Mullard **VOLUME 2**

Maintenance Types

receiving and amplifying valves

cathode ray tubes

Issued by
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Made and printed in England by Wightman & Co. Ltd., 1-3 Brixton Road, London, S.W.9

Mullard Technical Handbook

GENERAL INDEX TO VOLUME TWO

This index in alphabetical sequence includes only those Mullard Receiving and Amplifying Valves and Cathode Ray Tubes which, while not recommended for use in new equipment, are still available for maintaining existing apparatus.

The issue number or date given against each type shows the latest information available, and should correspond to that given on the data sheet at the bottom left-hand corner of each page.

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GENERAL INDEX TO VOLUME TWO

MAINTENANCE TYPE
RECEIVING VALVES

FULL-WAVE RECTIFIER

AZ31

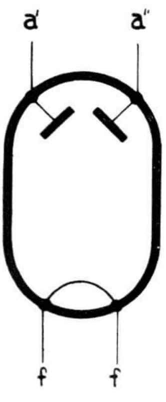
Directly-heated power rectifier for a.c. mains-operated equipment.

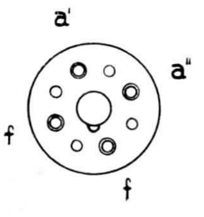
FILAMENT

V_f	4.0	V
I_f	1.1	A

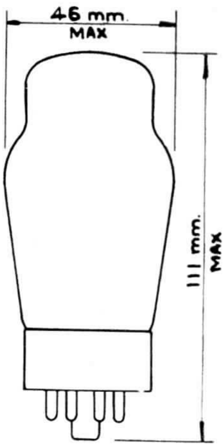
LIMITING VALUES

$V_{a\ (r.m.s.)}$ max.	2×500	2×400	2×300	V
I_{out} max.	60	75	100	mA
C max.	60	60	60	μF





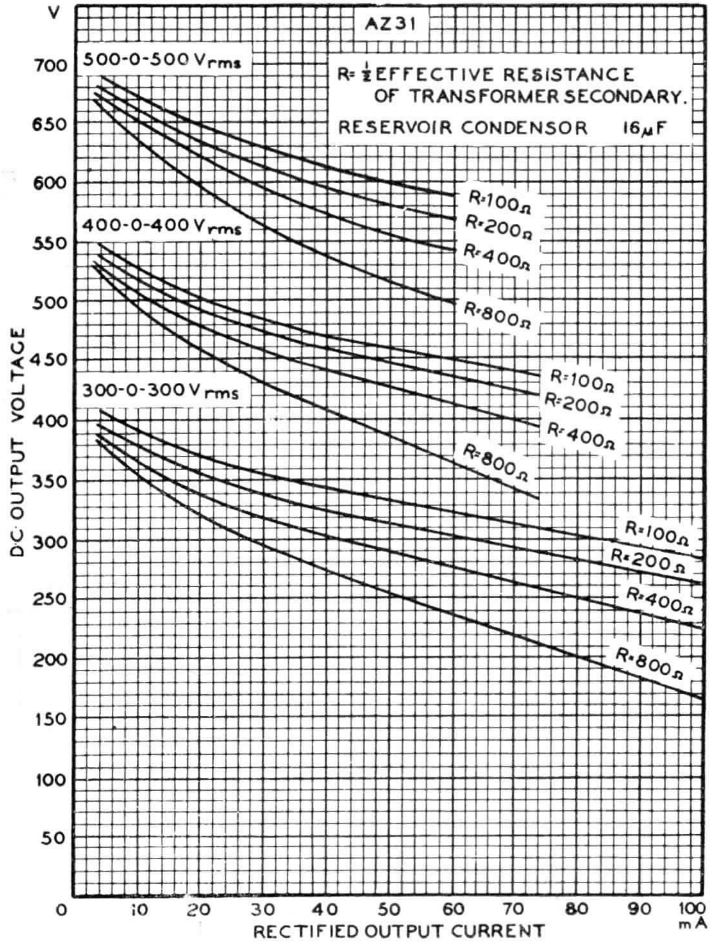
OCTAL BASE



AZ31

FULL-WAVE RECTIFIER

Directly-heated power rectifier for a.c. mains-operated equipment.



RECTIFIER CHARACTERISTICS

TRIODE HEXODE

CCH35

Triode hexode for use as frequency changer. The hexode section is designed for operation with a.g.c.

