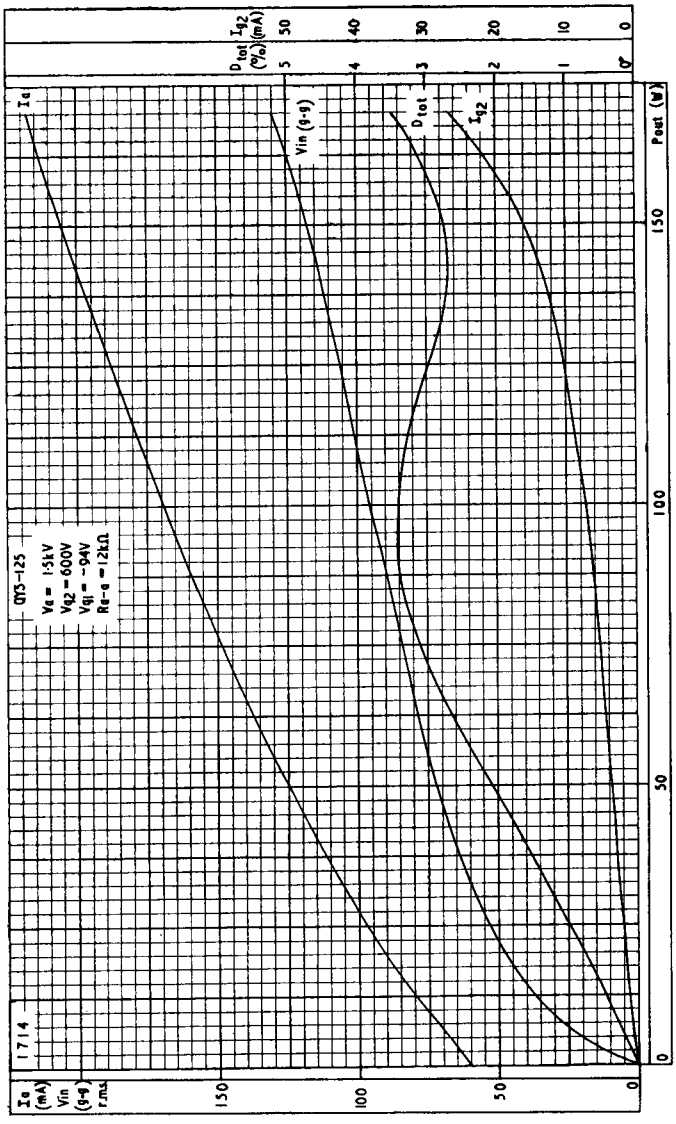


FREQUENCY CHARACTERISTICS AS CLASS "C" TELEGRAPHY AMPLIFIER

V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

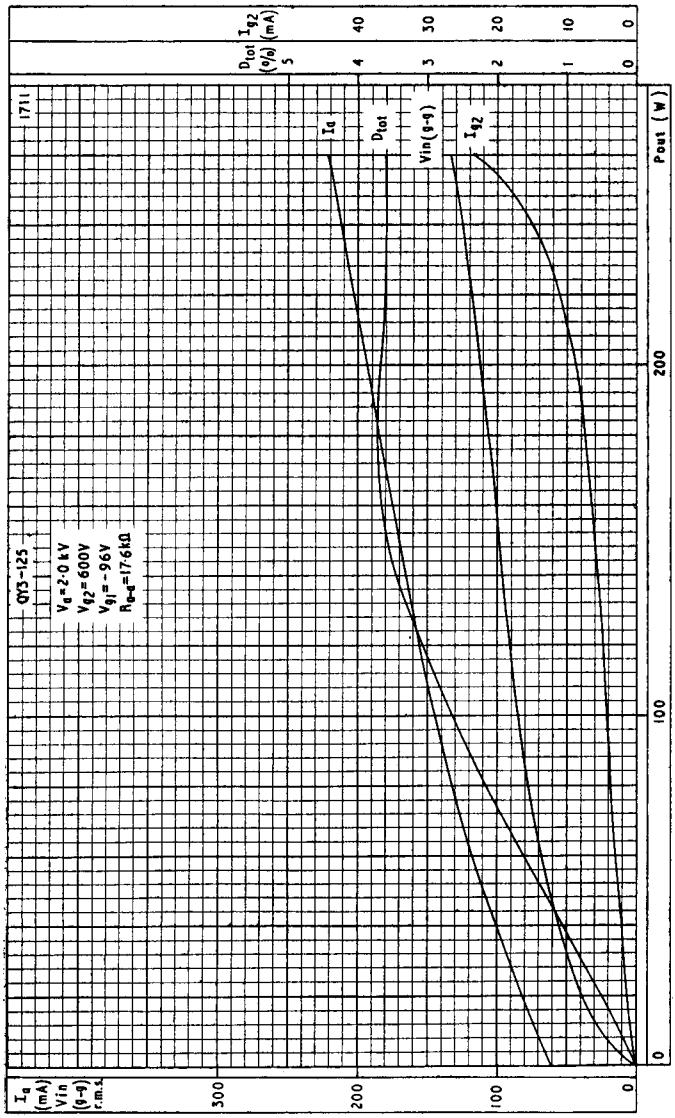


OPERATING CONDITIONS FOR TWO VALVES AS CLASS "B" AUDIO AMPLIFIER WITHOUT GRID CURRENT AND V_a=1.5 kV

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

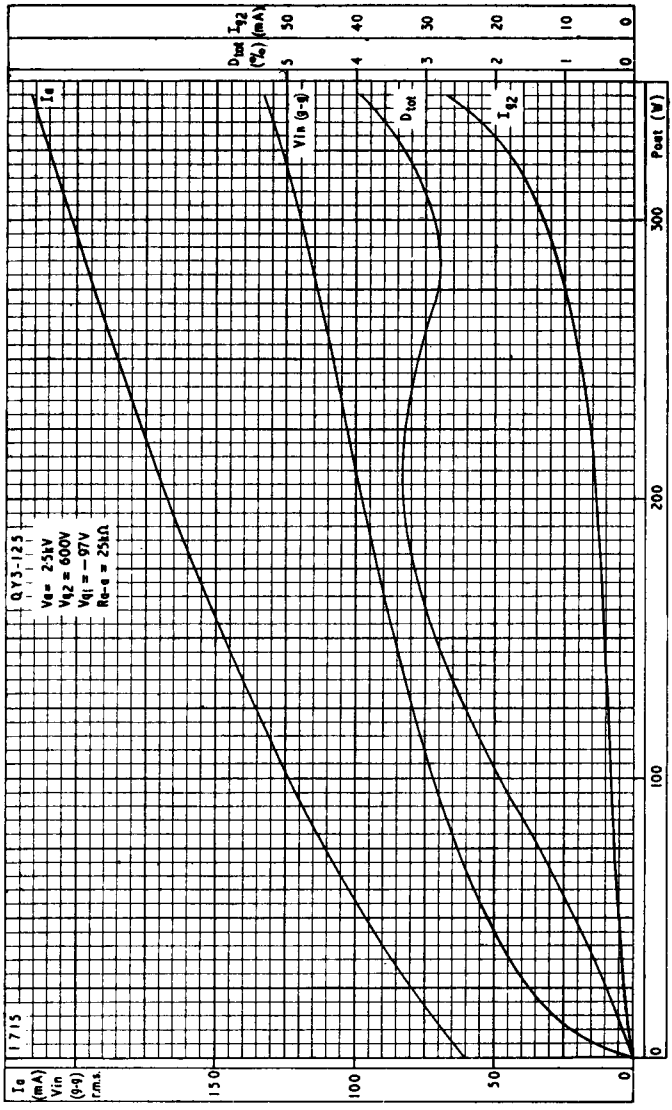


OPERATING CONDITIONS FOR TWO VALVES AS CLASS "B" AUDIO AMPLIFIER WITHOUT GRID CURRENT AND V_a=2.0kV

V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

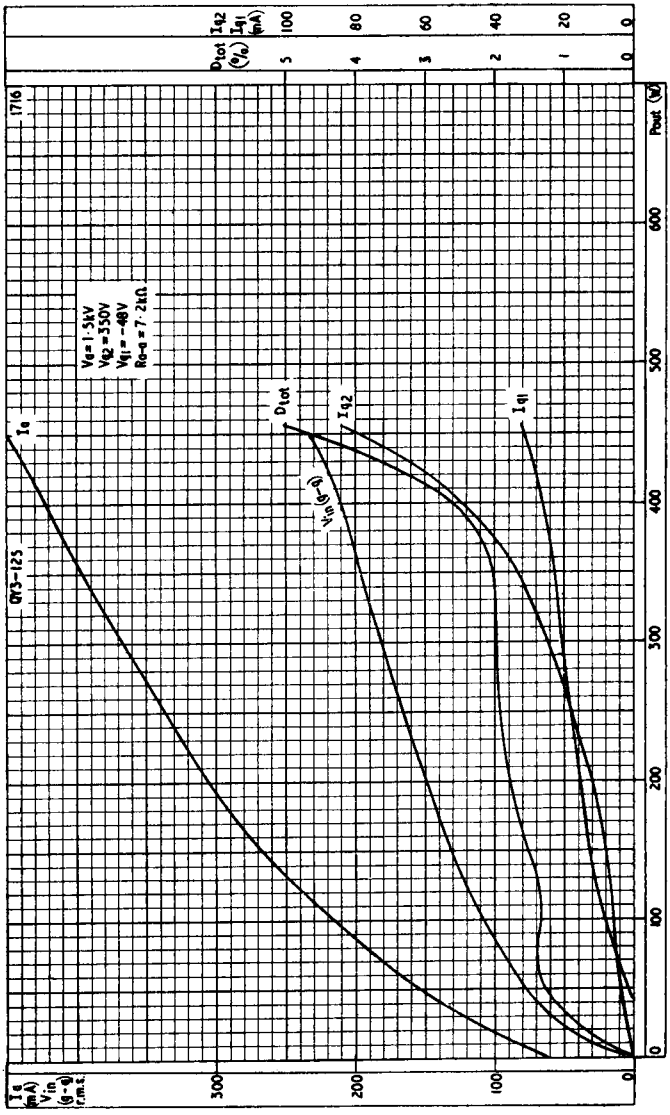


OPERATING CONDITIONS FOR TWO VALVES AS CLASS "B" AUDIO AMPLIFIER WITHOUT GRID CURRENT AND V_a=2.5 kV

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

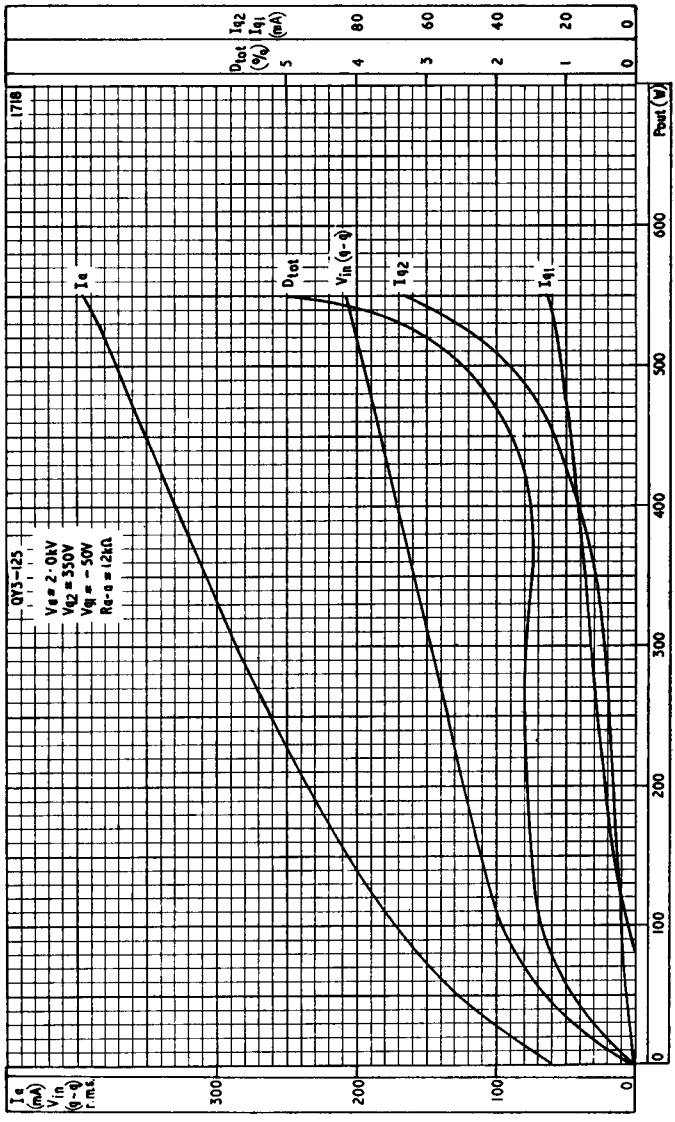


OPERATING CONDITIONS FOR TWO VALVES AS CLASS "B" AUDIO AMPLIFIER WITH GRID CURRENT AND V_a=1.5 kV

V.H.F. POWER TETRODE

QY3-125

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s.

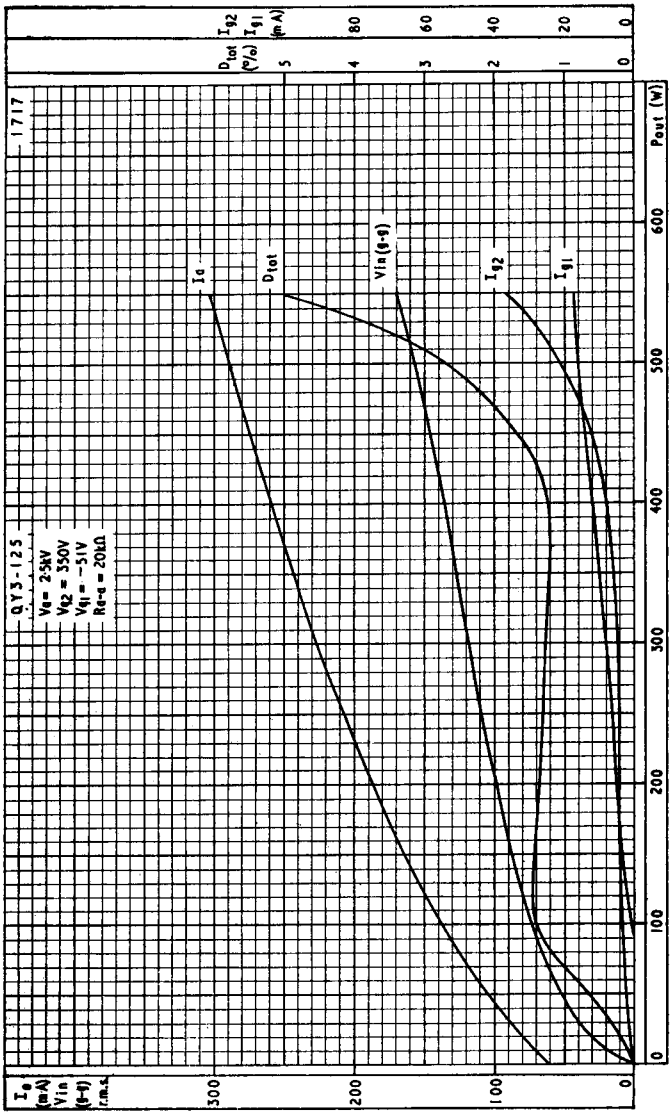


OPERATING CONDITIONS FOR TWO VALVES AS CLASS "B" AUDIO AMPLIFIER WITH GRID CURRENT AND V_a=2.0 kV

QY3-125

V.H.F. POWER TETRODE

All-glass tetrode rated for a maximum anode dissipation of 125W and suitable for use at frequencies up to 200 Mc/s



OPERATING CONDITIONS FOR TWO VALVES AS CLASS "B" AUDIO AMPLIFIER WITH GRID CURRENT AND $V_a = 2.5$ kV

BEAM POWER TETRODE

QY4-400

Application: *Power amplifier, oscillator or modulator*
Power output: 1.1kW *continuous rating*
Frequency: 110Mc/s *at full ratings*
Construction: *Glass, forced-air cooled*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT Thoriated tungsten

V_f	5.0	V
I_f	14.5	A

MOUNTING POSITION Vertical, base down

CAPACITANCES

C_{in}	12.7	pF
C_{out}	4.9	pF
C_{a-g1}	120	mpF

CHARACTERISTICS (measured at $V_a = 2.5kV$, $V_{g2} = 500V$, $I_a = 100mA$)

g_m	4.0	mA/V
μ_{g1-g2}	5.1	

COOLING

Forced-air cooling

T_{anode} seal max.	220	°C
T_{base} seals max.	180	°C
T_{bulb} max.	350	°C

$p_a < 250W$

In order to keep within the temperature limits of the base seals, an air flow of at least 5cu.ft/min must be directed at the base and commence immediately the filament is energised.

$p_a > 250W$

An air flow over the envelope up to 14cu.ft/min will be required. In order to assist the circulation of the cooling air, a glass chimney surrounding the valve should be used.

CLASS "C" AMPLIFIER AND OSCILLATOR

Limiting values (absolute ratings)

f max.	110	Mc/s
V_a max.	4.0	kV
V_{g2} max.	600	V
$-V_{g1}$ max.	500	V
p_a max.	400	W
p_{g2} max.	35	W
p_{g1} max.	10	W
I_k max.	420	mA
$i_{k(pk)}$ max.	2.2	A
R_{g1-f} max.	50	kΩ

Operating conditions

f	<75	<75	<75	Mc/s
V_a	2.5	3.0	4.0	kV
V_{g2}	500	500	500	V
V_{g1}	−200	−220	−220	V
I_a	350	350	350	mA
I_{g2}	46	46	40	mA
I_{g1}	6.5	6.0	6.0	mA
$V_{in(pk)}$	290	305	305	V
$P_{load\ (driver)}$	12	12	12	W
p_a	235	250	300	W
p_{g2}	17.5	15	12.5	W
η_a	73	76	79	%
P_{out}	0.64	0.8	1.1	kW
P_{load} ($\eta_{transfer}$ = 85%)	545	680	935	W

Operating conditions

f	100	100	Mc/s
V_a	3.5	4.0	kV
V_{g2}	500	500	V
V_{g1}	−170	−170	V
I_a	250	270	mA
I_{g2}	17	15.5	mA
I_{g1}	9.0	10	mA
$V_{in(pk)}$	235	240	V
$P_{load\ (driver)}$ (approx.)	20	20	W
p_a	225	280	W
η_a	74	74	%
P_{out} (approx.)	650	800	W
P_{load} ($\eta_{transfer}$ = 80%)	520	640	W

CLASS "C" AMPLIFIER (ANODE AND SCREEN-GRID MODULATION)

Limiting values (absolute ratings)

Carrier conditions for modulation factor of 1

f max.	75	Mc/s
V_a max.	3.2	kV
V_{g2} max.	600	V
$-V_{g1}$ max.	500	V
p_a max.	270	W
p_{g2} max.	35	W
p_{g1} max.	10	W
I_k max.	330	mA
$i_{k(pk)}$ max.	1.7	A
R_{g1-f} max.	50	kΩ

Operating conditions

f	≦75	≦75	≦75	Mc/s
V_a	2.0	2.5	3.0	kV
V_{g2}	500	500	500	V
V_{g1}	−220	−220	−220	V
I_a	275	275	275	mA
I_{g2}	30	28	26	mA
I_{g1}	6.0	6.0	6.0	mA
$v_{in(pk)}$	305	305	305	V
$P_{load\ (driver)}$	3.5	3.5	3.5	W
p_a	170	178	195	W
p_{g2}	15	14	13	W
η_a	69	74	76	%
P_{out}	380	510	630	W
P_{load} ($\eta_{transfer}$ = 85%)	325	435	535	W
For 100% modulation				
$P_{mod.}$	285	350	420	W
$v_{g2(pk)}$ mod.	400	400	400	V

CLASS "B" R.F. AMPLIFIER (S.S.B.)

Limiting values (absolute ratings)

f max.	110	Mc/s
V_a max.	4.0	kV
p_a max.	400	W
V_{g2} max.	850	V
p_{g2} max.	35	W
I_k max.	400	mA
R_{g1-f} max.	250	kΩ

Operating conditions

f	≦110	≦110	≦110	Mc/s
V_a	3.0	3.5	4.0	kV
V_{g2}	810	750	705	V
V_{g1}	−140	−135	−130	V
$I_{a(o)}$	90	75	65	mA
I_a (single tone)	300	280	250	mA
I_a (two tone)	215	200	175	mA
$I_{g2(o)}$	0	0	0	mA
I_{g2} (max. sig.)	18	15	11	mA
I_{g1}	0	0	0	mA
$v_{in(pk)}$	140	135	130	V
p_a (max. sig.)	395	400	375	W
p_{g2} (max. sig.)	7.0	9.0	12	W
P_{out} (two tone)	250	300	325	W
P.E.P.	500	600	650	W

QY4-400

BEAM POWER TETRODE

CLASS "AB" AUDIO AMPLIFIER AND MODULATOR (TWO VALVES IN PUSH-PULL)

Limiting values (absolute ratings)

V_a max.	4.0	kV
V_{g2} max.	800	V
V_{g2} max. ($T_{pin}<120°C$)	1.0	kV
p_a max.	400	W
p_{g2} max.	35	W
p_{g1} max.	10	W
I_k max.	400	mA
$i_{k(pk)}$ max.	1.3	A
R_{g1-f}	250	kΩ

Operating conditions (without I_{g1})

V_a	2.5	3.0	3.5	4.0	kV
V_{g2}	750	750	750	750	V
V_{g1} (approx.)	−130	−137	−145	−150	V
$I_{a(o)}$	2×95	2×80	2×70	2×60	mA
I_a (max. sig.)	2×318	2×318	2×305	2×292	mA
I_{g2} (max. sig.)	2×14	2×13	2×16	2×20	mA
$V_{in(g1-g1)}$ r.m.s.	184	194	205	212	V
p_a	2×370	2×400	2×400	2×400	W
η_a	53	58	62	66	%
R_{a-a}	6.8	8.9	11.5	14.5	kΩ
P_{out}	0.85	1.11	1.33	1.54	kW

Operating conditions (with I_{g1})

V_a	2.5	3.0	3.5	4.0	kV
V_{g2}	500	500	500	500	V
V_{g1} (approx.)	−75	−80	−85	−90	V
$I_{a(o)}$	2×95	2×90	2×80	2×80	mA
I_a (max. sig.)	2×350	2×350	2×350	2×319	mA
I_{g2} (max. sig.)	2×25	2×20	2×19	2×16	mA
I_{g1}	2×3.0	2×3.0	2×3.0	2×3.0	mA
$V_{in(g1-g1)}$ r.m.s.	205	205	215	215	V
P_{drive}	8.6	9.0	10.2	7.0	W
p_a	2×320	2×362	2×400	2×400	W
η_a	63	65	67	69	%
R_{a-a}	8.0	10	11.3	15	kΩ
P_{out}	1.11	1.375	1.65	1.75	kW

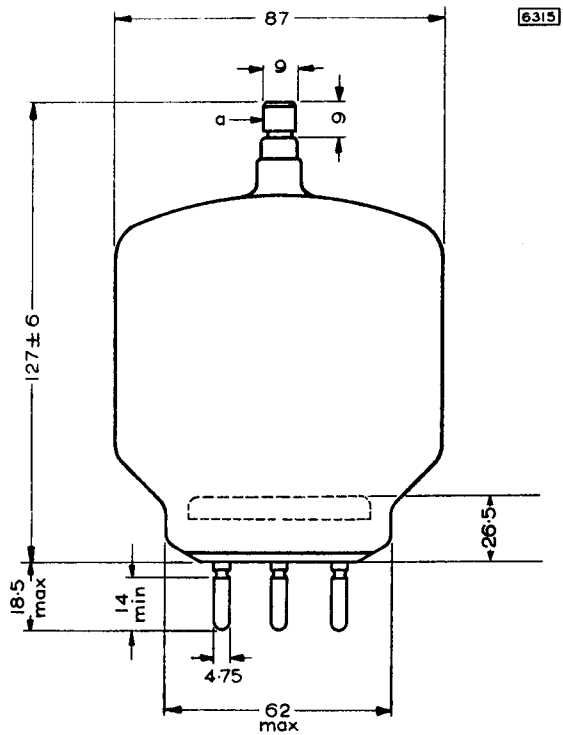
WEIGHT

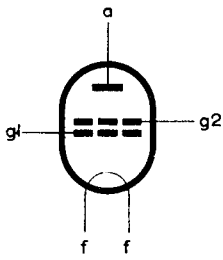
Valve only	9	oz
	255	g

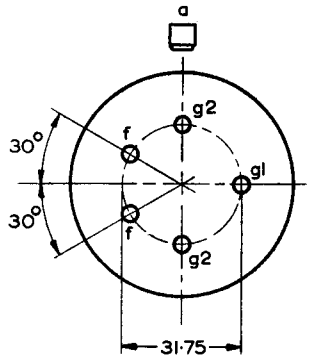
ACCESSORIES

Socket	40211/01
Anode connector	40624
Glass chimney	40666

QY4-400

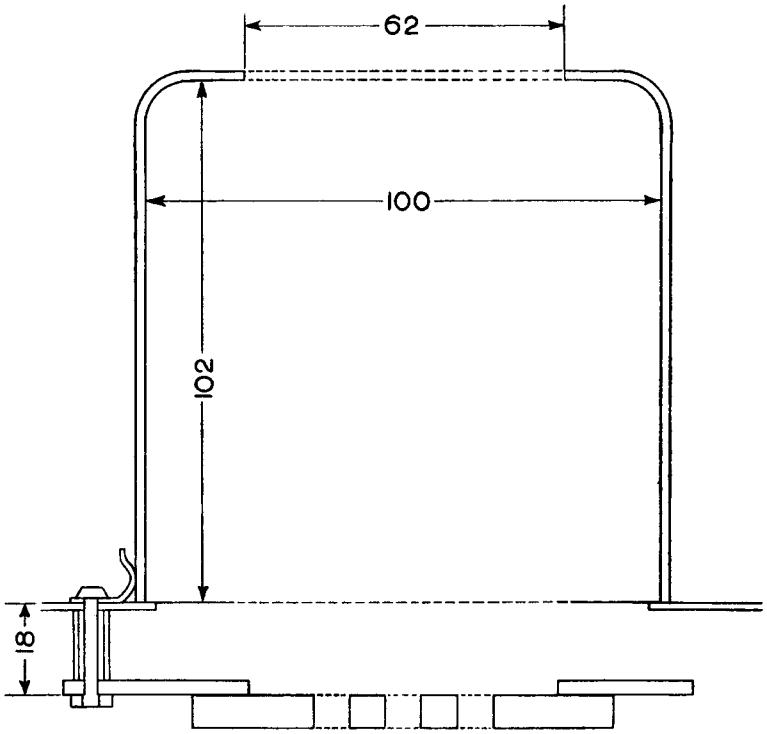






All dimensions in mm

B5F Base.

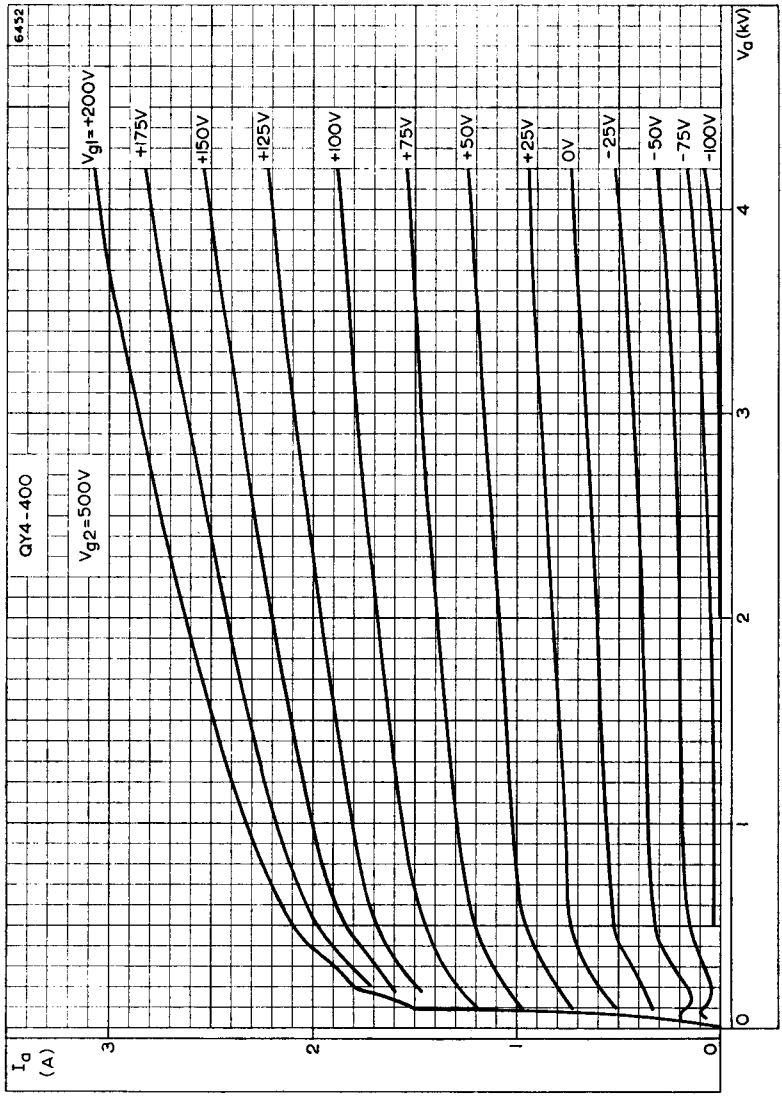


Glass chimney

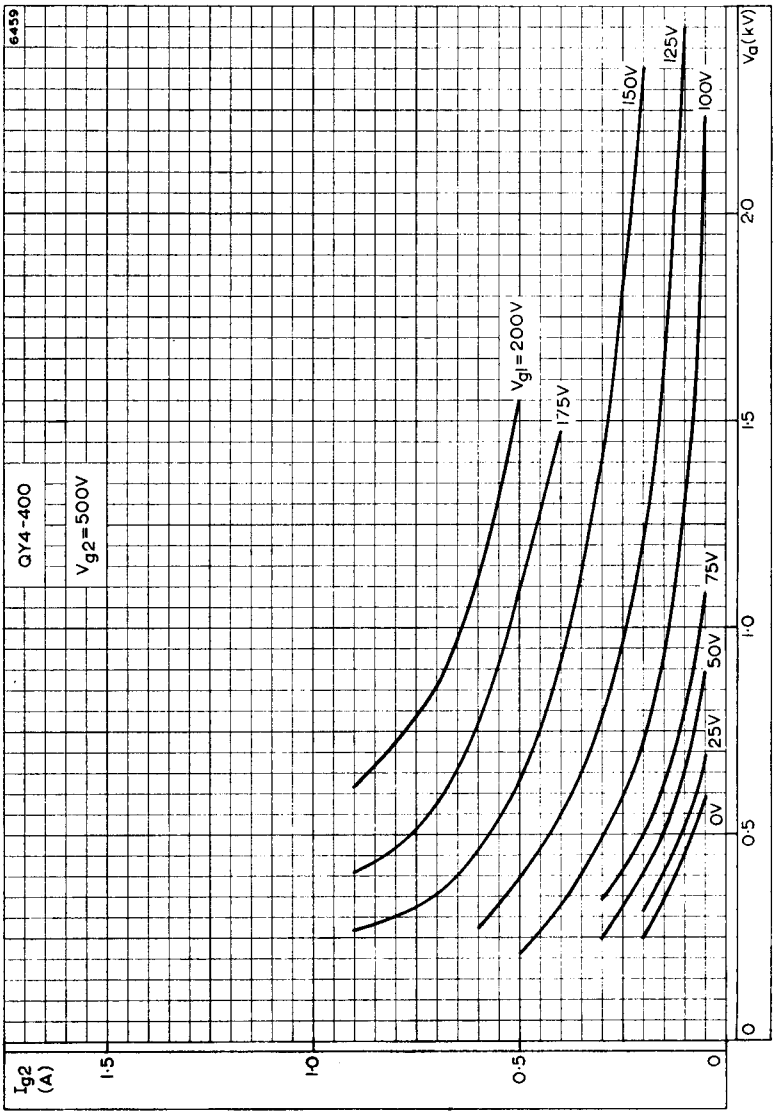
All dimensions in mm

6451

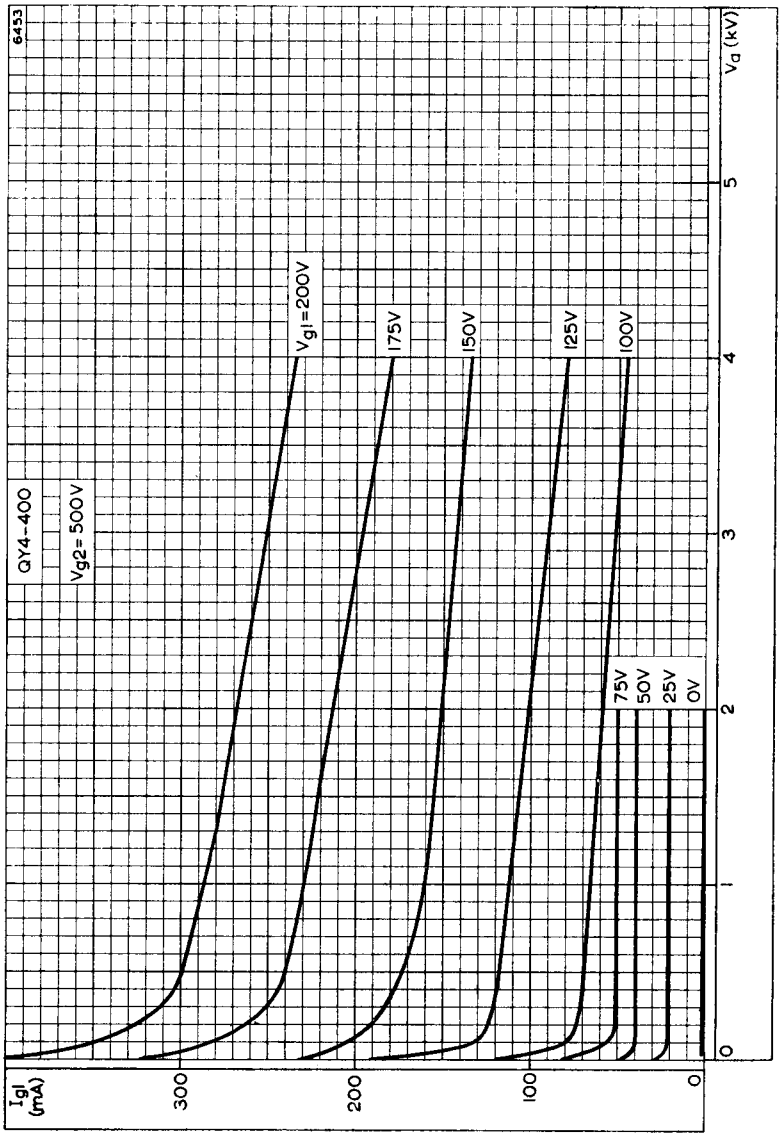
QY4-400



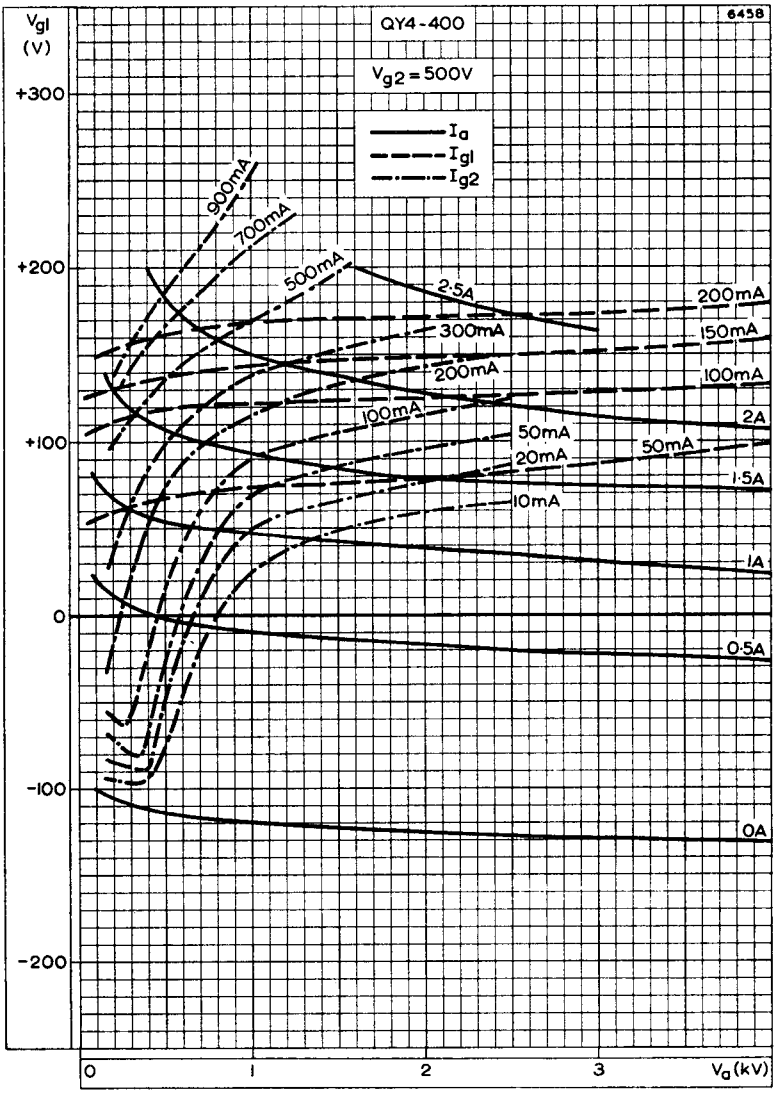
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



CONSTANT CURRENT CURVES

BEAM POWER TETRODE QY4-400

QUICK REFERENCE DATA

Forced-air cooled beam power tetrode suitable for use as power amplifier, oscillator or modulator.

	Class 'B' Linear Amplifier for S.S.B. operation	Class 'C' Telephony Anode and Screen Grid Modulation	Class 'C' Telegraphy or F.M. Telephony	
f	60	75	100	Mc/s
P_{out}	*650	630	800	W
f max.	110	75	110	Mc/s
V_a max.	4.0	3.2	4.0	kV
p_a max.	400	270	400	W

* P.E. P_{out}

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

f	<75	<75	<75	100	100	Mc/s
P_{out}	640	800	1100	650	800	W
P_{load}	550	680	940	520	640	W
η_a	73	76	79	74	74	%
V_a	2.5	3.0	4.0	3.5	4.0	kV
I_a	350	350	350	250	270	mA
V_{g2}	500	500	500	500	500	V
I_{g2}	35	30	25	17	16	mA
$-V_{g1}$	200	220	220	170	170	V
I_{g1}	6.5	6.0	6.0	9.0	10	mA
$V_{in\ (pk)}$	290	305	305	235	240	V
P_{load} (driver)	12	12	12	20	20	W
p_a	235	250	300	225	280	W
p_{g2}	17.5	15	12.5	8.5	8.0	W

CLASS 'C' TELEPHONY ANODE AND SCREEN-GRID MODULATION

Maximum operating conditions

	C.C.S.			I.C.A.S.	
f	75	75	75	30	Mc/s
P_{out}	380	510	630	765	W
P_{load}	324	435	540	650	W
η_a	69	74	76	77	%
V_a	2.0	2.5	3.0	3.65	kV
I_a	275	275	275	275	mA
V_{g2}	500	500	500	500	V
I_{g2}	40	38	36	30	mA
$-V_{g1}$	220	220	220	225	V
I_{g1}	6.0	6.0	6.0	6.0	mA
$v_{in(pk)}$	305	308	305	308	V
P_{load} (driver)	3.5	3.5	3.5	-	W
p_a	170	178	195	235	W
p_{g2}	20	19	18	15	W
For 100% modulation					
P_{mod}	275	344	413	500	W
$v_{g2(pk)}$	400	400	400	400	V

CLASS 'B' LINEAR AMPLIFIER FOR SINGLE SIDEBAND OPERATION

Maximum operating conditions at $I_{a(o)}$ = 90mA

f	60	Mc/s
P.E. P_{out}	500	W
P.E. P_{load}	425	W
**d_3	36	dB
**d_5	42	dB
V_a	3.0	kV
V_{g2}	810	V
***$-V_{g1}$	140	V
$I_{a(o)}$	90	mA
$I_{g2(o)}$	0	mA

	Single tone	Double tone	
I_a	300	215	mA
I_{g2}	15	11	mA
I_{g1}	0	0	mA
$V_{in(pk)}$	140	–	V
P_{load} (driver)	3.0	–	W
p_a	400	395	W
η_a	56	39	%

Maximum operating conditions at $I_{a(o)}$ = 75mA

f	60	Mc/s
P.E.P_{out}	600	W
P.E.P_{load}	510	W
**d_3	36	dB
**d_5	40	dB
V_a	3.5	kV
V_{g2}	750	V
***$-V_{g1}$	135	V
$I_{a(o)}$	75	mA
$I_{g2(o)}$	0	mA

	Single tone	Double tone	
I_a	280	200	mA
I_{g2}	12	8.4	mA
I_{g1}	0	0	mA
$V_{in(pk)}$	135	–	V
P_{load} (driver)	3.0	–	W
p_a	380	400	W
η_a	61	43	%

Maximum operating conditions at $I_{a(o)}$ = 65mA

f		60	Mc/s
P.E. P_{out}		650	W
P.E. P_{load}		550	W
**d_3		34	dB
**d_5		40	dB
V_a		4.0	kV
V_{g2}		705	V
***$-V_{g1}$		130	V
$I_{a(o)}$		65	mA
$I_{g2(o)}$		0	mA
	Single tone	Double tone	
I_a	250	175	mA
I_{g2}	10	7.0	mA
I_{g1}	0	0	mA
$v_{in\ (pk)}$	130	-	V
P_{load} (driver)	3.0	-	W
p_a	350	375	W
η_a	65	47	%

**Third and fifth order intermodulation products.
Maximum values encountered at any level of drive voltage referred to the amplitude of either of the two tones at that level.

***Adjust to give the desired value of $I_{a(o)}$.

CLASS 'AB2' AUDIO AMPLIFIER

Maximum operating conditions for two valves in push-pull

P_{out}	1.11	1.38	1.65	1.75	kW
R_{a-a}	9.0	10	11.3	15	kΩ
V_a	2.5	3.0	3.5	4.0	kV
V_{g2}	500	500	500	500	V
**$-V_{g1}$	75	80	85	90	V
$I_{a(o)}$	2 x 95	2 x 90	2 x 80	2 x 80	mA
I_a (max. sig)	2 x 350	2 x 350	2 x 350	2 x 319	mA
I_{g2} (max. sig)	2 x 30	2 x 20	2 x 20	2 x 20	mA
I_{g1}	2 x 7.0	2 x 6.5	2 x 6.5	2 x 6.0	mA
$V_{in\ (g1-g1)\ r.m.s.}$	205	205	215	215	V
P_{load} (driver)	8.6	9.0	10.2	7.0	W
p_a	2 x 320	2 x 362	2 x 400	2 x 400	W
η_a	64	66	68	69	%

CLASS 'AB1' AUDIO AMPLIFIER

Maximum operating conditions for two valves in push-pull

P_{out}	0.85	1.11	1.33	1.54	kW
R_{a-a}	6.8	8.9	11.5	14.5	kΩ
V_a	2.5	3.0	3.5	4.0	kV
V_{g2}	750	750	750	750	V
**$-V_{g1}$	130	137	145	150	V
$I_{a(o)}$	2 x 95	2 x 80	2 x 70	2 x 60	mA
I_a (max. sig)	2 x 318	2 x 318	2 x 305	2 x 293	mA
I_{g2} (max. sig)	2 x 11.6	2 x 11	2 x 13.5	2 x 15	mA
$V_{in\ (g1-g1)\ r.m.s.}$	184	194	205	212	V
p_a	2 x 370	2 x 400	2 x 400	2 x 400	W
η_a	54	58	63	66	%

**Adjust to give the desired value of $I_{a(o)}$.

ABSOLUTE MAXIMUM RATINGS

	Class 'AB1' or 'AB2' audio	Class 'B' S.S.B.	Class 'C' Telephony C.C.S.	Class 'C' Telephony I.C.A.S.	Class 'C' Telegraphy	
f max.	-	110	75	30	110	Mc/s
V_a max.	4.0	4.0	3.2	4.0	4.0	kV
V_{g2} max.	*800	850	600	600	600	V
$-V_{g1}$ max.	-	-	500	500	500	V
I_k max.	400	400	330	330	420	mA
p_a max.	400	400	270	270	400	W
p_{g2} max.	35	35	35	35	35	W
I_{g1} max.	25	-	25	25	25	mA
p_{g1} max.	10	-	10	10	10	W
R_{g1-f} max.	250	250	50	50	50	kΩ

*This can be increased to 1.0kV if $T_{base-seals} < 120^{o}C$.

CATHODE

Directly heated, thoriated tungsten

V_f	5.0	V
I_f	14.1	A

CAPACITANCES

c_{a-g1}	120	mpF
c_{out}	4.9	pF
c_{in}	12.7	pF

CHARACTERISTICS (measured at $V_a = 2.5kV$, $V_{g2} = 500V$, $I_a = 100mA$)

g_m	4.0	mA/V
μ_{g1-g2}	5.1	

MOUNTING POSITION

Vertical, base up or down

COOLING

Forced-air

Maximum temperatures

Anode seal	220	°C
Base seals	180	°C
Bulb	350	°C

p_a < 250W

In order to keep within the temperature limits of the base seals, an air flow of at least 5ft^3/min (0.15m^3/min) must be directed at the base and commence immediately the filament is energised.

p_a > 250W

An air flow over the envelope up to 14ft^3/min (0.4 m^3/min) will be required. In order to assist the circulation of the cooling air, a glass chimney surrounding the valves should be used.

PHYSICAL DATA

	lb	kg
Weight of valve	0.42	0.19
Weight of valve and carton (9 valves per carton)	6.5	2.95

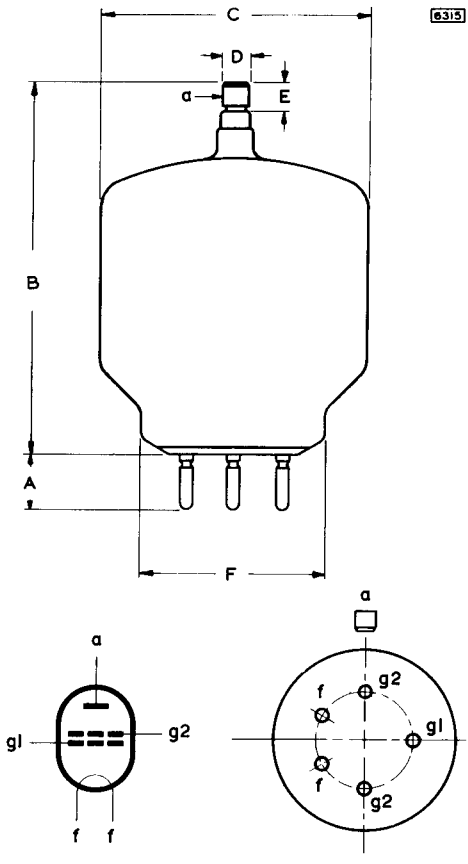
ACCESSORIES

Socket	40211/01
Anode connector	40624
Glass chimney	40666

DIMENSIONS OF VALVE

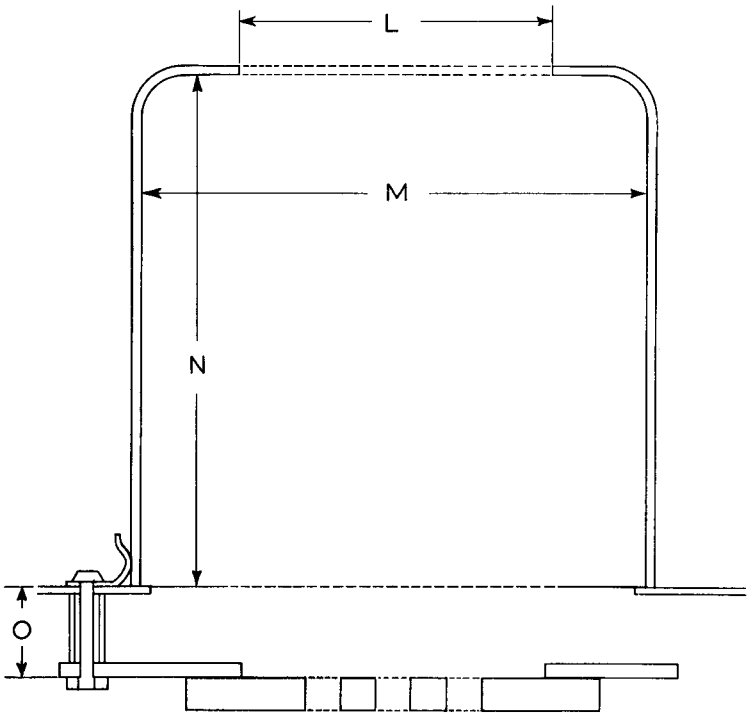
	Inches	Millimetres		Inches	Millimetres
A	0.728	18.5 max.	D	0.354	9.0
B	5.000±0.236	127±6.0	E	0.354	9.0
C	3.425	87	F	2.441	62 max.

Inch dimensions derived from original millimetre dimensions



B5F Base

(According to B.S.448)



Glass chimney

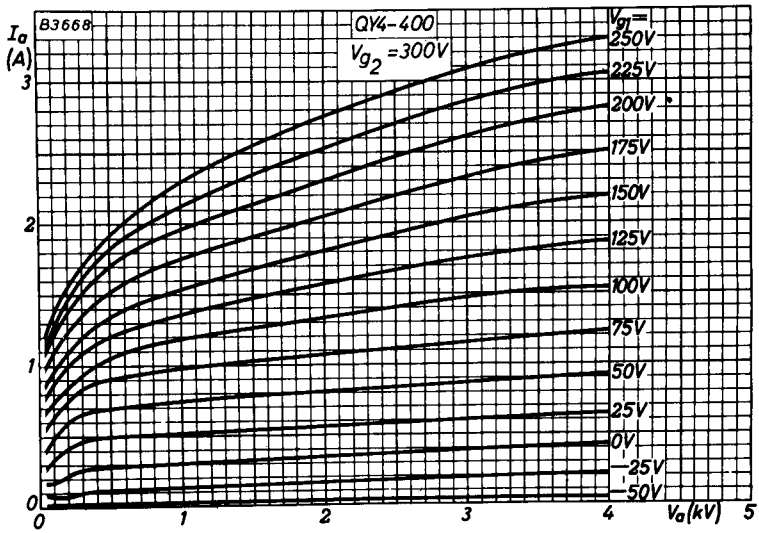
All dimensions in mm

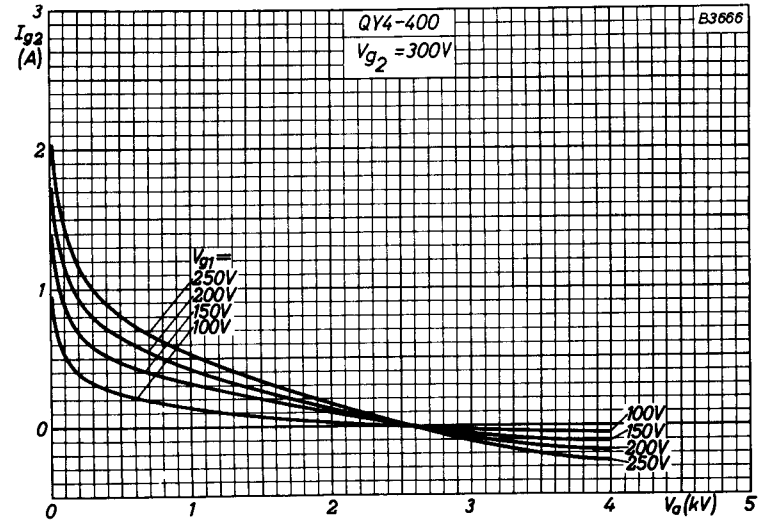
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DIMENSIONS OF GLASS CHIMNEY

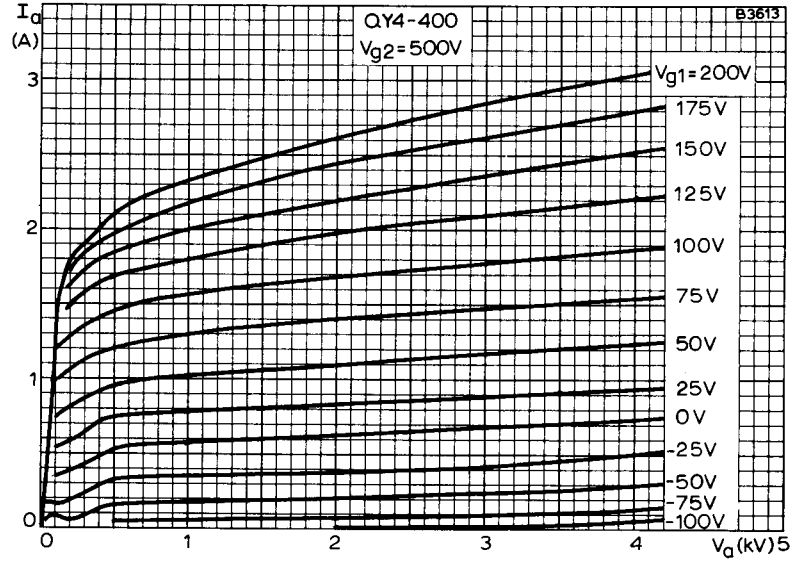
	Inches	Millimetres
L	2.441	62
M	3.937	100
N	4.016	102
O	0.709	18

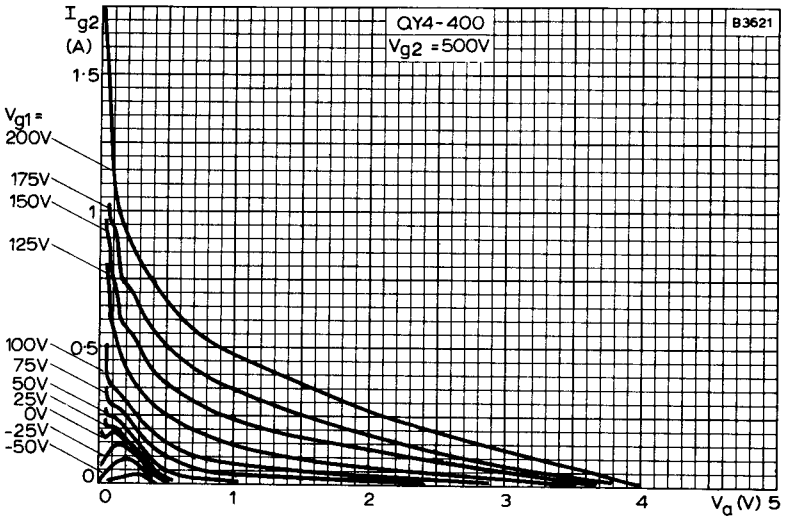
Inch dimensions derived from original millimetre dimensions



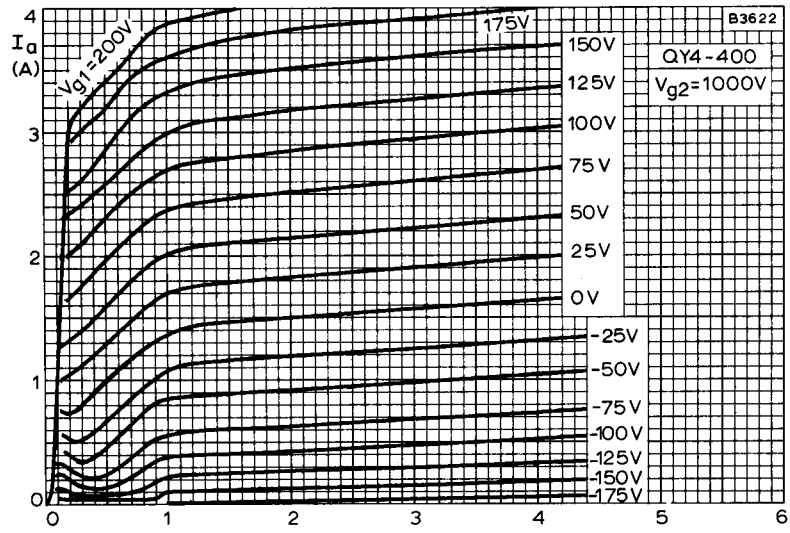


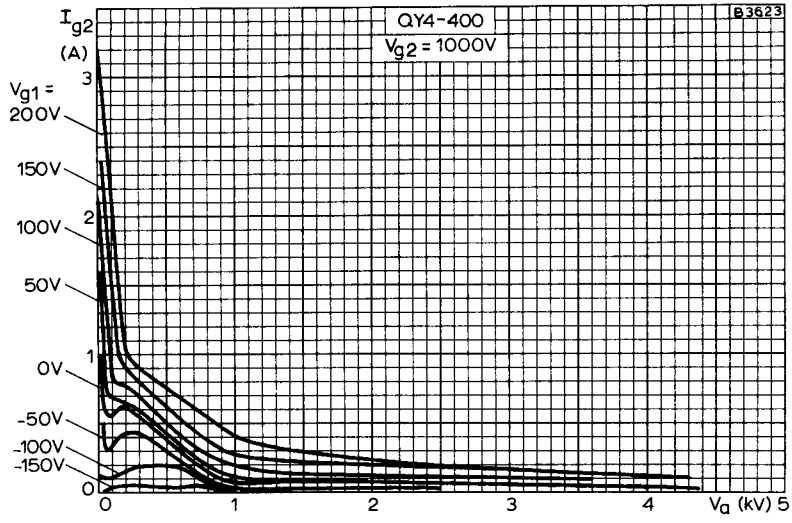
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V



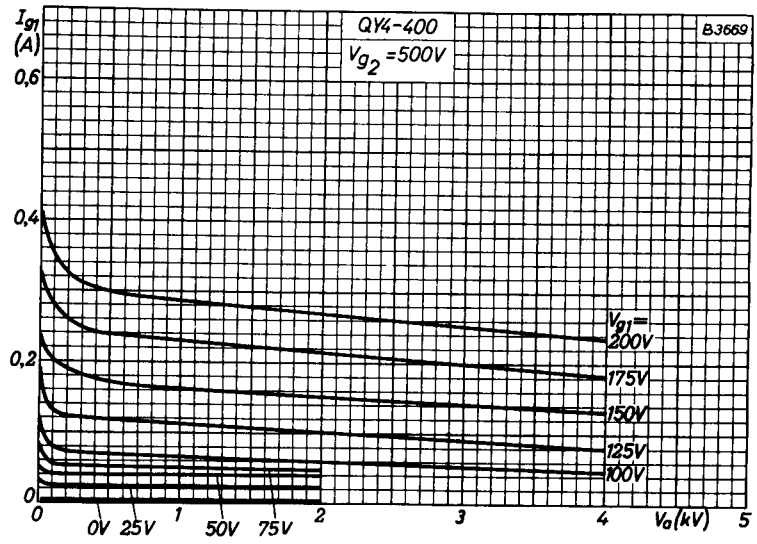


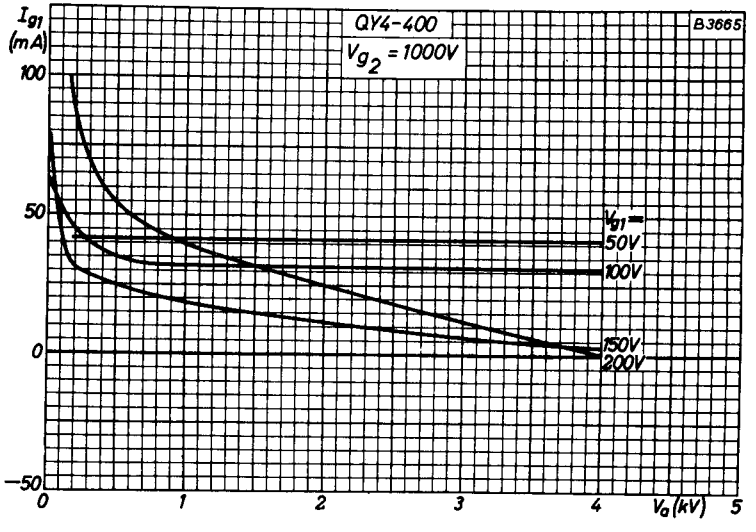
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2}=500V



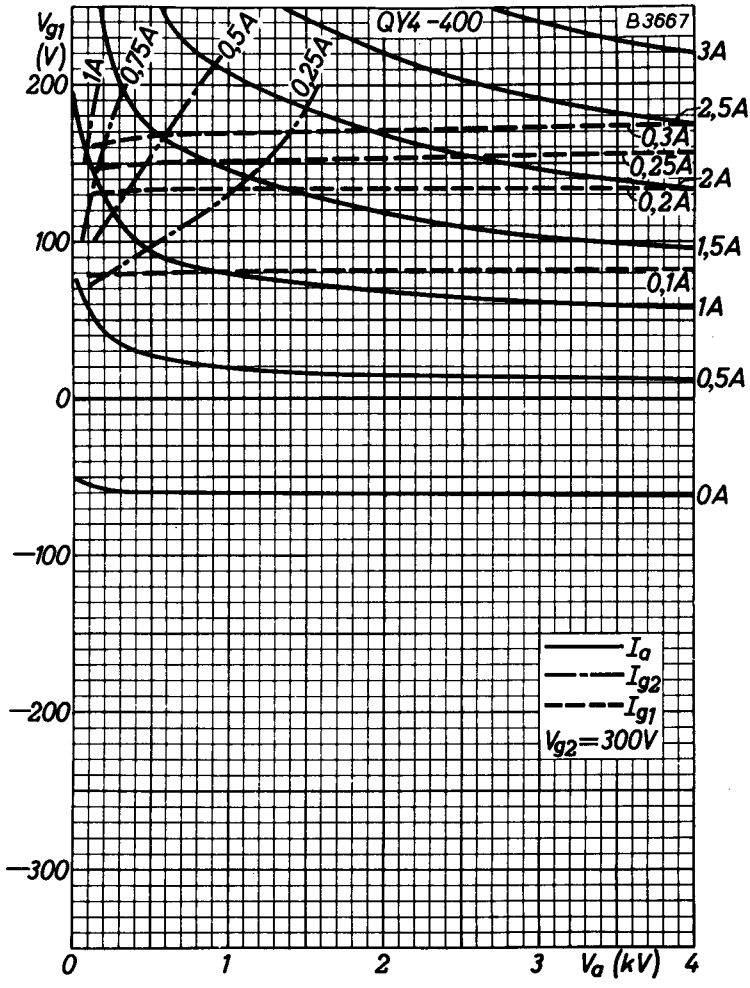


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2}=1000V

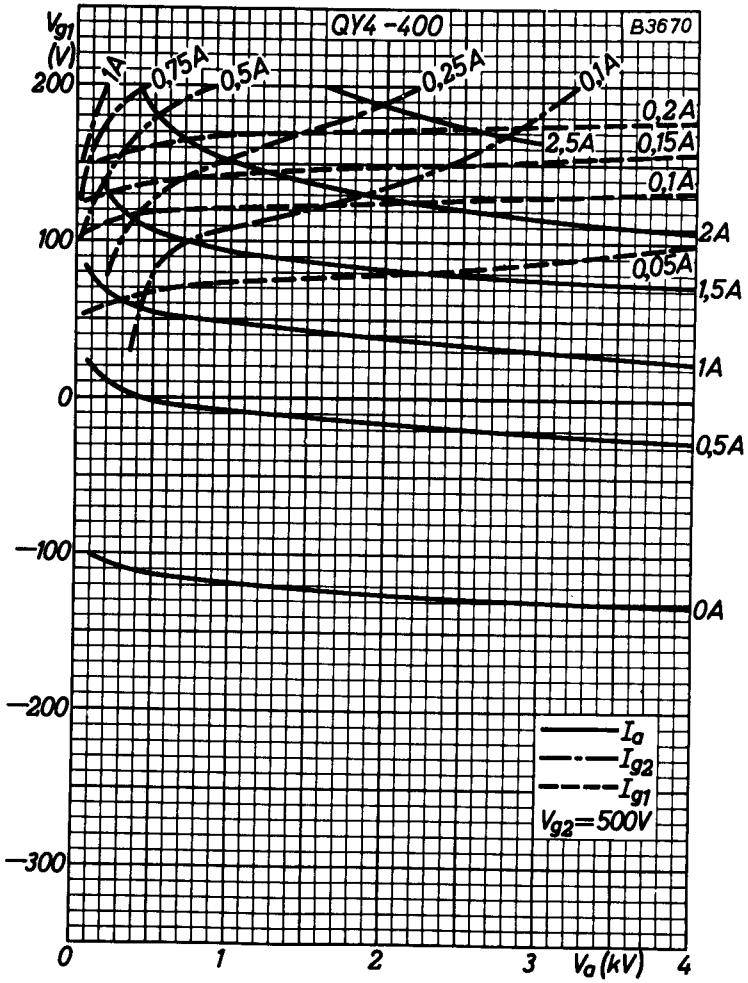




CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 500V AND 1000V



CONSTANT CURRENT CHARACTERISTICS. V_{g2}=300V



CONSTANT CURRENT CHARACTERISTICS. V_{g2} = 500V

V. H. F. POWER TETRODE **QY4-500A**

PRELIMINARY DATA

QUICK REFERENCE DATA

Forced-air cooled power tetrode, intended for use as v.h.f. power amplifier or oscillator.

	Class 'B' Television	Class 'C' Telegraphy or F.M. Telephony	
fout	220	186	Mc/s
Pout	1200	630	W
f max.	220	220	Mc/s
Va max.	3.0	4.0	V
pa max.	500	500	W

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES which precede this section of the handbook.

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Absolute maximum ratings

f max.	220	Mc/s
Va max.		
f < 120 Mc/s	4.0	kV
f < 220 Mc/s	3.0	kV
Vg2 max.	500	V
-Vg1 max.	500	V
Ia max.	350	mA
Ig2 max.	60	mA
Ig1 max.	30	mA
pa max.	500	W
pg2 max.	30	W
pg1 max.	10	W

Typical operating conditions

f	110	110	110	186	Mc/s
Va	2.5	3.0	4.0	3.0	kV
Vg2	500	500	500	500	V
-Vg1	150	150	150	150	V
Ia	310	310	315	300	mA
Ig2	26	24	22	22	mA
Ig1	15	16	16	11	mA
vin(pk)	230	230	230	220	V
Pload (driver)	15	15	15	20	W
pa	245	260	330	270	W
Pout	530	670	930	630	W
Pload	475	600	835	570	W
ηa	68.5	72	73.5	70	%

CLASS 'B' TELEVISION SERVICE
Negative modulation, positive synchronisation.

Absolute maximum ratings - each valve

f max.	220	Mc/s
Va max.	3.0	kV
Vg2 max.	500	V
Ia (black) max.	350	mA
Ia (sync) max.	465	mA
pa (sync) max.	500	W
pg2 (sync) max.	30	W
pg1 (sync) max.	10	W

Typical operating conditions - two valves in push-pull.

f	220	220	Mc/s
B (-3.0dB)	5.0	5.0	Mc/s
Va	1.85	2.4	kV
Vg2	500	500	V
-Vg1	100	100	V
vin (g1-g1) pk (sync)	280	370	V
Ia (sync)	2 x 285	2 x 400	mA
Ia (black)	2 x 215	2 x 300	mA
Ig2 (sync)	2 x 20	2 x 35	mA
Ig2 (black)	2 x 2.0	2 x 3.0	mA
Ig1 (sync)	2 x 10	2 x 15	mA
Ig1 (black)	2 x 2.0	2 x 5.0	mA
Pload (driver)	40	75	W
pa (black)	2 x 230	2 x 380	W
Pout (sync)	600	1200	W
Pout (black)	340	680	W
Pload (sync)	480	960	W
Pload (black)	270	560	W

CATHODE

Directly heated, thoriated tungsten

Vf	5.0	V
If	13.5	A

CAPACITANCES

cin	12.8	pF
cout	5.6	pF
ca-g1	0.05	pF

CHARACTERISTICS (measured at Va = 2.5kV, Vg2 = 500V, Ia = 200mA)

gm	5.0	mA/V
μg1-g2	6.0	

COOLING

Tseals max.	150	°C
Tanode max.	150	°C

COOLING

In order to keep within both temperature limits at p_a = 500 W it may be necessary to pass a minimum flow of air of 1.15 m^3/min. (40 ft^3/min.) through the anode cooler. A flow of air must also be directed on the base and screen seals. This cooling should be applied before the application of filament voltage and continued for three minutes after filament voltage has been removed.

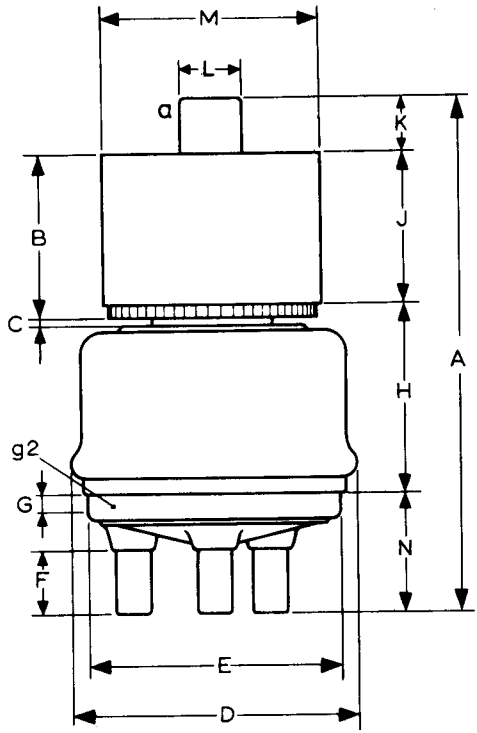
MOUNTING POSITION

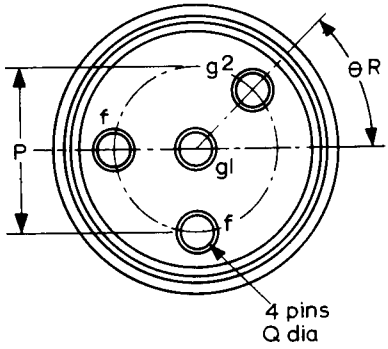
Vertical, base up or down.

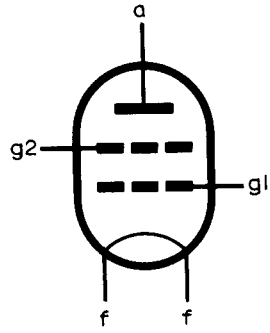
PHYSICAL DATA	oz	g
Weight of valve	17	490
Weight of valve and carton	40	1135

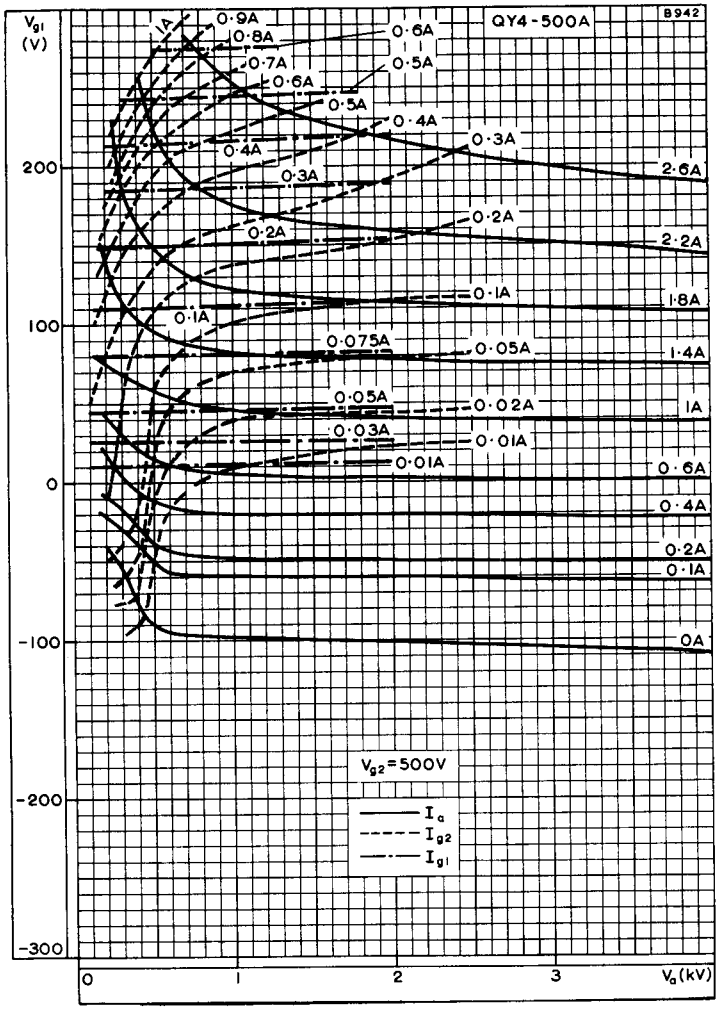
DIMENSIONS

	Inches	Millimetres	
A	4.724	120	
B	1.496	38	
C	0.063	1.6	min.
D	2.638	67	
E	2.374 ± 0.014	60.3 ± 0.35	
F	0.563	14.3	min.
G	0.158	4	
H	1.575	40	
J	1.378	35	
K	0.500	12.7	
L	0.563	14.3	
M	2.008	51	
N	1.000	25.4	
P	1.496	38	
Q	0.315	8	
ΘR	45°		


B1653
M
L
a
K
J
B
C
H
A
g2
G
N
F
E
D


g2
θR
f
P
gl
f
4 pins
Q dia


a
g2
gl
f
f



CONSTANT CURRENT CURVES Vg2 = 500V

R.F. POWER TETRODE

QY5-500

Application: *R.F. power amplifier, frequency multiplier or modulator.*
Power output: *1.76kW continuous rating.*
Frequency: *75Mc/s at full ratings, 110Mc/s at reduced ratings.*
Construction: *Glass, radiation or low velocity air cooled.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT Thoriated tungsten

V_f	10	V
I_f	9.9	A

MOUNTING POSITION

Vertical, base up or down

CAPACITANCES

c_{in}	24	pF
c_{out}	8.3	pF
c_{a-g1}	250	mpF

CHARACTERISTICS (measured at I_a = 120mA)

g_m	7.0	mA/V
μ_{g1-g2}	9.5	

COOLING

In order to keep the temperature below the maximum permitted values it may be necessary to direct an air flow onto the seals.

$T_{anode\ seal}$ max.	220	°C
$T_{base\ seals}$ max.	180	°C
T_{bulb} max.	250	°C

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Limiting values (absolute ratings)

V_a max. ($f \leqslant 75$Mc/s)	5.0	kV
V_a max. ($f = 110$Mc/s)	4.5	kV
p_a max.	500	W
V_{g2} max.	700	V
p_{g2} max.	65	W
$-V_{g1}$ max.	500	V
p_{g1} max.	25	W
I_k max.	600	mA
$i_{k(pk)}$ max.	3.0	A
$R_{g1\ f}$ max.	5.0	kΩ

Typical operation

f	⩽60	⩽60	100	Mc/s
V_a	4.0	5.0	4.5	kV
V_{g2}	600	600	600	V
V_{g1}	−200	−200	−200	V
I_a	450	440	400	mA
I_{g2}	90	80	70	mA
I_{g1}	39	35	30	mA
$v_{in(pk)}$	350	350	340	V
$P_{load(driver)}$	22	20	30	W
p_a	390	440	500	W
η_a	78	80	72	%
P_{out}	1.41	1.76	1.3	kW
P_{load} ($\eta_{transfer}$ = 85%)	1.2	1.5	1.1	kW

QY5-500

R.F. POWER TETRODE

CLASS 'C' AMPLIFIER (ANODE AND SCREEN-GRID MODULATION)

Limiting values (absolute ratings)

Carrier conditions for a modulation factor of 1

f max.	75	Mc/s
V_a max.	4.0	kV
p_a max.	330	W
V_{g2} max.	700	V
p_{g2} max.	50	W
$-V_{g1}$ max.	500	V
p_{g1} max.	25	W
I_k max.	520	mA
$i_{k(pk)}$ max.	4.7	A
R_{g1-f} max.	50	kΩ

Typical operation

Screen grid modulated via a choke of 2H

f	60	Mc/s
V_a	4.0	kV
V_{g2}	600	V
V_{g1}	−240	V
I_a	380	mA
I_{g2}	80	mA
I_{g1}	20	mA
$v_{in(pk)}$	415	V
$P_{load(driver)}$	22	W
p_a	320	W
p_{g2}	48	W
η_a	79	%
P_{out}	1.2	kW
P_{load} ($\eta_{transfer} = 85\%$)	1.02	kW

For 100% modulation

$P_{mod.}$	760	W

CLASS 'B' R.F. AMPLIFIER (S.S.B.)

Limiting values (absolute ratings)

f max.	75	Mc/s
V_a max.	5.0	kV
p_a max.	500	W
V_{g2} max.	700	V
p_{g2} max.	65	W
I_k max.	550	mA
$i_{k(pk)}$ max.	1.8	A
R_{g1-f} max.	50	kΩ

Typical operation

f	60	Mc/s
V_a	5.0	kV
V_{g2}	700	V
V_{g1}	−90	V
$I_{a(o)}$	56	mA
I_a (single tone)	280	mA
I_a (two tone)	200	mA
$I_{g2(o)}$	0	mA
I_{g2} (max. sig.)	25	mA
I_{g1} (max. sig.)	1.0	mA
$V_{in(pk)}$	130	V
P_a (max. sig.)	500	W
P_{g2} (max. sig.)	18	W
P_{out} (two tone)	450	W
η_a	64.5	%
P.E.P.	900	W
P_{load} ($\eta_{transfer}$ = 85%)	760	W

CLASS 'B' AUDIO AMPLIFIER AND MODULATOR (TWO VALVES IN PUSH-PULL)

Limiting values (absolute ratings)

V_a max.	5.0	kV
p_a max.	500	W
V_{g2} max.	700	V
p_{g2} max.	65	W
$-V_{g1}$ max.	500	V
I_{g1} max.	45	mA
I_k max.	550	mA
$i_{k(pk)}$ max.	1.8	A
$R_{g1\ t}$ max.	50	kΩ

Typical operation

V_a	4.0	4.0	5.0	kV
V_{g2}	600	600	600	V
V_{g1}	−62.5	−60	−62.5	V
$I_{a(o)}$	2×45	2×55	2×50	mA
I_a (max. sig.)	2×285	2×366	2×290	mA
I_{g2} (max. sig.)	2×40	2×60	2×43	mA
I_{g1}	2×13.5	2×18	2×13	mA
$V_{in(g1-g1)}$ r.m.s.	178	214	182	V
P_{drive}	2×1.5	2×2.5	2×1.5	W
P_a	2×300	2×340	2×340	W
P_{out}	1.68	2.25	2.22	kW
R_{a-a}	20	16	26	kΩ
η_a	74	76.5	76.5	%
D_{tot}	4.7	5.0	5.0	%

QY5-500

R.F. POWER TETRODE

WEIGHT

Valve only	{ 13.22 oz 375 g

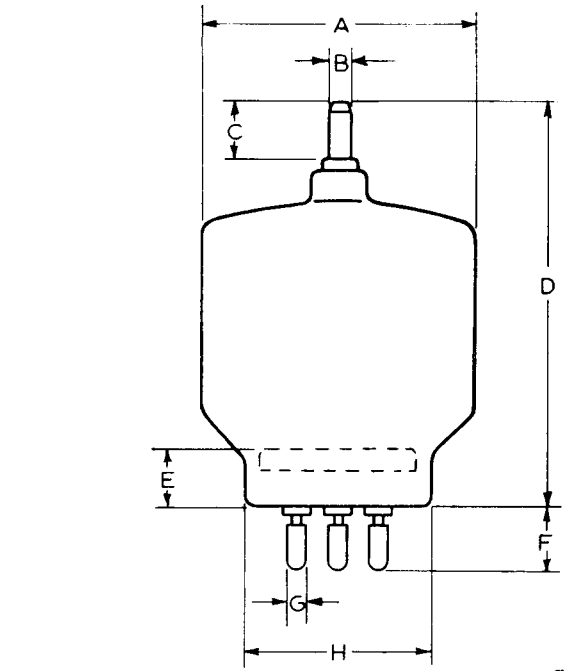
ACCESSORIES

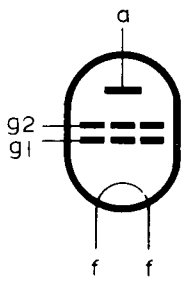
Socket	40216
Clip for anode connection	40626

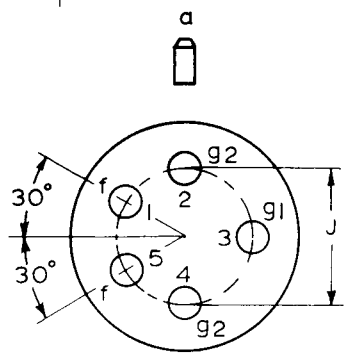
DIMENSIONS

	Inches	*Millimetres*	
A	4.65	118	max.
B	0.374	9.5	
C	0.984	25	
D	6.93 ± 0.24	176 ± 6	
E	0.984	25	
F	1.06	27	
G	0.374	9.5	
H	3.19	81	max.
J	1.50	38.1	

QY5-500



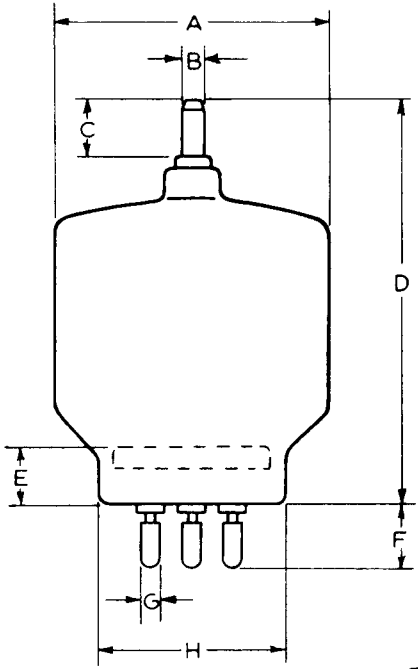


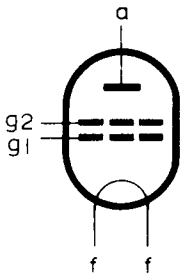


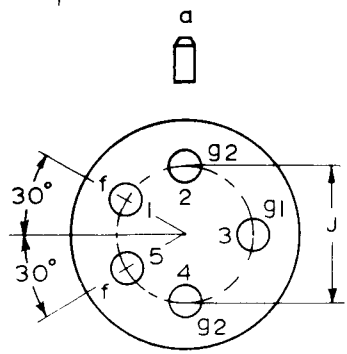
8104

B5F Base

QY5-500



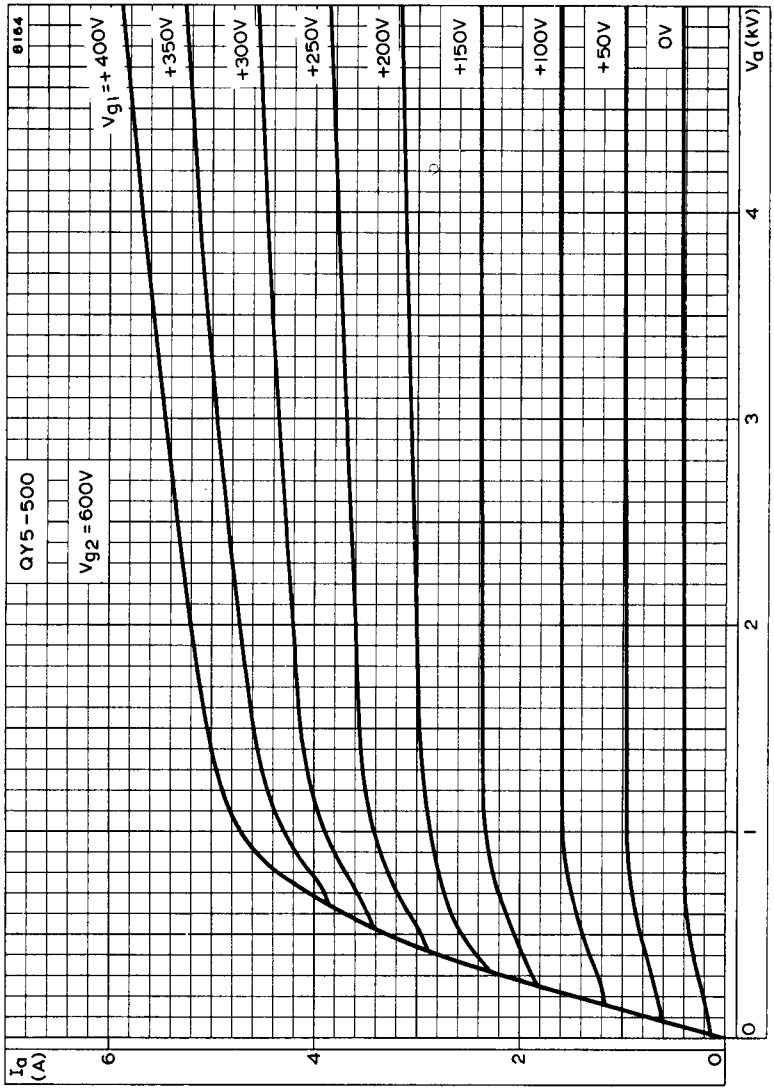




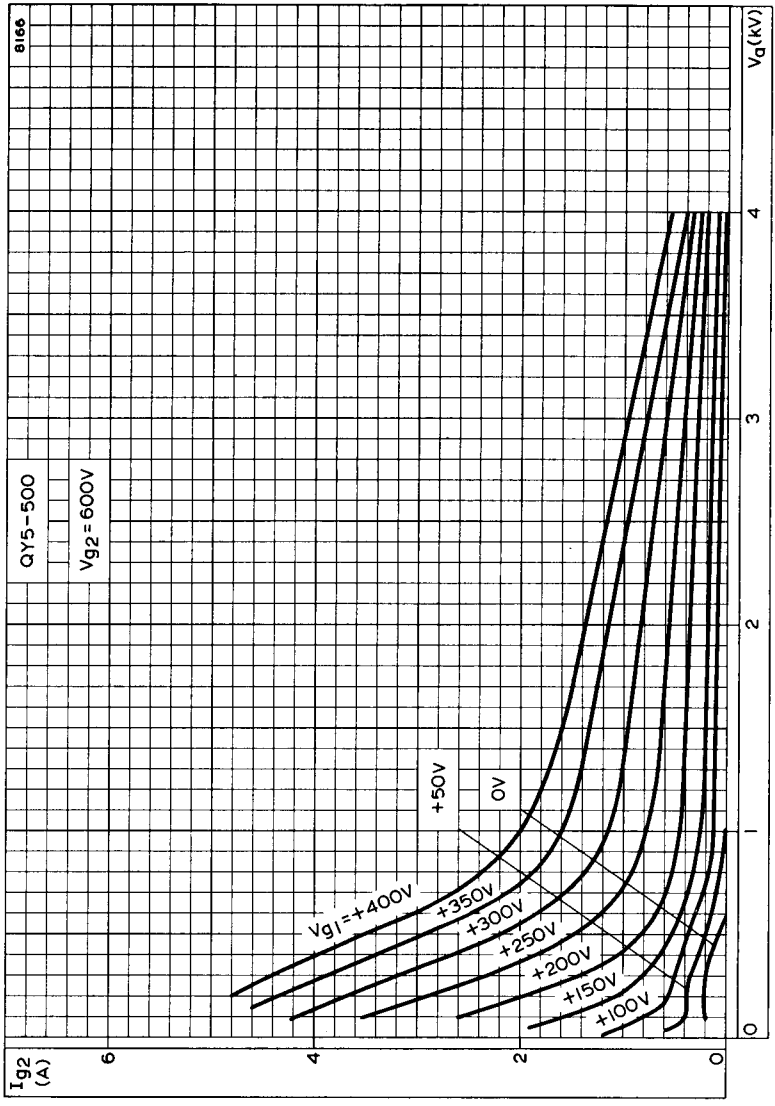
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B5K Base

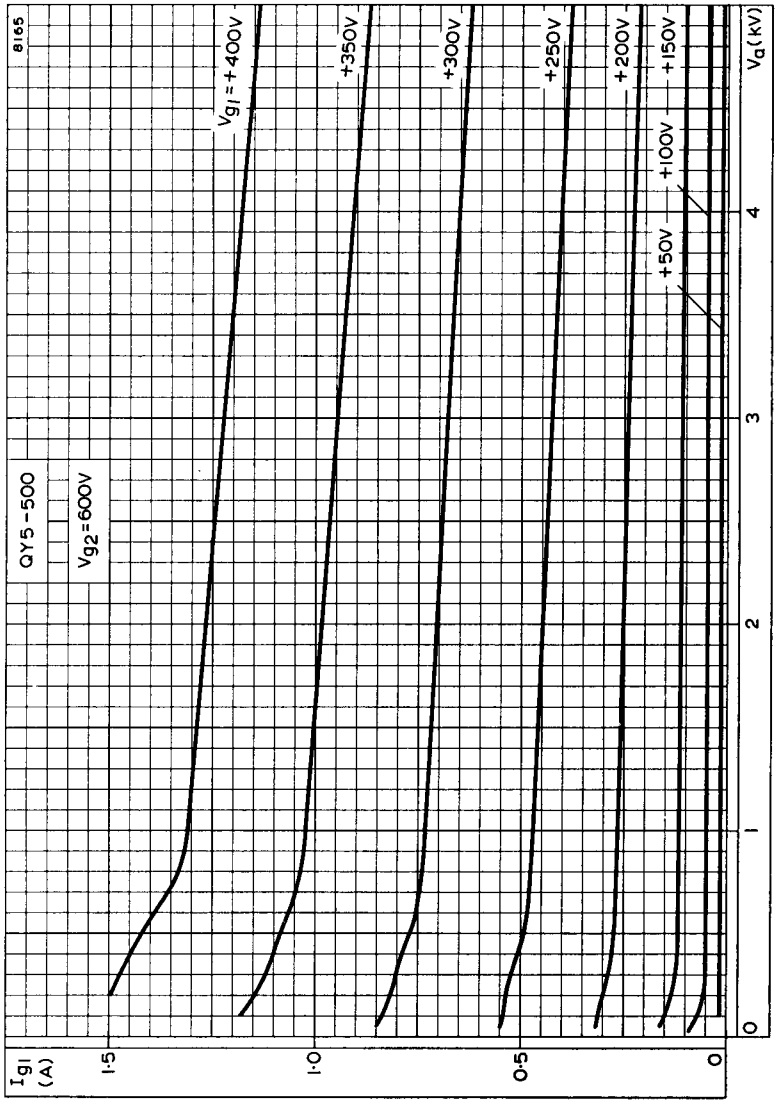
QY5-500



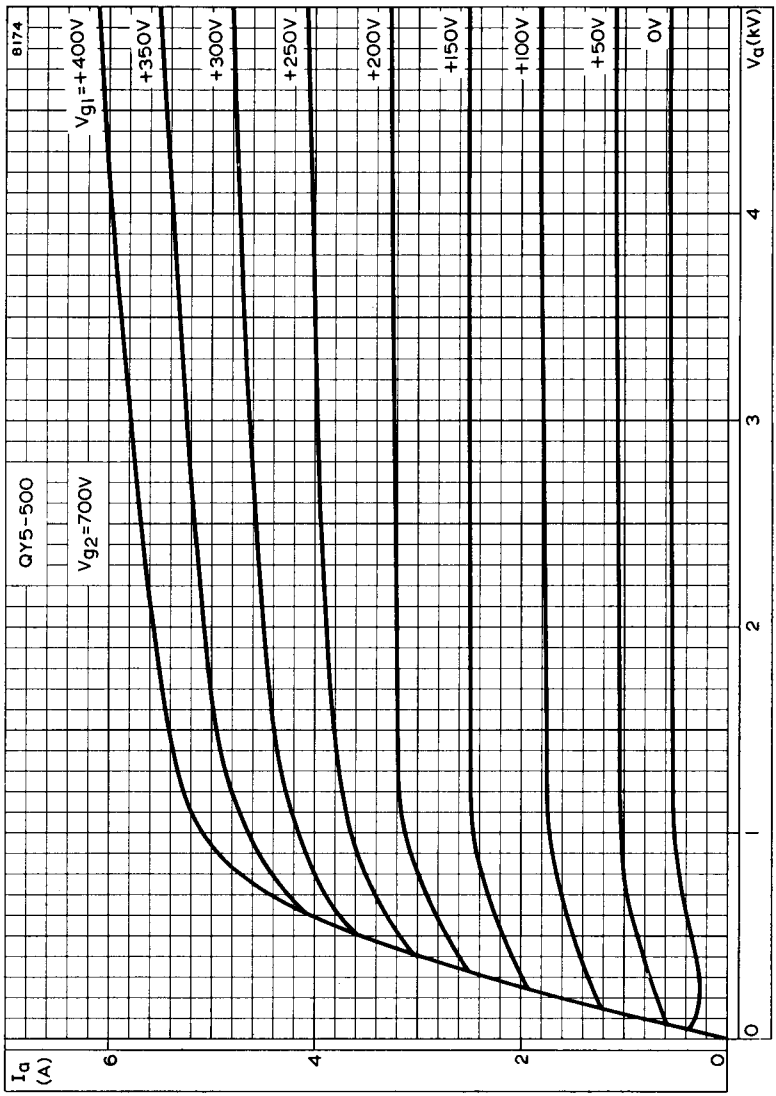
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 600V.



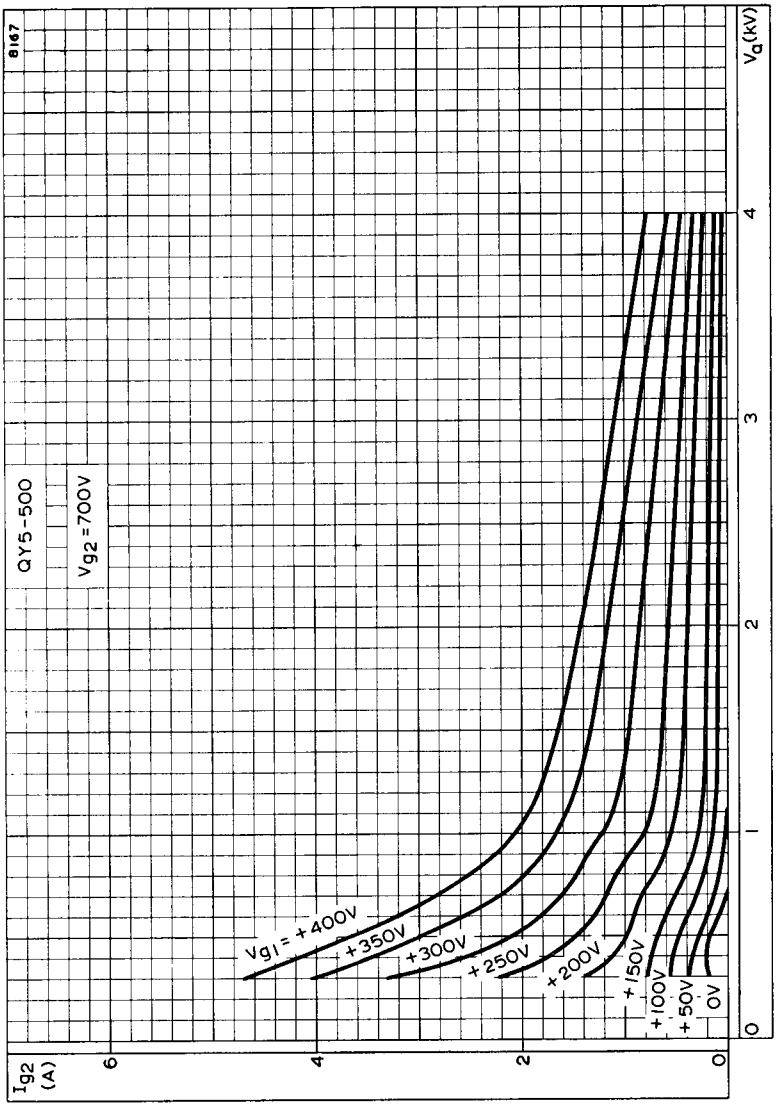
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 600V.



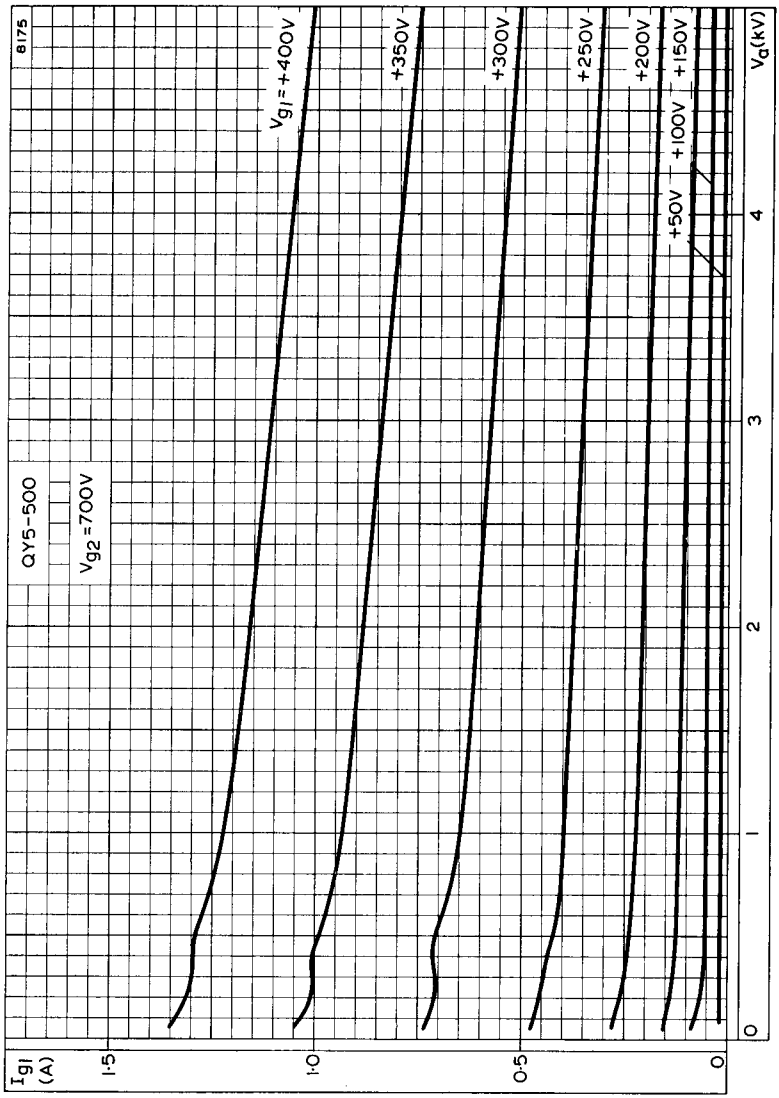
CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 600V.



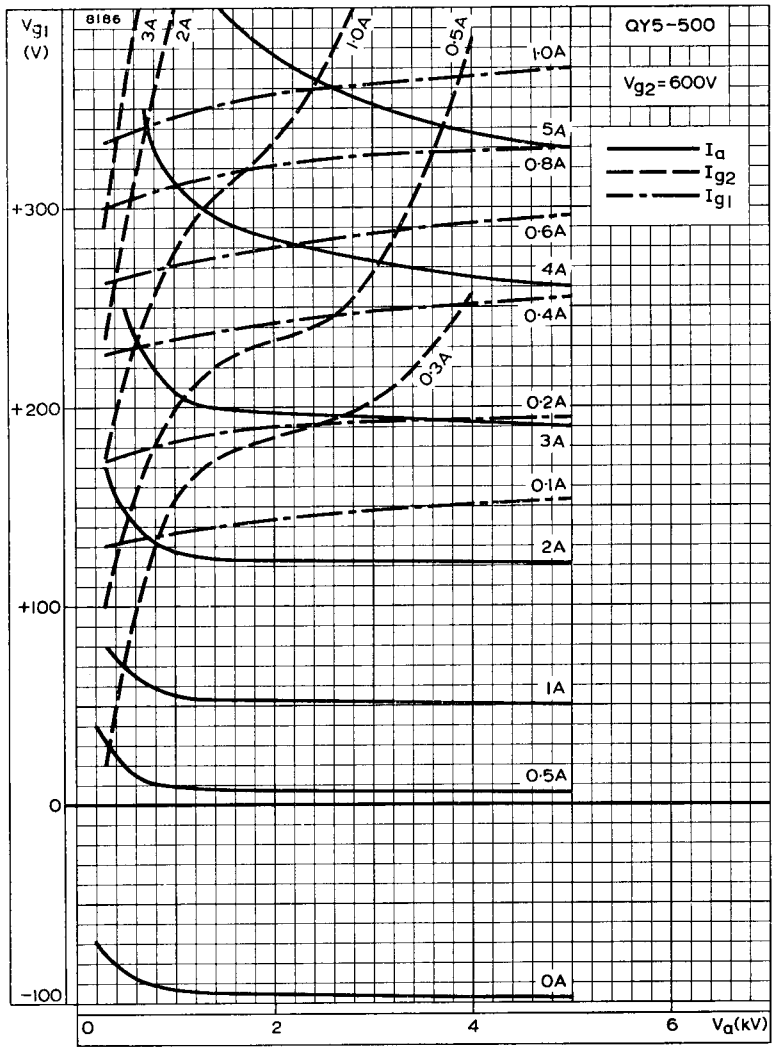
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 700V.



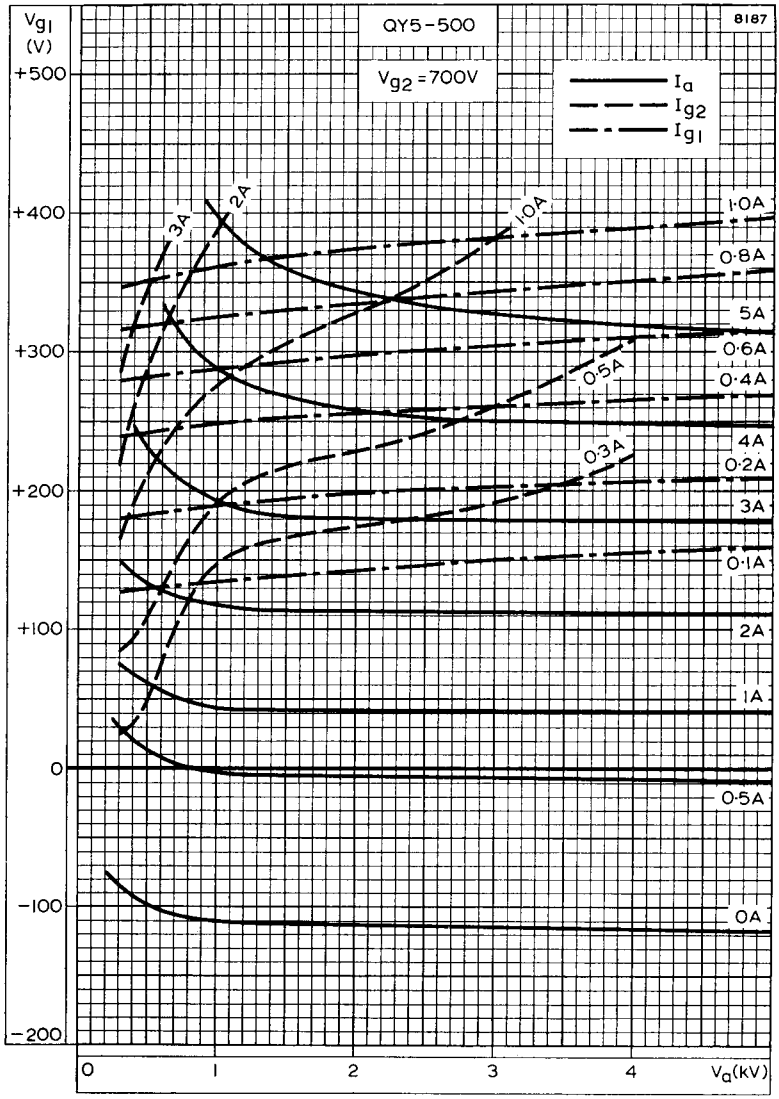
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 700V$.



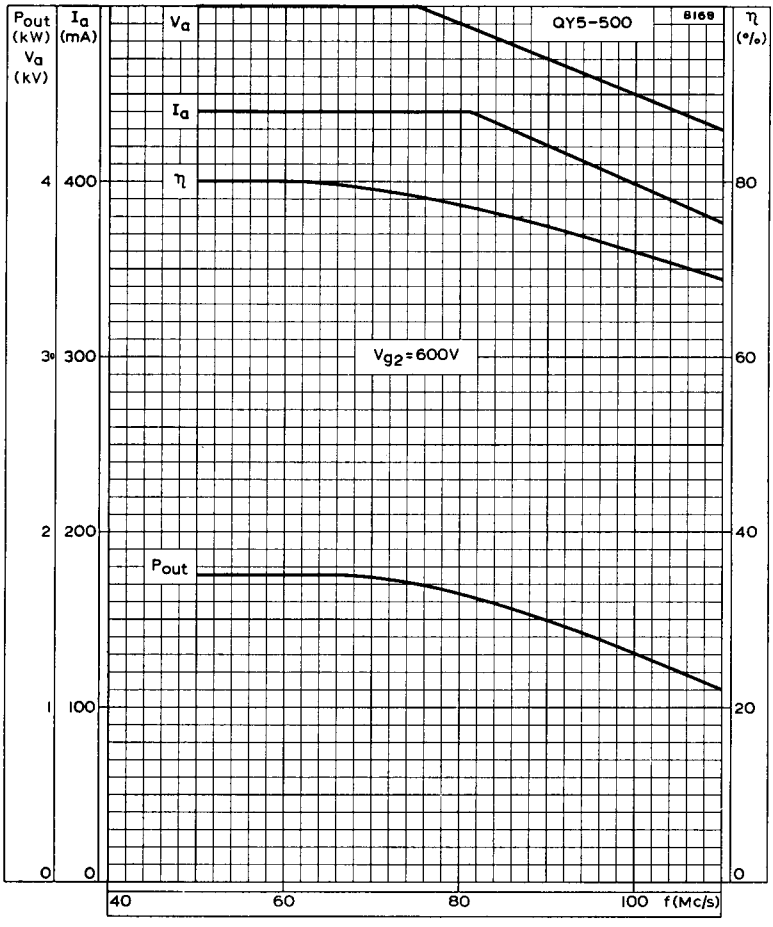
CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 700V.



CONSTANT CURRENT CURVES V_{g2} = 600V.



CONSTANT CURRENT CURVES. V_{g2} = 700V.



FREQUENCY CHARACTERISTICS

R.F. POWER TETRODE

QY5-800

PRELIMINARY DATA

QUICK REFERENCE DATA

Radiation and convection cooled tetrode intended for use as a linear amplifier in single side band suppressed carrier applications.

	Class 'C' telegraphy	Class 'AB1' SSB.	
f max.	30	30	Mc/s
V_a max.	5.5	5.5	kV
p_a max.	800	800	W
Performance			
f	30	30	Mc/s
P_{out}	2.4	1.3	kW

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT

Thoriated tungsten

V_f	7.5	V
I_f	22.6	A
$I_{f(surge)}$ max.	45	A

MOUNTING POSITION

Vertical

CAPACITANCES

C_{in}	47.6	pF
C_{out}	9.5	pF
C_{a-g1}	100	mpF

CHARACTERISTICS

V_a	4.0	kV
V_{g2}	600	V
I_a	200	mA
g_m	10	mA/V
μ_{g1-g2}	5.1	

QY5-800

R.F. POWER TETRODE

COOLING

In order to keep the temperature below the maximum permitted values it may be necessary to direct an air flow on to the seals.

$T_{anode\ seal}$ max.	220	°C
$T_{base\ seals}$ max.	180	°C
T_{bulb} max.	350	°C

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Absolute maximum ratings

f max.	30	Mc/s
V_a max.	5.5	kV
p_a max.	800	W
V_{g2} max.	800	V
p_{g2} max.	120	W
$-V_{g1}$ max.	500	V
I_{g1} (max.)	35	mA
I_k max.	925	mA
$i_{k(pk)}$ max.	4.5	A
R_{g1-f} max.	20	kΩ

Typical operation

f	30	Mc/s
V_a	5.0	kV
V_{g2}	600	V
V_{g1}	−240	V
I_a	600	mA
I_{g2}	185	mA
I_{g1}	20	mA
$v_{in(pk)}$	300	V
$P_{load\ (driver)}$	10	W
p_a	600	W
η_a	80	%
P_{out}	2.4	kW
P_{load}	2.0	kW

QY5-800

CLASS 'AB1' SINGLE SIDEBAND SUPPRESSED CARRIER

Absolute maximum ratings

f max.	30	Mc/s
V_a max.	5.5	kV
V_{g2} max.	800	V
p_a max.	800	W
p_{g2} max.	120	W
I_k max.	700	mA
$i_{k(pk)}$ max.	2.25	A
$-V_{g1}$ max.	500	V

Typical operation

Envelope peak to average $\geqslant 1$ and < 2

f	30	Mc/s
V_a	4.0	kV
V_{g2}	600	V
*V_{g1}	−110	V
$I_{a(o)}$	150	mA

'Single tone' modulation, maximum signal conditions

I_a	465	mA
I_{g2}	85	mA
I_{g1}	0	mA
$V_{in(pk)}$	100	V
$P_{load\ (driver)}$	3.0	W
p_a	560	W
p_{g2}	51	W
P_{out}	1.3	kW
η_a	69	%
P_{load}	1.11	kW

'Two tone' modulation, maximum signal conditions

I_a	330	mA
I_{g2}	40	mA
I_{g1}	0	mA
$V_{in(pk)}$	100	V
$P_{load\ (driver)}$	1.5	W
p_a	670	W
p_{g2}	24	W
P.E.P_{out}	1.3	kW
P_{out} (mean)	650	W
η_a	49	%
P.E.P_{load}	1.11	kW
†D_{im}	35	dB

*V_{g1} is set to give the $I_{a(o)}$ and will vary slightly from valve to valve.

†The voltage amplitude of all intermodulation products are below this level which is referred to the amplitude of either of the two tone frequencies. Relative to the peak envelope power these figures will be increased by 6dB. The figures are measured at full drive.

QY5-800

R.F. POWER TETRODE

PHYSICAL DATA

Weight of valve	1.4	lb
	620	g
Weight of valve plus carton	5.0	lb
	2.25	kg

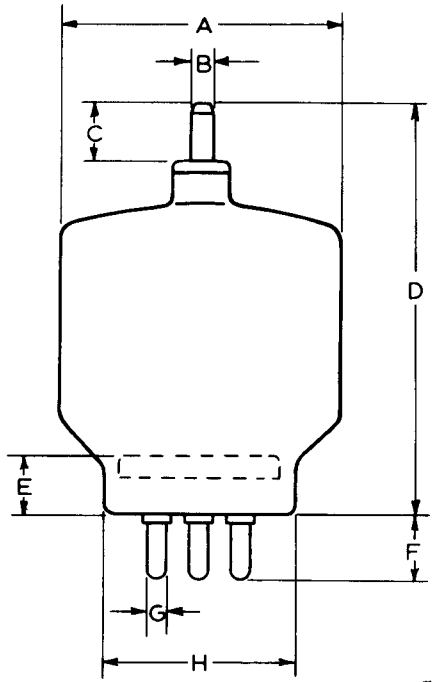
ACCESSORIES

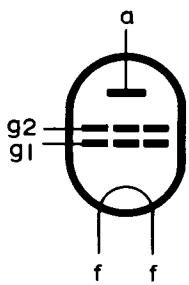
Socket	40216
Anode clip	40665

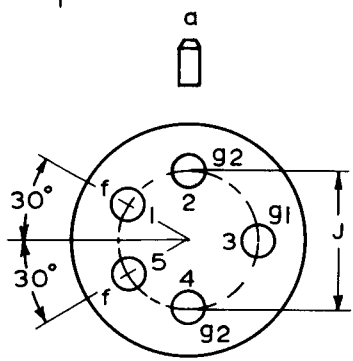
DIMENSIONS

	Inches	*Millimetres*	
A	6.02	153	max.
B	0.374	9.5	
C	0.98	25	
D	8.46 ± 0.24	215 ± 6	
E	1.75	44.5	
F	1.06	27	
G	0.374	9.5	
H	3.19	81	max.
J	1.50	38.1	

QY5-800



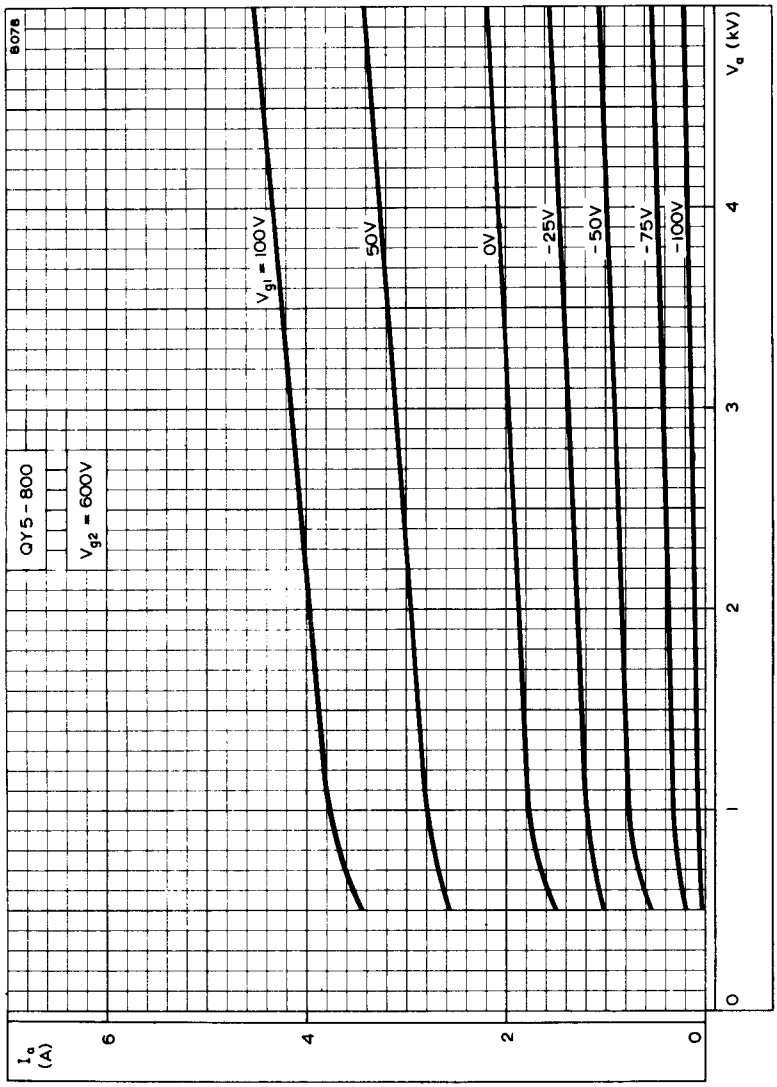




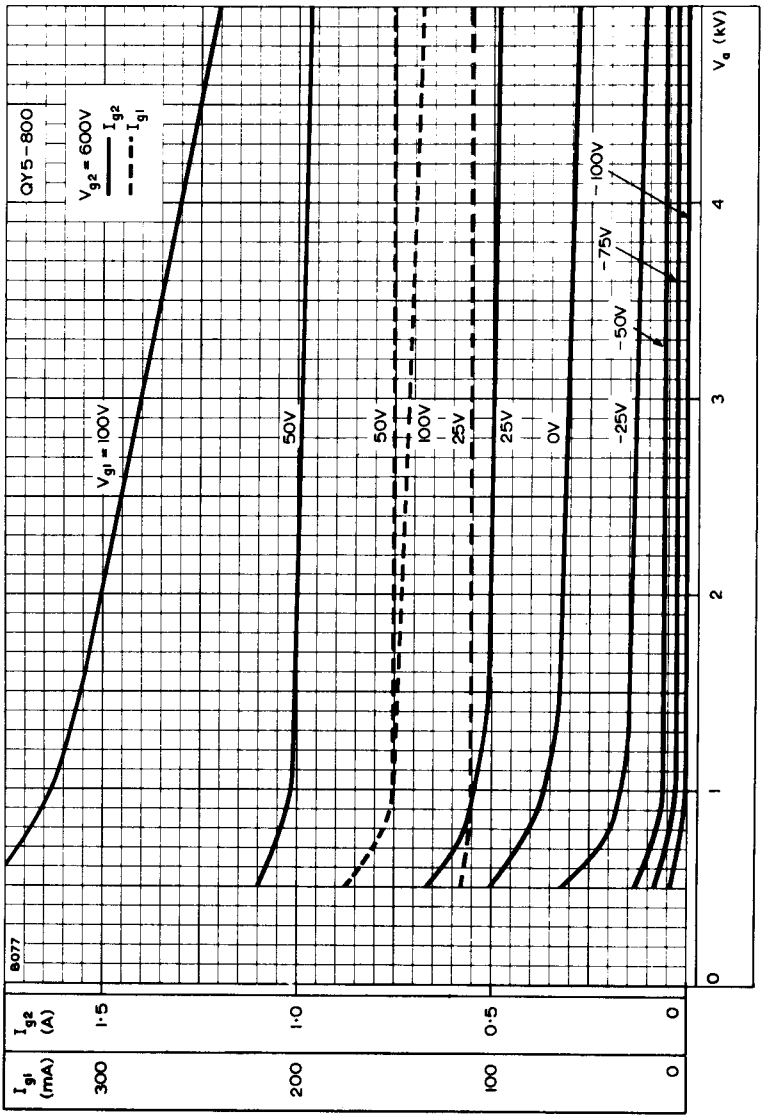
9321

B5K Base

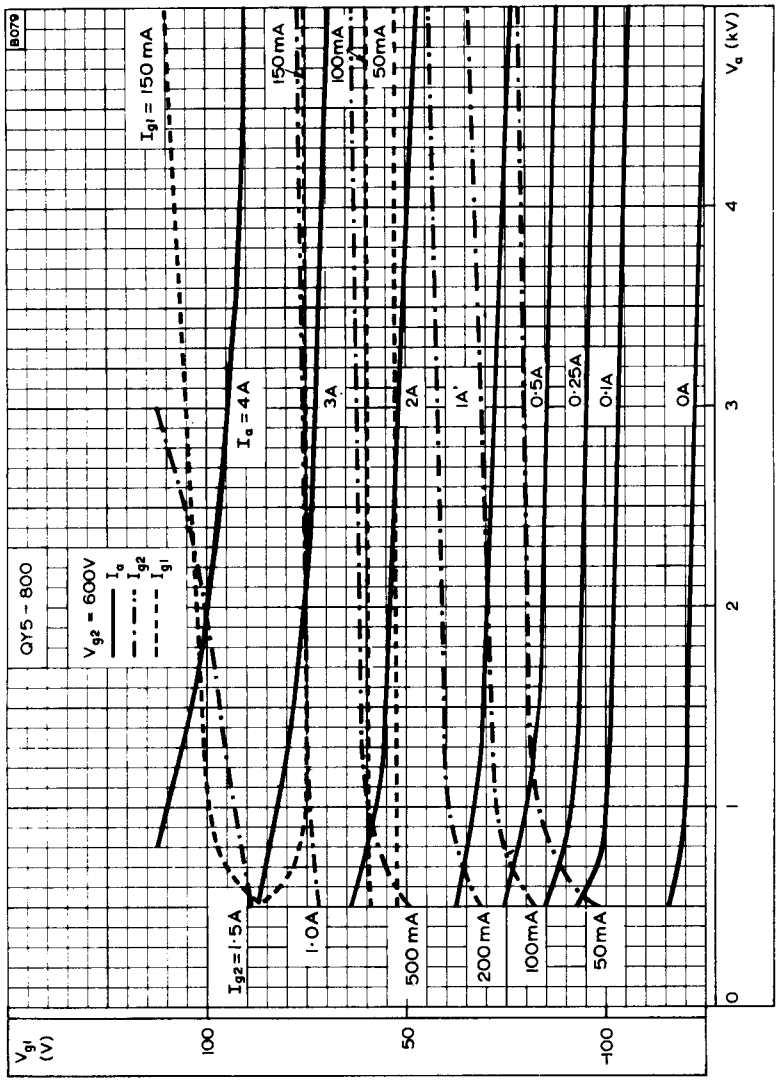
QY5-800



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



CONSTANT CURRENT CURVES

V.H.F. POWER TETRODE QY5-800

QUICK REFERENCE DATA

Radiation and convection cooled tetrode intended for use as a linear amplifier in single sideband suppressed carrier applications.

	Class 'AB1' Linear Amplifier for S.S.B. operation	Class 'C' Telegraphy or F.M. Telephony	
f	30	30	Mc/s
P_{out}	*1.3	2.4	kW
f max.	30	30	Mc/s
V_a max.	5.5	5.5	kV
p_a max.	800	800	W

*P.E.P_{out}

To be read in conjunction with

GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

f	30	Mc/s
P_{out}	2.4	kW
P_{load}	2.0	kW
η_a	80	%
V_a	5.0	kV
I_a	600	mA
V_{g2}	600	V
I_{g2}	185	mA
$-V_{g1}$	240	V
I_{g1}	20	mA
v_{in} pk	300	V
P_{load} (driver)	10	W
p_a	600	W

CLASS 'AB1' LINEAR AMPLIFIER FOR SINGLE SIDEBAND OPERATION

Maximum operating conditions

f	30	Mc/s
P.E.P$_{out}$	1.3	kW
P.E.P$_{load}$	1.1	kW
**d_3	35	dB
**d_5	40	dB
V_a	4.0	kV
V_{g2}	600	V
***$-V_{g1}$	110	V
$I_{a(o)}$	150	mA
$I_{g2(o)}$	8.0	mA

	Single tone	Double tone	
I_a	465	330	mA
I_{g2}	85	40	mA
I_{g1}	0	0	mA
$V_{in(pk)}$	100	100	V
P_{load} (driver)	3.0	-	W
p_a	560	670	W
η_a	69	49	%

**Third and fifth order intermodulation products. Maximum values encountered at any level of drive voltage referred to the amplitude of either of the two tones at that level.

***Adjust to give the desired value of $I_{a(o)}$.

ABSOLUTE MAXIMUM RATINGS

	Class 'AB1' S.S.B.	Class 'C' Telegraphy	
f max.	30	30	Mc/s
V_a max.	5.5	5.5	kV
V_{g2} max.	800	800	V
$-V_{g1}$ max.	500	500	V
I_k max.	700	925	mA
p_a max.	800	800	W
p_{g2} max.	120	120	W
I_{g1} max.	0	35	mA
p_{g1} max.	0	40	W
R_{g1-f} max.	20	20	kΩ

V.H.F. POWER TETRODE QY5-800

CATHODE

Directly heated, thoriated tungsten

V_f	7.5	V
I_f	22.6	A
$I_{f\ (surge)}$	45	A

CAPACITANCES

c_{a-g1}	100	nF
c_{out}	9.5	pF
c_{in}	47.6	pF

CHARACTERISTICS (measured at V_a = 4.0kV, V_{g2} = 600V, I_a = 200mA)

g_m	10	mA/V
μ_{g1-g2}	5.1	

MOUNTING POSITION

Vertical

COOLING

Radiation and convection.

Maximum temperatures

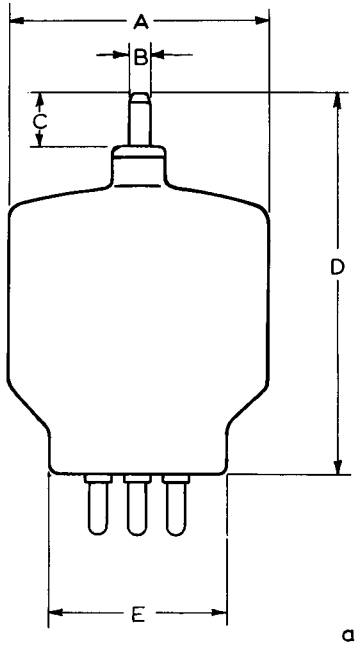
Anode seal	220	°C
Base seals	180	°C
Bulb	350	°C

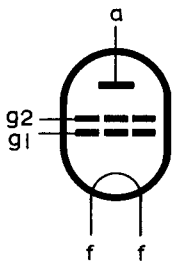
PHYSICAL DATA

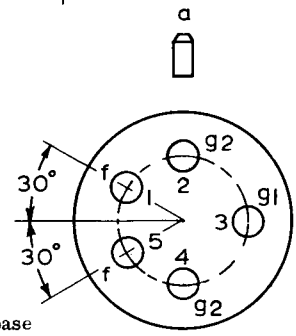
	lb	kg
Weight of valve	1.4	0.62
Weight of valve and carton	5.0	2.25

ACCESSORIES

Socket	40216
Anode clip	40665







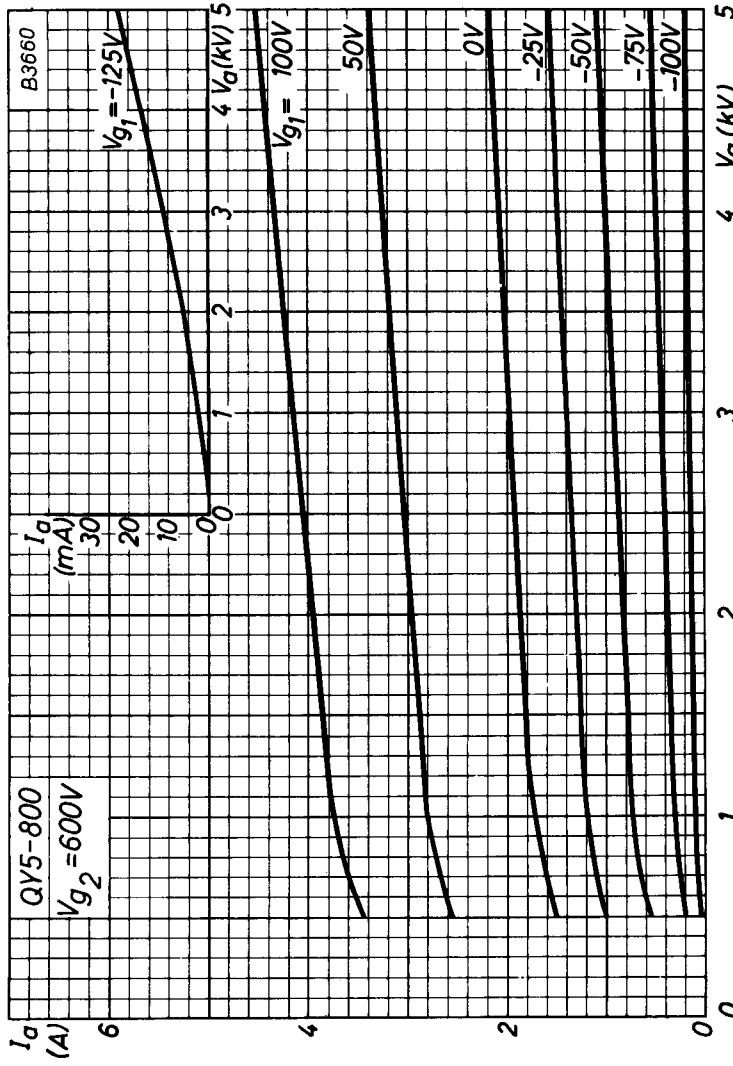
B5K base
(according to BS448)

9321

DIMENSIONS

	Inches	Millimetres	
A	6.023	153	max.
B	0.374	9.5	
C	0.984	25	
D	8.465 ± 0.236	215 ± 6.0	
E	3.189	81	max.

Inch dimensions derived from original millimetre dimensions.

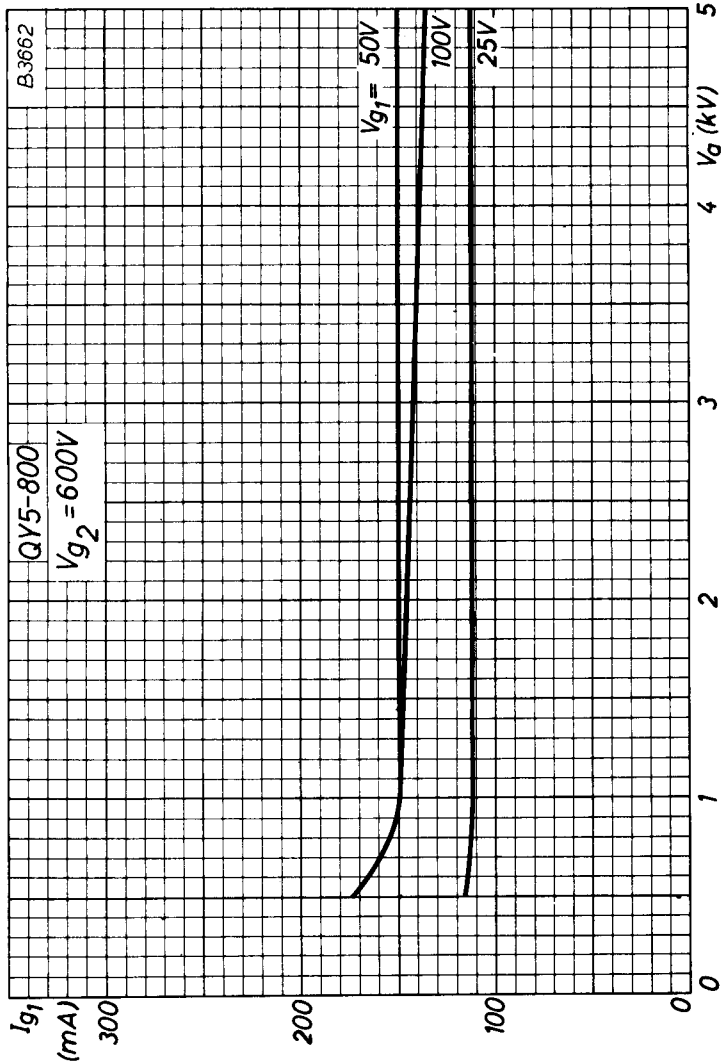


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, V_{g2} = 600V

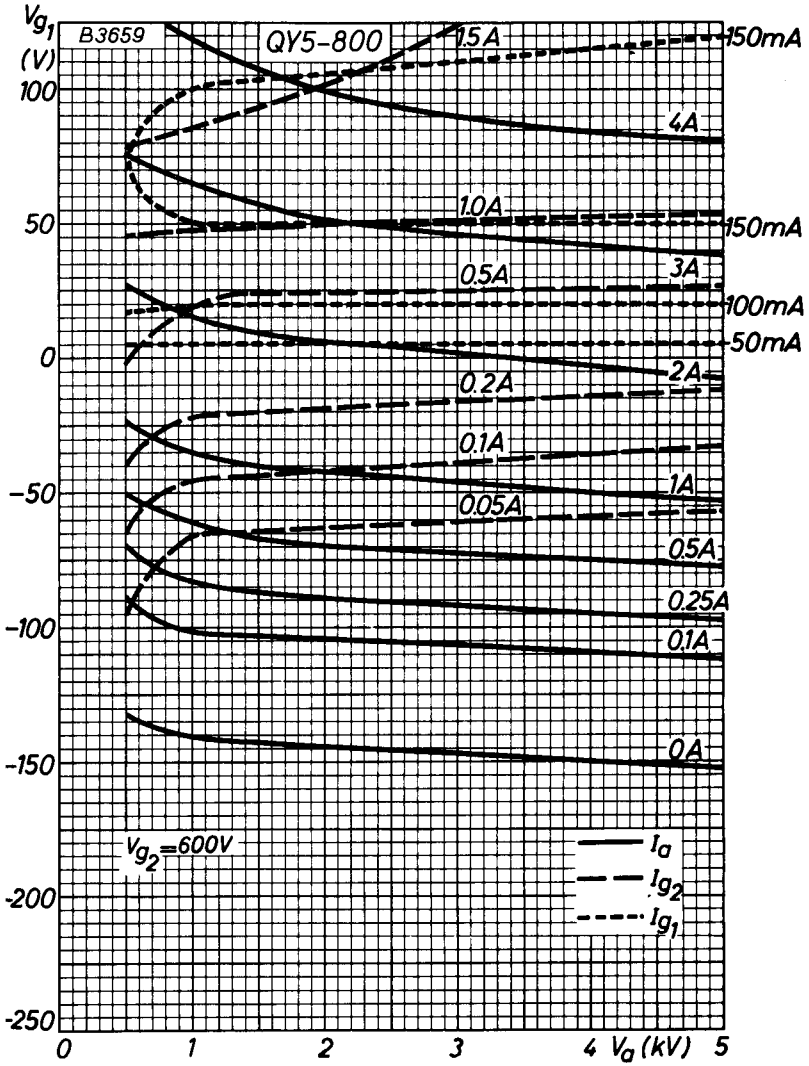


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

V_{g2} = 600V



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 600V



CONSTANT CURRENT CHARACTERISTICS. V_{g2} = 600V

U.H.F. POWER TETRODE QY3-1000A

PRELIMINARY DATA

QUICK REFERENCE DATA

External anode forced-air cooled tetrode. Intended for use as r.f. power amplifier.

Performance

f	800	Mc/s
P_{out}	2.5	kW
f max.	900	Mc/s
Va max.	4.5	kV
pa max.	1.5	kW

These data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES which precede this section of the handbook.

CLASS 'C' TELEGRAPHY, CATHODE MODULATED

Absolute maximum ratings

f max.	900	Mc/s
Va max.	4.5	kV
Vg2 max.	600	V
-Vg1 max.	300	V
Ia max.	900	mA
Ig2 max.	75	mA
Ig1 max.	100	mA
pa max.	1.5	kW
pg2 max.	50	W

Typical operating conditions

f	800	Mc/s
Va	4.2	kV
Vg2	450	V
-Vg1	110	V
Ia	850	mA
Ig2	28	mA
Ig1	50	mA
Pload (driver)	180	W
Pout	2.5	kW
Pload	2.1	kW
Power gain	12	

CLASS 'C' AMPLIFIER, CATHODE MODULATED FOR TELEVISION SERVICE
(negative modulation, positive synchronisation)

Absolute maximum ratings

f max.	900	Mc/s
Va max.	4.5	kV
Vg2 max. (sync)	600	V
-Vg1 max.	500	V
Ia max. (sync)	950	mA
Ig2 max. (sync)	75	mA
Ig1 max. (sync)	100	mA
pa max.	1.5	kW
pg2 max.	50	W

Typical operating conditions

f	800	Mc/s
Bandwidth (-3.0dB)	6.0	Mc/s
Va	4.2	kV
Vg2	400	V
-Vg1		
Sync	120	V
Black	175	V
White	345	V
Ia		
Sync	900	mA
Black	680	mA
Ig2		
Sync	15	mA
Black	5.0	mA
Ig1		
Sync	50	mA
Black	35	mA
Pload (driver) sync	220	W
Pout		
Sync	2.7	kW
Black	1.5	kW
Pload		
Sync	2.2	kW
Black	1.3	kW
Power gain	10	

CATHODE

Directly heated, thoriated tungsten.

*Vf	4.0	V
If	60	A
If (surge) max.	150	A

*It may be necessary to adjust the filament voltage for optimum performance depending upon the operating condition and frequency. The filament connection must be carefully screened from high frequency sources.

CAPACITANCES

ca-g1	150	mpF
ca-f	6.0	pF
cg1-f	46	pF

With g1 and g2 earthed

ca-g2	7.0	pF
ca-f	20	mpF
cg1-f	20	pF

CHARACTERISTICS (measured at Va = 3.0kV, Vg2 = 500V, Ia = 480mA)

gm	20	mA/V
μg1-g2	9.0	

COOLING

Forced-air cooled

Tanode max. (measured at point indicated on page D5)	180	°C
Tseals max.	220	°C

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea level. The airflow should be directed on the valve as shown on page D6. Typical values of inlet temperature, rate of airflow and pressure difference between the inlet and outlet of the radiator are given in the following table

Anode dissipation pa	Height above sea level h		Max. inlet temperature T in max	Min. rate of airflow per min.		Pressure difference between inlet and outlet of radiator
(kW)	(km)	(ft)	(°C)	(m^3)	(ft^3)	(mm H_2O)
1.5	0	0	45	3.2	113	75

MOUNTING POSITION Vertical

PHYSICAL DATA

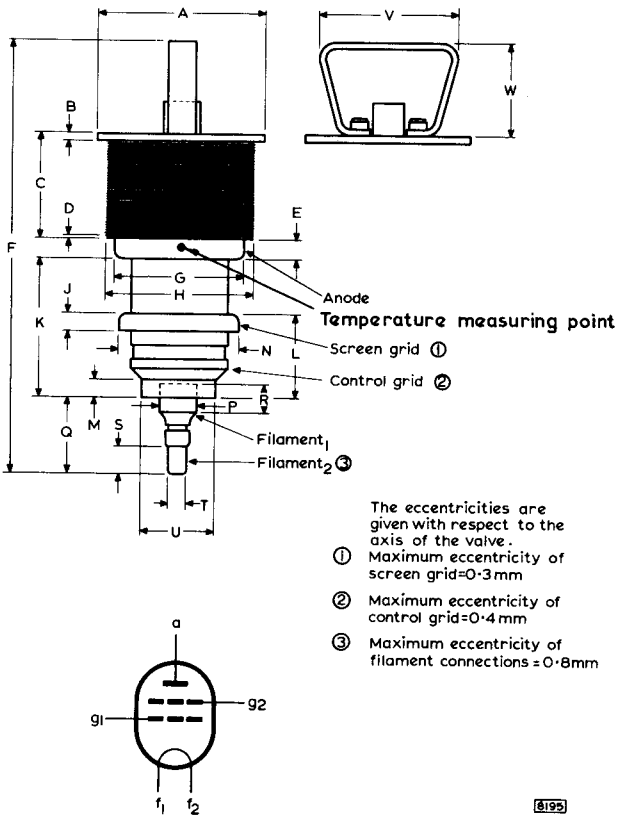
Weight of valve only	4 lb	3oz
	1.9	kg

OPERATING NOTE

In a cathode driven v.h.f. amplifier circuit, a tunable coaxial circuit is incorporated between g1 and g2 which introduces a variable capacitive reactance between the grids. This results in increased efficiency and negligible feedback from anode to cathode in the amplifier circuit.

DIMENSIONS

	Inches	Millimetres	
A	3.504	89	dia
B	0.118	3.0	
C	2.165	55	
D	0.079	2.0	
E	0.374	9.5	min
F	8.465	215	
G	2.756±0.012	70±0.3	dia
H	3.228±0.012	82±0.3	dia
J	0.354	9.0	min
K	2.913±0.039	74±1	
L	1.811±0.039	46±1	
M	0.374	9.5	min
N	2.520±0.012	64±0.3	dia
P	0.661±0.008	16.8±0.2	
Q	1.299±0.039	33±1	
R	0.374	9.5	min
S	0.512	13	min
T	0.358±0.008	9.1±0.2	dia
U	1.535±0.012	39±0.3	dia
V	2.480	63	
W	1.575	40	
AA	3.327	84.5	
BB	1.969	50	



The eccentricities are given with respect to the axis of the valve.

① Maximum eccentricity of screen grid=0·3 mm

② Maximum eccentricity of control grid=0·4 mm

③ Maximum eccentricity of filament connections = 0·8mm

Fig 1

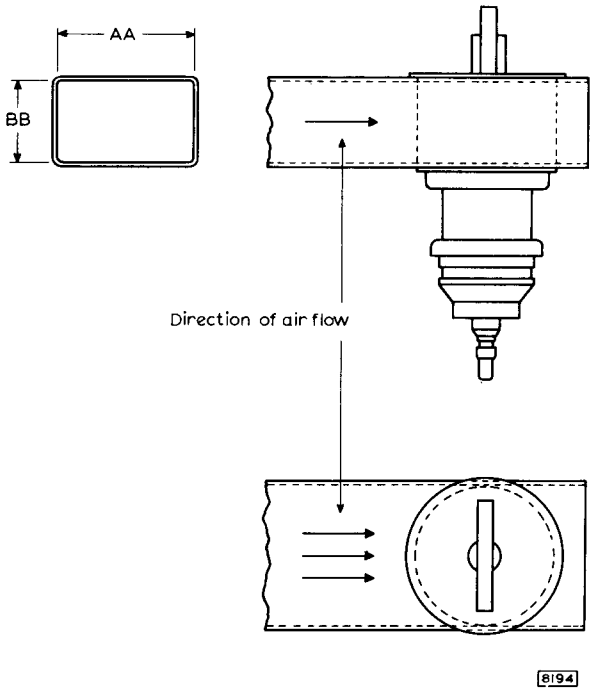
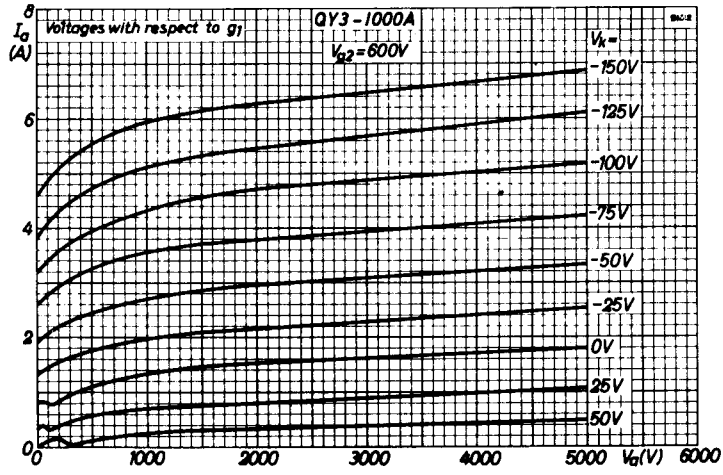
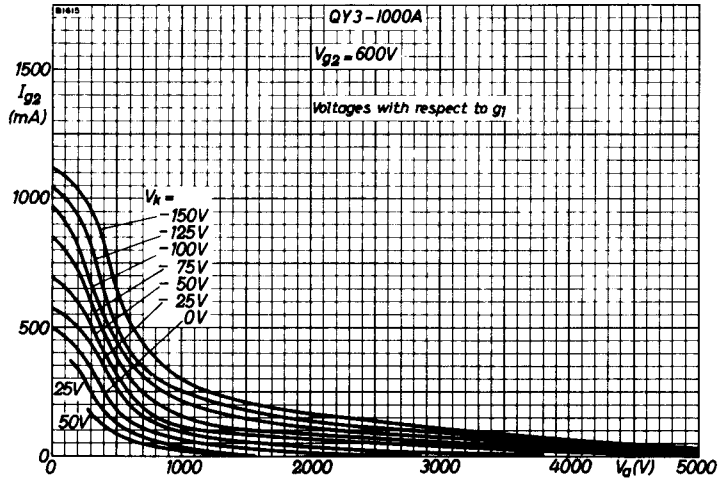
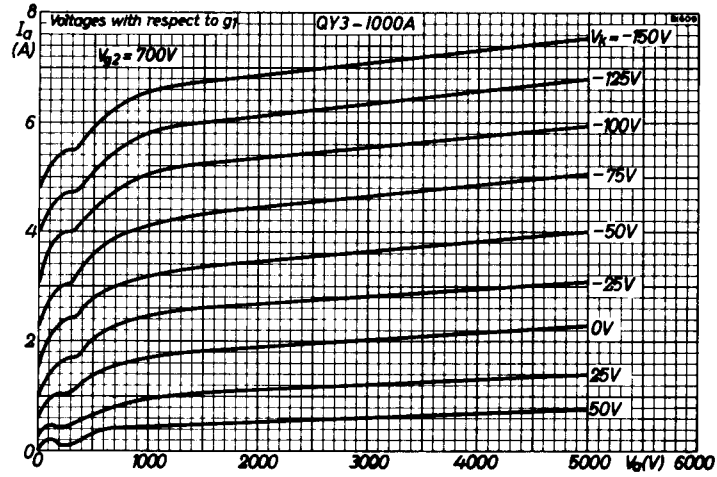


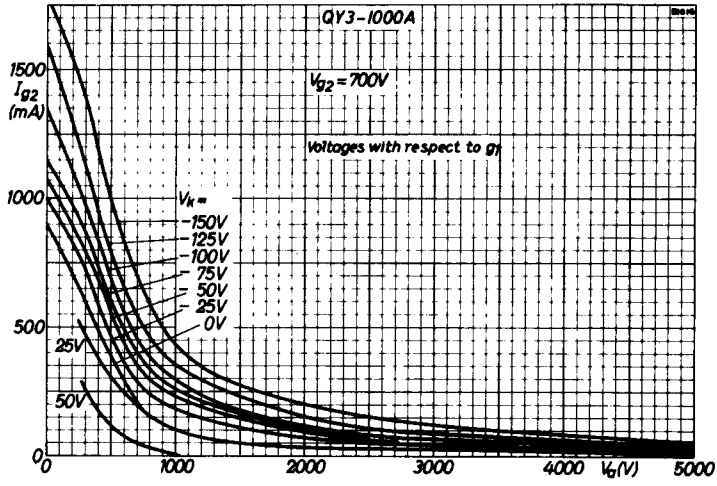
Fig 2



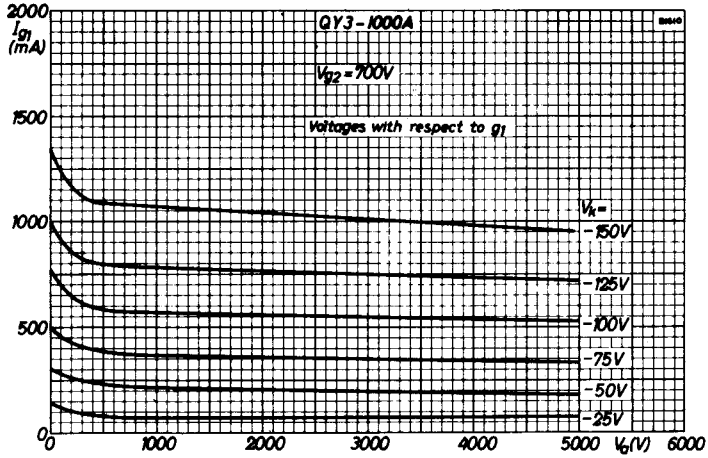


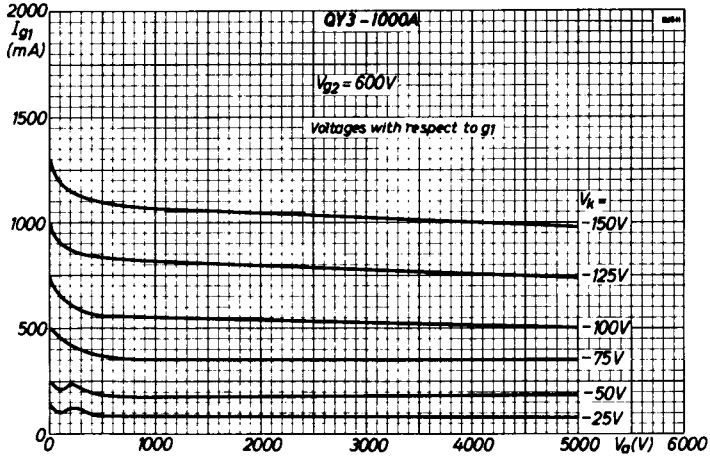
ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CATHODE VOLTAGE AS PARAMETER V_{g2} = 600V



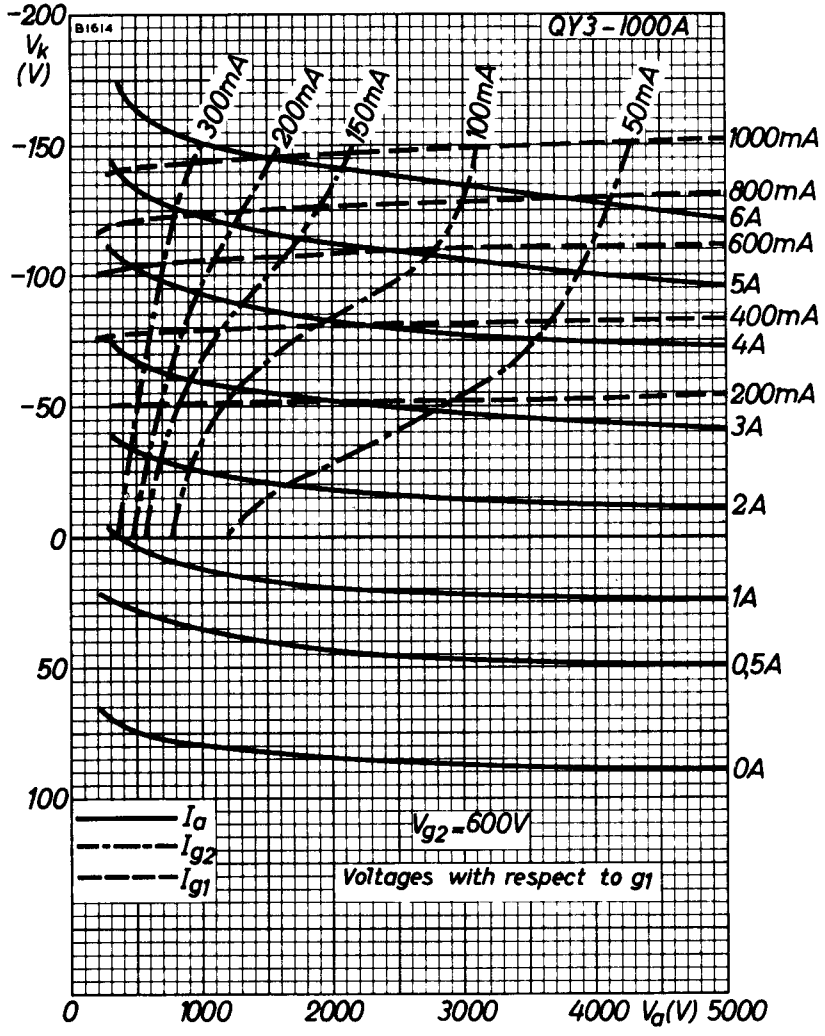


ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CATHODE VOLTAGE AS PARAMETER V_{g2} = 700V

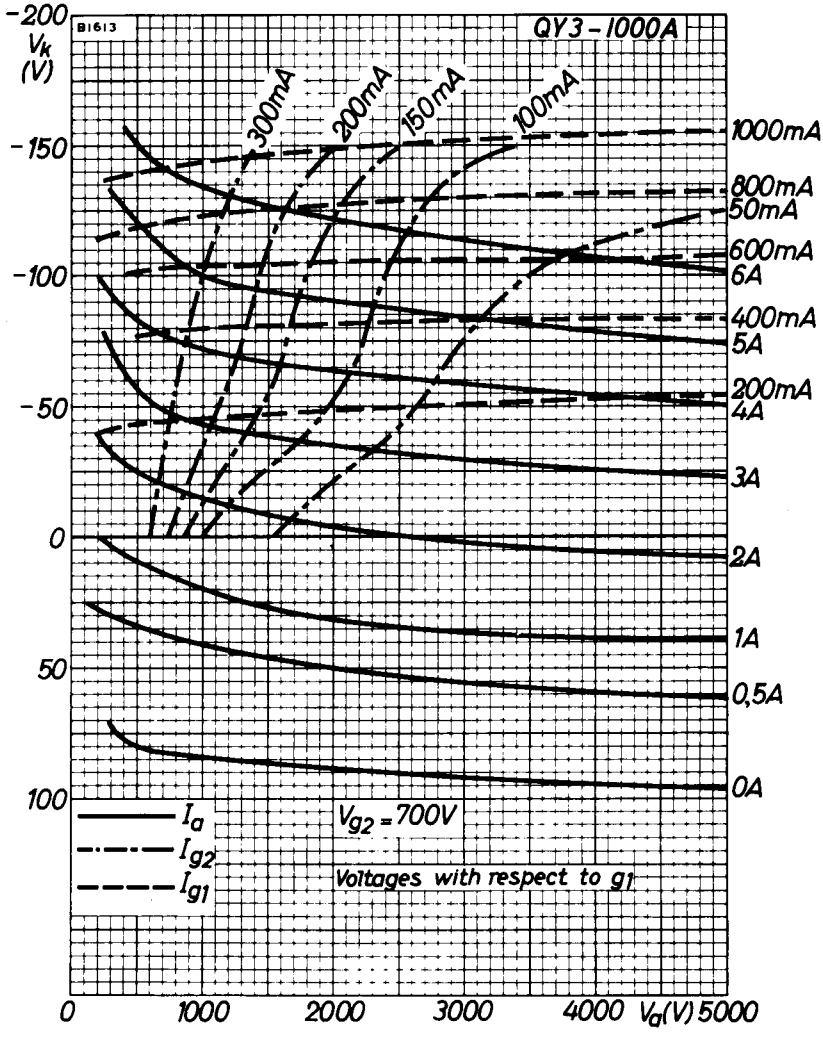




CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CATHODE VOLTAGE AS PARAMETER V_{g2} = 600V AND V_{g2} = 700V



CONSTANT CURRENT CURVES V_{g2} = 600V



CONSTANT CURRENT CURVES V_{g2} = 700V

R.F. POWER TETRODE

QY5-3000A

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

PRELIMINARY DATA

This data should be read in conjunction with " Operating Notes Part 1—Power Valves " included in this volume of the Handbook.

FILAMENT

Thoriated tungsten.

V_f	6.3	V
I_f	32.5	A

CAPACITANCES

c_{in}	23.5	μμF
c_{out}	8.4	μμF
c_{a-g1}	<0.35	μμF

CHARACTERISTICS (measured at V_a=4.0 kV, I_a=2.0 A)

g_m	19	mA/V
μ_{g1-g2}	8.5	

COOLING

Max. temperature of seals	180	°C
Max. bulb temperature	250	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals.

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea-level.

Typical values of input temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table.

Anode Dissipation	Height above sea-level	Input Temperature	Rate of flow of air	Pressure difference between inlet and outlet
p_a (kW)	h (m)	T_{in} (°C)	(m^3/min)	(mm of H_2O)
1.0	0	35	1.8	10
1.0	0	45	2.2	15
1.0	1,500	35	2.2	13
1.0	3,000	25	2.3	13
2.5	0	35	4.5	60
2.5	0	45	5.4	85
2.5	1,500	35	5.4	73
2.5	3,000	25	5.8	75
3.0	0	35	5.7	95

QY5-3000A

R.F. POWER TETRODE

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

OPERATION AS SINGLE VALVE R.F. POWER OSCILLATOR OR AMPLIFIER (CLASS "C" TELEGRAPHY)

Limiting Values

V_a max. (f <110 Mc/s)	5.0	kV
V_a max. (f <220 Mc/s)	4.0	kV
V_{g2} max.	800	V
$-V_{g1}$ max.	500	V
I_a max.	1.1	A
p_a max.	3.0	kW
p_{g2} max.	100	W
p_{g1} max.	30	W

Typical Operating Conditions

f	75	110	75	110	Mc/s
V_a	5	5	4	4.0	kV
V_{g2}	800	800	800	800	V
V_{g1}	−250	−250	−250	−250	V
I_a	1.1	1.1	1.1	1.1	A
I_{g2}	100	100	120	120	mA
I_{g1}	70	70	80	80	mA
$V_{in(pk)}$	480	480	500	500	V
P_{drive}	30	30	36	36	W
P_{out}	4.1	3.9	3.15	2.9	kW
η	74.5	71.5	72	69	%

OPERATION AS R.F. POWER AMPLIFIER (CLASS "C" ANODE AND SCREEN-GRID MODULATION). Screen-grid modulated through a choke of 60 H.

Limiting Values

V_a max. (f <110 Mc/s)	4.0	kV
V_a max. (f <220 Mc/s)	3.2	kV
V_{g2} max.	800	V
$-V_{g1}$ max.	500	V
I_a max.	900	mA
p_a max.	2.0	kW
*p_{g2} max.	100	W
p_{g1} max.	30	W

*For other methods of modulation, p_{g2} max. = 65 W.

Typical Operating Conditions

V_a	4.0	kV
V_{g2}	800	V
V_{g1}	−375	V
I_a	900	mA
I_{g2}	120	mA
I_{g1}	85	mA
$V_{in\ (pk)}$	625	V
P_{drive}	48	W
P_{out}	2.7	kW
η	75	%
For 100% modulation		
$P_{mod.}$	1.8	kW

R.F. POWER TETRODE

QY5-3000A

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

OPERATION AS R.F. AMPLIFIER CLASS "C" GRID-MODULATION FOR TELEVISION SERVICE (with positive modulation and negative synchronisation).

Limiting Values

f max.	220	Mc/s
V_a max.	4.0	kV
V_{g_2} max.	800	V
$-V_{g_1}$ max.	500	V
I_a (peak white) max.	1.1	A
I_{g_1} (peak white) max.	80	mA
P_{in} (peak white) max.	4.4	kW
p_a (peak white) max.	3.0	kW
p_{g_2} (peak white) max.	100	W

Typical Operating Conditions for 2 Valves in Push-Pull

f	170–220	170–220	Mc/s
*Bandwidth (–1.5 db)	—	6.5	Mc/s
*Bandwidth (–3.0 db)	7.5	12	Mc/s
V_a	4.0	4.0	kV
V_{g_2}	800	800	V
V_{g_1} (peak white)	–230	–230	A
V_{g_1} (black)	–380	–380	V
$v_{in\ (g_1-g_1)\ pk}$	850	850	V
I_a (peak white)	1.7	2.1	A
I_a (black)	0.5	0.6	A
I_{g_2} (peak white)	80	50	mA
I_{g_2} (black)	10	10	mA
I_{g_1} (peak white)	25	50	mA
I_{g_1} (black) (approx.)	0	0	mA
†P_{drive} (peak white)	200–300	300–400	W
P_{out} (peak white)	4.0	2.8	kW
P_{out} (black)	360	250	W
‡P_{load} (peak white)	2.8	1.96	kW

*Bandwidth based on a single LC circuit.

†Includes power dissipated in circuit and loading resistors.

‡With a circuit transfer efficiency of 70%.

OPERATION AS R.F. POWER AMPLIFIER CLASS "B" FOR TELEVISION SERVICE (with positive modulation and negative synchronisation).

Limiting Values

f max.	220	Mc/s
V_a max.	4.0	kV
V_{g_2} max.	800	V
I_a (peak white) max.	1.1	A
I_{g_1} (peak white) max.	80	mA
P_{in} (peak white) max.	4.4	kW
p_a (peak white) max.	3.0	kW
p_{g_2} (peak white) max.	100	W

QY5-3000A

R.F. POWER TETRODE

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW Primarily intended for use in V.H.F. television transmitters.

Typical Operating Conditions for 2 Valves in Push-Pull

f	170–220	Mc/s
*Bandwidth (–1.5 db)	6.5	Mc/s
*Bandwidth (–3.0 db)	12	Mc/s
V_a	4.0	kV
V_{g2}	800	V
V_{g1}	–150	V
$V_{in\ (g1-g1)(pk)}$ (peak white)	700	V
$V_{in\ (g1-g1)(pk)}$ (black)	350	V
I_a (peak white)	2.1	A
I_a (black)	0.6	A
I_{g2} (peak white)	50	mA
I_{g2} (black)	10	mA
I_{g1} (peak white)	50	mA
I_{g1} (black) (approx.)	0	mA
†P_{drive} (peak white)	200 to 300	W
P_{out} (peak white)	2.8	kW
P_{out} (black)	250	W
‡P_{load} (peak white)	1.96	kW

*Bandwidth based on a single LC circuit.

†Includes power dissipated in circuit and loading resistors.

‡With a circuit transfer efficiency of 70%.

OPERATION AS R.F. AMPLIFIER CLASS "C" GRID-MODULATION FOR TELEVISION SERVICE (with negative modulation and positive synchronisation).

Limiting Values

f max.	220	Mc/s
V_a max.	4.0	kV
V_{g2} max.	800	V
$-V_{g1}$ max.	500	V
I_a (sync.) max.	1.5	A
P_{in} (sync.) max.	6.0	kW
p_a (sync.) max.	3.0	kW
p_{g2} (sync.) max.	100	W
p_{g1} (sync.) max.	30	W

Typical Operating Conditions for 2 Valves in Push-Pull

f	170–220	170–220	Mc/s
*Bandwidth (–1.5 db)	6.5	—	Mc/s
*Bandwidth (–3 db)	12	7.5	Mc/s
V_a	4.0	4.0	kV
V_{g2}	800	800	V
V_{g1} (sync.)	–150	–150	V
V_{g1} (black)	–230	–230	V
V_{g1} (white)	–450	–450	V
$V_{in(g1-g1)pk}$	850	850	V
I_a (sync.)	2.75	2.75	A
I_a (black)	2.1	1.7	A
I_{g2} (sync.)	110	250	mA

(continued)

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

Typical Operating Conditions for 2 Valves in Push-Pull (*contd.*)

I_{g_2} (black)	50	80	mA
I_{g_1} (sync.)	100	80	mA
I_{g_1} (black)	50	25	mA
†P_{drive} (sync.)	300–400	200–300	W
P_{out} (sync.)	5.0	5.9	kW
P_{out} (black)	2.8	4.0	kW
‡P_{load} (sync.)	3.5	4.13	kW

*Bandwidth based on a single LC circuit.

†Includes power dissipated in circuit and loading resistors.

‡With a circuit transfer efficiency of 70%.

OPERATION AS R.F. AMPLIFIER CLASS "B" FOR TELEVISION SERVICE (with negative modulation and positive synchronisation).

Limiting Values

f max.	220	Mc/s
V_a max.	4.0	kV
V_{g_2} max.	800	V
I_a (sync.) max.	1.5	A
P_{in} (sync.) max.	6.0	kW
p_a (sync.) max.	3.0	kW
p_{g_2} (sync.) max.	100	W
p_{g_1} (sync.) max.	30	W

Typical Operating Conditions for 2 Valves in Push-Pull

f	170–220	Mc/s
*Bandwidth (–1.5 db)	6.5	Mc/s
*Bandwidth (–3 db)	12	Mc/s
V_a	4.0	kV
V_{g_2}	800	V
V_{g_1}	–150	V
$v_{in(g_1-g_1)pk}$ (sync.)	850	V
$v_{in(g_1-g_1)pk}$ (black)	700	V
I_a (sync.)	2.75	A
I_a (black)	2.1	A
I_{g_2} (sync.)	110	mA
I_{g_2} (black)	50	mA
I_{g_1} (sync.)	100	mA
I_{g_1} (black)	50	mA
†P_{drive} (sync.)	300–400	W
P_{out} (sync.)	5.0	kW
P_{out} (black)	2.8	kW
‡P_{load} (sync.)	3.5	kW

*Bandwidth based on a single LC circuit.

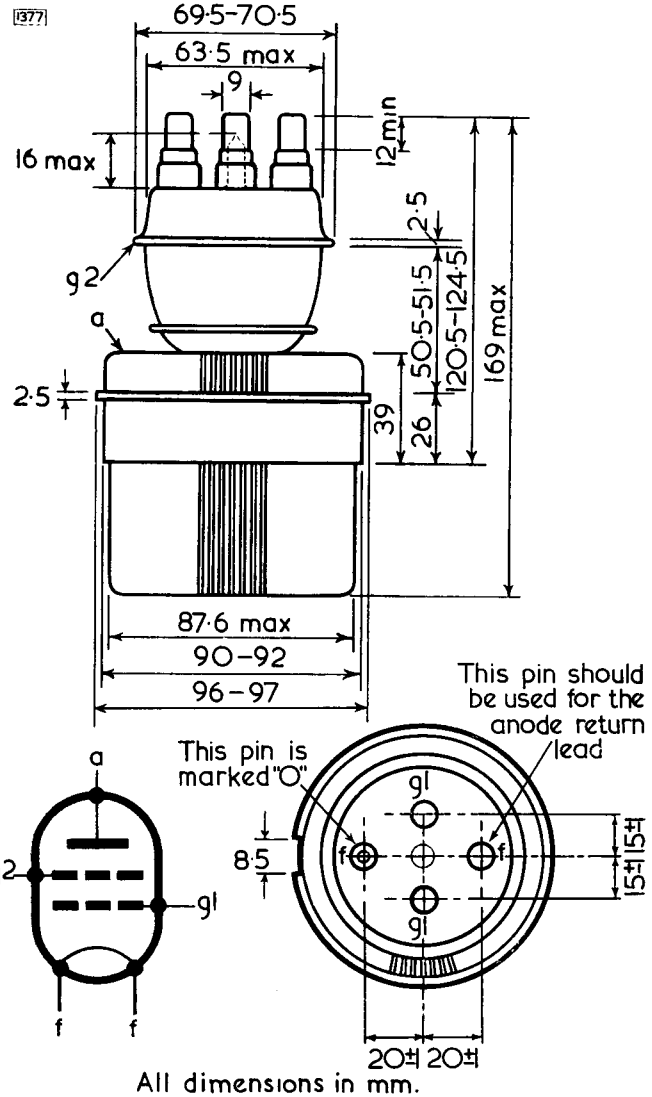
†Includes power dissipated in circuit and loading resistors.

‡With a circuit transfer efficiency of 70%.

QY5-3000A

R.F. POWER TETRODE

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

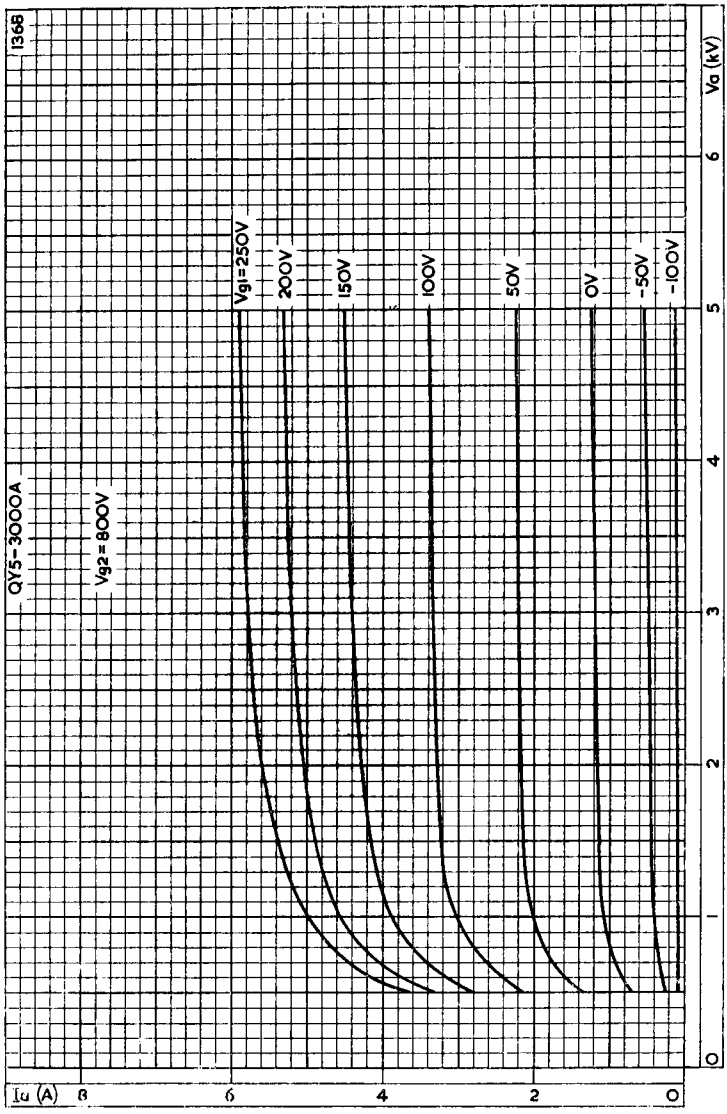


All dimensions in mm.

R.F. POWER TETRODE

QY5-3000A

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

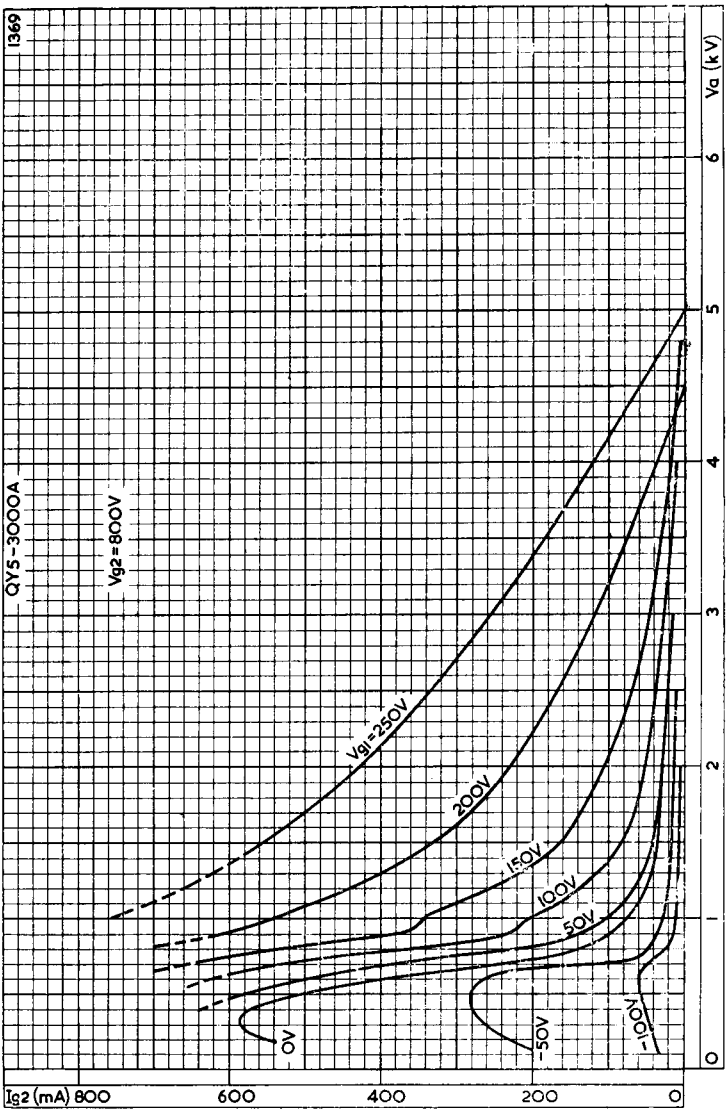


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

QY5-3000A

R.F. POWER TETRODE

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

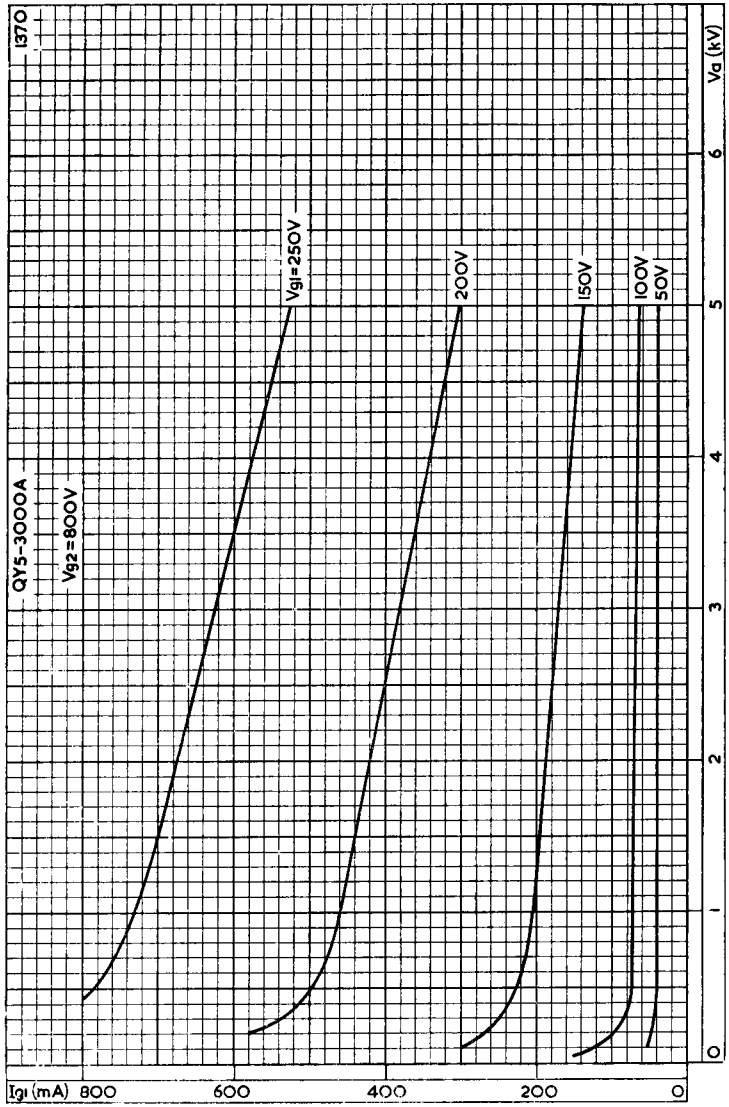


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

R.F. POWER TETRODE

QY5-3000A

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

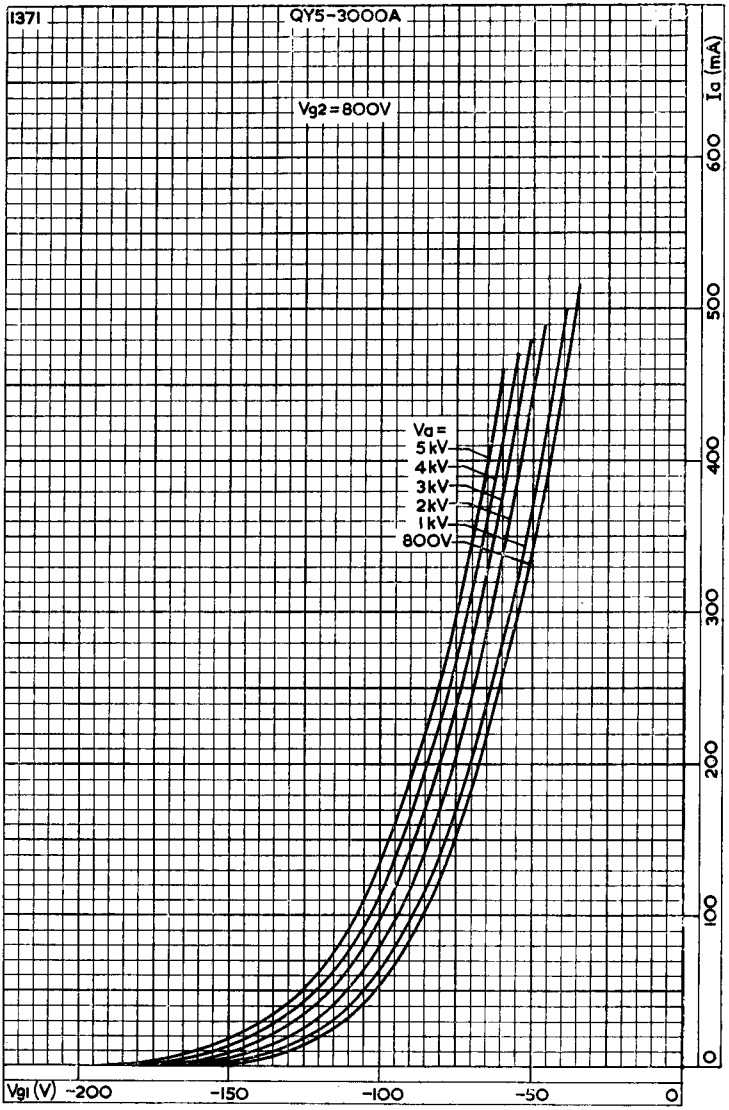


CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

QY5-3000A

R.F. POWER TETRODE

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

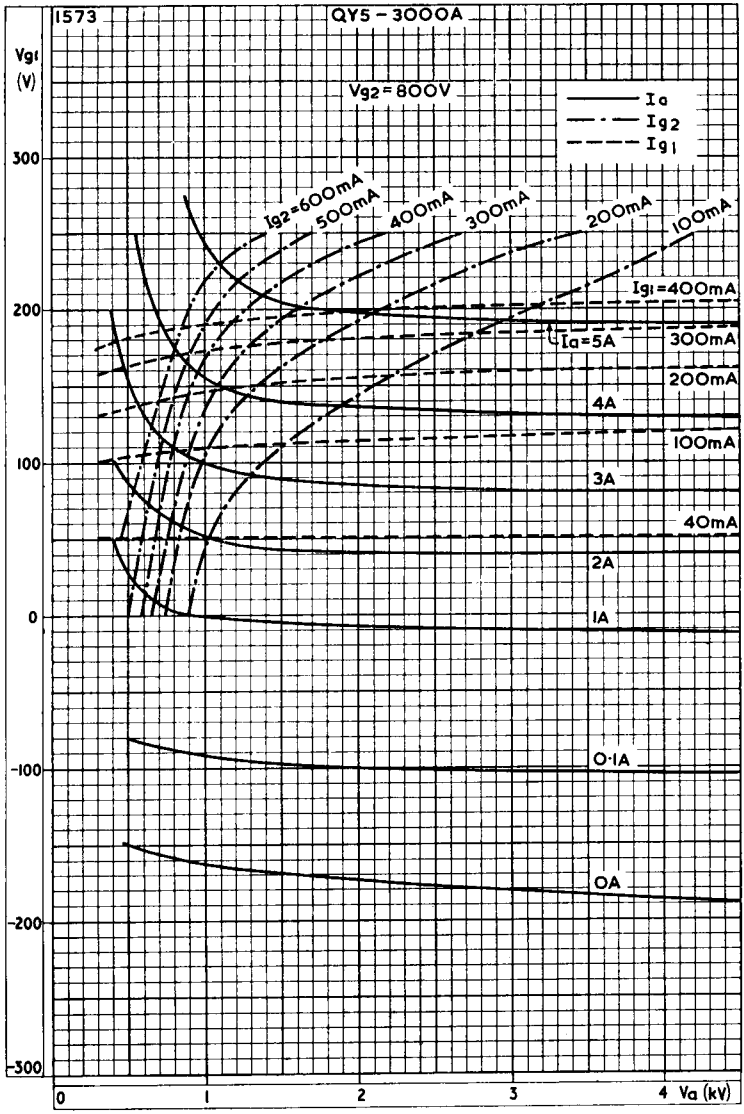


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER

R.F. POWER TETRODE

QY5-3000A

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

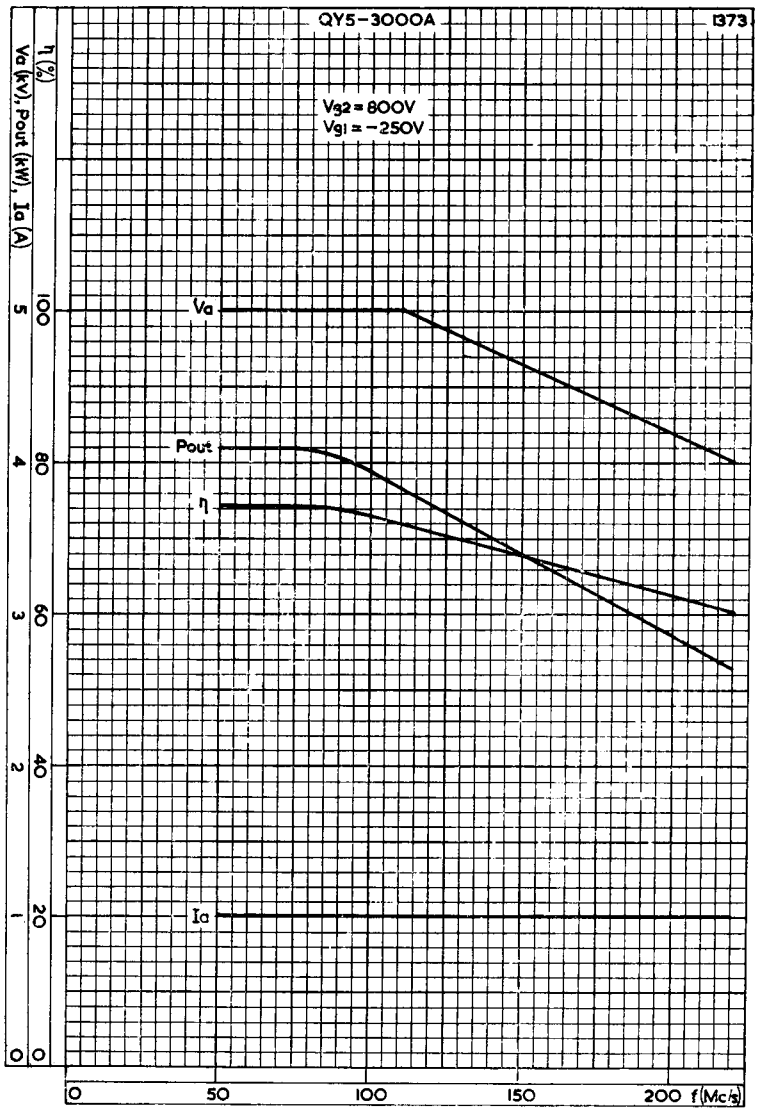


CONSTANT CURRENT CURVES

QY5-3000A

R.F. POWER TETRODE

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.

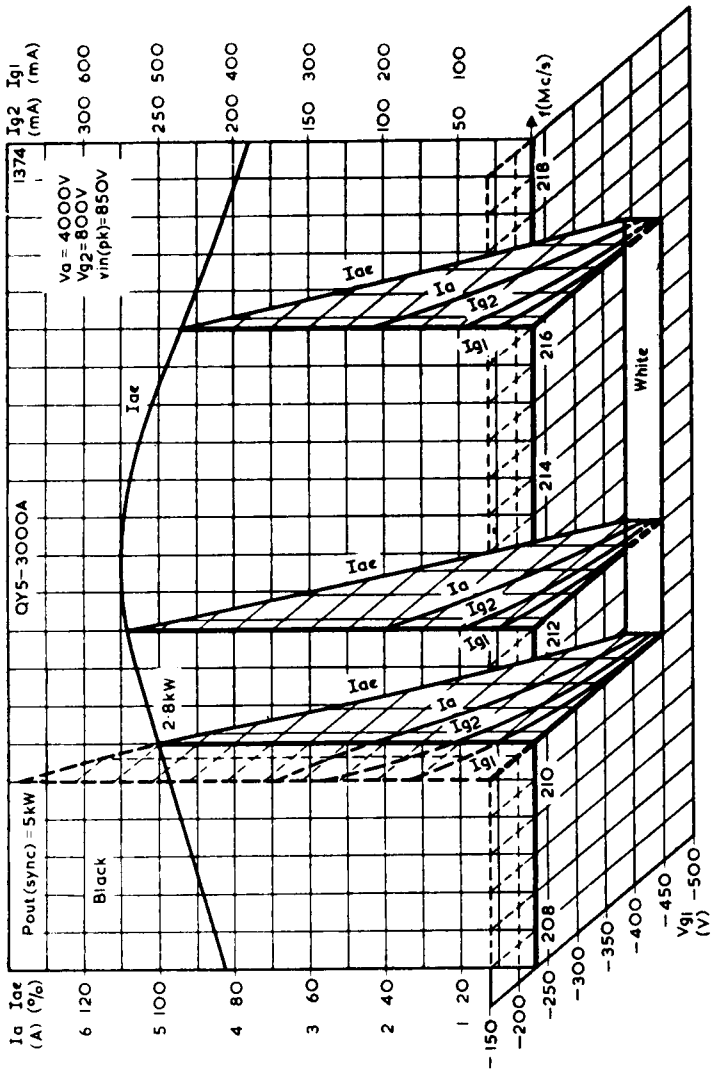


FREQUENCY CHARACTERISTICS.
SINGLE VALVE CLASS "C" TELEGRAPHY

R.F. POWER TETRODE

QY5-3000A

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.



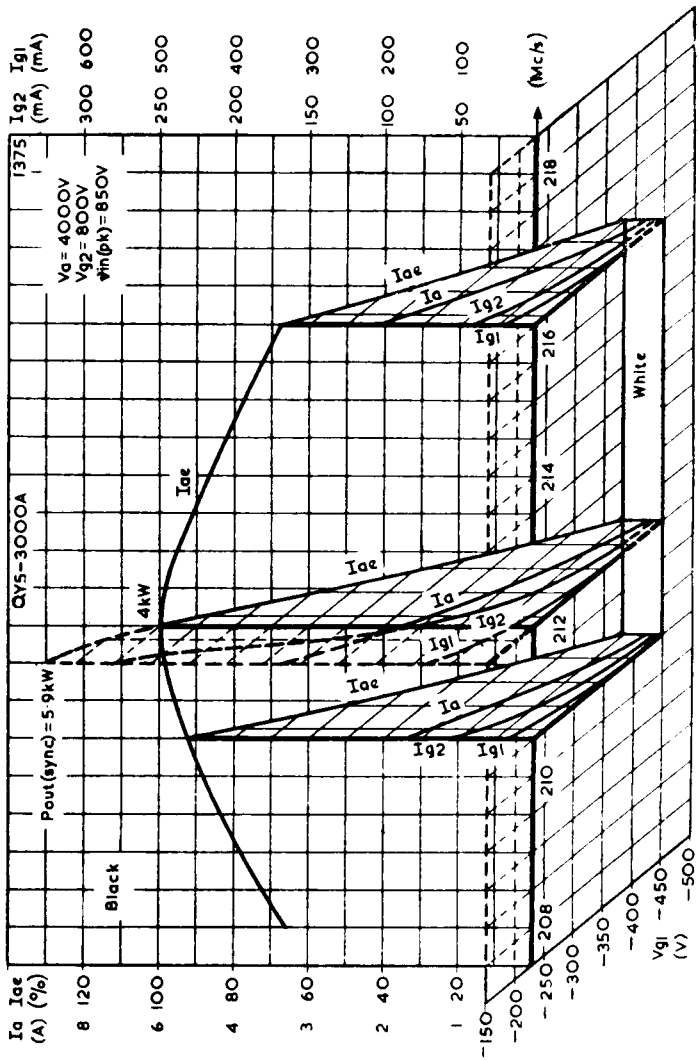
OPERATION OF TWO VALVES AS R.F. AMPLIFIER CLASS "C" GRID MODULATION FOR TELEVISION SERVICE, WITH NEGATIVE MODULATION AND POSITIVE SYNCHRONISATION

P_{out} (sync.) = 5.0 kW

QY5-3000A

R.F. POWER TETRODE

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.



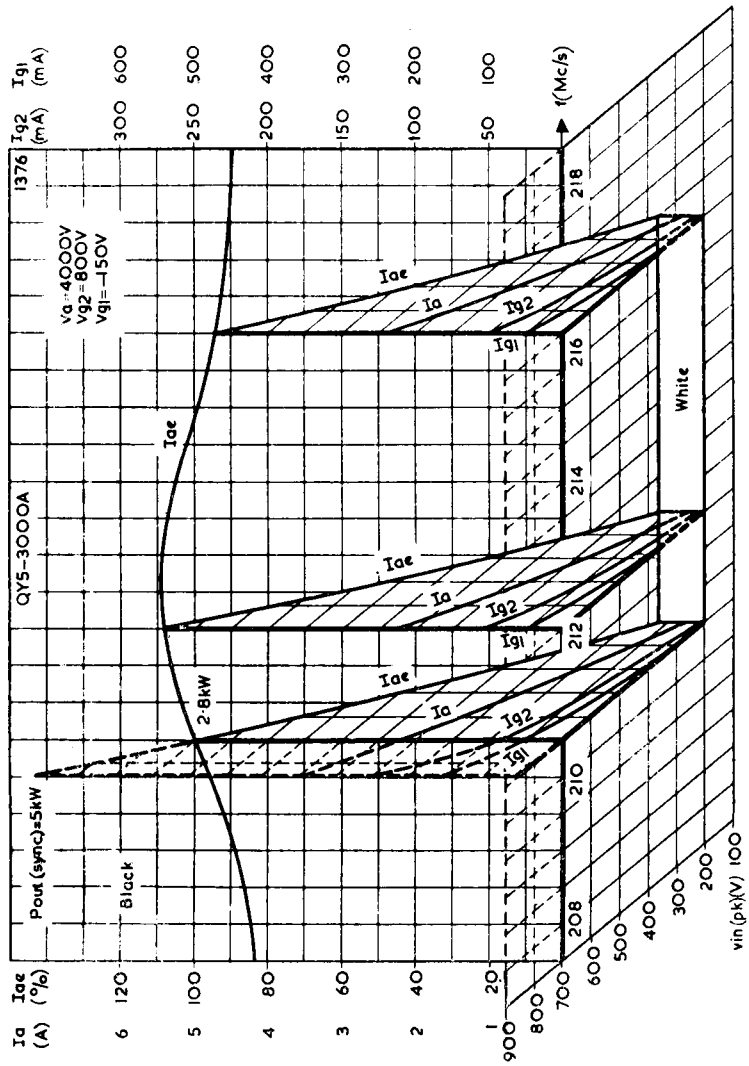
OPERATION OF TWO VALVES AS R.F. AMPLIFIER CLASS "C" GRID MODULATION FOR TELEVISION SERVICE, WITH NEGATIVE MODULATION AND POSITIVE SYNCHRONISATION

P_{out} (sync.) = 5.9 kW

R.F. POWER TETRODE

QY5-3000A

High-power forced air-cooled tetrode, rated for a maximum anode dissipation of 3 kW. Primarily intended for use in V.H.F. television transmitters.



OPERATION OF TWO VALVES AS R.F. AMPLIFIER CLASS "B" FOR TELEVISION SERVICE, WITH NEGATIVE MODULATION AND POSITIVE SYNCHRONISATION

R.F. POWER TETRODE

QY5-3000W

High-power water-cooled tetrode, rated for a maximum anode dissipation of 3kW. Primarily intended for use in V.H.F. television transmitters.

PRELIMINARY DATA

This data should be read in conjunction with "Operating Notes Part 1—Power Valves" included in this volume of the Handbook.

FILAMENT Thoriated tungsten.

V_f	6.3	V
I_f	32.5	A

CAPACITANCES

C_{in}	23.5	$\mu\mu$F
C_{out}	8.4	$\mu\mu$F
C_{a-g1}	< 0.35	$\mu\mu$F

CHARACTERISTICS (Measured at V_a = 4.0 kV, I_a = 2.0 A.)

g_m	19	mA/V
μ_{g1-g2}	8.5	

COOLING

Max. temperature of seals	180	°C
Max. bulb temperature	250	°C

Typical values of input temperature, rate of flow of water and pressure difference between the inlet and outlet housing at various anode dissipations are given in the following table:—

Anode Dissipation P_a (kW)	Input Temperature T_{in} (°C)	Rate of flow of water (litres/min)	Pressure difference between inlet and outlet (atm)
1.0	20	2.5	0.073
1.0	50	3.0	0.1
2.0	20	2.5	0.073
2.0	50	4.8	0.25
3.0	20	3.0	0.105
3.0	50	6.9	0.55

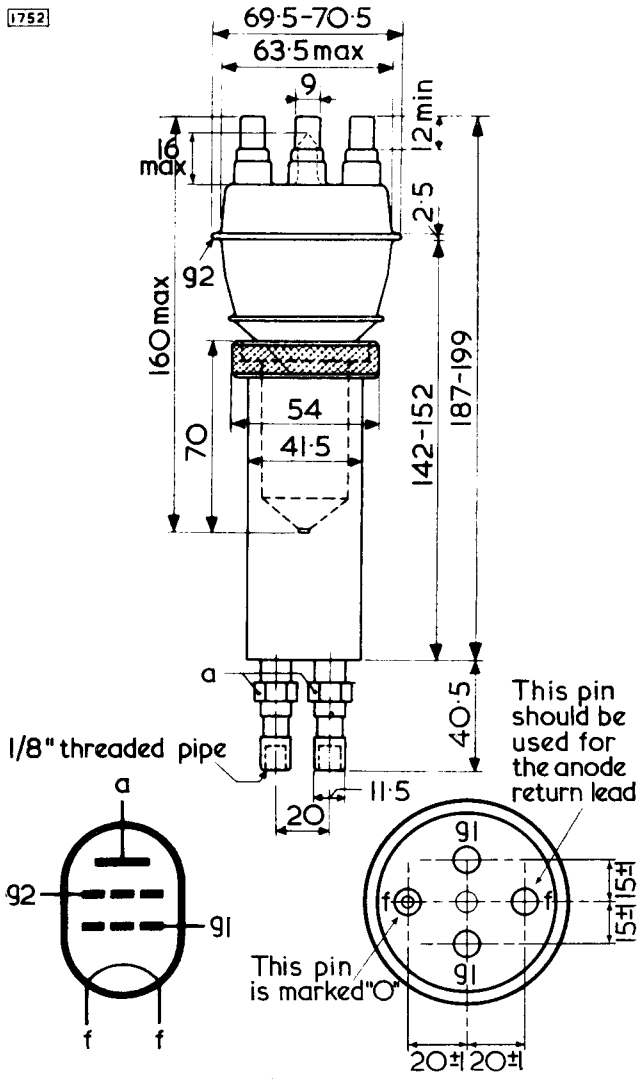
In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals. Air cooling will in general not be necessary at frequencies ≤75 Mc/s and $V_a \leq 4.0$ kV (V_a ≤3.2 kV for class "C" anode and screen-grid modulation). At $V_a \leq 5.0$ kV ($V_a \leq 4.0$ kV for class "C" anode and screen-grid modulation) air cooling will in general be necessary at all frequencies.

The characteristics, operating conditions and limiting values are identical with those given for QY5-3000A.

QY5-3000W

R.F. POWER TETRODE

High-power water-cooled tetrode, rated for a maximum anode dissipation of 3kW. Primarily intended for use in V.H.F. television transmitters.



All dimensions in mm.

R.F. POWER TETRODE

QY5-3000A
QY5-3000W

QUICK REFERENCE DATA

Power tetrodes intended for use in V.H.F. television transmitters. The QY5-3000A is forced-air cooled, and the QY5-3000W water cooled.

	Class 'C' telegraphy	Class 'C' television	Class 'AB' S.S.B.	Class 'B' A.F.	
f max.	220	220	220	—	Mc/s
V_a max.	5.0	4.0	5.0	5.0	kV
p_a max.	3.0	3.0	3.0	3.0	kW
Performance					
f	75	220	30	—	Mc/s
P_{out}	4.1	4.0	1.57	9.5	kW

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT

Thoriated tungsten

V_f	6.3	V
I_f	32.5	A

CAPACITANCES

C_{in}	23.5	pF
C_{out}	8.4	pF
C_{a-g1}	< 350	mpF

CHARACTERISTICS (measured at V_a = 4.0kV, I_a = 2.0A)

g_m	19	mA/V
μ_{g1-g2}	8.5	

COOLING

T_{seals} max.	180	°C
T_{bulb} max.	250	°C

QY5-3000A

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals.

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea-level.

Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table.