HEATER

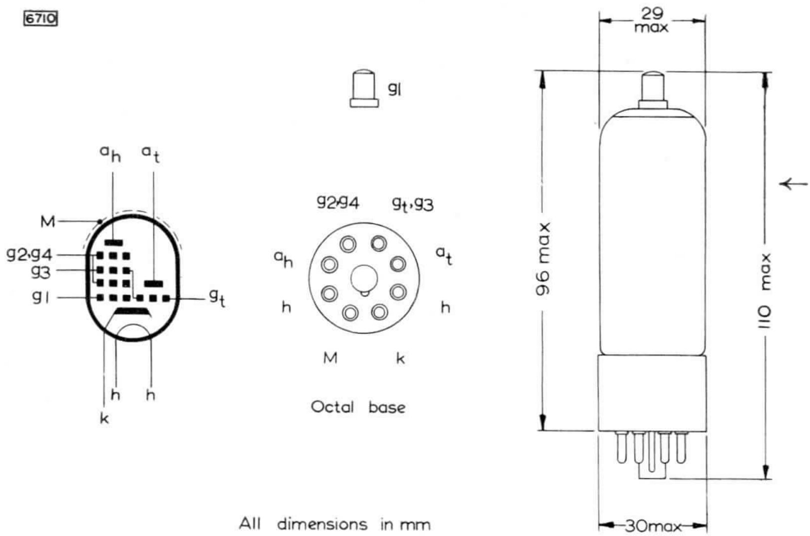
Suitable for a.c. or d.c. operation

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.



MINIATURE DIODE PENTODE

DAF91

Short grid-base pentode, particularly suitable for A.F. voltage amplification, combined with a single diode.

FILAMENT

This valve is suitable for d.c. operation only.

V_f	1.4	V
I_f	0.05	A

CAPACITANCES (Measured without external shield)

c_{a-g1}	<0.4	μμF
c_{in}	2.0	μμF
c_{out}	2.8	μμF
c_{ad-all}	1.5	μμF

CHARACTERISTICS

Pentode Section

V_a	67.5	90	V
V_{g2}	67.5	90	V
I_a	1.6	2.7	mA
I_{g2}	0.4	0.63	mA
V_{g1}	0	0	V
g_m	625	720	μA/V
r_a	600	500	kΩ
μ_{g1-g2}	13.5	13.5	

Diode Section

The diode anode is located at the negative end of the filament.

LIMITING VALUES

Pentode Section

V_a max.	90	V
p_a max.	250	mW
V_{g2} max.	90	V
p_{g2} max.	60	mW
V_{g1} max.	0	V
I_k max.	4.5	mA
*R_{g1-f} max.	3.0	MΩ

* R_{g1-f} max. = 22MΩ if grid current biasing is employed.

This valve can be used without special precautions against microphony in circuits in which the input voltage, V_{in}, is not less than 40 mV for an output of 50 mW from the output stage.

Diode Section

P.I.V. max.	100	V
I_{ad} max.	0.2	mA
$i_{ad\,(pk)}$ max.	1.2	mA

DAF91

MINIATURE DIODE PENTODE

Short grid-base pentode, particularly suitable for A.F. voltage amplification, combined with a single diode.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER, CONNECTED AS PENTODE. ($V_{g1}=0$).

V_b (V)	R_a (M Ω)	I_a (μA)	R_{g2} (M Ω)	I_{g2} (μA)	$\frac{V_{out}}{V_{in}}$	V_{out} (V r.m.s.)	D_{tot} (%)	$\frac{V_{out}}{V_{in}}$*	V_{out}* (V r.m.s.)	R_{g1}** (M Ω)
90	0.27	220	1.0	61	49	4.9	0.8	42.4	14.4	0.47
90	0.27	220	1.0	61	60	6.0	1.4	51.5	17.5	1.0
90	0.27	220	1.0	61	69	6.9	2.0	58.9	20.0	4.7
90	0.47	130	1.8	36	66.5	6.65	1.7	59	16.5	1.0
90	0.47	130	1.8	36	83.5	8.35	3.1	72.5	20.3	4.7
90	0.47	130	1.8	36	87	8.7	3.5	75	21.0	10
90	1.0	65	3.9	18.7	90	9.0	3.0	84	15.1	2.2
90	1.0	65	3.9	18.7	104	10.4	3.3	96.8	17.4	4.7
90	1.0	65	3.9	18.7	110	11.0	3.6	103.5	17.6	10
67.5	0.27	145	1.0	41	41	4.1	1.8	37.9	9.85	0.47
67.5	0.27	145	1.0	41	50	5.0	1.3	45	12.6	1.0
67.5	0.27	145	1.0	41	57	5.7	1.6	50.6	15.2	4.7
67.5	0.47	87	1.8	25	55	5.5	1.7	49.6	10.4	1.0
67.5	0.47	87	1.8	25	68	6.8	2.0	60.3	13.9	4.7
67.5	0.47	87	1.8	25	70	7.0	2.1	61.8	14.8	10
67.5	1.0	45	3.9	13	71	7.1	2.3	66.8	10.0	2.2
67.5	1.0	45	3.9	13	82	8.2	2.5	75.3	12.8	4.7
67.5	1.0	45	3.9	13	86.5	8.65	2.7	78.8	13.4	10
45	0.27	80	1.0	23.2	31	1.55	2.1	30.4	3.95	0.47
45	0.27	80	1.0	23.2	38.8	1.94	1.9	35.3	6.0	1.0
45	0.27	80	1.0	23.2	45	2.25	1.2	39.7	7.55	4.7
45	0.47	50	1.8	14.6	43	2.15	2.0	41.6	5.0	1.0
45	0.47	50	1.8	14.6	55	2.75	1.7	49.3	7.4	4.7
45	0.47	50	1.8	14.6	57	2.85	1.6	50.6	7.6	10
45	1.0	25	3.9	7.7	56	2.8	2.9	56	5.6	2.2
45	1.0	25	3.9	7.7	65	3.25	2.4	59	6.5	4.7
45	1.0	25	3.9	7.7	70	3.5	2.0	62.7	6.9	10

* $D_{tot}=5\%$.

** Grid resistor of following valve.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER, CONNECTED AS TRIODE. (g_2 to a).

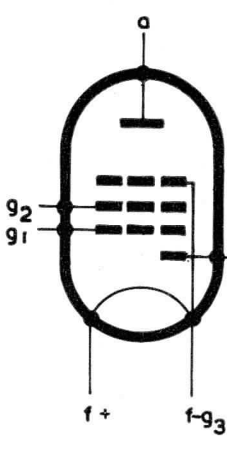
V_b (V)	R_a (k Ω)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	D_{tot} (%)	R_{g1}* (M Ω)
90	220	0.25	11.0	5	1.0	0.68
90	470	0.13	11.5	5	0.8	1.5

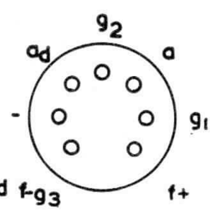
* Grid resistor of following valve.

MINIATURE DIODE PENTODE

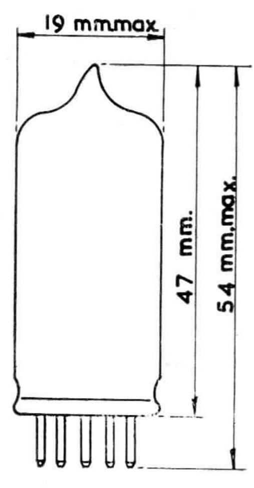
DAF91

Short grid-base pentode, particularly suitable for A.F. voltage amplification, combined with a single diode.





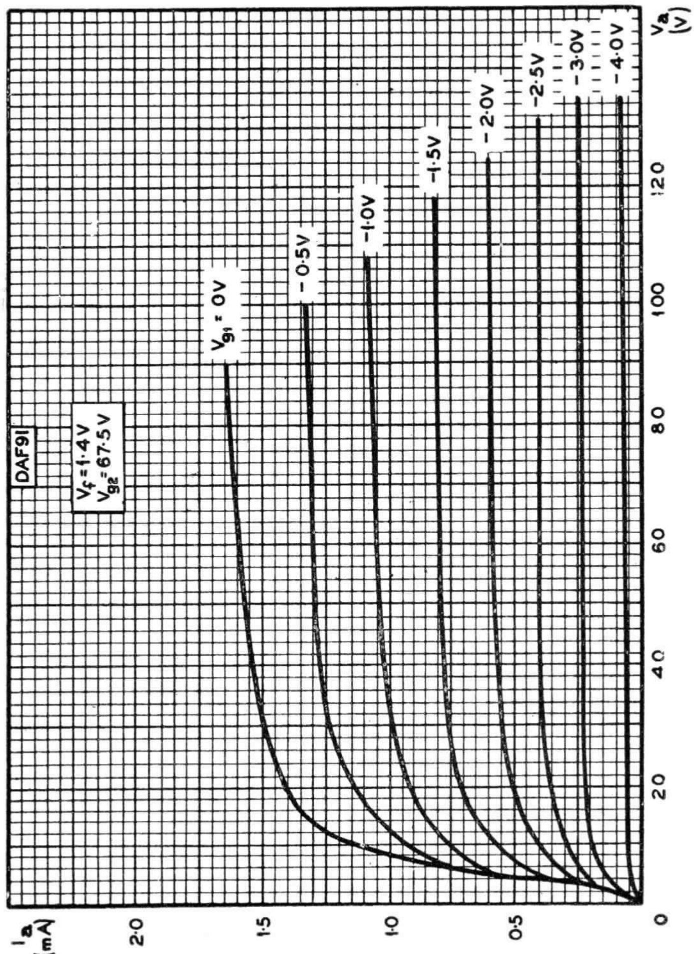
B7G BASE



DAF91

MINIATURE DIODE PENTODE

Short grid-base pentode, particularly suitable for A.F. voltage amplification, combined with a single diode.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

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

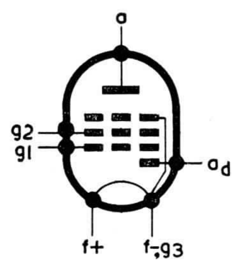
This valve can be used without special precautions against microphony in circuits in which the input voltage, V_{in}, is not less than 20mV for an output of 50mW from the output stage.