Anode Dissipation	Height above sea-level		Inlet Temperature	Rate of flow of air per minute		Pressure difference between inlet and outlet	
P_a (kW)	h (m)	(ft)	T_{in} (°C)	(m^3)	(ft^3)	(mm H_2O)	(in H_2O)
1.0	0	0	35	1.8	63.6	10	0.39
1.0	0	0	45	2.2	74.2	15	0.59
1.0	1,500	4,921	35	2.2	74.2	13	0.51
1.0	3,000	9,842	25	2.3	81.2	13	0.51
2.5	0	0	35	4.5	158.9	60	2.36
2.5	0	0	45	5.4	190.7	85	3.35
2.5	1,500	4,921	35	5.4	190.7	73	2.87
2.5	3,000	9,842	25	5.8	204.8	75	2.95
3.0	0	0	35	5.7	201.3	95	3.74

QY5-3000W

Typical values of inlet temperature, rate of flow of water and pressure difference between the inlet and outlet housing at various anode dissipations are given in the following table:—

Anode Dissipation	Inlet Temperature	Rate of flow of water per minute		Pressure difference between inlet and outlet
P_a (kW)	T_{in} (°C)	(litres)	(gal)	(atm)
1.0	20	2.5	0.55	0.073
1.0	50	3.0	0.66	0.1
2.0	20	2.5	0.55	0.073
2.0	50	4.8	1.06	0.25
3.0	20	3.0	0.66	0.105
3.0	50	6.9	1.52	0.55

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals. Air cooling will in general not be necessary at frequencies $\leqslant$75 Mc/s and $V_a \leqslant 4.0$ kV ($V_a \leqslant 3.2$ kV for class "C" anode and screen-grid modulation). At $V_a \leqslant 5.0$ kV ($V_a \leqslant 4.0$ kV for class "C" anode and screen-grid modulation) air cooling will in general be necessary at all frequencies.

QY5-3000A
QY5-3000W

CLASS "C" TELEGRAPHY OR F.M. TELEPHONY

Absolute maximum ratings

V_a max. ($f < 110$Mc/s)	5.0	kV
V_a max. ($f < 220$Mc/s)	4.0	kV
V_{g2} max.	800	V
$-V_{g1}$ max.	500	V
I_a max.	1.1	A
p_a max.	3.0	kW
p_{g2} max.	100	W
p_{g1} max.	30	W

Typical operating conditions

f	75	110	75	110	Mc/s
V_a	5.0	5.0	4.0	4.0	kV
V_{g2}	800	800	800	800	V
V_{g1}	−250	−250	−250	−250	V
I_a	1.1	1.1	1.1	1.1	A
I_{g2}	100	100	120	120	mA
I_{g1}	70	70	80	80	mA
$V_{in(pk)}$	480	480	500	500	V
P_{drive}	30	30	36	36	W
P_{out}	4.1	3.9	3.15	2.9	kW
η_a	74.5	71.5	72	69	%

CLASS "C" ANODE AND SCREEN-GRID MODULATION

Screen-grid modulated through a choke of 60H

Absolute maximum ratings

Carrier condition for a modulation factor of 1.

V_a max. ($f < 110$Mc/s)	4.0	kV
V_a max. ($f < 220$Mc/s)	3.2	kV
V_{g2} max.	800	V
$-V_{g1}$ max.	500	V
I_a max.	900	mA
p_a max.	2.0	kW
*p_{g2} max.	100	W
p_{g1} max.	30	W

*For other methods of modulation, P_{g2} max. = 65W.

Typical operating conditions

V_a	4.0	kV
V_{g2}	800	V
V_{g1}	−375	V
I_a	900	mA
I_{g2}	120	mA
I_{g1}	85	mA
$V_{in(pk)}$	625	V
P_{drive}	48	W
P_{out}	2.7	kW
η_a	75	%
For 100% modulation		
$P_{mod.}$	1.8	kW

QY5-3000A
QY5-3000W

R.F. POWER TETRODE

CLASS "C" GRID-MODULATION FOR TELEVISION SERVICE

(with positive modulation and negative synchronisation)

Absolute maximum ratings

f max.	220	Mc/s
V_a max.	4.0	kV
V_{g2} max.	800	V
$-V_{g1}$ max.	500	V
I_a (peak white) max.	1.1	A
I_{g1} (peak white) max.	80	mA
P_{in} (peak white) max.	4.4	kW
p_a (peak white) max.	3.0	kW
p_{g2} (peak white) max.	100	W

Typical operating conditions for 2 valves in push-pull

f	170–220	170–220	Mc/s
*Bandwidth (–1.5db)	—	6.5	Mc/s
*Bandwidth (–3.0db)	7.5	12	Mc/s
V_a	4.0	4.0	kV
V_{g2}	800	800	V
V_{g1} (peak white)	–230	–230	V
V_{g1} (black)	–380	–380	V
$V_{in(g1-g1)pk}$	850	850	V
I_a (peak white)	1.7	2.1	A
I_a (black)	0.5	0.6	A
I_{g2} (peak white)	80	50	mA
I_{g2} (black)	10	10	mA
I_{g1} (peak white)	25	50	mA
I_{g1} (black) approx.	0	0	mA
†P_{drive} (peak white)	200–300	300–400	W
P_{out} (peak white)	4.0	2.8	kW
P_{out} (black)	360	250	W
‡P_{load} (peak white)	2.8	1.96	kW

*Bandwidth based on a single LC circuit.

†Includes power dissipated in circuit and loading resistors.

‡With a circuit transfer efficiency of 70%.

QY5-3000A
QY5-3000W

CLASS "B" FOR TELEVISION SERVICE

(with positive modulation and negative synchronisation)

Absolute maximum ratings

f max.	220	Mc/s
V_a max.	4.0	kV
V_{g2} max.	800	V
I_a (peak white) max.	1.1	A
I_{g1} (peak white) max.	80	mA
P_{in} (peak white) max.	4.4	kW
p_a (peak white) max.	3.0	kW
p_{g2} (peak white) max.	100	W

Typical operating conditions for 2 valves in push-pull

f	170–220	Mc/s
*Bandwidth (–1.5 db)	6.5	Mc/s
*Bandwidth (–3.0 db)	12	Mc/s
V_a	4.0	kV
V_{g2}	800	V
V_{g1}	–150	V
$V_{in(g1-g1)(pk)}$ (peak white)	700	V
$v_{in(g1-g1)(pk)}$ (black)	350	V
I_a (peak white)	2.1	A
I_a (black)	0.6	A
I_{g2} (peak white)	50	mA
I_{g2} (black)	10	mA
I_{g1} (peak white)	50	mA
I_{g1} (black) (approx.)	0	mA
†P_{drive} (peak white)	200 to 300	W
P_{out} (peak white)	2.8	kW
P_{out} (black)	250	W
‡P_{load} (peak white)	1.96	kW

*Bandwidth based on a single LC circuit.

†Includes power dissipated in circuit and loading resistors.

‡With a circuit transfer efficiency of 70%.

QY5-3000A
QY5-3000W

R.F. POWER TETRODE

CLASS "C" GRID-MODULATION FOR TELEVISION SERVICE

(with negative modulation and positive synchronisation)

Absolute maximum ratings

f max.	220	Mc/s
V_a max.	4.0	kV
V_{g2} max.	800	V
$-V_{g1}$ max.	500	V
I_a (sync.) max.	1.5	A
P_{in} (sync.) max.	6.0	kW
p_a (sync.) max.	3.0	kW
p_{g2} (sync.) max.	100	W
p_{g1} (sync.) max.	30	W

Typical operating conditions for 2 valves in push-pull

f	170–220	170–220	Mc/s
*Bandwidth (–1.5 db)	6.5	—	Mc/s
*Bandwidth (–3 db)	12	7.5	Mc/s
V_a	4.0	4.0	kV
V_{g2}	800	800	V
V_{g1} (sync.)	–150	–150	V
V_{g1} (black)	–230	–230	V
V_{g1} (white)	–450	–450	V
$v_{in(g1-g1)pk}$	850	850	V
I_a (sync.)	2.75	2.75	A
I_a (black)	2.1	1.7	A
I_{g2} (sync.)	110	250	mA
I_{g2} (black)	50	80	mA
I_{g1} (sync.)	100	80	mA
I_{g1} (black)	50	25	mA
†P_{drive} (sync.)	300–400	200–300	W
P_{out} (sync.)	5.0	5.9	kW
P_{out} (black)	2.8	4.0	kW
‡P_{load} (sync.)	3.5	4.13	kW

*Bandwidth based on a single LC circuit.

†Includes power dissipated in circuit and loading resistors.

‡With a circuit transfer efficiency of 70%.

QY5-3000A
QY5-3000W

CLASS "B" FOR TELEVISION SERVICE

(with negative modulation and positive synchronisation)

Absolute maximum ratings

f max.	220	Mc/s
V_a max.	4.0	kV
V_{g2} max.	800	V
I_a (sync.) max.	1.5	A
P_{in} (sync.) max.	6.0	kW
p_a (sync.) max.	3.0	kW
p_{g2} (sync.) max.	100	W
p_{g1} (sync.) max.	30	W

Typical operating conditions for 2 valves in push-pull

f	170–220	Mc/s
*Bandwidth (–1.5 db)	6.5	Mc/s
*Bandwidth (–3 db)	12	Mc/s
V_a	4.0	kV
V_{g2}	800	V
V_{g1}	–150	V
$v_{in(g1-g1)pk}$ (sync.)	850	V
$v_{in(g1-g1)pk}$ (black)	700	V
I_a (sync.)	2.75	A
I_a (black)	2.1	A
I_{g2} (sync.)	110	mA
I_{g2} (black)	50	mA
I_{g1} (sync.)	100	mA
I_{g1} (black)	50	mA
†P_{drive} (sync.)	300–400	W
P_{out} (sync.)	5.0	kW
P_{out} (black)	2.8	kW
‡P_{load} (sync.)	3.5	kW

*Bandwidth based on a single LC circuit.

†Includes power dissipated in circuit and loading resistors.

‡With a circuit transfer efficiency of 70%.

QY5-3000A
QY5-3000W

R.F. POWER TETRODE

CLASS "AB" SINGLE SIDEBAND SUPPRESSED CARRIER

Absolute maximum ratings

f max.	200	Mc/s
V_a max.	5.0	kV
V_{g2} max.	1.0	kV
p_a max.	3.0	kW
p_{g2} max.	100	W
I_k max.	1.2	A
$i_{k(pk)}$ max.	3.8	A
$-V_{g1}$ max.	500	V

Typical operating conditions

Envelope peak to average $\geqslant 1$ and < 2

f	30	30	30	Mc/s
V_a	5.0	5.0	5.0	kV
V_{g2}	1.0	1.0	1.0	kV
*V_{g1}	−120	−117	−85	V
$I_{a(o)}$	200	200	500	mA

"Single tone" modulation, maximum signal conditions

I_a	474	505	640	mA
I_{g2}	20	70	15	mA
I_{g1}	0	20	0	mA
$V_{in(pk)}$	120	134	85	V
$P_{load(driver)}$	3.0	5.0	3.0	W
p_a	1.02	0.96	1.82	kW
p_{g2}	20	70	15	W
P_{out}	1.35	1.57	1.38	kW
η_a	57	63	43	%
P_{load}	1.15	1.34	1.17	kW

"Two tone" modulation, maximum signal conditions

I_a	351	380	576	mA
I_{g2}	8.5	25	7.0	mA
I_{g1}	0	1.5	0	mA
$V_{in(pk)}$	120	134	85	V
$P_{load(driver)}$	1.5	2.5	1.5	W
p_a	1.08	1.12	2.19	kW
p_{g2}	8.5	25	7.0	W
P.E.P_{out}	1.35	1.57	1.38	kW
P_{out} (mean)	675	785	690	W
η_a	38	41	24	%
P.E.$P_{(load)}$	1.15	1.34	1.17	kW
†$D_{i.m.}$	33	30	42	dB

*V_{g1} is set to give the $I_{a(o)}$ and will vary slightly from valve to valve.

†The voltage amplitude of all intermodulation products are below this level, which is referred to the amplitude of either of the two tone frequencies. Relative to the peak envelope power these figures will be increased by 6dB. The figures are measured at full drive.

QY5-3000A
QY5-3000W

CLASS "B" A.F.

Absolute maximum ratings

V_a max.	5.0	kV
V_{g2} max.	800	V
I_k max.	1.7	A
$i_{k(pk)}$ max.	5.3	A
p_a max.	3.0	kW
p_{g2} max.	100	W
p_{g1} max.	30	W

Typical operating conditions for 2 valves in push-pull

V_a	5.0	5.0	4.0	4.0	kV
V_{g2}	800	800	800	800	V
V_{g1}	−107	−107	−103	−93	V
$I_{a(o)}$	2×100	2×100	2×100	2×150	mA
I_a (max. sig.)	2×1.1	2×1.46	2×0.6	2×1.37	A
I_{g2} (max. sig.)	2×50	2×120	2×60	2×75	mA
I_{g1}	2×40	2×150	2×11	2×84	mA
$V_{in(g1-g1)r.m.s.}$	420	505	259	414	V
P_{drive}	2×11	2×50	2×2.0	2×40	W
p_a	2×1.9	2×2.55	2×0.9	2×2.36	kW
η_a	65	65	62	57	%
R_{a-a}	5.0	3.7	7.0	3.43	kΩ
P_{out}	7.2	9.5	3.0	6.25	kW

ACCESSORIES

Filament and control grid clips	40634
Screen grid connector	40622
Insulating pedestal (QY5-3000A)	40635
Water jacket (QY5-3000W)	K713

PHYSICAL DATA

	QY5-3000A	QY5-3000W	
Weight of valve	4.96	0.77	lb
	2.25	0.35	kg
Weight of valve plus carton	12.6	2.4	lb
	5.7	1.1	kg

QY5-3000A
QY5-3000W

CLASS "B" A.F.

Absolute maximum ratings

V_a max.	5.0	kV
V_{g2} max.	800	V
I_k max.	1.7	A
$i_{k(pk)}$ max.	5.3	A
p_a max.	3.0	kW
p_{g2} max.	100	W
p_{g1} max.	30	W

Typical operating conditions for 2 valves in push-pull

V_a	5.0	5.0	4.0	4.0	kV
V_{g2}	800	800	800	800	V
V_{g1}	−107	−107	−103	−93	V
$I_{a(o)}$	2×100	2×100	2×100	2×150	mA
I_a (max. sig.)	2×1.1	2×1.46	2×0.6	2×1.37	A
I_{g2} (max. sig.)	2×50	2×120	2×60	2×75	mA
I_{g1}	2×40	2×150	2×11	2×84	mA
$V_{in(g1-g1)r.m.s.}$	420	505	259	414	V
P_{drive}	2×11	2×50	2×2.0	2×40	W
p_a	2×1.9	2×2.55	2×0.9	2×2.36	kW
η_a	65	65	62	57	%
R_{a-a}	5.0	3.7	7.0	3.43	kΩ
P_{out}	7.2	9.5	3.0	6.25	kW

ACCESSORIES

Filament and control grid clips	40634
Screen grid connector	40622
Insulating pedestal (QY5-3000A)	40635
Water jacket (QY5-3000W)	K713

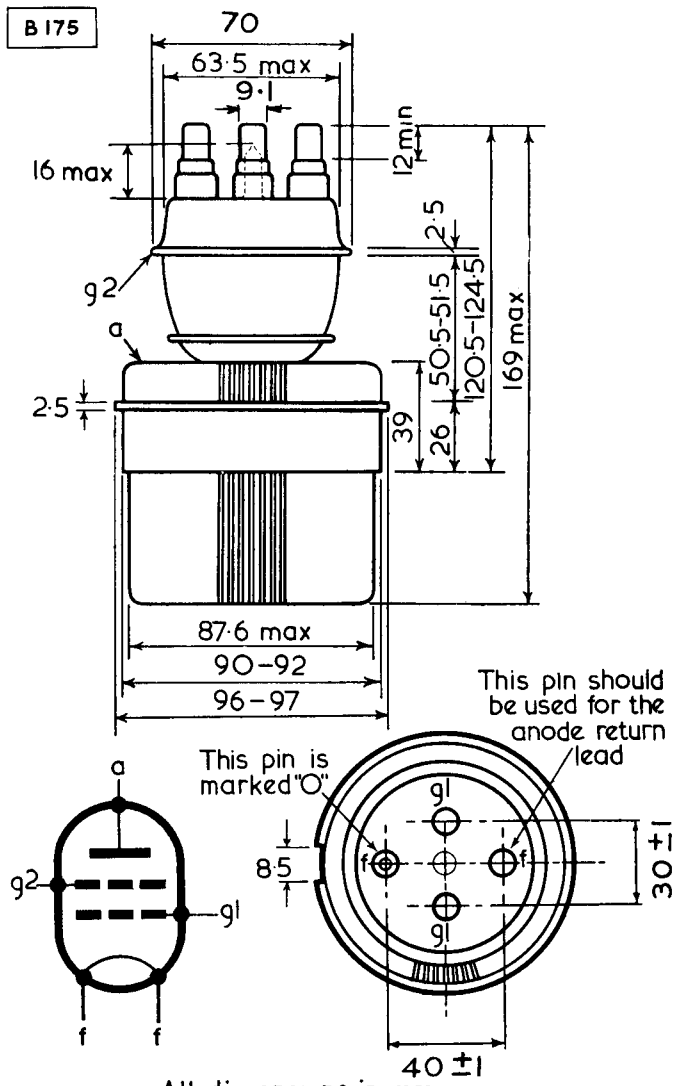
PHYSICAL DATA

	QY5-3000A	QY5-3000W	
Weight of valve	4.96	0.77	lb
	2.25	0.35	kg
Weight of valve plus carton	12.6	2.4	lb
	5.7	1.1	kg

QY5-3000A
QY5-3000W

R.F. POWER TETRODE

OUTLINE DRAWING OF QY5-3000A

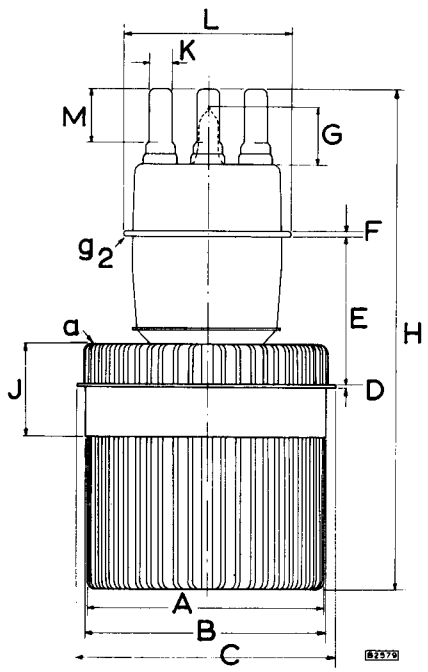


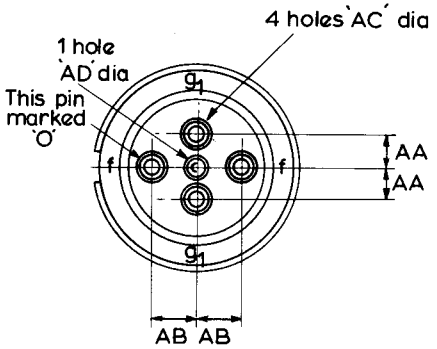
All dimensions in mm.

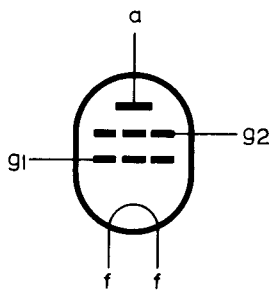
QY5-3000A
QY5-3000W

R.F. POWER TETRODE

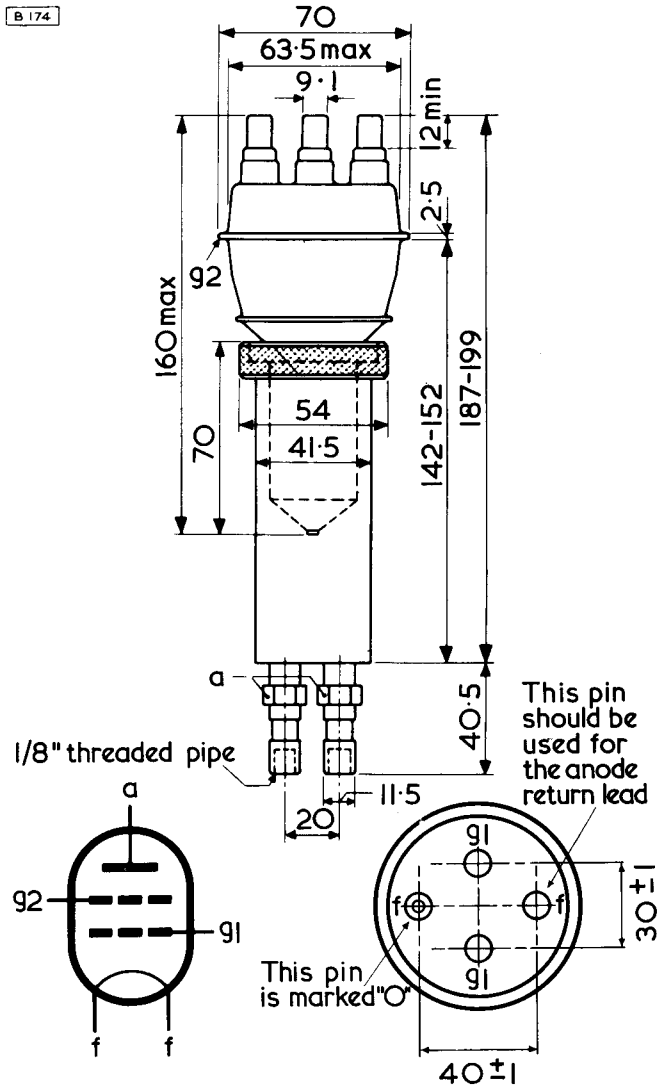
OUTLINE DRAWING OF QY5-3000A







OUTLINE DRAWING OF QY5-3000W



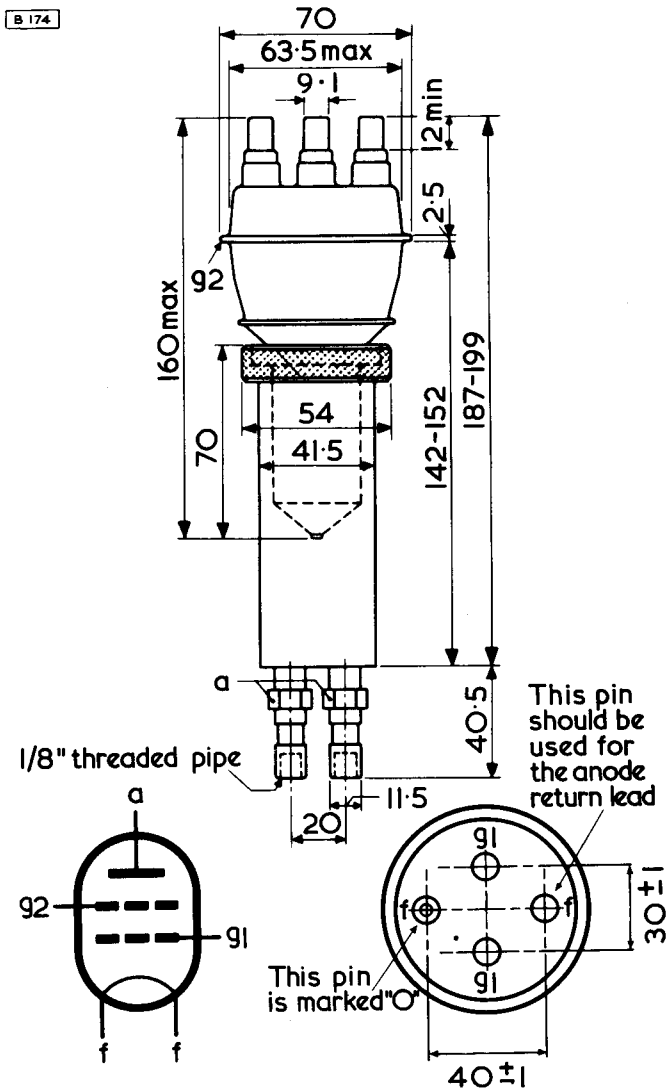
All dimensions in mm.

DIMENSIONS

	Inches	*Millimetres*	
A	3.445	87.5	max
B	3.583 ± 0.031	91 ± 0.8	
C	3.799 ± 0.015	96.5 ± 0.4	
D	0.098 ± 0.020	2.5 ± 0.5	
E	2.008 ± 0.015	51 ± 0.4	
F	0.098 ± 0.020	2.5 ± 0.5	
G	0.630	16	max
H	6.614	168	max
J	1.535 ± 0.039	39 ± 1.0	
K	0.354 ± 0.004	9.0 ± 0.1	
L	2.756 ± 0.015	70 ± 0.4	
M	0.394	10	min
AA	0.591 ± 0.002	15 ± 0.05	
AB	0.787 ± 0.002	20 ± 0.05	
AC	0.394 ± 0.002	10 ± 0.05	
AD	0.295 ± 0.002	7.5 ± 0.5	

Inch dimensions derived from original millimetre dimensions.

OUTLINE DRAWING OF QY5-3000W

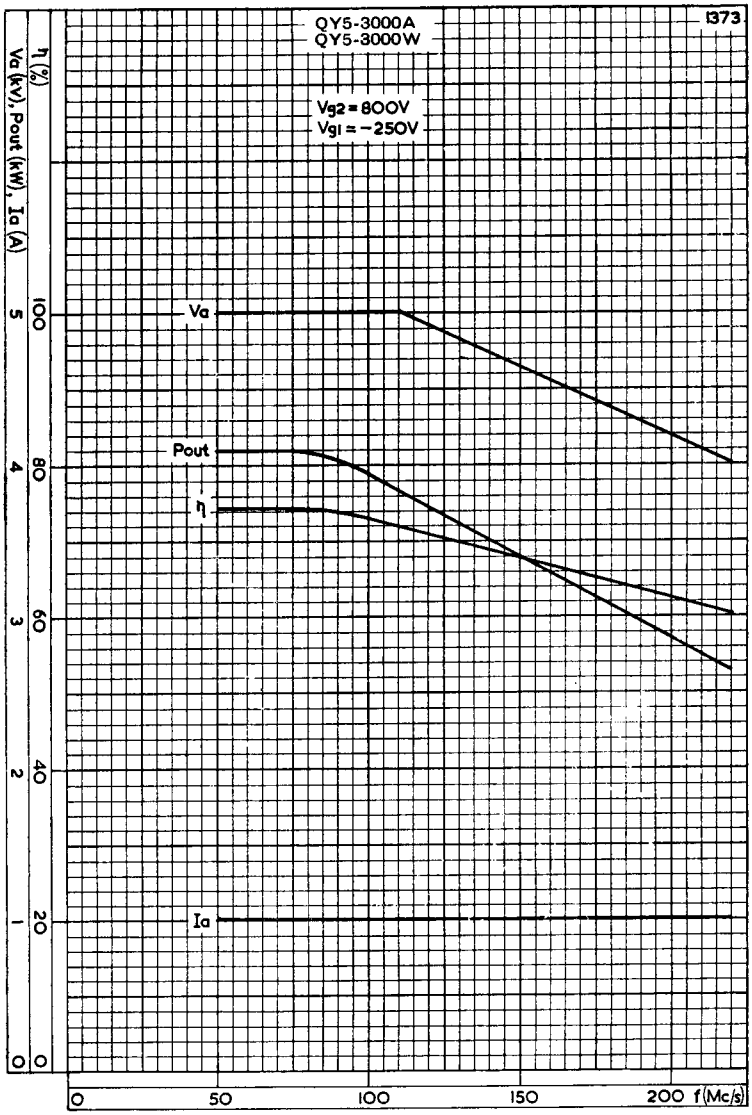


All dimensions in mm.

QY5-3000A
QY5-3000W

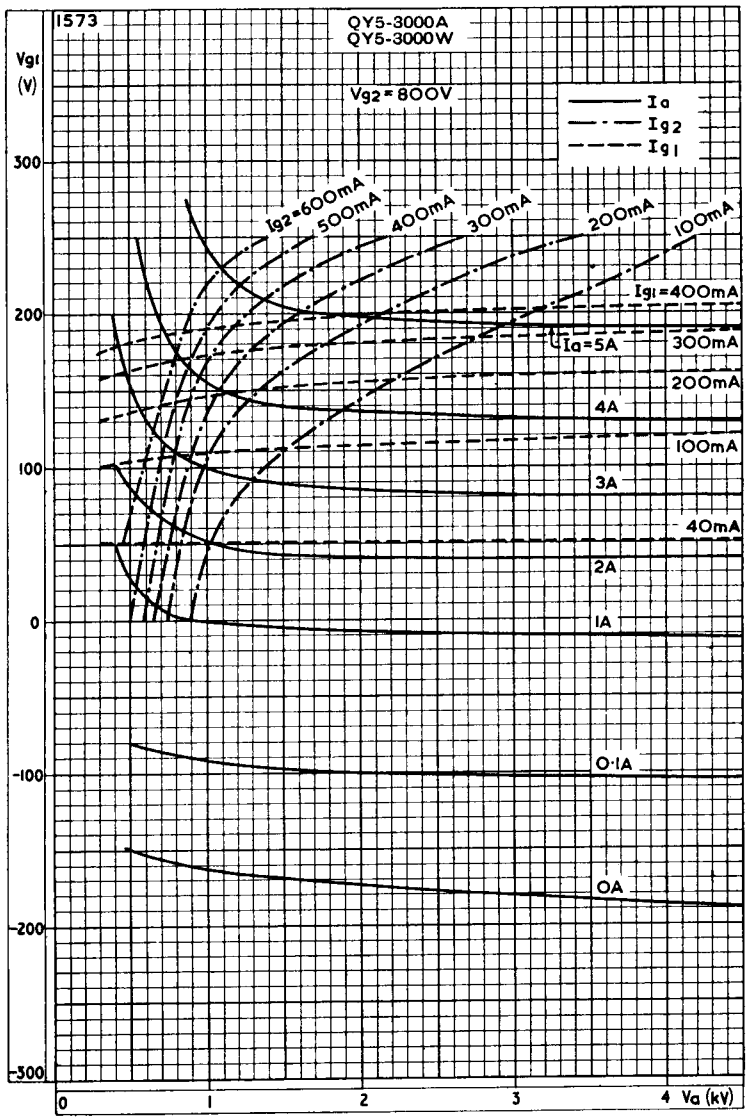


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

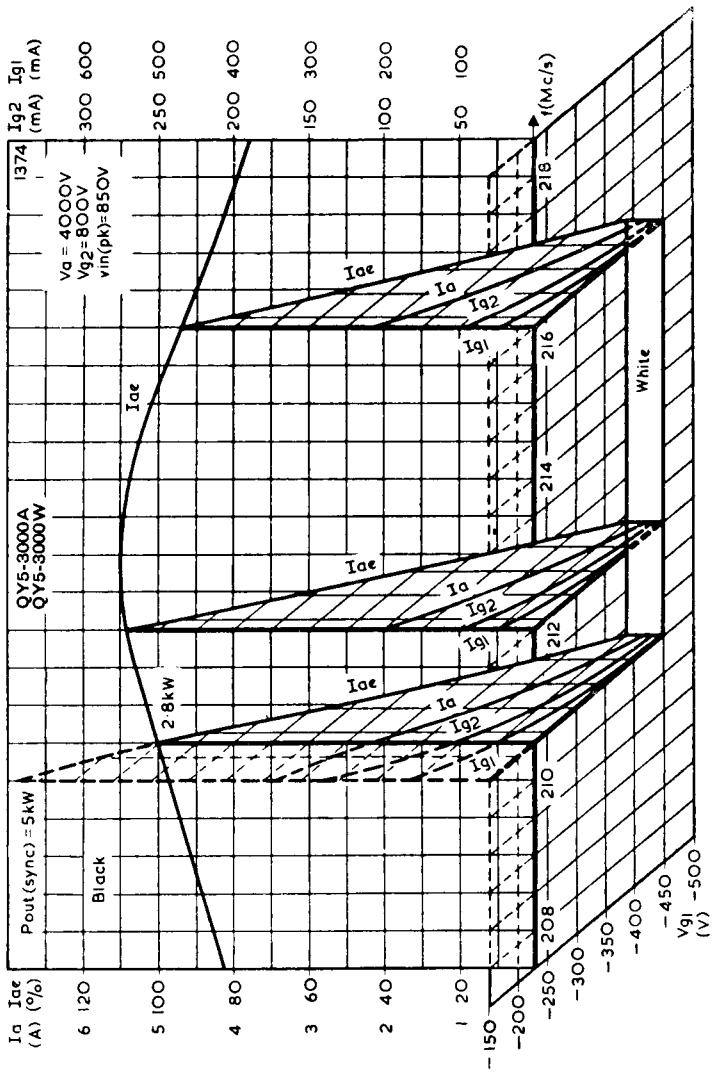


FREQUENCY CHARACTERISTICS.
SINGLE VALVE CLASS "C" TELEGRAPHY

QY5-3000A
QY5-3000W

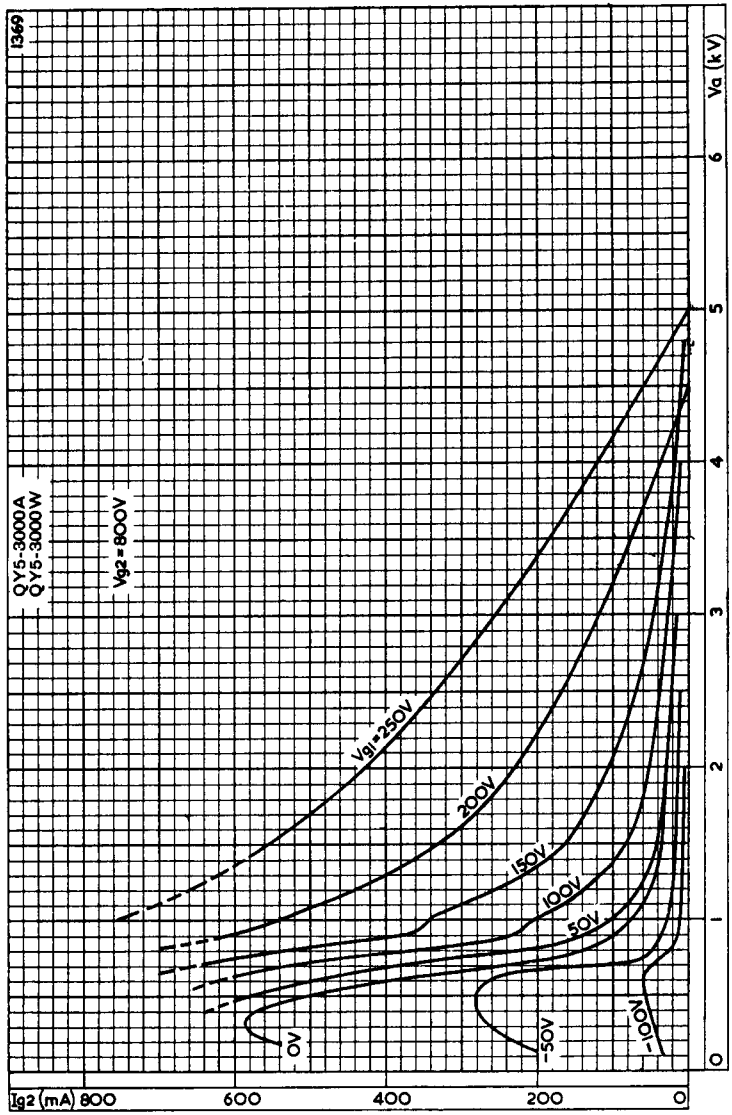


CONSTANT CURRENT CURVES

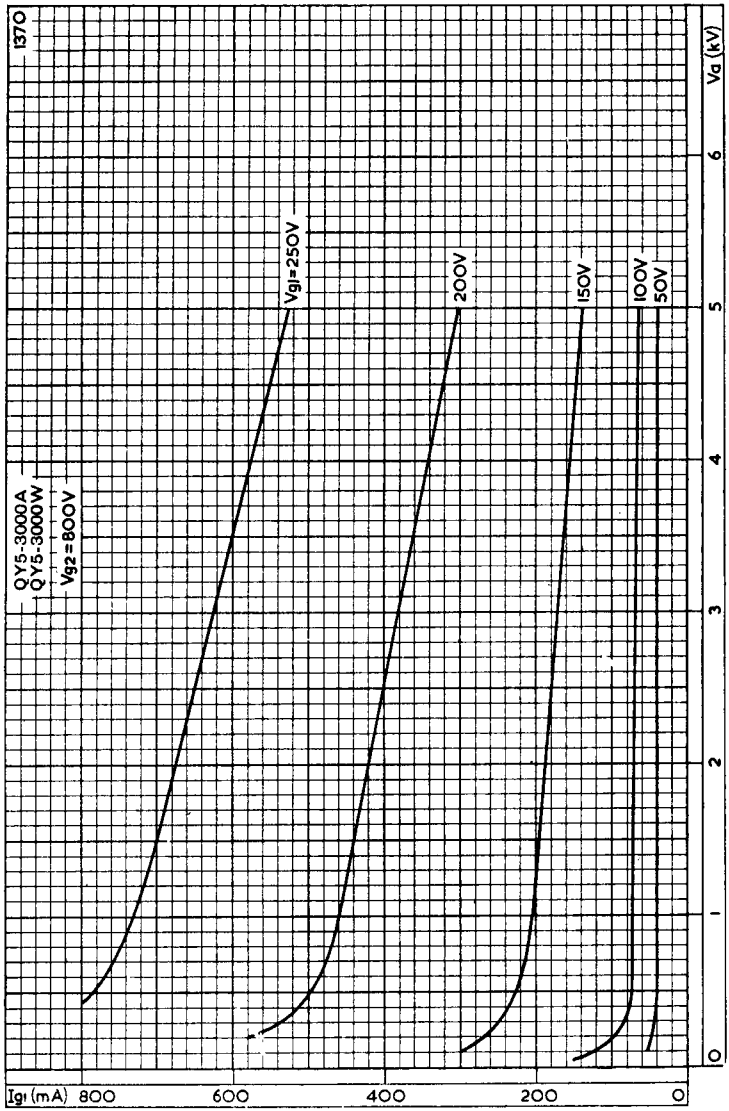


OPERATION OF TWO VALVES AS R.F. AMPLIFIER CLASS "C" GRID MODULATION FOR TELEVISION SERVICE, WITH NEGATIVE MODULATION AND POSITIVE SYNCHRONISATION

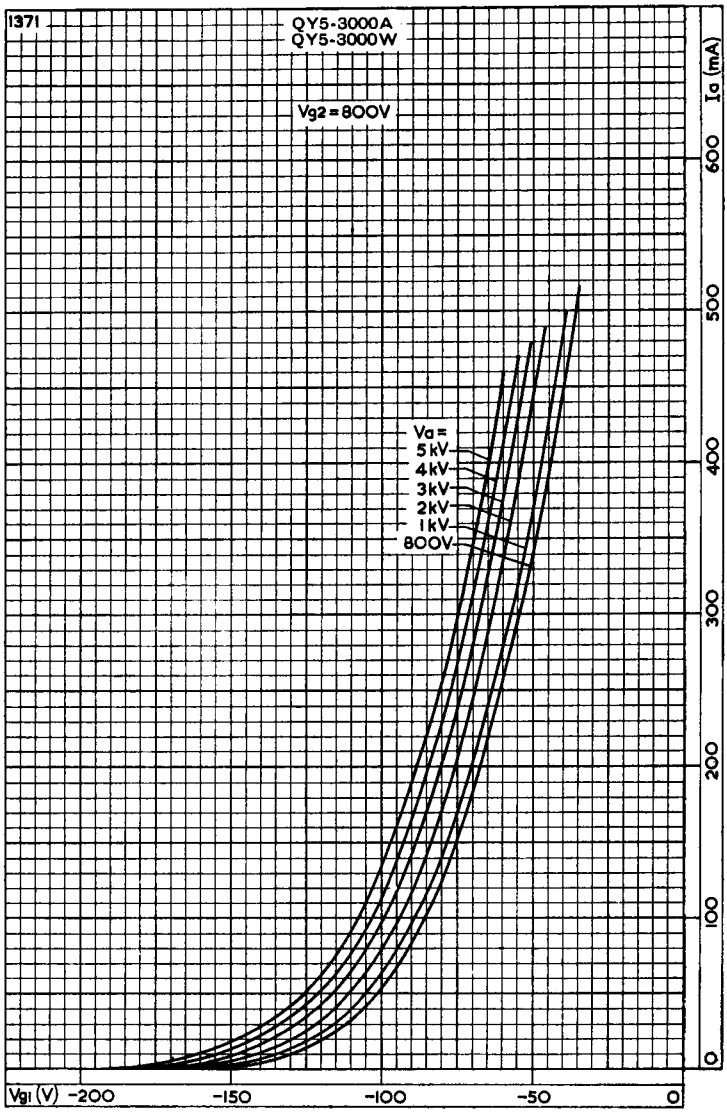
P_{out} (sync.) = 5.0kW



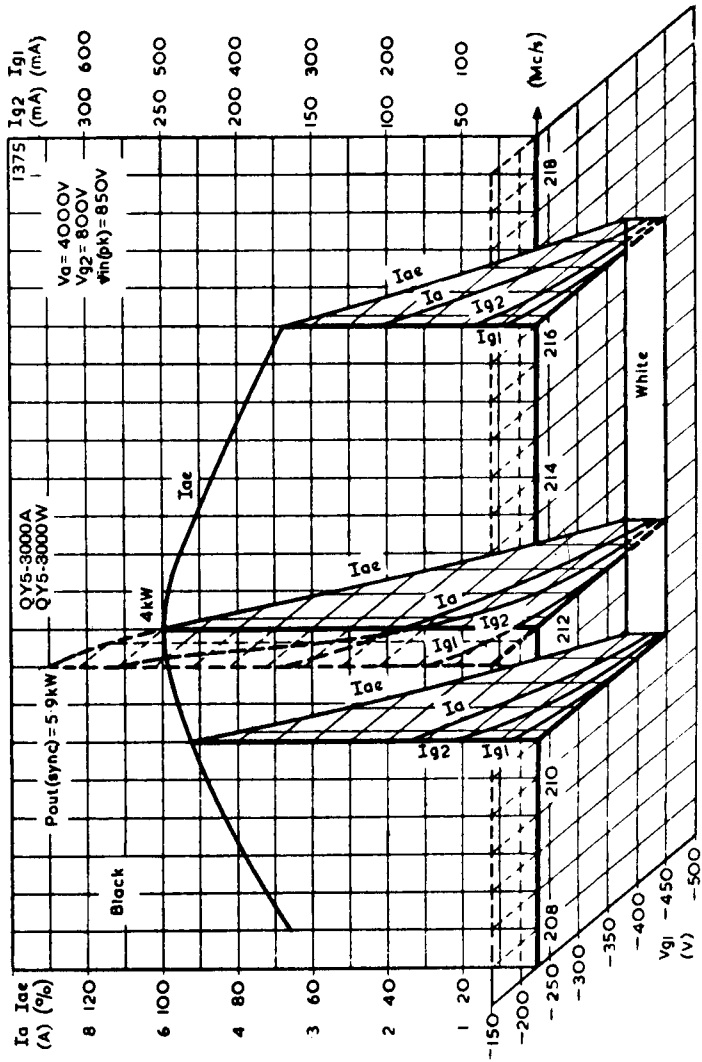
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



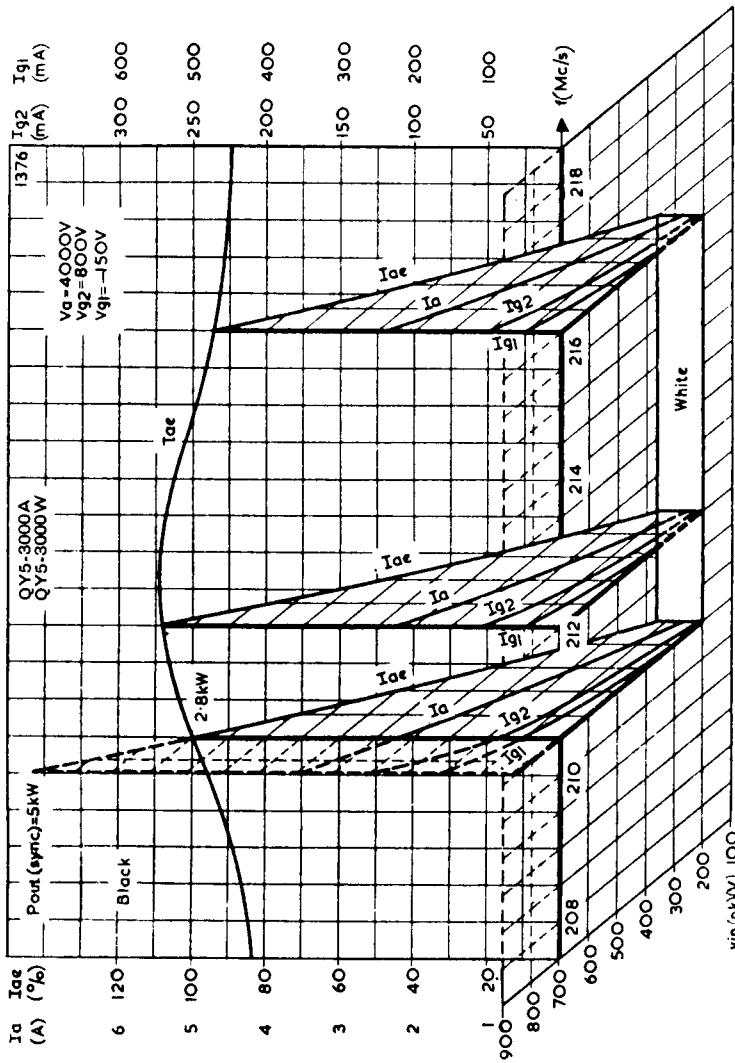
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER



OPERATION OF TWO VALVES AS R.F. AMPLIFIER CLASS "C" GRID MODULATION FOR TELEVISION SERVICE, WITH NEGATIVE MODULATION AND POSITIVE SYNCHRONISATION

P_{out} (sync.) = 5.9kW

QY5-3000A
QY5-3000W



OPERATION OF TWO VALVES AS R.F. AMPLIFIER CLASS "B" FOR TELEVISION SERVICE, WITH NEGATIVE MODULATION AND POSITIVE SYNCHRONISATION

TETRODE

QYS50-P40

Application: *Pulse Modulator*
Ratings: *50kV, 40A*
Construction: *Silica envelope*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT Thoriated tungsten

V_f	$11.5^{+0.5}_{-0.2}$	V
I_f	64	A

The filament current must never exceed a surge value of 100A at any time during the warming-up period.

MOUNTING

Position — Vertical, anode terminal uppermost

The valve may be supported by a semi-rigid, or cushioned, insulating clamp around the silica envelope. Alternatively, it may be purchased already fitted in a holder with plug-in contacts.

CAPACITANCES

C_{a-g1}	3.0	pF
C_{g1-all}	45	pF
C_{a-all}	31	pF

CHARACTERISTICS

g_m (V_a = 10kV, I_a = 30A)	38	mA/V
μ_{g1-g2} (V_a = 10kV, I_a = 80mA)	4.0	
$-V_{g1}$ (I_a = 1mA at V_a = 55kV, V_{g2} = 5.0kV)	< 3.4	kV

COOLING

Natural cooling

T_{seals} max.	260	°C
T_{anode} max.	810	°C

RADIATION HAZARD

There is considerable X-radiation from this valve and equipment should incorporate adequate shielding for the safety of operator. Lead sheet of 1mm thickness is satisfactory but it must extend far enough to stop reflections through small gaps and holes as well as the direct radiation from the valve.

PULSE MODULATOR

Limiting values (absolute ratings)

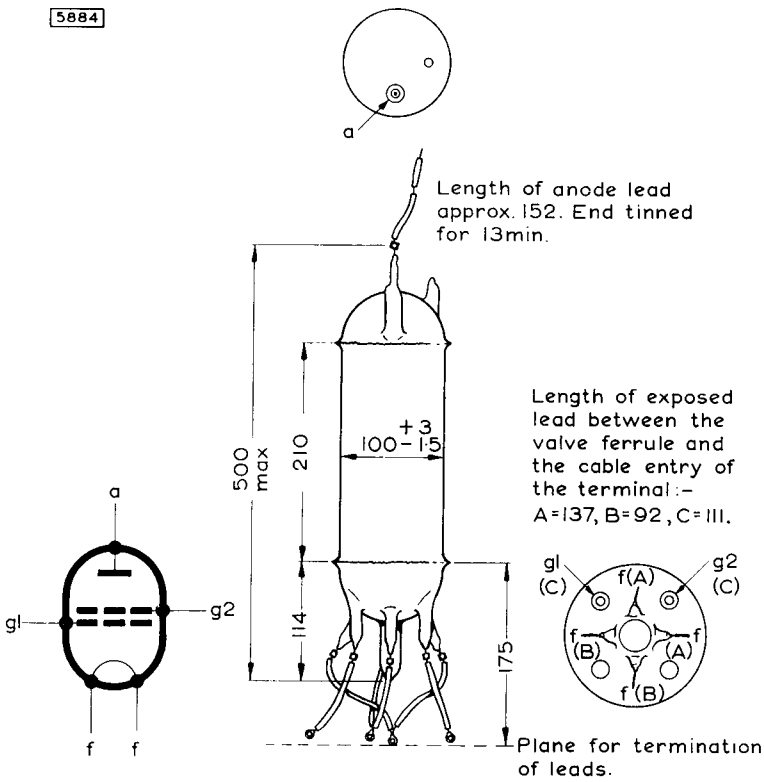
$v_{a(pk)}$ max.	55	kV
V_a max.	50	kV
$V_{g2(b)}$ max.	6.0	kV
V_{g2} max.	5.5	kV
$-V_{g1}$ max.	7.0	kV
I_k(pulse) max. for $t_p < 5\mu s$	50	A
Duty factor max.	0.001	
p_a max.	700	W
p_{g2} max.	250	W

Operating conditions

t_p	5.0	1.0	μs
Duty factor	0.0005	0.0005	
V_a	50	45	kV
V_{g2}	5.0	5.0	kV
V_{g1}	–4.0	–3.2	kV
V_{g1}(pulse)	4.3	3.8	kV
I_a(pulse)	30	40	A
I_a	15	20	mA
I_{g2}	1.0	1.0	mA
I_{g1}	*	*	
R_a	6.0	20	kΩ
I_{Ra}(pulse)	7.0	2.0	A
R_{load}(effective)	1.8	1.0	kΩ
I_{load}(pulse)	23	38	A
V_{load}(pulse)	43	37	kV

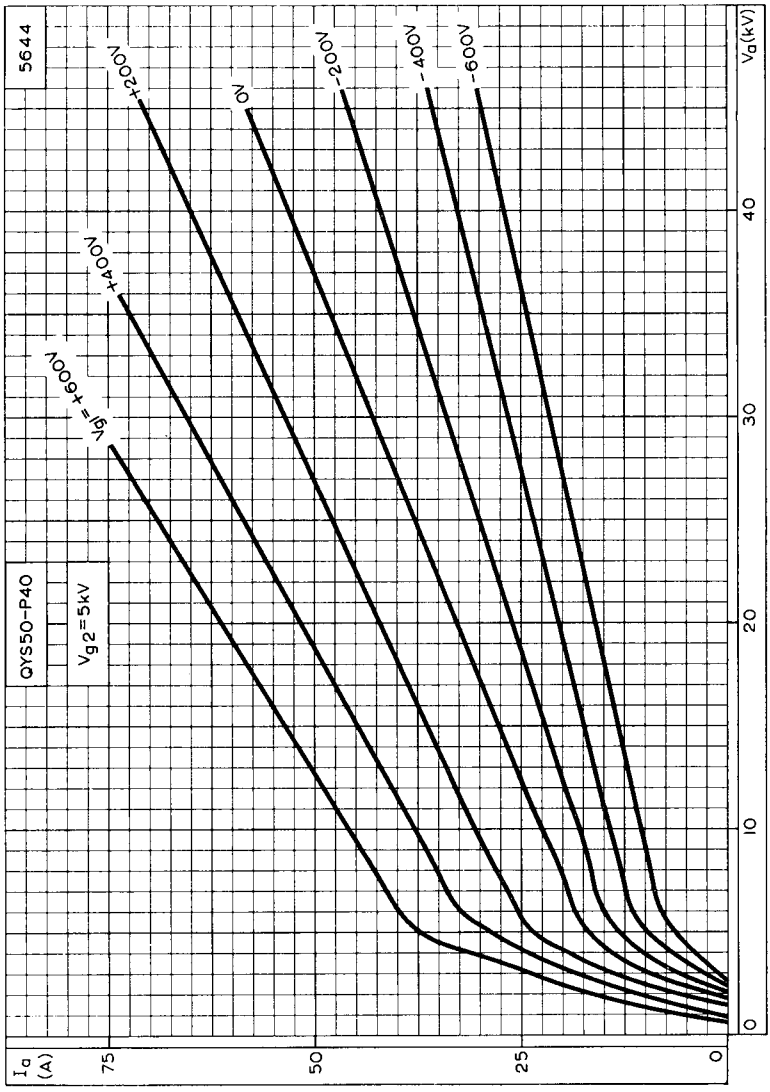
*The grid current is negative and the power supply should have an impedance of approximately 300Ω.

QYS50-P40



All dimensions in mm

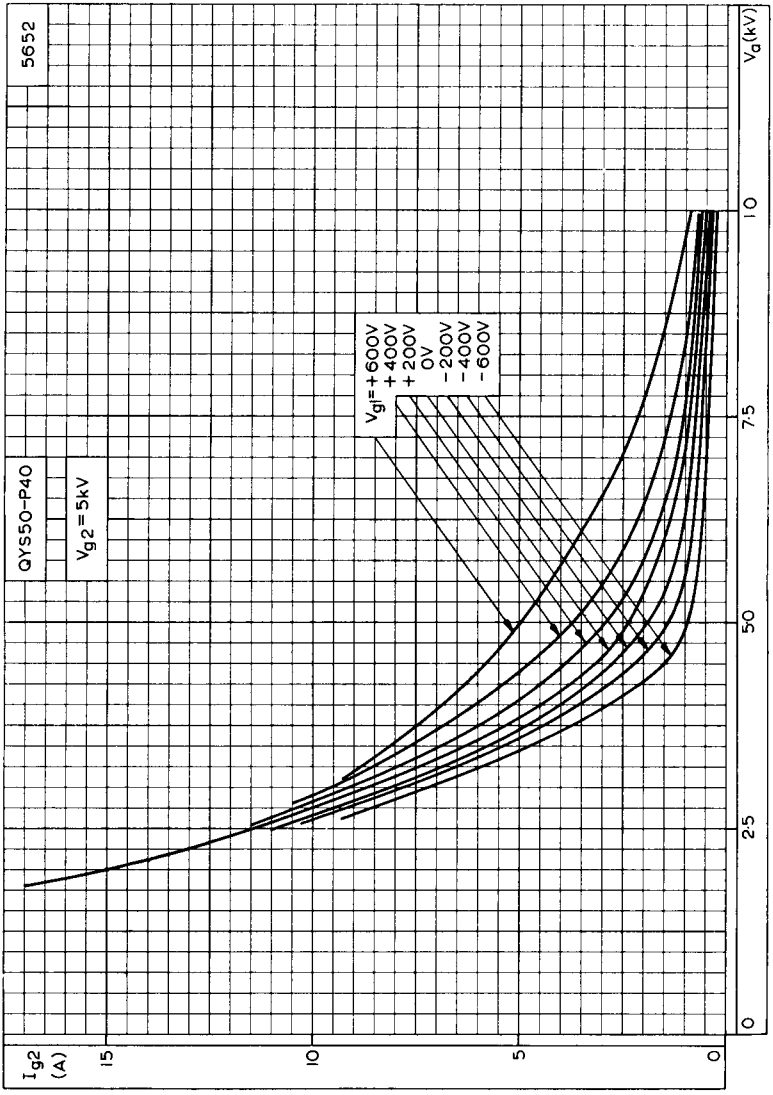
QYS50-P40



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE = 5kV

QYS50-P40

TETRODE



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE = 5kV

QUICK HEATING TETRODE

QZ06-20

QUICK REFERENCE DATA

Quick heating V.H.F. power amplifier for mobile transmitters. 70% power output in less than half a second.

f max.	175	Mc/s
V_a max.	650	V
p_a max.	25	W
Performance		
f	60	Mc/s
P_{out}	65	W

These data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES which precede this section of the handbook.

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY (Intermittent mobile service)

Absolute maximum ratings

f max.	175	Mc/s
V_a max.		
f < 60Mc/s	650	V
f = 175Mc/s	400	V
V_{g2} max.	200	V
$-V_{g1}$ max.	150	V
I_a max.	160	mA
I_{g1} max.	5.0	mA
p_a max.	25	W
p_{g2} max.	5.0	W
R_{g1-k} max.	30	kΩ

Typical operating conditions

f	60	175	Mc/s
V_a	600	400	V
V_{g2}	180	190	V
$-V_{g1}$	71	54	V
I_a	150	150	mA
I_{g2}	15	15	mA
I_{g1}	2.8	2.2	mA
$v_{in(pk)}$	91	68	V
P_{load} (driver)	2.0	5.0	W
p_a	25	25	W
p_{g2}	2.7	2.9	W
η_a	73.5	58	%
P_{out}	65	35	W
P_{load}	53	28	W

QZ06-20

QUICK HEATING TETRODE

CLASS 'C' ANODE AND SCREEN GRID MODULATION (Intermittent mobile service)

Absolute maximum ratings

Carrier condition for a modulation factor of 1

f max.	175	Mc/s
V_a max.		
f < 60Mc/s	480	V
f = 175Mc/s	350	V
V_{g2} max.	250	V
$-V_{g1}$ max.	150	V
I_a max.	120	mA
I_{g1} max.	3.5	mA
P_a	14	W
P_{g2} max.	2.0	W
R_{g1-k} max.	30	kΩ

Typical operating conditions

f	60	60	Mc/s
V_a	475	400	V
V_{g2}	135	150	V
$-V_{g1}$	77	87	V
I_a	94	112	mA
I_{g2}	9.0	12	mA
I_{g1}	2.8	3.4	mA
$v_{in(pk)}$	95	107	V
P_{load} (driver)	0.3	0.4	W
P_a	11	13	W
P_{g2}	1.2	1.8	W
η_a	75	71	%
P_{out}	34	32	W
P_{load}	29	27	W
$\eta_{transfer}$	85	85	%

CATHODE

Quick heating filament. 70% P_{out} in less than 0.5 second.

V_f	1.6	V
I_f	3.2	A
Frequency of filament supply		
Sine wave	max. 200	c/s
Square wave	Any	

The filament has been designed to accept temporary variations in supply voltage of ±15%.

CAPACITANCES

C_{a-g1}	< 240	mpF
C_{in}	13.5	pF
C_{out}	8.5	pF

QUICK HEATING TETRODE

QZ06-20

CHARACTERISTICS (measured at V_a = 200V, V_{g2} = 200V, I_a = 100mA)

g_m	7.0	mA/V
μ_{g1-g2}	4.5	

COOLING

Radiation and convection

T_{bulb} max.	220	°C

MOUNTING POSITION

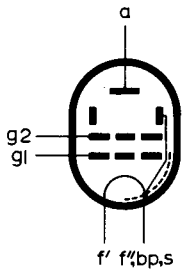
Any

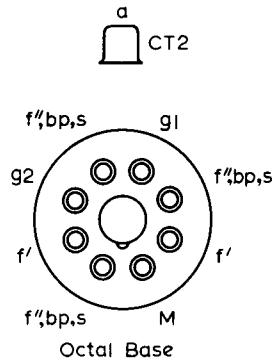
PHYSICAL DATA

Weight of valve	2.08	oz
	59	g
Weight of valve plus carton	3.0	oz
	85	g

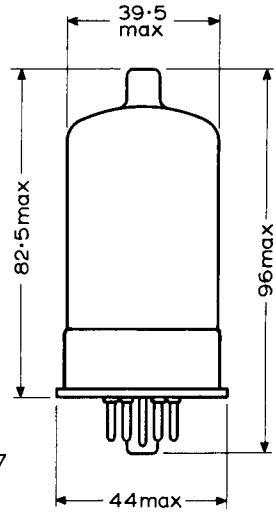
ACCESSORIES

Socket	5903/13
Anode cap	28906 022





Octal Base

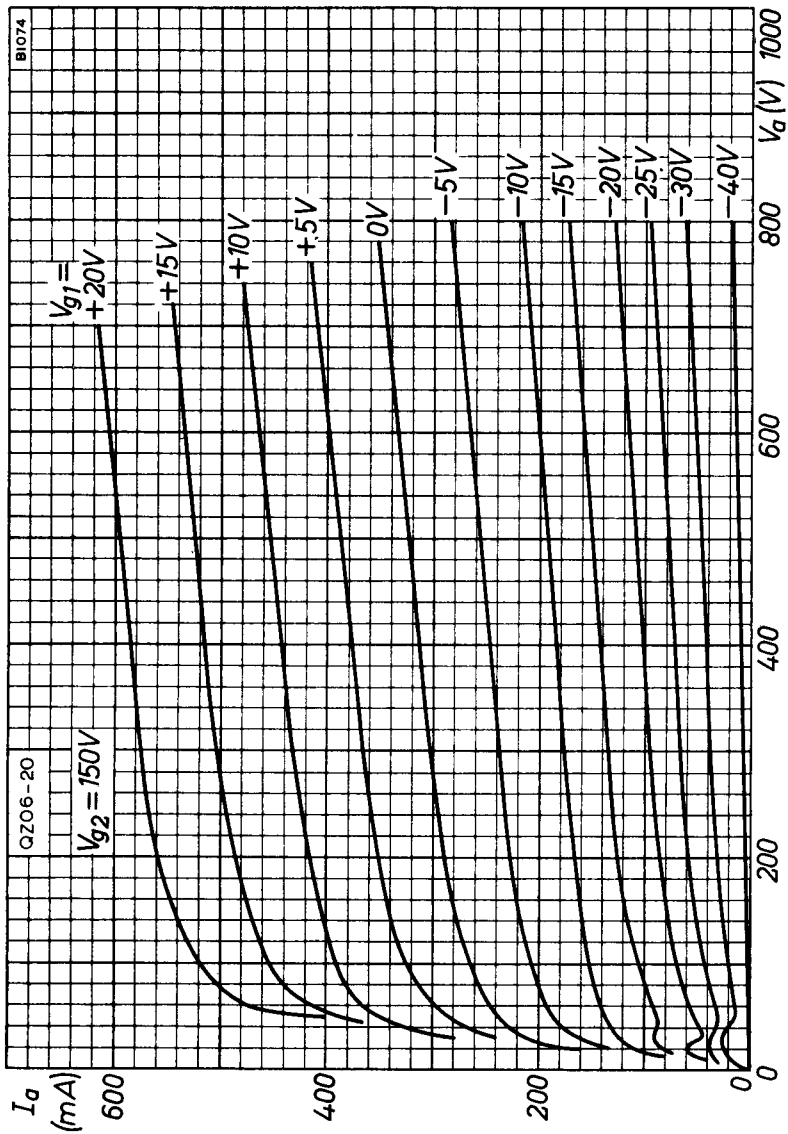


Connect contacts 1,4 and 6 together and contacts 2 and 7 together externally to reduce the effective contact resistance .

8228

All dimensions in mm

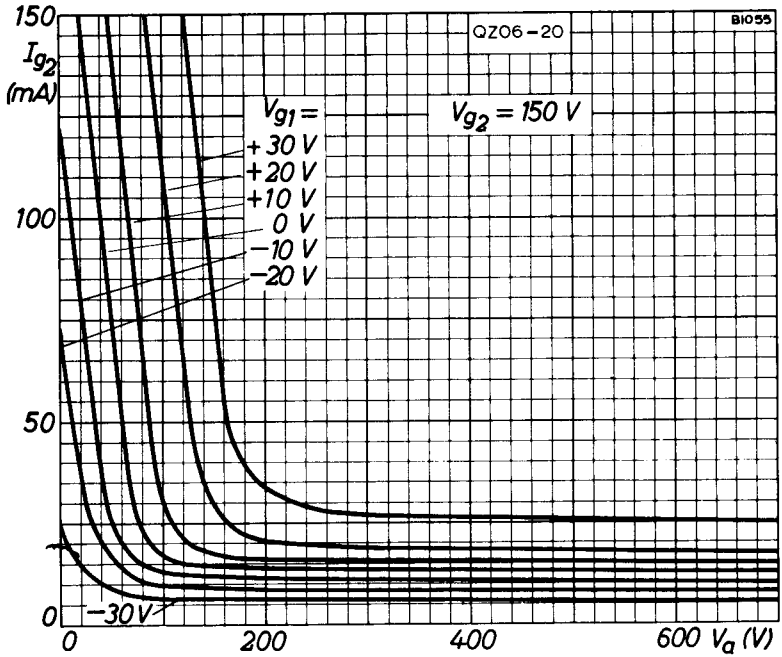
QZ06-20

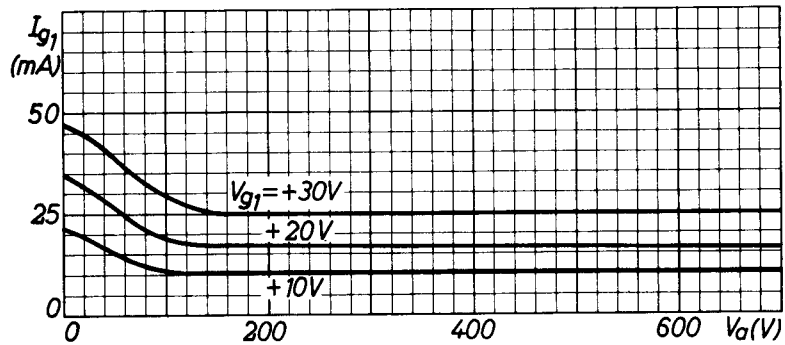


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
V_{g2} = 150V

QZ06-20

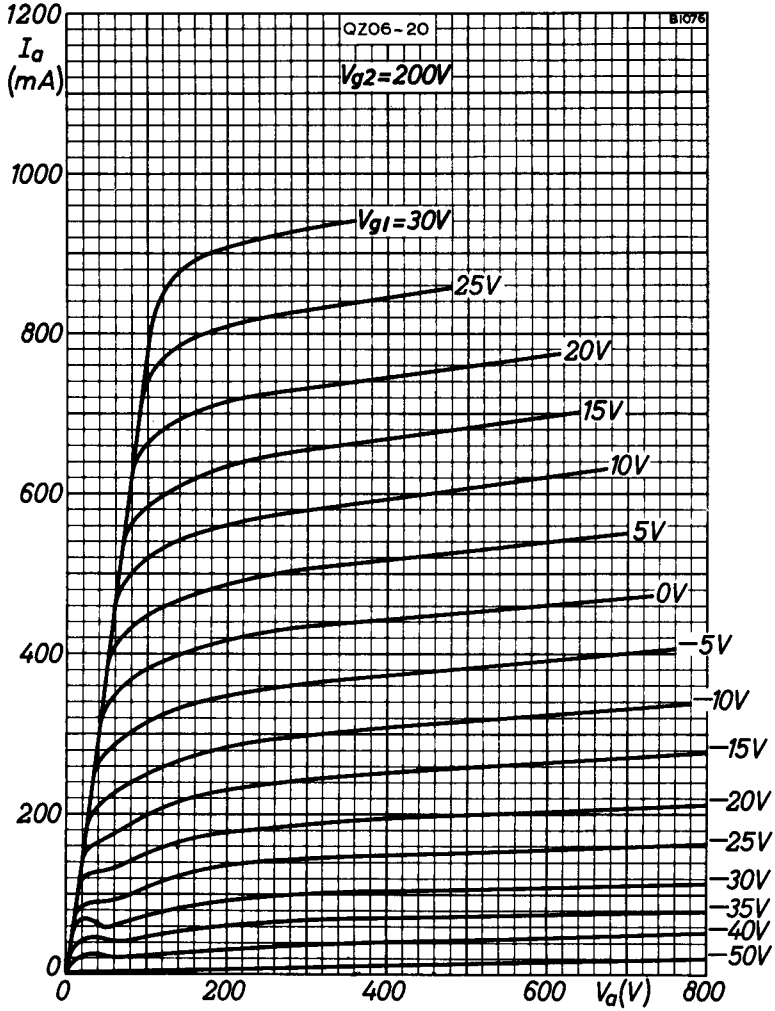
QUICK HEATING TETRODE





SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
V_{g2} = 150V

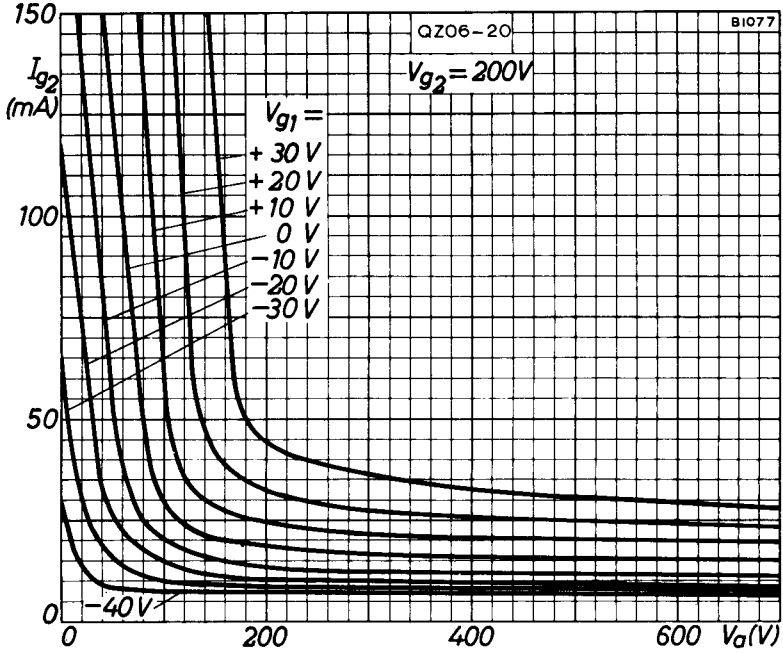
QZ06-20

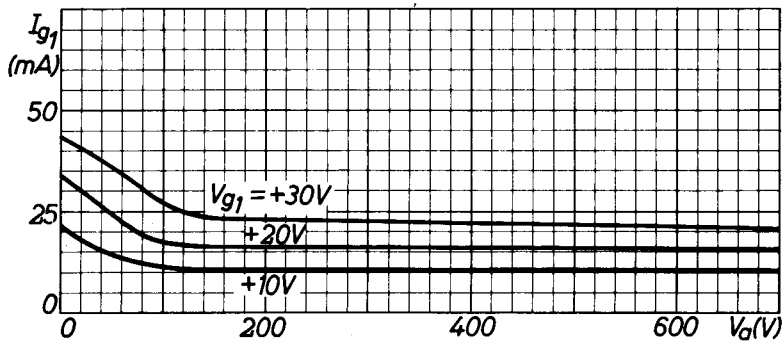


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
V_{g2} = 200V

QZ06-20

QUICK HEATING TETRODE





SCREEN-GRID AND CONTROL-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER.
V_{g2} = 200V

MERCURY VAPOUR RECTIFIER

RG4-1000

This data sheet should be read in conjunction with "Operating Notes, Part II—Mercury Vapour Rectifiers", included in this volume of the Handbook.

FILAMENT

V_f	5.0	V
I_f	6.75	A

LIMITING VALUES

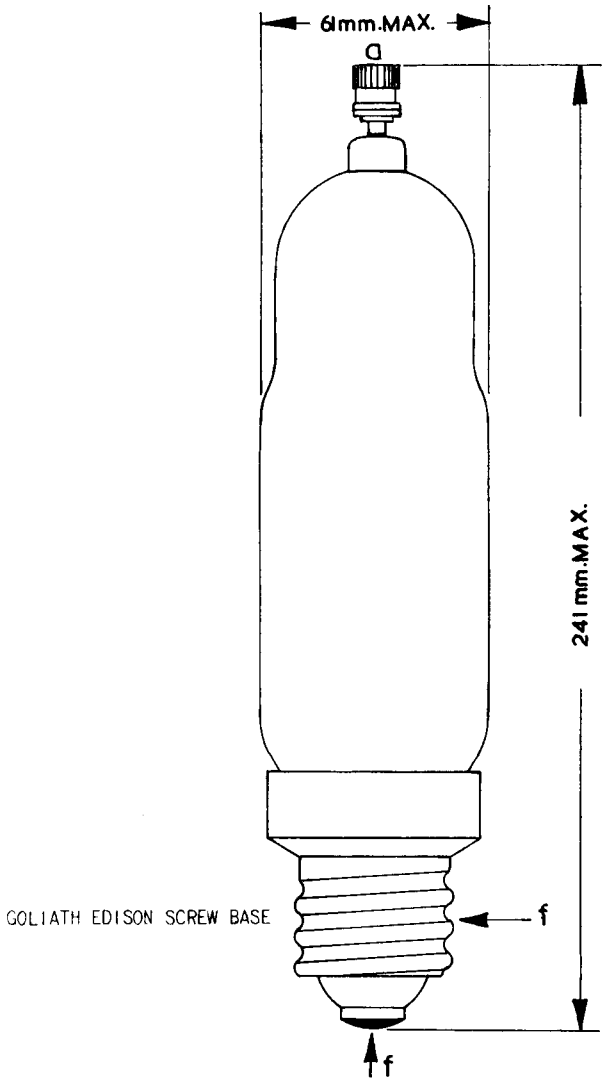
Max. Peak Inverse Voltage (150c/s max.)	13,000	V
Max. Peak Anode Current	5	A
Max. Mean Anode Current	1.25	A
Voltage Drop across Valve (approx.)	16	V
Ambient Temperature	10 to 40	°C
Condensed Mercury Temperature	25 to 65	°C

FULL LOAD OPERATING CONDITIONS

Circuit	No. of Valves	Full Load D.C. Output		Applied A.C. Volts	Initial Filter Elements	
		(V)	(A)	($V_{r.m.s.}$)	$L_{min.}$ (H)	$C_{max.}$ (μF)
Single Phase Full Wave	2	4,140	2.5	4,600 (per valve)	2.5	6
Single Phase Bridge	4	8,280	2.5	9,200 (total)	5	3
Three Phase Half Wave	3	5,370	3.75	4,600 (per phase)	1.5	4
Three Phase Full Wave	6	12,400	3.75	5,300 (per phase)	3.0	2

RG4-1000

MERCURY VAPOUR RECTIFIER



WEIGHTS

Valve only	10oz.	(0.28 Kg.)
Valve and Carton	3lb. 10oz.	(1.64 Kg.)

Mullard
H.F. PENTODE

SP13

The SP13 is an indirectly heated straight H.F. Pentode for use in D.C./A.C. receivers, and for car radio, as an R.F. amplifier, detector or L.F. amplifier.

HEATER CHARACTERISTICS

Heater Voltage	Vf = 13·0 volts
Heater Current	If = 0·2 amp
Heating Time—60 seconds	

DIMENSIONS

Overall Length ...	= 109 mm.
Overall Diameter...	= 42 mm.
Bulb Finish—Metallised	

OPERATING CHARACTERISTICS AS R.F. AMPLIFIER

Normal Anode Voltage	Va_w	= 200 volts
Normal Auxiliary Grid Voltage	$Vg2_w$	= 100 volts
Anode Current	Ia_w	= 3·3 mA
Control Grid Voltage	$-Vg1$	= 2 volts
Anode Impedance	Ri_w	= 1·3 megohms
Amplification Factor	G_w	= 3,000
Mutual Conductance (Ia = 3·3 mA)	S_w	= 2·2 mA/V
Cathode Bias Resistance	Rk	= 400 ohms

OPERATING CHARACTERISTICS AS SPEECH DETECTOR

Anode Voltage (line)	Va	= 200 volts
Series Resistance (Grid 2)	Rg2	= 1·0 megohm
Anode Resistance	Ra	= 0·3 megohm

OPERATING CHARACTERISTICS AS L.F. AMPLIFIER

Anode Voltage	Va	= 200 volts
Auxiliary Grid Voltage	Vg2	= 100 volts
Anode Load	Ra	= 0·1 megohm
Bias Resistance	Rk	= 2,500 ohms

CAPACITIES

Anode to Control Grid	Cag1	= <0·003 $\mu\mu$F
Cathode to Control Grid	Ckg1	= 7·1 $\mu\mu$F
Anode to Cathode + Auxiliary Grid	Cak+g2	= 7·7 $\mu\mu$F

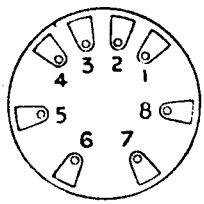
LIMITS

Maximum Anode Voltage	Va_{max}	= 200 volts
Maximum Anode Dissipation	Wa_{max}	= 1·0 watt
Maximum Cathode Current	Ik_{max}	= 6·0 mA
Maximum Auxiliary Grid Voltage	$Vg2_{max}$	= 100 volts
Maximum Resistance in Grid Circuit	$Rg1a_{max}$	= 1·5 megohms
Maximum Voltage Heater to Cathode	Vfk_{max}	= 125 volts
Maximum Resistance Heater to Cathode ...	Rfk_{max}	= 20,000 ohms
Range of Grid Voltage for 1 μA Grid Current ...	Vg1	= −0·5 to −1·0 volt

SP13

Mullard
H.F. PENTODE

CONNECTIONS

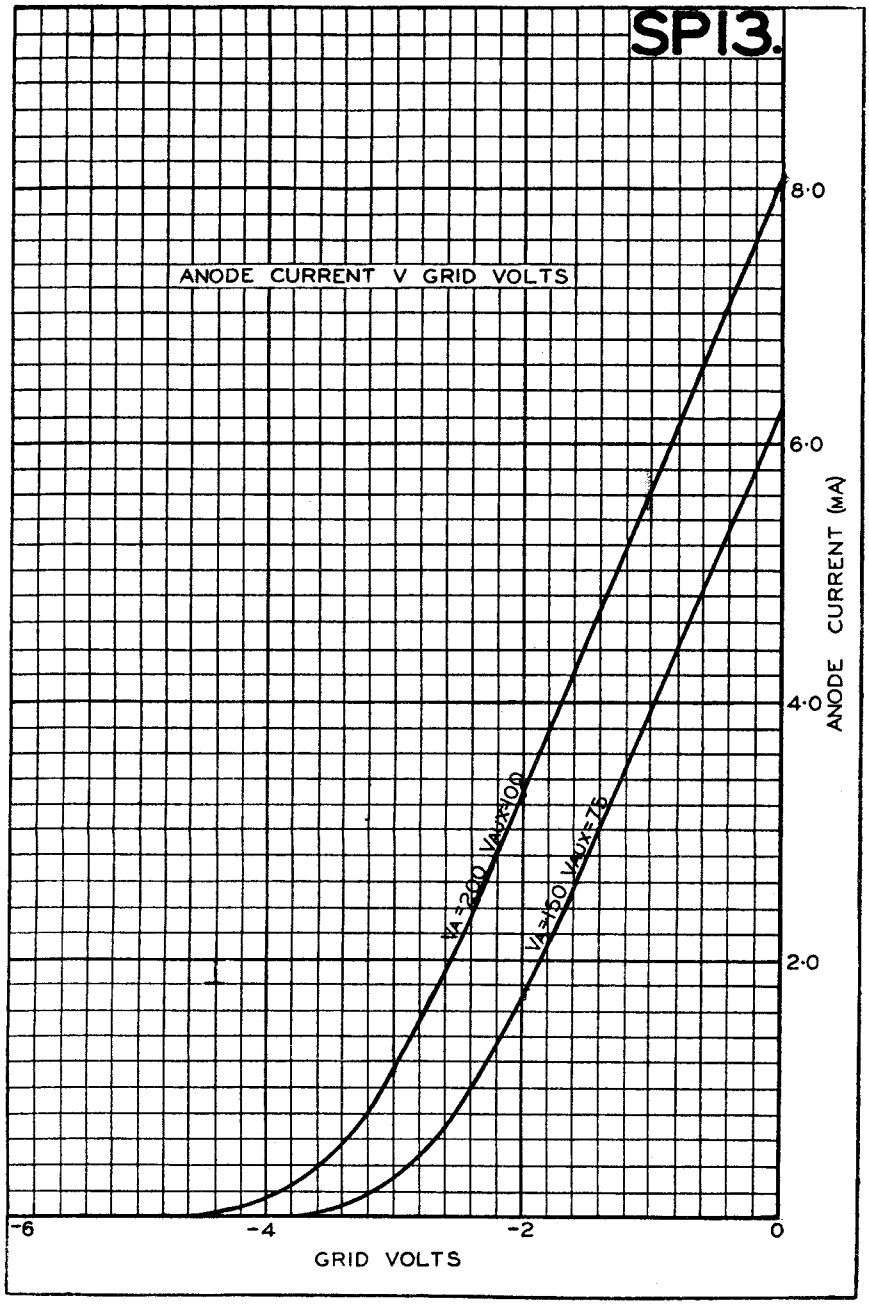


Viewed from under side of base

Contact No. 1 Metallising
" 2 Heater
" 3 Heater
" 4 Cathode
" 5 Suppressor Grid (G_3)
" 6 —
" 7 Auxiliary Grid (G_2)
" 8 Anode
Top Cap—Control Grid.

Mullard
H.F. PENTODE

SP13



1537

Mullard
H.F. PENTODE

SP13C

The SP13C is an indirectly heated straight H.F. Pentode for use in D.C./A.C. receivers, and for car radio.

HEATER CHARACTERISTICS

Heater Voltage ... ... Vf = 13·0 volts
Heater Current ... ... If = 0·2 amp
Heating Time—60 seconds

DIMENSIONS

Overall Length ... = 125 mm.
Overall Diameter... = 43 mm.
Bulb Finish—Metallised

OPERATING DATA AS R.F. AMPLIFIER

Normal Anode Voltage	Va_w	= 200 volts
Normal Auxiliary Grid Voltage	$Vg2_w$	= 200 volts
Anode Current	Ia_w	= 2·5 mA
Control Grid Voltage	$-Vg1_w$	= 2·2 volts
Auxiliary Grid Current	$Ig2_w$	= 0·9 mA
Amplification Factor	G_w	= 7,000
Mutual Conductance (Ia = 2·5 mA)	S_w	= 2·8 mA/V
Anode Impedance	Ri_w	= 2·5 megohms

OPERATING DATA AS SPEECH DETECTOR

Anode Voltage (line)	Va	= 200 volts
Series Resistance (Grid 2)	Rg2	= 0·5 megohm
Anode Resistance	Ra	= 0·1 megohm
Grid Condenser	Cg1	= 100 $\mu\mu$F
Grid Resistance	Rg1	= 0·5—1·0 megohm

CAPACITIES

Anode-Control Grid	Cag1	= <0·003 $\mu\mu$F
Input	Cg1	= 6·9 $\mu\mu$F
Output	Ca	= 8·1 $\mu\mu$F

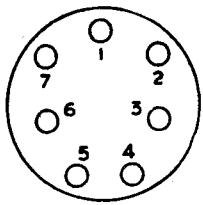
LIMITS

Maximum Anode Voltage	Va_{max}	= 200 volts
Maximum Anode Dissipation	Wa_{max}	= 1·0 watt
Maximum Cathode Current	Ik_{max}	= 6·0 mA
Maximum Auxiliary Grid Voltage	$Vg2_{max}$	= 200 volts
Maximum Auxiliary Grid Dissipation	$Wg2_{max}$	= 0·3 watt
Maximum Auxiliary Grid Current	$Ig2_{max}$	= 1·2 mA
Maximum Resistance in Grid Circuit	$Rg1a_{max}$	= 1·5 megohms
Maximum Voltage Heater to Cathode	Vfk_{max}	= 125 volts
Maximum Resistance Heater to Cathode ...	Rfk_{max}	= 20,000 ohms
Range of Grid Voltage for 1 μA Grid Current	Vg1	= −0·5 to −1·0 volt

SP13C

Mullard
H.F. PENTODE

CONNECTIONS

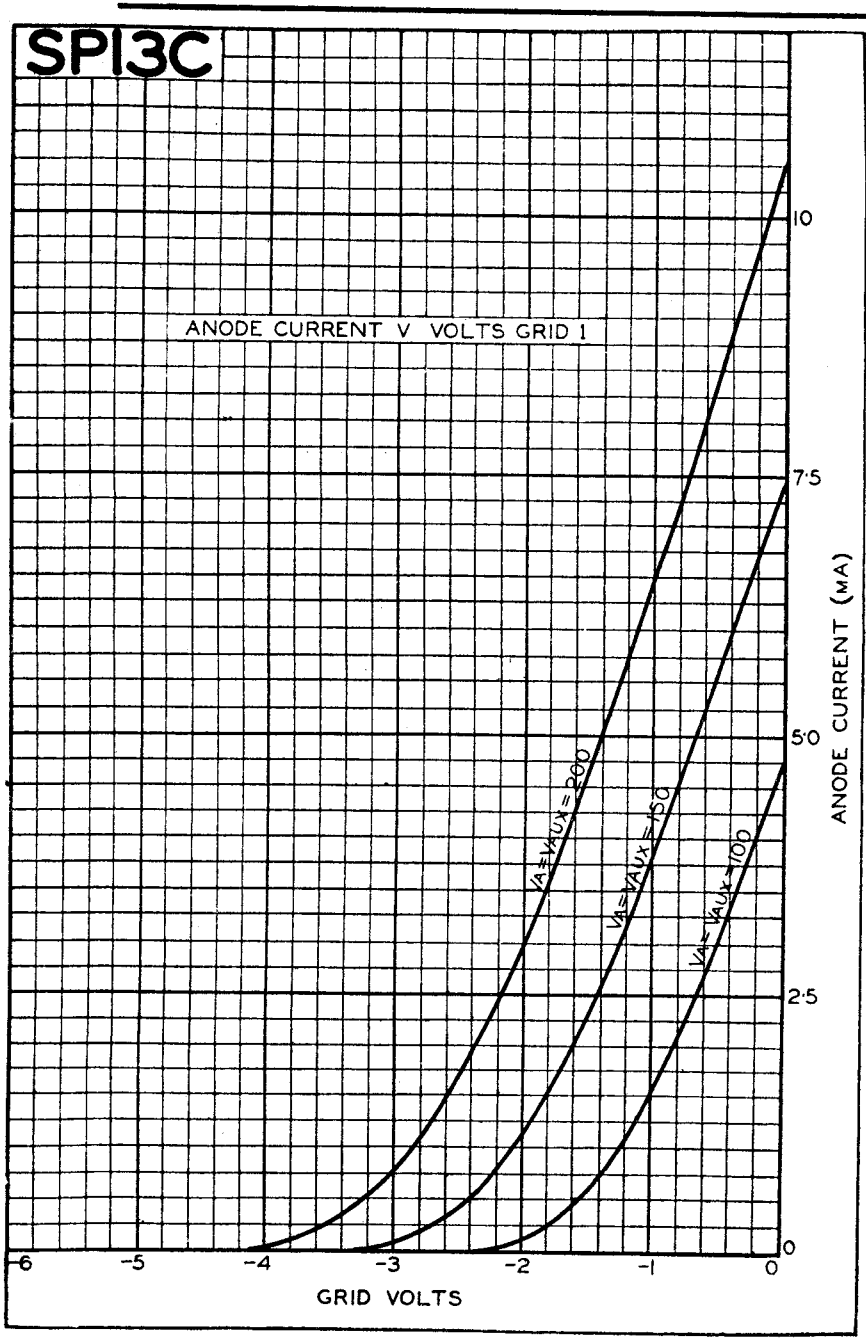


Viewed from free end of pins.

Pin No. 1 Metallisation
„ 2 Anode
„ 3 Suppressor Grid (G3)
„ 4 Heater
„ 5 Heater
„ 6 Cathode
„ 7 Auxiliary Grid (G2)
Top Cap—Control Grid

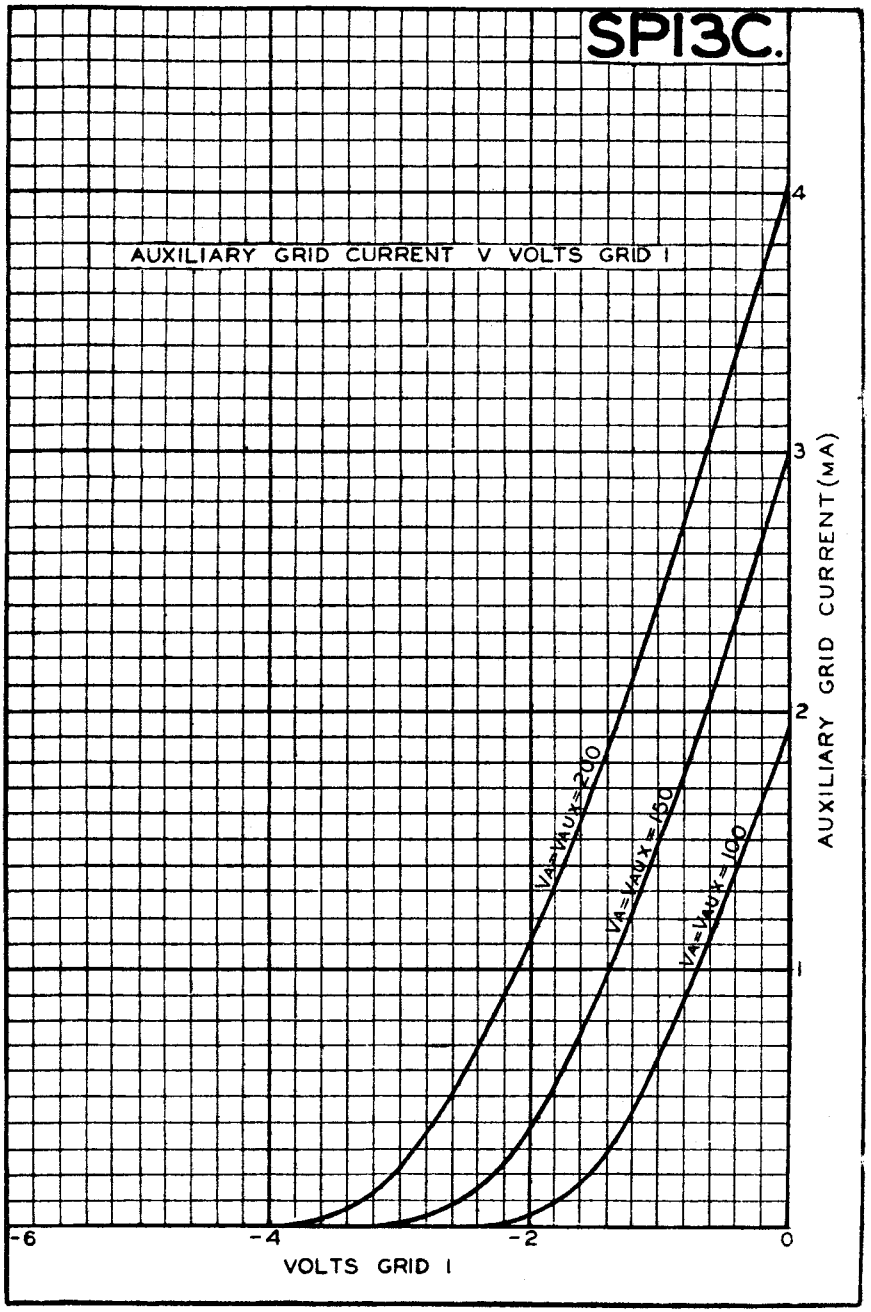
Mullard
H.F. PENTODE

SP13C



SP13C

Mullard
H.F. PENTODE



Mullard
TELEVISION DIODE

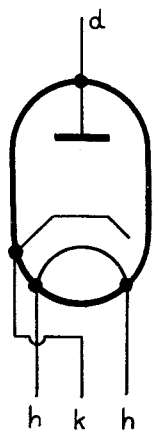
T4D

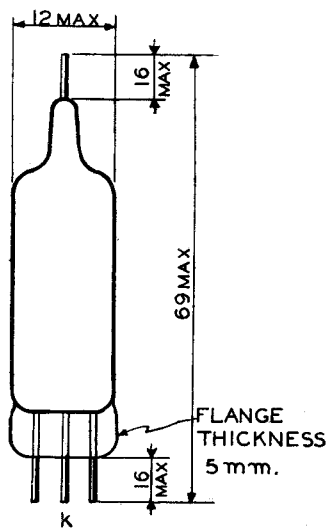
Heater	Vf =	4.0 V
	If =	0.2 A
Capacity	Cdk =	2.1 uuF

Operating Conditions

Vd max	50	V ←
Id max	5.0	mA ←
Vd max (Id = +0.3 uA).....	-1.3	V
Vfk	50	V
Rfk 20,000		ohms

Arrangement of electrodes and base connections

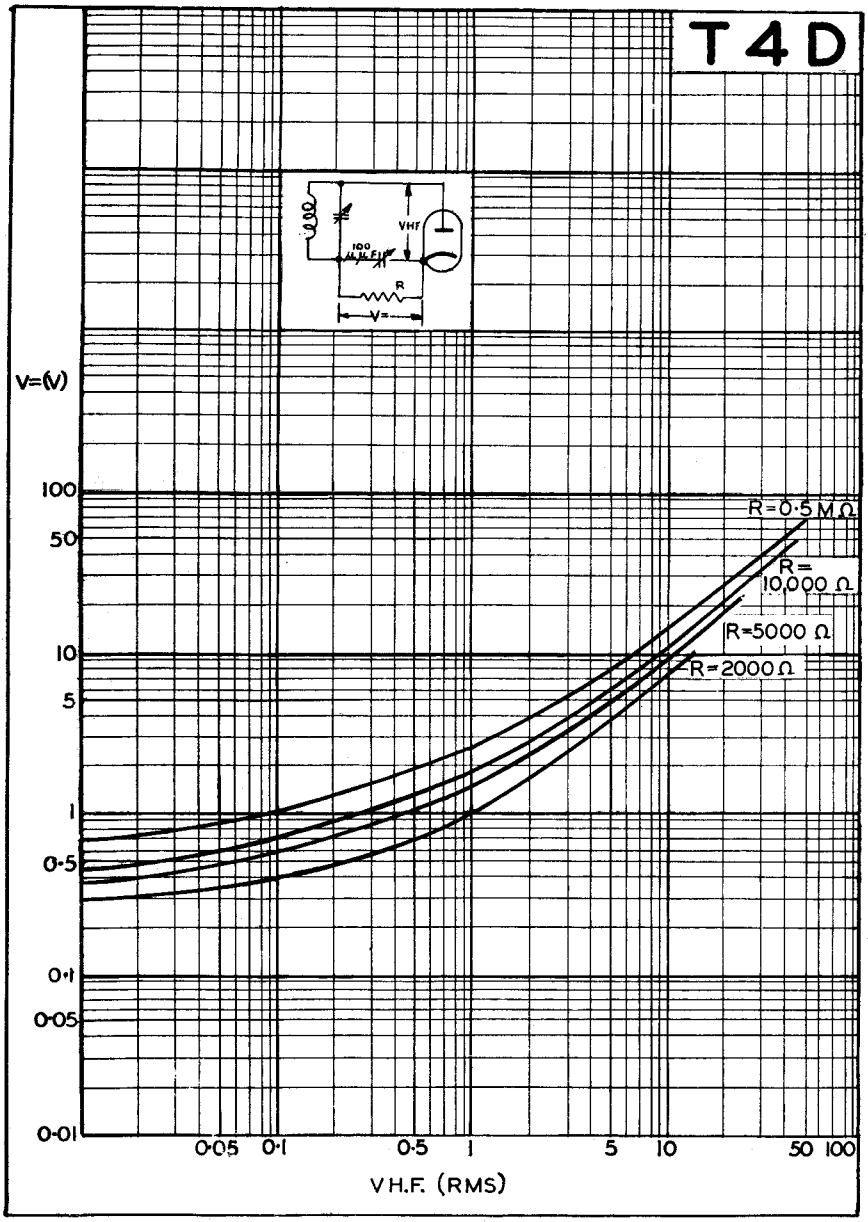




T4D

T4D

Mullard
TELEVISION DIODE



1839/2

DISC SEAL TRIODE

TD03-10

Indirectly-heated disc seal triode, without internal feedback, primarily intended for use as a common grid, earthed anode, concentric line oscillator. It may also be used as a power amplifier.

HEATER

Indirectly heated.

V_h	6.3	V
I_h (approx.	0.4	A

CAPACITANCES

c_{a-g}	1.1	μμF
c_{a-k}	0.02	μμF
c_{g-k}	2.2	μμF

CHARACTERISTICS

V_a	250	V
V_g	−3.5	V
I_a	20	mA
g_m	6.0	mA/V
μ	30	

LIMITING VALUES

V_a max.	350	V
p_a max.	10	W
I_a max.	50	mA
$i_{a(pk)}$ max.	150	mA
p_g max.	0.5	W
$T_{anode\ seal}$ max.	140	°C

In order to limit the anode seal temperature and also to limit the rate of change of anode seal temperature, it is necessary that the mass of metal in close thermal contact with the anode disc shall not be less than 60 grams (2 oz.) of brass or its thermal equivalent.

TD03-10

DISC SEAL TRIODE

Indirectly-heated disc seal triode, without internal feedback, primarily intended for use as a common grid, earthed anode, concentric line oscillator. It may also be used as a power amplifier.

OPERATING NOTES

A typical circuit arrangement is shown where the anode-to-grid and grid-to-cathode circuits are both coaxial lines, the grid line being common to both circuits.

Tuning is effected in both circuits by means of moveable bridges which should ideally be a quarter of a wavelength in length to ensure that the actual contact occurs at a current node. Over the wavelength range 10 to 60 cm a good compromise is obtained with a bridge of 2.5 cm in length.

It is essential that perfect contact is maintained between the lines and the bridges.

The heater-to-cathode circuit may be tuned by means of a capacity bridge. For the longer wavelengths tuning is not essential but must be employed for wavelengths around 10 cm. A bridge positioned 7.2 cm from the valve end of the cathode line will give satisfactory operation over the range 8-12 cm.

Feedback is obtained by means of an adjustable capacitive probe (6BA threaded rod) which makes contact with the anode line and passes through a $\frac{1}{4}$-in hole in the grid line. For wavelengths longer than 30 cm it is advisable to terminate the probe by a small circular disc. Below 30 cm this is unnecessary, and at approximately 10 cm the increased capacitance prohibits its use.

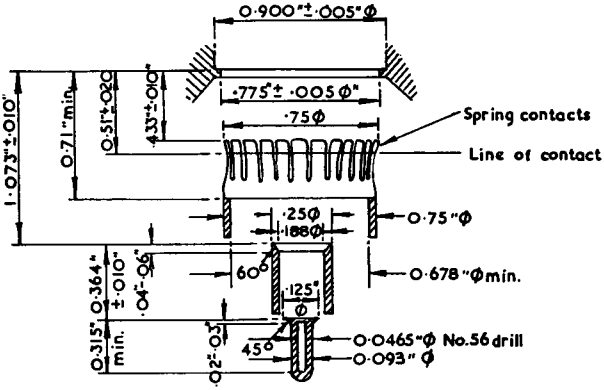
It is impossible to use a single probe position over each oscillator range and three positions A, B and C are given below for a typical circuit together with the range of wavelengths covered.

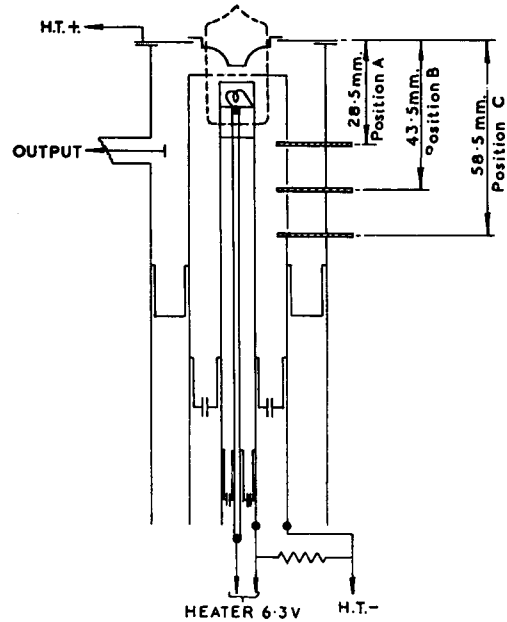
Probe Position	Distance from Anode Plane (mm)	Range of λ with Anode Line $\frac{3}{4}\lambda$ mode (cm)	Min. λ with Anode Line on $\frac{1}{4}\lambda$ mode (cm)
A	28.5	9 to 14	24
B	43.5	11 to 19	29
C	58.5	12 to 24	35

DISC SEAL TRIODE

TD03-10

Indirectly-heated disc seal triode, without internal feedback, primarily intended for use as a common grid, earthed anode, concentric line oscillator. It may also be used as a power amplifier.





TYPICAL CIRCUIT ARRANGEMENT FOR OSCILLATOR

TD03-10

DISC SEAL TRIODE

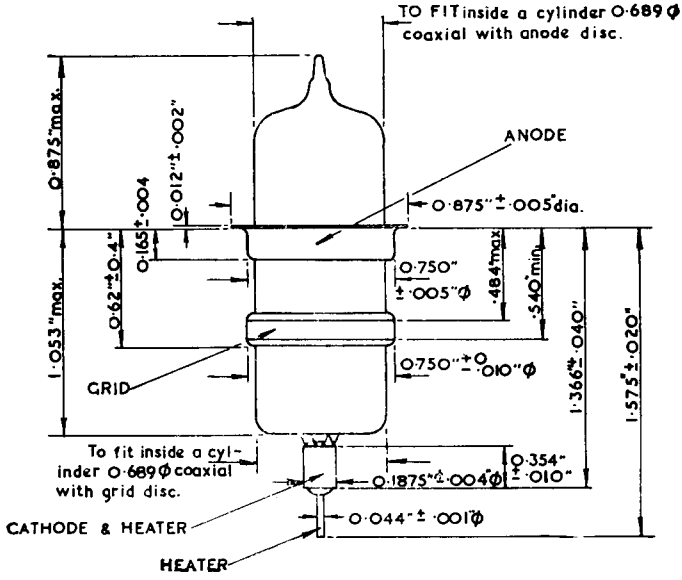
Indirectly-heated disc seal triode, without internal feedback, primarily intended for use as a common grid, earthed anode, concentric line oscillator. It may also be used as a power amplifier.

In order that bias may be used, a capacitor is incorporated in the grid-cathode bridge. The optimum value of bias varies with frequency and the following table gives the approximate values of cathode resistor for various wavelengths.

Operating Wavelength (cm)	Cathode Bias Resistor (Ω)
30	300 to 350
15	100
<12	0

Zero bias at a wavelength of 30 cm may cause a reduction in efficiency of 50%.

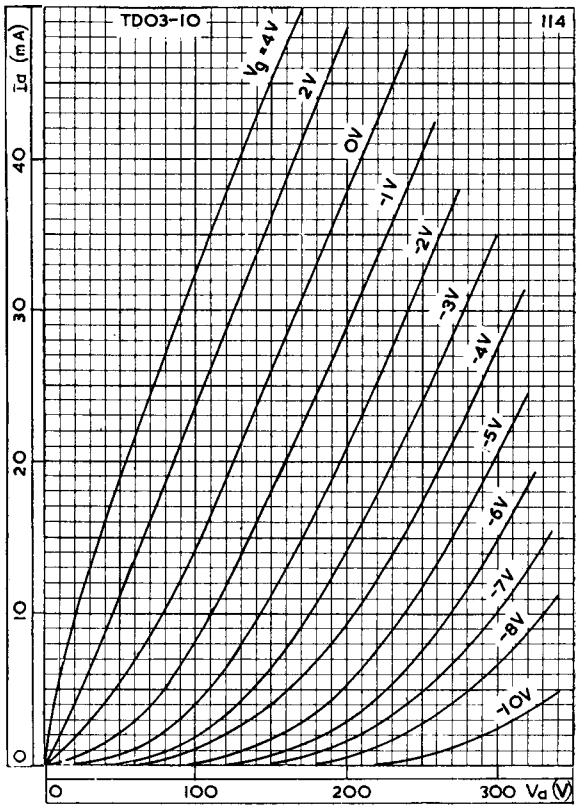
The output may be coupled into a 75 Ω line by means of a capacitive probe and this can be adjusted for optimum coupling by sliding the probe along the line, or by varying the depth of penetration towards the grid line.



DISC SEAL TRIODE

TD03-10

Indirectly-heated disc seal triode, without internal feedback, primarily intended for use as a common grid, earthed anode, concentric line oscillator. It may also be used as a power amplifier.

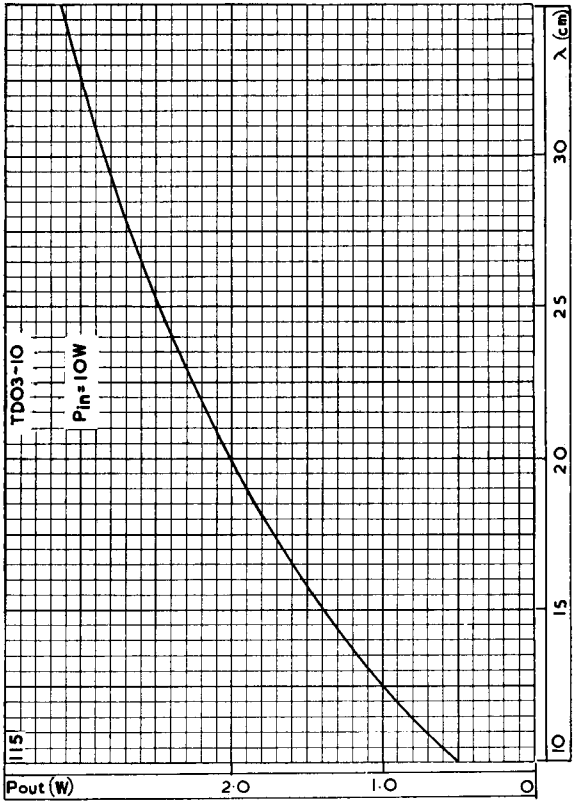


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

TD03-10

DISC SEAL TRIODE

Indirectly-heated disc seal triode, without internal feedback, primarily intended for use as a common grid, earthed anode, concentric line oscillator. It may also be used as a power amplifier.



OUTPUT POWER PLOTTED AGAINST WAVELENGTH

DISC SEAL TRIODE

TD03-10F

Indirectly heated disc seal triode, with internal feedback, primarily intended for use as a common grid earthed, anode, concentric line oscillator.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS — TRANSMITTING VALVES included in this volume of the handbook.

HEATER

V_h	6.3	V
I_h (approx.)	400	mA

MOUNTING POSITION

Any

CAPACITANCES

c_{a_g}	1.4	pF
c_{a_k}	0.045	pF
c_{g_k}	1.7	pF

CHARACTERISTICS (measured at $V_a = 250V$, $I_a = 20mA$, $V_g = -3.5V$)

g_m	6.0	mA/V
μ	30	

COOLING

$T_{anode\ seal}$ max.	140	°C

In order to limit the anode seal temperature and also to limit the rate of change of anode seal temperature, it is necessary that the mass of metal in close thermal contact with the anode disc shall not be less than 60g (2oz) of brass or its thermal equivalent.

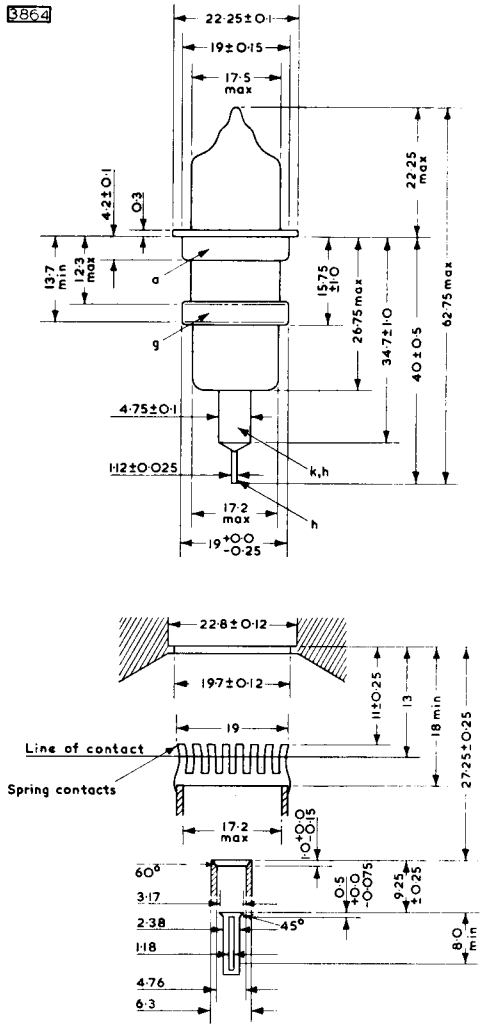
LIMITING VALUES

V_a max.	350	V
p_a max.	10	W
I_a max.	50	mA
$i_{a(pk)}$ max.	150	mA
p_g max.	500	mW

TD03-10F

DISC SEAL TRIODE

Indirectly heated disc seal triode, with internal feedback, primarily intended for use as a common grid, earthed anode, concentric line oscillator.



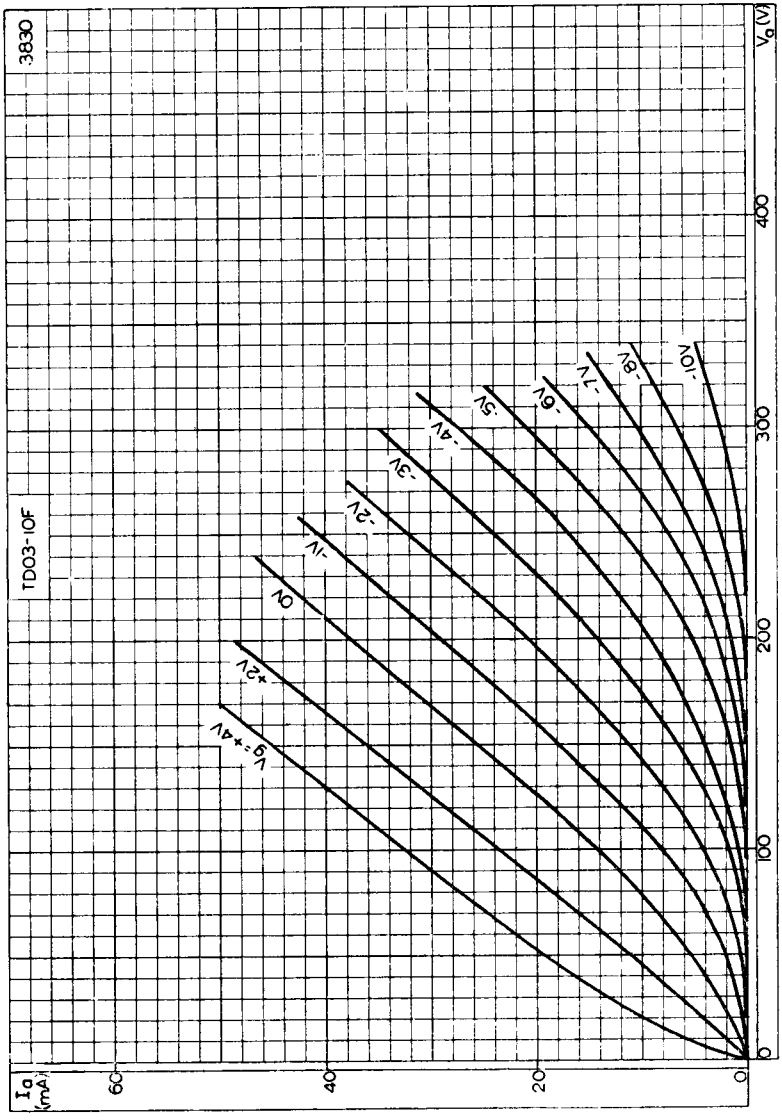
Note:
Eccentricity of grid, cathode and heater contacts shall not exceed 0·375

All dimensions in mm

DISC SEAL TRIODE

TD03-10F

Indirectly heated disc seal triode, with internal feedback, primarily intended for use as a common grid, earthed anode, concentric line oscillator.

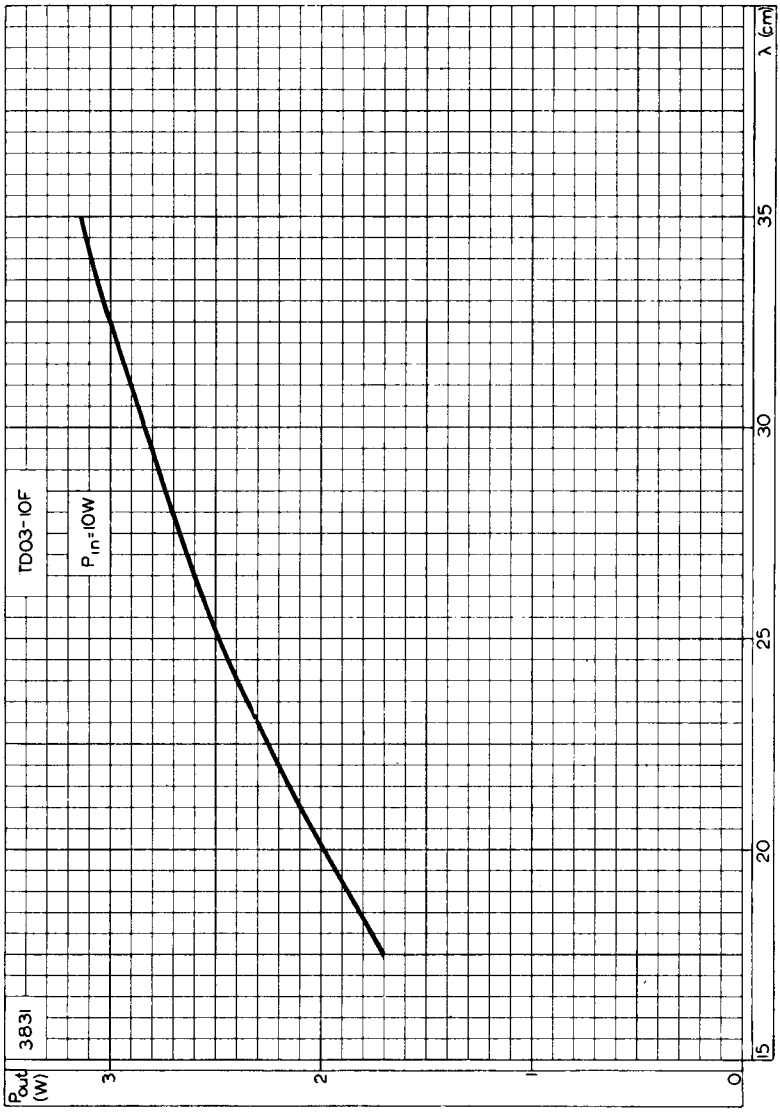


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

TD03-10F

DISC SEAL TRIODE

Indirectly heated disc seal triode, with internal feedback, primarily intended for use as a common grid, earthed anode concentric line oscillator.



POWER OUTPUT PLOTTED AGAINST WAVELENGTH

DISC SEAL TRIODE

TD03-5

Application: R.F. amplifier
Frequency: 2.0Gc/s
Construction: Disc seal, natural cooling

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this section of the handbook.

HEATER

V_h	6.3	V
I_h	400	mA

MOUNTING POSITION

Any

CAPACITANCES

$C_{a\ g}$	1.0	pF
$C_{a\ k}$	10	mpF
$C_{g\ k}$	2.0	pF

CHARACTERISTICS

V_a	250	V
I_a	10	mA
μ	70	
g_m	6.5	mA/V

OPERATING CONDITIONS

V_a	250	V
V_g	−2.0	V
I_a	10	mA
Noise factor		
at 1.0Gc/s with 15dB power gain	9.5	dB
at 1.5Gc/s with 13.5dB power gain	12	dB
at 2.0Gc/s with 11.5dB power gain	14.5	dB

LIMITING VALUES

V_a max.	350	V
I_k max.	25	mA
p_a max.	5.0	W
$T_{anode\ seal}$ max.	140	°C

In order to limit the anode seal temperature and also to limit the rate of change of temperature it is necessary that the mass of metal in close thermal contact with the anode disc shall not be less than 45g (1½ oz) of brass or its thermal equivalent.

TD03-5

DISC SEAL TRIODE

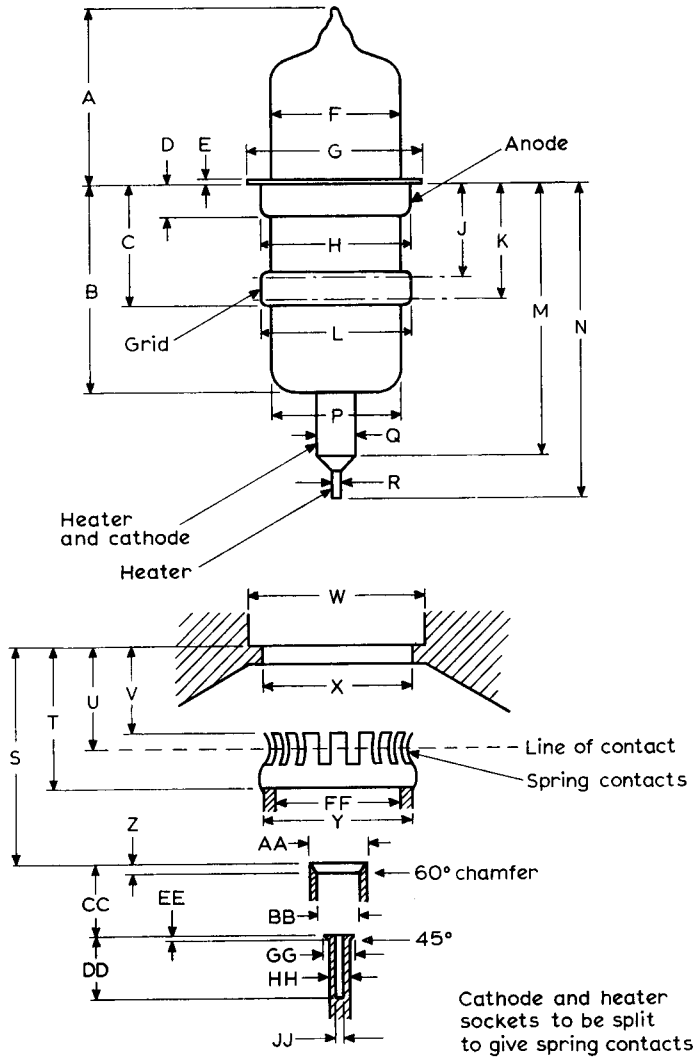
DIMENSIONS

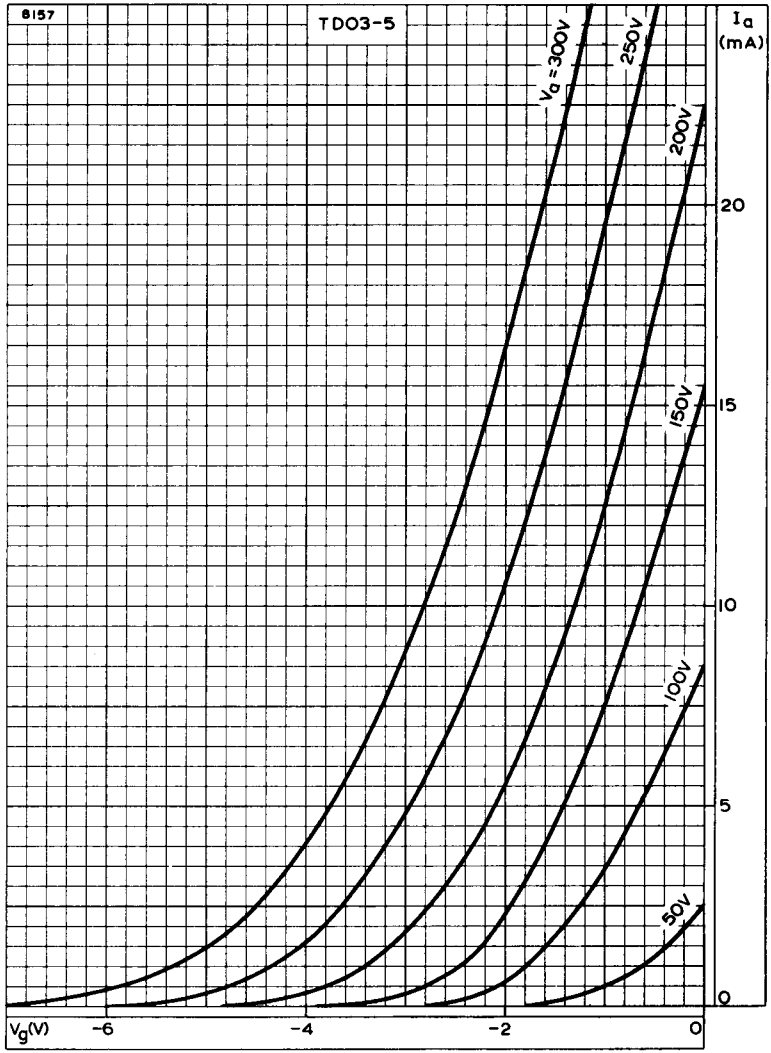
	Inches	*Millimetres*	
A	0.876	22.25	max.
B	1.053	26.75	max.
C	0.621 ± 0.039	15.75 ± 1.00	
D	0.165 ± 0.004	4.2 ± 0.1	
E	0.012	0.3	
F	*	*	
G	0.876 ± 0.004	22.25 ± 0.10	
H	0.748 ± 0.006	19.00 ± 0.15	
J	0.484	12.3	max.
K	0.539	13.7	min.
L	$0.748^{+0.000}_{-0.010}$	$19.00^{+0.00}_{-0.25}$	
M	1.366 ± 0.039	34.7 ± 1.0	
N	1.575 ± 0.020	40.0 ± 0.5	
P	†	†	
Q	0.187 ± 0.004	4.75 ± 0.10	
R	0.044 ± 0.001	1.120 ± 0.025	
S	1.073 ± 0.010	27.25 ± 0.25	
T	0.709	18	min.
U	0.512	13	
V	0.433 ± 0.010	11.00 ± 0.25	
W	0.898 ± 0.005	22.80 ± 0.12	
X	0.776 ± 0.005	19.70 ± 0.12	
Y	0.748	19	
Z	$0.039^{+0.000}_{-0.006}$	$1.00^{+0.00}_{-0.15}$	
AA	0.248	6.3	
BB	0.187	4.76	
CC	0.364 ± 0.010	9.25 ± 0.25	
DD	0.315	8.0	min.
EE	$0.020^{+0.000}_{-0.003}$	$0.500^{+0.000}_{-0.075}$	
FF	0.677	17.2	max.
GG	0.125	3.17	
HH	0.094	2.38	
JJ	0.046	1.18 (No. 56 drill)	

*To fit inside a cylinder of 17.5mm (0.689in) diameter co-axial with the anode disc. This diameter may be continued to maximum length.

†Grid disc to fit co-axially inside a cylinder of 17.2mm (0.677in) diameter.

Note—The eccentricity of the grid, cathode and heater contacts shall not exceed 0.375mm (0.015in).


A
F
D
E
G
Anode
C
H
J
K
B
M
N
Grid
L
P
Q
R
Heater
and cathode
Heater
W
X
U
V
T
S
Line of contact
Spring contacts
FF
Y
Z
AA
60° chamfer
CC
EE
BB
45°
GG
DD
HH
JJ
Cathode and heater
sockets to be split
to give spring contacts
8128



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER

DISC SEAL TRIODE

TD04-20

Application: *R.F. amplifier or oscillator.*
Power output: *13.5W at f = 1.0Gc/s.*
Construction: *Disc seal, natural cooling.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

CATHODE

Indirectly heated

V_h	6.3	V
I_h	1.0	A

MOUNTING POSITION

Any

CAPACITANCES

c_{a-g}	2.3	pF
c_{a-k}	50	mpF
c_{g-k}	5.0	pF

CHARACTERISTICS

V_a	400	V
I_a	50	mA
g_m	10	mA/V
μ	28	

LIMITING VALUES

V_a max.	400	V
p_a max.	20	W
I_k max.	150	mA
$i_{k(pk)}$ max.	600	mA
p_g max.	1.0	W
$T_{anode\ seal}$ max.	140	°C

In order to limit the anode seal temperature and also to limit the rate of change of temperature it is necessary that the mass of metal in close thermal contact with the anode disc should not be less than 120g (approx. 4 oz) of brass or its thermal equivalent.

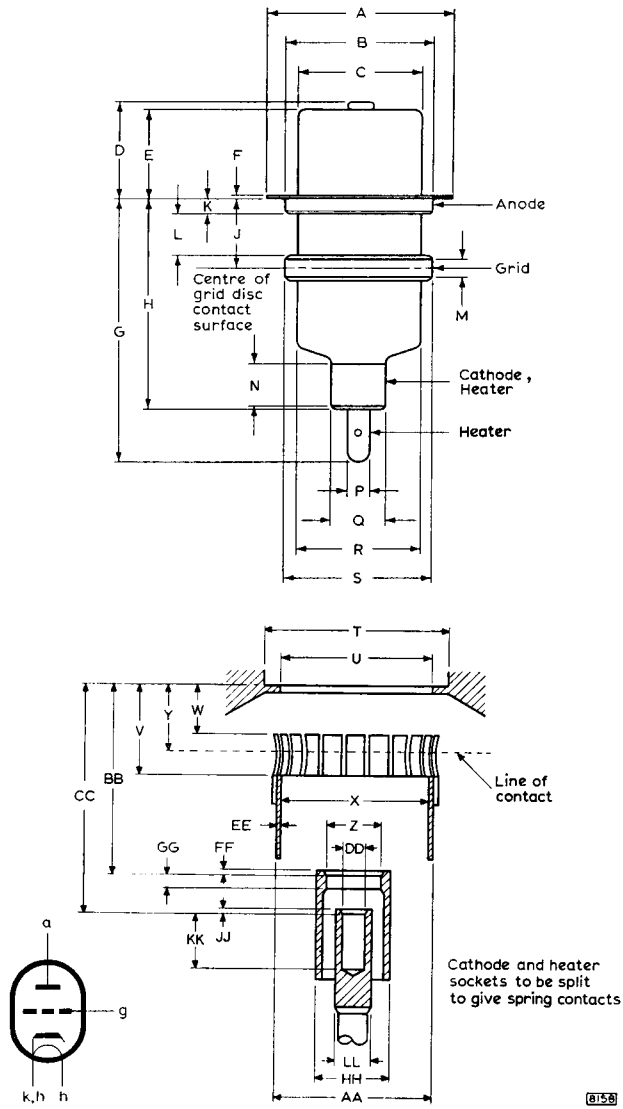
TD04-20

DISC SEAL TRIODE

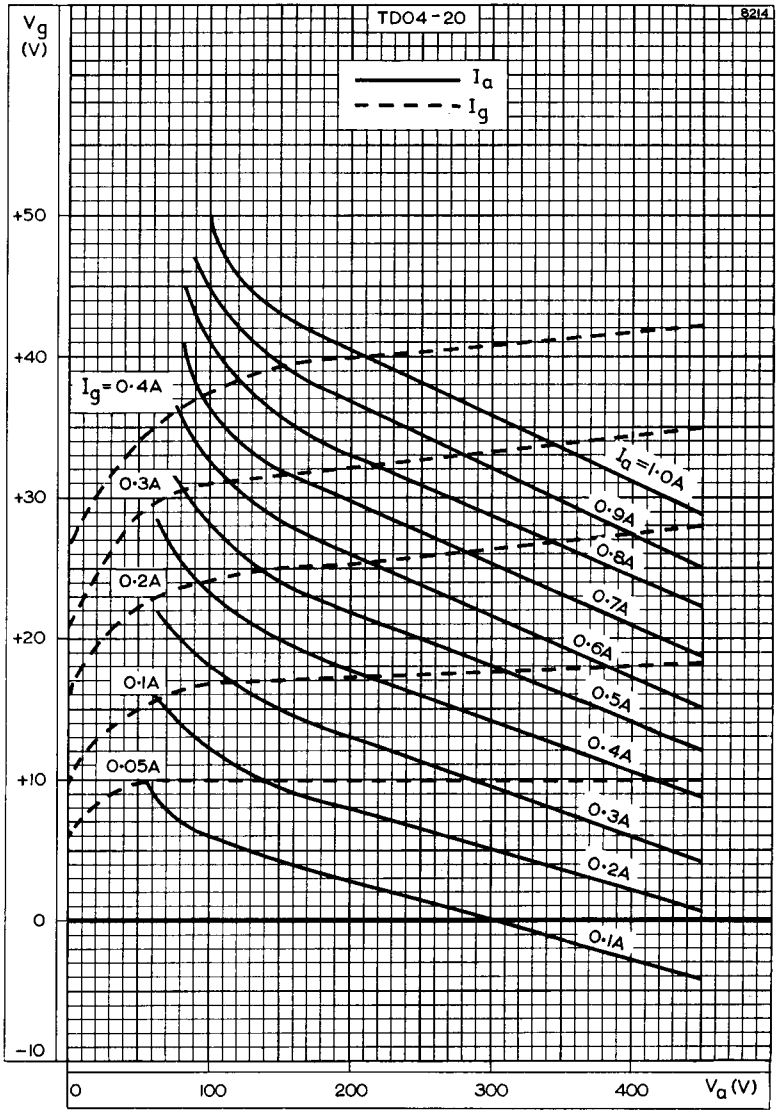
DIMENSIONS

	Inches	*Millimetres*	
A	1.252±0.020	31.8±0.5	
B	1.000±0.010	25.4±0.25	
C	*	*	
D	1.000	25.4	max.
E	0.902	22.9	max.
F	0.012±0.002	0.3±0.05	
G	1.772±0.059	45.0±1.5	
H	1.417±0.039	36±1	
J	0.465±0.030	11.8±0.75	
K	0.106	2.7	
L	0.280±0.020	7.1±0.5	
M	0.098	2.5	min.
N	0.299±0.059	7.6±1.5	
P	0.156±0.004	3.96±0.1	
Q	0.375 +0.015 −0.000	9.53 +0.38 −0.00	
R	*	*	
S	1.000±0.010	25.4±0.25	
T	1.275	32.39	min.
U	1.063±0.005	27.00±0.13	
V	0.630±0.010	16.00±0.25	
W	0.354±0.010	8.99±0.25	
X	1.000	25.40	
Y	0.453±0.010	11.51±0.25	
Z	0.375	9.53	
AA	1.063	27.00	
BB	1.260±0.010	32.00±0.25	
CC	1.535±0.010	38.99±0.25	
DD	0.156	3.96	
EE	0.031	0.79	
FF	0.031	0.79	
GG	0.094	2.39	
HH	0.500	12.70	
JJ	0.031	0.79	
KK	0.406	10.31	min.
LL	0.250	6.35	

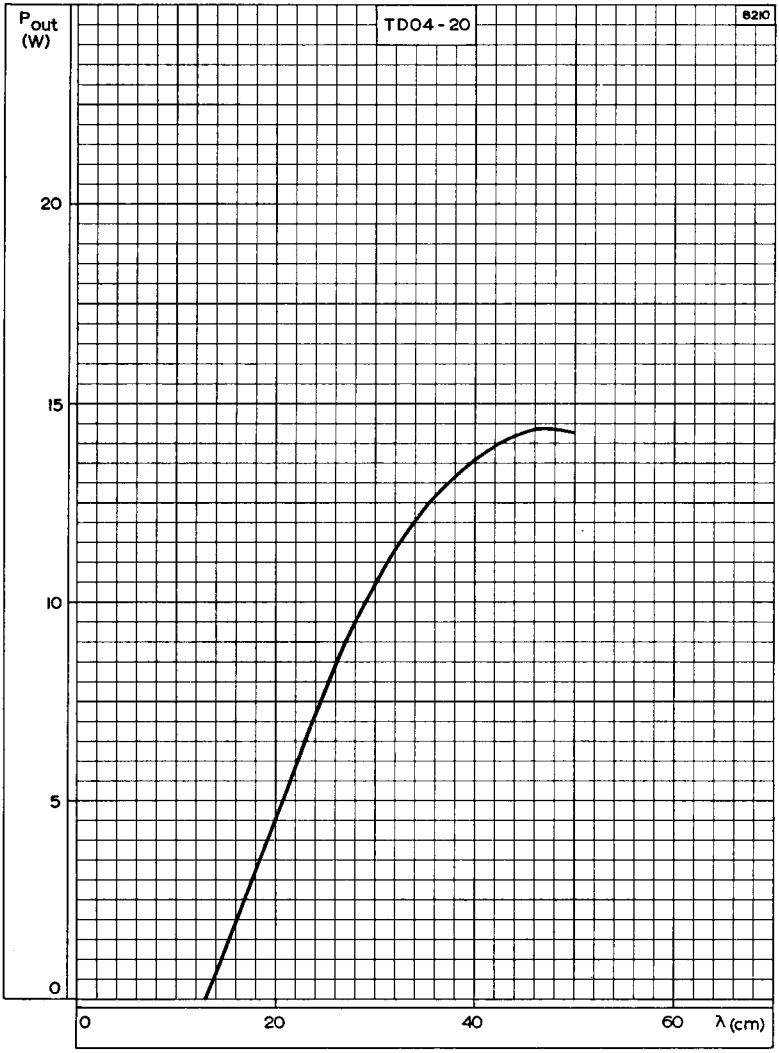
*To fit inside a cylinder 24.13mm (0.950 in) diameter, co-axial with the anode disc.


A
B
C
D
E
F
K
L
J
Anode
Grid
Centre of grid disc contact surface
H
G
M
N
Cathode, Heater
Heater
o
P
Q
R
S
T
U
V
Y
W
BB
CC
Line of contact
X
EE
Z
GG
FF
DD
KK
JJ
a
g
k,h
h
Cathode and heater sockets to be split to give spring contacts
LL
HH
AA
8158

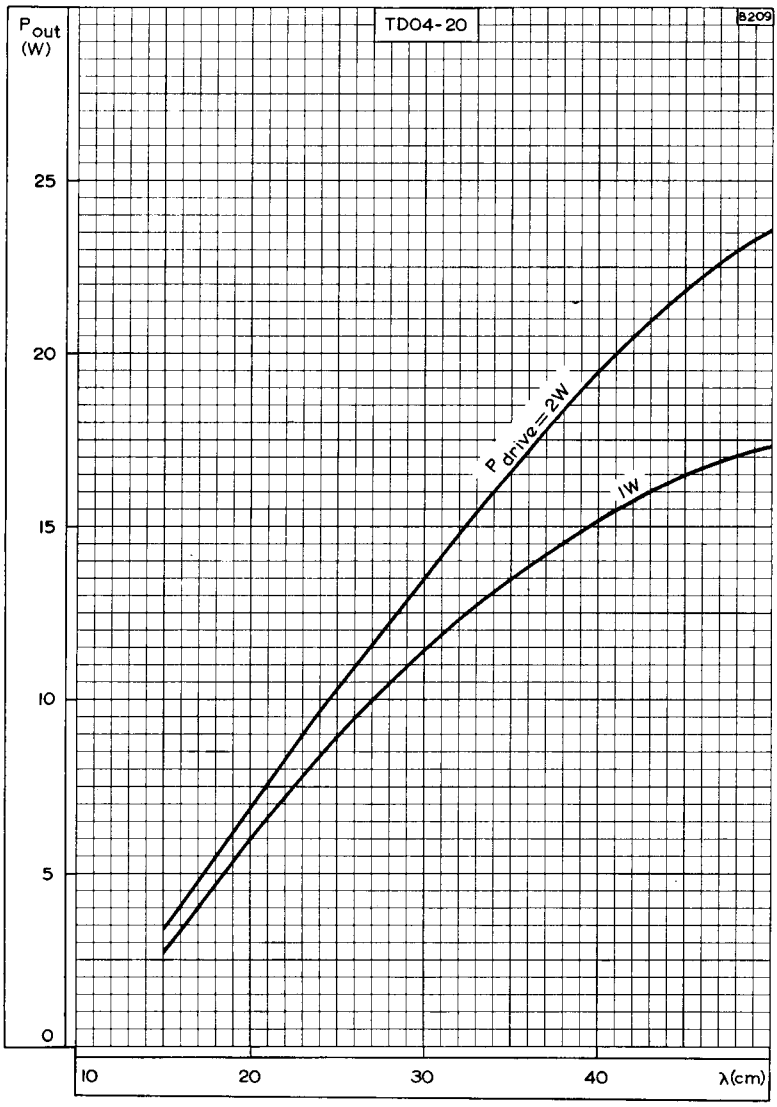
TD04-20



CONSTANT CURRENT CURVES



OUTPUT POWER PLOTTED AGAINST WAVELENGTH AS A COMMON GRID OSCILLATOR



OUTPUT POWER PLOTTED AGAINST WAVELENGTH AS A COMMON GRID AMPLIFIER

DISC SEAL TRIODE

TDI-100A

Application: *Grounded grid class 'C' power amplifier.*
Power output: *12W at 2500Mc/s.*
Frequency: *2500Mc/s at full ratings.*
Cooling: *Natural or forced-air.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS–MICROWAVE DEVICES preceding this section of the handbook.

HEATER

V_h	6.3	V
I_h	1.0	A

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

C_{a-g}	2.0	pF
C_{g-k}	6.6	pF
C_{a-k}	<0.035	pF

CHARACTERISTICS

V_a	600	V
I_a	78	mA
V_g	−2.3	V
g_m	25	mA/V
μ	100	

COOLING

Natural or forced-air

$T_{\text{anode core}}$ max.	175	°C
T_{seals} max.	175	°C

The amount of cooling air required using the recommended cowling (see drawing) is given in the curves. In most applications the seals will require additional cooling. If a cowling is not used, up to twice as much air may be required to keep the anode below its maximum rated temperature measured at the anode core.
Where the anode of the valve is in contact with a circuit which has a high thermal capacity, some cooling is provided by conduction.

CLASS 'C' TELEGRAPHY

Limiting values (absolute ratings)

V_a max.	1.0	kV
p_a max.	100	W
$-V_g$ max.	150	V
$+v_{g(pk)}$ max.	30	V
$-v_{g(pk)}$ max.	400	V
p_g max.	2.0	W
I_g max.	50	mA
I_k max.	125	mA

Operating conditions

f	500	2500	Mc/s
V_a	800	900	V
I_a	80	90	mA
V_g	−20	−22	V
I_g	32	27	mA
$P_{\text{load driver}}$	6	—	W
P_{out}	27	12	W

CLASS 'C' TELEPHONY

Limiting values (absolute ratings)

V_a max.	600	V
p_a max.	70	W
$-V_g$ max.	150	V
$+v_{g(pk)}$ max.	30	V
$-v_{g(pk)}$ max.	400	V
p_g max.	2.0	W
I_g max.	50	mA
I_k max.	100	mA

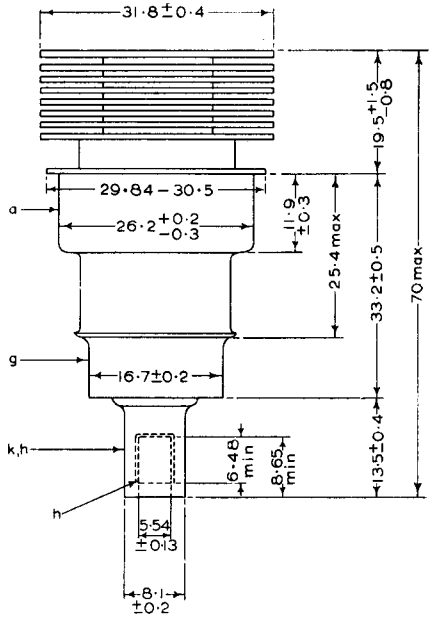
Operating conditions

f	500	Mc/s
V_a	600	V
I_a	65	mA
V_g	−16	V
I_g	35	mA
P_{drive} (approx.)	5.0	W
P_{out}	18	W

The TD1-100A operates at frequencies where transit time effects cause back bombardment heating of the cathode. At frequencies higher than 400 Mc/s, the heater voltage may have to be reduced after operation commences, depending on the conditions; e.g., for full voltage and current the following values apply:

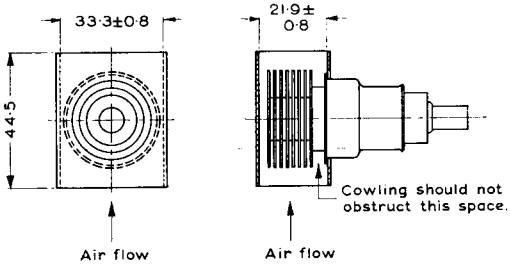
f (Mc/s)	V_h (V)
< 400	6.3
400 to 1000	6.0
1000 to 1500	5.5
1500 to 2000	5.0
> 2000	4.5

TDI-100A

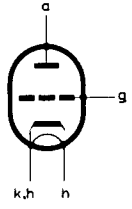


All dimensions in mm

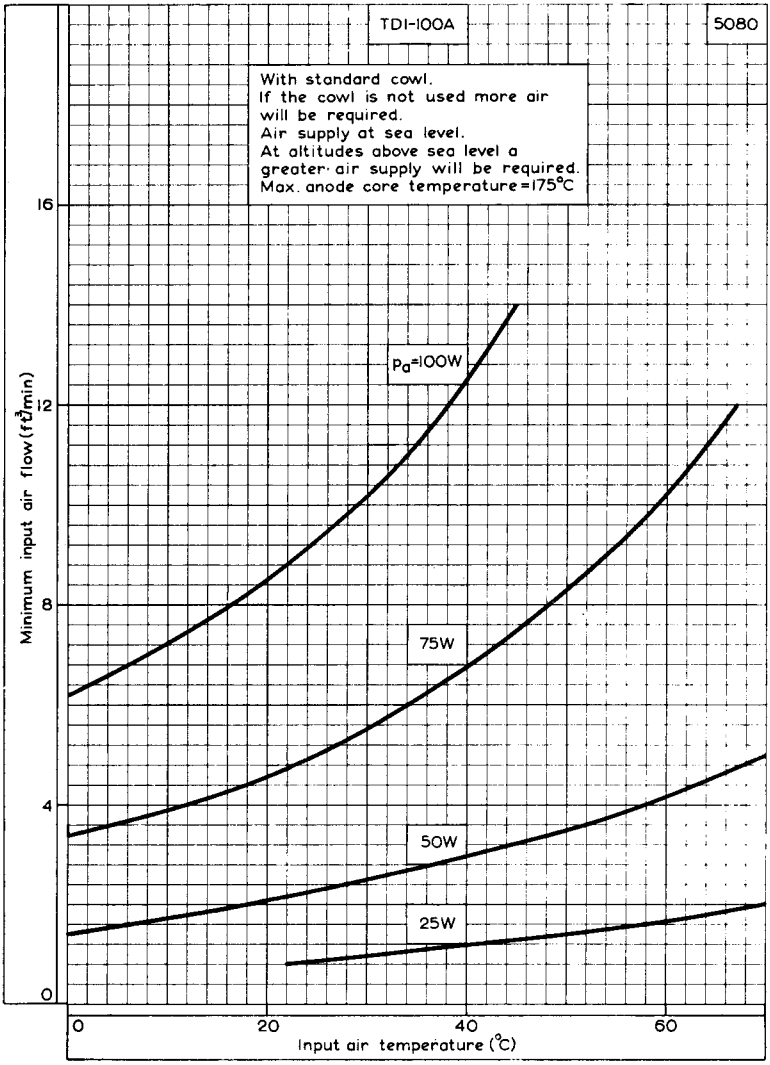
4398



Standard cowl

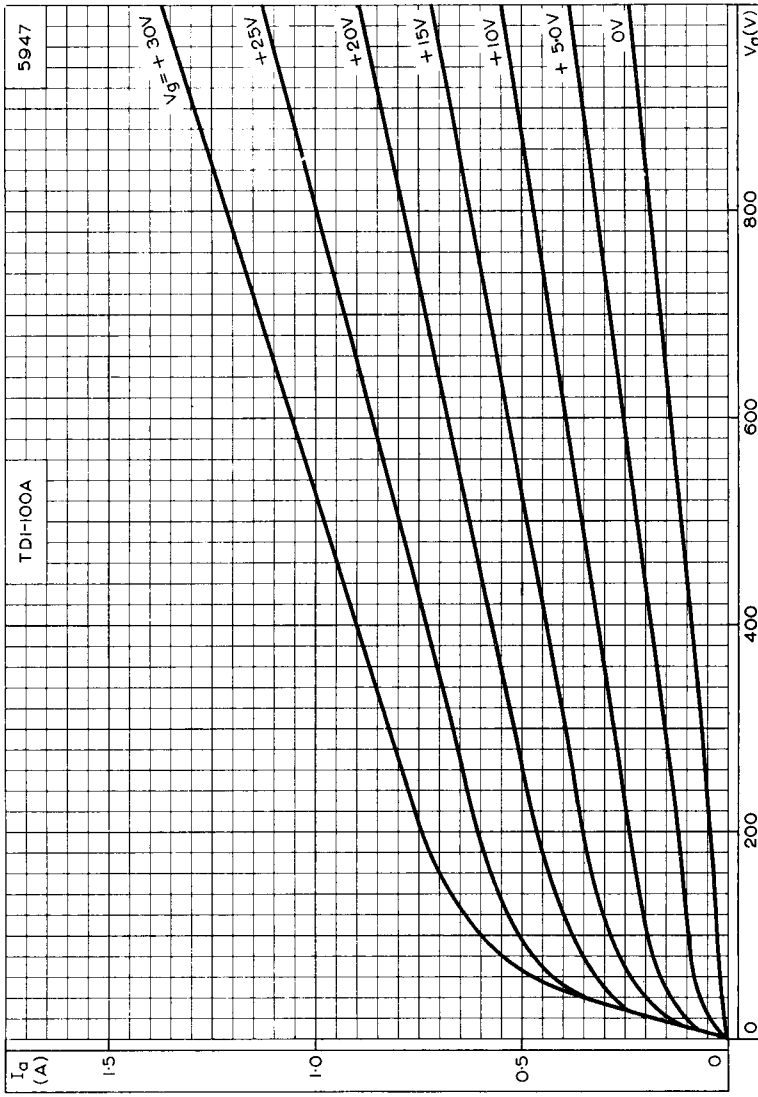


4398A



MINIMUM INPUT AIR FLOW PLOTTED AGAINST INPUT AIR TEMPERATURE

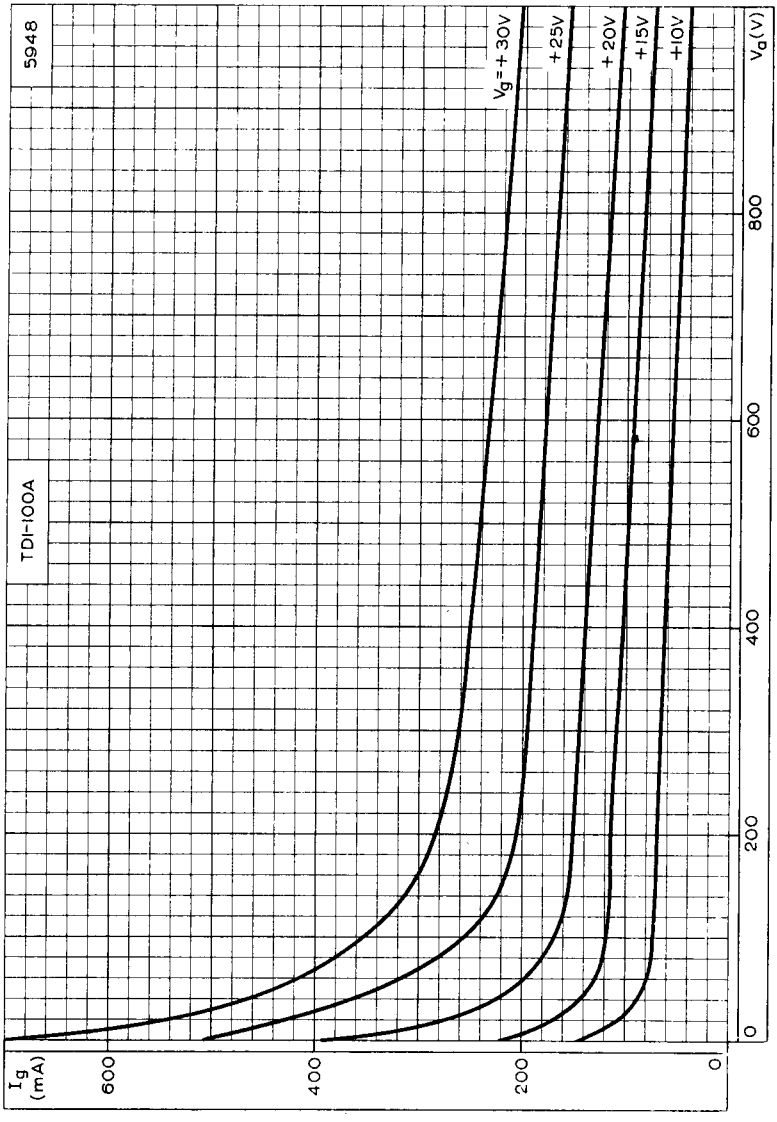
TD1-100A



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

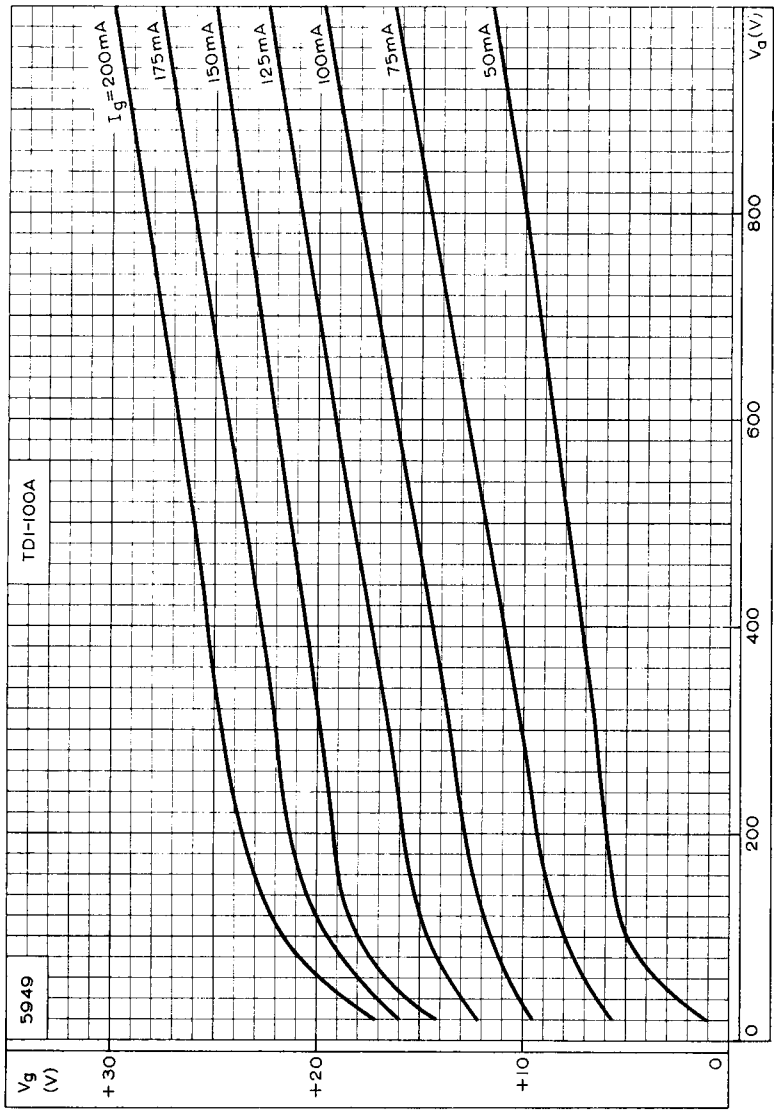
TDI-100A

DISC SEAL TRIODE

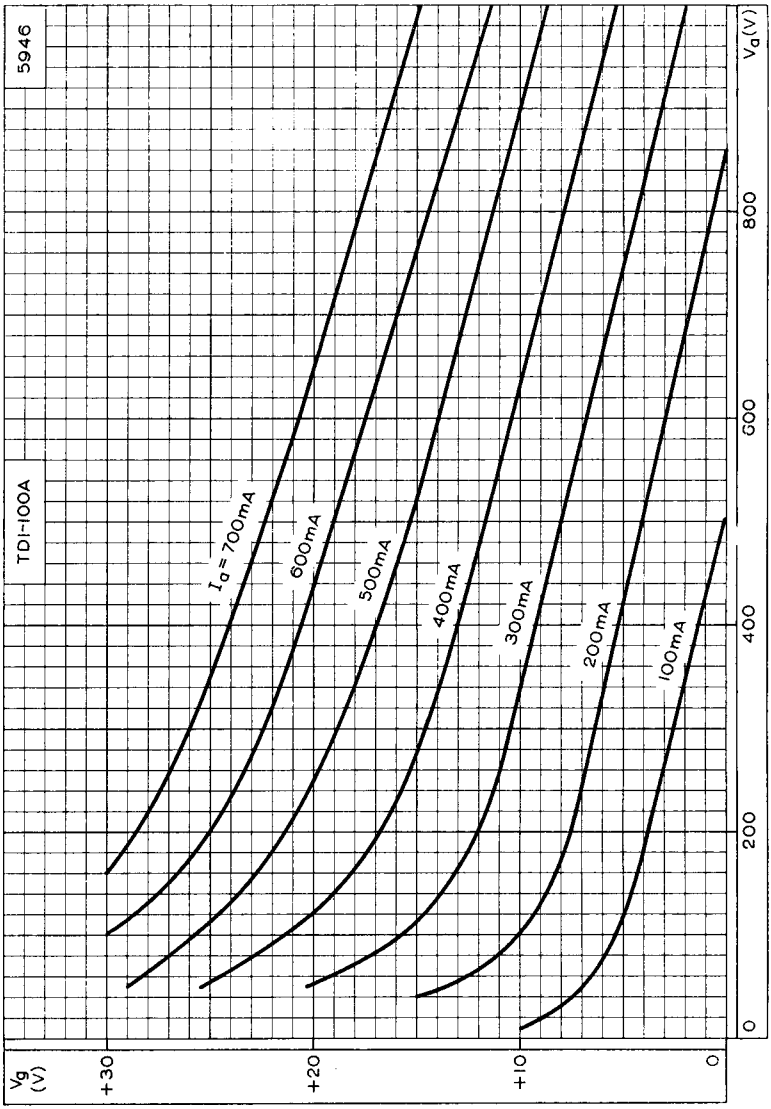


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

TDI-100A



CONSTANT GRID CURRENT CURVES



CONSTANT ANODE CURRENT CURVES

DISC SEAL TRIODE

TD2-400A

Application: *R.F. oscillator, amplifier or frequency multiplier.*
Power output: *600W at f=470Mc/s.*
Frequency: *470Mc/s at full ratings, 900Mc/s at reduced ratings.*
Construction: *Disc seal, ceramic envelope, forced-air cooled.*

This data should be used in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT

Thoriated tungsten

V_f (f <600Mc/s)	3.4	V
I_f	19	A

The TD2–400A operates at frequencies where transit time effects cause back bombardment heating of the cathode. At frequencies higher than 600Mc/s the filament voltage must be reduced immediately after operation commences, in accordance with the following table:—

f (Mc/s)	V_f (V)
<600	3.4
600 to 750	3.3
750 to 900	3.2

MOUNTING POSITION

Vertical, anode up or down

CAPACITANCES

C_{a-g}	6.5	pF
C_{g-f}	11.5	pF
C_{a-f}	120	mpF

CHARACTERISTICS

V_a	2.0	kV
I_a	200	mA
V_g	–40	V
g_m	10	mA/V
μ	33	

COOLING

Forced air

$T_{anode\ seal}$ max.	250	°C
$T_{grid\ seal}$ max.	250	°C
$T_{filament\ seal}$ max.	200	°C

At all values of anode dissipation and frequencies forced-air cooling of the seals is necessary to ensure that the maximum seal temperatures are not exceeded. Typical values of inlet temperature, rate of flow of air, and pressure difference between the inlet and outlet of the housing are given in the following table:—

Anode dissipation P_a (W)	Height above sea level h (km)	h (ft)	Max. inlet temperature T_{in} (°C)	Min. rate of flow of air per minute (m^3)	(ft^3)	Pressure difference between inlet and outlet (mm of water)	(in. of water)
400	0	0	45	0.65	23	12	0.47
400	1500	4920	35	0.65	23	12	0.47
400	3000	9840	25	0.65	23	12	0.47

TD2-400A

DISC SEAL TRIODE

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Limiting values (absolute ratings)

f max.	470	600	900	Mc/s
V_a max.	2.2	2.1	2.1	kV
p_a max.		400		W
I_k max.		520		mA
$i_{k(pk)}$ max.		2.7		A
$-V_g$ max.		300		V
I_g max.		120		mA
R_{g-f} max.		10		kΩ

Typical operation (grounded grid)

f	470	640	730	810	Mc/s
V_a	2.0	1.8	1.8	1.8	kV
I_a	400	400	400	400	mA
V_g	−140	−120	−120	−120	V
I_g	120	100	100	100	mA
$P_{load(driver)}$	120	105	105	105	W
p_a	290	310	340	392	W
η_a	63.5	57	53	45.5	%
*P_{out}	510+85	410+80	380+80	328+80	W
P_{load} ($\eta_{transfer}$ = 80%)	476	392	368	330	

*Includes power transferred from driver stage.

CLASS 'C' OSCILLATOR FOR R.F. INDUSTRIAL HEATING

Anode supply from transformer without intermediate rectifier

Limiting values (absolute ratings)

f max.	470	Mc/s
$V_{tr(r.m.s.)}$ max.	2.0	kV
p_a max.	170	W
I_k max.	295	mA
$i_{k(pk)}$ max.	2.3	A
$-V_g$ max.	300	V
I_g max.	85	mA
R_{g-f} max.	5.0	kΩ

Typical operation (grounded grid)

f	470	Mc/s
$V_{tr(r.m.s.)}$	1.8	kV
I_a	190	mA
I_g	70	mA
R_{g-f}	400	Ω
p_a	150	W
η_a	60	%
P_{out}	230	W
P_{load} (0.85 P_{out}–P_{drive})	160	W

CLASS 'C' OSCILLATOR FOR R.F. INDUSTRIAL HEATING

With d.c. anode supply

Limiting values (absolute ratings)

f max.	470	900	Mc/s
V_a max.	2.2	2.0	kV
p_a max.		400	W
I_k max.		520	mA
$i_{k(pk)}$ max.		2.7	A
$-V_g$ max.		300	V
I_g max.		120	mA
R_{g-f} max.		10	kΩ

Typical operation

f	470	810	Mc/s
V_a	2.0	1.8	kV
I_a	380	380	mA
*I_g	110	110	mA
R_{g-f}	1.0	1.0	kΩ
p_a	280	400	W
η_a	63	41	%
P_{out}	480	284	W
P_{load} (0.85 P_{out}–P_{drive})	340	200	W

*Using a current stabilising device as the grid resistance.

TD2-400A

DISC SEAL TRIODE

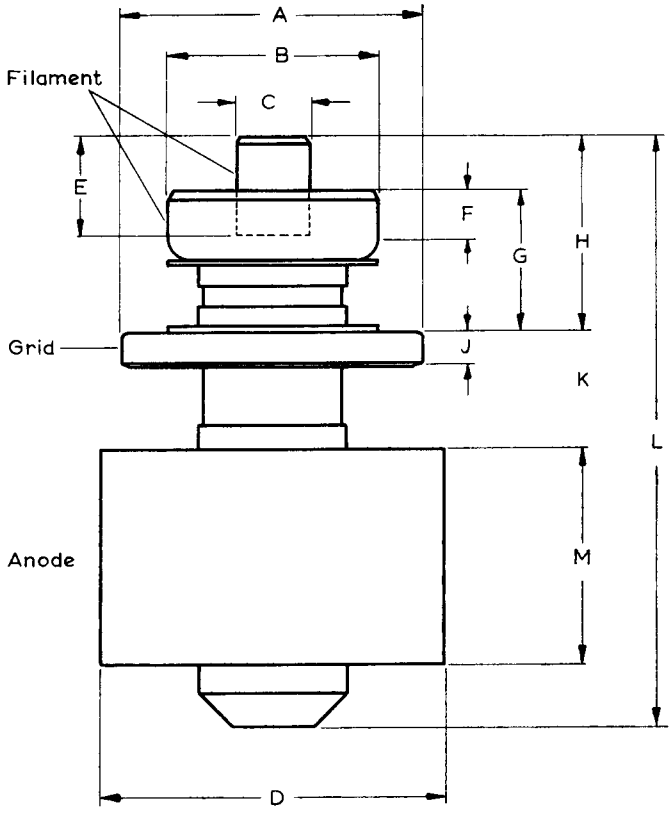
WEIGHT

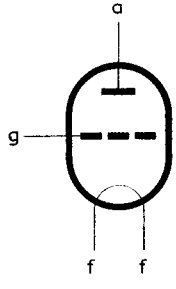
Valve only	5.5	oz
	157	gm
Shipping weight	9.0	oz
	250	gm

DIMENSIONS

	Inches	*Millimetres*	
A	1.433±0.008	36.4±0.2	
B	1.0±0.008	25.4±0.2	
C	0.354±0.008	9.0±0.2	
D	1.626±0.008	41.3±0.2	
E	0.472	12	
F	0.236	6.0	
G	0.669±0.020	17±0.5	
H	0.925±0.039	23.5±1.0	
J	0.158	4.0	
K	0.551±0.020	14±0.5	
L	2.992	76	max.
M	1.024	26	

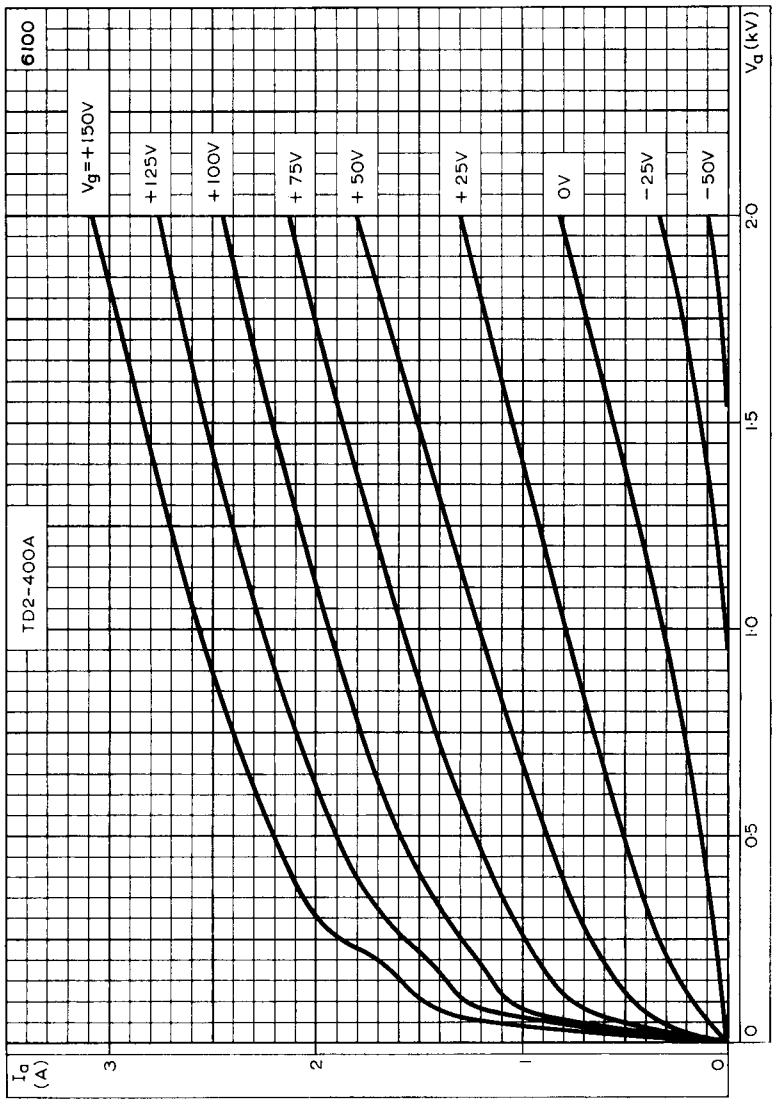
TD2-400A





6314

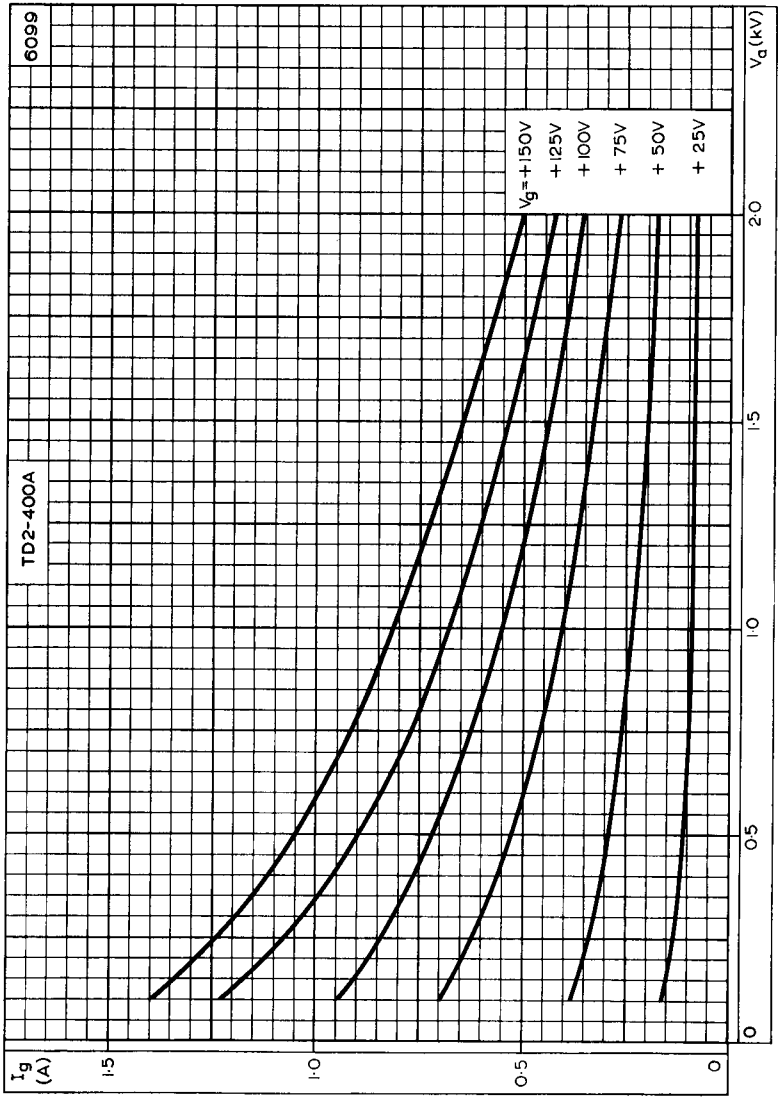
TD2-400A



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

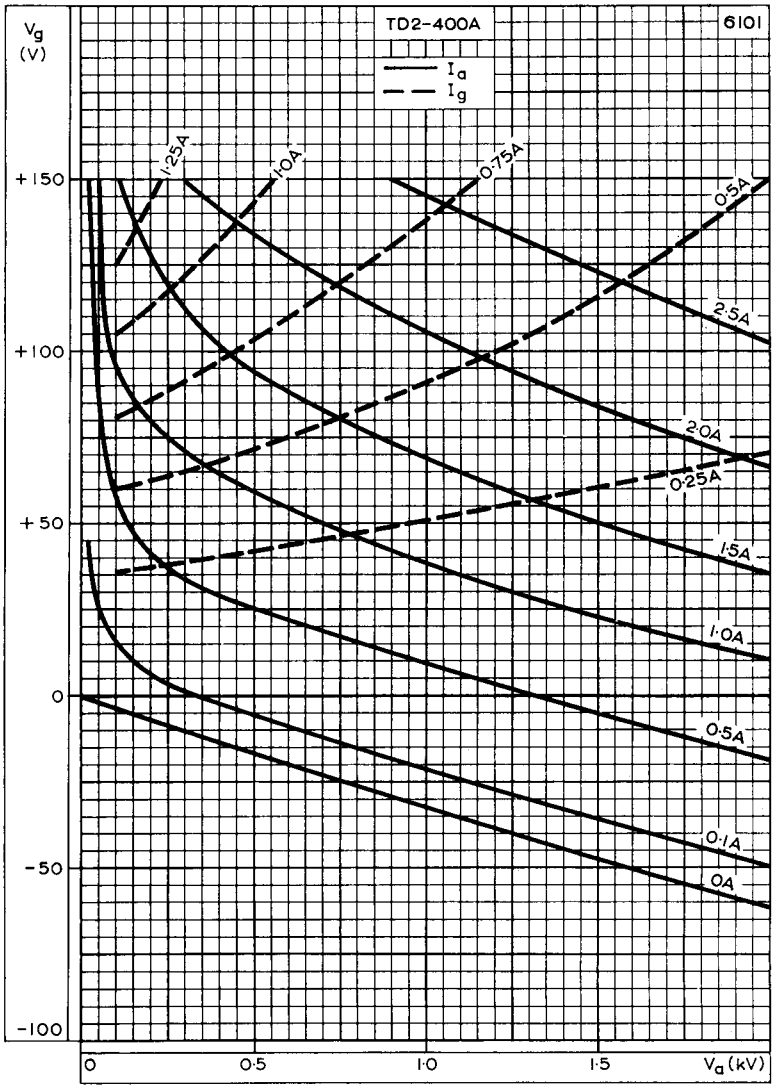
TD2-400A

DISC SEAL TRIODE



GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

TD2-400A



CONSTANT CURRENT CURVES

Typical operation (grounded grid)

f	470	Mc/s
$V_{tr(r.m.s.)}$	1.8	kV
I_a	190	mA
I_g	70	mA
R_{g-f}	400	Ω
p_a	150	W
η_a	60	%
P_{out}	230	W
P_{load} (0.85 P_{out}–P_{drive})	160	W

CLASS 'C' OSCILLATOR FOR R.F. INDUSTRIAL HEATING

With d.c. anode supply

Limiting values (absolute ratings)

f max.	470	900	Mc/s
V_a max.	2.2	2.0	kV
p_a max.		400	W
I_k max.		520	mA
$i_{k(pk)}$ max.		2.7	A
$-V_g$ max.		300	V
I_g max.		120	mA
R_{g-f} max.		10	kΩ

Typical operation

f	470	810	Mc/s
V_a	2.0	1.8	kV
I_a	380	380	mA
*I_g	110	110	mA
R_{g-f}	1.0	1.0	kΩ
p_a	280	400	W
η_a	63	41	%
P_{out}	480	284	W
P_{load} (0.85 P_{out}–P_{drive})	340	200	W

*Using a current stabilising device as the grid resistance.

TD2-400A

DISC SEAL TRIODE

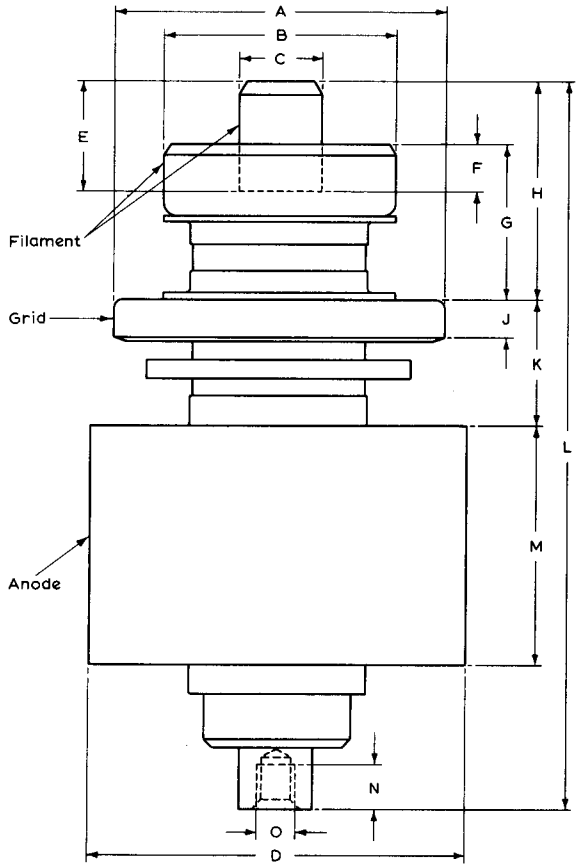
WEIGHT

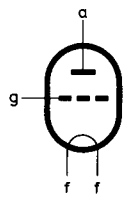
Valve only	5.5	oz
	157	g
Shipping weight	9.0	oz
	250	g

DIMENSIONS

	Inches	*Millimetres*		
A	1.433±0.008	36.4±0.2		
B	1.0±0.008	25.4±0.2		
C	0.354±0.008	9.0±0.2		
D	1.626±0.008	41.3±0.2		
E	0.472	12		
F	0.236	6.0		
G	0.669±0.020	17±0.5		
H	0.925±0.039	23.5±1.0		
J	0.158	4.0		
K	0.551±0.020	14±0.5		
L	3.268	83	max.	←
M	1.024	26		
N	0.158	4.0		←
O	4 millimetre metric thread			←

TD2-400A





8119

DISC SEAL TRIODE

TD2-500A

Application: *R.F. oscillator, amplifier or frequency multiplier.*
Power output: *580W at f = 625Mc/s.*
Frequency: *400Mc/s at full ratings, 1Gc/s at reduced ratings.*
Construction: *Disc seal, ceramic envelope, forced-air cooled.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT

Thoriated tungsten

V_f (f <600Mc/s)	3.4	V
I_f	19	A

The TD2–500A operates at frequencies where transit time effects cause back bombardment heating of the cathode. At frequencies higher than 600Mc/s, the filament voltage must be reduced immediately after operation commences in accordance with the following table:—

f (Mc/s)	V_f (V)
<600	3.4
600 to 750	3.3
750 to 1000	3.2

MOUNTING POSITION

Vertical with anode up or down

CAPACITANCES

C_{a-g}	3.8	pF
C_{g-f}	11	pF
C_{a-f}	50	mpF

CHARACTERISTICS

V_a	2.0	kV
I_a	240	mA
V_g	−2.0	V
g_m	14	mA/V
μ	70	
r_a	5.0	kΩ

COOLING

Forced air

T_{seals} max.	200	°C

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea level. Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table:—

Anode dissipation	Height above sea level		Max. inlet temperature	Min. rate of flow of air per minute		Pressure difference between inlet and outlet	
P_a	h		T_{in}	(m^3)	(ft^3)	(mm of	(in. of
(W)	(km)	(ft)	(°C)			water)	water)
500	0	0	45	0.9	32	24	0.94
500	1.5	4920	35	0.9	32	20	0.79
500	3.0	9840	25	1.0	35	21	0.83

TD2-500A

DISC SEAL TRIODE

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Limiting values (absolute ratings)

f max.	400	625	940	Mc/s
V_a max.	2.7	2.5	2.2	kV
p_a max.		500		W
I_k max.		575		mA
$i_{k(pk)}$ max.		3.0		A
$-V_g$ max.		300		V
I_g max.		175		mA
p_g max.		30		W
R_{g-f} max.		10		kΩ

Typical operation (grounded grid)

f	400	625	Mc/s
V_a	2.5	2.2	kV
I_a	380	380	mA
V_g	−70	−60	V
I_g	160	170	mA
$P_{load(driver)}$	70	65	W
p_a	330	302	W
η_a	65	64	%
*P_{out}	620+50	533+47	W
P_{load} ($\eta_{transfer}$ = 80%)	536	464	W

*Includes power transferred from driver stage.

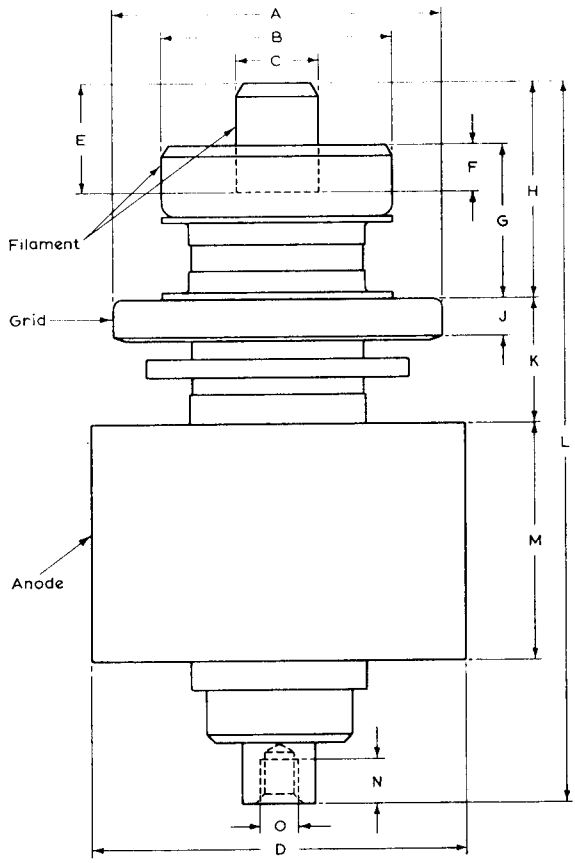
WEIGHT

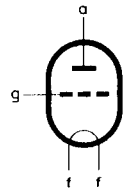
Valve only	6	oz
	160	g
Shipping weight	9	oz
	250	g

DIMENSIONS

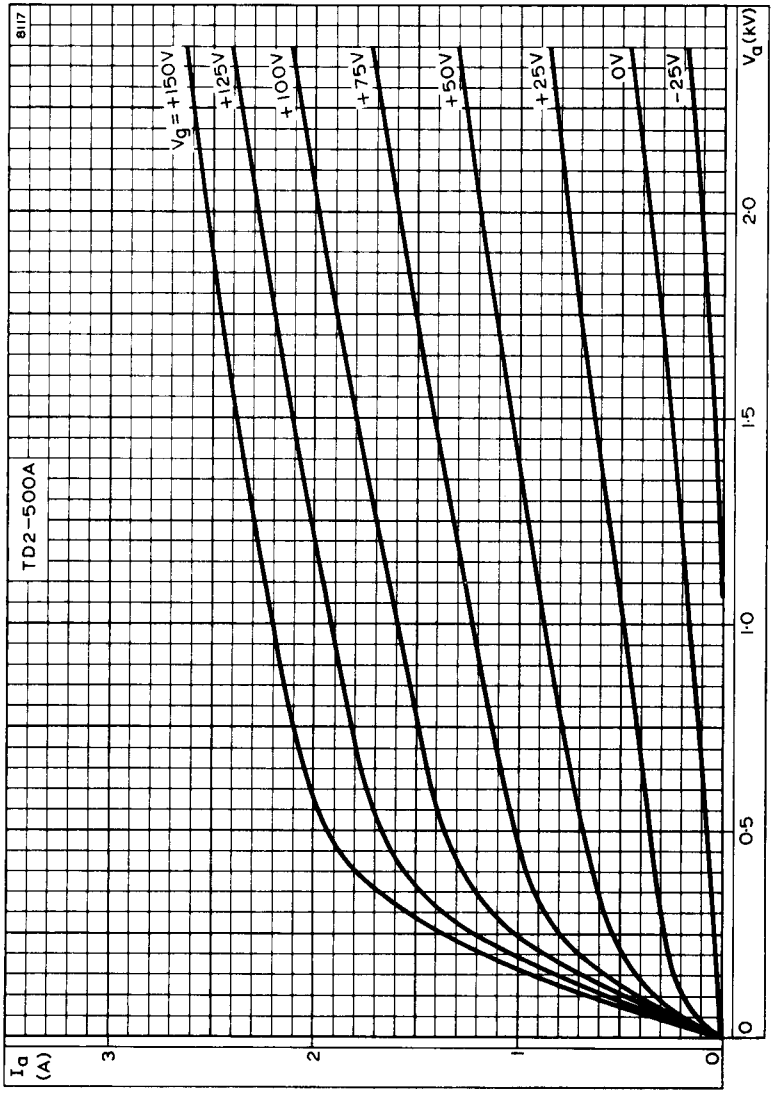
	Inches	*Millimetres*	
A	1.433±0.008	36.4±0.2	
B	1.0±0.008	25.4±0.2	
C	0.354±0.008	9.0±0.2	
D	1.626±0.008	41.3±0.2	
E	0.472	12	
F	0.236	6.0	
G	0.669±0.020	17±0.5	
H	0.925±0.039	23.5±1.0	
J	0.158	4.0	
K	0.551±0.020	14±0.5	
L	3.268	83	max.
M	1.024	26	
N	0.158	4.0	
O	4 millimetre metric thread		

TD2-500A





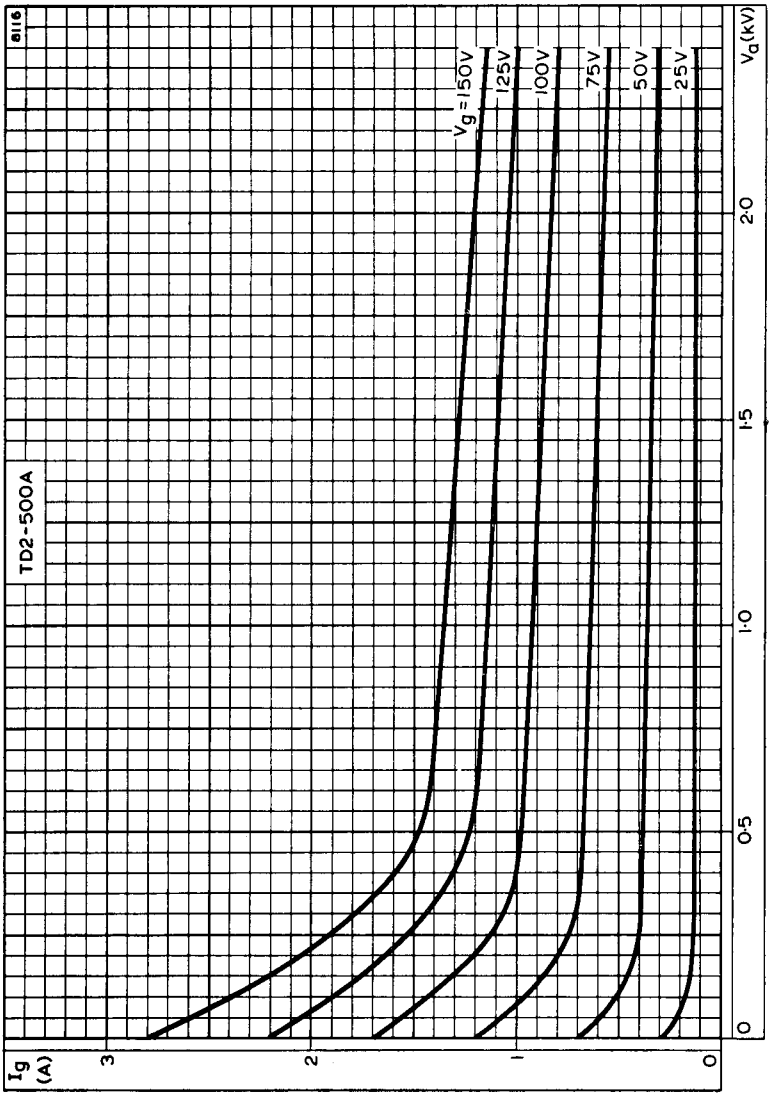
TD2-500A



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

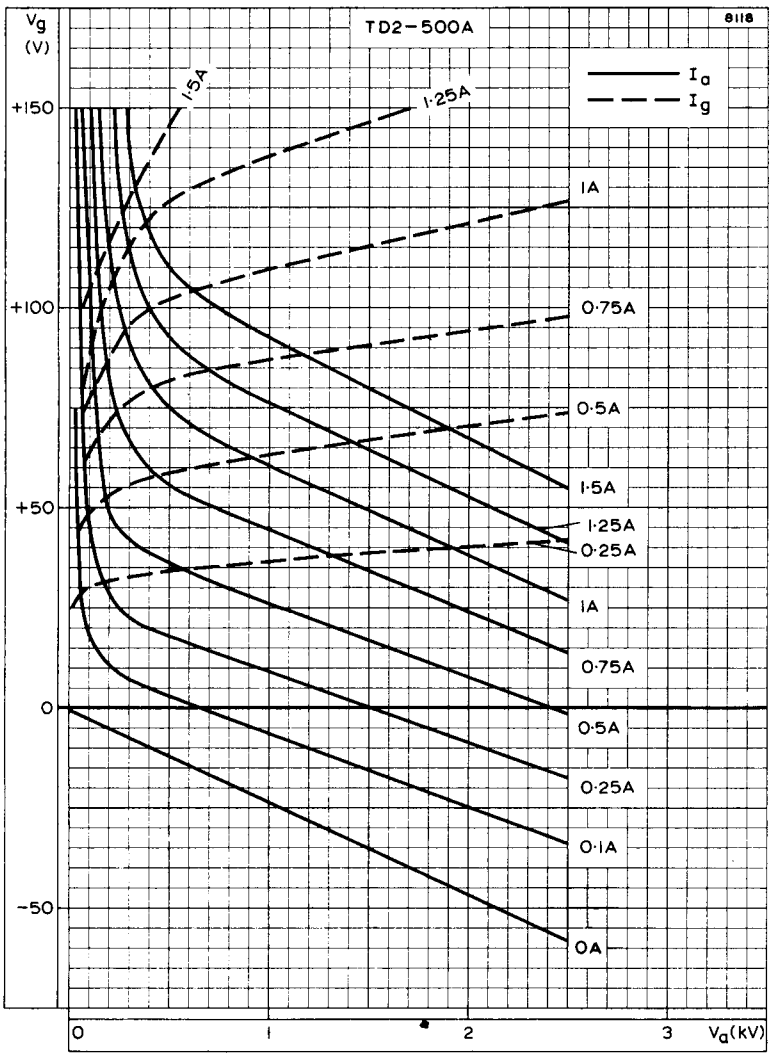
TD2-500A

DISC SEAL TRIODE



GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

TD2-500A



CONSTANT CURRENT CURVES

DISC SEAL TRIODE TD2-500A

QUICK REFERENCE DATA

Disc seal triode with ceramic envelope intended for use as a power amplifier, oscillator or frequency multiplier.

f		400	625	Mc/s
P_{out}		670	580	W
f max.	400	625	940	Mc/s
V_a max.	2.7	2.5	2.0	kV
p_a max.	500	500	500	W

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions for valve in common grid circuit amplifier

f	400	625	Mc/s
*P_{out}	620+50	533+47	W
P_{load}	470	405	W
η_a	64	64	%
V_a	2.5	2.5	kV
I_a	380	380	mA
V_g	70	60	V
I_g	160	170	mA
P_{load} (driver)	70	65	W
p_a	330	302	W

*Includes power transferred from driver stage.

ABSOLUTE MAXIMUM RATINGS

f max.	400	625	940	Mc/s
V_a max.	2.7	2.5	2.0	kV
V_g max.	300	300	300	V
I_k max.	575	575	560	mA
p_a max.	500	500	500	W

CATHODE

Directly heated, thoriated tungsten.

At frequencies higher than 600Mc/s, transit time causes back bombardment heating of the cathode. The filament voltage must be reduced immediately after operation commences in accordance with the following table:-

f	V_f
(Mc/s)	(V)
<600	3.4
600 to 750	3.2

I_f (at V_f=3.4V)	19	A

CAPACITANCES

c_{a-f}	50	mpF
c_{g-f}	11	pF
c_{a-g}	3.8	pF

CHARACTERISTICS (measured at V_a=2.0kV, I_a=240mA)

g_m	14	mA/V
μ	70	

MOUNTING POSITION

Vertical with anode up or down.

COOLING

Forced air

Maximum temperature

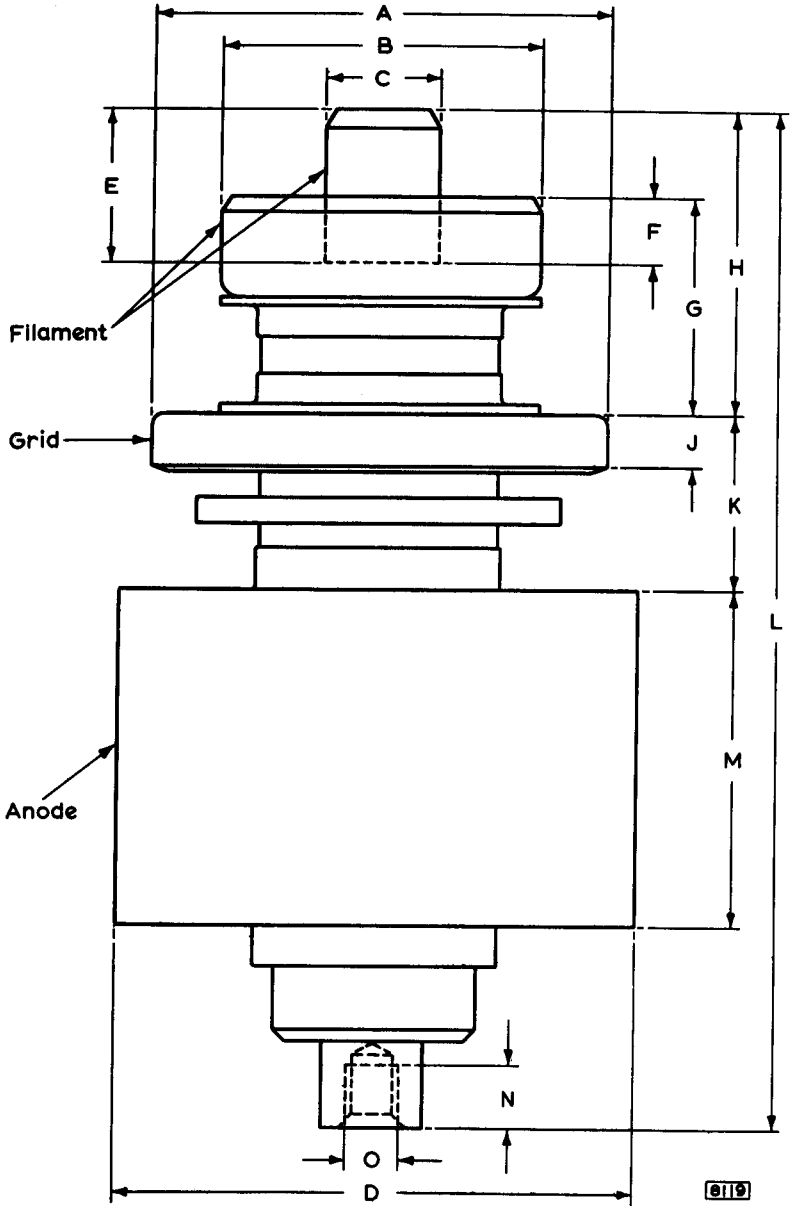
Seals	200	°C

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea level. Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table:-

Anode dissipation	Height above sea level		Max. inlet temperature	Min. rate of flow of air per minute		Pressure difference between inlet and outlet	
P_a (W)	h (km)	(ft)	T_{in} (°C)	(m^3)	(ft^3)	(mm of water)	(inches of water)
500	0	0	45	0.9	32	24	0.94
500	1.5	4920	35	0.9	32	20	0.79
500	3.0	9840	25	1.0	35	21	0.83

PHYSICAL DATA

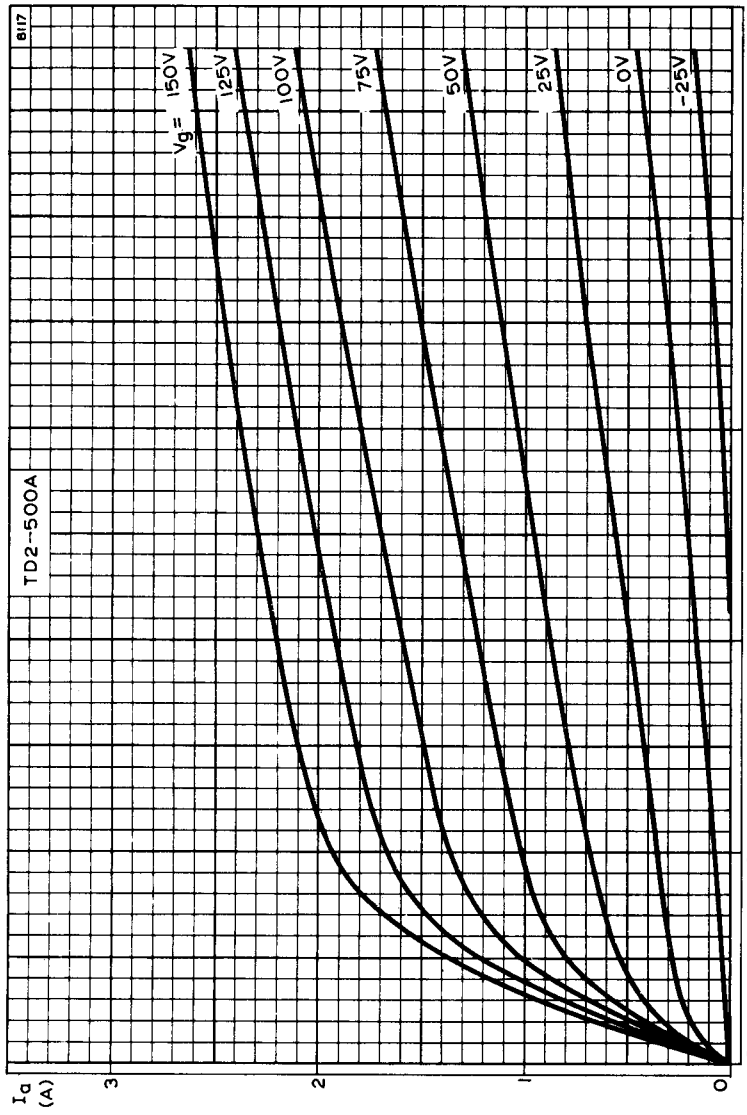
	oz	g
Weight of valve	6.0	170
Weight of valve plus carton	9.0	255


A
B
C
E
F
G
H
J
K
L
M
N
O
D
Filament
Grid
Anode
8119

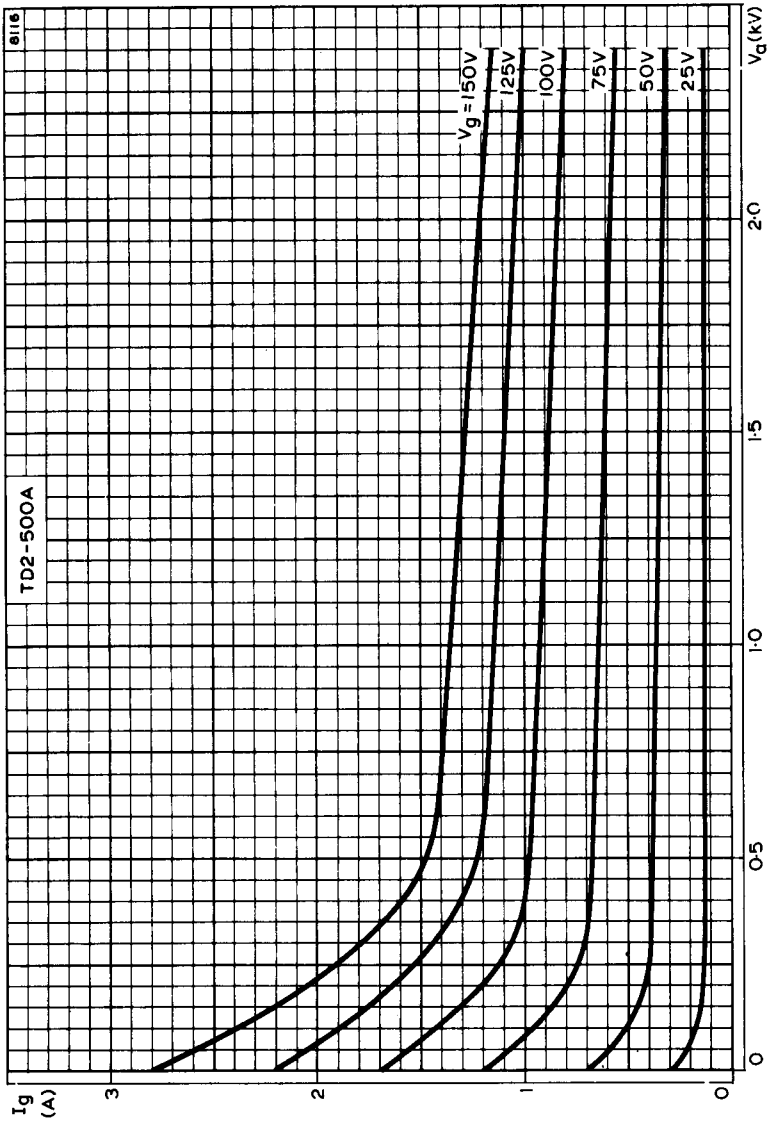
DIMENSIONS

	Inches	Millimetres	
A	1.433 ± 0.008	36.4 ± 0.2	
B	1.0 ± 0.008	25.4 ± 0.2	
C	0.354 ± 0.008	9.0 ± 0.2	
D	1.626 ± 0.008	41.3 ± 0.2	
E	0.48	12	min.
F	0.236	6.0	
G	0.669 ± 0.020	17 ± 0.5	
H	0.925 ± 0.039	23.5 ± 1.0	
J	0.158 ± 0.020	4.0 ± 0.5	
K	0.551 ± 0.020	14 ± 0.5	
L	3.26	83	max.
M	1.02	26	
N	0.158	4.0	
O	4 millimetre metric thread		

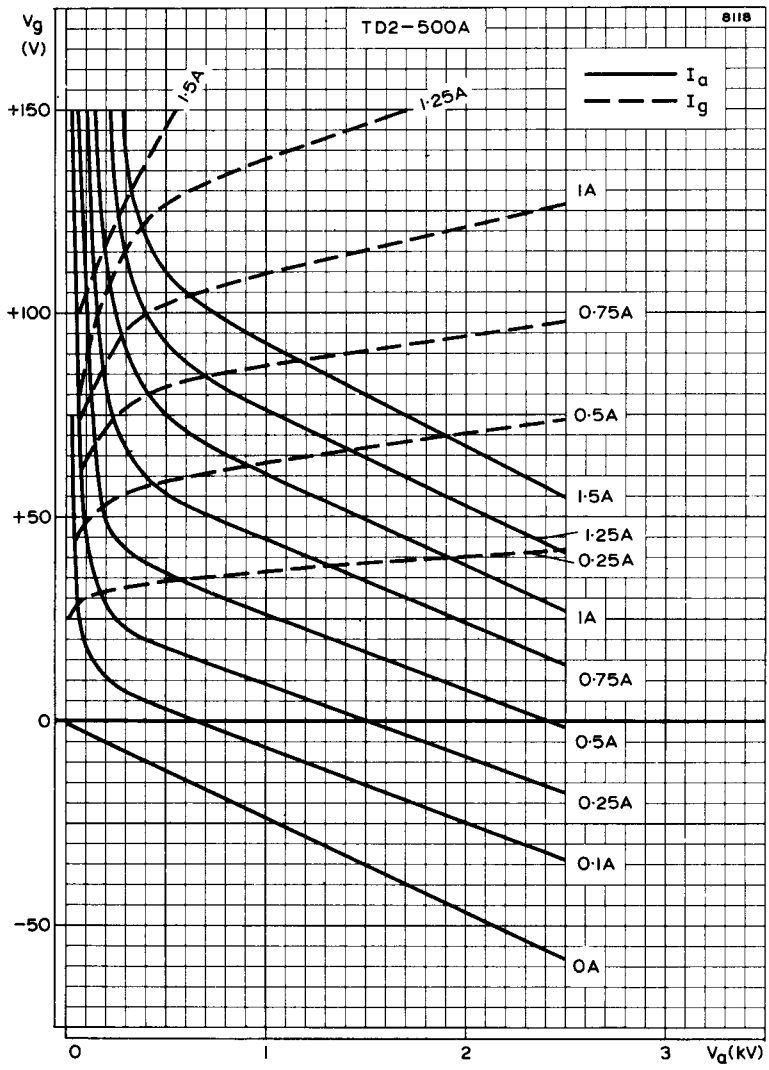
Inch dimensions derived from original millimetre dimensions



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



CONSTANT CURRENT CHARACTERISTICS

Mullard
DOUBLE-DIODE-TRIODE

TDD13C

The TDD13c is an indirectly heated double-diode-triode for use as combined detector and L.F. amplifier and for the application of automatic volume control in D.C./A.C. mains receivers.