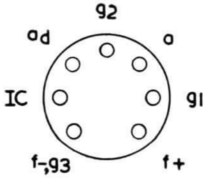
Diode section

P.I.V.	100	V
I_{ad} max.	200	μA
$i_{ad(pk)}$ max.	1.2	mA

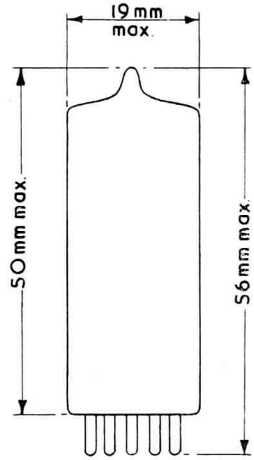
DIODE A.F. PENTODE

DAF96





B7G Base



2375

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)

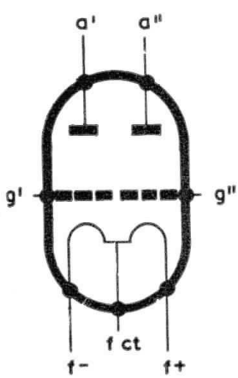
V_a	135	V
*V_g	−20	V
R_{g-f}	4.0	kΩ
R_k	570	Ω
$v_{in(pk)}$	2×45	mA
I_a	2×15	mA
I_g (approx.)	2×2.5	mV
p_g (approx.)	200	kW
P_{out} (approx.)	2.0	W

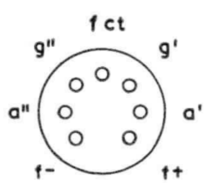
* Obtained from fixed supply, or by means of cathode or grid resistor of valve shown.

LIMITING VALUES (Intermittent operation)

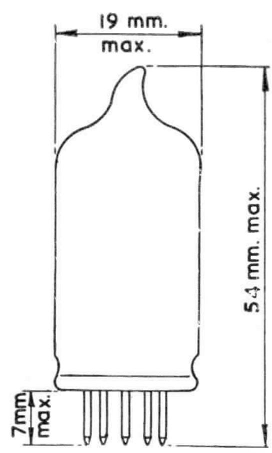
V_a max.	135	V
V_g max.	−30	V
I_a max.	2×15	mA
I_g max.	2×2.5	mA
p_a max.	2×1.0	W

For continuous operation the above maximum current and power ratings must be reduced by 50%.





B7G BASE



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

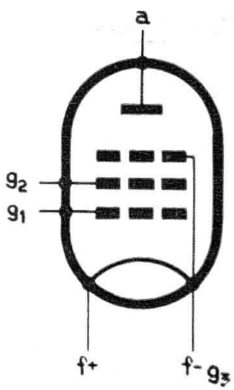
c_{a-g1}	<0.01	μμF
c_{in}	3.6	μμF
c_{out}	7.5	μμF

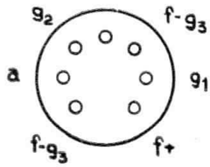
OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

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

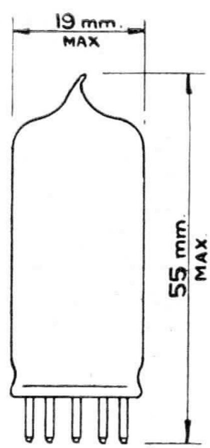
LIMITING VALUES

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





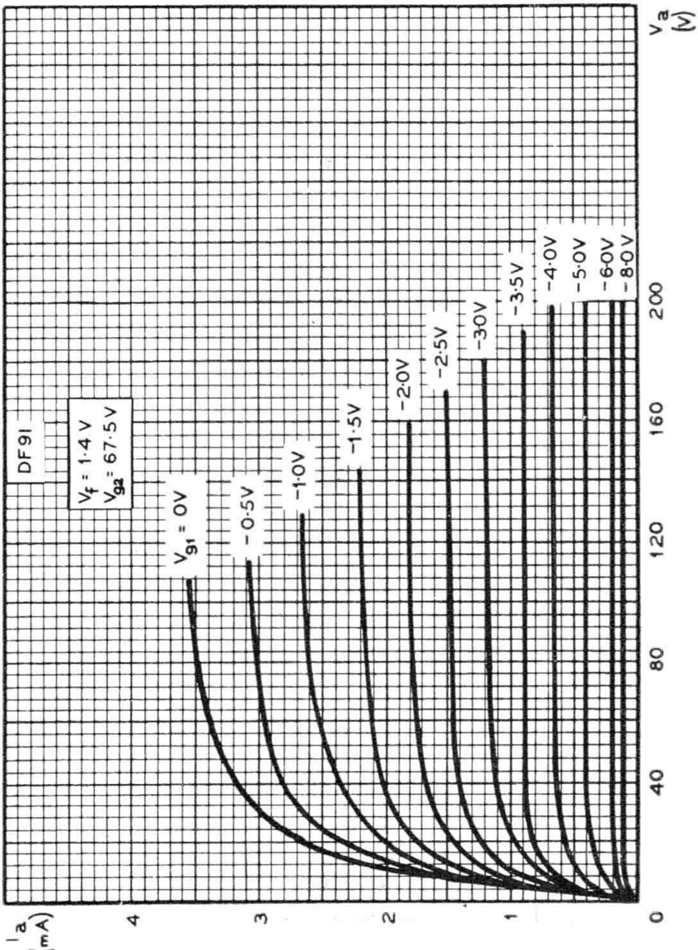
B7G BASE



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
WITH CONTROL-GRID VOLTAGE AS PARAMETER

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.