HEATER CHARACTERISTICS

Heater Voltage	Vf=13·0 volts.
Heater Current	If=0·2 amp.
Heating Time—60 seconds	

DIMENSIONS

Overall Length ...	=128 mm.
Overall Diameter...	= 45 mm.
Bulb Finish—Metallised	

OPERATING CHARACTERISTICS (Triode)

Normal Anode Voltage	Va_w	= 200 volts
Anode Current (−Vg1=5·0)	Ia_w	= 4·0 mA
Grid Volts (Ia=4·0 mA)	$-Vg1_w$	= 5·0 volts
Mutual Conductance	S_w	= 2·0 mA/V
Anode Impedance	Ri_w	= 13,500 ohms
Amplification Factor	G_w	= 27
Cathode Bias Resistor	Rk	= 1,250 ohms

OPERATING DATA AS R.C. AMPLIFIER

Anode Voltage (Line)	Va	= 200 volts
Anode Resistance	Ra	= 160,000 ohms
Bias Voltage	−Vg1	= 3·6 volts
Anode Current	Ia	= 0·65 mA
Bias Resistance	Rk	= 5,500 ohms
Amplification Factor	G	= 19·5
Maximum Output Volts (D=5% 2nd H.) ...	Vo	= 37 v. R.M.S.

CAPACITIES

Grid-Cathode	Cgk	= 3·5 μμF
Anode-Cathode	Cak	= 2·9 μμF
Cathode-Diode (1)	Ckd1	= 2·5 μμF
Cathode-Diode (2)	Ckd2	= 3·25 μμF
Diode (1)-Diode (2)	Cd1d2	= 0·3 μμF
Diode (1)-Control Grid	Cd1g	= <0·0015 μμF
Diode (2)-Control Grid	Cd2g	= <0.0015 μμF

TDD13C

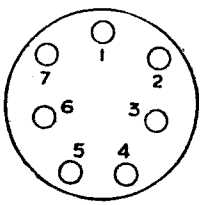
Mullard
DOUBLE-DIODE-TRIODE

LIMITS

Maximum Anode Voltage	... ...	Va_{max}	= 200 volts
Maximum Anode Dissipation	... ...	Wa_{max}	= 1·5 watts
Maximum Diode Anode Voltage (Peak)	...	Vd_{max}	= 200 volts
Maximum Diode Anode Current	... ...	Id_{max}	= 0·8 mA
Maximum Cathode Current	... ...	Ik_{max}	= 10·0 mA
Maximum Resistance in Grid Circuit	... ...	$RgIA_{max}$	= 1·5 megohms
Maximum Voltage—Heater to Cathode	...	Vfk_{max}	= 125 volts
Maximum Resistance—Heater to Cathode	...	Rfk_{max}	= 20,000 ohms

Range of Grid Voltage for 1 microamp. grid current = −0·2 to −0·8 volt

CONNECTIONS

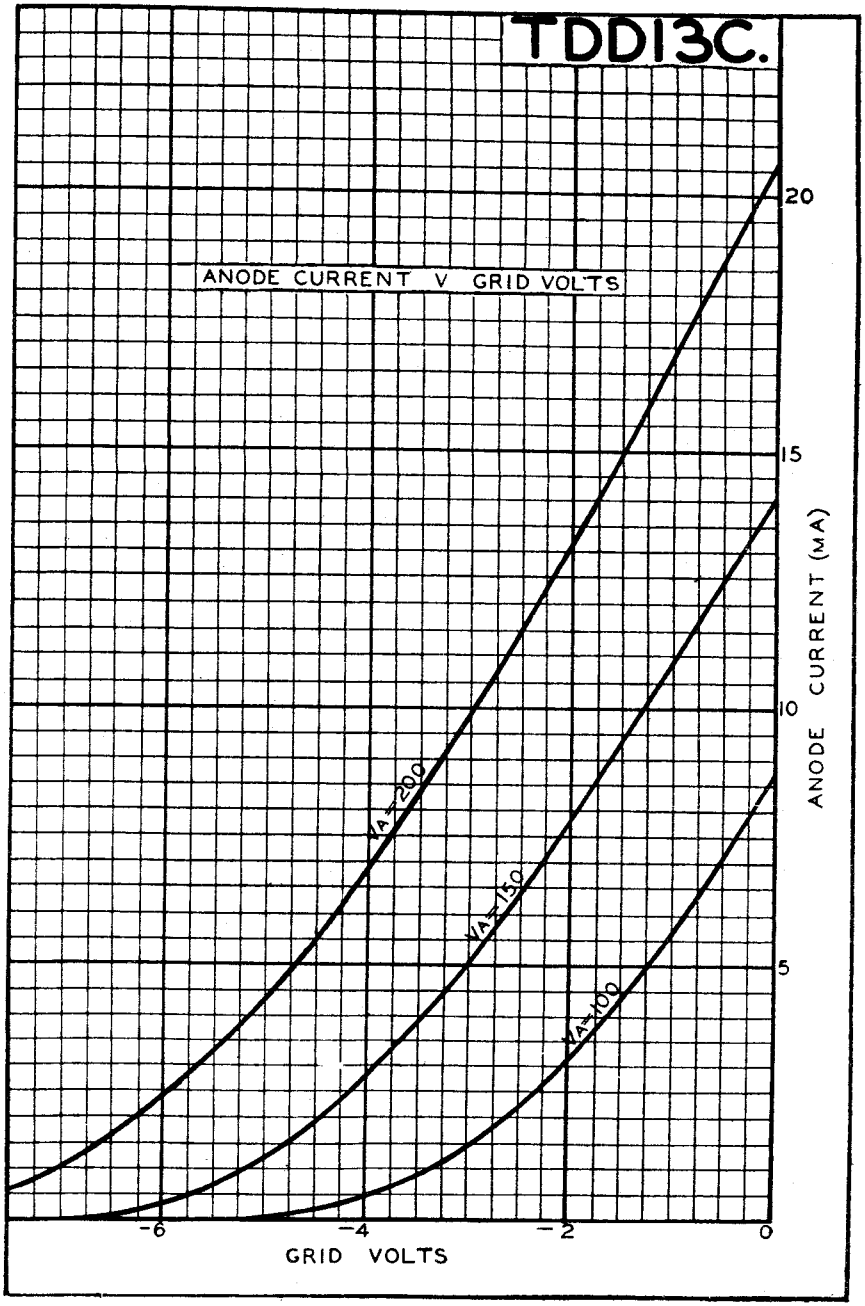


Viewed from free end of pins.

Pin No. 1 Diode (1)
" 2 Metallisation
" 3 Diode (2)
" 4 Heater
" 5 Heater
" 6 Cathode
" 7 Anode
Top Cap—Control Grid (G1)

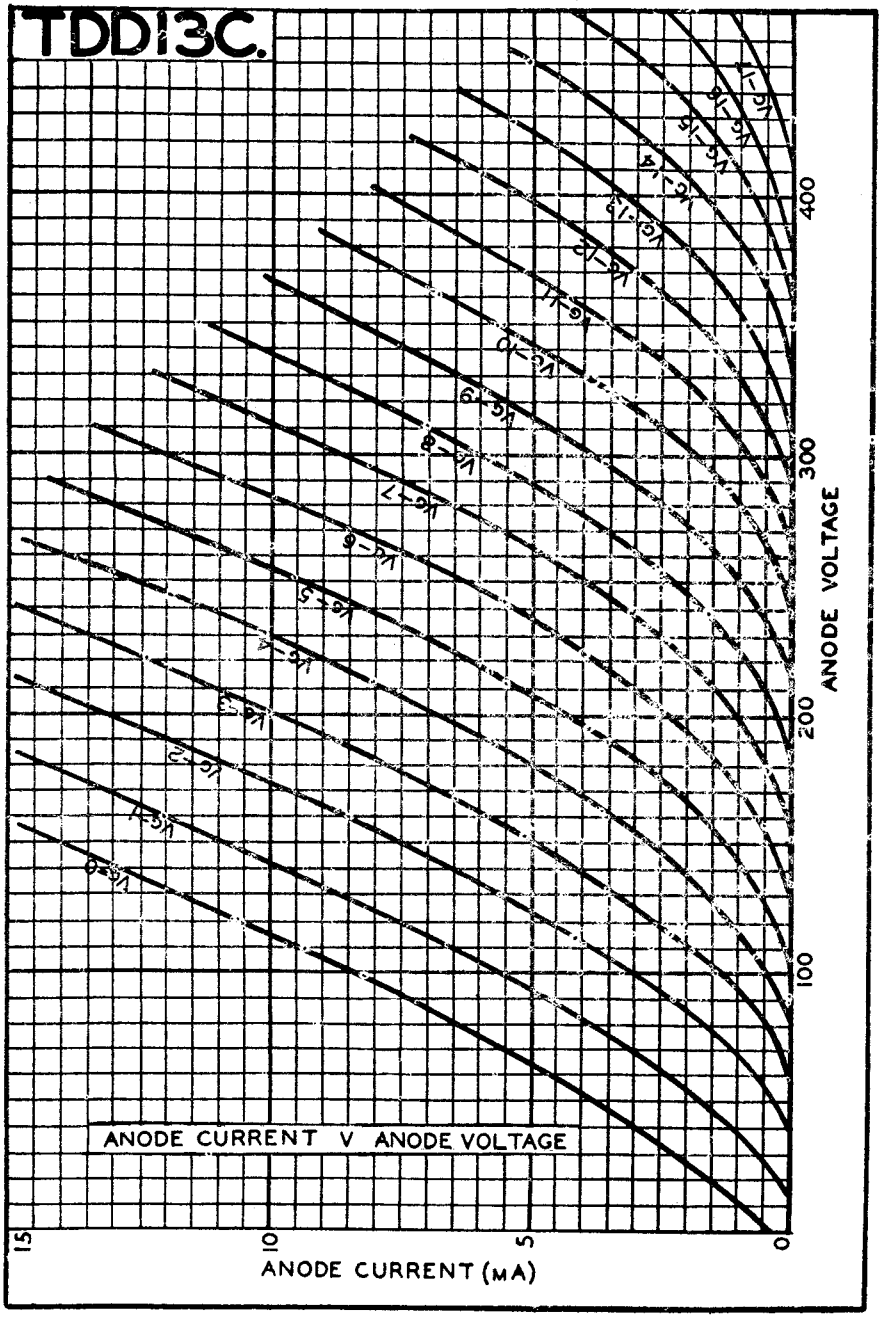
Mullard
DOUBLE-DIODE-TRIODE

TDD13C



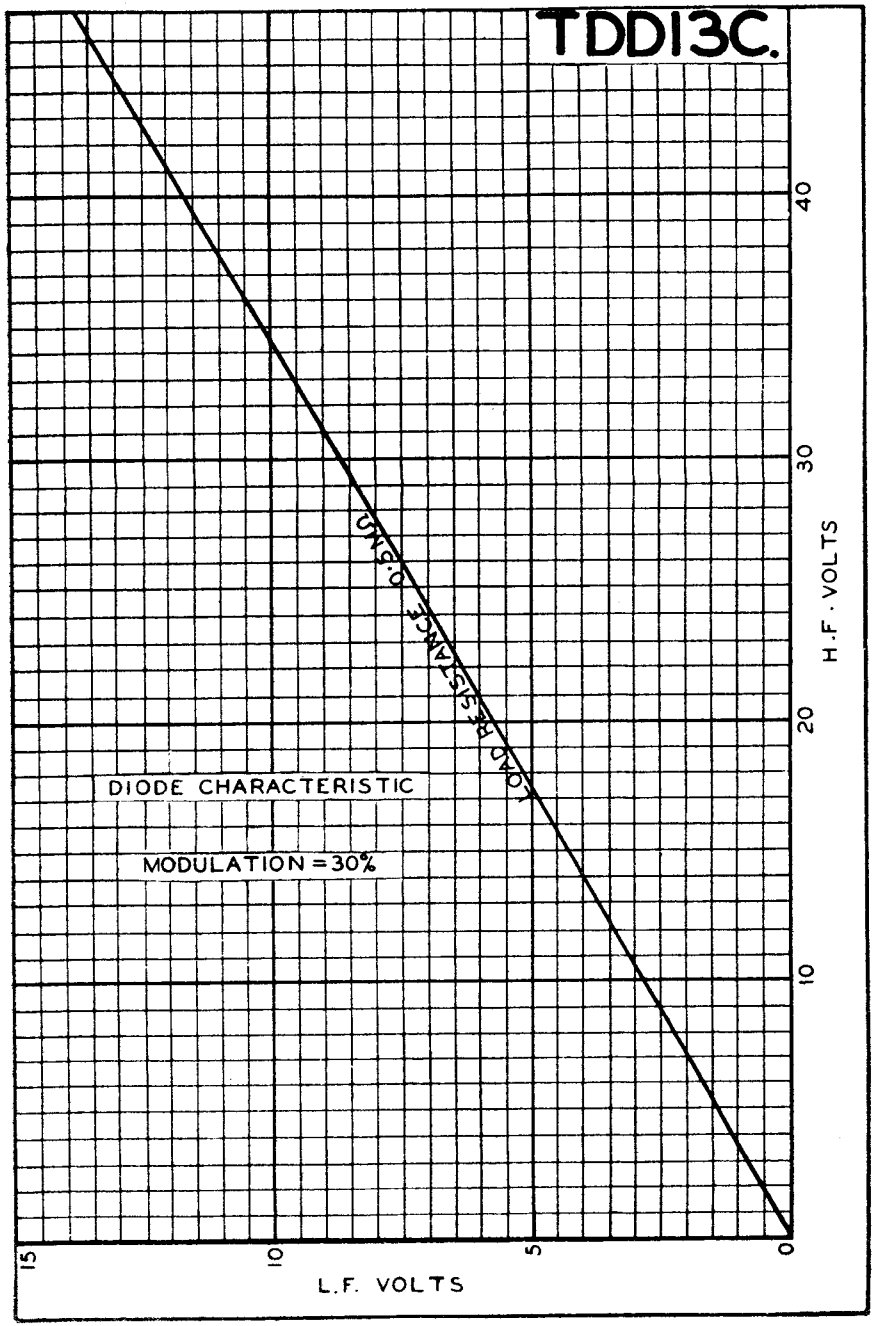
TDD13C

Mullard
DOUBLE-DIODE-TRIODE



Mullard
DOUBLE-DIODE-TRIODE

TDD13C



Mullard
TRIODE HEXODE

TH13C

The TH13C is an indirectly heated frequency changer for use in equipment having an A.C. or D.C. heater supply of 13 volts. It comprises a hexode mixer and a triode oscillator located on a common cathode assembly with adequate screening between each electrode system.

HEATER CHARACTERISTICS

Heater Voltage... ... Vf=13·0 volts
Heater Current ... If =0·31 amp
Heating Time—13 seconds

DIMENSIONS

Overall Length ... =148 mm.
Overall Diameter = 50 mm.
Bulb Finish—Metallised

OPERATING CHARACTERISTICS

Maximum Voltage Heater to Cathode ... Vfk_{max} =75 volts

For further characteristics and operating data see Type TH4. The TH13C and TH4 are identical except for Heater ratings.

Mullard
TRIODE HEXODE

TH21C

The TH21C is an indirectly heated frequency changer for use in D.C./A.C. mains superheterodyne receivers. It comprises a hexode mixer and a triode oscillator located on a common cathode assembly with adequate screening between each electrode system.

HEATER CHARACTERISTICS

Heater Voltage ... Vf=21·0 volts
Heater Current ... If =0·2 amp
Heating Time—30 seconds

DIMENSIONS

Overall Length ... =148 mm.
Overall Diameter... = 50 mm.
Bulb Finish—Metallised

OPERATING CHARACTERISTICS

Maximum Voltage Heater—Cathode ... Vfk_{max} =125 volts

For further characteristics and operating data refer to Type TH4. The TH21C and TH4 are identical except for Heater ratings.

Mullard
TRIODE HEXODE

TH22C

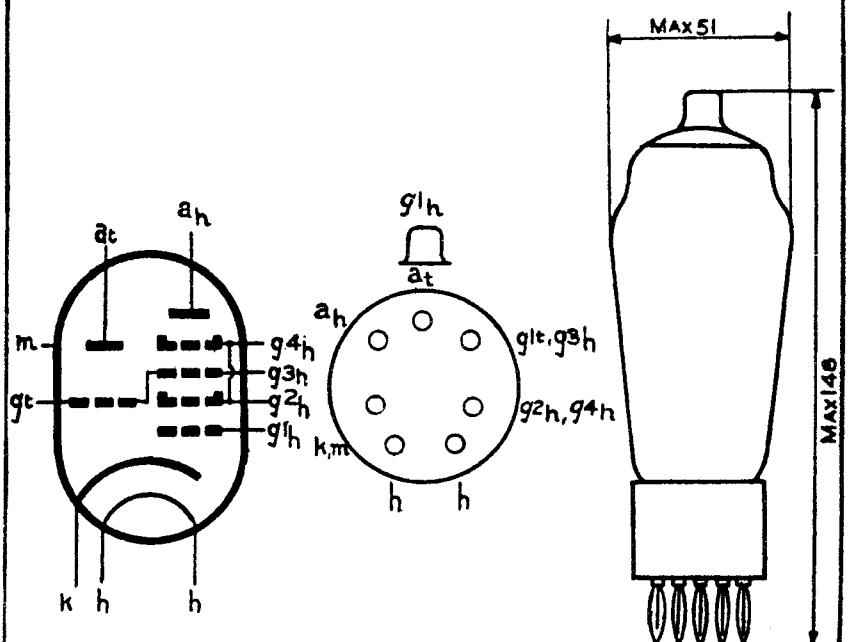
Heater	Vf	=	29 V
	If	=	0.2 A

Operating conditions.

Vfk ..... 125 V

For characteristics, curves and operating data, see type TH4A. Except for Heater rating, the TH22C and TH4A are identical.

Arrangement of electrodes and base connections



TH22C

Mullard
TRIODE HEPTODE

TH30C

Heater		Vf	=	29.0 V
		If	=	.0.2 A.
Capacities	Heptode	Cgl	=	8.4 uuF
		Ca	=	13.8 uuF
		Cglg3	=	0.16 uuF
	Triode	Cgk	=	13.6 uuF
		Cak	=	3.5 uuF

Operating conditions of heptode system.

Va	250	V
Vg2&4	100	V
Vosc (R.M.S)	8.0	V
-Vgl	2.5	V
Ia	3.25	mA
Ig2&4	6.0	mA
Sc	0.75	mA/V
Ri	1.5	megohms
Rk	140	ohms
Rg3	50,000	ohms

Operating Conditions of triode system.

Va	100	V
Ia	9.5	mA
S max (Vg3=0)	5.5	mA/V
g	17.5	

Limits of heptode system.

Va max	300	V
Wa max	1.0	W
Vg2&4 max	150	V
Wg2&4 max	0.6	W
Ig2&4 max (Vg2&4=100 V, Vgl=-2.5 V, Vosc=8.0 V, Rg3=50,000 ohms.)	7.5	mA
Ik max	25	mA
Vgl max (Igl=+0.3 uA)	-1.3	V
Rgla max	3.0	megohms
Vfk max	100	V
Rfk max	20,000	ohms

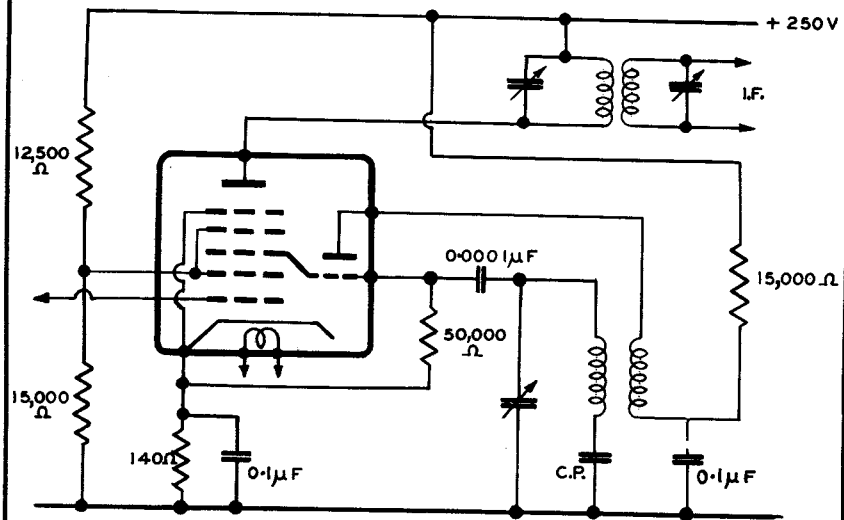
Limits of triode system.

Va max	125	V
Wa max	1.0	W
Vg max (Ig3=+0.3 uA)	-1.3	V

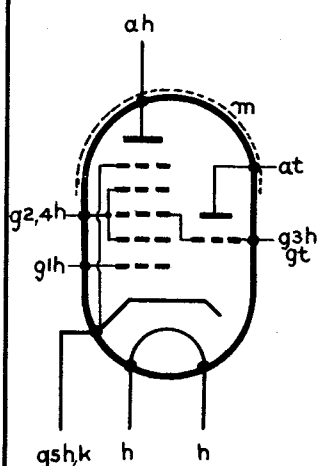
TH30C

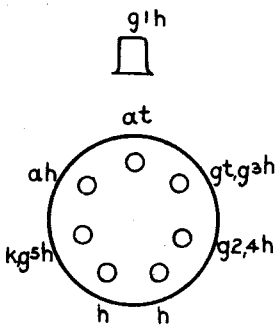
Mullard
TRIODE HEPTODE

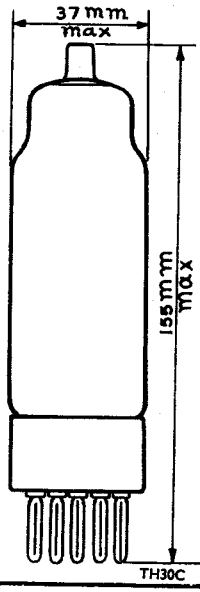
Circuit Diagram.



Arrangement of electrodes and base connections.

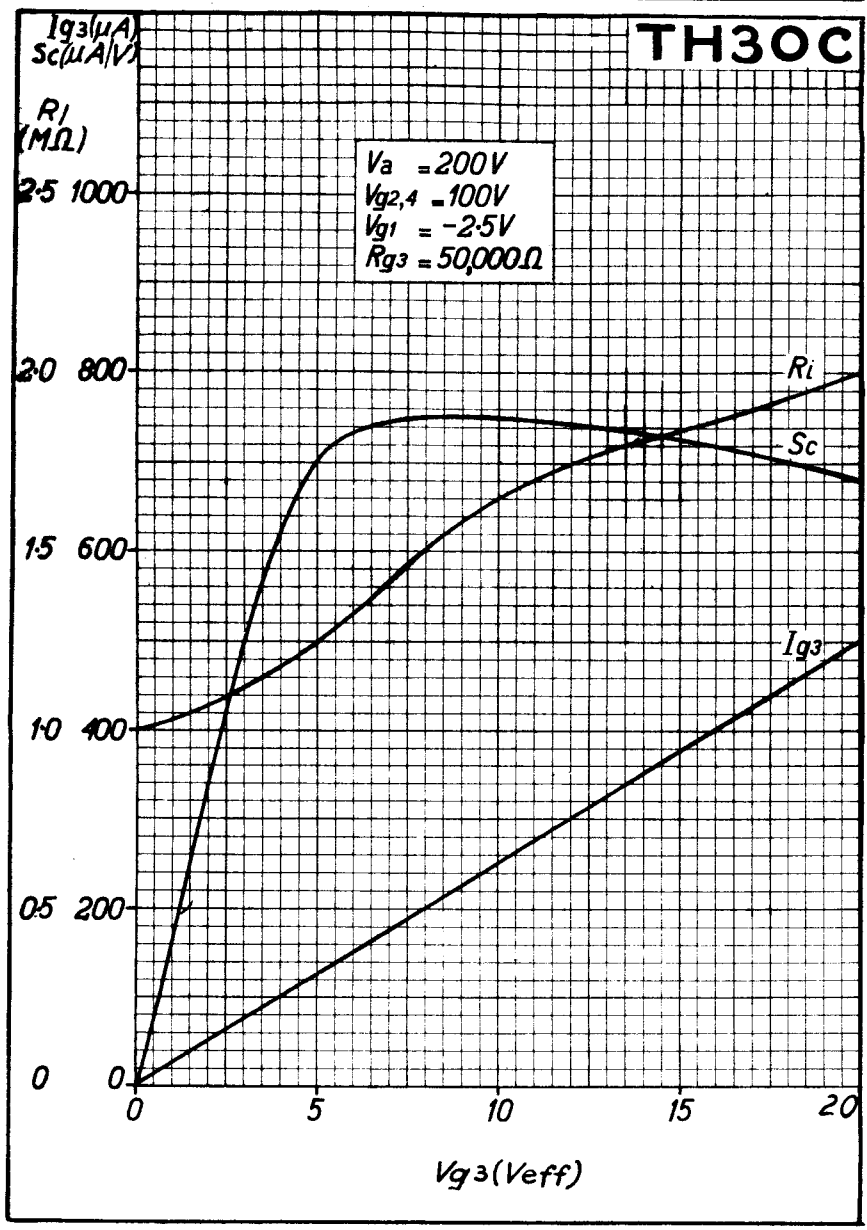






Mullard
TRIODE HEPTODE

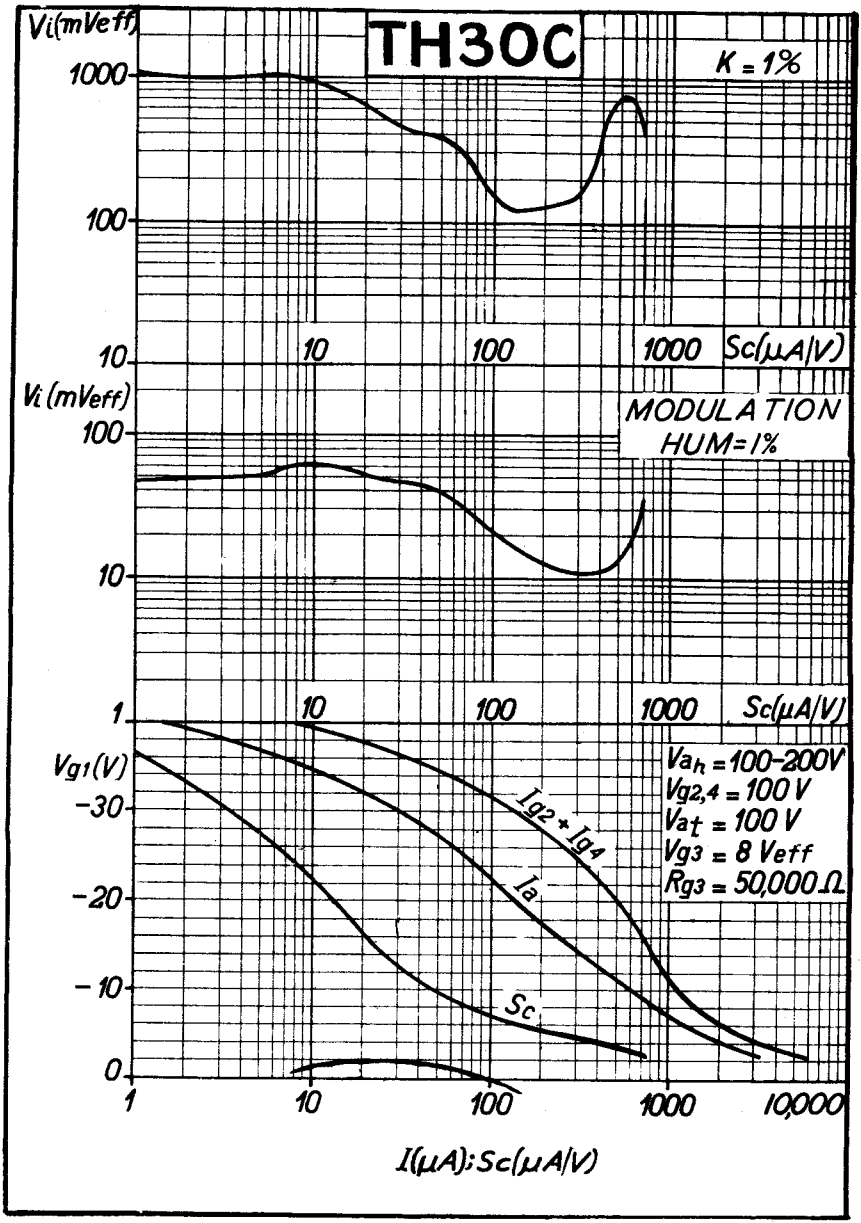
TH30C



1439/3

TH30C

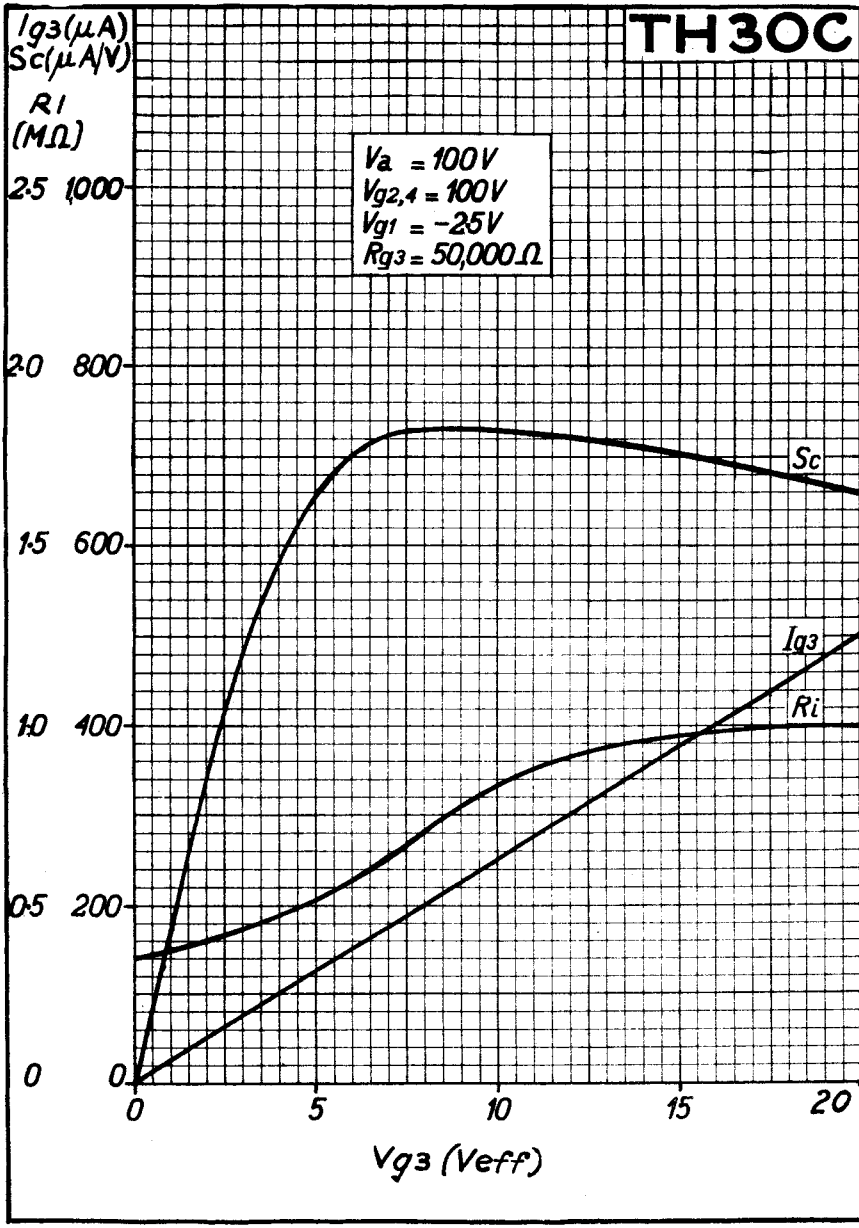
Mullard
TRIODE HEPTODE



1439/4

Mullard
TRIODE HEPTODE

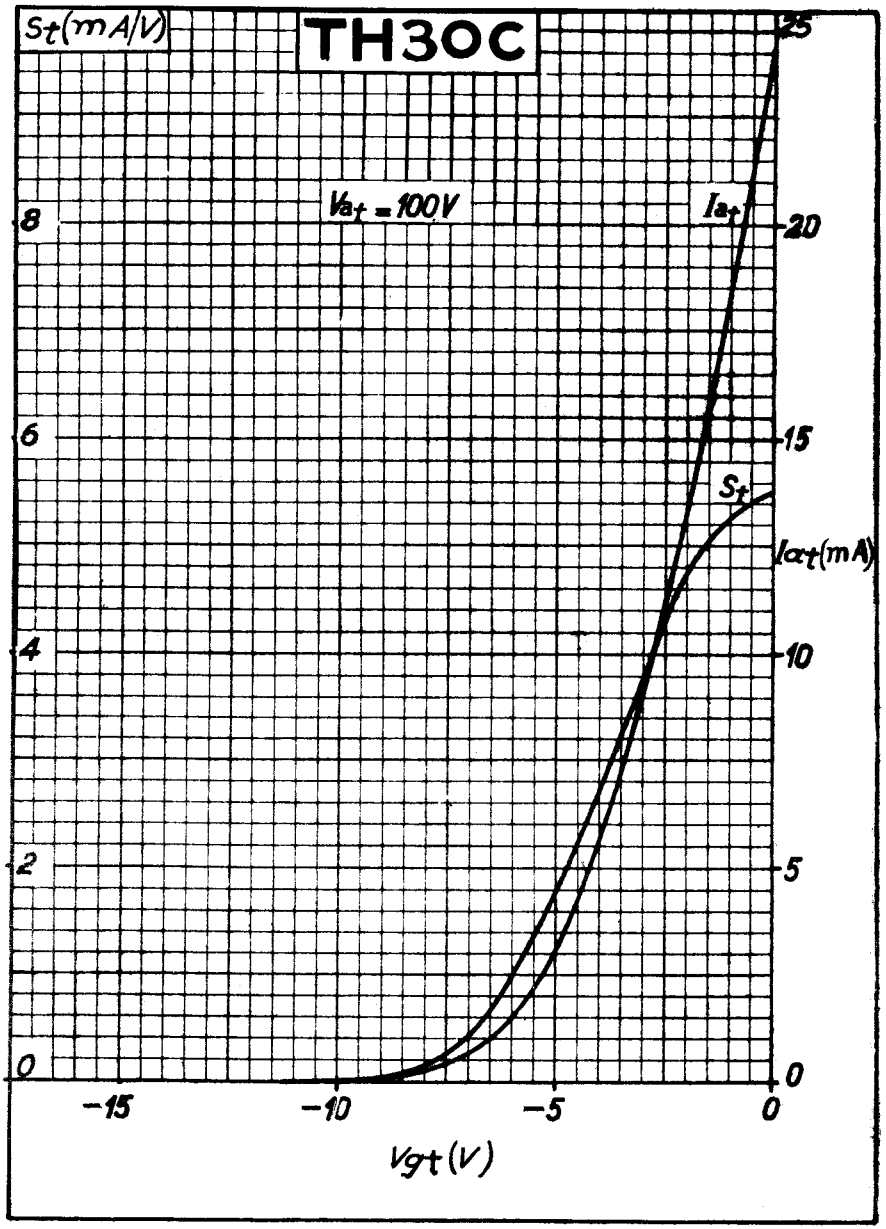
TH30C



1439/5

TH30C

Mullard
TRIODE HEPTODE



1439/6

Mullard

Television Secondary Emission Valve

TSE4

Heater	Vf	=	4.0 V
	If	=	1.1 A

Capacities	Ca	=	9.3 uuF
	Cg1	=	10.0 uuF
	Cag1	=	0.004 uuF

Operating Conditions

Va	250	V
Vg2	150	V
Vk2	150	V
Vg1	-2.5	V
Ia	8	mA
Ig2	0.7	mA
Ik2	6	mA
S (Ia = 8 mA)	14.5	mA/V
Ri (Ia = 8 mA)	100,000	ohms

Limiting Values.

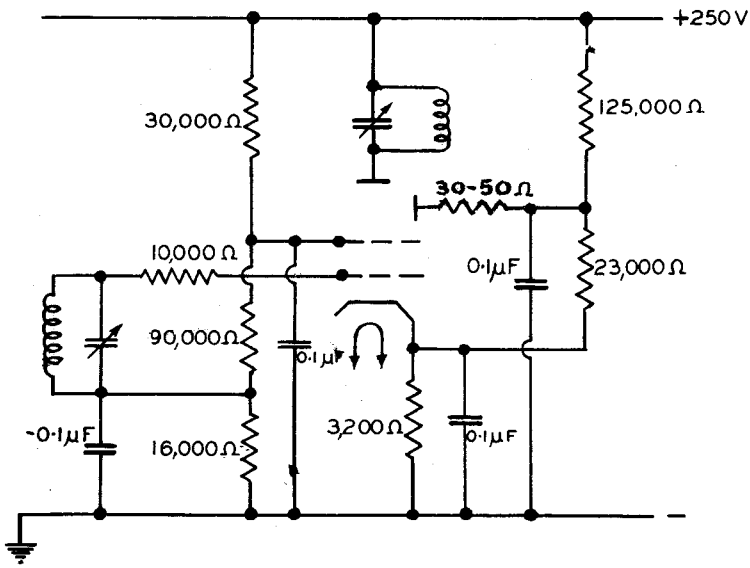
Vao max	550	V
Va max	250	V
Wa max	2	W
Vg2o max	550	V
Vg2 max	150	V
Wg2 max	0.11	W
Vk2o max	550	V
Vk2 max	150	V
Wk2 max	1.1	W
Ik max	4	mA
Vg1 max (Ig1 = +0.3 uA)	-1.3	V
Rg1a max	2	megohms
Vfk max	50	V
Rfk max	20,000	ohms

TSE4

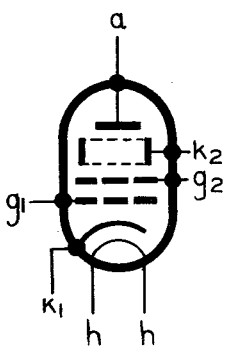
Mullard

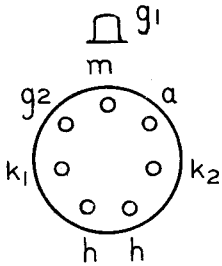
Television Secondary Emission Valve

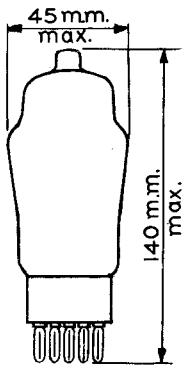
CIRCUIT DIAGRAM



Arrangement of electrodes and base connections.





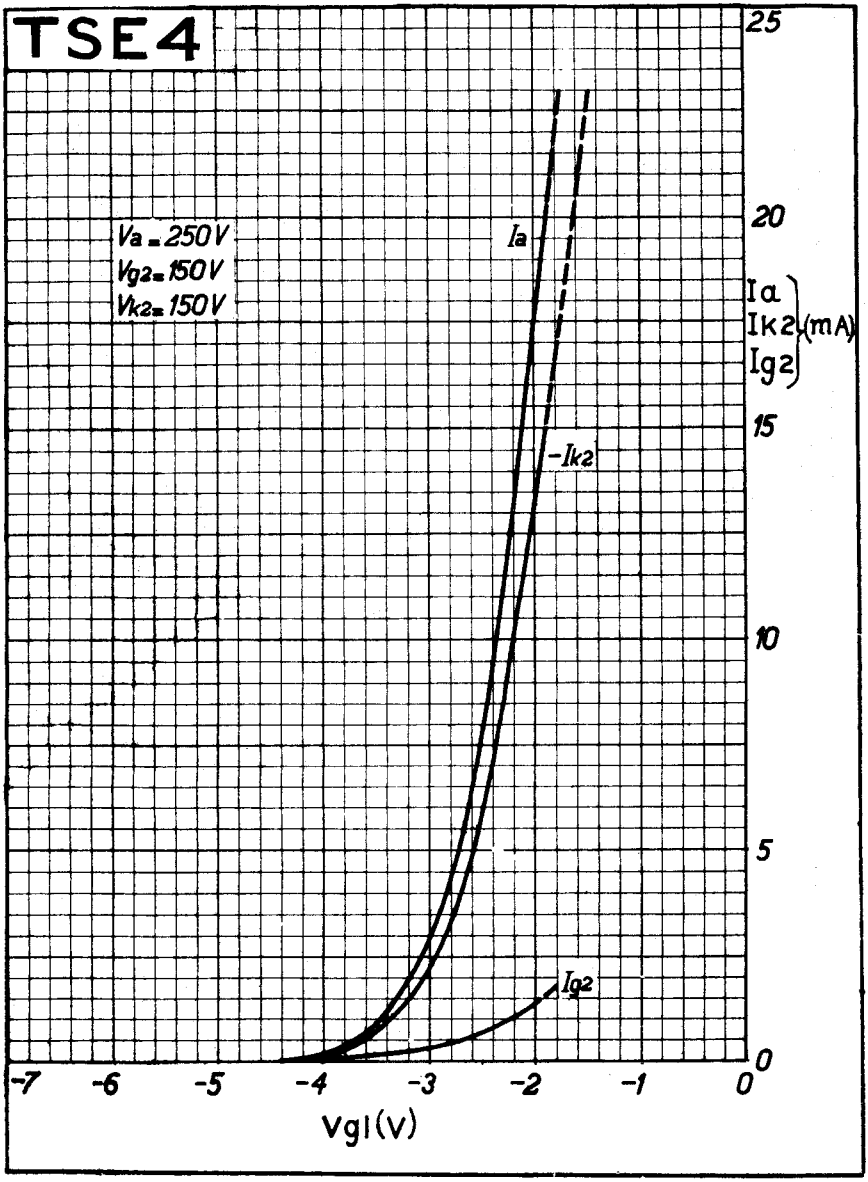


TSE4

Mullard

Television Secondary Emission Valve

TSE4

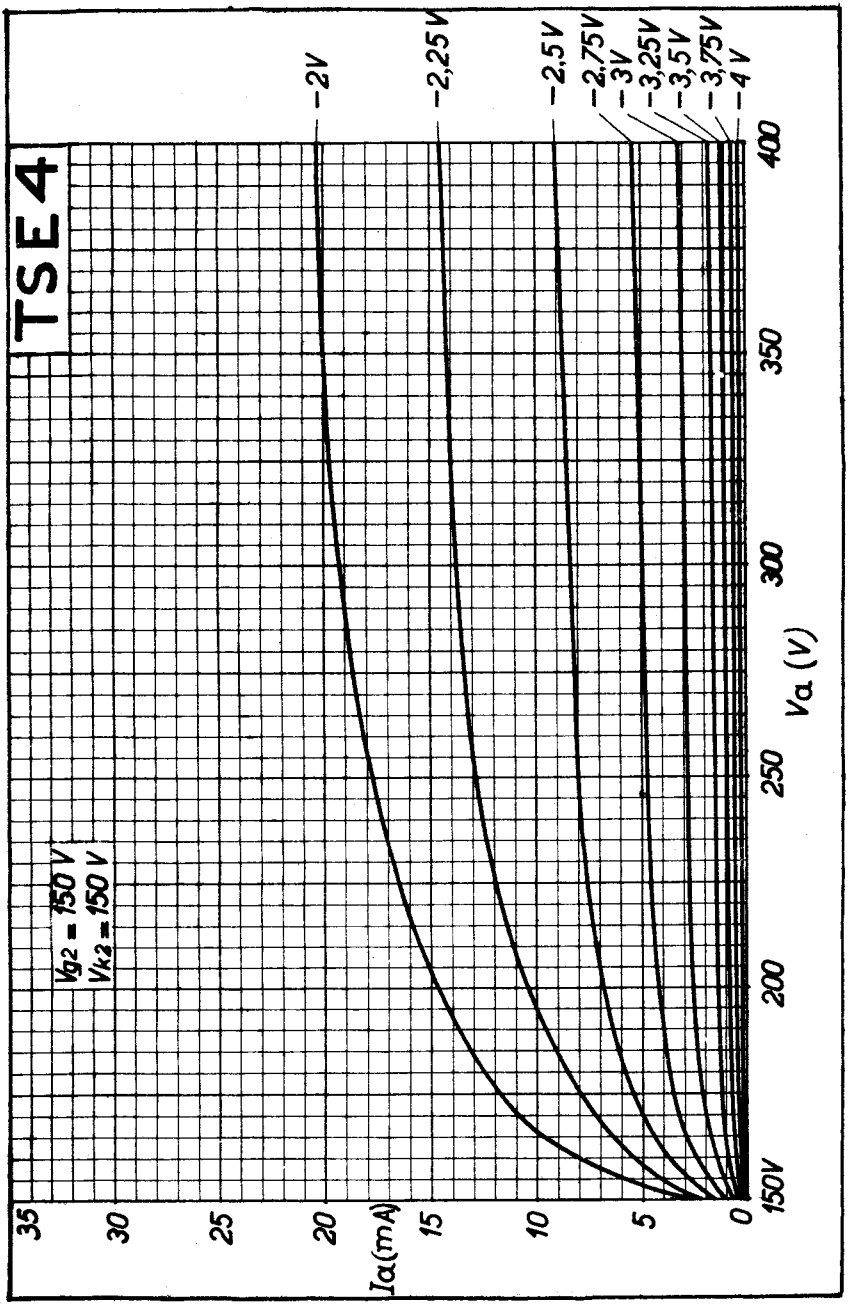


1739 3

TSE4

Mullard

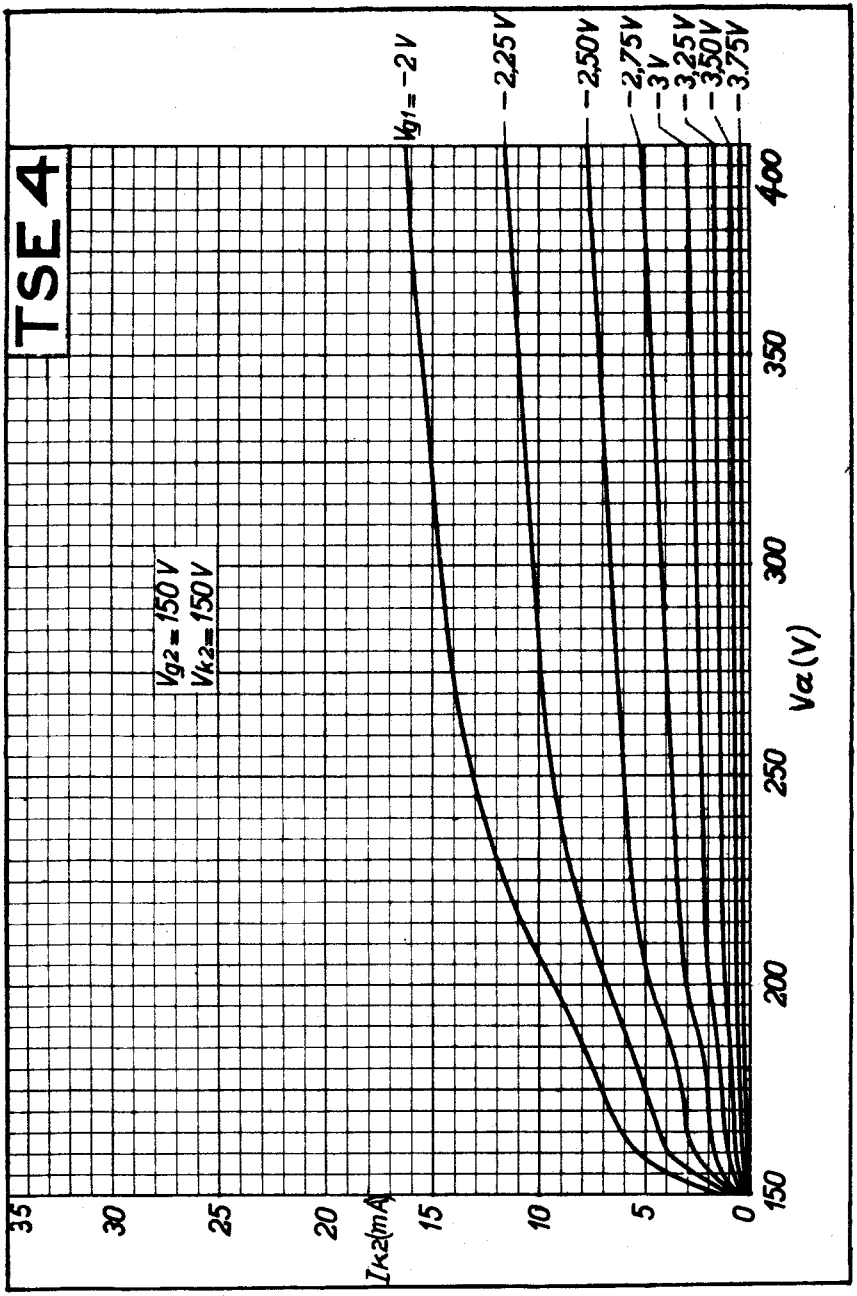
Television Secondary Emission Valve



Mullard

Television Secondary Emission Valve

TSE4



Mullard
HIGH-MU H.F. PENTODE

TSP4

The TSP4 is an indirectly heated high slope R.F. Pentode for A.C. mains. It has been specially designed for application in television receivers, and as such is suitable for general use, including that of an output valve for modulating a cathode ray tube.

HEATER CHARACTERISTICS

Heater Volts	Vf = 4·0 volts	
Heater Current	If = 1·3 amps	

Bulb Finish—Metallised

DIMENSIONS

Overall Length ...	= 138 mm.
Overall Diameter...	= 45·2 mm.

OPERATING DATA AS H.F. OR I.F. AMPLIFIER

Normal Anode Voltage	Va_w	= 200 volts
Normal Auxiliary Grid Voltage	$Vg2_w$	= 200 volts
Control Grid Voltage (Ia = 8·0 mA)	$-Vg1_w$	= 2·5 volts
Normal Anode Current (Vg1 = −2·5 V) ...	Ia_w	= 8·0 mA
Normal Auxiliary Grid Current	$Ig2_w$	= 1·5 mA
Slope	S_w	= 4·73 mA/V
Amplification Factor	G_w	= 6,730
Bias Resistance	Rk	= 260 ohms

OPERATING DATA AS OUTPUT VALVE FOR USE WITH CATHODE RAY TUBE

Normal Anode Voltage	Va_w	= 250 volts
Normal Auxiliary Grid Voltage	$Vg2_w$	= 250 volts
Control Grid Voltage (Ia = 10·5 mA)	$-Vg1_w$	= 3·0 volts
Normal Anode Current (Vg1 = −3·0 V) ...	Ia_w	= 10·5 mA
Normal Auxiliary Grid Current	$Ig2_w$	= 2·0 mA
Internal Resistance	Ri	= 0·75 megohm
Bias Resistance	Rk	= 250 ohms
Voltage Output (Ra—10,000 ohms $Vg_{eff.}$ = 0·55 volts R.M.S., D = 3·4% 2nd + 0·5% 3rd H.	Vo	= 30 v R.M.S.

CAPACITIES

Anode-Control Grid	Cag1	= ⊁0·01
Input	Cg1	= 9·6 μμF
Output	Ca	= 7·5 μμF

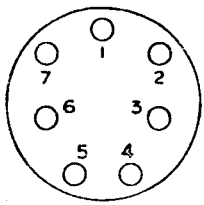
TSP4

Mullard
HIGH-MU H.F. PENTODE

LIMITS

Maximum Anode Voltage	Va_{max}	=	250 volts
Maximum Auxiliary Grid Voltage	$Vg2_{max}$	=	250 volts
Maximum Resistance in Grid Circuit	$Rg1a_{max}$	=	1·0 megohm
Maximum Cathode Current	Ik_{max}	=	20 mA
Grid Current commences at	$-Vg1$	=	1·0 volt

CONNECTIONS

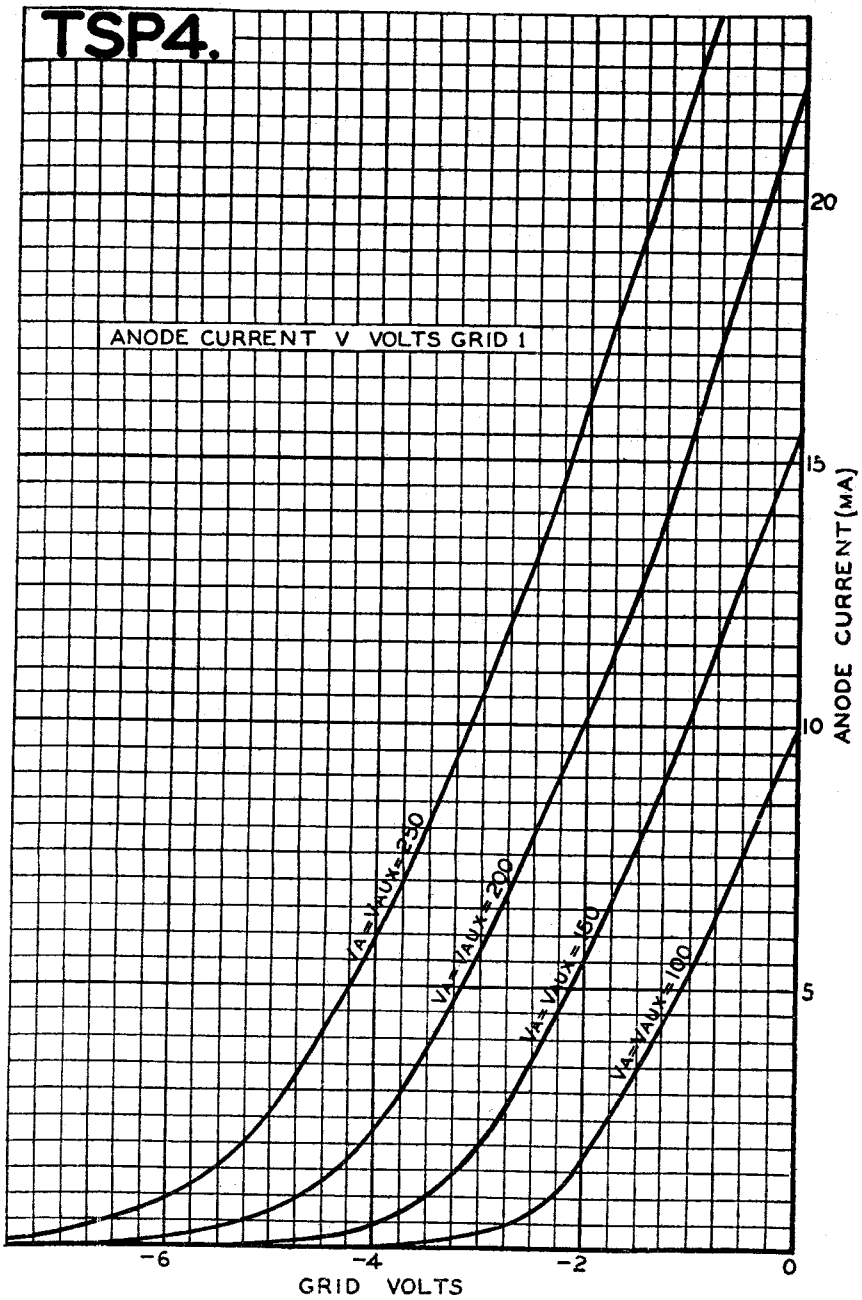


Viewed from free end of pins

Pin No. 1 Metallisation
„ 2 Anode
„ 3 Suppressor Grid (G3)
„ 4 Heater
„ 5 Heater
„ 6 Cathode
„ 7 Auxiliary Grid (G2)
Top Cap—Control Grid (G1)

Mullard
HIGH-MU H.F. PENTODE

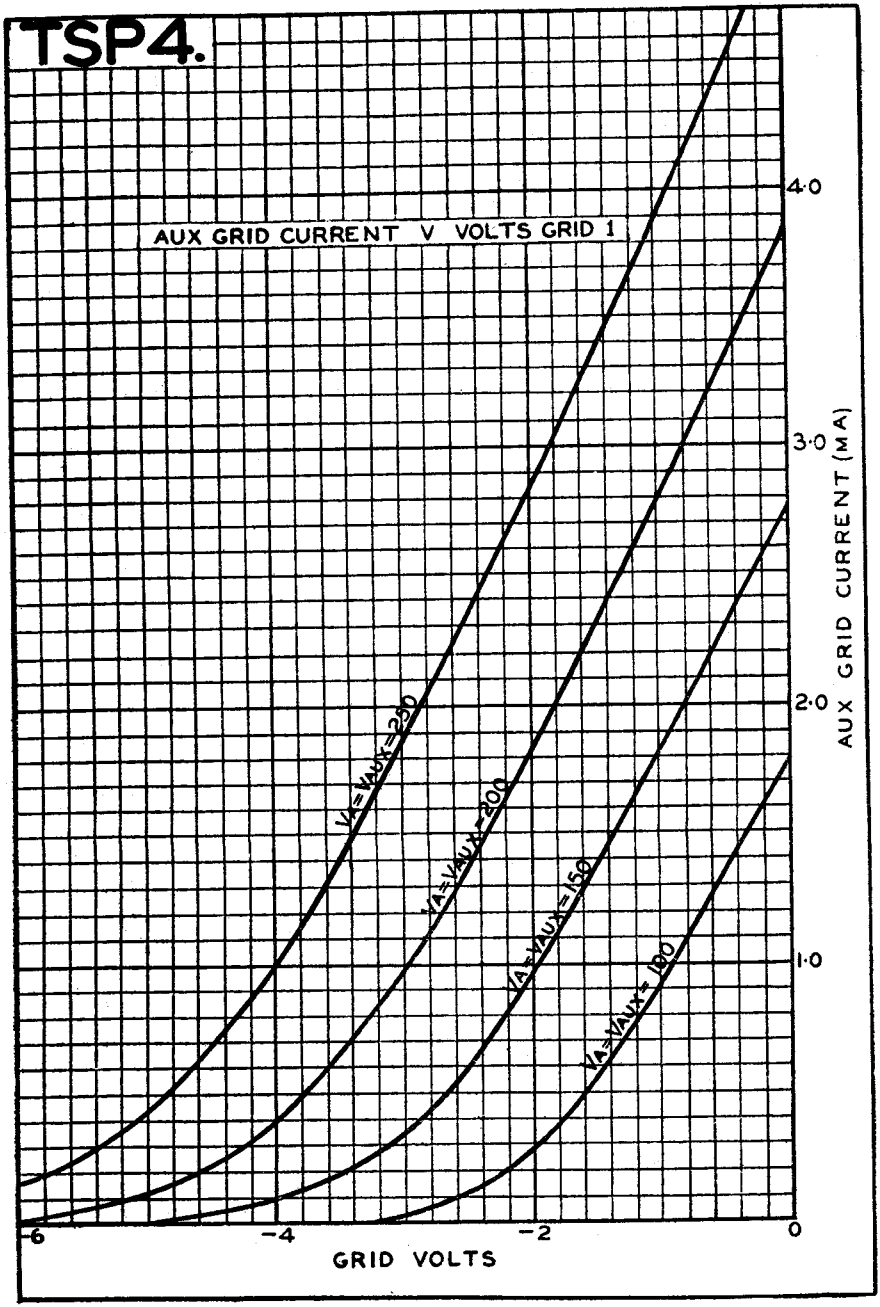
TSP4



TSP4

Mullard

HIGH-MU H.F. PENTODE



WATER-COOLED R.F. TRIODE TX12-20W

High-power water-cooled triode, primarily intended for use in the output stage of communications transmitters, also suitable for R.F. heating purposes.

MAINTENANCE TYPE

FILAMENT

Pure tungsten, suitable for a.c. or d.c. operation.

Marked V_f	18.5 ± 0.5	V
I_f (approx.)	85	A

(Marked volts give 10 amps emission for 90% saturation).

CAPACITANCES

C_{g-f}	28	μμF
C_{a-f}	1.5	μμF
C_{a-g}	26	μμF

CHARACTERISTICS (At V_a = 12 kV I_a = 1.0 A)

g_m	11	mA/V
μ	38	
r_a	3.5	kΩ

LIMITING VALUES

V_a max.	12	kV
I_k max.	3.0	A
I_g max.	0.5	A
p_a max.	18	kW
f max.	20	Mc/s
Min. water flow rate	4.5	gal/min
Max. water temp. rise	14	°C
Max. water outlet temp.	60	°C

TYPICAL OPERATING CONDITIONS AS CLASS "C" C.W. AMPLIFIER (At f = 1 Mc/s)

V_a	12	kV
V_g	−900	V
I_a	2.63	A
I_g	0.37	A
$V_{drive\ (pk)}$	1.85	kV
P_{drive}	700	W
P_{out}	22	kW
p_a	9.5	kW
η	70	%

TYPICAL OPERATING CONDITIONS AS CLASS "B" AMPLIFIER WITH MODULATED INPUT (At f = 1 Mc/s)

V_a	12	kV
V_g	−300	V

	(Carrier)	(Peak values for 100% mod.)	
I_a	1.1	2.5	A
I_g	–	0.2	A
$V_{drive\ (pk)}$	430	860	V
P_{drive}	–	160	W
P_{out}	4.25	19	kW
p_a	9.0	11	kW
η	32	63.5	%

TRIODE

TY12-15A

Application: *R.F. amplifier.*
Power output: *40kW continuous rating.*
Frequency: *30Mc/s at full ratings.*
Construction: *External anode, forced-air cooled.*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES, which precede this section of the handbook.

FILAMENT

Thoriated tungsten

V_f	8.0	V
*I_f	130	A

*The filament current must never exceed a surge value of 280A at any time during the warming-up period.

MOUNTING POSITION

Vertical, anode down

CAPACITANCES

C_{a-g}	27	pF
C_{g-f}	45	pF
C_{a-f}	600	mpF

CHARACTERISTICS (measured at V_a = 12kV, I_a = 2A)

μ	33	
g_m	25	mA/V
g_m (at V_a = 2kV, I_a = 22A)	40	mA/V

COOLING

Forced-air cooling

T_{seals} max.	220	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals.

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea-level. Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table.

Anode dissipation p_a (kW)	Height above sea-level h (km)	(ft.)	Inlet temperature T_{in} (°C)	Min. rate of flow of air per minute (m^3)	(ft^3)	Pressure difference between inlet and outlet (mm of H_2O)
7.0	0	0	35	6.6	235	10
7.0	0	0	45	7.7	270	13
7.0	1.5	4920	35	7.9	280	12
7.0	3.0	9840	25	8.3	295	12
10	0	0	35	10.5	370	23
10	0	0	45	12.2	430	31
10	1.5	4920	35	12.6	445	28
10	3.0	9840	25	13.2	465	27
15	0	0	35	18.1	640	60
15	0	0	45	21.2	750	79
15	1.5	4920	35	21.7	765	73
15	3.0	9840	25	22.3	790	70

CLASS 'C' TELEGRAPHY

Limiting values (absolute ratings)

f max.	30	Mc/s
V_a max.	13	kV
I_k max.	5.8	A
$i_{k(pk)}$ max.	28	A
V_g max.	−1.5	kV
I_g max.	1.0	A
p_a max.	15	kW
p_g max.	750	W
R_{g-f} max.	10	kΩ

Operating conditions

f	30	Mc/s
V_a	12	kV
I_a	4.5	A
V_g	−1.0	kV
I_g	800	mA
$v_{in(pk)}$	1.6	kV
$P_{load\ driver}$	1.25	kW
p_a	13	kW
η_a	76	%
P_{out}	41	kW
P_{load} ($\eta_{transfer}$ = 85%)	34.8	kW

TY12-15A

CLASS 'C' ANODE MODULATION

Limiting values (absolute ratings) carrier condition for a modulation factor of 1

f max.	30	Mc/s
V_a max.	10	kV
I_k max.	4.8	A
$i_{k(pk)}$ max.	42	A
V_g max.	−1.5	kV
I_g max.	1.0	A
p_a max.	10	kW
p_g max.	750	W
R_{g-f} max.	10	kΩ

Operating conditions

f	30	Mc/s
V_a	10	kV
I_a	3.5	A
V_g	−1.0	kV
I_g	800	mA
$v_{in(pk)}$	1.5	kV
$P_{load\ driver}$	1.2	kW
p_a	7.5	kW
η_a	78.5	%
P_{out}	27.5	kW
P_{load} ($\eta_{transfer}$ = 85%)	23.5	kW
For 100% modulation		
P_{mod}	17.5	kW

CLASS 'B' A.F.

Limiting values (absolute ratings)

V_a max.	13	kV
I_k max.	4.5	A
$i_{k(pk)}$ max.	14	A
p_a max.	15	kW
R_{g-f} max.	10	kΩ

Operating conditions (two valves)

V_a	10	kV
$I_{a(o)}$	2×100	mA
I_a (max. sig.)	2×1.6	A
V_g	−290	V
$V_{in(g-g)(r.m.s.)}$	640	V
I_g	2×35	mA
$P_{load\ driver}$	2×17	W
p_a	2×6.4	kW
η_a	60	%
R_{a-a}	6.24	kΩ
P_{out}	19.2	kW

TY12-15A

TRIODE

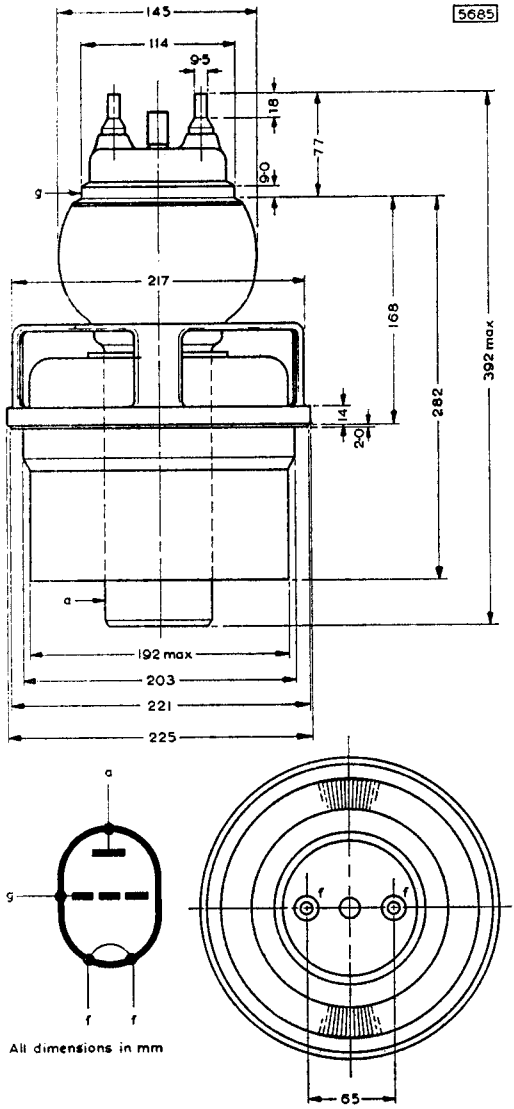
WEIGHT

Valve only	42	lbs
	19	kg
Shipping weight	186	lbs
	84.5	kg

ACCESSORIES

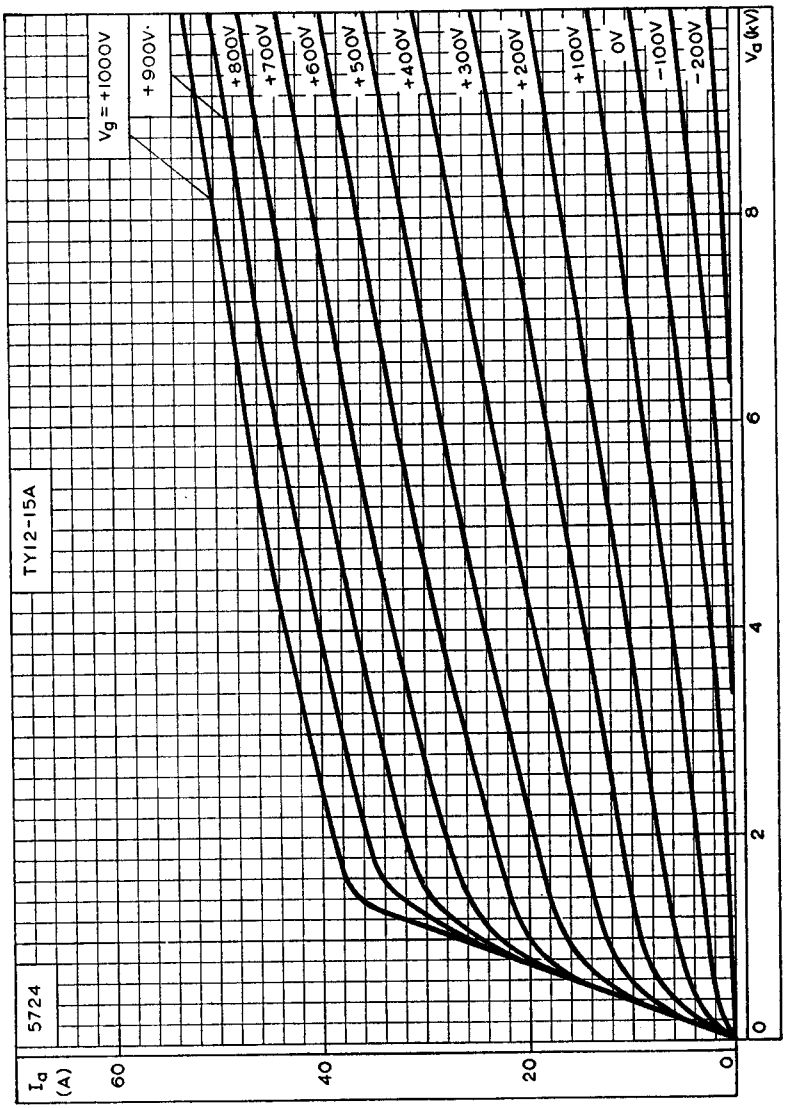
Insulating pedestal	40648
Grid connector	40663
Filament clips with lead	40662

TY12-15A



All dimensions in mm

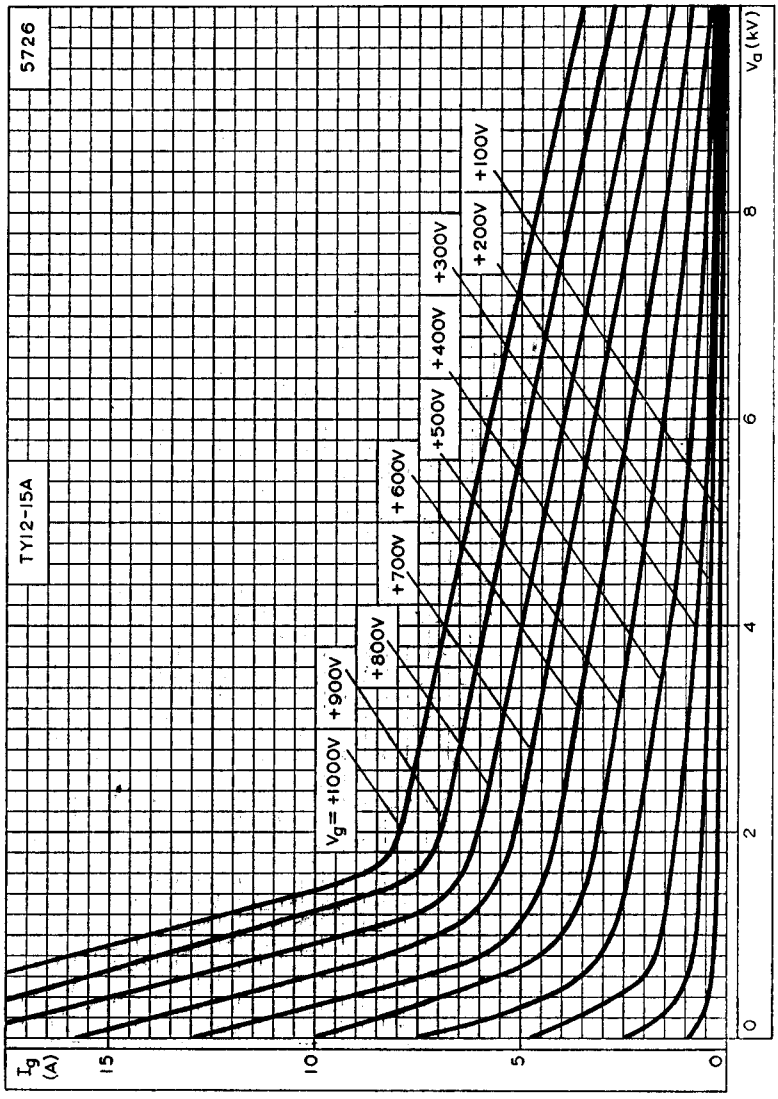
TY12-15A



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

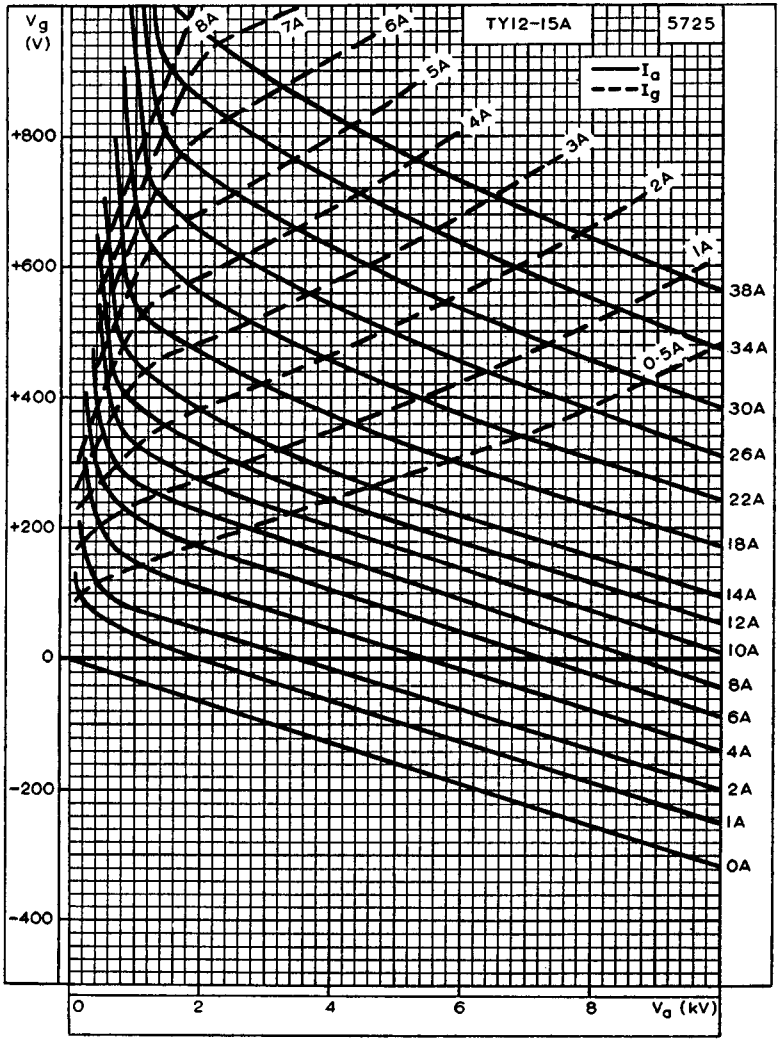
TY12-15A

TRIODE



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

TY12-15A



CONSTANT CURRENT CURVES

TY12-15A

QUICK REFERENCE DATA

External anode, forced-air cooled triode for use as r.f. power amplifier, oscillator or a.f. power amplifier.

	Class 'C' telegraphy	Class 'C' anode modulation	Class 'B' A.F.	
f max.	30	30	—	Mc/s
V_a max.	13	10	13	kV
p_a max.	15	10	15	kW
Performance				
f	30	30	—	Mc/s
P_{out}	41	27.5	40	kW

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES, which precede this section of the handbook.

FILAMENT

Thoriated tungsten

V_f	8.0	V
*I_f	130	A

*The filament current must never exceed a surge value of 280A at any time during the warming-up period.

MOUNTING POSITION

Vertical, anode down

CAPACITANCES

C_{a-g}	27	pF
C_{g-f}	45	pF
C_{a-f}	600	mpF

CHARACTERISTICS (measured at V_a = 12kV, I_a = 2A)

μ	33	
g_m	25	mA/V
g_m (at V_a = 2kV, I_a = 22A)	40	mA/V

COOLING

Forced-air cooling

T_{seals} max.	220	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals.

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea-level. Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table.

Anode dissipation p_a	Height above sea-level h		Inlet temperature T_{in}	Min. rate of flow of air per minute		Pressure difference between inlet and outlet
(kW)	(km)	(ft.)	(°C)	(m^3)	(ft^3)	(mm of H_2O)
7.0	0	0	35	6.6	235	10
7.0	0	0	45	7.7	270	13
7.0	1.5	4920	35	7.9	280	12
7.0	3.0	9840	25	8.3	295	12
10	0	0	35	10.5	370	23
10	0	0	45	12.2	430	31
10	1.5	4920	35	12.6	445	28
10	3.0	9840	25	13.2	465	27
15	0	0	35	18.1	640	60
15	0	0	45	21.2	750	79
15	1.5	4920	35	21.7	765	73
15	3.0	9840	25	22.3	790	70

CLASS 'C' TELEGRAPHY

Absolute maximum ratings

f max.	30	Mc/s
V_a max.	13	kV
I_k max.	5.8	A
$i_{k(pk)}$ max.	28	A
V_g max.	−1.5	kV
I_g max.	1.0	A
p_a max.	15	kW
p_g max.	750	W
R_{g-f} max.	10	kΩ

Operating conditions

f	30	Mc/s
V_a	12	kV
I_a	4.5	A
V_g	−1.0	kV
I_g	800	mA
$v_{in(pk)}$	1.6	kV
$P_{load\ (driver)}$	1.25	kW
p_a	13	kW
η_a	76	%
P_{out}	41	kW
P_{load}	34.8	kW

TY12-15A

CLASS 'C' ANODE MODULATION

Absolute maximum ratings (carrier condition for a modulation factor of 1)

f max.	30	Mc/s
V_a max.	10	kV
I_k max.	4.8	A
$i_{k(pk)}$ max.	42	A
V_g max.	−1.5	kV
I_g max.	1.0	A
p_a max.	10	kW
p_g max.	750	W
R_{g-f} max.	10	kΩ

Operating conditions

f	30	Mc/s
V_a	10	kV
I_a	3.5	A
V_g	−1.0	kV
I_g	800	mA
$V_{in(pk)}$	1.5	kV
$P_{load\ driver}$	1.2	kW
p_a	7.5	kW
η_a	78.5	%
P_{out}	27.5	kW
P_{load}	23.5	kW
For 100% modulation		
P_{mod}	17.5	kW

CLASS 'B' A.F.

Absolute maximum ratings

V_a max.	13	kV
I_k max.	4.5	A
$i_{k(pk)}$ max.	14	A
p_a max.	15	kW
R_{g-f} max.	10	kΩ

Operating conditions (two valves) ←

V_a	10	10	8.0	kV
$I_{a(o)}$	2×100	2×500	2×500	mA
I_a (max. sig.)	2×2.0	2×3.3	2×4.2	A
V_g	−290	−270	−220	V
$V_{in(g-g)r.m.s.}$	325	440	430	V
I_g	2×143	2×875	2×800	mA
$P_{load\ driver}$	2×55	2×360	2×300	W
p_a	2×8.0	2×12.8	2×13.6	kW
η_a	60	61	59.5	%
R_{a-a}	5.5	4.4	2.3	kΩ
P_{out}	24	40	40	kW
P_{load}	22	36	36	kW

TY12-15A

TRIODE

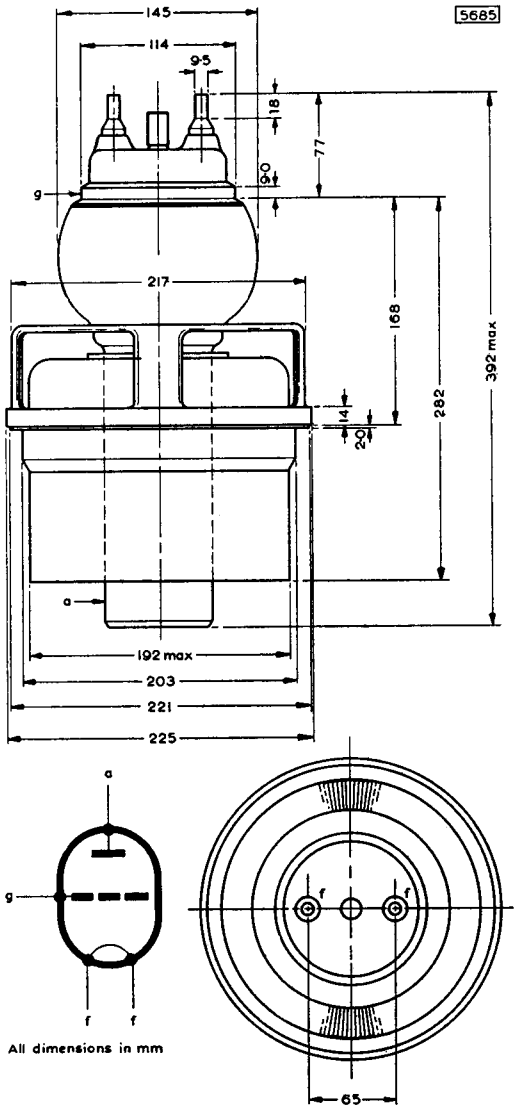
WEIGHT

Valve only	42	lb
	19	kg
Shipping weight	186	lb
	84.5	kg

ACCESSORIES

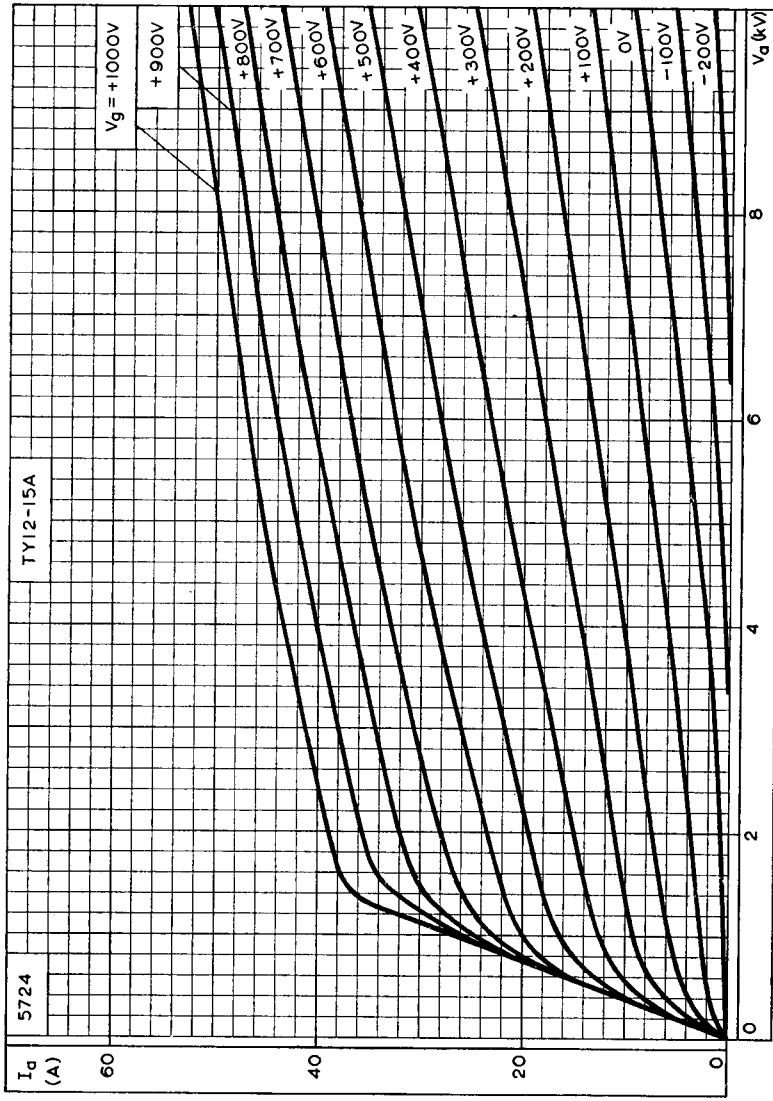
Insulating pedestal	40648
Grid connector	40663
Filament clips with lead	40662

TY12-15A

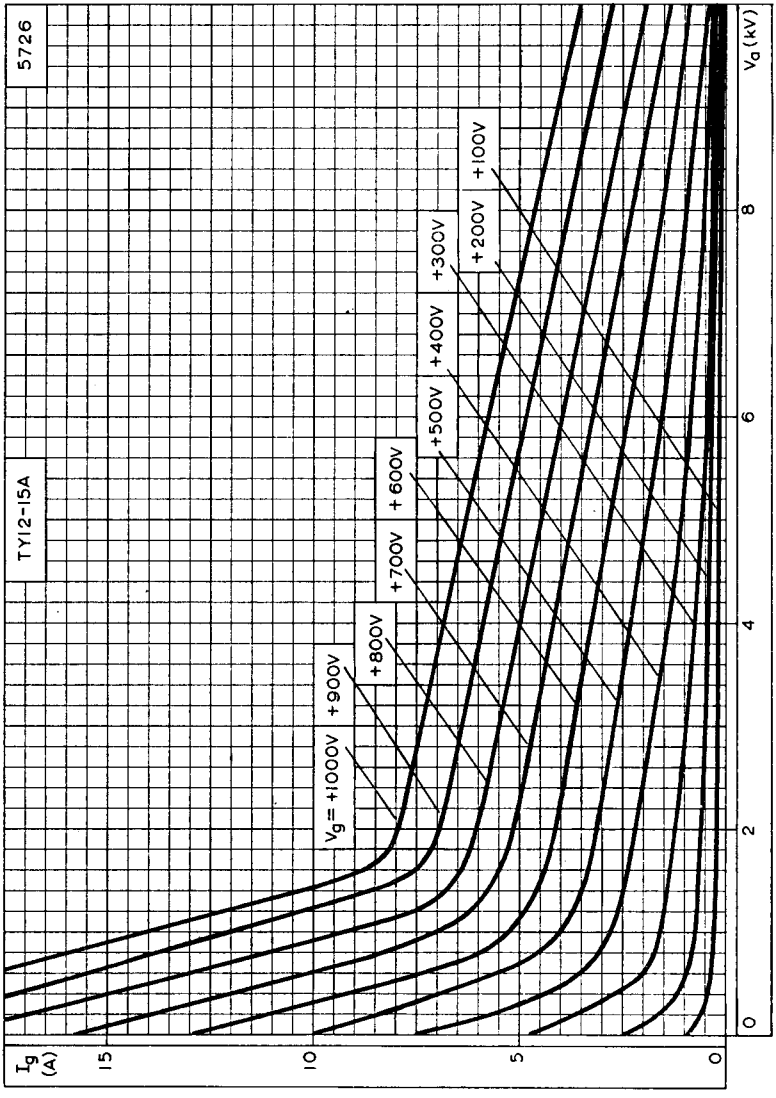


All dimensions in mm

TY12-15A

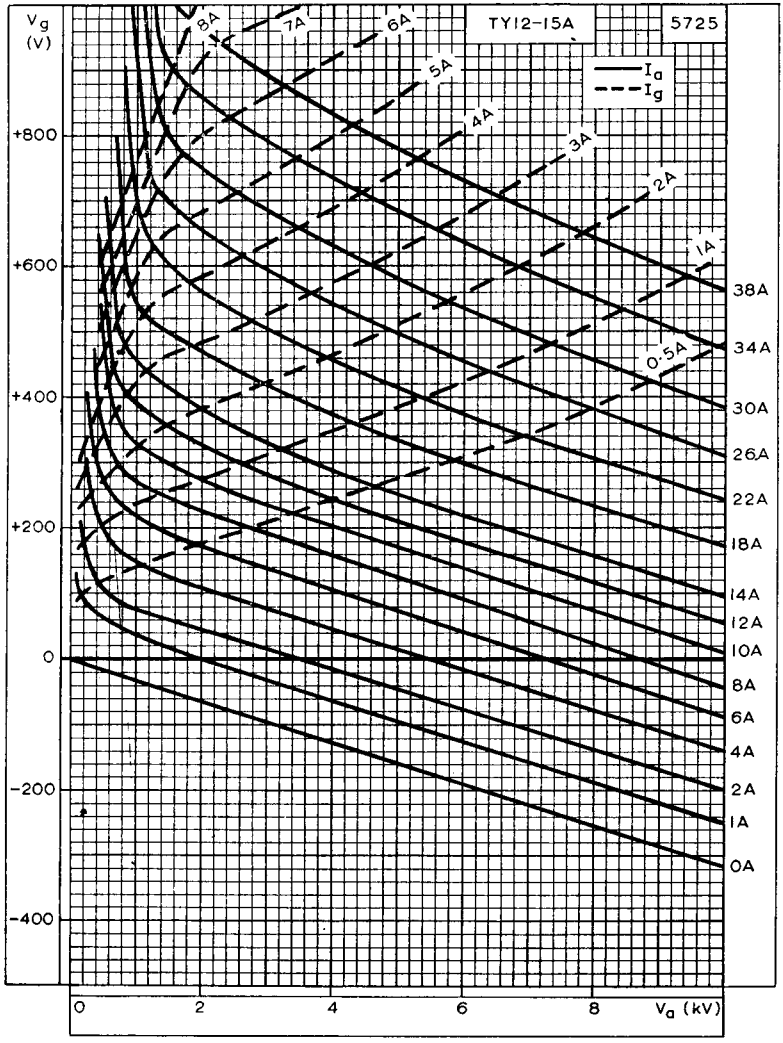


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

TY12-15A



CONSTANT CURRENT CURVES

TRIODE

TY12-20A

Application: *R.F. industrial heating.*
Power output: *39kW continuous rating.*
Frequency: *30Mc/s at full rating.*
Construction: *External anode, forced air-cooled.*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT Thoriated tungsten

V_f	8.0	V
I_f	130	A

The filament current must never exceed a surge value of 280A at any time during the warming up period. The filament has been designed to accept temporary voltage fluctuations of $^{+5}_{-10}$%

MOUNTING POSITION

Vertical, anode down

CAPACITANCES

C_{a-g}	23.5	pF
C_{g-f}	42.5	pF
C_{a-f}	0.9	pF

CHARACTERISTICS (measured at V_a = 12kV, I_a = 2A)

g_m	25	mA/V
g_m (at V_a = 1kV, I_a = 20A)	30	mA/V
μ	21	

COOLING

Forced air-cooling

Max. temperature of seals	220	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals. The amount of forced air-cooling required for this valve depends upon the anode dissipation and the height above sea-level. Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet housing are given overleaf.

Anode dissipation P_a	Height above sea-level h		Inlet temperature T_{in}	Min. rate of flow of air per minute		Pressure difference between inlet and outlet
(kW)	(km)	(ft)	(°C)	(m^3)	(ft^3)	(mm of H_2O)
7.0	0	0	35	6.6	235	10
7.0	0	0	45	7.7	270	13
7.0	1.5	4920	35	7.9	280	12
7.0	3.0	9840	25	8.3	295	12
10	0	0	35	10.5	370	23
10	0	0	45	12.3	435	31
10	1.5	4920	35	12.6	445	28
10	3.0	9840	25	13.2	465	27
15	0	0	35	18.1	640	60
15	0	0	45	21.2	750	79
15	1.5	4920	35	21.7	765	73
15	3.0	9840	25	22.8	805	70

CLASS 'C' OSCILLATOR

Anode supply from three-phase full-wave rectifier without smoothing filter

Limiting values (absolute ratings)

f max.	30	Mc/s
V_a max.	13	kV
I_a max.	4.8	A
V_g max.	−2.0	kV
I_g max.	1.5	A
p_a max.	15	kW
R_{g-f} max.	10	kΩ
p_g max.	1.1	kW

Operating conditions

f	30	30	30	Mc/s
$V_{tr(r.m.s.)}$	8.9	7.4	6.0	kV
V_a	12	10	8.0	kV
I_a	4.5	4.5	4.5	A
I_g	0.9	0.9	0.9	A
p_a	15	13.7	12.8	kW
η_a	72.5	70	64.5	%
R_{g-f}	1.1	1.0	0.9	kΩ
R_a	1500	1200	700	Ω
Feedback ratio	0.16	0.18	0.22	
P_{out}	39	31.3	23.2	kW
*P_{load}	33	26.6	19.7	kW

*0.85 (P_{out}–P_{drive})

TY12-20A

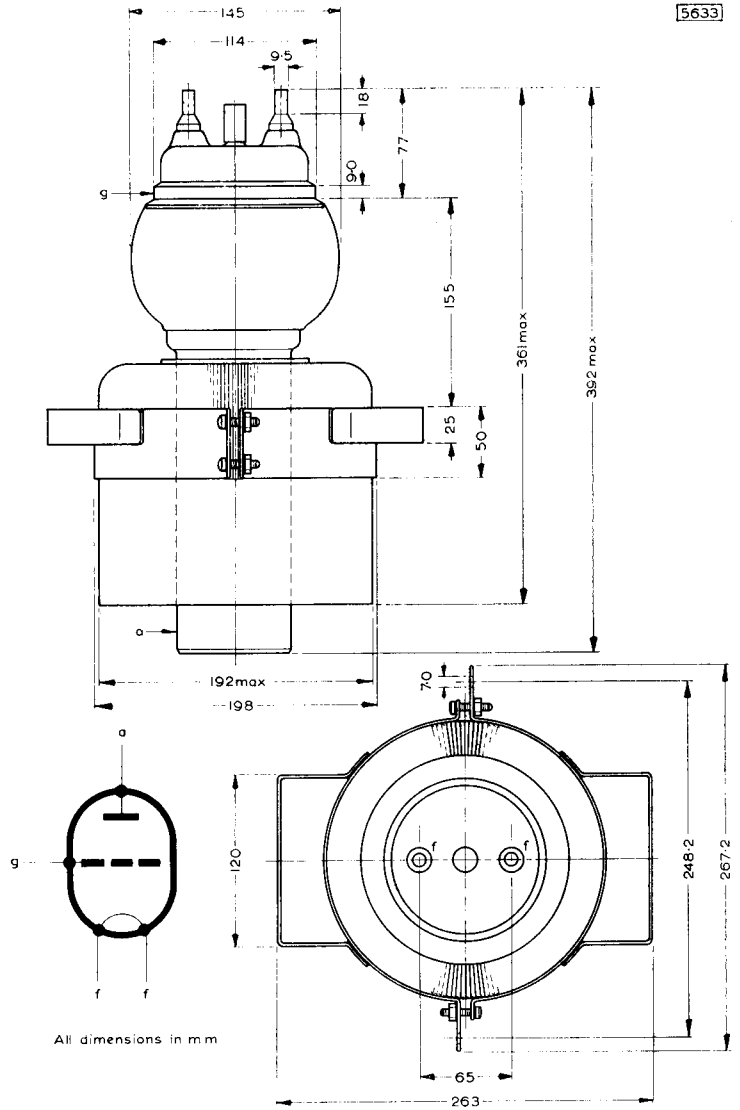
WEIGHT

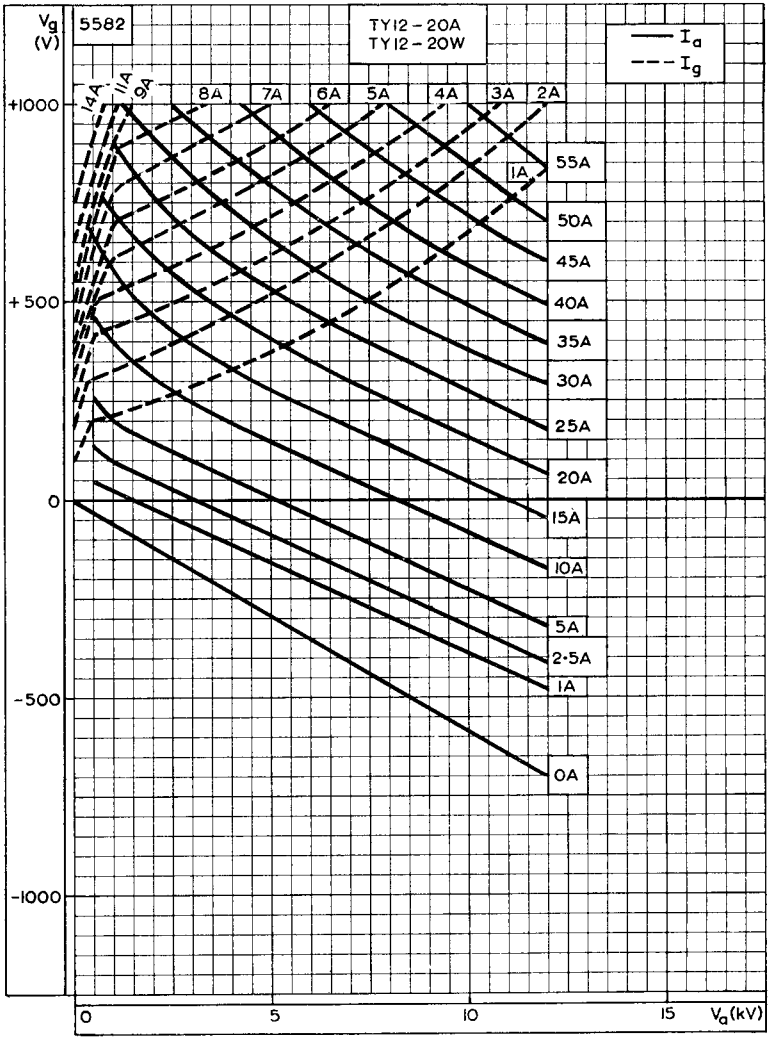
Valve only	36	lbs
	16.5	kg
Insulating pedestal	20	lbs
	9.0	kg
Shipping weight	186	lbs
	84.5	kg

ACCESSORIES

Insulating pedestal	40648
Grid connector	40663
Filament clips with lead	40662

TY12-20A


5633
145
114
9·5
18
77
9·0
g
155
361 max
392 max
25
50
a
192 max
198
7·0
248·2
267·2
120
f
f
65
263
a
g
f
f
All dimensions in mm



CONSTANT CURRENT CURVES

TRIODE

TY12-20A

Application: *R.F. industrial heating.*
Power output: *39kW continuous rating.*
Frequency: *30Mc/s at full rating.*
Construction: *External anode, forced-air cooled.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT Thoriated tungsten

V_f	8.0	V
I_f	130	A

The filament current must never exceed a surge value of 280A at any time during the warming up period. The filament has been designed to accept temporary voltage fluctuations of $^{+5\%}_{-10}$

MOUNTING POSITION

Vertical, anode down

CAPACITANCES

c_{a-g}	23.5	pF
c_{g-f}	45	pF
c_{a-f}	900	mpF

CHARACTERISTICS (measured at $V_a = 12kV$, $I_a = 2A$)

g_m	25	mA/V
g_m (at $V_a = 1kV$, $I_a = 20A$)	30	mA/V
μ	21	

COOLING

Forced-air cooling

Max. temperature of seals	220	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals. The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea-level. Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet housing are given overleaf.

TY12-20A

TRIODE

Anode dissipation p_a	Height above sea-level h		Inlet temperature T_{in}	Min. rate of flow of air per minute		Pressure difference between inlet and outlet
(kW)	(km)	(ft)	(°C)	(m^3)	(ft^3)	(mm of H_2O)
7.0	0	0	35	6.6	235	10
7.0	0	0	45	7.7	270	13
7.0	1.5	4920	35	7.9	280	12
7.0	3.0	9840	25	8.3	295	12
10	0	0	35	10.5	370	23
10	0	0	45	12.3	435	31
10	1.5	4920	35	12.6	445	28
10	3.0	9840	25	13.2	465	27
15	0	0	35	18.1	640	60
15	0	0	45	21.2	750	79
15	1.5	4920	35	21.7	765	73
15	3.0	9840	25	22.8	805	70

CLASS 'C' OSCILLATOR

Anode supply from three-phase full-wave rectifier without smoothing filter

Absolute maximum ratings

f max.	30	Mc/s
V_a max.	13	kV
I_a max.	5.0	A
V_g max.	−2.0	kV
I_g max.	1.5	A
p_a max.	20	kW
R_{g-f} max.	10	kΩ
p_g max.	1.1	kW

Operating conditions

f	30	30	30	Mc/s
$V_{tr(r.m.s.)}$	8.9	7.4	6.0	kV
V_a	12	10	8.0	kV
I_a	4.5	4.5	4.5	A
I_g	0.9	0.9	0.9	A
p_a	15	13.7	12.8	kW
η_a	72.5	70	64.5	%
R_{g-f}	1.1	1.0	0.9	kΩ
R_a	1450	1100	800	Ω
Feedback ratio	0.16	0.19	0.24	
P_{out}	39	31.2	23.2	kW
P_{load}	33	26.6	19.7	kW

TY12-20A

CLASS 'B' A.F.

Absolute maximum ratings

V_a max.	13	kV
I_a max.	4.8	A
p_a max.	20	kW
R_{g-f} max.	10	kΩ

Operating conditions

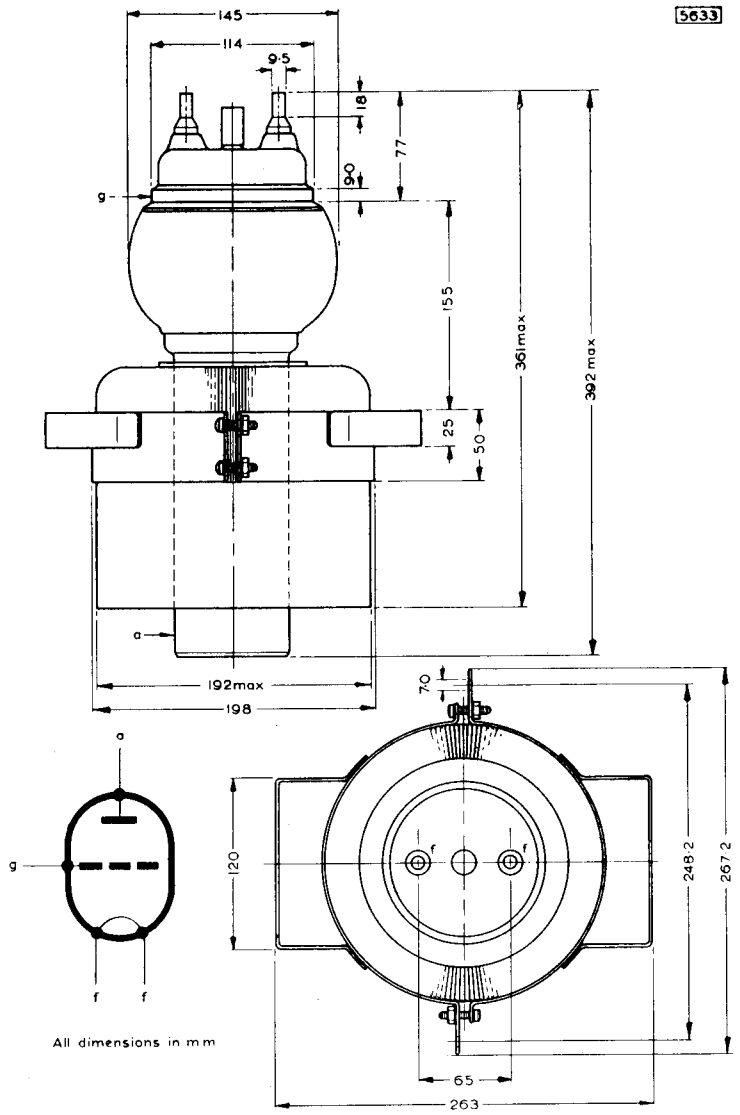
V_a	8.0	10	12	kV
$I_{a(o)}$	2 × 350	2 × 400	2 × 450	mA
I_a (max. sig.)	2 × 4.2	2 × 4.2	2 × 3.8	A
V_g	−420	−500	−550	V
$V_{in(g-g)}$ (r.m.s.)	1.24	1.32	1.35	kV
I_g	2 × 825	2 × 700	2 × 630	mA
$P_{load\ (driver)}$	2 × 680	2 × 640	2 × 610	W
p_a	12.6	14.8	14.9	kW
η_a	62	65	67	%
R_{a-a}	2.07	2.6	3.73	kΩ
P_{out}	42	54.5	61.5	kW

WEIGHT

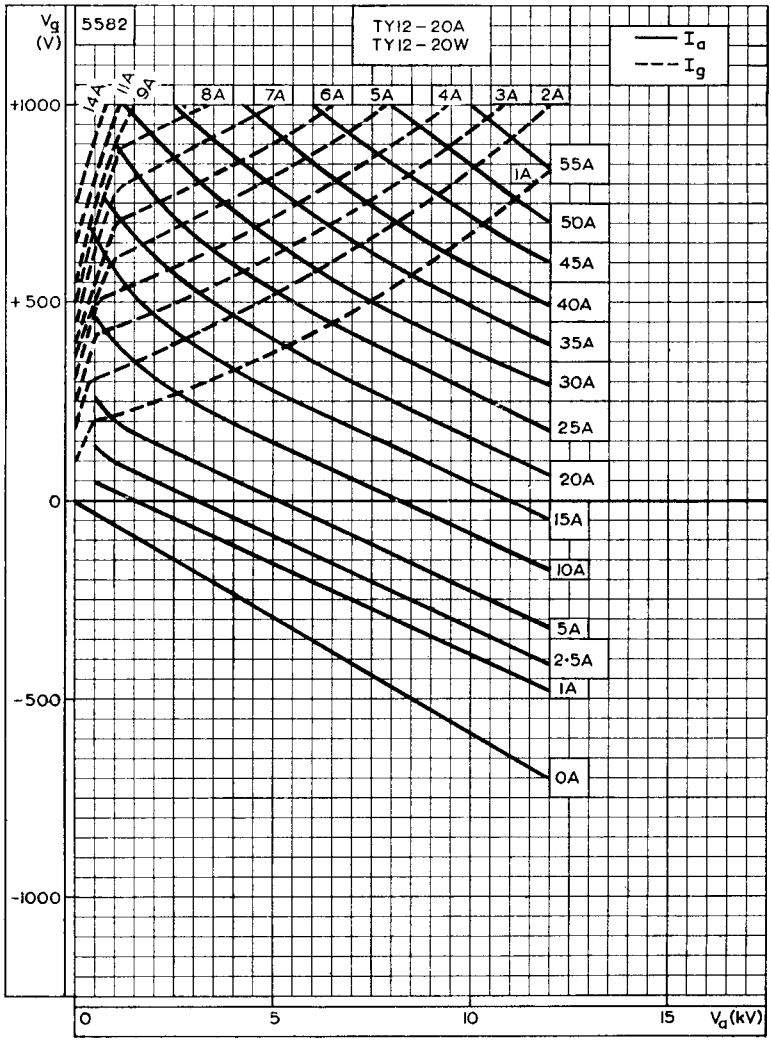
Weight of valve	35.5	lb
	16.1	kg
Weight of valve plus carton	121.5	lb
	55.1	kg
Weight of insulating pedestal	15.8	lb
	7.15	kg
Weight of insulating pedestal plus carton	21.2	lb
	9.6	kg

ACCESSORIES

Insulating pedestal	40648
Grid connector	40663
Filament clips with lead	40662


5633
145
114
9·5
18
77
90
g
155
361max
392 max
25
50
a
192max
198
7·0
a
g
f
f
120
248·2
267·2
65
263
All dimensions in mm

TY12-20A



CONSTANT CURRENT CURVES

TRIODE

TYI2-20W

Application: *R.F. industrial heating.*
Power Output: *39kW continuous rating.*
Frequency: *30Mc/s at full rating.*
Construction: *External anode, water-cooled.*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT Thoriated tungsten

V_f	8.0	V
I_f	130	A

The filament current must never exceed a surge value of 280A at any time during the warming up period. The filament has been designed to accept temporary voltage fluctuations of $^{+5}_{-10}\%$

MOUNTING POSITION

Vertical, anode down

CAPACITANCES

C_{a-g}	23.5	pF
C_{g-f}	42.5	pF
C_{a-f}	0.9	pF

CHARACTERISTICS (measured at $V_a = 12kV$, $I_a = 2A$)

g_m	25	mA/V
g_m (at $V_a = 1.0kV$, $I_a = 20A$)	30	mA/V
μ	21	

COOLING

Water cooling

Max. temperature of seals	220	°C
Max. inlet temperature of water	50	°C

Typical values of inlet temperature, rate of flow of water, and pressure difference between the inlet and outlet housing at various anode dissipations are given overleaf.

Anode dissipation p_a	Inlet temperature T_{in}	Rate of flow of water per minute		Pressure difference between inlet and outlet
(kW)	(°C)	(litres)	(gal)	(atm)
5.0	20	6.0	1.5	0.02
5.0	50	15	3.5	0.22
10	20	11	2.5	0.1
10	50	25	5.5	0.7
15	20	16	3.5	0.25
15	50	37	8.0	1.3
20	20	22	5.0	0.5
20	50	49	10.5	2.3

At inlet temperatures between 20 and 50°C the required quantity of water can be found by linear interpolation. In order to keep within the temperature limits it is necessary to direct a flow of air on to the seals. The air flow should be started at the application of filament voltage.

WEIGHT

Valve only	7.0	lbs
	3.0	kg
Shipping weight	83	lbs
	37.7	kg
Water jacket	4.5	lbs
	2.1	kg

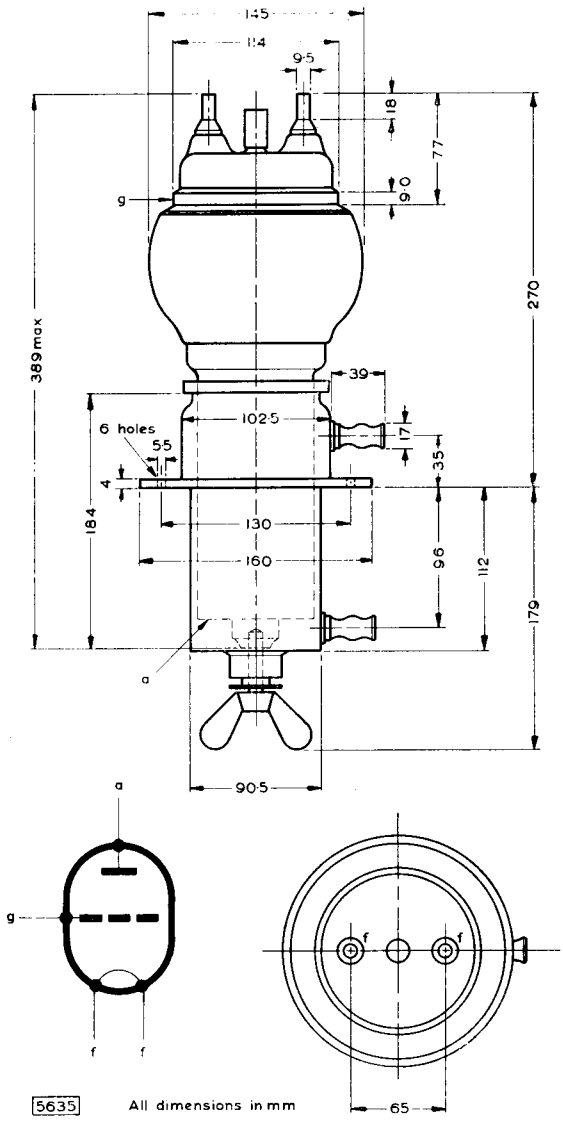
ACCESSORIES

Water jacket	K717
Grid connector	40663
Filament clips with lead	40662

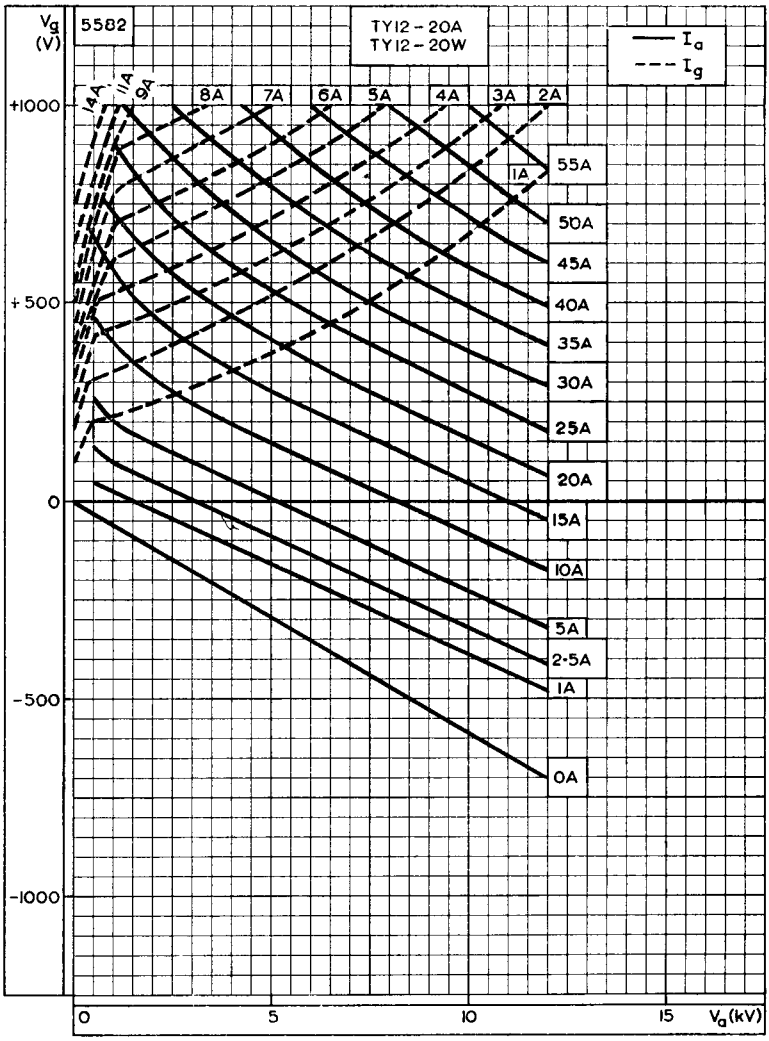
The characteristics, operating conditions, limiting values and curves are identical with those given for the TY12-20A but for the following difference:

p_a max.	***20***	***kW***

TYI2-20W



5635 All dimensions in mm



CONSTANT CURRENT CURVES

R.F. POWER TRIODE

TY12-20A
TY12-20W

QUICK REFERENCE DATA

External anode triodes intended for use as r.f. oscillators or a.f. power amplifiers.

The TY12-20A is forced-air cooled, and the TY12-20W is water cooled.

	Class 'C' industrial oscillator	Class 'B' A.F.	
f max.	30	—	Mc/s
V_a max.	13	13	kV
p_a max.	20	20	kW
Performance			
f	30	—	Mc/s
P_{out}	39	61.5	kW

Unless otherwise shown, data is applicable to both types

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

INDUSTRIAL OPERATION AS CLASS 'C' OSCILLATOR

Absolute maximum ratings

f max.	30	Mc/s
V_a max.	13	kV
I_a max.	5.0	A
$-V_g$ max.	2.0	kV
I_g max.	1.5	A
p_a max.	20	kW
$R_{g\ f}$ max.	10	kΩ
p_g max.	1.1	kW

Typical operating conditions

f	30	30	30	Mc/s
V_a	12	10	8.0	kV
$V_{tr(r.m.s.)}$	8.9	7.4	6.0	kV
I_a	4.5	4.5	4.5	A
I_g	0.9	0.9	0.9	A
p_a	15	13.7	12.8	kW
η_a	72.5	70	64.5	%
R_{g-f}	1.1	1.0	0.9	kΩ
R_a	1450	1100	800	Ω
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.16	0.19	0.24	
P_{out}	39	31.3	23.2	kW
P_{load}	33	26.6	19.7	kW

TY12-20A
TY12-20W

R.F. POWER TRIODE

CLASS 'B' A.F.

Absolute maximum ratings

V_a max.	13	kV
I_a max.	4.8	A
p_a max.	20	kW
R_{g-f} max.	10	kΩ

Typical operating conditions

V_a	8.0	10	12	kV
$I_{a(o)}$	2×350	2×400	2×450	mA
I_a (max. signal)	2×4.2	2×4.2	2×3.8	A
$-V_g$	420	500	550	V
$V_{in(g-g)r.m.s.}$	1.24	1.32	1.35	kV
I_g	2×825	2×700	2×630	mA
$P_{load(driver)}$	2×680	2×640	2×610	W
p_a	12.6	14.8	14.9	kW
η_a	62	65	67	%
R_{a-a}	2.07	2.6	3.73	kΩ
P_{out}	42	54.5	61.5	kW

CATHODE

Thoriated tungsten

**V_f	8.0	V
*I_f	130	A

*The filament current must never exceed a surge value of 280A at any time during the warming-up period.

**The filament has been designed to accept temporary variations in supply voltage of +5% and −10%.

MOUNTING POSITION

Vertical, anode down

CAPACITANCES

c_{a-g}	23.5	pF
c_{g-f}	42.5	pF
c_{a-f}	0.9	pF

CHARACTERISTICS (Measured at V_a = 12kV, I_a = 2A)

g_m	25	mA/V
μ	21	
g_m (Measured at V_a = 1kV, I_a = 20A)	30	mA/V

COOLING

TY12-20A

Forced-air cooling

T_{seals} max. 220 °C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals. The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea-level. Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet housing are given below.

Anode dissipation P_a	Height above sea-level h		Inlet temperature T_{in}	Min. rate of flow of air per minute		Pressure difference between inlet and outlet
(kW)	(km)	(ft)	(°C)	(m^3)	(ft^3)	(mm of H_2O)
7.0	0	0	35	6.6	235	10
7.0	0	0	45	7.7	270	13
7.0	1.5	4920	35	7.9	280	12
7.0	3.0	9840	25	8.3	295	12
10	0	0	35	10.5	370	23
10	0	0	45	12.3	435	31
10	1.5	4920	35	12.6	445	28
10	3.0	9840	25	13.2	465	27
15	0	0	35	18.1	640	60
15	0	0	45	21.2	750	79
15	1.5	4920	35	21.7	765	73
15	3.0	9840	25	22.8	805	70

TY12-20W

Water cooling

T_{seals} max.	220	°C
T_{inlet} max.	50	°C

Typical values of inlet temperature, rate of flow of water, and pressure difference between the inlet and outlet housing at various anode dissipations are given below.

Anode dissipation P_a	Inlet temperature T_{in}	Rate of flow of water per minute		Pressure difference between inlet and outlet
(kW)	(°C)	(litres)	(gal)	(atm)
5.0	20	6.0	1.5	0.02
5.0	50	15	3.5	0.22
10	20	11	2.5	0.1
10	50	25	5.5	0.7
15	20	16	3.5	0.25
15	50	37	8.0	1.3
20	20	22	5.0	0.5
20	50	49	10.5	2.3

At inlet temperatures between 20 and 50°C the required quantity of water can be found by linear interpolation. In order to keep within the temperature limits it is necessary to direct a flow of air on to the seals. The air flow should be started at the application of filament voltage.

PHYSICAL DATA

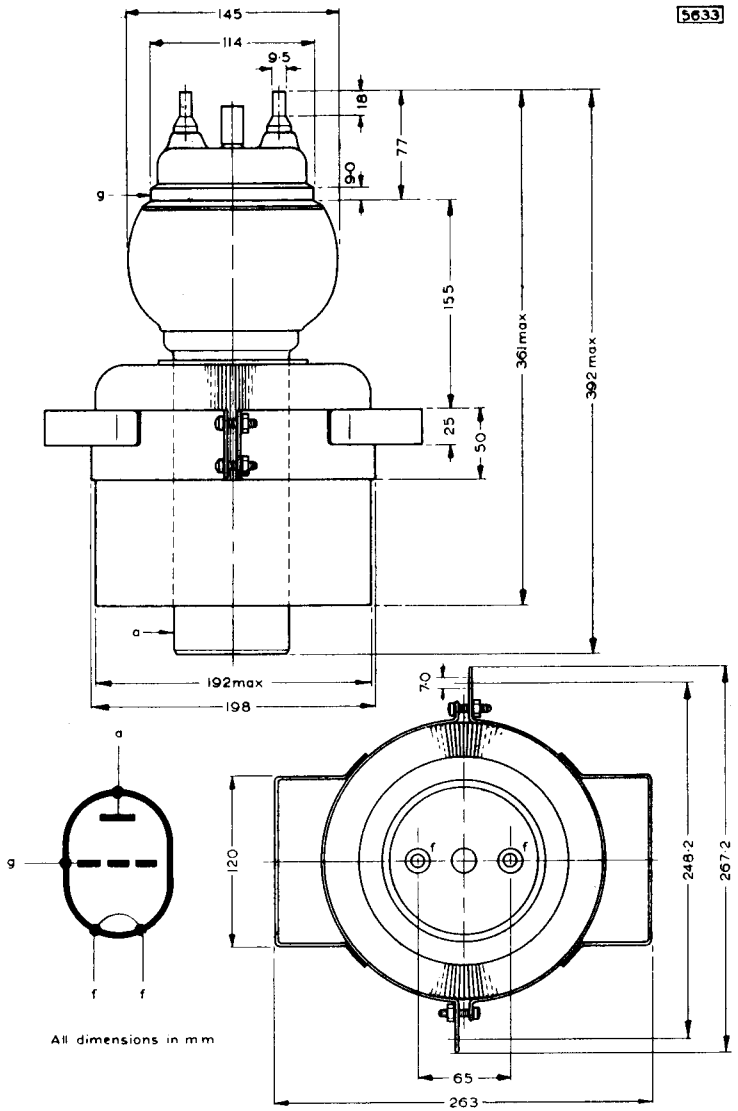
	TY12-20A	TY12-20W	
Weight of valve	35.5	7.0	lb
	16.1	3.0	kg
Weight of valve plus carton	121.5	83	lb
	55.1	37.7	kg
Weight of insulating pedestal (TY12-20A)		15.8	lb
		7.15	kg
Weight of water jacket (TY12-20W)		4.5	lb
		2.1	kg

ACCESSORIES

Insulating pedestal (TY12-20A)	40648
Water jacket (TY12-20W)	K722
Grid connector	40663
Filament clips with lead	40662
Rubber gasket	89 039 48

TY12-20A
TY12-20W

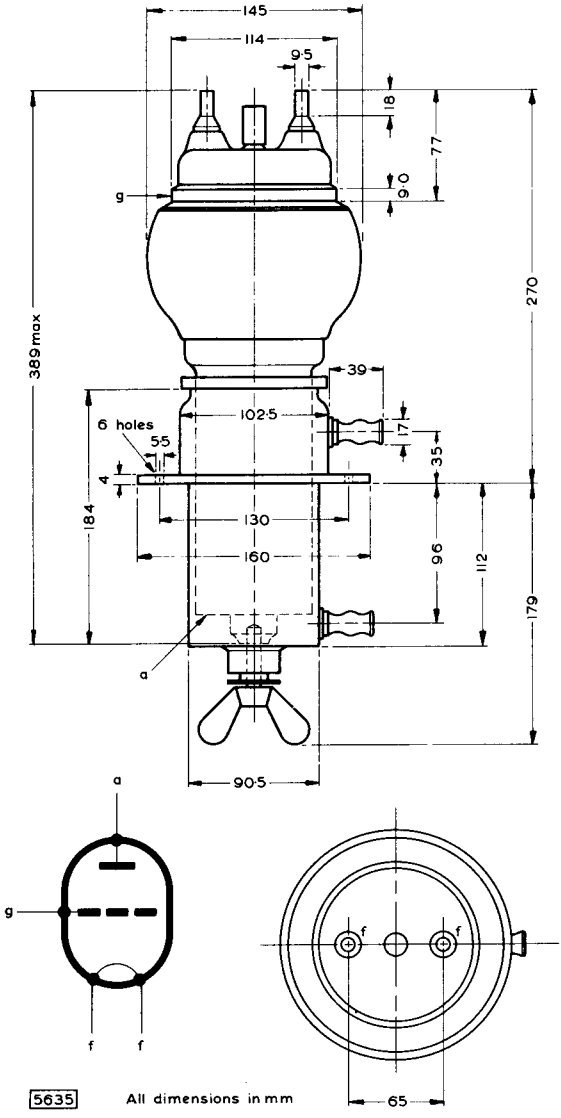
TY12-20A



TY12-20A
TY12-20W

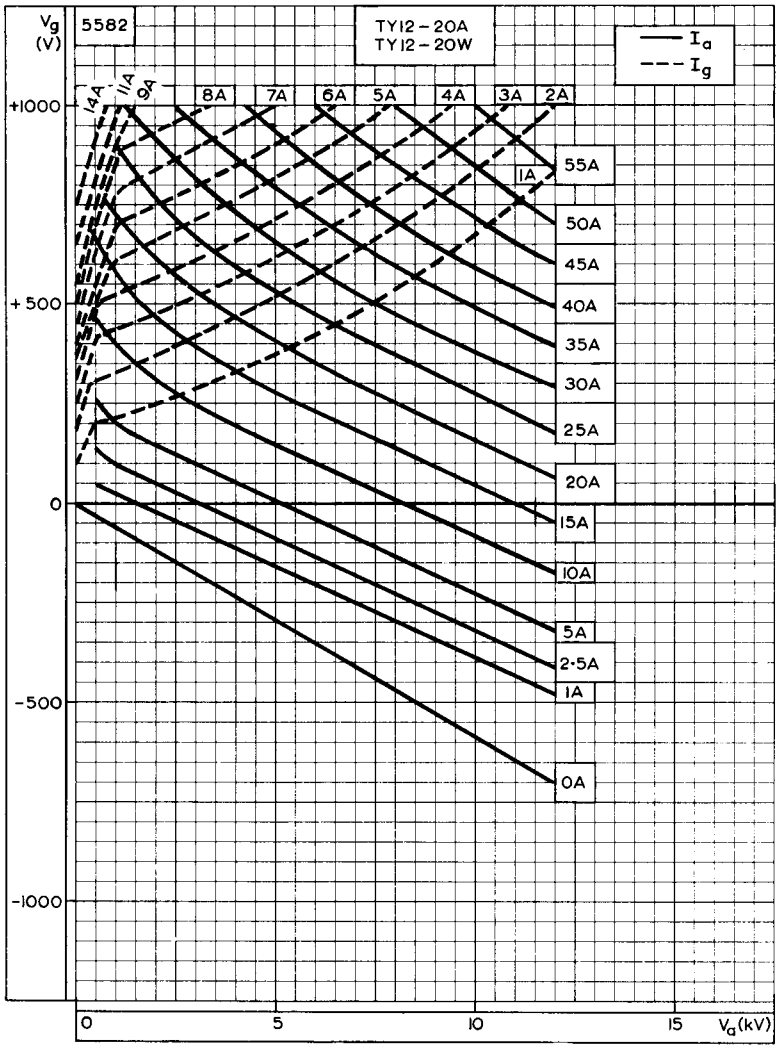
R.F. POWER TRIODE

TY12-20W



5635 All dimensions in mm

TY12-20A
TY12-20W



CONSTANT CURRENT CURVES

TRIODE

TY12-25A

Application: *R.F. Industrial heating.*
Power Output: *37.5kW continuous rating.*
Frequency: *30Mc/s max. at full rating*
Construction: *External anode, forced-air cooled.*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT Thoriated tungsten

V_f	8.0	V
*I_f	98	A

*The filament current must never exceed a surge value of 210A at any time during the warming-up period.

MOUNTING POSITION Vertical, with anode down.

CAPACITANCES

C_{a-g}	28	pF
C_{a-f}	0.3	pF
C_{g-f}	33	pF

CHARACTERISTICS

g_m (measured at V_a=2kV, I_a=13A)	30	mA/V
g_m (measured at V_a=12kV, I_a=2A)	20	mA/V
μ (measured at I_a=4A)	34	

COOLING

Forced-air

Max. temperature of seals 180 °C

The amount of forced-air cooling required for this valve depends on the height above sea level and the anode dissipation.
Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table:-

Anode dissipation	Height above sea level	Max. inlet temperature	Min. rate of flow of air	Pressure difference between inlet and outlet
P_a (kW)	h (m)	T_{in} (°C)	(m^3/min)	(mm of H_2O)
7.0	0	35	6.6	10
7.0	0	45	7.7	13
7.0	1500	35	7.9	12
7.0	3000	25	8.3	12
10	0	35	10.5	23
10	0	45	12.3	31
10	1500	35	12.6	28
10	3000	25	13.2	27
15	0	35	18.1	60
15	0	45	21.2	79
15	1500	35	21.7	73
15	3000	25	22.8	70

TY12-25A

TRIODE

OPERATION AS SINGLE VALVE R.F. OSCILLATOR (CLASS 'C')

Limiting values (absolute ratings)

f max.	30	Mc/s
V_a max.	13	kV
I_a max.	4.8	A
$-V_g$ max.	1.5	kV
I_g max.	800	mA
p_a max.	15	kW
R_{g-f} max.	10	kΩ

Maximum operating conditions

f	30	30	30	Mc/s
$V_{transformer\ (r.m.s.)}$	6.0*	7.4*	8.9*	kV
V_a	8.0	10	12	kV
I_a	4.5	4.5	4.5	A
I_g	800	800	800	mA
R_{g-f}	0.75	1.0	1.25	kΩ
P_{in}	36	45	54	kW
p_a	13	13.9	15	kW
P_{out}	22	30	37.5	kW
η	61.2	66.7	69.5	%
**P_{load}	18.7	25.5	32	kW

Typical operating conditions

f	30	30	30	30	Mc/s
$V_{transformer\ (r.m.s.)}$	5.1†	6.0*	7.4*	8.9*	kV
V_a	6.0	8.0	10	12	kV
I_a	3.0	3.2	3.2	3.2	A
I_g	600	550	500	500	mA
R_{g-f}	0.67	1.1	1.6	2.0	kΩ
P_{in}	18	25.6	32	38.4	kW
p_a	6.0	7.7	8.7	9.4	kW
P_{out}	11.3	17.1	22.4	28	kW
η	63	67	70	73	%
**P_{load}	9.6	14.5	19	24	kW

*Anode voltage obtained from a 3 phase full-wave rectifier without filter.

†Anode voltage obtained from a 3 phase half-wave rectifier without filter.

**At 85% transfer efficiency.

TY12-25A

OPERATING NOTE

To ensure a uniform r.f. current distribution in the grid seal, especially at higher frequencies, the grid lead should be connected to the middle wing nut of the grid bracket.

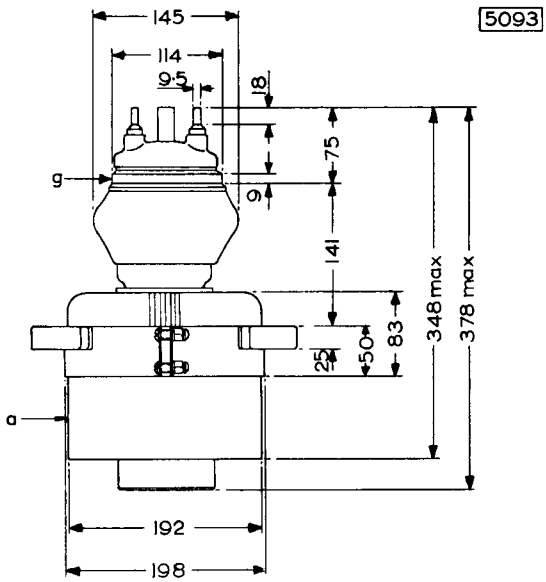
ACCESSORIES

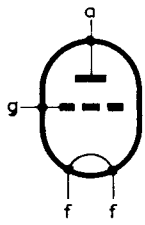
Information on these items can be obtained from the Government and Industrial Valve Division, Mullard Limited.

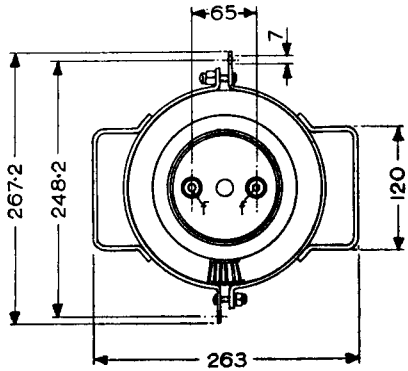
WEIGHT

Valve only	17.5 38.5	kg lb
Shipping weight	85.5 188	kg lb

TY12-25A



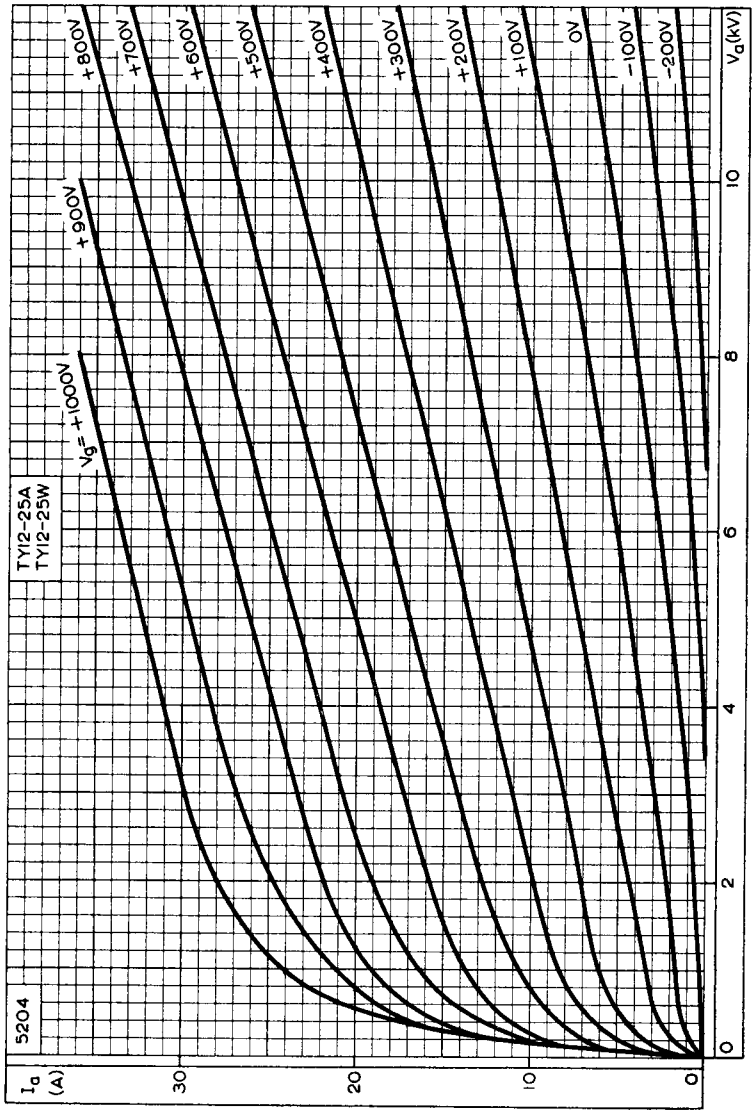




All dimensions in mm

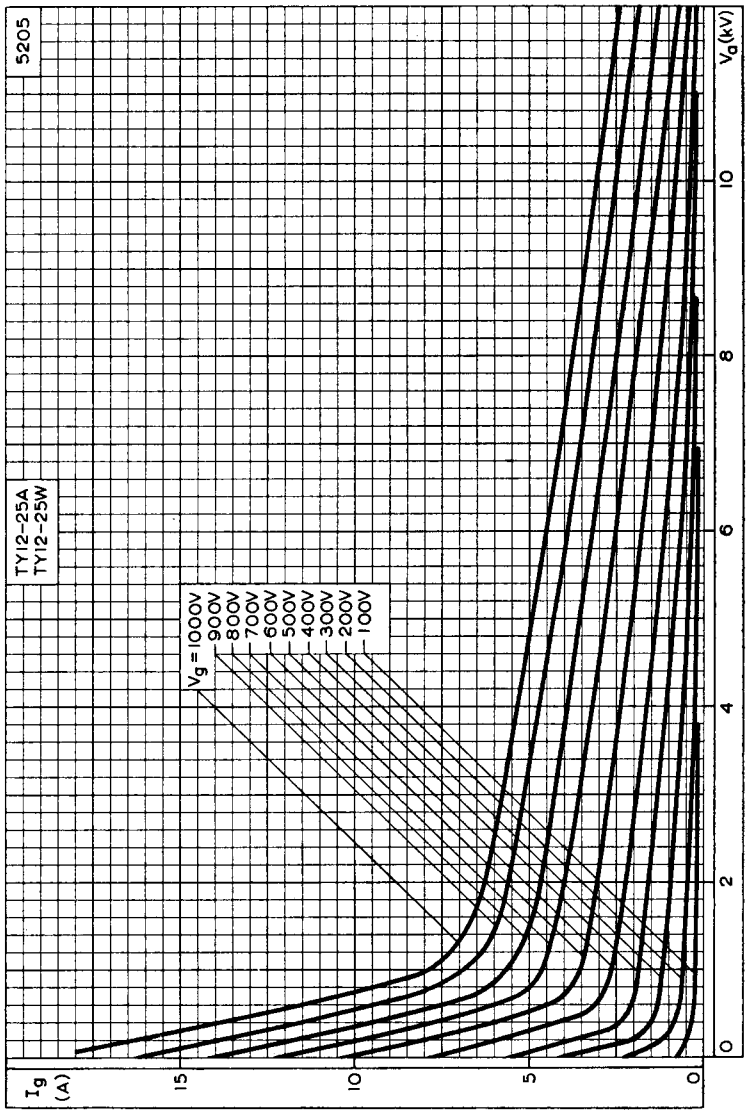
TY12-25A

TRIODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

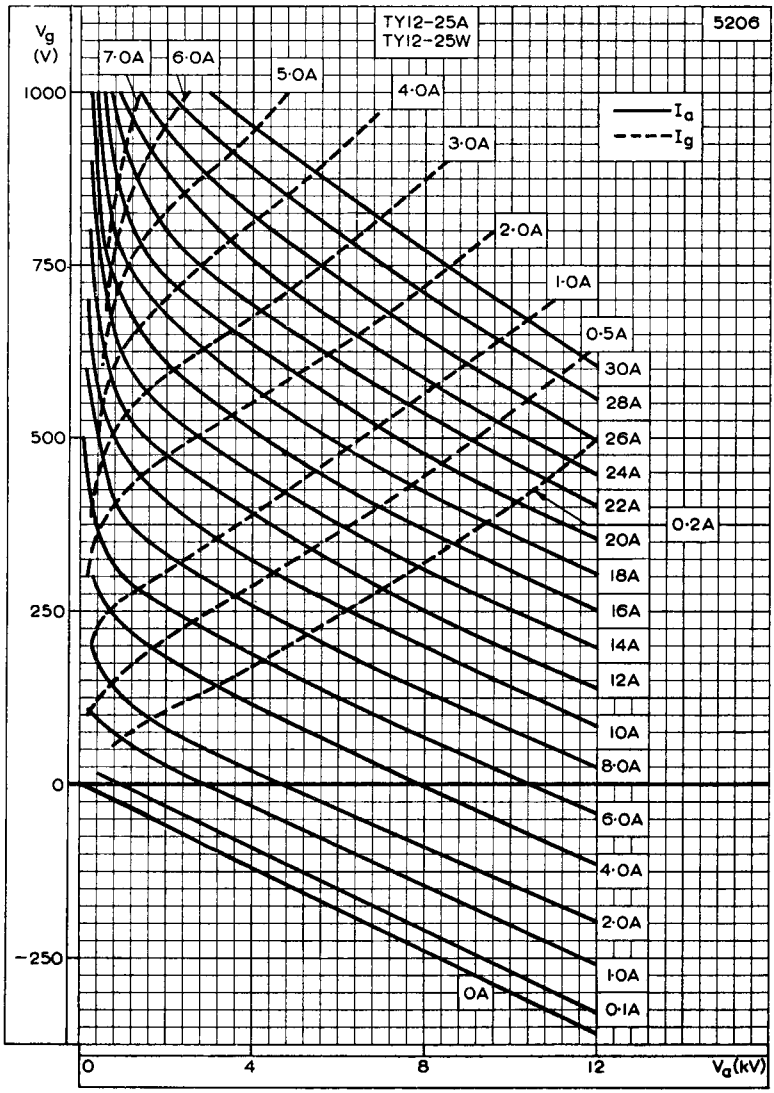
TY12-25A



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

TY12-25A

TRIODE



CONSTANT CURRENT CURVES

TRIODE

TY12-25W

Application: *R.F. Industrial heating.*
Power Output: *37.5kW continuous rating.*
Frequency: *30Mc/s at full rating.*
Construction: *External anode, water-cooled.*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT Thoriated tungsten

V_f	8.0	V
*I_f	98	A

*The filament current must never exceed a surge value of 210A at any time during the warming-up period.

MOUNTING POSITION

Vertical, with anode down.

CAPACITANCES

C_{a-g}	28	pF
C_{a-f}	0.3	pF
C_{g-f}	33	pF

CHARACTERISTICS

g_m (measured at V_a=2kV, I_a=13A)	30	mA/V
g_m (measured at V_a=12kV, I_a=2A)	20	mA/V
μ (measured at I_a=4A)	34	

COOLING

Water-cooled

Max. temperature of seals	180	°C
Max. water inlet temperature	50	°C

It is necessary to direct a flow of air on the seals.

Typical values of inlet temperature, rate of flow of water and pressure difference between inlet and outlet housing at various values of anode dissipation are given in the following table:-

Anode dissipation	Inlet temperature	Rate of flow of water	Difference in pressure between inlet and outlet
P_a (kW)	T_{in} (°C)	(Litres/min.)	(atm)
5.0	20	6.0	0.02
5.0	50	15	0.22
10	20	11	0.1
10	50	25	0.7
15	20	16	0.25
15	50	37	1.3
20	20	22	0.5
20	50	49	2.3

At temperatures between 20°C and 50°C the required water flow may be found by interpolation.

TY12-25W

TRIODE

The characteristics, curves, operating conditions and limiting values are identical with those of the TY12-25A with the following exception :-

OPERATION AS SINGLE VALVE R.F. OSCILLATOR (CLASS 'C')

Limiting value (absolute rating)

p_a max.	20	kW

OPERATING NOTE

To ensure a uniform r.f. current distribution in the grid seal, especially at higher frequencies, the grid lead should be connected to the middle wing nut of the grid bracket.

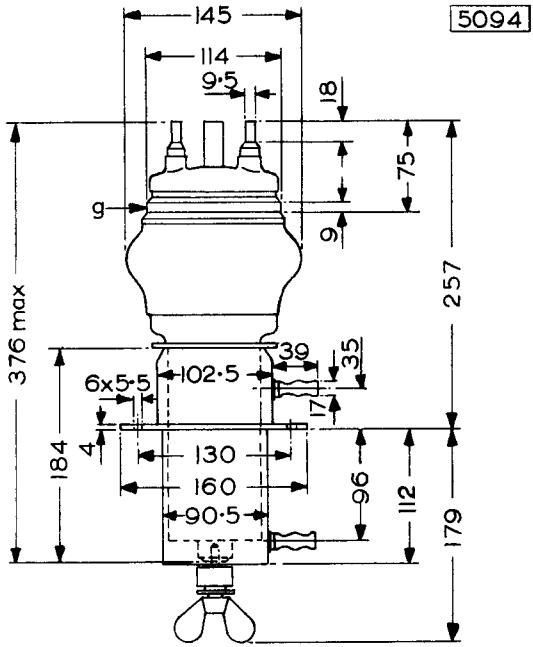
ACCESSORIES

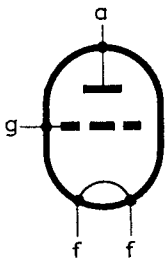
Information on these items can be obtained from the Government and Industrial Valve Division, Mullard Limited.

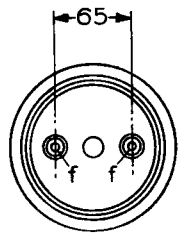
WEIGHT

Valve only	2.8	kg
	6.2	lb
Shipping weight	37.5	kg
	82.5	lb

TY12-25W







All dimensions in mm

R.F. POWER TRIODE

TY12-50A

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with "Operating Notes, Part 1—Power Valves" included in this volume of the Handbook.

FILAMENT Thoriated tungsten.

V_f	17.5	V
I_f	196	A

The total filament current is shared between three terminals and it is important to ensure that the connections to these terminals and to the supply bus-bars are securely made and have negligible contact resistance. The filament limbs are internally connected in parallel and a faulty external connection could cause a high current in the other terminals leading to excessive heating of the glass seals.

MOUNTING POSITION

Vertical, with anode down.

CAPACITANCES

C_{a-k}	3.4	μμF
C_{g-k}	116	μμF
C_{a-g}	86	μμF

CHARACTERISTICS (Measured at V_a=10 kV, I_a=5 A)

g_m	50	mA/V
μ	27	
g_m max. (at V_a=3 kV, I_a=50 A)	92	mA/V

COOLING

Maximum temperature of seals 180 °C

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea-level. Typical values of input temperature, rate of flow of air, and pressure difference between the inlet and outlet of the housing are given in the following table.

Anode Dissipation	Height above sea-level	Maximum Inlet Temperature	Minimum rate of flow of air	Pressure Difference between inlet and outlet
P_a (kW)	h (m)	T_{in} (°C)	(m^3/min)	(mm of H_20)
30	0	35	35	114
30	0	45	40	143
30	1500	35	42	136
30	3000	25	44	132
45	0	35	54	275
45	0	45	62.5	335
45	1500	35	64.5	322
45	3000	25	68	319

TY12-50A

R.F. POWER TRIODE

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.

When operated at frequencies above 6 Mc/s, special attention must be given to the temperatures of the anode and grid-seals. They are cooled by air flowing through the slots provided at the top of the cooler housing. In certain cases, particularly at low anode dissipations and when cooling with the minimum quantity of air, the flow of air to the seals will not be sufficient to maintain the seal temperatures below the maximum permitted value at frequencies above 6 Mc/s. In these cases, a larger quantity of air must be supplied.

When using the special filament connectors, together with connecting leads of adequate cross-section, it is not, as a rule, necessary to provide additional air cooling of the filament terminals. In order to ensure uniform distribution of current, care must be taken to ensure firm contact with the filament terminals.

R.F. HEATING APPLICATIONS

For these applications, individual requirements should be discussed with the Industrial Technical Service Dept., Mullard Limited.

OPERATING CONDITIONS AS A SINGLE VALVE R.F. POWER OSCILLATOR OR AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max. (f <4 Mc/s)	15	kV
V_a max. (f <15 Mc/s)	13.5	kV
$-V_g$ max.	1.2	kV
I_k max.	15	A
$i_{k(pk)}$ max.	75	A
I_g max.	3.0	A
p_a max.	45	kW

Typical Operating Conditions

f	15	20	25	27.5	30	Mc/s
V_a	12	12	11	10.5	10	kV
V_g	−1000	−1000	−900	−850	−800	V
I_a	12	10.5	8.5	7.5	6.7	A
I_g	2.25	2.0	1.6	1.5	1.4	A
$v_{in(pk)}$	1.7	1.65	1.45	1.35	1.3	kV
P_{drive}	3.5	3.0	2.1	1.9	1.7	kW
p_a	36	31.5	23.5	20	17	kW
P_{out}	108	94.5	70	59	50	kW
*P_{load}	86.4	75.6	56	47.2	40	kW
η	75	75	75	75	75	%

*With a circuit transfer efficiency of 80%.

OPERATION AS R.F. POWER AMPLIFIER (CLASS "C" ANODE MODULATION)

Limiting Values

V_a max.	10	kV
$-V_g$ max.	1.2	kV
I_k max.	12	A
$i_{k(pk)}$ max.	120	A
I_g max.	3.0	A
p_a max.	30	kW

R.F. POWER TRIODE

TY12-50A

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.

Typical Operating Conditions

f	15	20	25	27.5	30	Mc/s
V_a	10	10	9.0	8.5	8.0	kV
V_g	−1050	−1050	−925	−900	−850	V
I_a	8.5	7.0	6.2	5.7	5.25	A
I_g	2.6	2.0	2.0	1.9	1.8	A
$v_{in(pk)}$	1.75	1.65	1.5	1.45	1.4	kV
P_{drive}	4.1	3.0	2.7	2.5	2.3	kW
p_a	20	17.5	15	13.5	12	kW
P_{out}	65	52.5	41	35	30	kW
*P_{load}	52	42	32.8	28	24	kW
η	76.5	75	73.5	72	71.5	%
For 100% modulation						
$P_{mod.}$	42.5	35	28	24.5	21	kW

*With a circuit transfer efficiency of 80%.

OPERATION AS CLASS "B" A.F. AMPLIFIER OR MODULATOR

Limiting Values

V_a max.	15	kV
I_k max.	16	A
$i_{k(pk)}$ max.	50	A
p_a max.	45	kW
R_{g-f} max.	20	kΩ

TYPICAL OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

V_a	12	10	10	9.0	8.5	8.0	kV
V_g	−450	−375	−400	−350	−325	−300	V
R_{a-a}	1.2	1.7	2.06	2.08	2.12	2.21	kΩ
$I_{a(o)}$	2×650	2×500	2×200	2×250	2×250	2×250	mA
I_a (max. sig.)	2×12	2×6.6	2×5.4	2×4.8	2×4.4	2×4.1	A
I_g	2×2.5	2×0.9	2×0.7	2×0.65	2×0.55	2×0.4	A
$V_{in(g-g)\ (r.m.s.)}$	1457	1047	1033	920	849	792	V
P_{drive}	2×2.4	2×0.6	2×0.5	2×0.4	2×0.3	2×0.25	kW
p_a	2×43	2×19.5	2×15.5	2×12.2	2×10.4	2×9.4	kW
P_{out}	202	93	77	62	54	46.8	kW
η	70	71	71	72	72	71	%

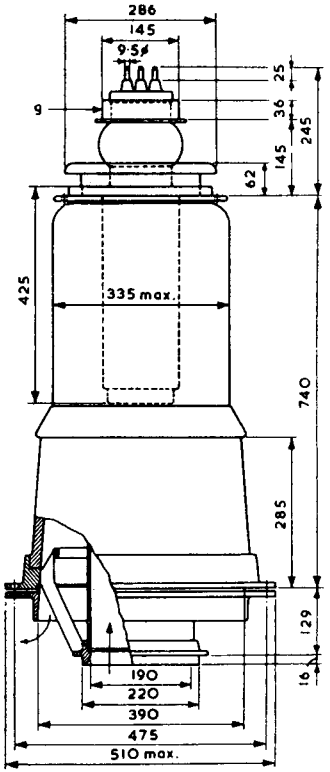
WEIGHT

Valve only	30 Kg (66 lb)
Cooler housing	90 Kg (200 lb)

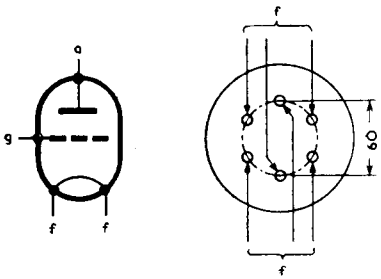
TY12-50A

R.F. POWER TRIODE

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.



Valve mounted in cooler housing.



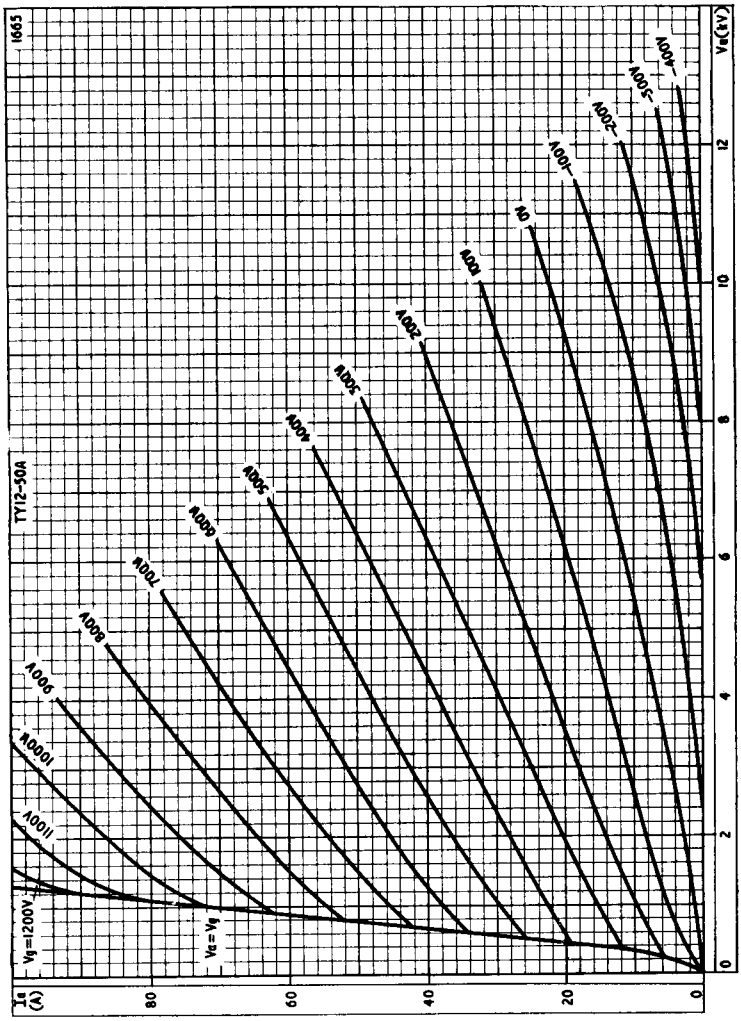
1702

All dimensions in mm.

R.F. POWER TRIODE

TY12-50A

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.

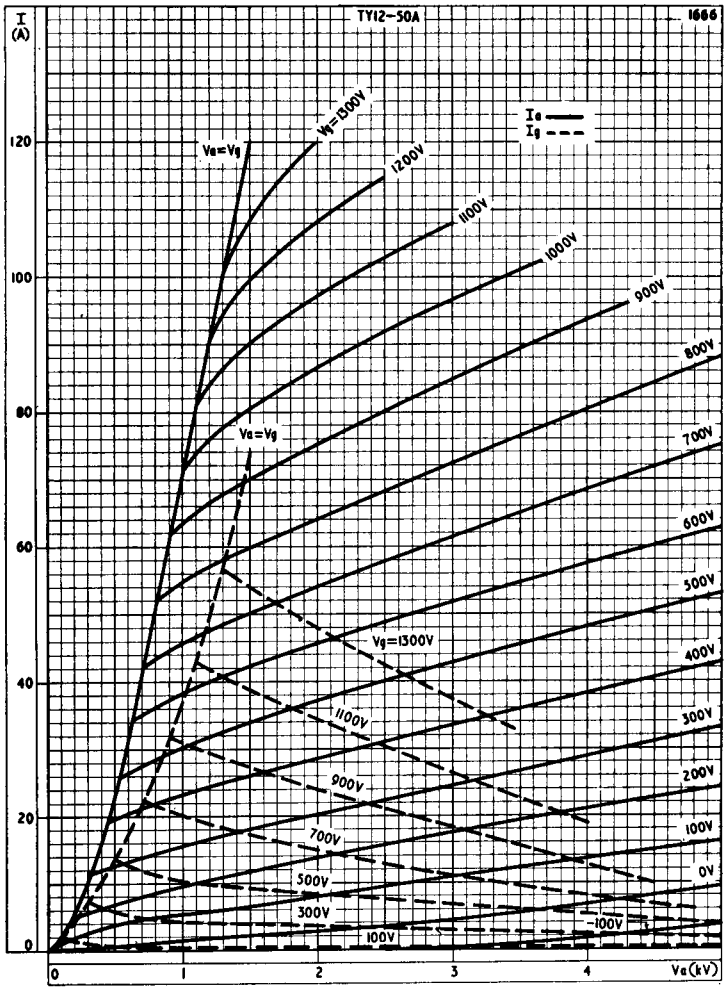


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

TY12-50A

R.F. POWER TRIODE

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.

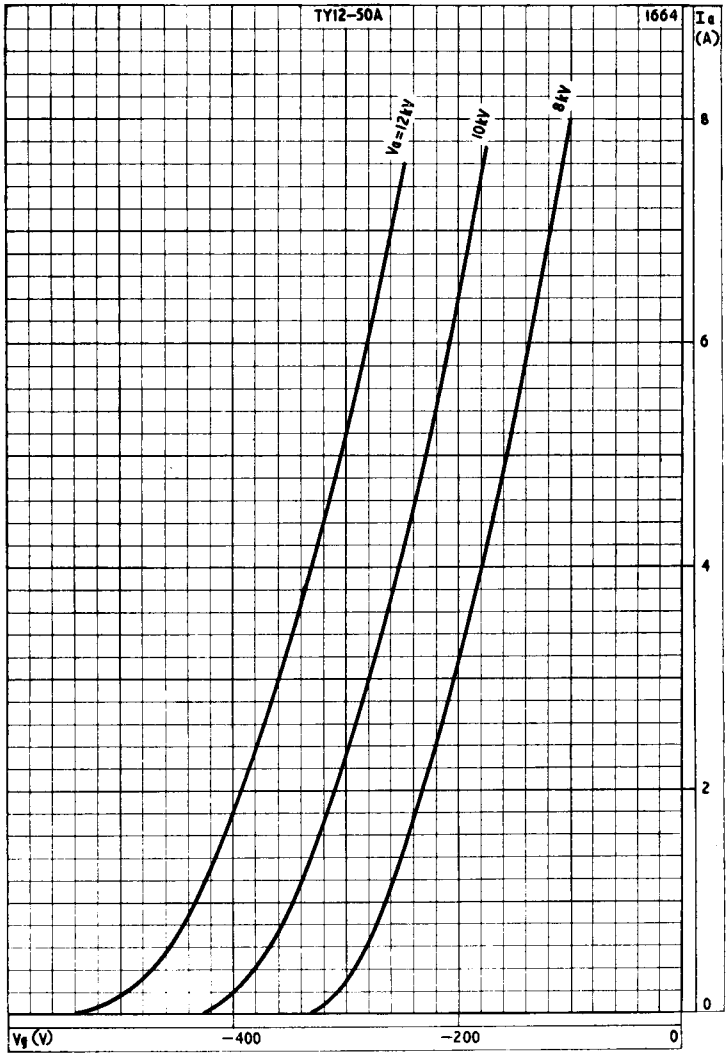


ANODE AND GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

R.F. POWER TRIODE

TY12-50A

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.

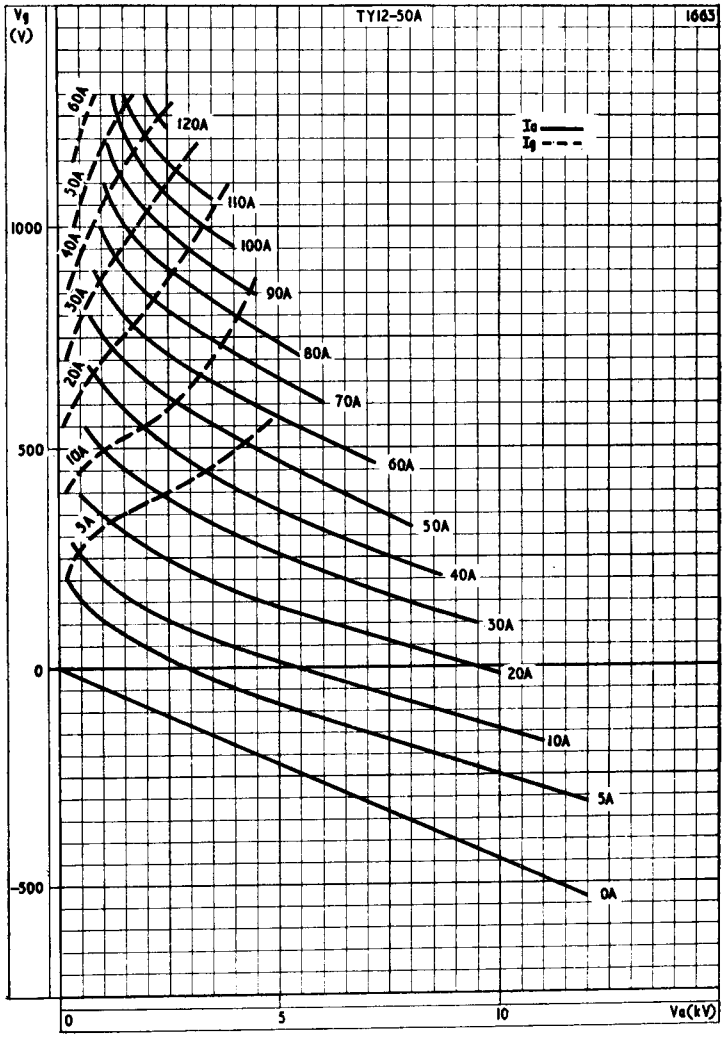


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

TY12-50A

R.F. POWER TRIODE

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.



CONSTANT CURRENT CURVES

R.F. POWER TRIODE

TY12-50A

High-power forced-air cooled triode, rated for a maximum anode dissipation of 45 kW and suitable for use at frequencies up to 30 Mc/s.



FILAMENT CURRENT PLOTTED AGAINST FILAMENT VOLTAGE

R.F. POWER TRIODE

TY12-50W

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with "Operating Notes, Part 1—Power Valves" included in this volume of the Handbook.

FILAMENT Thoriated tungsten.

V_f	17.5	V
I_f	196	A

The total filament current is shared between three terminals and it is important to ensure that the connections to these terminals and to the supply bus-bars are securely made and have negligible resistance. The filament limbs are internally connected in parallel and a faulty external connection could cause a high current in the other terminals leading to excessive heating of the glass seals.

MOUNTING POSITION Vertical, with anode down.

CAPACITANCES

C_{a-k}	3.4	μμF
C_{g-k}	116	μμF
C_{a-g}	86	μμF

CHARACTERISTICS (measured at V_a=10 kV, I_a=5 A)

g_m	50	mA/V
μ	27	
g_m max. (V_a=3 kV, I_a=50 A)	92	mA/V

COOLING

The amount of water-cooling required for this valve depends upon the anode dissipation and the temperature of the water. Typical values of rate of flow of water and pressure lost in the jacket are given in the following table.

Anode Dissipation P_a (kW)	Maximum Inlet Temperature T_{in} (°C)	Minimum* rate of flow of water (Litres/Min.)	Pressure loss in jacket (atm)
30	20	25	0.15
30	50	45	0.45
50	20	32	0.25
50	50	65	0.85
100	20	55	0.6
100	50	120	3.0

*Rate of flow of water for temperatures intermediate between 20 and 50°C can be determined by linear interpolation.

TY12-50W

R.F. POWER TRIODE

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.

Max. inlet temperature of water	50	°C
Max. temperature of seals	180	°C

In order to ensure that the max. temperature (180°C) of the seals is not exceeded it may be necessary to divert a stream of air upon the seals. This flow of air must commence upon or before the application of the filament voltage.

Anode and grid-seals may be cooled by connecting a blower of suitable size to the air inlet of the anti-corona ring attached to the valve. At frequencies below 6 Mc/s, air cooling will not normally be necessary. Above 6 Mc/s, air cooling must be used in order to prevent overheating of the anode- and grid-seals. At the maximum frequency (30 Mc/s) and the published operating conditions at least 2.5m³ (95 ft³) per minute is required with a pressure loss of about 500 mm (20 in) water column.

When using the special filament connectors together with connecting leads of adequate cross-section, it is not, as a rule, necessary to provide additional air cooling of the filament terminals. In order to ensure uniform distribution of current, care should be taken to ensure firm contact with the filament terminals.

R.F. HEATING APPLICATIONS

For these applications, individual requirements should be discussed with the Industrial Technical Service Department, Mullard Ltd.

OPERATION AS A SINGLE VALVE R.F. POWER OSCILLATOR OR AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max. (f <4 Mc/s)	15	kV
V_a max. (f <15 Mc/s)	13.5	kV
$-V_g$ max.	1.2	kV
I_k max.	15	A
$i_{k(pk)}$ max.	75	A
I_g max.	3.0	A
p_a max.	50	kW

Typical Operating Conditions

f	15	20	25	27.5	30	Mc/s
V_a	12	12	11	10.5	10	kV
V_g	−1000	−1000	−900	−850	−800	V
I_a	12	10.5	8.5	7.5	6.7	A
I_g	2.25	2.0	1.6	1.5	1.4	A
$v_{in(pk)}$	1.7	1.65	1.45	1.35	1.3	kV
P_{drive}	3.5	3.0	2.1	1.9	1.7	kW
P_a	36	31.5	23.5	20	17	kW
P_{out}	108	94.5	70	59	50	kW
*P_{load}	86.4	75.6	56	47.2	40	kW
η	75	75	75	75	75	%

*With a circuit transfer efficiency of 80%.

R.F. POWER TRIODE

TY12-50W

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.

OPERATION AS R.F. POWER AMPLIFIER (CLASS "C" ANODE MODULATION)

Limiting Values

V_a max.	10	kV
$-V_g$ max.	1.2	kV
I_k max.	12	A
$i_{k(pk)}$	120	A
I_g max.	3.0	A
p_a max.	33	kW

Typical Operating Conditions

f	15	20	25	27.5	30	Mc/s
V_a	10	10	9.0	8.5	8.0	kV
V_g	–1050	–1050	–925	–900	–850	V
I_a	8.5	7.0	6.2	5.7	5.25	A
I_g	2.6	2.0	2.0	1.9	1.8	A
$v_{in(pk)}$	1.75	1.65	1.5	1.45	1.4	kV
P_{drive}	4.1	3.0	2.7	2.5	2.3	kW
p_a	20	17.5	15	13.5	12	kW
P_{out}	65	52.5	41	35	30	kW
*P_{load}	52	42	32.8	28	24	kW
η	76.5	75	73.5	72	71.5	%
For 100% modulation						
P_{mod}	42.5	35	28	24.5	21	kW

*With a circuit transfer efficiency of 80%.

OPERATION AS R.F. AMPLIFIER (CLASS "B" TELEPHONY)

Limiting Values

V_a max. (f <4 Mc/s)	15	kV
V_a max. (f <15 Mc/s)	13.5	kV
I_k max.	20	A
$i_{k(pk)}$ max.	60	A
p_a max.	100	kW

Typical Operating Conditions

f	15	Mc/s
V_a	12	kV
V_g	–420	V
I_a	12.2	A
$v_{in(pk)}$	700	V
p_a	94.5	kW
P_{out}	51.5	kW
*P_{load}	41.2	kW
η	35	%
For 100% modulation		
I_g	4.5	A
P_{drive}	5.7	kW

*With a circuit transfer efficiency of 80%.

TY12-50W

R.F. POWER TRIODE

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.

OPERATION AS CLASS "B" A.F. AMPLIFIER OR MODULATOR

Limiting Values

V_a max.	15	V
I_k max.	16	A
$i_{k(pk)}$ max.	50	A
p_a max.	50	kW
R_{g-f} max.	20	kΩ

Typical Operating Conditions for 2 Valves in Push-Pull

V_a	12	10	10	9.0	8.5	8.0	kV
V_g	−450	−375	−400	−350	−325	−300	V
R_{a-a}	1.2	1.7	2.06	2.08	2.12	2.21	kΩ
$I_{a(0)}$	2×650	2×500	2×200	2×250	2×250	2×250	mA
I_a (max. sig.)	2×12	2×6.6	2×5.4	2×4.8	2×4.4	2×4.1	A
I_g	2×2.5	2×0.9	2×0.7	2×0.65	2×0.55	2×0.4	A
$V_{in(g-g)\ (r.m.s.)}$	1457	1047	1033	920	849	792	V
P_{drive}	2×2.4	2×0.6	2×0.5	2×0.4	2×0.3	2×0.25	kW
p_a	2×43	2×19.5	2×15.5	2×12.2	2×10.4	2×9.4	kW
P_{out}	202	93	77	62	54	46.8	kW
η	70	71	71	72	72	71	%

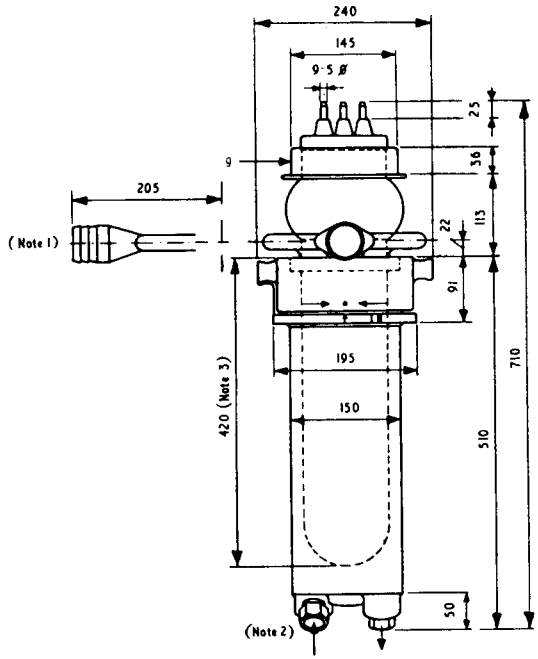
WEIGHT

Valve only	14 kg (31 lb)
Water jacket	19.5 kg (43 lb)

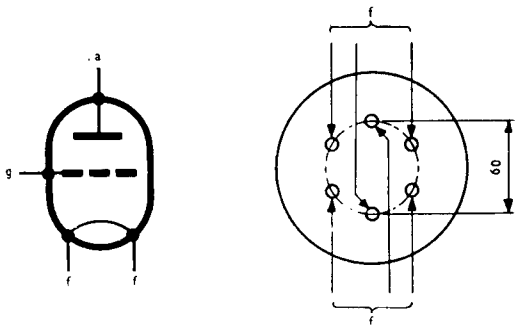
R.F. POWER TRIODE

TY12-50W

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.



Valve mounted in water jacket.



1703 All dimensions in mm.

Note 1.—A connecting hose with an inner diameter of 1.75 in. is required.

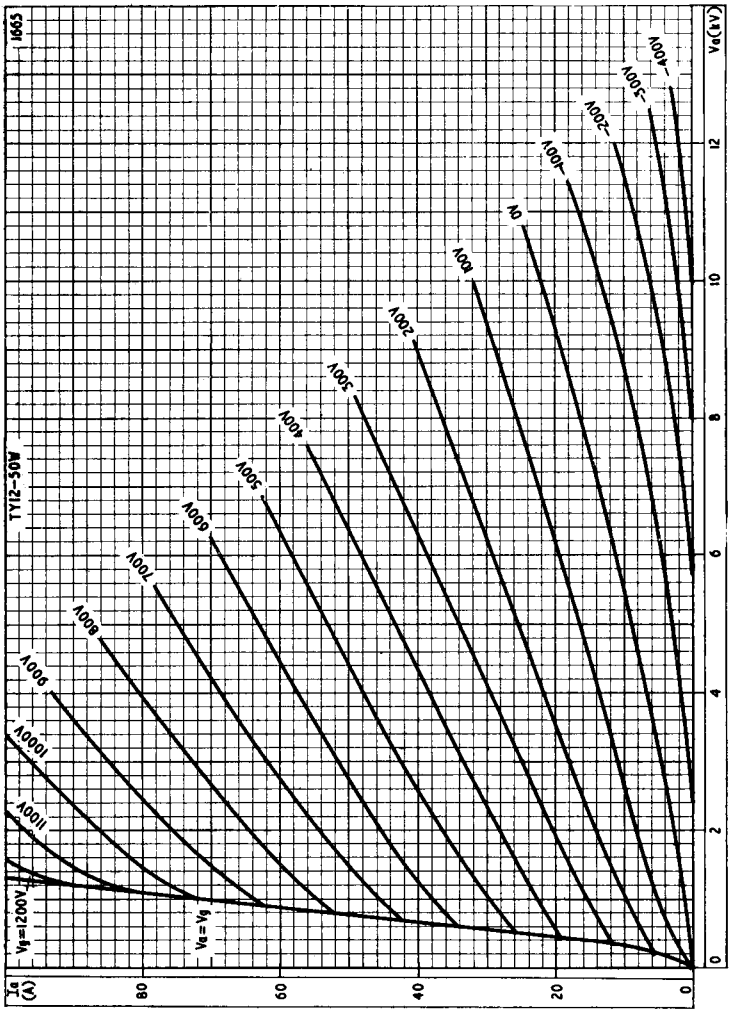
Note 2.—Coupling for metal tubing with an outer diameter of 28 mm.

Note 3.—To remove the valve from its water-jacket a free height of 420 mm above the valve is required.

TY12-50W

R.F. POWER TRIODE

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.

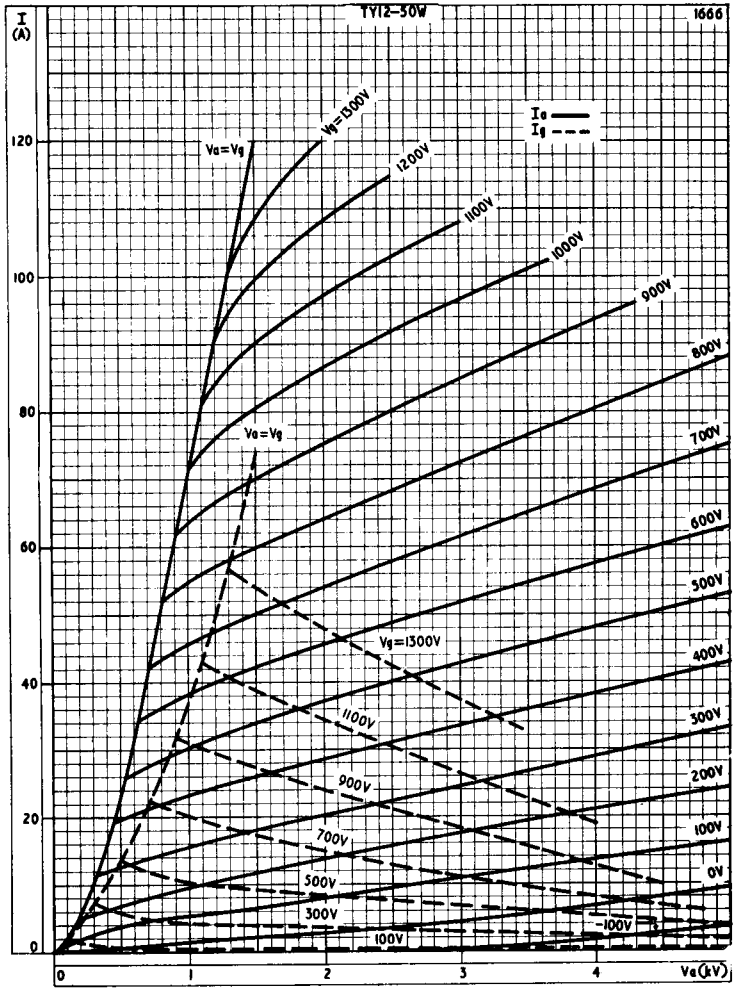


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

R.F. POWER TRIODE

TY12-50W

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.

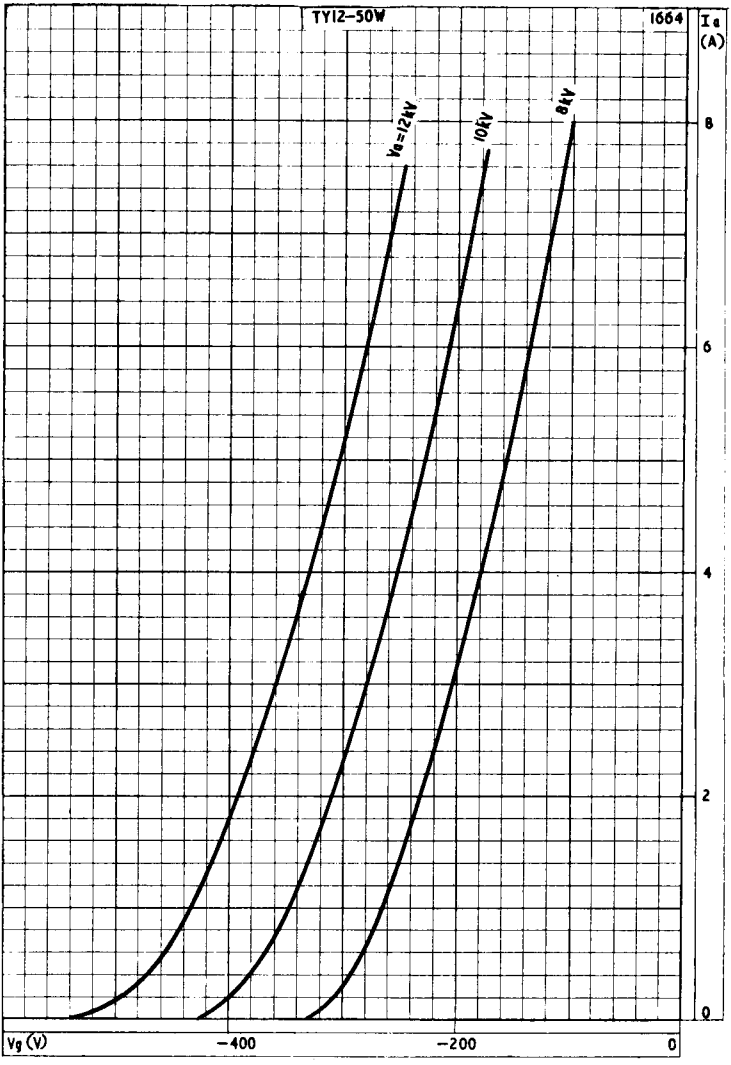


ANODE AND GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

TY12-50W

R.F. POWER TRIODE

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.

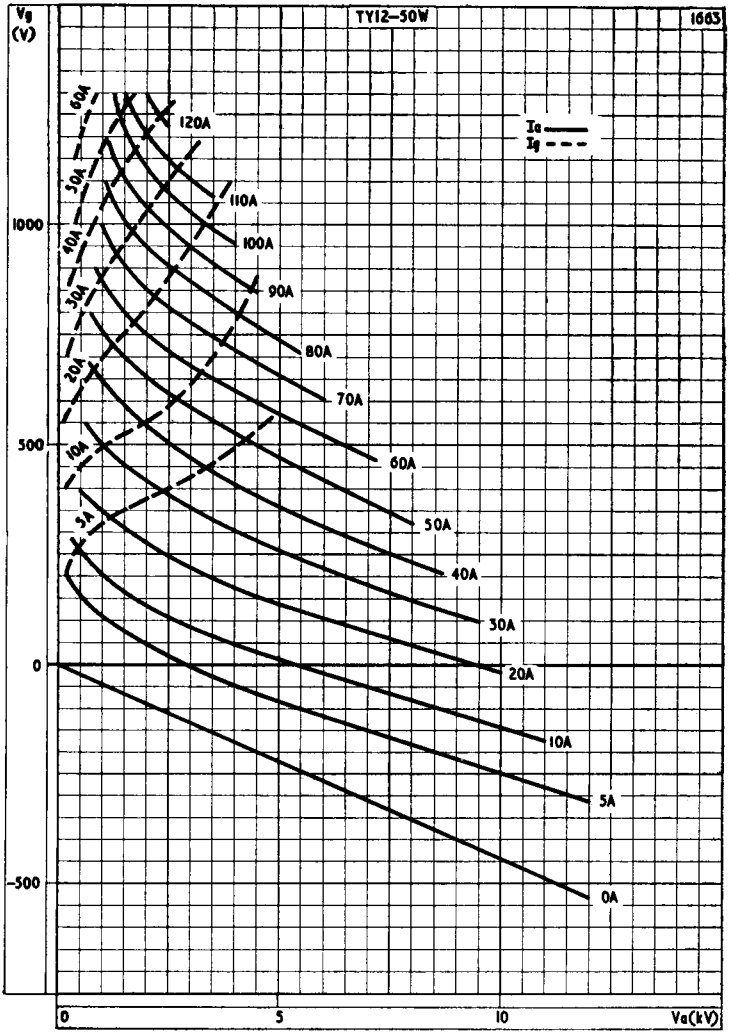


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

R.F. POWER TRIODE

TY12-50W

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.

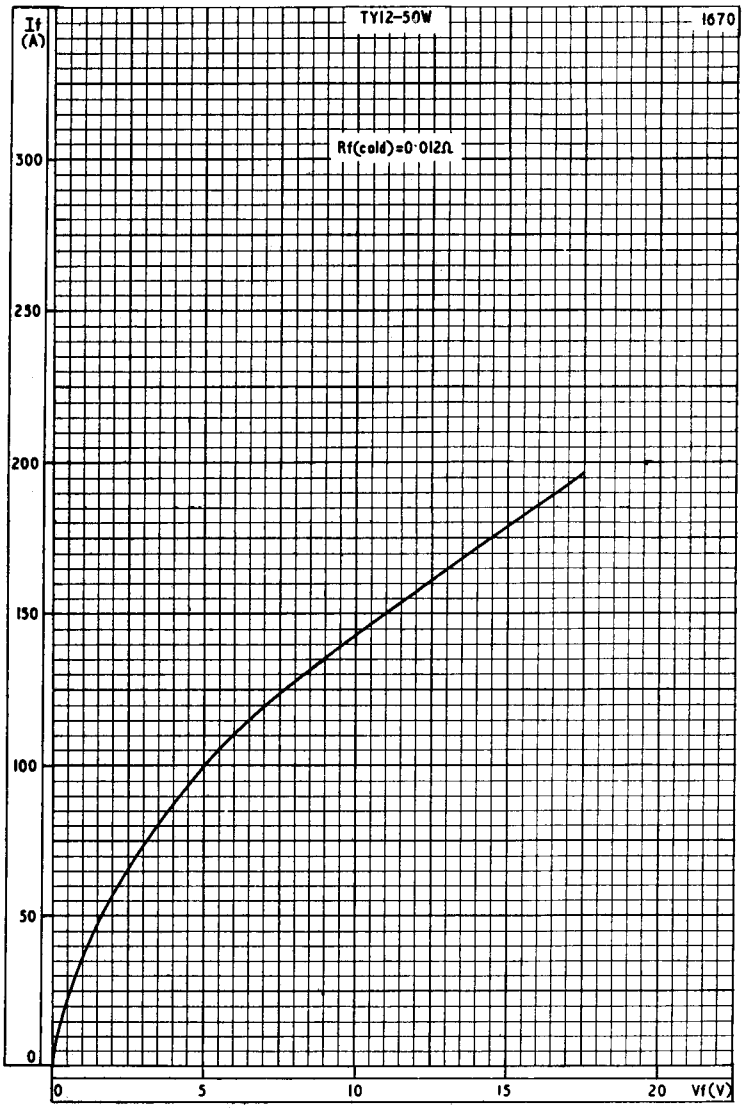


CONSTANT CURRENT CURVES

TY12-50W

R.F. POWER TRIODE

High-power water-cooled triode, rated for a maximum anode dissipation of 50 kW and suitable for use at frequencies up to 30 Mc/s.



FILAMENT CURRENT PLOTTED AGAINST FILAMENT VOLTAGE

V.H.F. POWER TRIODE

TY12-50W

QUICK REFERENCE DATA

Water cooled r.f. power triode

	Class 'B' Audio Amplifier or Modulator	Class 'B' Telephony	Class 'C' Anode and Screen grid Modulation	Class 'C' Telegraphy or F.M. Telephony	
f	-	15	30	30	Mc/s
P_{out}	202	51.5	30	50	kW
f max.	-	30	30	30	Mc/s
V_a max. (f< 4Mc/s)	15	15	10	15	kV
(f< 15Mc/s)	-	13.5	-	13.5	kV
p_a max.	50	100	33	50	kW

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

f	15	20	25	27.5	30	Mc/s
P_{out}	108	94.5	70	59	50	kW
P_{load}	86.4	75.6	56	47.2	40	kW
η_a	75	75	75	75	75	%
V_a	12	12	11	10.5	10	kV
I_a	12	10.5	8.5	7.5	6.7	A
$-V_{g1}$	1000	1000	900	850	800	V
I_{g1}	2.25	2.0	1.6	1.5	1.4	A
$v_{in(pk)}$	1.7	1.65	1.45	1.35	1.3	kV
$P_{load(driver)}$	3.5	3.0	2.1	1.9	1.7	kW
p_a	36	31.5	23.5	20	17	kW

CLASS 'C' ANODE AND SCREEN GRID MODULATION

Maximum operating conditions
Carrier conditions for 100% modulation

f	15	20	25	27.5	30	Mc/s
P_{out}	65	52.5	41	35	30	kW
P_{load}	52	42	32.8	28	24	kW
η_a	76.5	75	73.5	72	71.5	%
V_a	10	10	9.0	8.5	8.0	kV
I_a	8.5	7.0	6.2	5.7	5.25	A
$-V_{g1}$	1050	1050	925	900	850	V
I_{g1}	2.6	2.0	2.0	1.9	1.8	A
$v_{in(pk)}$	1.75	1.65	1.5	1.45	1.4	kV
$P_{load(driver)}$	4.1	3.0	2.7	2.5	2.3	kW
p_a	20	17.5	15	13.5	12	kW
For 100% modulation						
P_{mod}	42.5	35	28	24.5	21	kW

CLASS 'B' TELEPHONY

Maximum operating conditions

f	15	Mc/s
P_{out}	51.5	kW
P_{load}	41.2	kW
η_a	35	%
V_a	12	kV
I_a	12.2	A
$-V_{g1}$	420	V
$v_{in(pk)}$	700	V
p_a	94.5	kW
For 100% modulation		
P_{drive}	5.7	kW
I_{g1}	4.5	A

CLASS 'B' AUDIO AMPLIFIER OR MODULATOR

Maximum operating conditions

P_{out}	202	93	77	kW
R_{a-a}	1.2	1.7	2.06	kΩ
V_a	12	10	10	kV
$I_{a(o)}$	2 x 650	2 x 500	2 x 200	mA
I_a (max. sig.)	2 x 12	2 x 6.6	2 x 5.4	A
$-V_{g1}$	450	375	400	V
I_{g1}	2 x 2.5	2 x 0.9	2 x 0.7	A
$V_{in(g-g)}$ r.m.s.	1457	1047	1033	V
$P_{load(driver)}$	2 x 2.4	2 x 0.6	2 x 0.5	kW
p_a	2 x 43	2 x 19.5	2 x 15.5	kW
η_a	70	71	71	%

P_{out}	62	54	46.8	kW
R_{a-a}	2.08	2.12	2.21	kΩ
V_a	9.0	8.5	8.0	kV
$I_{a(o)}$	2 x 250	2 x 250	2 x 250	mA
I_a (max. sig.)	2 x 4.8	2 x 4.4	2 x 4.1	A
$-V_{g1}$	350	325	300	V
I_{g1}	2 x 0.65	2 x 0.55	2 x 0.4	A
$V_{in(g-g)}$ r.m.s.	920	849	792	V
$P_{load(driver)}$	2 x 0.4	2 x 0.3	2 x 0.25	kW
p_a	2 x 12.2	2 x 10.4	2 x 9.4	kW
η_a	72	72	71	%

ABSOLUTE MAXIMUM RATINGS

	Class 'B' A.F.	Class 'B' Telephony	Class 'C' Telephony	Class 'C' Telegraphy	
V_a max. (f< 15Mc/s)	15	15	10	15	kV
(f<15Mc/s)	-	13.5	-	13.5	kV
$-V_g$ max.	-	-	1.2	1.2	kV
I_k max.	16	20	12	15	A
p_a max.	50	100	33	50	kW
I_g max.	-	-	3.0	3.0	A
R_{g-f} max.	20	-	-	-	kΩ

CATHODE

Directly heated, thoriated tungsten

V_f	17.5	V
I_f	196	A

The total filament current is shared between three terminals and it is important to ensure that the connections to these terminals and to the supply bus-bars are securely made and have negligible contact resistance. The filament limbs are internally connected in parallel and a faulty external connection could cause a high current in the other terminals leading to excessive heating of the glass seals.

CAPACITANCES

c_{a-k}	3.4	pF
c_{g-k}	116	pF
c_{a-g}	86	pF

CHARACTERISTICS (measured at V_a = 10kV, I_a = 5A)

g_m	50	mA/V
μ	27	
g_m max. (at V_a = 3kV, I_a = 50A)	92	mA/V

MOUNTING POSITION — Vertical, anode down

COOLING

Water cooled

Maximum temperatures

Seals	180	^{o}C
Water inlet	50	^{o}C

The amount of water-cooling required for this valve depends upon the anode dissipation and the temperature of the water. Typical values of rate of flow of water and pressure lost in the jacket are given in the following table.

Anode Dissipation	Maximum Inlet Temperature	*Minimum rate of flow of water	Pressure loss in jacket
P_a (kW)	T_{in} (^{o}C)	(Litres/Min)	(atm)
30	20	25	0.15
30	50	45	0.45
50	20	32	0.25
50	50	65	0.85
100	20	55	0.6
100	50	120	3.0

*Rate of flow of water for temperatures intermediate between 20 and 50°C can be determined by linear interpolation.

In order to ensure that the max. temperature (180°C) of the seals is not exceeded it may be necessary to divert a stream of air upon the seals. This flow of air must commence upon or before the application of the filament voltage.

Anode and grid-seals may be cooled by connecting a blower of suitable size to the air inlet of the anti-corona ring attached to the valve. At frequencies below 6Mc/s, air cooling will not normally be necessary. Above 6Mc/s, air cooling must be used in order to prevent overheating of the anode- and grid-seals. At the maximum frequency (30Mc/s) and the published operating conditions at least 2.5m^3 (95ft^3) per minute is required with a pressure loss of about 500mm (20in) water column.

When using the special filament connectors together with connecting leads of adequate cross-section, it is not, as a rule, necessary to provide additional air cooling of the filament terminals. In order to ensure uniform distribution of current, care should be taken to ensure firm contact with the filament terminals.

PHYSICAL DATA

Weight of valve	31	lb
	14	kg
Weight of water jacket	45	lb
	20.5	kg
Weight of valve plus carton	180	lb
	82	kg

ACCESSORIES

Water jacket	K714
Filament clips x 6	40628

DIMENSIONS

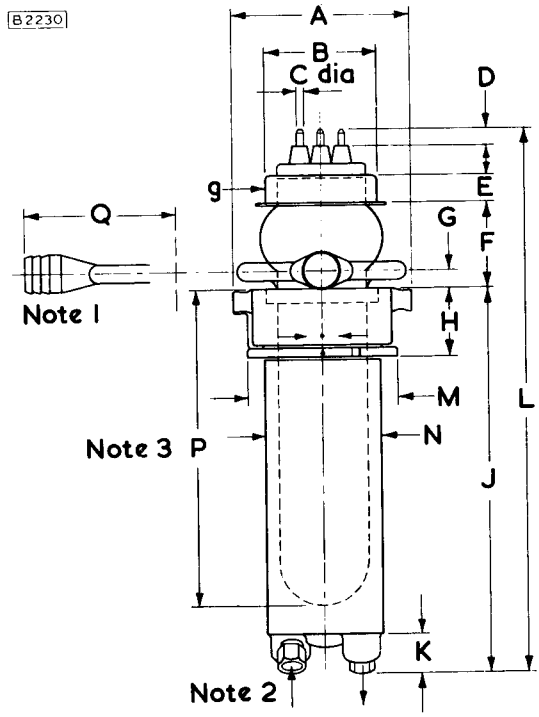
	Inches	Millimetres
A	9.45	240
B	5.71	145
C	0.37	9.5
D	0.98	25
E	1.42	36
F	4.45	113
G	0.87	22
H	3.58	91
J	20.08	510
K	1.97	50
L	27.95	710
M	7.68	195
N	5.91	150
P	16.54	420
Q	8.07	205
R	2.36	60

Inch dimensions derived from original millimetre dimensions.

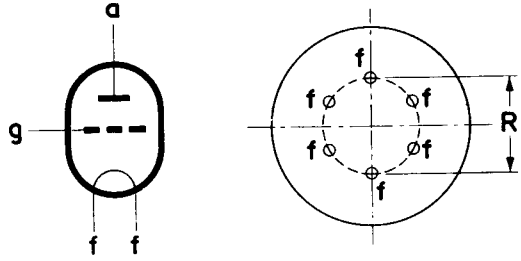
Note 1 A connecting hose with an inner diameter of 44.5mm (1.75in) is required.