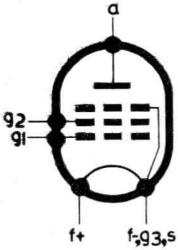
LIMITING VALUES

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.



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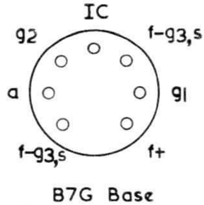
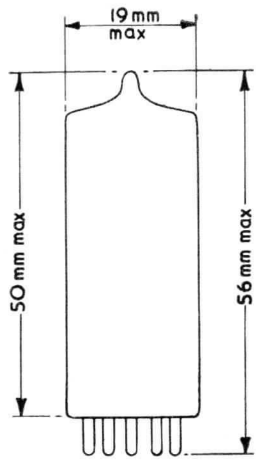




MINIATURE HEPTODE FREQUENCY CHANGER

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

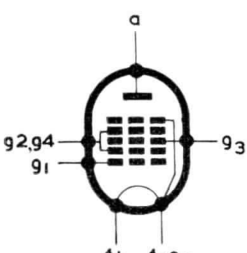
In these circuits—

C designates a decoupling capacitor.

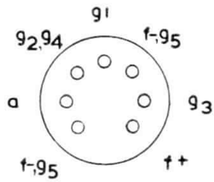
L_C is a filament choke of 12 μH inductance and with a d.c. resistance of less than 0.5 Ω.

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: $C=100$ $\mu\mu$F, $L_b=11$ μH.

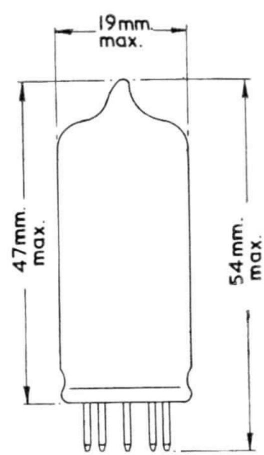
L_D is the short wave coil and should have a Q of approximately 115 at 6.5 Mc/s.