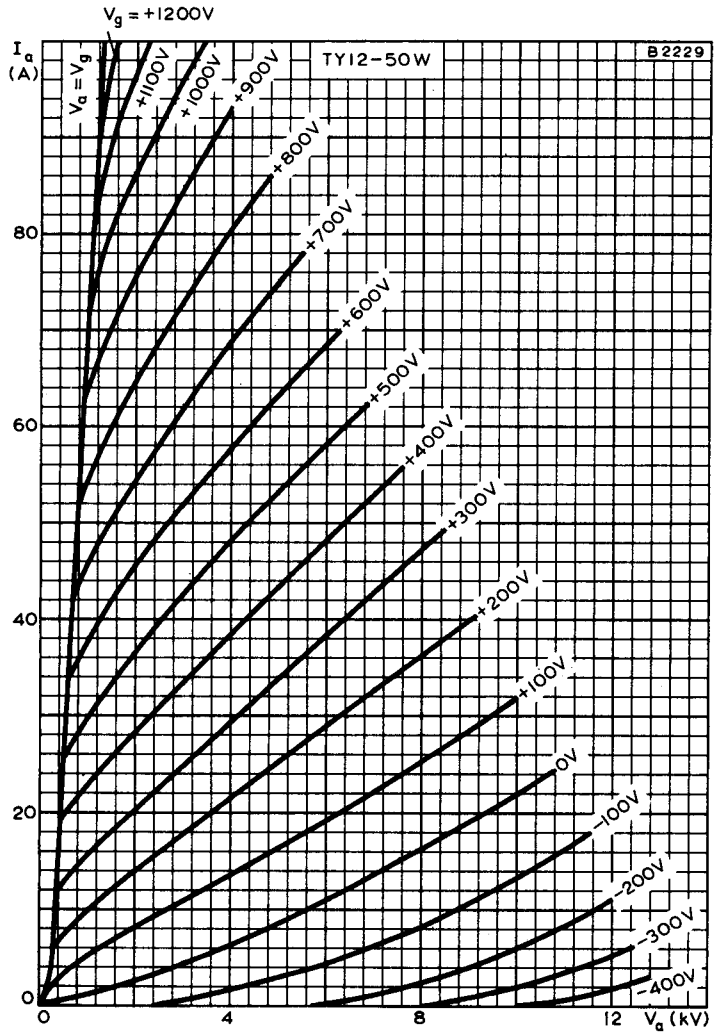
Note 2 Coupling for metal tubing with an outer diameter of 28mm (1.10in).

Note 3 To remove the valve from its water jacket a free height of 420mm (16.54in) above the valve is required.

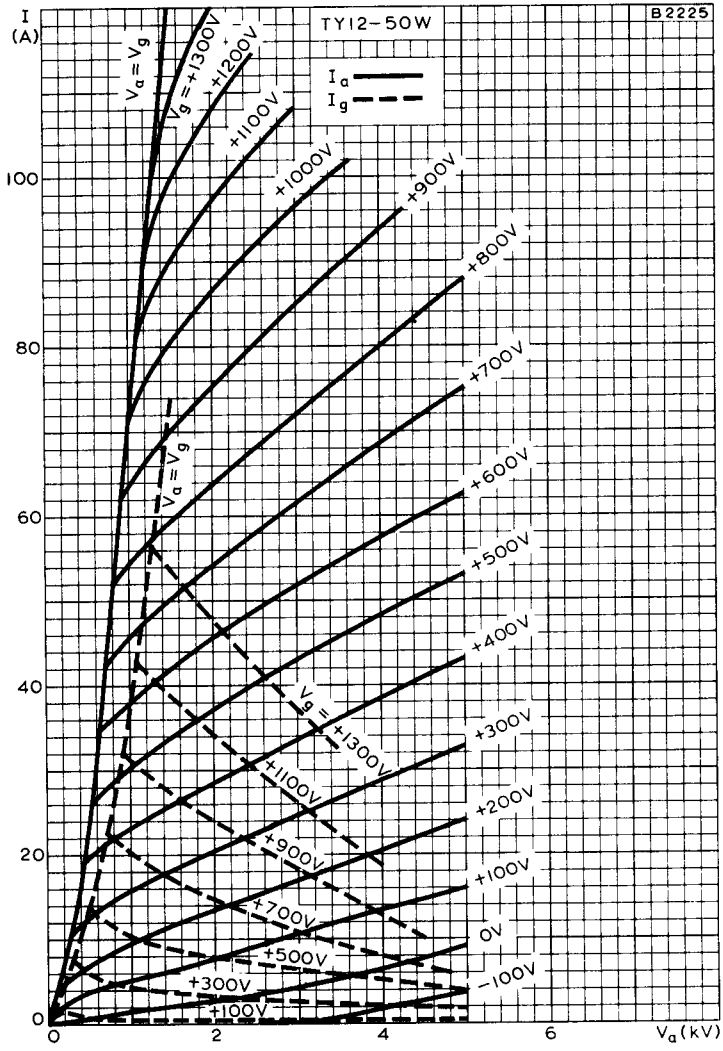


Valve mounted in water jacket

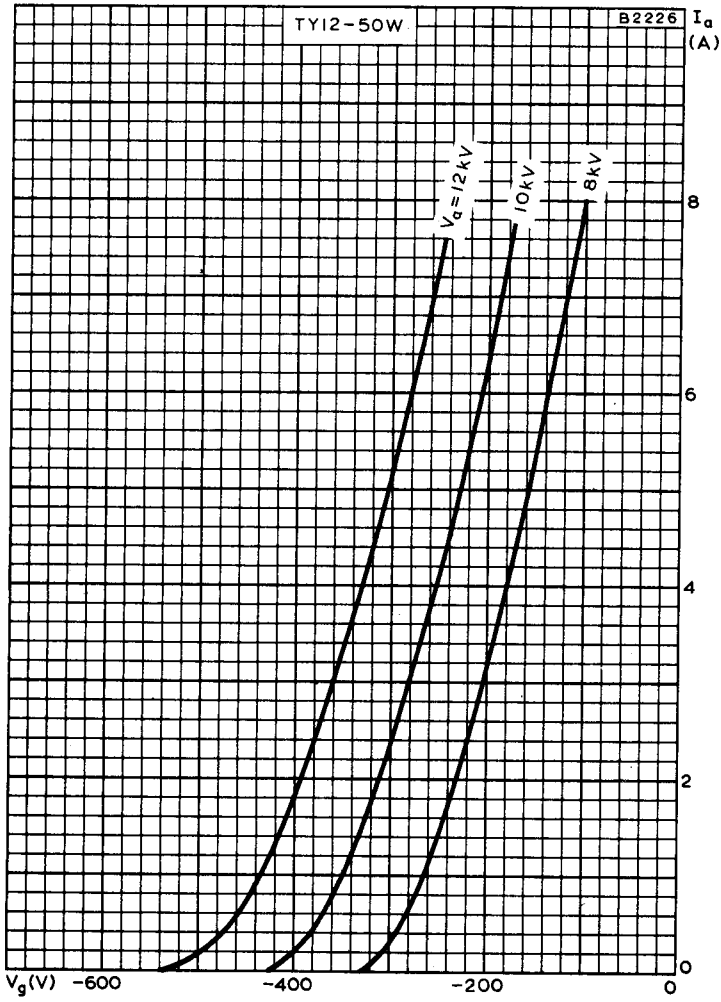




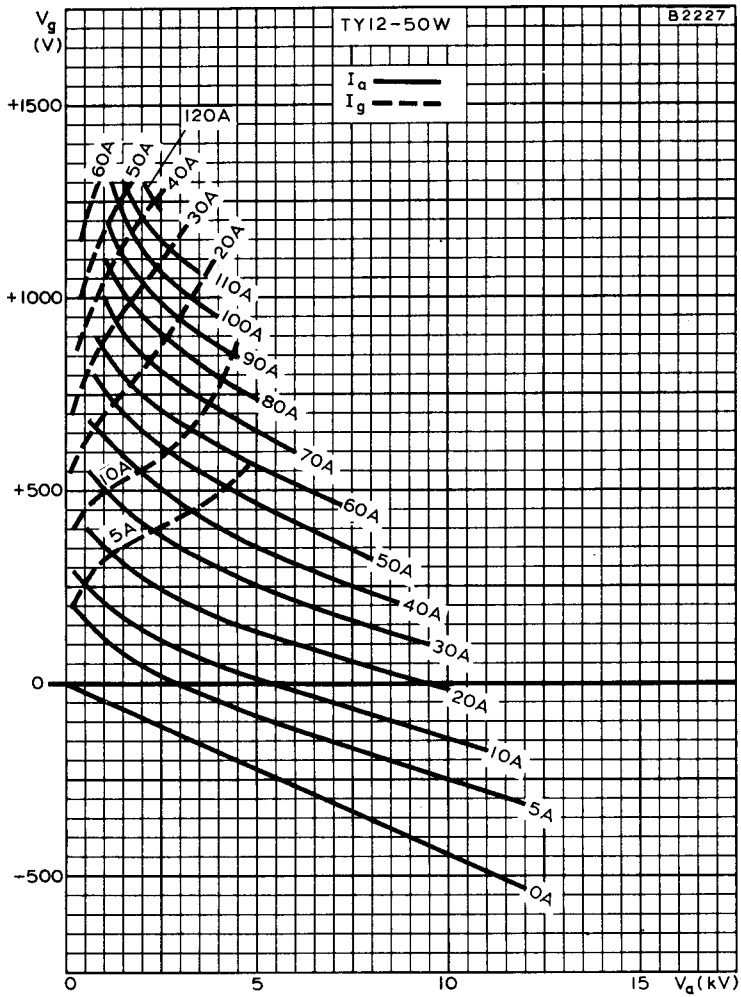
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER



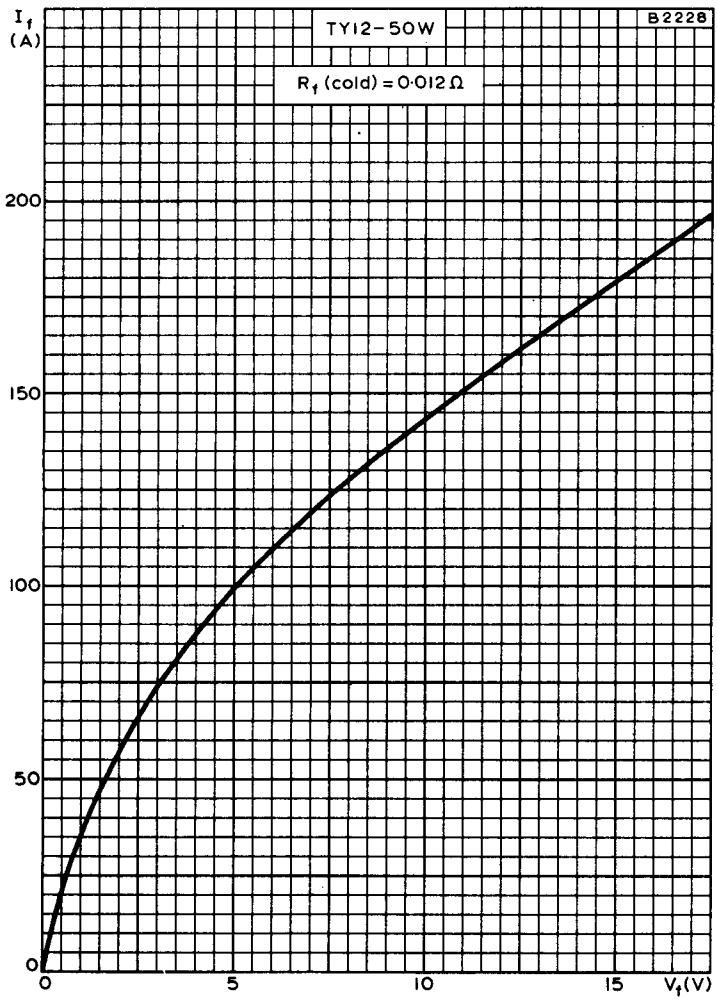
ANODE AND GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER



CONSTANT CURRENT CHARACTERISTICS



FILAMENT CURRENT PLOTTED AGAINST FILAMENT VOLTAGE

TY12-50A
TY12-50W
TY12-50H

QUICK REFERENCE DATA

Triode for use as r.f. or a.f. power amplifier or oscillator.
The TY12-50A is forced-air cooled.
The TY12-50W is water cooled by means of a separate jacket.
The TY12-50H has an integral helical water cooler.

	Audio Amplifier or Modulator, Class 'B'	Telephony Class 'B' (TY12-50W) (TY12-50H)	Anode Modulation Class 'C'	Telegraphy or F.M. Telephony, Class 'C'	
f	-	15	30	30	Mc/s
P_{out}	202	51.5	31	50	kW
f max.	-	30	30	30	Mc/s
V_a max.					
f < 4Mc/s	15	15	-	15	kV
f < 15Mc/s	-	13.5	10	13.5	kV
p_a max.					
TY12-50A	45	-	30	45	kW
TY12-50W/H	50	100	30	50	kW

Unless otherwise stated, data is applicable to all types

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

TELEGRAPHY OR F.M. TELEPHONY, CLASS 'C'

OPERATING CONDITIONS

f	15	20	25	27.5	30	Mc/s
P_{out}	108	94.5	70	59	50	kW
P_{load}	86.4	75.6	56	47.2	40	kW
η_a	75	75	75	75	75	%
V_a	12	12	11	10.5	10	kV
I_a	12	10.5	8.5	7.5	6.7	A
$-V_{g1}$	1000	1000	900	850	800	V
I_{g1}	2.25	2.0	1.6	1.5	1.4	A
$v_{in(pk)}$	1.7	1.65	1.45	1.35	1.3	kV
$P_{load(driver)}$	3.5	3.0	2.1	1.9	1.7	kW
p_a	36	31.5	23.5	20	17	kW

ANODE MODULATION, CLASS 'C'

OPERATING CONDITIONS (Carrier conditions for 100% modulation)

f	15	20	25	27.5	30	Mc/s
P_{out}	68	54.5	42.5	36.5	31	kW
P_{load}	52	42	32.8	28	24	kW
η_a	80	78	76	75	74	%
V_a	10	10	9.0	8.5	8.0	kV
I_a	8.5	7.0	6.2	5.7	5.25	A
$-V_{g1}$	1050	1050	925	900	850	V
I_{g1}	2.6	2.0	2.0	1.9	1.8	A
$v_{in(pk)}$	1.75	1.65	1.5	1.45	1.4	kV
$P_{load(driver)}$	4.1	3.0	2.7	2.5	2.3	kW
p_a	17	15.5	13.5	12	11	kW
For 100% modulation						
P_{mod}	42.5	35	28	24.5	21	kW

TELEPHONY, CLASS 'B'

OPERATING CONDITIONS for TY12-50W and TY12-50H

f	15	Mc/s
P_{out}	51.5	kW
P_{load}	41.2	kW
η_a	35	%
V_a	12	kV
I_a	12.2	A
$-V_{g1}$	420	V
$v_{in(pk)}$	700	V
p_a	94.5	kW
For 100% modulation		
P_{drive}	5.7	kW
I_{g1}	4.5	A

AUDIO AMPLIFIER OR MODULATOR, CLASS 'B'

OPERATING CONDITIONS (2 valves in push-pull)

P_{out}	202	116	77	kW
R_{a-a}	1.2	1.5	2.06	kΩ
V_a	12	10	10	kV
$I_{a(o)}$	2 × 650	2 × 500	2 × 200	mA
$I_{a(max.sig.)}$	2 × 12	2 × 7.9	2 × 5.4	A
$-V_{g1}$	450	375	400	V
I_{g1}	2 × 2.5	2 × 1.9	2 × 0.7	A
$V_{in(g-g)\ r.m.s.}$	1457	1189	1033	V
$P_{load(driver)}$	2 × 2.4	2 × 1.44	2 × 0.5	kW
p_a	2 × 43	2 × 21	2 × 15.5	kW
η_a	70	75	71	%

P_{out}	62	54	46.8	kW
R_{a-a}	2.08	2.12	2.21	kΩ
V_a	9.0	8.5	8.0	kV
$I_{a(o)}$	2 × 250	2 × 250	2 × 250	mA
$I_{a(max.sig.)}$	2 × 4.8	2 × 4.4	2 × 4.1	A
$-V_{g1}$	350	325	300	V
I_{g1}	2 × 0.65	2 × 0.55	2 × 0.4	A
$V_{in(g-g)r.m.s.}$	920	849	792	V
$P_{load(driver)}$	2 × 0.4	2 × 0.3	2 × 0.25	kW
p_a	2 × 12.2	2 × 10.4	2 × 9.4	kW
η_a	72	72	71	%

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	A.F. Class 'B'	Telephony Class 'B' TY12-50W/H	Telephony Class 'C'	Telegraphy Class 'C'	
f max.	-	30	30	30	Mc/s
V_a max.					
f< 4Mc/s	15	15	-	15	kV
f< 15Mc/s	-	13.5	10	13.5	kV
$-V_g$ max.	-	-	1.2	1.2	kV
I_a max.	12	12.5	10.5	12	A
p_a max.					
TY12-50A	45	-	30	45	kW
TY12-50W/H	50	100	30	50	kW
I_g max.	-	-	3.5	3.0	A
R_{g-f} max.	20	-	-	-	kΩ

CATHODE

Directly heated, thoriated tungsten.

V_f	17.5	V
*I_f	196	A
r_f (cold)	0.012	Ω

*The filament current must never exceed a peak value of 420A at any time during the initial energising schedule.
The total filament current is shared between three terminals and it is important to ensure that the connections to these terminals and to the supply busbars are securely made and have negligible contact resistance. The filament limbs are internally connected in parallel and a faulty external connection could cause a high current in the other terminals leading to excessive heating of the glass seals.
When connecting the filament the three pins of each group must be joined.

CAPACITANCES

c_{out}	3.4	pF
c_{in}	116	pF
c_{a-g}	86	pF

CHARACTERISTICS (measured at V_a = 10kV, I_a = 5A)

g_m	50	mA/V
μ	27	
g_m max. (at V_a = 3kV, I_a = 50A)	92	mA/V

MOUNTING POSITION

Vertical, anode down

COOLING

TY12-50A

Forced-air cooled

Maximum seals temperature 180 °C

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea level. Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table:

Anode dissipation	Height above sea level	Maximum inlet temperature	Minimum rate of air flow per minute		Pressure difference between inlet and outlet	
(kW)	(m)	(°C)	(ft^3)	(m^3)	(mm H_2O)	(in H_2O)
30	0	35	1236	35	114	4.49
30	0	45	1412	40	143	5.63
30	1500	35	1483	42	136	5.39
30	3000	25	1554	44	132	5.20
45	0	35	1907	54	275	10.83
45	0	45	2207	62.5	335	13.19
45	1500	35	2278	64.5	322	12.68
45	3000	25	2401	68	319	12.56

When operated at frequencies above 6Mc/s, special attention must be given to the temperatures of the anode and grid seals. They are cooled by air flowing through the slots provided at the top of the cooler housing. In certain cases, particularly at low anode dissipations and when cooling with the minimum quantity of air, the flow of air to the seals will not be sufficient to maintain the seal temperatures below the maximum permitted value at frequencies above 6Mc/s. In these cases, a larger quantity of air must be supplied.

When using the special filament connectors, together with connecting leads of adequate cross-section, it is not, as a rule, necessary to provide additional air cooling of the filament terminals. In order to ensure uniform distribution of current, care must be taken to ensure firm contact with the filament terminals.

Water cooled anode, low velocity air flow on seals.

Maximum temperatures

Seals	180	^{o}C
Water inlet	50	^{o}C

The amount of water cooling required for these valves depends upon the anode dissipation and the temperature of the water. Typical values of rate of flow of water and pressure loss are given in the following table:

Anode dissipation	Maximum inlet temperature	*Minimum rate of flow of water		Pressure loss
(kW)	(^{o}C)	(l/min)	(gal/min)	(atm)
30	20	25	5.5	0.15
30	50	45	9.9	0.45
50	20	32	7.0	0.25
50	50	65	14.3	0.85
100	20	55	12.1	0.6
100	50	120	26.4	3.0

*Rate of flow of water for temperatures between 20 and 50°C can be determined by linear interpolation.

In order to ensure that the maximum seals temperature (180°C) is not exceeded it may be necessary to direct a flow of air on to the seals. This flow of air must commence on or before the application of the filament voltage.

Anode and grid seals may be cooled by connecting a blower of suitable size to the air inlet of the anti-corona ring attached to the valve. At frequencies below 6Mc/s, air cooling will not normally be necessary. Above 6Mc/s air cooling must be used in order to prevent overheating of the anode and grid seals. At the maximum frequency (30Mc/s) and the published operating conditions at least 2.5m^3(90 ft^3) per minute is required with a pressure loss of about 500mm (20in) of water.

When using the special filament connectors together with connecting leads of adequate cross-section it is not, as a rule, necessary to provide additional air cooling of the filament terminals. In order to ensure uniform distribution of current, care should be taken to ensure firm contact with the filament terminals.

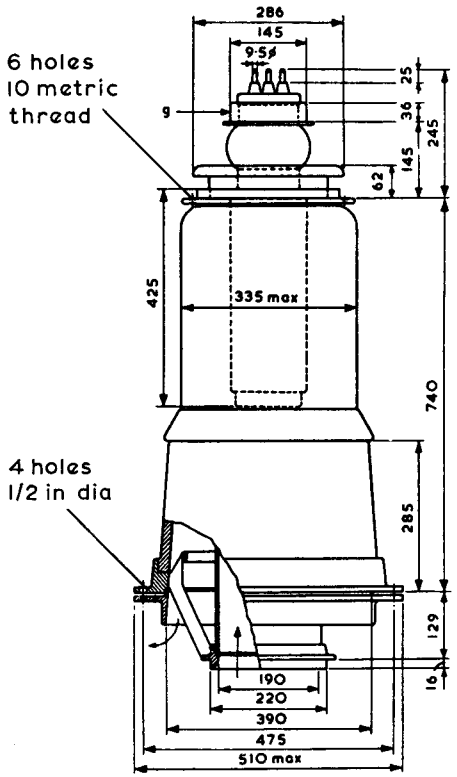
PHYSICAL DATA

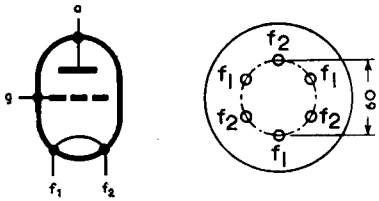
	TY12-50A	TY12-50W	TY12-50H	
Weight of valve	63	31	42	lb
	28.5	14	19	kg
Weight of water jacket	-	45	-	lb
	-	20.5	-	kg
Weight of cooler housing	159	-	-	lb
	72	-	-	kg
Weight of valve plus carton	214	180	-	lb
	97	82	-	kg

ACCESSORIES

Cooler housing (TY12-50A)	K506
Water jacket (TY12-50W)	K714
Filament clips × 6	40628

OUTLINE DRAWING OF TY12-50A MOUNTED IN COOLER HOUSING K506

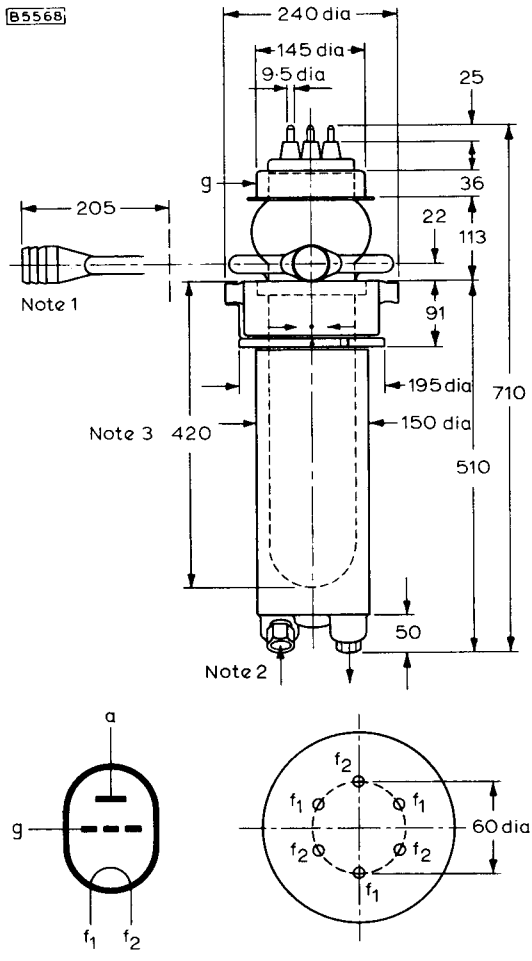




All dimensions in mm

B5619

OUTLINE DRAWING OF TY12-50W MOUNTED IN WATER JACKET K714

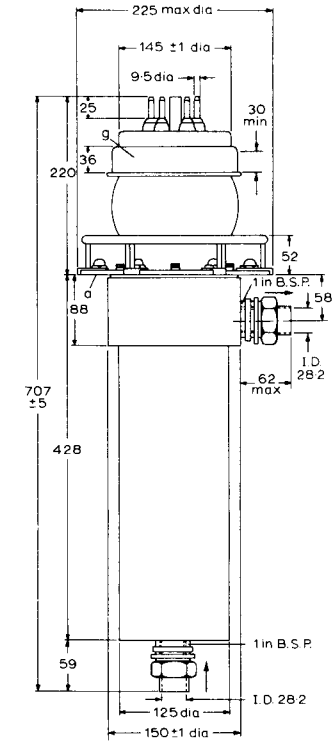


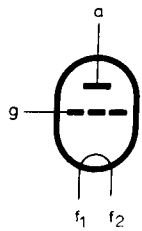
All dimensions in mm

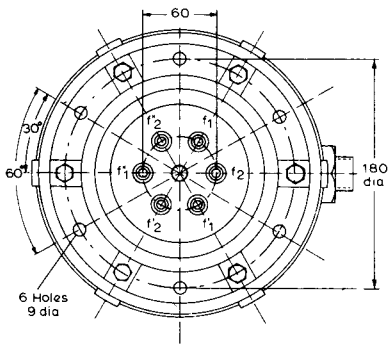
Notes

1. A connecting hose with an inner diameter of 44.5mm (1.75in) is required.
2. Coupling for metal tubing with an outer diameter of 28mm (1.10in).
3. To remove the valve from its water jacket a free height of 420mm (16.54in) above the valve is required.

OUTLINE DRAWING OF TY12-50H

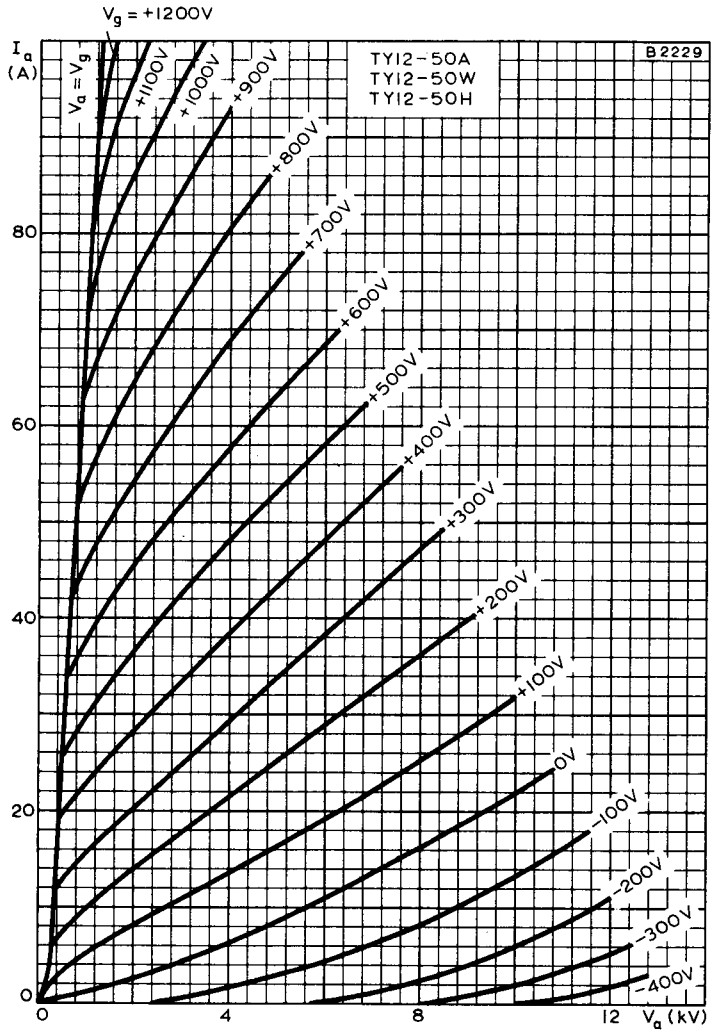




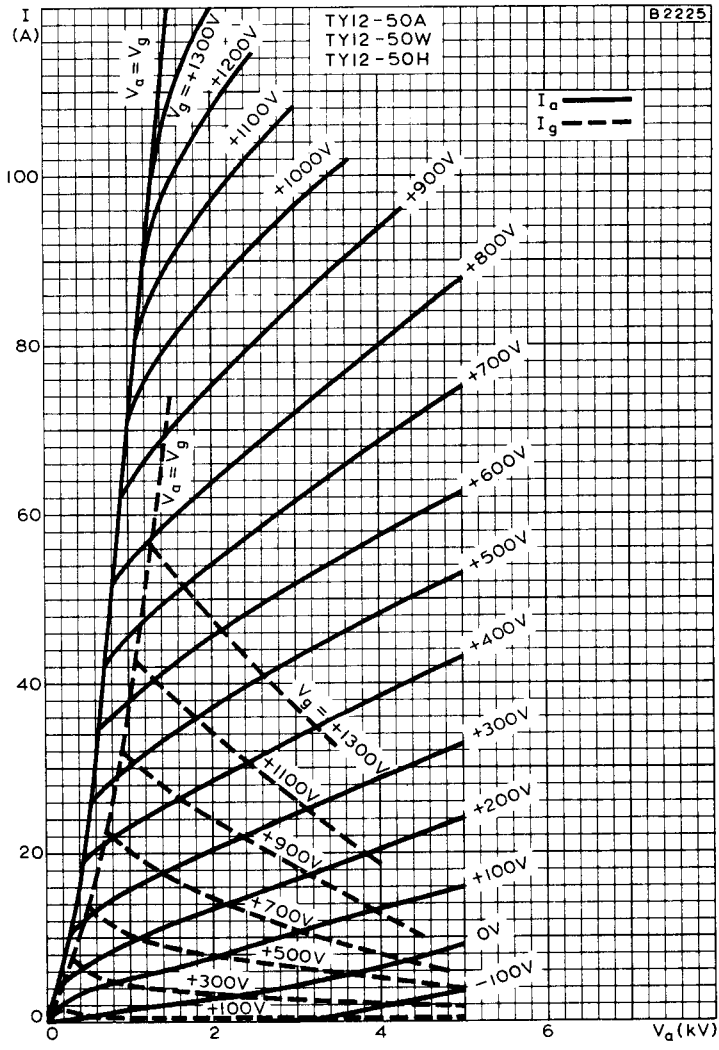


All dimensions in mm

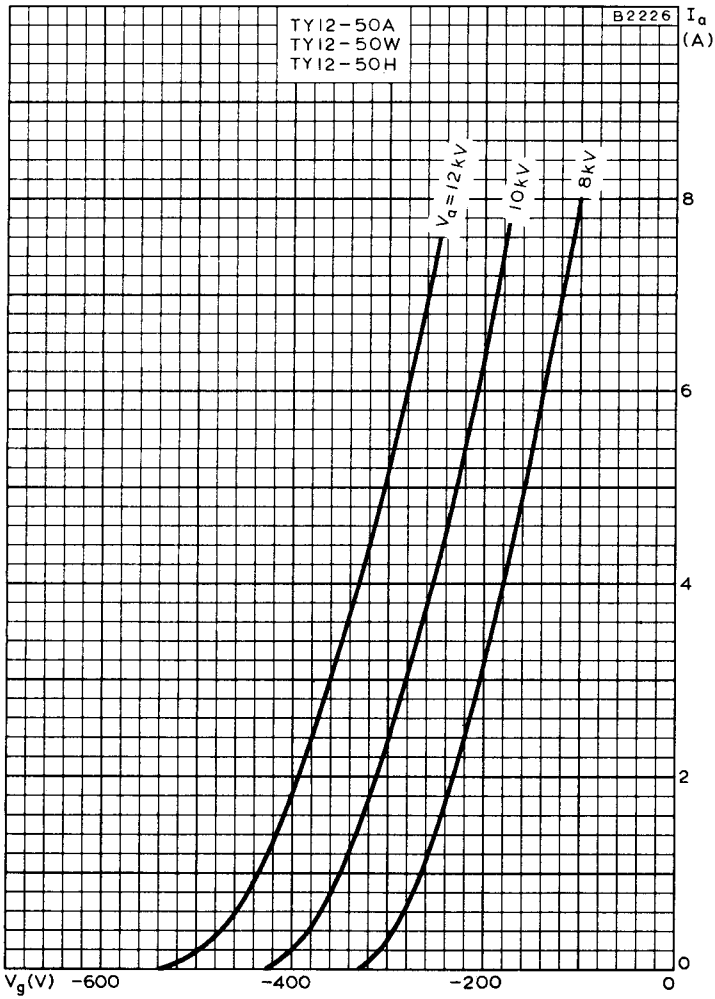
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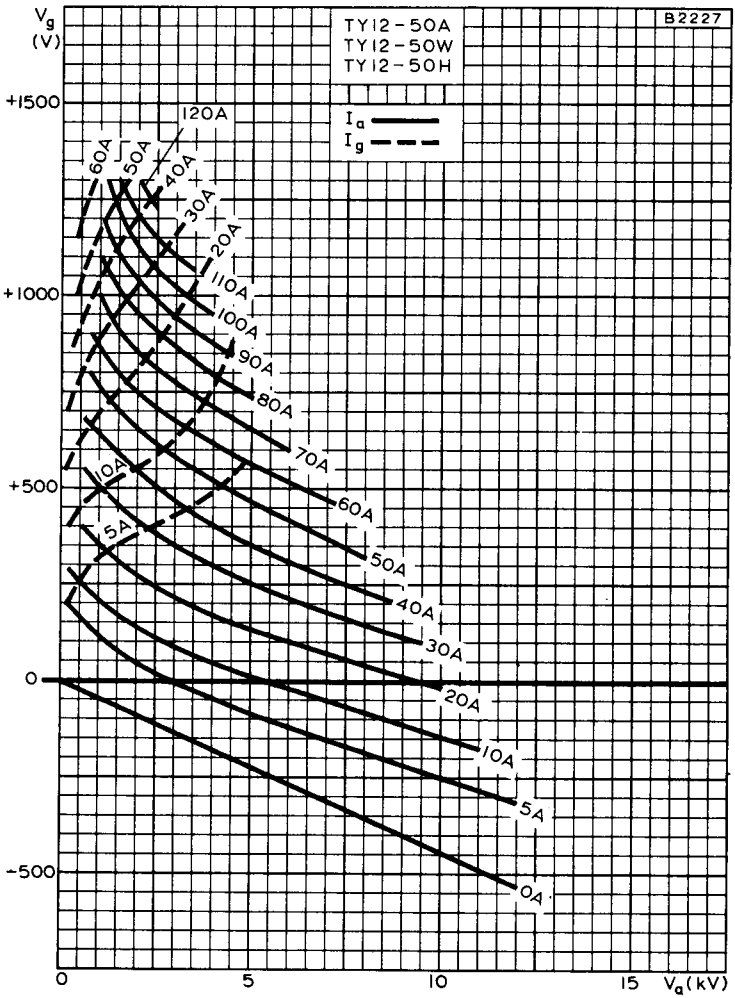
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER



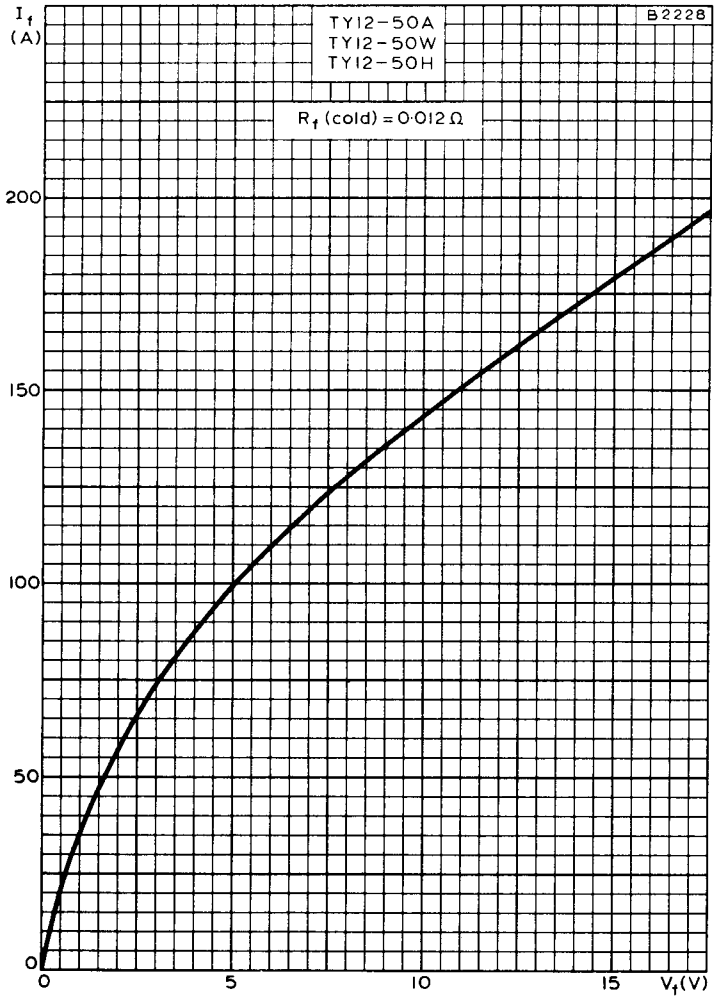
ANODE AND GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER



CONSTANT CURRENT CHARACTERISTICS



FILAMENT CURRENT PLOTTED AGAINST FILAMENT VOLTAGE

V.H.F. POWER TRIODE

TY2-125

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

This data should be read in conjunction with "Operating Notes, Part 1—Power Valves" included in this volume of the Handbook.

FILAMENT Thoriated tungsten

V_f	6.3	V
I_f	5.4	A

MOUNTING POSITION Vertical only, base up or down.

CAPACITANCES

c_{a-g}	5.5	$\mu\mu$F
c_{g-f}	5.5	$\mu\mu$F
c_{a-f}	0.1	$\mu\mu$F

CHARACTERISTICS (Measured at V_a=2.5 kV; I_a=44 mA)

g_m	2.8	mA/V
μ	25	

COOLING

Maximum temperature of base pins	180	°C
Maximum temperature of anode seal	220	°C

When the valve is operated at near maximum ratings it is possible that the maximum temperature limits may be exceeded, in which case an air flow of up to 5 cu. ft. (150 litres) per minute must be directed towards the centre of the valve base.

An anode terminal connector having a large area is necessary in order to keep the anode seal cool.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "B" TELEPHONY)

Limiting Values

V_a max.	2.5	kV
p_a max. (corresponding to an anode temperature of 850°C i.e. red heat)	135	W
p_g max.	16	W
I_k max.	250	mA
$i_{k(pk)}$ max.	1.6	A
R_{g-f} max. (fixed bias)	100	k Ω
R_{g-f} max. (automatic bias)	200	k Ω

TY2-125

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

Typical Operating Conditions

f	≦150	≦150	≦150	≦200	Mc/s
V_a	1.5	2.0	2.5	2.0	kV
V_g	–45	–67	–87	–67	V
I_a	120	97	77	97	mA
$v_{in(pk)}$	100	100	100	100	V
p_a	121	130	128	134	W
P_{out}	59	64	65	60	W
η	33	33	34	31	%
*P_{load}	47	51	52	48	W
For 100% Modulation					
I_g	52	28	20	28	mA
P_{drive}	9.4	5.1	3.6	8.0	W

*With a circuit Transfer Efficiency of 80%

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER OSCILLATOR OR AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	2.5	kV
p_a max. (corresponding to an anode temperature of 850°C i.e. red heat)	135	W
p_g max.	16	W
I_k max.	250	mA
$i_{k(pk)}$ max.	1.6	A
R_{g-f} max. (fixed bias)	100	k Ω
R_{g-f} max. (automatic bias)	200	k Ω

Typical Operating Conditions

f	≦150	≦150	≦150	≦150	≦200	Mc/s
V_a	1.0	1.5	2.0	2.5	2.0	kV
V_g	–80	–110	–150	–200	–150	V
I_a	205	205	205	205	175	mA
I_g	40	40	40	40	35	mA
$v_{in(pk)}$	260	300	340	390	300	V
p_a	79	98	115	122	105	W
P_{drive}	10	11	13	14	20	W
P_{out}	126	210	295	390	245	W
η	61.5	68	72	76	70	%
*P_{load}	100	168	236	312	196	W

*With a circuit Transfer Efficiency of 80%

V.H.F. POWER TRIODE

TY2-125

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

OPERATING CONDITIONS FOR TWO VALVES AS R.F. POWER AMPLIFIER (CLASS "C" ANODE MODULATION)

Limiting Values

V_a max.	2.0	kV
p_a max. (corresponding to an anode temperature of 850°C i.e. red heat)	135	W
p_g max.	16	W
I_k max.	250	mA
$i_{k(pk)}$ max.	2.5	A
R_{g_f} max. (fixed bias)	100	k Ω
R_{g_r} max. (automatic bias)	200	k Ω

Typical Operating Conditions

f	≤150	≤150	≤150	≤200	Mc/s
V_a	1.0	1.5	2.0	1.5	kV
V_g	−130	−180	−225	−180	V
I_a	2×127	2×127	2×127	2×127	mA
I_g	2×40	2×40	2×40	2×40	mA
$v_{in(g-g)pk}$	640	740	830	740	V
P_{drive}	2×11.5	2×13.5	2×15	2×21	W
p_a	2×32	2×38	2×51	2×41	W
P_{out}	190	306	408	300	W
η	74	80	80	78	%
*P_{load}	152	245	325	240	W
For 100% Modulation					
P_{mod}	126	191	255	191	W

*With a circuit Transfer Efficiency of 80%

OPERATING CONDITIONS FOR TWO VALVES AS GROUNDED GRID R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	2.5	kV
p_a max. (corresponding to an anode temperature of 850°C i.e. red heat)	135	W
p_g max.	16	W
I_k max.	250	mA
$i_{k(pk)}$ max.	1.6	A
R_{g_f} max. (fixed bias)	100	k Ω
R_{g_r} max. (automatic bias)	200	k Ω

TY2-125

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

Typical Operating Conditions at f ≦150 Mc/s

V_a	1.0	1.5	2.0	2.5	kV
V_g	−80	−110	−150	−200	V
I_a	2×205	2×205	2×205	2×205	mA
I_g	2×40	2×40	2×40	2×40	mA
$v_{in(g-g)pk}$	520	600	680	780	V
P_{drive}	2×50	2×59	2×68	2×79	W
p_a	2×79	2×97	2×115	2×122	W
*P_{out}	252+80	420+96	590+110	780+130	W
†η	61.5	68	72	76	%
‡P_{load}	265	410	560	730	W

*Includes power transferred from driver stage.

†Valve efficiency.

‡With a Circuit Transfer Efficiency of 80%.

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL AS CLASS "B" A.F. POWER AMPLIFIER OR MODULATOR (With I_{g1})

Limiting Values

V_a max.	2.5	kV
p_a max.	135	W
p_g max.	16	W
I_k max.	250	mA
$i_{k(pk)}$ max.	1.6	A
R_{g-f} max. (fixed bias)	100	kΩ
R_{g-f} max. (automatic bias)	200	kΩ

Typical Operating Conditions

V_a	1.0	1.5	2.0	2.5	kV
V_g	−23	−46	−65	−86	V
$I_{a(o)}$	2×30	2×30	2×30	2×30	mA
I_a (max.sig.)	2×210	2×210	2×208	2×178	mA
I_g	2×40	2×40	2×42	2×42	mA
$V_{in(g-g)\ r.m.s.}$	210	240	280	295	V
P_{drive}	2×7.5	2×6.0	2×7.5	2×8.0	W
p_a	2×73	2×90	2×101	2×95	W
P_{out}	274	450	630	700	W
R_{a-a}	5.0	8.5	12	18.2	kΩ
η	65	71.5	76	78.5	%
D_{tot}	2.2	2.9	3.7	5.0	%

V.H.F. POWER TRIODE

TY2-125

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

INDUSTRIAL RATINGS

Limiting Values (Absolute Ratings)

f max.	150	Mc/s
$V_{a(d.c.)}$ max.	2.5	kV
$v_{a(pk)}$ a.c. max.	4.0	kV
I_a max.	200	mA
$i_{a(pk)}$ a.c. max.	260	mA
p_a max.	135	W
I_g max. (at p_a max.)	40	mA
I_g max. (at 25% p_a max.)	50	mA
$R_{g.\,f}$ max.	15	k Ω

DIELECTRIC HEATER WITHOUT PROTECTION

Recommended rated operating condition for a dielectric heater employing single phase, full wave rectification (unsmoothed) for the anode supply.

f	150	Mc/s
$V_{transformer\ (r.m.s.)}$	2500–0–2500	V
V_a	2.24	kV
P_{in}	310	W
I_a	112	mA
I_g	33	mA
R_{g-f}	6.0	k Ω
p_a (at 72% η)	87	W
P_{out} (less P_{drive})	203	W
*P_{load}	162	W

*With a circuit transfer efficiency of 80%.

DIELECTRIC HEATER WITH PROTECTION

Operating condition for a dielectric heater employing single-phase full wave rectification (unsmoothed) for the anode supply and incorporating the maximum protection for the valve against overload, under drive and inefficient operation.

f	150	Mc/s
$V_{transformer\ (r.m.s.)}$	2500–0–2500	V
V_a	2.24	kV
P_{in}	480	W
I_a	173	mA
I_g	36	mA
R_{g-f}	5.5	k Ω
p_a (at 72% η)	135	W
P_{out} (less P_{drive})	325	W
*P_{load}	260	W

*With a circuit transfer efficiency of 80%.

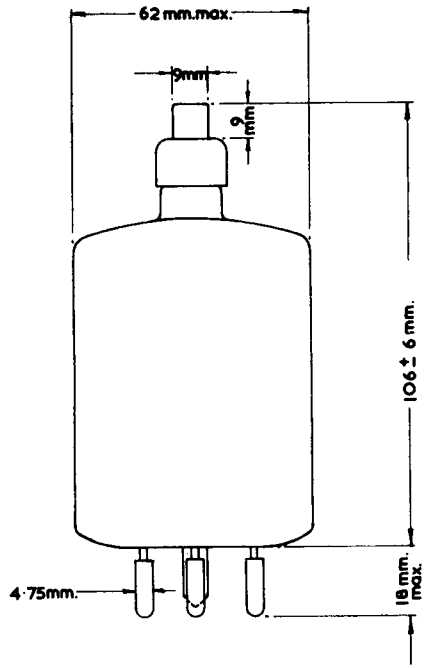
WEIGHT

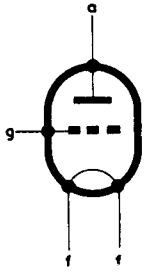
Valve only	4	ozs
	110	g

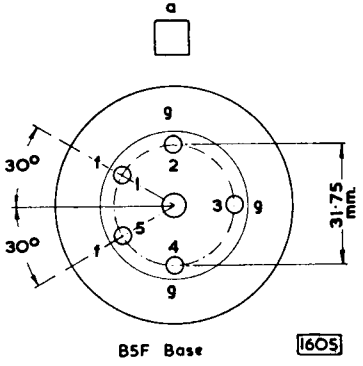
TY2-125

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.







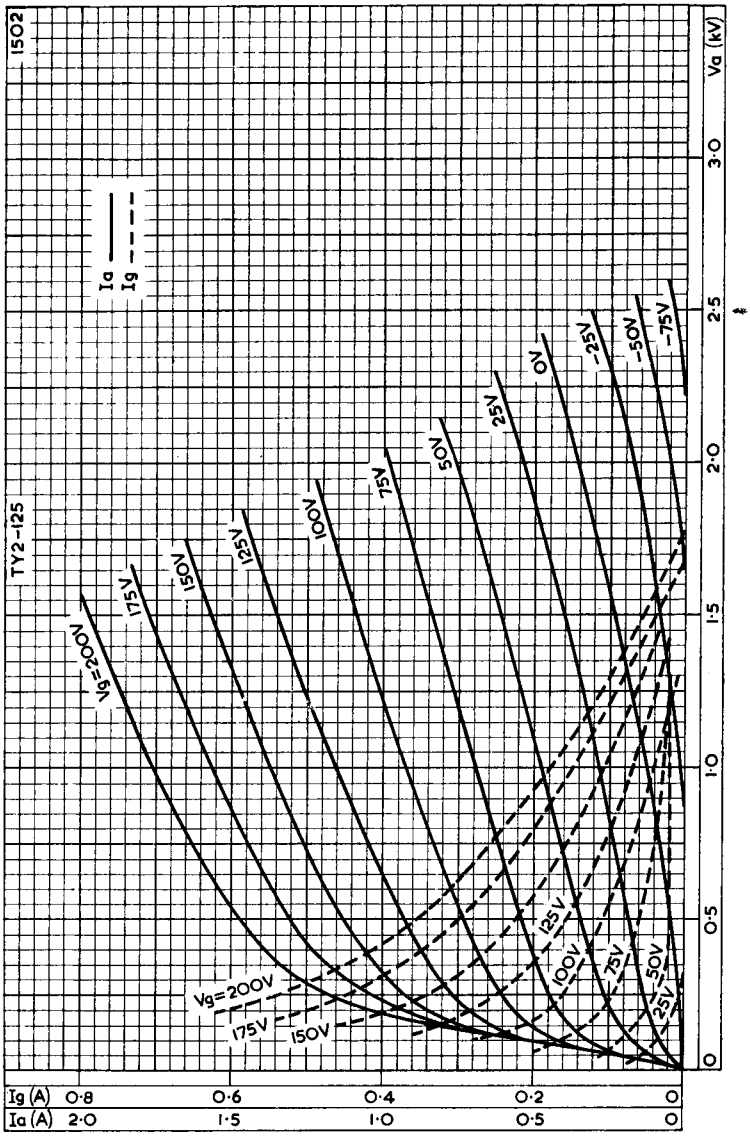
B5F Base

1605

V.H.F. POWER TRIODE

TY2-125

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

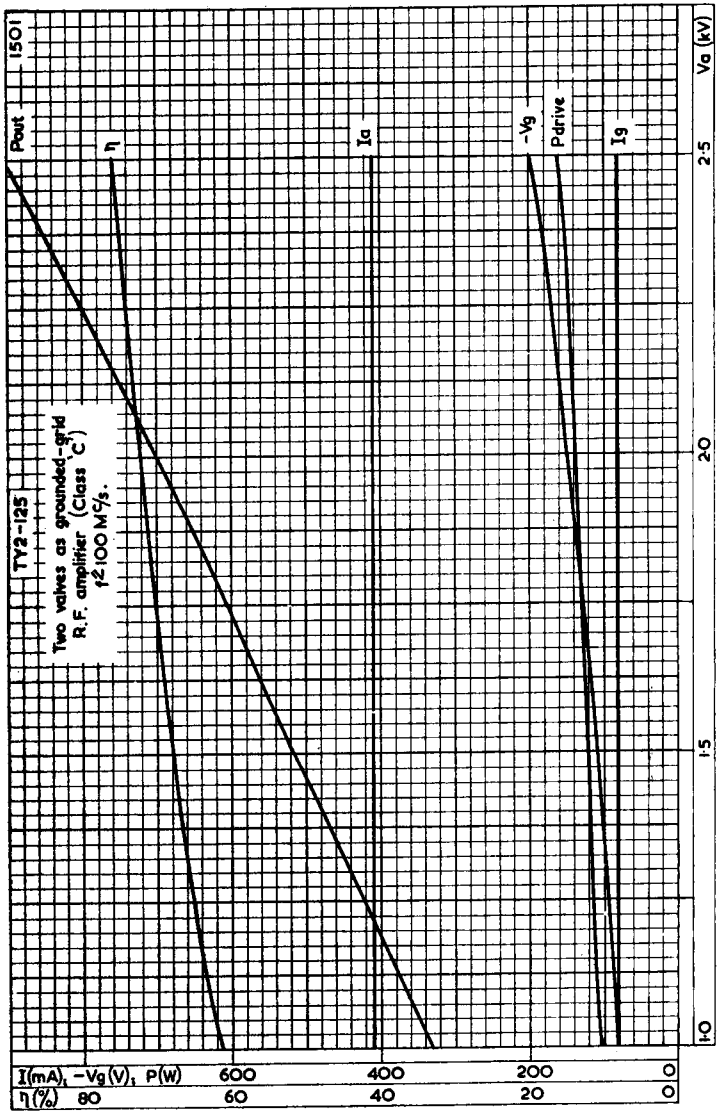


ANODE AND GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

TY2-125

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

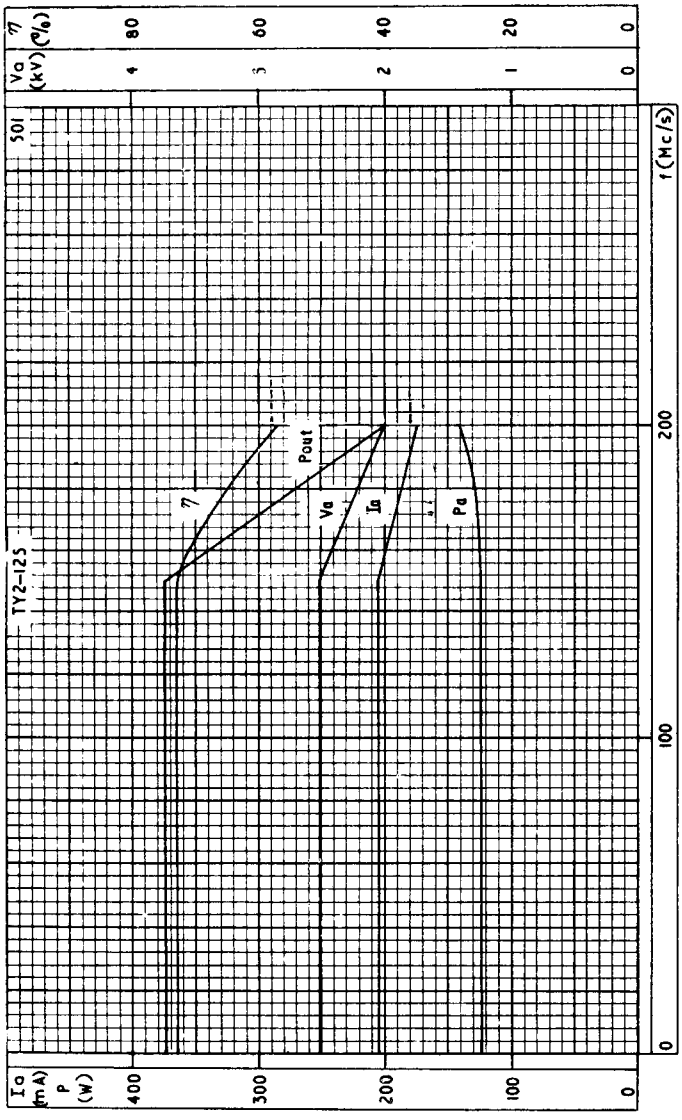


TWO VALVES AS CLASS "C" GROUNDED-GRID R.F. AMPLIFIER

V.H.F. POWER TRIODE

TY2-125

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

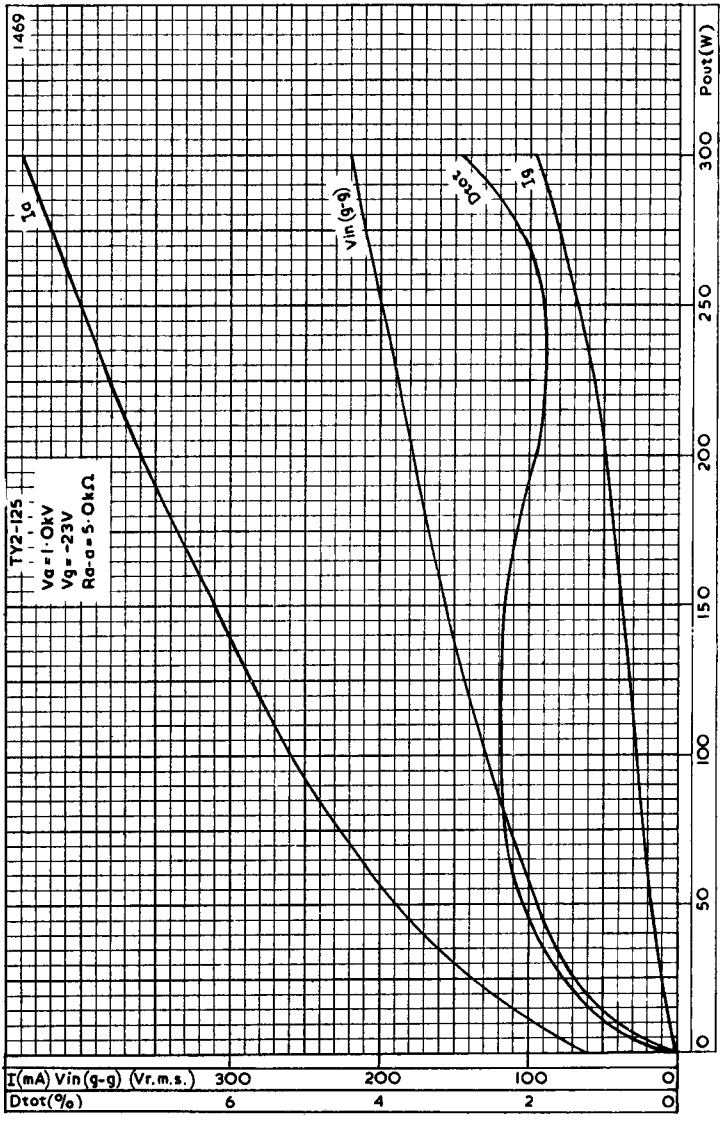


FREQUENCY CHARACTERISTICS

TY2-125

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

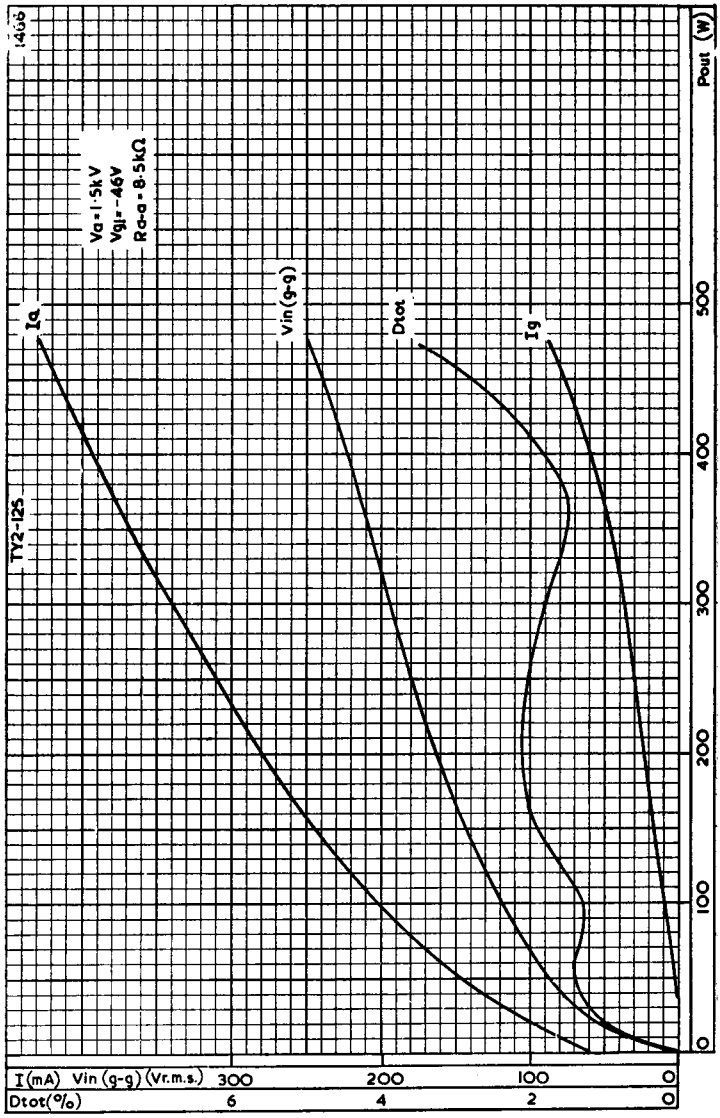


TWO VALVES AS CLASS "B" A.F. AMPLIFIER V_a=1.0 kV

V.H.F. POWER TRIODE

TY2-125

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

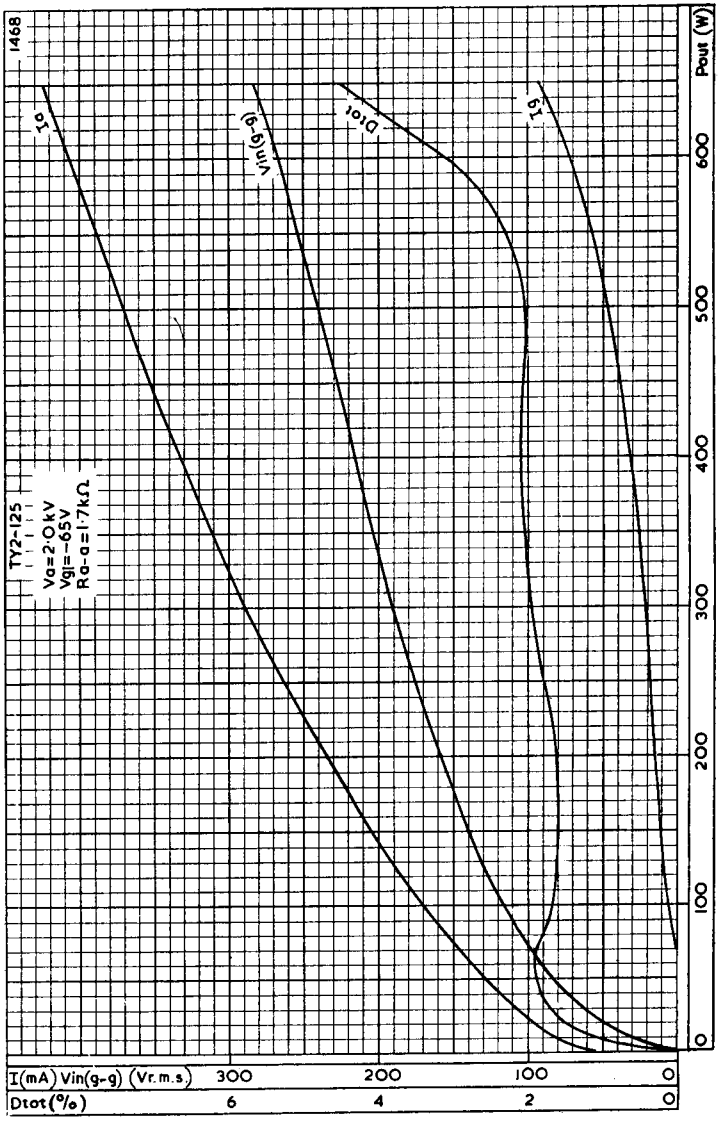


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. $V_a = 1.5$ kV

TY2-125

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.

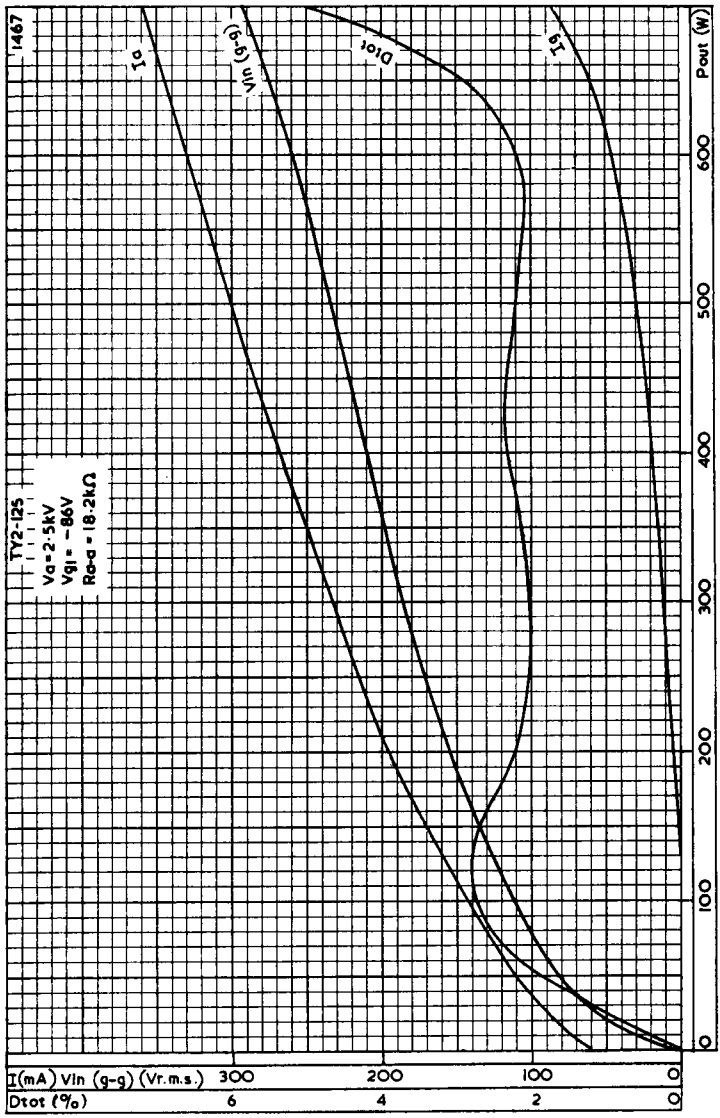


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=2.0 kV

V.H.F. POWER TRIODE

TY2-125

All-glass triode rated for a maximum anode dissipation of 135 W and suitable for use at frequencies up to 200 Mc/s.



TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=2.5 kV

V.H.F. POWER TRIODE

TY3-250

All-glass triode rated for a maximum anode dissipation of 250W and suitable for use at frequencies up to 150 Mc/s.

This data should be read in conjunction with "Operating Notes, Part I—Power Valves" included in this volume of the Handbook.

FILAMENT Thoriated tungsten.

V_f	5.0	V
I_f	14	A

MOUNTING POSITION Vertical, base up or down.

CAPACITANCES

c_{a-f}	0.15	$\mu\mu$F
c_{g-f}	7.0	$\mu\mu$F
c_{a-g}	5.3	$\mu\mu$F

CHARACTERISTICS (Measured at I_a=90 mA)

g_m	5.0	mA/V
μ	25	

COOLING

Maximum temperature of base pins	180	°C
Maximum temperature of anode seal	220	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the anode seal and the base of the valve when operated at frequencies above 30 Mc/s. The air stream on to the base should be directed so that it also passes over the envelope. Below 30 Mc/s radiation cooling from the envelope is sufficient but an anode terminal connection of large surface area is necessary in order to keep the anode seal cool.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	3.0	kV
p_a max.	250	W
p_g max.	30	W
I_k max.	480	mA
$i_{k(pk)}$ max.	3.0	A
R_{g-f} max.	100	k Ω

Typical Operating Conditions at f ≦100 Mc/s

V_a	1.5	2.0	2.5	3.0	kV
V_g	–120	–150	–200	–250	V
I_a	400	400	400	365	mA
I_g	80	80	69	69	mA
$v_{in(pk)}$	295	320	380	430	V
P_{drive}	22	23	24	27	W
p_a	175	215	250	250	W
P_{out}	425	585	750	845	W
η	71	73	75	77	%
*P_{load}	340	470	600	670	W

*With a circuit transfer efficiency of 80%

TY3-250

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 250W and suitable for use at frequencies up to 150 Mc/s.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "B" TELEPHONY)

Limiting Values

V_a max.	3.0	kV
p_a max.	250	W
p_g max.	30	W
I_k max.	300	mA
$i_{k(pk)}$ max.	1.5	A
R_{g-f} max.	100	k Ω

Typical Operating Conditions at f ≦100 Mc/s

V_a	2.0	2.5	3.0	kV
V_g	–70	–90	–110	V
I_a	188	153	130	mA
$v_{in(pk)}$	86	89	91	V
p_a	250	250	250	W
P_{out}	126	133	140	W
η	33	35	36	%
*P_{load}	100	106	112	W
For 100% Modulation				
I_g	85	70	62	mA
P_{drive}	13.2	11.3	10.2	W

*With a circuit transfer efficiency of 80%

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "C" ANODE MODULATION)

Limiting Values

V_a max.	2.5	kV
p_a max.	250	W
p_g max.	30	W
I_k max.	350	mA
$i_{k(pk)}$ max.	3.0	A
R_{g-f} max.	100	k Ω

Typical Operating Conditions at f ≦100 Mc/s

V_a	2.0	2.5	kV
V_g	–225	–300	V
I_a	250	250	mA
I_g	70	70	mA
$v_{in(pk)}$	370	440	V
P_{drive}	24	28	W
p_a	125	143	W
P_{out}	375	482	W
η	75	77	%
*P_{load}	300	385	W
For 100% Modulation			
P_{mod}	250	312	W

*With a circuit transfer efficiency of 80%

V.H.F. POWER TRIODE

TY3-250

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

OPERATING CONDITIONS FOR TWO VALVES AS GROUNDED GRID R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	3.0	kV
p_a max.	250	W
p_g max.	30	W
I_k max.	480	mA
$i_{k(pk)}$ max.	3.0	A
R_{g-f} max.	100	k Ω

Typical Operating Conditions at f ≦100 Mc/s

V_a	1.5	2.0	2.5	3.0	kV
V_g	−120	−150	−200	−250	V
I_a	2×400	2×400	2×400	2×363	mA
I_g	2×80	2×80	2×69	2×69	mA
$V_{in(g-g)\ pk}$	590	640	760	860	V
P_{drive}	2×116	2×125	2×147	2×155	W
*P_{out}	850+190	1170+204	1500+247	1680+256	W
†η	71	73	75	77	%
‡P_{load}	830	1100	1400	1550	W

*Includes power transferred from driver stage.

†Valve efficiency.

‡With a circuit transfer efficiency of 80%.

OPERATING CONDITIONS FOR TWO VALVES AS A.F. CLASS "B" AMPLIFIER OR MODULATOR

Limiting Values

V_a max.	3.0	kV
p_a max.	250	W
p_g max.	30	W
I_k max.	480	mA
$i_{k(pk)}$ max.	3.0	A
R_{g-f} max.	100	k Ω

Typical Operating Conditions

V_a	1.5	2.0	2.5	3.0	kV
V_g	−47.5	−68.5	−90	−110	V
$I_{a(o)}$	2×50	2×50	2×50	2×50	mA
I_a (max. sig.)	2×390	2×390	2×335	2×280	mA
I_g	2×90	2×90	2×70	2×60	mA
$V_{in(g-g)\ r.m.s.}$	2×132	2×150	2×155	2×165	V
R_{a-a}	4.65	6.45	9.65	14.2	k Ω
p_a	2×155	2×180	2×180	2×180	W
P_{out}	860	1200	1300	1340	W
D_{tot}	3.0	3.2	3.6	4.4	%

TY3-250

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

INDUSTRIAL RATINGS

Limiting Values (Absolute Ratings)

V_a max.	3.0	kV
p_a max.	250	W
p_g max.	30	W
I_k max.	480	mA
$i_{k(pk)}$ max.	3.0	A
R_{g-f} max.	100	k Ω

Operating conditions providing reserves against such exigencies as variations of supply voltages, insertion of load material of poor power factor and *momentary* overload due to circuit flash-over. A reliable overload circuit breaker is necessary to protect the valve in case oscillation ceases for any reason.

Anode Supply	Smoothed d.c.	F.W. rectification unsmoothed	
$V_{transformer\ (r.m.s.)}$	—	2700–0–2700	V
V_a	2.7	2.43	kV
I_a	250	225	mA
I_g	85	76	mA
I_g (I_a=100 mA)	110	90	mA
R_{g-f}	3.5	3.5	k Ω
P_{drive}	33	33	W
p_a	160	160	W
P_{out}	513	513	W
*P_{load}	370	370	W
†P_{load} (with poor load)	310	310	W
†p_a	250	250	W

*With a circuit transfer efficiency of 75%.

†This condition can result from setting up a dielectric heater to treat a normal load of say, phenolic resin and substituting a similar weight of a different powder of different electrical characteristics.

Operating conditions for a valve fully protected against every contingency.

Anode Supply	Smoothed d.c.	F.W. Rectification unsmoothed	
$V_{transformer\ (r.m.s.)}$	—	3000–0–3000	V
V_a	3.0	2.7	kV
I_a	363	327	mA
I_g	70	63	mA
R_{g-f}	3.5	3.5	k Ω
P_{drive}	27	27	W
p_a	250	250	W
P_{out}	840	840	W
*P_{load}	630	630	W

*With a circuit transfer efficiency of 75%.

V.H.F. POWER TRIODE

TY3-250

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

WEIGHT

Valve only	6	ozs
	170	g

CIRCUIT NOTES

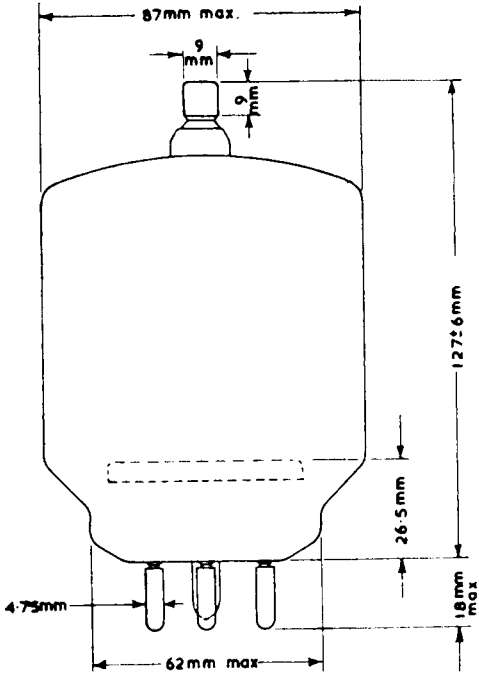
1. The R F. circuit returns must be brought to the filament connection on Pin No. 1.

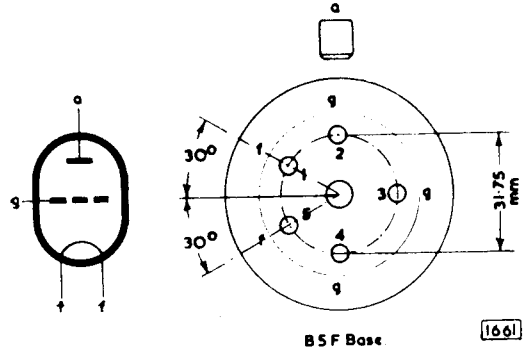
2 To ensure equal distribution of the currents through the seal the grid leads should be strapped together at the valve holder and the circuit connections joined to the midpoint of the strap. This should not be allowed to impair the free flotation of individual contacts.

TY3-250

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.





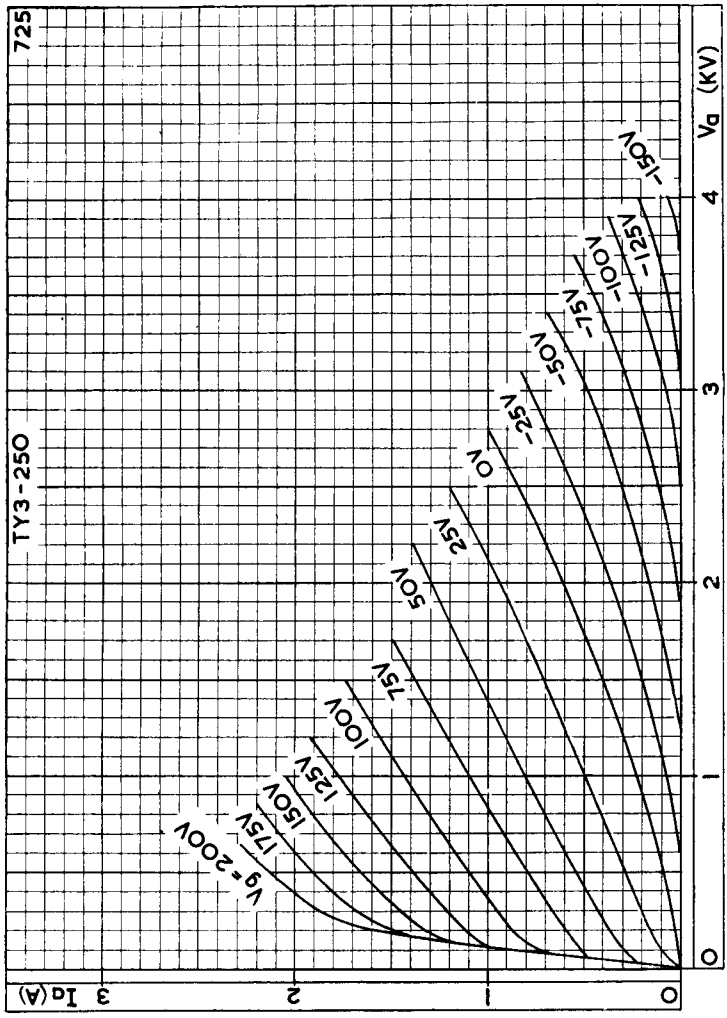
B5F Base

1661

V.H.F. POWER TRIODE

TY3-250

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

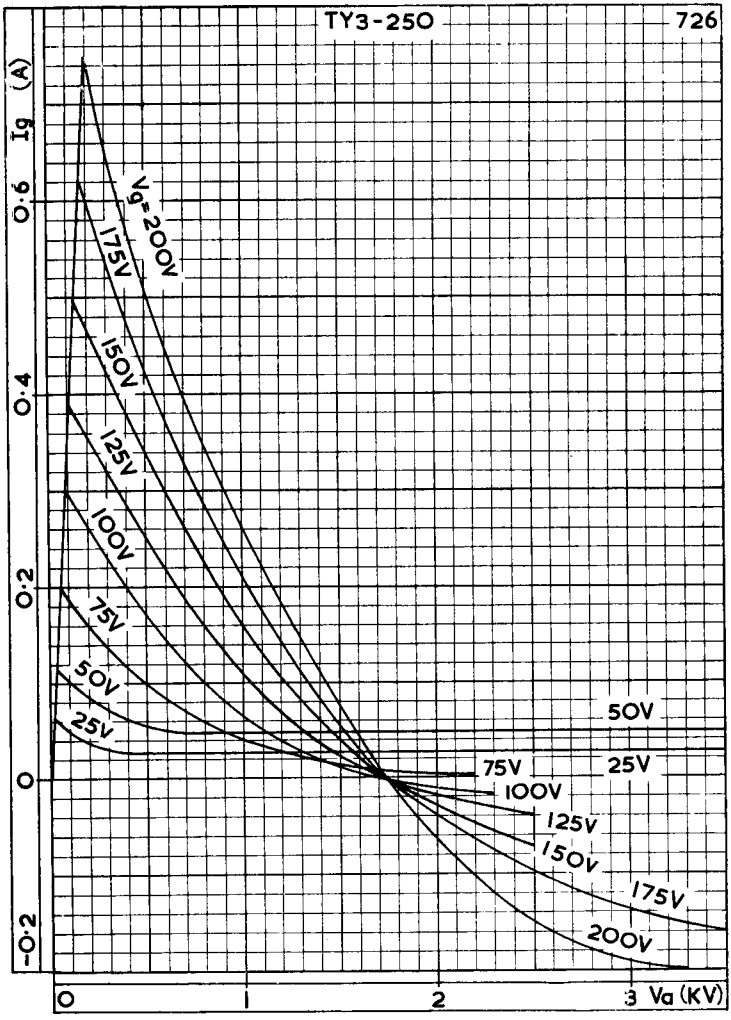


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

TY3-250

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

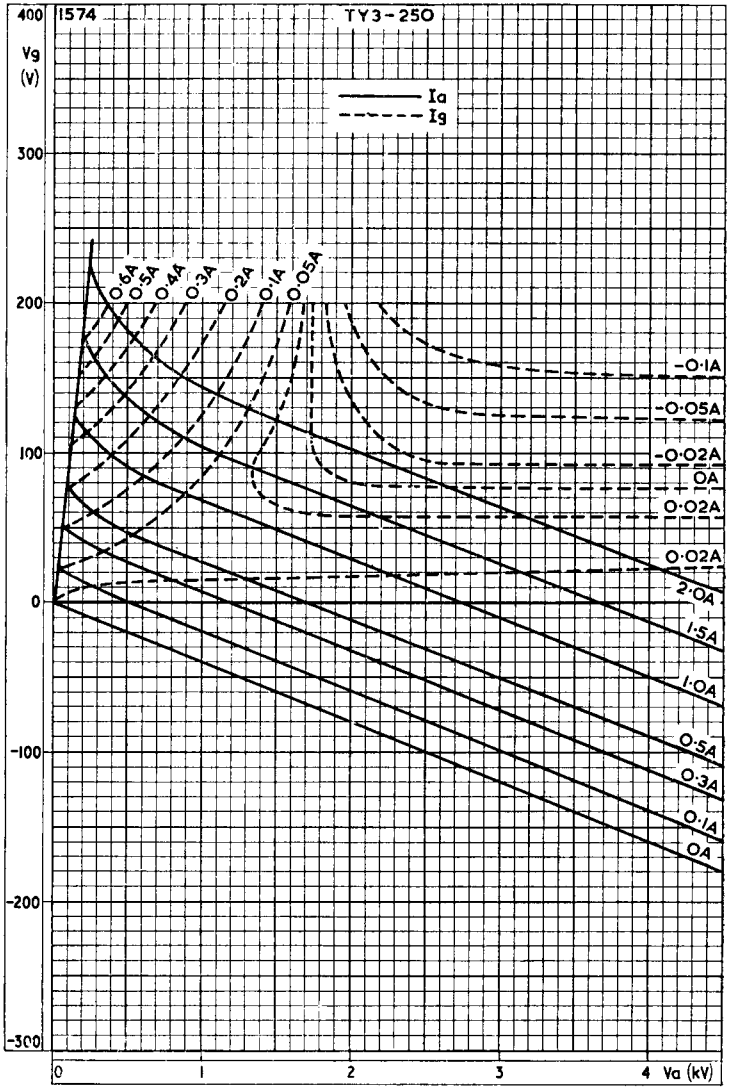


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

V.H.F. POWER TRIODE

TY3-250

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

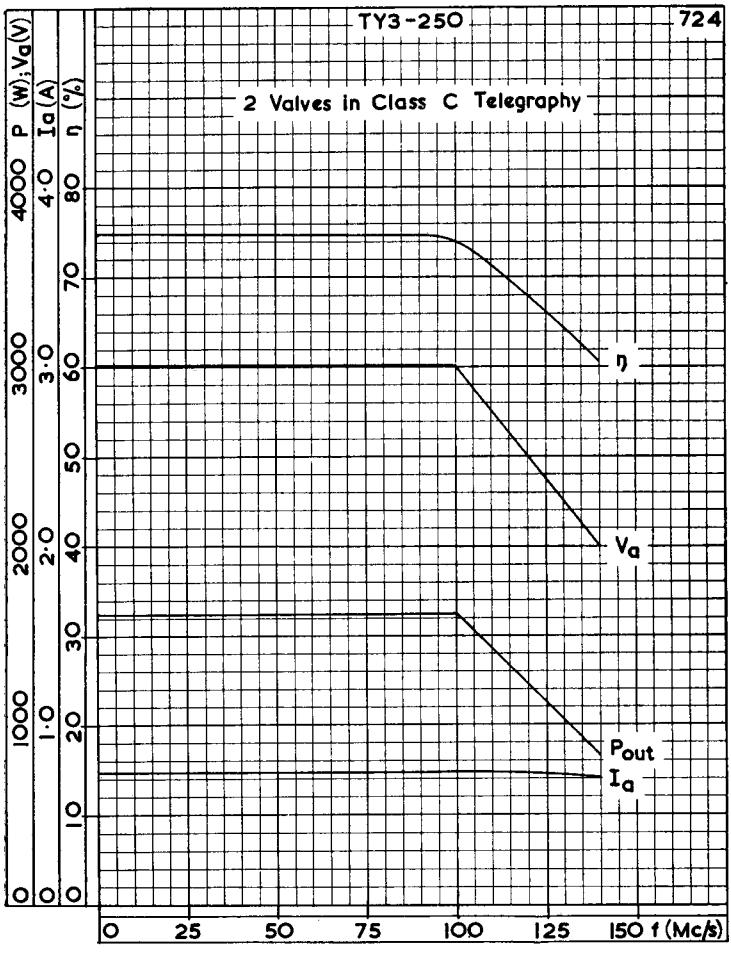


CONSTANT CURRENT CURVES

TY3-250

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

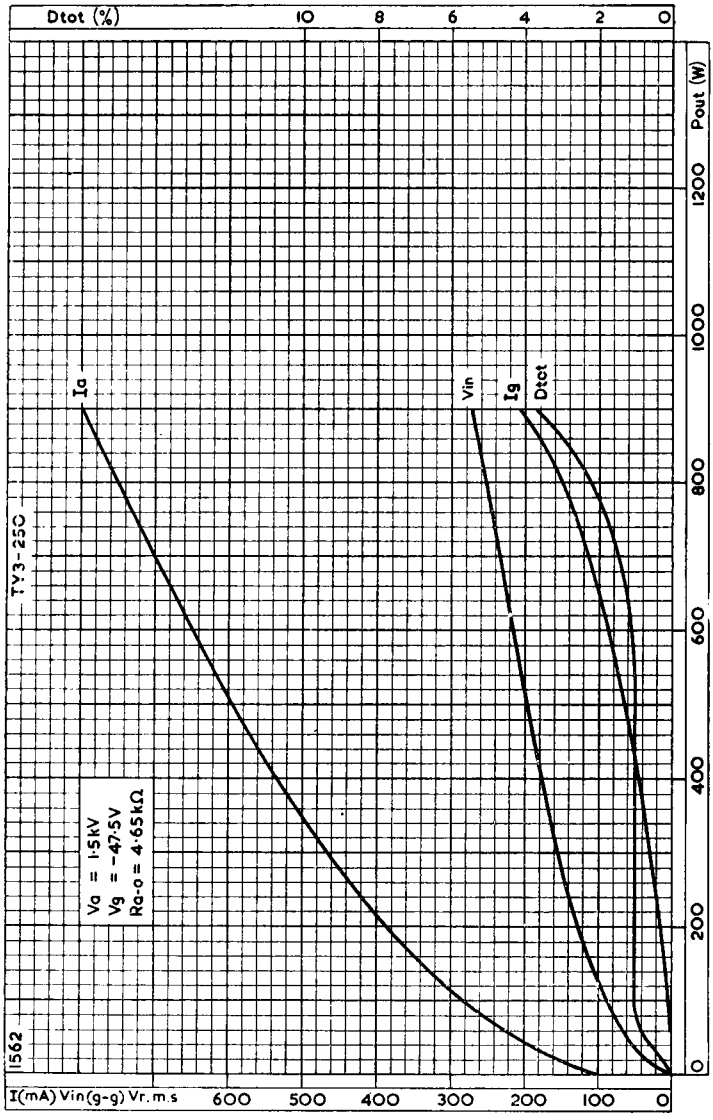


FREQUENCY CHARACTERISTICS

V.H.F. POWER TRIODE

TY3-250

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

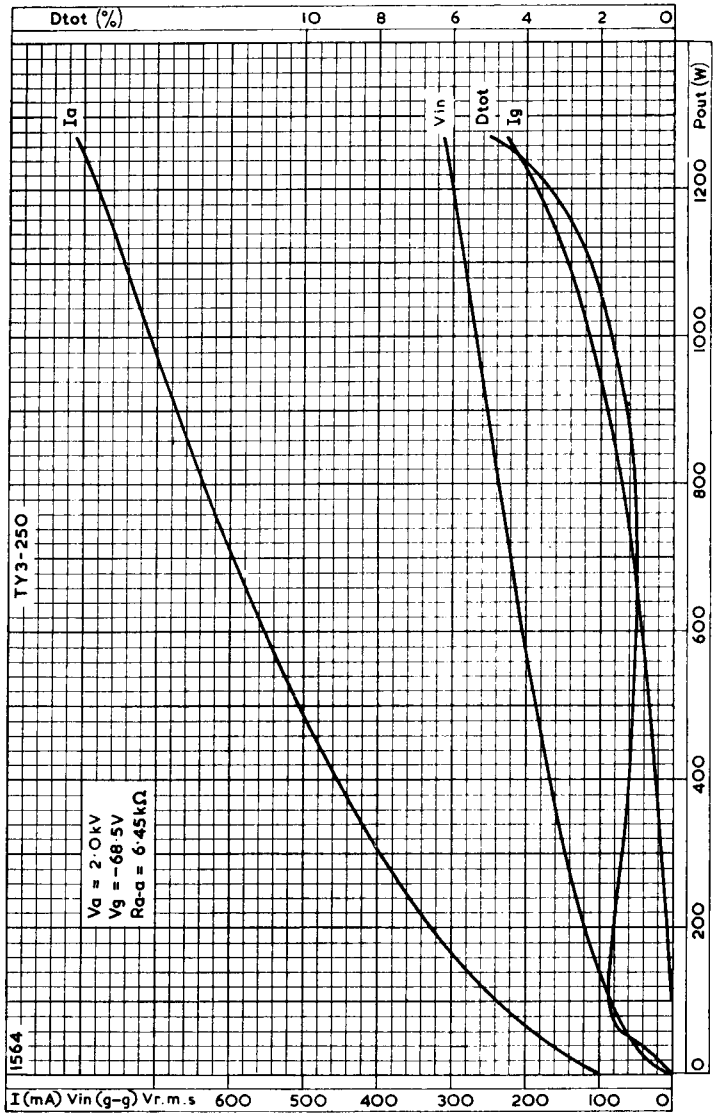


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=1.5 kV

TY3-250

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

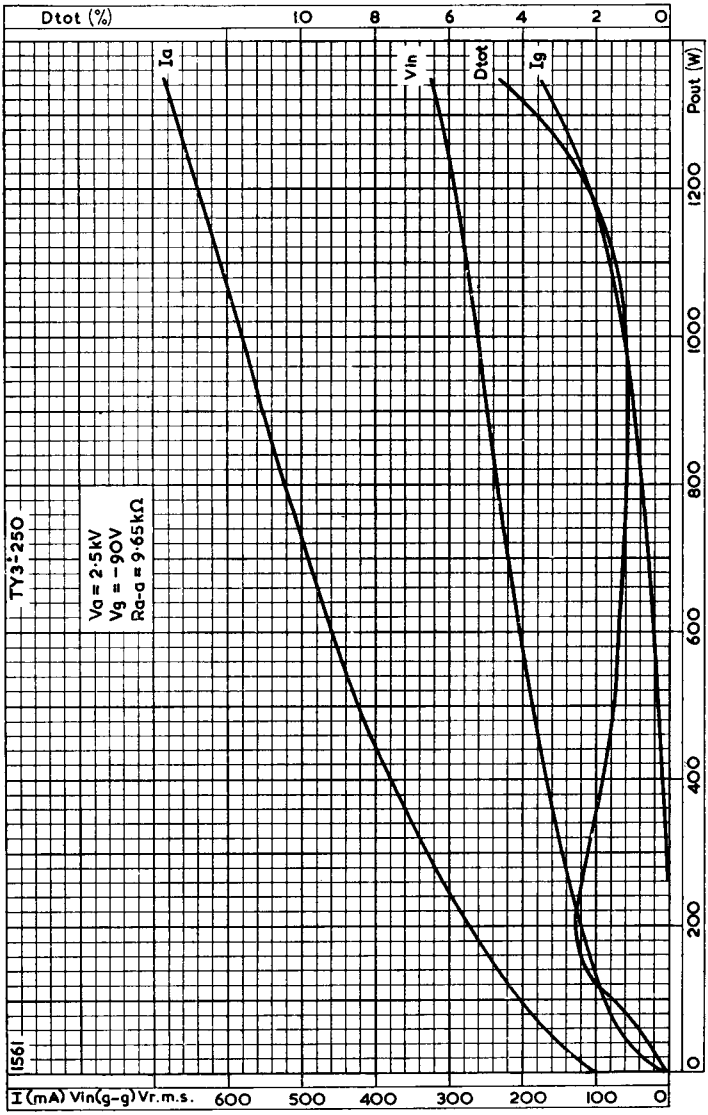


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. $V_a = 2.0$ kV

V.H.F. POWER TRIODE

TY3-250

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.

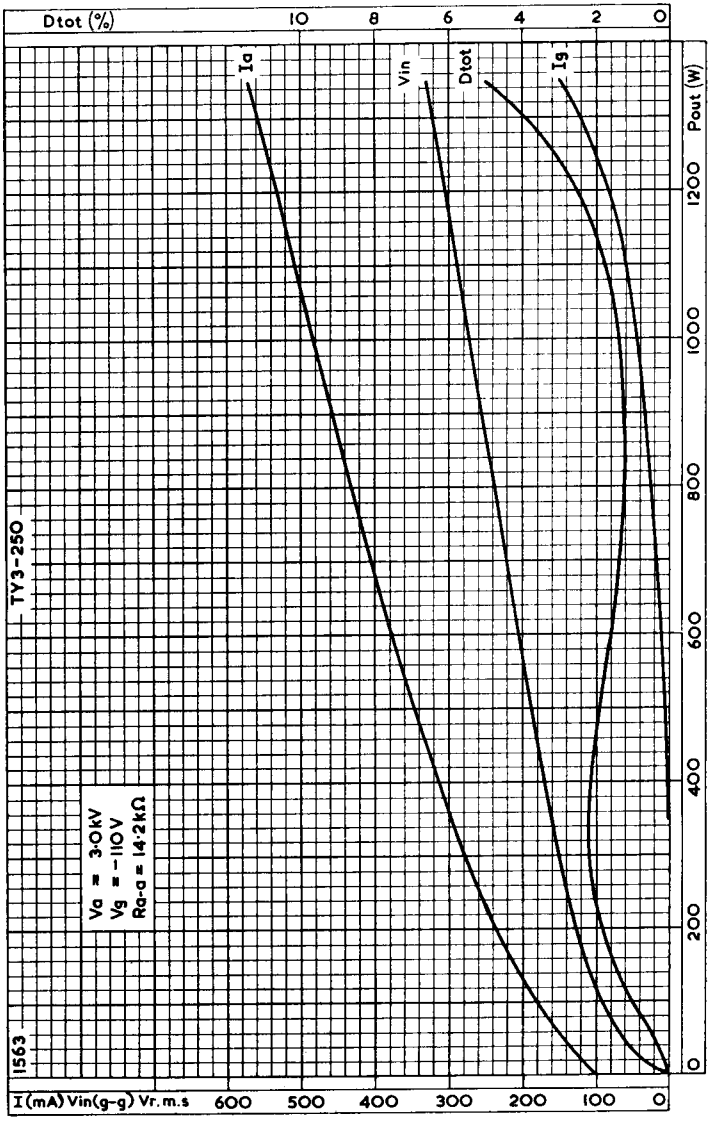


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=2.5 kV

TY3-250

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 250 W and suitable for use at frequencies up to 150 Mc/s.



TWO VALVES AS CLASS "B" A.F. AMPLIFIER. $V_a = 3.0$ kV

V.H.F. POWER TRIODE

TY4-350

All-glass triode rated for a maximum anode dissipation of 400W, and suitable for use at frequencies up to 75Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT Thoriated tungsten

V_f	10	V
I_f	10	A

MOUNTING POSITION

Vertical – with filament connectors up or down.
Horizontal – with plane of electrodes vertical.

CAPACITANCES

C_{a-g}	6.3	pF
C_{g-f}	12.3	pF
C_{a-f}	8.5	pF

CHARACTERISTICS (measured at I_a=200mA)

g_m	4.0	mA/V
μ	35	

COOLING

$T_{anode\ seal}$ max.	145	°C

It is necessary to keep the temperature of the dome between the anode and grid seals below 145°C and under some conditions of operation an air flow of up to 40 cu.ft./min. from a 2-in. diameter nozzle directed at this area may be necessary.

OPERATION AS SINGLE VALVE R.F. POWER OSCILLATOR OR AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

	Forced air cooling	*Natural cooling*	
V_a max.	4.0	3.0	kV
p_a max.	400	300	W
$-V_g$ max.	500	500	V
I_g max.	100	100	mA
p_g max.	20	20	W
I_k max.	600	600	mA
$i_{k(pk)}$ max.	3.0	3.0	A
R_{g-f} max.	15	15	kΩ

TY4-350

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 400W, and suitable for use at frequencies up to 75Mc/s.

Typical Operating Conditions

	Forced air cooling	*Natural cooling*	
f	<20	<30	Mc/s
V_a	4.0	3.0	kV
V_g	−200	−200	V
I_a	450	415	mA
$v_{in(pk)}$	375	360	V
I_g	75	55	mA
p_a	360	245	W
P_{out}	1.44	1.0	kW
$P_{load(driver)}$	35	33	W
η	80	80	%
*P_{load}	1152	800	W

*With a circuit transfer efficiency of 80%.

OPERATION AS R.F. POWER AMPLIFIER (CLASS "C" TELEPHONY, ANODE MODULATION)

Limiting Values (carrier condition for modulation factor of 1)

	Forced air cooling	*Natural cooling*	
V_a max.	3.0	2.5	kV
p_a max.	270	200	W
$-V_g$ max.	500	500	V
I_g max.	100	100	mA
p_g max.	20	20	W
I_k max.	550	500	mA
$i_{k(pk)}$ max.	2.7	2.5	A
R_{g-f} max.	15	15	kΩ

Typical Operating Conditions

	Forced air cooling	*Natural cooling*	
f	<20	<30	Mc/s
V_a	3.0	2.5	kV
V_g	−300	−300	V
I_a	415	335	mA
I_g	85	75	mA
$v_{in(pk)}$	490	460	V
p_a	245	200	W
$P_{load(driver)}$	50	50	W
η	80	76	%
P_{out}	1000	635	W
*P_{load}	800	508	W
For 100% modulation			
P_{mod}	622	420	W

*With a circuit transfer efficiency of 80%.

V.H.F. POWER TRIODE

TY4-350

All-glass triode rated for a maximum anode dissipation of 400W, and suitable for use at frequencies up to 75Mc/s.

OPERATION AS CLASS "B" A.F. POWER AMPLIFIER OR MODULATOR

Limiting Values

	Forced air cooling	*Natural cooling*	
V_a max.	4.0	3.0	kV
p_a max.	400	300	W
I_g max.	100	100	mA
I_k max.	600	600	mA
$i_{k(pk)}$ max.	2.0	2.0	A

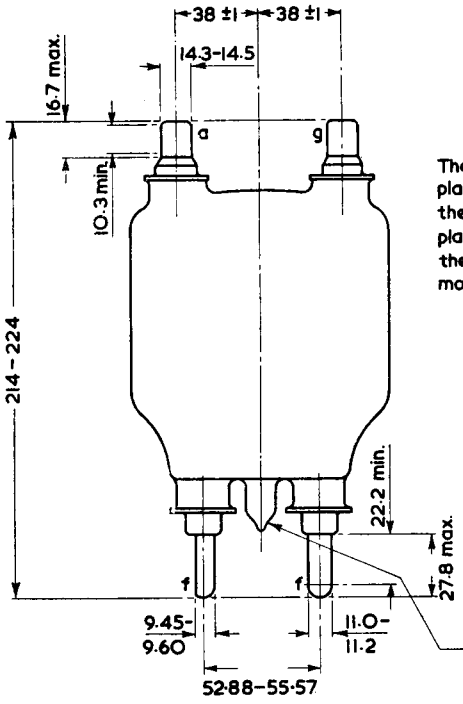
Typical Operating Conditions for two Valves in Push-Pull (with I_g)

	Forced air cooling	*Natural cooling*	
V_a	4.0	3.0	kV
V_g	−100	−70	V
$I_{a(o)}$	2×50	2×50	mA
I_a (max. sig.)	2×400	2×375	mA
$V_{in(g-g)r.m.s.}$	336	280	V
I_g	2×67	2×56	mA
R_{a-a}	12	9.5	kΩ
P_{out}	2.4	1.65	kW

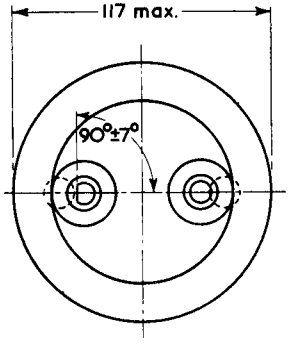
TY4-350

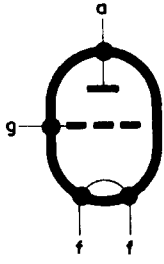
V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 400W, and suitable for use at frequencies up to 75Mc/s.



The horizontal angle between the plane determined by the axes of the filament terminals and the plane determined by the axes of the grid and anode caps is not more than 5°





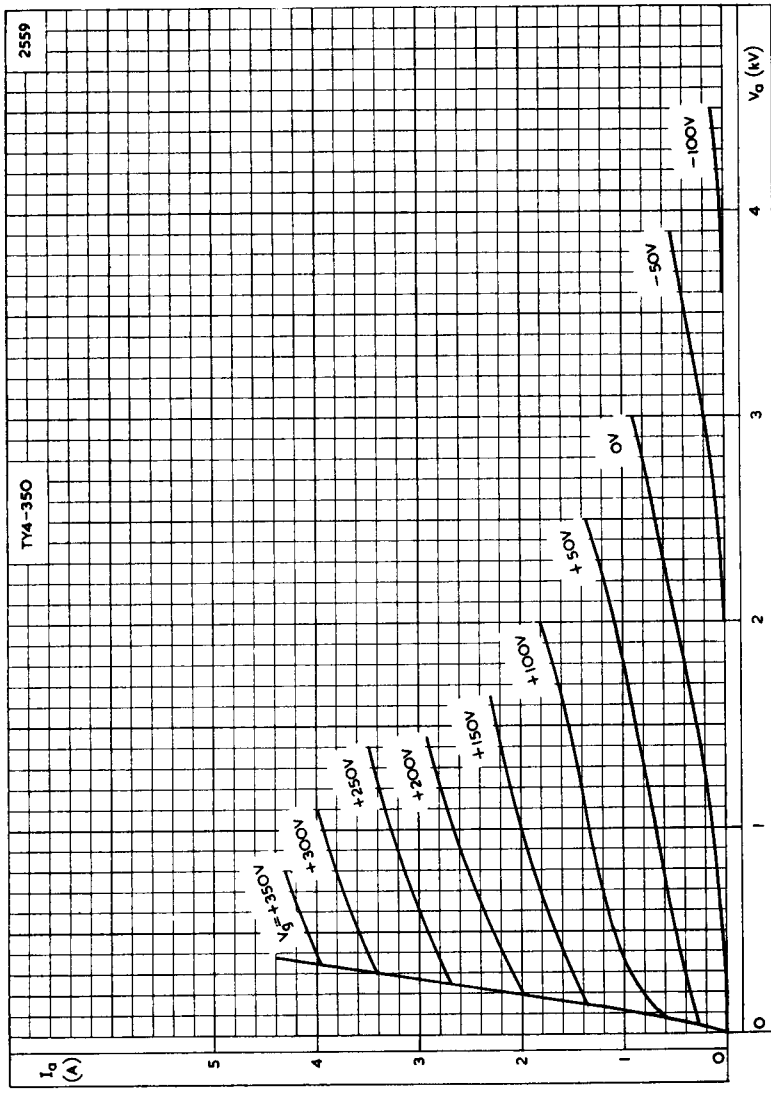
2597

All dimensions in mm

V.H.F. POWER TRIODE

TY4-350

All glass triode rated for a maximum anode dissipation of 400W, and suitable for use at frequencies up to 75Mc/s.

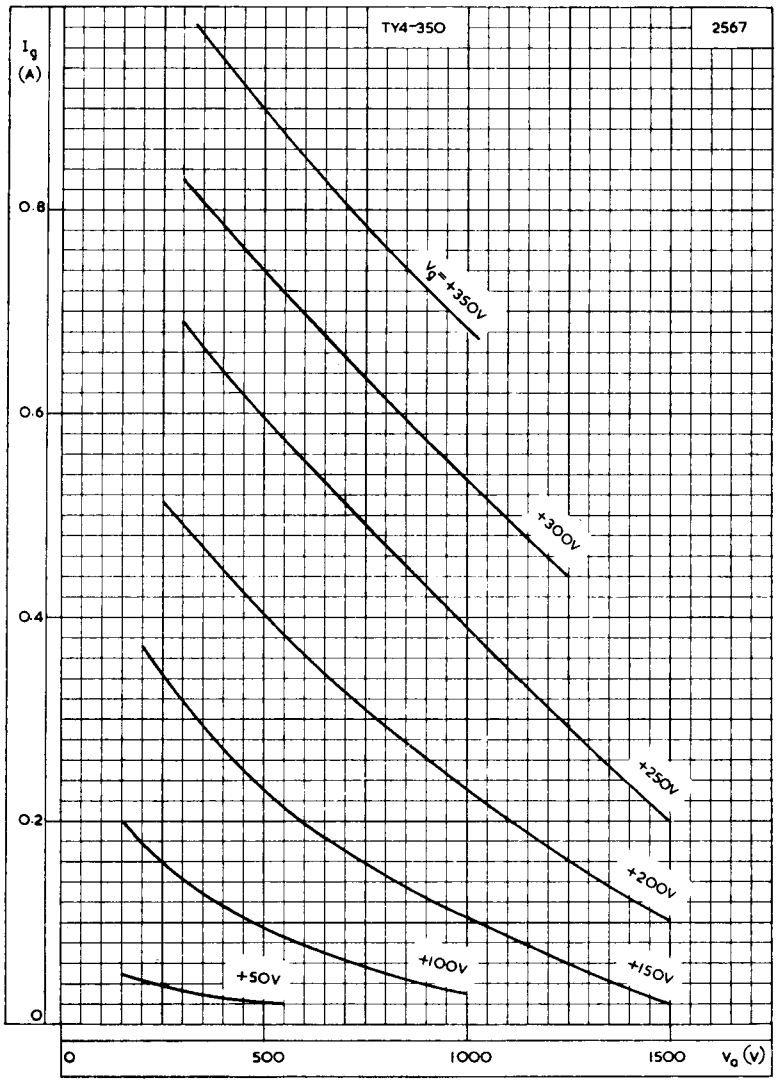


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

TY4-350

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 400W, and suitable for use at frequencies up to 75Mc/s.



GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

PRELIMINARY DATA

QUICK REFERENCE DATA

All glass triode suitable for use as r.f. power oscillator or amplifier, or a.f. power amplifier.

	Dielectric or Induction Heating	Plastic Welding	Class 'AB' A.F.	Class 'C' Telegraphy	
fout	80	80	-	30	Mc/s
Pout	0.84	1.6	1.5	1.2	kW
ηa	78	80	70	78	%
fmax	100	100	-	100	Mc/s
Va max	4.0	4.0	4.0	4.0	kV
pa max	350	350	350	350	W

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES.

INDUSTRIAL OPERATION AS CLASS 'C' OSCILLATOR

Maximum Operating Conditions

D.C.Supply

f	≤85	≤85	≤85	Mc/s
Du	1.0	0.5	0.5	-
t_{on}	-	60	1	s
t_{off}	-	60	1	s
V_a	3.0	4.0	4.0	kV
I_a	360	390	500	mA
I_g	85	90	115	mA
R_g	3.0	3.9	3.0	kΩ
R_a	1.8	2.3	1.8	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.15	0.14	0.15	-
η_a	78	80	80	%
p_a	240	312	400	W
P_{out}	0.84	1.25	1.60	kW
$P_{load} = 85\% (P_{out} - P_{drive})$	0.68	1.03	1.32	kW

Single Phase Full Wave Rectified Supply, Unsmoothed.

f		≤85	≤85	≤85	Mc/s
Du		1	0.5	0.5	-
t_{on}		-	60	1	s
t_{off}		-	60	1	s
V_{tr}		3.0	4.0	4.0	kV
V_a(r.m.s.)		2.7	3.6	3.6	kV
I_a(r.m.s.)		360	390	500	mA
I_a		325	350	450	mA
I_g(r.m.s.)		85	90	115	mA
I_g		75	81	104	mA
R_g		3.0	3.9	3.0	kΩ
R_a		1.8	2.3	1.8	kΩ
Feedback ratio	$\frac{V_{in(pk)}}{V_{a(pk)}}$	0.15	0.14	0.15	-
η_a		78	80	80	%
p_a		240	312	400	W
P_{out}		0.84	1.25	1.60	kW
$P_{load} = 85\% (P_{out} - P_{drive})$		0.68	1.03	1.32	kW

Absolute Maximum Ratings

Supply	D.C.	Single Phase F.W. Rectification Unsmoothed	
f max	100	100	Mc/s
V_a max	4.0	3.6	kV
$-V_g$ max	500	450	V
p_a max	350	350	W
p_g max	40	40	W
I_k max	490	440	mA
R_g max.	100	100	kΩ

CLASS 'AB' AMPLIFIER

Maximum Operating Conditions, Two Valves In Push-pull

V_a	4.0	3.0	2.5	kV
$-V_g$	142	110	82	V
I_a(0)	2 x 90	2 x 60	2 x 90	mA
I_a(max sig)	2 x 270	2 x 290	2 x 300	mA
I_g(max sig)	2 x 30	2 x 60	2 x 60	mA
$V_{in(g-g)}$ r.m.s.	340	330	286	V
p_a	2 x 320	2 x 220	2 x 210	W
R_{a-a}	16	14	9	kΩ
P_{out}	1.5	1.3	1.1	kW
η_a	70	75	71	%
D_{tot}	2	4	3	%

Absolute Maximum Ratings

$V_a$max	4.0	kV
$p_a$max	350	W
$I_k$max	490	mA
$-V_g$max	500	V
$R_g$max	100	kΩ

CLASS 'C' AMPLIFIER TELEGRAPHY OR F.M. TELEPHONY

Maximum Operating Conditions

f	≤30	≤100	≤100	≤100	Mc/s
V_a	4.0	3.0	2.5	1.5	kV
$-V_g$	350	250	200	120	V
I_a	380	363	400	400	mA
I_g	80	69	69	80	mA
$V_{g(pk)}$	535	430	380	295	V
η_a	78	77	75	71	%
p_a	320	250	250	175	W
P_{out}	1.20	0.84	0.75	0.43	kW
P_{load}	1.00	0.70	0.64	0.36	kW

In Common Grid Circuit, Two Valves In Push-pull

f	100	Mc/s
V_a	3.0	kV
$-V_g$	250	V
I_a	2 x 363	mA
I_g	2 x 69	mA
$V_{g(pk)}$	2 x 430	V
η_a	77	%
p_a	500	W
P_{out} (including P_{drive})	1.94	kW

Absolute Maximum Ratings

$V_a$max	4.0	kV
$p_a$max	350	W
$p_g$max	40	W
$I_k$max	490	mA
$-V_g$max	500	V
$R_g$max	100	kΩ

CATHODE

Directly heated, thoriated tungsten filament

V_f	5.0	V
I_f	14	A

CAPACITANCES

c_{g-f}	150	mpF
c_{a-f}	7.0	pF
c_{a-g}	5.3	pF

CHARACTERISTICS

(Measured at I_a = 90mA)

g_m	5.0	mA/V
μ	25	

COOLING

Maximum temperature of base pin seals	180	°C
Maximum temperature of anode seal	220	°C

Below 30 Mc/s, radiation and convection cooling is likely to be sufficient but an anode terminal connector of large volume and surface area is necessary in order to keep the anode seal cool.

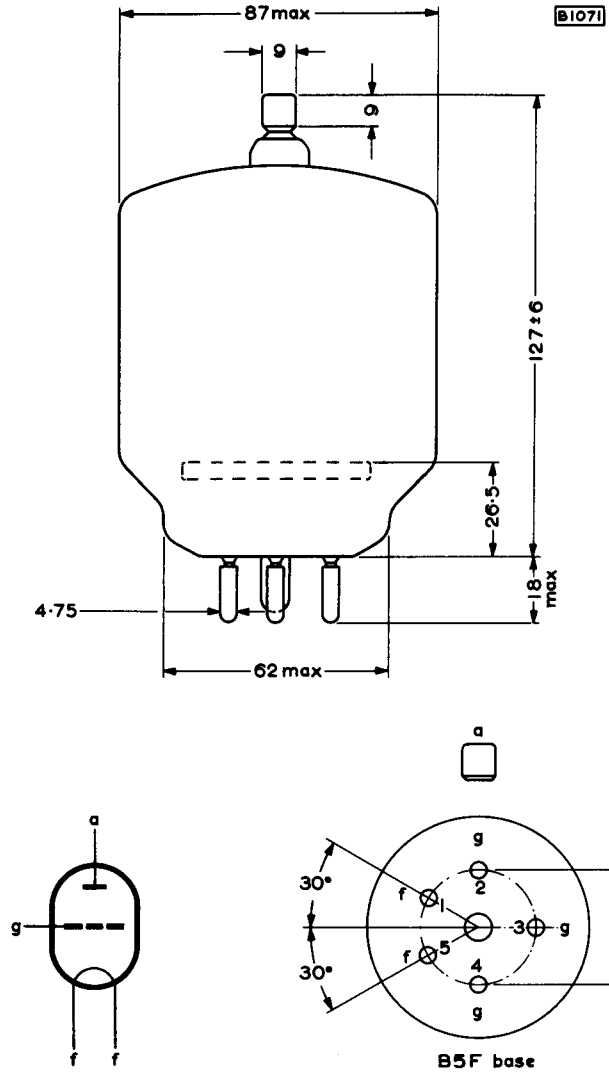
Above 30 Mc/s or with high ambient temperature it may be necessary to direct a flow of cool air to the anode seal and to the base of the valve.

MOUNTING POSITION

Vertical, base up or down.

PHYSICAL DATA

Weight of valve	6 oz.	(170 g)
Weight of valve in carton	1 lb 8oz.	(680 g)



All dimensions in mm

V.H.F. POWER TRIODE

TY4-500

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

This data should be read in conjunction with "Operating Notes Part I—Power Valves" included in this volume of the Handbook.

FILAMENT Thoriated tungsten

V_f	10	V
I_f	9.9	A

MOUNTING POSITION Vertical only, base up or down.

C_{a-g}	8.0	μμF
C_{g-f}	10	μμF
C_{a-f}	0.3	μμF

CHARACTERISTICS

g_m	4.5	mA/V
μ	28	

COOLING

Max. temperature of base pins	180	°C
Max. temperature of anode seal	220	°C

In order to keep within the temperature limits it may be necessary to direct a low velocity flow of air on to the anode seal and the base of the valve when operated at maximum ratings at frequencies above 50 Mc/s. The air stream on to the base should be directed so that it also passes over the envelope. Below 50 Mc/s, radiation cooling from the envelope is sufficient but an anode terminal connector of large surface area is necessary in order to keep the anode seal cool.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	4.0	kV
p_a max.	450	W
p_g max.	50	W
I_g max.	115	mA
I_k max.	650	mA
$i_{k(pk)}$ max.	5.0	A

Typical Operating Conditions at f ≤100 Mc/s

V_a	2.5	3.0	3.5	4.0	kV
V_g	−200	−250	−300	−350	V
I_a	535	535	535	535	mA
I_g	115	115	115	115	mA
$v_{in(pk)}$	405	460	520	580	V
P_{drive}	42	48	54	60	W
p_a	390	425	450	450	W
P_{out}	950	1175	1430	1690	W
*P_{load}	760	940	1144	1350	W
η_t	71	73.5	76	79	%

*With a circuit transfer efficiency of 80%

TY4-500

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

OPERATING CONDITIONS AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "C" ANODE MODULATION)

Limiting Values

V_a max.	3.0	kV
p_a max.	300	W
p_g max.	50	W
I_g max.	115	mA
I_k max.	550	mA
$i_{k(pk)}$ max.	5.0	A

Typical Operating Conditions at f ≤100 Mc/s

V_a	3.0	kV
V_g	−375	V
I_a	450	mA
I_g	85	mA
$v_{in(pk)}$	580	V
P_{drive}	42	W
p_a	300	W
P_{out}	1050	W
*P_{load}	840	W
η	78	%
For 100% modulation		
P_{mod}	675	W

*With a circuit transfer efficiency of 80%

OPERATING CONDITIONS FOR TWO VALVES AS GROUNDED GRID R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting Values

V_a max.	4.0	kV
p_a max.	450	W
p_g max.	50	W
I_g max.	115	mA
I_k max.	650	mA
$i_{k(pk)}$ max.	5.0	A

Typical Operating Conditions at f ≤100 Mc/s

V_a	2.5	3.0	3.5	4.0	kV
V_g	−200	−250	−300	−350	V
I_a	2×535	2×535	2×535	2×535	mA
I_g	2×115	2×115	2×115	2×115	mA
$v_{in(g-g)\ pk}$	810	920	1040	1160	V
P_{drive}	2×212	2×248	2×274	2×320	W
p_a	2×390	2×425	2×450	2×450	W
*P_{out}	1900+340	2350+400	2860+440	3380+520	W
†P_{load}	1790	2200	2640	3120	W
‡η	71	73.5	76	79	%

*Includes power transferred from driving stage.

†With a circuit transfer efficiency of 80%

‡Valve efficiency.

V.H.F. POWER TRIODE

TY4-500

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

INDUSTRIAL RATINGS

Limiting Values (Absolute Ratings)

V_a max.	4.0	kV
p_a max.	450	W
p_g max.	50	W
I_g (p_a=450W) max.	115	mA
I_g (p_a=150W) max.	150	mA
I_k max.	650	mA
$i_{k(pk)}$ max.	5.0	A

Recommended operating conditions providing reserves against such exigencies as variations of supply voltage, insertion of load material of poor power factor and *momentary* overload due to circuit flashover.

A reliable overload circuit breaker is necessary to protect the valve in case oscillation ceases for any reason.

Anode Supply	Smoothed d.c.	F.W. rectification: unsmoothed	
$V_{transformer\ (r.m.s.)}$	—	4000–0–4000	V
V_a	3.6	3.24	kV
I_a	386	348	mA
I_g	120	108	mA
I_g (at I_a=120 mA)	150	135	mA
R_{g-f}	3.0	3.0	kΩ
P_{drive}	67	67	W
P_{out}	1.06	1.06	kW
P_{load} (matched)	750	750	W
p_a	310	310	W
*P_{load} (typical)	650	650	W
p_a	450	450	W

*This condition results from setting up a dielectric heater to treat a normal load of, say, phenolic resin and substituting a similar weight of a different powder, such as paper-filled urea coloured with titanium oxide.

Operating conditions for a valve fully protected against every contingency.

Anode Supply	Smoothed d.c.	F.W. rectification: unsmoothed	
$V_{transformer\ (r.m.s.)}$	—	4000–0–4000	V
V_a	4.0	3.6	kV
I_a	535	482	mA
I_g	115	100	mA
I_g (at I_a=150 mA)	150	135	mA
R_{g-f}	3.0	3.0	kΩ
P_{drive}	60	60	W
P_{out}	1.69	1.69	kW
*P_{load}	1.25	1.25	kW
p_a	450	450	W

*With a transfer efficiency of 77%

TY4-500

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

OPERATING CONDITIONS FOR TWO VALVES AS A.F. CLASS "B" AMPLIFIER OR MODULATOR

Limiting Values

V_a max.	4.0	kV
p_a max.	450	W
p_g max.	50	W
I_g max.	140	mA
I_k max.	700	mA
$i_{k(pk)}$ max.	2.2	A

Typical Operating Conditions

V_a	2.5	3.0	3.5	4.0	kV
V_g	−75	−94	−114	−135	V
$I_{a(o)}$	2× 70	2× 70	2× 70	2× 70	mA
I_a(max. sig.)	2×555	2×500	2×442	2×368	mA
I_g	2×127	2×130	2×115	2× 93	mA
$V_{in(g-g)\ (r.m.s.)}$	378	400	402	404	V
p_a	2×375	2×380	2×330	2×329	W
R_{a-a}	5.2	7.5	10.2	14.5	kΩ
P_{out}	2.0	2.31	2.44	2.21	kW
η	72	77	78.8	77.5	%
D_{tot}	3.5	5.0	5.0	5.0	%

WEIGHT

Valve only	13.5	ozs
	380	g

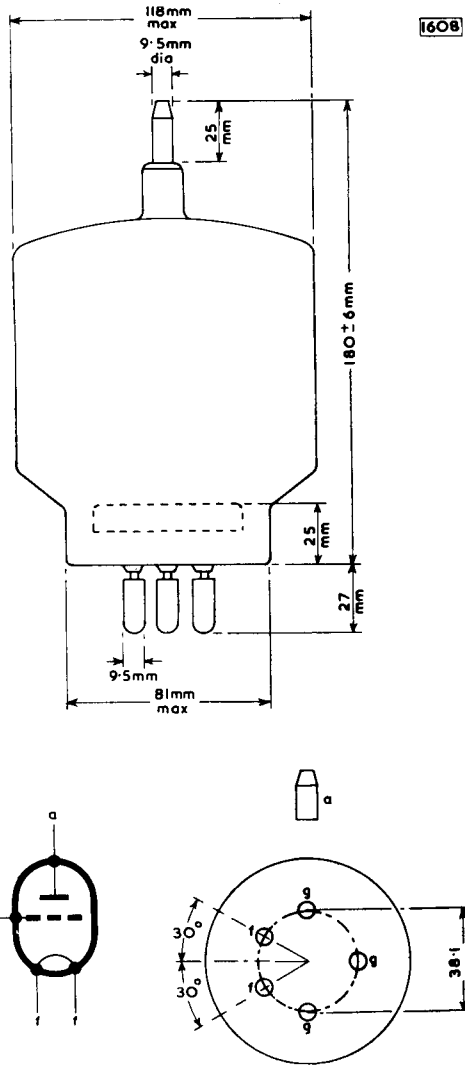
CIRCUIT NOTES

To ensure equal distribution of the currents through the seals the grid leads should be strapped together at the valve holder and the circuit connections joined to the midpoint of the strap. This should not be allowed to impair the free flotation of individual contacts.

V.H.F. POWER TRIODE

TY4-500

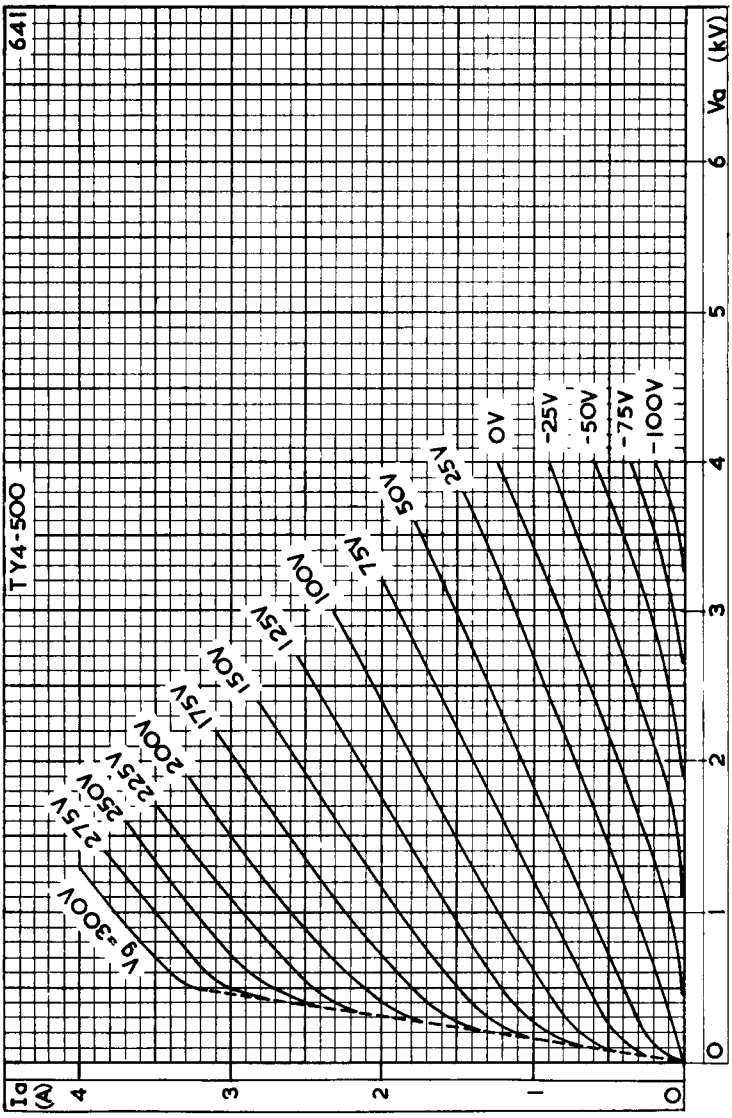
All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.



TY4-500

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

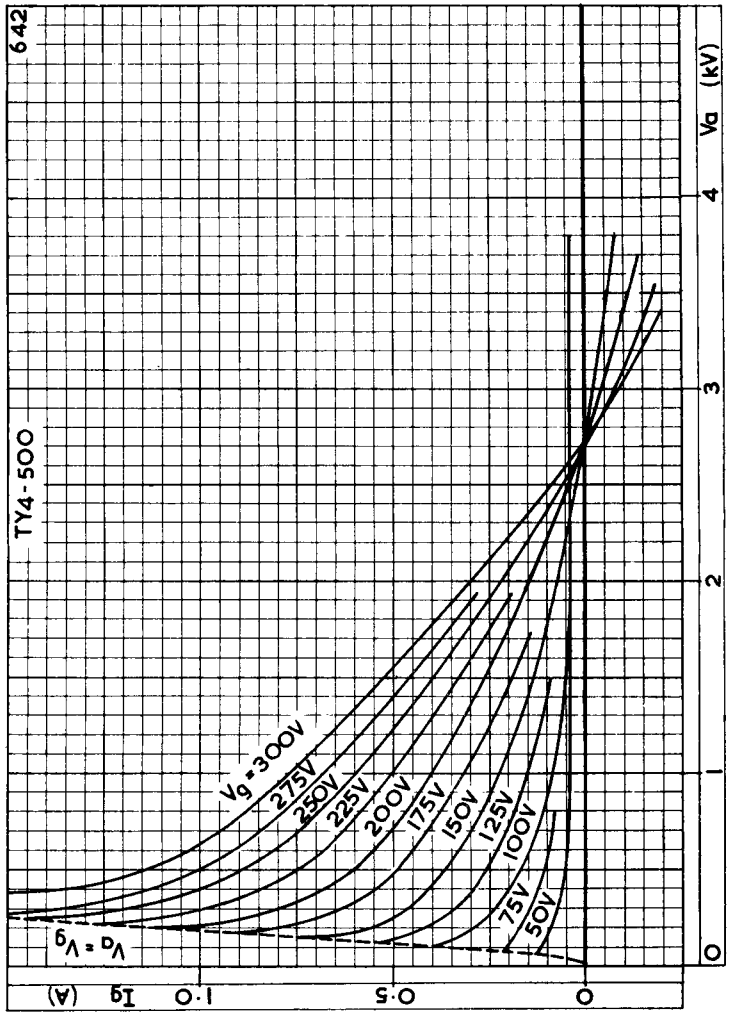


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

V.H.F. POWER TRIODE

TY4-500

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

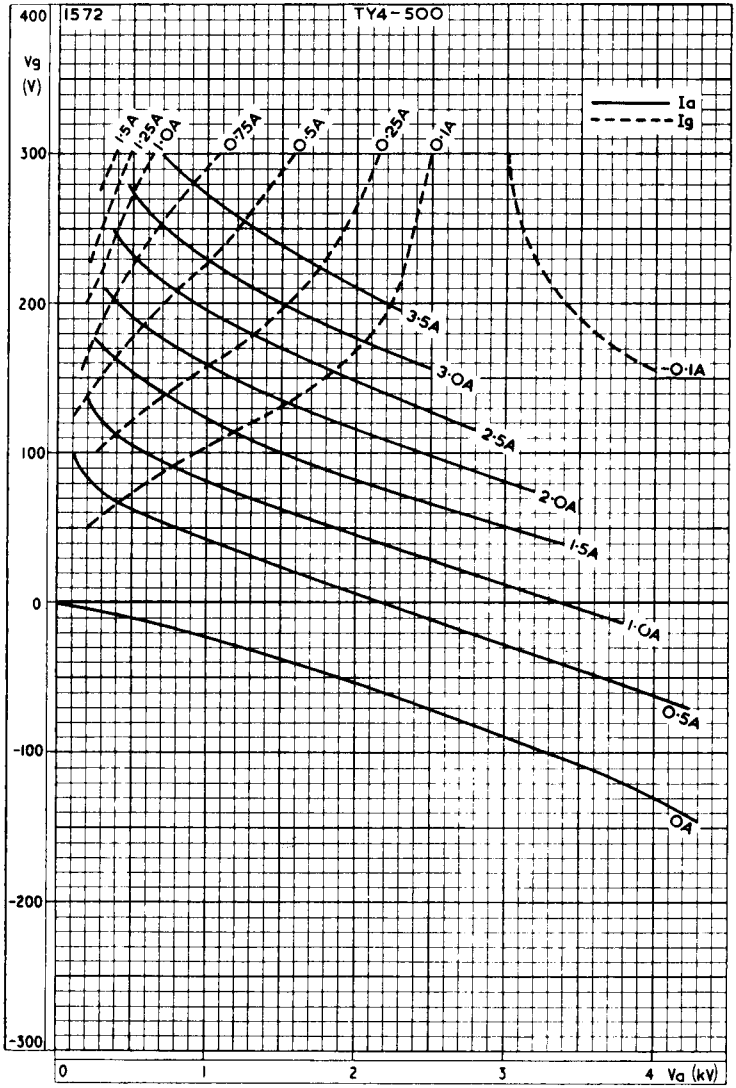


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

TY4-500

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

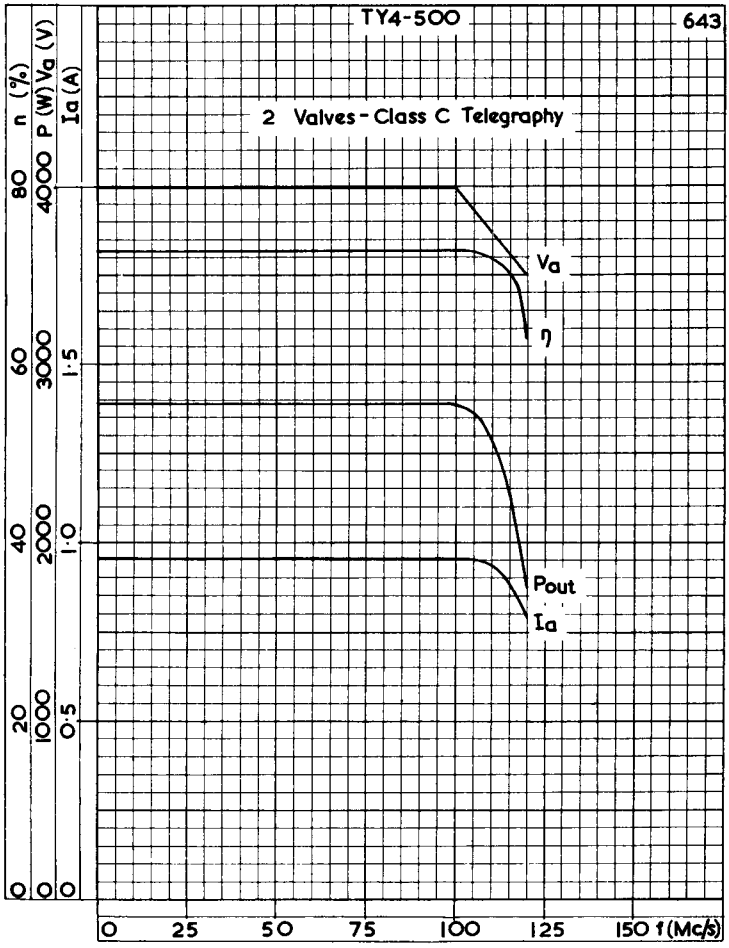


CONSTANT CURRENT CURVES

V.H.F. POWER TRIODE

TY4-500

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

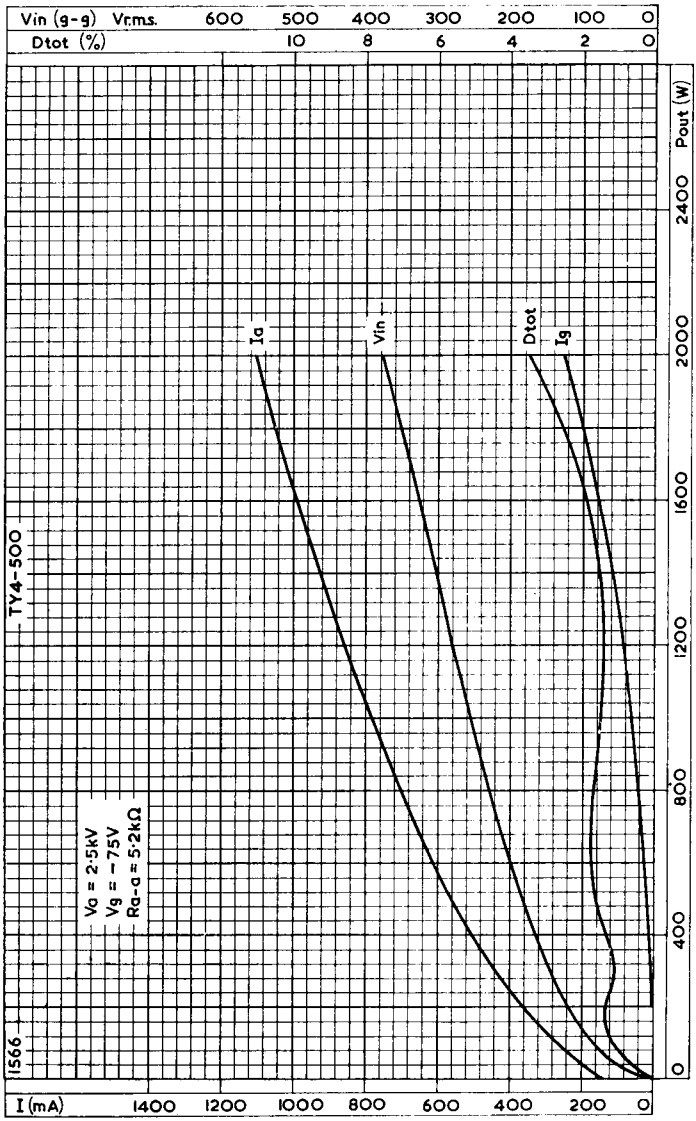


FREQUENCY CHARACTERISTICS

TY4-500

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

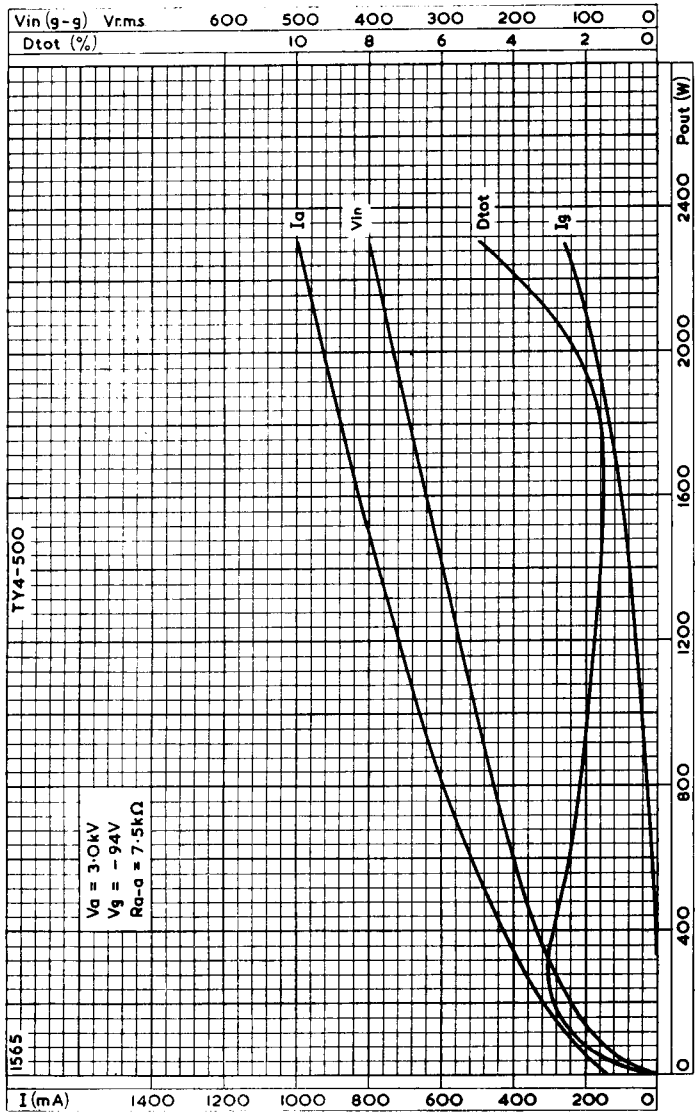


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. $V_a = 2.5$ kV

V.H.F. POWER TRIODE

TY4-500

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

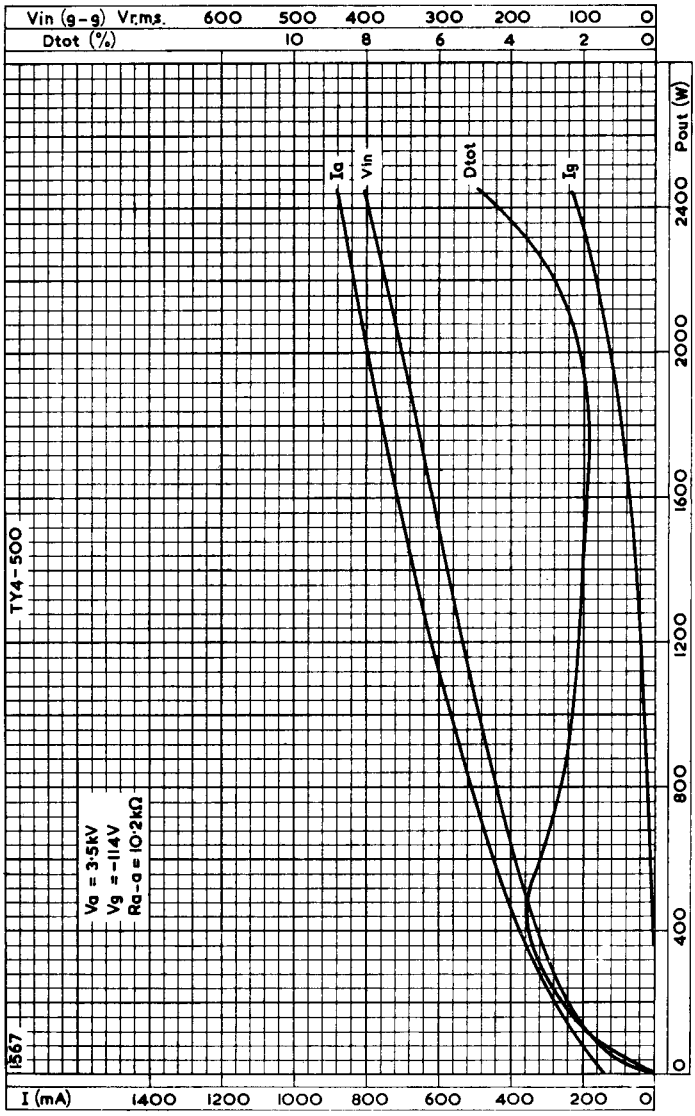


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=3.0 kV

TY4-500

V.H.F. POWER TRIODE

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s.

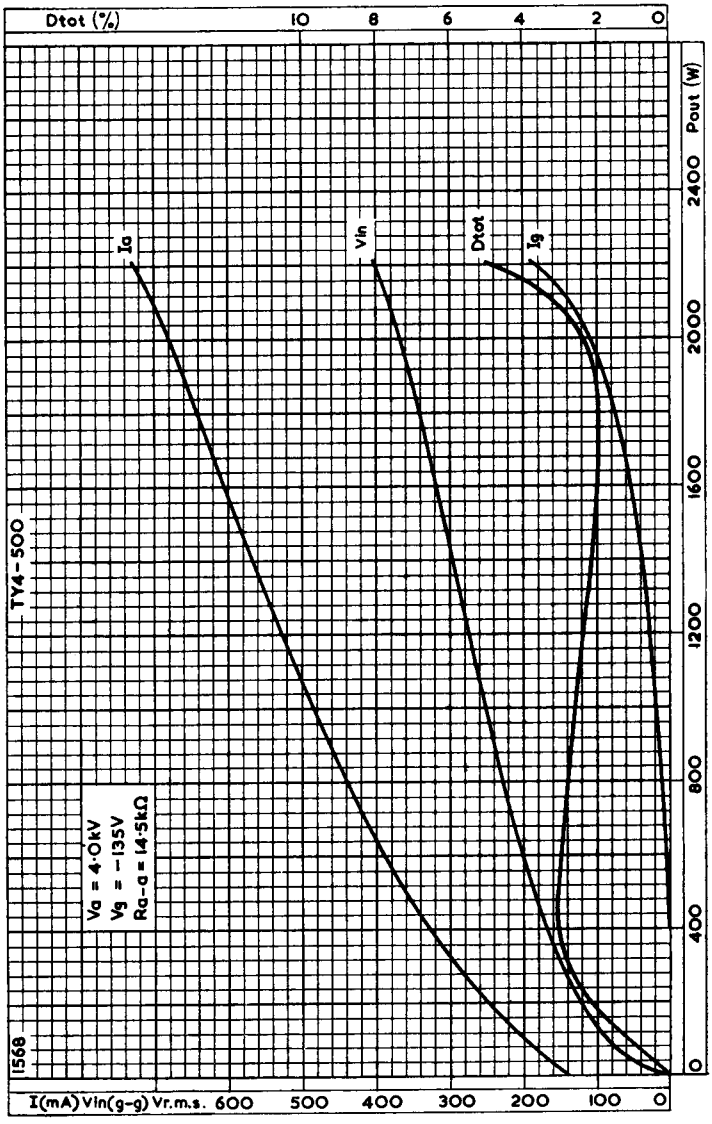


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. $V_a = 3.5$ kV

V.H.F. POWER TRIODE

TY4-500

All-glass triode rated for a maximum anode dissipation of 450 W and suitable for use at frequencies up to 120 Mc/s



TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=4.0 kV

TY4-500

QUICK REFERENCE DATA

Radiation cooled triode intended for use as r.f. amplifier or oscillator or a.f. amplifier.

	Class 'C' telegraphy	Class 'C' industrial oscillator	Class 'B' A.F.	
f max.	120	100	—	Mc/s
V_a max.	4.0	4.0	4.0	kV
p_a max.	450	450	450	W
Performance				
f	100	100	—	Mc/s
P_{out}	1.69	1.14	2.44	kW

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT Thoriated tungsten

V_f	10	V
I_f	9.9	A

MOUNTING POSITION Vertical only, base up or down

CAPACITANCES

C_{a-g}	7.0	pF
C_{g-f}	8.0	pF
C_{a-f}	170	mpF

CHARACTERISTICS

g_m (I_a=125mA)	4.5	mA/V
μ	28	

COOLING

Max. temperature of base pins	180	°C
Max. temperature of anode seal	220	°C

In order to keep within the temperature limits it may be necessary to direct a low velocity flow of air on to the anode seal and the base of the valve when operated at maximum ratings at frequencies above 50Mc/s. The air stream on to the base should be directed so that it also passes over the envelope. Below 50Mc/s, radiation cooling from the envelope is sufficient but an anode terminal connector of large surface area is necessary in order to keep the anode seal cool.

TY4-500

V.H.F. POWER TRIODE

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Absolute maximum ratings

V_a max.	4.0	kV
p_a max.	450	W
p_g max.	50	W
I_g max.	115	mA
I_k max.	650	mA
$i_{k(pk)}$ max.	5.0	A

Typical operating conditions, grounded cathode

f	100	100	100	100	Mc/s
V_a	2.5	3.0	3.5	4.0	kV
V_g	−200	−250	−300	−350	V
I_a	535	535	535	535	mA
I_g	115	115	115	115	mA
$v_{in(pk)}$	405	460	520	580	V
P_{drive}	42	48	54	60	W
p_a	390	425	450	450	W
P_{out}	950	1175	1430	1690	W
P_{load}	760	940	1144	1350	W
η_a	71	73.5	76	79	%

Typical operating conditions, grounded grid (two valves)

f	100	100	100	100	Mc/s
V_a	2.5	3.0	3.5	4.0	kV
V_g	−200	−250	−300	−350	V
I_a	2 × 535	2 × 535	2 × 535	2 × 535	mA
I_g	2 × 115	2 × 115	2 × 115	2 × 115	mA
$v_{in(g-g)\ pk}$	810	920	1040	1160	V
P_{drive}	2 × 212	2 × 248	2 × 274	2 × 320	W
p_a	2 × 390	2 × 425	2 × 450	2 × 450	W
*P_{out}	1900 + 340	2350 + 400	2860 + 440	3380 + 520	W
P_{load}	1.79	2.2	2.64	3.12	kW
η_a	71	73.5	76	79	%

*Includes power transferred from driver stage.

CLASS 'C' ANODE MODULATION

Absolute maximum ratings (carrier condition for a modulation factor of 1)

V_a max.	3.0	kV
p_a max.	300	W
p_g max.	50	W
I_g max.	115	mA
I_k max.	550	mA
$i_{k(pk)}$ max.	5.0	A

Typical operating conditions at f ⩽ 100Mc/s

V_a	3.0	kV
V_g	−375	V
I_a	450	mA
I_g	85	mA
$v_{in(pk)}$	580	V
P_{drive}	42	W
p_a	300	W
P_{out}	1.05	kW
P_{load}	840	W
η_a	78	%
For 100% modulation		
P_{mod}	675	W

CONTINUOUS INDUSTRIAL OPERATION AS CLASS 'C' OSCILLATOR

Absolute maximum ratings

f max.	100	Mc/s
V_a max.	4.0	kV
p_a max.	450	W
p_g max.	50	W
I_k max.	650	mA
$i_{k(pk)}$ max.	5.0	A
I_g (loaded) max.	115	mA
I_g (unloaded) max.	150	mA

Typical operating conditions

Supply	F.W. rectification unsmoothed	
f	100	Mc/s
$V_{tr(r.m.s.)}$	3.5-0-3.5	kV
V_a	3.15	kV
I_a	415	mA
I_g	120	mA
R_{g-f}	3.0	kΩ
R_a	1.4	kΩ
Feedback ratio $\frac{v_{in(pk)}}{v_{a(pk)}}$	0.2	
P_{drive}	60	W
p_a	420	W
P_{out} (less P_{drive})	1.14	kW
η_a	74	%
P_{load}	950	W

TY4-500

V.H.F. POWER TRIODE

INTERMITTENT OPERATION FOR DIELECTRIC WELDING ←

Absolute maximum ratings

f max.	100	Mc/s
Duty factor max.	0.5	
Averaging time max.	10	s
V_a max.	4.0	kV
p_a max.	700	W
p_g max.	72	W
I_g (loaded) max.	160	mA
I_k max.	900	mA
$i_{k(pk)}$ max.	5.0	A

Typical operating conditions

Supply	Smoothed d.c.	F.W. rectification unsmoothed	
f	100	100	Mc/s
Duty factor	0.5	0.5	
Averaging time	10	10	s
$V_{tr(r.m.s.)}$	—	3.5-0-3.5	kV
V_a	3.5	3.15	kV
I_a	750	675	mA
I_g (loaded)	140	125	mA
R_{g-f}	2.2	2.2	kΩ
R_a	2.2	2.2	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.2	0.2	
P_{drive}	75	75	W
P_{out} (less P_{drive})	1.86	1.86	kW
p_a	690	690	W
η_a	74	74	%
P_{load}	1.5	1.5	kW

CLASS 'B' A.F.

Limiting values

V_a max.	4.0	kV
p_a max.	450	W
p_g max.	50	W
I_g max.	140	mA
I_k max.	700	mA
$i_{k(pk)}$ max.	2.2	A

Typical operating conditions

V_a	2.5	3.0	3.5	4.0	kV
V_g	−75	−94	−114	−135	V
$I_{a(o)}$	2 × 70	2 × 70	2 × 70	2 × 70	mA
I_a (max. sig.)	2 × 555	2 × 500	2 × 442	2 × 368	mA
I_g	2 × 127	2 × 130	2 × 115	2 × 93	mA
$V_{in(g-g)\ (r.m.s.)}$	378	400	402	404	V
p_a	2 × 375	2 × 380	2 × 330	2 × 329	W
R_{a-a}	5.2	7.5	10.2	14.5	kΩ
P_{out}	2.0	2.31	2.44	2.21	kW
η_a	72	77	78.8	77.5	%
D_{tot}	3.5	5.0	5.0	5.0	%

TY4-500

WEIGHT

Valve only	14.8	oz
	420	g
Valve plus carton	3.1	lb
	1.4	kg

CIRCUIT NOTES

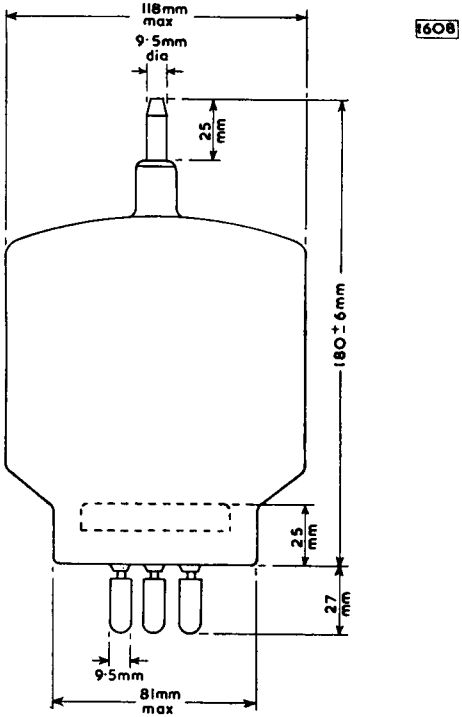
To ensure equal distribution of the currents through the seals the grid leads should be strapped together at the valve holder and the circuit connections joined to the midpoint of the strap. This should not be allowed to impair the free flotation of individual contacts.

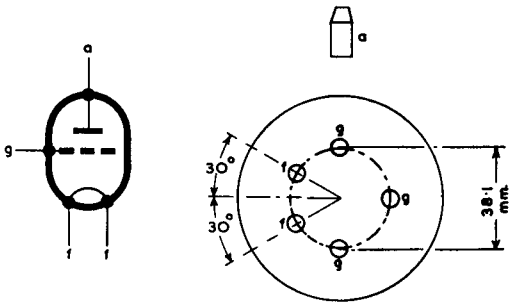
ACCESSORIES

Socket	40216
Anode clip	40626

TY4-500

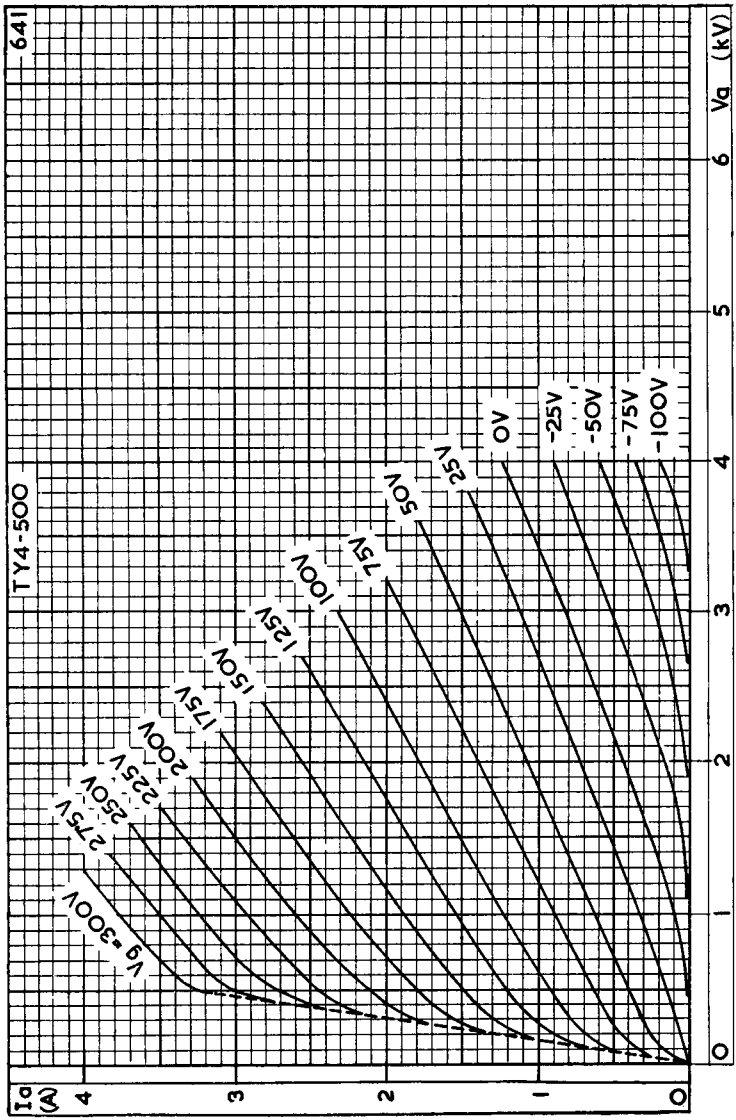
V.H.F. POWER TRIODE



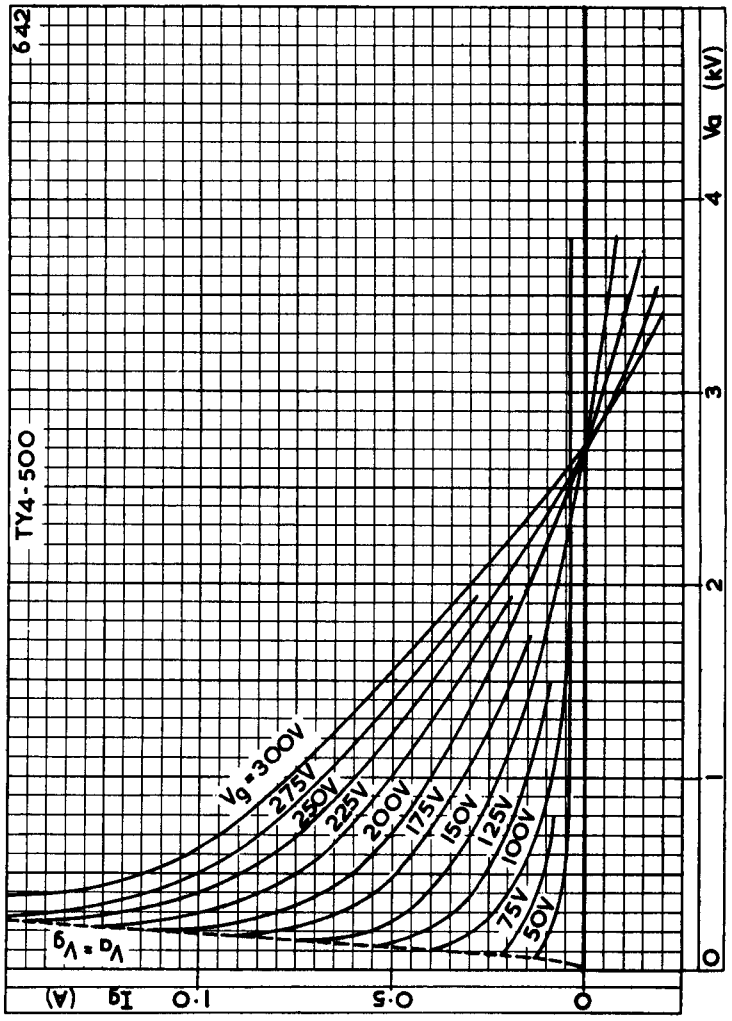


B5K Base

TY4-500

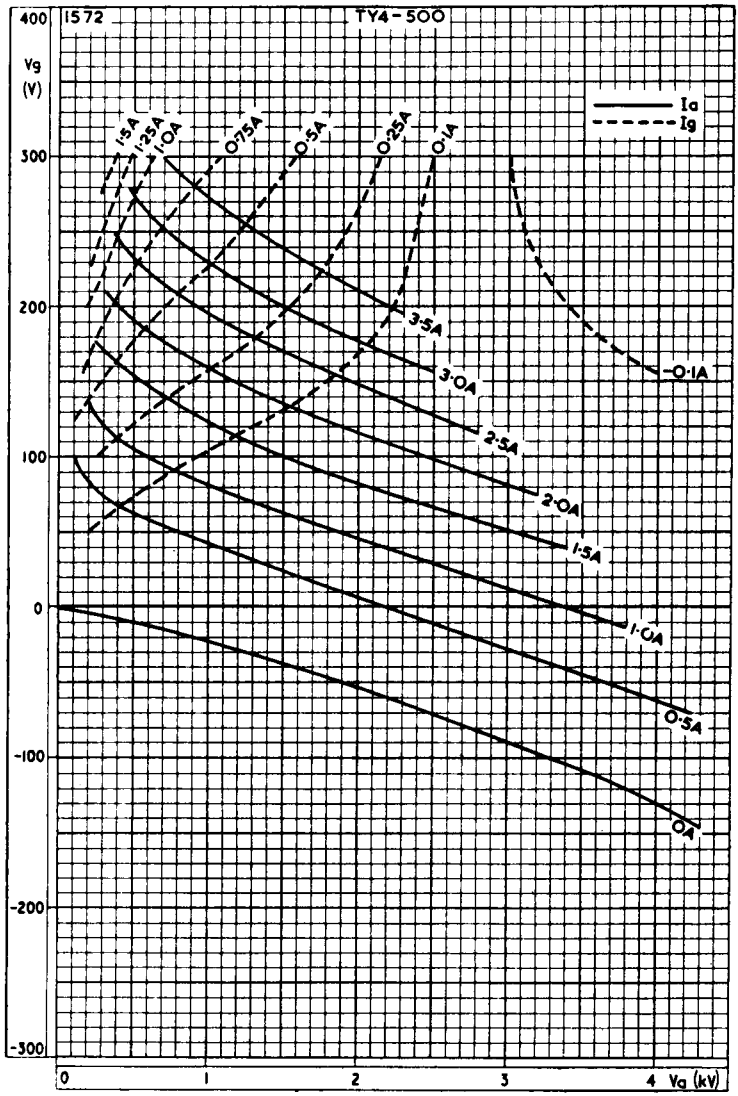


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

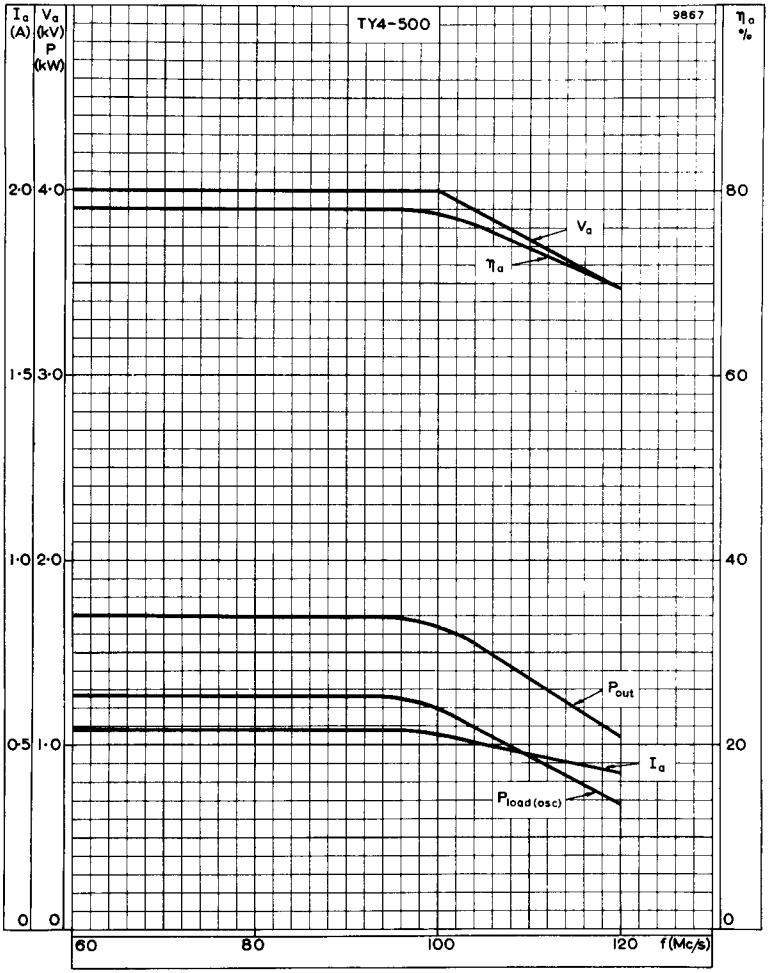


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

TY4-500

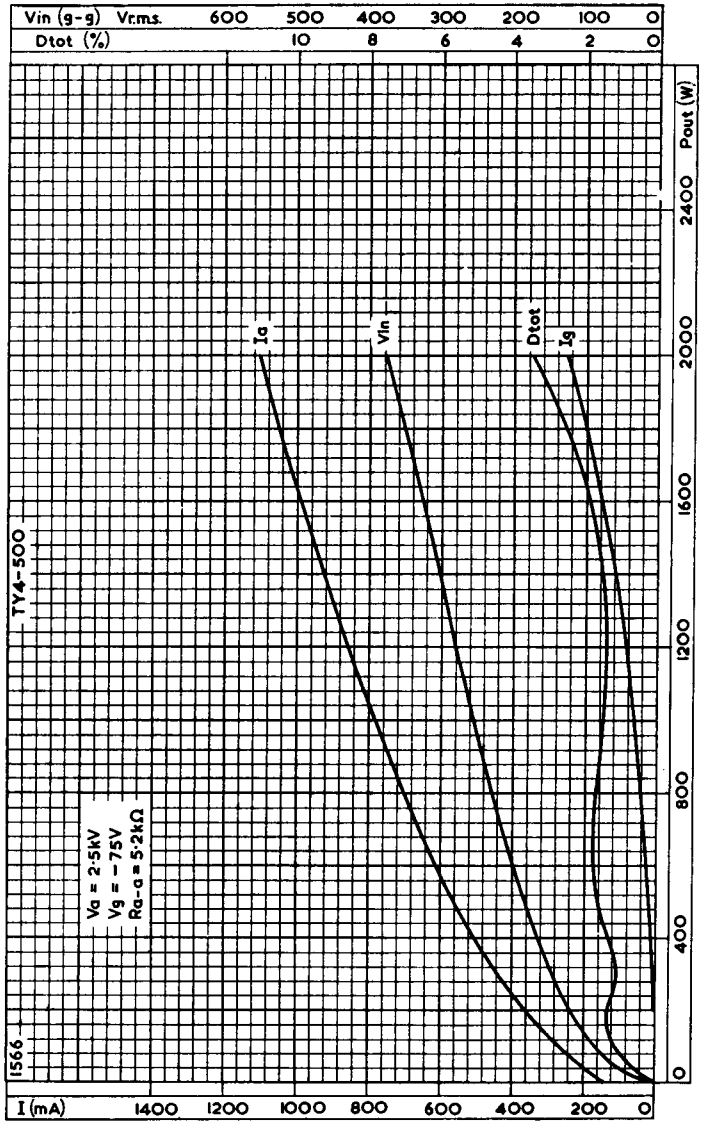


CONSTANT CURRENT CURVES

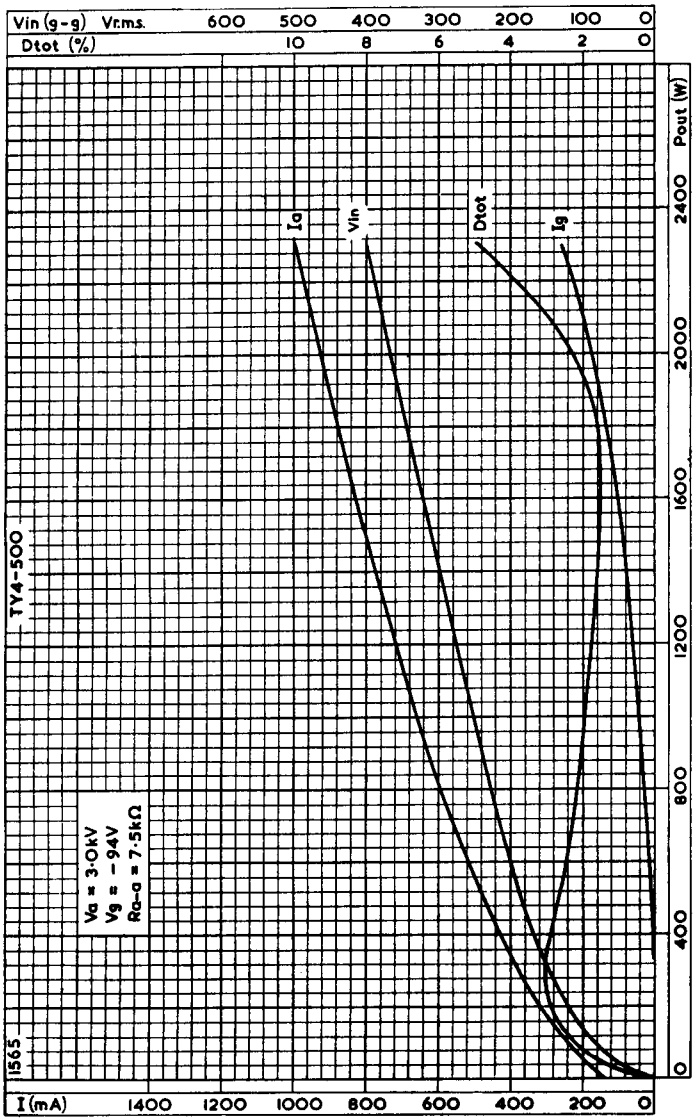


FREQUENCY CHARACTERISTICS, SINGLE VALVE AS CLASS 'C' AMPLIFIER AND OSCILLATOR

TY4-500

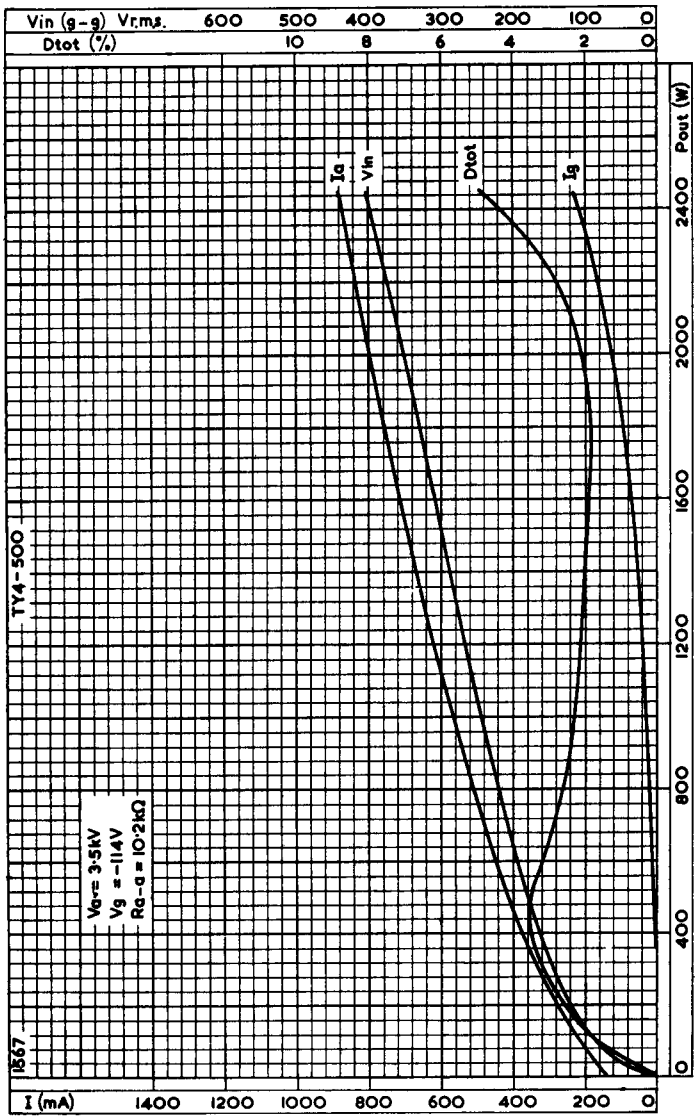


TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=2.5 kV



TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=3.0 kV

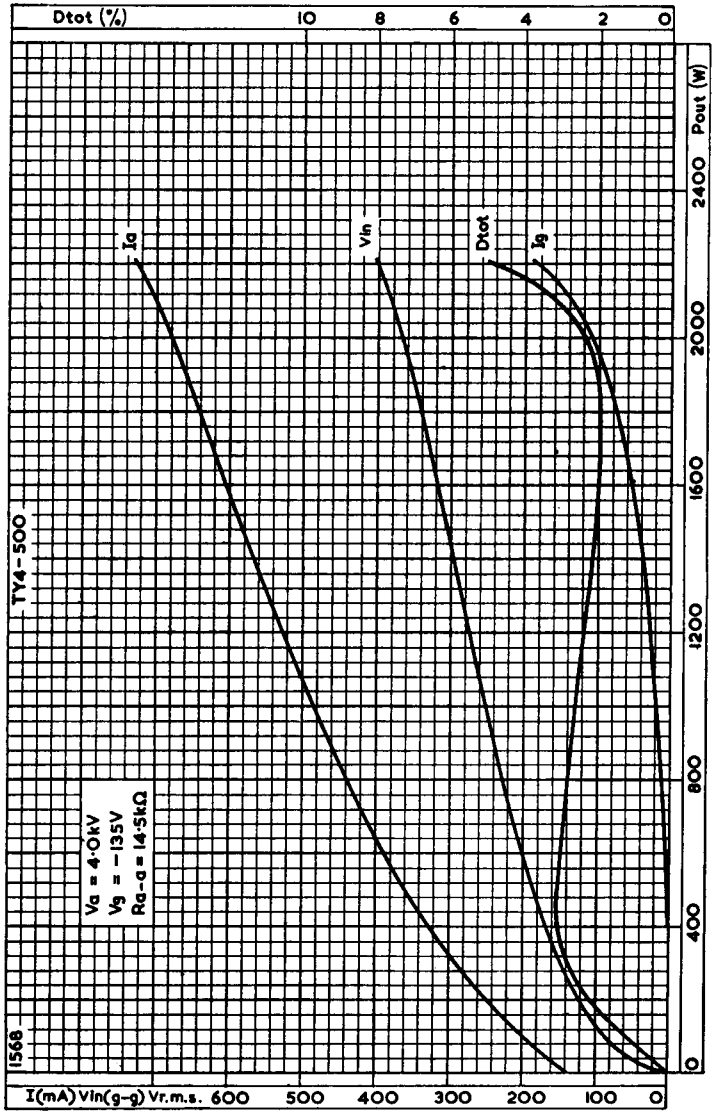
TY4-500



TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=3.5 kV

TY4-500

V.H.F. POWER TRIODE



TWO VALVES AS CLASS "B" A.F. AMPLIFIER. V_a=4.0 kV

TRIODE

TY5-500

Application: *R.F. industrial heating.*
Power output: *1.6kW continuous rating.*
Frequency: *50Mc/s at full rating.*
Construction: *Glass; radiation cooled anode.*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES preceding this section of the handbook.

FILAMENT Thoriated tungsten

*V_f	5.0	V
I_f	32.5	A

*The filament has been designed to accept temporary fluctuations $^{+5}_{-10}$%

MOUNTING POSITION

Vertical only, base down

CAPACITANCES

C_{a-g}	5.1	pF
C_{g-f}	9.2	pF
C_{a-f}	0.2	pF

CHARACTERISTICS (measured at V_a = 4kV, I_a = 120mA)

g_m	3.3	mA/V
g_m (at V_a = 1.0kV, I_a = 2.3A)	10	mA/V
μ	21	

COOLING

Normally	Low velocity air flow
*At reduced input or with intermittent ratings	Natural

T_{seals} max.	220	°C
T_{bulb} max.	350	°C

*See examples in typical data.

ACCESSORIES

Socket	B8.700.51
Anode clip	40626

TY5-500

TRIODE

CLASS 'C' OSCILLATOR

With d.c. anode supply

LIMITING VALUES (absolute ratings)

f max.			50	Mc/s
V_a max.			5.0	kV
V_g max.			−1.25	kV
R_{g-f} max.			15	kΩ
Duty factor max.	1	0.5	0.2	
Averaging time max.	—	10	5.0	s
p_a max.	500	700	1000	W
I_a max.	560	780	1100	mA
p_g max.	85	95	110	W
I_g max. (at p_a max.)	210	290	420	mA

OPERATING CONDITIONS

Cooling	Additional	Natural		
f	≦50	≦50	≦50	Mc/s
Duty factor	1	0.5	0.2	
t_{on}	—	5.0	1.0	s
t_{off}	—	5.0	4.0	s
V_a	4.0	4.0	4.0	kV
I_a	490	650	825	mA
I_g	140	190	240	mA
p_a	450	630	900	W
η_a	77	76	73	%
R_{g-f}	2.7	2.0	1.7	kΩ
R_a	4.7	3.4	2.7	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.2	0.22	0.24	
P_{out}	1.5	2.0	2.4	kW
*P_{load}	1.2	1.6	1.9	kW

*0.85 (P_{out}–P_{drive})

TY5-500

CLASS 'C' OSCILLATOR

Anode supply single phase, full wave rectifier without smoothing filter.

LIMITING VALUES (absolute ratings)

f max.			50	Mc/s
V_a max.			4.5	kV
V_g max.			850	V
R_{g-f} max.			15	kΩ
Duty factor max.	1.0	0.5	0.2	
Averaging time max.	—	10	5.0	s
p_a max.	500	700	1000	W
I_a max.	450	630	900	mA
p_g max.	85	95	110	W
I_g max. (at p_a max.)	190	195	380	mA

OPERATING CONDITIONS

Cooling	Additional	Natural		
f	≦50	≦50	≦50	Mc/s
Duty factor	1.0	0.5	0.2	
t_{on}	—	5.0	1.0	s
t_{off}	—	5.0	4.0	s
$V_{tr(r.m.s.)}$	4.5	4.5	4.5	kV
V_a	4.05	4.05	4.05	kV
I_a	400	530	675	mA
I_g	125	165	210	mA
p_a	450	630	900	W
η_a	77	76	73	%
R_{g-f}	2.7	2.2	1.7	kΩ
R_a	5.9	4.3	3.5	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.16	0.17	0.18	
P_{out}	1.53	2.0	2.46	kW
*P_{load}	1.25	1.5	2.0	kW

*0.85 ($P_{out} - P_{drive}$)

TY5-500

TRIODE

CLASS 'C' OSCILLATOR

Anode supply from three phase half-wave rectifier.

LIMITING VALUES (absolute ratings)

f max.			50	Mc/s
V_a max.			5.0	kV
V_g max.			−1.25	kV
R_{g-f} max.			15	kΩ
Duty factor max.	1.0	0.5	0.2	
Averaging time max.	—	10	5.0	s
p_a max.	500	700	1000	W
I_a max.	560	780	1100	mA
p_g max.	85	95	110	mA
I_g max. (at p_a max.)	210	290	420	mA

OPERATING CONDITIONS

Cooling	Additional	Natural		
f	≦50	≦50	≦50	Mc/s
Duty factor	1	0.5	0.2	
t_{on}	—	5.0	1.0	s
t_{off}	—	5.0	4.0	s
$V_{tr(r.m.s.)}$	3.4	3.4	3.4	kV
V_a	4.0	4.0	4.0	kV
I_a	480	640	820	mA
I_g	140	190	240	mA
p_a	450	630	900	W
η_a	77	76	73	%
R_{g-f}	2.7	2.0	1.7	kΩ
R_a	4.7	3.4	2.7	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.2	0.22	0.24	
P_{out}	1.5	2.0	2.4	kW
*P_{load}	1.2	1.6	1.9	kW

*0.85 ($P_{load} - P_{drive}$)

TY5-500

CLASS 'C' OSCILLATOR

Anode supply from transformer without intermediate rectifier.

LIMITING VALUES (absolute ratings)

f max.			50	Mc/s
$V_{tr(r.m.s.)}$ max.			5.0	kV
V_g max.			−850	V
R_{g-f} max.			15	kΩ
Duty factor max.	1	0.5	0.2	
Averaging time max.	—	10	5.0	s
p_a max.	500	700	1000	W
I_a max.	320	450	640	mA
p_g max.	85	95	110	W
I_g max. (at p_a max.)	110	155	220	mA

OPERATING CONDITIONS

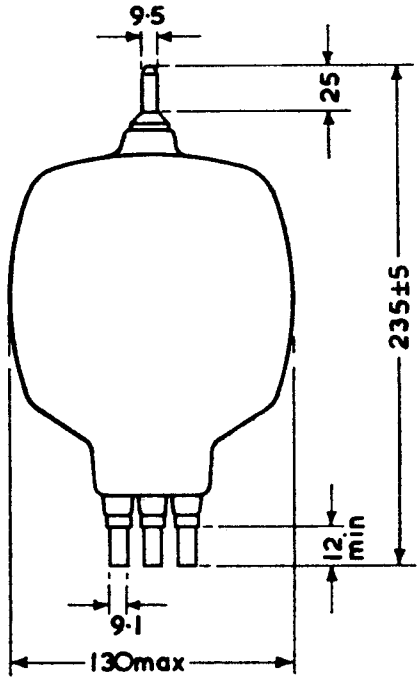
Cooling	Additional	Natural		
f	≦50	≦50	≦50	Mc/s
Duty factor	1.0	0.5	0.2	
t_{on}	—	5.0	1.0	s
t_{off}	—	5.0	4.0	s
$V_{tr(r.m.s.)}$	4.5	4.5	4.5	kV
*I_a	280	420	600	mA
*I_g	80	120	170	mA
p_a	380	500	800	W
η_a	77	76	73	%
R_{g-f}	2.7	1.8	1.3	kΩ
R_a	4.3	2.9	2.0	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.18	0.22	0.25	
P_{out}	1.08	1.6	2.2	kW
**P_{load}	0.9	1.3	1.7	kW

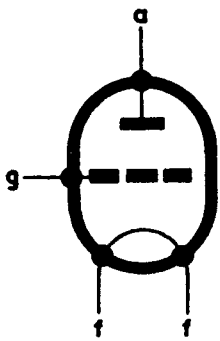
*Averaged over one cycle of supply frequency.

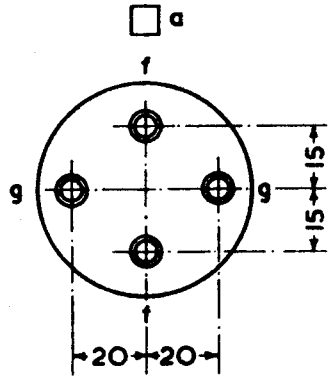
**0.85 ($P_{out} - P_{drive}$)

TY5-500

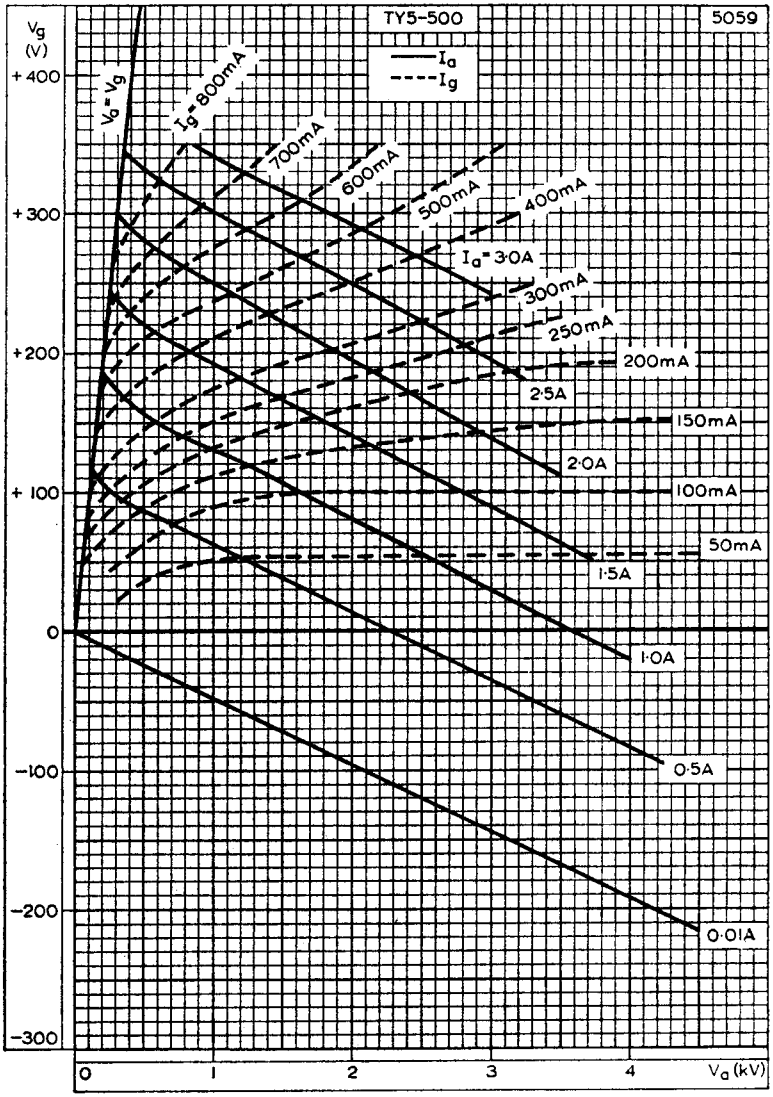
5082







All dimensions in mm



CONSTANT CURRENT CURVES

R.F. POWER TRIODE

Application: *R.F. industrial oscillator*
Power output: *4.1kW continuous rating*
Frequency: *50Mc/s at full ratings*
Construction: *External anode, forced-air cooled*

TY6-1250A

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT Directly heated, thoriated tungsten

*V_f	6.3	V
I_f	65	A

*The filament has been designed to accept temporary voltage fluctuations of up to +5% or −10%

MOUNTING POSITION Vertical only, anode up or down

CAPACITANCES

$C_{a\ g}$	7.2	pF
C_{g-f}	13	pF
C_{a-f}	<500	mpF

CHARACTERISTICS (measured at V_a=6kV, I_a=240mA)

g_m	7.0	mA/V
μ	23	

COOLING

Forced air

T_{seals} max.	200	°C
T_{anode} max.	270	°C

An airflow should be directed to anode and seals in order to keep the temperature below the specified limits.

At sea level and at a temperature of 35°C an airflow of 70ft³(2m³) per minute is sufficient for cooling the anode in continuous operation at maximum anode dissipation.

At higher altitudes and/or higher inlet temperatures a correspondingly greater amount of air should be applied.

The filament and grid seals require an airflow of 11ft³(0.3m³) per minute.

The airflow should be directed on the valve as indicated in Fig. 1. To keep the anode seal, opposite the nozzle, below the maximum temperature a deflection plate as indicated in Fig. 1 should be used. This should be made of a suitable insulating material such as p.t.f.e. This deflection plate can be clipped on the anode or mounted on the valve socket or on the chassis.

CLASS 'C' OSCILLATOR

Anode supply from 3-phase rectifier without smoothing filter continuous operation.

Limiting values (absolute ratings)

f max.	50	Mc/s
V_a max.	7.0	kV
I_k max.	2.0	A
$i_{k(pk)}$ max.	12	A
p_a max.	1.3	kW
$-V_g$ max.	1.25	kV
I_g max.	400	mA
R_{g-f} max.	10	kΩ

Typical operation

f	50	Mc/s
$V_{tr(r.m.s.)}$	5.1	kV
V_a	6.0	kV
I_a	900	mA
I_g	280	mA
p_a	1.3	kW
η_a	76	%
R_{g-f}	2.0	kΩ
R_a	3.3	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.16	
P_{out}	4.1	kW
*P_{load}	3.3	kW

*0.85 ($P_{out}-P_{drive}$)

CLASS 'C' OSCILLATOR

Anode supply from 3-phase rectifier without smoothing filter, intermittent operation.

Limiting values (absolute ratings)

f max.	50	Mc/s
V_a max.	7.0	kV
p_a max.	2.1	kW
I_k max.	2.3	A
$i_{k(pk)}$ max.	14	A
$-V_g$ max.	1.25	kV
I_g max.	400	mA
R_{g-t} max.	10	kΩ

Typical operation

Duty cycle t_{on}	see page C4	
f	50	Mc/s
$V_{tr(r.m.s.)}$	5.1	kV
V_a	6.0	kV
I_a	1.33	A
I_g	380	mA
p_a	2.1	kW
η_a	74	%
R_{g-t}	1.45	kΩ
R_a	2.2	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.17	
P_{out}	5.9	kW
*P_{load}	4.75	kW

*0.85 (P_{out}–P_{drive})

WEIGHT

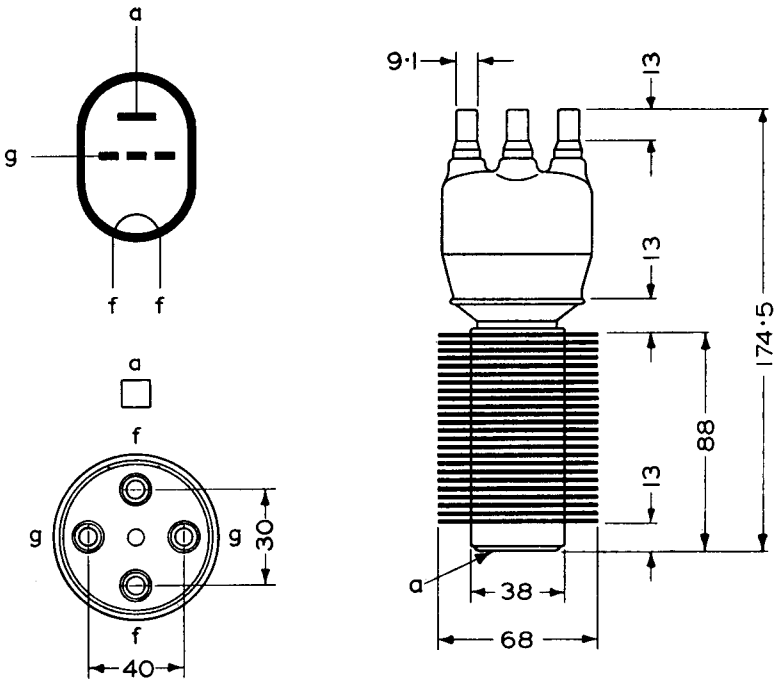
Valve only	1 lb 13oz 800 g
Shipping weight	3 lb 10oz 1.6 kg

ACCESSORIES

Socket	B8.700.51

TY6-1250A

R.F. POWER TRIODE



All dimensions in mm

7452

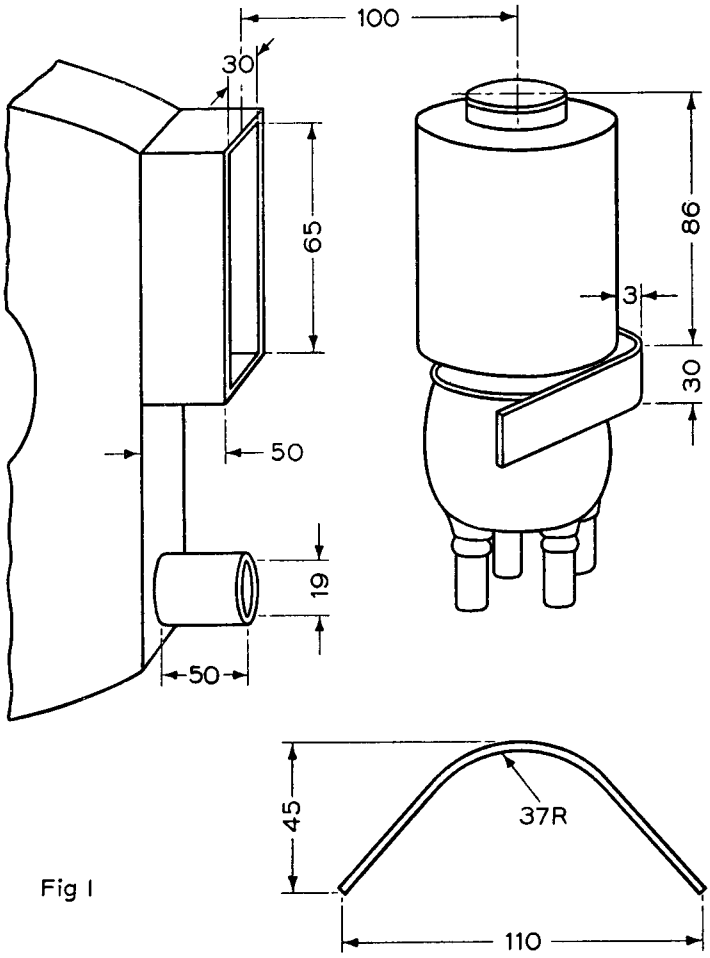


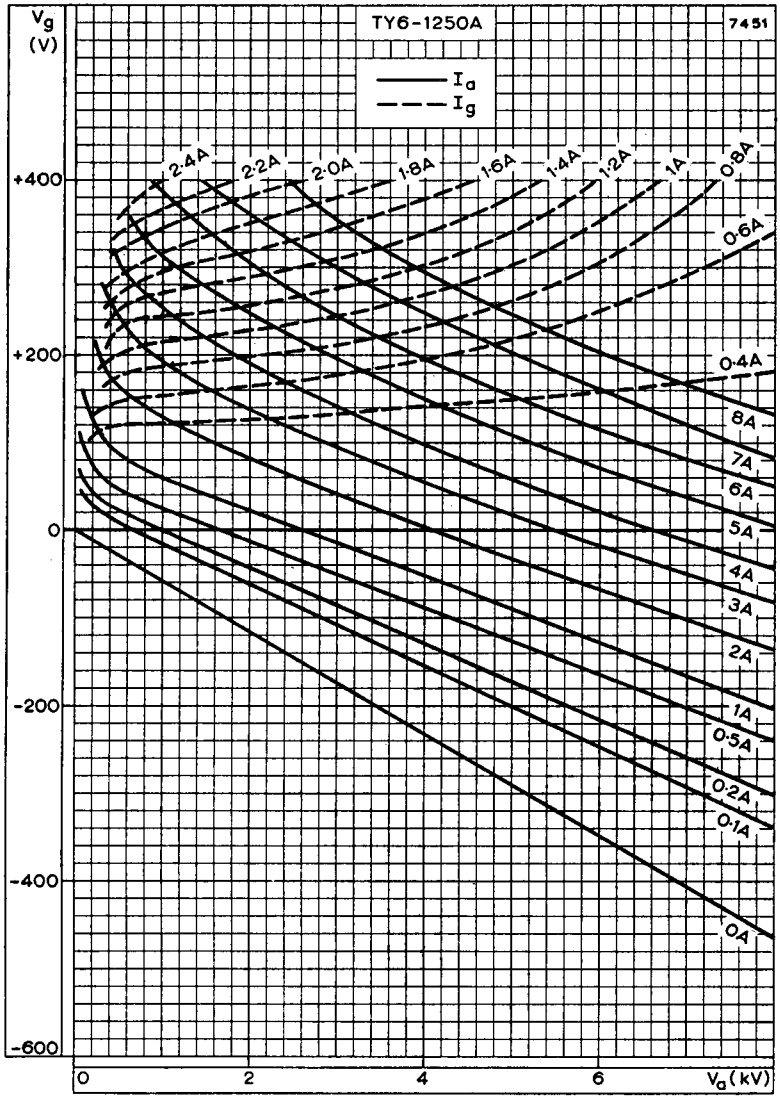
Fig 1

All dimensions in mm

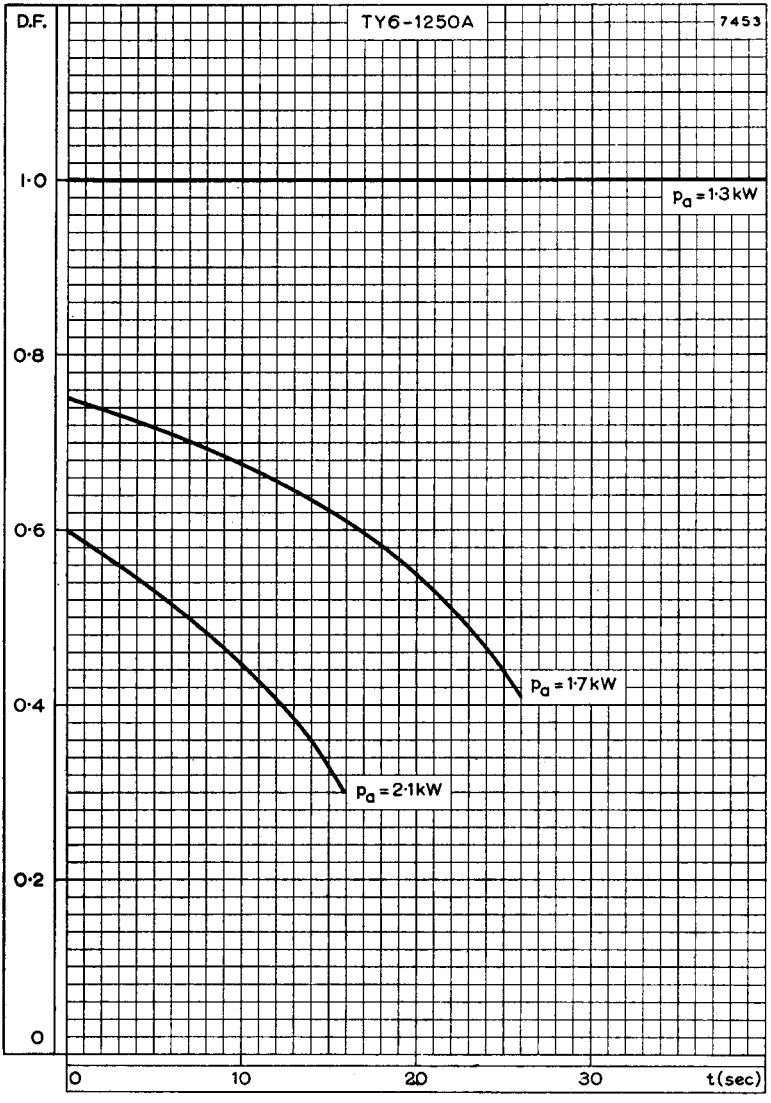
7461

FIG. 1. COOLING ARRANGEMENT

TY6-1250A



CONSTANT CURRENT CURVES



DUTY FACTOR PLOTTED AGAINST TIME FOR INTERMITTENT OPERATION

TRIODE

TY6-12A

Application: *V.H.F. power amplifier*
Power output: *17kW continuous rating*
Frequency: *110Mc/s at full ratings, 220Mc/s at reduced ratings*
Construction: *External anode, forced-air cooled*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT Directly heated, thoriated tungsten

V_f	6.3	V
*I_f	154	A
r_f (cold)	0.0054	Ω

*The filament current must never exceed a surge value of 500A at any time during the warming-up period.

MOUNTING POSITION Vertical only, base up or down

CAPACITANCES

$C_{a\ g}$	29	pF
$C_{g\ f}$	65	pF
$C_{a\ f}$	600	mpF

CHARACTERISTICS

V_a	4.0	kV
I_a	1.0	A
g_m	60	mA/V
μ	60	

COOLING

Forced air

Maximum temperature of anode and grid seals	180	°C

In order to keep below the specified temperature limit, it may be necessary to direct an air flow on the seals as indicated on page D5. At 220Mc/s, for example, an air flow of 21ft.^{3} (0.6m^3) per minute should be directed on each seal.

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea level.

Typical values of inlet temperature, rate of air flow and pressure difference between the inlet and outlet of the housing are given in the following table:—

Anode dissipation	Height above sea-level		Max. inlet temperature	Min. rate of air flow (per min.)		Pressure difference between inlet and outlet
p_a	h		T_{in}			
(kW)	(km)	(ft)	(°C)	(m^3)	(ft^3)	(mm of water)
5.5	0	0	35	5.0	177	16
5.5	1.5	4900	35	5.9	208	16
5.5	3.0	9800	25	5.7	201	16
8.0	0	0	35	7.7	272	35
8.0	1.5	4900	35	9.0	318	40
8.0	3.0	9800	25	9.0	318	36
10	0	0	35	11	388	65
10	1.5	4900	35	13	459	75
10	3.0	9800	25	13	459	66

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Limiting values (absolute ratings)

f max.	110	Mc/s
V_a max.	5.5	kV
p_a max.	10	kW
$-V_g$ max.	500	V
I_g max.	1.5	A
I_k max.	7.5	A
$i_{k(pk)}$ max.	40	A
P_{in} max.	30	kW

Typical operation

f	110	Mc/s
V_a	5.0	kV
V_g	−300	V
I_a	4.8	A
I_g	1.2	A
$v_{in(pk)}$	520	V
$P_{load(driver)}$	2.75	kW
p_a	9.0	kW
η_a	62.5	%
*P_{out}	15+2	kW
P_{load} (η transfer = 85%)	14.5	kW

*Includes power transferred from driver stage.

TY6-12A

LINEAR GROUNDED GRID POWER AMPLIFIER FOR TELEVISION SERVICE (with positive modulation and negative synchronisation)

Limiting values

f max.	88	220	Mc/s
V_a max.	5.5	4.5	kV
p_a (peak white) max.	10	10	kW
I_a (peak white) max.	6.0	6.0	A
I_g (peak white) max.	1.2	1.2	A
P_{in} (peak white) max.	25	22	kW

Typical operation (at centre frequency of the resonance curve)

f	40 to 88	170 to 220	Mc/s
Bandwidth (-3.0dB)	6.0	12	Mc/s
V_a	5.0	4.0	kV
V_g	-90	-75	V
$V_{in(pk)}$			
peak white	270	255	V
black	110	95	V
I_a			
peak white	4.8	4.8	A
black	1.45	1.45	A
I_g			
peak white	1.0	1.0	A
black	200	200	mA
$P_{load(driver)}$			
peak white	1.4	1.3	kW
*P_{out}			
peak white	17	12	kW
black	1.7	1.2	kW
P_{load}			
peak white (η transfer = 70%)	11.9	8.4	kW

*Includes power transferred from driver stage.

CLASS 'B' LINEAR GROUNDED GRID POWER AMPLIFIER FOR TELEVISION SERVICE (with negative modulation and positive synchronisation)

Limiting values (absolute ratings)

f max.	88	220	Mc/s
V_a max.	5.5	4.5	kV
$p_{a\ (sync.)}$ max.	10	10	kW
$I_{a\ (sync.)}$ max.	6.0	6.0	A
$I_{g\ (sync.)}$ max.	1.2	1.2	A
$P_{in\ (sync.)}$ max.	25	22	kW

TY6-12A

TRIODE

Typical operation (at centre frequency of the resonance curve)

	40 to 88	170 to 220	
f			Mc/s
Bandwidth (–1.5dB)	—	7.0	Mc/s
Bandwidth (–3.0dB)	6.0	12	Mc/s
V_a	5.0	4.0	kV
V_g	–90	–75	V
$V_{in(pk)}$			
sync.	270	255	V
black	200	180	V
I_a			
sync.	4.8	4.8	A
black	3.6	3.6	A
I_g			
sync.	1.0	1.0	A
black	350	350	mA
$P_{load(driver)}$			
sync.	1.4	1.3	kW
*P_{out}			
sync.	17	12	kW
black	9.6	6.75	kW
P_{load}			
sync. (η transfer = 70%)	11.9	8.4	kW

*Includes power transferred from driver stage.

WEIGHT

Valve only 20 lb 15oz (9.5kg)

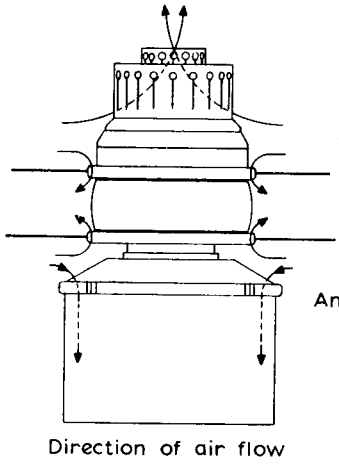
ACCESSORIES

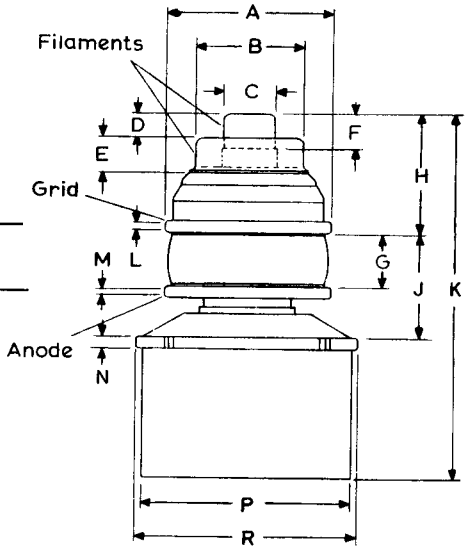
Insulating pedestal	40654
Anode connector	40651
Grid connector	40651
Inner filament connector	40652
Outer filament connector	40653

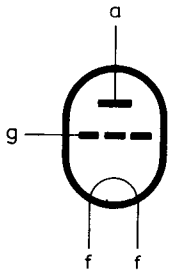
DIMENSIONS

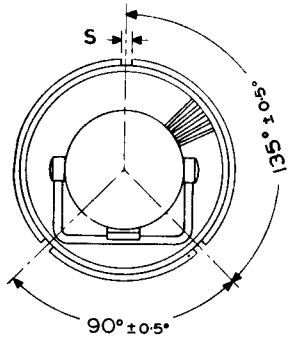
	Inches	*Millimetres*		*Inches*	*Millimetres*
A	5.000–0.039	127–1.0	J	3.051±0.039	77.5±1.0
B	3.228+0.019	82+0.5	K	10.847±0.059	275.5±1.5
C	1.595+0.019	40.5+0.5	L	0.217	5.5
D	0.709±0.039	18±1.0	M	0.217	5.5
E	0.984±0.039	25±1.0	N	0.315±0.012	8.0±0.3
F	1.024±0.039	26±1.0	P	6.260±0.028	159±0.7
G	1.595±0.039	40.5±1.0	R	6.654±0.019	169±0.5
H	3.543±0.039	90±1.0	S	0.354+0.019	9.0+0.5

TY6-12A


Direction of air flow

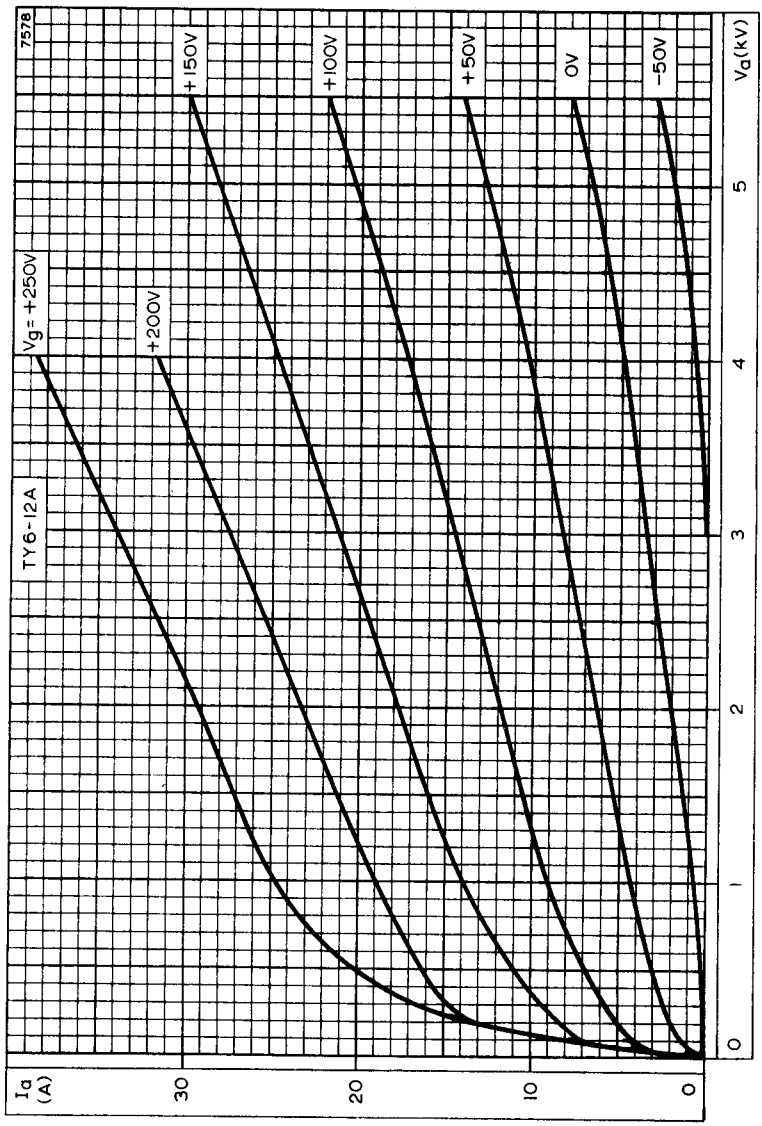

A
Filaments
B
C
D
E
F
Grid
H
M
L
G
J
K
Anode
N
P
R


a
g
f
f


S
135° ±0·5°
90° ±0·5°

7577

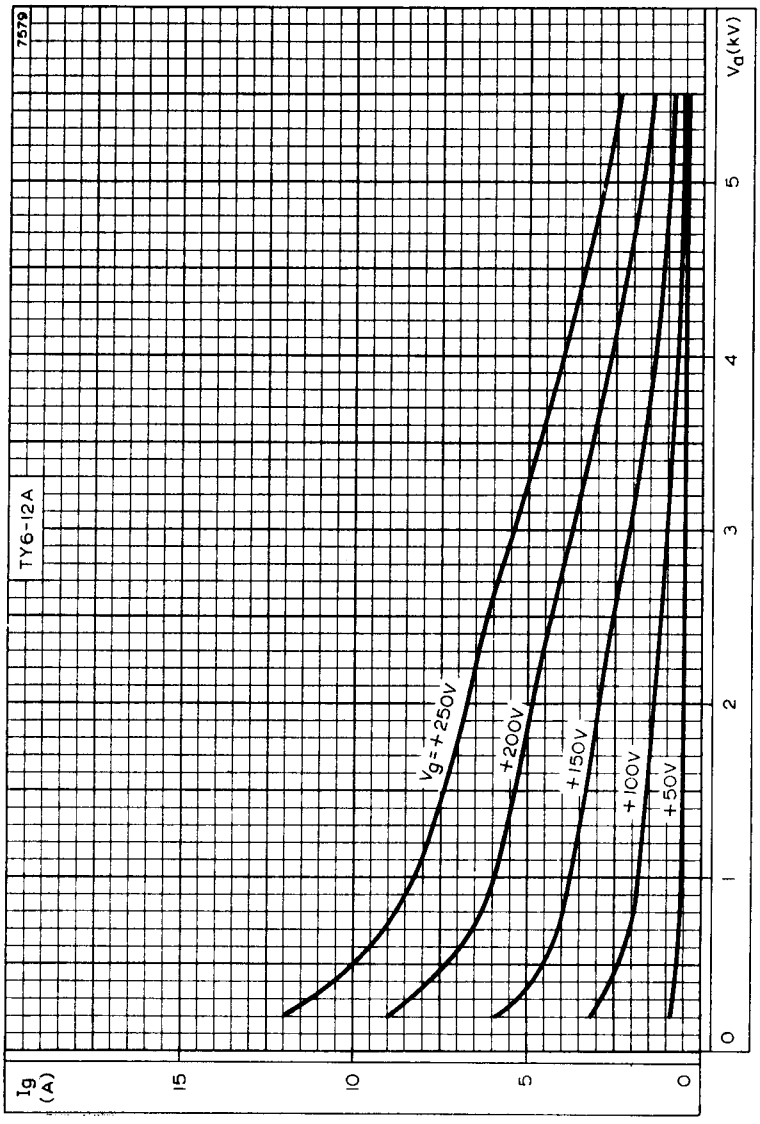
TY6-12A



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

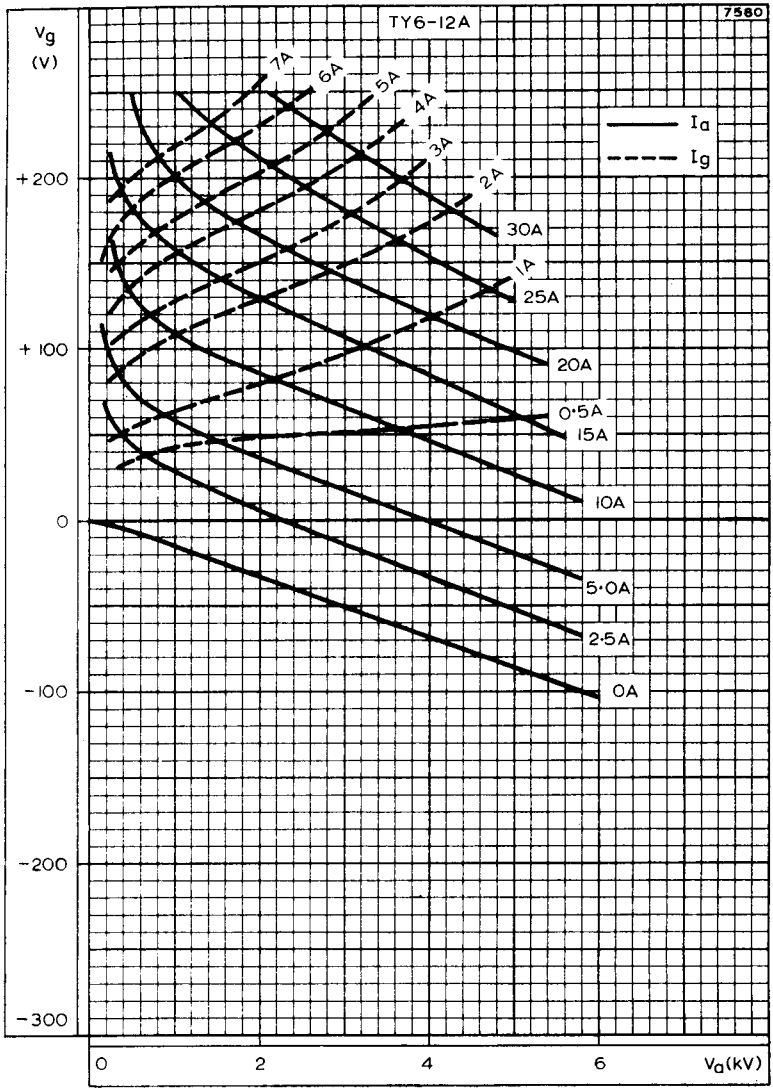
TY6-12A

TRIODE

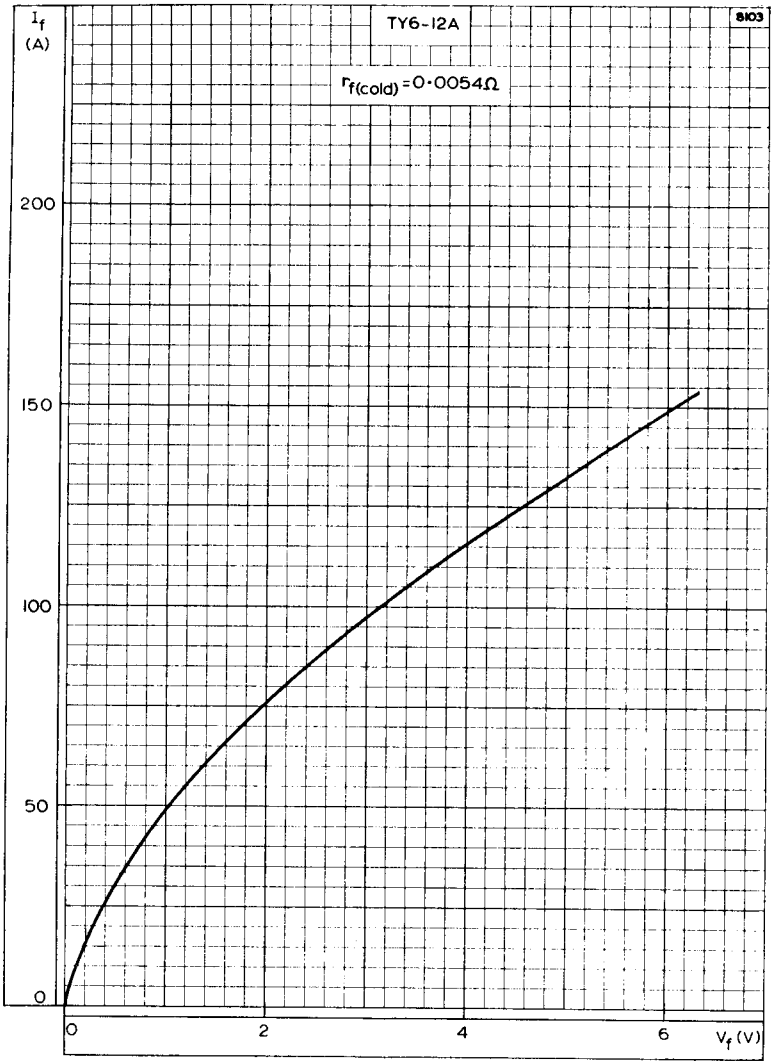


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

TY6-12A



CONSTANT CURRENT CURVES



FILAMENT CURRENT PLOTTED AGAINST FILAMENT VOLTAGE

V.H.F. INDUSTRIAL TRIODE

TY6-3000A

QUICK REFERENCE DATA

Forced-air cooled triode intended for use as Class 'C' industrial oscillator.

f	30	Mc/s
P_{out}	7.6	kW
f max.	150	Mc/s
V_a max.	6.0	kV
p_a max.	3.0	kW

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

INDUSTRIAL OSCILLATOR, CLASS 'C'

OPERATING CONDITIONS

f	30	30	Mc/s
P_{out}	5.8	7.6	kW
P_{load}	5.0	6.7	kW
Duty factor	1.0	1.0	
η_a	77	78	%
V_a	5.0	6.0	kV
I_a	1.5	1.63	A
$-V_g$	300	350	V
I_g	300	310	mA
R_{g-f}	1.0	1.13	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.125	0.12	
P_{drive}	157	180	W
p_a	1.7	2.2	kW
p_g	76	84	W

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

f max.	150	Mc/s
V_a max.	7.0	kV
$-V_g$ max.	1.0	kV
I_g max.	350	mA
I_k max.	2.5	A
$i_{k(pk)}$ max.	15	A
p_a max.	3.0	kW
p_g max.	110	W
R_{g-f} max.	10	kΩ

CATHODE

Directly heated, thoriated tungsten

V_f	12.6	V
I_f	33	A

CAPACITANCES

c_{a-g}	24	pF
c_{out}	0.5	pF
c_{in}	21	pF

CHARACTERISTICS (measured at V_a = 2.5kV, I_a = 0.9A)

g_m	22	mA/V
μ	26	

MOUNTING POSITION

Vertical, with base up or down

COOLING

Forced-air cooled (see curves on pages C4 and C5)

Maximum temperatures

Anode and grid seals	180	°C
Filament seals	210	°C

The amount of forced-air cooling required for the anode of this valve depends upon the anode dissipation and temperature and pressure of inlet air.

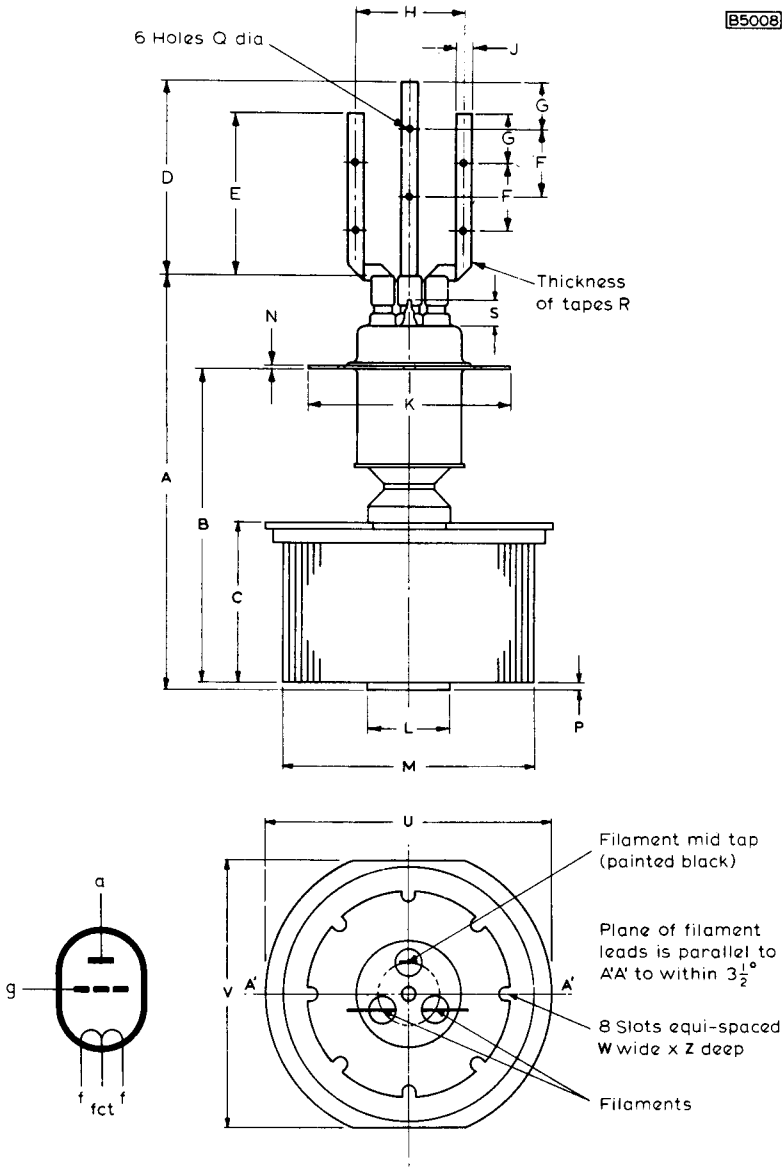
PHYSICAL DATA

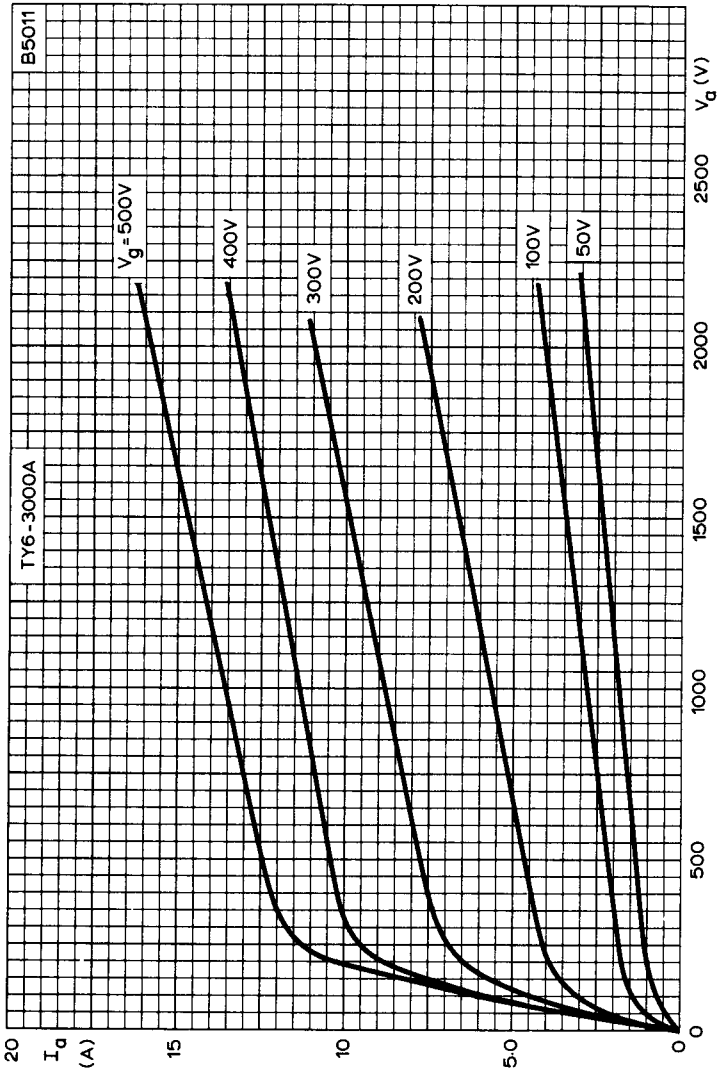
	lb	kg
Weight of valve	8.4	3.8

DIMENSIONS

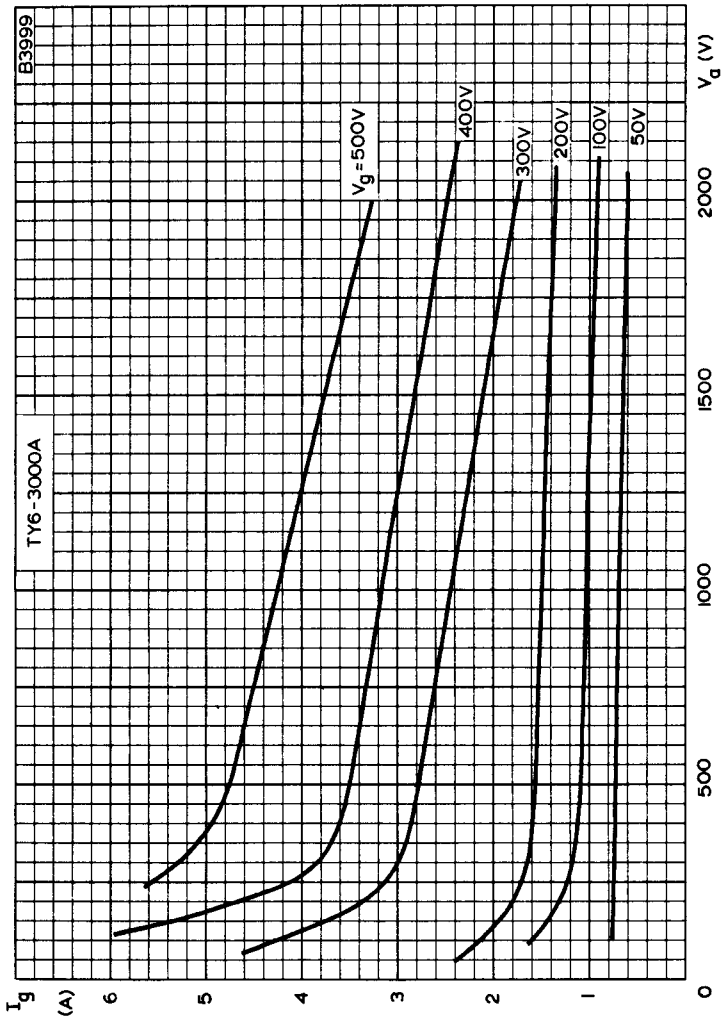
	Inches	Millimetres	
A	8.46	215	max.
B	6.075 ± 0.059	154.3 ± 1.5	
C	3.406 ± 0.039	86.5 ± 1.0	
D	4.252 ± 0.078	108 ± 2.0	
E	3.425 ± 0.039	88 ± 1.0	
F	1.378 ± 0.039	35 ± 1.0	
G	0.866 ± 0.078	20 ± 2.0	
H	2.500	63.5	max.
J	0.315 ± 0.019	8.0 ± 0.5	
K	4.567 ± 0.019	116 ± 0.5	dia.
L	1.969 ± 0.008	50 ± 0.2	dia.
M	5.929 ± 0.039	150.6 ± 1.0	dia.
N	0.063 ± 0.007	1.6 ± 0.2	
P	0.178 ± 0.008	4.5 ± 0.2	
Q	0.145 ± 0.002	3.70 ± 0.05	
R	4 x 0.010	4 x 0.25	
S	0.78	20	max.
U	6.512 ± 0.019	165.4 ± 0.5	
V	6.256 ± 0.019	158.9 ± 0.5	
W	0.182 ± 0.004	4.62 ± 0.1	
Z	0.205 ± 0.008	5.20 ± 0.20	

Inch dimensions derived from original millimetre dimensions

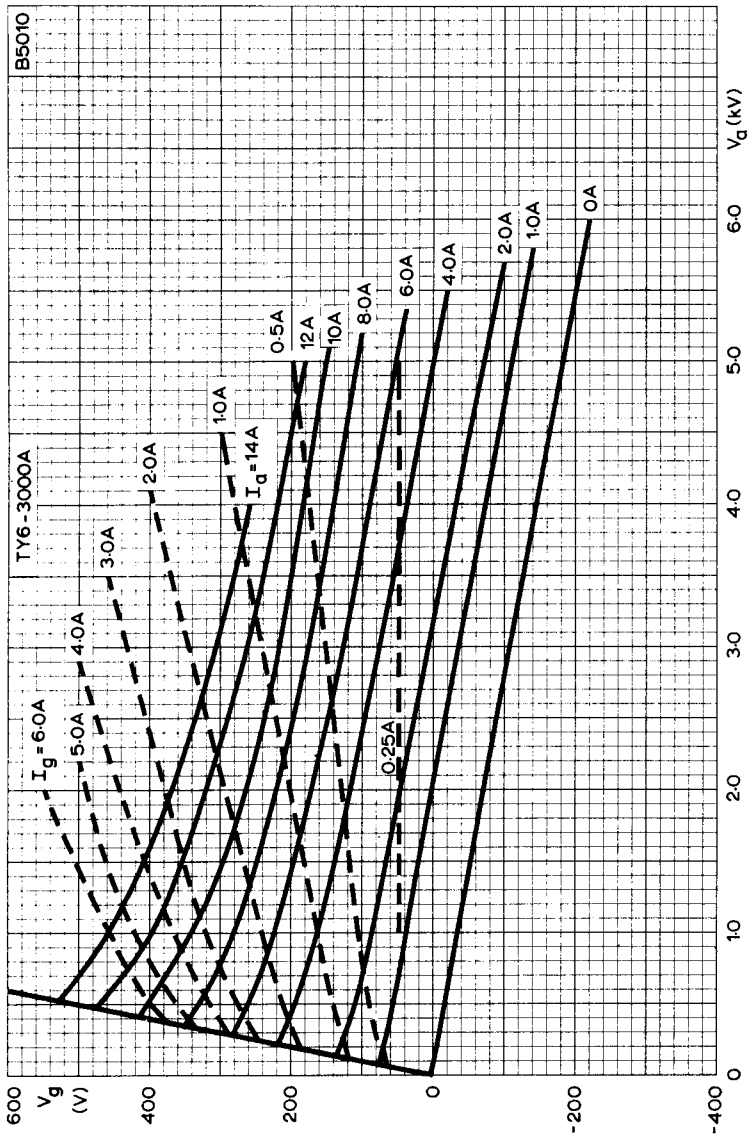

B5008
6 Holes Q dia
H
J
G
G
F
F
D
E
Thickness
of tapes R
N
S
K
A
B
C
L
P
M
U
Filament mid tap
(painted black)
Plane of filament
leads is parallel to
A'A' to within 3½°
8 Slots equi-spaced
W wide x Z deep
Filaments
V
A'
A'
a
g
f
fct
f



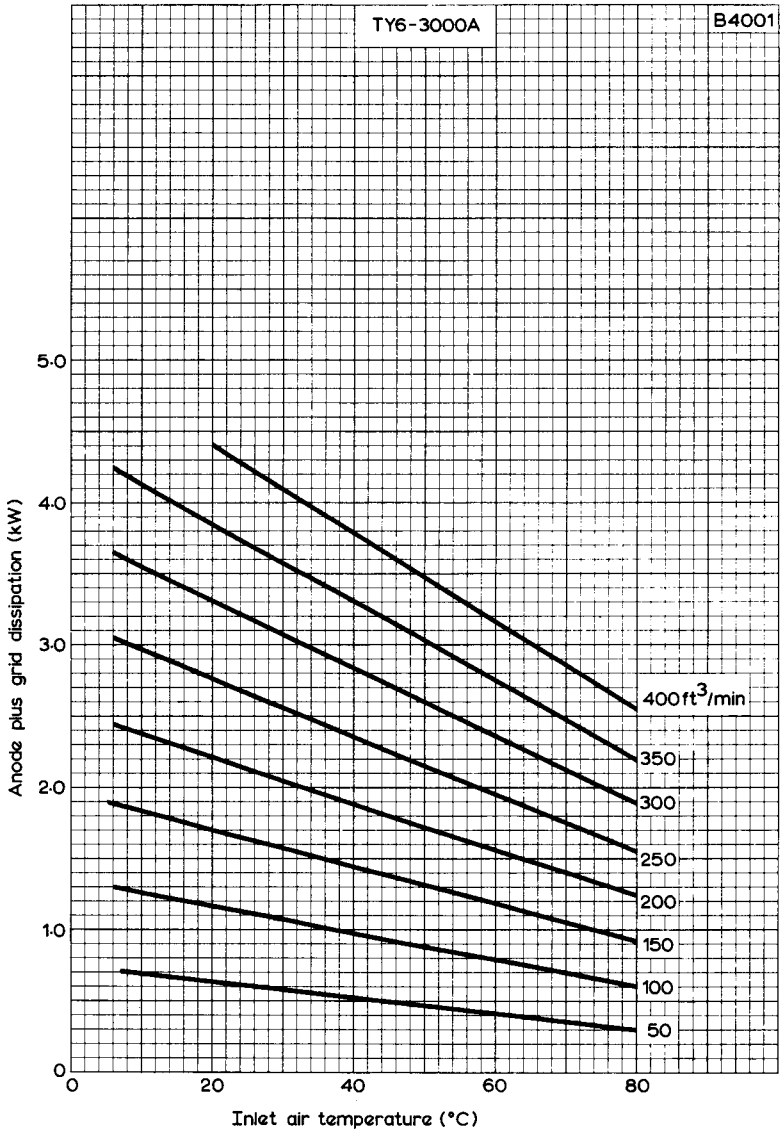
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



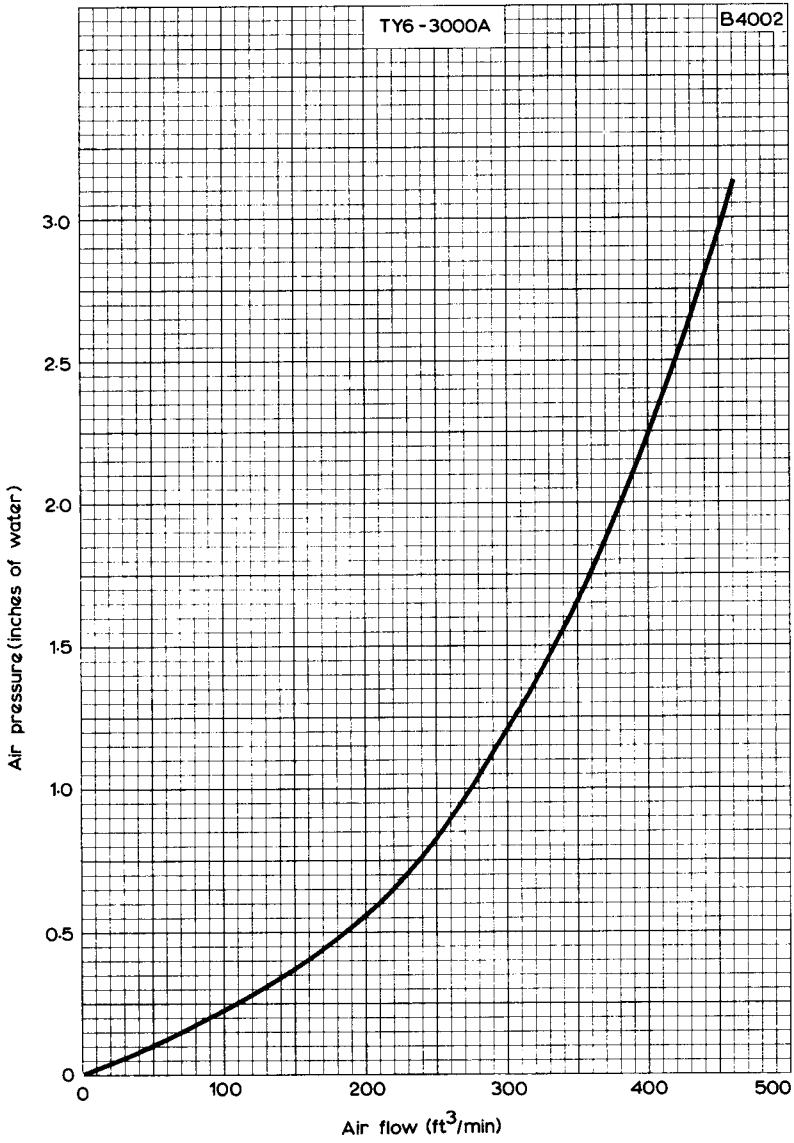
GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



CONSTANT CURRENT CHARACTERISTICS



AIR COOLING CHARACTERISTICS



AIR FLOW CHARACTERISTICS

V.H.F. POWER TRIODE

TY6-5000W

High power water cooled triode rated for a maximum anode dissipation of 6kW. Primarily intended for use in v.h.f. transmitters.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT

Thoriated Tungsten

V_f	12.6	V
I_f	33	A

The connection f_{ct} is intended for use as the cathode current return and is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30Mc/s all three filament pins should be interconnected with suitable capacitors.

The connections to the filament pins and to the supply bus-bars must be securely made and have negligible contact resistance.

MOUNTING POSITION

Vertical, with anode downwards

CAPACITANCES

C_{in}	16	pF
C_{out}	0.3	pF
C_{a-g}	11	pF

CHARACTERISTICS (measured at V_a=4kV, I_a=1.0A)

g_m	17	mA/V
μ	32	

COOLING

Maximum temperature of anode and grid seals	180	°C
Maximum inlet temperature of water	50	°C

TY6-5000W

V.H.F. POWER TRIODE

High power water cooled triode rated for a maximum anode dissipation of 6kW. Primarily intended for use in v.h.f. transmitters.

Typical values of inlet temperature, rate of flow of water and pressure difference between the inlet and outlet housing at various anode dissipations are given in the following table.

Anode dissipation p_a (kW)	Inlet temperature T_{in} (°C)	Rate of flow of water (litres/min)	Pressure difference between inlet and outlet (atm)
1.0	20	2.5	0.08
1.0	50	3.0	0.1
2.0	20	2.5	0.08
2.0	50	5.0	0.3
4.0	20	4.0	0.18
4.0	50	9.0	0.9
6.0	20	6.0	0.4
6.0	50	14	2.5

At inlet temperatures between 20 and 50°C the required quantity of water can be found by linear interpolation. In order to keep within the temperature limits it is necessary to direct a flow of air on to the seals at frequencies above 30Mc/s. The air flow should be started at the application of filament voltage.

The characteristics, operating conditions, and limiting values are identical with those given for TY6-5000A but for the following differences.

OPERATION AS R.F. AMPLIFIER, CLASS 'B' TELEPHONY, CLASS 'C' TELEGRAPHY CLASS 'C' TELEVISION, (GRID MODULATION NEGATIVE SYNCHRONISATION), CLASS 'B' A.F. AMPLIFIER.

p_a max. 6.0 kW

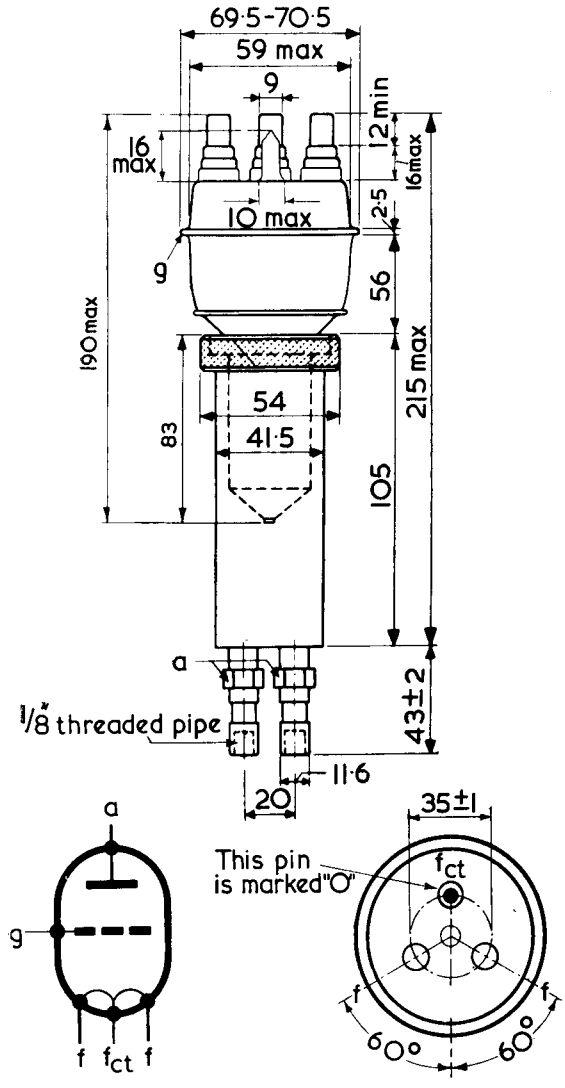
OPERATION AS R.F. POWER AMPLIFIER, CLASS 'C' ANODE MODULATION.

p_a max. 4.0 kW

V.H.F. POWER TRIODE

TY6-5000W

High power water cooled triode rated for a maximum anode dissipation of 6kW. Primarily intended for use in v.h.f. transmitters.



3385

All dimensions in mm.

V.H.F. POWER TRIODE

TY6-5000A

Application: *V.H.F. Power amplifier*
Power Output: *6.9kW continuous rating*
Frequency: *75Mc/s at full ratings*
Construction: *External anode, forced-air cooled*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES included in this volume of the handbook.

FILAMENT Thoriated tungsten

V_f	12.6	V
I_f	33	A

The connection f_{ct} is intended for use as the cathode current return and is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30Mc/s all three filament pins should be interconnected with suitable capacitors.

The connections to the filament pins and to the supply bus-bars must be securely made and have negligible contact resistance.

MOUNTING POSITION

Vertical, base up or down.

CAPACITANCES

C_{in}	16	pF
C_{out}	0.3	pF
C_{a-g}	11	pF

CHARACTERISTICS (measured at V_a=4.0kV, I_a=1.0A)

g_m	17	mA/V
μ	32	

COOLING

Forced-air		
Max. temperature of anode and grid seals	180	°C
Max. temperature of pin seals	220	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals.

The amount of forced air cooling required for this valve depends upon the anode dissipation and the height above sea-level.

Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table.

TY6-5000A

V.H.F. POWER TRIODE

Anode dissipation	Height above sea-level		Inlet temperature	Rate of flow of air per minute		Pressure difference between inlet and outlet
p_a (kW)	h (km)	(ft)	T_{in} (°C)	(m^3)	(ft^3)	(mm of H_2O)
1.0	0	0	35	3.0	105	8.0
1.0	0	0	45	3.1	110	8.0
1.0	1.5	4920	35	3.7	130	9.0
1.0	3.0	9840	25	4.1	145	10
3.0	0	0	35	5.2	185	23
3.0	0	0	45	6.1	215	29
3.0	1.5	4920	35	6.2	220	26
3.0	3.0	9840	25	6.6	235	26
5.0	0	0	35	9.2	325	68
5.0	0	0	45	10.7	380	90
5.0	1.5	4920	35	11.2	395	81
5.0	3.0	9840	25	11.6	410	79

OPERATION AS SINGLE VALVE R.F. POWER OSCILLATOR OR AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting values

V_a max.	6.0	kV
p_a max.	5.0	kW
I_k max.	1.85	A
$i_{k(pk)}$ max.	8.5	A
I_g max.	350	mA
$-V_g$ max.	1.0	kV
p_g max.	120	W

Typical operating conditions at f = 75Mc/s

V_a	4.0	5.0	6.0	kV
V_g	−200	−300	−400	V
I_a	1.37	1.5	1.5	A
I_g	350	330	310	mA
$v_{in(pk)}$	500	640	740	V
$P_{load(driver)}$	190	240	275	W
p_a	1.5	1.9	2.1	kW
P_{out}	4.0	5.6	6.9	kW
η	73	75	76.5	%
*P_{load}	3.2	4.5	5.5	kW

*With a circuit transfer efficiency of 80%

OPERATION AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "B" TELEPHONY)

Limiting values (carrier conditions for a modulation factor of 1)

V_a max.	6.0	kV
p_a max.	5.0	kW
I_k max.	1.45	A
$i_{k(pk)}$ max.	4.6	A
p_g max.	120	W

Typical operating conditions at f = 75Mc/s

V_a	5.0	6.0	kV
V_g	−145	−180	V
I_a	900	990	mA
$v_{in(pk)}$	225	250	V
p_a	3.0	4.0	kW
P_{out}	1.45	1.9	kW
η_t	32	32	%
*P_{load}	1.16	1.52	kW
For 100% modulation			
I_g	320	300	mA
$P_{load(driver)}$	160	170	W

*With a circuit transfer efficiency of 80%

OPERATION AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS "C" ANODE MODULATION)

Limiting values (carrier conditions for a modulation factor of 1)

V_a max.	5.0	kV
p_a max.	3.4	kW
$-V_g$ max.	1.0	kV
I_k max.	1.65	A
$i_{k(pk)}$ max.	7.5	A
I_g max.	350	mA
p_g max.	120	W

Typical operating conditions at f = 75Mc/s

V_a	3.0	3.5	4.0	4.5	5.0	kV
*V_g	−250	−300	−300	−350	−400	V
I_a	1.0	1.2	1.2	1.2	1.2	A
I_g	300	300	300	300	300	mA
$v_{in(pk)}$	510	600	600	650	690	V
$P_{load\ (driver)}$	170	205	205	230	205	W
p_a	0.8	1.2	1.3	1.3	1.3	kW
P_{out}	2.2	3.0	3.5	4.1	4.7	kW
η	73	71.5	73	76	78	%
**P_{load}	1.76	2.4	2.8	3.3	3.75	kW
For 100% modulation						
P_{mod}	1.5	2.1	2.4	2.7	3.0	kW

*This bias voltage is partially obtained by the use of a grid resistor.
**With a circuit transfer efficiency of 80%

TY6-5000A

V.H.F. POWER TRIODE

OPERATION AS GROUNDED GRID R.F. POWER AMPLIFIER (CLASS "C" TELEGRAPHY OR F.M. TELEPHONY)

Limiting values (per valve)

V_a max.	6.0	kV
p_a max.	5.0	kW
V_{f-g} max.	1.0	kV
I_k max.	1.85	A
$i_{k(pk)}$ max.	8.5	A
I_g max.	350	mA
p_g max.	120	W

Typical operating conditions for two valves

f	75	110	110	220	Mc/s
V_a	6.0	4.0	5.0	4.0	kV
V_{f-g}	400	200	300	200	V
I_a	2×1.5	2×1.37	2×1.5	2×1.25	A
I_g	2×310	2×350	2×330	2×200	mA
$v_{in(f-f)pk}$	1480	1000	1280	900	V
$P_{load\ (driver)}$	2×1190	2×705	2×965	2×395	W
p_a	2×2.1	2×1.7	2×2.2	2×2.5	kW
*P_{out}	13.8+1.82	7.6+1.0	10.6+1.46	5.0+0.6	kW
**η	76.5	69	71	50	%
***P_{load}	12.5	6.9	9.6	4.5	kW

*Includes power transferred from driver stage

**Valve efficiency

***With a circuit transfer efficiency of 80%

OPERATION AS A.F. CLASS "B" AMPLIFIER OR MODULATOR

Limiting values (each valve)

V_a max.	6.0	kV
p_a max.	5.0	kW
I_k max.	1.8	A
$i_{k(pk)}$ max.	5.7	A
p_g max.	120	W
R_{g-f} max.	15	kΩ

Typical operating conditions for two valves in push-pull

V_a	3.0	3.5	4.0	4.5	5.0	6.0	kV
V_g	−90	−100	−112	−125	−138	−165	V
$I_{a(o)}$	2×65	2×75	2×100	2×100	2×110	2×125	mA
I_a(max. sig.)	2×800	2×950	2×940	2×920	2×910	2×1500	mA
I_g	2×200	2×180	2×190	2×190	2×140	2×280	mA
$V_{in(g-g)r.m.s.}$	400	440	450	465	470	645	V
R_{a-a}	4.4	4.2	4.9	6.1	6.4	4.9	kΩ
$P_{load\ (driver)}$	2×52	2×50	2×54	2×27	2×42	2×115	W
p_a	2×0.75	2×1.0	2×1.1	2×1.15	2×1.25	2×2.35	kW
P_{out}	3.3	4.6	5.3	6.0	6.6	13.3	kW
D_{tot}	3.3	2.9	2.6	3.7	3.3	4.3	%
η	69	70	71	72	73	74	%

OPERATION AS R.F. AMPLIFIER CLASS "C" GRID-MODULATION FOR TELEVISION SERVICE (with positive modulation and negative synchronisation)

Limiting values (each valve)

V_a max.	5.0	kV
p_a (peak white) max.	5.0	kW
$-V^g$ max.	1.0	kV
P_{in} (peak white) max.	9.5	kW
p_g (peak white) max.	120	W
I_k (peak white) max.	2.2	A
$i_{k(pk)}$ (peak white) max.	10	A

Typical operating conditions for two valves in push-pull

f	48 to 75	Mc/s
*Bandwidth (–1.5dB)	5.25	Mc/s
*Bandwidth (–3.0dB)	8.0	Mc/s
V_a	5.0	kV
V_g (peak white)	–200	V
V_g (black)	–460	V
V_g (sync.)	–580	V
$v_{in(g-g)pk}$	1.0	kV
I_a (peak white)	2×1.9	A
I_a (black)	2×400	mA
I_g (peak white)	2×250	mA
I_g (black)	0	mA
**$P_{load\ (driver)}$ (peak white)	250	W
P_{out} (peak white)	9.0	kW
P_{out} (black)	600	W
***P_{load} (peak white)	6.3	kW

*Bandwidth based on a single LC circuit.

**Includes power dissipated in circuit and loading resistors.

***With a circuit transfer efficiency of 70%.

OPERATION AS R.F. POWER AMPLIFIER CLASS "C" GRID-MODULATION FOR TELEVISION SERVICE (with negative modulation and positive synchronisation)

Limiting values (each valve)

f max.	75	220	Mc/s
V_a max.	5.0	4.0	kV
p_a (sync.) max.	5.0	4.0	kW
P_{in} (sync.) max.	9.5	6.5	kW
p_g (sync.) max.	120	120	W
$-V_g$ max.	1.0	1.0	kV
I_k (sync.) max.	2.2	1.8	A
$i_{k(pk)}$ (sync.) max.	10	8.1	A

Typical operating conditions for two valves in push-pull

f	48 to 75	170 to 220	Mc/s
*Bandwidth (–1.5dB)	5.25	6.5	Mc/s
*Bandwidth (–3.0dB)	8.0	10	Mc/s
V_a	5.0	4.0	kV
V_g (sync.)	–200	–150	V
V_g (black)	–300	–225	V
V_g (white)	–550	–500	V
$v_{in\ (g-g)pk}$ (sync.)	1.0	1.0	kV
I_a (sync.)	2×1.9	2×1.6	A
I_a (black)	2×1.3	2×1.3	A
I_g (sync.)	2×250	2×200	mA
I_g (black)	2×175	2×110	mA
**$P_{load\ (driver)}$ (sync.)	250	350 to 450	W
P_{out} (sync.)	9.0	6.0	kW
P_{out} (black)	5.35	3.37	kW
***P_{load} (sync.)	6.3	4.2	kW

*Bandwidth based on a single LC circuit.

**Includes power dissipated in circuit and loading resistors.

***With a circuit transfer efficiency of 70%.

OPERATION AS LINEAR POWER AMPLIFIER FOR TELEVISION SERVICE (with negative modulation and positive synchronisation)

Limiting values (each valve)

f max.	75	220	Mc/s
V_a max.	5.0	4.0	kV
P_{in} (sync.) max.	9.5	6.5	kW
p_a(sync.) max.	5.0	4.0	kW
p_g (sync.) max.	120	120	W
I_k (sync.) max.	2.2	1.8	A
$i_{k(pk)}$ (sync.) max.	10	8.1	A

Typical operating conditions for two valves in push-pull

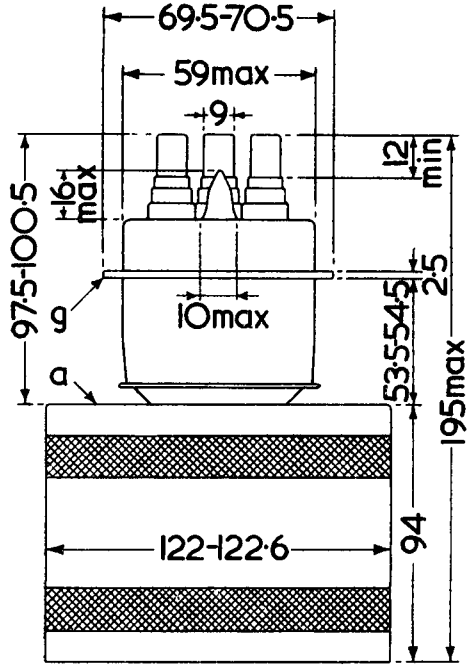
f	48 to 75	170 to 220	Mc/s
*Bandwidth (–1.5dB)	5.25	6.5	Mc/s
*Bandwidth (–3.0dB)	8.0	10	Mc/s
V_a	5.0	4.0	kV
V_g	–200	–150	V
$v_{in(g-g)pk}$ (sync.)	1.0	1.0	kV
$v_{in(g-g)pk}$ (black)	800	750	V
$v_{in(g-g)pk}$ (white)	100	200	V
I_a (sync.)	2×1.9	2×1.6	A
I_a (black)	2×1.5	2×1.3	A
I_a (white)	2×100	2×100	mA
I_g (sync.)	2×250	2×200	mA
I_g (black)	2×110	2×110	mA
I_g (white)	0	0	mA
**$P_{load\ (driver)}$ (sync.)	250	350 to 450	W
P_{out} (sync.)	9.0	6.0	kW
P_{out} (black)	5.35	3.37	kW
***P_{load} (sync.)	6.3	4.2	kW

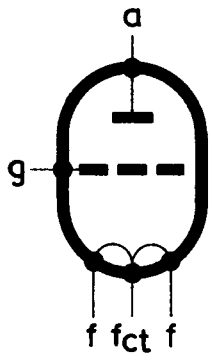
*Bandwidth based on a single LC circuit.

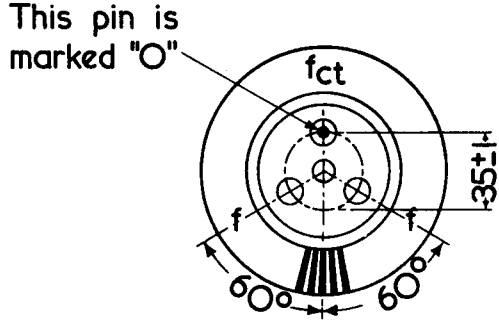
**Includes power dissipated in circuit and loading resistors.

***With a circuit transfer efficiency of 70%.

TY6-5000A

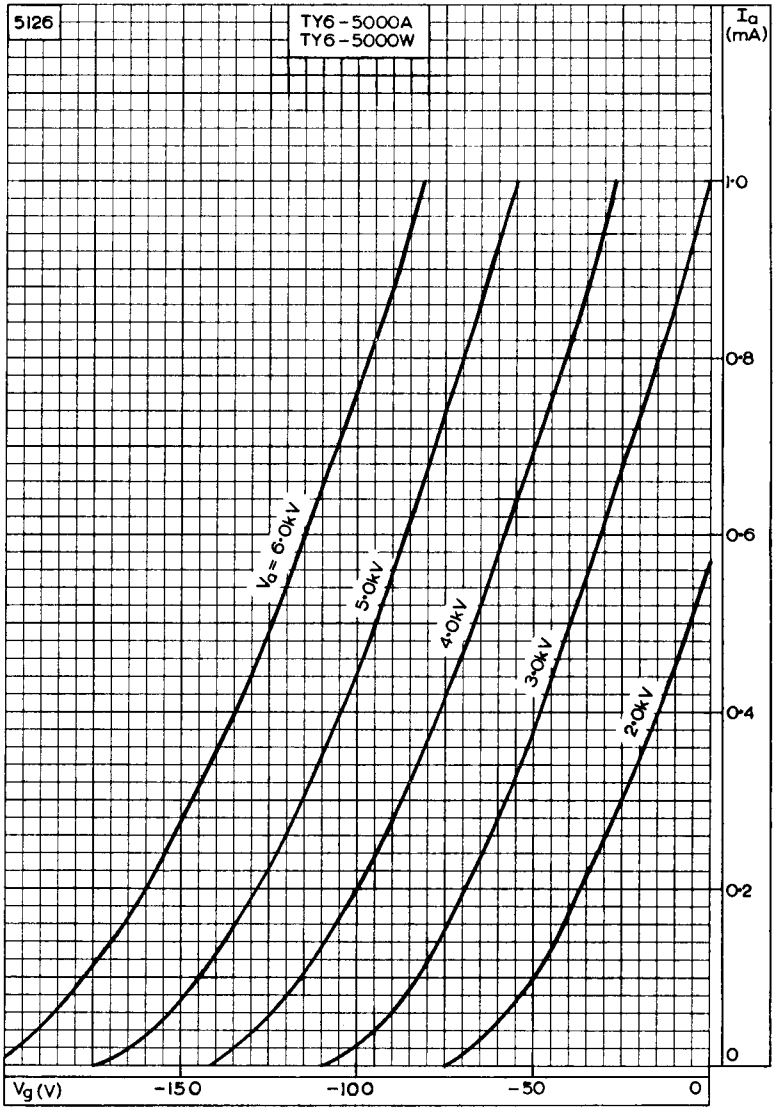






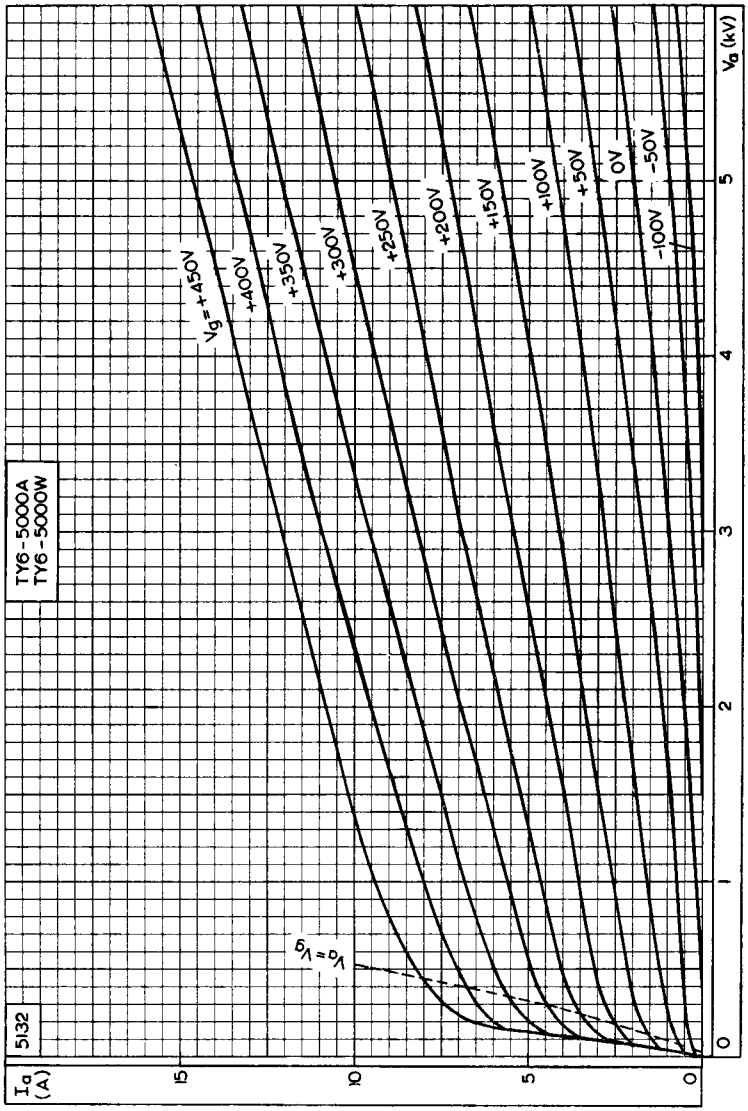
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All dimensions in mm

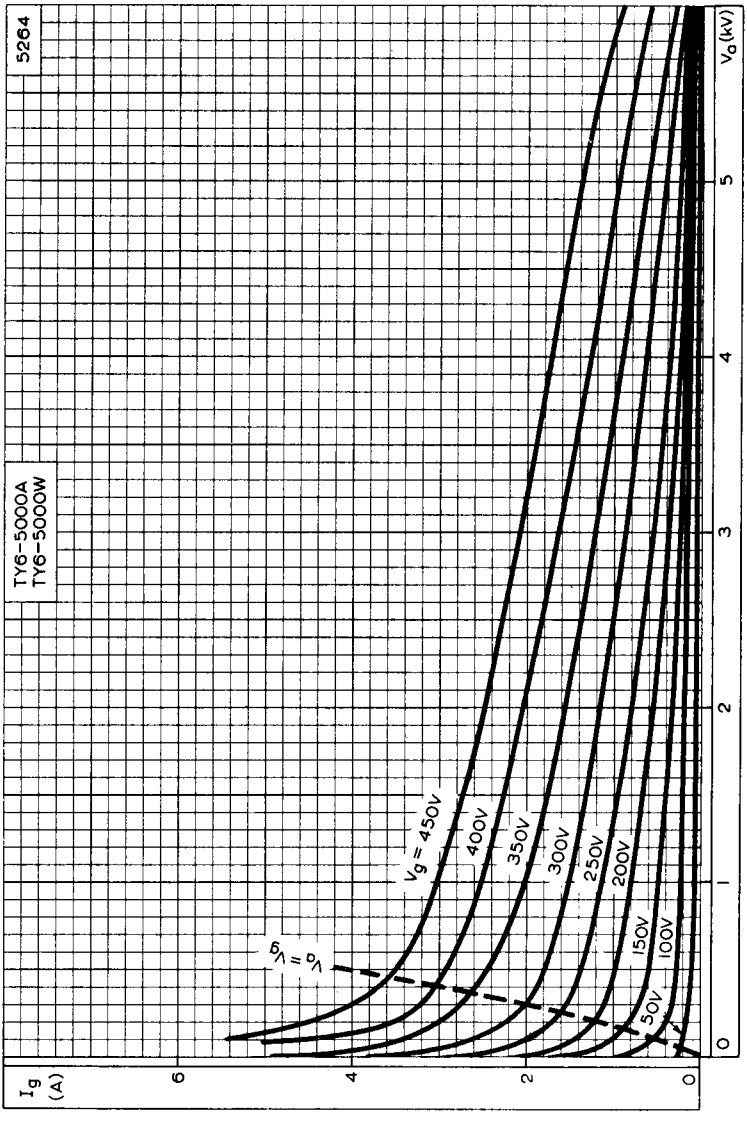


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

TY6-5000A

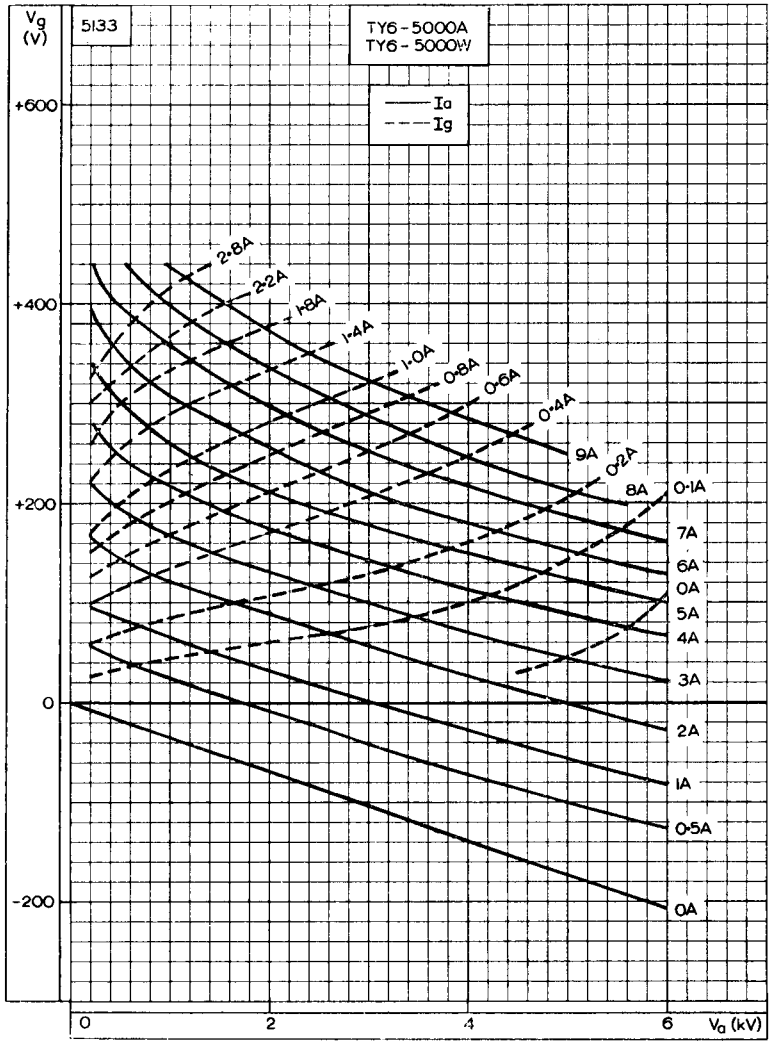


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

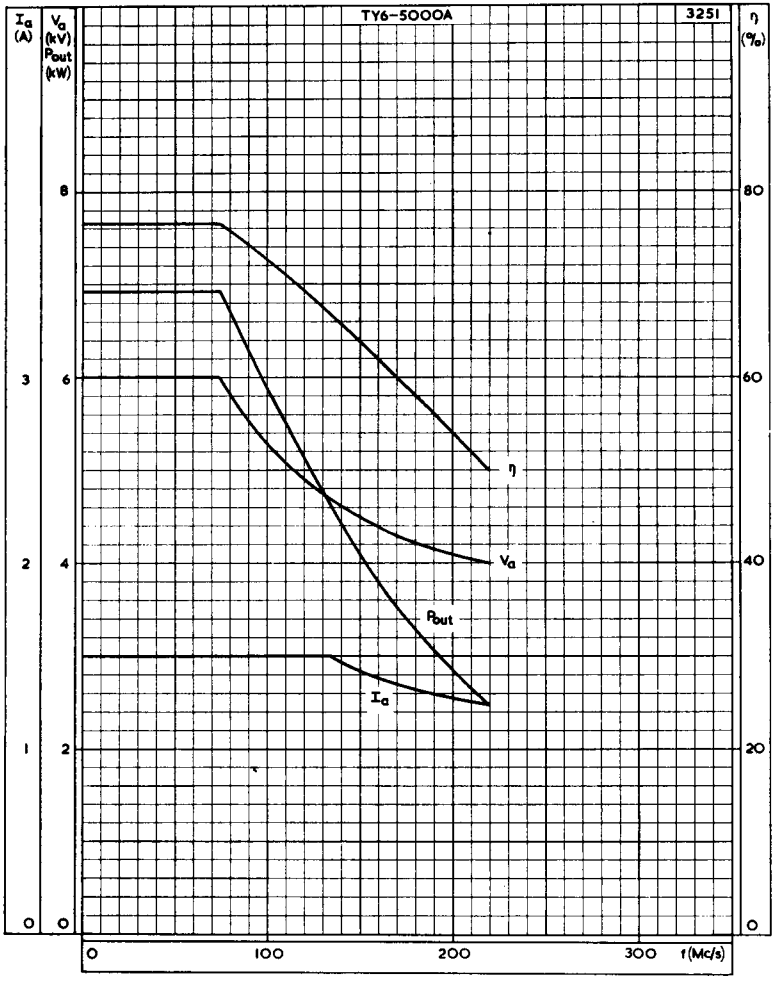


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

TY6-5000A



CONSTANT CURRENT CURVES



FREQUENCY CHARACTERISTICS

V.H.F. POWER TRIODE

TY6-5000A
TY6-5000W
TY6-5000H

QUICK REFERENCE DATA

External anode triode, intended for use as v.h.f. amplifier or oscillator or a.f. amplifier.

The TY6-5000A is forced-air cooled.
The TY6-5000W is water cooled by means of a water jacket.
The TY6-5000H is water cooled by means of an integral helical water cooler.

	Class 'C' Telegraphy or F.M. Telephony		Class 'C' Telephony Anode Modulation	Class 'B' Telephony	Class 'B' A.F.	
f	75	75	75	75	-	Mc/s
P_{out}	6.9	*13.8	4.7	1.9	13.3	kW
f max	75		75	75	-	Mc/s
V_a max	6.0		5.0	6.0	6.0	kV
p_a max	5.0		3.4	5.0	5.0	kW

*Grounded grid configuration

Class 'C' Amplifier T.V. Service

	Positive modulation Negative synchronisation	Negative modulation Positive synchronisation		Linear Power Amplifier		
f	48 to 75	48 to 75	170 to 220	48 to 75	170 to 220	Mc/s
P_{out}	9.0	9.0	6.0	9.0	6.0	kW
f max	75	75	220	75	220	Mc/s
V_a max	5.0	5.0	4.0	5.0	4.0	kV
p_a max	5.0	5.0	4.0	5.0	4.0	kW

Unless otherwise shown, data is applicable to all types

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Typical operating conditions

f	75	75	75	Mc/s
P_{out}	4.0	5.6	6.9	kW
P_{load}	3.2	4.5	5.5	kW
η_a	73	75	77	%
V_a	4.0	5.0	6.0	kV
I_a	1.37	1.5	1.5	A
$-V_g$	200	300	400	V
I_g	350	330	310	mA
$v_{in(pk)}$	500	640	740	V
$P_{load\ (driver)}$	190	240	275	W
p_a	1.5	1.9	2.1	kW

Typical operating conditions for two valves in grounded grid configuration

f	75	110	110	220	Mc/s
*P_{out}	13.8 + 1.82	7.6 + 1.0	10.6 + 1.46	5.0 + 0.6	kW
P_{load}	12.5	6.9	9.6	4.5	kW
η	77	69	71	50	%
V_a	6.0	4.0	5.0	4.0	kV
I_a	2 x 1.5	2 x 1.37	2 x 1.5	2 x 1.25	A
V_{f-g}	400	200	300	200	V
I_g	2 x 310	2 x 350	2 x 330	2 x 200	mA
$v_{in(f-f)\ pk}$	1.48	1.0	1.28	0.9	kV
$P_{load\ (driver)}$	2 x 1.19	2 x 0.705	2 x 0.965	2 x 0.395	kW
p_a	2 x 2.1	2 x 1.7	2 x 2.2	2 x 2.5	kW

*Includes power transferred from driver stage.

CLASS 'C' TELEPHONY ANODE MODULATION

Typical operating conditions (Carrier conditions for 100% modulation)

f	75	75	75	75	75	Mc/s
P_{out}	2.2	3.0	3.5	4.1	4.7	kW
P_{load}	1.76	2.4	2.8	3.3	3.75	kW
η_a	73	72	73	76	78	%
V_a	3.0	3.5	4.0	4.5	5.0	kV
I_a	1.0	1.2	1.2	1.2	1.2	A
*$-V_g$	250	300	300	350	400	V
I_g	300	300	300	300	300	mA
$v_{in(pk)}$	510	600	600	650	690	V
$P_{load\ (driver)}$	170	205	205	230	205	W
p_a	0.8	1.2	1.3	1.3	1.3	kW
For 100% modulation						
P_{mod}	1.5	2.1	2.4	2.7	3.0	kW

*This bias voltage is partially obtained by the use of a grid resistor.

CLASS 'B' TELEPHONY

Typical operating conditions (Carrier conditions for 100% modulation)

f	75	75	Mc/s
P_{out}	1.45	1.9	kW
P_{load}	1.16	1.52	kW
η_a	32	32	%
V_a	5.0	6.0	kV
I_a	900	990	mA
$-V_g$	145	180	V
$v_{in(pk)}$	225	250	V
p_a	3.0	4.0	kW
For 100% modulation			
I_g	320	300	mA
$P_{load(driver)}$	160	170	W

CLASS 'B' AUDIO AMPLIFIER OR MODULATOR

Typical operating conditions for two valves in push-pull

P_{out}	3.3	4.6	5.3	6.0	6.6	13.3	kW
D_{tot}	3.3	2.9	2.6	3.7	3.3	4.3	%
R_{a-a}	4.4	4.2	4.9	6.1	6.4	4.9	kΩ
V_a	3.0	3.5	4.0	4.5	5.0	6.0	kV
$-V_g$	90	100	112	125	138	165	V
$I_{a(o)}$	2 x 65	2 x 75	2 x 100	2 x 100	2 x 110	2 x 125	mA
I_a (max. sig.)	2 x 800	2 x 950	2 x 940	2 x 920	2 x 910	2 x 1500	mA
I_g	2 x 200	2 x 180	2 x 190	2 x 190	2 x 140	2 x 280	mA
$V_{in\ (g-g)}$ r.m.s.	400	440	450	465	470	645	V
$P_{load\ (driver)}$	2 x 52	2 x 50	2 x 54	2 x 27	2 x 42	2 x 115	W
p_a	2 x 0.75	2 x 1.0	2 x 1.1	2 x 1.15	2 x 1.25	2 x 2.35	kW
η_a	69	70	71	72	73	74	%

CLASS 'C' AMPLIFIER FOR TELEVISION SERVICE COMMON CATHODE, BIAS MODULATED

Positive modulation, negative synchronisation

Typical operating conditions for two valves in push-pull

f	48 to 75	Mc/s
Bandwidth (-1.5dB)	5.25	Mc/s
Bandwidth (-3.0dB)	8.0	Mc/s
P_{out} (white)	9.0	kW
P_{load} (white)	6.3	kW
V_a	5.0	kV
$-V_g$ (white)	200	V
(black)	460	V
(sync)	580	V
I_a (white)	2 x 1.9	A
(black)	2 x 400	mA
I_g (white)	2 x 250	mA
(black)	0	mA
$V_{in\ (g-g)\ pk}$ (white)	1.0	kV
$P_{load\ (driver)}$ white	250	W

CLASS 'C' AMPLIFIER FOR TELEVISION SERVICE
COMMON CATHODE, BIAS MODULATED

Negative modulation, positive synchronisation

Typical operating conditions for two valves in push-pull

f	48 to 75	170 to 220	Mc/s
Bandwidth (-1.5dB)	5.25	6.5	Mc/s
Bandwidth (-3.0dB)	8.0	10	Mc/s
P_{out} (sync)	9.0	6.0	kW
P_{load} (sync)	6.3	4.2	kW
V_a	5.0	4.0	kV
$-V_g$ (sync)	200	250	V
(black)	300	225	V
(white)	550	500	V
I_a (sync)	2 x 1.9	2 x 1.6	A
(black)	2 x 1.3	2 x 1.3	A
I_a (sync)	2 x 250	2 x 200	mA
(black)	2 x 175	2 x 110	mA
$v_{in\ (g-g)\ pk}$ (sync)	1.0	1.0	kV
$P_{load\ (driver)}$ sync	250	350 to 450	W

CLASS 'C' LINEAR POWER AMPLIFIER
COMMON CATHODE, BIAS MODULATED

Negative modulation, positive synchronisation

Typical operating conditions for two valves in push-pull

f	48 to 75	170 to 220	Mc/s
Bandwidth (-1.5dB)	5.25	6.5	Mc/s
Bandwidth (-3.0dB)	8.0	10	Mc/s
P_{out} (sync)	9.0	6.0	kW
P_{load} (sync)	6.3	4.2	kW
V_a	5.0	4.0	kV
$-V_g$	200	150	V
I_a (sync)	2 x 1.9	2 x 1.6	A
(black)	2 x 1.5	2 x 1.3	A
(white)	2 x 100	2 x 100	mA
I_g (sync)	2 x 250	2 x 200	mA
(black)	2 x 110	2 x 110	mA
(white)	0	0	mA
$v_{in\ (g-g)\ pk}$ (sync)	1.0	1.0	kV
(black)	800	750	V
(white)	100	100	V
$P_{load\ (driver)}$ sync	250	350 to 450	W

ABSOLUTE MAXIMUM RATINGS

	Class 'C' Telegraphy	Class 'C' Telephony	Class 'B' Telephony	Class 'C' A.F.	
V_a max.	6.0	5.0	6.0	6.0	kV
$-V_g$ max.	*1.0	1.0	-	-	kV
I_k max.	1.85	1.65	1.45	1.8	A
$i_{k(pk)}$ max.	8.5	7.5	4.6	5.7	A
p_a max.	5.0	3.4	5.0	5.0	kW
I_g max.	350	350	-	-	mA
p_g max.	120	120	120	120	W
R_{g-f} max.	-	-	-	15	kΩ

*V_{f-g} in grounded grid configuration

	CLASS 'C' AMPLIFIER			T.V. SERVICE		
	Positive modulation Negative synchronisation	Negative modulation Positive synchronisation		Linear Power Amplifier Negative Modulation Positive synchronisation		
f max.	-	75	220	75	220	Mc/s
V_a max.	5.0	5.0	4.0	5.0	4.0	kV
$-V_g$ max.	1.0	1.0	1.0	-	-	kV
I_k max..	2.2	2.2	1.8	2.2	1.8	A
$i_{k(pk)}$ max.	10	10	8.1	10	8.1	A
p_a max.	5.0	5.0	4.0	5.0	4.0	kW
p_g max.	120	120	120	120	120	W
P_{in} max.	9.5	9.5	6.5	9.5	6.5	kW

CATHODE

Directly heated, thoriated tungsten

*V_f	12.6	V
I_f	33	A

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

The connection f_{ct} is intended for use as the cathode current return and is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30Mc/s all three filament pins should be interconnected with suitable capacitors.

CAPACITANCES

C_{a-g}	11	pF
C_{out}	300	mpF
C_{in}	16	pF

CHARACTERISTICS (measured at V_a = 4.0kV, I_a = 1.0A)

g_m	17	mA/V
μ	32	

MOUNTING POSITION

Vertical, with base up or down

COOLING

TY6-5000A

Forced-air cooled

Maximum temperatures

Anode and grid seals	180	°C
Pin seals	210	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals.

The amount of forced air cooling required for this valve depends upon the anode dissipation and the height above sea-level.

Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table.

Anode dissipation	Height above sea level		Inlet temperature	Rate of flow of air per minute		Pressure difference between inlet and outlet
P_a (kW)	h (km)	(ft)	T_{in} (°C)	(m^3)	(ft^3)	(mm of H_2O)
1.0	0	0	35	3.0	105	8.0
1.0	0	0	45	3.1	110	8.0
1.0	1.5	4920	35	3.7	130	9.0
1.0	3.0	9840	25	4.1	145	10
3.0	0	0	35	5.2	185	23
3.0	0	0	45	6.1	215	29
3.0	1.5	4920	35	6.2	220	26
3.0	3.0	9840	25	6.6	235	26
5.0	0	0	35	9.2	325	68
5.0	0	0	45	10.7	380	90
5.0	1.5	4920	35	11.2	395	81
5.0	3.0	9840	25	11.6	410	79

TY6-5000W

Water cooled anode, low velocity air flow on seals

Maximum temperatures

Anode and grid seals	180	°C
Water inlet	50	°C

Typical values of inlet temperature, rate of flow of water and pressure difference between the inlet and outlet housing at various anode dissipations are given in the following table.

Anode dissipation	Inlet temperature	Rate of flow of water per minute		Pressure difference between inlet and outlet
P_a (kW)	T_{in} (°C)	(litres)	(gal)	(atm)
1.0	20	2.5	0.55	0.08
1.0	50	5.0	1.10	0.1
2.0	20	2.5	0.55	0.08
2.0	50	5.0	1.10	0.3
4.0	20	4.0	0.88	0.18
4.0	50	9.0	1.98	0.9
6.0	20	6.0	1.32	0.4
6.0	50	14	3.08	2.5

At inlet temperatures between 20 and 50°C the required quantity of water can be found by linear interpolation. In order to keep within the temperature limits it is necessary to direct a flow of air on to the seals at frequencies above 30Mc/s. The air flow should be started at the application of filament voltage.

TY6-5000H

Water cooled anode, low velocity air flow on seals

Maximum temperatures.

Water inlet	50	°C
Filament seals	210	°C
Anode and grid seals	180	°C

The amount of water cooling required for this valve depends on the anode dissipation and the temperature of the water.

Typical values of rate of flow of water through helix and pressure loss in the helix are given in the curve on page C2. The minimum rate of flow of

water through helix required can be found from the curves on page C3. At frequencies above 30Mc/s and at ambient temperatures above 35°C both grid and filament seals should be cooled by a low velocity air flow.

PHYSICAL DATA

	TY6-5000A	TY6-5000W	TY6-5000H	
Weight of valve	9.7	1.8	1.8	lb
	4.4	0.8	0.8	kg
Weight of valve plus carton	22	3.6	3.7	lb
	10	1.6	1.7	kg
Weight of insulating pedestal	4.6	-	-	lb
	2.1	-	-	kg
Weight of insulating pedestal plus carton	6.8	-	-	lb
	3.1	-	-	kg
Weight of water jacket	-	1.7	-	lb
	-	0.76	-	kg
Weight of water jacket plus carton	-	2.0	-	lb
	-	0.9	-	kg

ACCESSORIES

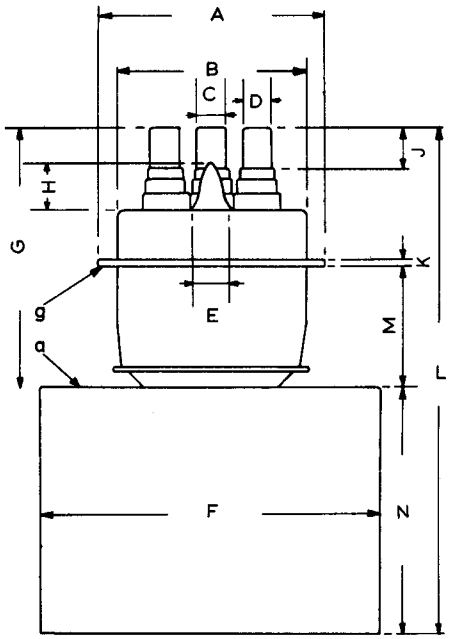
Filament clips x 2	40634
Filament centre clip x 1	40649
Grid connector x 1 >30Mc/s	40622
Grid connector x 1 <30Mc/s	40650
Insulating pedestal x 1 (TY6-5000A)	40630
Water jacket x 1 (TY6-5000W)	K721

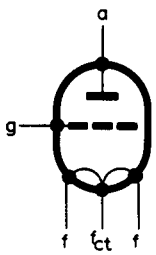
Dimensions of TY6-5000A

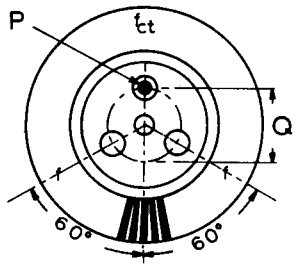
	Inches	Millimetres	
A	2.756 ± 0.020	70 ± 0.5	
B	2.323	59	max
C	0.413	10.5	
D	0.354	9.0	
E	0.394	10	max
F	4.815 ± 0.012	122.3 ± 0.3	
G	3.898 ± 0.059	99 ± 1.5	
H	0.630	16	max
J	0.472	12	min
K	0.098	2.5	
L	7.677	195	max
M	2.126 ± 0.020	54 ± 0.5	
N	3.701	94	
P	0.413	10.5	dia
Q	1.378 ± 0.039	35 ± 1.0	

Inch dimensions derived from original millimetre dimensions.

OUTLINE DRAWING OF TY6-5000A







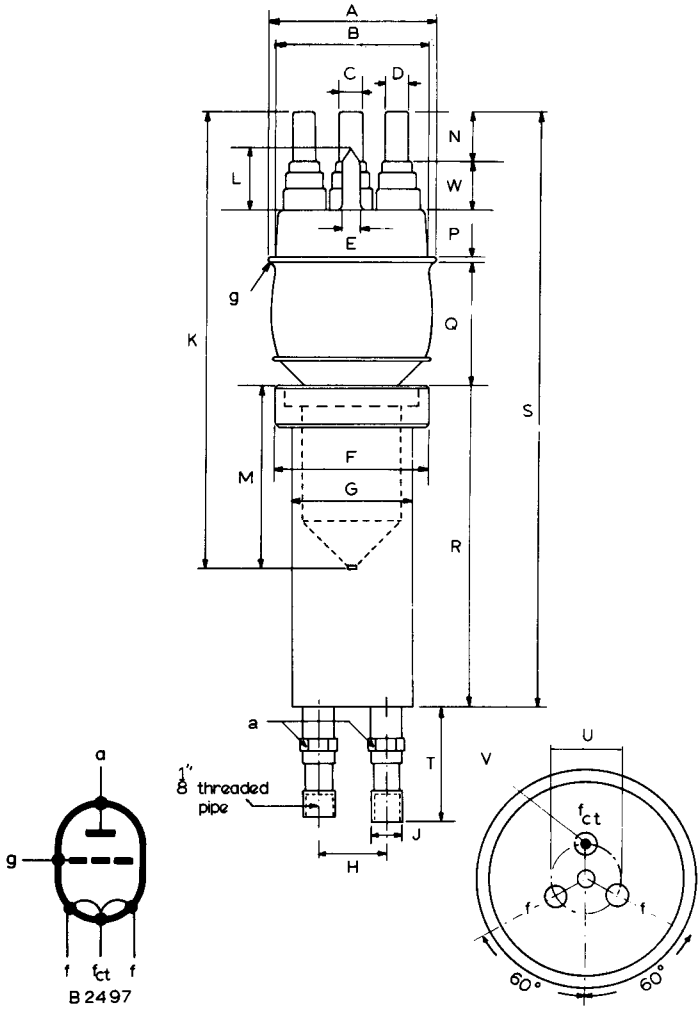
B 2495

Dimensions of TY6-5000W

	Inches	Millimetres	
A	2.756 ± 0.020	70 ± 0.5	
B	2.323	59	max
C	0.413	10.5	
D	0.354	9.0	
E	0.394	10	max
F	2.126	54	
G	1.634	41.5	
H	0.788	20	
J	0.457	11.6	
K	7.480	190	max
L	0.630	16	max
M	3.268	83	
N	0.472	12	min
P	0.098	2.5	
Q	2.205	56	
R	4.130	105	
S	8.465	215	max
T	1.713 ± 0.079	43.5 ± 2.0	
U	1.378 ± 0.039	35 ± 1.0	
V	0.413	10.5	dia
W	0.630	16	max

Inch dimensions derived from original millimetre dimensions.

OUTLINE DRAWING OF TY6-5000W

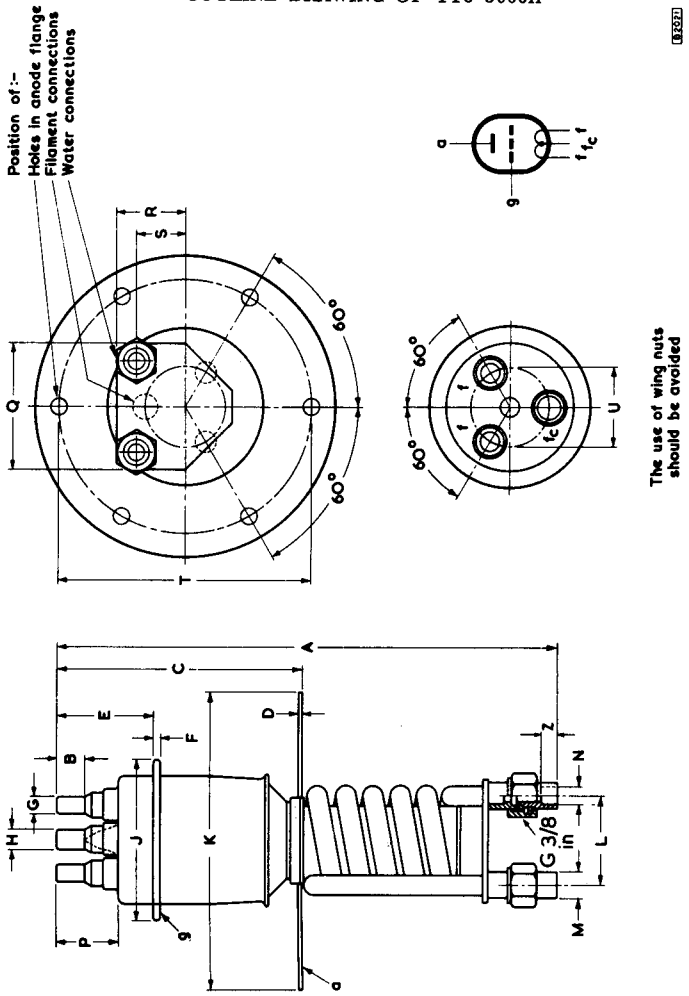


Dimensions of TY6-5000H

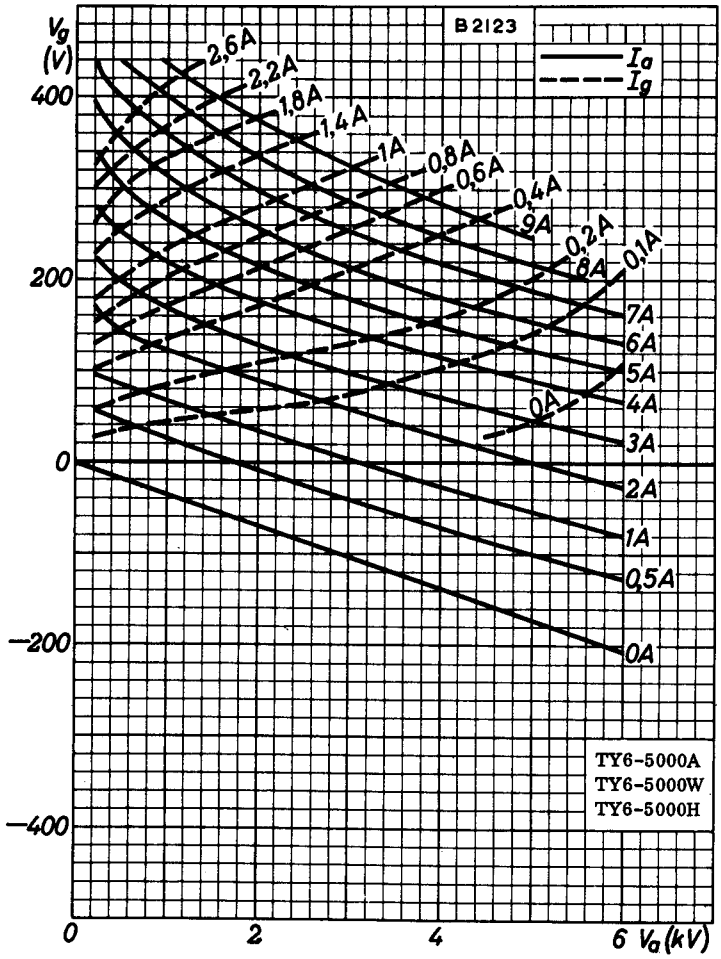
	Inches	Millimetres	
A	8.622	219	
B	0.472	12	min.
C	4.134	105	
D	0.079	2	
E	1.693	43	
F	0.098	2.5	
G	0.358	9.1	dia.
H	0.413	10.5	dia.
J	2.756	70	dia.
K	5.118	130	dia.
L	1.535	39	
M	0.394	10	dia.
N	0.315	8	dia.
P	0.630	16	max.
Q	2.283	58	
R	1.260	32	
S	0.827	21	
T	4.331	110	
U	1.378	35	
Z	0.394	10	

Inch dimensions derived from original millimetre dimensions.

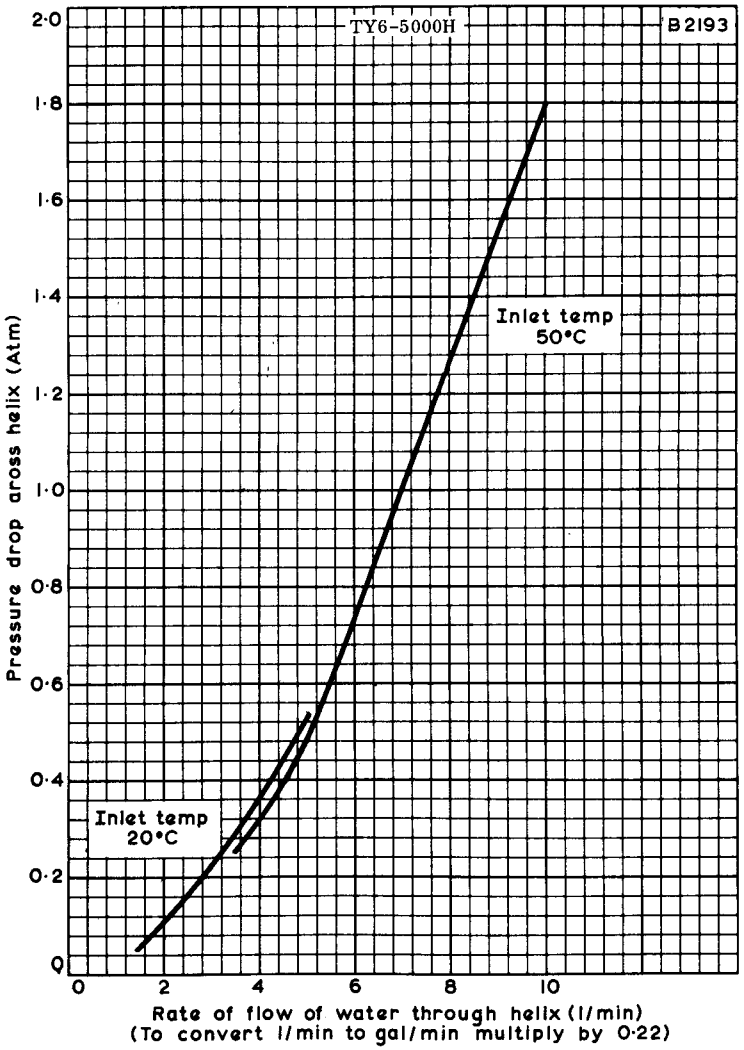
OUTLINE DRAWING OF TY6-5000H



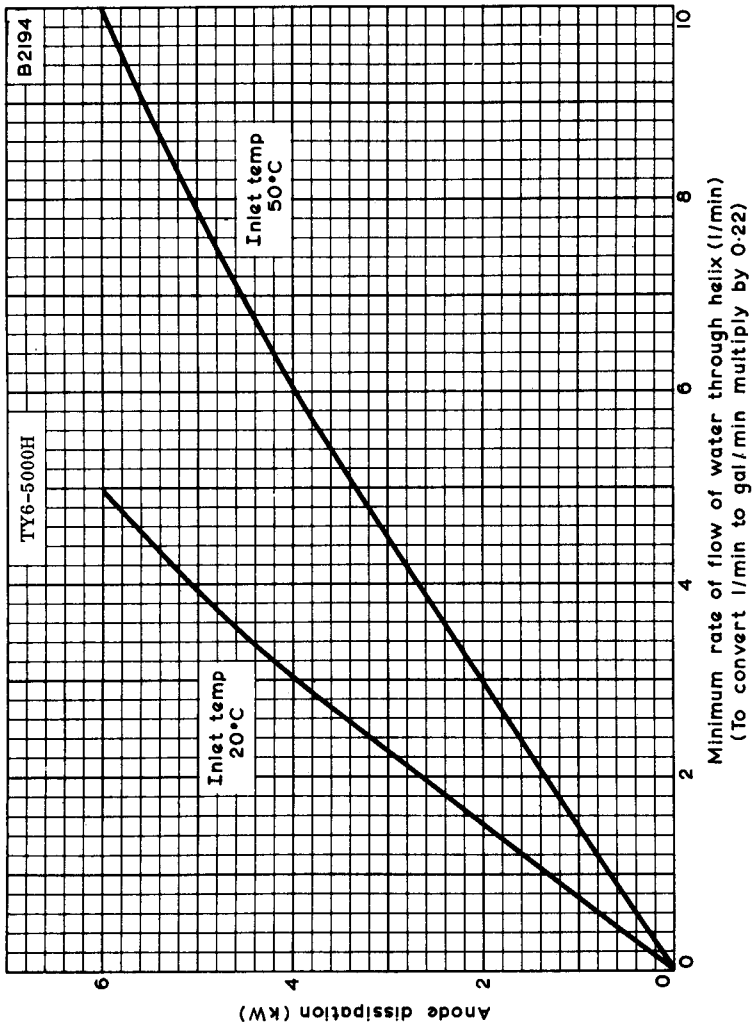
The use of wing nuts should be avoided



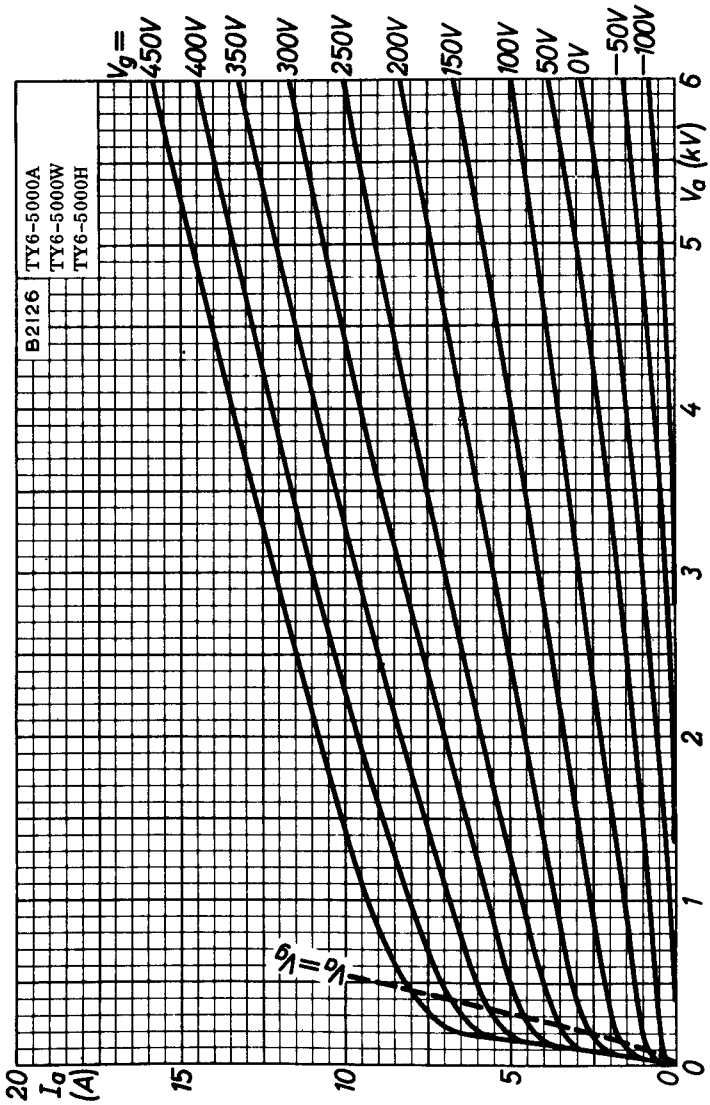
CONSTANT CURRENT CHARACTERISTICS



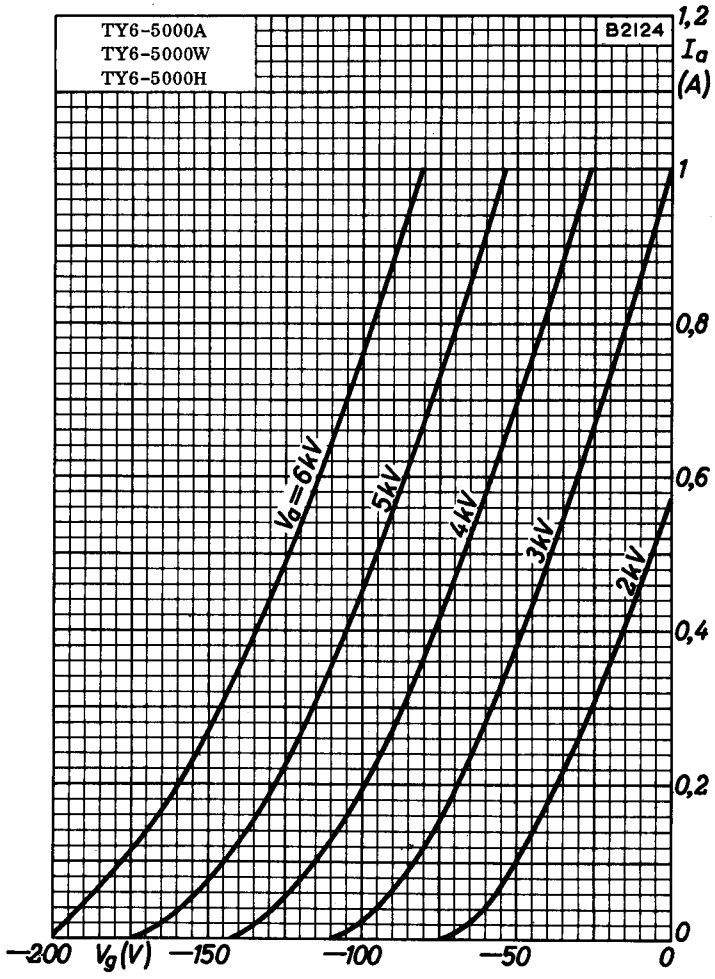
PRESSURE DROP ACROSS HELIX PLOTTED AGAINST RATE OF FLOW OF WATER THROUGH HELIX FOR INLET TEMPERATURES OF 20 AND 50°C.



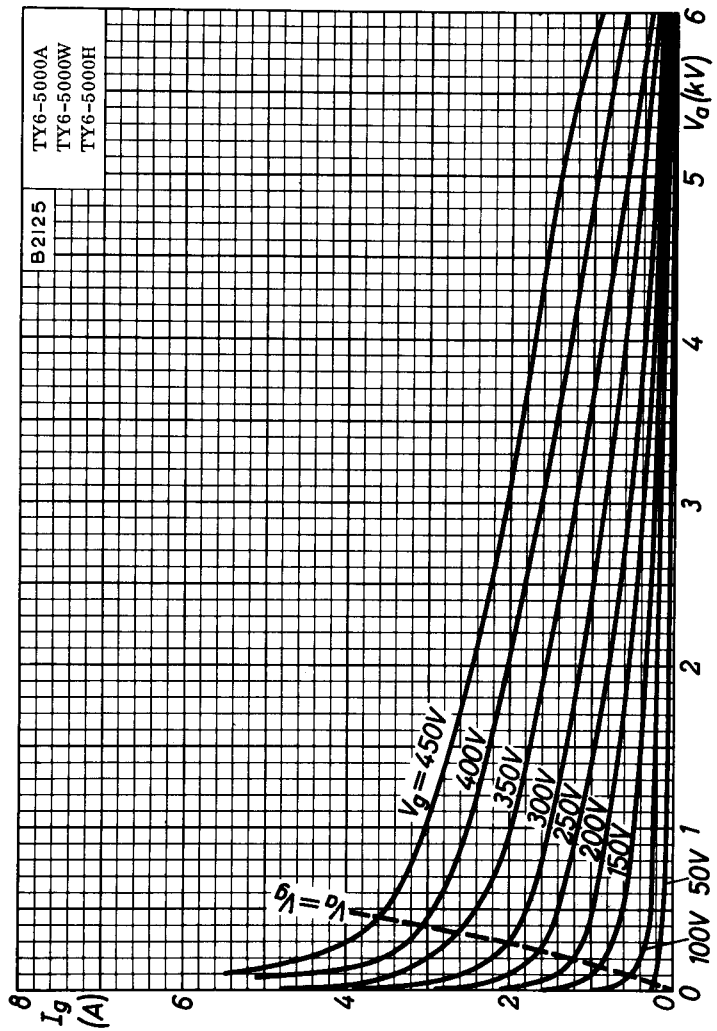
ANODE DISSIPATION PLOTTED AGAINST MINIMUM RATE OF FLOW OF WATER THROUGH HELIX FOR INLET TEMPERATURES OF 20 AND 50°C.



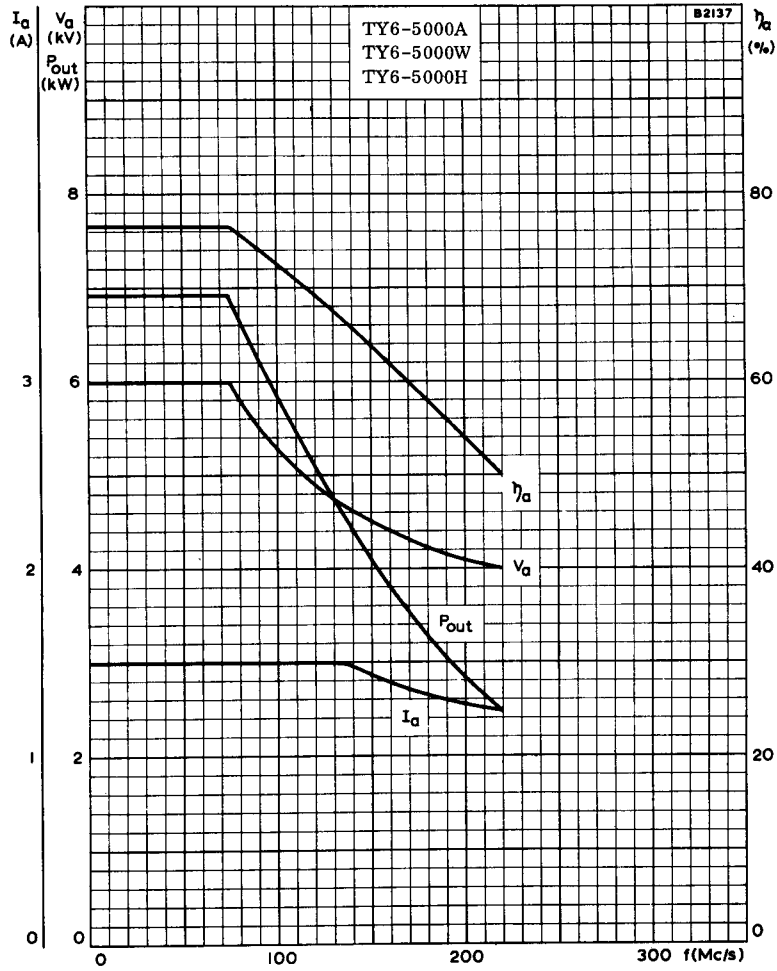
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER



GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER



FREQUENCY CHARACTERISTICS

V.H.F. POWER TRIODE

TY6-5000A
TY6-5000W
TY6-5000H

QUICK REFERENCE DATA

External anode triode, intended for use as v.h.f. amplifier or oscillator or a.f. amplifier.
The TY6-5000A is forced-air cooled.
The TY6-5000W is water cooled by means of a water jacket.
The TY6-5000H is water cooled by means of an integral helical water cooler.

	Telegraphy or F.M. Telephony, Class 'C'		Telephony, Anode Modulation Class 'C'	Telephony, Class 'B'	Audio Amplifier or Modulator Class 'B'	
f	75	75	75	75	-	Mc/s
P_{out}	6.9	*13.8	4.7	1.9	13.3	kW
f max.	75		75	75	-	Mc/s
V_a max.	6.0		5.0	6.0	6.0	kV
p_a max.						
TY6-5000A	5.0		3.4	5.0	5.0	kW
TY6-5000W/H	6.0		4.0	6.0	6.0	kW ←

*Grounded grid configuration.

Amplifier for Television Service, Class 'C'

	Positive Modulation Negative Synchronisation	Negative Modulation Positive Synchronisation		Linear Power Amplifier		
f	48 to 75	48 to 75	170 to 220	48 to 75	170 to 220	Mc/s
P_{out}	9.0	9.0	6.0	9.0	6.0	kW
f max.	75	75	220	75	220	Mc/s
V_a max.	5.0	5.0	4.0	5.0	4.0	kV
p_a max.						
TY6-5000A	5.0	5.0	4.0	5.0	4.0	kW
TY6-5000W/H	6.0	5.0	4.0	5.0	4.0	kW ←

Unless otherwise shown, data is applicable to all types

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

TELEGRAPHY OR F.M. TELEPHONY, CLASS 'C'

OPERATING CONDITIONS

f	75	75	75	Mc/s
P_{out}	4.0	5.6	6.9	kW
P_{load}	3.2	4.5	5.5	kW
η_a	73	75	77	%
V_a	4.0	5.0	6.0	kV
I_a	1.37	1.5	1.5	A
$-V_g$	200	300	400	V
I_g	350	330	310	mA
$v_{in(pk)}$	500	640	740	V
$P_{load(driver)}$	190	240	275	W
p_a	1.5	1.9	2.1	kW

OPERATING CONDITIONS for two valves in grounded grid configuration

f	75	110	110	220	Mc/s
*P_{out}	13.8+1.82	7.6+1.0	10.6+1.46	5.0+0.6	kW
P_{load}	12.5	6.9	9.6	4.5	kW
η_a	77	69	71	50	%
V_a	6.0	4.0	5.0	4.0	kV
I_a	2×1.5	2×1.37	2×1.5	2×1.25	A
V_{f-g}	400	200	300	200	V
I_g	2×310	2×350	2×330	2×200	mA
$v_{in(f-f)pk}$	1.48	1.0	1.28	0.9	kV
$P_{load(driver)}$	2×1.19	2×0.705	2×0.965	2×0.395	kW
p_a	2×2.1	2×1.7	2×2.2	2×2.5	kW

*Includes power transferred from driver stage

TELEPHONY, ANODE MODULATION, CLASS 'C'

OPERATING CONDITIONS (Carrier conditions for 100% modulation)

f	75	75	75	75	75	Mc/s
P_{out}	2.2	3.0	3.5	4.1	4.7	kW
P_{load}	1.76	2.4	2.8	3.3	3.75	kW
η_a	73	72	73	76	78	%
V_a	3.0	3.5	4.0	4.5	5.0	kV
I_a	1.0	1.2	1.2	1.2	1.2	A
*$-V_g$	250	300	300	350	400	V
I_g	300	300	300	300	300	mA
$V_{in(pk)}$	510	600	600	650	690	V
$P_{load(driver)}$	170	205	205	230	205	W
p_a	0.8	1.2	1.3	1.3	1.3	kW
For 100% modulation						
P_{mod}	1.5	2.1	2.4	2.7	3.0	kW

*This bias voltage is partially obtained by the use of a grid resistor.

TELEPHONY, CLASS 'B'

OPERATING CONDITIONS (Carrier conditions for 100% modulation)

f	75	75	Mc/s
P_{out}	1.45	1.9	kW
P_{load}	1.16	1.52	kW
η_a	32	32	%
V_a	5.0	6.0	kV
I_a	900	990	mA
$-V_g$	145	180	V
$V_{in(pk)}$	225	250	V
p_a	3.0	4.0	kW
For 100% modulation			
I_g	320	300	mA
$P_{load(driver)}$	160	170	W

AMPLIFIER FOR TELEVISION SERVICE, GRID MODULATED, CLASS 'C'

Negative modulation, positive synchronisation

OPERATING CONDITIONS for two valves in push-pull

f	48 to 75	170 to 220	Mc/s
Bandwidth (-1.5dB)	5.25	6.5	Mc/s
Bandwidth (-3.0dB)	8.0	10	Mc/s
P_{out} (sync)	9.0	6.0	kW
P_{load} (sync)	6.3	4.2	kW
V_a	5.0	4.0	kV
$-V_g$ (sync)	200	150	V ←
(black)	300	225	V
(white)	550	500	V
I_a (sync)	2 × 1.9	2 × 1.6	A
(black)	2 × 1.3	2 × 1.3	A
I_g (sync)	2 × 250	2 × 200	mA ←
(black)	2 × 175	2 × 110	mA
$v_{in(g-g)pk}$ (sync)	1.0	1.0	kV
$P_{load(driver)}$ sync	250	350 to 450	W

LINEAR POWER AMPLIFIER FOR TELEVISION SERVICE, GRID MODULATED, CLASS 'C'

Negative modulation, positive synchronisation

OPERATING CONDITIONS for two valves in push-pull

f	48 to 75	170 to 220	Mc/s
Bandwidth (-1.5dB)	5.25	6.5	Mc/s
Bandwidth (-3.0dB)	8.0	10	Mc/s
P_{out} (sync)	9.0	6.0	kW
P_{load} (sync)	6.3	4.2	kW
V_a	5.0	4.0	kV
$-V_g$	200	150	V
I_a (sync)	2 × 1.9	2 × 1.6	A
(black)	2 × 1.5	2 × 1.3	A
(white)	2 × 100	2 × 100	mA
I_g (sync)	2 × 250	2 × 200	mA
(black)	2 × 110	2 × 110	mA
(white)	0	0	mA
$v_{in(g-g)pk}$ (sync)	1.0	1.0	kV
(black)	800	750	V
(white)	0	200	V ←
$P_{load(driver)}$ sync	250	350 to 450	W

CATHODE

Directly heated, thoriated tungsten

*V_f	12.6	V
I_f	33	A

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

The connection f_{ct} is intended for use as the cathode current return. It is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30Mc/s all three filament pins should be interconnected with suitable capacitors.

CAPACITANCES

c_{a-g}	11	pF
c_{out}	300	mpF
c_{in}	16	pF

CHARACTERISTICS (measured at V_a = 4.0kV, I_a = 1.0A)

g_m	17	mA/V
μ	32	

MOUNTING POSITION

Vertical, with base up or down

COOLING

TY6-5000A

Forced-air cooled

Maximum temperatures

Anode and grid seals	180	°C
Pin seals	210	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals.
The amount of forced-air cooling required for this valve depends upon the anode dissipation and height above sea level.
Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table:

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Telegraphy Class 'C'	Telephony Class 'C'	Telephony Class 'B'	A.F. Class 'B'	
V_a max.	6.0	5.0	6.0	6.0	kV
$-V_g$ max.	*1.0	1.0	-	-	kV
I_a max.	1.5	1.3	1.1	1.5	A
$i_{k(pk)}$ max.	8.5	7.5	4.6	5.7	A
p_a max.					
TY6-5000A	5.0	3.4	5.0	5.0	kW
TY6-5000W/H	6.0	4.0	6.0	6.0	kW ←
I_g max.	350	350	-	-	mA
p_g max.	120	120	120	120	W
R_{g-f} max.	-	-	-	15	kΩ

*V_{f-g} in grounded grid configuration.

Amplifier for Television Service, Class 'C'

	Positive Modulation Negative Synchronisation	Negative Modulation Positive Synchronisation		Linear Power Amplifier Negative Modulation Positive Synchronisation		
f max.	-	75	220	75	220	Mc/s
V_a max.	5.0	5.0	4.0	5.0	4.0	kV
$-V_g$ max.	1.0	1.0	1.0	-	-	kV
I_a max.	1.9	1.9	1.6	1.9	1.6	A
$i_{k(pk)}$ max.	10	10	8.1	10	8.1	A
p_a max.						
TY6-5000A	5.0	5.0	4.0	5.0	4.0	kW
TY6-5000W/H	6.0	5.0	4.0	5.0	4.0	kW ←
p_g max.	120	120	120	120	120	W
P_{in} max.	9.5	9.5	6.5	9.5	6.5	kW

V.H.F. POWER TRIODE

TY6-5000A
TY6-5000W
TY6-5000H

AMPLIFIER FOR TELEVISION SERVICE, GRID MODULATED, CLASS 'C'

Positive modulation, negative synchronisation

OPERATING CONDITIONS for two valves in push-pull

f	48 to 75	Mc/s
Bandwidth (-1.5dB)	5.25	Mc/s
Bandwidth (-3.0dB)	8.0	Mc/s
P_{out} (white)	9.0	kW
P_{load} (white)	6.3	kW
V_a	5.0	kV
$-V_g$ (white)	200	V
(black)	460	V
(sync)	580	V
I_a (white)	2 × 1.9	A
(black)	2 × 400	mA
I_g (white)	2 × 250	mA
(black)	0	mA
$V_{in(g-g)pk}$ (white)	1.0	kV
$P_{load(driver)}$ white	250	W

AUDIO AMPLIFIER OR MODULATOR, CLASS 'B'

OPERATING CONDITIONS for two valves in push-pull

P_{out}	3.3	4.6	5.3	6.0	6.6	13.3	kW
D_{tot}	3.3	2.9	2.6	3.7	3.3	4.3	%
R_{a-a}	4.4	4.2	4.9	6.1	6.4	4.9	kΩ
V_a	3.0	3.5	4.0	4.5	5.0	6.0	kV
$-V_g$	90	100	112	125	138	165	V
$I_{a(o)}$	2×65	2×75	2×100	2×100	2×110	2×125	mA
$I_{a(max.sig.)}$	2×800	2×950	2×940	2×920	2×910	2×1500	mA
I_g	2×200	2×180	2×190	2×90	2×140	2×280	mA
$V_{in(g-g)r.m.s.}$	400	440	450	465	470	645	V
$P_{load(driver)}$	2×52	2×50	2×54	2×27	2×42	2×115	W
P_a	2×0.75	2×1.0	2×1.1	2×1.15	2×1.25	2×2.35	kW
η_a	69	70	71	72	73	74	%

Anode dissipation	Height above sea level		Inlet temperature	Rate of flow of air per minute		Pressure difference between inlet and outlet
(kW)	(km)	(ft)	(^{o}C)	(m^3)	(ft^3)	(mm H_2O)
1.0	0	0	35	3.0	105	8.0
1.0	0	0	45	3.1	110	8.0
1.0	1.5	4920	35	3.7	130	9.0
1.0	3.0	9840	25	4.1	145	10
3.0	0	0	35	5.2	185	23
3.0	0	0	45	6.1	215	29
3.0	1.5	4920	35	6.2	220	26
3.0	3.0	9840	25	6.6	235	26
5.0	0	0	35	9.2	325	68
5.0	0	0	45	10.7	380	90
5.0	1.5	4920	35	11.2	395	81
5.0	3.0	9840	25	11.6	410	79

TY6-5000W

Water cooled anode, low velocity air flow on seals.

Maximum temperatures

Anode and grid seals	180	^{o}C
Water inlet	50	^{o}C

Typical values of inlet temperature, rate of flow of water and pressure difference between the inlet and outlet housing at various anode dissipations are given in the following table:

Anode dissipation	Inlet temperature	Rate of flow of water per minute		Pressure difference between inlet and outlet
(kW)	(^{o}C)	(litres)	(gal)	(atm)
1.0	20	2.5	0.55	0.08
1.0	50	3.0	0.66	0.1
2.0	20	2.5	0.55	0.08
2.0	50	5.0	1.10	0.3
4.0	20	4.0	0.88	0.18
4.0	50	9.0	1.98	0.9
6.0	20	6.0	1.32	0.4
6.0	50	14	3.08	2.5

At inlet temperatures between 20 and 50°C the required quantity of water can be found by linear interpolation. In order to keep within the temperature limits it is necessary to direct a flow of air on to the seals at frequencies above 30Mc/s. The air flow should be started at the application of filament voltage.

TY6-5000H

Water cooled anode, low velocity air flow on seals

Maximum temperatures

Water inlet	50	°C
Filament seals	210	°C
Anode and grid seals	180	°C

The amount of water cooling required for this valve depends on the anode dissipation and the temperature of the water.
Typical values of rate of flow of water through helix and pressure loss in the helix are given in the curve on page C2. The minimum rate of flow of water through helix required can be found from the curves on page C3. At frequencies above 30Mc/s and at ambient temperatures above 35°C both grid and filament seals should be cooled by a low velocity air flow.

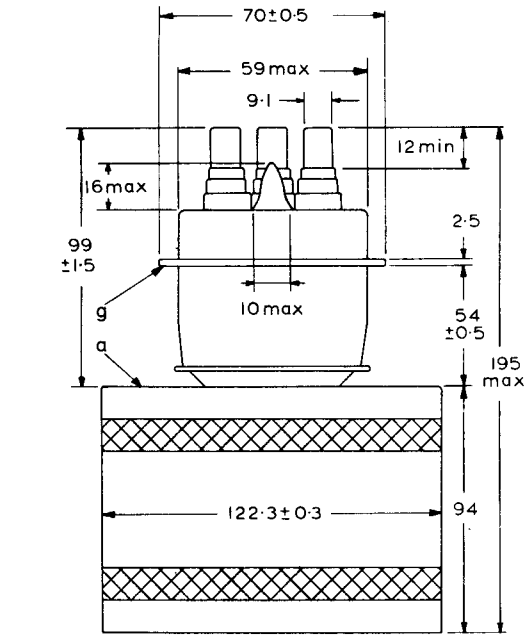
PHYSICAL DATA ←

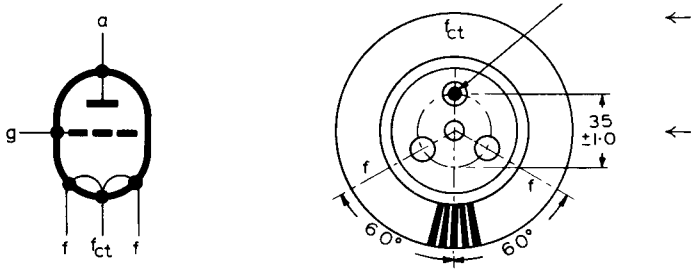
	TY6-5000A	TY6-5000W	TY6-5000H	
Weight of valve	10.1	1.0	1.8	lb
	4.6	0.45	0.8	kg
Weight of valve plus carton	17.9	2.6	3.7	lb
	8.1	1.2	1.7	kg
Weight of insulating pedestal	4.6	-	-	lb
	2.1	-	-	kg
Weight of insulating pedestal plus carton	6.8	-	-	lb
	3.1	-	-	kg
Weight of water jacket	-	1.1	-	lb
	-	0.52	-	kg
Weight of water jacket plus carton	-	1.7	-	lb
	-	0.75	-	kg

ACCESSORIES ←

Filament clips × 3	40634
Grid connector × 1 >30Mc/s	40622
Grid connector × 1 <30Mc/s	40650
Insulating pedestal × 1 (TY6-5000A)	40630
Water jacket × 1 (TY6-5000W)	K713

OUTLINE DRAWING OF TY6-5000A

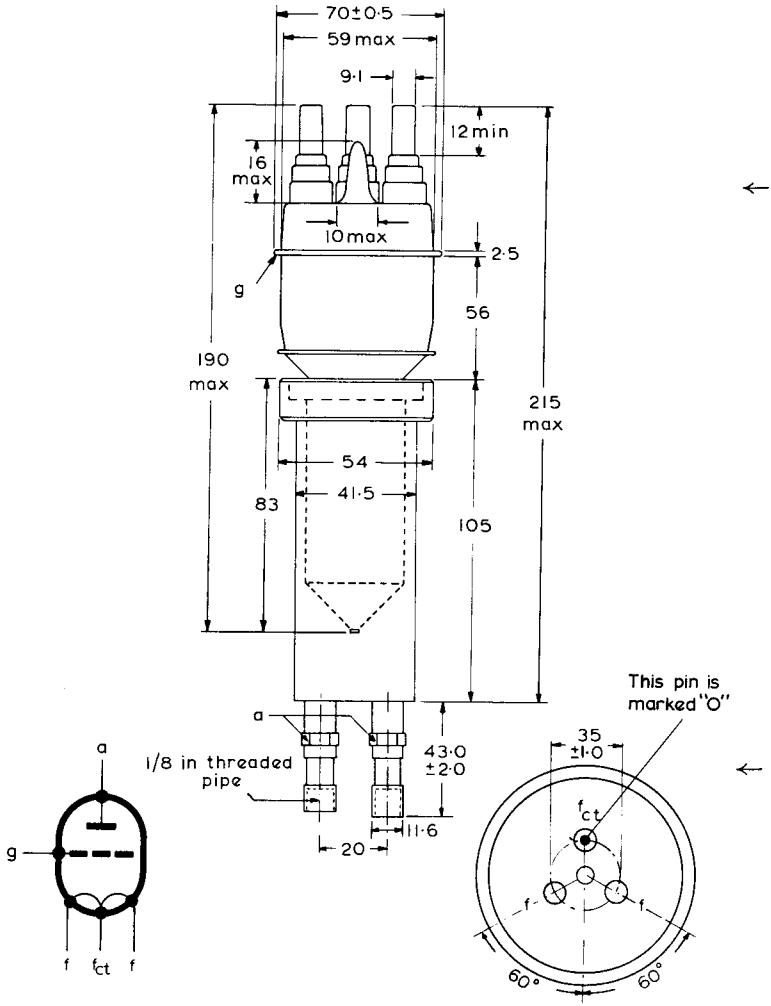




All dimensions in mm

B5523

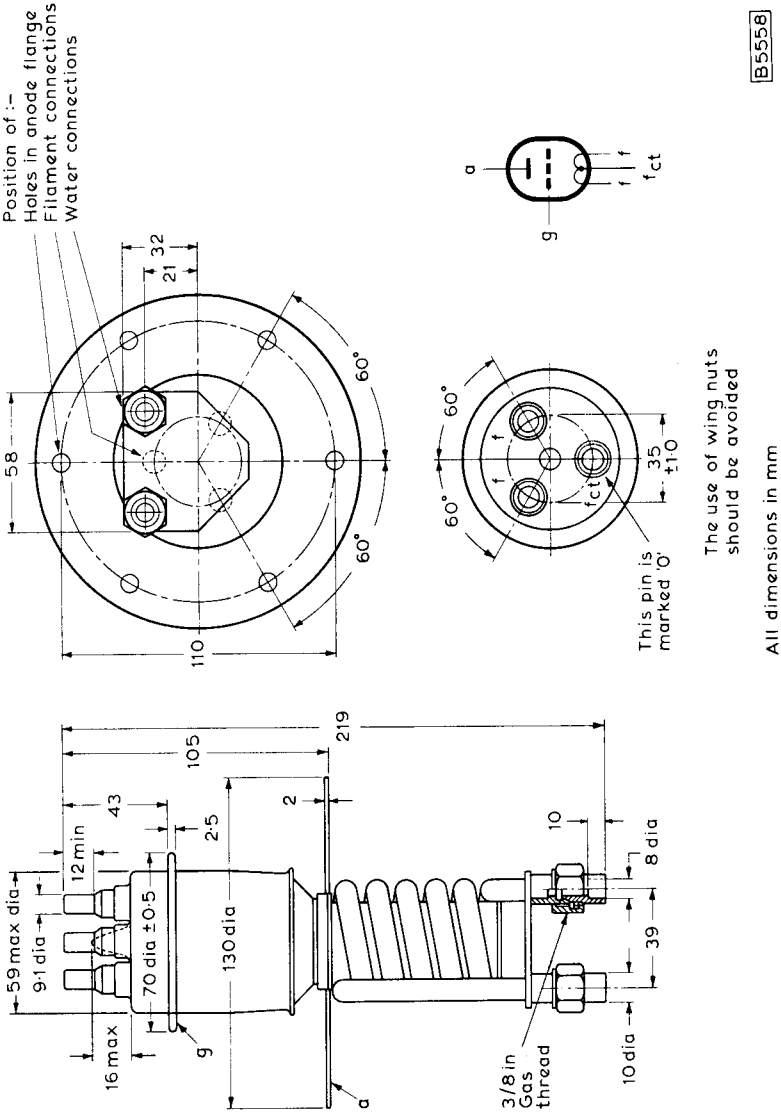
OUTLINE DRAWING OF TY6-5000W MOUNTED IN WATER JACKET K713



All dimensions in mm

B5522

OUTLINE DRAWING OF TY6-5000H



V.H.F. POWER TRIODE

TY6-5000B

TENTATIVE DATA

QUICK REFERENCE DATA

Forced air cooled triode intended for use as oscillator or amplifier

	Class 'B' Audio amplifier	Class 'C' Television	Class 'C' Telephony	Class 'C' Telegraphy or F.M. Telephony	
f	-	220	75	110	Mc/s
P_{out}	13.3	4.0	4.7	4.8	kW
f max.	-	220	220	220	Mc/s
V_a max.	6.0	5.0	5.0	6.2	kV
p_a max.	5.0	5.0	3.4	5.0	kW

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

f	30	30	30	110	*220	Mc/s
P_{out}	4.0	5.6	6.9	4.8	2.65	kW
P_{load}	3.2	4.5	5.5	3.9	2.15	kW
η_a	73	75	76.5	70	70	%
V_a	4.0	5.0	6.0	5.0	3.0	kV
I_a	1.37	1.5	1.5	1.25	1.25	A
$-V_g$	200	300	400	300	160	V
I_g	300	330	310	300	250	mA
P_{load} (driver)	190	240	275	250	510	W
p_a	1.5	1.9	2.1	1.45	1.6	kW

*Grounded grid configuration

CLASS 'C' ANODE MODULATION

Maximum operating conditions
(Carrier conditions for 100% modulation)

f	75	110	Mc/s
P_{out}	4.7	2.8	kW
P_{load}	3.75	2.25	kW
η_a	78.5	75	%
V_a	5.0	4.0	kV
I_a	1.2	0.93	A
$-V_g$	400	350	V
I_g	300	240	mA
$P_{load\ (driver)}$	205	130	W
p_a	1.3	0.92	kW

CLASS 'C' AMPLIFIER FOR TELEVISION SERVICE
COMMON CATHODE BIAS MODULATED

Negative modulation, positive synchronisation
Maximum operating conditions

f		48-75	Mc/s
P_{out} (sync)		9.0	kW
P_{load} (sync)		6.3	kW
Bandwidth (-3.0 dB)		8.0	Mc/s
V_a		5.0	kV
$-V_g$	sync	200	V
	black	300	V
	white	550	V
I_a	sync	1.9	A
	black	1.3	A
I_g	sync	250	mA
	black	175	mA
$P_{load\ (driver)}$	sync	250	W

CLASS 'B' AUDIO AMPLIFIER

Maximum operating conditions for two valves in push-pull

P_{out}	13.3	kW
D_{tot}	4.3	%
R_{a-a}	4.9	kΩ
V_a	6.0	kV
$I_{a(o)}$	2 x 125	mA
I_a (max. sig.)	2 x 1.5	A
$-V_g$	165	V
I_g	2 x 280	mA
$V_{in\ (g-g)}$ r.m.s.	645	V
$P_{load\ (driver)}$	2 x 115	W
p_a	2 x 2.35	kW
η_a	74	%

ABSOLUTE MAXIMUM RATINGS

	Class 'B' Audio	Class 'C' T.V.	Class 'C' Telephony	Class 'C' Telegraphy	
V_a max. (f = 220Mc/s)	-	4.0	3.2	4.0	kV
(f ≤ 75Mc/s)	6.0	5.0	5.0	6.2	kV
$-V_g$ max.	-	*1.0	1.0	1.0	kV
I_k max.	1.8	*1.8	1.65	1.85	A
p_a max.	5.0	*4.0	3.4	5.0	kW
I_g max.	-	-	350	350	mA
p_g max.	120	*120	120	120	W

*(sync) level

CATHODE

Directly heated, thoriated tungsten

V_f	12.6	A
I_f	33	A

The connection f_{ct} is intended for use as the cathode current return and is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30Mc/s all three filament leads should be interconnected with suitable capacitors.

CAPACITANCES

c_{a-g}	11	pF
c_{in}	16	pF
c_{out}	300	mpF

CHARACTERISTICS (measured at V_a = 4.0kV, I_a = 1.0A)

g_m	17	mA/V
μ	32	

MOUNTING POSITION

Vertical, base up or down.

COOLING Forced-air cooled

Maximum temperatures

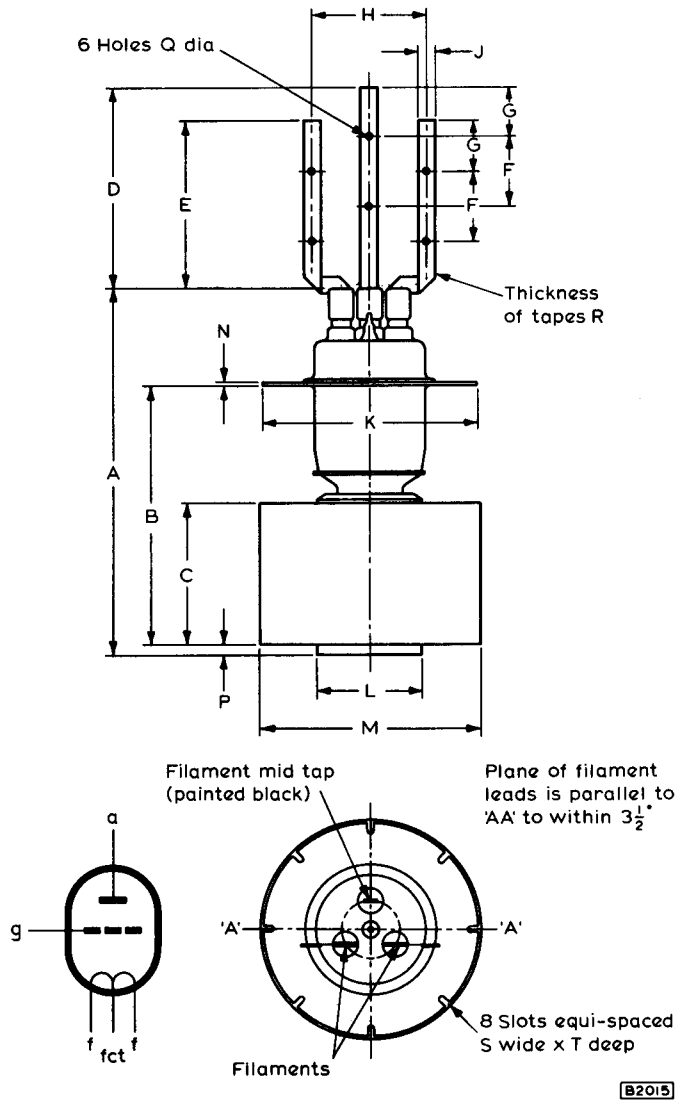
T_{anode} seals	180	°C
T_{grid} seals	180	°C
T_{pin} seals	220	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals.

The amount of forced air cooling required for this valve depends upon the anode dissipation and the height above sea-level.

Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table.

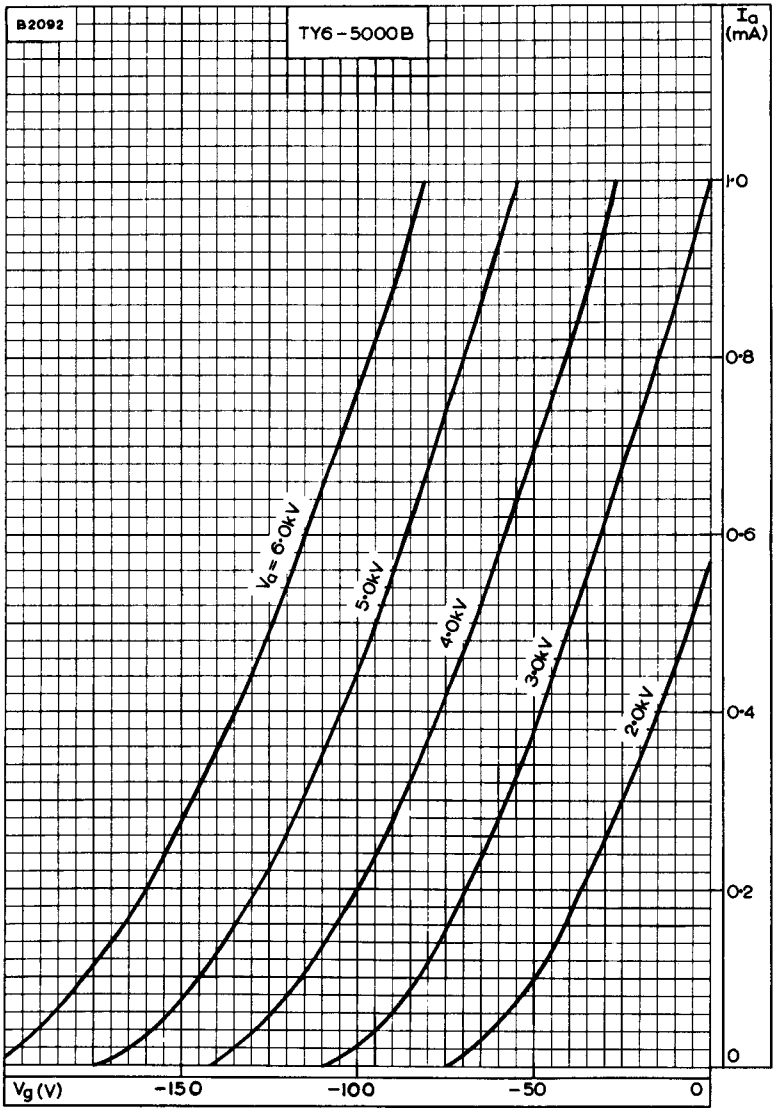
Anode dissipation	Height above sea-level		Inlet Temperature	Rate of flow of air per minute		Pressure difference between inlet and outlet
pa	h		Tin			
(kW)	(km)	(ft)	(^{o}C)	(m^3)	(ft^3)	(mm of water)
1.0	0	0	35	3.0	105	8.0
1.0	0	0	45	3.1	110	8.0
1.0	1.5	4920	35	3.7	130	9.0
1.0	3.0	9840	25	4.1	145	10
3.0	0	0	35	5.2	185	23
3.0	0	0	45	6.1	215	29
3.0	1.5	4920	35	6.2	220	26
3.0	3.0	9840	25	6.6	235	26
5.0	0	0	35	9.2	325	68
5.0	0	0	45	10.7	380	90
5.0	1.5	4920	35	11.2	395	81
5.0	3.0	9840	25	11.6	410	79


6 Holes Q dia
H
J
G
G
F
F
D
E
Thickness
of tapes R
N
K
A
B
C
P
L
M
Filament mid tap
(painted black)
Plane of filament
leads is parallel to
'AA' to within 3½°
a
g
'A'
'A'
f
fct
f
8 Slots equi-spaced
S wide x T deep
Filaments
B2015

Dimensions

	Inches	millimetres	
A	9.626	193.68	max
B	2.252 ± 3.2	133.4 ± 3.2	
C	2.874	73	max
D	4.252 ± 0.079	108 ± 2	
E	3.504 ± 0.039	89 ± 1	
F	1.378 ± 0.079	35 ± 2	
G	0.866 ± 0.079	22 ± 2	
H	2.500	63.5	max
J	0.315 ± 0.020	8.0 ± 0.5	
K	4.567 ± 0.020	116 ± 0.5	
L	2.250	57.15	max
M	4.626 ± 0.063	117.5 ± 1.6	
N	0.063 ± 0.008	1.6 ± 0.2	
P	0.189	4.8	max
Q	0.164 ± 0.002	3.7 ± 0.05	
R	4 x 0.010	4 x 0.25	nom
S	0.182 ± 0.004	4.62 ± 0.1	
T	0.205 ± 0.008	5.20 ± 0.2	←

Inch dimensions derived from original millimetre dimensions.

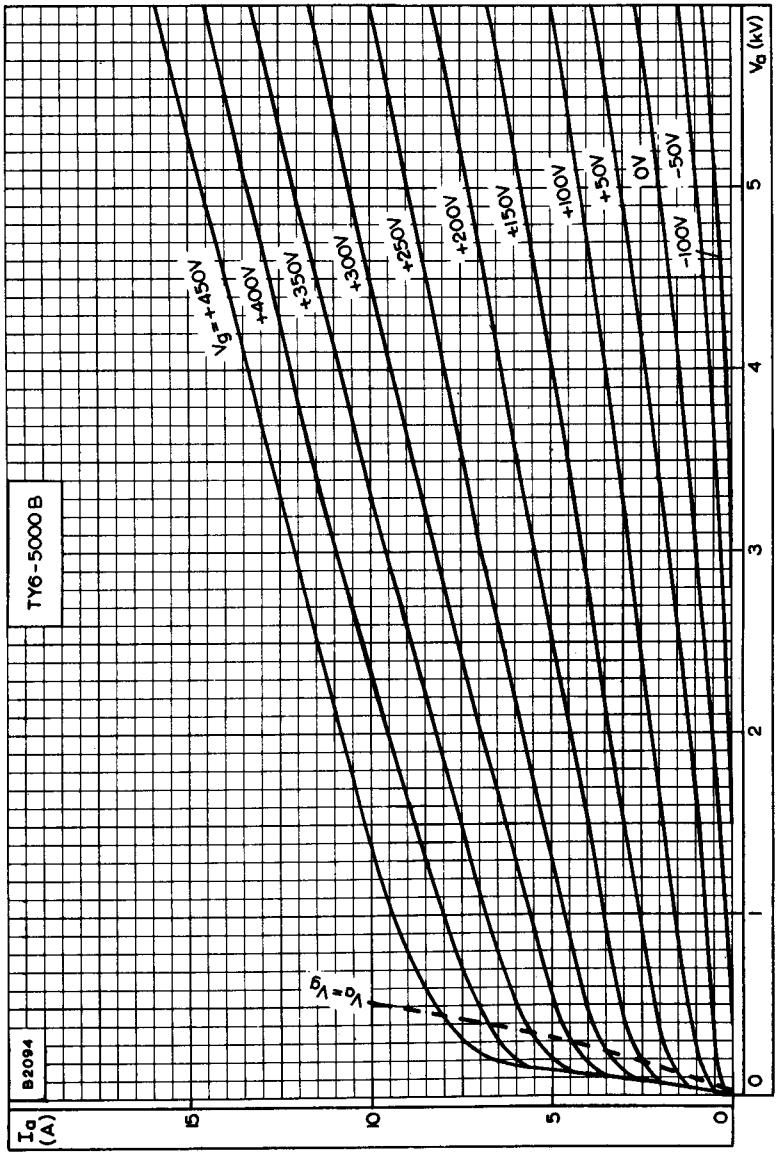


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER

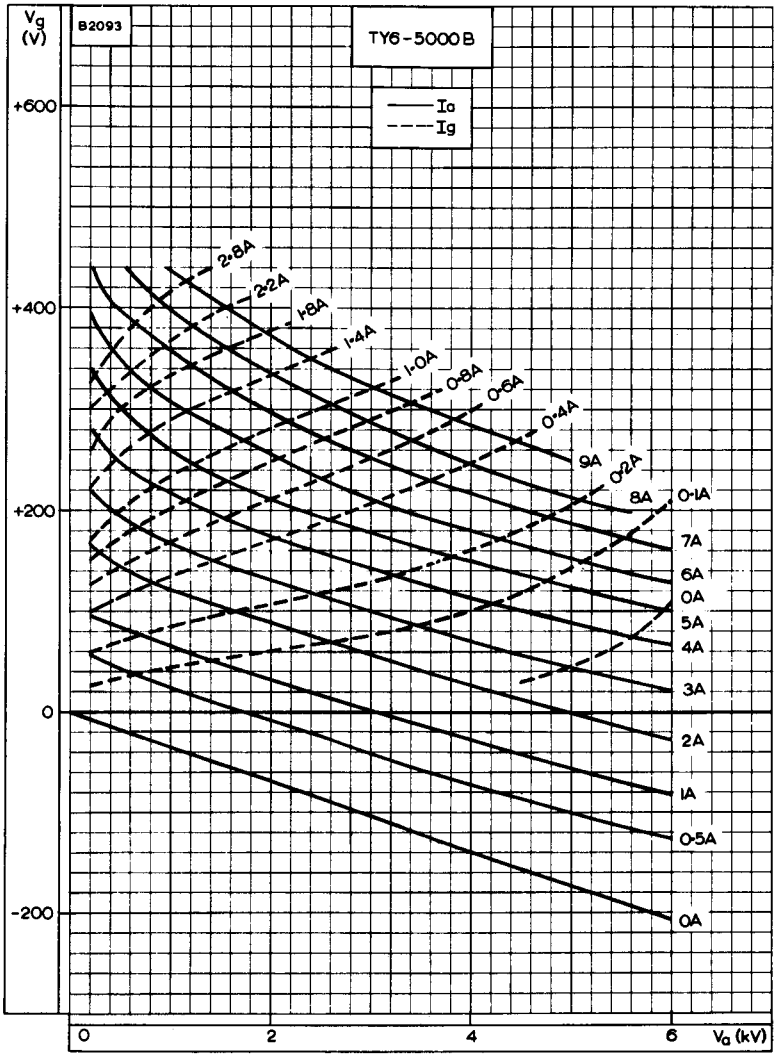


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER

TY6-5000B



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER



CONSTANT CURRENT CURVES

TRIODE

TY6-800

Application: *R.F. Industrial heating.*
Power Output: *2.7kW continuous rating.*
Frequency: *50Mc/s max. at full ratings.*
Construction: *Glass, radiation cooled anode.*

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES preceding this section of the handbook.

FILAMENT Thoriated tungsten

*V_f	6.3	V
I_f	32.5	A

*The filament has been designed to accept temporary fluctuations of $^{+5}_{-10}\%$.

MOUNTING POSITION

Vertical only, base down

CAPACITANCES

C_{a-g}	6.2	pF
C_{g-f}	10.5	pF
C_{a-f}	0.25	pF

CHARACTERISTICS (measured at $V_a = 4kV$, $I_a = 190mA$)

g_m	5.1	mA/V
g_m (at $V_a = 1.0kV$, $I_a = 3.0A$)	9.0	mA/V
μ	22	

COOLING

Normally	Low velocity air flow
*At reduced input or intermittent ratings	Natural

Maximum temperature of seals	220	°C
Maximum bulb temperature	350	°C

*See examples in typical data.

ACCESSORIES

Socket	B8.700.51
Anode clip	40626

TY6-800

TRIODE

CLASS 'C' POWER OSCILLATOR

With d.c. anode supply.

LIMITING VALUES

f max.			50	Mc/s
V_a max.			6.0	kV
V_g max.			−1.25	kV
R_{g-f} max.			10	kΩ
Duty factor max.	1.0	0.5	0.2	
Averaging time max.	—	10	5.0	s
p_a max.	800	1200	1500	W
I_a max.	750	1100	1400	mA
p_g max.	120	150	175	W
I_g max. (at p_a max.)	300	375	400	mA

OPERATING CONDITIONS

Cooling	Additional		Natural		
f	≦50	≦50	≦50	≦50	Mc/s
Duty factor	1.0	1.0	0.2	0.5	
t_{on}	—	—	1	5.0	s
t_{off}	—	—	4	5.0	s
V_a	3.0	5.0	5.0	5.0	kV
I_a	700	700	1200	960	mA
I_g	240	225	310	240	mA
p_a	546	788	1380	1100	W
η_a	74	77.5	77	77	%
R_{g-f}	1.5	2.5	2.0	2.2	kΩ
R_a	2.0	3.8	2.2	2.8	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.3	0.2	0.23	0.22	
P_{out}	1.55	2.7	4.6	3.7	kW
*P_{load}	1.2	2.1	3.6	3.0	kW

*$0.85(P_{out}-P_{drive})$

TY6-800

CLASS 'C' POWER OSCILLATOR

Anode supply single phase, full wave rectifier without smoothing filter.

LIMITING VALUES

f max.			50	Mc/s
V_a max.			5.4	kV
V_g max.			–1.25	kV
R_{g-f} max.			10	kΩ
Duty factor max.	1.0	0.5	0.2	
Averaging time max.	—	10	5.0	s
p_a max.	800	1200	1500	W
I_a max.	670	1000	1250	mA
p_g max.	120	150	175	W
I_g max. (at p_a max.)	270	400	500	mA

OPERATING CONDITIONS

Cooling	Additional		Natural		
f	≦50	≦50	≦50	≦50	Mc/s
Duty factor	1.0	1.0	0.5	0.2	
t_{on}	—	—	5.0	1.0	s
t_{off}	—	—	5.0	4.0	s
V_a	3.15	4.5	4.5	4.5	kV
I_a	600	600	760	870	mA
I_g	180	150	220	240	mA
p_a	620	750	1100	1400	W
η_a	73	77	74	72	%
R_{g-f}	1.5	2.5	1.7	1.6	kΩ
R_a	2.5	3.8	3.3	2.6	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.2	0.17	0.2	0.2	
P_{out}	1.7	2.55	3.13	3.6	kW
*P_{load}	1.4	2.2	2.6	3.0	kW

*$0.85(P_{out}-P_{drive})$

TY6-800

TRIODE

CLASS 'C' POWER OSCILLATOR

Anode supply from three phase half-wave rectifier.

LIMITING VALUES

f max.			50	Mc/s
V_a max.			6.0	kV
V_g max.			−1.25	kV
R_{g-f} max.			10	kΩ
Duty factor max.	1.0	0.5	0.2	
Averaging time max.	—	10	5.0	s
p_a max.	800	1200	1500	W
I_a max.	750	1100	1400	mA
p_g max.	120	150	175	W
I_g max. (at p_a max.)	300	450	560	mA

OPERATING CONDITIONS

Cooling	Additional	Natural		
f	≦50	≦50	≦50	Mc/s
Duty factor	1.0	0.5	0.2	
t_{on}	—	5.0	1.0	s
t_{off}	—	5.0	4.0	s
$V_{tr(r.m.s.)}$ max.	4.25	4.25	4.25	kV
V_a	5.0	5.0	5.0	kV
I_a	700	740	900	mA
I_g	160	170	210	mA
p_a	780	960	1200	W
η_a	78	74	73	%
R_{g-f}	2.5	2.4	1.9	kΩ
R_a	3.8	3.4	2.4	kΩ
Feedback Ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.16	0.17	0.17	
P_{out}	2.7	2.74	3.3	kW
*P_{load}	2.3	2.2	2.7	kW

*$0.85(P_{out}-P_{drive})$

TY6-800

CLASS 'C' POWER OSCILLATOR

Anode supply from transformer without intermediate rectifier.

LIMITING VALUES

f max.			50	Mc/s
$V_{tr(r.m.s.)}$ max.			5.6	kV
V_g max.			−1.25	kV
R_{g-f} max.			10	kΩ
Duty factor max.	1.0	0.5	2.0	
Averaging time max.	—	10	5.0	s
p_a max.	800	1200	1500	W
*I_a max.	400	600	750	mA
p_g max.	120	150	175	W
*I_g max. (at p_a max.)	160	240	300	mA

OPERATING CONDITIONS

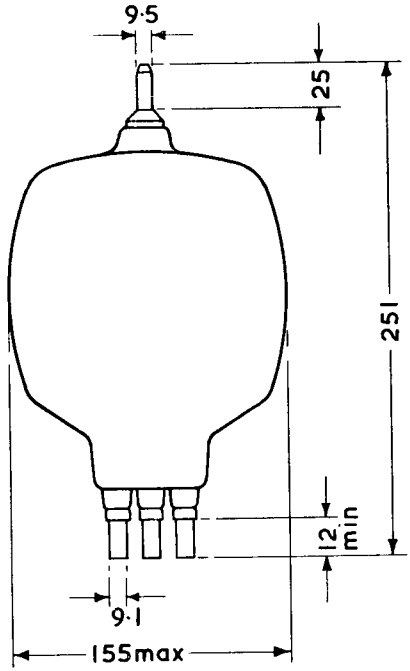
Cooling	Additional	Natural		
f	≦50	≦50	≦50	Mc/s
Duty factor	1.0	0.5	0.2	
t_{on}	—	5.0	1.0	s
t_{off}	—	5.0	4.0	s
$V_{tr(r.m.s.)}$	5.2	5.2	5.2	kV
*I_a	360	540	675	mA
*I_g	100	150	190	mA
p_a	520	870	1170	W
η_a	75	72	70	%
R_{g-f}	1800	1200	950	Ω
R_a	3.2	2.2	1.7	kΩ
Feedback Ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.15	0.2	0.23	
P_{out}	1.56	2.24	2.73	kW
**P_{load}	1.3	1.85	2.26	kW

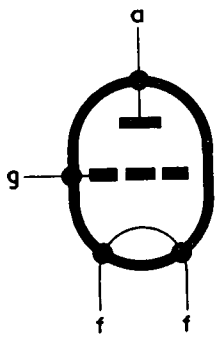
*Averaged over one cycle of supply frequency.

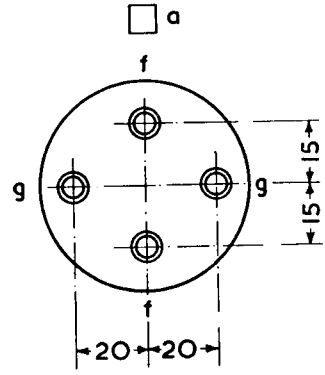
**$0.85(P_{out}-P_{drive})$

TY6-800

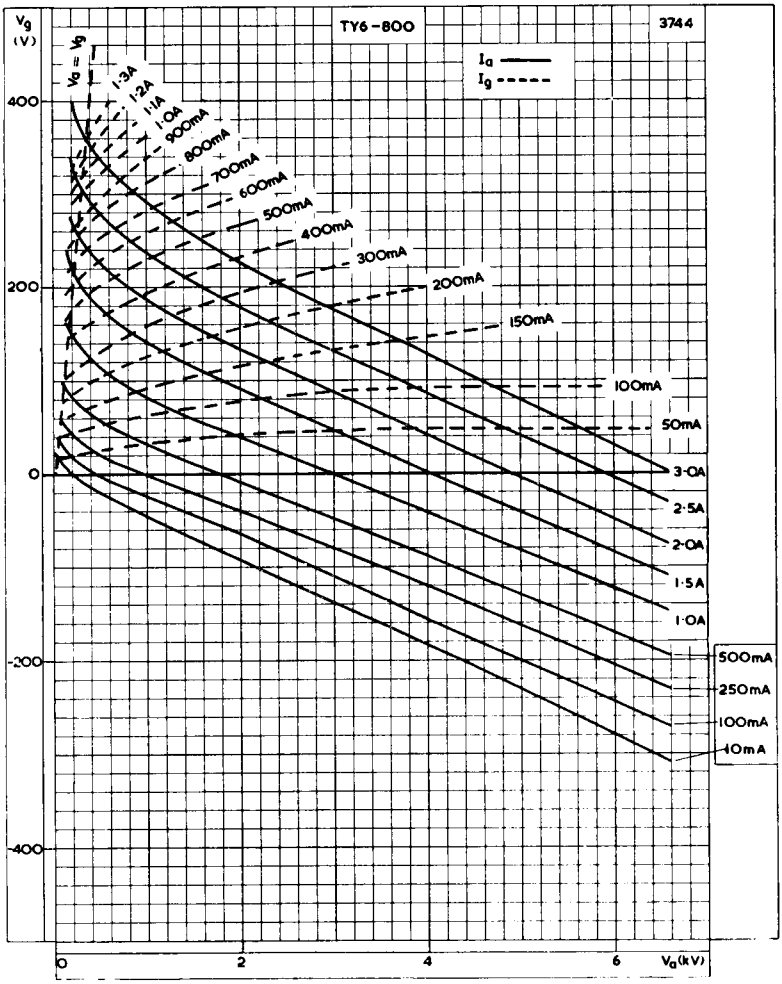
3752







All dimensions in mm



CONSTANT CURRENT CURVES

R.F. POWER TRIODE

TY7-6000A

Forced-air cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES, preceding this section of the handbook.

FILAMENT Thoriated tungsten

V_f	12.6	V
I_f	33	A

The connection f_{et} is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30Mc/s all three filament pins should be interconnected with suitable capacitors.

MOUNTING POSITION Vertical, anode up or down

CAPACITANCES

C_{a-g}	11	pF
C_{in}	16	pF
C_{out}	0.3	pF

CHARACTERISTICS (measured at V_a=6kV, I_a=1A)

g_m	15	mA/V
μ	32	

COOLING

Max. temperature of filament seals	210	°C
Max. temperature of grid and anode seals	180	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the filament and grid seals.

The valve must not be operated without a heat dissipating connector on pin f_{et}.

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea level.

Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table:

Anode dissipation P_a (kW)	Height above sea-level h (m)	Max. inlet temperature T_{in} (°C)	Min. rate of flow of air (m^3/min)	Pressure difference between inlet and outlet (mm of H_2O)
2.0	0	35	4.8	20
2.0	0	45	5.7	25
2.0	1500	35	5.7	23
2.0	3000	25	6.1	23
3.5	0	35	6.2	32
3.5	0	45	7.3	42
3.5	1500	35	7.3	36
3.5	3000	25	7.8	36
6.0	0	35	9.2	68
6.0	0	45	10.7	91
6.0	1500	35	11.2	81
6.0	3000	25	11.7	80

TY7-6000A

R.F. POWER TRIODE

Forced-air cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.

OPERATION AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY)

Limiting values (absolute ratings)

f max.	30	Mc/s
V_a max.	7.2	kV
I_k max.	2.8	A
$i_{k(pk)}$ max.	14	A
$-V_g$ max.	1.25	kV
I_g max.	600	mA
p_a max.	6.0	kW
p_g max.	250	W

Typical operating conditions

f	30	30	30	30	30	30	Mc/s
V_a	5.0	5.0	6.0	6.0	6.5	6.5	kV
V_g	−300	−300	−400	−400	−450	−450	V
I_a	2.0	2.0	2.0	2.0	2.0	2.0	A
I_g	500	600	500	600	500	600	mA
$v_{in(pk)}$	660	700	780	820	820	850	V
P_{drive}	297	378	350	443	370	460	W
p_a	2.9	2.7	3.5	2.8	3.5	3.0	kW
P_{out}	7.1	7.3	8.5	9.2	9.5	10	kW
η	71	73	71	76.7	73	77	%
P_{load}	5.7	5.8	7.0	7.4	7.6	8.0	kW

OPERATION AS SINGLE VALVE R.F. POWER AMPLIFIER (CLASS 'C' TELEPHONY)

Limiting values (carrier condition for modulation factor of 1)

f max.	30	Mc/s
V_a max.	5.5	kV
I_k max.	2.4	A
$i_{k(pk)}$ max.	12	A
$-V_g$ max.	1.25	kV
I_g max.	600	mA
p_a max.	4.0	kW
p_g max.	250	W

Typical operating conditions

f	30	30	30	Mc/s
V_a	4.0	5.0	5.0	kV
V_g	−300	−400	−400	V
I_a	1.6	1.4	1.6	A
I_g	600	500	600	mA
$v_{in(pk)}$	680	730	800	V
P_{drive}	367	328	432	W
p_a	1.4	1.4	1.6	kW
P_{out}	5.0	5.6	6.4	kW
η	78	80	80	%
P_{load}	4.0	4.5	5.1	kW
For 100% modulation				
P_{mod}	3.2	3.5	4.0	kW

R.F. POWER TRIODE

TY7-6000A

Forced-air cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.

OPERATION AS CLASS 'B' A.F. POWER AMPLIFIER OR MODULATOR

Limiting values (absolute ratings)

V_a max.	7.2	kV
I_k max.	2.8	A
$i_{k(pk)}$ max.	10	A
p_a max.	6.0	kW
p_g max.	250	W
R_{g-f} max.	15	kΩ

Typical operating conditions for two valves in push-pull

V_a	4.0	5.0	5.0	7.0	kV
V_g	−120	−145	−145	−210	V
R_{a-a}	3.8	5.5	4.8	4.15	kΩ
$V_{in(g-g)r.m.s.}$	630	483	588	854	V
$I_{a(o)}$	2×100	2×150	2×150	2×200	mA
I_a (max. sig.)	2×1.25	2×1.1	2×1.25	2×2.0	A
I_g	2×315	2×220	2×350	2×560	mA
$P_{load(driver)}$	2×140	2×65	2×130	2×310	W
p_a	2×1.45	2×1.5	2×1.7	2×4.0	kW
P_{out}	7.1	8.0	9.0	20	kW
η	71	72.5	72.5	71.5	%

OPERATION AS SINGLE VALVE R.F. OSCILLATOR (CLASS 'C')

For industrial use with anode voltage from three phase half-wave rectifier without filter.

Limiting values (absolute ratings)

f max.	55	Mc/s
V_a max.	7.0	kV
p_a max.	6.0	kW
I_k max.	2.3	A
$i_{k(pk)}$ max.	11	A
$-V_g$ max.	1.25	kV
I_g max. (unloaded condition)	700	mA
I_g max. (loaded condition)	500	mA
p_g max.	250	W
R_{g-f} max.	10	kΩ

Typical operating conditions

f	50	Mc/s
$V_{transformer(r.m.s.)}$	5.1	kV
V_a	6.0	kV
I_a	1.5	A
I_g (unloaded condition)	700	mA
I_g (loaded condition)	400	mA
R_{g-f}	1.0	kΩ
P_{drive}	300	W
p_a	2.7	kW
*P_{out}	6.0	kW
η	67	%

*Includes circuit losses.

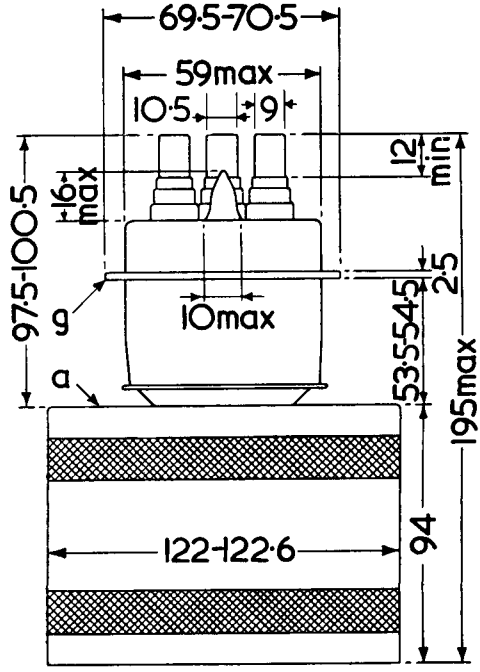
WEIGHT

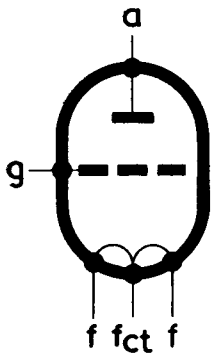
Valve only	10.1	lb
	4.6	kg
Shipping weight	17.8	lb
	8.1	kg
Dimensions of packing	346×346×520	mm

TY7-6000A

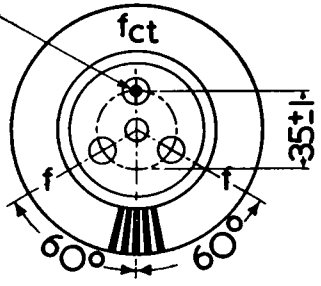
R.F. POWER TRIODE

Forced-air cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.





This pin is 10·5mm diameter



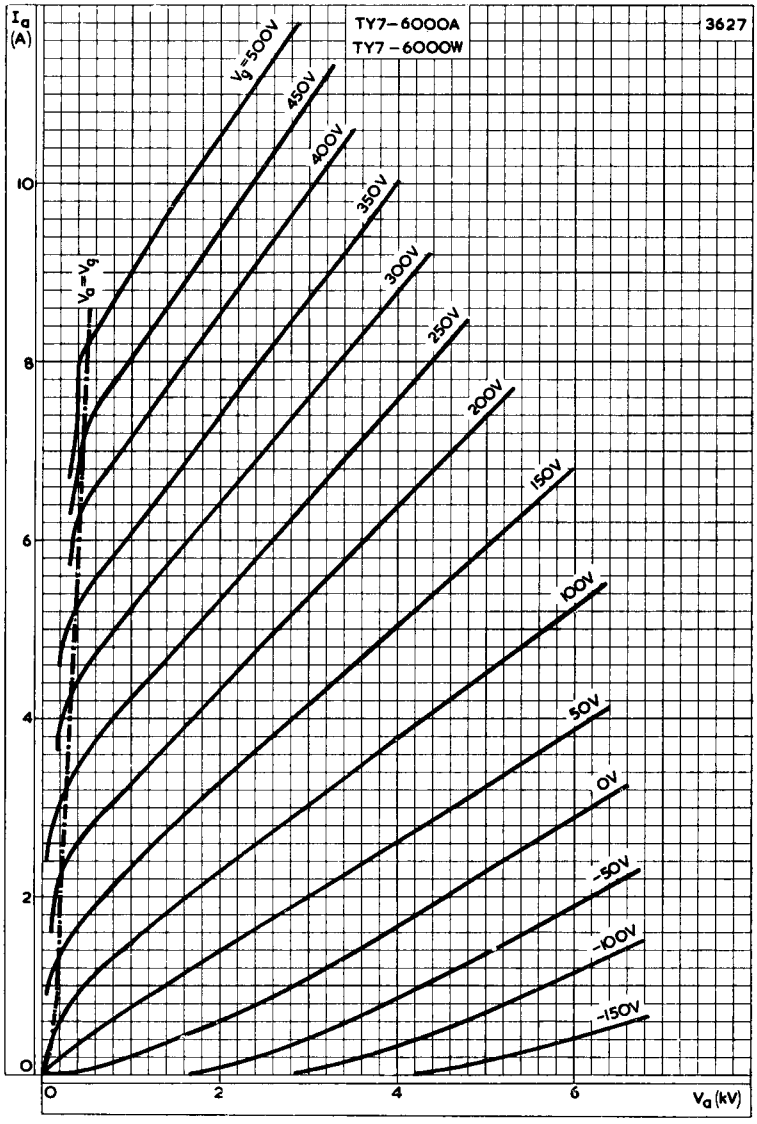
3690

All dimensions in mm

R.F. POWER TRIODE

TY7-6000A

Forced-air cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.

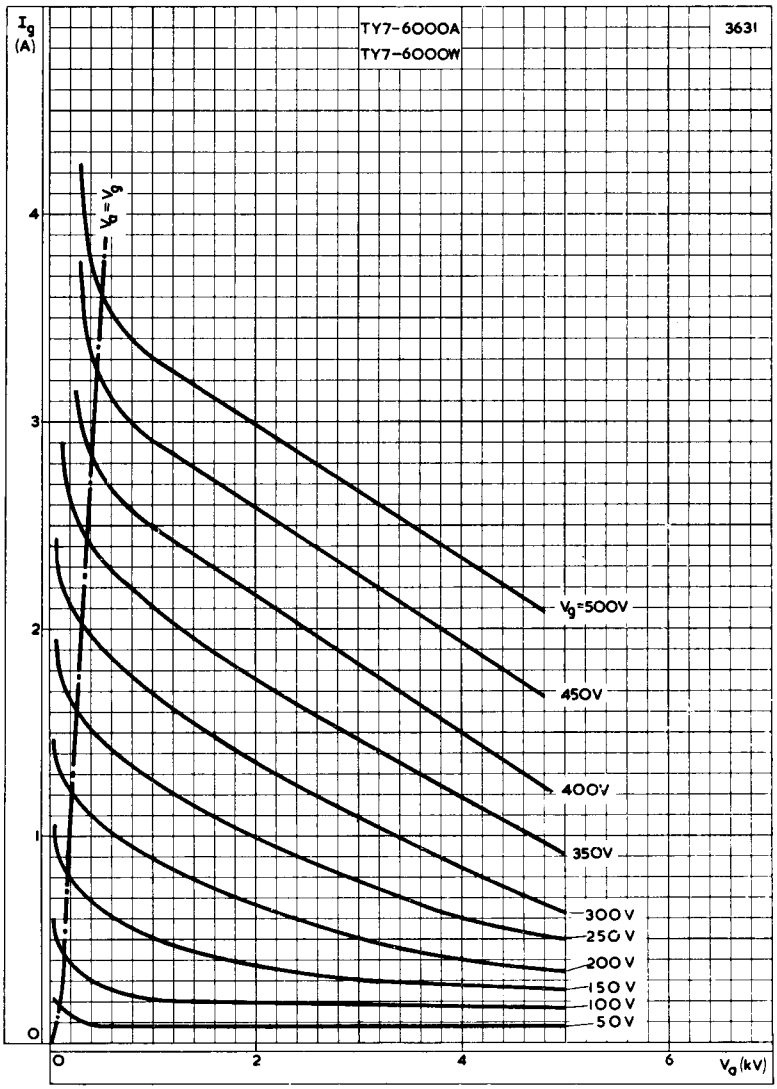


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

TY7-6000A

R.F. POWER TRIODE

Forced-air cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.

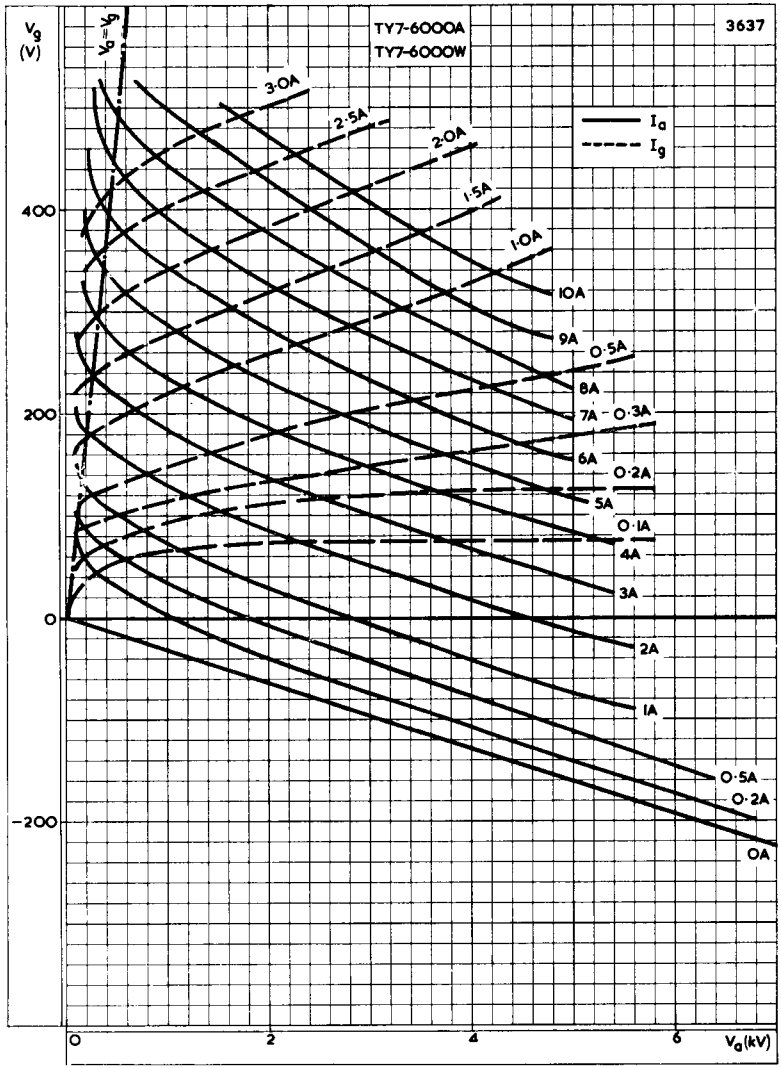


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

R.F. POWER TRIODE

TY7-6000A

Forced-air cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.



CONSTANT CURRENT CURVES

R.F. POWER TRIODE

TY7-6000W

Water cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES, preceding this section of the handbook.

FILAMENT Thoriated tungsten

V_f	12.6	V
I_f	33	A

The connection f_{ct} is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30Mc/s all three filament pins should be interconnected with suitable capacitors.

MOUNTING POSITION Vertical, anode up or down

CAPACITANCES

C_{a-g}	11	pF
C_{in}	16	pF
C_{out}	0.3	pF

CHARACTERISTICS (measured at V_a=6kV, I_a=1A)

g_m	15	mA/V
μ	32	

COOLING

Max. temperature of filament seals	210	°C
Max. temperature of grid and anode seals	180	°C

The valve must not be operated without a heat dissipating connector on pin f_{ct}.

TY7-6000W

R.F. POWER TRIODE

Water cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.

Typical values of inlet temperature, rate of flow of water and pressure difference between the inlet and outlet housing at various anode dissipations are given in the following table:

Anode dissipation p_a (kW)	Inlet temperature T_{in} (°C)	Rate of flow of water (litres/min)	Pressure difference between inlet and outlet (atm)
1.0	20	2.5	0.08
1.0	50	5.0	0.1
2.0	20	2.5	0.08
2.0	50	5.0	0.3
4.0	20	4.0	0.18
4.0	50	9.0	0.9
6.0	20	6.0	0.4
6.0	50	14	2.5

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals. Air cooling will in general not be necessary at frequencies $\leq$30Mc/s and a maximum ambient temperature of 35°C. At frequencies between 30 and 50Mc/s or at higher ambient temperatures a low velocity air flow to the grid and filament seals will be necessary.

WEIGHT

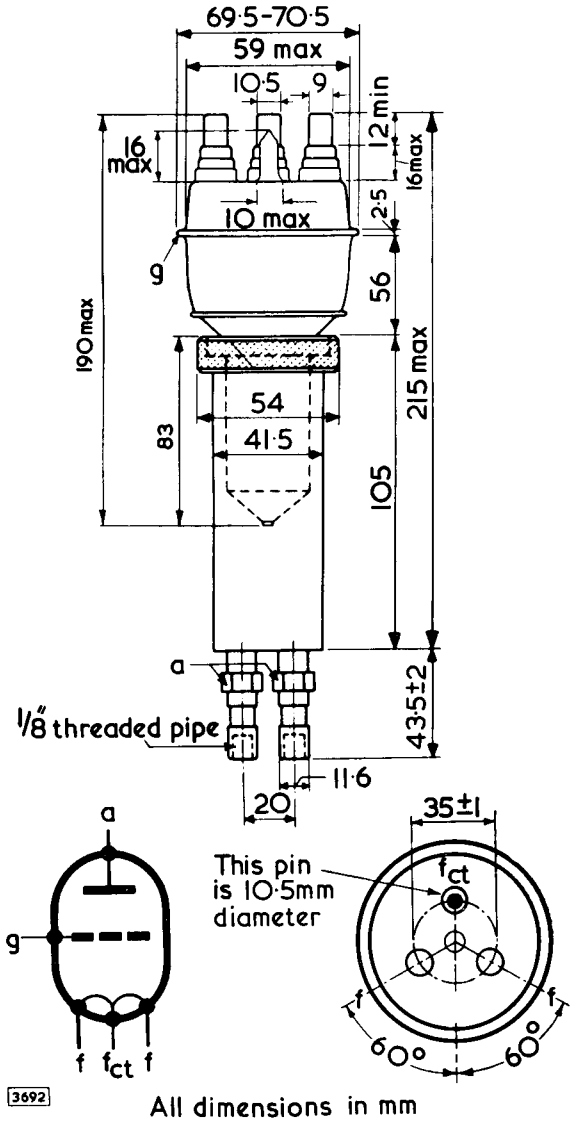
Valve only	15.8	oz
	450	g
Shipping weight	2.6	lb
	1.2	kg

The characteristics, curves, operating conditions and limiting values are identical with those given for TY7-6000A.

R.F. POWER TRIODE

TY7-6000W

Water cooled triode rated for a maximum anode dissipation of 6kW and suitable for use at frequencies up to 55Mc/s.



All dimensions in mm

TY7-6000W

Typical values of inlet temperature, rate of flow of water and pressure difference between the inlet and outlet housing at various anode dissipations are given in the following table:

Anode dissipation p_a (kW)	Inlet temperature T_{in} (°C)	Rate of flow of water per minute (litres)	(gal)	Pressure difference between inlet and outlet (atm)
1.0	20	2.5	0.55	0.08
1.0	50	5.0	1.10	0.1
2.0	20	2.5	0.55	0.08
2.0	50	5.0	1.10	0.3
4.0	20	4.0	0.88	0.18
4.0	50	9.0	1.98	0.9
6.0	20	6.0	1.32	0.4
6.0	50	14	3.08	2.5

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals. Air cooling will in general not be necessary at frequencies $\leqslant$ 30Mc/s and a maximum ambient temperature of 35°C. At frequencies between 30 and 50Mc/s or at higher ambient temperatures a low velocity air flow to the grid and filament seals will be necessary.

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Absolute maximum ratings

f max.	30	Mc/s
V_a max.	7.2	kV
I_k max.	2.8	A
$i_{k(pk)}$ max.	14	A
$-V_g$ max.	1.25	kV
I_g max.	600	mA
p_a max.	6.0	kW
p_g max.	250	W

Typical operating conditions

f	30	30	30	30	30	30	Mc/s
V_a	5.0	5.0	6.0	6.0	6.5	6.5	kV
V_g	−300	−300	−400	−400	−450	−450	V
I_a	2.0	2.0	2.0	2.0	2.0	2.0	A
I_g	500	600	500	600	500	600	mA
$v_{in(pk)}$	660	700	780	820	820	850	V
P_{drive}	297	378	350	443	370	460	W
p_a	2.9	2.7	3.5	2.8	3.5	3.0	kW
P_{out}	7.1	7.3	8.5	9.2	9.5	10	kW
η_a	71	73	71	76.7	73	77	%
P_{load}	5.7	5.8	7.0	7.4	7.6	8.0	kW

TY7-6000A
TY7-6000W

R.F. POWER TRIODE

CLASS 'C' TELEPHONY

Absolute maximum ratings

(carrier condition for modulation factor of 1)

f max.	30	Mc/s
V_a max.	5.5	kV
I_k max.	2.4	A
$i_{k(pk)}$ max.	12	A
$-V_g$ max.	1.25	kV
I_g max.	600	mA
p_a max.	4.0	kW
p_g max.	250	W

Typical operating conditions

f	30	30	30	Mc/s
V_a	4.0	5.0	5.0	kV
V_g	−300	−400	−400	V
I_a	1.6	1.4	1.6	A
I_g	600	500	600	mA
$v_{in(pk)}$	680	730	800	V
P_{drive}	367	328	432	W
p_a	1.4	1.4	1.6	kW
P_{out}	5.0	5.6	6.4	kW
η_a	78	80	80	%
P_{load}	4.0	4.5	5.1	kW
For 100% modulation				
P_{mod}	3.2	3.5	4.0	kW

CLASS 'B' A.F.

Absolute maximum ratings

V_a max.	7.2	kV
I_k max.	2.8	A
$i_{k(pk)}$ max.	10	A
p_a max.	6.0	kW
p_g max.	250	W
R_{g-f} max.	15	kΩ

Typical operating conditions for two valves in push-pull

V_a	4.0	5.0	5.0	7.0	kV
V_g	−120	−145	−145	−210	V
R_{a-a}	3.8	5.5	4.8	4.15	kΩ
$V_{in(g-g)r.m.s.}$	630	483	588	854	V
$I_{a(o)}$	2×100	2×150	2×150	2×200	mA
I_a (max. sig.)	2×1.25	2×1.1	2×1.25	2×2.0	A
I_g	2×315	2×220	2×350	2×560	mA
$P_{load(driver)}$	2×140	2×65	2×130	2×310	W
p_a	2×1.45	2×1.5	2×1.7	2×4.0	kW
P_{out}	7.1	8.0	9.0	20	kW
η_a	71	72.5	72.5	71.5	%

TY7-6000A
TY7-6000W

INDUSTRIAL OPERATION AS CLASS 'C' OSCILLATOR

Anode supply from three-phase half-wave rectifier without smoothing filter.

Absolute maximum ratings

f max.		85	55	Mc/s
V_a max.		6.5	7.0	kV
p_a max.			6.0	kW
I_k max.			2.5	A
$i_{k(pk)}$ max.			11	A
$-V_g$ max.			1.25	kV
I_g max. (unloaded)			700	mA
I_g max. (loaded)			500	mA
p_g max.			250	W
R_{g-f} max.			10	kΩ

Typical operating conditions

f	55	85	85	Mc/s
$V_{tr(r.m.s.)}$	5.55	5.13	4.27	kV
V_a	6.5	6.0	5.0	kV
I_a	1.7	1.5	1.7	A
I_g (unloaded)	700	700	700	mA
I_g (loaded)	500	400	450	mA
R_{g-f}	900	1000	850	Ω
R_a	2.0	2.3	1.6	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.15	0.15	0.19	
P_{drive}	350	300	350	W
p_a	2.4	2.5	2.4	kW
P_{out}	8.6	6.5	6.1	kW
P_{out} (less P_{drive})	8.25	6.2	5.75	kW
η_a	78	72	72	%
P_{load}	7.0	5.5	5.0	kW

ACCESSORIES

Filament clips	40634
Filament centre-pin clip	40649
Grid connector	40622
f < 30Mc/s	40650
Insulating pedestal (TY7-6000A)	40630
Water jacket (TY7-6000W)	K713

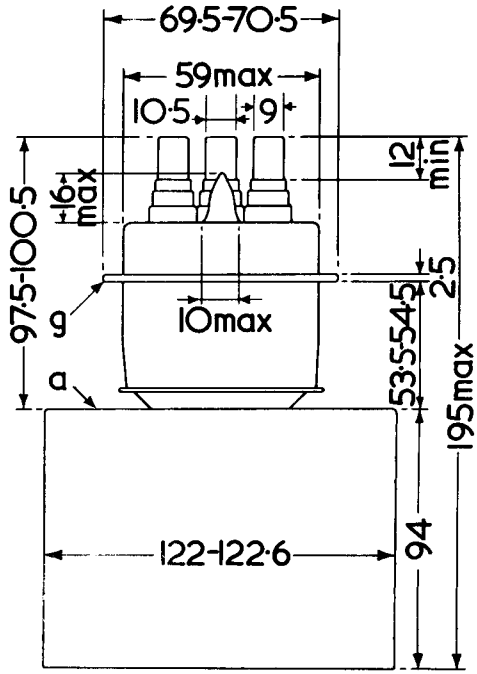
PHYSICAL DATA

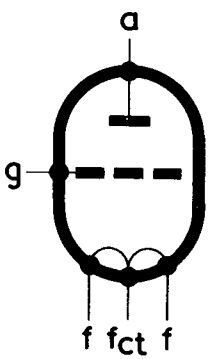
	TY7-6000A	TY7-6000W	
Weight of valve	10.1	1.0	lb
	4.6	0.45	kg
Weight of valve plus carton	17.8	2.6	lb
	8.1	1.2	kg
Dimensions of carton	13.6 × 13.6 × 20.5		in
	346 × 346 × 520		mm

TY7-6000A
TY7-6000W

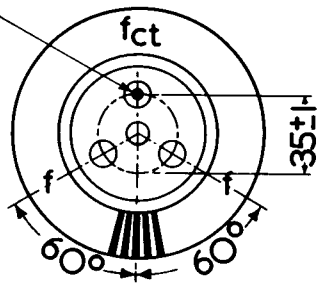
R.F. POWER TRIODE

OUTLINE DRAWING OF TY7-6000A





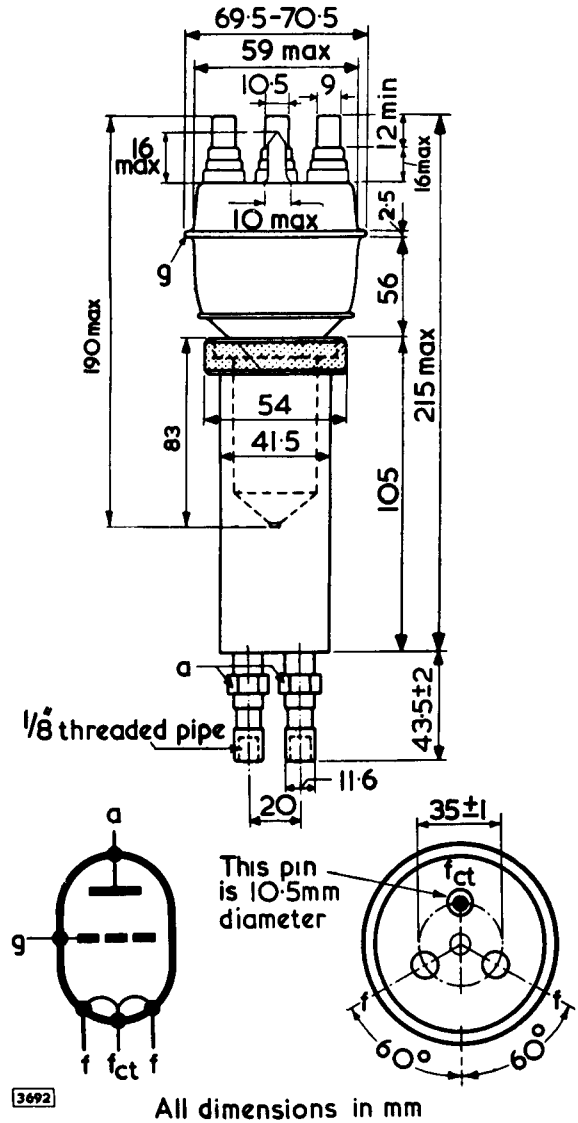
This pin is 10·5mm diameter



9969

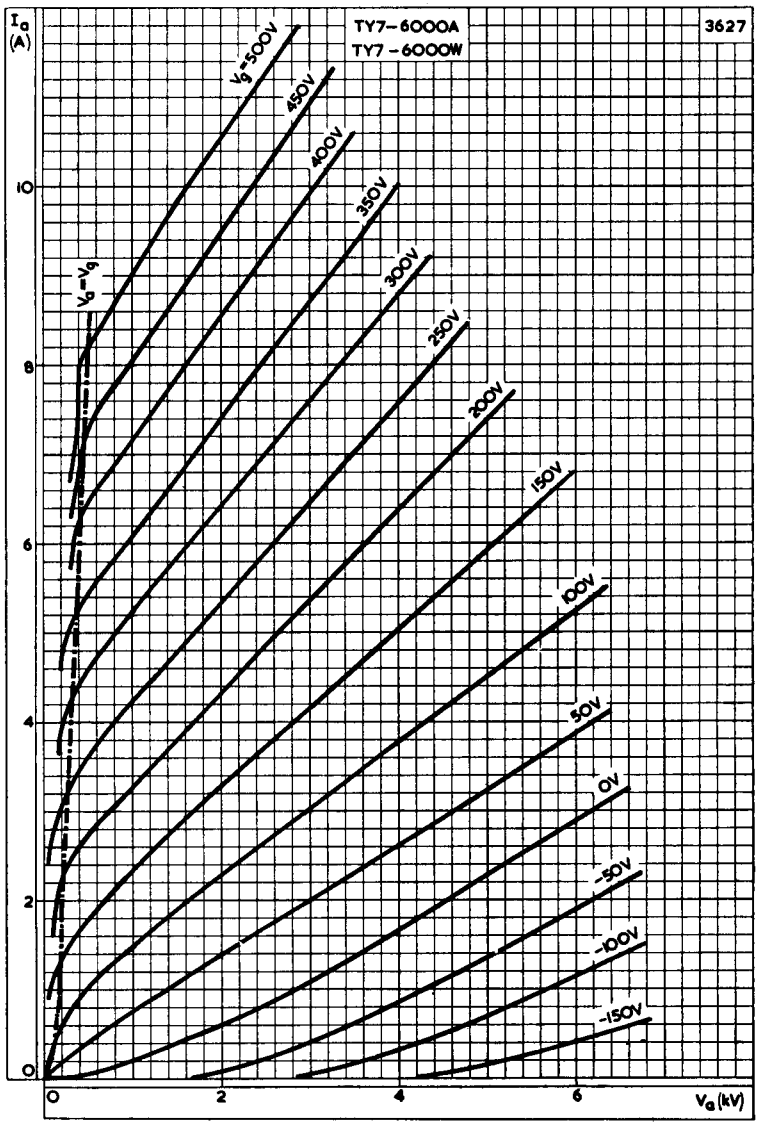
All dimensions in mm

OUTLINE DRAWING OF TY7-6000W

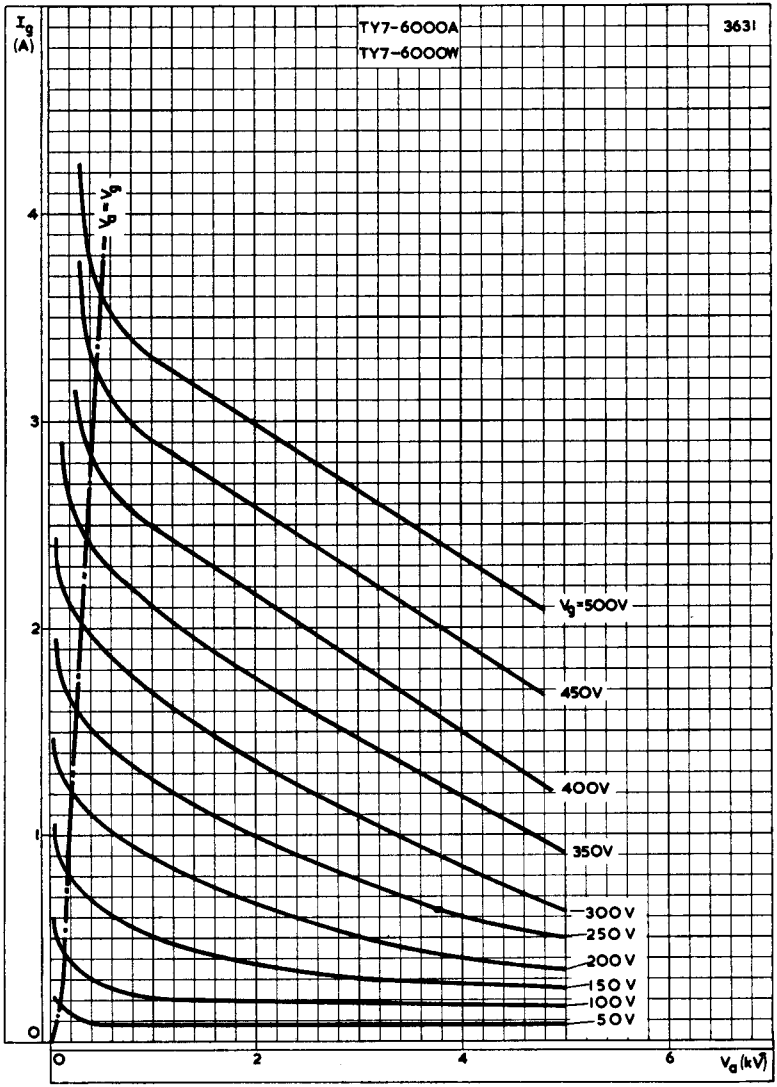


All dimensions in mm

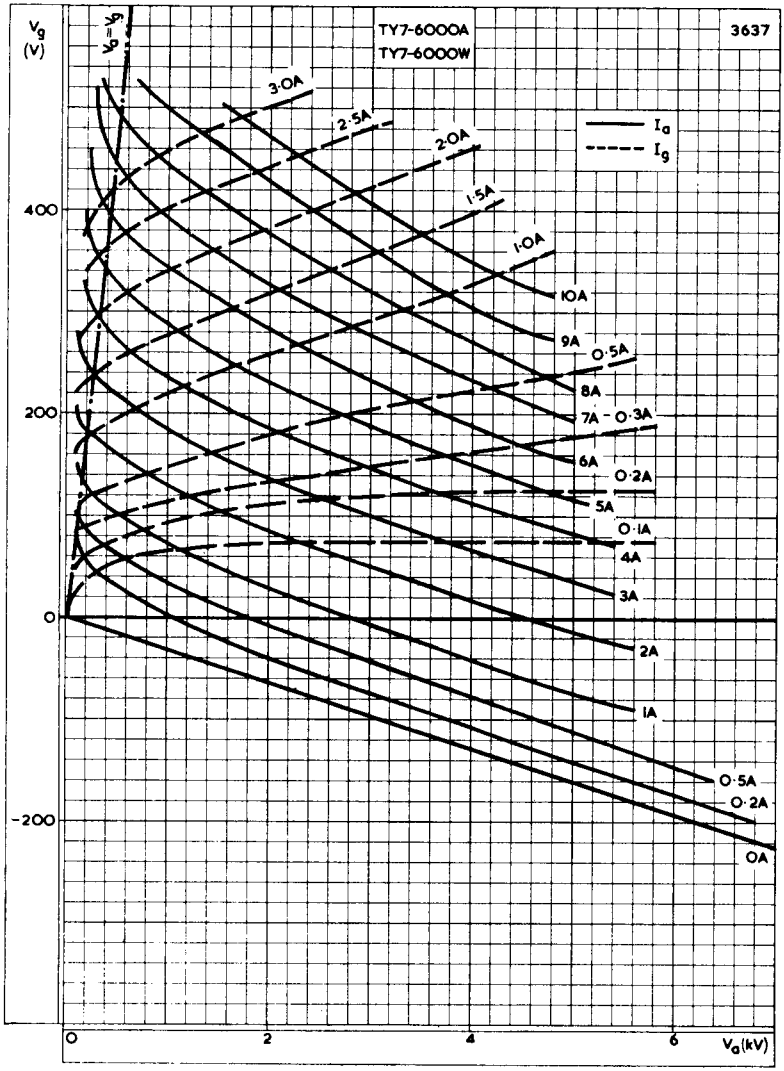
TY7-6000A
TY7-6000W



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



CONSTANT CURRENT CURVES

V.H.F. POWER TRIODE

TY7-6000A
TY7-6000W
TY7-6000H

QUICK REFERENCE DATA

External anode triode, intended for use as v.h.f. amplifier or oscillator or a.f. amplifier.

The TY7-6000A is forced-air cooled.
The TY7-6000W is water cooled by means of a water jacket.
The TY7-6000H is water cooled by means of an integral helical water cooler.

	Class 'C' Telegraphy or F.M. Telephony	Class 'C' Industrial Oscillator	Class 'B' Audio Amplifier	
f	30	55	-	Mc/s
P_{out}	10	8.25	20	kW
f max.	30	85	-	Mc/s
V_a max.	7.2	7.0	7.2	kV
p_a max.	6.0	6.0	6.0	kW

Unless otherwise shown, data is applicable to all types.