533



B7G BASE

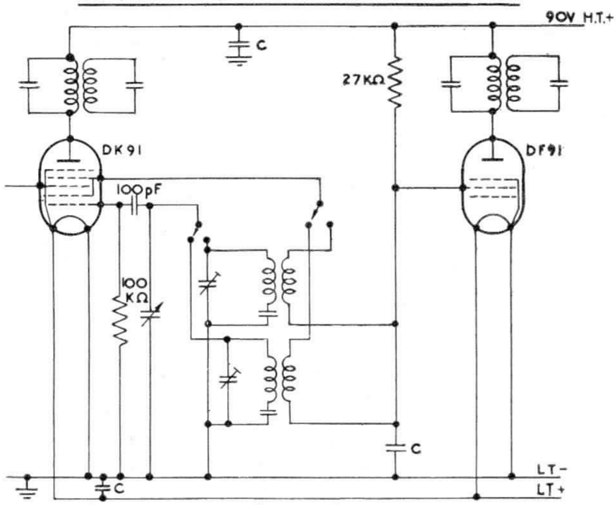


MINIATURE HEPTODE FREQUENCY CHANGER

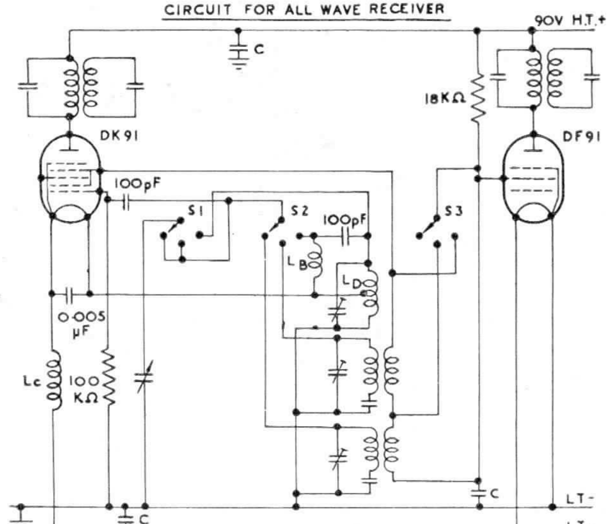
DK91

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

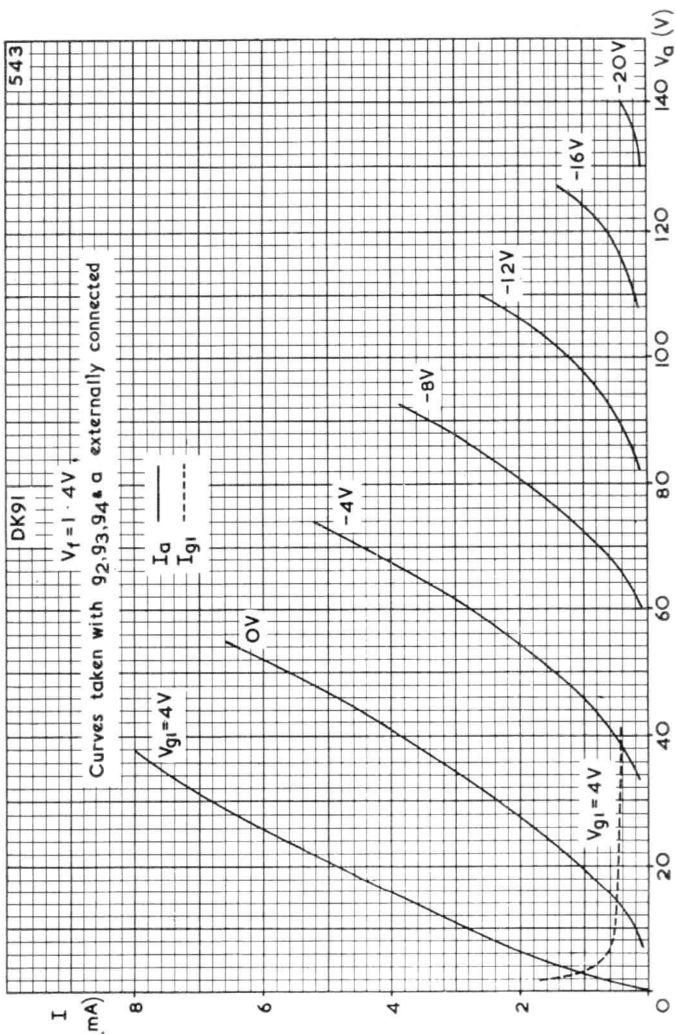


O63

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.

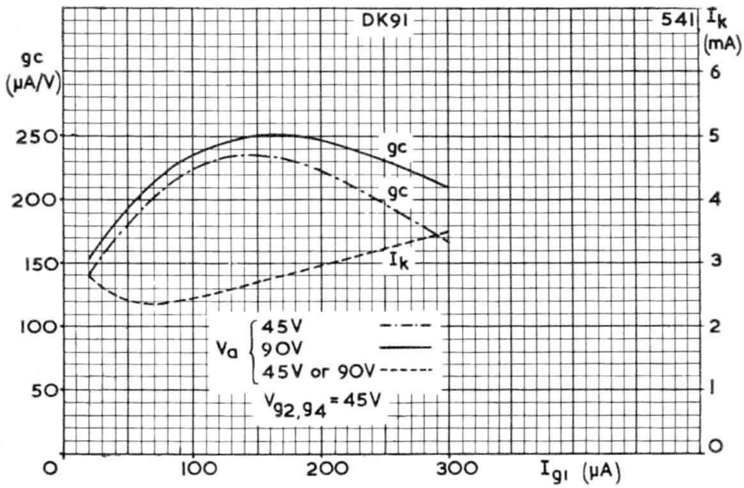


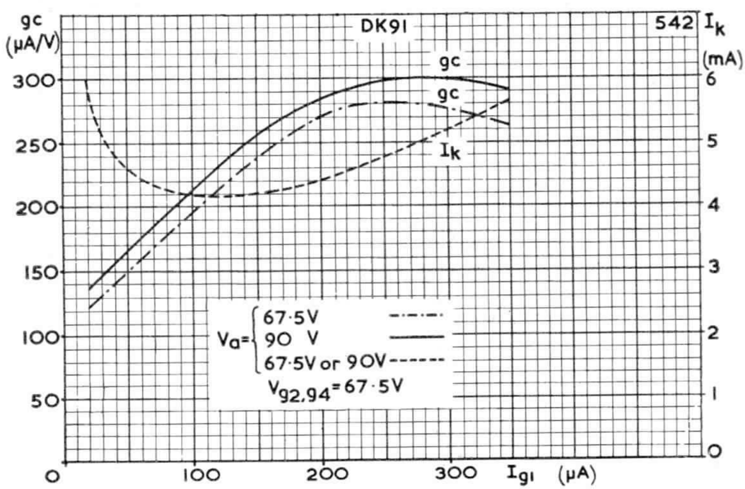
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

MINIATURE HEPTODE FREQUENCY CHANGER

DK91

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.