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Typical operating conditions

f	30	30	30	30	30	30	Mc/s
P_{out}	7.1	7.3	8.5	9.2	9.5	10	kW
P_{load}	5.7	5.8	7.0	7.4	7.6	8.0	kW
η_a	71	73	71	77	73	77	%
V_a	5.0	5.0	6.0	6.0	6.5	6.5	kV
I_a	2.0	2.0	2.0	2.0	2.0	2.0	A
$-V_g$	300	300	400	400	450	450	V
I_g	500	600	500	600	500	600	mA
$v_{in(pk)}$	660	700	780	820	820	850	V
$P_{load\ (driver)}$	297	378	350	443	370	460	W
p_a	2.9	2.7	3.5	2.8	3.5	3.0	kW

CLASS 'C' TELEPHONY ANODE MODULATION

Typical operating conditions (Carrier conditions for 100% modulation)

f	30	30	30	Mc/s
P_{out}	5.0	5.6	6.4	kW
P_{load}	4.0	4.5	5.1	kW
η_a	78	80	80	%
V_a	4.0	5.0	5.0	kV
I_a	1.6	1.4	1.6	A
$-V_g$	300	400	400	V
I_g	600	500	500	mA
$v_{in(pk)}$	680	730	800	V
$P_{load\ (driver)}$	367	328	432	W
p_a	1.4	1.4	1.6	kW
For 100% modulation				
P_{mod}	3.2	3.5	4.0	kW

CLASS 'B' AUDIO AMPLIFIER

Typical operating conditions for two valves in push-pull

P_{out}	7.1	8.0	9.0	20	kW
R_{a-a}	3.8	5.5	4.8	4.15	kΩ
V_a	4.0	5.0	5.0	7.0	kV
$-V_g$	120	145	145	210	V
$I_{a\ (o)}$	2 x 100	2 x 150	2 x 150	2 x 200	mA
$I_{a\ (max.\ sig.)}$	2 x 1.25	2 x 1.1	2 x 1.25	2 x 2.0	A
I_g	2 x 315	2 x 220	2 x 350	2 x 560	mA
$V_{in\ (g-g)}$ r.m.s.	630	483	588	854	V
$P_{load\ (driver)}$	2 x 140	2 x 65	2 x 130	2 x 310	W
p_a	2 x 1.45	2 x 1.5	2 x 1.7	2 x 4.0	kW
η_a	71	72.5	72.5	71.5	%

INDUSTRIAL OPERATION AS CLASS 'C' OSCILLATOR

Anode supply from three-phase halfwave rectifier without filter

Typical operating conditions

f	55	85	85	Mc/s
P_{out}	8.6	6.5	6.1	kW
P_{out} (less P_{drive})	8.25	6.2	5.75	kW
P_{load}	7.0	5.5	5.0	kW
η_a	78	72	72	%
V_{tr} (r.m.s.)	5.55	5.13	4.27	kV
V_a	6.5	6.0	5.0	kV
I_a	1.7	1.5	1.7	A
I_g (loaded)	500	400	450	mA
I_g (unloaded)	700	700	700	mA
Feedback ratio $\frac{V_{in(pk)}}{V_{out(pk)}}$	0.15	0.15	0.19	
P_{load} (driver)	350	300	350	W
p_a	2.4	2.5	2.4	kW
R_{g-f}	900	1000	850	Ω
R_a	2.0	2.3	1.6	kΩ

ABSOLUTE MAXIMUM RATINGS

	Class 'C' Telegraphy	Class 'C' Telephony	Class 'B' A.F.	Class 'C' Oscillator	
V_a max (f = 30Mc/s)	7.2	5.5	7.2	-	kV
(f = 55Mc/s)	-	-	-	7.0	kV
(f = 85Mc/s)	-	-	-	6.5	kV
$-V_g$ max.	1.25	1.25	-	1.25	kV
i_k max	2.8	2.4	2.8	2.5	A
$i_{k(pk)}$ max	14	12	10	11	A
p_a max.	6.0	4.0	6.0	6.0	kW
I_g max.	600	600	-	*	mA
p_g max.	250	250	250	250	W
R_{g-f} max.	-	-	15	10	kΩ

*I_g (loaded) max	500	mA
I_g (unloaded) max	700	mA

CATHODE

Directly heated, thoriated tungsten

*V_f	12.6	V
I_f	33	A

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

The connection f_{ct} is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30Mc/s all three filament pins should be interconnected with suitable capacitors.

CAPACITANCE

c_{a-g}	11	pF
c_{in}	16	pF
c_{out}	300	mpF

CHARACTERISTICS (measured at V_a = 6.0kV, I_a = 1.0A)

g_m	15	mA/V
μ	32	

MOUNTING POSITION

Vertical, with anode up or down.

COOLING

The valve must not be operated without a heat dissipating connector on pin f_{ct}

TY7-6000A
Forced-air cooled
Maximum temperatures

Filament seals	210	°C
Anode and grid seals	180	°C

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the filament and grid seals.

The amount of forced-air cooling required for this valve depends upon the anode dissipation and the height above sea level.

Typical values of inlet temperature, rate of flow of air and pressure difference between the inlet and outlet of the housing are given in the following table

Anode dissipation	Height above sea level		Max. inlet temperature	Min. rate of flow of air per minute		Pressure difference between inlet and outlet	
p_a	h		T_{in}				
(kW)	(m)	(ft)	(^oC)	(m^3)	(ft^3)	(mmH_2O)	(in H_2O)
2.0	0	0	35	4.8	169	20	0.79
2.0	0	0	45	5.7	201	25	0.98
2.0	1500	4921	35	5.7	201	23	0.90
2.0	3000	9842	25	6.1	215	23	0.90
3.5	0	0	35	6.2	219	32	1.26
3.5	0	0	45	7.3	258	42	1.65
3.5	1500	4921	35	7.3	258	36	1.42
3.5	3000	9842	25	7.8	275	36	1.42
6.0	0	0	35	9.2	325	68	2.68
6.0	0	0	45	10.7	378	91	3.58
6.0	1500	4921	35	11.2	396	81	3.19
6.0	3000	9842	25	11.7	413	80	3.15

Water cooled anode and low velocity air flow on seals

Maximum temperatures

Filament seals	210	^{o}C
Anode and grid seals	180	^{o}C

Typical values of inlet temperature, rate of flow of water and pressure difference between the inlet and outlet housing at various anode dissipations are given in the following table

Anode dissipation	Inlet temperature	Rate of flow of water per minute		Pressure difference between inlet and outlet
P_a (kW)	T_{in} (^{o}C)	(litres)	(gal)	(atm)
1.0	20	2.5	0.55	0.08
1.0	50	5.0	1.10	0.1
2.0	20	2.5	0.55	0.08
2.0	50	5.0	1.10	0.3
4.0	20	4.0	0.88	0.18
4.0	50	9.0	1.98	0.9
6.0	20	6.0	1.32	0.4
6.0	50	14	3.08	2.5

In order to keep within the temperature limits it may be necessary to direct a flow of air on to the seals. Air cooling will in general not be necessary at frequencies ≤30Mc/s and a maximum ambient temperature of 35°C. At frequencies between 30 and 50Mc/s or at higher ambient temperatures at low velocity air flow to the grid and filament seals will be necessary.

TY7-6000H

Water cooled anode and low velocity air flow on seals

Maximum temperatures		
Filament seals	210	°C
Anode and grid seals	180	°C
Water inlet	50	°C

The amount of water cooling required for this valve depends on the anode dissipation and the temperature of the water.

Typical values of rate of flow of water through helix and pressure loss in the helix are given in the curve on page C2. The minimum rate of flow of water through helix required can be found from the curves on page C3.

At frequencies above 30Mc/s and at ambient temperatures above 35°C both grid and filament seals should be cooled by a low velocity air flow.

PHYSICAL DATA

	TY7-6000A	TY7-6000W	TY7-6000H	
Weight of valve	10.1	1.0	1.8	lb
	4.6	0.45	0.8	kg
Weight of valve plus carton	17.8	2.6	3.7	lb
	8.1	1.2	1.7	kg
Weight of insulating pedestal	5.1	-	-	lb
	2.3	-	-	kg
Weight of insulating pedestal plus carton	7.1	-	-	lb
	3.2	-	-	kg
Weight of water jacket	-	1.1	-	lb
	-	0.5	-	kg
Weight of water jacket plus carton	-	1.6	-	lb
	-	0.7	-	kg

ACCESSORIES

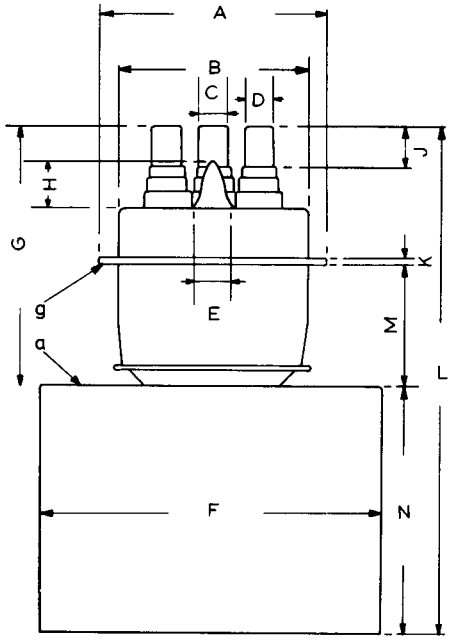
Filament clips x 2	40634
Filament centre-pin clip x 1	40649
Grid connector f > 30Mc/s	40622
f < 30Mc/s	40650
Insulating pedestal (TY7-6000A)	40630
Water jacket (TY7-6000W)	K713

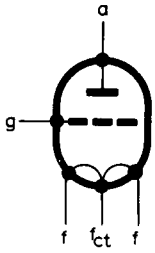
Dimensions of TY7-6000A

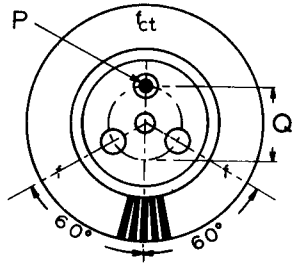
	Inches	Millimetres	
A	2.756 ± 0.020	70 ± 0.5	
B	2.323	59	max
C	0.413	10.5	
D	0.354	9.0	
E	0.394	10	max
F	4.815 ± 0.012	122.3 ± 0.3	
G	3.898 ± 0.059	99 ± 1.5	
H	0.630	16	max
J	0.472	12	min
K	0.098	2.5	
L	7.677	195	max
M	2.126 ± 0.020	54 ± 0.5	
N	3.701	94	
P	0.413	10.5	dia
Q	1.378 ± 0.039	35 ± 1.0	

Inch dimensions derived from original millimetre dimensions

OUTLINE DRAWING OF TY7-6000A







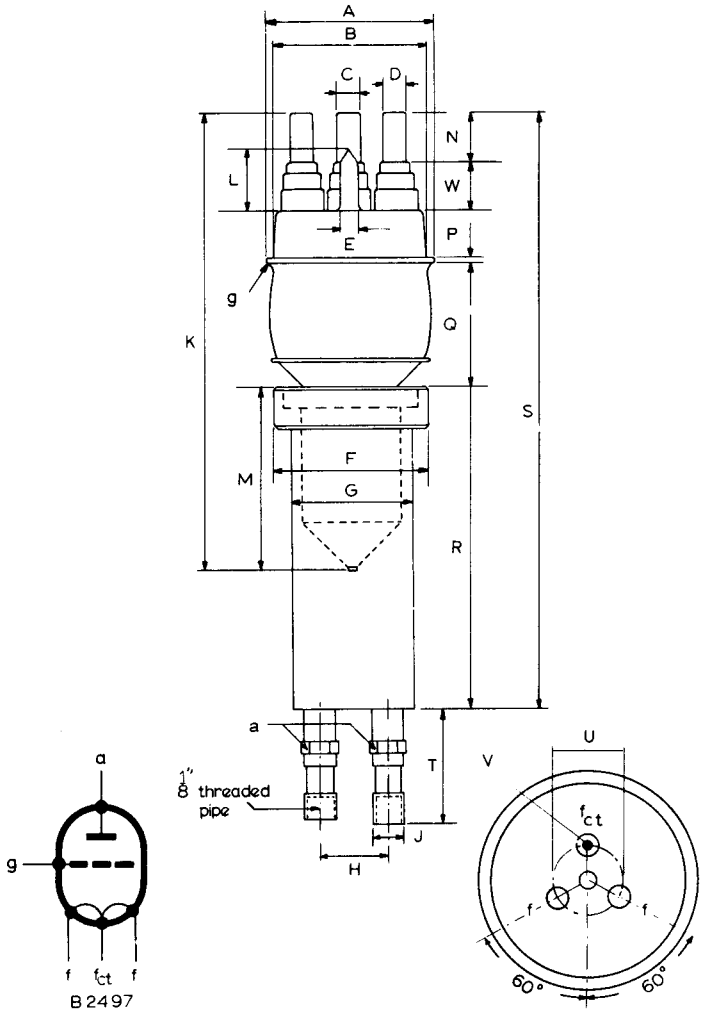
B 2495

Dimensions of TY7-6000W

	Inches	Millimetres	
A	2.756 ± 0.020	70 ± 0.5	
B	2.323	59	max
C	0.413	10.5	
D	0.354	9.0	
E	0.394	10	max
F	2.126	54	
G	1.634	41.5	
H	0.788	20	
J	0.457	11.6	
K	7.480	190	max
L	0.630	16	max
M	3.268	83	
N	0.472	12	min
P	0.098	2.5	
Q	2.205	56	
R	4.130	105	
S	8.465	215	max
T	1.713 ± 0.079	43.5 ± 2.0	
U	1.378 ± 0.039	35 ± 1.0	
V	0.413	10.5	dia
W	0.630	16	max

Inch dimensions derived from original millimetre dimensions

OUTLINE DRAWING OF TY7-6000W

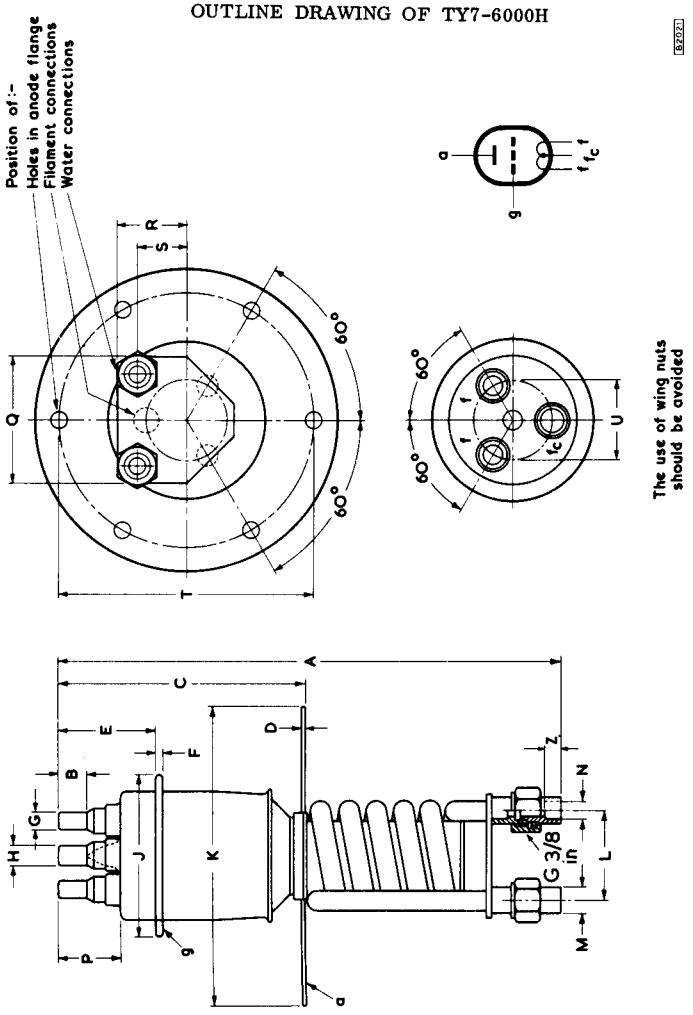


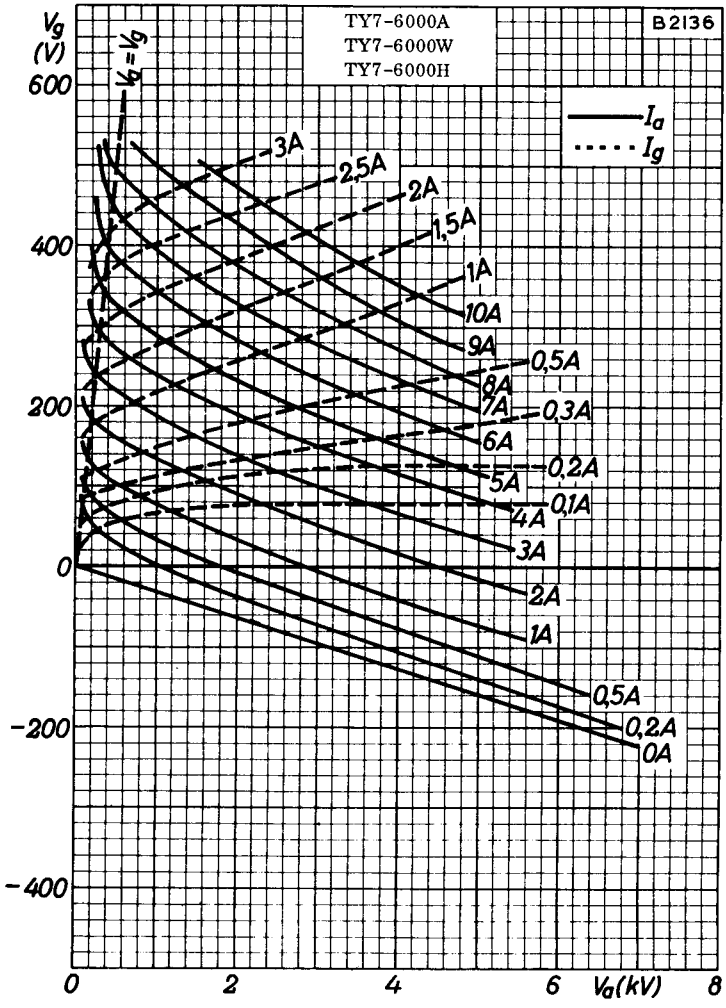
Dimensions of TY7-6000H

	Inches	millimetres	
A	8.622	219	
B	0.472	12	min
C	4.134	105	
D	0.079	2	
E	1.693	43	
F	0.098	2.5	
G	0.358	9.1	dia
H	0.413	10.5	dia
J	2.756	70	dia
K	5.118	130	dia
L	1.535	39	
M	0.394	10	dia
N	0.315	8	dia
P	0.630	16	max
Q	2.283	58	
R	1.260	32	
S	0.827	21	
T	4.331	110	
U	1.378	35	
Z	0.394	10	

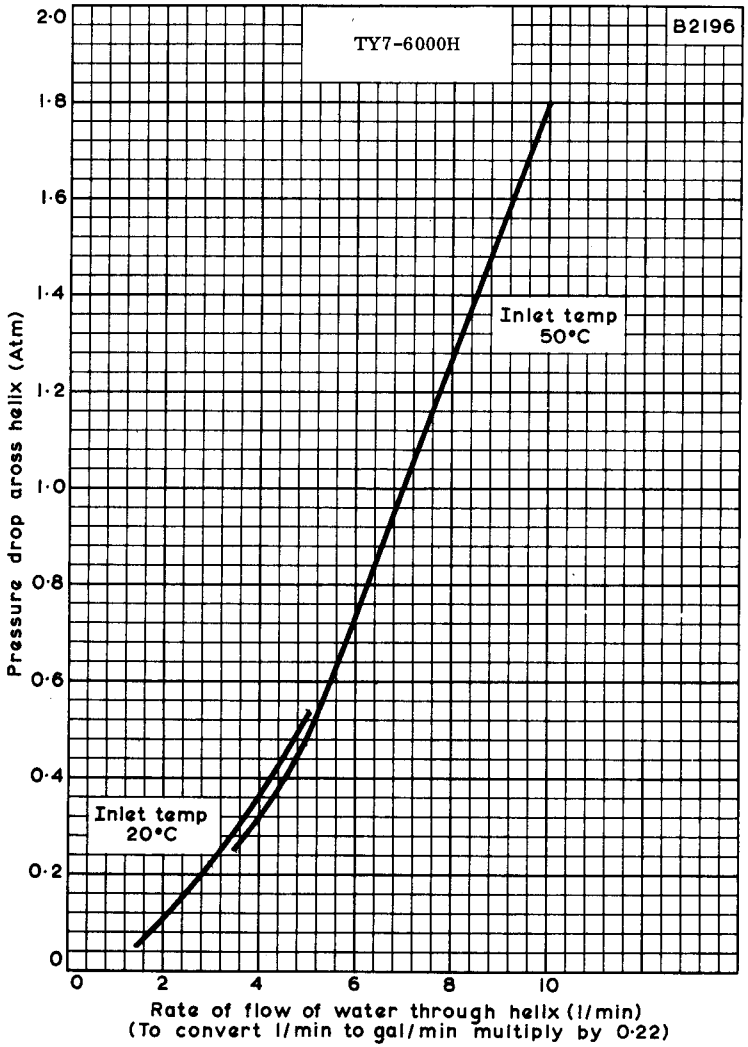
Inch dimensions derived from original millimetre dimensions

OUTLINE DRAWING OF TY7-6000H

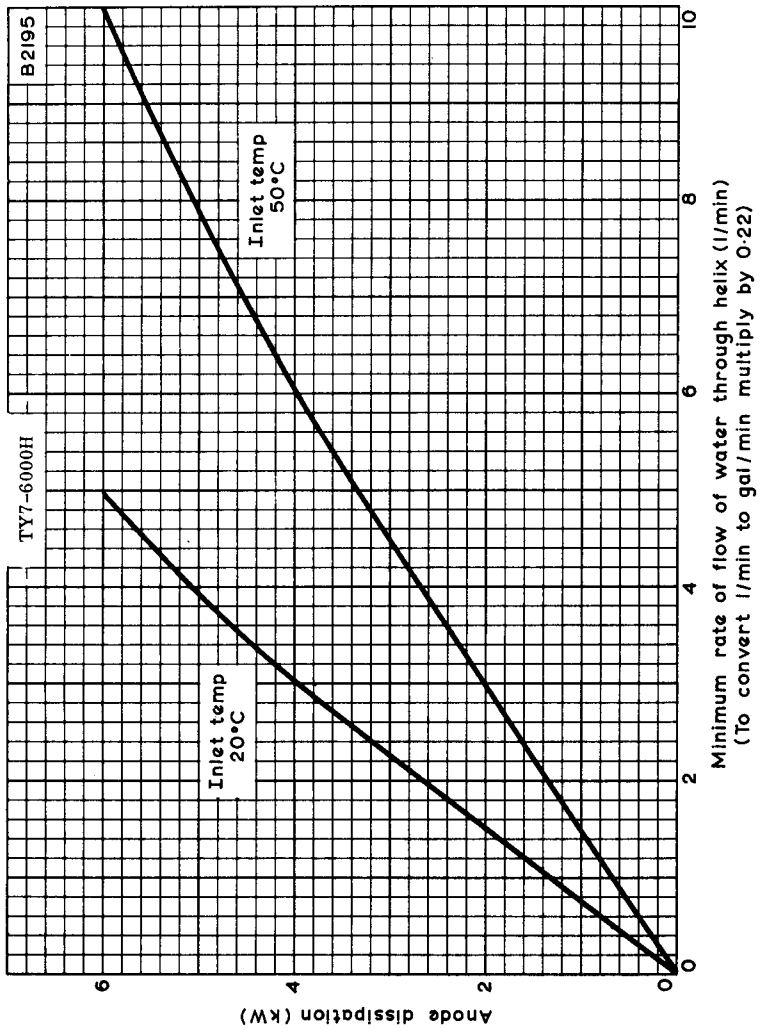




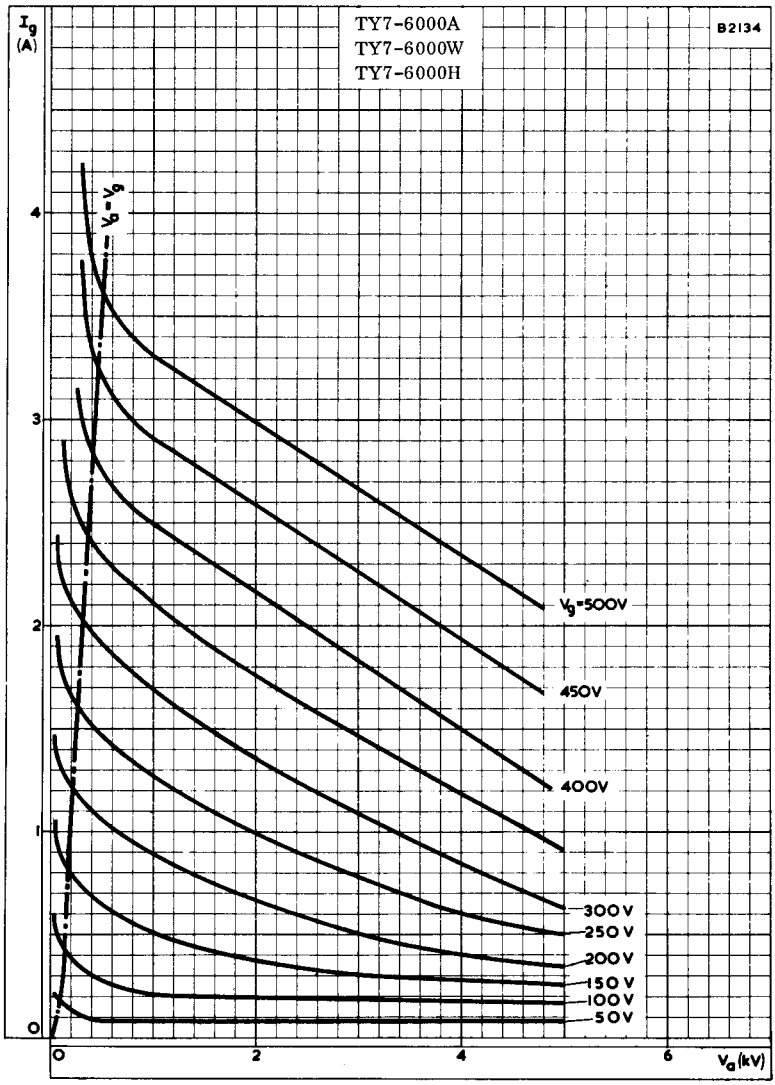
CONSTANT CURRENT CHARACTERISTICS



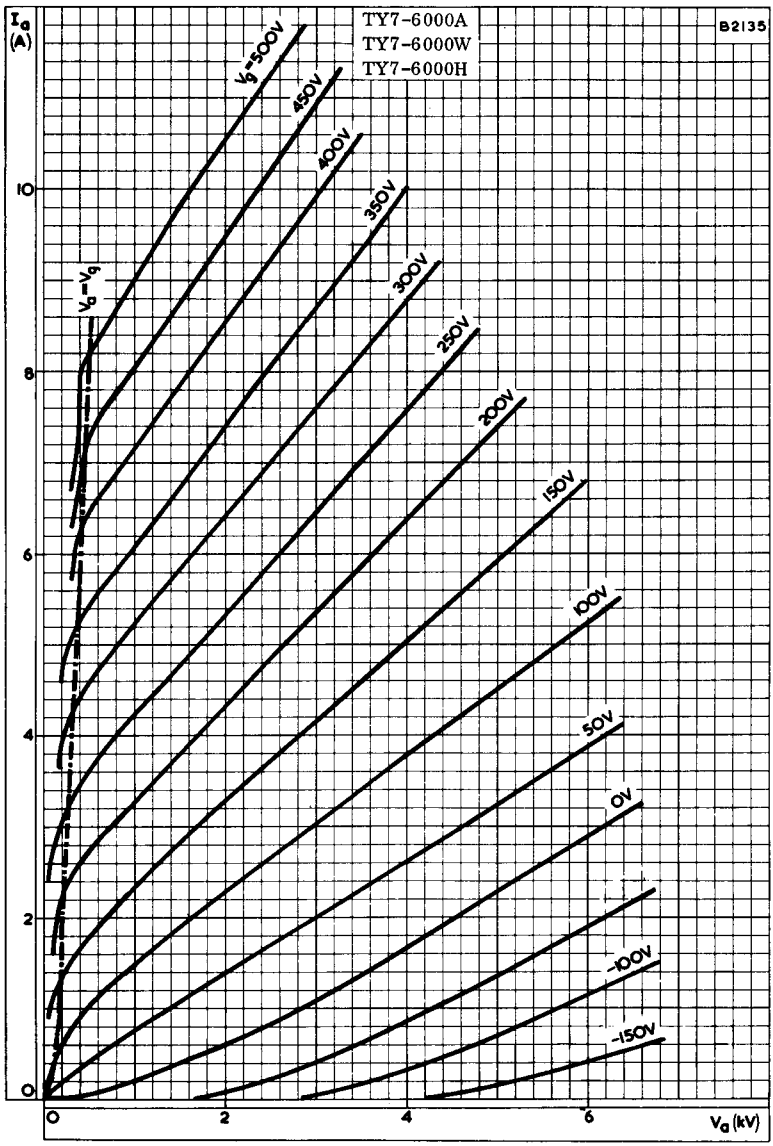
PRESSURE DROP ACROSS HELIX PLOTTED AGAINST RATE OF FLOW OF WATER THROUGH HELIX FOR INLET TEMPERATURES OF 20 AND 50°C.



ANODE DISSIPATION PLOTTED AGAINST MINIMUM RATE OF FLOW OF WATER THROUGH HELIX FOR INLET TEMPERATURES OF 20 AND 50°C.



GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER

TRIODE

TY8-15A

Application: *R.F. industrial heating.*
Power output: *14kW continuous ratings.*
Frequency: *30Mc/s at full ratings.*
Construction: *External anode, forced air cooled.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES, which precede this section of the handbook.

FILAMENT Directly heated, thoriated tungsten

V_f	6.3	V
*I_f	130	A

*The filament current must never exceed a surge value of 280A at any time during the warming-up period. The filament has been designed to accept temporary fluctuations of $^{+5}_{-10}$%.

MOUNTING POSITION Vertical, anode down

CAPACITANCES

C_{a-g}	33.5	pF
C_{g-f}	44.5	pF
C_{a-f}	1.2	pF

CHARACTERISTICS (measured at V_a = 6kV, I_a = 2.5A)

g_m	23	mA/V
g_m (at V_a = 500V, I_a = 14A)	28	mA/V
μ	17.5	

COOLING

Forced air

Max. temperature of seals 220 °C

The amount of forced air cooling required for this valve depends upon the anode dissipation and the height above sea level. Typical values of inlet temperature, rate of air flow and pressure difference between the inlet and outlet of the housing are given in the following table:

Anode dissipation p_a	Height above sea-level h		Inlet Temperature T_{in}	Min. rate of flow of air per minute		Pressure difference between inlet and outlet
(kW)	(km)	(ft)	(°C)	(m^3)	(ft^3)	(mm of H_2O)
5.0	0	0	45	5.9	210	15
5.0	0	0	35	5.2	185	12
5.0	1.5	4920	35	6.2	220	14
5.0	3.0	9840	25	6.6	235	15
7.5	0	0	45	9.0	320	34
7.5	0	0	35	8.0	285	27
7.5	1.5	4920	35	9.5	335	32
7.5	3.0	9840	25	10.2	360	34
10	0	0	45	12.3	435	63
10	0	0	35	11	390	50
10	1.5	4920	35	13	460	59
10	3.0	9840	25	14	495	64

TY8-15A

TRIODE

CLASS 'C' OSCILLATOR

Anode supply from three-phase half-wave rectifier without smoothing filter.

Limiting values (absolute ratings)

f max.	30	Mc/s
V_a max.	8.0	kV
$-V_g$ max.	1.6	kV
R_{g-f} max.	10	kΩ
p_a max.	10	kW
I_a max.	4.0	A
I_g max.	1.5	A
p_g max.	800	W

Typical operation

f	30	30	Mc/s
V_{tr} (r.m.s.)	5.9	5.1	kV
V_a	7.0	6.0	kV
I_a	3.5	3.3	A
I_g	950	800	mA
p_a	6.8	5.5	kW
η_a	72	72	%
R_{g-f}	0.95	1.0	kΩ
R_a	1.0	0.87	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.25	0.26	
P_{out}	17.7	14.3	kW
*P_{load}	14	11	kW

*0.85 ($P_{out}-P_{drive}$)

WEIGHT

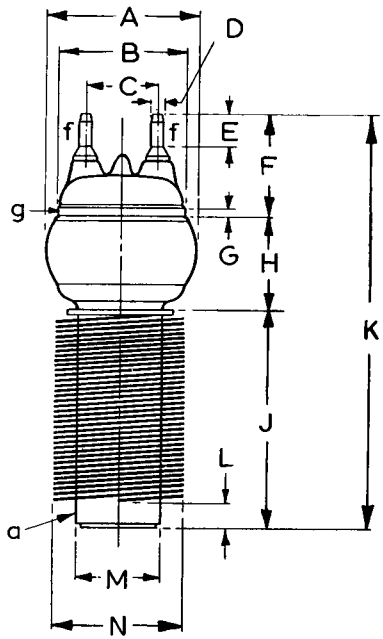
Valve only	9	lb
	3.8	kg
Shipping weight	70	lb
	31.8	kg

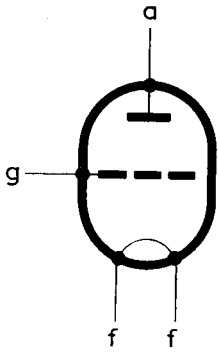
ACCESSORIES

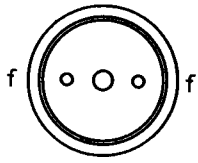
Filament clip	40662
Grid connector	40664
Insulating pedestal	K508

TY8-15A

7593



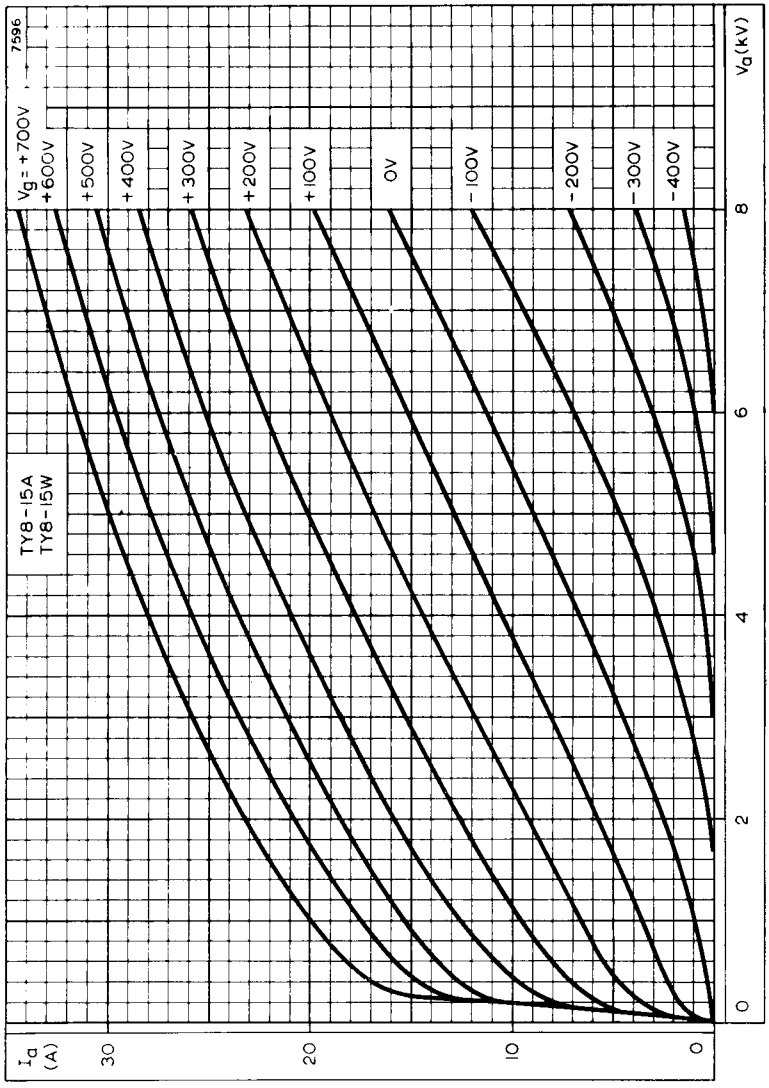




DIMENSIONS

	Inches	*Millimetres*	
A	4.528	115	
B	3.780	96	
C	2.126	54	
D	0.374	9.5	
E	0.984	25	
F	3.071	78	←
G	0.335	8.5	
H	2.992	76	←
J	6.220	158	max.←
K	12.402	315	max.←
L	0.709	18	
M	2.520	64	
N	3.976	101	max.←

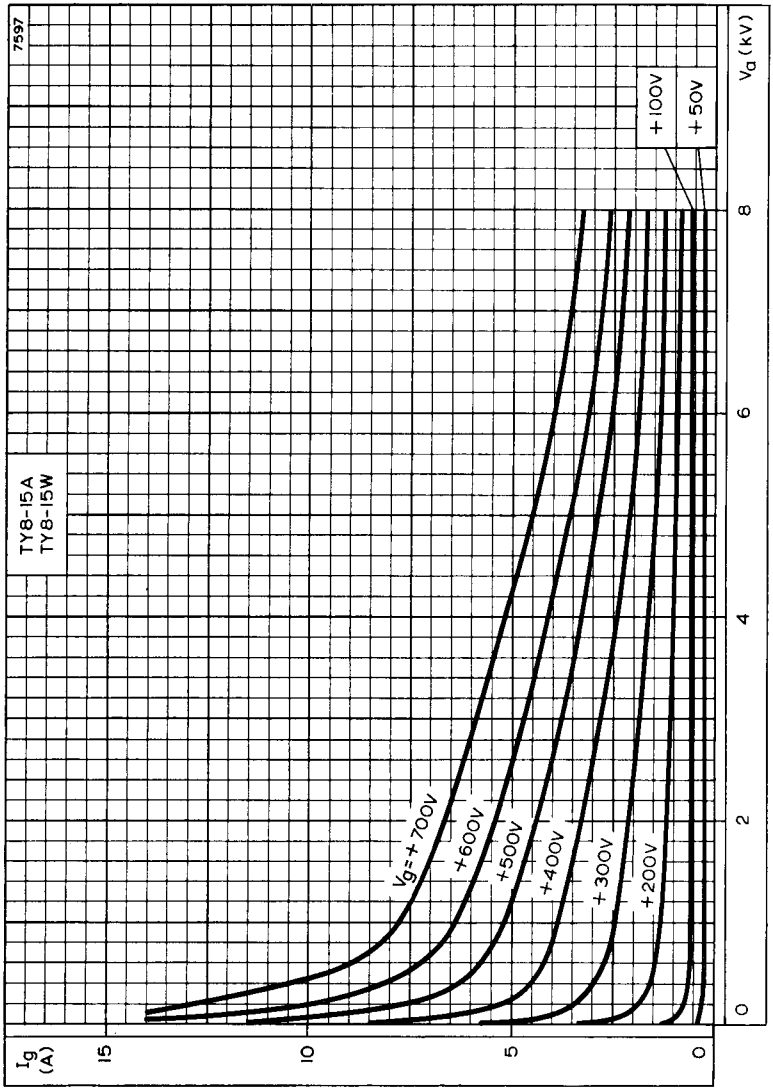
TY8-15A



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

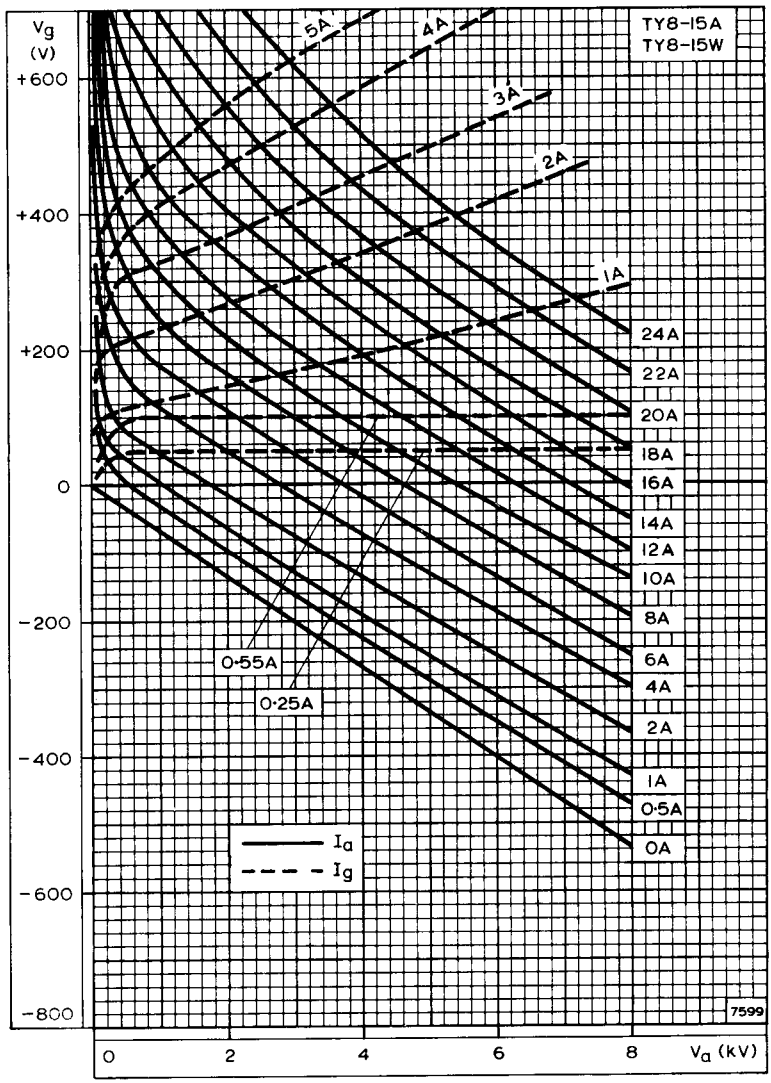
TY8-15A

TRIODE

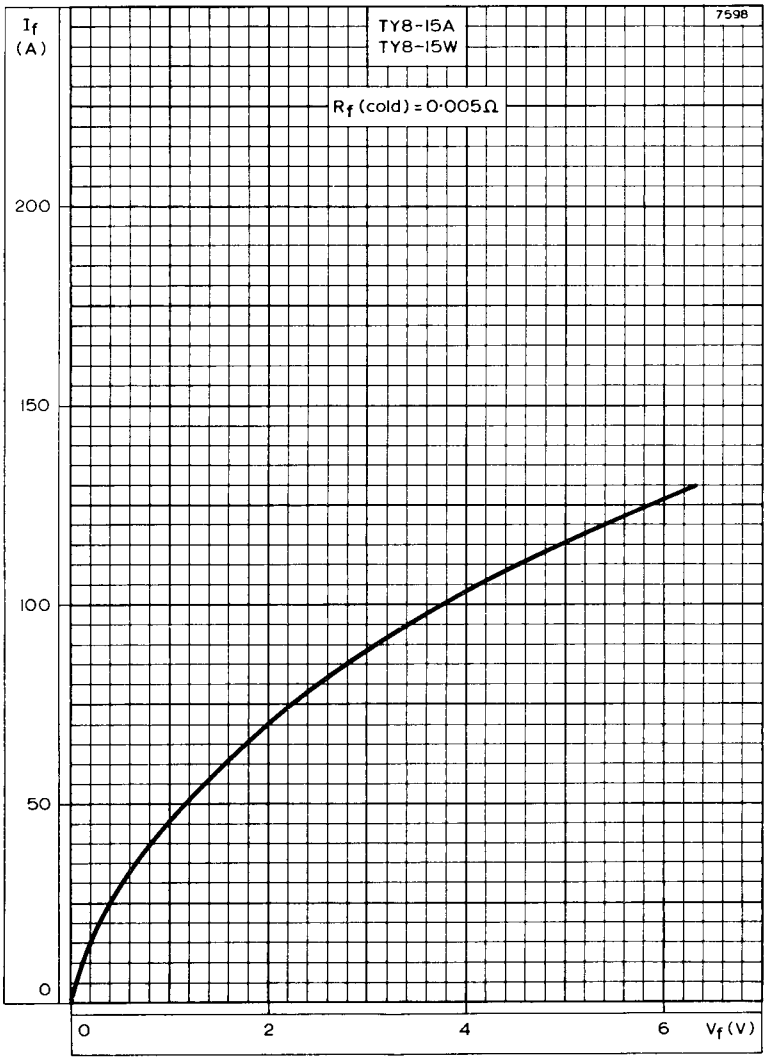


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

TY8-15A



CONSTANT CURRENT CHARACTERISTICS



FILAMENT CURRENT PLOTTED AGAINST FILAMENT VOLTAGE

PRELIMINARY DATA

QUICK REFERENCE DATA

Water-cooled triode, with fixed helix heat exchanger for r.f. industrial heating-applications.

f max.	30	Mc/s
Va max.	8.0	kV
pa max.	15	kW
Performance		
f	30	Mc/s
Pout	17.7	kW

This data should be read in conjunction with GENERAL OPERATING RECOMMENDATIONS - TRANSMITTING VALVES.

INDUSTRIAL OPERATION AS CLASS 'C' OSCILLATOR

Anode supply from three-phase full wave rectifier without smoothing filter.

Absolute maximum ratings

f max.	30	Mc/s
Va max.	8.0	kV
-Vg max.	1.6	kV
Rg-f max.	10	kΩ
pa max.	15	kW
Ia max.	4.0	A
Ig max.	1.5	A
pg max.	800	W

Typical operating conditions

f	30	30	Mc/s
Va	7.0	6.0	kV
Ia	3.5	3.3	A
Ig	950	800	mA
pa	6.8	5.5	kW
ηa	72	72	%
Rg-f	0.95	1.0	kΩ
Ra	1.0	0.87	kΩ
Feedback ratio $\frac{vin(pk)}{va\ (pk)}$	0.25	0.26	
Pout	17.7	14.3	kW
*Pload	14	11	kW

*0.85 (Pout-Pdrive)

FILAMENT

Directly heated, thoriated tungsten

Vf	6.3	V
*If	130	A
rf (cold)	0.005	Ω

*The filament current must never exceed a surge value of 280A at any time during the warming-up period. The filament has been designed to accept temporary variations in supply voltage of +5% and -10%.

CAPACITANCES

ca-g	33.5	pF
cg-f	44.5	pF
ca-f	1.2	pF

CHARACTERISTICS

(Measured at Va = 6kV, Ia = 2.5A)

gm	23	mA/V
μ	17.5	

(Measured at Va = 500V, Ia = 14A)

gm	28	mA/V

MOUNTING POSITION — Vertical, anode down

COOLING

Water cooled

Tseals max.	220	°C

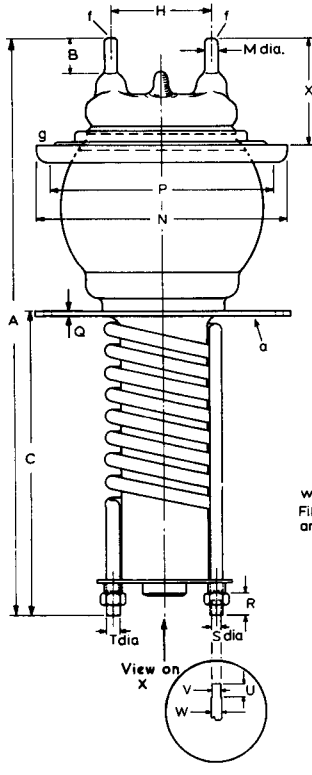
The amount of water cooling required for this valve depends on the anode dissipation and the temperature of the water. Typical values of rate of flow of water through helix and pressure loss in the helix are given in the curve on page C5. The minimum rate of flow of water through helix required can be found from the curves on page C6.

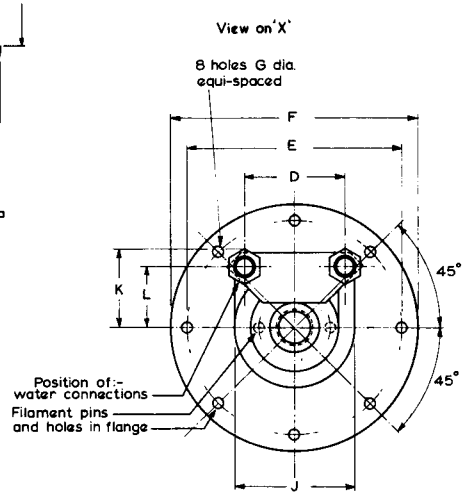
PHYSICAL DATA

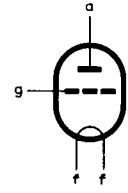
Weight of valve	6.7 3.0	lb kg
Weight of valve plus carton	67 30.5	lb kg

ACCESSORIES

Filament clip	40662
Grid connector	40664



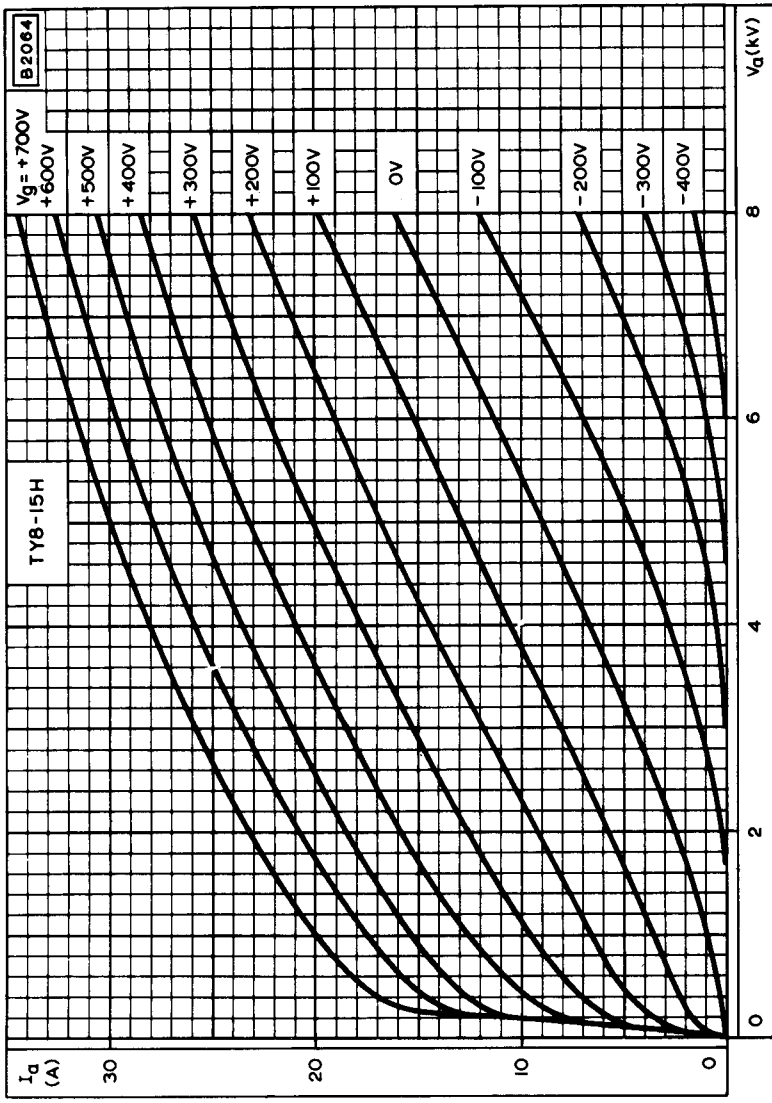




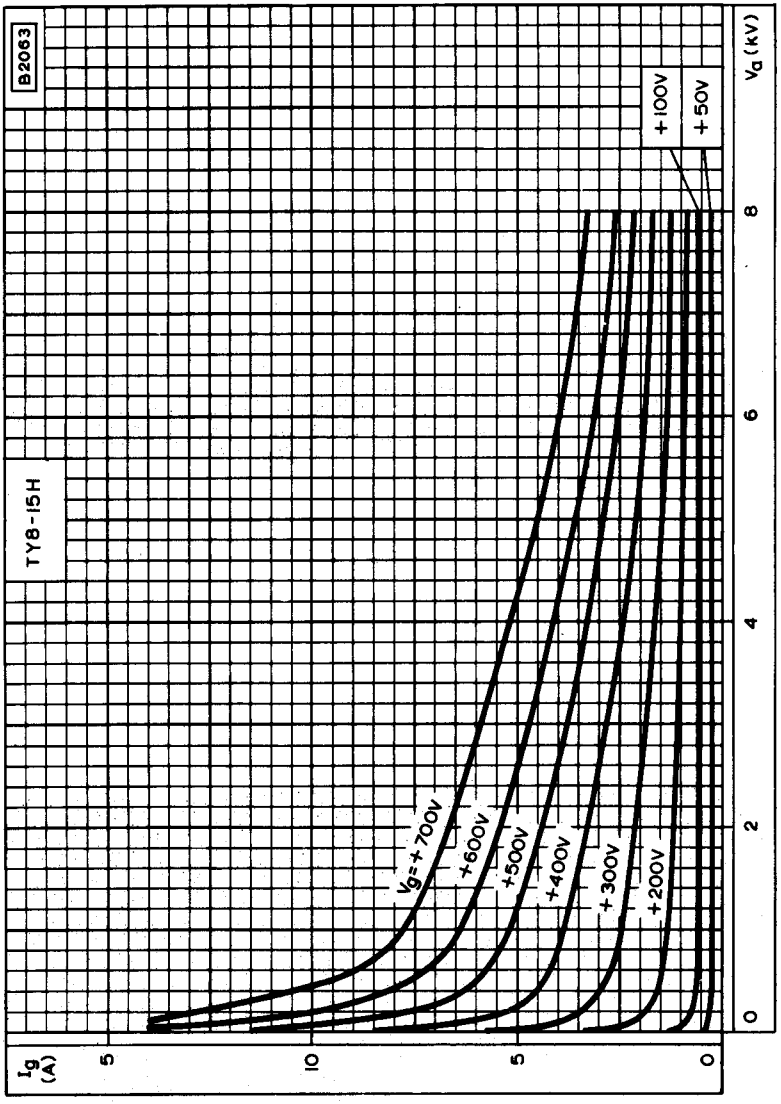
DIMENSIONS

	Inches	Millimetres		Inches	Millimetres
A	13.819	351	M	0.374	9.5
B	0.984	25	N	6.417	163
C	7.677	195	P	5.827	148
D	2.953	75	Q	0.118	3
E	6.378	162	R	0.472	12
F	7.283	185	S	0.472	12
G	0.276	7	T	0.630	16
H	2.126	54	U	1.000	25.4
J	3.406	86.5	V	0.472	12
K	2.205	56	W	0.5	12.7
L	1.654	42			

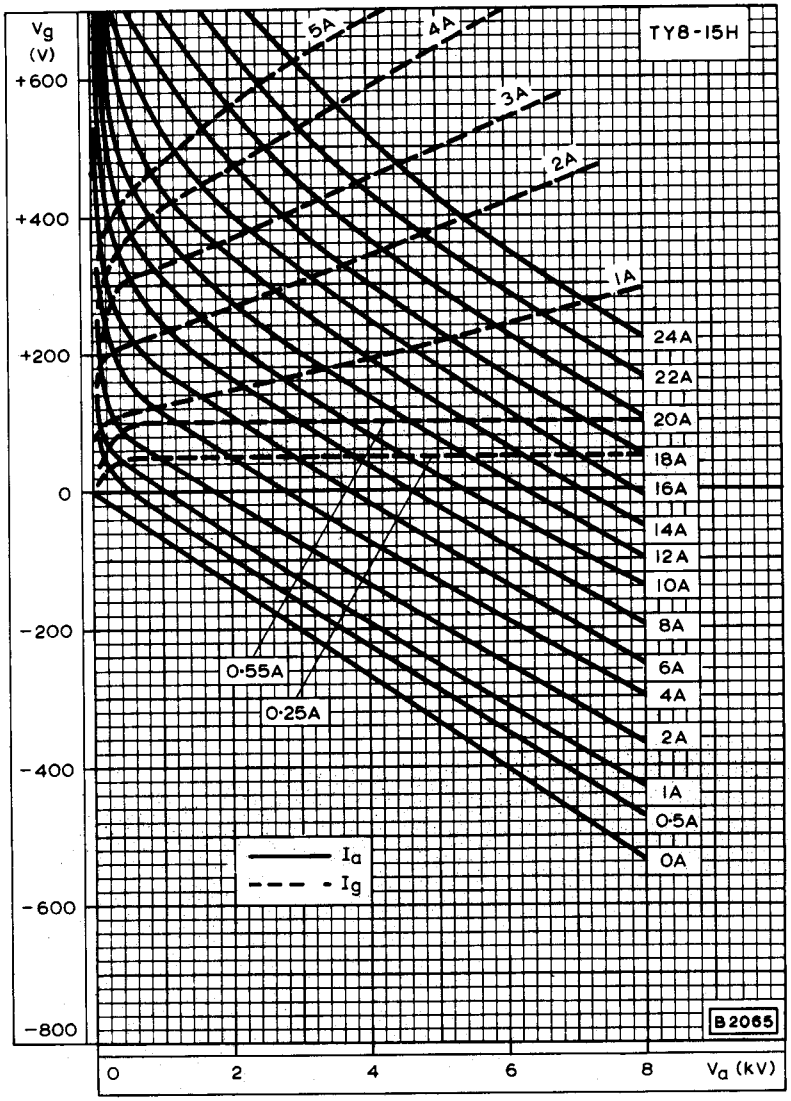
Inch dimensions derived from original millimetre dimensions.



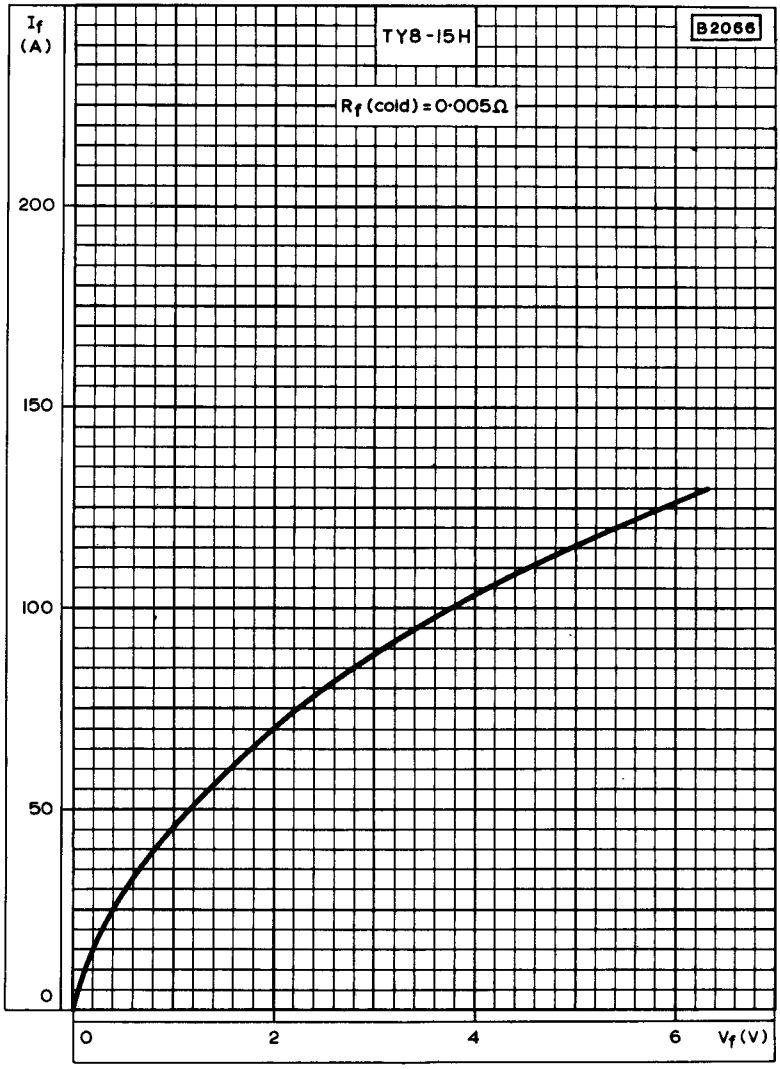
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



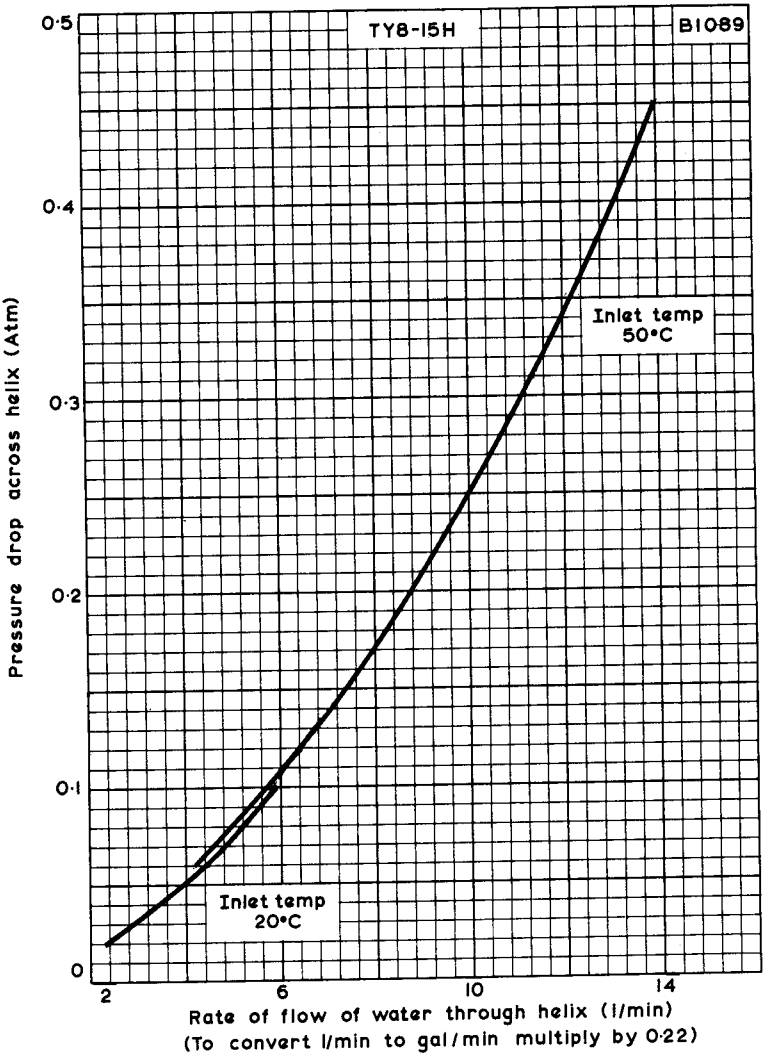
GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



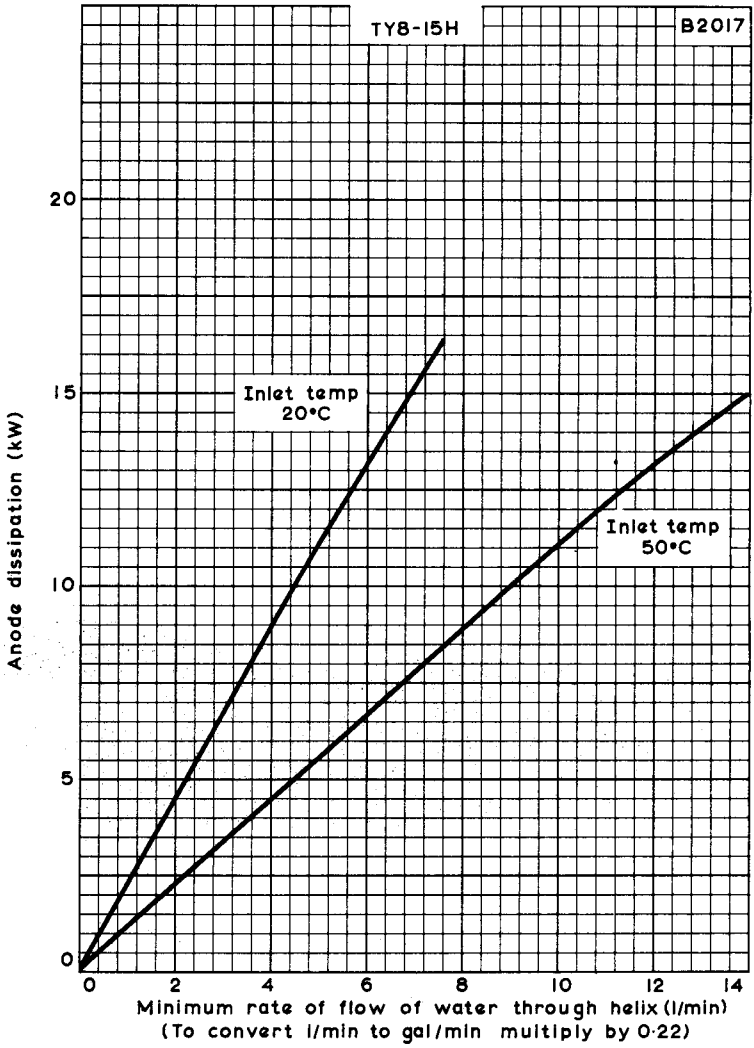
CONSTANT CURRENT CHARACTERISTICS



FILAMENT CURRENT PLOTTED AGAINST FILAMENT VOLTAGE



PRESSURE DROP ACROSS HELIX PLOTTED AGAINST RATE OF FLOW OF WATER THROUGH HELIX



ANODE DISSIPATION PLOTTED AGAINST MINIMUM RATE OF FLOW OF WATER THROUGH HELIX FOR INLET TEMPERATURES OF 20 AND 50°C

TRIODE

TY8-15W

Application: *R.F. industrial heating.*
Power output: *14kW continuous rating.*
Frequency: *30Mc/s at full ratings.*
Construction: *External anode, water cooled.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES, which precede this section of the handbook.

FILAMENT Directly heated, thoriated tungsten

V_f	6.3	V
*I_f	130	A

*The filament current must never exceed a surge value of 280A at any time during the warming up period. The filament has been designed to accept temporary fluctuations of $^{+5}_{-10}$%

MOUNTING POSITION Vertical, anode down

CAPACITANCES

C_{a-g}	33.5	pF
C_{g-f}	44.5	pF
C_{a-f}	1.2	pF

CHARACTERISTICS (measured at V_a = 6kV, I_a = 2.5A)

g_m	23	mA/V
g_m (at V_a = 500V, I_a = 14A)	28	mA/V
μ	17.5	

COOLING

Water cooled

Max. temperature of seals 220 °C

The amount of water cooling required for this valve depends upon the anode dissipation and the temperature of the water. Typical values of rate of water flow and pressure loss in the jacket are given in the following table:

Anode dissipation P_a (kw)	Inlet temperature T_{in} (°C)	Minimum rate of water flow per minute (litres)	(gal)	Pressure loss in jacket (atm)
5.0	20	4.5	1.0	0.03
5.0	50	12	2.6	0.2
10	20	9.5	2.0	0.15
10	50	22	5.0	0.6
15	20	15	3.5	0.3
15	50	34	7.5	1.4

At inlet temperatures between 20 and 50°C the required quantity of water can be found by linear interpolation.

TY8-15W

TRIODE

CLASS 'C' OSCILLATOR

Anode supply from three-phase half-wave rectifier without smoothing filter.

Limiting values (absolute ratings)

f max.	30	Mc/s
V_a max.	8.0	kV
$-V_g$ max.	1.6	kV
R_{g-f} max.	10	kΩ
p_a max.	15	kW
I_a max.	4.0	A
I_g max.	1.5	A
p_g max.	800	W

Typical operation

f	30	30	Mc/s
$V_{tr(r.m.s.)}$	5.9	5.1	kV
V_a	7.0	6.0	kV
I_a	3.5	3.3	A
I_g	950	800	mA
p_a	6.8	5.5	kW
η_a	72	72	%
R_{g-f}	0.95	1.0	kΩ
R_a	1.0	0.87	kΩ
Feedback ratio $\frac{V_{in(pk)}}{V_{a(pk)}}$	0.25	0.26	
P_{out}	17.7	14.3	kW
*P_{load}	14	11	kW

*0.85 (P_{out}–P_{drive})

WEIGHT

Valve only	6	lb
	2.5	kg
Shipping weight	67	lb
	30.5	kg

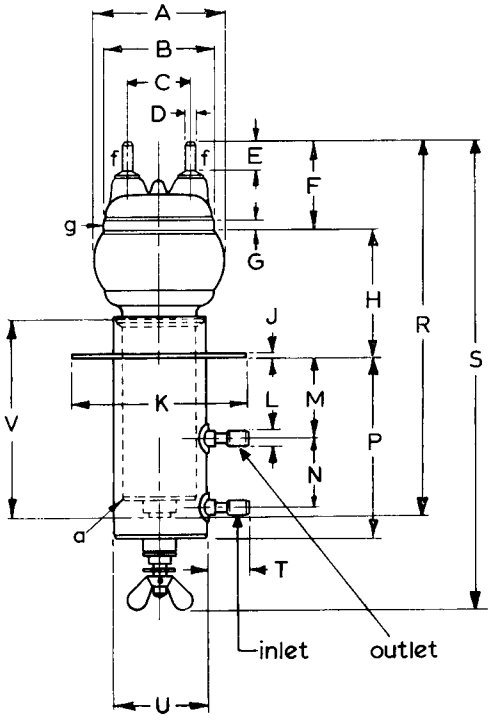
ACCESSORIES

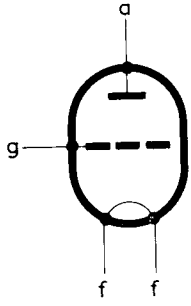
Filament clip	40662
Grid connector	40664
Water jacket	K720

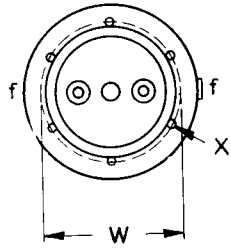
DIMENSIONS

	Inches	Millimetres			Inches	Millimetres	
A	4.528	115		M	2.717	69	
B	3.780	96		N	1.969	50	←
C	2.126	54		P	6.024	153	←
D	0.374	9.5		R	12.992	330	max.←
E	0.984	25		S	16.339	415	max.←
F	3.071	78	←	T	1.535	39	←
G	0.335	8.5		U	3.150	80	
H	4.370	111	←	V	6.890	175	←
J	0.197	5.0		W	4.724	120	
K	5 906	150		X	0.295	7.5	
L	0.551	14					

TY8-15W

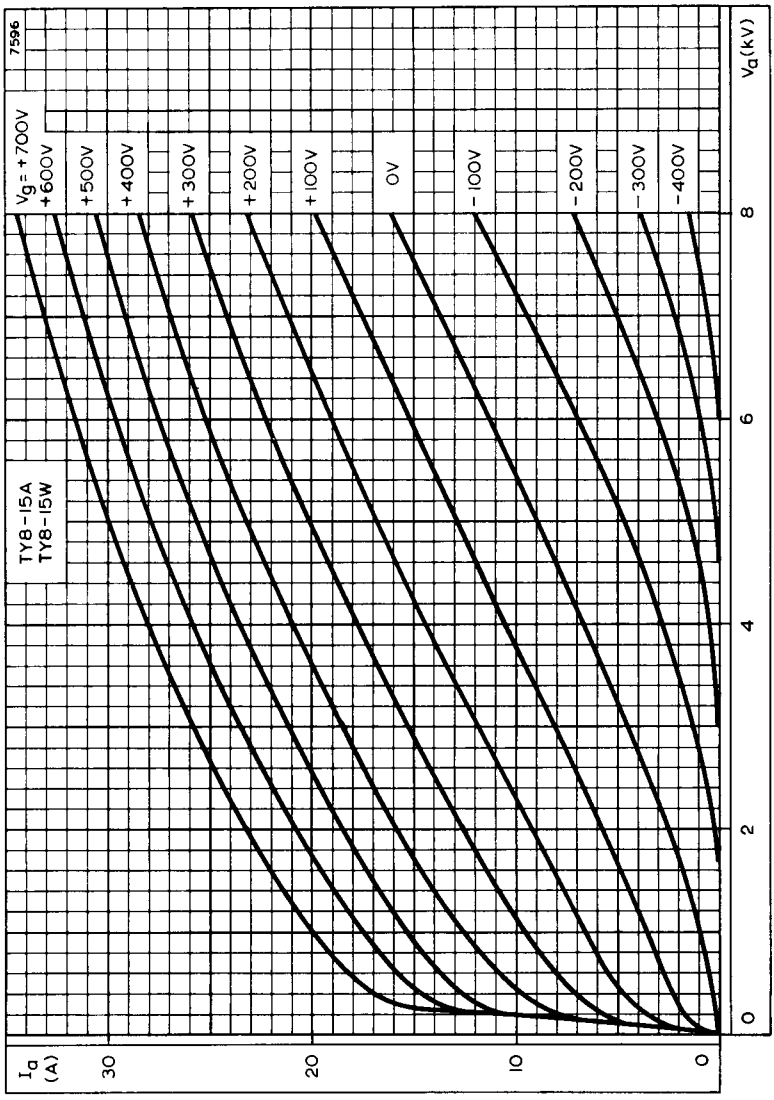






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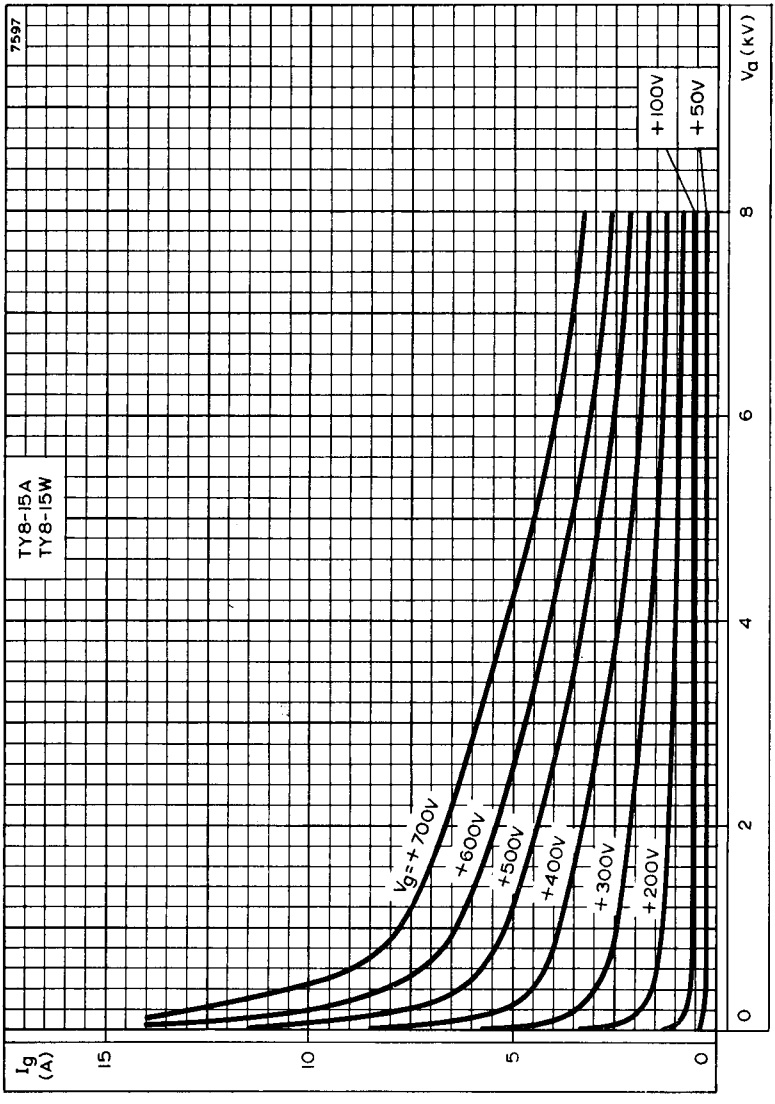
TY8-15W



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER

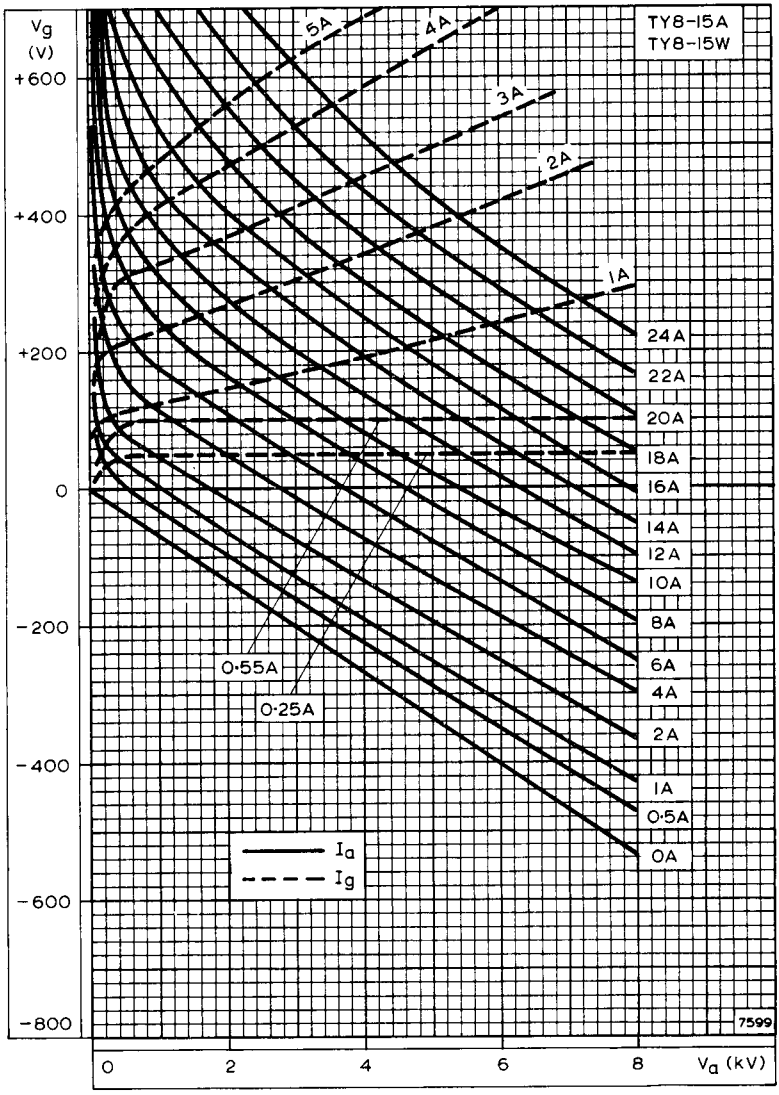
TY8-15W

TRIODE

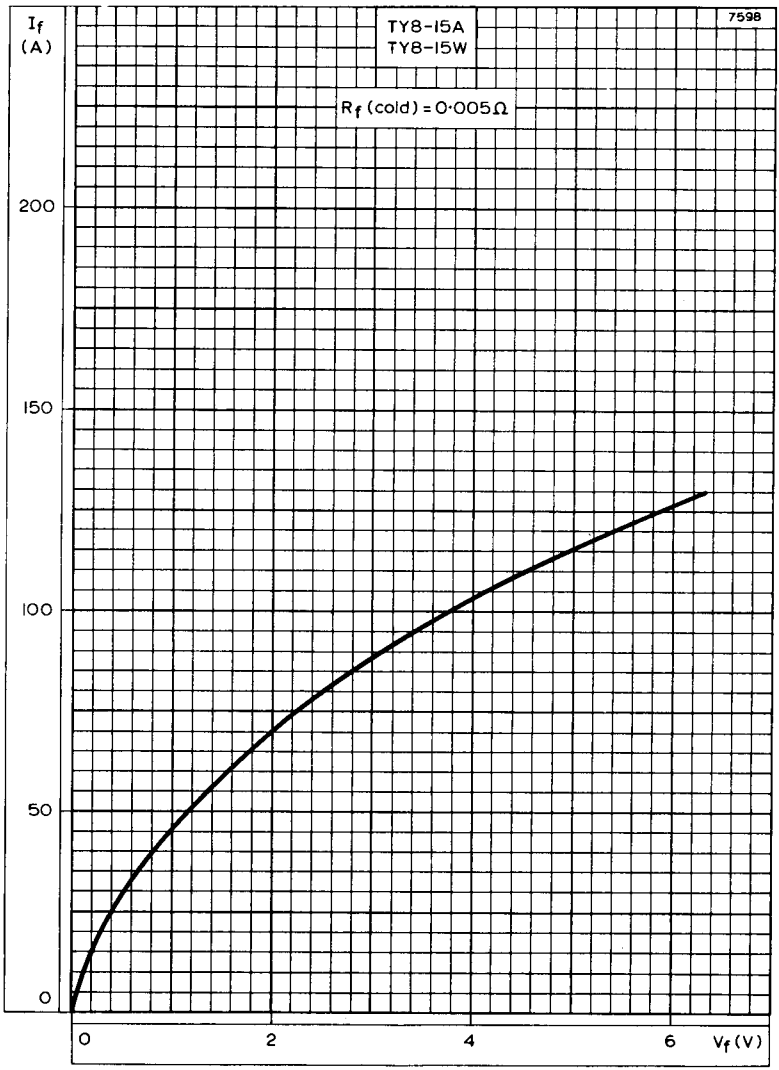


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER

TY8-15W



CONSTANT CURRENT CHARACTERISTICS



FILAMENT CURRENT PLOTTED AGAINST FILAMENT VOLTAGE

V.H.F. POWER TRIODE

TY8-6000A
TY8-6000W
TY8-6000H

TENTATIVE DATA

QUICK REFERENCE DATA

External anode triode, intended for use as industrial Class 'C' oscillator

The TY8-6000A is forced-air cooled.
The TY8-6000W is water cooled by means of a water jacket.
The TY8-6000H is water cooled by means of an integral helical water cooler.

f	50	Mc/s
P_{out} (less P_{drive})	7.2	kW
f max.	50	Mc/s
V_a max.	8.0	kV
p_a max.	6.0	kW

Unless otherwise shown data is applicable to all types

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

INDUSTRIAL OPERATION AS CLASS 'C' OSCILLATOR

Anode supply from three-phase halfwave rectifier

Typical operating conditions

f	50	50	Mc/s
P_{out}	7.5	6.2	kW
P_{out} (less P_{drive})	7.2	5.9	kW
P_{load}	6.1	5.0	kW
η_a	70	71	%
V_{tr} (r.m.s.) per phase	6.15	5.3	kV
V_a	7.2	6.2	kV
I_a (loaded)	1.5	1.4	A
I_a (unloaded)	370	400	mA
I_g (loaded)	360	370	mA
I_g (unloaded)	470	470	mA
Feedback ratio $\frac{V_{in(pk)}}{V_{out(pk)}}$	0.17	0.17	
p_a	3.3	2.5	kW
R_{g-f}	1.85	1.5	kΩ
R_a	2.3	2.1	kΩ

Absolute maximum ratings

f max.	50	Mc/s
V_a max.	8.0	kV
$-V_g$ max.	1.25	kV
I_a max.	1.8	A
p_a max.	6.0	kW
I_g (loaded) max.	400	mA
I_g (unloaded) max.	500	mA
R_{g-f} max.	10	kΩ

CATHODE

Directly heated, thoriated tungsten

*V_f	12.6	V
I_f	33	A

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

CAPACITANCES

c_{a-g}	7.9	pF
c_{out}	1.0	pF
c_{in}	14.2	pF

CHARACTERISTICS (measured at V_a = 6.0kV, I_a = 1.0A)

g_m	12	mA/V
μ	24	

MOUNTING POSITION

Vertical, with anode down.

TY8-6000A
Forced-air cooled
Maximum temperatures
Seals 220 °C

The amount of forced-air cooling required for this valve depends on the height above sea level and the anode dissipation.

Typical values for continuous operation of inlet temperature, rate of flow of air and pressure difference between the inlet and the outlet of the housing are given in the following table.

For intermittent operation see the curve on page C4.

Anode dissipation P_a	Height above sea level h		Inlet temperature T_{in}	Minimum rate of flow of air per minute		Pressure difference between inlet and outlet	
(kW)	(km)	(ft)	°C	(m^3)	(ft^3)	(mm of H_2O)	(in of H_2O)
2.0	0	0	35	4.8	170	20	0.8
2.0	0	0	45	5.7	200	25	1.0
2.0	1.5	4920	35	5.7	200	23	0.9
2.0	3.0	9840	25	6.1	215	23	0.9
4.0	0	0	35	6.8	240	38	1.5
4.0	0	0	45	7.9	280	49	1.9
4.0	1.5	4920	35	7.8	275	42	1.7
4.0	3.0	9840	25	8.4	300	42	1.7
6.0	0	0	35	9.2	325	68	2.7
6.0	0	0	45	10.7	380	90	3.5
6.0	1.5	4920	35	11.2	395	81	3.2
6.0	3.0	9840	25	11.7	415	81	3.2

Water cooled anode, low velocity air flow on seals.

Maximum temperatures

Seals	220	°C
Water inlet	50	°C

The amount of forced-air cooling required for this valve depends on the temperature of the water. Typical values of rate of flow of water and pressure lost in the jacket are given in the following table : -

Anode dissipation P_a (kW)	Inlet temperature T_{in} (°C)	Minimum rate of water flow per minute (litres)	(gal)	Pressure loss in jacket (atm)
2.0	20	2.5	0.55	0.06
	50	5.0	1.1	0.2
4.0	20	4.0	0.88	0.14
	50	9.0	1.98	0.7
6.0	20	6.0	1.32	0.3
	50	14.0	3.08	1.9

At inlet temperatures between 20 and 50°C the required quantity of water can be found by linear interpolation.

TY8-6000H

Water cooled anode, low velocity air flow on seals.

Maximum temperatures

Seals	220	°C
Water inlet	50	°C

The amount of water cooling required for this valve depends on the anode dissipation and temperature of the water.

Typical values of rate of flow of water through helix and pressure loss in the helix are given in the curve on page C2. The minimum rate of flow of water through helix required can be found from the curves on page C3. To avoid excessive temperatures at frequencies above 4Mc/s both grid terminals should be connected in parallel and care should be taken to distribute the R. F. current evenly between them and a low velocity air flow should be directed on the seals.

PHYSICAL DATA

	TY8-6000A	TY8-6000W	TY8-6000H	
Weight of valve	9.7	1.8	2.2	lb
	4.4	0.8	1.0	kg
Weight of valve plus carton	22	3.6	4.2	lb
	10	1.6	1.9	kg
Weight of insulating pedestal	4.6	-	-	lb
	2.1	-	-	kg
Weight of insulating pedestal plus carton	6.8	-	-	lb
	3.1	-	-	kg
Weight of water jacket	-	1.7	-	lb
	-	0.76	-	kg
Weight of water jacket plus carton	-	2.0	-	lb
	-	0.9	-	kg

ACCESSORIES

TY8-6000A

Grid and filament connectors x 4	40634
Insulating pedestal x 1	40630

TY8-6000W

Grid and filament connectors x 4	40634
Water jacket x 1	K721

TY8-6000H

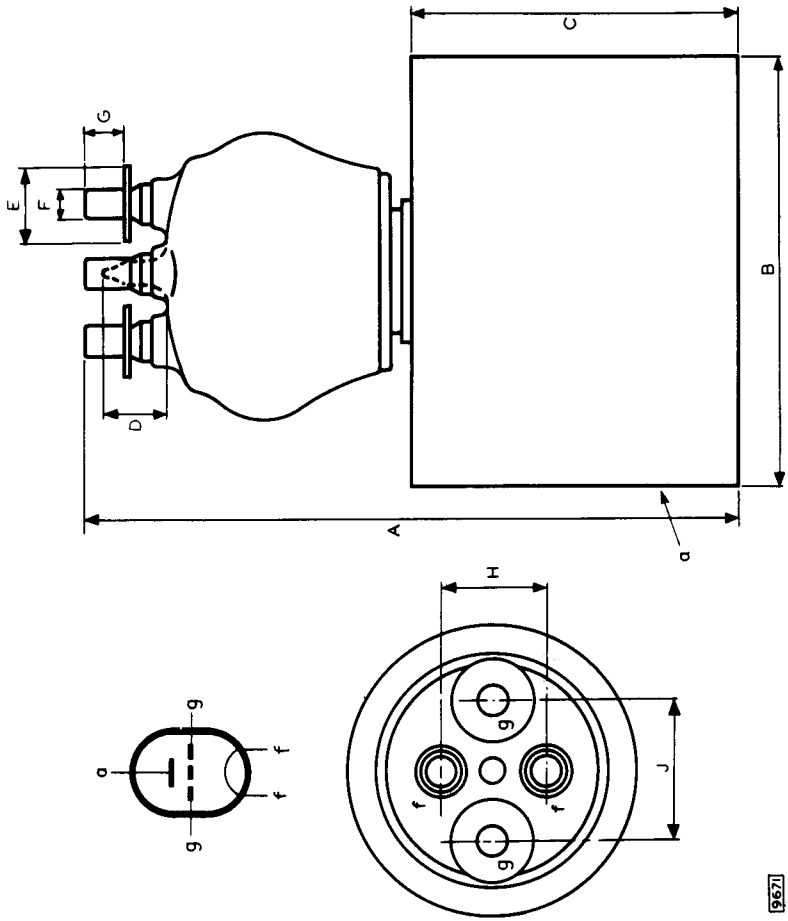
Grid and filament connectors x 4	40634

Dimensions of TY8-6000A

	Inches	Millimetres	
A	0.732	186	max
B	4.815 ± 0.012	122.3 ± 0.3	dia
C	3.70	94	
D	0.71	18	max
E	0.87	22	dia
F	0.358	9.1	dia
G	0.43	11	min
H	1.18	30	
J	1.57	40	

Inch dimensions derived from original millimetre dimensions.

OUTLINE DRAWING OF TY8-6000A

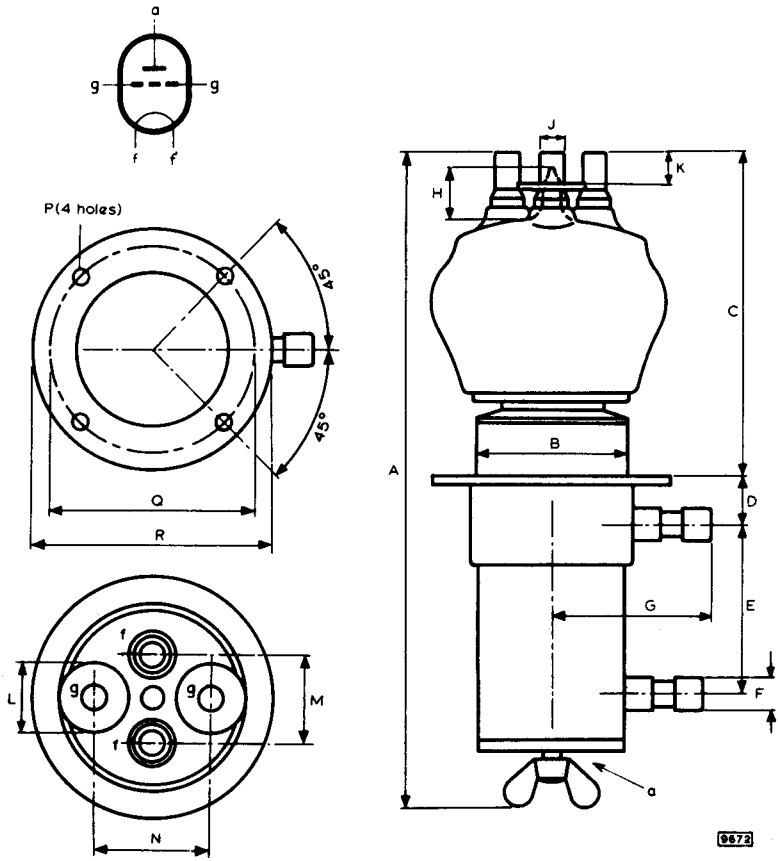


Dimensions of TY8-6000W

	Inches	Millimetres	
A	8.62	224	max
B	2.05	52	dia
C	4.37	111	
D	0.650	16.5	
E	2.24	57	
F	0.453	11.5	dia
G	2.146	54.5	
H	0.71	18	max
J	0.358	9.1	dia
K	0.43	11	min
L	0.87	22	
M	1.18	30	
N	1.57	40	
P	0.24	6.0	dia
Q	2.76	70	
R	3.228 ± 0.008	82 ± 0.2	

Inch dimensions derived from original millimetre dimensions.

OUTLINE DRAWING OF TY8-6000W



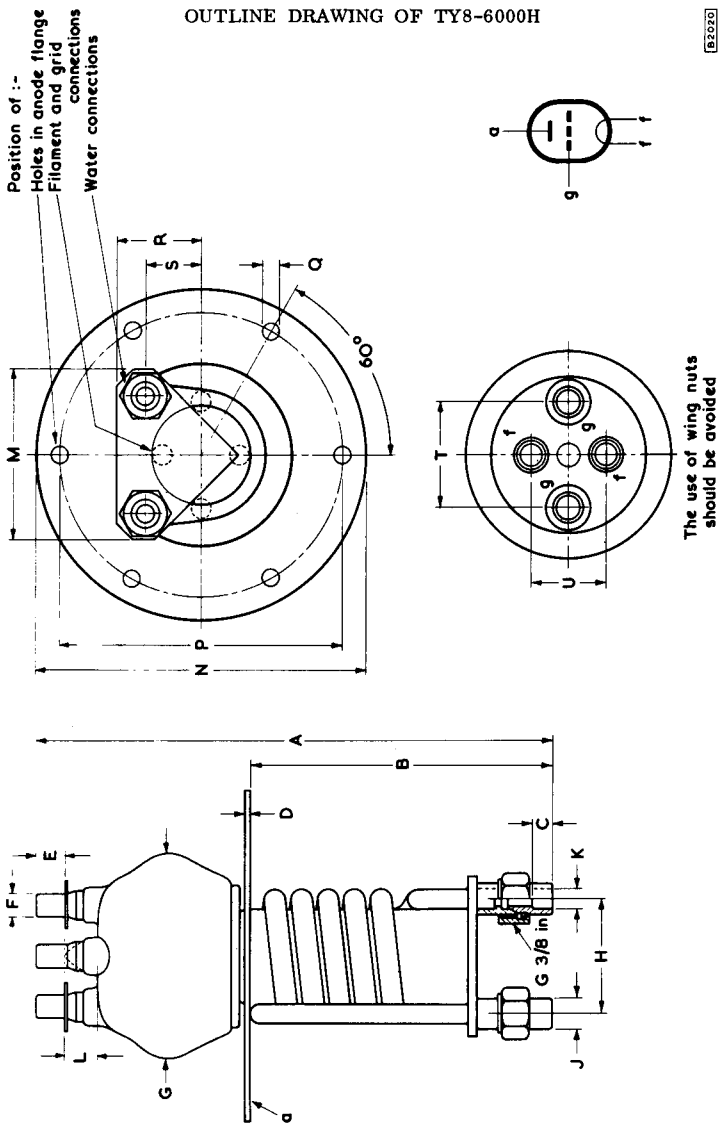
Dimensions of TY8-6000H

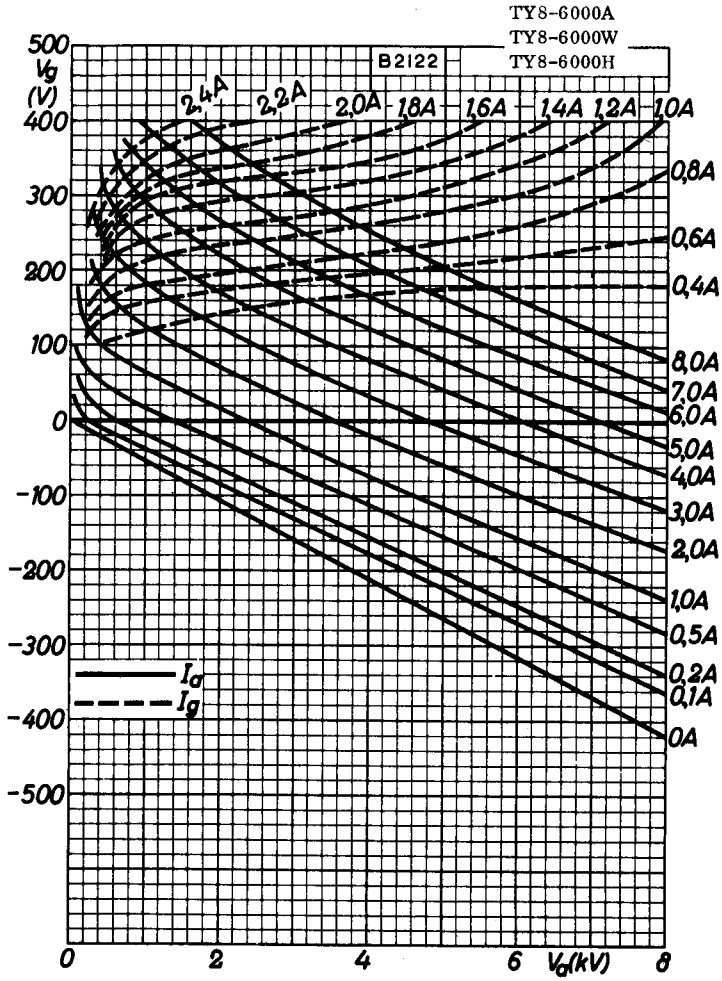
	Inches	millimetres	
A	8.287	210.5	
B	4.882	124	
C	0.394	10	
D	0.079	2	
E	0.433	11	min
F	0.358	9.1	dia
G	3.386	86	dia. max.
H	1.811	46	
J	0.394	10	dia
K	0.315	8	dia
L	0.709	18	max
M	2.559	65	
N	5.118	130	
P	4.331	110	
Q	0.276	7	dia
R	1.339	34	
S	0.906	23	
T	1.575	40	
U	1.181	30	

Inch dimensions derived from original millimetre dimensions.

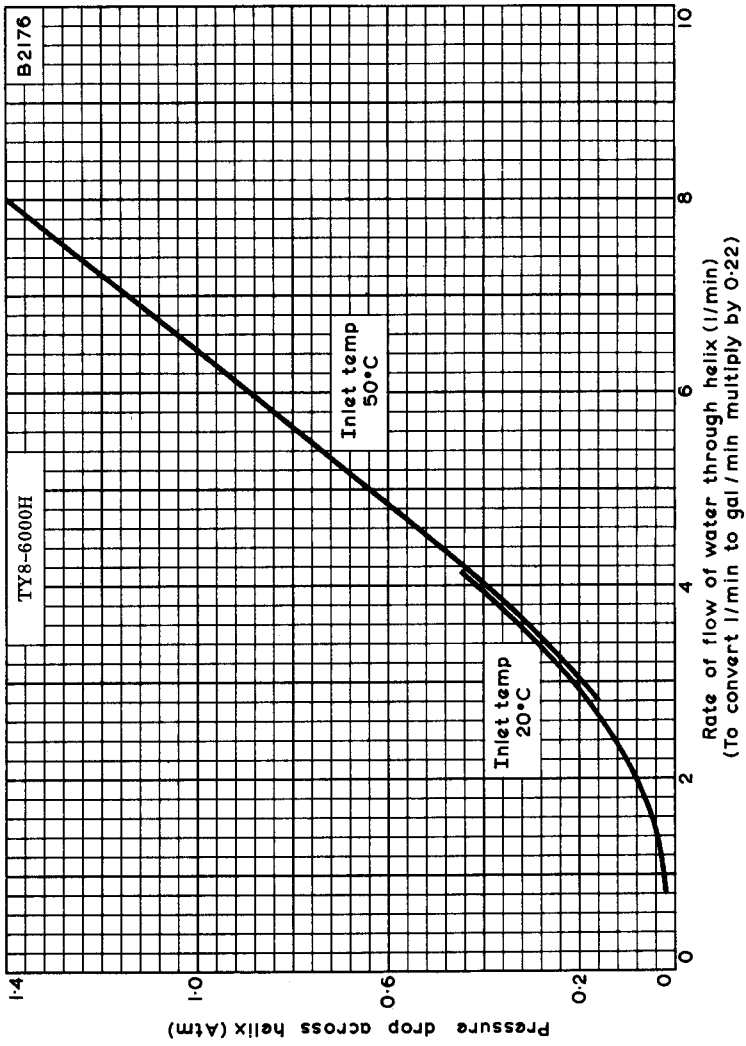
OUTLINE DRAWING OF TY8-6000H

B2020

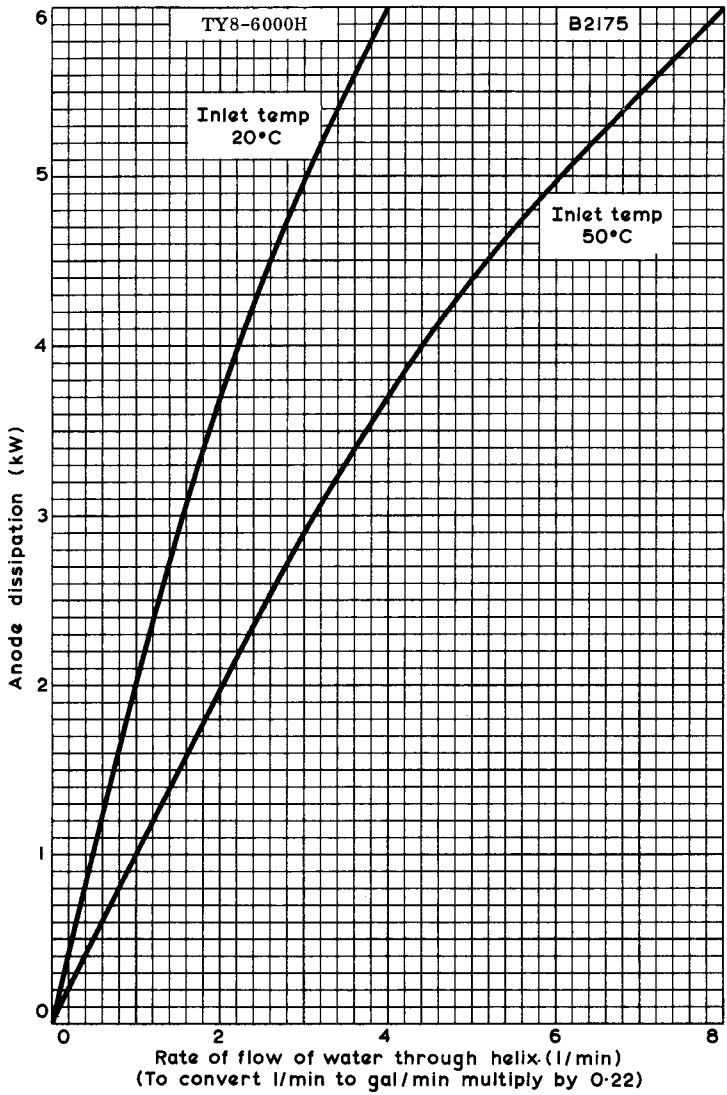




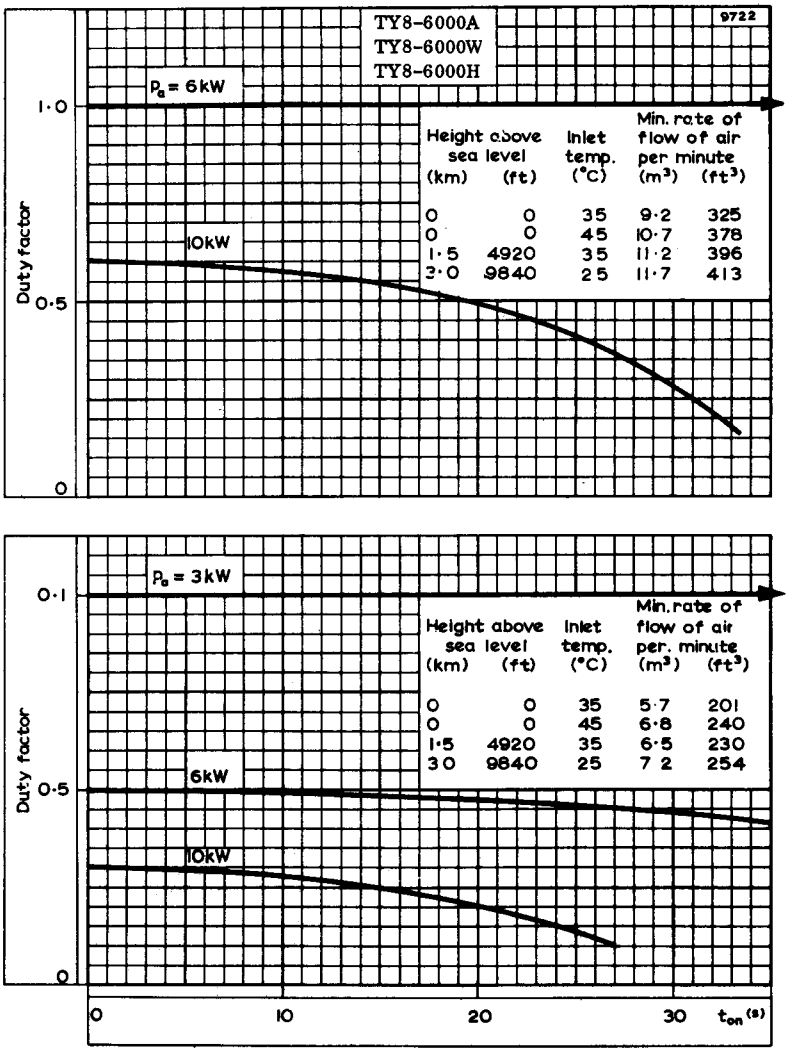
CONSTANT CURRENT CHARACTERISTICS



PRESSURE DROP ACROSS HELIX PLOTTED AGAINST RATE OF FLOW OF WATER THROUGH HELIX FOR INLET TEMPERATURES OF 20 AND 50°C.



ANODE DISSIPATION PLOTTED AGAINST MINIMUM RATE OF FLOW OF WATER THROUGH HELIX FOR INLET TEMPERATURES OF 20 AND 50°C.


TY8-6000A
TY8-6000W
TY8-6000H
9722
P_a = 6kW
1·0
0·5
0
Duty factor
10kW
Height above sea level (km) (ft)
Inlet temp. (°C)
Min. rate of flow of air per minute (m^3) (ft^3)
0 0 35 9·2 325
0 0 45 10·7 378
1·5 4920 35 11·2 396
3·0 9840 25 11·7 413
P_a = 3kW
0·1
0·5
0
Duty factor
6kW
10kW
Height above sea level (km) (ft)
Inlet temp. (°C)
Min. rate of flow of air per. minute (m^3) (ft^3)
0 0 35 5·7 201
0 0 45 6·8 240
1·5 4920 35 6·5 230
3 0 9840 25 7 2 254
0
10
20
30
t_{on} (s)

R.F. POWER TRIODE

TYS2-250

Power triode in silica envelope, rated for a continuous anode dissipation of 250W. Its main application is as a self-excited oscillator in low power r.f. heating equipment, but it may also be employed as an r.f. power amplifier in industrial or transmitting apparatus.

This data sheet should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES, which precede this section of the handbook.

MAINTENANCE TYPE

FILAMENT

Thoriated tungsten, suitable for a.c. or d.c. operation.

V_f	6.5	V
I_f (approx.)	12	A

MOUNTING POSITION

Vertical

CAPACITANCES

c_{a-g}	11	pF
c_{g-f}	5.0	pF
c_{a-f}	1.0	pF

CHARACTERISTICS (measured at $V_a = 2.0kV$, $I_a = 80mA$)

g_m	3.5	mA/V
μ	10.5	
r_a	3.0	kΩ

LIMITING VALUES (absolute ratings)

V_a max. (≤50Mc/s)	2.5	kV
(≤75Mc/s)	2.0	kV
p_a max.	250	W
I_k max.	500	mA
I_g max.	65	mA
$-V_g$ max.	350	V
R_{g-f} max.	7.5	kΩ
P_{in} max. (≤50Mc/s)	1.0	kW
(≤75Mc/s)	800	W

For frequencies above 75Mc/s reduced voltages and inputs must be used, as shown on page C3.

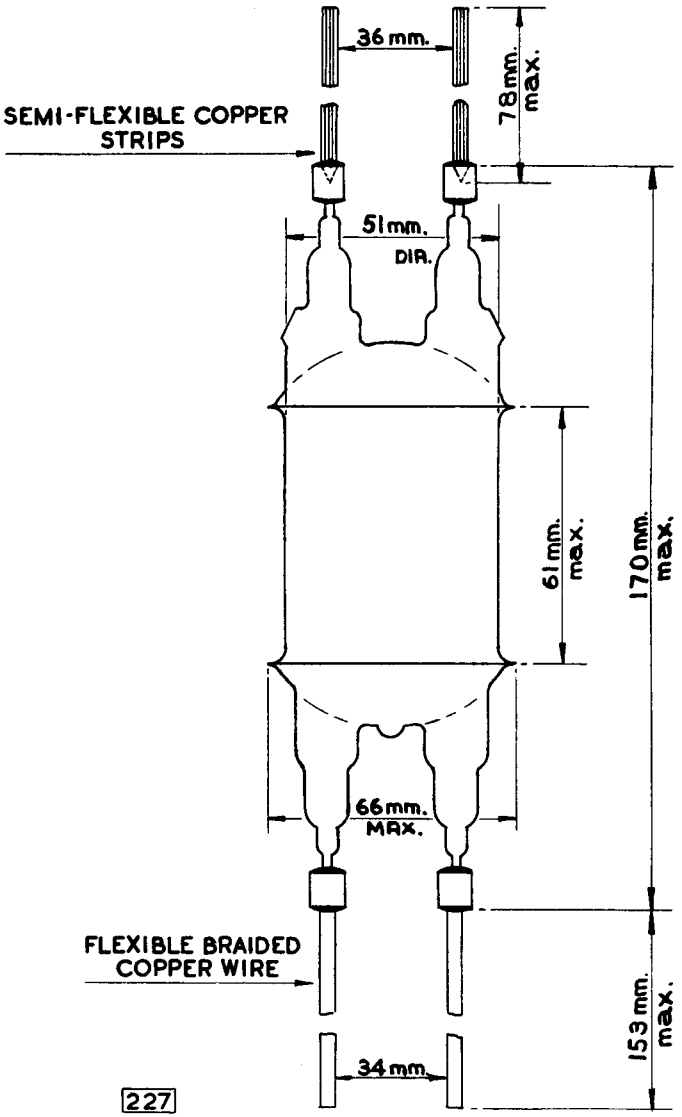
10 per cent. increase may be allowed on the above voltages for ripple and h.t. regulation.

OPERATING CONDITIONS AS CLASS "C" AMPLIFIER

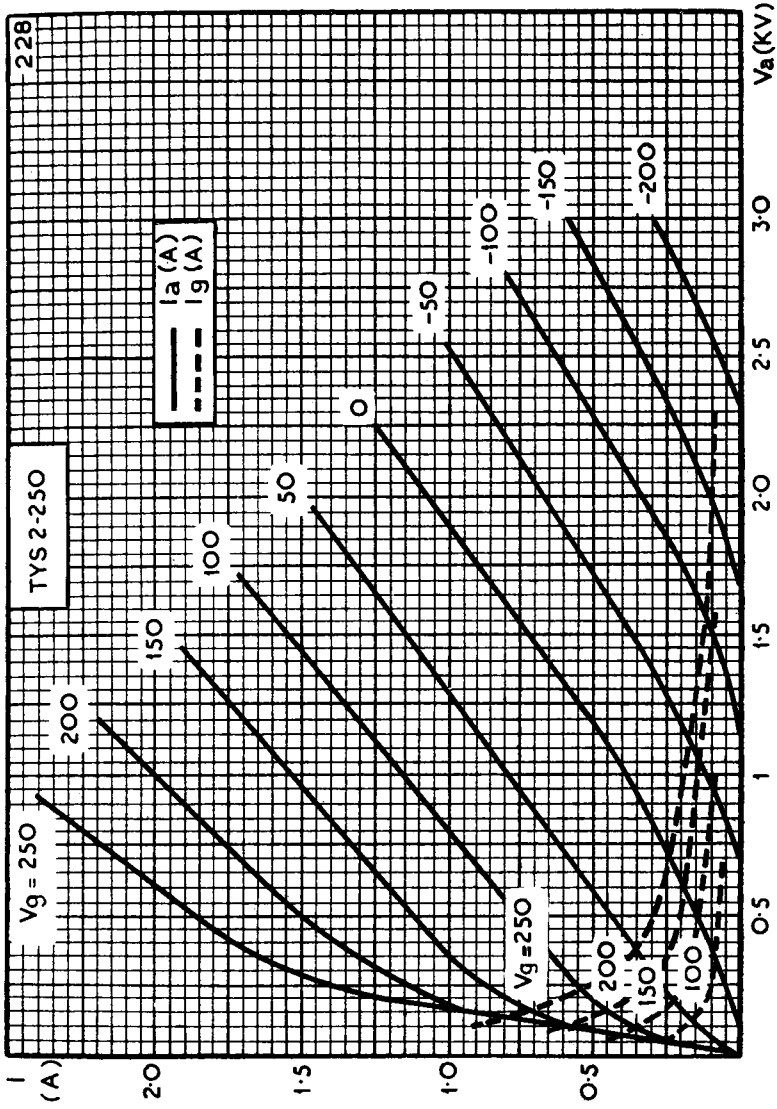
f	75	10	Mc/s
V_a	2.0	2.0	kV
V_g	−250	−290	V
I_a	400	400	mA
I_g	50	60	mA
P_{out}	550	760	W
η	69	76	%

WEIGHT

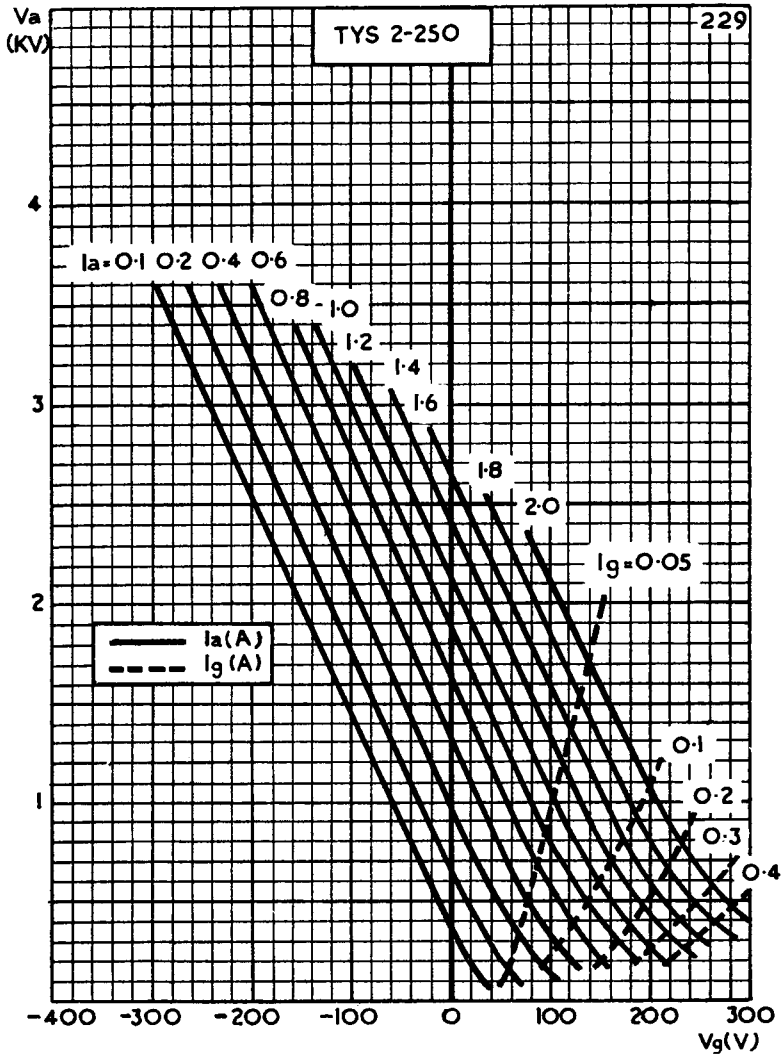
Valve only	5	oz
	153	g


36 mm.
78 mm. max.
SEMI-FLEXIBLE COPPER STRIPS
51 mm. DIA.
61 mm. max.
170 mm. max.
66 mm. MAX.
FLEXIBLE BRAIDED COPPER WIRE
153 mm. max.
34 mm.
227

TYS2-250

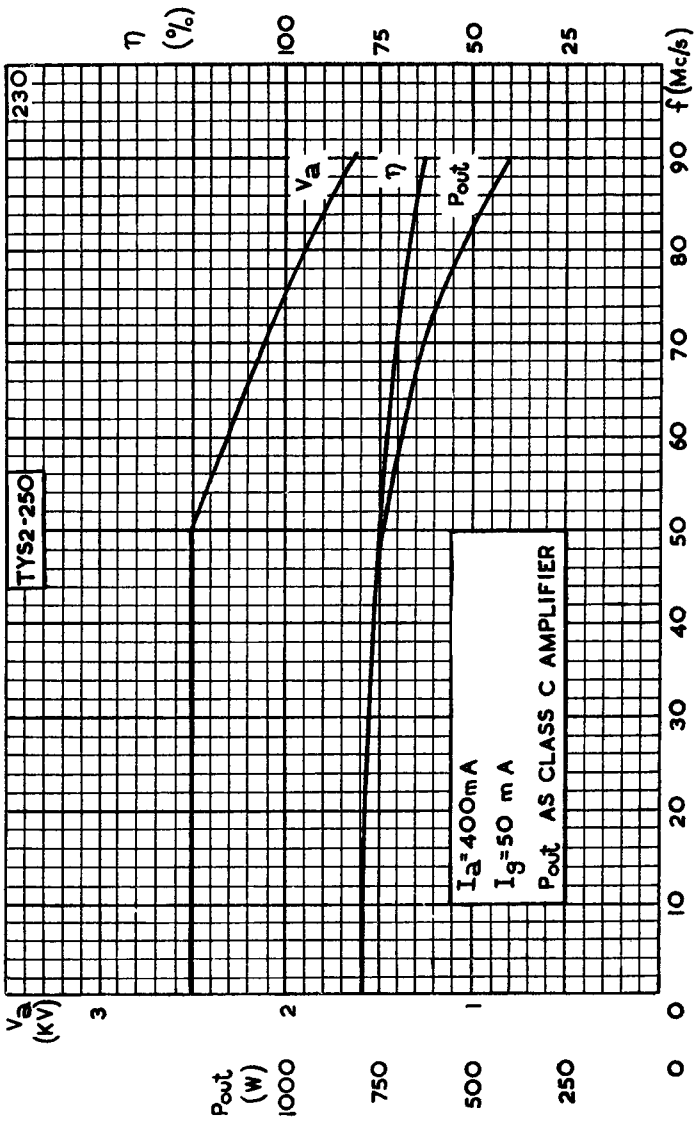


ANODE CURRENT PLOTTED AGAINST ANODE VOLTS



CONSTANT CURRENT CURVES

TYS2-250



ANODE VOLTAGE, OUTPUT POWER AND EFFICIENCY
PLOTTED AGAINST OPERATING FREQUENCY

R.F. POWER TRIODE

TYS4-500

R.F. power triode in silica envelope, and rated for an anode dissipation of 500W. Primarily intended as a self-excited oscillator in r.f. heating equipment, but also as an r.f. amplifier in transmitting or industrial equipment.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT

Thoriated tungsten, suitable for a.c. or d.c. operation

V_f	10	V
I_f (approx.)	10	A

MOUNTING POSITION

Vertical, filament leads downwards

CAPACITANCES

c_{a-g}	10	pF
c_{g-f}	7.5	pF
c_{a-f}	1.5	pF

CHARACTERISTICS (measured at V_a = 2.0kV, I_a = 250mA)

g_m	6.0	mA/V
μ	24	
r_a	4.0	kΩ

LIMITING VALUES (absolute ratings)

*$V_{a(d.c.)}$ max. (with natural cooling of seals)	4.0	kV
p_a max.	500	W
I_k max.	750	mA
$i_{k(pk)}$ max.	3.0	A
I_g max. (at p_a max.)	100	mA
I_g max. (at 25% of p_a max.)	130	mA
R_{g-f} max.	10	kΩ
Temperature of central area of anode (at p_a max.)	870	°C
Max. temperature of metal-to-glass seals	260	°C
f max. (at V_a max. and natural cooling)	30	Mc/s

*This figure may be allowed to rise to 4.5kV to cover temporary excesses due to the regulation resistance of the equipment, etc.

MAINTENANCE TYPE

MAXIMUM OPERATING CONDITIONS AS CLASS "C" AMPLIFIER WITH NATURAL COOLING

This assumes complete protection for the valve against overload of the anode and/or grid and against inefficiency due to under-drive, etc.

f	15	Mc/s
V_a	4.0	kV
V_g	−310	V
I_a	500	mA
I_g	75	mA
η	75	%
P_{out}	1.5	kW
P_a	500	W
P_{load} ($\eta_{transfer}$ = 80%)	1.2	kW

DIELECTRIC HEATER WITH PROTECTION

Operating conditions for a dielectric heater employing single-phase, full-wave rectification (unsmoothed) for the anode supply and incorporating the maximum protection for the valve against overload, under-drive and inefficient operation.

f	18	Mc/s
V_{tr}	4,000–0–4,000	V
V_a	3.59	kV
P_{in}	1.79	kW
I_a	404	mA
R_{g-f}	4.5	kΩ
I_g	68	mA
P_a (at η = 73%)	485	W
P_{out} (less P_{drive})	1.25	kW
P_{load} ($\eta_{transfer}$ = 80%)	1.0	kW

This condition leaves a 3% tolerance on anode dissipation.

DIELECTRIC HEATER WITHOUT PROTECTION

Recommended operating condition for a dielectric heater employing single-phase, full-wave rectification (unsmoothed) for the anode supply, natural cooling of the oscillator valve and an over-current circuit-breaker as the sole protection.

f	18	Mc/s
V_{tr}	4,000–0–4,000	V
V_a	3.59	kV
P_{in}	1.2	kW
I_a	270	mA
R_{g-f}	4.5	kΩ
I_g	75	mA
P_a (at η = 73%)	322	W
P_{out} (less P_{drive})	828	W
P_{load} ($\eta_{transfer}$ = 80%)	660	W

INDUCTION HEATER

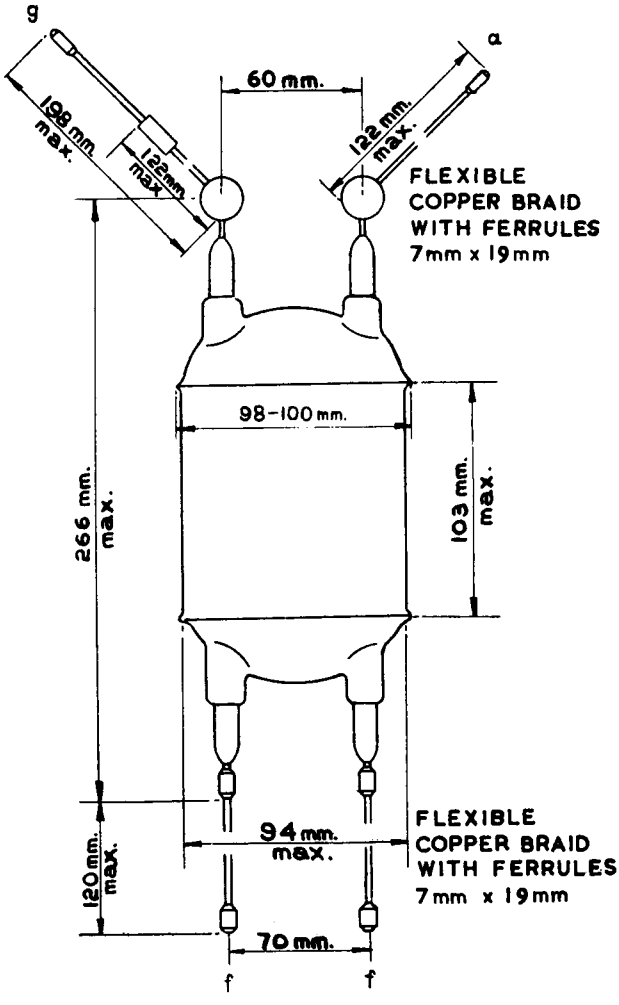
Maximum rated operating conditions, at the peak of the work cycle, for an induction heater employing single-phase, full-wave rectification for the anode supply.

f	450	kc/s
V_{tr}	4,000–0–4 000	V
V_a	3.59	kV
P_{in}	1.64	kW
I_a	370	mA
R_{g-f}	4.5	kΩ
I_g	70	mA
P_a (at $\eta = 75\%$)	410	W
P_{out} (less P_{drive})	1.23	kW
P_{load} ($\eta_{transfer} = 77\%$)	950	W

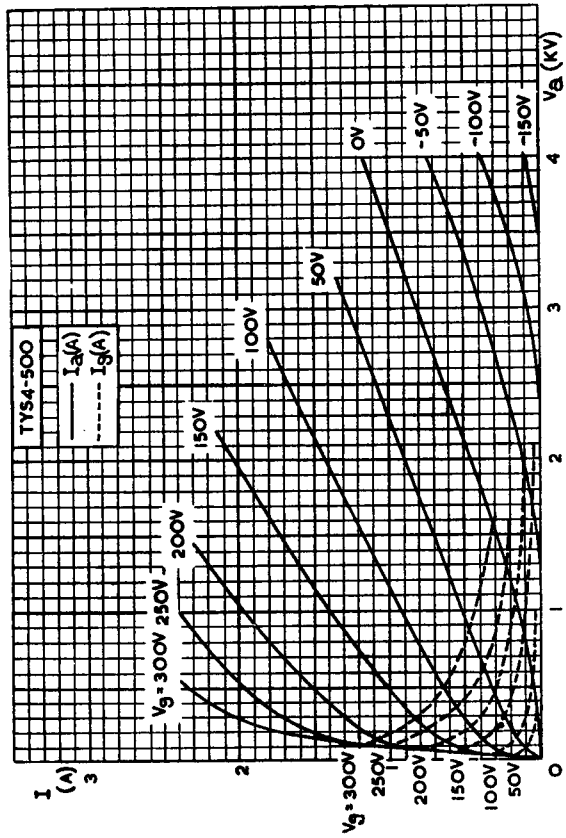
This condition makes an allowance in the anode dissipation for the supply voltage being 5% high and for an unwitting overload of 10% occurring concurrently.

WEIGHT

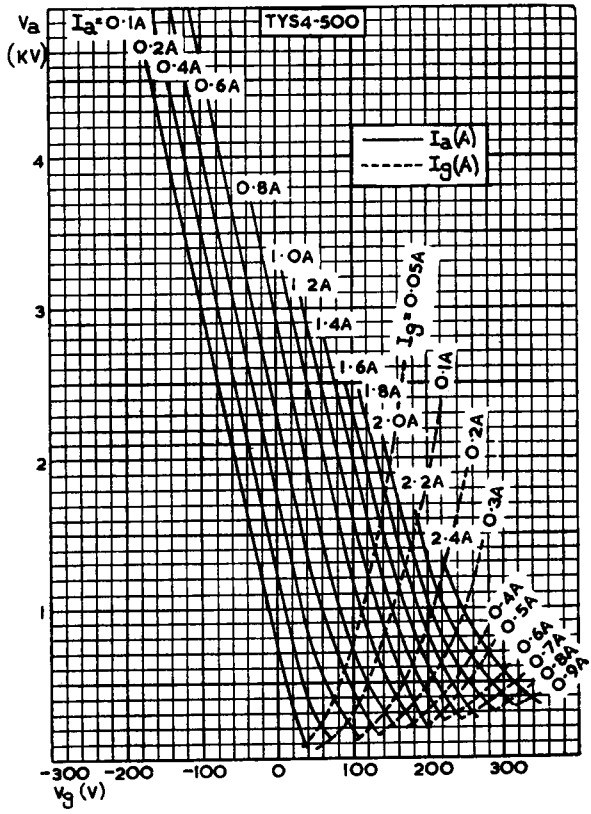
Valve only	1 lb	3 oz
	525	g


g
a
60 mm.
198 mm. max.
122 mm. max.
122 mm. max.
FLEXIBLE COPPER BRAID WITH FERRULES 7mm x 19mm
98-100 mm.
266 mm. max.
103 mm. max.
94 mm. max.
120 mm. max.
FLEXIBLE COPPER BRAID WITH FERRULES 7mm x 19mm
70 mm.
f
f

TYS4-500



ANODE AND GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



CONSTANT CURRENT CURVES

R.F. POWER TRIODE

TYS5-1000

R.F. power triode in silica envelope, rated for a continuous anode dissipation of 1.5kW, and for operation at 30Mc/s. Primarily intended as a self-excited oscillator in r.f. heating equipment, but also suitable for use as a r.f. amplifier in transmitting or industrial equipment. Forced-air cooling is not required.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES which precede this section of the handbook

FILAMENT Thoriated tungsten, suitable for a.c. or d.c. operation

V_f	10	V
I_f (approx.)	26	A
Resistor for limiting starting current	0.27 ± 5%	Ω

MOUNTING POSITION Vertical, filament leads downwards

CAPACITANCES

c_{a-g}	23	pF
c_{g-f}	15.5	pF
c_{a-f}	1.5	pF

CHARACTERISTICS (measured at V_a = 5kV, I_a = 300mA)

g_m	6.0	mA/V
μ	35	
r_a	5.85	kΩ

LIMITING VALUES (absolute ratings)

V_a max.	5.0	kV
p_a max.	1.5	kW
I_k max.	1.4	A
$-V_g$ max.	600	V
I_g max.	160	mA
Max. operating frequency at full ratings	30	Mc/s

OPERATING CONDITIONS AS CLASS "C" SELF-EXCITED OSCILLATOR AT 3Mc/s

V_a	5.0	kV
V_g	−360	V
I_a	1.1	A
I_g	127	mA
P_{out}	4.0	kW
η	73	%

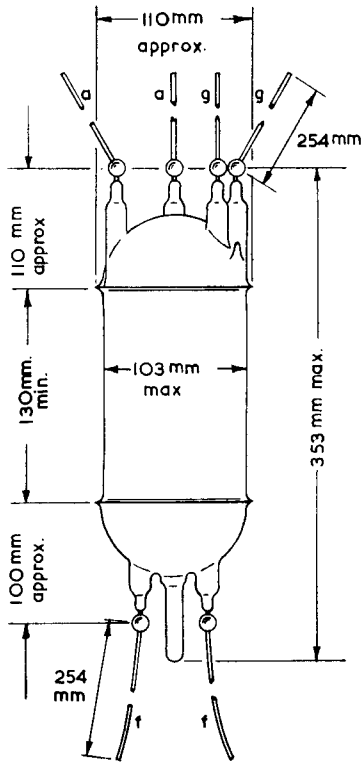
WEIGHT

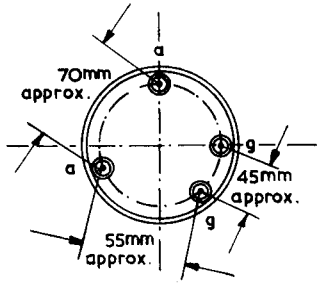
Valve only	1 lb	7 oz
	650	g

MAINTENANCE TYPE

TYS5-1000

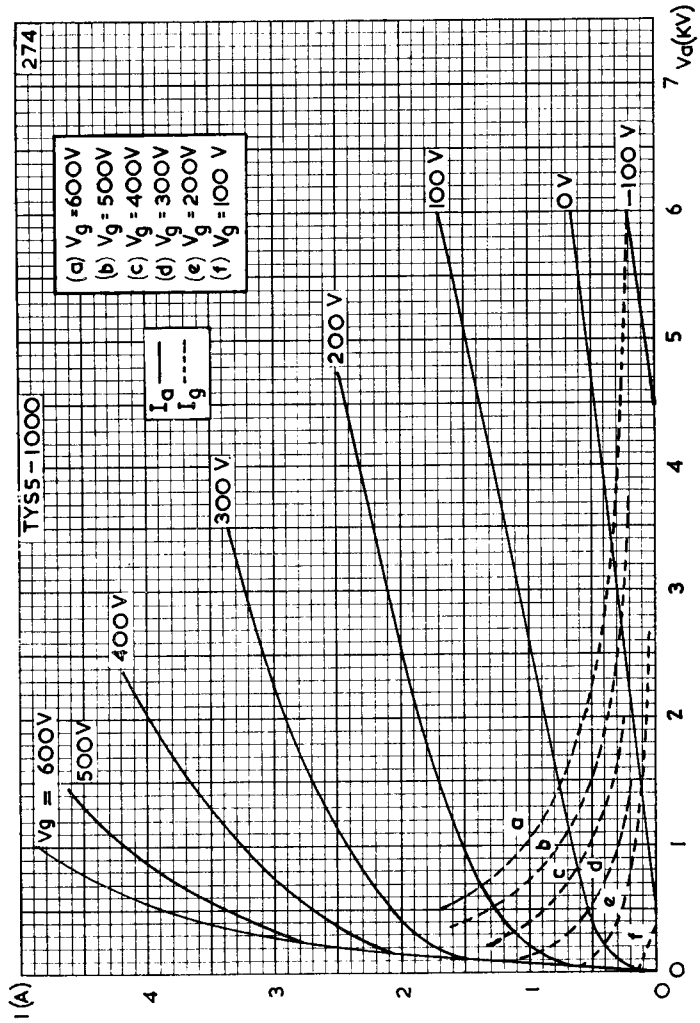
R.F. POWER TRIODE



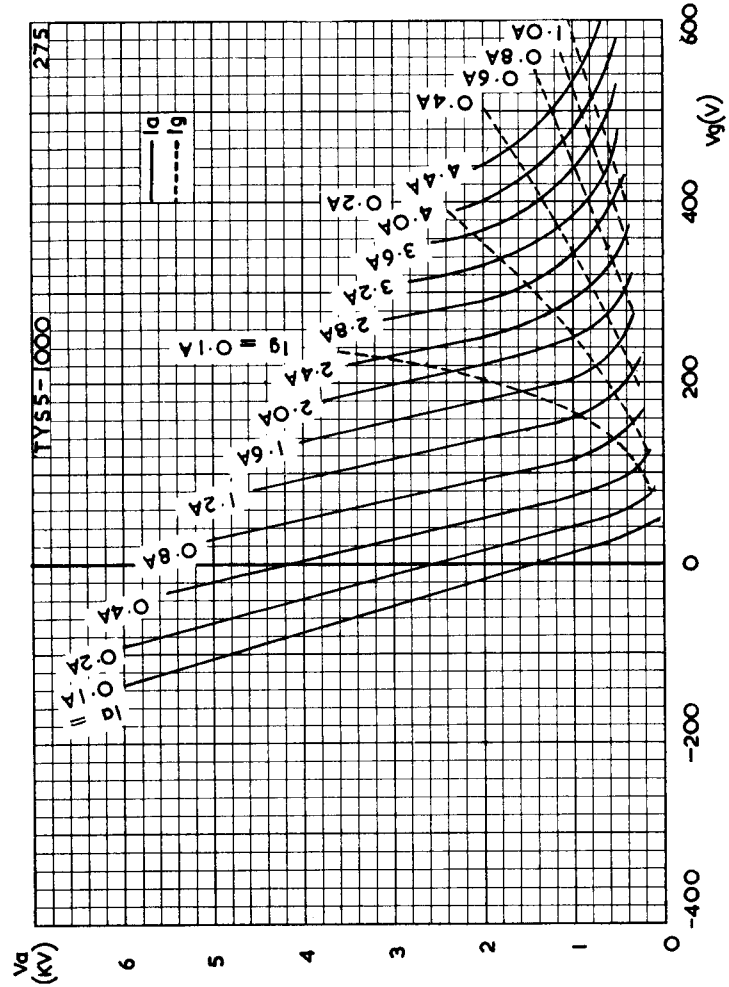


267

TYS5-1000



ANODE CURRENT AND GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE



CONSTANT CURRENT CURVES

R.F. POWER TRIODE

TYS5-2000

R.F. power triode in silica envelope, rated for a continuos anode dissipation of 2.0kW. Primarily intended as a self-excited oscillator in r.f. heating equipment, but also suitable for use as an r.f. amplifier in transmitting or industrial equipment.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – TRANSMITTING VALVES which precede this section of the handbook.

FILAMENT

Thoriated tungsten, suitable for a.c. or d.c. operation.

V_f	14.5	V
I_f	26	A

MOUNTING POSITION

Vertical, filament leads downwards

CAPACITANCES

C_{a-g}	35	pF
C_{a-f}	4.0	pF
C_{g-f}	20	pF

CHARACTERISTICS (measured at $V_a = 5.0kV$, $I_a = 500mA$)

g_m	10	mA/V
μ	30	
r_a	3.0	kΩ

LIMITING VALUES (absolute ratings)

V_a max.	5.0	kV
p_a max. (continuous)	2.0	kW
*p_a max. (intermittent overload)	2.5	kW
I_g max.	250	mA
I_k max.	2.0	A
Max. frequency at above ratings	20	Mc/s
Max. operating frequency	30	Mc/s

*The intermittent overload anode dissipation must in no circumstances exceed a period of 2 min, and the average anode dissipation over the duty cycle must not exceed the continuous rating.

OPERATING CONDITIONS AS CLASS "C" SELF-EXCITED OSCILLATOR AT 3Mc/s

V_a	5.0	kV
V_g	–475	V
I_a	1.65	A
I_g	240	mA
$V_{grf(pk)}$	975	V
P_{out}	6.2	kW
η	75	%

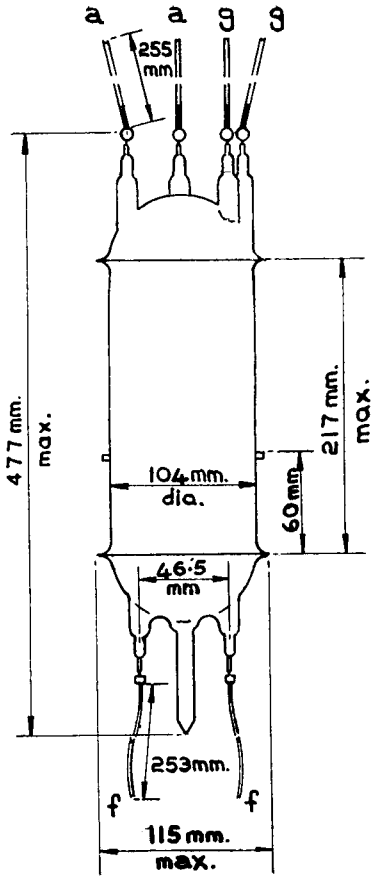
WEIGHT

Valve only	2 lb	4 oz
	1.02	kg

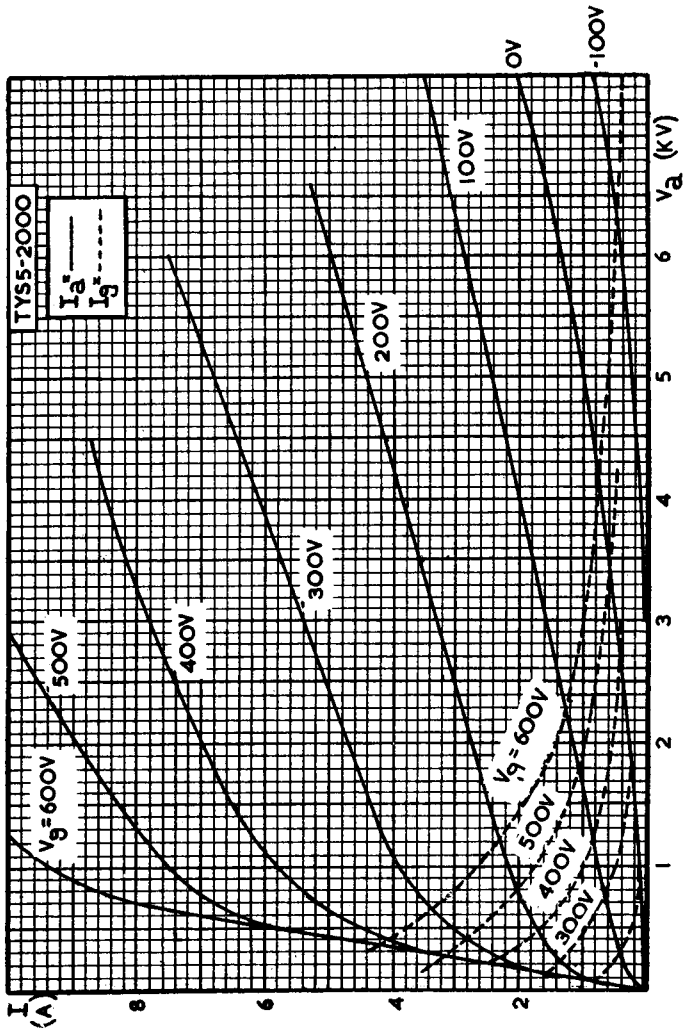
MAINTENANCE TYPE

TYS5-2000

R.F. POWER TRIODE



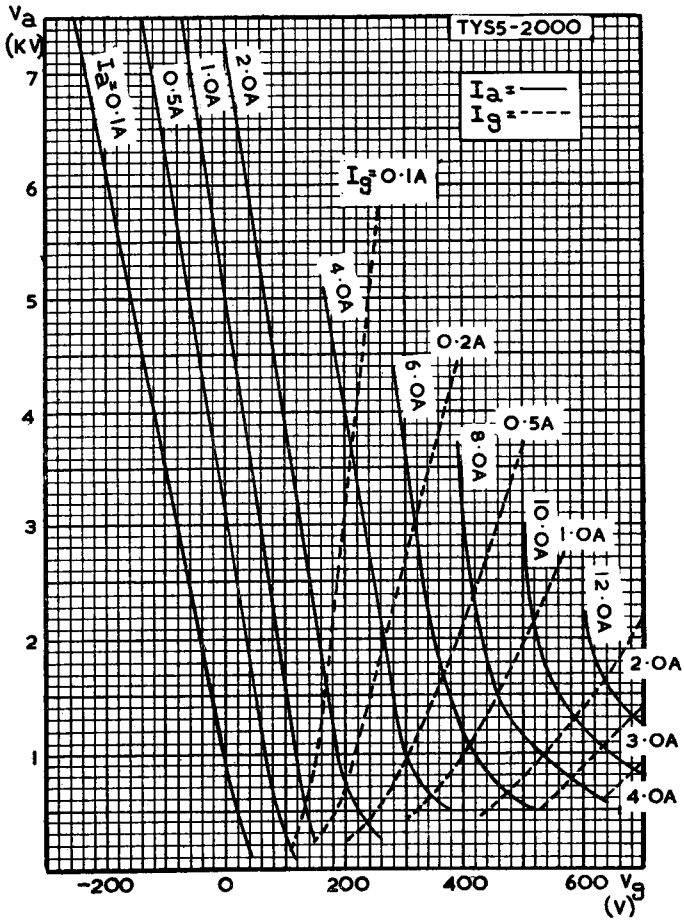
TYS5-2000



ANODE AND GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

TYS5-2000

R.F. POWER TRIODE



CONSTANT CURRENT CURVES

R.F. POWER TRIODE

TYS5-3000

R.F. power triode in silica envelope, rated for an anode dissipation of 3.5 kW. Primarily intended as a self-excited oscillator in R.F. heating equipment, but also suitable for use as R.F. amplifier in transmitting or industrial equipment.

This data should be read in conjunction with "Operating Notes, Part I—Power Valves" included in this volume of the Handbook.

FILAMENT

Thoriated tungsten suitable for use on a.c. or d.c. supply.

V_f	20.5	V
I_f (approx.)	26	A

MOUNTING POSITION

This valve must be operated in the vertical position with the filament leads downward.

CAPACITANCES

C_{a-g}	35	μμF
C_{a-f}	3.5	μμF
C_{g-f}	25	μμF

CHARACTERISTICS (At V_a=5.0kV; I_a=800mA)

g_m	15	mA/V
μ	32	
r_a	2.1	kΩ

LIMITING VALUES (Absolute Ratings)

V_a max. (natural cooling of seals)	6.0	kV
p_a max.	3.5	kW
I_g max. (at max. p_a)	400	mA
I_k max.	2.8	A
f max. for above ratings	12	Mc/s
*V_a max. (at 20 Mc/s with natural cooling)	4.0	kV
T_a max. (at hottest part of anode)	950	°C

*A small fan directed towards the terminals will allow this voltage to be raised to its maximum value.

LIMITING CONDITIONS AS CLASS "C" AMPLIFIER WITH NATURAL COOLING

f	3.0	Mc/s
V_a	6.0	kV
V_g	−550	V
I_a	2.33	A
I_g	350	mA
$V_{in(pk)}$	1.1	kV
η	75	%
p_a	3.5	kW
P_{out}	10.5	kW

TYS5-3000

R.F. POWER TRIODE

R.F. power triode in silica envelope, rated for an anode dissipation of 3.5 kW. Primarily intended as a self-excited oscillator in R.F. heating equipment, but also suitable for use as R.F. amplifier in transmitting or industrial equipment.

RECOMMENDED OPERATING CONDITIONS AS CLASS "C" SELF-EXCITED OSCILLATOR FOR A DIELECTRIC HEATER

A ventilating fan providing some cooling of the anode seals and a non-regulated supply are assumed.

f	20	Mc/s
V_a	6.0	kV
I_a	1.5	A
R_{g-f}	2.2	k Ω
I_g	250	mA
$V_{in(pk)}$	950	V
η	70	%
P_a	2.7	kW
P_{out}	6.3	kW
*P_{load}	5.0	kW

*Assuming a circuit transfer efficiency of approximately 85%.

RECOMMENDED OPERATING CONDITIONS AS CLASS "C" SELF-EXCITED OSCILLATOR IN AN INDUCTION HEATER

This is suitable for repetition work on a short duty cycle and with a non-regulated supply.

f	450	kc/s
V_a	6.0	kV
I_a	2.0	A
R_{g-f}	1.7	k Ω
I_g	320	mA
$V_{in(pk)}$	1.0	kV
η	76	%
P_a	2.9	kW
P_{out}	9.1	kW
*P_{load}	7.0	kW

*Assuming a circuit transfer efficiency of approximately 80%.

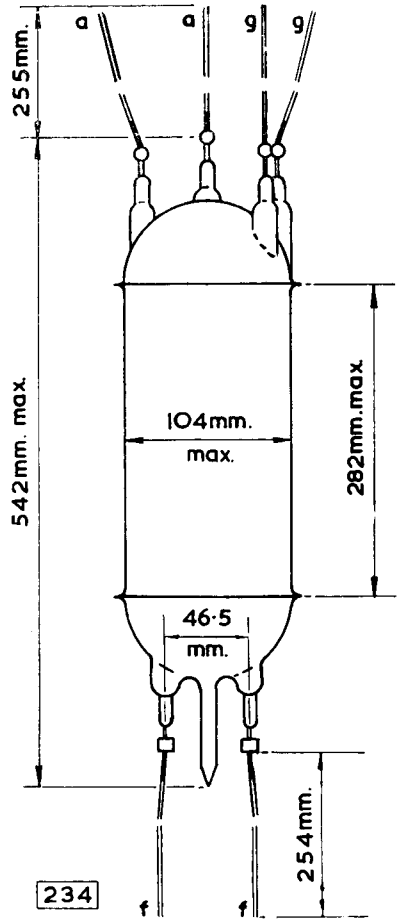
WEIGHT

Valve only { 2 lb. 14 oz. / 1.3 kg.

R.F. POWER TRIODE

TYS5-3000

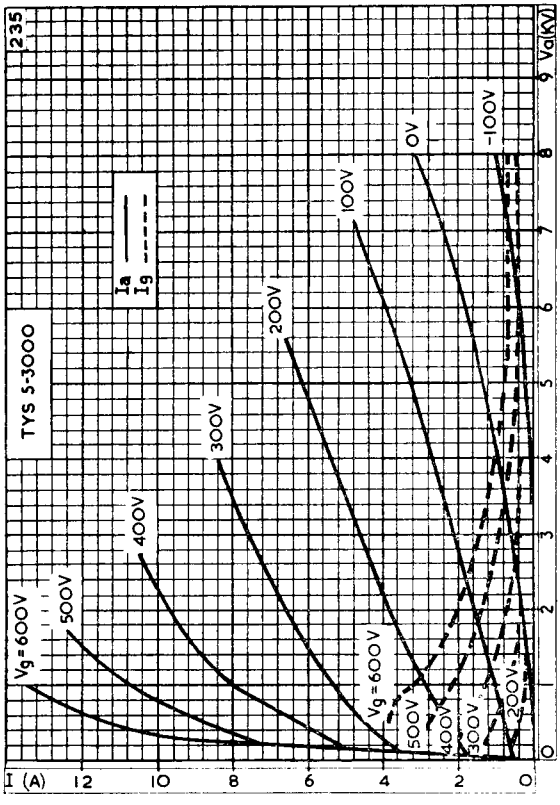
R.F. power triode in silica envelope, rated for an anode dissipation of 3.5 kW. Primarily intended as a self-excited oscillator in R.F. heating equipment, but also suitable for use as R.F. amplifier in transmitting or industrial equipment.



TYS5-3000

R.F. POWER TRIODE

R.F. power triode in silica envelope, rated for an anode dissipation of 3.5 kW. Primarily intended as a self-excited oscillator in R.F. heating equipment, but also suitable for use as R.F. amplifier in transmitting or industrial equipment.

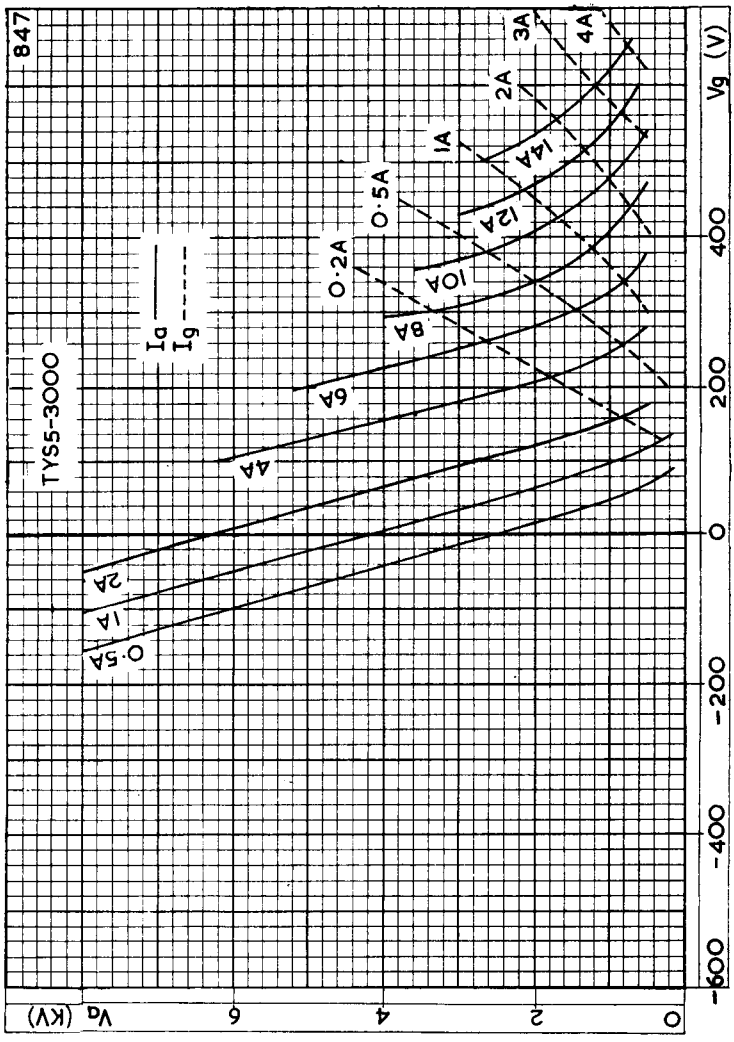


ANODE AND GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

R.F. POWER TRIODE

TYS5-3000

R.F. power triode in silica envelope, rated for an anode dissipation of 3.5 kW. Primarily intended as a self-excited oscillator in R.F. heating equipment, but also suitable for use as R.F. amplifier in transmitting or industrial equipment.



CONSTANT CURRENT CURVES.

DOUBLE TRIODE

UCC84

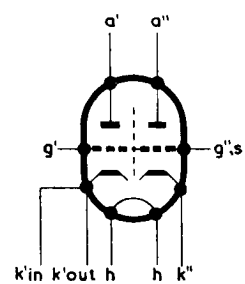
Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220 Mc/s in television equipment with series connected heaters.

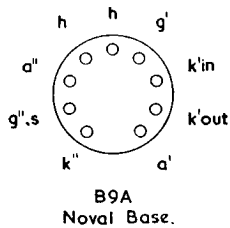
HEATER

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

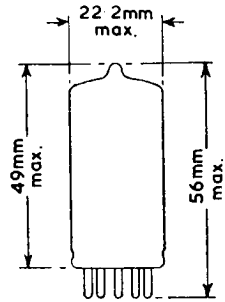
I_h	100	mA
V_h	21	V

For characteristics, operating conditions and limiting values see Type PCC84.





B9A
Noval Base.



1390

The triode on pins 6, 7, 8, 9 should have grounded-cathode connection and that on pins 1, 2, 3 should have grounded-grid connection.

TRIODE PENTODE

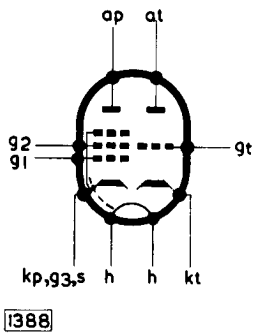
UCF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220 Mc/s in television equipment with series-connected heaters.

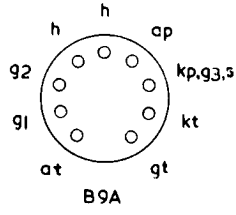
HEATER

I_h	100	mA
V_h	27	V

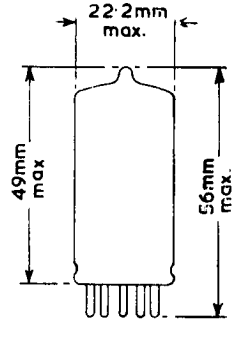
For characteristics, operating conditions and limiting values see Type PCF80.



1388



B9A
Noval Base



TRIODE PENTODE

UCL83

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

HEATER

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

I_h	100	mA
V_h	38	V

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{at-gp}	<0.1	pF
c_{at-ap}	<1.6	pF
c_{gt-gp}	<0.03	pF
c_{gt-ap}	<0.05	pF

Pentode section

c_{a-g1}	<0.2	pF
c_{in}	5.7	pF
c_{out}	4.7	pF
c_{g1-h}	0.4	pF

Triode section

c_{a-g}	1.6	pF
c_{in}	2.3	pF
c_{out}	0.32	pF

CHARACTERISTICS

Pentode section

V_a	170	V
V_{g2}	170	V
I_a	30	mA
I_{g2}	5.0	mA
V_{g1}	−9.5	V
g_m	5.5	mA/V
r_a	53	kΩ
μ_{g1-g2}	10	

Triode section

V_a	170	200	V
I_a	1.6	2.4	mA
V_g	−1.5	−1.5	V
g_m	2.1	2.5	mA/V
r_a	40	34	kΩ
μ	82	85	

UCL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_a	170	200	V
V_{g_2}	170	200	V
V_{g_1}	−9.5	−13	V
$I_{a(o)}$	30	27	mA
$I_{g_2(o)}$	5.0	4.4	mA
R_a	5.5	7.5	kΩ
$V_{in(r.m.s.)}$	5.0	5.2	V
P_{out}	2.2	2.5	W
D_{tot}	10	10.5	%

Two valves in class 'AB' push-pull

V_a	170	200	V
V_{g_2}	170	200	V
R_k	180	220	Ω
$I_{a(o)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g_2(o)}$	2×3.8	2×3.9	mA
I_{g_2} (max. sig.)	2×6.25	2×8.5	mA
R_{a-a}	6.5	7.5	kΩ
$V_{in(g_1-g_1)r.m.s.}$	17	23.5	V
P_{out}	5.0	7.2	W
D_{tot}	3.6	4.2	%

TRIODE SECTION AS A.F. VOLTAGE AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (μA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	R_{g_1}* (kΩ)
170	100	650	1.8	49	15.3	330
200	100	720	2.2	47	17.7	330

$\frac{V_{out}}{V_{in}}$ measured with an input of 100mV

V_{out} measured for a total harmonic distortion of 5%

*Grid resistor of following valve.

LIMITING VALUES

Pentode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	5.4	W
$V_{g_{2(b)}}$ max.	550	V
V_{g_2} max.	250	V
p_{g_2} max.	1.2	W
p_{g_2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g_1-k} max. (self-bias)	500	kΩ
R_{g_1-k} max. (fixed bias)	250	kΩ
V_{h-k} max. (r.m.s. or d.c. cathode positive)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

TRIODE PENTODE

UCL83

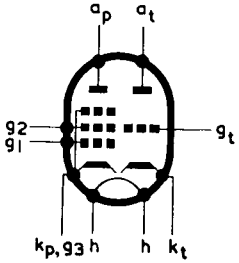
Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

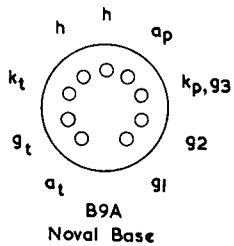
LIMITING VALUES

Triode Section

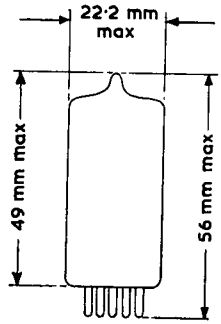
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k} max (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

2224





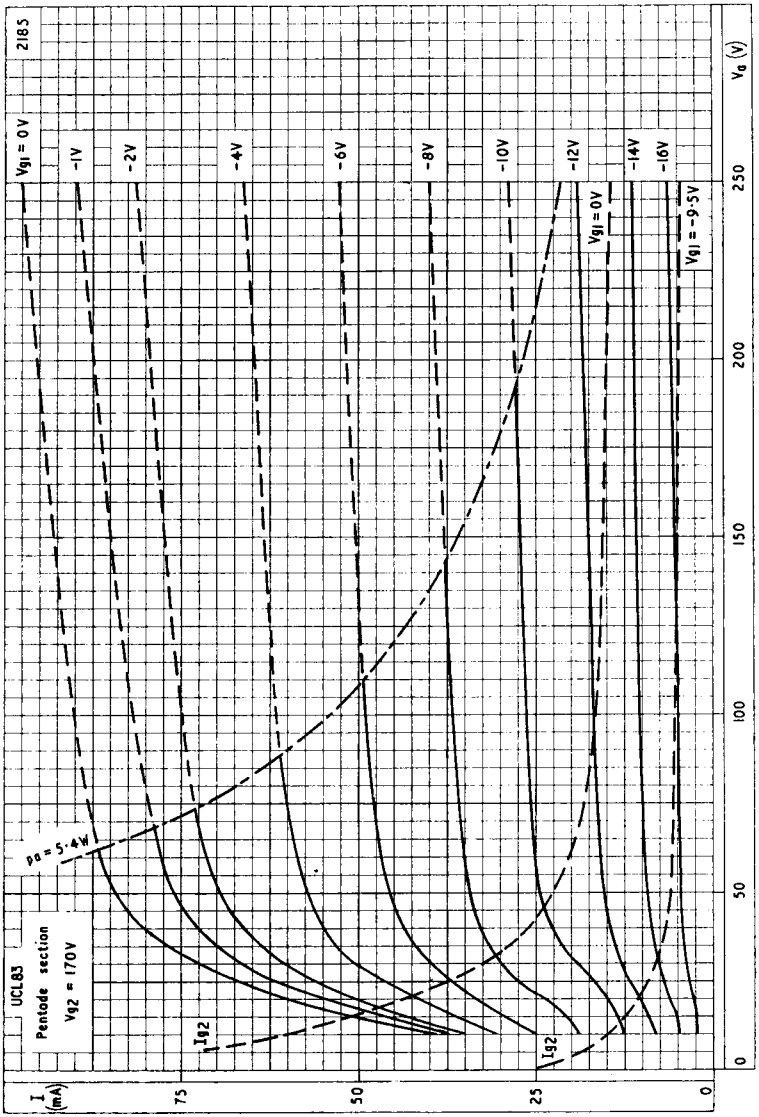
B9A
Noval Base



UCL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g_2}=170V

VOLTAGE AMPLIFYING PENTODE

UF86

Low-noise pentode intended for use as r.c. coupled a.f. voltage amplifier, particularly in the early stages of high-gain audio amplifiers and microphone preamplifiers with series connected heaters.

HEATER

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

I_h	100	mA
V_h	12.6	V

CAPACITANCES (measured without an external screen)

C_{out}	5.3	pF
C_{in}	3.8	pF
C_{a-g1}	<50	mpF
C_{g1-h}	<2.5	mpF

CHARACTERISTICS

V_a	200	V
V_{g3}	0	V
V_{g2}	140	V
I_a	3.0	mA
I_{g2}	600	μA
V_{g1}	−2.0	V
g_m	2.0	mA/V
r_a	2.5	MΩ
μ_{g1-g2}	38	
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V

OPERATING CONDITIONS AS R.C. COUPLED A.F. AMPLIFIER

Pentode connection

V_b (V)	R_a (kΩ)	R_{g2} (MΩ)	R_k (kΩ)	I_a (mA)	I_{g2} (μA)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	R_{g1}** (kΩ)
200	100	0.39	1.0	1.35	280	115	38	330
150	100	0.47	1.5	0.8	180	104	26	330
100	100	0.47	1.8	0.5	100	90	12	330
200	220	1.0	2.2	0.7	120	188	37	680
150	220	1.0	2.7	0.5	100	165	26	680
100	220	1.0	3.3	0.3	80	130	15	680

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV.

*Output voltage at $D_{tot} = 5\%$.

**Grid resistor of following valve.

Triode connection (g_2 connected to a, g_3 to k)

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	D_{tot}* (%)	R_{g1}† (kΩ)
200	47	1.8	1.2	25.8	26.5	3.9	150
150	47	1.2	1.5	24	22	5.8	150
100	47	0.67	2.2	22	15	8.8	150
200	100	1.0	2.2	30	31	4.0	330
150	100	0.7	2.7	28	25	5.5	330
100	100	0.4	3.3	26	16.5	6.5	330
200	220	0.55	3.9	32	31	3.7	680
150	220	0.4	3.9	31	24	4.1	680
100	220	0.25	4.7	30	13	3.8	680

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV.

*Output voltage and distortion at the start of positive grid current. At lower output voltages the distortion is approximately proportional to the voltage.

†Grid resistor of following valve.

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	200	V
p_{g2} max.	200	mW
I_k max.	6.0	mA
R_{g1-k} max. ($p_a > 200$mW)	3.0	MΩ
R_{g1-k} max. ($p_a < 200$mW)	10	MΩ
V_{h-k} max. (cathode positive)	150	V
V_{h-k} max. (cathode negative)	100	V
*R_{h-k} max.	20	kΩ

*When used as a phase inverter immediately preceding the output stage, R_{h-k} max. may be 120kΩ.

OPERATING NOTES

1. Hum

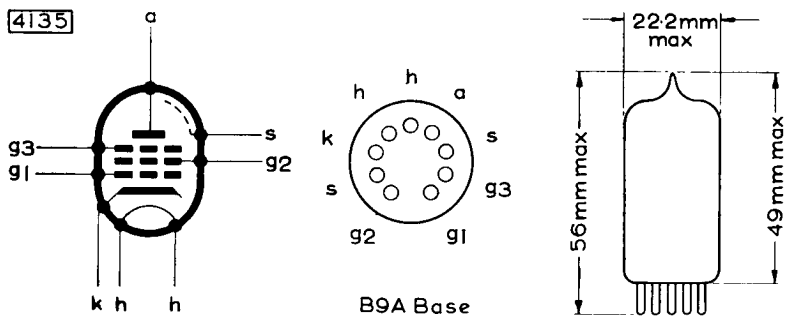
When used as a normal voltage amplifier with a line voltage of 200V, an anode load of 100kΩ and a grid resistor of 470kΩ the maximum hum level of the valve alone is 12μV, the average value being about 8μV when operated with one side of the heater earthed. The low level of hum attained with this valve can be completely masked by that due to an unsuitable valveholder, in which excessive leakage and capacitive coupling between pins will introduce considerable hum. The hum will be increased if the valve is not operated at the bottom of the chain.

2. Noise

The low-frequency noise generated by a valve is most conveniently specified as an equivalent voltage on the control grid for a specific bandwidth. For the UF86 under normal conditions, i.e. line voltage of 200V and an anode load of 100kΩ, the equivalent noise voltage is approximately 2μV for a frequency range 25 to 10,000c/s.

3. Microphony

Care in the design of the valve, to ensure that the electrode structure and its mounting are as rigid as possible, has reduced the microphony of the UF86 to a very low level. There are no appreciable internal resonances at frequencies below 1000c/s. At higher frequencies the effect of vibration is usually negligible on account of the damping provided by the chassis and the valveholder. In high-gain applications, such as tape recording, care should be taken in siting the valve, particularly when a loudspeaker is present in the same cabinet or when a motor is mounted on the same chassis. In such cases a flexible mounting for the valveholder or a separate weighted sub-chassis is advisable.



Mullard
INDIRECTLY HEATED RECTIFIER

UR1C

The UR1C is a single-wave power rectifier for use in D.C./A.C. mains receivers, where the heater is run in series with those of the preceding valves.

HEATER CHARACTERISTICS

Heater Voltage ... ... Vf=20·0 volts
Heater Current ... ... If=0·2 amp
Heating Time—70 secs.

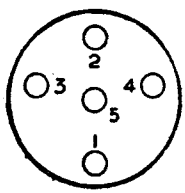
OVERALL DIMENSIONS

Overall Length ... =118 mm.
Overall Diameter... = 43 mm.

OPERATING DATA

Maximum Anode Voltage (R.M.S.)	Va_{max}	= 250 volts
Maximum Rectified Current	Ia_{max}	= 75 mA
Maximum D.C. Voltage Heater to Cathode ...	Vfk_{max}	= 350 volts
Maximum Value of Reservoir Condenser (with no resistance in anode lead)	$C1_{max}$	= 8·0 μF

CONNECTIONS



Pin No. 1 Anode
„ 2 —
„ 3 Heater
„ 4 Heater
„ 5 Cathode

Viewed from free end of pins.

OPERATING NOTE

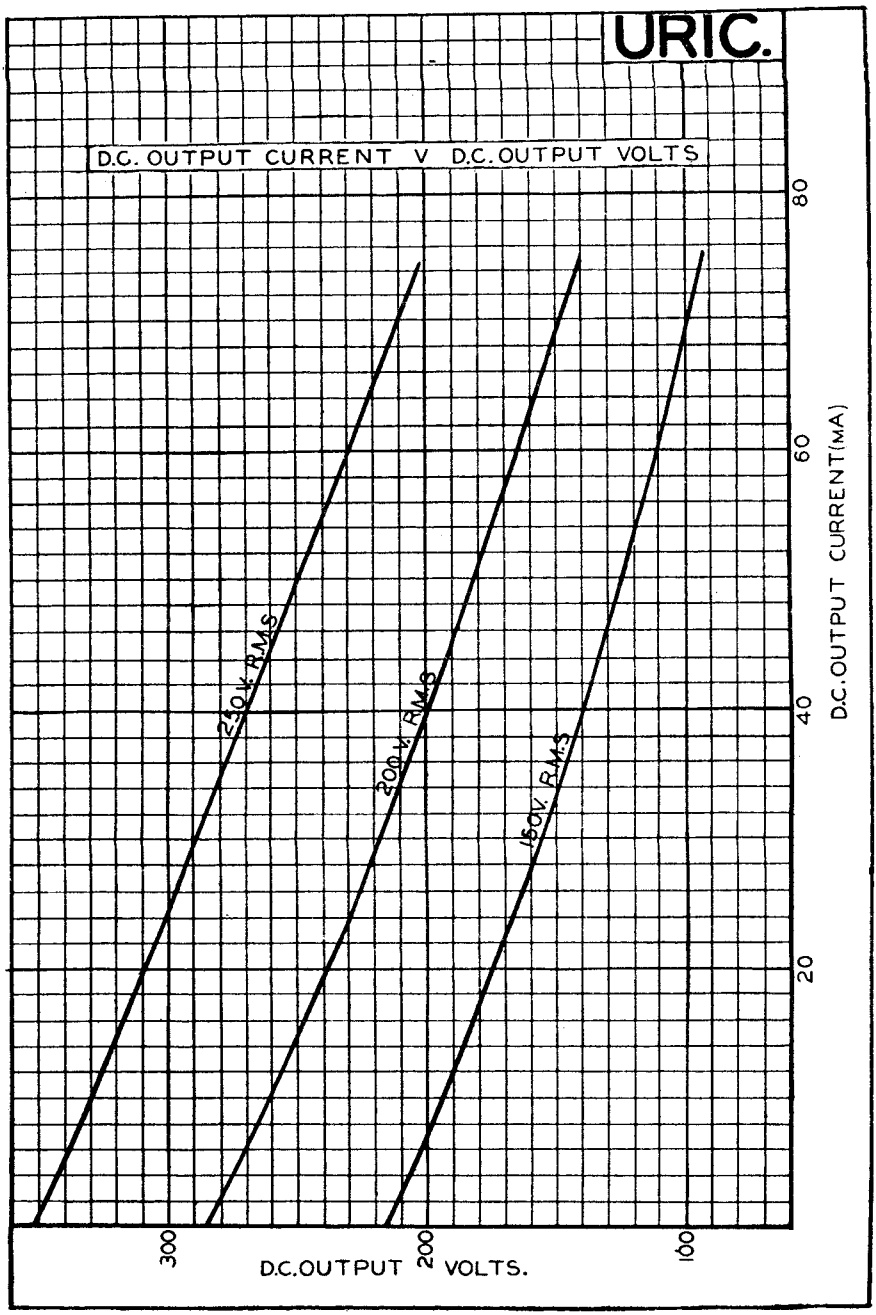
In order to protect the valve, it is essential that a resistance is included directly in the anode lead when large capacity smoothing condensers are used. Without this resistance the charging current of the first smoothing condenser may destroy the cathode of the rectifier should the receiver be switched off and on again quickly.

The maximum capacity of the smoothing condenser when no resistance is included is 8·0 μF. Where a 16 μF condenser is used the resistance value should be 75 ohms, and for a 32 μF condenser 125 ohms.

UR1C

Mullard

INDIRECTLY HEATED RECTIFIER



Mullard
INDIRECTLY HEATED RECTIFIER UR3C

The UR3C is an indirectly heated multiple rectifier for use in D.C./A.C. amplifiers and receivers, where the heaters are run in series with those of the preceding valves.

HEATER CHARACTERISTICS

Heater Volts	... ...	Vf=30 volts
Heater Current	... ...	If=0·2 amp
		Heating Time—75 secs.

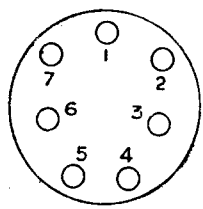
DIMENSIONS

Overall Length	...	=118 mm.
Overall Diameter		= 43 mm.

OPERATING CHARACTERISTICS

Maximum Anode Voltage (R.M.S.)	... ...	Va_{max}	= 2 x 250 volts
Maximum Rectified Current	... ...	Ia_{max}	= 120 mA
Maximum D.C. Voltage Heater to Cathode	...	Vfk_{max}	= 350 volts

CONNECTIONS



Viewed from free end of pins.

Pin No. 1 —
„ 2 Anode (1)
„ 3 Cathode (1)
„ 4 Heater
„ 5 Heater
„ 6 Cathode (2)
„ 7 Anode

OPERATING NOTE

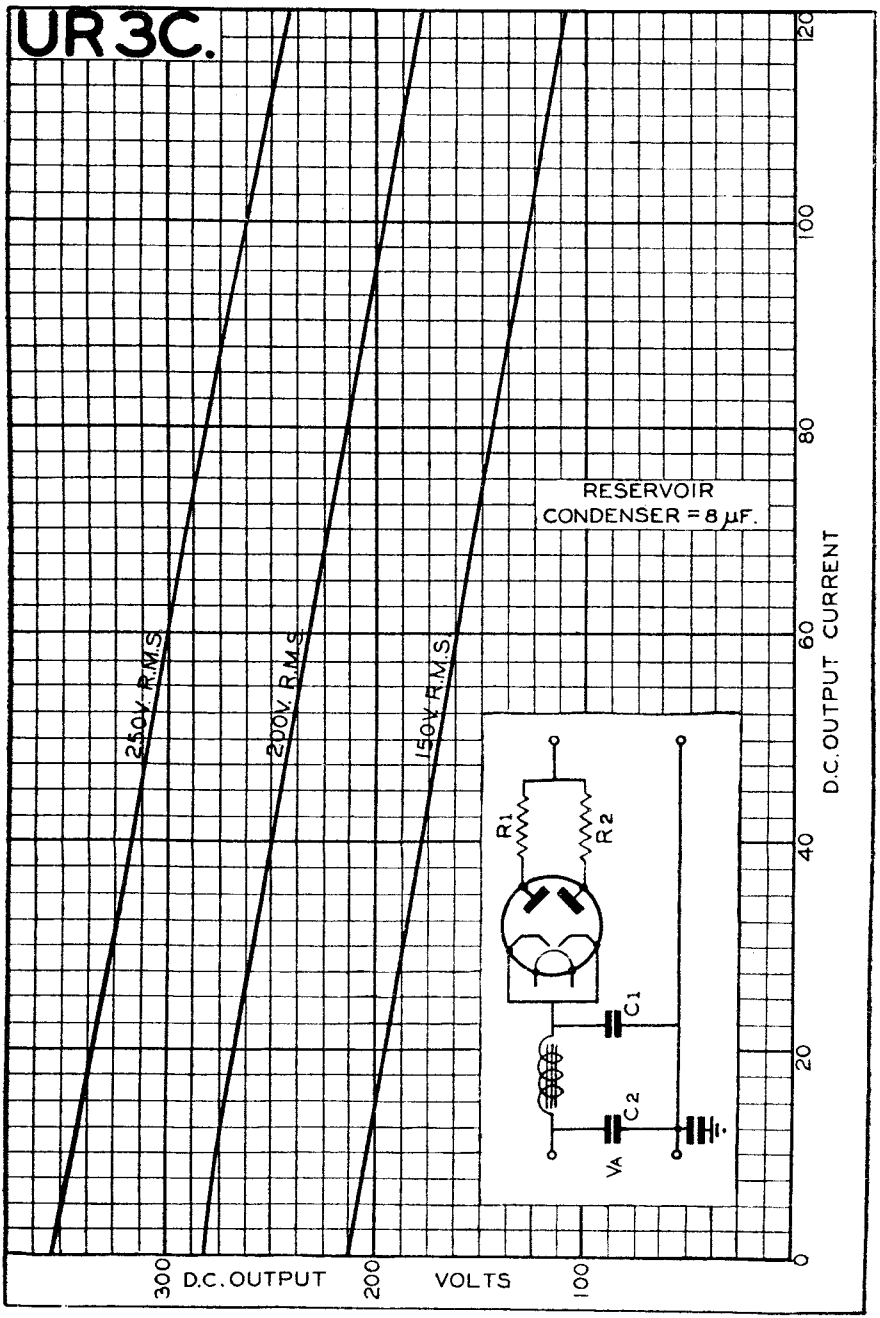
In order to protect the valve it is essential that a resistance is included directly in each anode lead when large capacity smoothing condensers are used, as shown in the following table. Without these resistances the charging current of the first smoothing condenser may destroy the cathode of the rectifier should the amplifier be switched off and on again quickly.

Maximum Capacity of Smoothing Condenser (C1) (C1)	Value of Resistance in series with each Anode (R1=R2)
8 μF	50 ohms
16 μF	75 ohms
32 μF	125 ohms

UR3C

Mullard

INDIRECTLY HEATED RECTIFIER



Mullard
VARIABLE-MU H.F. PENTODE VP13A

The VP13A is a variable-mu H.F. Pentode for use in D.C./A.C. mains operated receivers and for car radios.

HEATER CHARACTERISTICS

Heater Voltage	Vf = 13·0 volts	
Heater Current	If = 0·2 amp	
Heating Time—60 seconds		

DIMENSIONS

Overall Length ...	= 109 mm.
Overall Diameter...	= 42 mm.
Bulb Finish—Metallised	

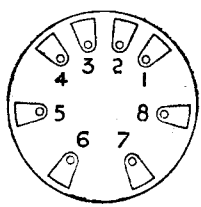
OPERATING CHARACTERISTICS

Normal Anode Voltage	Va_w	= 200 volts
Normal Auxiliary Grid Voltage	$Vg2_w$	= 100 volts
Anode Current (−Vg1 = 2V)	Ia_w	= 4·0 mA
Auxiliary Grid Current	$Ig2_w$	= 1·4 mA
Control Grid Voltage	$-Vg1_w$	= 2 volts
Mutual Conductance (Ia = 4 mA)	S_w	= 2·2 mA/V
Amplification Factor	G_w	= 2,200

LIMITS

Maximum Anode Voltage	Va_{max}	= 200 volts
Maximum Auxiliary Grid Voltage	$Vg2_{max}$	= 100 volts
Maximum Resistance in Grid Circuit	$Rg1_{max}$	= 1·5 megohms
Maximum Voltage Heater to Cathode	Vfk_{max}	= 125 volts
Range of Grid Voltage for 1 μA Grid Current...	Vg1	= −0·5 to −1·0 volt

CONNECTIONS



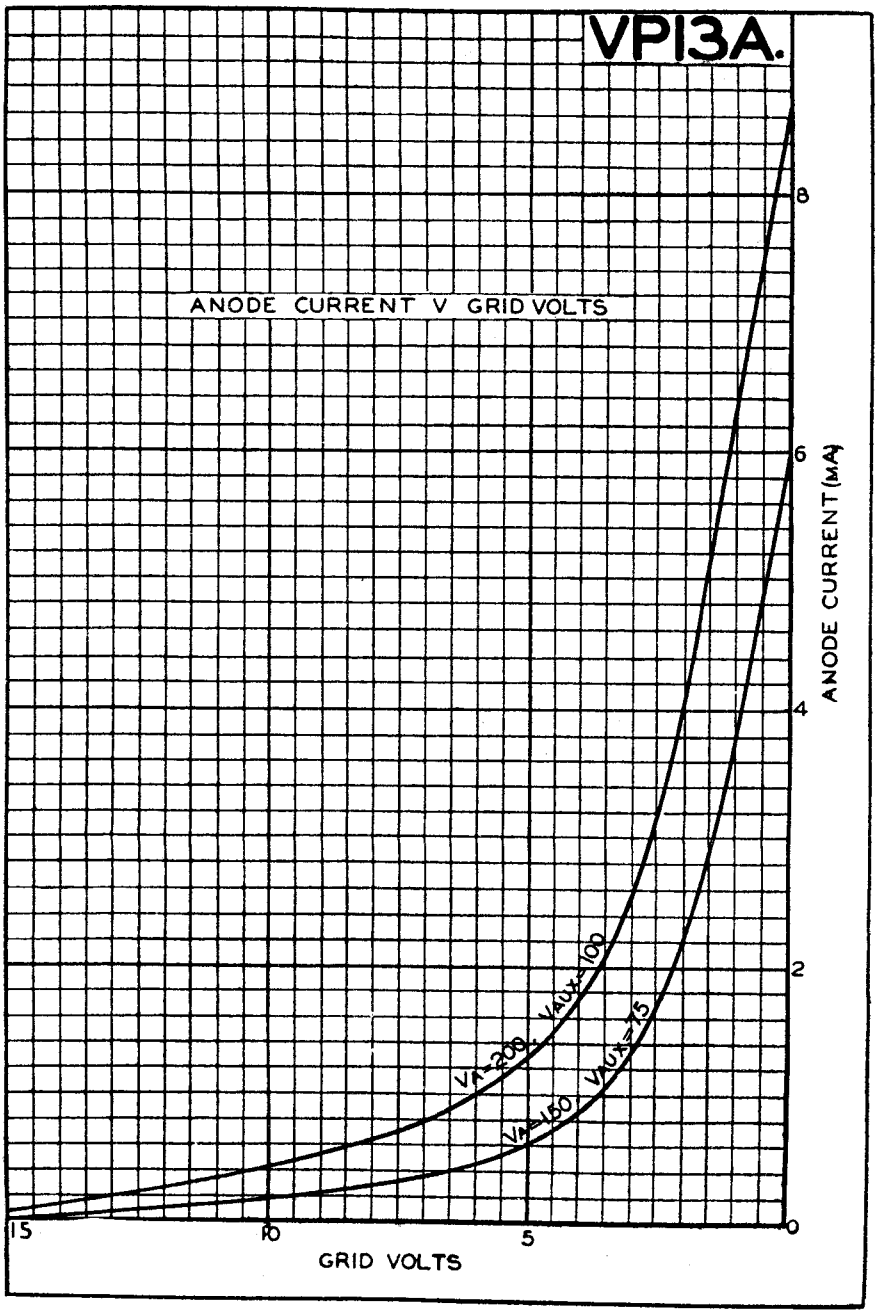
Viewed from underside of base.

Contact No. 1 Metallising
„ 2 Heater
„ 3 Heater
„ 4 Cathode
„ 5 Suppressor Grid (G3)
„ 6 —
„ 7 Auxiliary Grid (G2)
„ 8 Anode
Top Cap—Control Grid (G1)

VP13A

Mullard

VARIABLE-MU H.F. PENTODE



Mullard
VARIABLE-MU H.F. PENTODE VP13C

The VP13C is a variable-mu H.F. Pentode for use in D.C./A.C. mains operated receivers, and for car radio.

HEATER CHARACTERISTICS

Heater Voltage	Vf = 13·0 volts	
Heater Current	If = 0·2 amp.	
Heating Time—60 seconds		

DIMENSIONS

Overall Length ...	= 126 mm.
Overall Diameter	= 43 mm.
Bulb Finish—Metallised	

OPERATING CHARACTERISTICS

Normal Anode Voltage	Va_w	= 200 volts
Normal Auxiliary Grid Voltage	$Vg2_w$	= 200 volts
Anode Current	Ia_w	= 9·0 mA
Auxiliary Grid Current	$Ig2_w$	= 3·6 mA
Control Grid Voltage (Ia = 9·0 mA) ...	$-Vg1_w$	= 2·0 volts
Mutual Conductance ($-Vg1_w$ = 2·0 volts) ...	S_w	= 2·2 mA/V

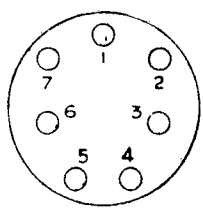
CAPACITIES

Anode-Control Grid	Cag1	= 0·0023 $\mu\mu$F
Output	Ca	= 8·0 $\mu\mu$F
Input	Cg1	= 6·1 $\mu\mu$F

LIMITS

Maximum Anode Voltage...	Va_{max}	= 200 volts
Maximum Anode Dissipation	Wa_{max}	= 2·5 watts
Maximum Auxiliary Grid Voltage	$Vg2_{max}$	= 200 volts
Maximum Auxiliary Grid Dissipation	$Wg2_{max}$	= 0·7 watt
Maximum Resistance Heater to Cathode ...	Rfk	= 20,000 ohms
Maximum Voltage Heater to Cathode	Vfk	= 125 volts
Maximum Resistance in Grid Circuit	$Rg1_{max}$	= 2·5 megohms
Range of Grid Voltage for 1 μA Grid Current ...	Vg1	= −0·1 to −0·7 volt

CONNECTIONS



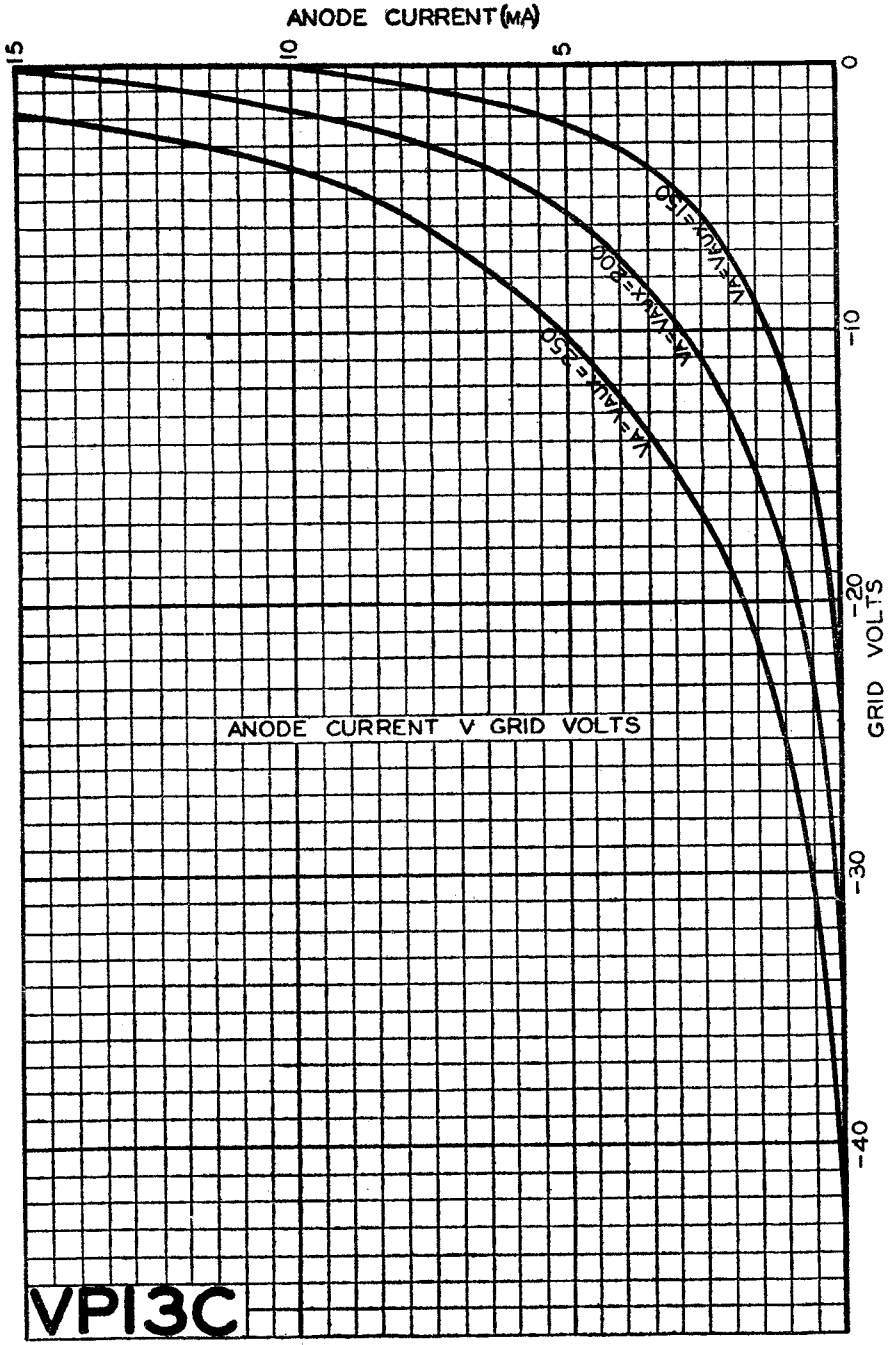
Viewed from free end of pins

Pin No. 1 Metallising
„ 2 Anode
„ 3 Suppressor Grid (G3)
„ 4 Heater
„ 5 Heater
„ 6 Cathode
„ 7 Auxiliary Grid (G2)
Top Cap—Control Grid (G4)

VP13C

Mullard

VARIABLE-MU H.F. PENTODE



TETRODE THYRATRON

Tetrode, mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.

XGQ2-6400

(MT105)

This data sheet should be read in conjunction with DEFINITIONS AND OPERATIONAL RECOMMENDATIONS—THYRATRONS, which precede this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	2.5	kV
Forward	2.5	kV
Max. cathode current		
Peak (25 c/s and above)	40	A
Peak (below 25 c/s)	12.8	A
Average (max. averaging time 15s)	6.4	A
Surge (fault protection max. duration 0.1s)	400	A
Max. negative control-grid voltage		
Before conduction	1.0	kV
During conduction	10	V
Max. average positive control-grid current for anode voltage more positive than −10V (averaging time 15s)	250	mA
Max. peak positive control-grid current during the time that the anode voltage is more positive than −10V	1.0	A
Max. control-grid resistor (Recommended min. control-grid resistor 10kΩ)	100	kΩ
Max. negative shield-grid voltage		
Before conduction	500	V
During conduction	10	V
Max. average positive shield-grid current for anode voltage more positive than −10V (averaging time 15s)	500	mA
Max. peak positive shield-grid current during the time that the anode-voltage is more positive than −10V	2.0	A
Max. shield-grid resistor	10	kΩ
Heater voltage limits	4.75 to 5.25	V
Min. cathode heating time	5.0	min
Condensed mercury temperature limits	40 to 80	°C

PRELIMINARY

XGQ2-6400

(MT105)

TETRODE THYRATRON

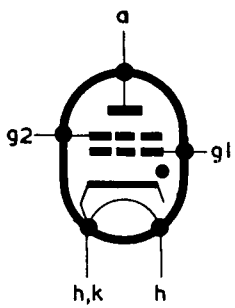
CHARACTERISTICS

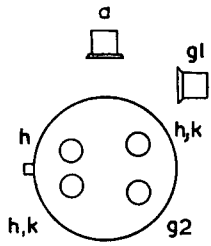
Electrical

Heater voltage	5.0	V
Average heater current at 5.0V	10	A
Anode to control-grid capacitance	2.0	pF
Deionisation time (approx.)	1000	μs
Ionisation time (approx.)	10	μs
Anode voltage drop	16	V

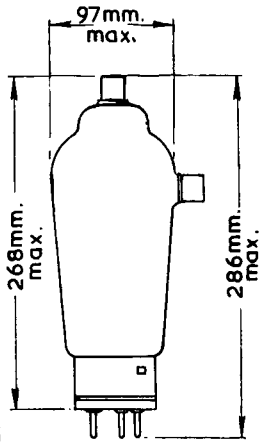
Mechanical

Type of cooling	Convection	
Mounting position	Vertical, base down	
Max. net weight	17	oz
	500	g





B4D BASE

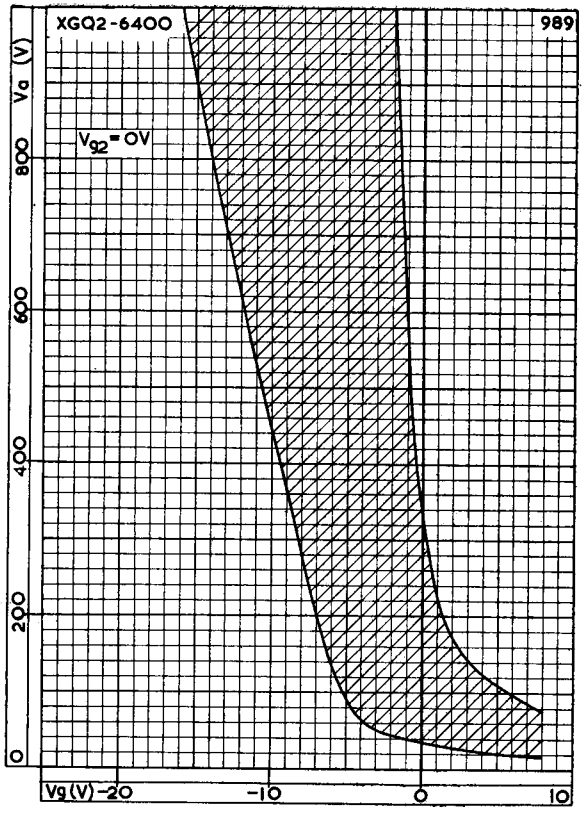


TETRODE THYRATRON

Tetrode, mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.

XGQ2-6400

(MT105)



CONTROL CHARACTERISTIC

TRIODE THYRATRON

XR1-1600

1.6 amp triode, inert gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

PRELIMINARY DATA

This data sheet should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS – THYRATRONS, which precede this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Maximum peak anode voltage		
Inverse	1.5	kV
Forward	1.5	kV
Maximum cathode current		
Normal service		
Peak (25c/s and above)	20	A
Average (max. averaging time 15s)	1.6	A
Ignitor firing service (Filament voltage = 2.75V)		
Peak	30	A
Average	0.5	A
Maximum negative grid voltage		
Before conduction	250	V
During conduction	10	V
Maximum positive grid current during the time that the anode voltage is more positive than –10V		
Peak	1.25	A
Average (averaging time 1 cycle)	100	mA
Maximum peak positive grid current during the time that the anode voltage is more negative than –10V	5.0	mA
Maximum grid resistor	100	kΩ
Minimum valve heating time	10	s
Maximum commutation factor	10	
Maximum ambient temperature	+70	°C

XR1-1600 TRIODE THYRATRON

CHARACTERISTICS

Electrical

*Filament voltage	2.5	V
*Filament current at 2.5V		
Maximum	9.5	A
Average	8.5	A
Anode to grid capacitance	350	mpF
Grid to cathode capacitance	10	pF
Recovery (deionisation) time (approx.)		
V_g = –250V	200	μs
V_g = –100V	300	μs
Ionisation time (approx.)	10	μs
Anode voltage drop (approx.)	10	V
Critical grid current at V_a = 1.5kV	<20	μA

*These ratings apply for normal service.

For ignitor firing service, the following ratings apply:

Filament voltage	2.75	V
Filament current at 2.75V		
Maximum	10.3	A
Average	9.2	A

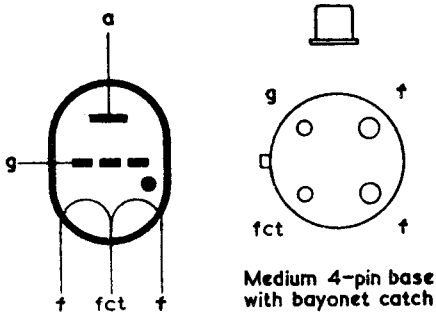
When two or more valves are used with one filament transformer, the centre tap of the filament transformer must be used for the circuit returns. This may also be connected to the filament centre-taps.