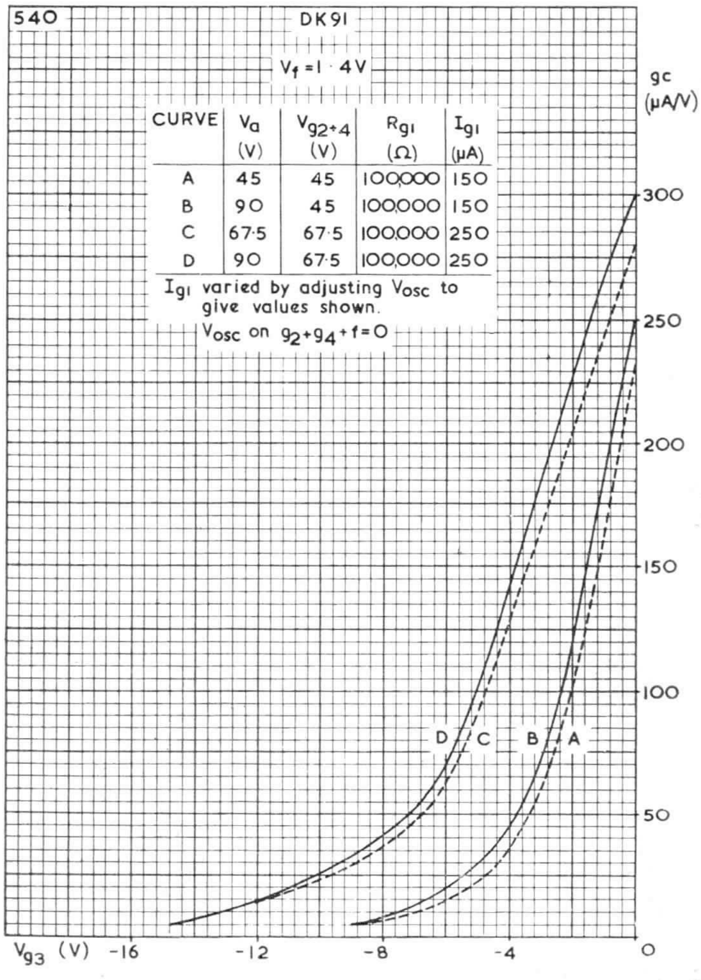
CONVERSION CONDUCTANCE AND CATHODE CURRENT PLOTTED AGAINST OSCILLATOR-GRID CURRENT

$R_{g1} = 0.1\ \mathrm{M}\Omega$ $V_{g3} = 0$

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for A.V.C.



CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL-GRID 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+)

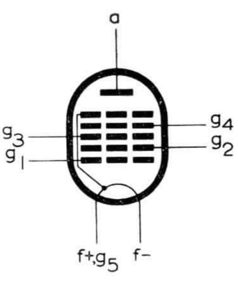
V_a	85	V
V_{g4}	60	V
V_{g3}	0	V
V_{g2}	30	V
I_{g2}	2.5	mA
$g_{m(g1-g2)}$	900	μA/V
μ_{g1-g2}	7.5	