Mechanical

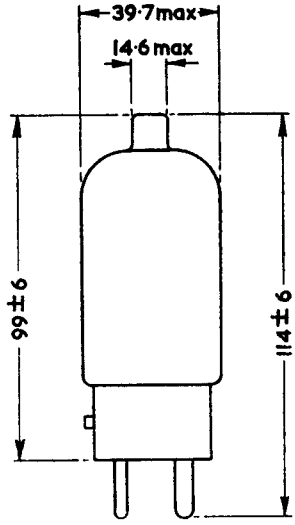
Type of cooling	Convection
Recommended mounting position	Any between horizontal and vertical with base down.
Maximum net weight	96 g / 3.4 oz

XR1-1600

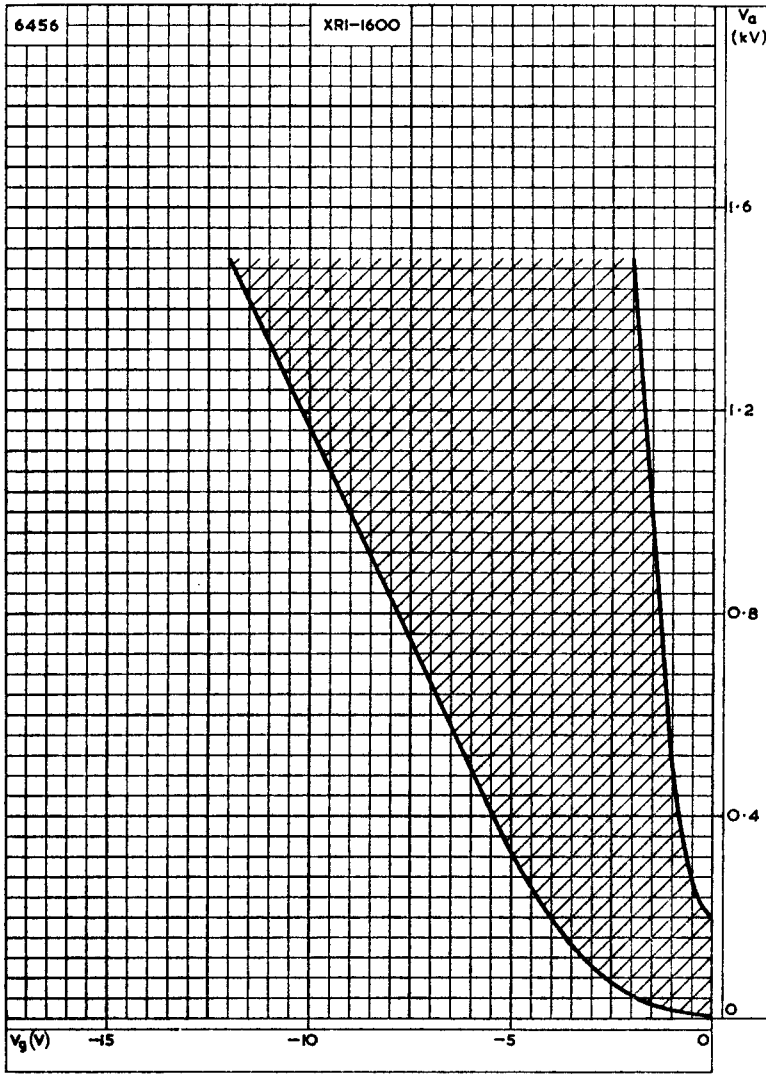
6460



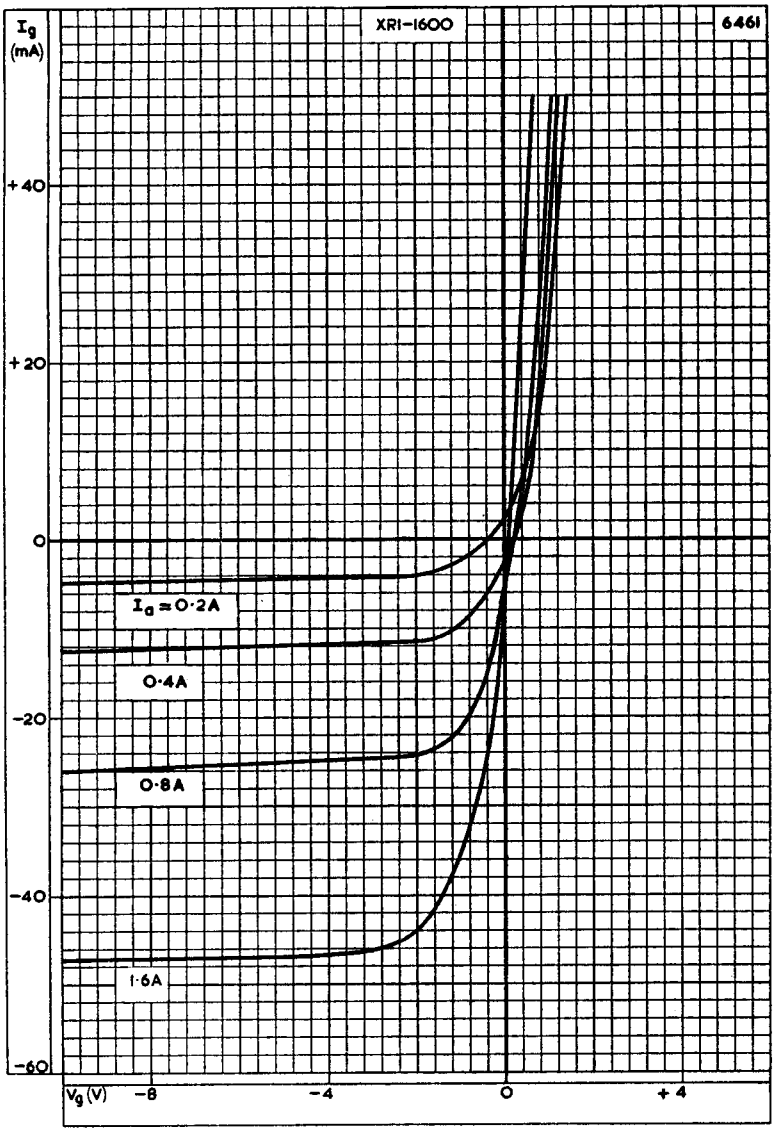
Medium 4-pin base
with bayonet catch



All dimensions in mm



CONTROL CHARACTERISTIC



GRID ION CURRENT CHARACTERISTIC

TRIODE THYRATRON

6.4A inert gas-filled triode thyratron with negative control characteristic. Primarily designed for motor control applications.

XR1-6400

(5545)

This data sheet should be read in conjunction with "DEFINITIONS AND OPERATIONAL RECOMMENDATIONS—THYRATRONS", which precede this section of the Handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	1.5	kV
Forward	1.5	kV
Max. cathode current		
Peak	80	A
Average (max. averaging time 15s)	6.4	A
Surge (fault protection max. duration 0.1s)	1120	A
Max. negative grid voltage		
Before conduction	250	V
During conduction	10	V
Max. average positive grid current for anode voltage more positive than −10V (averaging time 1 cycle)	200	mA
Max. peak positive grid current during the time that the anode voltage is more positive than −10V	2.5	A
Max. peak positive grid current during the time that the anode voltage is more negative than −10V	25	mA
Max. grid resistor (Recommended min. grid resistor 500Ω)	100	kΩ
Filament voltage limits	2.37 to 2.63	V
Min. valve heating time	60	s
Max. commutation factor	130	
Ambient temperature limits	−55 to +70	°C

CHARACTERISTICS

Electrical

Filament voltage	2.5	V
Filament current at 2.5V		
Average	21	A
Maximum	23	A
Anode to control-grid capacitance	0.8	pF
Control-grid to cathode capacitance	45	pF
Deionisation time (approx.)		
(a) V_g=−250V	50	μs
(b) V_g=−12V	500	μs
Ionisation time (approx.)	10	μs
Anode voltage drop (approx.)	16	V
Critical grid current at V_a=1.5 kV	<20	μA

OBSOLETE
NOT FOR NEW DESIGN

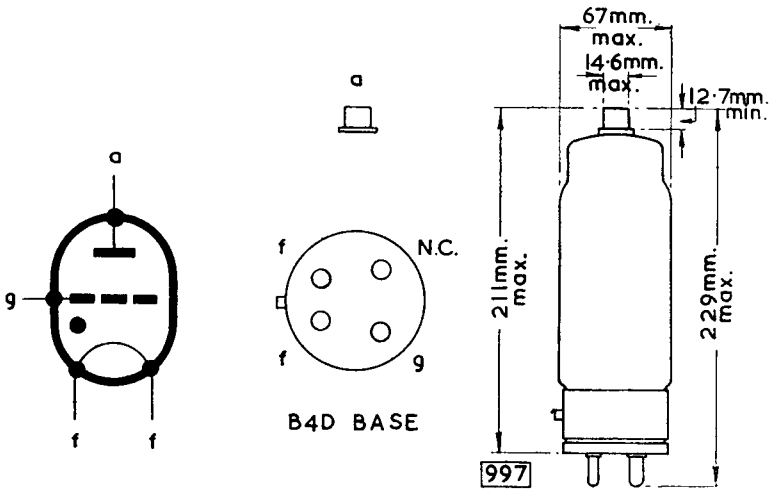
XR1-6400

(5545)

TRIODE THYRATRON

Mechanical

Type of cooling	Convection
Mounting position	Any position between horizontal and vertical with base downwards
Max. net weight	{ 12 oz. / 340 g

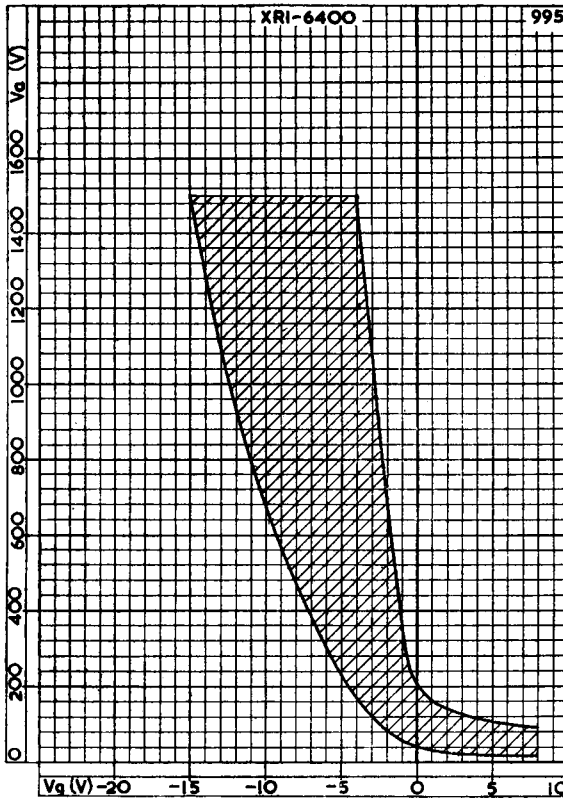


TRIODE THYRATRON

Triode, inert gas-filled thyratron with negative control characteristic. Primarily designed for motor control applications.

XR1-6400

(5545)



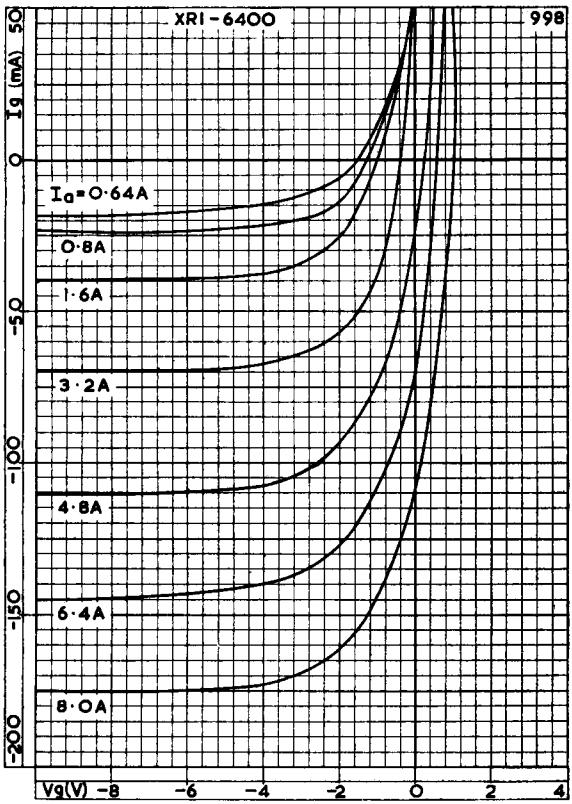
CONTROL CHARACTERISTIC

XR1-6400

(5545)

TRIODE THYRATRON

Triode, inert gas-filled thyratron with negative control characteristic. Primarily designed for motor control applications.



GRID ION CURRENT CHARACTERISTICS

V.H.F. INDUSTRIAL TRIODES

YD1150
YD1151
YD1152

QUICK REFERENCE DATA

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

The YD1150 is forced-air cooled.
The YD1151 is water-cooled by means of a separate jacket.
The YD1152 has an integral helical water cooler.

f	160	27.12	MHz
P_{out} (less P_{drive})	3.55	4.57	kW
f max.	160		MHz
V_a max.	7.2		kV
p_a max.	2.5		kW

Unless otherwise shown, data is applicable to all types

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

INDUSTRIAL OSCILLATOR, CLASS 'C'

OPERATING CONDITIONS

f	160	27.12	27.12	MHz
P_{out}	3.9	4.9	4.0	kW
P_{out} (less P_{drive})	3.55	4.57	3.75	kW
P_{load}	3.1	3.7	3.3	kW
Duty factor	1.0	1.0	1.0	
η_a	78	82	80	%
V_a	5.0	6.0	5.0	kV
I_a	1.0	1.0	1.0	A
$-V_g$	520	625	520	V
I_g	260	250	260	mA
R_{g-f}	2.0	2.5	2.0	kΩ
Feedback ratio $v_{in(pk)}/v_{a(pk)}$	0.17	0.17	0.17	
P_{drive}	350	330	250	W
p_a	1.1	1.1	1.0	kW
p_g	120	110	100	W
V_f	6.0	6.3	6.3	V

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

f max.	85	160	MHz
V_a max.	7.2	6.0	kV
$-V_g$ max.	1.0	1.0	kV
I_g max. on load	280	280	mA
off load	400	400	mA
I_k max.	1.4	1.4	A
$i_{k(pk)}$ max.	7.5	7.5	A
P_{in} max.	6.5	6.0	kW
p_a max.	2.5	2.5	kW
p_g max.	150	150	W
R_{g-f} max.	20	20	kΩ

CATHODE

Directly heated, thoriated tungsten

V_f (≤120MHz)	6.3	V
(>120MHz)	6.0	V
I_f (measured at 6.3V)	33	A

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

CAPACITANCES

c_{a-g}	14	pF
c_{a-f}	400	mpF
c_{g-f}	17	pF

CHARACTERISTICS (measured at $V_a = 2.0$kV, $I_a = 0.5$A)

g_m	10	mA/V
μ	20	

MOUNTING POSITION - YD1150, YD1152 Vertical, anode up or down
- YD1151 Vertical, anode down

COOLING

Maximum temperature of ceramic-metal seals 220 °C

YD1150 - Forced-air cooled. See curves on page C4

YD1151 - Anode water cooled using jacket type K713

Seals - low velocity air flow may be required

See curves on page C5

YD1152 - Anode water cooled with integral helical cooler

Seals - low velocity air flow may be required

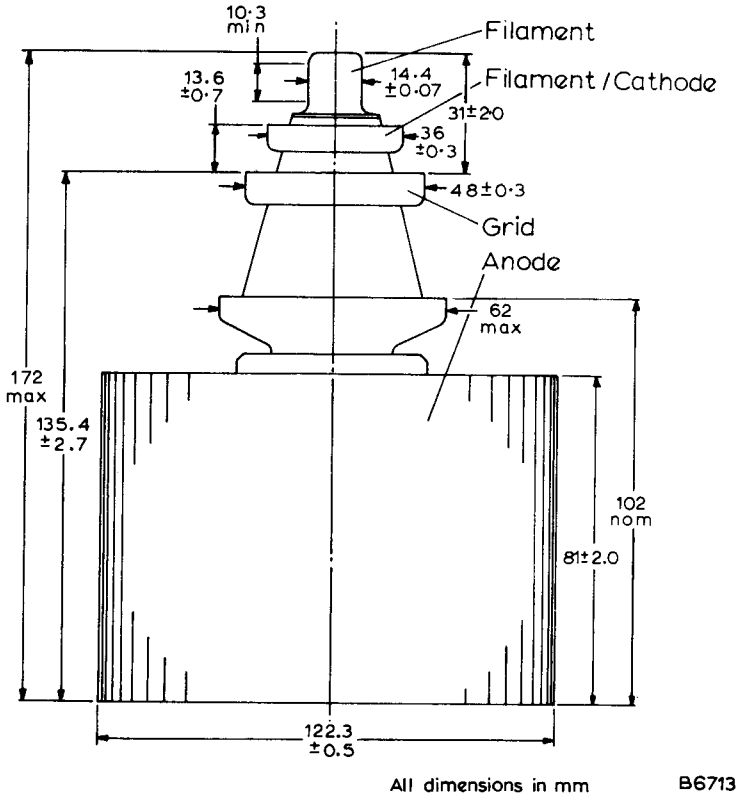
See curves on page C6

PHYSICAL DATA

	YD1150	YD1151	YD1152	
Weight of valve	6.6	1.4	1.9	lb
	3.0	0.65	0.85	kg

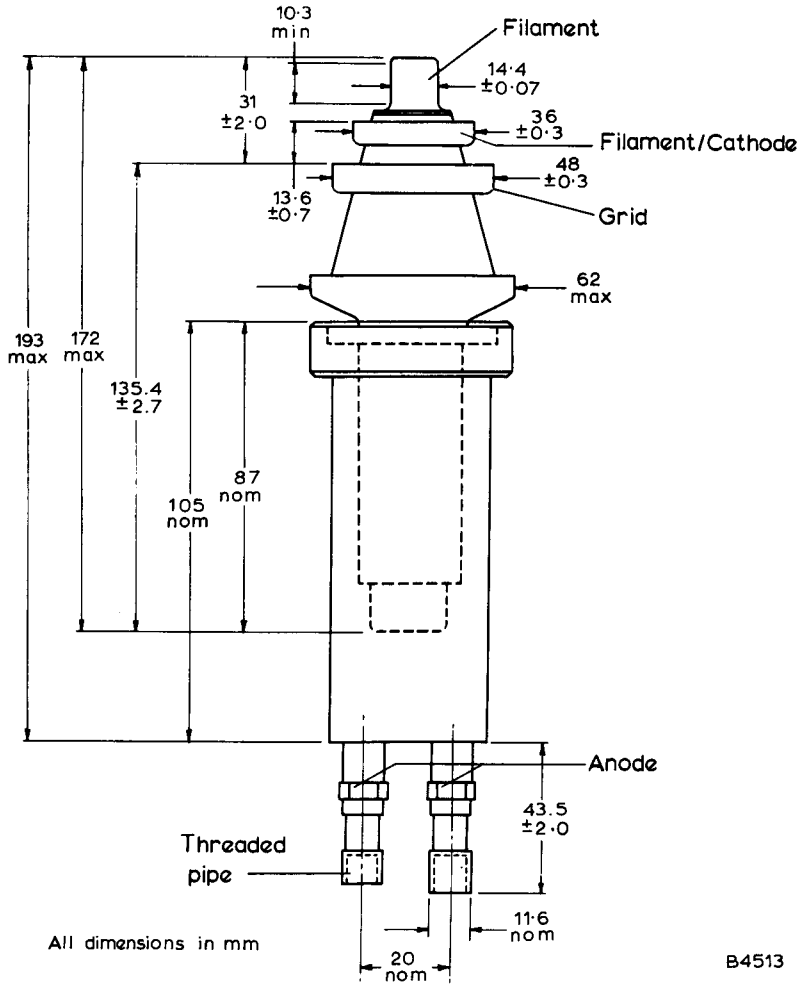
ACCESSORIES

Filament clip	40688
Filament/cathode clip	40689
Grid connector (f < 30MHz)	40686
Insulating pedestal (YD1150)	40630
Water jacket (YD1151)	K713

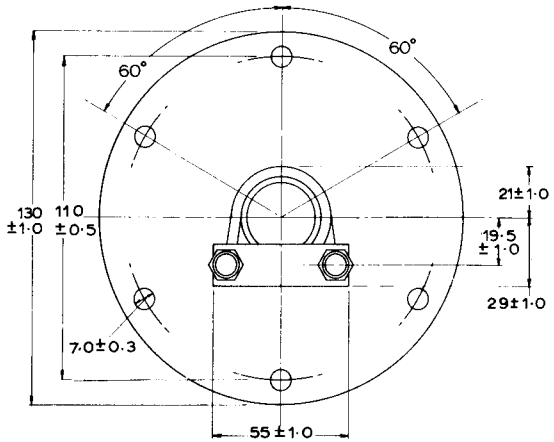


OUTLINE DRAWING OF YD1150

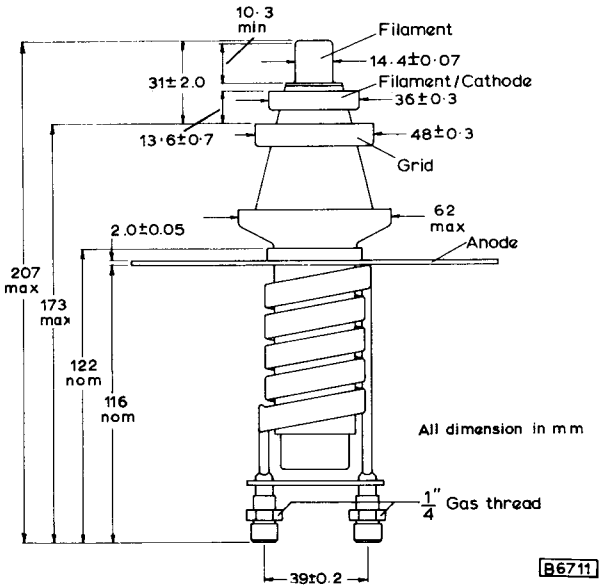
OUTLINE DRAWING OF YD1151 MOUNTED IN WATER JACKET K713

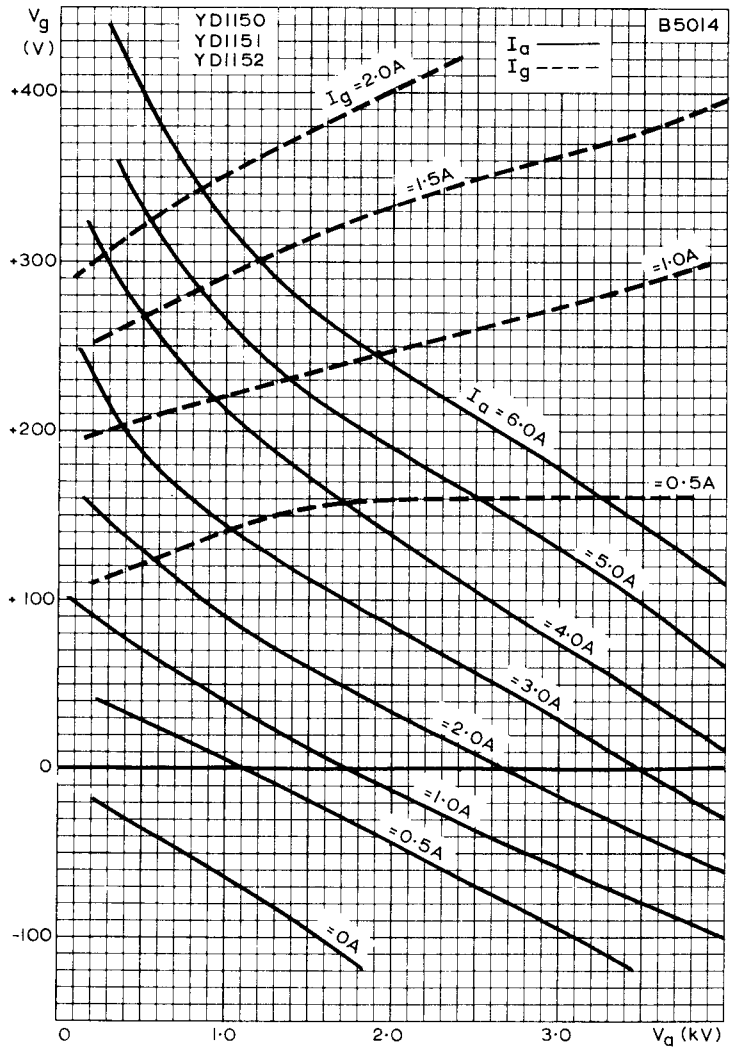


OUTLINE DRAWING OF YD1152

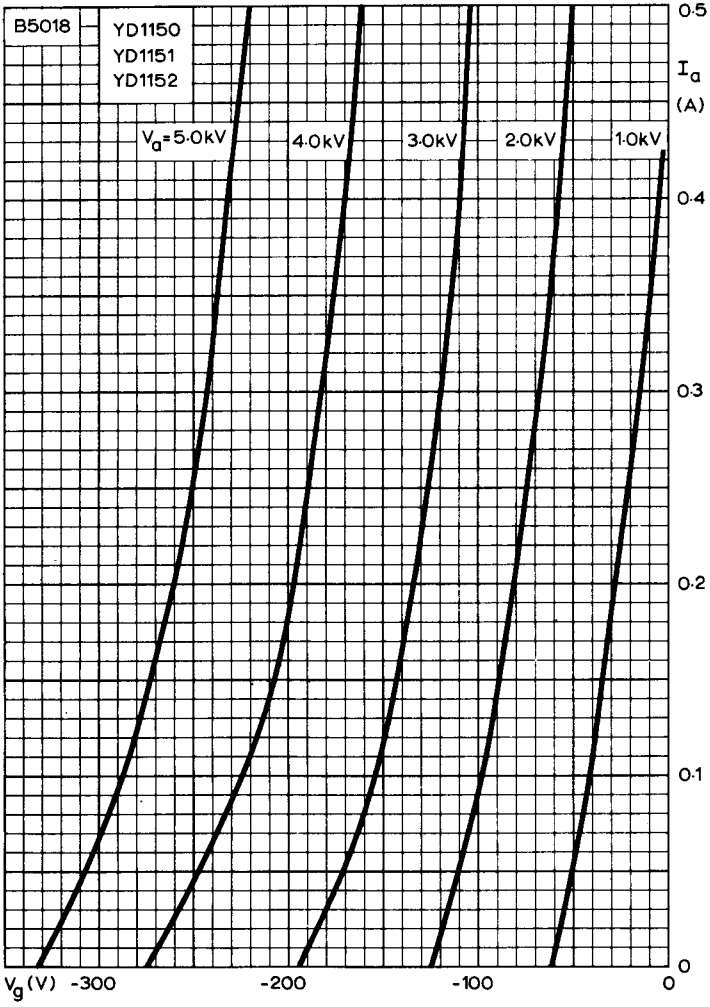


The use of wing nuts should be avoided

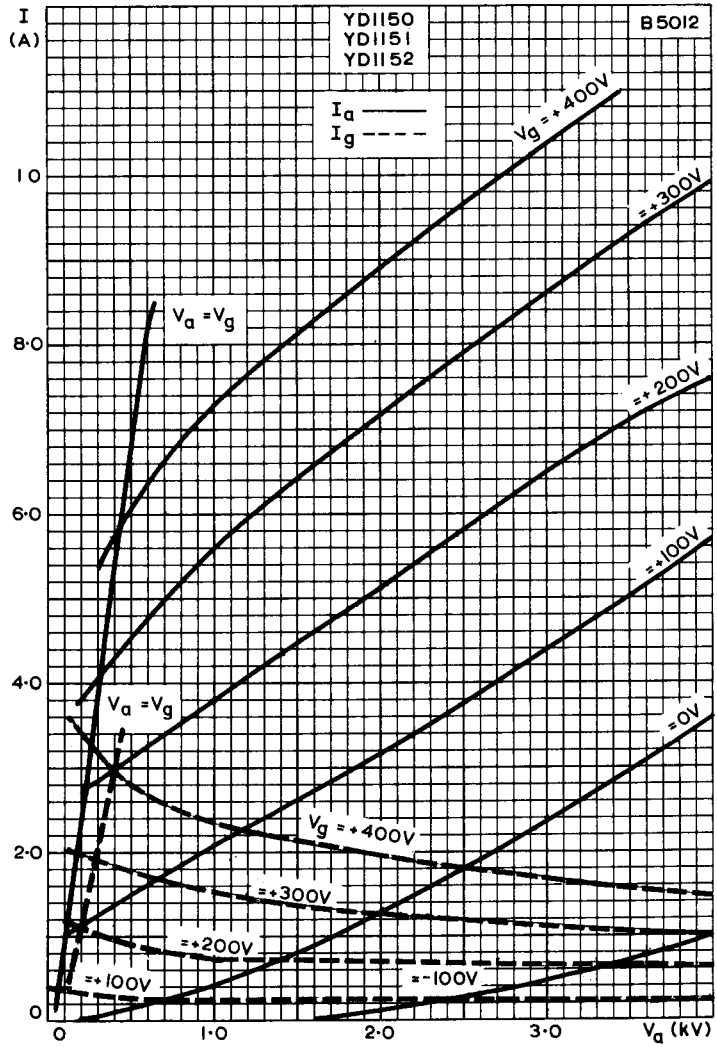




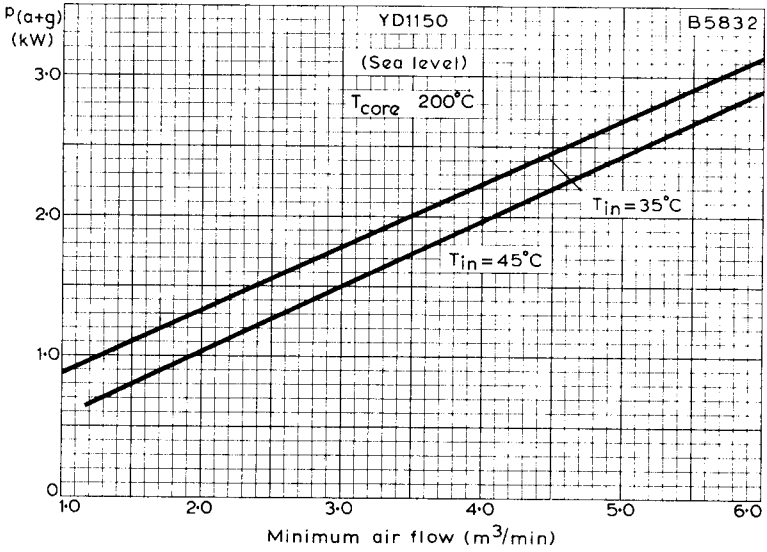
CONSTANT CURRENT CHARACTERISTICS

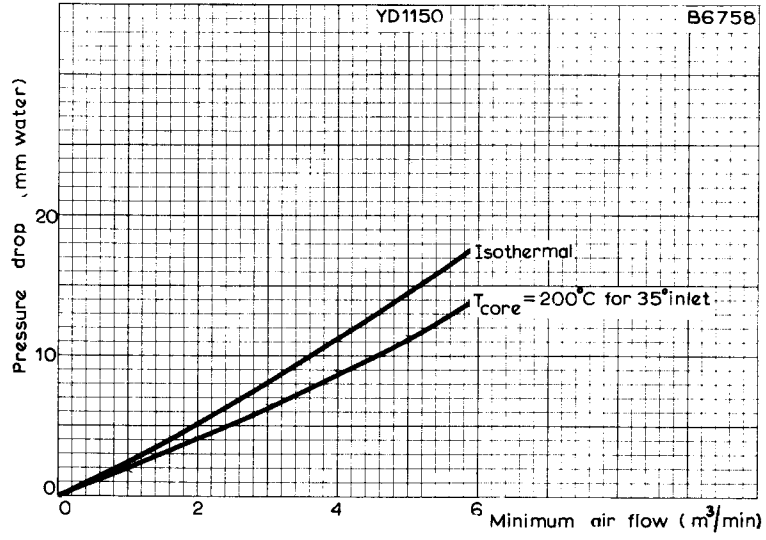


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER



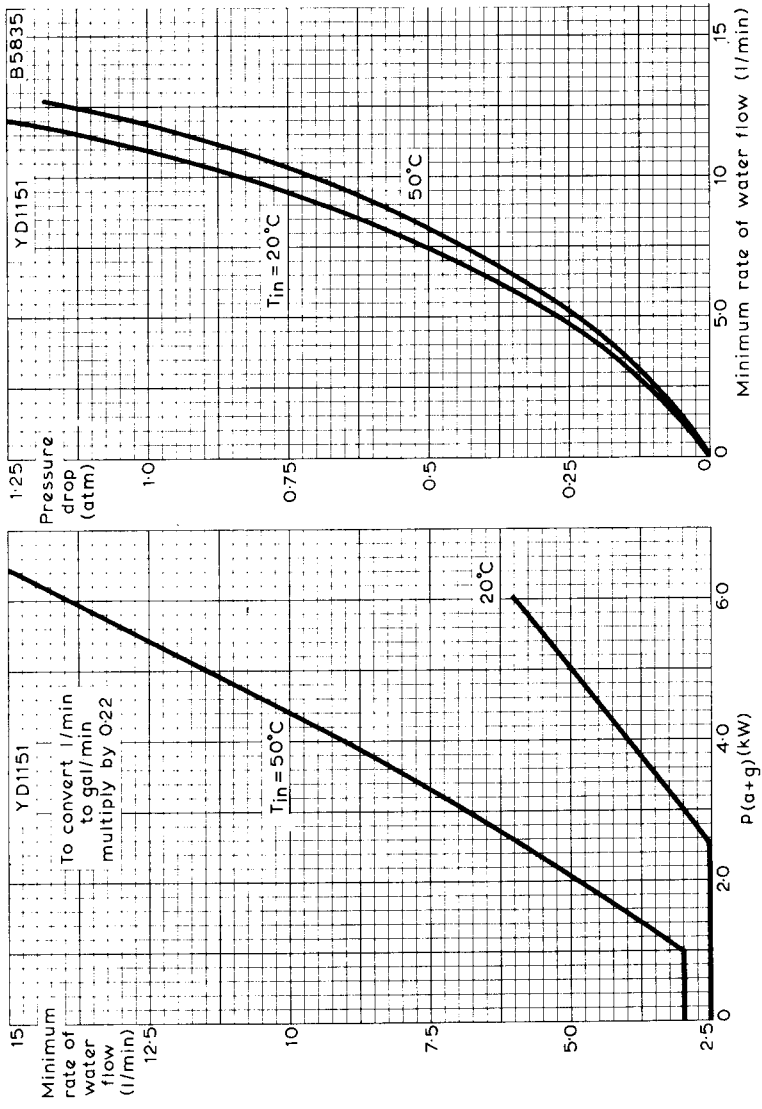
ANODE AND GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



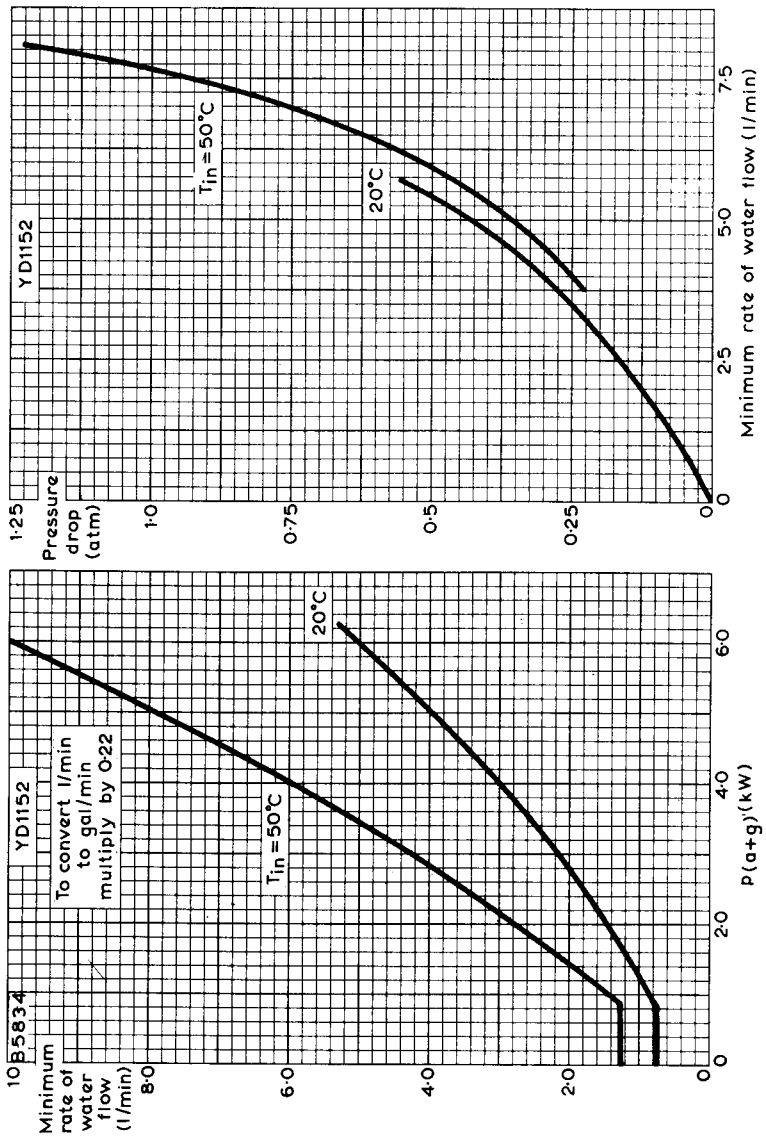


MINIMUM COOLING REQUIREMENTS AT SEA LEVEL WITH AIR INLET TEMPERATURES OF 35 AND 45°C AND A CORE TEMPERATURE OF 200°C

PRESSURE DROP PLOTTED AGAINST MINIMUM AIR FLOW FOR AN ISOTHERMAL CONDITION AND FOR A RISE IN CORE TEMPERATURE OVER INCOMING AIR OF 165°C



MINIMUM RATE OF WATER FLOW PLOTTED AGAINST ANODE AND GRID DISSIPATION FOR T_{in} = 20 AND 50°C
PRESSURE DROP PLOTTED AGAINST MINIMUM RATE OF WATER FLOW FOR T_{in} = 20 AND 50°C



MINIMUM RATE OF WATER FLOW PLOTTED AGAINST ANODE AND GRID DISSIPATION FOR T_{in} = 20 AND 50°C

PRESSURE DROP PLOTTED AGAINST MINIMUM RATE OF WATER FLOW FOR T_{in} = 20 AND 50°C

V.H.F. INDUSTRIAL TRIODE

YD1160
YD1161
YD1162

TENTATIVE DATA

QUICK REFERENCE DATA

External anode triode, intended for use as Class 'C' industrial oscillator.
The YD1160 is forced-air cooled.
The YD1161 is water cooled by means of a separate jacket.
The YD1162 has an integral helical water cooler.

f	27.12	160	Mc/s
P_{out} (less P_{drive})	7.65	7.15	kW
f max. at full input	160		Mc/s
V_a max.	7.0		kV
p_a max.	5.0		kW

Unless otherwise shown, data is applicable to all types
To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES

INDUSTRIAL OSCILLATOR, CLASS 'C'

OPERATING CONDITIONS

f	27.12	27.12	160*	Mc/s
P_{out}	7.5	8.0	7.5	kW
P_{out} (less P_{drive})	7.15	7.65	7.15	kW
P_{load}	6.1	6.5	6.4	kW
Duty factor	1.0	1.0	1.0	
η_a	83	80	75	%
V_a	6.0	5.0	5.0	kV
I_a	1.5	2.0	2.0	A
$-V_g$	615	490	480	V
I_g on load	410	490	480	mA
I_g off load	540	720	700	mA
R_{g-f}	1.5	1.0	1.0	kΩ
Feedback ratio $v_{in(pk)}/v_{a(pk)}$	0.15	0.15	0.15	
P_{drive}	350	350	350	W
p_a	1.6	2.0	2.5	kW
p_g	100	110	100	W
V_f	6.3	6.3	5.8	V

*In typical cavity circuit.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

f max. at full input	160	Mc/s
V_a max.	7.0	kV
$-V_g$ max.	1.0	kV
I_g max.	750	mA
I_k max.	2.8	A
$i_{k(pk)}$ max.	15	A
p_a max.	5.0	kW
p_g max.	250	W
R_{g-f} max.	20	kΩ

CATHODE

Directly heated, thoriated tungsten

*V_f	6.3	V
I_f	66	A

*It is recommended that the filament voltage be reduced to 5.8V at 160Mc/s operating frequency.

CAPACITANCES

c_{a-g}	19	pF
c_{out}	0.5	pF
c_{in}	16	pF

CHARACTERISTICS (measured at V_a = 2.0kV, I_a = 1.0A)

g_m	20	mA/V
μ	20	

MOUNTING POSITION

Vertical, with base up or down

COOLING

Maximum temperatures

Anode seal	220	°C
Grid seal	220	°C
Filament seals	220	°C
Radiator core	220	°C

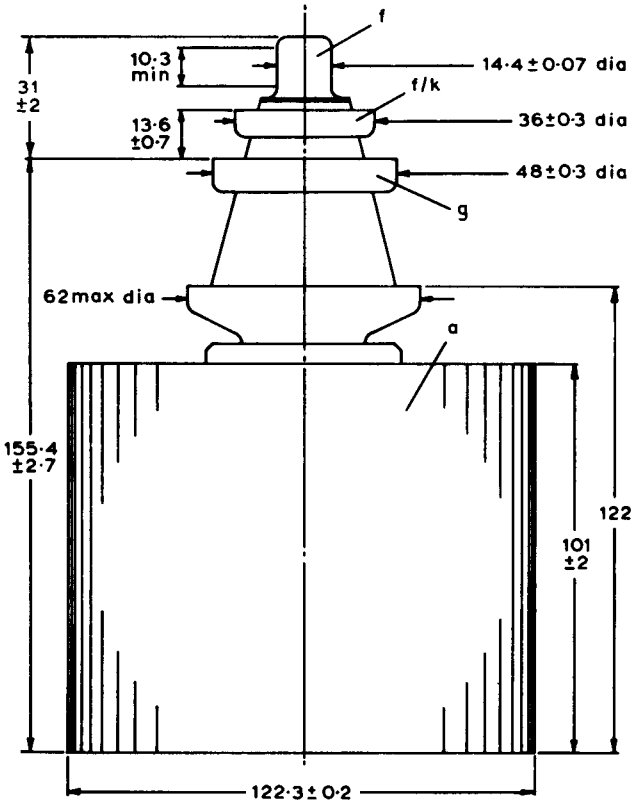
PHYSICAL DATA

	YD1160	YD1161	YD1162	
Weight of valve	8.5	1.5	2.3	lb
	3.9	0.66	1.03	kg
Weight of insulating pedestal	4.6	-	-	lb
	2.1	-	-	kg
Weight of insulating pedestal plus carton	6.8	-	-	lb
	3.1	-	-	kg
Weight of water jacket	-	1.6	-	lb
	-	0.73	-	kg

ACCESSORIES

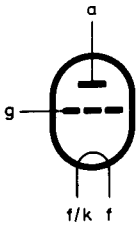
Filament connector	40688
Filament/cathode connector (f < 30Mc/s)	40689
Grid connector (f < 30Mc/s)	40686
Insulating pedestal x 1 (YD1160)	40630
Water jacket x 1 (YD1161)	K726

OUTLINE DRAWING OF YD1160

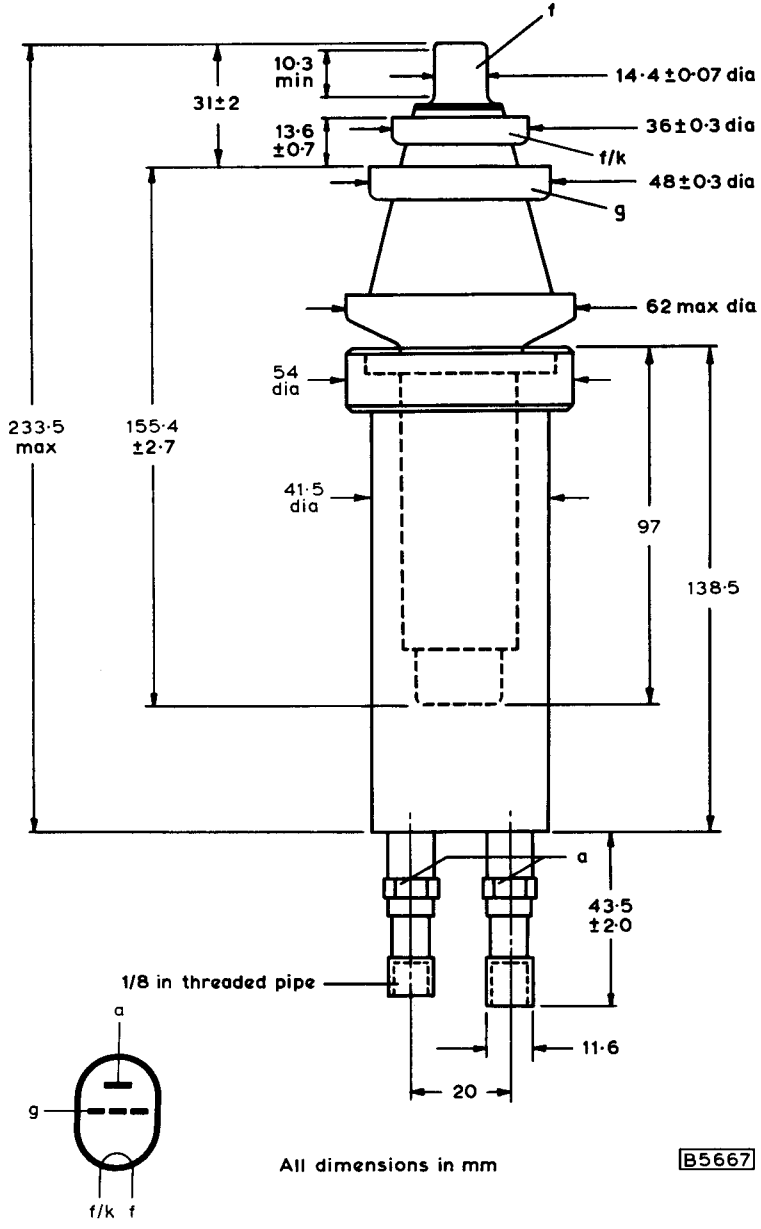


All dimensions in mm

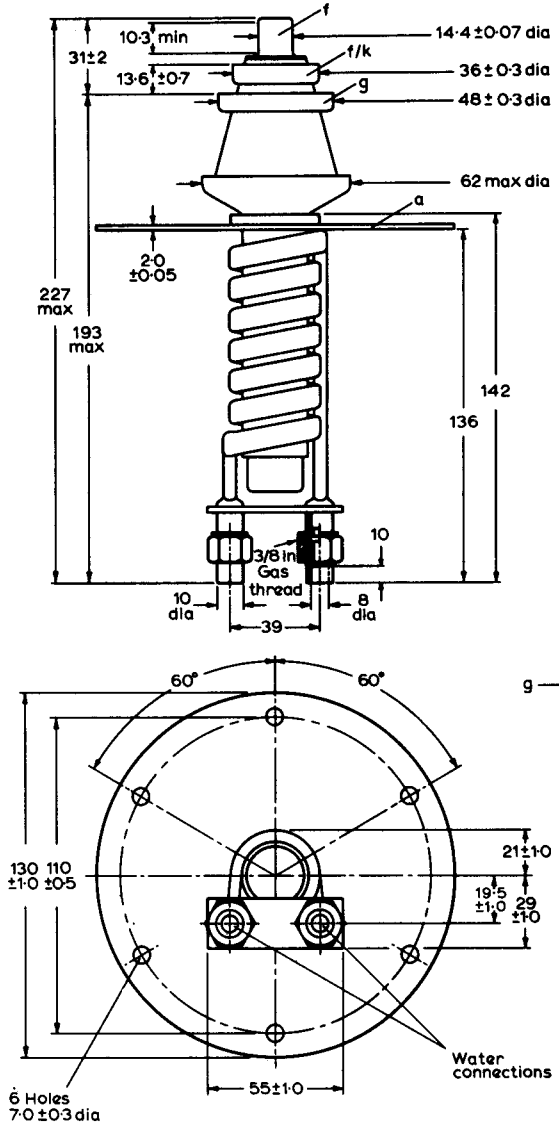
B5632



OUTLINE DRAWING OF YD1161 MOUNTED IN WATER JACKET K726

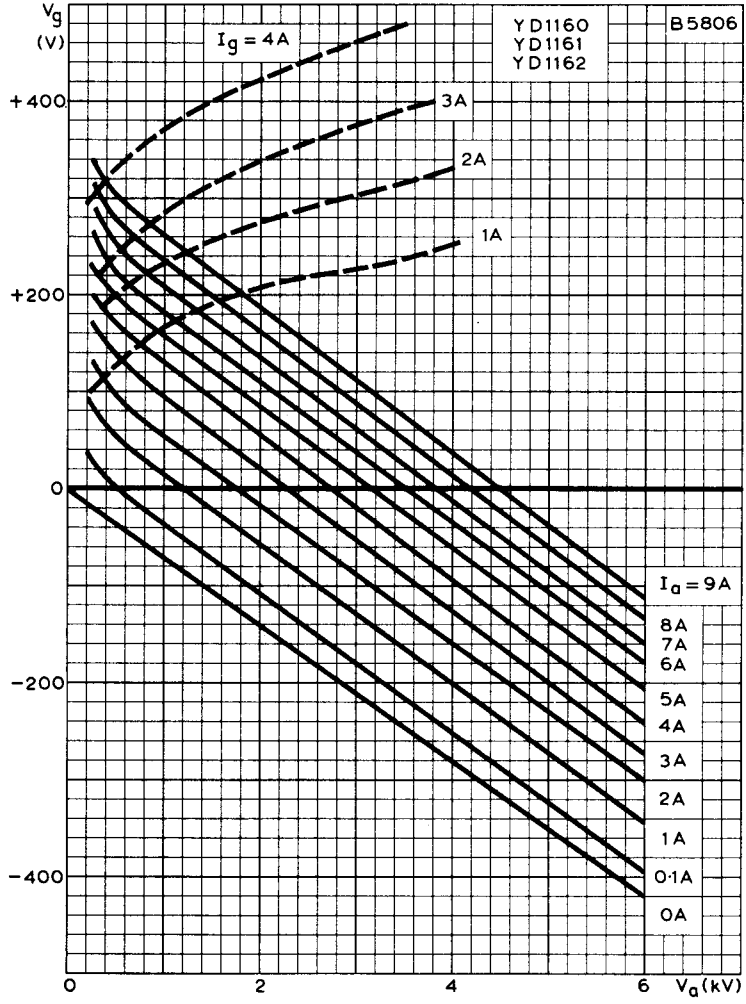


OUTLINE DRAWING OF YD1162

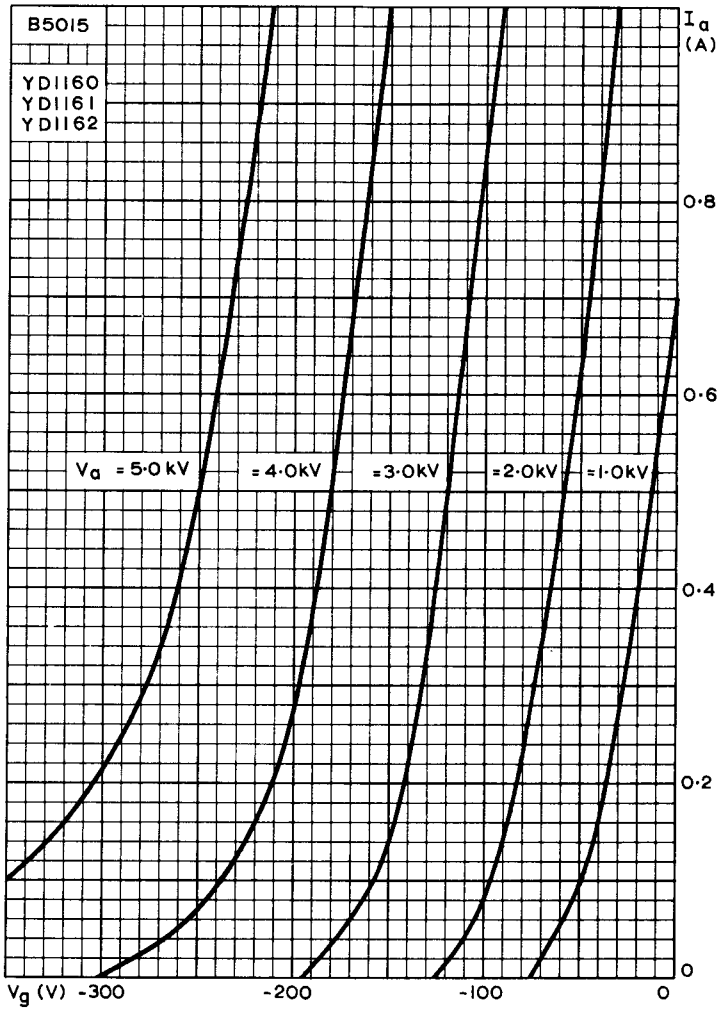


All dimensions in mm

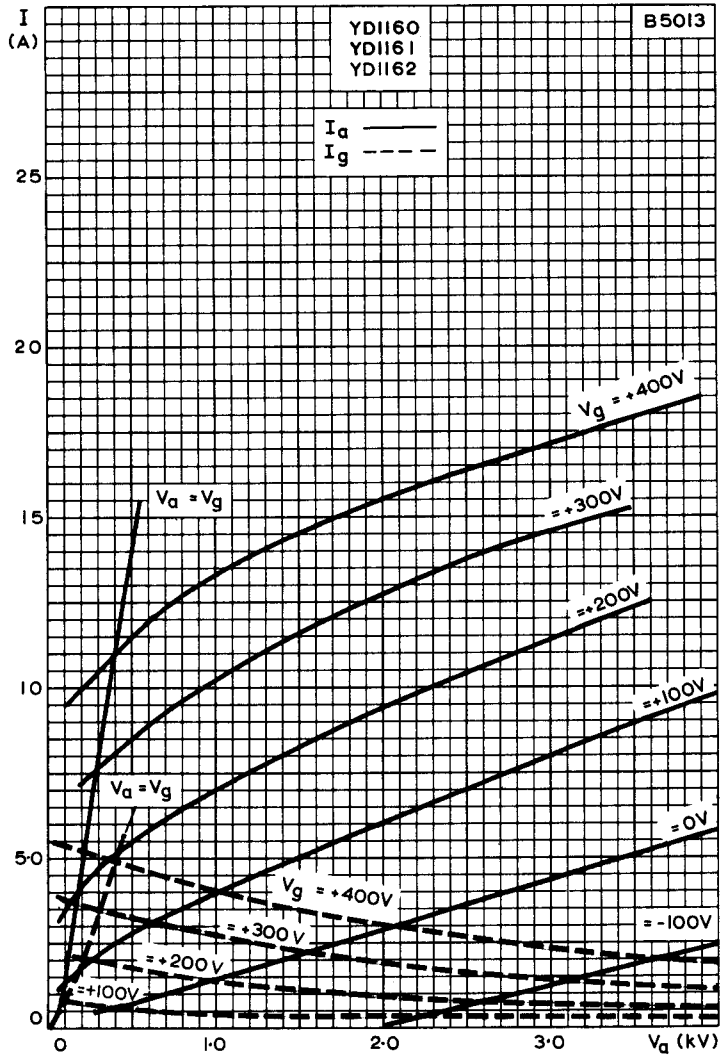
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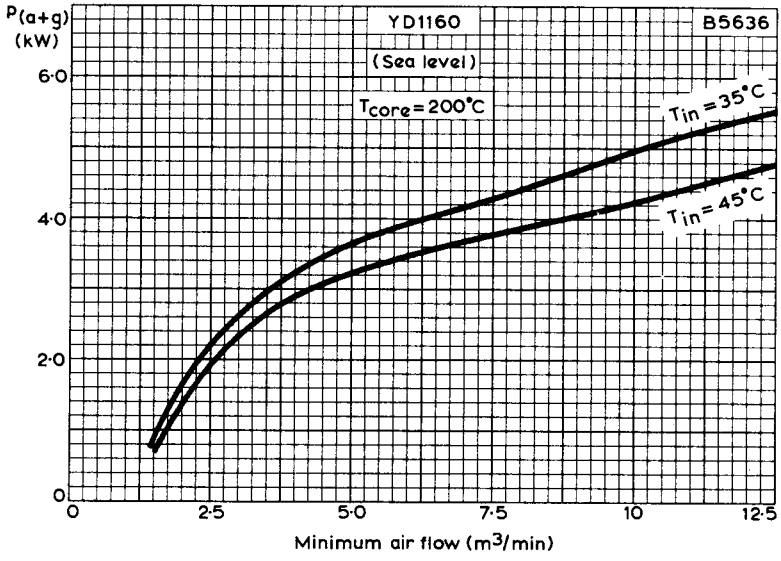
CONSTANT CURRENT CHARACTERISTICS

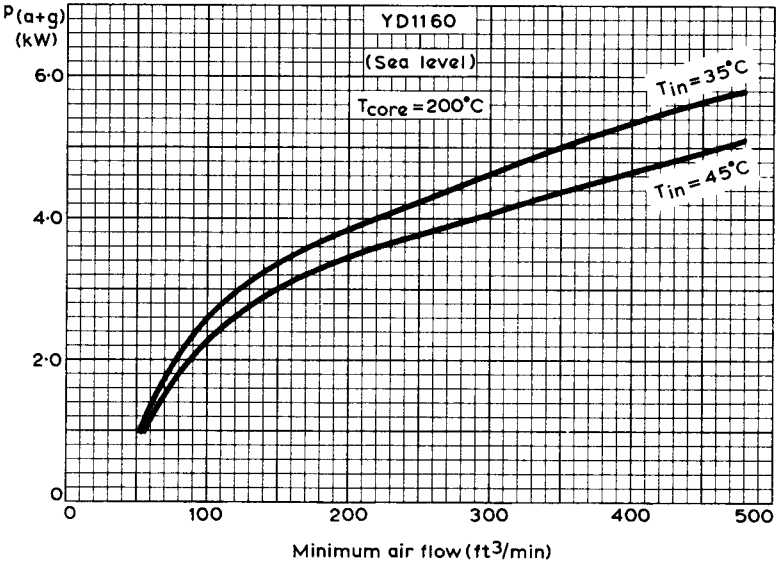


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER

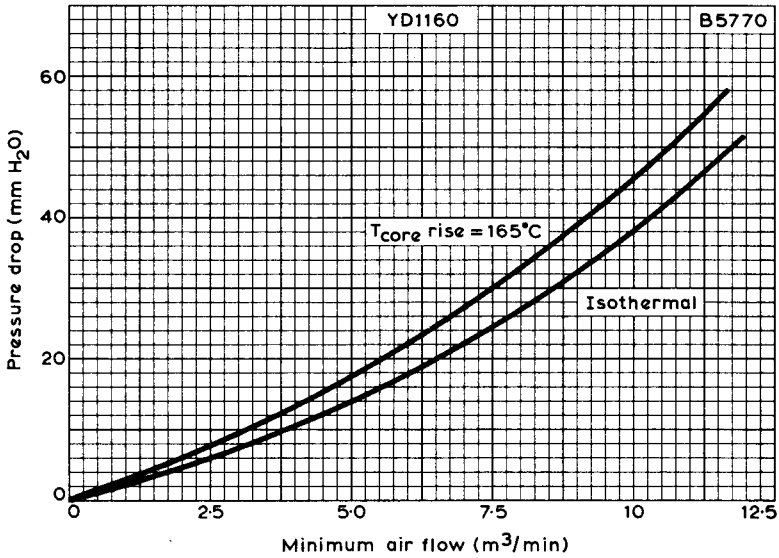


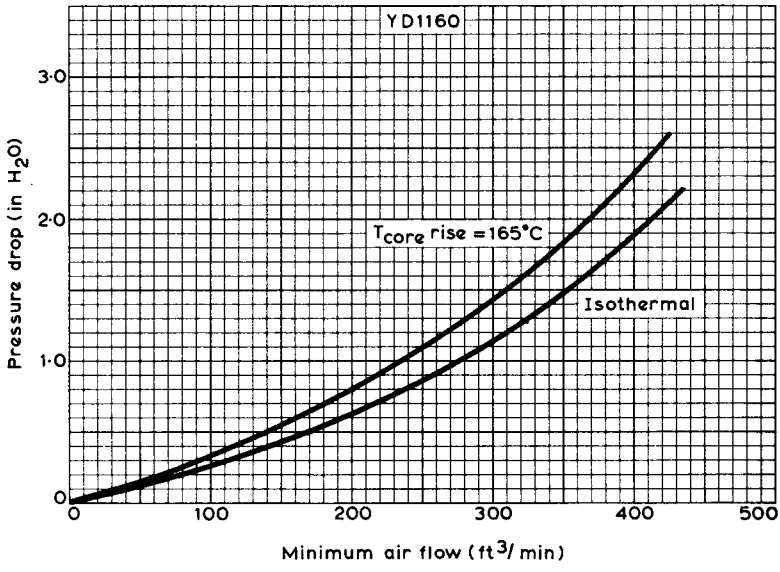
ANODE AND GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



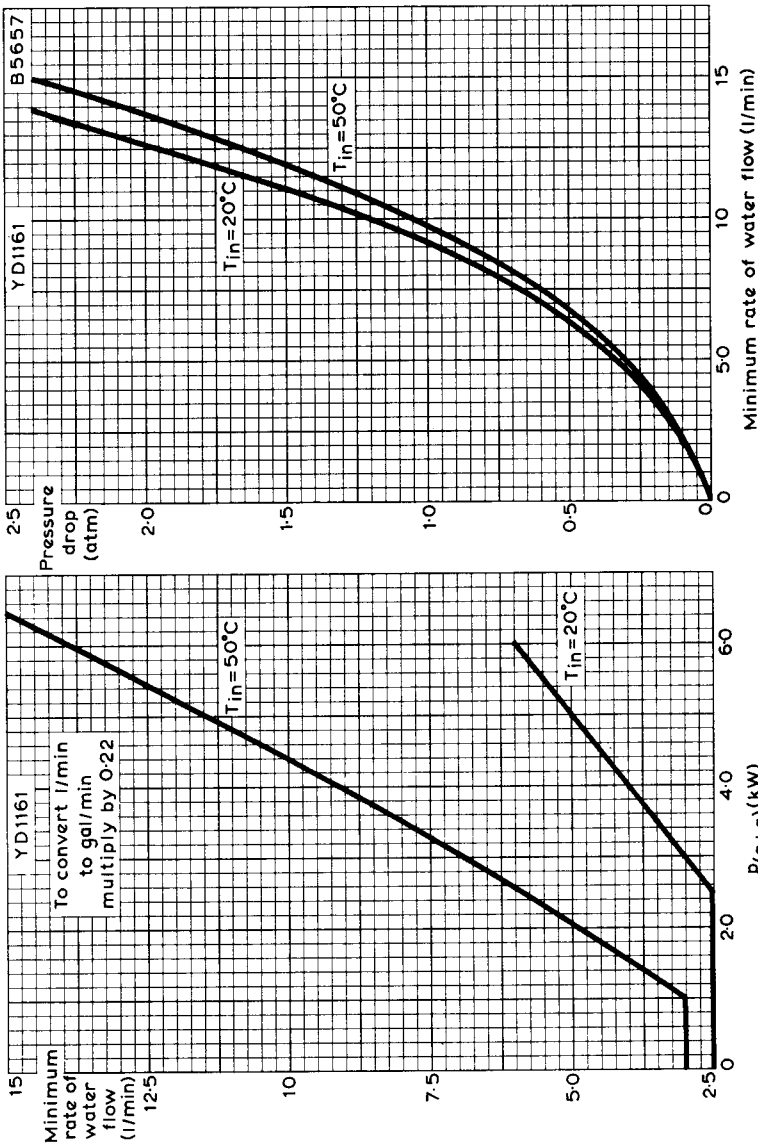


MINIMUM COOLING REQUIREMENTS WITH AIR INLET TEMPERATURES OF 35 AND 45°C AT SEA LEVEL. RADIATOR CORE TEMPERATURE = 200°C

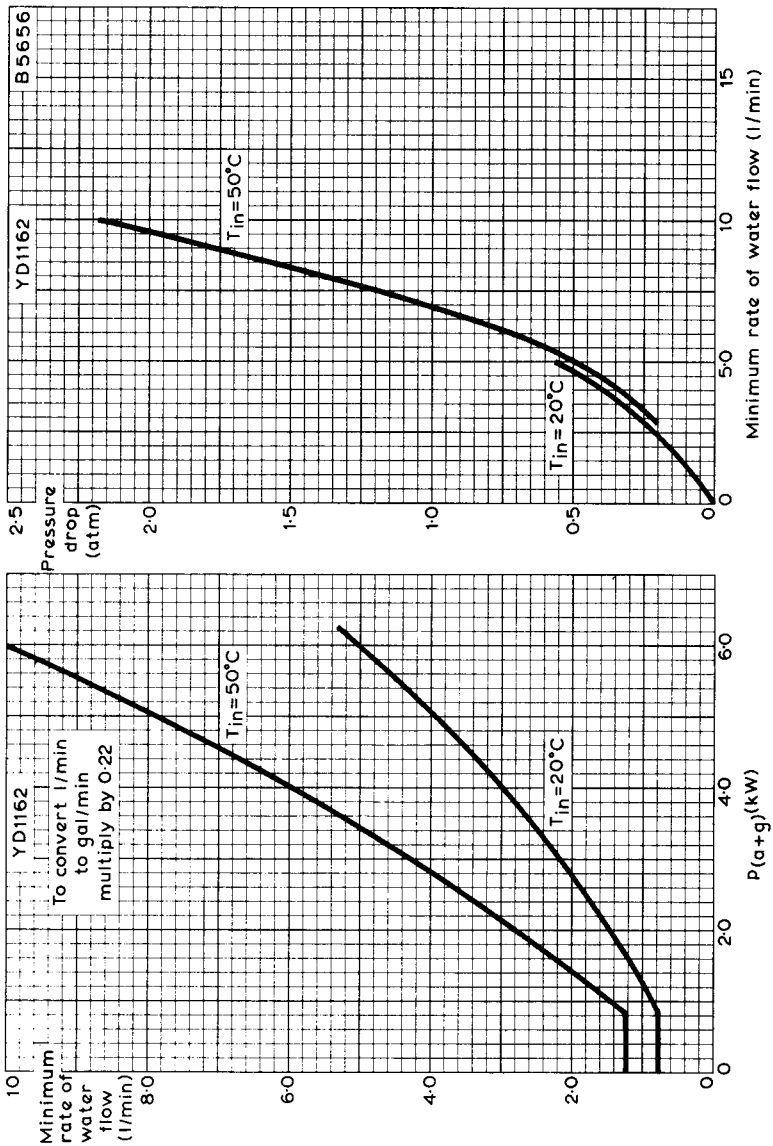




PRESSURE DROP PLOTTED AGAINST MINIMUM AIR FLOW FOR AN ISOTHERMAL CONDITION AND FOR A RISE IN CORE TEMPERATURE OVER INCOMING AIR OF 165°C



MINIMUM RATE OF WATER FLOW PLOTTED AGAINST ANODE AND GRID DISSIPATION FOR T_{in}=20 AND 50°C
PRESSURE DROP PLOTTED AGAINST MINIMUM RATE OF WATER FLOW FOR T_{in}=20 AND 50°C



MINIMUM RATE OF WATER FLOW PLOTTED AGAINST ANODE AND GRID DISSIPATION FOR T_{in}=20 AND 50°C

PRESSURE DROP PLOTTED AGAINST MINIMUM RATE OF WATER FLOW FOR T_{in}=20 AND 50°C

V.H.F. INDUSTRIAL TRIODES

YD1160
YD1161
YD1162

QUICK REFERENCE DATA

External anode triode, ceramic-metal construction, intended for use as class 'C' industrial oscillator.

The YD1160 is forced-air cooled.
The YD1161 is water cooled by means of a separate jacket.
The YD1162 has an integral helical water cooler.

f	27.12	150	MHz
P_{out} (less P_{drive})	8.8	7.15	kW
f max.	150		MHz
V_a max.	7.2		kV
p_a max.	5.0		kW

Unless otherwise shown, data is applicable to all types

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

INDUSTRIAL OSCILLATOR, CLASS 'C'

f	27.12	27.12	150	MHz
P_{out}	7.9	9.2	7.5	kW
P_{out} (less P_{drive})	7.5	8.8	7.15	kW
P_{load}	6.4	7.5	6.4*	kW
Duty factor	1.0	1.0	1.0	
η_a	82.5	78.5	75.5	%
V_a	6.0	6.5	5.0	kV
I_a	1.6	1.8	2.0	A
$-V_g$	615	690	480	V
I_g on load	480	430	480	mA
off load	600	580	650	mA
R_{g-f}	1.3	1.6	1.0	kΩ
Feedback ratio $v_{in(pk)}/v_{a(pk)}$	0.15	0.16	0.15	
P_{drive}	400	400	350	W
p_a	1.7	2.5	2.45	kW
p_g	120	110	100	W
V_f	6.3	6.3	5.8	V

*In typical cavity circuit.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

f	≤85	≤150	MHz
V_a max.	7.2	6.0	kV
P_{in} max.	12.5	11.0	kW
$-V_g$ max.	1.0	1.0	kV
I_g max. on load	550	550	mA
off load	750	750	mA
I_k max.	2.8	2.8	A
$i_{k(pk)}$ max.	15	15	A
p_a max.	5.0	5.0	kW
p_g max.	250	250	W
R_{g-f} max.	20	20	kΩ

CATHODE

Directly heated, thoriated tungsten

*V_f	6.3	V
I_f	66	A

*It is recommended that the filament voltage be reduced to 5.8V at 150MHz operating frequency.

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

CAPACITANCES

c_{a-g}	19	pF
c_{a-f}	0.5	pF
c_{g-f}	16	pF

CHARACTERISTICS (measured at V_a = 2.0kV, I_a = 1.0A)

g_m	22	mA/V
μ	20	

MOUNTING POSITION - YD1160, YD1162 Vertical, anode up or down
- YD1161 Vertical, anode down

COOLING

Maximum temperature of ceramic-metal seals 220 °C

YD1160 - Forced air cooled. See curves on pages C4 and C5

YD1161 - Anode - water cooled using jacket type K713

Seals - low velocity air flow may be required

See curves on page C6

YD1162 - Anode - water cooled with integral helical cooler

Seals - low velocity air flow may be required

See curves on page C7

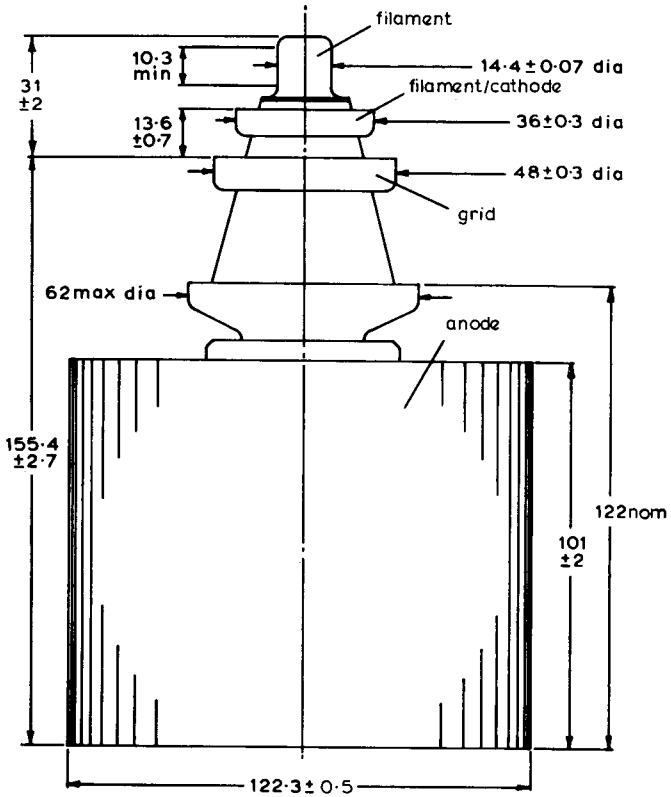
PHYSICAL DATA

	YD1160	YD1161	YD1162	
Weight of valve	8.5	1.5	2.3	lb
	3.9	0.66	1.03	kg
Weight of insulating pedestal	4.6	-	-	lb
	2.1	-	-	kg
Weight of insulating pedestal plus carton	6.8	-	-	lb
	3.1	-	-	kg
Weight of water jacket	-	1.6	-	lb
	-	0.73	-	kg

ACCESSORIES

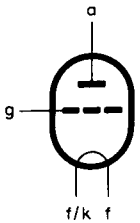
Filament connector	40688
Filament/cathode connector (f < 30MHz)	40689
Grid connector (f ≤30MHz)	40686
(f > 30MHz)	40687 ←
Insulating pedestal ×1 (YD1160)	40630
Water jacket ×1 (YD1161)	K726

OUTLINE DRAWING OF YD1160

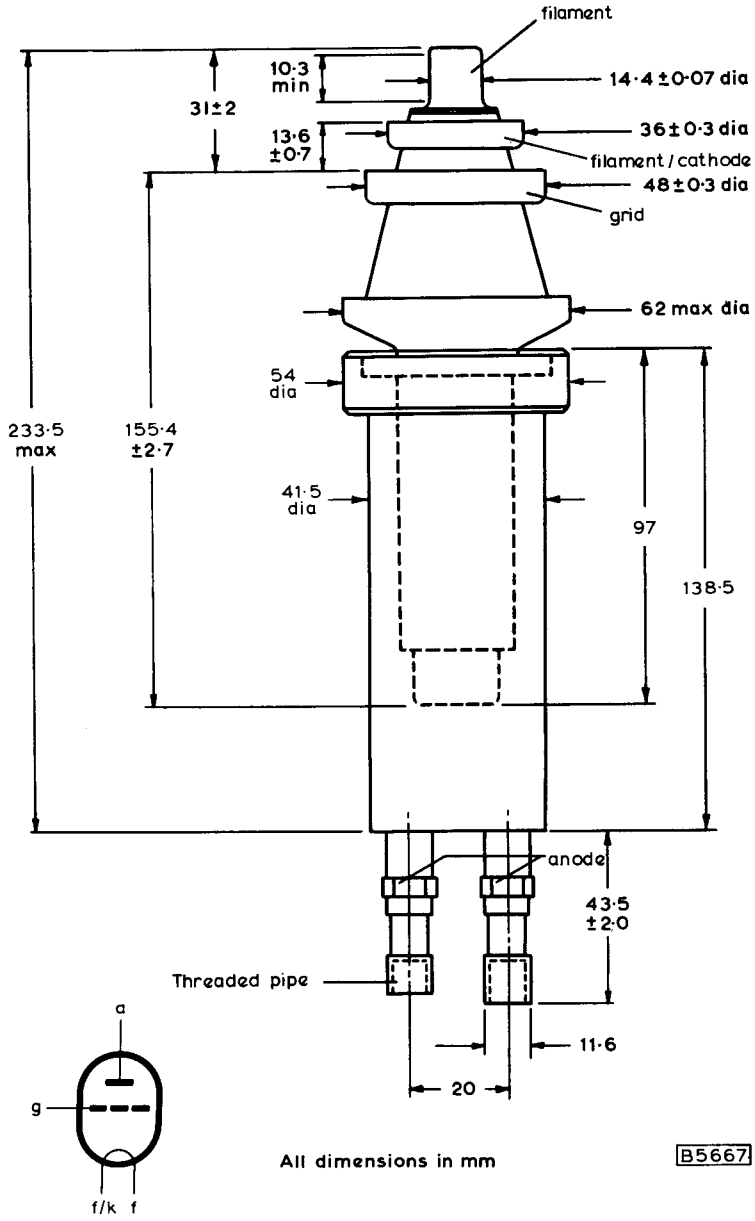


All dimensions in mm

B5632



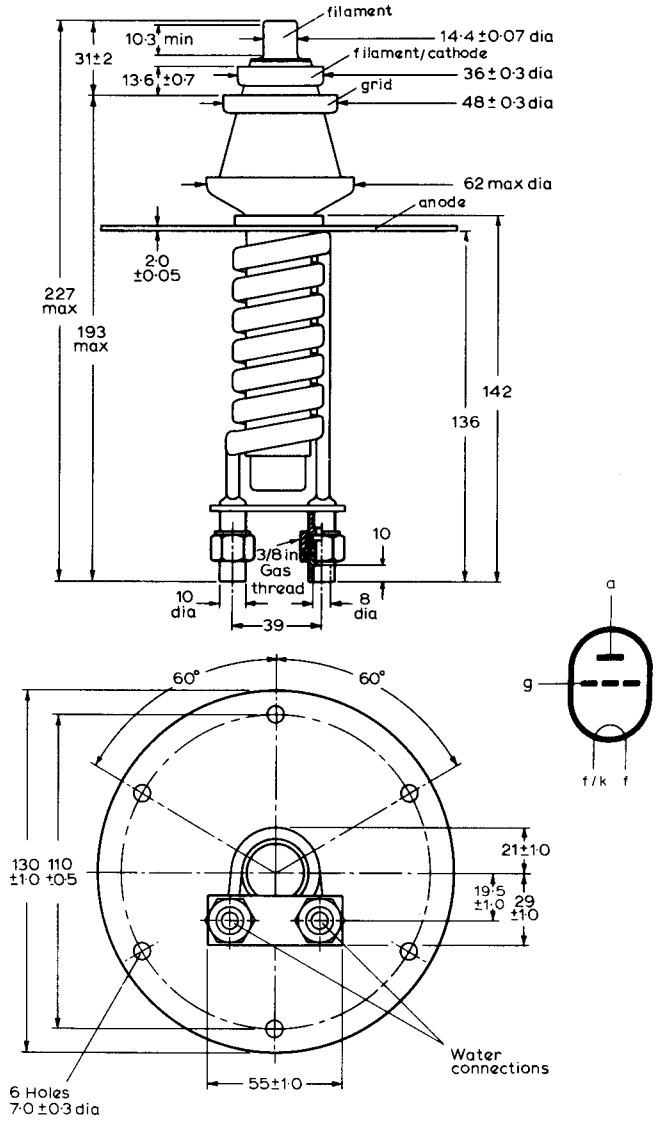
OUTLINE DRAWING OF YD1161 MOUNTED IN WATER JACKET K726



All dimensions in mm

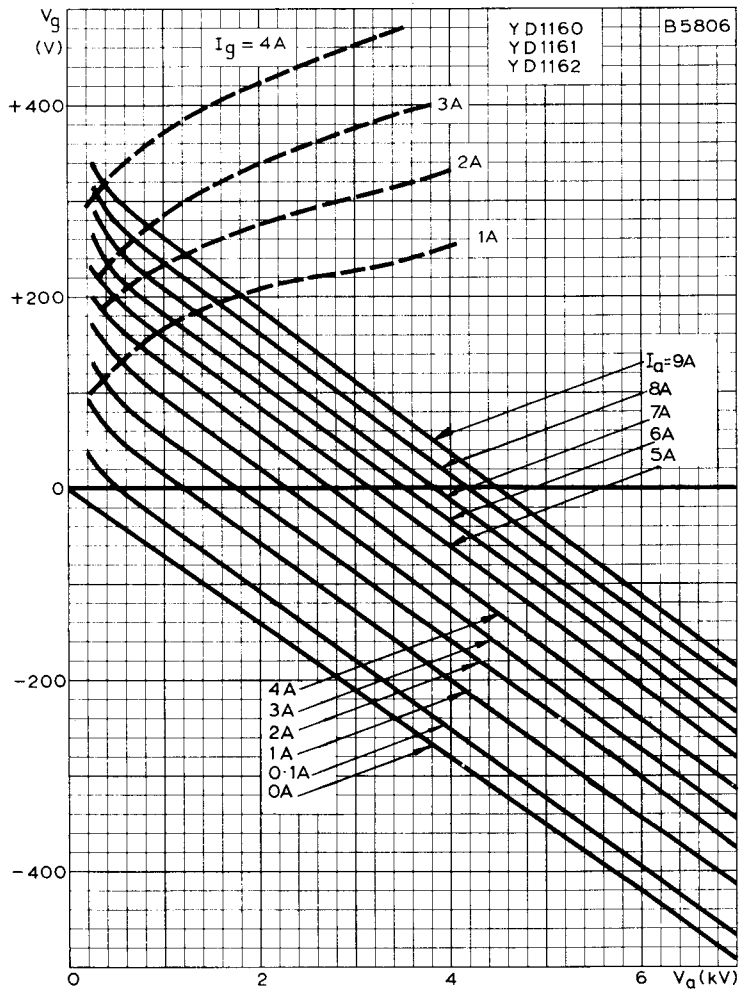
B5667

OUTLINE DRAWING OF YD1162

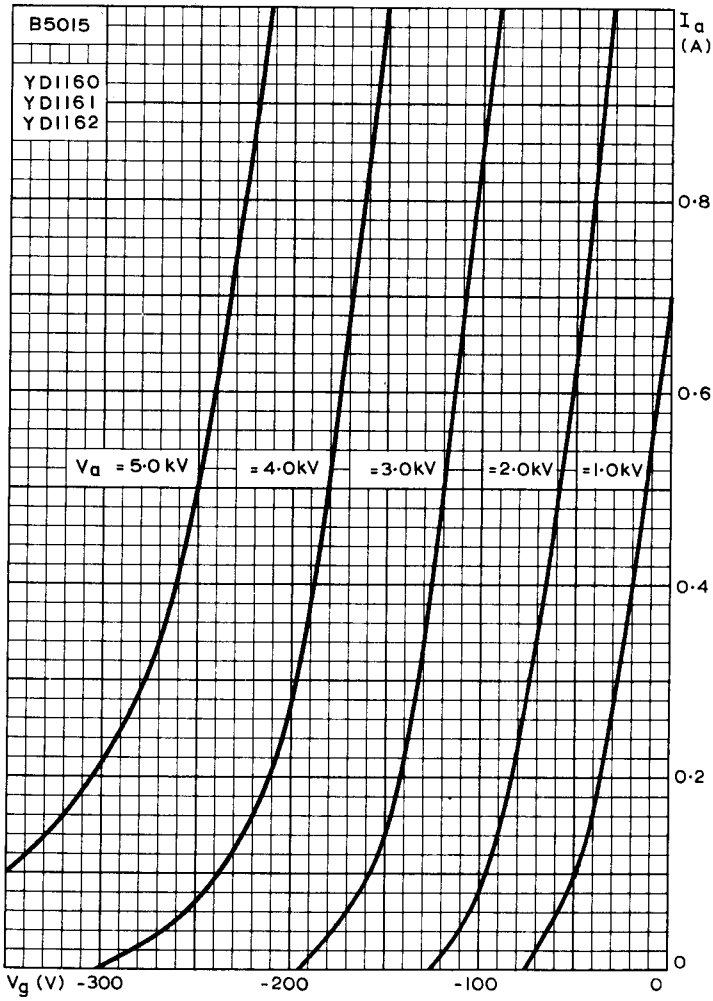


All dimensions in mm

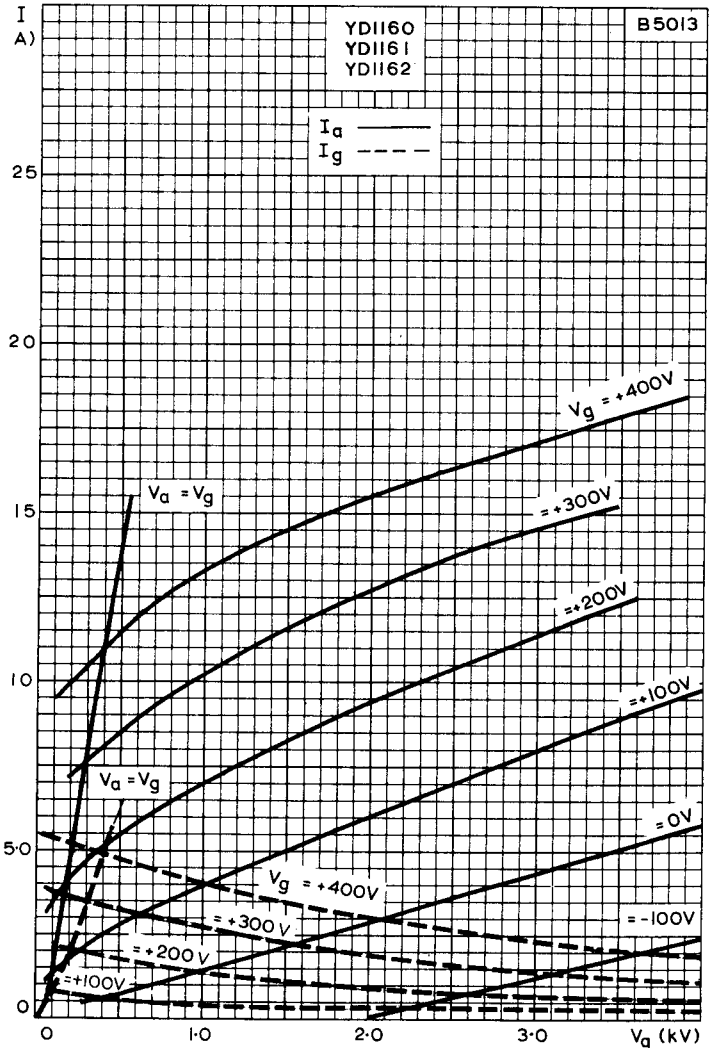
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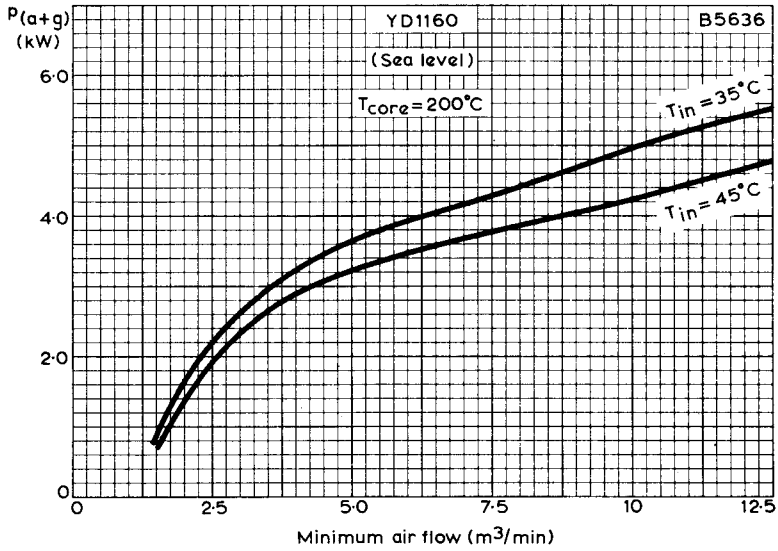
CONSTANT CURRENT CHARACTERISTICS

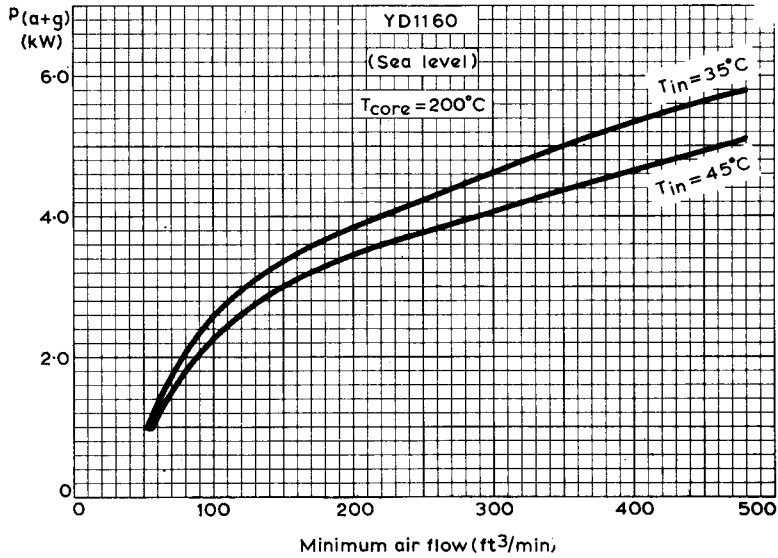


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER

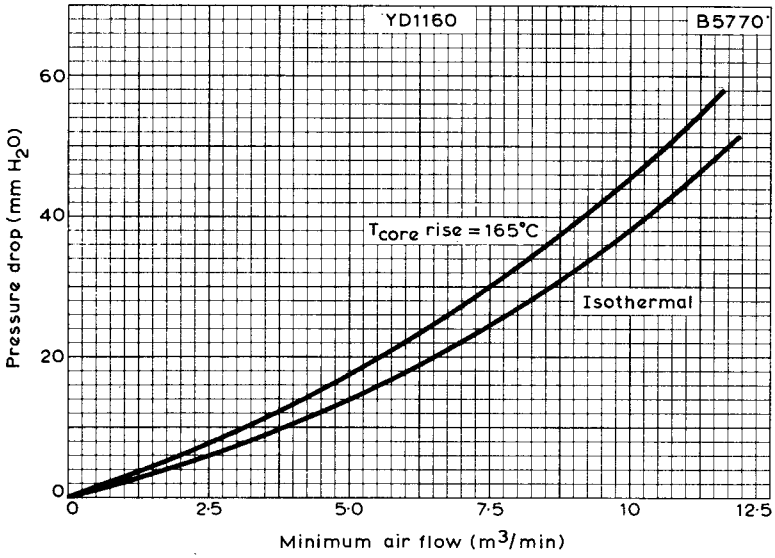


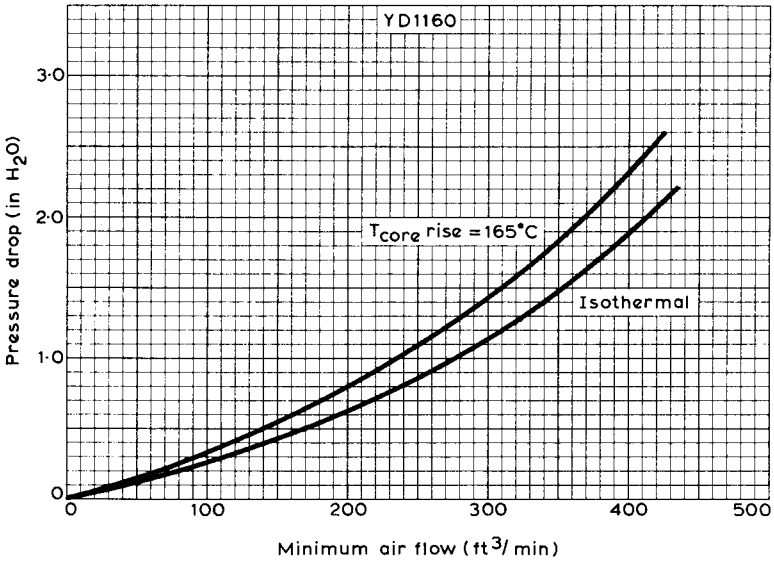
ANODE AND GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



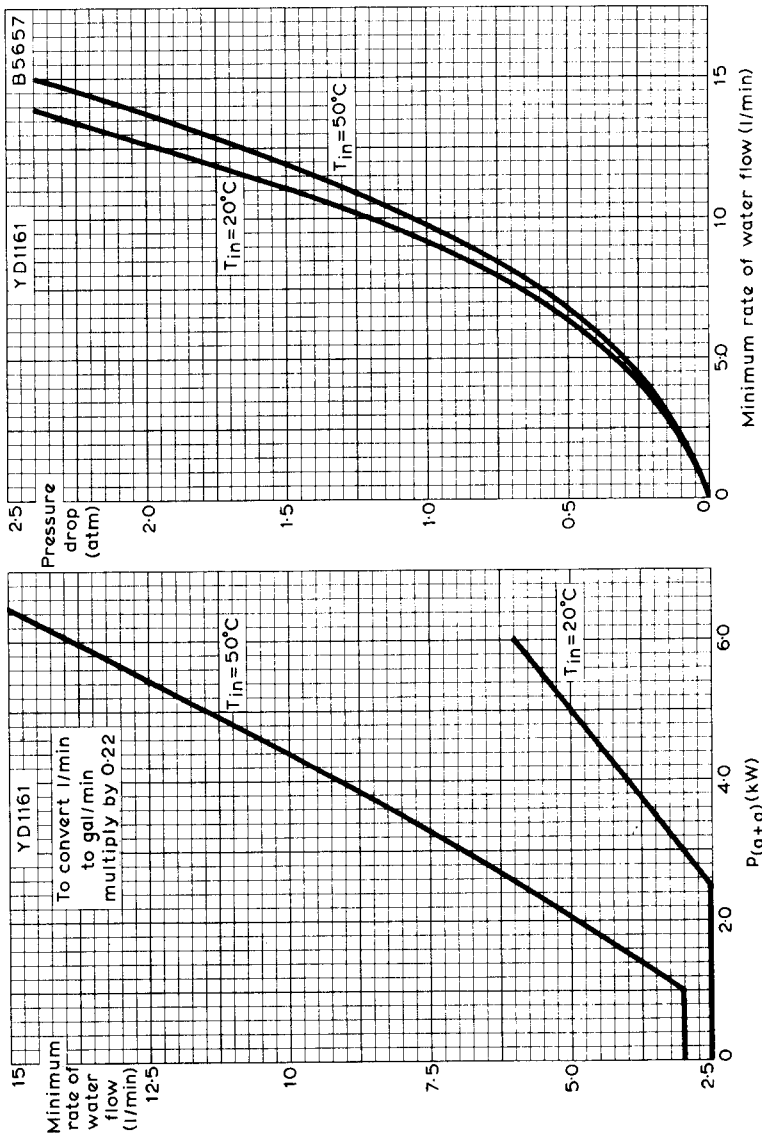


MINIMUM COOLING REQUIREMENTS WITH AIR INLET TEMPERATURES OF 35 AND 45°C AT SEA LEVEL. RADIATOR CORE TEMPERATURE = 200°C

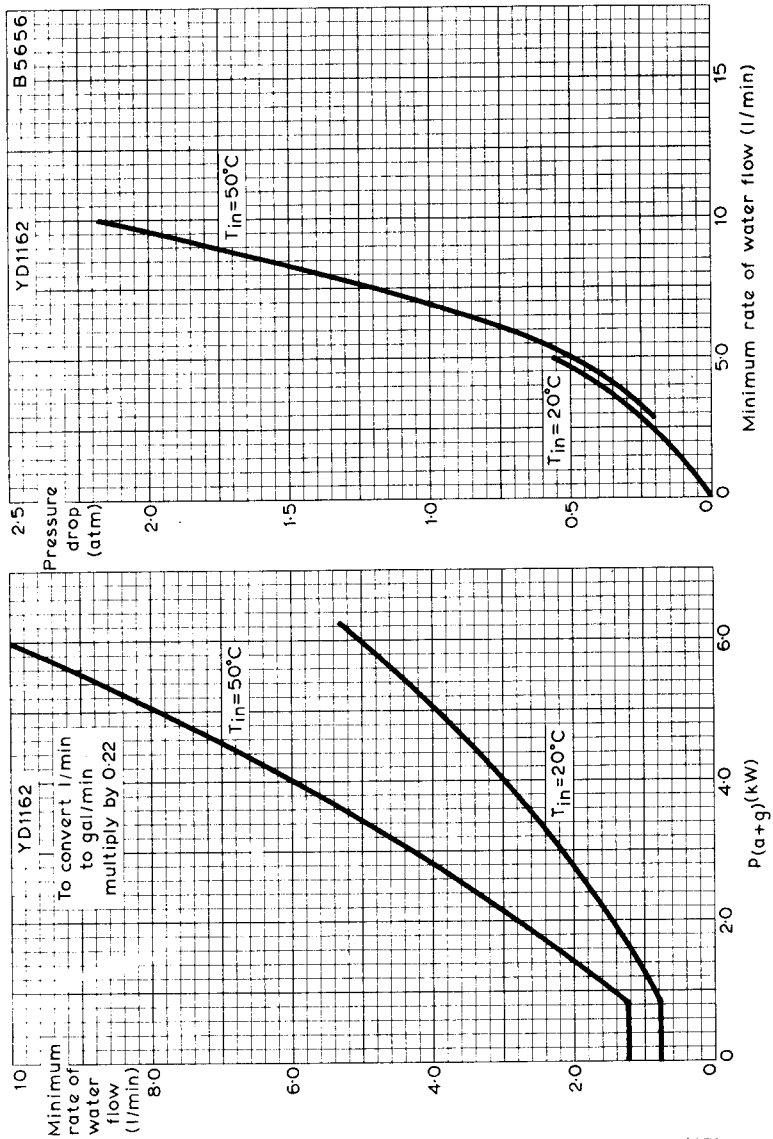




PRESSURE DROP PLOTTED AGAINST MINIMUM AIR FLOW FOR AN ISOTHERMAL CONDITION AND FOR A RISE IN CORE TEMPERATURE OVER INCOMING AIR OF 165°C



MINIMUM RATE OF WATER FLOW PLOTTED AGAINST ANODE AND GRID DISSIPATION FOR T_{in}=20 AND 50°C
PRESSURE DROP PLOTTED AGAINST MINIMUM RATE OF WATER FLOW FOR T_{in}=20 AND 50°C



MINIMUM RATE OF WATER FLOW PLOTTED AGAINST ANODE AND GRID DISSIPATION FOR T_{in} = 20 AND 50°C
PRESSURE DROP PLOTTED AGAINST MINIMUM RATE OF WATER FLOW FOR T_{in} = 20 AND 50°C

V.H.F. INDUSTRIAL TRIODES

YD1170
YD1171
YD1172

TENTATIVE DATA

QUICK REFERENCE DATA

External anode triode, of ceramic to metal construction, intended for use as an industrial oscillator at frequencies up to 120 MHz.
The YD1170 is forced-air cooled.
The YD1171 is water cooled by means of a separate water jacket.
The YD1172 has an integral helical water cooler.

f	120	MHz
P_{out} (less P_{drive})	15.4	kW
f max.	120	MHz
V_a max.	7.2	kV
p_a max.	10	kW

Unless otherwise stated, data is applicable to all types

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

INDUSTRIAL OSCILLATOR, CLASS 'C'

OPERATING CONDITIONS

f	120	MHz
P_{out}	16.2	kW
P_{out} (less P_{drive})	15.4	kW
P_{load}	13.5*	kW
Duty factor	1.0	
η_a	79.4	%
V_a	6.0	kV
I_a	3.4	A
$-V_g$	460	V
I_g on load	920	mA
I_g off load	1.35	A
R_{g-f}	500	Ω
Feedback ratio $v_{in(pk)}/v_{a(pk)}$	0.13	
p_a	4.2	kW
p_g	275	W

*Cavity circuit, 90% transfer.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

f max.	120	MHz
P_{in} max.	24	kW
V_a max.	7.2	kV
$-V_g$ max.	1.5	kV
I_a max.	4.0	A
I_g max. on load	1.0	A
off load	1.5	A
I_k max.	4.8	A
$i_{k(pk)}$ max.	25	A
p_a max.	10	kW
R_{g-f} max.	10	kΩ

CATHODE

Directly heated, thoriated tungsten

V_f <100MHz	5.8	V
100-120MHz	5.5	V
I_f	130	A
$i_{f(pk)}$ max. (starting)	800	A
r_f (cold)	0.0056	Ω

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

CAPACITANCES

c_{a-g}	24	pF
c_{g-f}	47	pF
c_{a-f}	0.6	pF

CHARACTERISTICS (at V_a=6.0kV, I_a=2.0A)

g_m	33	mA/V
μ	29	

MOUNTING POSITION - YD1170, YD1172 Vertical, anode up or down
YD1171 Vertical, anode down

COOLING

YD1170

Anode - Forced-air cooled

Seals - At the higher values of anode dissipation and at the highest operating frequencies additional cooling is required.

Temperatures

All seals max.	200	°C
Envelope max.	200	°C
Air inlet max.	45	°C

Anode dissipation	Height above sea level	Inlet temperature	Outlet temperature	Rate of air flow per minute		Pressure difference between inlet and outlet
(kW)	(km)	(°C)	(°C)	(m^3)	(ft^3)	(mm H_2O)
10	0	35	94	9.5	335	55
8.0	0	35	105	6.5	229	28
6.0	0	35	113	4.5	159	15
4.0	0	35	117	3.0	106	8.0
10	0	45	98	11.0	388	69
8.0	0	45	108	7.6	265	35
6.0	0	45	115	5.2	184	19
4.0	0	45	119	3.5	123	10
10	1.5	35	94	11.4	405	63
8.0	1.5	35	105	7.8	273	32
6.0	1.5	35	113	5.4	194	17
4.0	1.5	35	117	3.6	131	9.0
10	3.0	25	90	12	424	62
8.0	3.0	25	102	8.2	291	32
6.0	3.0	25	111	5.7	203	17
4.0	3.0	25	116	3.8	138	9.0

YD1171

Anode - Water cooled (separate water jacket)

Seals - For frequencies >4 MHz air cooling is required.

Temperatures

All seals max.	200	°C
Envelope max.	200	°C
Water inlet max.	50	°C

Anode dissipation	Inlet temperature	Outlet temperature	Rate of water flow per minute		Pressure difference between inlet and outlet
(kW)	(°C)	(°C)	(litres)	(gal)	(atm)
10	20	36	10	2.2	0.6
8.0	20	37	7.8	1.72	0.38
6.0	20	38	5.7	1.25	0.22
10	50	61	15	3.3	1.25
8.0	50	62	11.3	2.49	0.75
6.0	50	62	8.2	1.80	0.42

For inlet temperatures between 20 and 50°C the required water flow can be found by linear interpolation.

YD1172

Anode - Water cooled (integral cooler)

Seals - For frequencies >4 MHz air cooling is required.

Temperatures

All seals max.	200	°C
Envelope max.	200	°C
Water inlet max.	50	°C

Anode dissipation	Inlet temperature	Outlet temperature	Rate of water flow per minute		Pressure difference between inlet and outlet
(kW)	(°C)	(°C)	(litres)	(gal)	(atm)
10	20	46	6.0	1.32	0.25
8.0	20	49	4.5	0.99	0.15
6.0	20	53	3.0	0.66	0.07
10	50	67	9.0	1.98	0.52
8.0	50	69	6.7	1.47	0.31
6.0	50	72	4.5	0.99	0.15

For inlet temperatures between 20 and 50°C the required water flow can be found by linear interpolation.

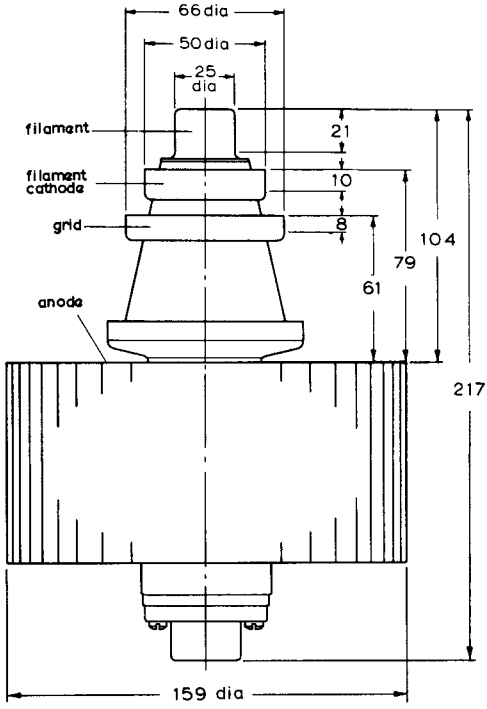
PHYSICAL DATA

	YD1170	YD1171	YD1172	
Weight of valve	7.5	1.5	2.0	kg
	16.5	3.3	4.4	lb
Weight of insulating	4.25	-	-	kg
pedestal	9.4	-	-	lb
Weight of water jacket	-	2.0	-	kg
	-	4.4	-	lb

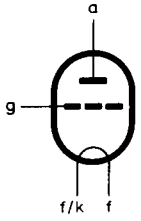
ACCESSORIES

Filament connector	40692
Filament/cathode connector	40693
Grid connector (f≤4.0MHz)	40690
Grid connector (f>4.0MHz)	40691
Filament cables ×2	40715
Insulating pedestal (YD1170)	40654
Water jacket (YD1171)	K727

OUTLINE DRAWING OF YD1170

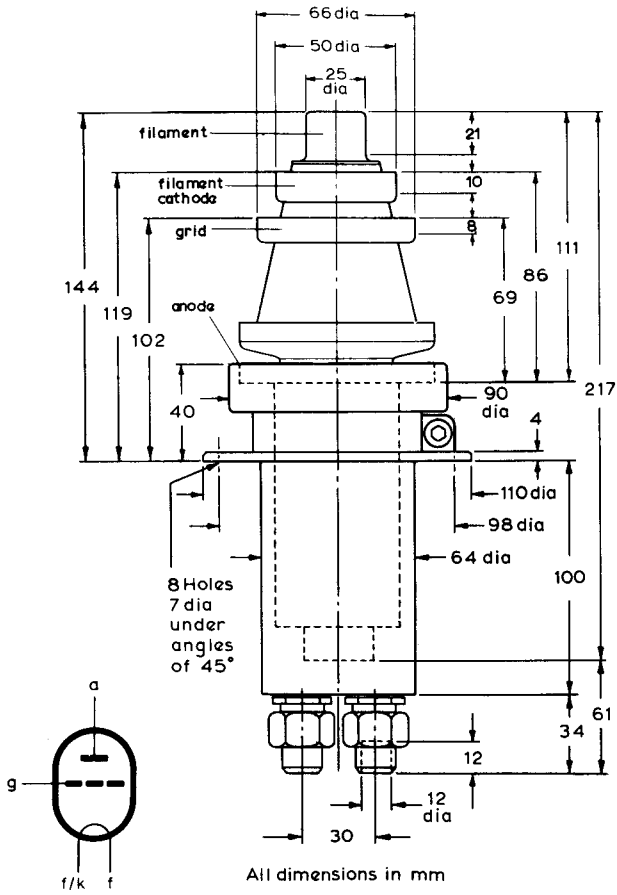


All dimensions in mm



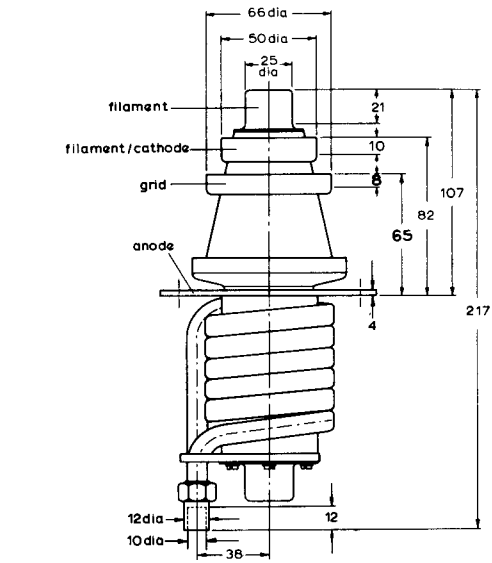
B5767

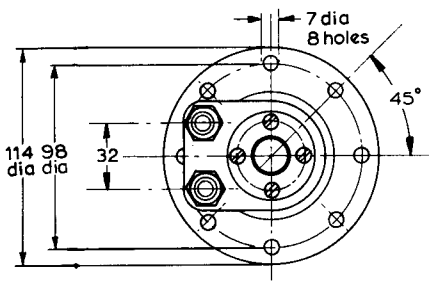
OUTLINE DRAWING OF YD1171 MOUNTED IN WATER JACKET K727

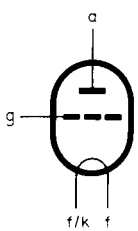


B5751

OUTLINE DRAWING OF YD1172

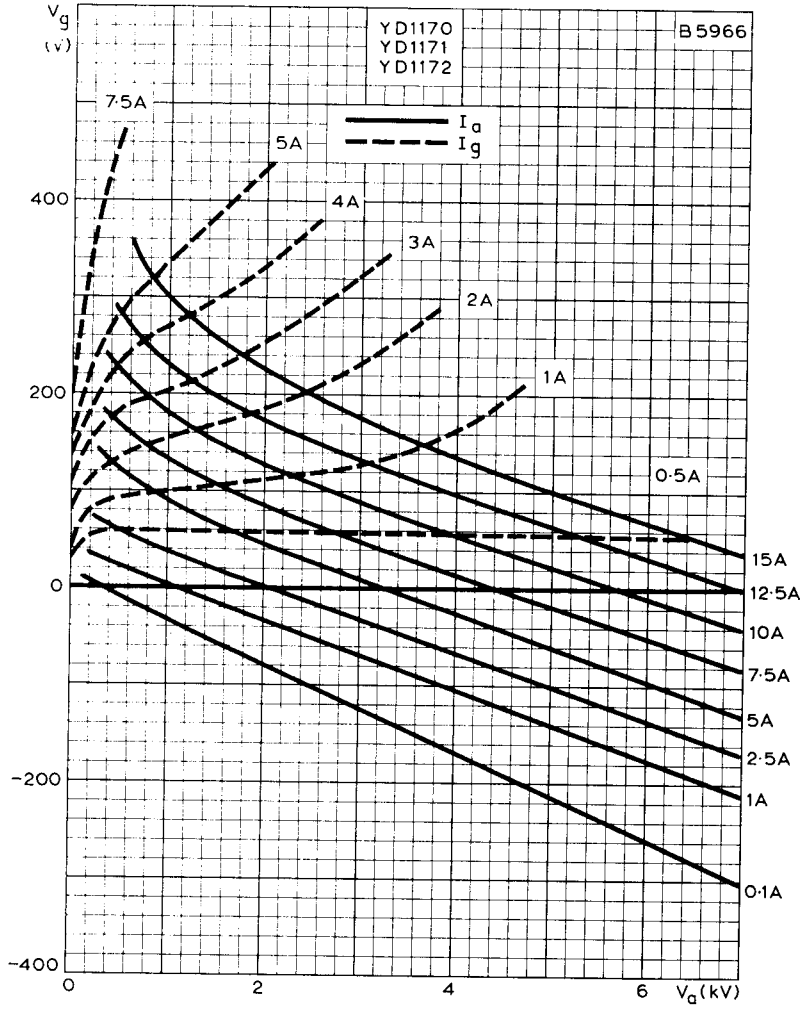






All dimensions in mm

B6734



CONSTANT CURRENT CHARACTERISTICS

R.F. INDUSTRIAL TRIODE

YD1182

TENTATIVE DATA

QUICK REFERENCE DATA

External anode triode of ceramic-metal construction, water cooled by means of an integral water cooler, intended for use as a class 'C' industrial oscillator.

f	≤80	MHz
P_{out} (less P_{drive})	30	kW
f max.	80	MHz
V_a max.	9.0	kV
p_a max.	20	kW

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

INDUSTRIAL OSCILLATOR, CLASS 'C'

OPERATING CONDITIONS

f	≤80	MHz
P_{out}	32.4	kW
P_{out} (less P_{drive})	30	kW
P_{load}	25.5	kW
Duty factor	1.0	
η_a	80	%
V_a	7.5	kV
I_a	5.4	A
$-V_g$	653	V
I_g	1.45	A
R_{g-f}	450	Ω
Feedback ratio $v_{in(pk)}/v_{a(pk)}$	0.17	
P_{drive}	2.4	kW
p_a	8.1	kW

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

f max.	80	MHz
V_a max.	9.0	kV
$-V_g$ max.	1.5	kV
I_g max. on load	1.6	A
off load	2.4	A
I_k max.	7.5	A
$i_{k(pk)}$ max.	40	A
P_{in} max.	45	kW
p_a max.	20	kW
R_{g-f} max.	10	kΩ

CATHODE

Directly heated, thoriated tungsten

V_f	7.0	V
I_f	175	A
$i_{f(pk)}$ max. (starting)	1.0	kA
r_f(cold)	0.0042	Ω

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

CAPACITANCES

c_{a-g}	32	pF
c_{a-f}	1.0	pF
c_{g-f}	61	pF

CHARACTERISTICS (measured at V_a = 7.0kV, I_a = 3.5A)

g_m	60	mA/V
μ	34	

MOUNTING

Vertical, anode up or down

COOLING

Anode - water cooled with integral cooler.

Seals - low velocity air flow at frequencies >4MHz

Temperatures

Anode seal max.	200	°C
Grid seal max.	200	°C
Filament seals max.	200	°C
Envelope max.	200	°C
Water inlet max.	50	°C

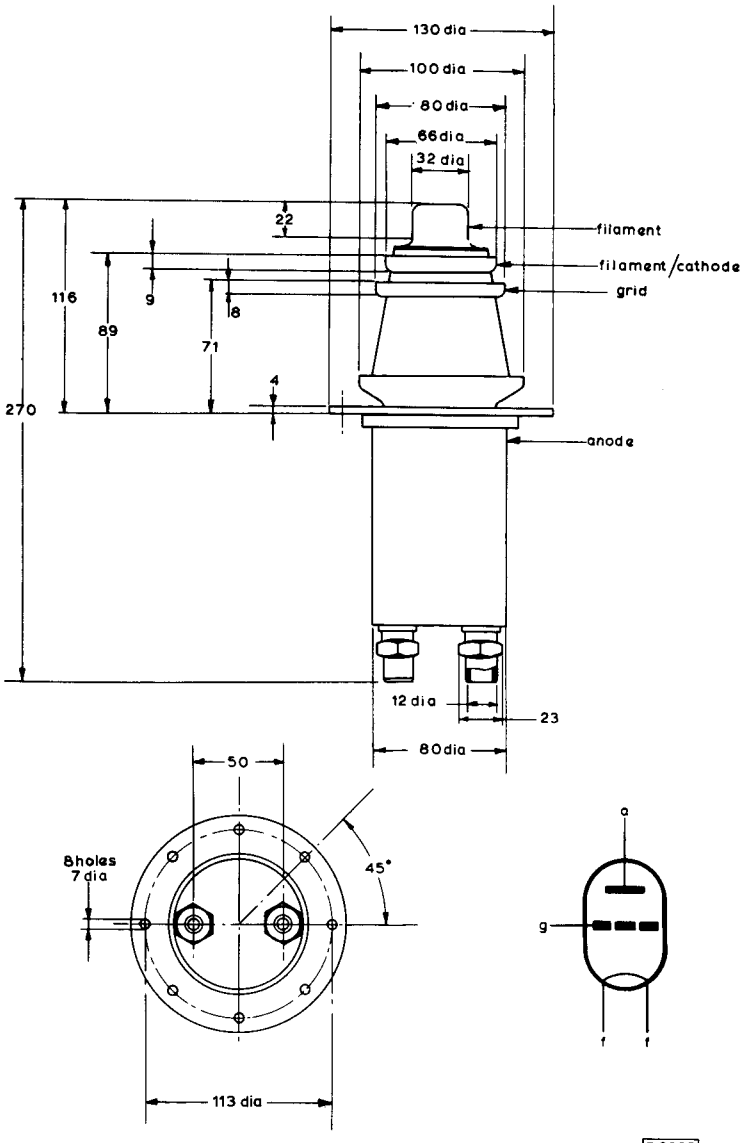
WATER COOLING CHARACTERISTICS

Anode Dissipation (kW)	Inlet Temperature (°C)	Rate of flow (l/min)	Inlet Pressure (Atm)	Outlet Temperature (°C)
20	20	15	0.7	40

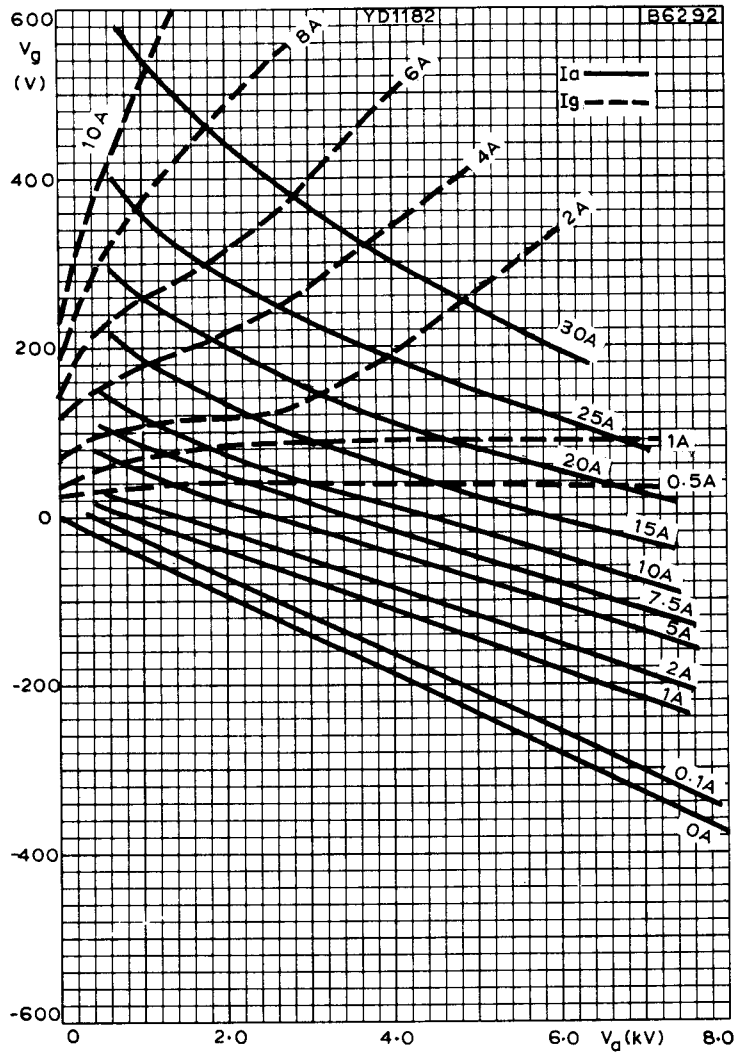
ACCESSORIES

Grid connector f ≤4.0MHz		40710
f>4.0MHz		40711
Filament connectors (both types required)		40708
	and	40709
Filament cables (× 2)		40720

OUTLINE DRAWING OF YD1182



All dimensions in mm. B6295



CONSTANT CURRENT CHARACTERISTICS

R.F. INDUSTRIAL TRIODE

YD1192

TENTATIVE DATA

QUICK REFERENCE DATA

External anode triode of ceramic-metal construction, water cooled by means of an integral water cooler, intended for use as a class 'C' industrial oscillator.

f	30	MHz
P_{out} (less P_{drive})	60	kW
f max.	30	MHz
V_a max.	9.6	kV
p_a max.	40	kW

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

INDUSTRIAL OSCILLATOR, CLASS 'C'

OPERATING CONDITIONS

f	30	MHz
P_{out}	62.3	kW
P_{out} (less P_{drive})	60	kW
P_{load}	55	kW
Duty factor	1.0	
η_a	78	%
V_a	8.0	kV
I_a	10	A
$-V_g$	675	V
I_g on load	2.25	A
off load	3.3	A
R_{g-f}	300	Ω
Feedback ratio $v_{in(pk)}/v_{a(pk)}$	0.14	
P_{drive}	2.3	kW
p_a	17.7	kW

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

f max.	30	MHz
V_a max.	9.6	kV
P_{in} max.	96	kW
$-V_g$ max.	1.5	kV
I_g max. on load	2.5	A
off load	3.5	A
I_k max.	14.5	A
$i_{k(pk)}$ max.	68	A
p_a max.	40	kW
R_{g-f} max.	10	kΩ

CATHODE

Directly heated, thoriated tungsten

*V_f	8.4	V
I_f	235	A
$i_{f(pk)}$ max. (starting)	1.0	kA
r_f (cold)	0.0039	Ω

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

CAPACITANCES

c_{a-g}	45	pF
c_{a-f}	1.7	pF
c_{g-f}	100	pF

CHARACTERISTICS (measured at $V_a = 8.0$kV, $I_a = 6.0$A)

g_m	110	mA/V
μ	31	

MOUNTING POSITION — Vertical, anode up or down

COOLING

Anode - water cooled with integral cooler

Seals - low velocity air flow at frequencies >4MHz

Temperatures

Anode seal max.	200	°C
Grid seal max.	200	°C
Filament seals max.	200	°C
Envelope max.	200	°C
Water inlet max.	50	°C

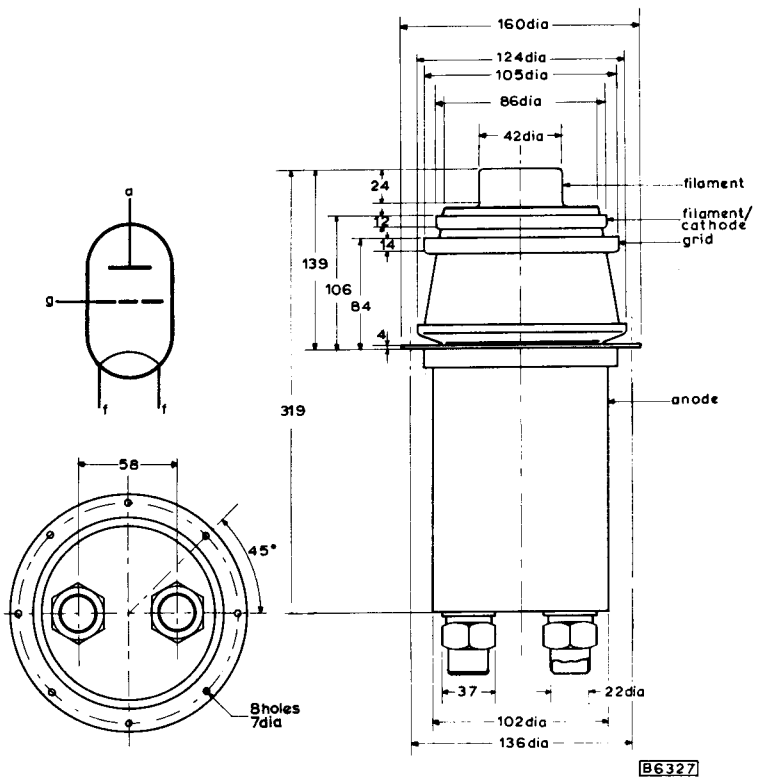
WATER COOLING CHARACTERISTICS

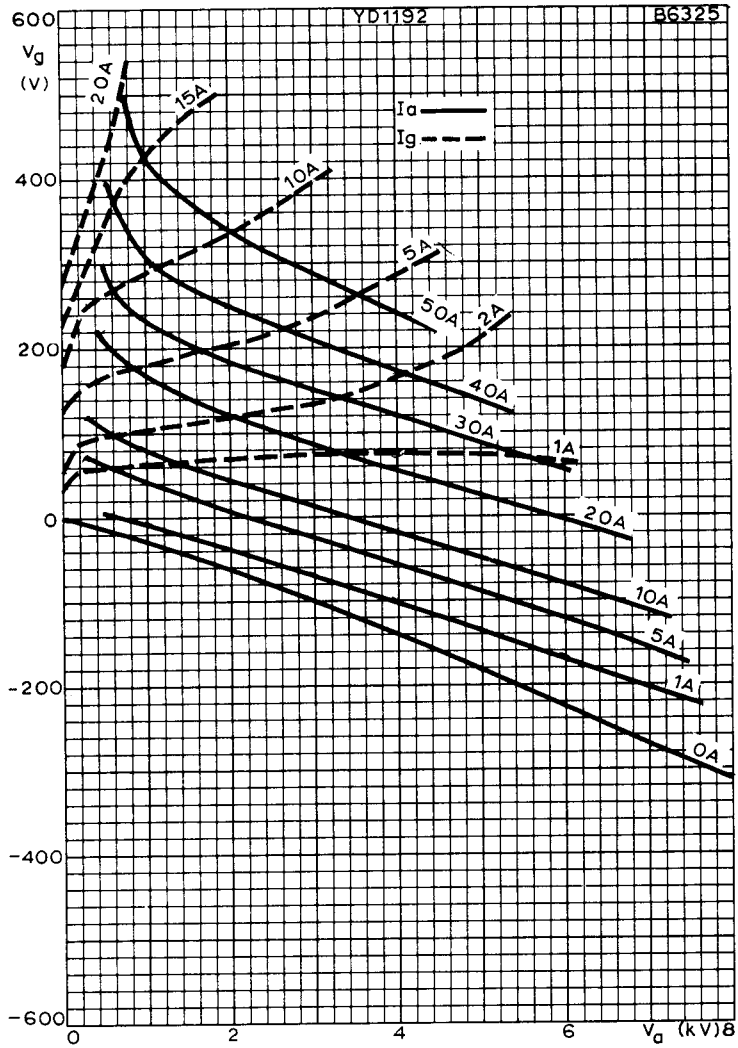
Anode Dissipation (kW)	Inlet Temperature (°C)	Rate of flow (l/min)	Inlet Pressure (Atm)	Outlet Temperature (°C)
40	20	30	0.7	40

ACCESSORIES

Grid connector (f ≤4.0MHz)		40707
Filament connectors (both types required)		40705
	and	40706
Filament cables		40718
	and	40719

OUTLINE DRAWING OF YD1192





CONSTANT CURRENT CHARACTERISTICS

R.F. INDUSTRIAL TRIODE

YD1212

TENTATIVE DATA

QUICK REFERENCE DATA

External anode triode of ceramic-metal construction, water cooled by means of an integral cooler, intended for use as a class 'C' industrial oscillator.

f	≤30	MHz
P_{out} (less P_{drive})	240	kW
f max.	30	MHz
V_a max.	16.8	kV
p_a max.	120	kW

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

INDUSTRIAL OSCILLATOR, CLASS 'C'

OPERATING CONDITIONS

f	30	MHz
P_{out}	247.5	kW
P_{out} (less P_{drive})	240	kW
P_{load}	215*	kW
Duty factor	1.0	
η_a	75.2	%
V_a	14	kV
I_a	23.5	A
$-V_g$	900	V
I_g on load	6.0	A
off load	6.4	A
R_{g-f}	150	Ω
Feedback ratio $v_{in(pk)}/v_{a(pk)}$	0.11	
P_{drive}	7.5	kW
p_a	81.5	kW

*Cavity circuit, 90% transfer

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

f max.	30	MHz
V_a max.	16.8	kV
P_{in} max.	375	kW
$-V_g$ max.	2.0	kV
I_g max. on load	7.0	A
off load	8.5	A
I_k max.	34	A
$i_{k(pk)}$ max.	160	A
p_a max.	120	kW
p_g max.	3.0	kW
R_{g-f} max.	10	kΩ

CATHODE

Directly heated, thoriated tungsten

V_f	12.6	V
I_f	380	A
$i_{f(pk)}$ max. (starting)	1.0	kA
r_f (cold)	0.0036	Ω

CAPACITANCES

c_{a-g}	60	pF
c_{a-f}	3.0	pF
c_{g-f}	185	pF

CHARACTERISTICS (measured at $V_a = 13kV$, $I_a = 11A$)

g_m	200	mA/V
μ	33	

MOUNTING POSITION Vertical, anode up or down

COOLING

Anode-water cooled with integral cooler

Seals -low velocity air flow or water cooled connectors

Temperatures

Anode seal max.	200	°C
Grid seal max.	200	°C
Filament seals max.	200	°C
Envelope max.	200	°C
Water inlet max.	50	°C

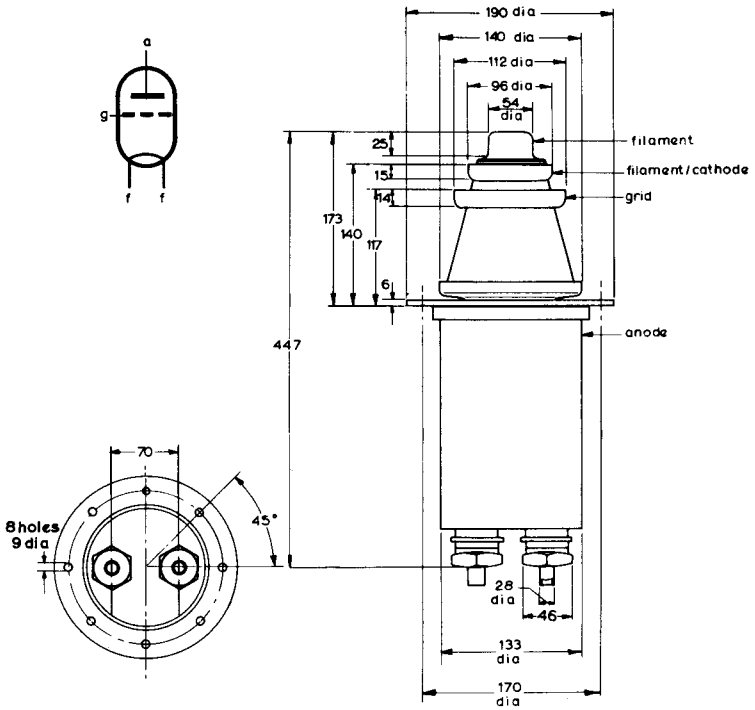
WATER COOLING CHARACTERISTICS

Anode Dissipation (kW)	Inlet Temperature (°C)	Rate of flow (l/min)	Inlet Pressure (atm)	Outlet Temperature (°C)
120	20	60	0.65	50

ACCESSORIES

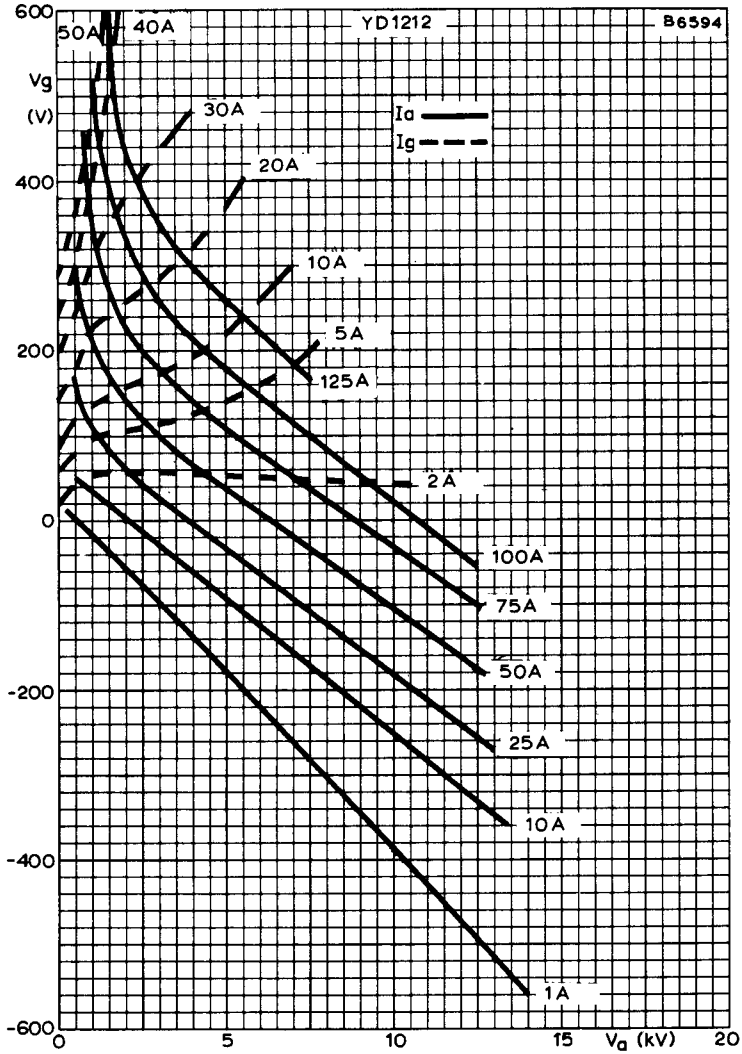
Grid connector, f ≤4.0MHz	40694
Filament connectors (both types required)	40695 and 40696
Filament cables	40716 and 40717

OUTLINE DRAWING OF YD1212



All dimensions in mm.

B6398



CONSTANT CURRENT CHARACTERISTICS

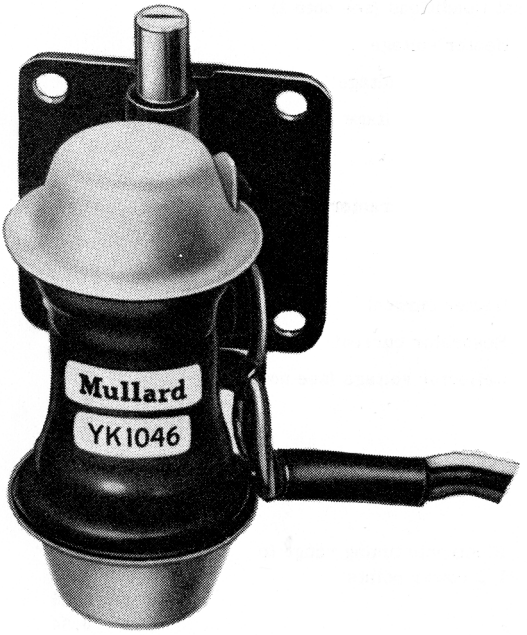
KLYSTRON YK1046

TENTATIVE DATA

QUICK REFERENCE DATA		
X-band, lightweight reflex klystron, with integral tuning cavity for local oscillator applications.		
Frequency range	9.16 to 9.34	GHz
Power output	35	mW
Construction	Aluminium body with flying leads	
Output connection	Waveguide 16 flange	

Services type: CV6195

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



TYPICAL OPERATION (at 9.25GHz)

Operating Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	275	V
Reflector voltage	-85	V
Load v.s.w.r.	≤1.1:1	

Typical Performance

Resonator current	22	mA
Power output	35	mW
Electronic tuning range to 1/2 power points	30	MHz

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.45	A

TEST CONDITIONS AND LIMITS

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

Test Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	275	V
Reflector voltage	Adjust	
Load v.s.w.r.	≤1.1:1	

Limits and Characteristics

	Frequency (GHz)	Min.	Max.	
Heater current	-	0.4	0.5	A
Resonator current	-	-	40	mA
Reflector voltage (see note 2)	9.16	-75	-100	V
	9.25	-75	-100	V
	9.34	-75	-100	V
Power output (see note 2)	9.16	25	60	mW
	9.25	25	60	mW
	9.34	25	60	mW
Electronic tuning range to 1/2 power points	9.16	25	-	MHz
	9.25	25	-	MHz
	9.34	25	-	MHz

Limits and Characteristics (cont'd)

	Frequency (GHz)	Min.	Max.	
Reflector modulator sensitivity (see note 3)	-	0.5	1.5	MHz
Frequency pulling (see note 4)	-	-	6.0	MHz
Mechanical tuning rate	9.16 to 9.34	150	250	MHz/turn
Mechanical tuning torque	-	0.07	0.22	Nm
	-	0.7	2.2	(kg cm)
Mechanical tuning range	-	9.16	9.34	GHz
Frequency temperature coefficient (see note 5)	9.25	-50	-200	kHz/degC
Frequency modulation under vibration, peak acceleration = 10g at 30Hz to 1kHz	9.25	-	200	kHz peak
Mode separation (see note 6)	9.16 to 9.34	-50	-125	V

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.7	6.9	V
Resonator voltage	-	350	V
Resonator current	-	45	mA
Reflector voltage (see note 2)	-20	-500	V
Body temperature (see note 7)	-	150	^{o}C
Storage temperature	-55	+75	^{o}C
v.s.w.r.	-	1.5:1	
Impedance of reflector/cathode circuit	-	500	kΩ

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of klystrons which are then life tested under the stated test conditions. If the klystron is to be operated under different conditions from those specified, Mullard Ltd. should be consulted to verify that the life will not be affected. The klystron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on pages 2 and 3.

	Min.	Max.	
Power output (at 9.25GHz)	15	-	mW
Electronic tuning range	20	-	MHz

MOUNTING POSITION — Any

COOLING — Natural

PHYSICAL DATA

	g	oz	
Weight of klystron	92	3.25	
Dimensions of storage carton	120 × 120 × 145		mm

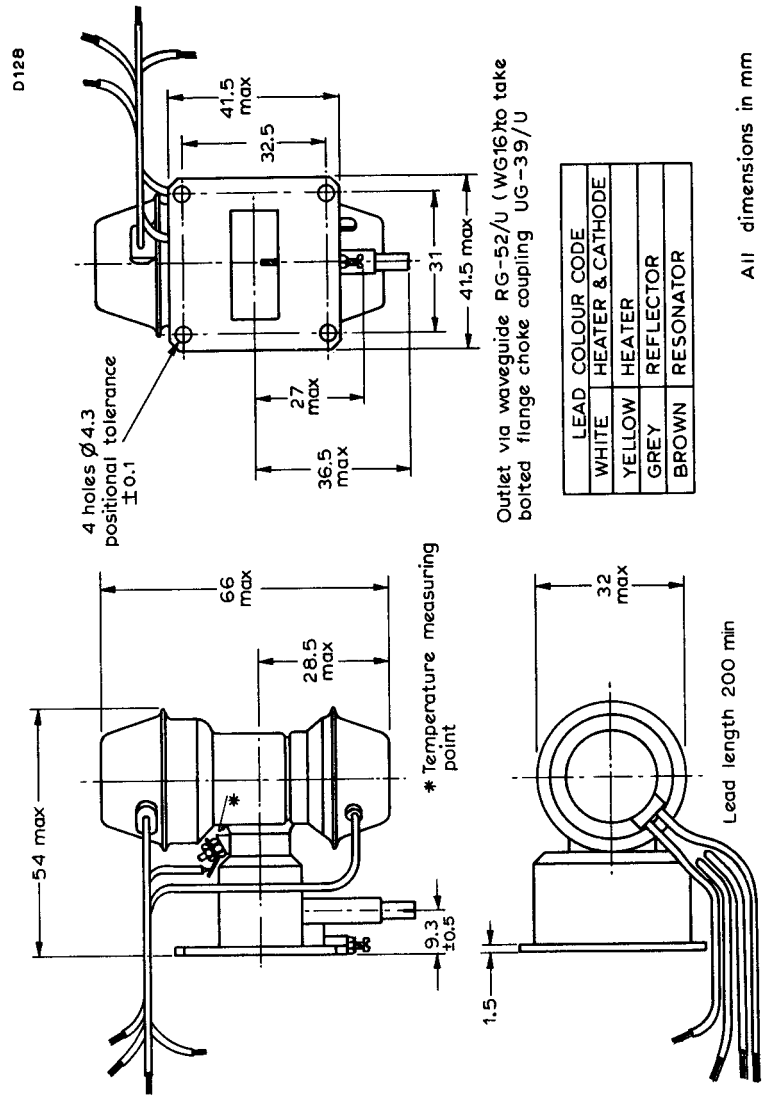
NOTES

1. Tests are made with the klystron rigidly connected to and in good thermal contact with a UG-39/U flange on an RG-52/U (WG16) waveguide.
2. Reflector voltage adjusted for the maximum power point of the mode. The reflector voltage must never be allowed to fall below the minimum value specified in the ratings.
3. Measured at mode optimum, 1 volt peak to peak deviation.
4. Measured with a v.s.w.r. of 1.5:1 varied through all phases. The power output must not be less than 10mW and the frequency versus reflector voltage must be continuous between the half power points.
5. Measured over the ambient temperature range -50 to +70°C.
6. No mode or part of a mode other than the required mode will exist within the specified reflector voltage range as the valve is mechanically tuned over the complete frequency range.
7. Measured at the point indicated on the outline drawing. For maximum valve life the klystron should be operated at temperatures below the specified maximum.

Dimensions
(Rounded outwards)

mm	in	mm	in
1.5	0.059	32.5	1.279
Ø 4.3	Ø 0.169	36.5 max.	1.437 max.
9.3 ± 0.5	0.366 ± 0.020	41.5 max.	1.634 max.
27 max.	1.06 max.	54 max.	2.13 max.
28.5 max.	1.122 max.	66 max.	2.60 max.
31	1.22	200 min.	7.87 min.
32 max.	1.26 max.		

OUTLINE DRAWING



V.H.F. POWER PENTODE

YL1000

Directly heated v.h.f. power pentode for use as a power amplifier or frequency multiplier in portable and mobile equipment.

PRELIMINARY DATA

FILAMENT (parallel operation only)

V_f	1.1 (±15%)	V
I_f	880	mA
t_h max. (P_{out} = 70% of final value)	0.5	s

CAPACITANCES (unshielded)

c_{a-g1}	< 150	mpF
c_{in}	6.5	pF
c_{out}	3.8	pF
c_{g1-f}	1.5	pF

CHARACTERISTICS

V_a	120	V
V_{g2}	120	V
V_{g1}	–6.5	V
I_a	30	mA
I_{g2}	2.3	mA
g_m	4.3	mA/V
μ_{g1-g2}	7.0	

DESIGN CENTRE RATINGS

$V_{a(b)}$ max.	500	V
V_a max.	300	V
p_a max.	5.0	W
$V_{g2(b)}$ max.	500	V
V_{g2} max.	300	V
p_{g2} max.	1.0	W
V_{g1} max.	–100	V
+ $v_{g1(pk)}$ max.	25	V
I_k max.	50	mA
R_{g1-f} max.	2.0	MΩ
T_{bulb} max.	200	°C
V_f max. (absolute)	1.27	V
V_f min. (absolute)	0.93	V

CLASS 'C' OPERATION F.M. TELEPHONY

Maximum recommended operating conditions

These conditions are based on reaching either the maximum electrode ratings or the point where load efficiency (η_{load}) begins to fall rapidly. The conditions for 175Mc/s were measured in a circuit with a parallel tuned output circuit. If a series tuned output circuit is used at this frequency with the same operating conditions, approx. 10% higher P_{load} figures are obtained.

YL1000

V.H.F. POWER PENTODE

CLASS 'C' OPERATION F.M. TELEPHONY AT f = 50Mc/s

Power amplifier

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
300	150	−35	40
250	150	−35	40
200	150	−35	40
150	150	−35	32
100	100	−23	22

Frequency doubler

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
300	150	−90	40
250	150	−90	40
200	150	−90	38
150	150	−90	32
100	100	−60	20

Frequency trebler

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
300	150	−100	29
250	150	−100	35
200	150	−100	32
150	150	−100	28
100	100	−100	20

CLASS 'C' OPERATION F.M. TELEPHONY AT f = 175Mc/s

Power amplifier

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max (mA)
300	150	−35	30
250	150	−35	37
200	150	−35	40
150	150	−35	40
100	100	−23	28

Frequency doubler

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
300	150	−90	26
250	150	−90	32
200	150	−90	38
150	150	−90	32
100	100	−90	20

Frequency trebler

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
250	150	−100	27
200	150	−100	32
150	150	−100	28
100	100	−100	20

TYPICAL OPERATION CLASS 'C' OPERATION F.M. TELEPHONY

Amplifier at f = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+V_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–35	10	1.45	0.006	–4.5	1.68	56
			20	2.6	0.045	2.5	3.8	63.3
			30	3.0	0.45	9.0	6.1	67.8
			40	3.5	0.85	14.5	8.0	66.6
250	150	–35	10	1.62	0.008	–2.0	1.5	60
			20	3.1	0.08	3.5	3.3	65
			30	4.0	0.55	10	5.1	68
			40	5.0	0.95	17	6.7	67
200	150	–35	10	1.95	0.025	–1.5	1.3	65
			20	3.8	0.20	5.5	2.75	69
			30	5.0	0.75	12	4.1	68
			40	6.0	1.05	18	5.2	65
150	150	–35	10	2.6	0.038	–1.0	1.0	67
			20	4.3	0.24	6.0	2.05	68
			30	6.0	0.85	13.5	2.95	65.5
100	100	–23	10	2.1	0.09	1.5	0.6	60
			20	3.4	0.7	9.0	1.22	61
			25	4.5	1.2	13	1.45	57.6

Frequency doubler at f_{out} = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+V_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–90	10	1.38	0.015	0.5	1.58	52.7
			20	2.15	0.28	8.5	3.42	57
			30	2.6	0.73	15	5.15	57.2
			40	3.4	0.95	21	6.62	55.1
250	150	–90	10	1.6	0.024	1.2	1.36	54.4
			20	2.4	0.38	9.5	3.0	60
			30	3.2	0.80	15.5	4.45	59.3
			40	4.2	1.02	22	5.6	56
200	150	–90	10	2.05	0.04	2.0	1.16	58
			20	2.9	0.45	10	2.5	62.5
			30	3.6	0.85	16.5	3.5	58.3
150	150	–90	10	2.4	0.05	2.5	0.86	57.3
			20	3.8	0.56	11	1.8	60
			30	4.5	0.95	18	2.48	55.2
100	100	–60	10	1.95	0.26	6.0	0.53	53
			20	3.1	0.92	13	0.94	47

YL1000

V.H.F. POWER PENTODE

Frequency trebler at f_{out} = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+v_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–100	10	1.0	0.01	0.8	1.2	40
			20	1.75	0.26	9.5	2.6	43.3
250	150	–100	10	1.16	0.012	1.0	1.05	42
			20	1.9	0.3	10	2.24	44.8
			30	2.3	0.7	17	3.2	42.7
200	150	–100	10	1.4	0.015	1.3	0.9	45
			20	2.05	0.35	10.5	1.88	47
			30	2.45	0.72	17.5	2.7	45
150	150	–100	10	1.7	0.027	1.9	0.67	44.7
			20	2.35	0.39	11	1.44	48
100	100	–100	10	1.1	0.29	7.5	0.47	47
			20	2.2	1.02	17	0.8	40

Amplifier at f = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
300	150	–35	15	0.9	0	0.98	21.7
			20	1.34	0	1.66	27.7
			25	1.56	0.01	2.48	33.1
			30	2.08	0.07	3.3	36.7
250	150	–35	15	1.0	0	0.91	24.3
			20	1.42	0	1.48	29.4
			25	1.96	0.01	2.17	34.7
			30	2.25	0.1	2.88	38.5
			35	2.42	0.2	3.6	41.1
200	150	–35	15	1.3	0	0.81	27
			20	1.96	0	1.37	32.5
			25	2.12	0.02	1.9	38
			30	2.4	0.11	2.5	41.7
			35	2.64	0.28	3.08	44
			40	3.0	0.5	3.69	46.1
150	150	–35	15	1.74	0	0.7	31.1
			20	2.14	0.01	1.14	38
			25	2.5	0.03	1.56	41.7
			30	2.9	0.12	2.0	44.5
			35	3.2	0.3	2.42	46.1
			40	3.5	0.55	2.82	47
100	100	–23	15	1.28	0.04	0.56	37.3
			20	1.5	0.22	0.89	44.5
			25	1.82	0.54	1.18	47.2

Frequency doubler at f_{out} = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
300	150	–90	15	0.84	0	0.82	18.2
			20	1.1	0.12	1.46	24.3
			25	1.22	0.34	2.1	28
250	150	–90	15	0.98	0.02	0.8	21.3
			20	1.26	0.15	1.35	27
			25	1.4	0.4	1.88	30
			30	1.62	0.6	2.4	32
200	150	–90	15	1.2	0.04	0.73	24.3
			20	1.4	0.22	1.2	30
			25	1.6	0.42	1.7	34
			30	1.85	0.66	2.15	35.9
			35	2.0	0.8	2.55	36.5
150	150	–90	15	1.58	0.06	0.66	29.4
			20	1.76	0.26	1.04	34.7
			25	2.07	0.46	1.42	37.9
			30	2.25	0.72	1.78	39.5
			35	2.36	0.88	2.1	40
100	100	–60	15	1.0	0.38	0.54	36
			20	1.36	0.7	0.74	37

Frequency trebler f_{out} = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
250	150	–100	15	0.88	0.04	0.6	16
			20	1.12	0.18	0.95	19
			25	1.26	0.4	1.29	20.7
200	150	–100	15	1.02	0.05	0.55	18.3
			20	1.24	0.22	0.86	21.5
			25	1.42	0.42	1.15	23
			30	1.66	0.6	1.42	23.7
150	150	–100	15	1.26	0.07	0.49	21.8
			20	1.42	0.30	0.76	25.3
			25	1.64	0.44	0.99	26.4
100	100	–100	15	0.94	0.52	0.4	26.7
			20	1.5	0.84	0.5	25

YL1000

V.H.F. POWER PENTODE

CLASS 'C' A.M. TELEPHONY

Maximum carrier conditions for 100% modulation

Output tuned circuit

	Single valve operation			Push-pull operation		
	Parallel	Parallel	Series			
f	50	175	175	50	175	Mc/s
V_a	250	200	200	250	200	V
V_{g2}	150	150	150	150	150	V
V_{g1}	−35	−35	−35	−35	−35	V
I_a	32	31	32	2×32	2×32	mA
I_{g2}	4.2	2.45	2.5	2×4.2	2×2.5	mA
I_{g1}	0.62	0.14	0.18	2×0.62	2×0.18	mA
P_{load}	5.4	2.65	3.05	12	6.2	W
η	67.5	42	47	75	48.5	%
For 100% modulation						
P_{mod}	4.2	3.2	3.3	8.4	6.4	W
$v_{g2(pk)}$	135	120	120	135	120	V

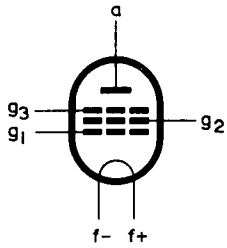
Maximum carrier conditions for anode and screen-grid modulation for various modulation depths. f = 175Mc/s

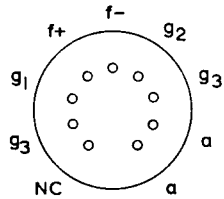
m (%)	V_a (V)	I_a (mA)	p_a (max.) (W)	p_{g2} (max.) (W)	P_{load}* (W)	Output tuned circuit
100	200	31	3.3	0.67	2.65	Parallel
	200	32	3.3	0.67	3.05	Series
	200	64	2×3.3	2×0.67	6.2	Push-Pull
75	220	34	3.9	0.78	3.2	Parallel
	220	35	3.9	0.78	3.65	Series
	220	70	2×3.9	2×0.78	7.4	Push-Pull
50	235	35	4.45	0.89	3.47	Parallel
	235	36	4.45	0.89	3.96	Series
	235	72	2×4.45	2×0.89	8.0	Push-Pull
25	245	37	4.85	0.97	3.82	Parallel
	245	38	4.85	0.97	4.37	Series
	245	76	2×4.85	0.97	8.8	Push-Pull
0	250	38	5.0	1.0	4.02	Parallel
	250	39	5.0	1.0	4.55	Series
	250	80	2×5.0	2×1.0	9.6	Push-Pull

*Estimated value

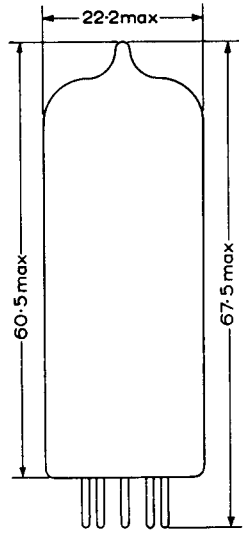
These conditions may be varied for operation at lower frequencies. Operation at 100% modulation with $V_a > 250V$, $I_a > 32mA$ is not permitted and the p_a max. and p_{g2} max. limits shown above must never be exceeded.

YL1000





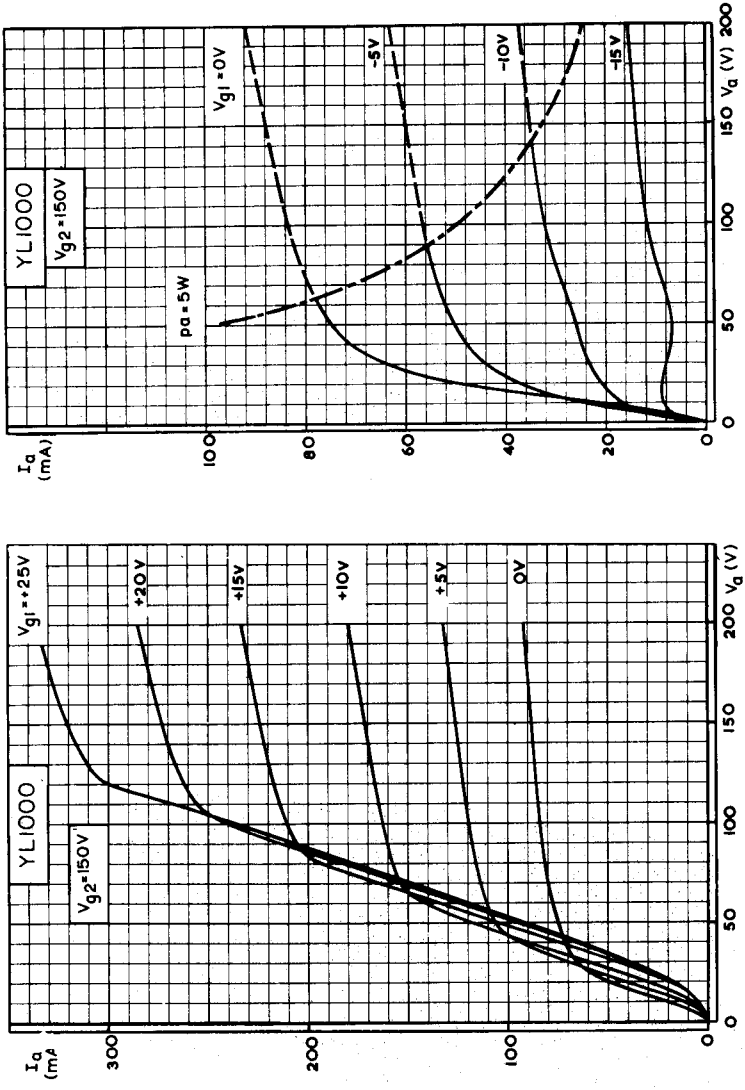
B9A Base



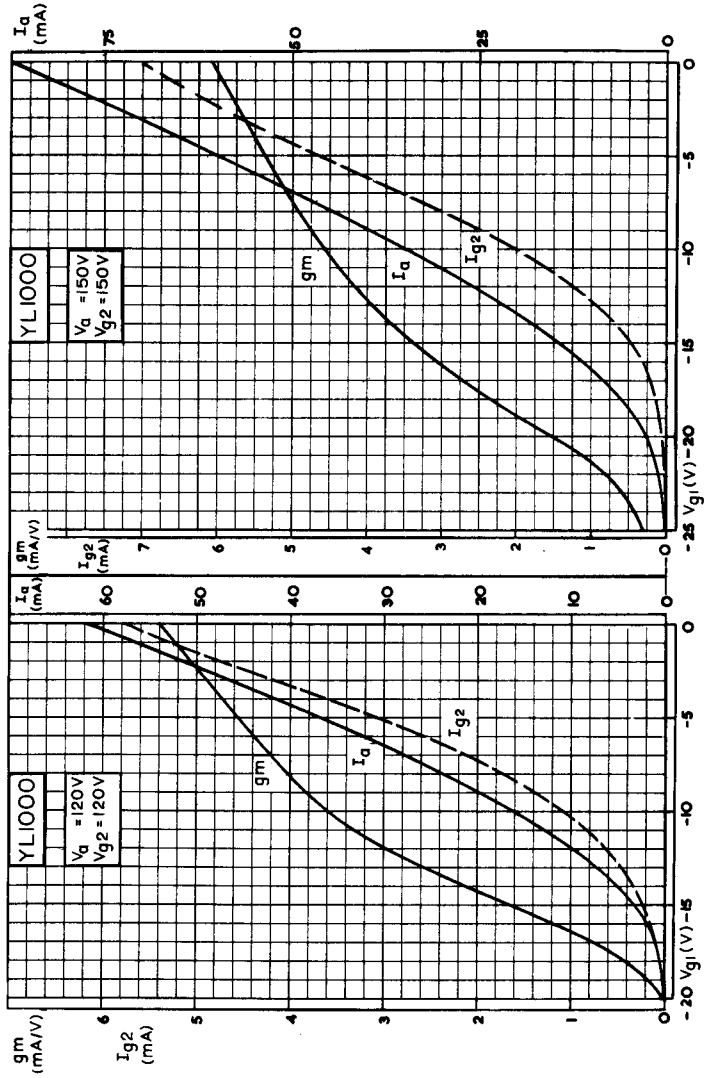
All dimensions in mm

9283

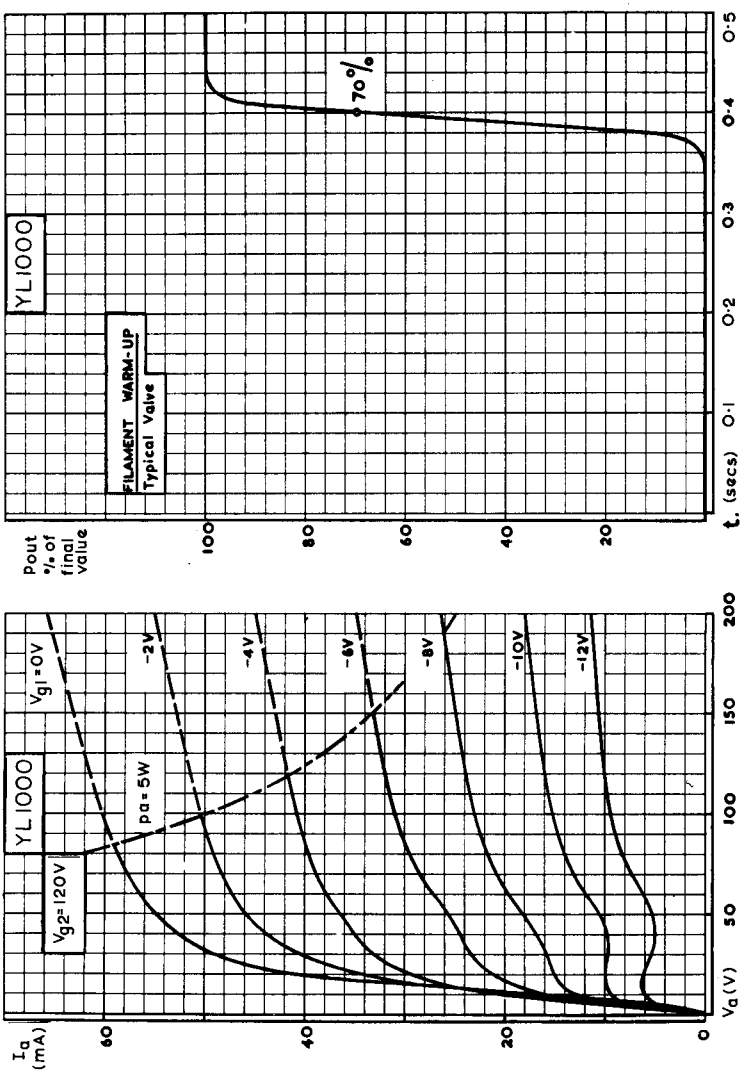
YL1000



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=150V

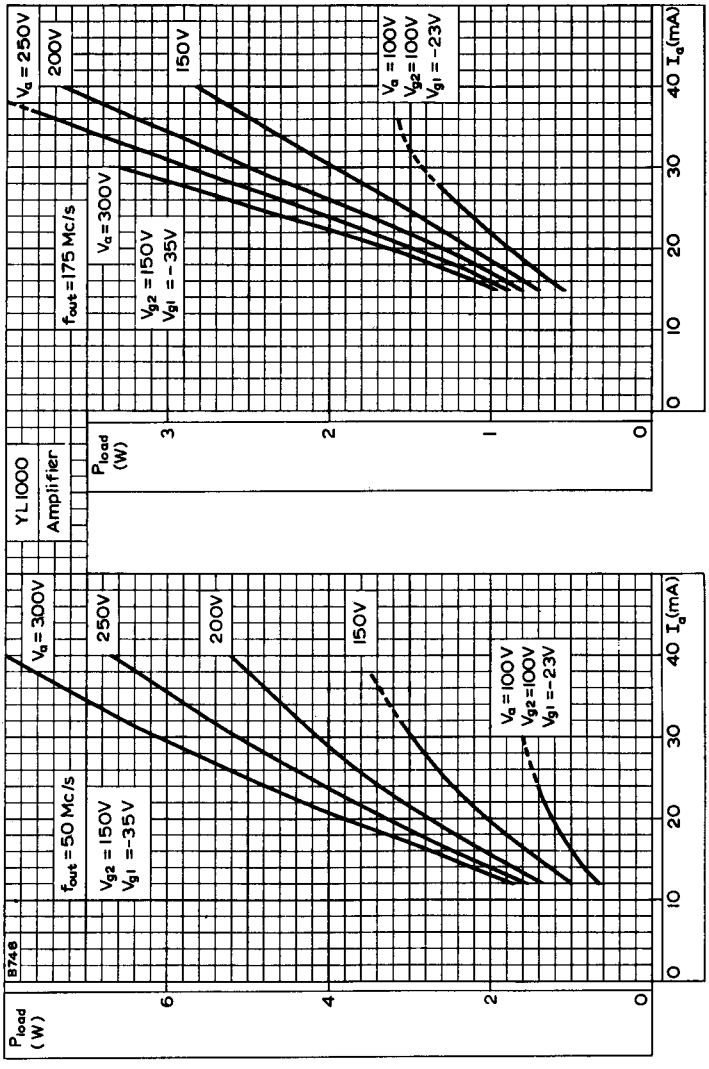


ANODE CURRENT, SCREEN-GRID CURRENT, AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

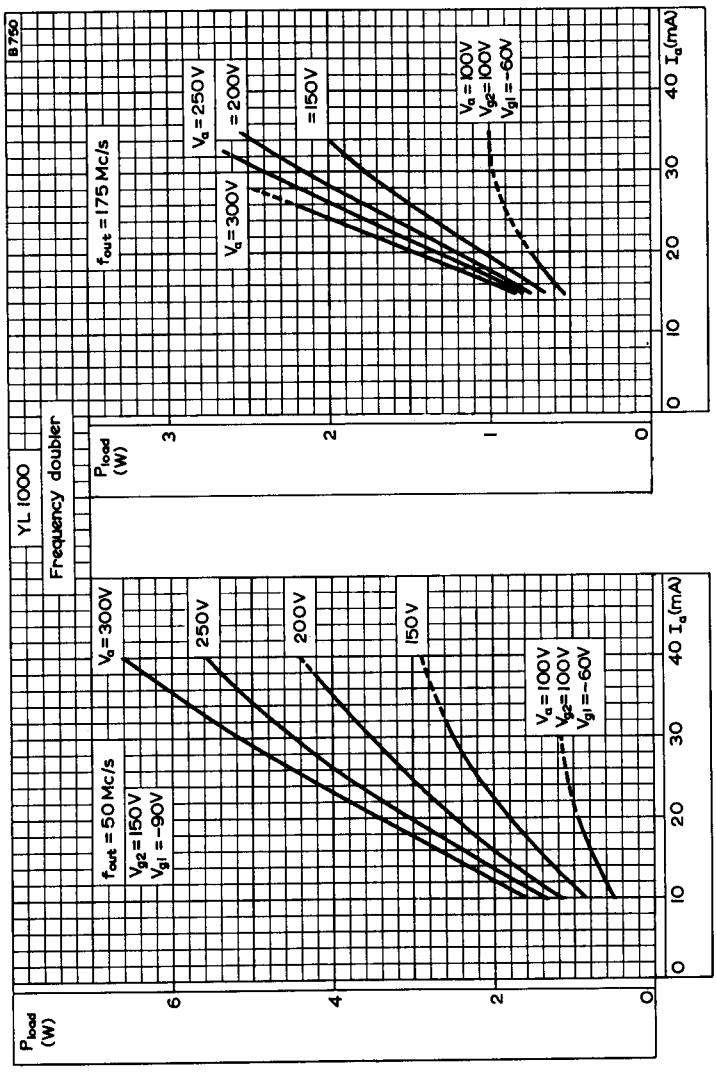


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=120V

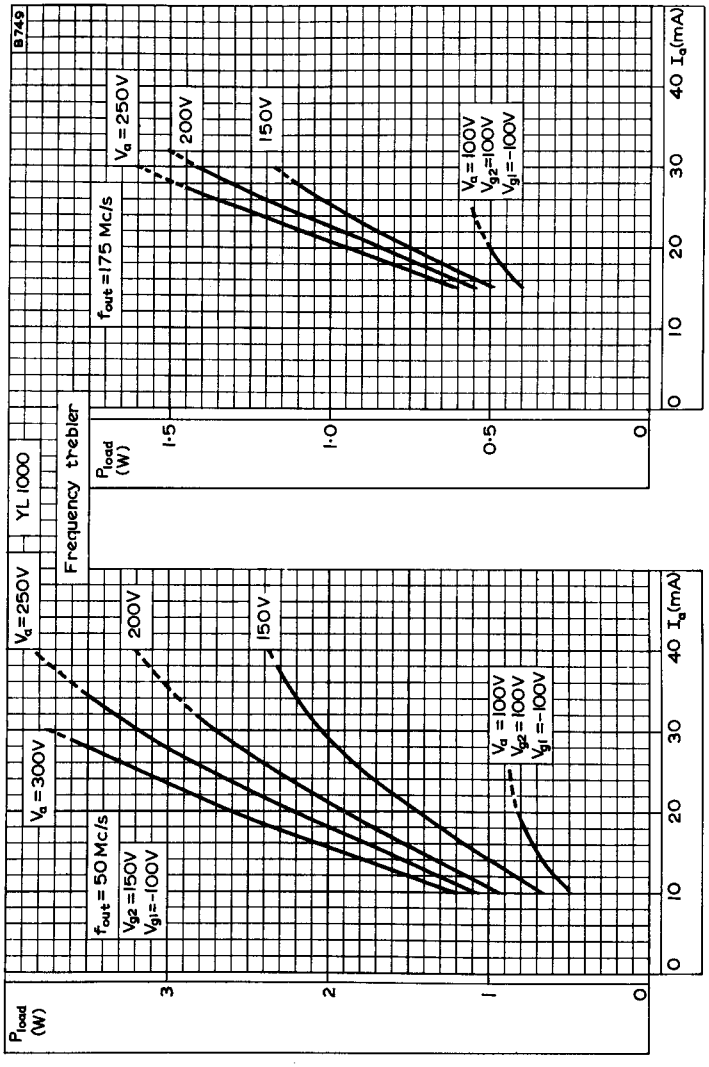
FILAMENT WARM-UP TIME



LOAD POWER AS AN AMPLIFIER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES



LOAD POWER AS A FREQUENCY DOUBLER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES



LOAD POWER AS A FREQUENCY TREBLER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES

V.H.F. POWER PENTODE

YL1000

Directly heated v.h.f. power pentode for use as a power amplifier or frequency multiplier in portable and mobile equipment.

FILAMENT (parallel operation only)

V_f	1.1 (±15%)	V
I_f	880	mA
t_h max. (P_{out} = 70% of final value)	0.5	s

CAPACITANCES (unshielded)

C_{a-g1}	< 150	mpF
C_{in}	6.0	pF ←
C_{out}	3.5	pF ←
C_{g1-f}	1.5	pF

CHARACTERISTICS

V_a	120	V
V_{g2}	120	V
V_{g1}	−6.5	V
I_a	30	mA
I_{g2}	2.3	mA
g_m	4.3	mA/V
μ_{g1-g2}	7.0	

RATINGS (DESIGN CENTRE SYSTEM)

$V_{a(b)}$ max.	500	V
V_a max.	300	V
p_a max.	5.0	W
$V_{g2(b)}$ max.	500	V
V_{g2} max.	300	V
p_{g2} max.	1.0	W
V_{g1} max.	−100	V
$+V_{g1(pk)}$ max.	25	V
I_k max.	50	mA
R_{g1-f} max.	2.0	MΩ
T_{bulb} max.	200	°C
V_f max. (absolute)	1.27	V
V_f min. (absolute)	0.93	V

CLASS 'C' OPERATION F.M. TELEPHONY

Maximum recommended operating conditions

These conditions are based on reaching either the maximum electrode ratings or the point where load efficiency (η_{load}) begins to fall rapidly. The conditions for 175Mc/s were measured in a circuit with a parallel tuned output circuit. If a series tuned output circuit is used at this frequency with the same operating conditions, approx. 10% higher P_{load} figures are obtained.

CLASS 'C' OPERATION F.M. TELEPHONY AT f = 50Mc/s

Power amplifier	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
	300	150	−35	40
	250	150	−35	40
	200	150	−35	40
	150	150	−35	32
	100	100	−23	22

Frequency doubler	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
	300	150	−90	40
	250	150	−90	40
	200	150	−90	38
	150	150	−90	32
	100	100	−60	20

Frequency trebler	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
	300	150	−100	29
	250	150	−100	35
	200	150	−100	32
	150	150	−100	28
	100	100	−100	20

CLASS 'C' OPERATION F.M. TELEPHONY AT f = 175Mc/s

Power amplifier	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max (mA)
	300	150	−35	30
	250	150	−35	37
	200	150	−35	40
	150	150	−35	40
	100	100	−23	28

Frequency doubler	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
	300	150	−90	26
	250	150	−90	32
	200	150	−90	38
	150	150	−90	32
	100	100	−90	20

Frequency trebler	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
	250	150	−100	27
	200	150	−100	32
	150	150	−100	28
	100	100	−100	20

YL1000

TYPICAL OPERATION CLASS 'C' OPERATION F.M. TELEPHONY

Amplifier at f = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+V_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–35	10	1.45	0.006	–4.5	1.68	56
			20	2.6	0.045	2.5	3.8	63.3
			30	3.0	0.45	9.0	6.1	67.8
			40	3.5	0.85	14.5	8.0	66.6
250	150	–35	10	1.62	0.008	–2.0	1.5	60
			20	3.1	0.08	3.5	3.3	65
			30	4.0	0.55	10	5.1	68
			40	5.0	0.95	17	6.7	67
200	150	–35	10	1.95	0.025	–1.5	1.3	65
			20	3.8	0.20	5.5	2.75	69
			30	5.0	0.75	12	4.1	68
			40	6.0	1.05	18	5.2	65
150	150	–35	10	2.6	0.038	–1.0	1.0	67
			20	4.3	0.24	6.0	2.05	68
			30	6.0	0.85	13.5	2.95	65.5
100	100	–23	10	2.1	0.09	1.5	0.6	60
			20	3.4	0.7	9.0	1.22	61
			25	4.5	1.2	13	1.45	57.6

Frequency doubler at f_{out} = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+V_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–90	10	1.38	0.015	0.5	1.58	52.7
			20	2.15	0.28	8.5	3.42	57
			30	2.6	0.73	15	5.15	57.2
			40	3.4	0.95	21	6.62	55.1
250	150	–90	10	1.6	0.024	1.2	1.36	54.4
			20	2.4	0.38	9.5	3.0	60
			30	3.2	0.80	15.5	4.45	59.3
			40	4.2	1.02	22	5.6	56
200	150	–90	10	2.05	0.04	2.0	1.16	58
			20	2.9	0.45	10	2.5	62.5
			30	3.6	0.85	16.5	3.5	58.3
150	150	–90	10	2.4	0.05	2.5	0.86	57.3
			20	3.8	0.56	11	1.8	60
			30	4.5	0.95	18	2.48	55.2
100	100	–60	10	1.95	0.26	6.0	0.53	53
			20	3.1	0.92	13	0.94	47

Frequency trebler at f_{out} = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+v_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–100	10	1.0	0.01	0.8	1.2	40
			20	1.75	0.26	9.5	2.6	43.3
250	150	–100	10	1.16	0.012	1.0	1.05	42
			20	1.9	0.3	10	2.24	44.8
			30	2.3	0.7	17	3.2	42.7
200	150	–100	10	1.4	0.015	1.3	0.9	45
			20	2.05	0.35	10.5	1.88	47
			30	2.45	0.72	17.5	2.7	45
150	150	–100	10	1.7	0.027	1.9	0.67	44.7
			20	2.35	0.39	11	1.44	48
100	100	–100	10	1.1	0.29	7.5	0.47	47
			20	2.2	1.02	17	0.8	40

Amplifier at f = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
300	150	–35	15	0.9	0	0.98	21.7
			20	1.34	0	1.66	27.7
			25	1.56	0.01	2.48	33.1
			30	2.08	0.07	3.3	36.7
250	150	–35	15	1.0	0	0.91	24.3
			20	1.42	0	1.48	29.4
			25	1.96	0.01	2.17	34.7
			30	2.25	0.1	2.88	38.5
			35	2.42	0.2	3.6	41.1
200	150	–35	15	1.3	0	0.81	27
			20	1.96	0	1.37	32.5
			25	2.12	0.02	1.9	38
			30	2.4	0.11	2.5	41.7
			35	2.64	0.28	3.08	44
			40	3.0	0.5	3.69	46.1
150	150	–35	15	1.74	0	0.7	31.1
			20	2.14	0.01	1.14	38
			25	2.5	0.03	1.56	41.7
			30	2.9	0.12	2.0	44.5
			35	3.2	0.3	2.42	46.1
			40	3.5	0.55	2.82	47
100	100	–23	15	1.28	0.04	0.56	37.3
			20	1.5	0.22	0.89	44.5
			25	1.82	0.54	1.18	47.2

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Frequency doubler at f_{out} = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
300	150	–90	15	0.84	0	0.82	18.2
			20	1.1	0.12	1.46	24.3
			25	1.22	0.34	2.1	28
250	150	–90	15	0.98	0.02	0.8	21.3
			20	1.26	0.15	1.35	27
			25	1.4	0.4	1.88	30
			30	1.62	0.6	2.4	32
200	150	–90	15	1.2	0.04	0.73	24.3
			20	1.4	0.22	1.2	30
			25	1.6	0.42	1.7	34
			30	1.85	0.66	2.15	35.9
			35	2.0	0.8	2.55	36.5
150	150	–90	15	1.58	0.06	0.66	29.4
			20	1.76	0.26	1.04	34.7
			25	2.07	0.46	1.42	37.9
			30	2.25	0.72	1.78	39.5
			35	2.36	0.88	2.1	40
100	100	–60	15	1.0	0.38	0.54	36
			20	1.36	0.7	0.74	37

Frequency trebler f_{out} = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
250	150	–100	15	0.88	0.04	0.6	16
			20	1.12	0.18	0.95	19
			25	1.26	0.4	1.29	20.7
200	150	–100	15	1.02	0.05	0.55	18.3
			20	1.24	0.22	0.86	21.5
			25	1.42	0.42	1.15	23
			30	1.66	0.6	1.42	23.7
150	150	–100	15	1.26	0.07	0.49	21.8
			20	1.42	0.30	0.76	25.3
			25	1.64	0.44	0.99	26.4
100	100	–100	15	0.94	0.52	0.4	26.7
			20	1.5	0.84	0.5	25

CLASS 'C' A.M. TELEPHONY

Maximum carrier conditions for 100% modulation

Output tuned circuit

	Single valve operation			Push-pull operation		
	Parallel	Parallel	Series			
f	50	175	175	50	175	Mc/s
V_a	250	200	200	250	200	V
V_{g2}	150	150	150	150	150	V
V_{g1}	−35	−35	−35	−35	−35	V
I_a	32	31	32	2×32	2×32	mA
I_{g2}	4.2	2.45	2.5	2×4.2	2×2.5	mA
I_{g1}	0.62	0.14	0.18	2×0.62	2×0.18	mA
P_{load}	5.4	2.65	3.05	12	6.2	W
η	67.5	42	47	75	48.5	%
For 100% modulation						
P_{mod}	4.2	3.2	3.3	8.4	6.4	W
$v_{g2(pk)}$	135	120	120	135	120	V

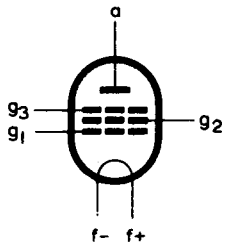
Maximum carrier conditions for anode and screen-grid modulation for various modulation depths. f = 175Mc/s

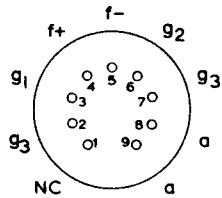
m (%)	V_a (V)	I_a (mA)	p_a (max.) (W)	p_{g2} (max.) (W)	P_{load}* (W)	Output tuned circuit
100	200	31	3.3	0.67	2.65	Parallel
	200	32	3.3	0.67	3.05	Series
	200	64	2×3.3	2×0.67	6.2	Push-Pull
75	220	34	3.9	0.78	3.2	Parallel
	220	35	3.9	0.78	3.65	Series
	220	70	2×3.9	2×0.78	7.4	Push-Pull
50	235	35	4.45	0.89	3.47	Parallel
	235	36	4.45	0.89	3.96	Series
	235	72	2×4.45	2×0.89	8.0	Push-Pull
25	245	37	4.85	0.97	3.82	Parallel
	245	38	4.85	0.97	4.37	Series
	245	76	2×4.85	0.97	8.8	Push-Pull
0	250	38	5.0	1.0	4.02	Parallel
	250	39	5.0	1.0	4.55	Series
	250	80	2×5.0	2×1.0	9.6	Push-Pull

*Estimated value

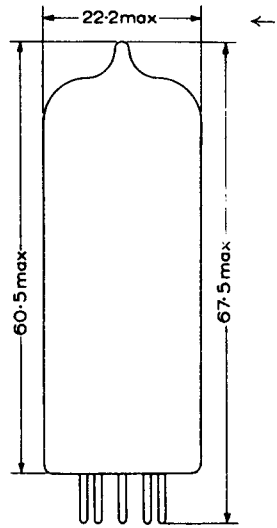
These conditions may be varied for operation at lower frequencies. Operation at 100% modulation with $V_a > 250V$, $I_a > 32mA$ is not permitted and the p_a max. and p_{g2} max. limits shown above must never be exceeded.

YL1000





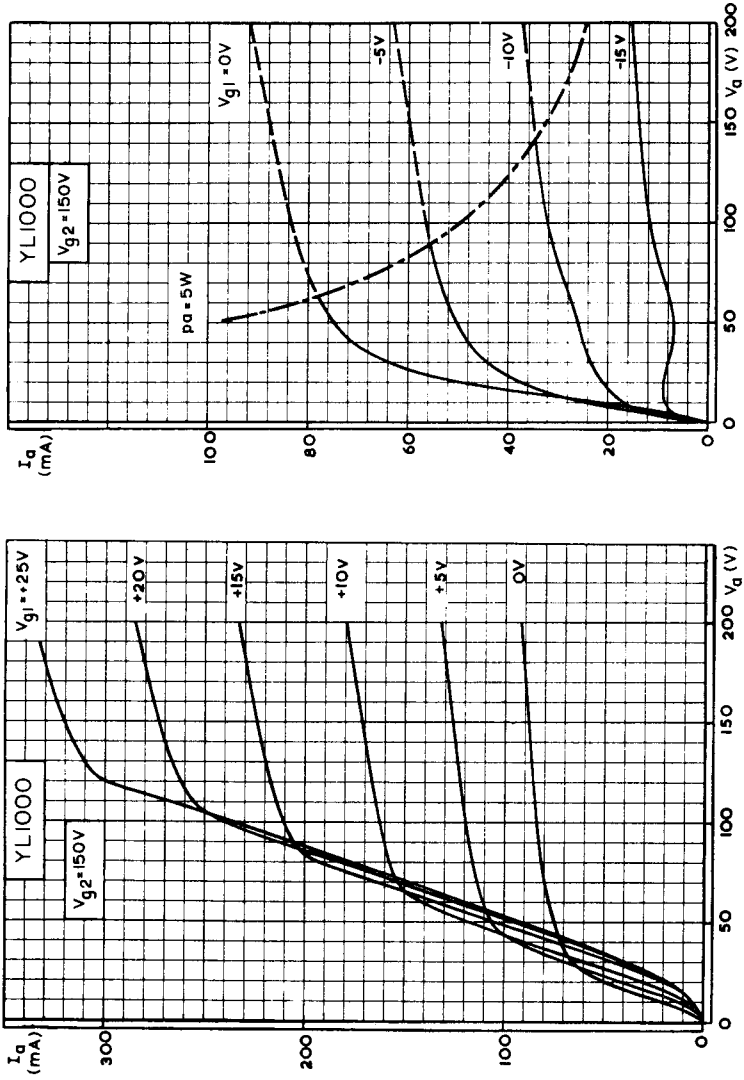
B9A Base



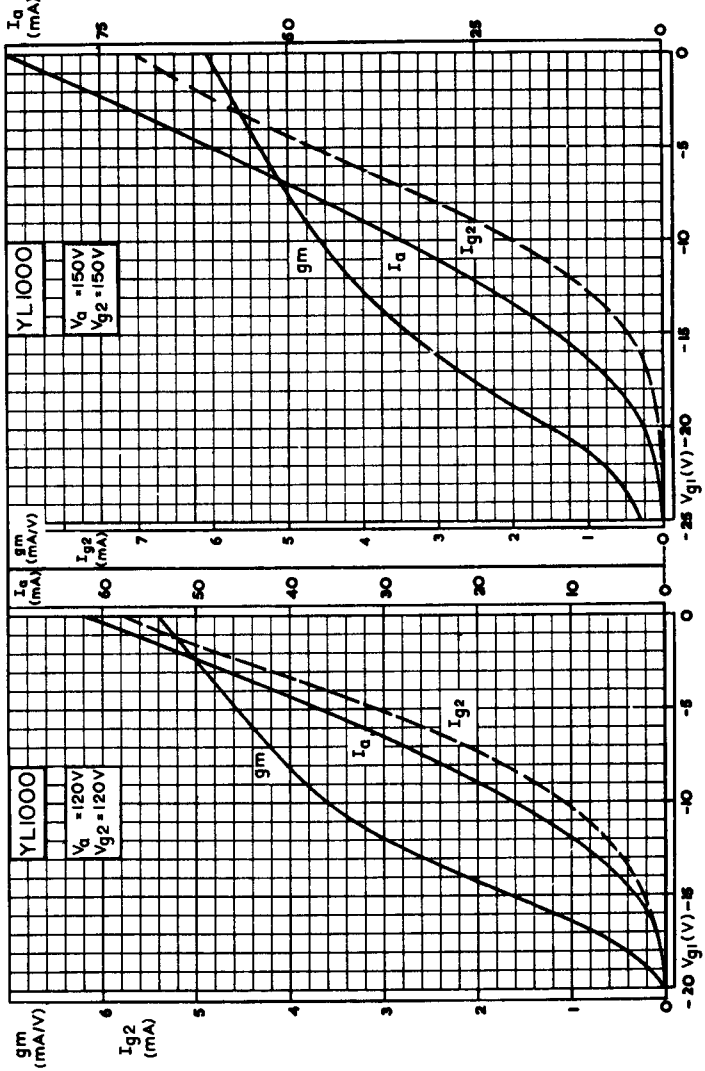
All dimensions in mm

B 4662

YL1000

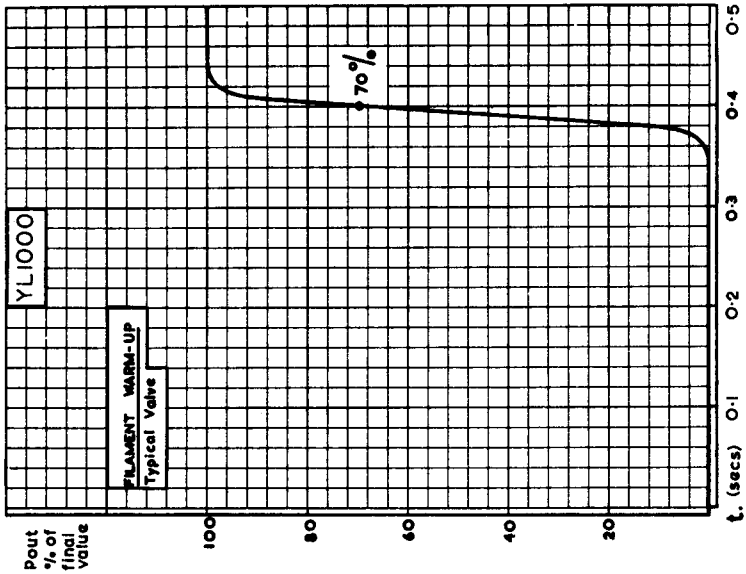


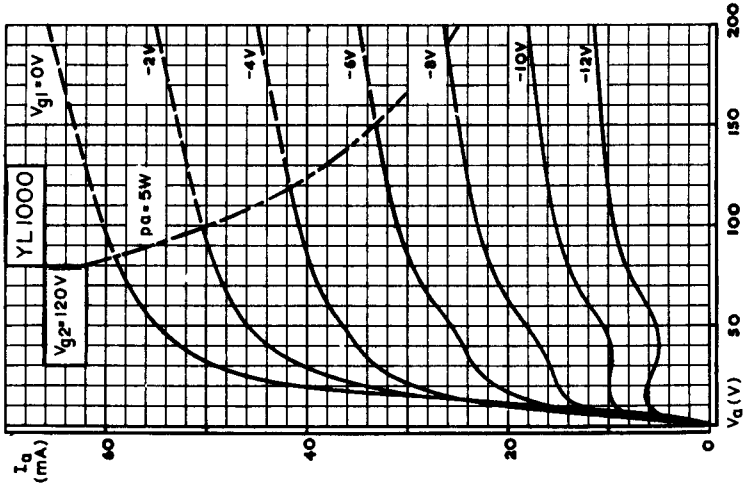
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=150V



ANODE CURRENT, SCREEN-GRID CURRENT, AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

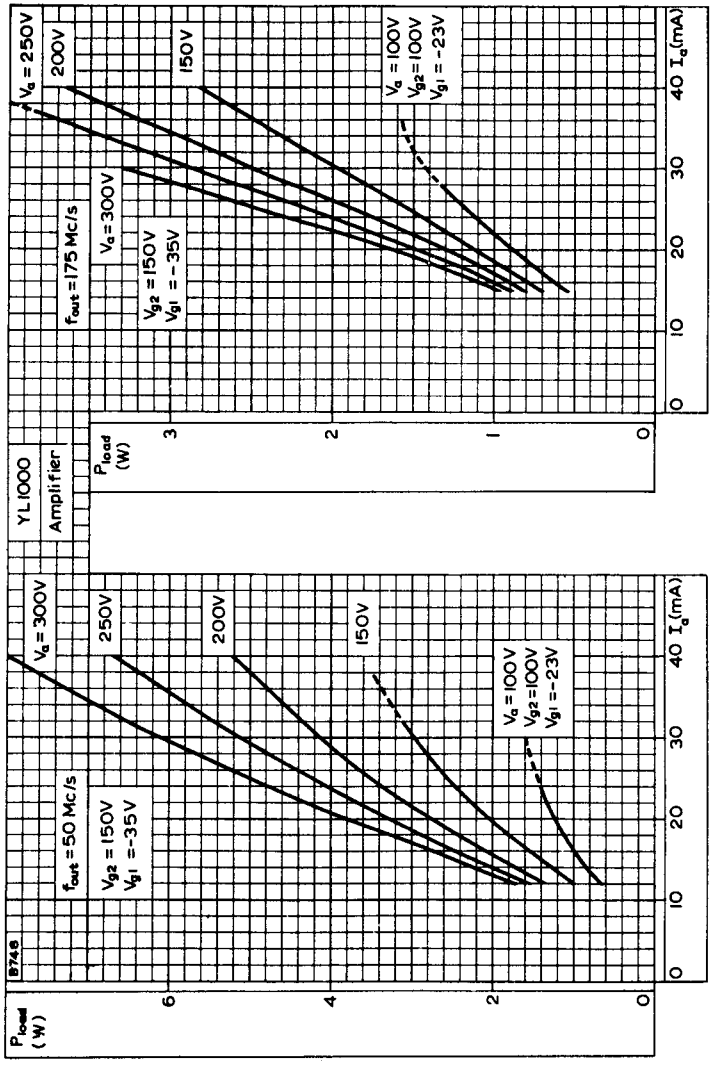
YL1000



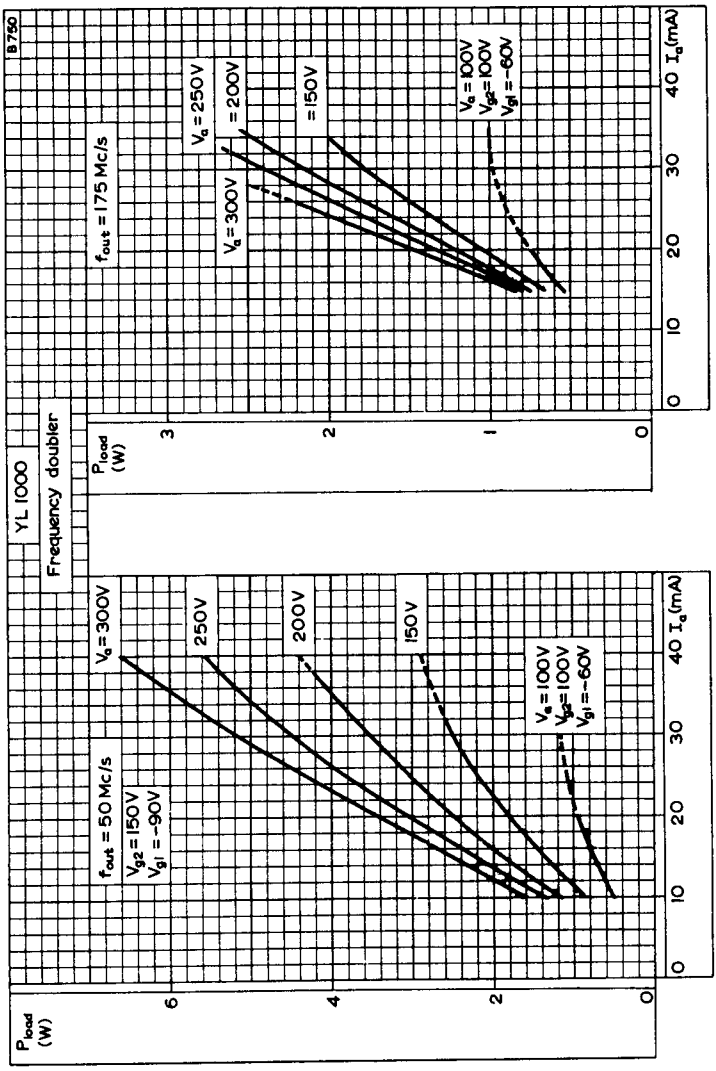


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=120V

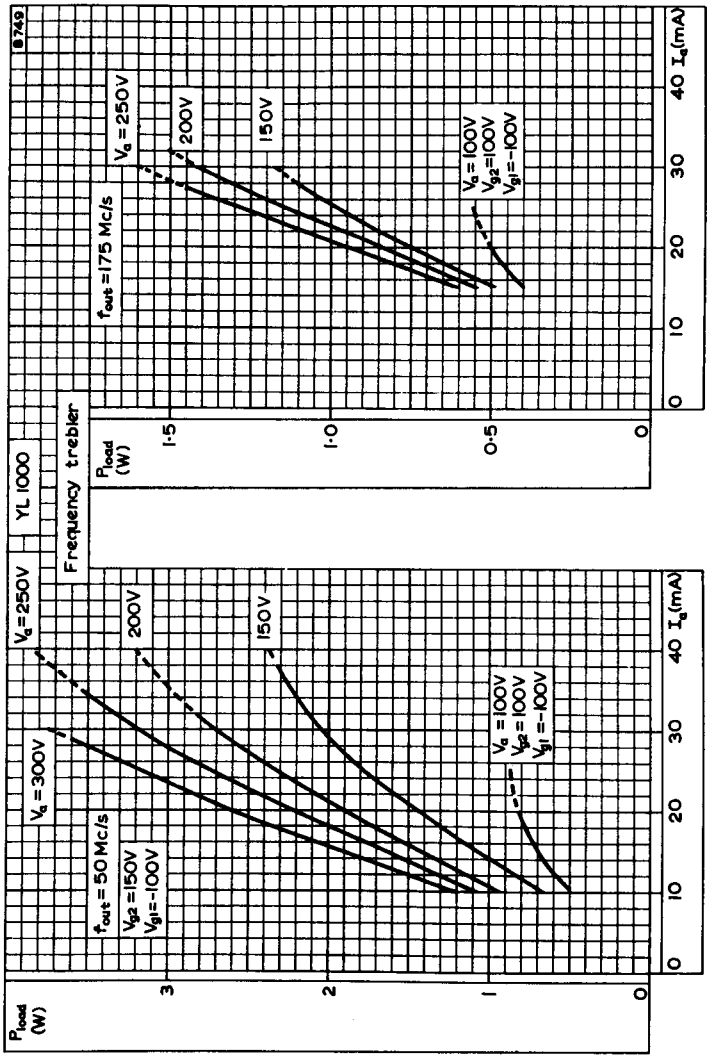
FILAMENT WARM-UP TIME



LOAD POWER AS AN AMPLIFIER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES



LOAD POWER AS A FREQUENCY DOUBLER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES



LOAD POWER AS A FREQUENCY TREBLER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES

not complete

QUICK HEATING DOUBLE TETRODE

YL1020
QQZ03-20

Typical operating conditions

f_{out}	200	460	Mc/s
V_a	300	300	V
V_{g2}	250	250	V
$-V_{g1}$	175	175	V
$V_{in(pk)}$	2×205	2×205	V
I_a	2×45	2×45	mA
I_{g2}	2×4.0	2×3.5	mA
I_{g1}	2×3.0	2×2.5	mA
P_{load} (driver)	3.0	5.0	W
η_a	33	26	%
P_a	2×9.0	2×10	W
P_{out}	9.0	7.0	W
P_{load}	7.0	5.5	W

OPERATING NOTE

I_{g1} and I_{g2} will vary from valve to valve, hence the use of fixed resistors R_{g1} and R_{g2} will result in variation of input and output power. It is therefore recommended that R_{g2} be made adjustable.

CATHODE

Quick heating directly heated filament. 70% P_{out} in less than 0.5 second. ←

*V_f d.c. or r.m.s.	1.6	V
I_f	4.25	A

Frequency of filament supply

Sine wave	max 200	c/s
Square wave	Any	

*The filament has been designed to accept temporary fluctuations of supply voltage of ±15%. ←

CAPACITANCES

c_{out} (two sections in push-pull)	1.5	pF
c_{in} (two sections in push-pull) Internally neutralised for push-pull operation.	4.0	pF

CHARACTERISTICS (measured at V_a = 300V, V_{g2} = 250V, I_a = 40mA)

g_m	4.0	mA/V
μ_{g1-g2}	9.0	

COOLING

Radiation and Convection cooled

Maximum temperatures ←

Base-seals	180	°C
Anode seal	250	°C
Bulb	250	°C

Anode connectors providing a high degree of heat transfer by radiation or conduction should be used.

YL1020
QQZ03-20

QUICK HEATING DOUBLE TETRODE

MOUNTING POSITION

ANY (but see G.O.R's)

PHYSICAL DATA

Weight of valve	1.8	oz
	50	g
Weight of valve in carton	9.0	oz
	250	g

ACCESSORIES

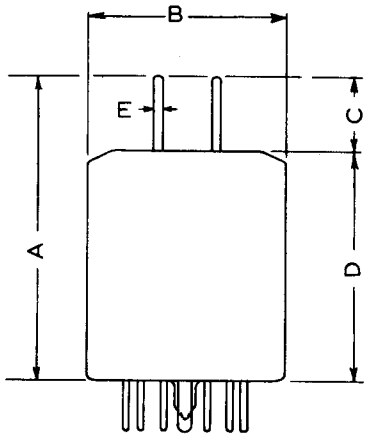
Anode clips	40623
Socket	40202

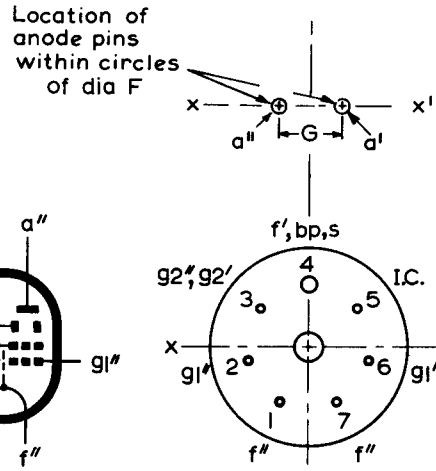
DIMENSIONS

	Inches	*Millimetres*	
A	2.874	73	max.
B	1.811	46	max.
C	0.650 ± 0.059	16.5 ± 1.5	
D	2.165	55	max.
E	0.079 ± 0.004	2.0 ± 0.1	
F	0.098 ± 0.001	2.5 ± 0.03	
G	0.551 ± 0.001	14 ± 0.03	

Inch dimensions derived from original millimetre dimensions.

YL1020
QQZ03-20





B7A Base

Contacts 1 and 7 should be strapped together externally to reduce the effective contact resistance.

B1571

V.H.F. QUICK HEATING DOUBLE TETRODE

YL1030 QQZ06-40

PRELIMINARY DATA

QUICK REFERENCE DATA

Quick heating double tetrode for use as u.h.f. power amplifier or frequency multiplier in mobile transmitters.

70% of normal power output is obtained within 0.5 second.

		Class 'C' Telephony Anode and screen grid modulated	Class 'C' Telegraphy or F.M. Telephony	
f		180	180	Mc/s
P_{out}		64	85	W
f max.		500	500	Mc/s
V_a max.				
	(f = 200 Mc/s)	600	750	V
	(f = 500 Mc/s)	400	500	V
p_a max.		2 x 14	2 x 20	W

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions		Intermittent Mobile Service	
f	180	180	Mc/s
P_{out}	53	85	W
P_{load}	45	75	W
η_a	66	71	%
V_a	400	600	V
I_a	2 x 100	2 x 100	mA
V_{g2}	250	250	V
I_{g2}	2 x 8.0	2 x 9.0	mA
$-V_{g1}$	60	80	V
I_{g1}	2 x 3.0	2 x 3.5	mA
$P_{load\ (driver)}$	3.0	4.0	W
p_a	2 x 13.5	2 x 17.5	W
p_{g2}			W

CLASS 'C' TELEPHONY AND SCREEN-GRID MODULATION

Maximum operating conditions (Carrier conditions for 100% modulation)		Intermittent Mobile Service	
f	180	180	Mc/s
P_{out}	39	64	W
P_{load}	32	53	W
η_a	65	71	%
V_a	400	600	V
I_a	2 x 75	2 x 75	mA
V_{g2}	250	250	V
I_{g2}	2 x 9.0	2 x 9.0	mA
$-V_{g1}$	70	80	V
I_{g1}	2 x 2.0	2 x 2.0	mA
$P_{load\ (driver)}$	4.0	5.0	W
p_a	2 x 10.5	2 x 13	W
For 100% modulation			
P_{mod}	47	47	W
$v_{g2\ (pk)}$	185	185	V

FREQUENCY MULTIPLIER

Maximum operating conditions			Intermittent mobile service	
f_{out}/f_{in}	150/50	150/50	470/157	Mc/s
P_{out}	18	20	16	W
P_{load}	14.5	16	12	W
η_a	31	33	31	%
V_a	400	500	400	V
I_a	2 x 72	2 x 60	2 x 65	mA
V_{g2}	250	250	250	V
I_{g2}	2 x 8.0	2 x 5.0	2 x 6.0	mA
$-V_{g1}$	150	150	175	V
I_{g1}	2 x 2.5	2 x 3.0	2 x 2.9	mA
$V_{in(pk)}$	360	360	360	V
$P_{load\ (driver)}$	9.0	10	8.0	W
p_a	2 x 20	2 x 20	2 x 18	W

V.H.F. QUICK HEATING DOUBLE TETRODE

YL1030 QQZ06-40

ABSOLUTE MAXIMUM RATINGS

	Frequency Multiplier	Class 'C' Telephony	Class 'C' Telegraphy	
V_a max. (f = 200 Mc/s)	750	600	750	V
(f = 500Mc/s)	-	400	500	V
V_{g2} max.	300	300	300	V
$-V_{g1}$ max.	175	175	100	V
I_k max.	2 x 100	2 x 120	2 x 120	mA
p_a max.	2 x 20	2 x 14	2 x 20	W
p_{g2} max.	2 x 3.5	2 x 2.3	2 x 3.5	W
I_{g1} max.	-	2 x 5.0	2 x 5.0	mA
p_{g1} max.	2 x 1.0	2 x 1.0	2 x 1.0	W
R_{g1-k} max. per section. (fixed bias)	50	50	50	kΩ
R_{g1-k} max. per section. (automatic bias)	100	100	100	kΩ
$V_{g2\ (b)}$ max.	600	600	600	V

CATHODE

Quick heating directly heated filament.

70% P_{out} in less than 0.5 second.

* V_f	2.1	V
I_f	4.5	A

Frequency of filament supply

Sine wave	max. 200	c/s
Square wave	Any	

* The filament has been designed to accept temporary fluctuations of supply voltage of ± 15%.

CAPACITANCES

c_{out} (two sections in push-pull)	2.0	pF
c_{in} (two sections in push-pull)	6.0	pF

CHARACTERISTICS (each section) Measured at I_a = 30 mA

g_m	4.5	mA/V
μ_{g1-g2}	8.0	

MOUNTING POSITION Any

COOLING

Radiation and convection cooled

Maximum temperatures

Seals	250	°C
Pins	180	°C
Bulb	250	°C

Anode connectors providing a high degree of heat transfer by radiation or by conduction should be used.

PHYSICAL DATA

	oz	g
Weight of valve	0.53	16
Weight of valve and carton	0.8	23

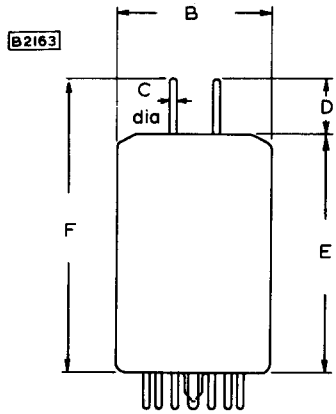
DIMENSIONS

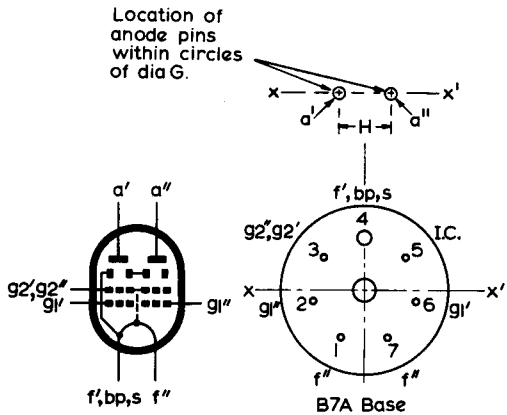
	Inches	millimetres
B	1.811	46 max
C	0.079 ± 0.001	2.0 ± 0.01
D	0.650 ± 0.059	16.5 ± 1.5
E	2.874 ± 0.059	73 ± 1.5
F	3.524 ± 0.118	89.5 ± 3.0
G	0.098 ± 0.001	2.5 ± 0.03
H	0.551 ± 0.001	14 ± 0.03

Inch dimensions derived from original millimetre dimensions.

V.H.F. QUICK HEATING DOUBLE TETRODE

YL1030 QQZ06-40



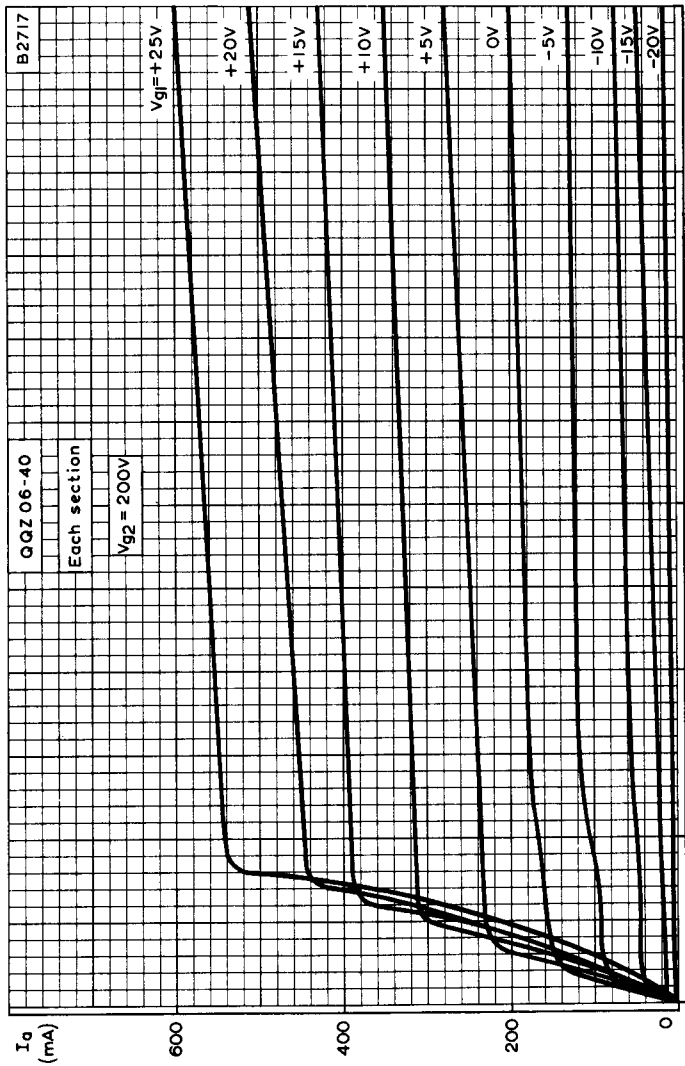


B7A Base

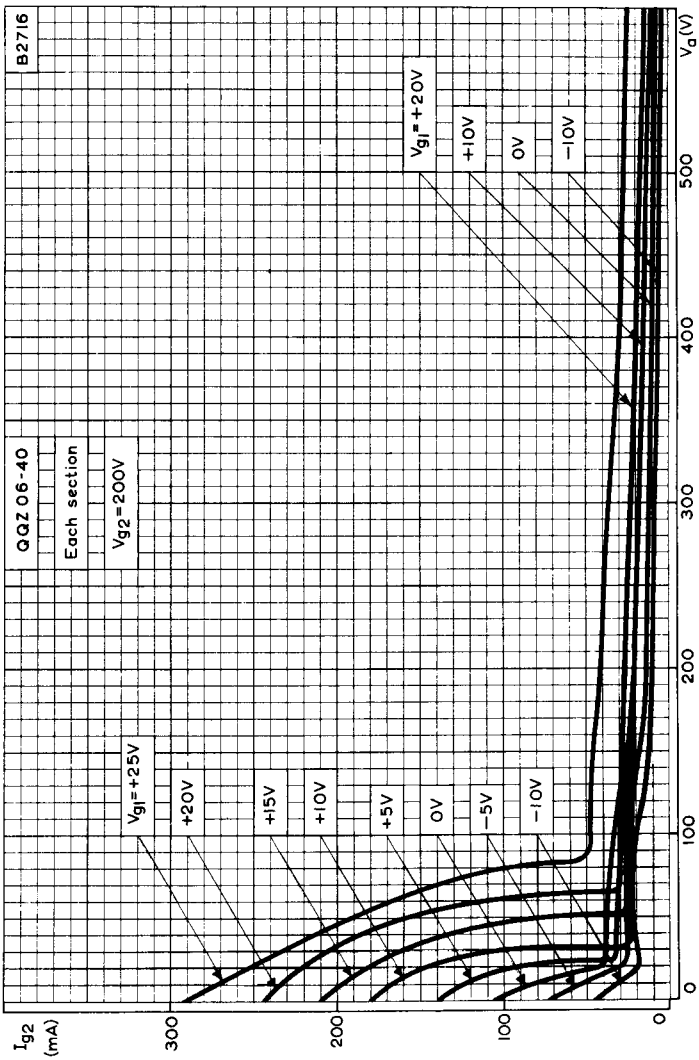
Contacts 1 and 7 should be strapped together externally to reduce the effective contact resistance.

V.H.F. QUICK HEATING DOUBLE TETRODE

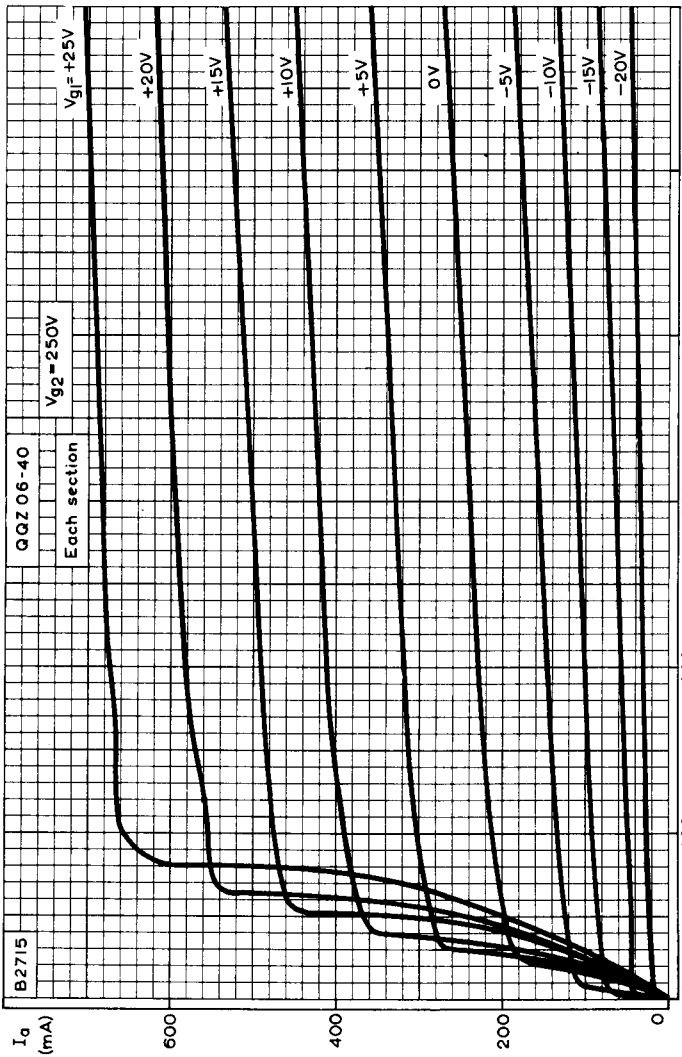
YL1030 QQZ06-40



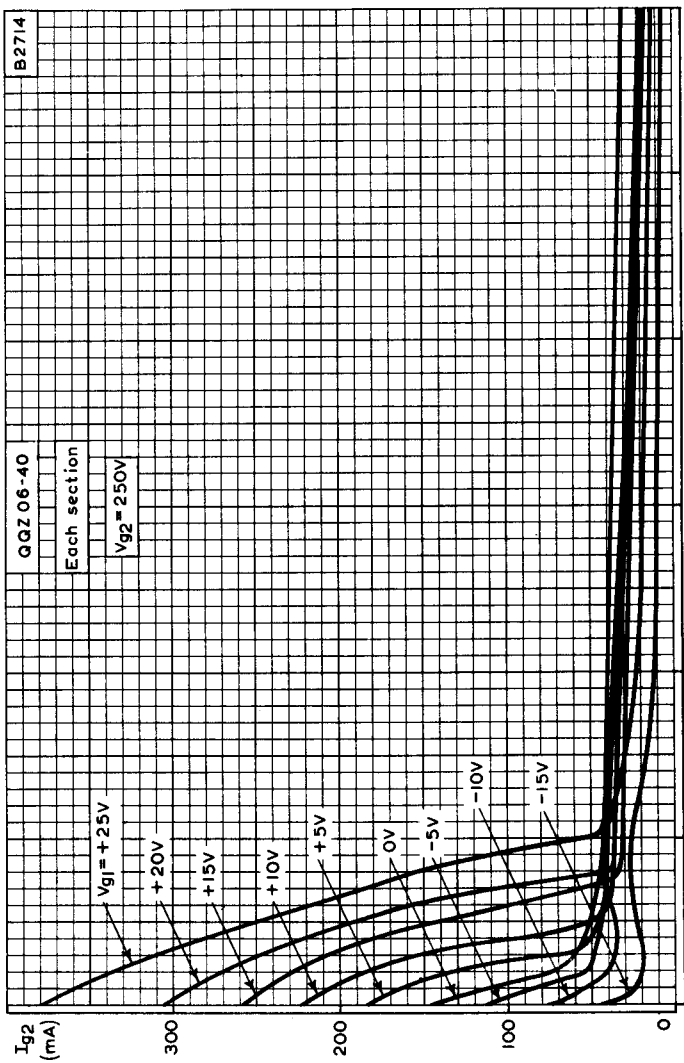
ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V



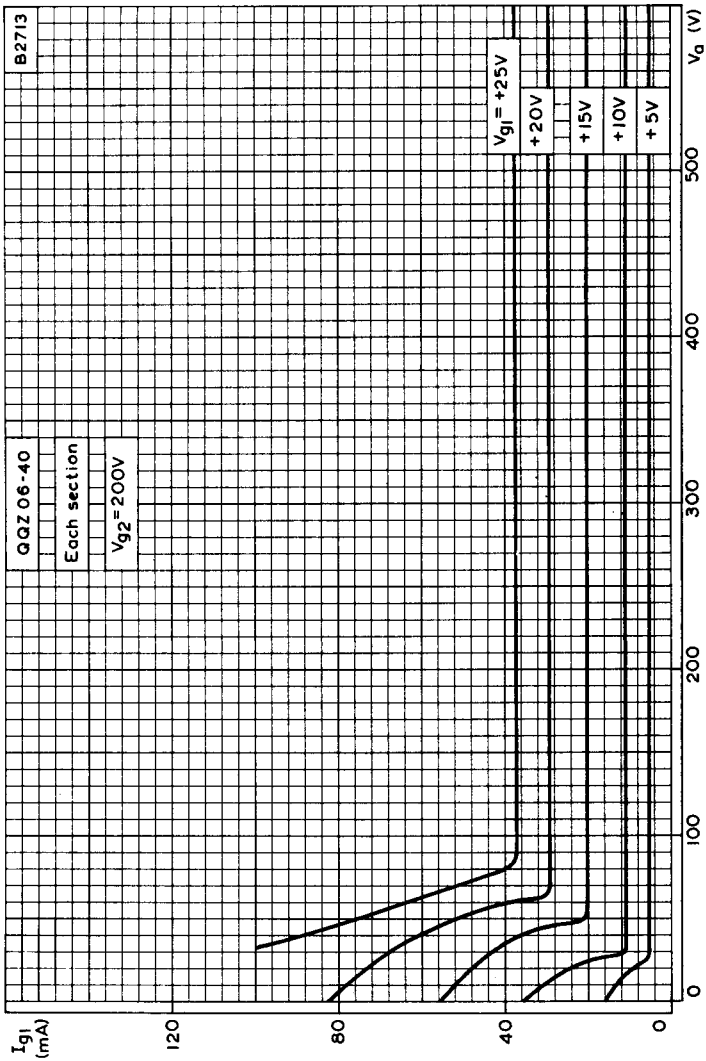
SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 200V



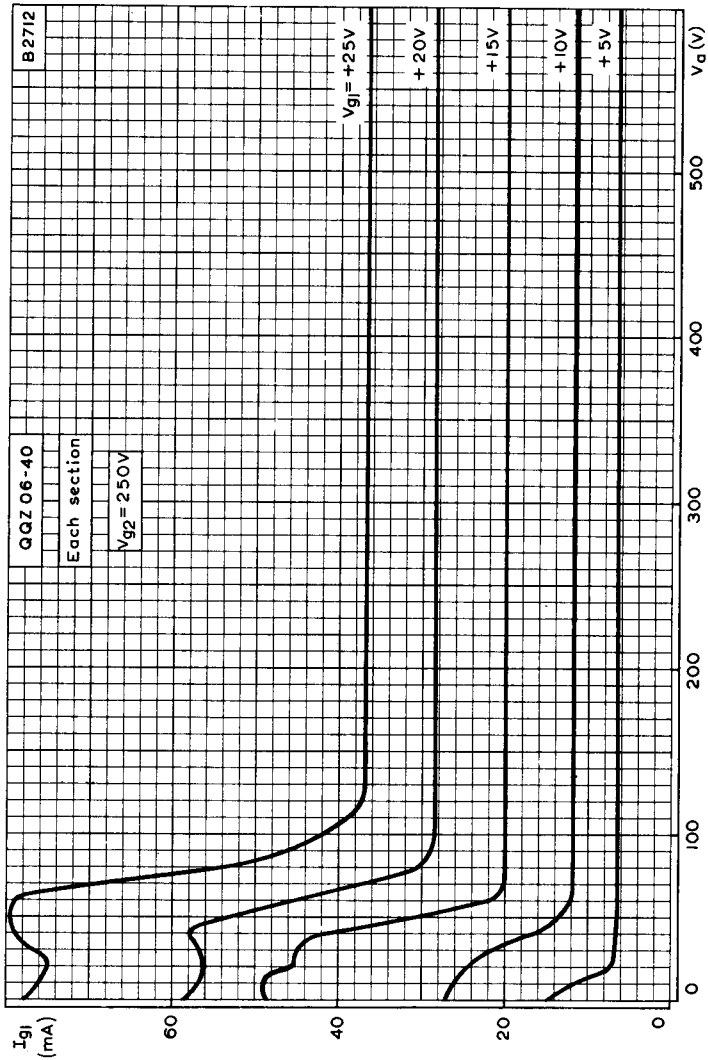
ANODE CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 250V



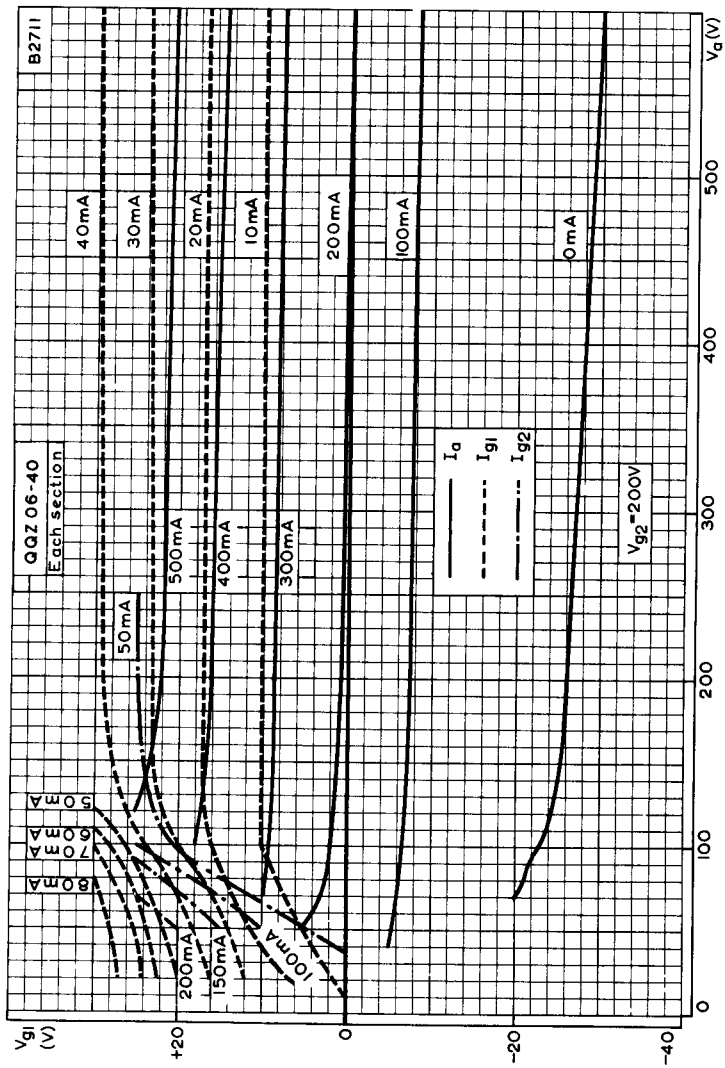
SCREEN-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=250V



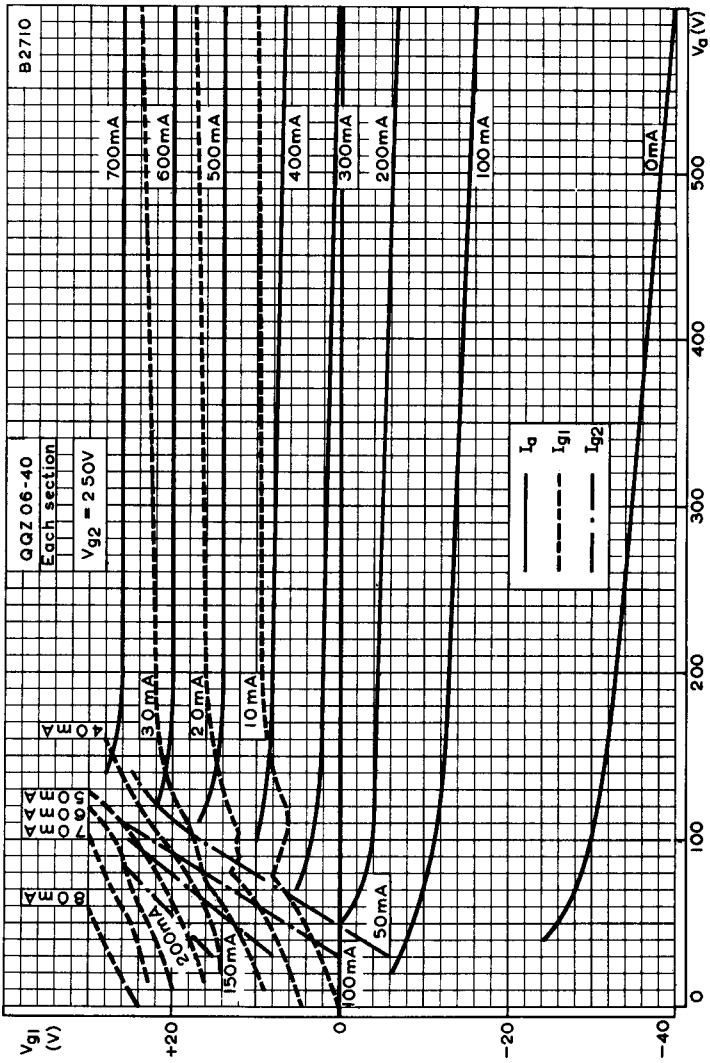
CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=200V



CONTROL-GRID CURRENT FOR EACH SECTION PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 250V



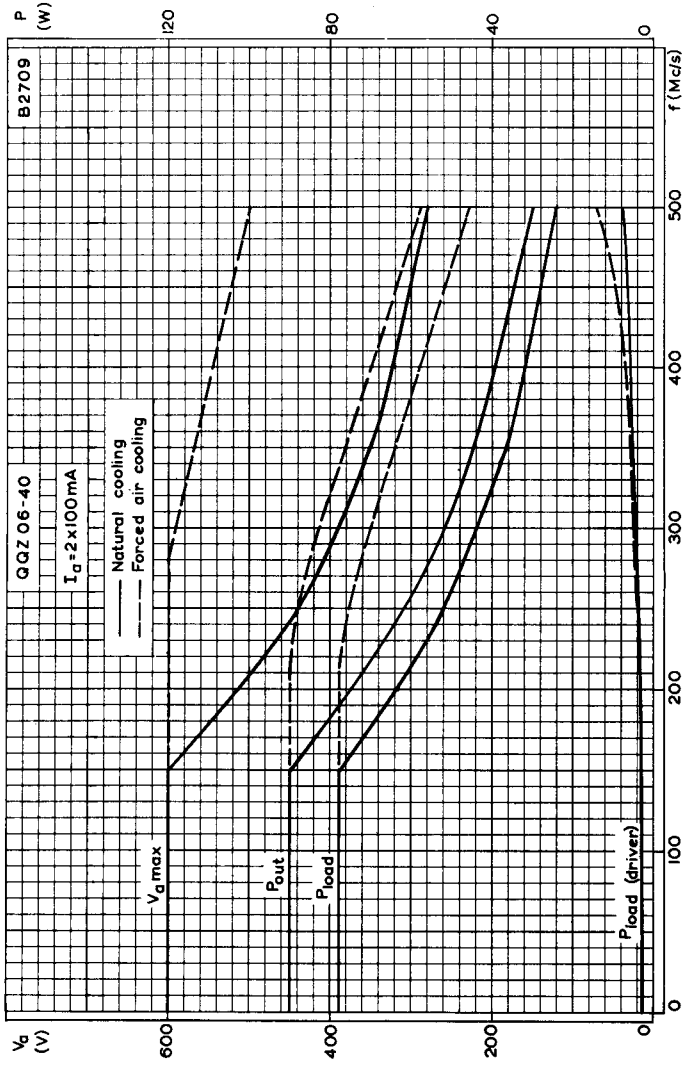
CONSTANT CURRENT CHARACTERISTICS FOR EACH SECTION V_{g2} = 200V



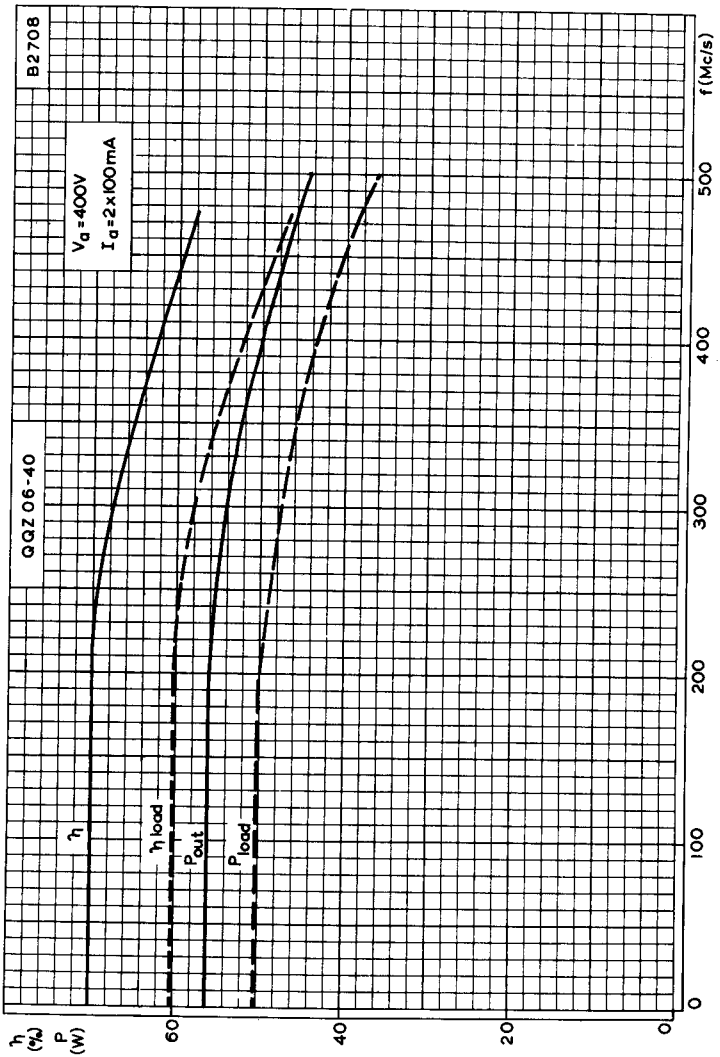
CONSTANT CURRENT CHARACTERISTICS FOR EACH SECTION V_{g2} = 250V

V.H.F. QUICK HEATING DOUBLE TETRODE

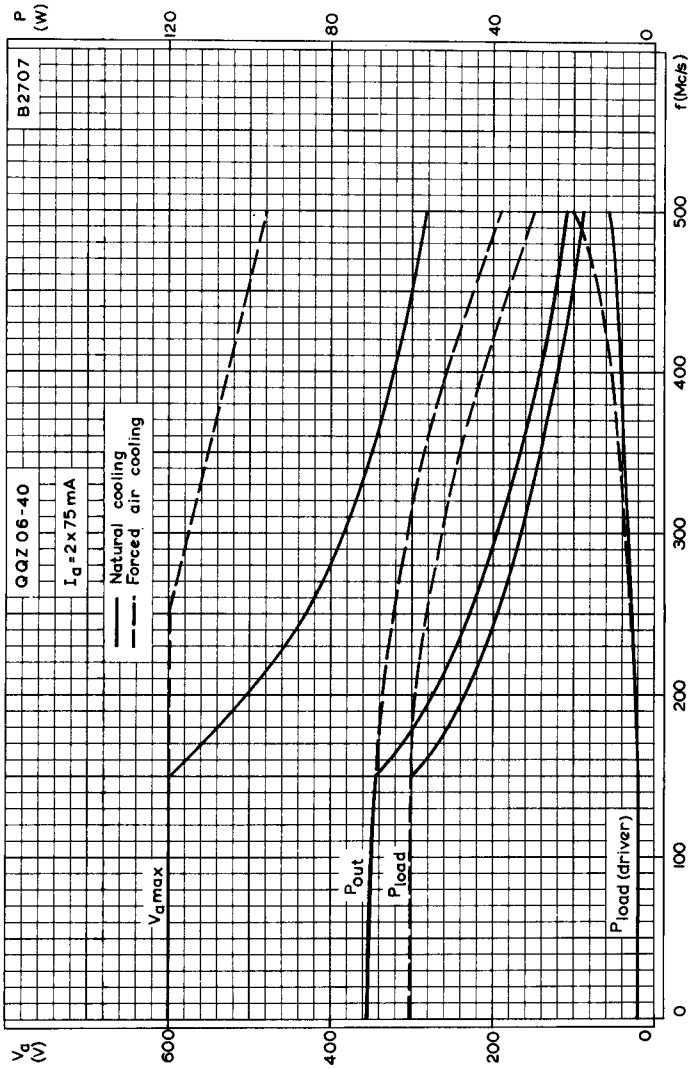
YL1030 QQZ06-40



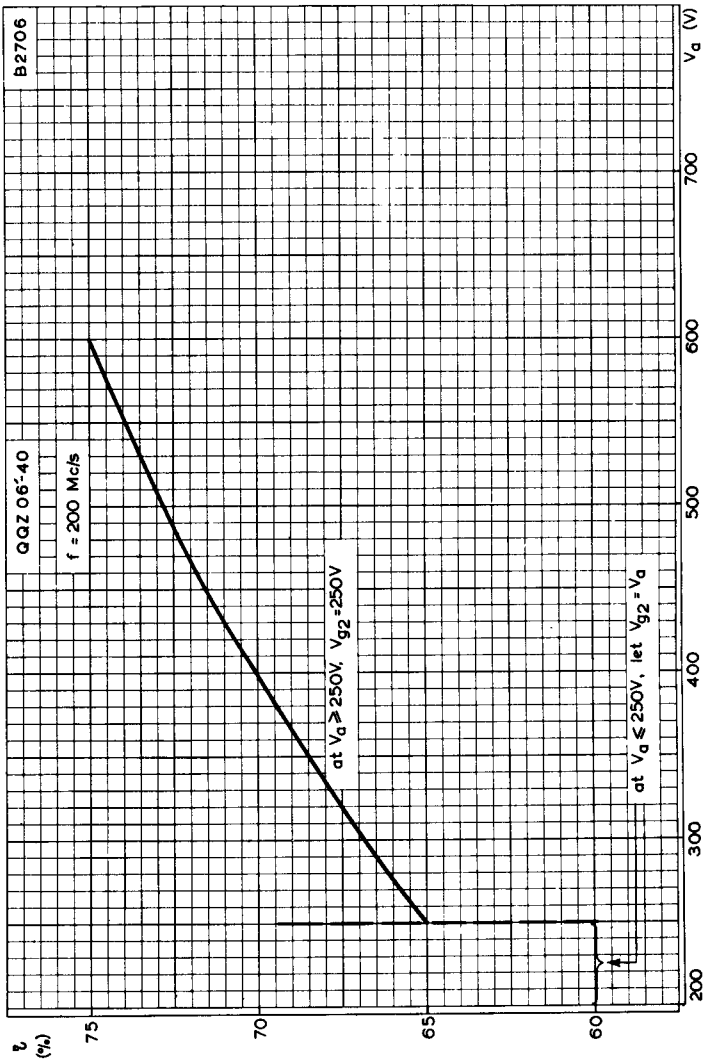
MAXIMUM OPERATING CONDITIONS FOR A PUSH-PULL R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY



FREQUENCY CHARACTERISTICS FOR OPERATING CONDITIONS AS A PUSH-PULL R.F. POWER AMPLIFIER (CLASS 'C' TELEGRAPHY OR F.M. TELEGRAPHY)



MAXIMUM OPERATING CONDITIONS FOR AN ANODE AND SCREEN-GRID MODULATED R.F. POWER AMPLIFIER (CLASS 'C' TELEPHONY)



ANODE EFFICIENCY PLOTTED AGAINST ANODE VOLTAGE FOR CLASS 'C' PUSH-PULL TELEGRAPHY

V.H.F. DOUBLE TETRODE

YL1060

TENTATIVE DATA

QUICK REFERENCE DATA

Radiation cooled double tetrode intended for use as a v.h.f. amplifier, oscillator, frequency multiplier and modulator.

	Class 'C' Telephony Anode and Screen Grid Modulation		Class 'C' Telegraphy or F.M. Telephony		
	C.C.S.	I.C.A.S.	C.C.S.	I.C.A.S.	
f	175	175	175	175	Mc/s
P_{out}	97	122	150	180	W
$f_{max.}$	175	175	175	175	Mc/s
V_a max.	800	800	1000	1000	V
p_a max.	2 x 21	2 x 23.5	2 x 30	2 x 34	W

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

	C.C.S.		I.C.A.S.		
f	175	175	175	175	Mc/s
P_{out}	150	146	166	180	W
P_{load}	132	125	147	163	W
η_a	75	73	77	75	%
V_a	900	1000	900	1000	V
I_a	2 x 110	2 x 100	2 x 120	2 x 120	mA
V_{g2}	245	230	260	260	V
I_{g2}	2 x 6.3	2 x 5.6	2 x 8.5	2 x 8.3	mA
$-V_{g1}$	90	85	85	85	V
I_{g1}	2 x 3	2 x 2.9	2 x 2.9	2 x 2.9	mA
$P_{load(driver)}$	3.5	3.5	3.5	3.5	W
p_a	2 x 25	2 x 27	2 x 25	2 x 30	W
p_{g2}	2 x 1.5	2 x 1.25	2 x 2.25	2 x 2.15	W

CLASS 'C' TELEPHONY ANODE AND SCREEN GRID MODULATION

Maximum operating conditions. (Carrier conditions for 100% modulation).

	C.C.S.	I.C.A.S.	
f	175	175	Mc/s
P_{out}	97	122	W
P_{load}	85	107	W
η_a	72	74	%
V_a	750	800	V
I_a	2 x 90	2 x 100	mA
V_{g2}	250	225	V
I_{g2}	2 x 5.1	2 x 4.4	mA
$-V_{g1}$	66	75	V
I_{g1}	2 x 2.2	2 x 2.5	mA
$P_{load(driver)}$	3.4	3.0	W
p_a	2 x 19	2 x 21	W
p_{g2}	2 x 1.3	2 x 1.0	W
For 100% modulation			
$P_{mod.}$	68	80	W
$v_{g2(pk)}$	90	80	V

ABSOLUTE MAXIMUM RATINGS

	Class 'C' Telephony		Class 'C' Telegraphy		
	C.C.S.	I.C.A.S.	C.C.S.	I.C.A.S.	
f max.	175	175	175	175	Mc/s
V_a max.	800	800	1000	1000	V
V_{g2} max.	250	250	300	300	V
$-V_{g1}$ max.	175	175	175	175	V
I_k max.	2 x 105	2 x 115	2 x 125	2 x 135	mA
p_a max.	2 x 21	2 x 23.5	2 x 30	2 x 34	W
p_{g2} max.	2 x 2.5	2 x 2.8	2 x 3.5	2 x 4.0	W
I_{g1} max.	2 x 5.0	2 x 5.0	2 x 5.0	2 x 5.0	mA
R_{gl-k} max. (each unit)	50	50	50	50	kΩ
V_{h-k} max. (each unit)	100	100	100	100	V

V.H.F. DOUBLE TETRODE

YL1060

CATHODE

Indirectly heated, oxide coated

	Parallel	Series	
V_h	6.3	12.6	V
I_h	1.8	0.9	A

CAPACITANCES

c_{a-g1} (each section)	max 90	mpF
c_{out} (two sections in push-pull)	3.2	pF
c_{in} (two sections in push-pull)	10.5	pF

Internally neutralised for push-pull operation

CHARACTERISTICS (measured at I_a = 30mA)

g_m	4.5	mA/V
μ_{g1-g2}	8.2	

MOUNTING POSITION

Vertical with base up or down.

Horizontal with the anode pins in a horizontal plane.

COOLING

Radiation and low velocity air flow

Maximum temperatures

Anode seal	250	°C
Bulb	250	°C
Base	180	°C

When the valve is operated at maximum ratings or with high ambient temperatures it may be necessary to direct an air flow on the bulb and anode seals.

PHYSICAL DATA

	oz	g
Weight of valve only	2.5	71

ACCESSORIES

Socket 40202

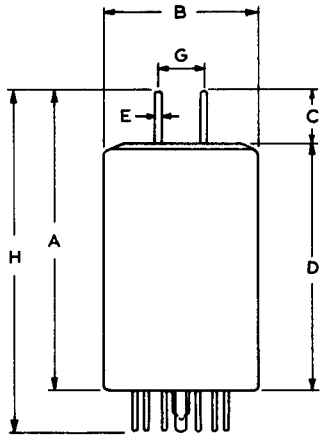
DIMENSIONS

	Inches	Millimetres
A	3.583	91
B	1.756	44.6
C	0.630	16
D	2.953	75
E	0.126	3.2
F	0.200	5.08
G	0.728	18.5
H	4.055	103

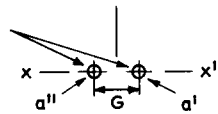
Inch dimensions derived from original millimetre dimensions except dimension 'F'.

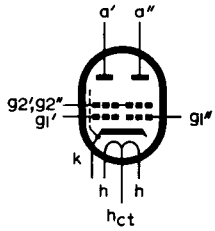
V.H.F. DOUBLE TETRODE

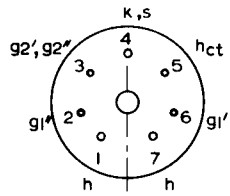
YL1060



Location of anode pins within circles of dia. 'F'



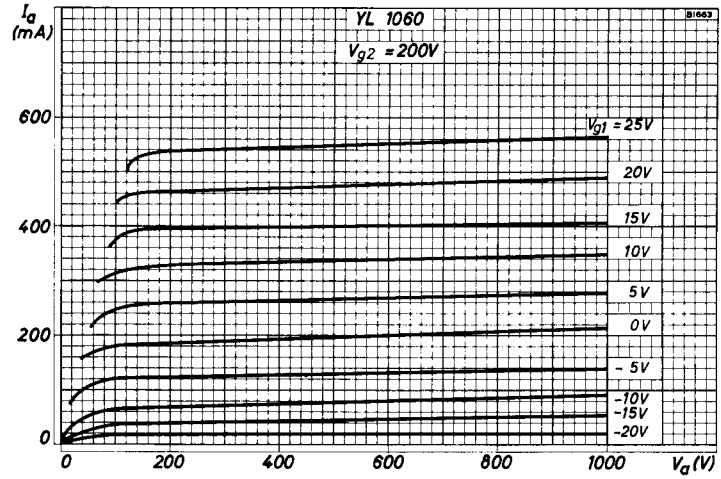


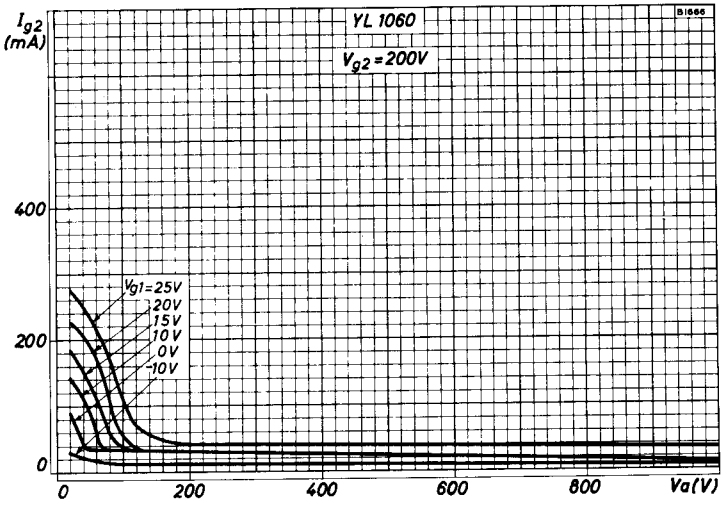


Septar base

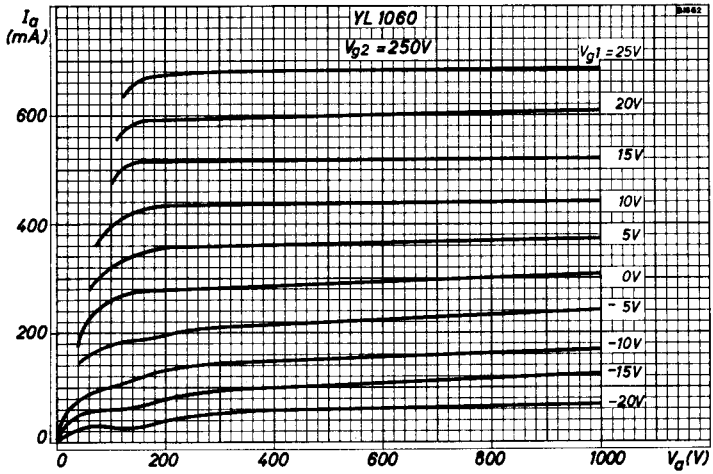
V.H.F. DOUBLE TETRODE

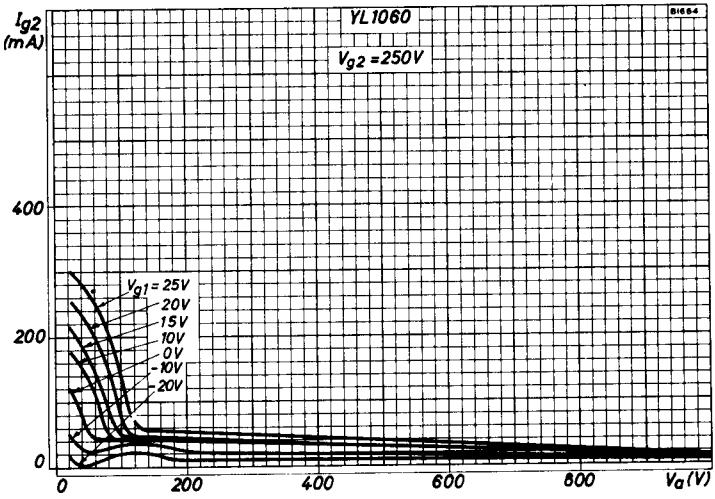
YL1060



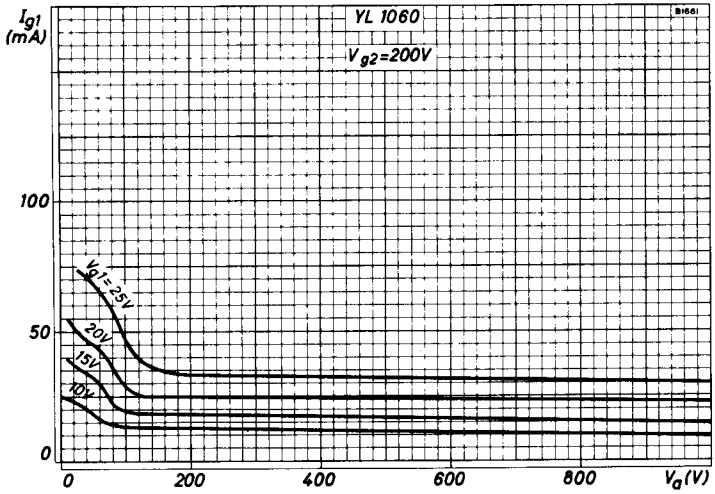


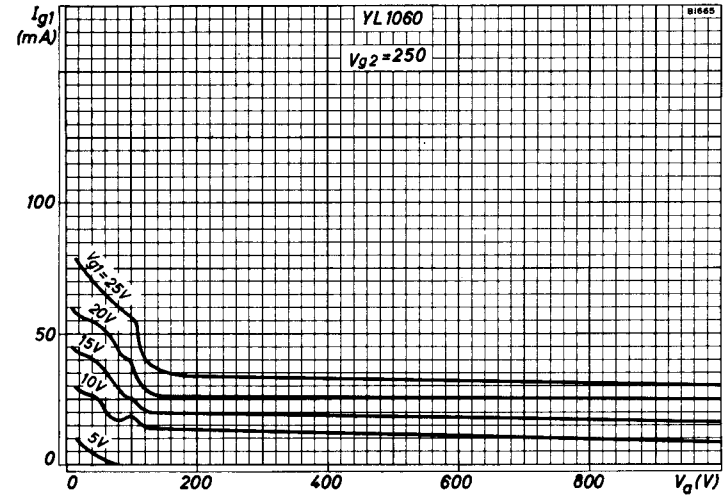
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. Vg2 = 200V.



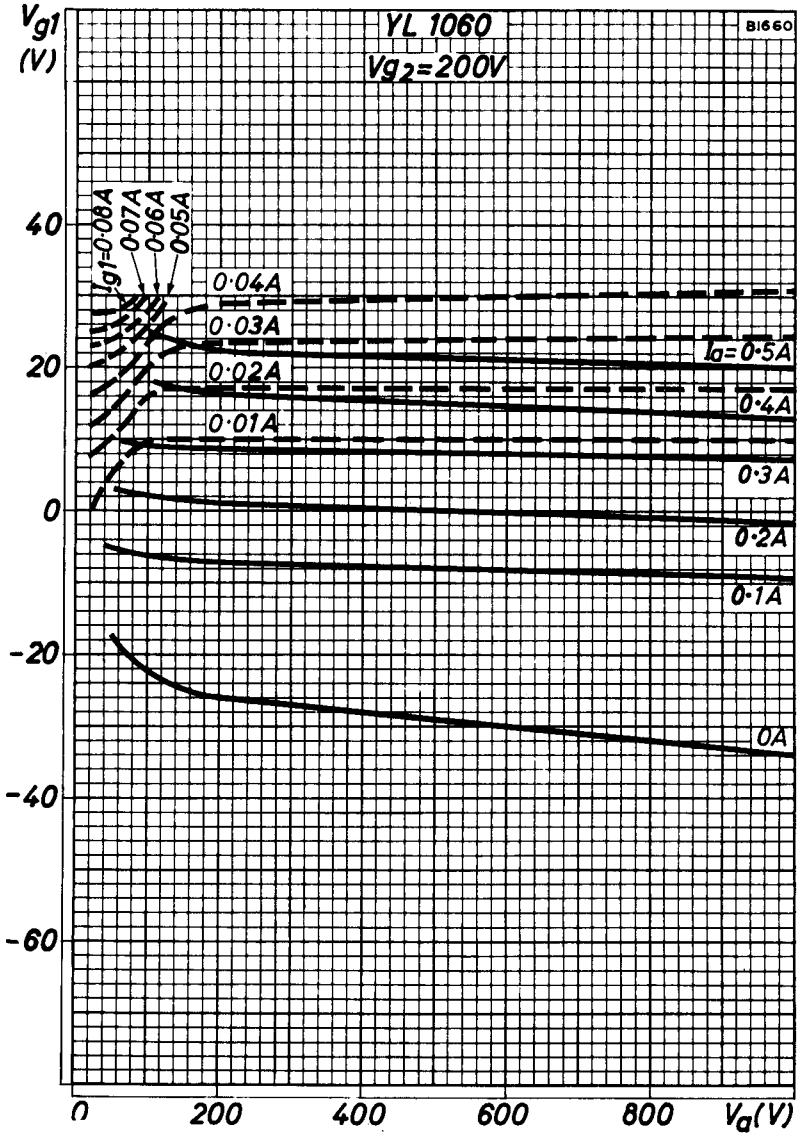


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. Vg2 = 250V.

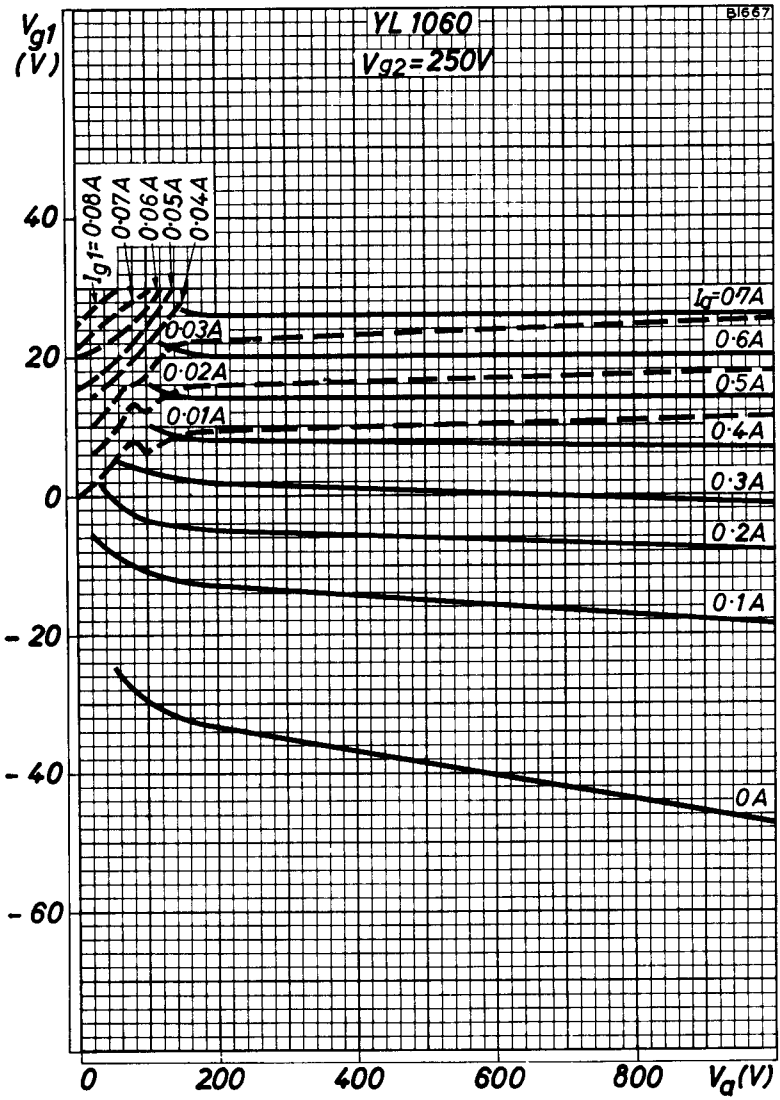




CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER Vg2 = 200V and 250V.



CONSTANT CURRENT CHARACTERISTICS V_{g2} = 200V



CONSTANT CURRENT CHARACTERISTICS. V_{g2} = 250V

QUICK HEATING DOUBLE TETRODE

YL1080

PRELIMINARY DATA

QUICK REFERENCE DATA

Quick heating single-ended double tetrode for mobile transmitters. 70 % power output in less than half a second.

	Frequency Trebler	Class 'C' Telegraphy or F.M. Telephony	
fout	200	200	Mc/s
Pout	5	14.5	W
f max.	200	200	Mc/s
Va max.	300	300	V
pa max.	2 x 5.0	2 x 5.0	W

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES which precede this section of the handbook.

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Absolute maximum ratings

f max.	200	Mc/s
Va max.	300	V
Vg2	200	V
-Vg1 max.	150	V
Ig1 max.	2 x 3.0	mA
Ik max.	2 x 50	mA
ik (pk) max.	2 x 225	mA
pa max.	2 x 5.0	W
pg2 max.	2 x 1.0	W
pg1 max.	2 x 0.2	W
Rg1 - f max.	100	kΩ

Typical operation

f	200	200	200	Mc/s
Va	300	250	200	V
Vg2	170	170	150	V
-Vg1	40	40	40	V
vin(g1-g1) pk	110	110	115	V
Ia	2 x 37.5	2 x 33.5	2 x 35	mA
Ig2	2 x 1.2	2 x 0.9	2 x 1.1	mA
Ig1	2 x 0.9	2 x 1.1	2 x 1.4	mA
pa	2 x 4.0	2 x 2.9	2 x 2.8	W
pg2	2 x 0.2	2 x 0.15	2 x 0.17	W
Pload (driver)	1.0	1.0	1.0	W
Pout	14.5	11	8.4	W
Pload	12	9.0	7.4	W
ηa	65	65	60	%

CLASS 'C' ANODE AND SCREEN-GRID MODULATION
Carrier conditions for a modulation factor of 1.

Absolute maximum ratings

f max.	200	Mc/s
Va max.	240	V
Vg2 max.	200	V
-Vg1 max.	150	V
Ig1 max.	2 x 3.0	mA
Ik max.	2 x 40	mA
ik (pk) max.	2 x 180	mA
pa max.	2 x 3.3	W
pg2 max.	2 x 1.65	W
pg1 max.	2 x 0.2	W
Rg1-k max.	100	kΩ

Typical operation

f	200	Mc/s
Va	200	V
Vg2	130	V
-Vg1	50	V
Ia	2 x 33.5	mA
Ig2	2 x 1.3	mA
Ig1	2 x 0.75	mA
vin(g1-g1)pk	130	V
Pload (driver)	1.0	W
pa	2 x 2.65	W
pg2	0.46	W
Pout	8.0	W
Pload	7.0	W
ηa	60	%
For 100 % modulation		
P mod.	7.0	W
vg2 (pk)	130	V

FREQUENCY TREBLER

Absolute maximum ratings

f max.	200	Mc/s
Va max.	300	V
Vg2 max.	200	V
-Vg1 max.	150	V
Ig1 max.	2 x 2.0	mA
Ik max.	2 x 35	mA
ik(pk) max.	2 x 225	mA
pa max.	2 x 5.0	W
pg2 max.	2 x 1.0	W
pg1 max.	2 x 0.2	W
Rg1-f max.	100	kΩ

QUICK HEATING DOUBLE TETRODE

YL1080

Typical operation

fout	200	200	200	Mc/s
Va	300	250	200	V
Vg2	160	160	160	V
-Vg1	100	100	100	V
Ia	2 x 24	2 x 25	2 x 28.5	mA
Ig2	2 x 1.0	2 x 0.95	2 x 1.5	mA
Ig1	2 x 1.0	2 x 1.0	2 x 1.6	mA
vin(g1-g1)pk	230	230	230	V
pa	2 x 4.7	2 x 4.25	2 x 4.0	W
pg2	2 x 0.15	2 x 0.16	2 x 0.23	W
Pload (driver)	1.0	1.0	2.0	W
Pout	5	4	3.5	W
Pload	3.5	3.0	2.8	W
ηa	35	34	31	%

OPERATING NOTE

Ig1 and Ig2 will vary from valve to valve, hence the use of fixed resistors (Rg1 and Rg2) will result in variations of input and output power. It is therefore recommended that Rg2 be made adjustable.

CATHODE

Directly heated, harp type, 70 % Pout in less than 0.5 second.

Vf (d.c. or r.m.s.)	1.6	V
If	2.5	A

Frequency of filament supply

Sine wave	max. 200	c/s
Square wave	Any	

CAPACITANCES

Internally neutralised for push-pull operation.

ca-g1 (each section)	100	mpF
cout (each section)	3.2	pF
cin (each section)	8.5	pF
ca''-g1'	100	mpF
ca'-g1''	100	mpF
cg1'-g1''	2.4	pF
ca'-a''	75	mpF

CHARACTERISTICS (measured at Va = 200V, Vg2 = 200V, Ia = 30mA)

gm	3.5	mA/V
μg1-g2	7.5	

COOLING

Radiation and convection

Tbulb max.	225	°C
Tpins max.	120	°C

MOUNTING POSITION Any

PHYSICAL DATA

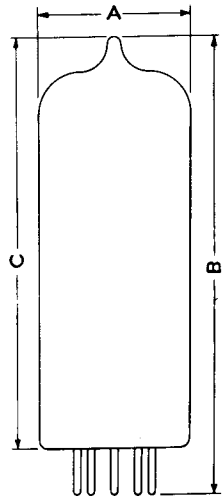
Weight of valve	0.6	oz
	16	g
Weight of valve plus carton	0.8	oz
	23	g

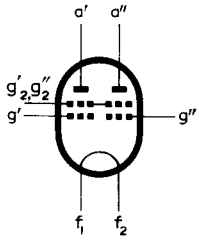
QUICK HEATING DOUBLE TETRODE

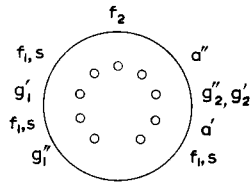
YL1080

B1147

Dimensions (max)		
	Inches	Millimetres
A	0·875	22·2
B	3·094	78·5
C	2·813	71·5



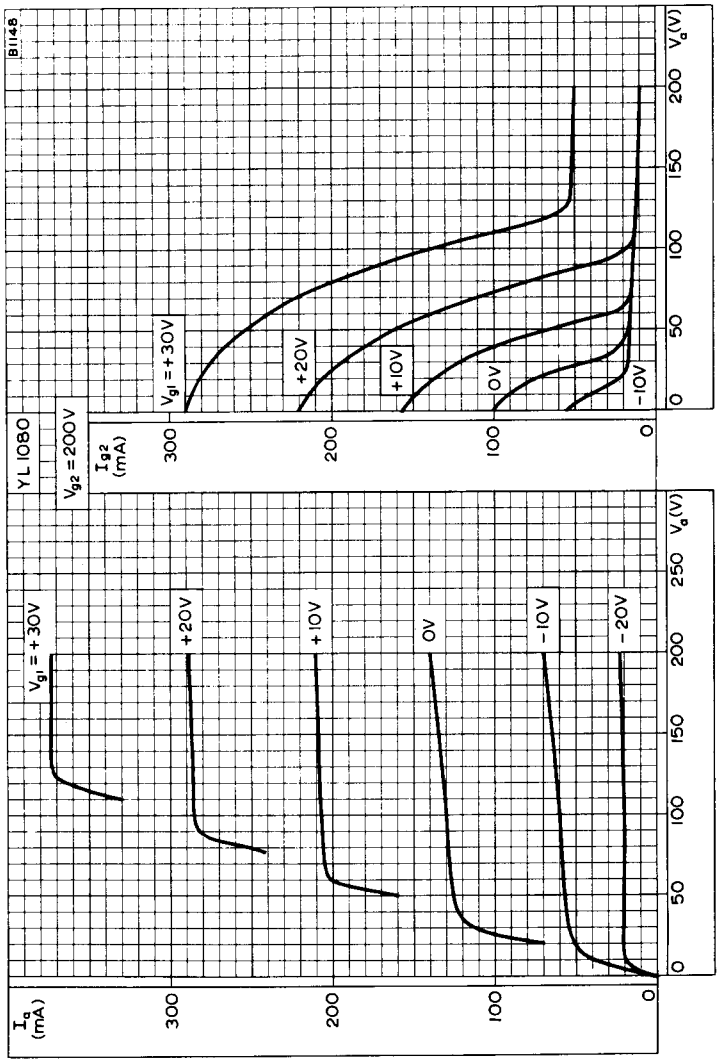




B9A Base

QUICK HEATING DOUBLE TETRODE

YL1080



ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL GRID VOLTAGE AS PARAMETER Vg2=200V.

U.H.F. BEAM POWER TETRODES

YL1100 YL1102 YL1101 YL1103

TENTATIVE DATA

QUICK REFERENCE DATA

Beam power tetrodes intended for use as r.f. power amplifiers in transmitters, oscillators and frequency multipliers at frequencies up to 2000Mc/s.
YL1101 is similar to YL1100 except for heater ratings.
YL1102 and YL1103 are conduction-cooled versions of YL1100 and YL1101 respectively.

	Linear Amplifier for Television Service, Class 'AB$_1$'	Telephony, Anode and Screen Grid Modulation Class 'C'	Telegraphy or F.M. Telephony, Class 'C'		
f	790	400	400	1200	Mc/s
P_{load}	13	45	80	40	W
f max.	1200	1200	1200		Mc/s
V_a max.	1000	800	1000		V
p_a max.	115	75	115		W

Unless otherwise shown, data is applicable to all types

To be read in conjunction with

GENERAL OPERATIONAL RECOMMENDATIONS - TRANSMITTING VALVES

TELEGRAPHY OR F.M. TELEPHONY, CLASS 'C'

OPERATING CONDITIONS

	Grid Drive		Cathode Drive	
f	400	1200	1200	Mc/s
P_{out}	90	45	45	W
P_{load}	80	40	42*	W
η_a	68	29	29	%
V_a	900	900	900	V
I_a	170	170	170	mA
V_{g2}	300**	300**	300	V
I_{g2}	1.0	1.0	3.2	mA
$-V_{g1}$	30	22	31	V
I_{g1}	10	4.0	3.4	mA
$P_{load(driver)}$	3.0	5.0	8.0	W
p_a	43	108	108	W
p_{g2}	0.3	0.3	1.0	W

*Includes power transferred from driver stage.

**Fixed supply or supply derived from the anode supply by means of a voltage divider.

TELEPHONY, ANODE AND SCREEN-GRID MODULATION, CLASS 'C'

OPERATING CONDITIONS (Carrier conditions for 100% modulation)

f	400	Mc/s
P_{out}	50	W
P_{load}	45	W
η_a	54	%
V_a	700	V
I_a	130	mA
V_{g2}	250	V
I_{g2}	10	mA
$-V_{g1}$	50	V
I_{g1}	10	mA
$P_{load(driver)}$	3.0	W
p_a	41	W
p_{g2}	2.5	W
For 100% modulation		
P_{mod}	93	W
$v_{g2(pk)}$	150	V

LINEAR AMPLIFIER FOR TELEVISION SERVICE, CLASS 'AB$_1$'

Sound and vision

OPERATING CONDITIONS for valve in common grid circuit

f	790	Mc/s
Bandwidth (-1dB)	8.0	Mc/s
$P_{load(pk)}$	13	W
*Intermodulation products	-52	dB
V_{a-g1}	800	V
V_{g2-g1}	365	V
**V_{k-g1}	+15	V
$I_{a(o)}$	125	mA
$I_{a(max.sig.)}$	152	mA
I_{g2}	7.0	mA
I_{g1}	0	mA
†$P_{load(driver)pk}$	1.3	W

*The intermodulation product in the passband of the output signal is measured with reference to peak envelope output.

**Adjust to give the desired value of $I_{a(o)}$.

†The driver signal consists of three independent r.f. signal voltages.

i.e.	Picture carrier	- 8dB	with respect to the sum
	Sideband signal	- 17dB	signal amplitude of the
	Sound carrier	- 7dB	composite signal.

CATHODE

Indirectly heated, a.c. or d.c., oxide coated.

	YL1100 YL1102	YL1101 YL1103	
V_h	26.5	6.3	V
I_h	0.52	2.1	A
t_{h-k} min.	60	60	s

The heater voltage must be reduced depending on the operating conditions and the frequency

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Television Class 'AB$_1$'	Telegraphy Class 'C'	Telephony Class 'C'	
f max.	1200	1200	1200	Mc/s
V_a max.	1000	1000	800	V
V_{g2} max.	300	300	300	V
$-V_{g1}$ max.	100	100	100	V
I_a max.	180	180	150	mA
p_a max.	115	115	75	W
p_{g2} max.	4.5	4.5	3.0	W
I_{g1} max.	-	30	30	mA
R_{g1-k} max.	30	30	30	kΩ

CAPACITANCES

c_{a-g1}	<0.065	pF
c_{g1-k+h}	14	pF
c_{a-k+h}	<0.015	pF
c_{g2-g1}	19	pF
c_{a-g2}	4.4	pF
c_{g2-k+h}	<0.4	pF

CHARACTERISTICS (measured at V_a = 1.0kV, V_{g2} = 250V, I_a = 100mA)

g_m	16	mA/V
μ_{g1-g2}	18	

MOUNTING POSITION

Any

COOLING

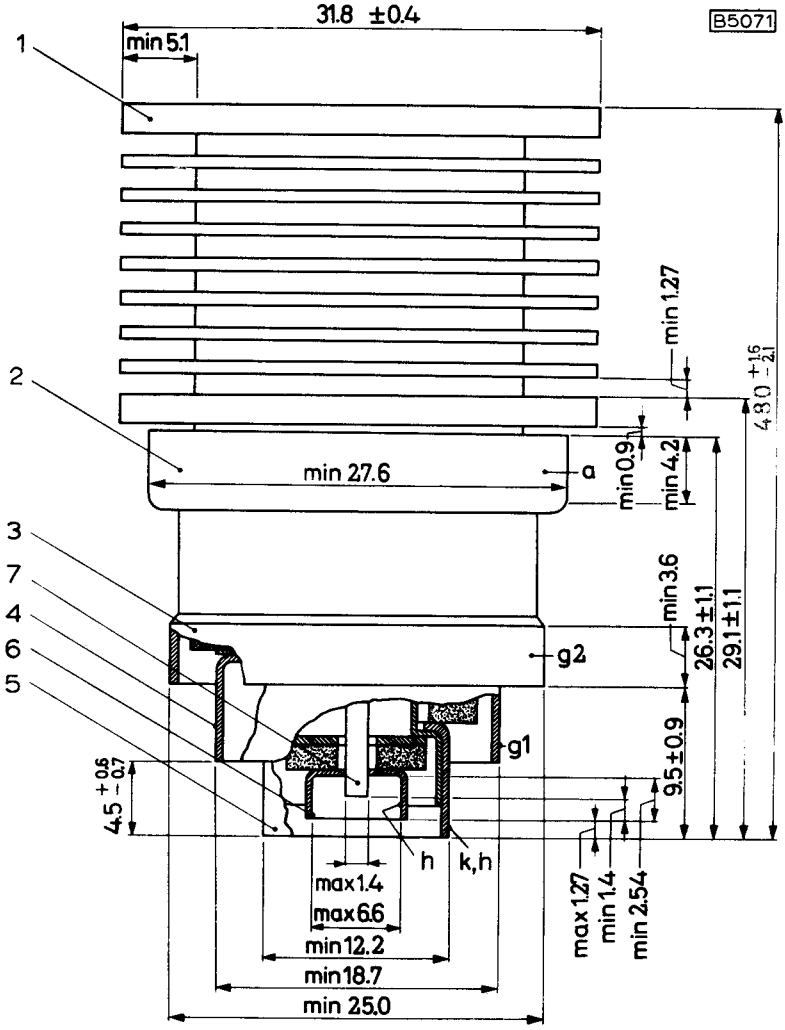
YL1100 and YL1101 - Forced-air cooling for radiator and seals.
YL1102 and YL1103 - Heat sink cooling.

Maximum temperature of anode and all seals	250	°C

PHYSICAL DATA

	oz	g
Weight of valve	2.0	60

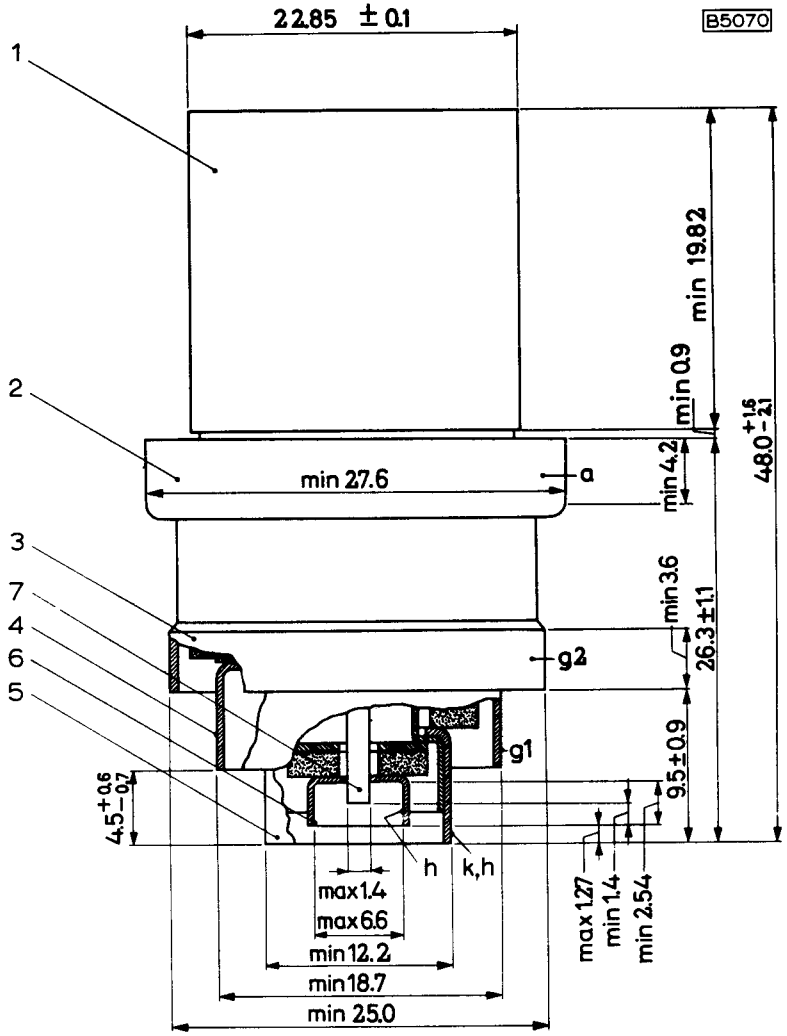
OUTLINE DRAWING OF YL1100 AND YL1101



Radiator and terminals lie inside or outside concentric cylinders:

1. Radiator	i.d. 33.40mm	5. Cathode terminal	i.d. 13.16mm
2. Anode terminal	i.d. 28.40mm	6. Heater terminals	o.d. 6.07mm
3. g_2 terminal	i.d. 25.86mm	7. Heater terminals	i.d. 1.78mm
4. g_1 terminal	i.d. 19.38mm		

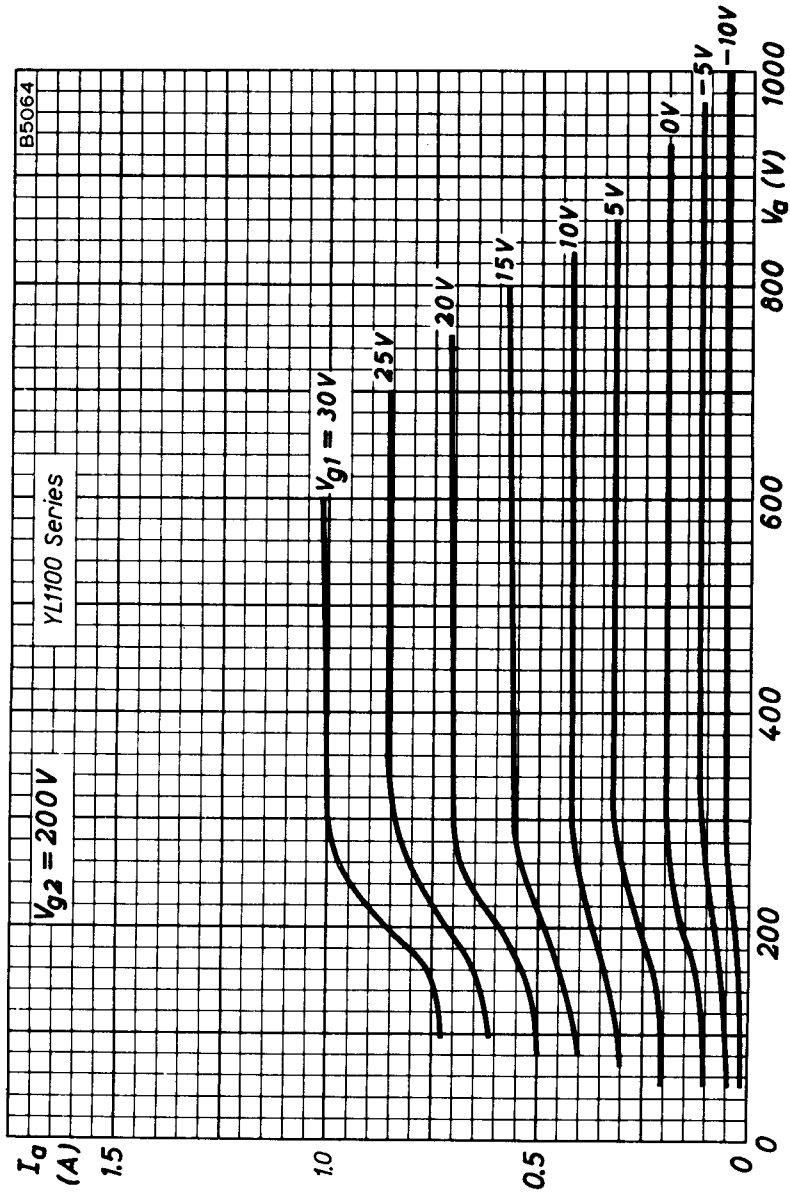
All dimensions in mm



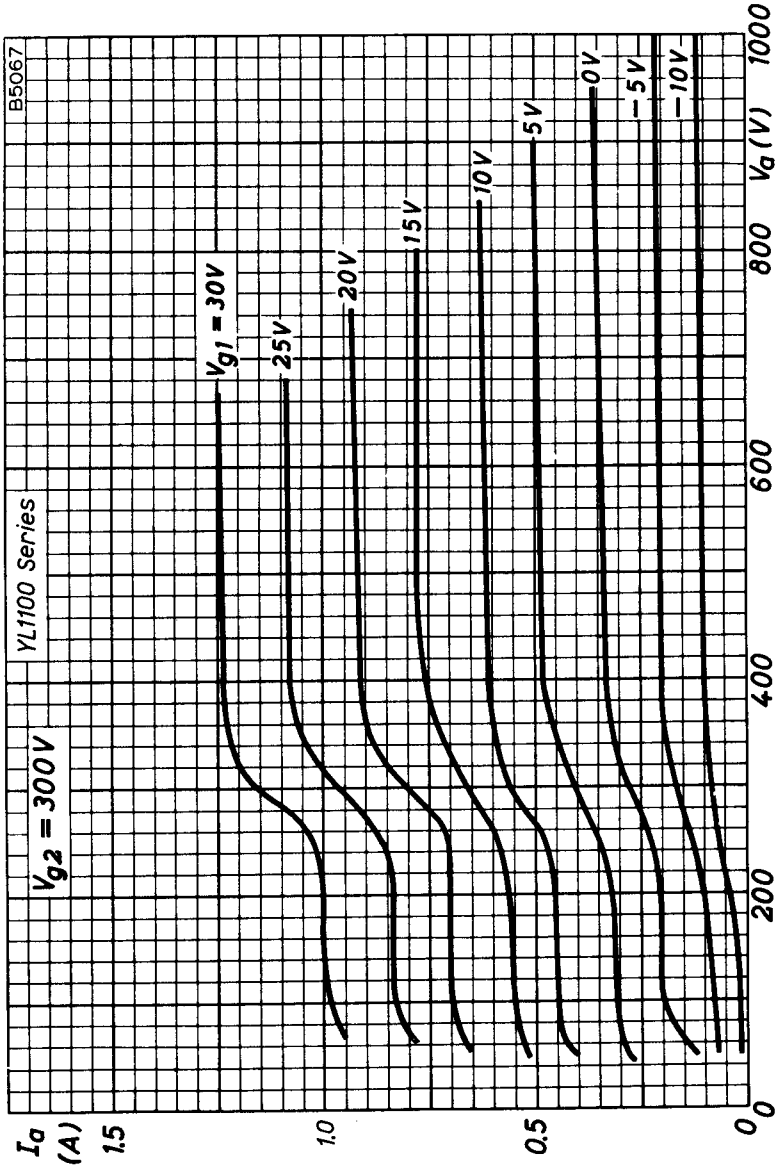
Cooling cylinder and terminals lie inside or outside concentric cylinders:

1. Cooling cylinder	i.d.	24.15mm	5. Cathode terminal	i.d.	13.16mm
2. Anode terminal	i.d.	28.40mm	6. Heater terminals	o.d.	6.07mm
3. g_2 terminal	i.d.	25.86mm	7. Heater terminals	i.d.	1.78mm
4. g_1 terminal	i.d.	19.38mm			

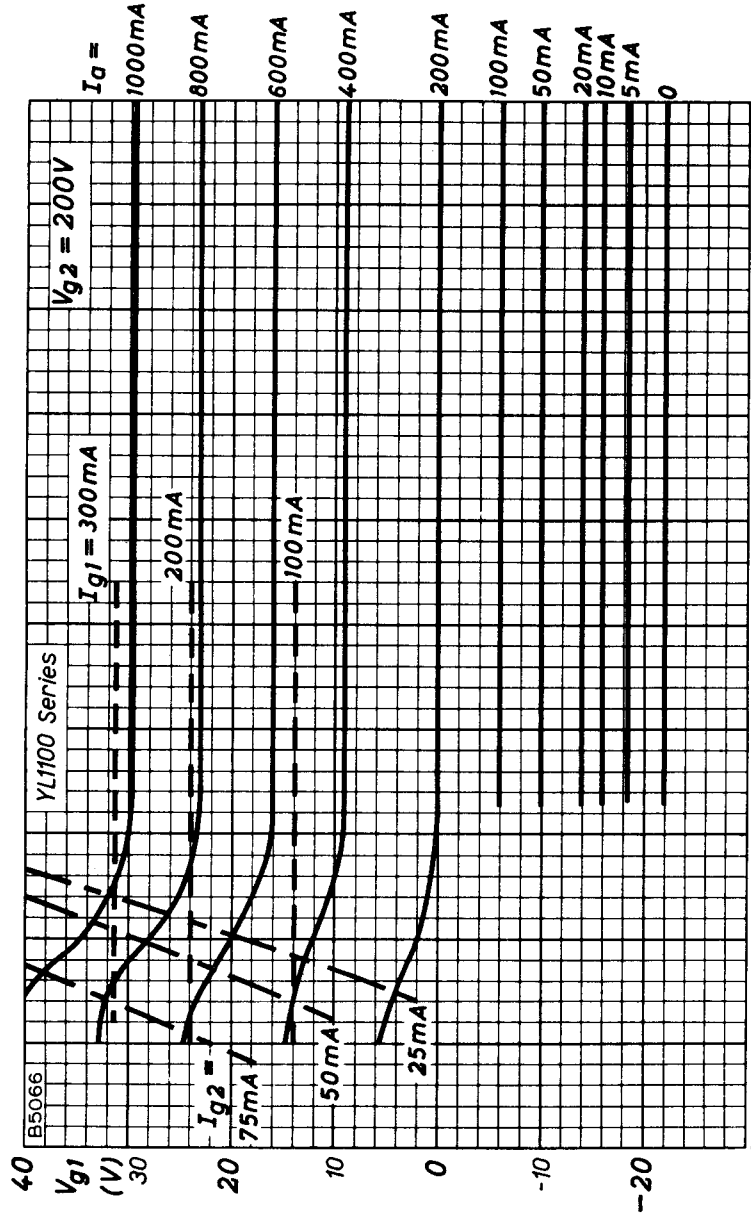
All dimensions in mm



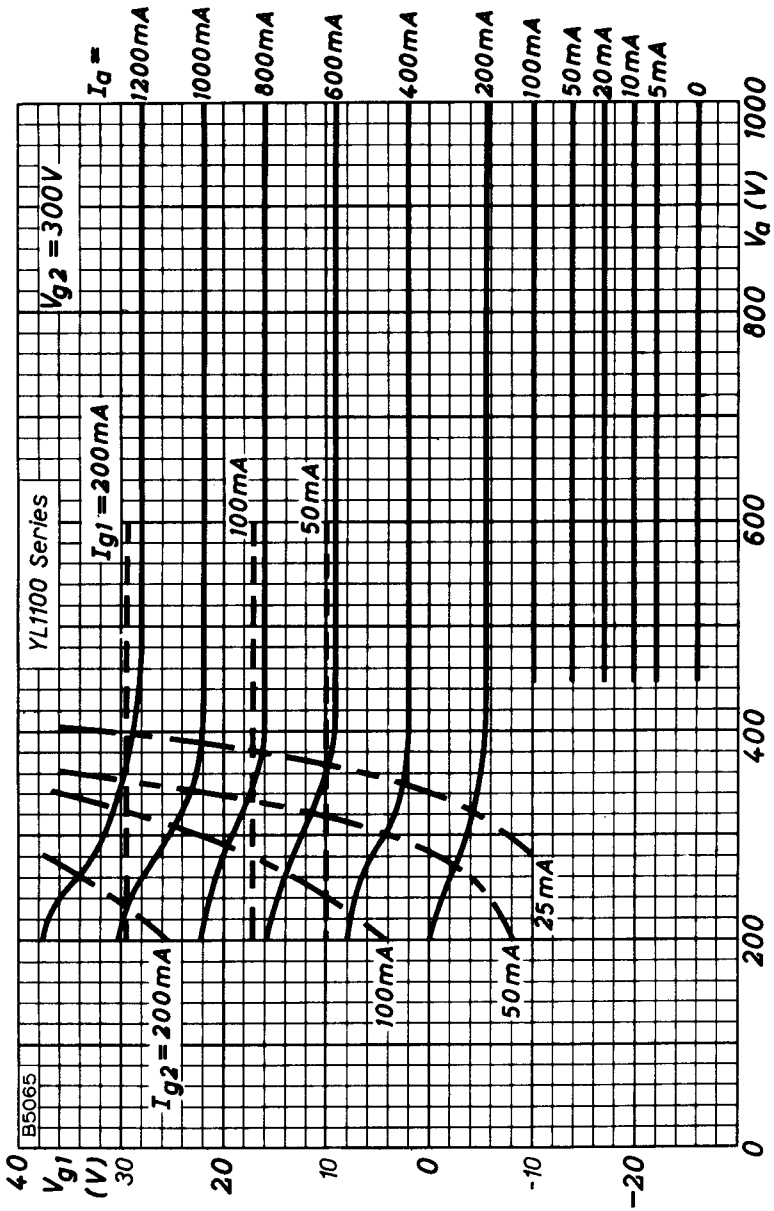
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V



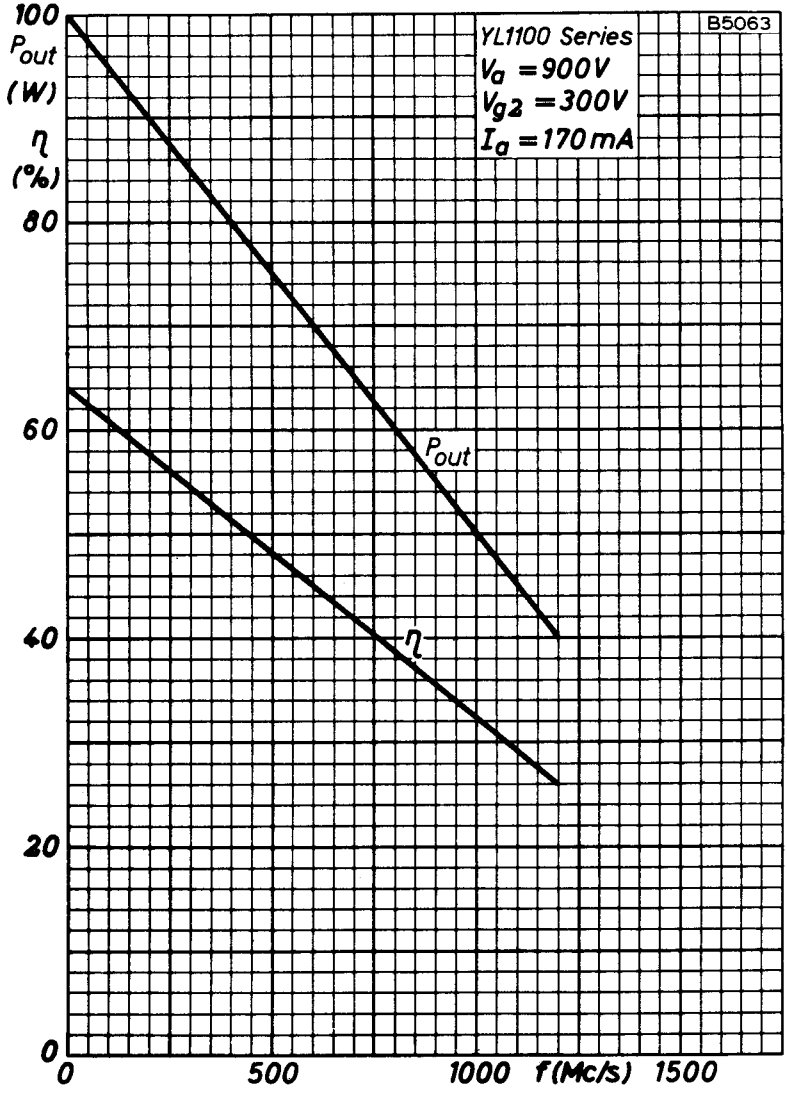
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 300V



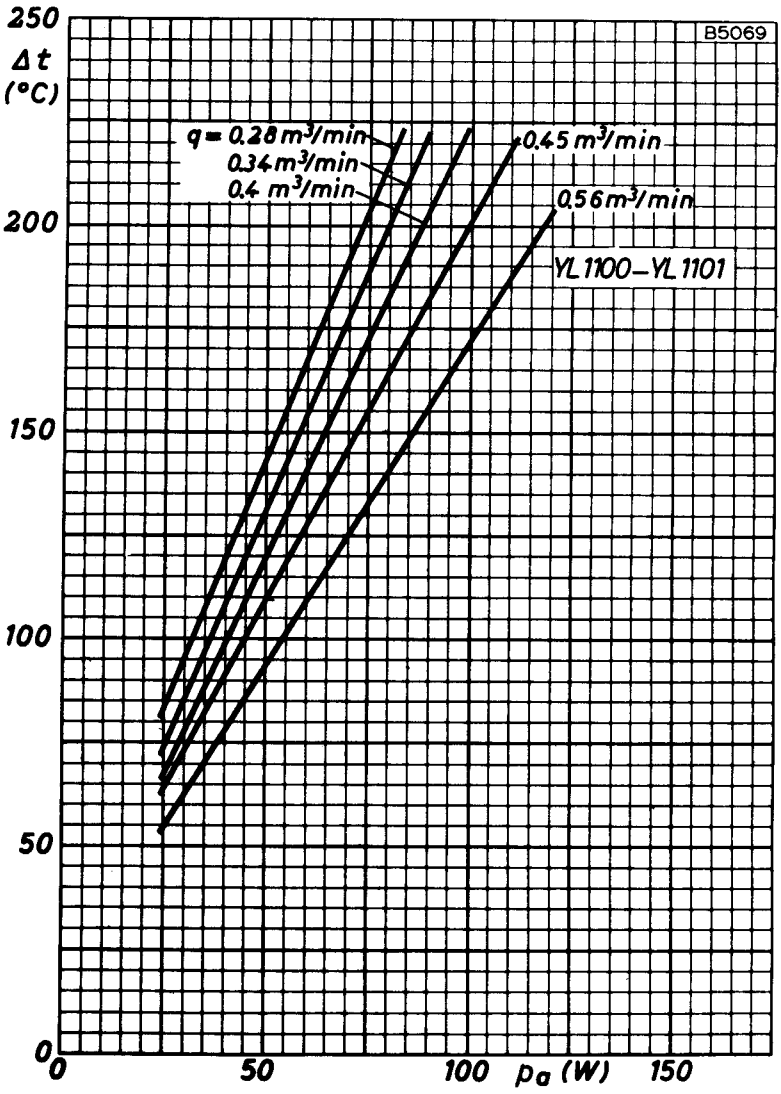
CONSTANT CURRENT CHARACTERISTICS. V_{g2} = 200V



CONSTANT CURRENT CHARACTERISTICS. V_{g2} = 300V

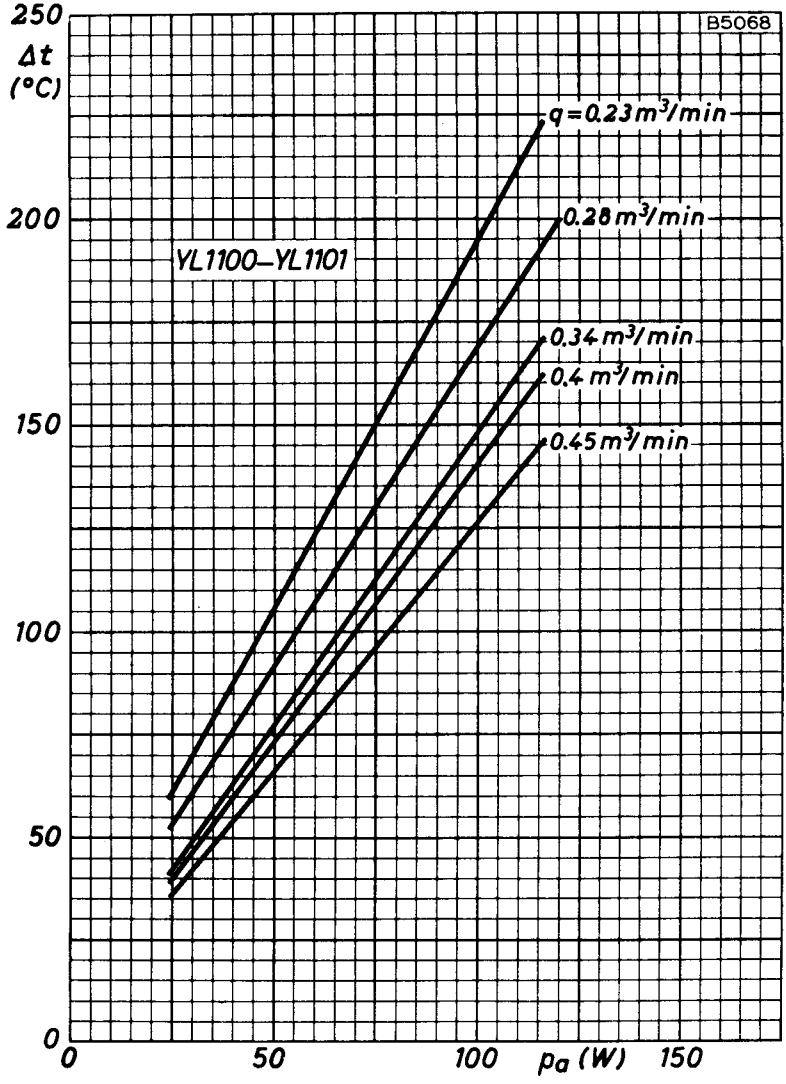


FREQUENCY CHARACTERISTICS FOR CLASS 'C' TELEGRAPHY
OPERATING CONDITIONS V_a = 900V, V_{g2} = 300V, I_a = 170mA



Difference of temperature (Δ_t = $t_{anode\ terminal}$ - $t_{incoming\ air}$) plotted against anode dissipation with rate of air flow as parameter. Air duct of 25 x 38mm. Distance between air duct opening and radiator is 32mm.

(To convert cubic metres to cubic feet multiply by 35.31)



Difference of temperature (Δ_t = $t_{anode\ terminal}$ - $t_{incoming\ air}$) plotted against anode dissipation with rate of air flow as parameter. Radiator in air duct of 25 x 38mm.

(To convert cubic metres to cubic feet multiply by 35.31)

U.H.F. BEAM POWER TETRODE

YL1110

TENTATIVE DATA

QUICK REFERENCE DATA

Forced-air cooled coaxial beam power tetrode. Intended for use as an u.h.f. amplifier or oscillator in common grid circuit.

	Class 'A' Amplifier for T.V. Translator Service	Class 'C' Telegraphy or F.M. Telephony		Class 'B' Linear Amplifier S.S.B.	
f	-	790	470	30	Mc/s
P_{out}	**55	590+30	765+25	*1000	W
f max.	1215	1215		1215	Mc/s
V_a max.	2.5	2.5		2.5	kV
p_a max.	600	700		600	W

*P.E.P_{out}

**P_{load}

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

CLASS 'B' LINEAR AMPLIFIER FOR SINGLE SIDEBAND OPERATION

Maximum operating conditions

f	30	Mc/s
P.E.P_{out}	1000	W
P.E.P_{load}	930	W
***d_3	27	dB
***d_5	30	dB
V_a	2.5	kV
V_{g2}	450	V
****$-V_{g1}$	43	V
$I_{a(o)}$	160	mA
$I_{g2(o)}$	0	mA

	Single tone	Double tone	
I_a	500	350	mA
I_{g2}	22.5	3.0	mA
I_{g1}	0.3	0	mA
$v_{in(pk)}$	42	42	V
$P_{load(driver)}$	2.0	2.0	W
p_a	250	375	W
η_a	80	57	%

***Maximum values encountered at any level of drive voltage referred to the amplitude of either of the two tones at that level. Third and fifth order intermodulation products.

****Adjust to give the stated values of $I_{a(o)}$.

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions (cathode drive)

f	790	470	Mc/s
†P_{out}	590 + 30	765 + 25	W
P_{load}	590	730	W
η_a	47	61	%
V_a	2.5	2.5	kV
I_a	500	500	mA
V_{g2}	400	400	V
I_{g2}	7.0	8.0	mA
$-V_{g1}$	45	35	V
I_{g1}	10	12	mA
$P_{load(driver)}$	60	35	W
p_a	660	485	W

†Includes power transferred from driver stage.

CLASS 'A' LINEAR AMPLIFIER FOR T.V. TRANSLATOR SERVICE SOUND + VISION

Maximum operating conditions

Bandwidth	6.5	Mc/s
P_{load}	55	W
V_a	2.5	kV
V_{g2}	1.2	kV
$-V_{g1}$	30	V
I_a	400	mA
I_{g2}	-10	mA
$P_{load(driver)}$	5.0	W

CLASS 'C' TELEPHONY ANODE AND SCREEN GRID MODULATION

Maximum operating conditions (cathode drive)

f	400	Mc/s
†P_{out}	670 + 25	W
P_{load}	600	W
η_a	67	%
V_a	2.0	kV
I_a	500	mA
V_{g2}	400	V
I_{g2}	8.0	mA
$-V_{g1}$	35	V
I_{g1}	12	mA
$P_{load(driver)}$	35	W
p_a	330	W
p_{g2}	3.2	W
For 100% modulation		
P_{mod}	500	W

†Includes power transferred from driver stage.

ABSOLUTE MAXIMUM RATINGS

	Class 'C' Telephony	Class 'C' Telegraphy	Class 'A' T.V.	Class 'B' S.S.B.	
V_a max.	2.0	2.5	2.5	2.5	kV
V_{g2} max.	1.2	1.2	1.2	1.2	kV
$-V_{g1}$ max.	250	250	250	250	V
I_k max.	600	600	600	600	mA
p_a max.	400	700	600	600	W
p_{g2} max.	17	25	25	25	W
I_{g1} max.	100	100	100	100	mA
R_{g1-k} max.	15	15	15	15	kΩ

CATHODE

Indirectly heated, oxide coated

V_h	6.3	V
I_h	7.9	A
t_{h-k} min.	120	s

CAPACITANCES

c_{k-all}	30	pF
c_{a-k}	0.01	pF
c_{a-all}	5.3	pF

CHARACTERISTICS

μ_{g1-g2} (measured at $V_a = V_{g2} = 225V$, $I_a = 100mA$)	13	
g_m (measured at $V_a = 2.5kV$, $V_{g2} = 400V$, $I_a = 240mA$)	22	mA/V

MOUNTING POSITION — Any

COOLING

Forced-air

Maximum temperature

Anode and all seals	250	°C

Forced-air cooling will be required for the radiator and ceramic to metal seals.

The amount of forced-air cooling of the anode at an air inlet temperature of 25°C is given in the table below:-

Anode dissipation p_a(W)	Minimum air flow q min. (m^3/min. ft^3/min.)	Pressure p_{in} (mm water)
100	0.06, 2.12	2.0
300	0.12, 4.24	4.0
600	0.32, 11.30	17
700	0.46, 16.25	25

PHYSICAL DATA

	oz	g
Weight of valve only	12	340

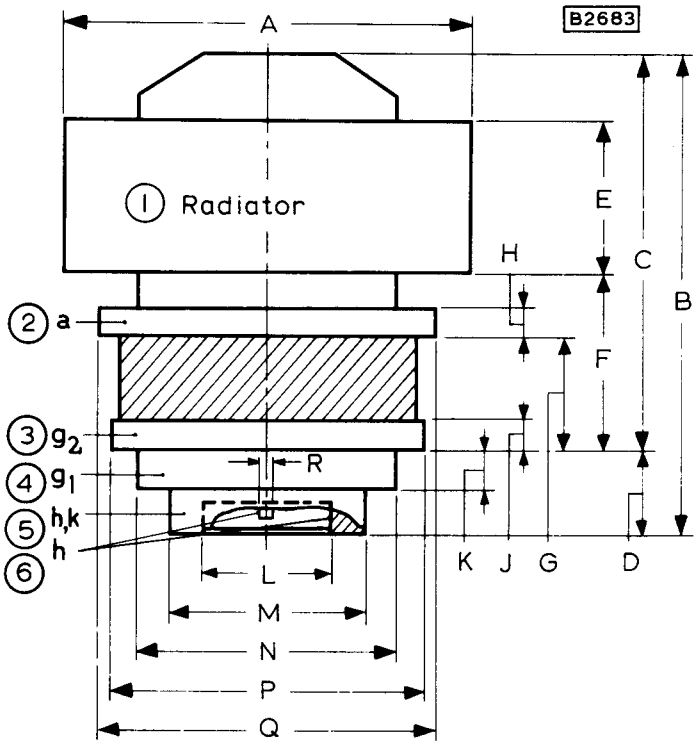
DIMENSIONS

	Inches	Millimetres	
A	2.059±0.031	52.3±0.8	
B	2.400	60.95	max.
C	1.941±0.039	49.3±1.0	
D	0.402±0.020	10.2±0.5	
E	0.756±0.020	19.2±0.5	
F	0.894±0.035	22.7±0.9	
G	0.575±0.020	14.6±0.5	
H	0.146	3.7	min.
J	0.150	3.8	min.
K	0.201±0.020	5.1±0.5	
L	0.669	17	max.
M	0.992	25.2	min.
N	1.291	32.8	min.
P	1.591	40.4	min.
Q	1.744	44.3	min.
R	0.063	1.6	max.

Inch dimensions derived from original millimetre dimensions.

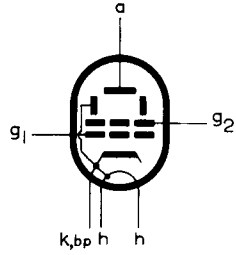
U.H.F. BEAM POWER TETRODE

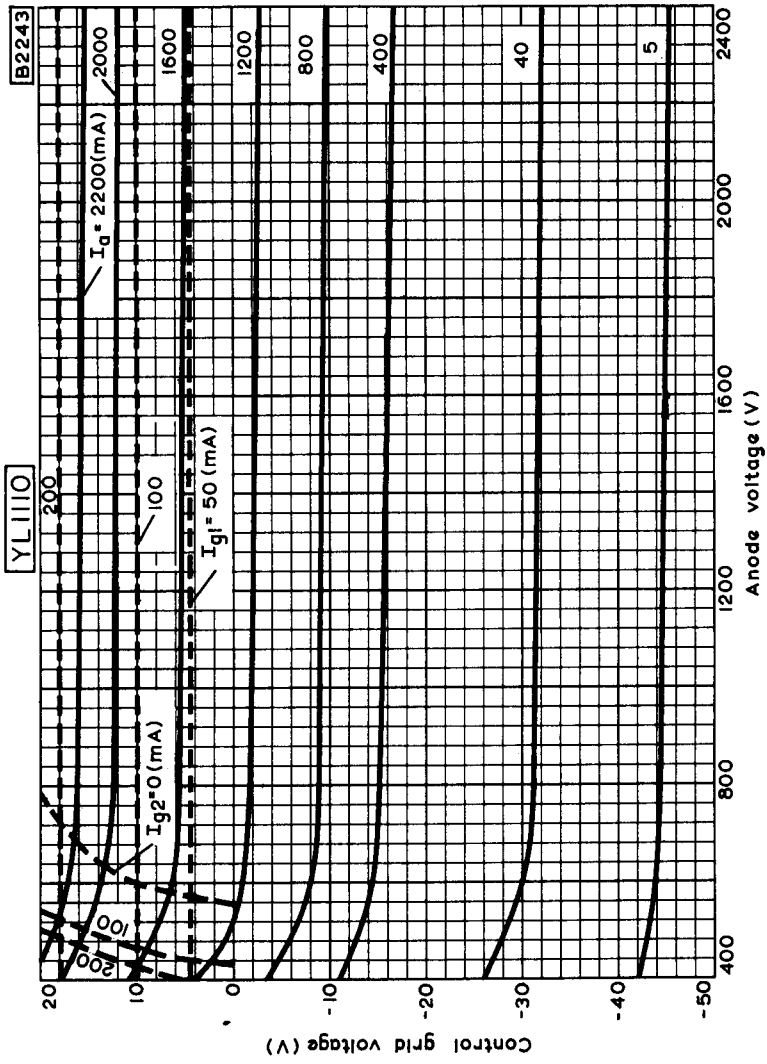
YL1110



The radiator and connections lie inside or outside concentric circles with the following diameters

1.	2.108 in	53.54 mm	inside
2.	1.799 in	45.69 mm	inside
3.	1.609 in	40.87 mm	inside
4.	1.319 in	33.50 mm	inside
5.	1.019 in	25.88 mm	inside
6.	0.619 in	15.72 mm	outside
	0.099 in	2.51 mm	inside





CONSTANT CURRENT CHARACTERISTICS

U.H.F. BEAM POWER TETRODE

YL1110

TENTATIVE DATA

QUICK REFERENCE DATA

Forced-air cooled coaxial beam power tetrode intended for use as u.h.f. amplifier or oscillator at frequencies up to 1215Mc/s.

	Amplifier for TV Translator Service, Class 'A'	Telegraphy or F.M. Telephony, Class 'C'		Linear Amplifier S.S.B. Class 'B'	
f	-	790	470	30	Mc/s
P_{out}	**55	590 + 30	765 + 25	*680	W
f max.	1215	1215		1215	Mc/s
V_a max.	2.5	2.5		2.5	kV
p_a max.	600	700		600	W

*P.E.P_{out} **P_{load}

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

LINEAR AMPLIFIER FOR SINGLE SIDEBAND OPERATION, CLASS 'B'

OPERATING CONDITIONS ←

f	30		Mc/s
$P.E.P_{out}$	680		W
$P.E.P_{load}$	610		W
$*d_3$	-31		dB
$*d_5$	-36		dB
V_a	2.5		kV
V_{g2}	450		V
$**-V_{g1}$	37		V
$I_{a(o)}$	160		mA
$I_{g2(o)}$	0		mA
	Single Tone	Double Tone	
I_a	500	350	mA
I_{g2}	22.5	2.5	mA
I_{g1}	0	0	mA
$v_{in(pk)}$	36	36	V
$P_{load(driver)}$	1.0	1.0	W
p_a	530	535	W
η_a	54	39	%

*Maximum values encountered at any level of drive voltage referred to the amplitude of either of the two tones at that level. Third and fifth order intermodulation products.

**Adjust to give the stated values of $I_{a(o)}$.

TELEGRAPHY OR F.M. TELEPHONY, CLASS 'C'

OPERATING CONDITIONS for valve in common grid circuit.

f	790	470	Mc/s
†P_{out}	590 + 30	765 + 25	W
P_{load}	590	730	W
η_a	47	61	%
V_{a-g1}	2.5	2.5	kV
I_a	500	500	mA
V_{g2-g1}	400	400	V
I_{g2}	7.0	8.0	mA
V_{k-g1}	45	35	V
I_{g1}	10	12	mA
$P_{load(driver)}$	60	35	W
p_a	660	485	W

†Includes power transferred from driver stage.

LINEAR AMPLIFIER FOR TELEVISION TRANSLATOR SERVICE, CLASS 'A'

Sound and vision.

OPERATING CONDITIONS

Bandwidth (-1dB)	>6.5	Mc/s
P_{load}	55	W
*Intermodulation products	-51	dB
V_a	1.4	kV
V_{g2}	0.4	kV
$-V_{g1}$	30	V
I_a	400	mA
I_{g2}	-10	mA
$P_{load(driver)}$	5.0	W

*The intermodulation product in the passband of the output signal is measured with reference to peak envelope output.

TELEPHONY, ANODE AND SCREEN GRID MODULATION, CLASS 'C'

OPERATING CONDITIONS (cathode drive) ←

f	400	Mc/s
†P_{out}	640	W
P_{load}	600	W
η_a	64	%
V_a	2.0	kV
I_a	500	mA
V_{g2}	400	V
I_{g2}	8.0	mA
$-V_{g1}$	35	V
I_{g1}	12	mA
$P_{load(driver)}$	35	W
p_a	360	W
p_{g2}	3.2	W
For 100% modulation		
P_{mod}	502	W

†Includes power transferred from driver stage.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Telephony Class 'C'	Telegraphy Class 'C'	TV Class 'A'	S.S.B. Class 'B'	
V_a max.	2.0	2.5	2.5	2.5	kV
V_{g2} max.	1.2	1.2	1.2	1.2	kV
$-V_{g1}$ max.	250	250	250	250	V
I_a max.	500	500	500	500	mA
p_a max.	400	700	600	600	W
p_{g2} max.	17	25	25	25	W
I_{g1} max.	100	100	100	100	mA
R_{g1-k} max.	15	15	15	15	kΩ

CATHODE ←

Indirectly heated, oxide coated, matrix type.

V_h	6.3	V
I_h	7.85	A
t_{h-k} min.	120	s

The heater has been designed to accept temporary fluctuations of supply voltage of ±10%.

The heater voltage must be reduced depending on operating conditions and frequency.

U.H.F. BEAM POWER TETRODE

YL1110

CAPACITANCES

c_{a-g1}	<0.11	pF
c_{g1-k+h}	29	pF
c_{a-k+h}	<0.011	pF
c_{g1-g2}	37	pF
c_{g2-k+h}	<1.1	pF

CHARACTERISTICS

μ_{g1-g2} (measured at $V_a = V_{g2} = 225V$, $I_a = 100mA$)	13	
g_m (measured at $V_a = 2.5kV$, $V_{g2} = 400V$, $I_a = 240mA$)	22	mA/V

MOUNTING POSITION

Any

COOLING

Forced-air cooling will be required for the radiator and ceramic to metal seals.

Maximum temperature of anode and all seals 250 °C

The amount of forced-air cooling of the anode at an air inlet temperature of 25°C is given in the table below:-

Anode dissipation (W)	Minimum rate of air flow (m^3/min)	(ft^3/min)	Pressure (mm water)
100	0.06	2.12	2.0
300	0.12	4.24	4.0
600	0.32	11.30	17
700	0.46	16.25	25

A low velocity air flow is required for all other electrodes and seals.

PHYSICAL DATA

	oz	g
Weight of valve only	12	340

DIMENSIONS

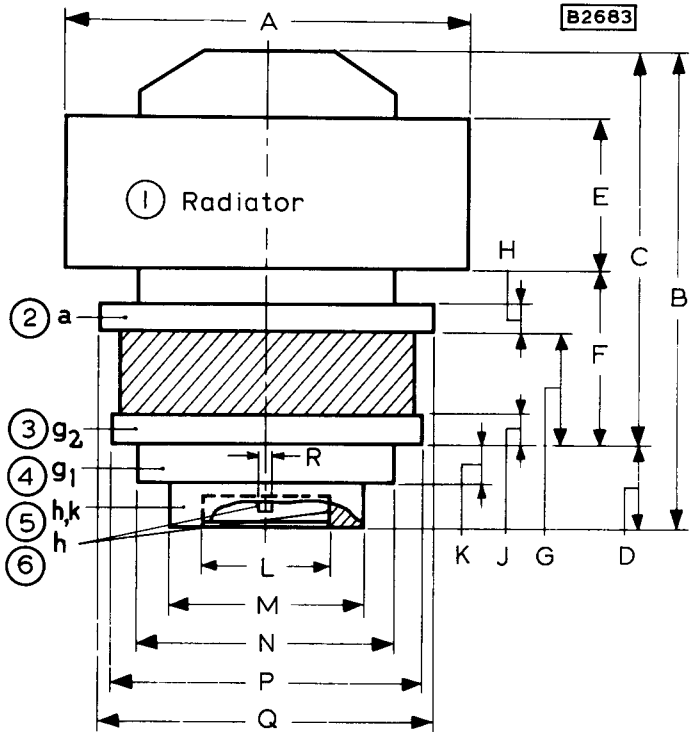


	Inches	Millimetres	
A	$2.059\ ^{+0.031}_{-0.027}$	$52.3\ ^{+0.8}_{-0.7}$	
B	2.399	60.95	max.
C	1.941 ± 0.039	49.3 ± 1.0	
D	0.402 ± 0.020	10.2 ± 0.5	
E	0.756 ± 0.020	19.2 ± 0.5	
F	0.894 ± 0.035	22.7 ± 0.9	
G	0.575 ± 0.020	14.6 ± 0.5	
H	0.146	3.7	min.
J	0.150	3.8	min.
K	0.201 ± 0.020	5.1 ± 0.5	
L	0.66	17	max.
M	0.993	25.2	min.
N	1.292	32.8	min.
P	1.591	40.4	min.
Q	1.744	44.3	min.
R	0.062	1.6	max.

Inch dimensions derived from original millimetre dimensions

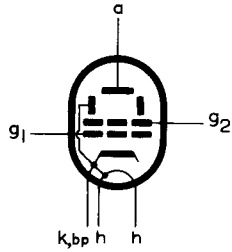
U.H.F. BEAM POWER TETRODE

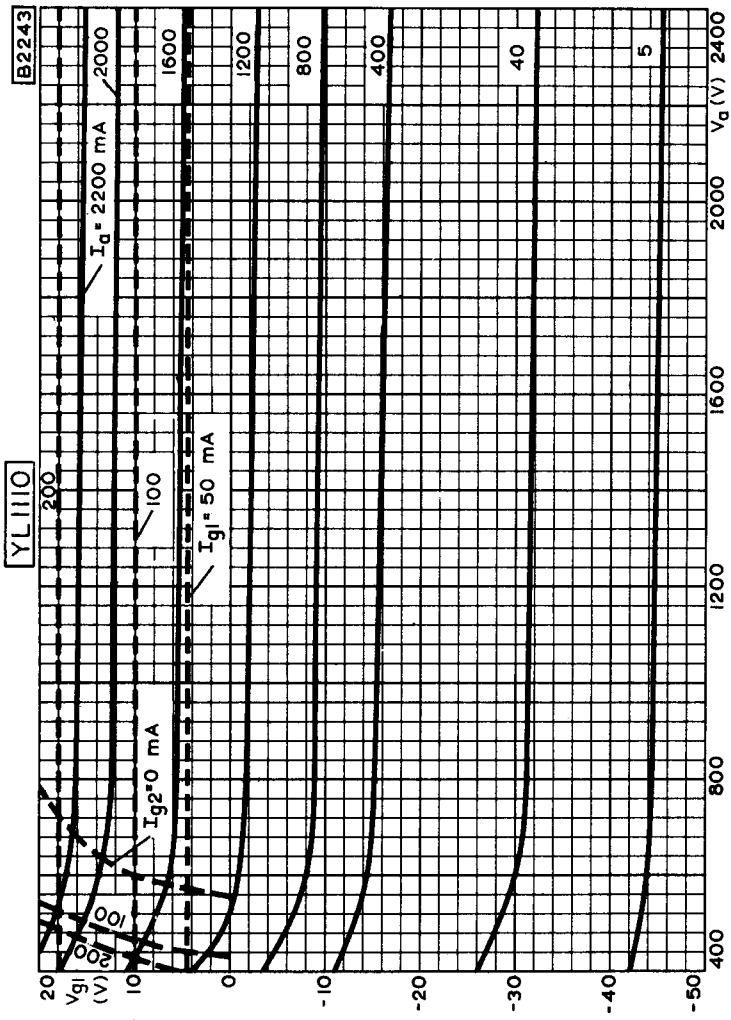
YL1110



The radiator and connections lie inside or outside concentric circles with the following diameters

1.	2.108 in	53.54 mm	inside
2.	1.799 in	45.69 mm	inside
3.	1.609 in	40.87 mm	inside
4.	1.319 in	33.50 mm	inside
5.	1.019 in	25.88 mm	inside
6.	0.619 in	15.72 mm	outside
	0.099 in	2.51 mm	inside





CONSTANT CURRENT CHARACTERISTICS

QUICK HEATING DOUBLE TETRODE

YL1130

QUICK REFERENCE DATA

Amplifier and frequency multiplier for intermittent use in mobile transmitters. 70% power output in less than 0.5 seconds.

	Frequency Trebler	Telephony, Anode and Screen Grid Modulation, Class 'C'		Telegraphy or F.M. Telephony, Class 'C'		
f	500/167	200	500	200	500	Mc/s
P_{out}	3.5	9.4	6.6	16	8.0	W
f max.	500	500		500		Mc/s
V_a max.						
(f = 200Mc/s)	-	240		300		V
(f = 500Mc/s)	200	200		200		V
p_a max.	2×4.0	2×2.6		2×4.0		W

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

TELEGRAPHY OR F.M. TELEPHONY, CLASS 'C'

OPERATING CONDITIONS

f	200	500	Mc/s
P_{out}	16	8.0	W
P_{load}	13	6.5	W
η_a	68	57	%
V_a	275	175	V
I_a	2×42.5	2×40	mA
V_{g2}	175	175	V
I_{g2}	2×7.0	2×6.0	mA
$-V_{g1}$	20	22	V
I_{g1}	2×1.3	2×1.2	mA
$v_{in(g1-g1)pk}$	65	65	V
$P_{load(driver)}$	0.7	1.5	W
p_a	2×3.5	2×3.0	W
p_{g2}	2×1.2	2×1.0	W

TELEPHONY, ANODE AND SCREEN-GRID MODULATION, CLASS 'C'

OPERATING CONDITIONS (Carrier conditions for 100% modulation).

f	200	500	Mc/s
P_{out}	9.4	6.6	W
P_{load}	8.0	5.0	W
η_a	67	59	%
V_a	220	175	V
I_a	2 x 32	2 x 32	mA
V_{g2}	175	175	V
I_{g2}	2 x 4.0	2 x 3.5	mA
$-V_{g1}$	35	30	V
I_{g1}	2 x 1.2	2 x 1.2	mA
$v_{in(g1-g1)pk}$	105	100	V
$P_{load(driver)}$	0.6	1.5	W
p_a	2 x 2.4	2 x 2.3	W
p_{g2}	2 x 0.8	2 x 0.8	W
For 100% modulation			
P_{mod}	8.0	6.5	W
$v_{g2(pk)}$	125	125	V

FREQUENCY TREBLER

OPERATING CONDITIONS

f_{out}/f_{in}		500/167	Mc/s
P_{out}		3.5	W
P_{load}		2.0	W
η_a		33	%
V_a		175	V
I_a		2 x 30	mA
V_{g2}		175	V
I_{g2}		2×4.5	mA ←
$-V_{g1}$		75	V
I_{g1}		2×1.2	mA ←
$v_{in(g1-g1)pk}$		175	V
$P_{load(driver)}$		1.5	W ←
p_a		2 x 3.5	W
p_{g2}		2 x 0.8	W

QUICK HEATING DOUBLE TETRODE

YL1130

RATINGS (ABSOLUTE MAXIMUM SYSTEM) ←

	Frequency Trebler	Telephony, Class 'C'		Telegraphy, Class 'C'		
f max.	500	200	500	200	500	Mc/s
V_a max.	200	240	200	300	200	V
V_{g2} max.	200	200	200	200	200	V
$-V_{g1}$ max.	150	150	150	150	150	V
I_k max.	2 x 40	2 x 40	2 x 40	2×60	2×60	mA
p_a max.	2 x 4.0	2 x 2.6	2 x 2.6	2 x 4.0	2 x 4.0	W
p_{g2} max.	2 x 1.3	2 x 1.0	2 x 1.0	2×1.5	2×1.5	W
I_{g1} max.	2 x 3.0	2 x 3.0	2 x 3.0	2×5.0	2×5.0	mA
p_{g1} max.	2 x 0.2	2 x 0.2	2 x 0.2	2 x 0.2	2 x 0.2	W
R_{g1-f} max. (per section)	100	100	100	100	100	kΩ

CATHODE

Quick heating directly heated filament. 70% P_{out} in less than 0.5 second.

*V_f	1.1	V
I_f	2.9	A ←

Frequency of filament supply

Sine wave	max. 200	c/s
Square wave	Any	

*The filament has been designed to accept temporary fluctuations of supply voltage of ±15%.

CAPACITANCES

c_{in} (two sections in push-pull)	4.1	pF
c_{out} (two sections in push-pull)	1.2	pF

Internally neutralised for push-pull operation.

CHARACTERISTICS (measured at $V_a = V_{g2} = 175V$, $I_a = 40mA$)

g_m	7.0	mA/V
μ_{g1-g2}	22	←

MOUNTING POSITION Any

If the valve is mounted horizontally it is recommended that pins 3 and 7 be in the vertical plane.

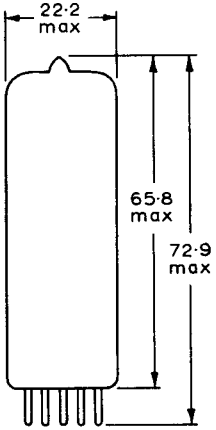
COOLING Radiation and convection

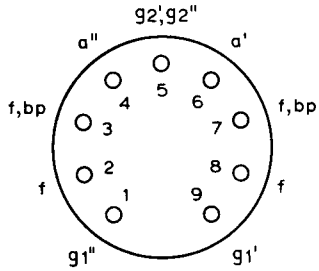
Maximum bulb temperature 230 °C

PHYSICAL DATA

	oz	g
Weight of valve	0.6	16

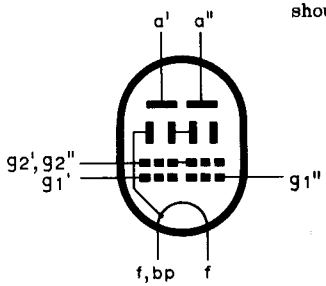
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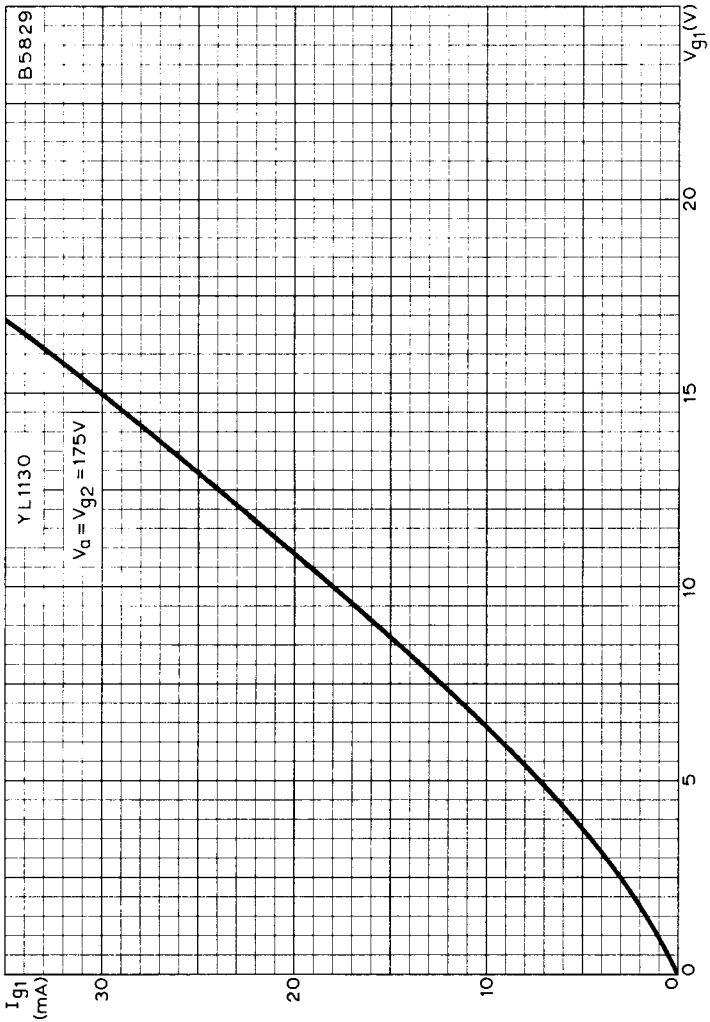
B9A Base

Filament connections (pins 3, 7 and 2, 8) should be connected in parallel on the socket.

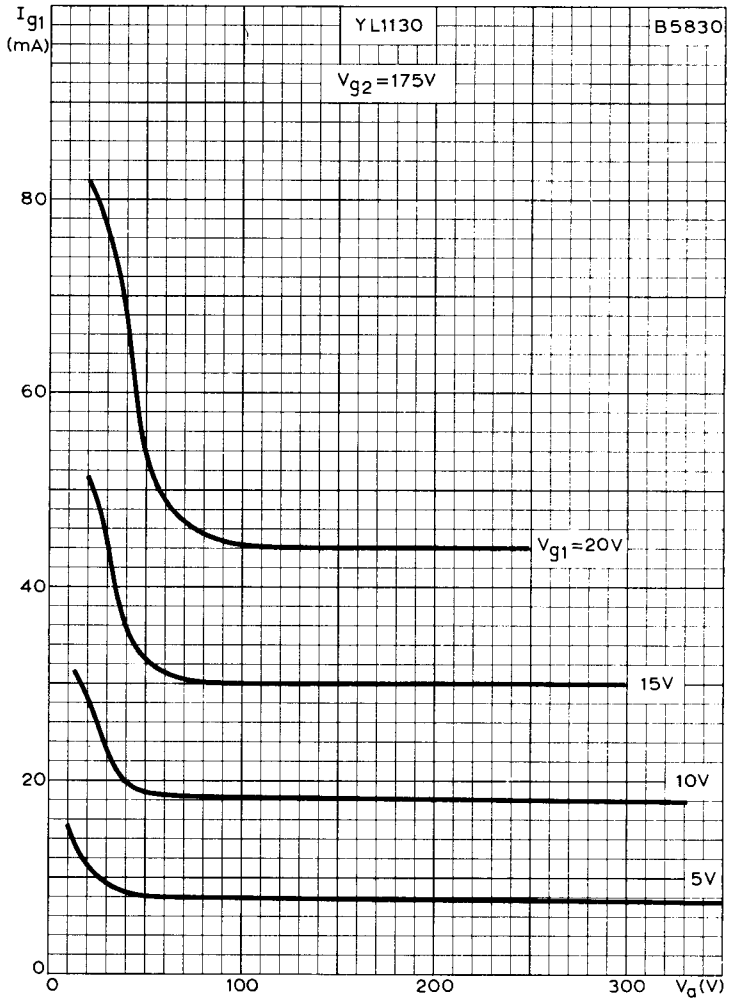


All dimensions in mm

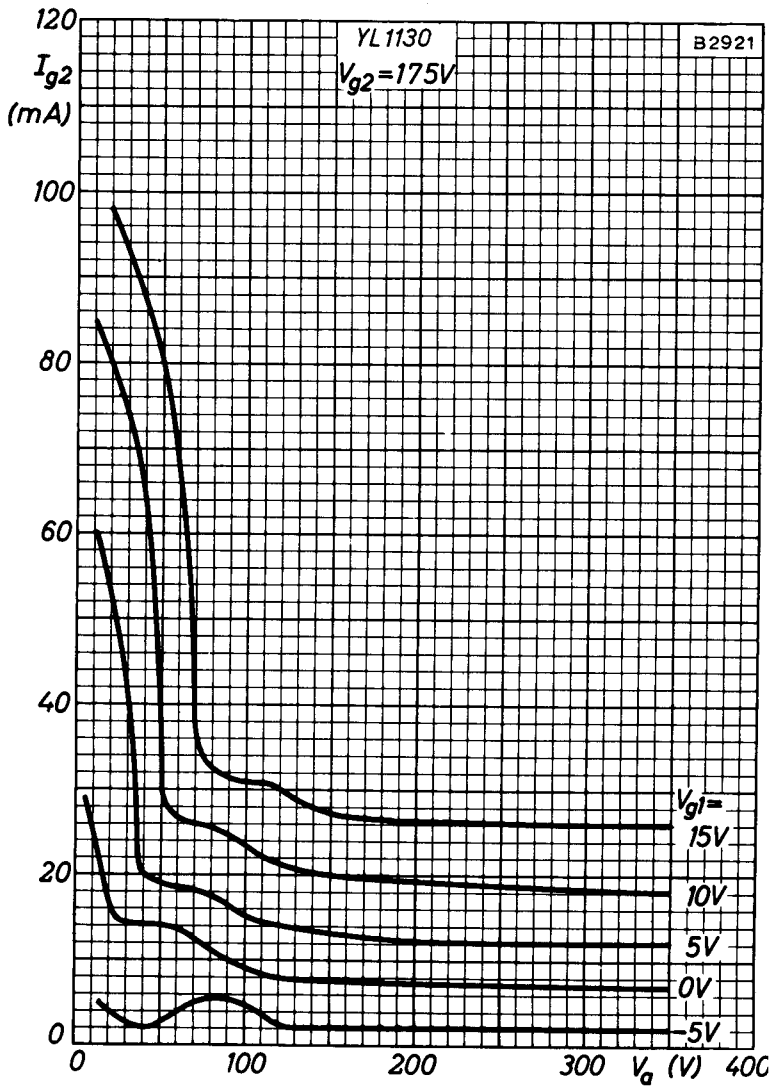
B5826



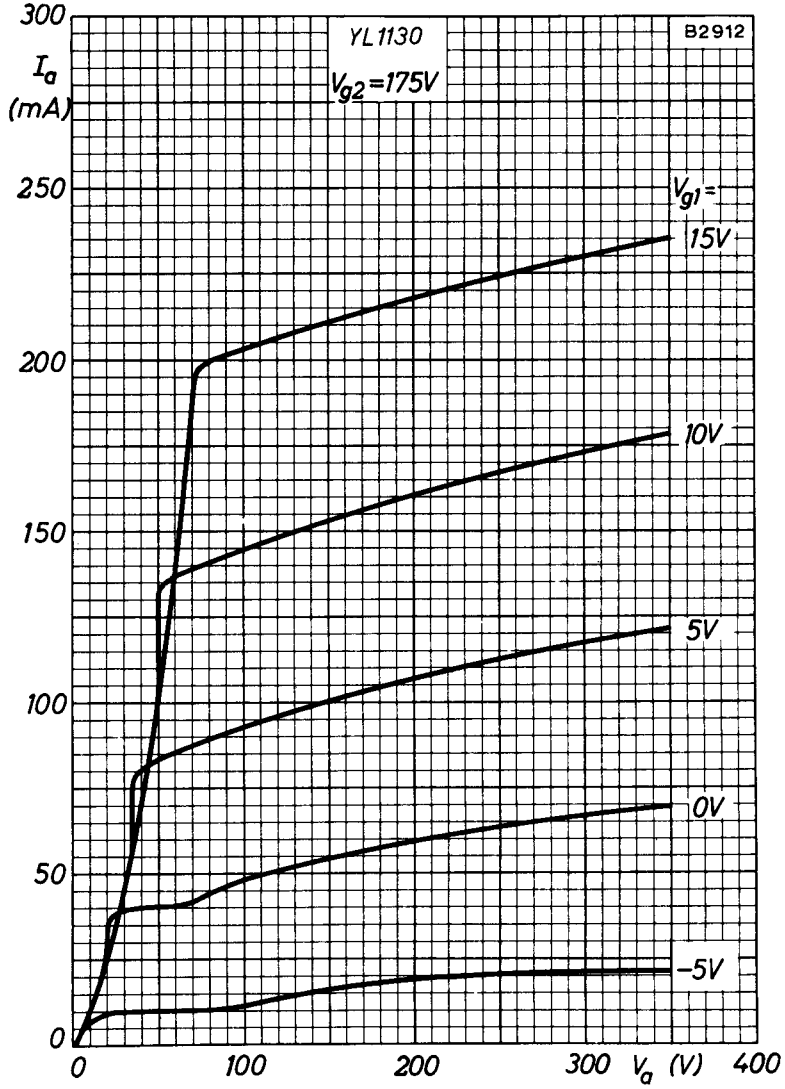
CONTROL-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 175V$ (EACH SECTION)



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER
V_{g2}=175V (EACH SECTION)



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER
V_{g2}=175V (EACH SECTION)



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER
V_{g2}=175V (EACH SECTION)

V.H.F. BEAM POWER TETRODE

YL1150

TENTATIVE DATA

QUICK REFERENCE DATA

Radiation and convection cooled beam power tetrode intended for use as a linear v.h.f. amplifier for s.s.b., Class 'C' v.h.f. amplifier or l.f. Class 'AB' amplifier or modulator.

	Class 'AB' Amplifier or Modulator	Class 'B' Linear Amplifier for S.S.B.		Class 'C' Telegraphy or F.M. Telephony	
f	-	30	60	30	Mc/s
P_{out}	2 x 100	*120	*109	150	W
f max.	-	60		60	Mc/s
V_a max.	750	750		750	V
p_a max.	75	75		75	W

*P.E. P_{out}

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

CLASS 'B' LINEAR AMPLIFIER FOR SINGLE SIDEBAND OPERATION

Maximum operating conditions

f		30	Mc/s
$P.E.P_{out}$		120	W
$P.E.P_{load}$		110	W
$**d_3$		30	dB
$**d_5$		40	dB
V_a		600	V
V_{g2}		250	V
$***-V_{g1}$		55	V
$I_{a(o)}$		100	mA
$I_{g2(o)}$		3.0	mA
	Single tone	Double tone	
I_a	328	221	mA
I_{g2}	27.5	15	mA
I_{g1}	0	0	mA
$V_{in(pk)}$	40	40	V
$P_{load\ (driver)}$	1.0	1.0	W
p_a	77	73	W
η_a	61	45	%

f		60	Mc/s
P.E.P_{out}		109	W
P.E.P_{load}		100	W
**d_3		30	dB
**d_5		40	dB
V_a		600	V
V_{g2}		250	V
***-V_{g1}		50	V
$I_{a(o)}$		100	mA
$I_{g2(o)}$		3.0	mA
	Single tone	Double tone	
I_a	325	220	mA
I_{g2}	28	14	mA
I_{g1}	0.5	0.1	mA
$v_{in(pk)}$	50	50	V
$P_{load(driver)}$	1.0	1.0	W
p_a	75	72	W
η_a	51	38	%

**Maximum values encountered at any level of drive voltage referred to the amplitude of either of the two tones at that level. Third and fifth order intermodulation products.

***Adjust to give stated value of $I_{a(o)}$

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

f	30	Mc/s
P_{out}	150	W
P_{load}	120	W
η_a	76	%
V_a	600	V
I_a	330	mA
V_{g2}	250	V
I_{g2}	28	mA
$-V_{g1}$	90	V
I_{g1}	0	mA
$P_{load(driver)}$	1.0	W
p_a	48	W
p_{g2}	7.0	W

CLASS 'AB' AUDIO AMPLIFIER OR MODULATOR

Maximum operating conditions for two valves in push-pull

P_{out}	200	W
†D_{tot}	≤2	%
R_{a-a}	2.8	kΩ
V_a	600	V
V_{g2}	250	V
††$-V_{g1}$	50	V
$I_{a(o)}$	2 × 100	mA
$I_{g2(o)}$	2 × 3.0	mA
I_a (max. sig.)	2 × 260	mA
I_{g2} (max. sig.)	2 × 24	mA
I_{g1}	0	mA
$V_{in(g1-g1)}$ r.m.s.	100	V
p_a	2 × 56	W
η_a	64	%

†Total distortion encountered at maximum output.

††Adjust to give the stated value of $I_{a(o)}$.

ABSOLUTE MAXIMUM RATINGS

V_a max.	750	V
V_{g2} max.	300	V
$-V_{g1}$ max.	100	V
I_k max.	360	mA
p_a max.	75	W
p_{g2} max.	7.5	W
I_{g1} max.	10	mA
R_{g1-k} max.	10	kΩ
V_{h-k} max.	100	V

CATHODE

Indirectly heated, oxide coated

	Parallel	Series	
V_h	6.3	12.6	V
I_h	2.6	1.3	A

CAPACITANCES

c_{out}	10.7	pF
c_{in}	22	pF
c_{a-g1}	0.2	pF

CHARACTERISTICS (measured at V_a = 600V, V_{g2} = 250V and I_a = 100mA)

g_m	35	mA/V
μ_{g1-g2}	4.7	

MOUNTING POSITION

Vertical or horizontal with plane of anodes vertical.

COOLING

Radiation and convection

Maximum temperatures

Bulb	350	°C
Anode seal	220	°C
Base pin seals	180	°C

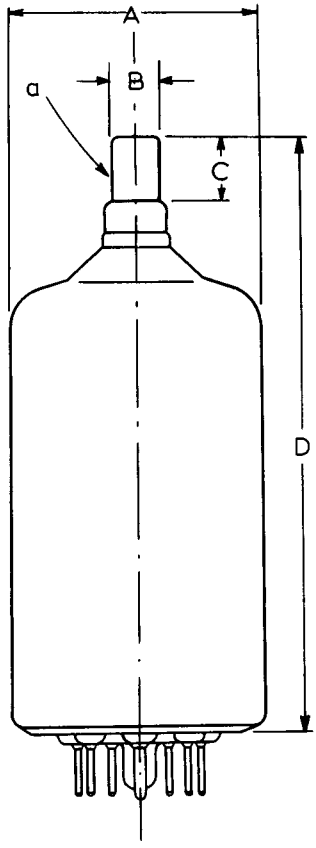
PHYSICAL DATA

	oz	g
Weight of valve	3.9	110

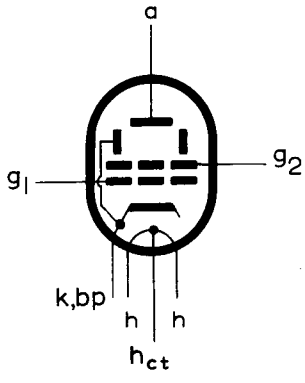
ACCESSORIES

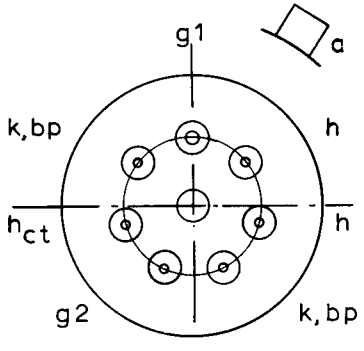
Socket	40202
Anode connector	40624

B2795



Dimensions		
	Inches	Millimetres
A	2·047	52 max
B	0·358	9·1
C	0·472	12 min
D	4·646	120

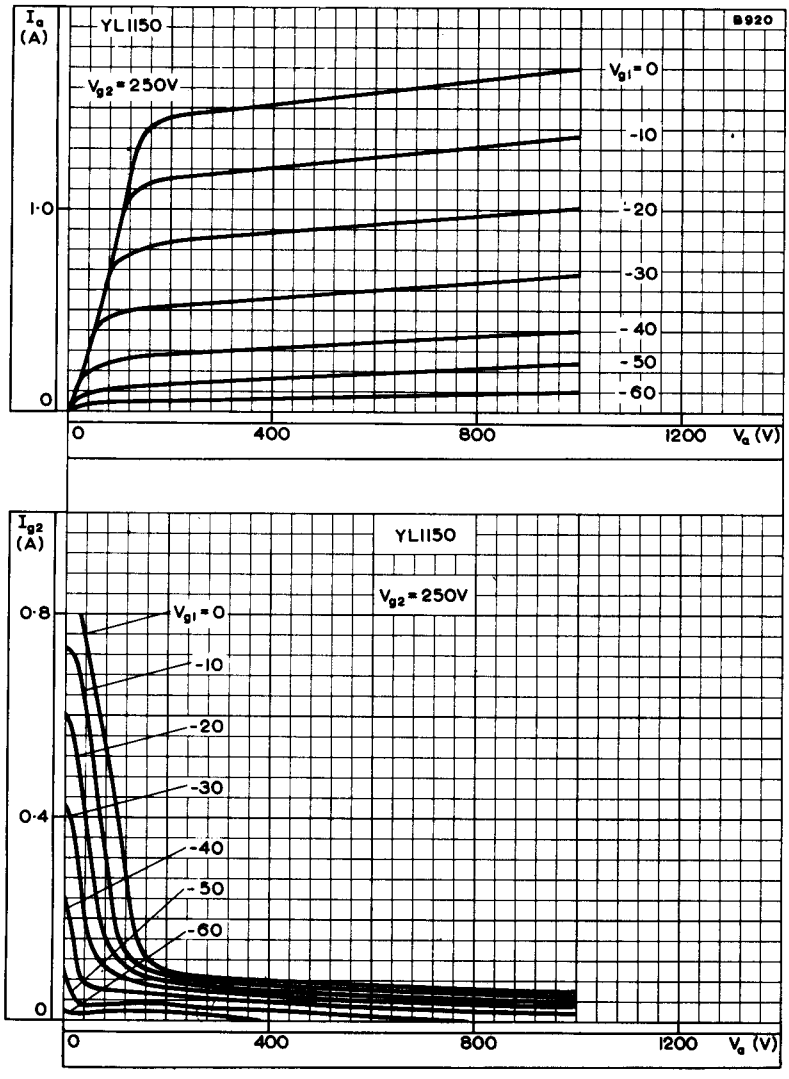




Septar base

V.H.F. BEAM POWER TETRODE

YL1150



ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER Vg2 = 250V

V.H.F. BEAM POWER TETRODE

YL1150

TENTATIVE DATA

QUICK REFERENCE DATA

Beam power tetrode primarily intended for use as a linear v.h.f. amplifier in single sideband transmitters.

	Linear Amplifier for S.S.B. Operation, Class 'AB'	A.F. Amplifier and Modulator, Class 'AB'	
f	30	-	Mc/s
P_{out}	124 (P.E.P.)	2 x 100	W ←
f max.	60	-	Mc/s
V_a max.	750	750	V
p_a max.	75	75	W

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

AUDIO AMPLIFIER AND MODULATOR, CLASS 'AB' (Two valves in push-pull)

OPERATING CONDITIONS

P_{out}	200	W
*D_{tot}	≤2	%
R_{a-a}	2.8	kΩ
V_a	600	V
V_{g2}	250	V
**$-V_{g1}$	50	V
$I_{a(o)}$	2 x 100	mA
$I_{g2(o)}$	2 x 3.0	mA
$I_{a(max.sig.)}$	2 x 260	mA
$I_{g2(max.sig.)}$	2 x 24	mA
I_{g1}	0	mA
$V_{in(g1-g1)r.m.s.}$	71	V ←
p_a	2 x 56	W
p_{g2}	2 x 6.0	W ←
η_a	64	%

*Total distortion encountered at maximum output.
**Adjust to give the desired value of $I_{a(o)}$.

LINEAR AMPLIFIER FOR SINGLE SIDEBAND OPERATION, CLASS 'AB'

OPERATING CONDITIONS ←

f	30		Mc/s
$P.E.P_{out}$	124		W
$P.E.P_{load}$	110		W
$*d_3$	33		dB
$*d_5$	40		dB
V_a	600		V
V_{g2}	250		V
$**-V_{g1}$	50		V
$I_{a(o)}$	100		mA
$I_{g2(o)}$	3.0		mA
	Single Tone	Double Tone	
I_a	325	220	mA
I_{g2}	22	12	mA
I_{g1}	0	0	mA
$V_{in(pk)}$	50	50	V
$P_{load(driver)}$	2.0	2.0	W
p_a	71	70	W
p_{g2}	7.0	3.5	W
η_a	57	42	%

*Third and fifth order intermodulation products. Maximum values encountered at any level of drive voltage referred to the amplitude of either of the two tones at that level.
Relative to the peak envelope power these figures will be increased by 6dB.

**Adjust to give the desired value of $I_{a(o)}$.

CATHODE

Indirectly heated, oxide coated

	Parallel	Series	
V_h	6.3	12.6	V
I_h	1.62	0.81	A ←
t_{h-k} min.	30		s ←

V.H.F. BEAM POWER TETRODE

YL1150

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	S.S.B. Class 'AB'	A.F. Amplifier Class 'AB'	
f max.	60	-	Mc/s
V_a max.	750	750	V
V_{g2} max.	300	300	V
$-V_{g1}$ max.	100	100	V
I_a max.	350	350	mA
p_a max.	75	75	W
p_{g2} max.	7.5	7.5	W
I_{g1} max.	10	10	mA
p_{g1} max.	0.5	0.5	W
R_{g1-k} max.	10	10	kΩ

CAPACITANCES

c_{a-g1}	0.2	pF
c_{out}	10.7	pF
c_{in}	22	pF

CHARACTERISTICS

g_m (at V_a = 600V, V_{g2} = 250V, I_a = 100mA)	10	mA/V ←
μ_{g1-g2} (at V_a = 600V, V_{g2} = 250V, I_a = 0.1A)	4.7	

MOUNTING POSITION

Any

COOLING

Radiation and convection cooling

Maximum temperatures

Bulb	350	°C
Base pin seal	180	°C
Anode seal	220	°C

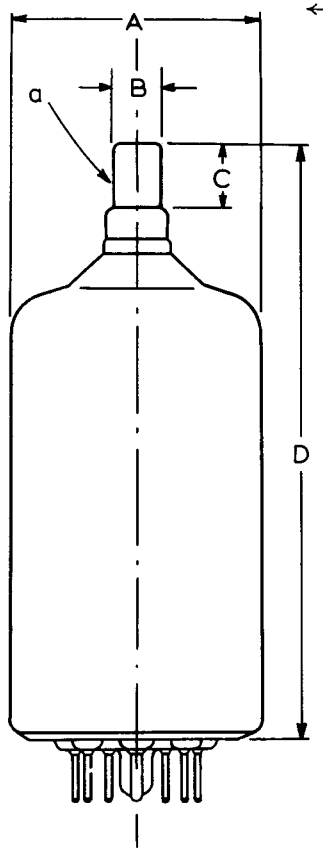
PHYSICAL DATA

	oz	g
Weight of valve	3.9	110

ACCESSORIES

Socket	40202
Anode connector	40624

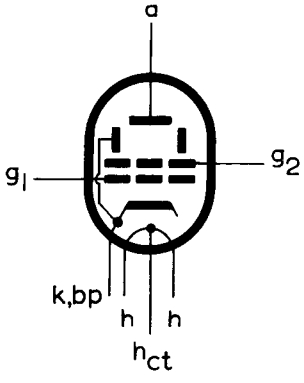
B5482

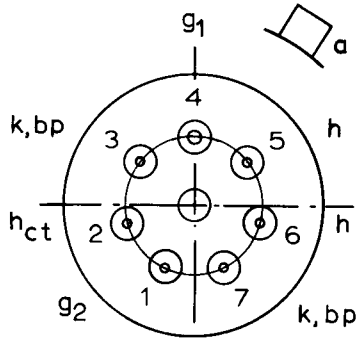


DIMENSIONS

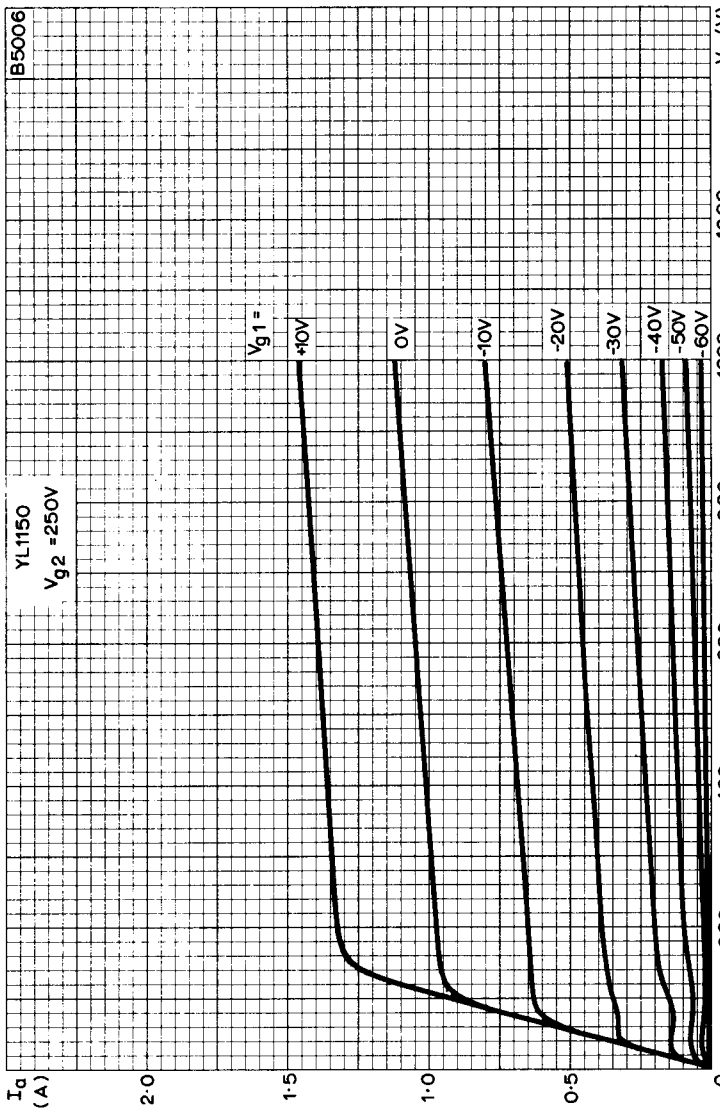
	Inches	Millimetres
A	1.97	50
B	0.358	9.1
C	0.51	13
D	4.65	120

Inch dimensions derived from original millimetre dimensions.

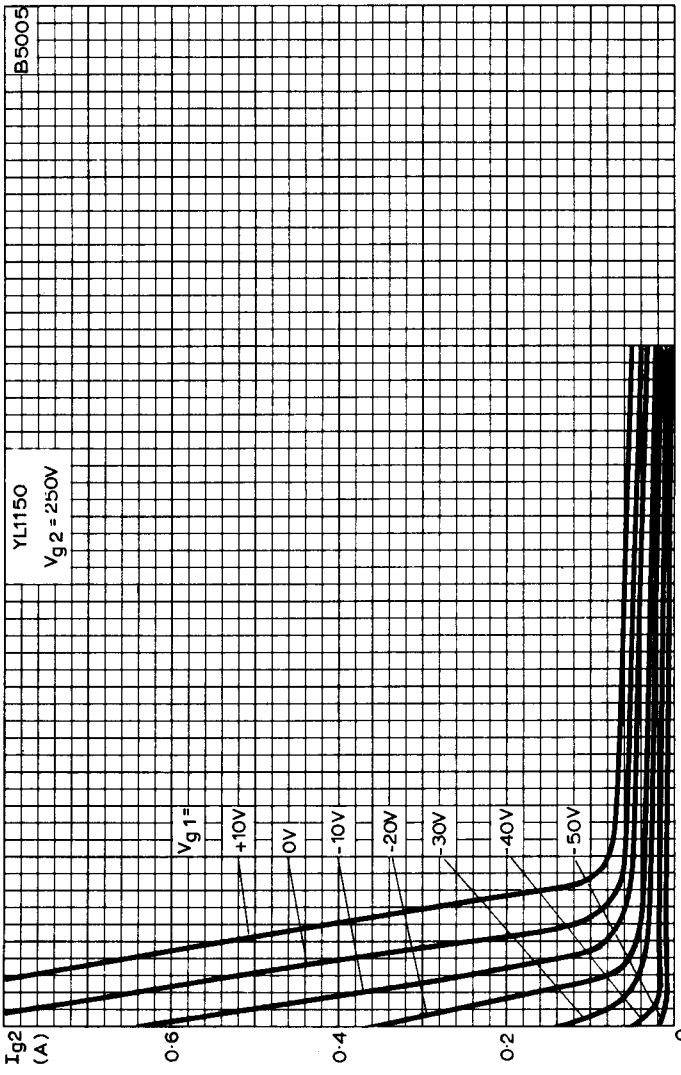




B7A base



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V

QUICK HEATING DOUBLE TETRODE

YL1190

TENTATIVE DATA

QUICK REFERENCE DATA

Amplifier and frequency multiplier for mobile transmitters

	Frequency Trebler	Telephony, Anode and Screen Grid Modulation, Class 'C'	Telegraphy or F.M. Telephony Class 'C'		
f	500/167	175	200	500	Mc/s
P_{out}	6.5	19	33	19	W
f max.	500	500	500		Mc/s
V_a max.					
(f = 200Mc/s)	-	330	400		V
(f = 500Mc/s)	300	250	300		V
p_a max.	2 x 8.0	2 x 5.5	2 x 8.0		W

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

TELEGRAPHY OR F.M. TELEPHONY, CLASS 'C'

OPERATING CONDITIONS

f	200	500	Mc/s
P_{out}	33	19	W
†P_{load}	26	14	W
η_a	67	52	%
V_a	350	260	V
I_a	2 x 70	2 x 70	mA
V_{g2}	140	175	V
I_{g2}	23.5	20	mA
$-V_{g1}$	13	22.5	V
I_{g1}	2 x 6.5	2 x 3.25	mA
$V_{in(g1-g1)pk}$	85	65	V
$P_{load(driver)}$	1.0	2.5	W
p_a	2 x 8.0	2 x 8.0	W
p_{g2}	3.1	2.7	W

†With a circuit transfer efficiency of 80%.

FREQUENCY TREBLER

OPERATING CONDITIONS

f_{out}/f_{in}	500/167	Mc/s
P_{out}	6.5	W
P_{load}	3.0	W
η_a	29	%
V_a	250	V
I_a	2 x 45	mA
V_{g2}	250	V
I_{g2}	14	mA
$-V_{g1}$	70	V
I_{g1}	2 x 2.5	mA
$v_{in(g1-g1)pk}$	170	V
$P_{load(driver)}$	2.2	W
p_a	2 x 8.0	W
p_{g2}	2.4	W

TELEPHONY, ANODE AND SCREEN-GRID MODULATION, CLASS 'C'
(Two sections in push-pull)

OPERATING CONDITIONS (Carrier conditions for 100% modulation)

f	175	Mc/s
P_{out}	19	W
P_{load}	15	W
η_a	72	%
V_a	280	V
I_a	2 x 50	mA
V_{g2}	150	V
I_{g2}	19	mA
$-V_{g1}$	35	V
I_{g1}	2 x 4.0	mA
$v_{in(g1-g1)pk}$	50	V
$P_{load(driver)}$	1.5	W
p_a	2 x 4.5	W
p_{g2}	2 x 1.4	W
p_{g1}	2 x 0.18	W
For 100% modulation		
P_{mod}	16	W
$v_{g2(pk)}$	120	V

QUICK HEATING DOUBLE TETRODE

YL1190

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Frequency Trebler	Telephony Class 'C'		Telegraphy Class 'C'		
f max.	500	200	500	200	500	Mc/s
V_a max.	300	330	250	400	300	V
V_{g2} max.	200	200	200	200	200	V
$-V_{g1}$ max.	150	150	100	150	100	V
I_a max.	2 x 50	2 x 56		2 x 75		mA
p_a max.	2 x 8.0	2 x 5.5		2 x 8.0		W
p_{g2} max.	3.5	2 x 1.5		3.5		W
I_{g1} max.	2 x 3.0	2 x 5.0		2 x 7.0		mA
R_{g1-f} max.	100	100		100		kΩ

CATHODE

Quick heating directly heated filament. 70% P_{out} in less than 0.5 seconds.

*V_f	1.1	V
I_f	3.8	A

Frequency of filament supply

Sine wave	max. 200	c/s
Square wave	Any	

*The filament has been designed to accept temporary fluctuations of supply voltage of ±15%.

CAPACITANCES

c_{out} (two sections in push-pull)	1.2	pF
c_{in} (two sections in push-pull)	4.7	pF

Internally neutralised for push-pull operation up to 500Mc/s.

CHARACTERISTICS (measured at V_a = 150V, V_{g2} = 150V, I_a = 45mA)

g_m	9.5	mA/V
μ_{g1-g2}	22	

MOUNTING POSITION Any

If the valve is mounted with its main axis horizontal it is recommended that pins 3 and 7 be in a horizontal plane.

COOLING

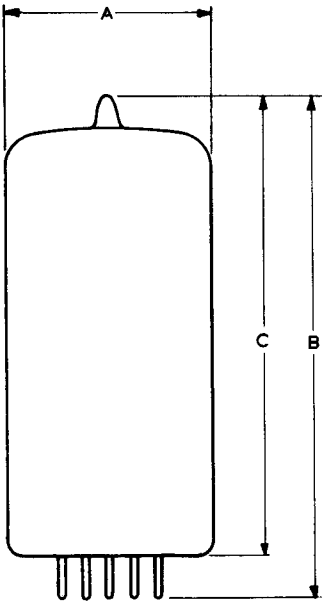
Radiation and convection cooling

Maximum temperatures

Bulb	230	°C

PHYSICAL DATA

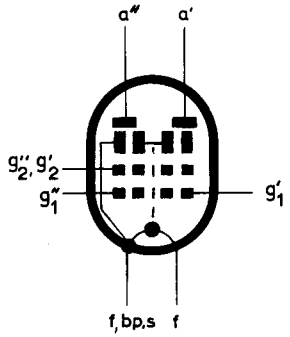
	oz	g
Weight of valve	1.0	27



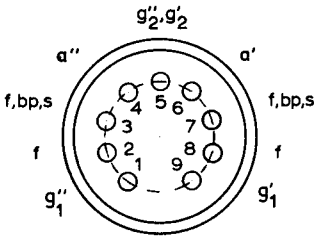
DIMENSIONS

	Inches	Millimetres
A	1.189	30.2 max.
B	2.909	73.9 max.
C	2.591	65.8 max.

Inch dimensions derived from original millimetre dimensions.

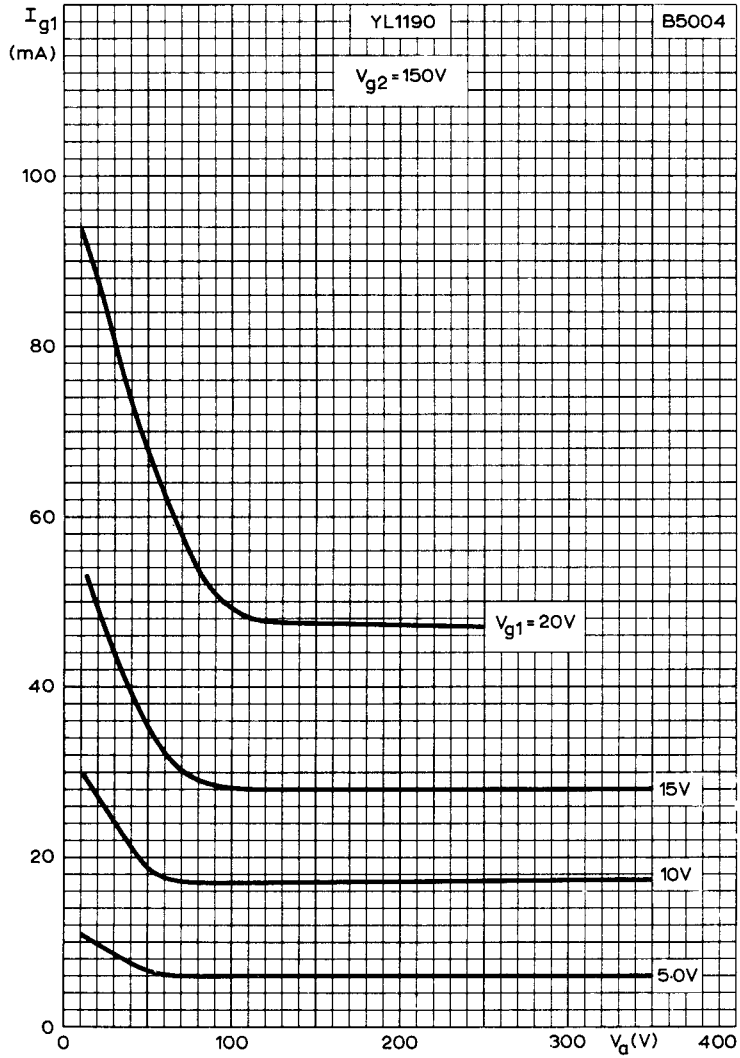


B5061

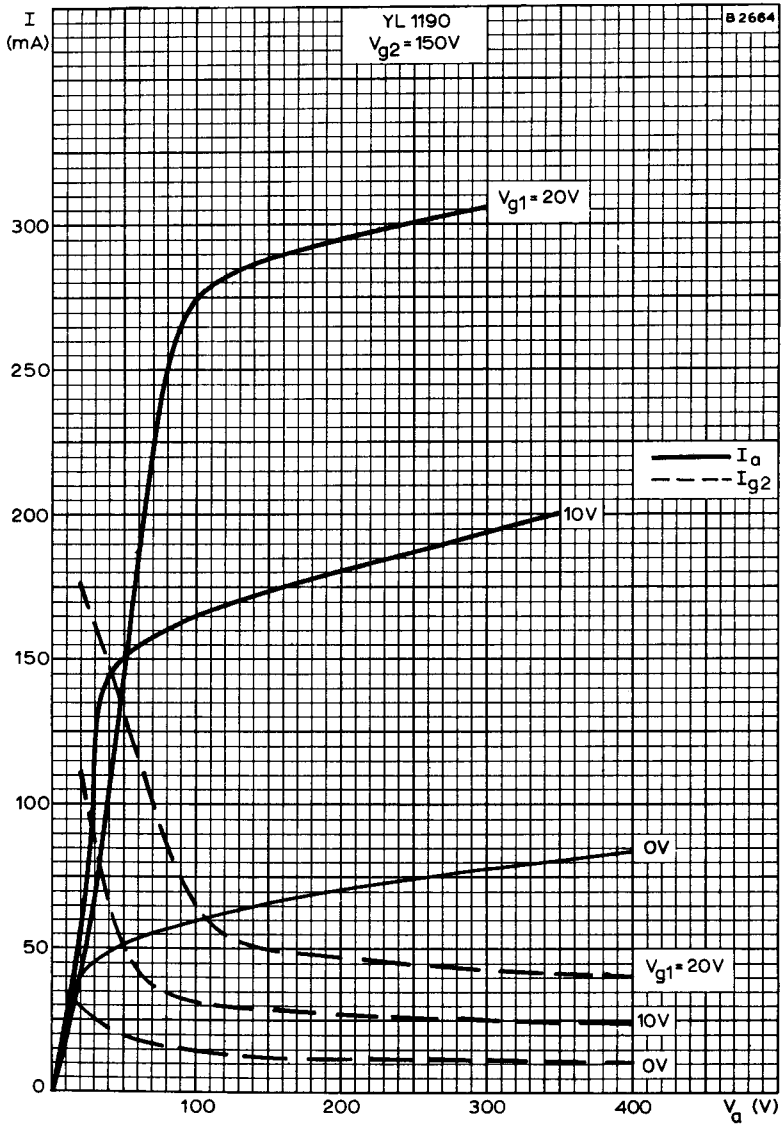


B9D Base

Filament connections (pins 3, 7 and 2, 8) should be connected in parallel on the socket.



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V.



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V.

V.H.F. DOUBLE TETRODE

YL1240

TENTATIVE DATA

QUICK REFERENCE DATA

Single ended double tetrode intended for mobile service as Class 'C' amplifier, oscillator or frequency multiplier.

	Frequency Trebler		Class 'C' Telegraphy or F.M. Telephony		
	C.C.S.	I.C.A.S.	C.C.S.	I.C.A.S.	
f	-	174/58	200	200	Mc/s
P_{out}	-	12	22	33	W
f max.	200	200	200	200	Mc/s
V_a max.	400	450	400	450	V
p_a max.	2 x 7.5	2 x 10	2 x 7.5	2 x 10	W

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

CLASS 'C' TELEGRAPHY OR F.M. TELEPHONY

Maximum operating conditions

	C.C.S.	I.C.A.S.		
f	200	200	200	Mc/s
P_{out}	22	31	33	W
P_{load}	20	28	30	W
η_a	64	70	67	%
V_a	400	400	450	V
I_a	2 x 43	2 x 55	2 x 55	mA
V_{g2}	155	200	200	V
I_{g2}	2 x 1.2	2 x 2.0	2 x 2.0	mA
$-V_{g1}$	59	50	50	V
I_{g1}	2 x 1.6	2 x 1.6	2 x 1.6	mA
$P_{load(driver)}$	1.0	1.2	1.2	W
p_a	2 x 6.0	2 x 6.5	2 x 8.5	W
R_{g1-k}	19	16	16	kΩ

FREQUENCY TREBLER

Maximum operating conditions

	I.C.A.S.	
f_{out}/f_{in}	174/58	Mc/s
P_{out}	12	W
P_{load}	10	W
η_a	40	%
V_a	350	V
I_a	2 x 43	mA
V_{g2}	165	V
I_{g2}	2 x 2.5	mA
$-V_{g1}$	150	V
I_{g1}	2 x 2.2	mA
$P_{load(driver)}$	2.0	W
p_a	2 x 10	W
R_{g1-k}	34	kΩ

ABSOLUTE MAXIMUM RATINGS

	Frequency Trebler		Class 'C' Telegraphy		
	C.C.S.	I.C.A.S.	C.C.S.	I.C.A.S.	
V_a max.	400	450	400	450	V
V_{g2} max.	200	200	200	200	V
$-V_{g1}$ max.	150	150	150	150	V
I_k max.	2 x 32	2 x 47	2 x 48	2 x 59	mA
p_a max.	2 x 7.5	2 x 10	2 x 7.5	2 x 10	W
p_{g2} max.	2 x 1.0	2 x 1.0	2 x 1.0	2 x 1.0	W
I_{g1} max.	2 x 3.0	2 x 4.0	2 x 3.0	2 x 4.0	mA
p_{g1} max.	2 x 0.2	2 x 0.2	2 x 0.2	2 x 0.2	W
V_{h-k} max.	100	100	100	100	V

V.H.F. DOUBLE TETRODE

YL1240

CATHODE

Indirectly heated, oxide coated

	Parallel	Series	
V_h	6.75	13.5	V
I_h	0.76	0.38	A

CAPACITANCES

c_{a-g1} (each section)	max. 0.1	pF
c_{in} (each section)	6.8	pF
c_{out} (each section)	3.2	pF
c_{in} (two section in push-pull)	5.4	pF
c_{out} (two sections in push-pull)	1.7	pF

CHARACTERISTICS (measured at I_a = 30mA)

g_m	3.3	mA/V
μ_{g1-g2}	7.5	

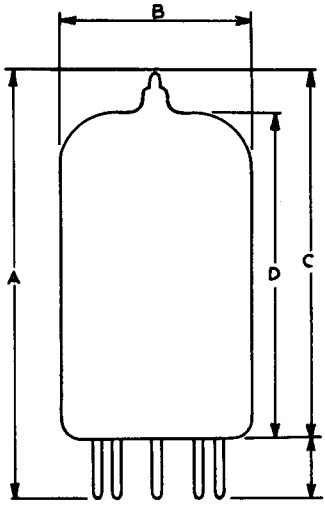
MOUNTING POSITION: Any

COOLING

Radiation and convection

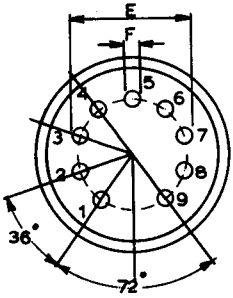
Maximum temperatures

Bulb	225	°C
Pin seal	120	°C

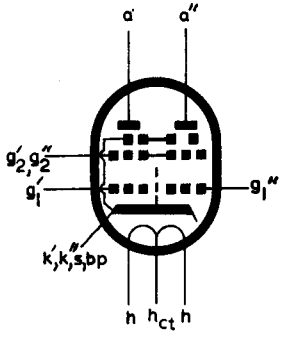


Dimensions	Inches	Millimetres	
A	3.110	79	max.
B	1.185	30.1	max.
C	2.732	69.4	max.
D	2.303±0.091	58.5±2.3	
E	0.687	17.45	
F	0.039	1.0	dia.

Inch dimensions derived from original millimetre dimensions



Pin No.	Electrode
1	g_1''
2	k'', k', s, bp
3	g_1'
4	h
5	h
6	a''
7	g_2'', g_2'
8	a'
9	h_{ct}



B2803

SUBMINIATURE COLD CATHODE TRIGGER TUBE

Z700U

Subminiature cold cathode trigger tube with primer cathode and ignited by a positive trigger potential. Primarily intended for use in decade counting and switching circuits up to maximum counting speeds in the region of 2 to 5kc/s.

To ensure that the characteristics of the tube are maintained in both light and darkness a priming discharge of some 3μA flowing continuously between anode and priming cathode is necessary.

PRELIMINARY DATA

CATHODE cold

CHARACTERISTICS

†*Trigger ignition voltage (V_a — 250V d.c.)	137 to 153	V
Recommended anode working voltage range	200 to 310	V
*Anode to cathode maintaining voltage (I_a = 3mA)	111 to 121	V
Typical trigger to cathode maintaining voltage (see page 6)	115	V
Recommended average cathode current range	2.0 to 4.0	mA
Recommended priming cathode resistor	18	MΩ
Minimum anode to priming cathode supply voltage	200	V

†The drift in trigger ignition voltage per tube is generally less than 3V. However, when the tube is ignited for very long periods, drawing negative starter current, a shift of trigger ignition voltage up to 175V may occur.

TRANSFER REQUIREMENTS

Current triggering:		
*Maximum transfer current (V_a — 250V)	30	μA

*These limits apply over life.

LIMITING VALUES (absolute ratings)

Maximum anode voltage	310	V
Maximum cathode current		
Peak	16	mA
Average (max. averaging time 1s)	4.0	mA
Maximum negative trigger current	See note 4	

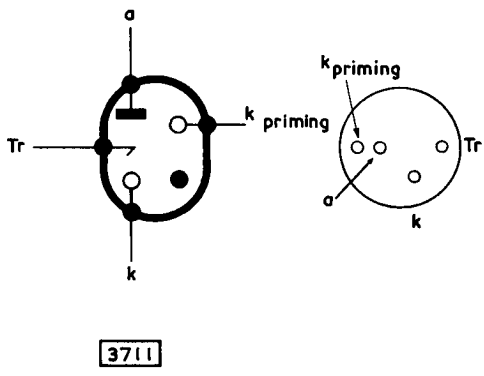
OPERATING NOTES

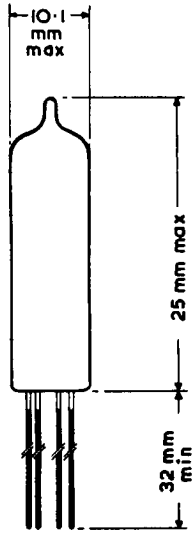
1. The trigger and priming cathode resistors should be mounted close to the tube.
2. Direct soldered connections to the leads of this tube must be at least 5mm from the seal and any bending of the tube leads must be at least 2.0mm from the seal.
3. If a tube is ignited with short pulses (20μs), the total trigger voltage (bias + pulse) must exceed 153V. A typical value with a 100pF coupling capacitor is 175V.
4. With the tube ignited the negative trigger current must not exceed 100μA.
5. The tube should not be mounted in contact with external conductive elements or spurious triggering may occur.

Z700U

SUBMINIATURE COLD CATHODE TRIGGER TUBE

Subminiature cold cathode trigger tube with primer cathode and ignited by a positive trigger potential. Primarily intended for use in decade counting and switching circuits up to maximum counting speeds in the region of 2 to 5kc/s.

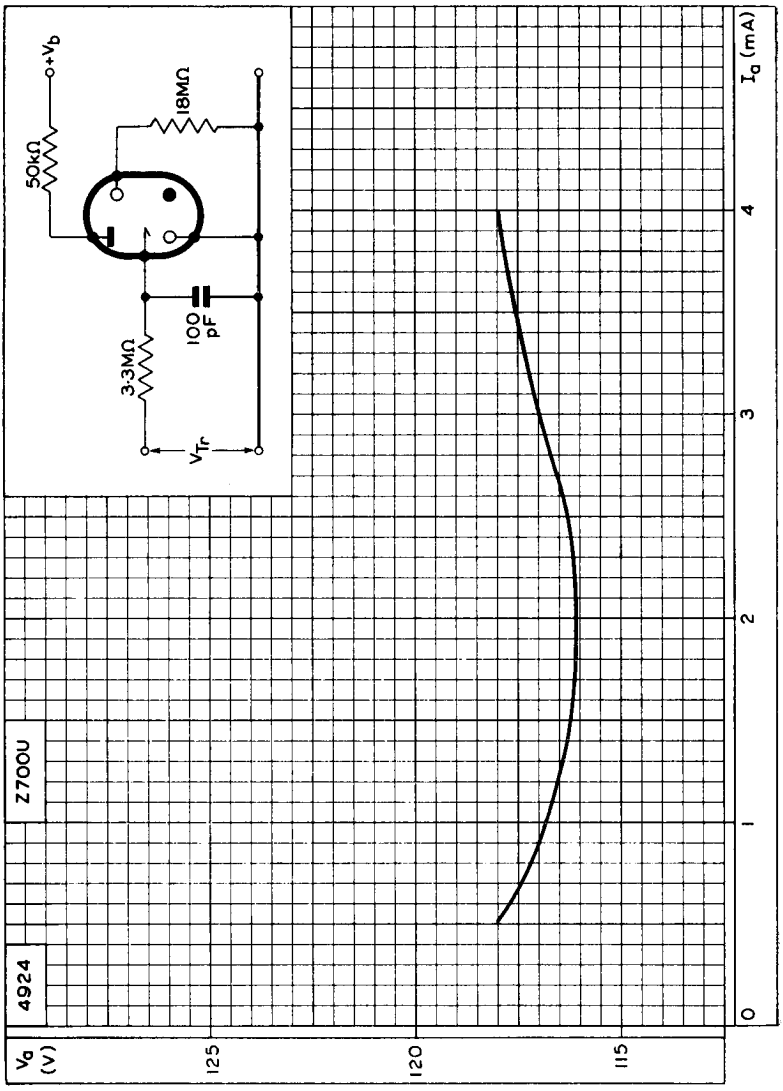




SUBMINIATURE COLD CATHODE TRIGGER TUBE

Z700U

Subminiature cold cathode trigger tube with primer cathode and ignited by a positive trigger potential. Primarily intended for use in decade counting and switching circuits up to maximum counting speeds in the region of 2 to 5kc/s.

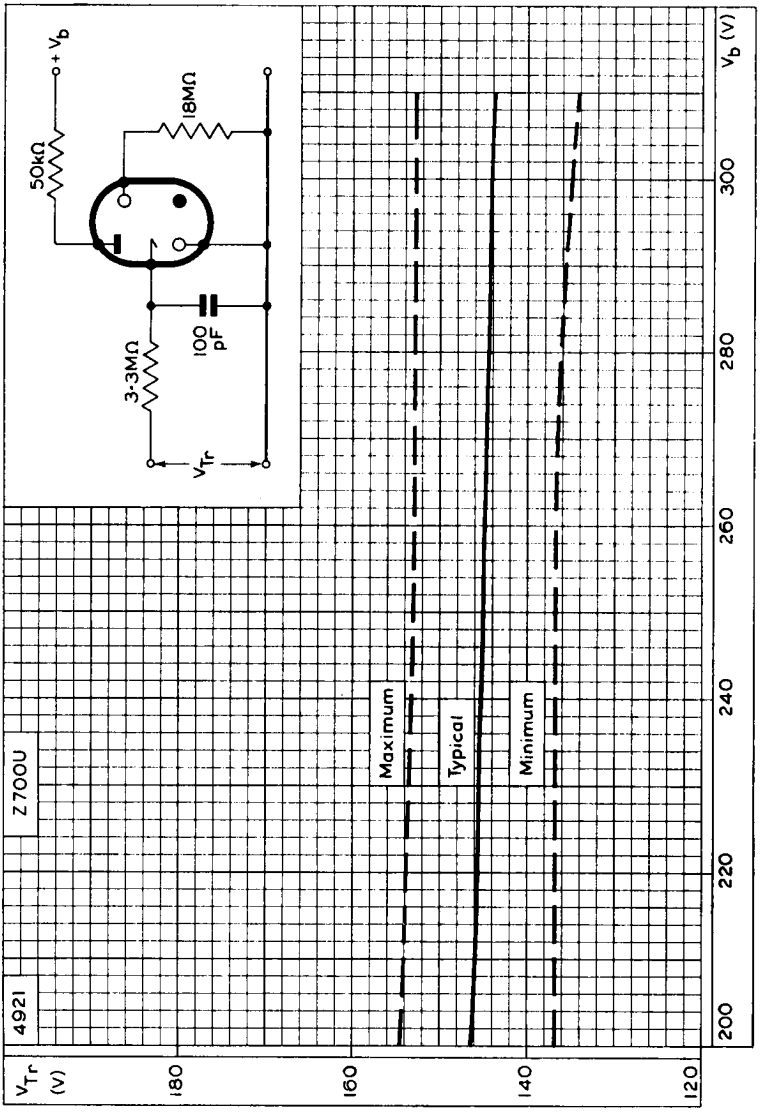


TYPICAL ANODE MAINTAINING VOLTAGE CHARACTERISTIC

Z700U

SUBMINIATURE COLD CATHODE TRIGGER TUBE

Subminiature cold cathode trigger tube with primer cathode and ignited by a positive trigger potential. Primarily intended for use in decade counting and switching circuits up to maximum counting speeds in the region of 2 to 5kc/s.

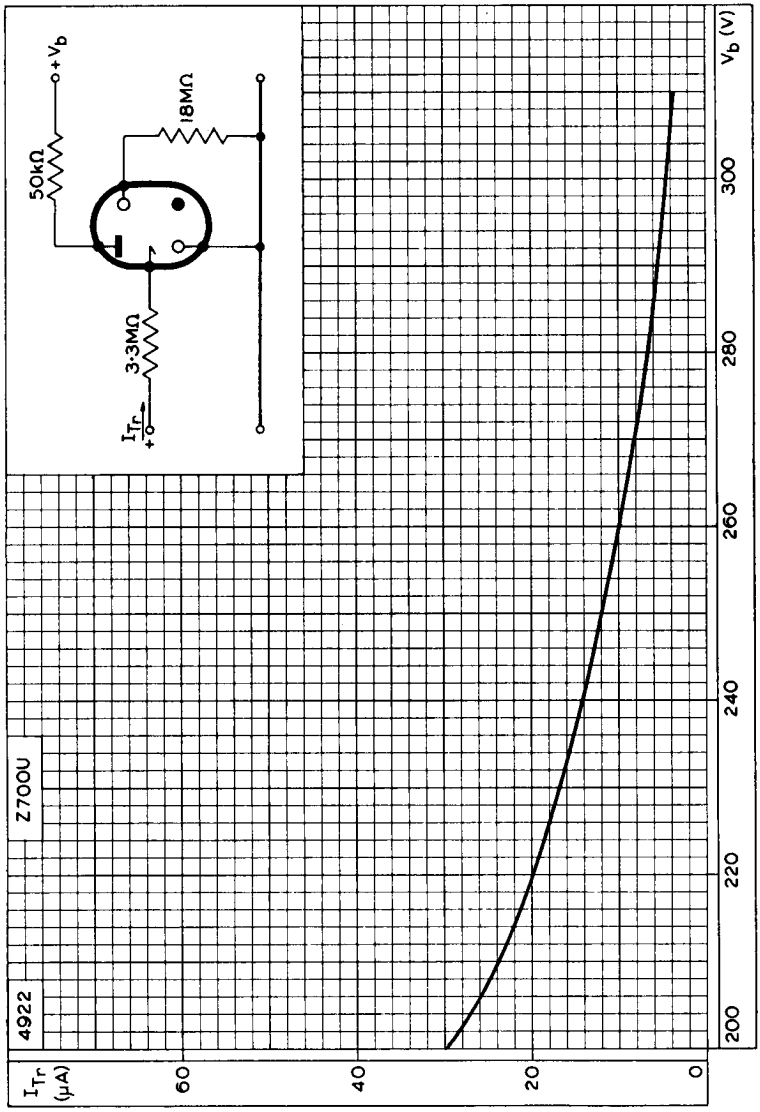


TRIGGER BREAKDOWN CHARACTERISTIC

SUBMINIATURE COLD CATHODE TRIGGER TUBE

Z700U

Subminiature cold cathode trigger tube with primer cathode and ignited by a positive trigger potential. Primarily intended for use in decade counting and switching circuits up to maximum counting speeds in the region of 2 to 5kc/s.

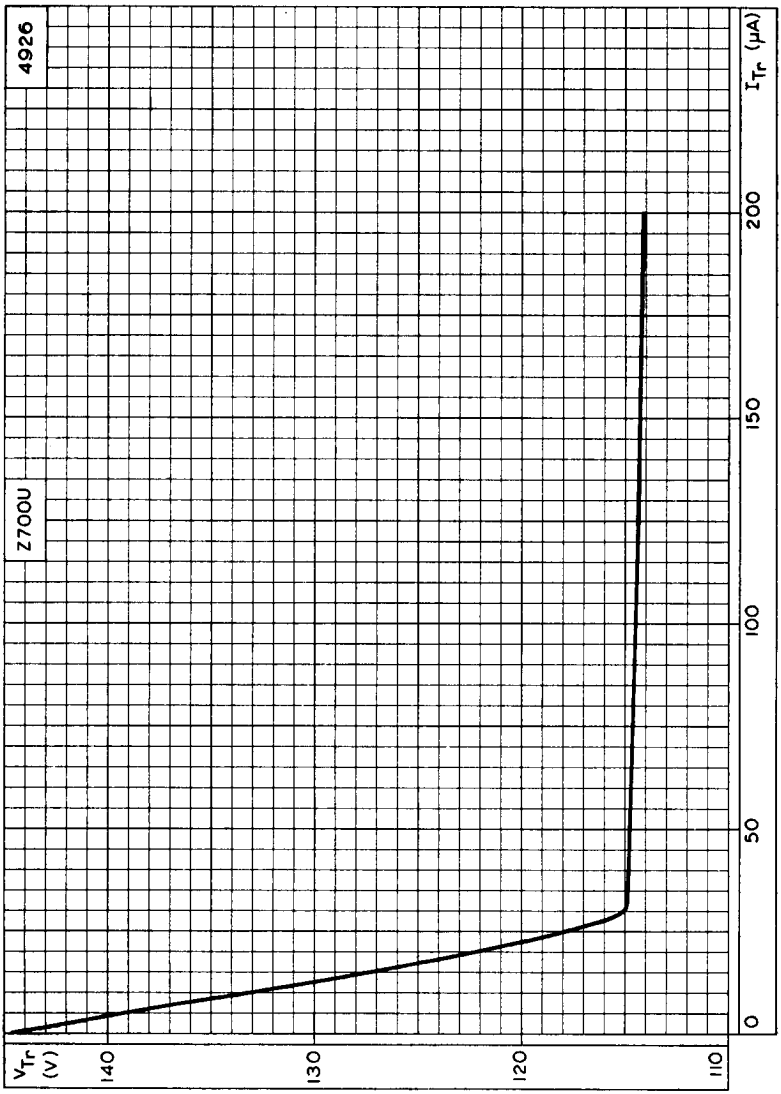


TYPICAL TRANSFER CHARACTERISTIC

Z700U

SUBMINIATURE COLD CATHODE TRIGGER TUBE

Subminiature cold cathode trigger tube with primer cathode and ignited by a positive trigger potential. Primarily intended for use in decade counting and switching circuits up to maximum counting speeds in the region of 2 to 5kc/s.



TYPICAL TRIGGER MAINTAINING VOLTAGE CHARACTERISTIC

COLD CATHODE TRIGGER TUBE

Z804U

Cold cathode trigger tube suitable for direct operation from 200 to 250Vr.m.s. a.c. supplies at mains frequencies. The tube is ignited by a negative trigger potential.

PRELIMINARY DATA

CATHODE cold

CHARACTERISTICS

*Trigger ignition voltage range, all tubes (V_a = 210 to 350V)	−115 to −131	V
*Anode maintaining voltage range, all tubes (I_a = 20mA)	106 to 115	V
Typical transfer current (V_a = 210V)	10	μA

*These limits apply over life

STABILITY

Maximum variation of trigger ignition voltage over life	±5·0	V
Maximum variation of anode maintaining voltage over life	±3·0	V

LIMITING VALUES (absolute ratings)

Maximum positive trigger current	400	μA
Maximum negative trigger current	400	μA
A.C. operation		
R.M.S. mains voltage		
Maximum	275	V
Minimum	180	V
Frequency		
Maximum	100	c/s
Minimum	10	c/s
Mean anode current		
Maximum	25	mA
Minimum	5·0	mA
Maximum averaging time	1	cycle
Peak anode current	125	mA
D.C. operation		
Supply voltage		
Maximum	350	V
Minimum	210	V
Anode current		
Maximum	40	mA
Minimum	5·0	mA

NOTES

The trigger may be operated either from d.c. or low frequency a.c.
Pin 2 should be connected to the cathode via a 2MΩ resistor.

Z804U

COLD CATHODE TRIGGER TUBE

Cold cathode trigger tube suitable for direct operation from 200 to 250V r.m.s. a.c. supplies at mains frequencies. The tube is ignited by a negative trigger potential.

OPERATING NOTES

This tube is primarily intended for relay operation on 200 – 250V. 50 c/s single phase supplies. The following notes refer to this duty.

The anode circuit

In designing the anode circuit care must be taken to ensure that the cathode current and anode voltage ratings are never exceeded.

The average current through the tube for a given relay RA can be adjusted by the choice of the relay resistance R1, but care must be taken since R1 also determines the peak current passed by the tube. Thus, when a given average current is required, it is possible to exceed the peak current rating particularly if the tube is fired late in the positive half cycle.

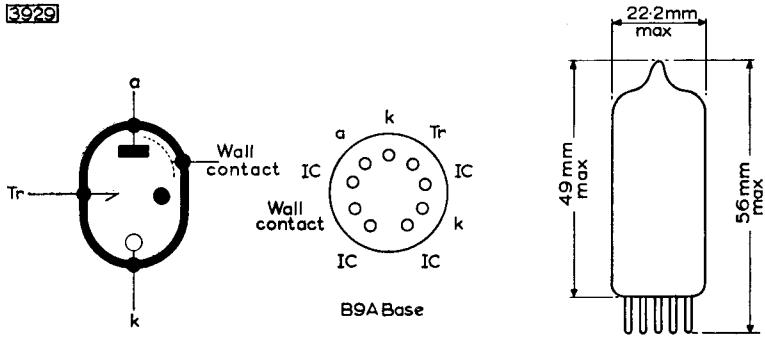
The forward and inverse voltages applied to the valve must not exceed the quoted values. Capacitor C connected across the relay provides a smooth relay current, thus avoiding 'chatter'. It should be remembered that the steady voltage across this capacitor adds to the a.c. inverse voltage across the tube but subtracts from the forward voltage.

The trigger circuit

The Z804U is ignited when the trigger voltage is approximately –120V. with respect to cathode. After ignition the trigger potential will rise to approximately +20V and remain there during anode conduction. Thus any capacitor connected between trigger and cathode has to be re-charged through about 140V every time the tube is fired, this compares with about 40V in tubes using conventional positive firing. Thus in direct current triggering any stray trigger – cathode capacitance should be reduced to a minimum.

There is a trigger ignition voltage hysteresis effect in the Z804U in that the trigger ignition voltage immediately following a conduction period is more positive, i.e. numerically smaller, by some 3V than the value after a long standby period.

3929

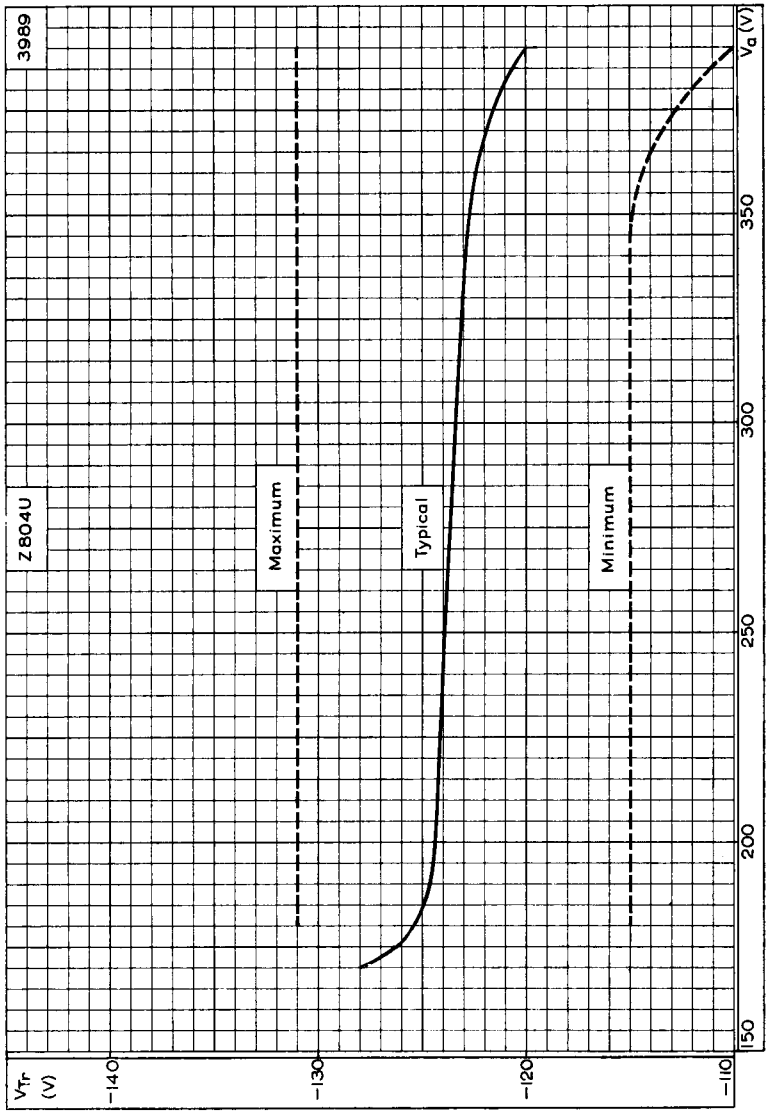


Wall contact (pin 2) must be connected to cathode via a 2MΩ resistor.

COLD CATHODE TRIGGER TUBE

Z804U

Cold cathode trigger tube suitable for direct operation from 200 to 250Vr.m.s. a.c. supplies at mains frequencies. The tube is ignited by a negative trigger potential.

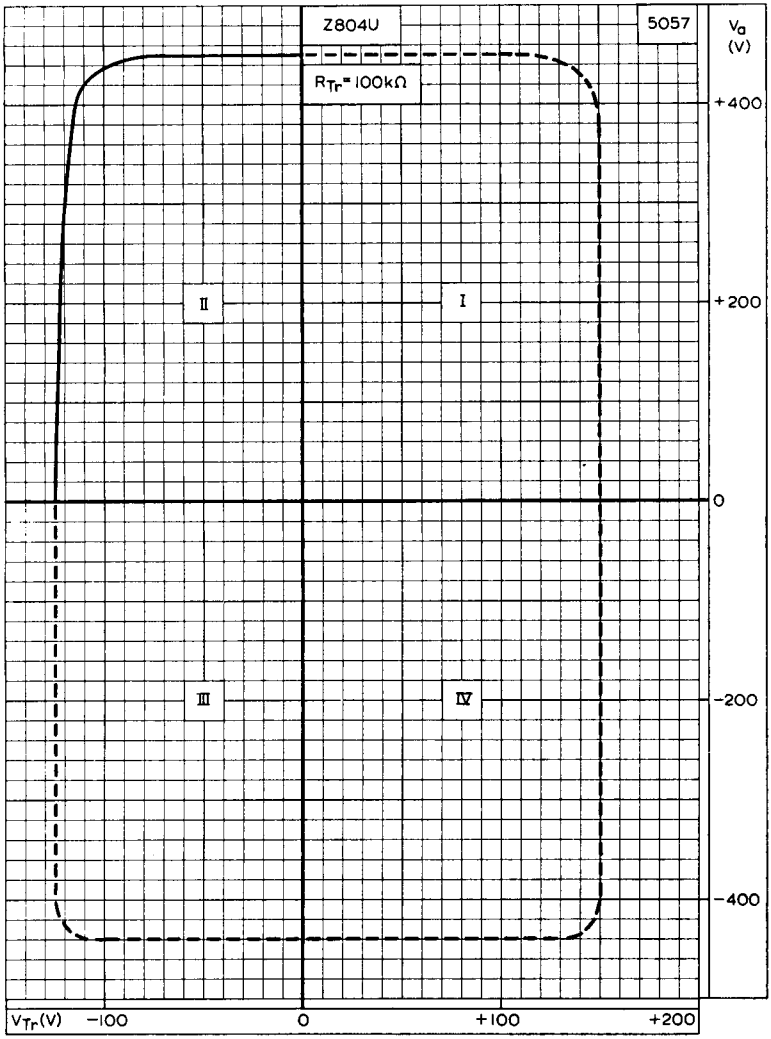


TRIGGER VOLTAGE PLOTTED AGAINST ANODE VOLTAGE FOR ALL TUBES OVER LIFE

Z804U

COLD CATHODE TRIGGER TUBE

Cold cathode trigger tube suitable for direct operation from 200 to 250Vr.m.s. a.c. supplies at mains frequencies. The tube is ignited by a negative trigger potential.



TYPICAL BREAKDOWN CHARACTERISTIC FOR DIFFERENT ELECTRODE POLARITIES

(The tube is recommended for operation in quadrant II only).

DOT MATRIX TUBE

ZM1250

DEVELOPMENT SAMPLE DATA

QUICK REFERENCE DATA

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

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

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

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

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

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

CHARACTERISTICS AND OPERATING CONDITIONS (contd.)

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

MOUNTING POSITION

Any

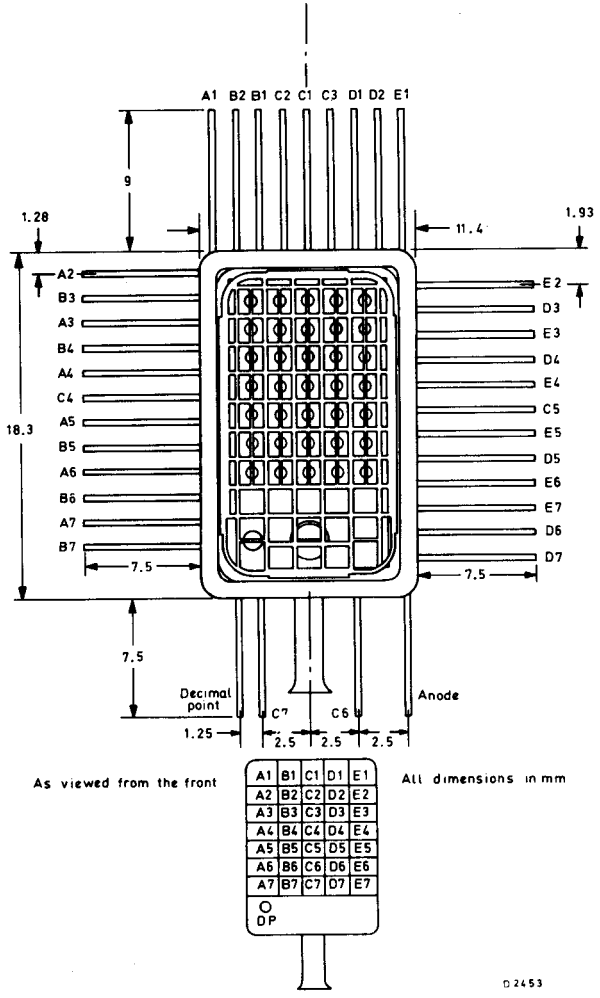
OPERATING NOTES

1. For envelope temperatures below $+10^{o}C$ the life expectancy of the tube is substantially reduced together with changes in characteristics.
2. The tube may be soldered directly into a printed circuit board.
3. The leads are tinned and may be dip-soldered to a minimum of 3mm from the envelope at a solder temperature of $240^{o}C$ for a maximum of 10 seconds.
4. Care should be taken when bending leads.
5. It is recommended that a red (blue-light absorbing) filter be used preferably of circularly polarised type.

OUTLINE AND DIMENSIONS NOTES

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

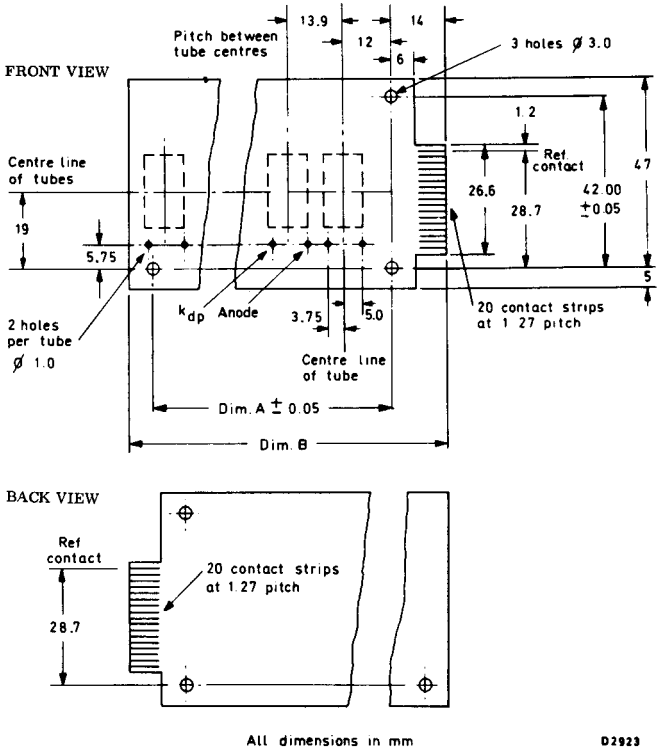
OUTLINE AND DIMENSIONS



DOT MATRIX TUBE ASSEMBLIES

Z1250-A Series

DEVELOPMENT SAMPLE DATA



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

FACE OF TUBE

Connections to cathodes listed in order with Reference Contact at top	
Front	Back
E1	D2
D1	C3
C1	C2
B1	B2
A1	E2
A2	D3
B3	E3
A3	D4
B4	E4
A4	C5
C4	E5
A5	D5
B5	E6
A6	E7
B6	D6
A7	D7
blank	blank
B7	blank
C7	blank
C6	blank

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

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

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

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