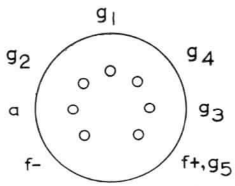
DK92

HEPTODE FREQUENCY CHANGER

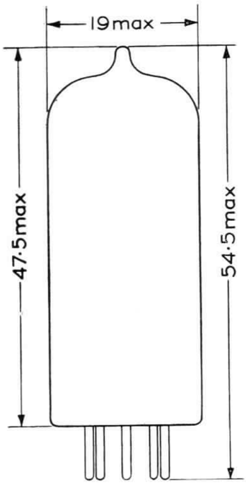
LIMITING VALUES

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



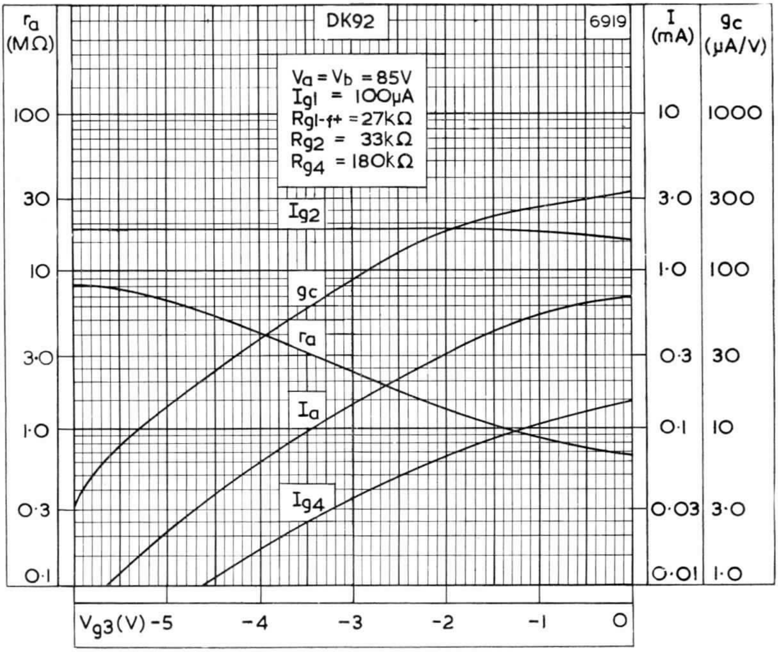


B7G Base

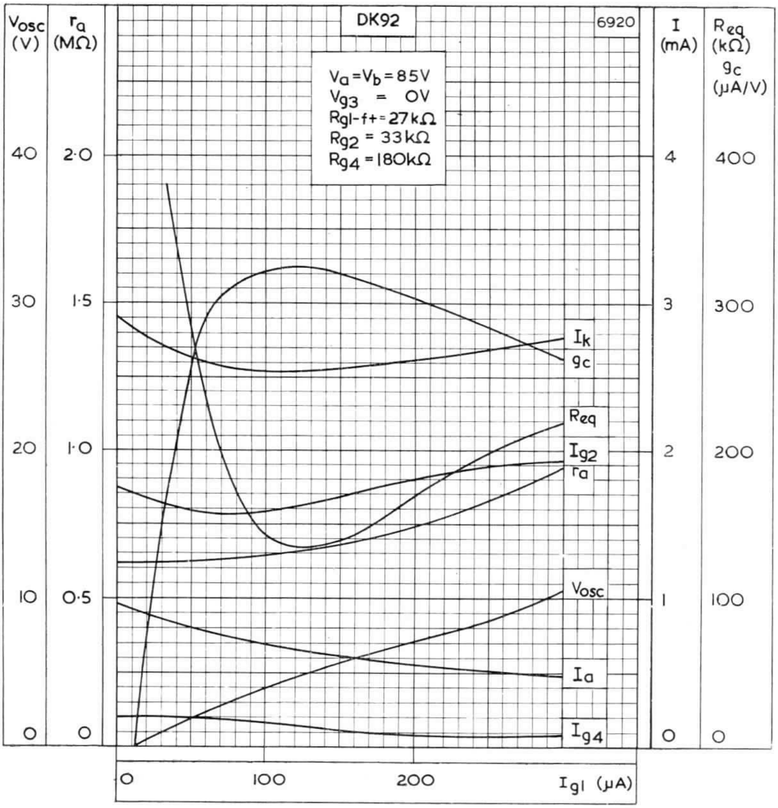


7081

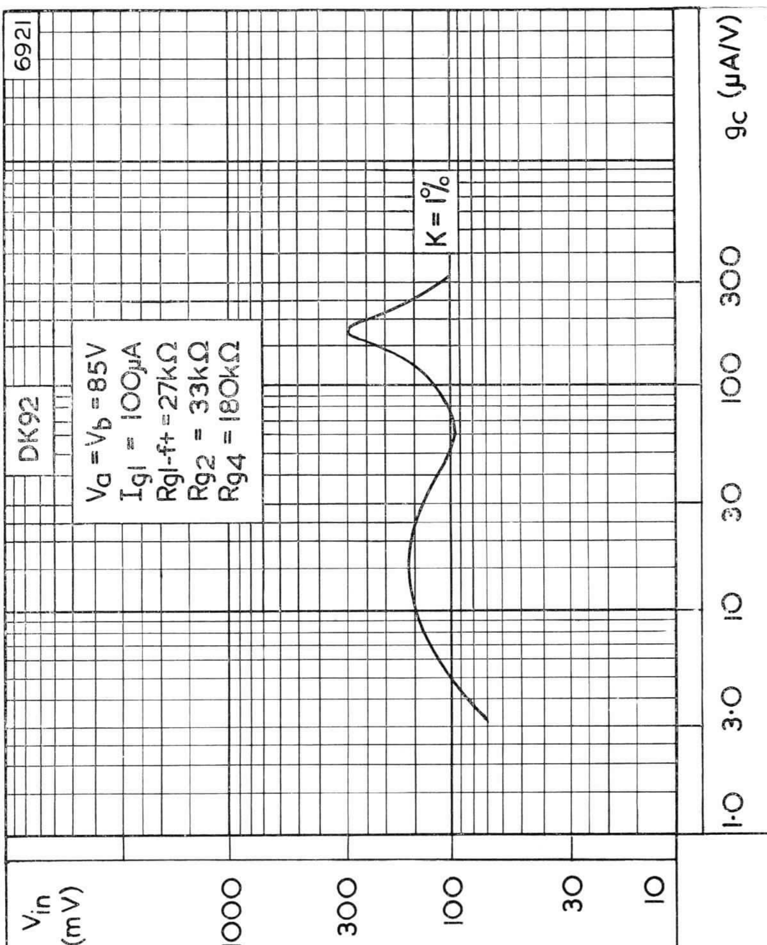
All dimensions in mm



ELECTRODE CURRENTS, CONVERSION CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



ELECTRODE CURRENTS, CONVERSION CONDUCTANCE, ANODE IMPEDANCE, EQUIVALENT NOISE RESISTANCE AND OSCILLATOR VOLTAGE PLOTTED AGAINST OSCILLATOR-GRID CURRENT



CROSS MODULATION CURVE

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_{g4}	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.

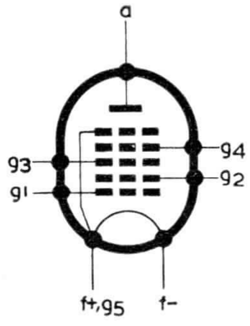
DK96

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. ($I_{g3}=+0.3\mu A$)	+1.0	V
V_{g1} max. ($I_{g1}=+0.3\mu A$)	0	V



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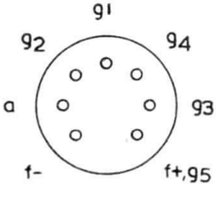
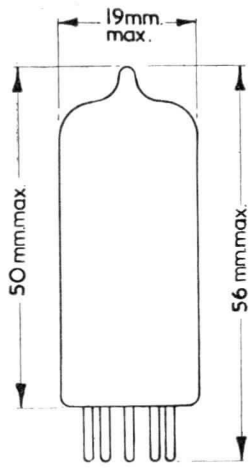


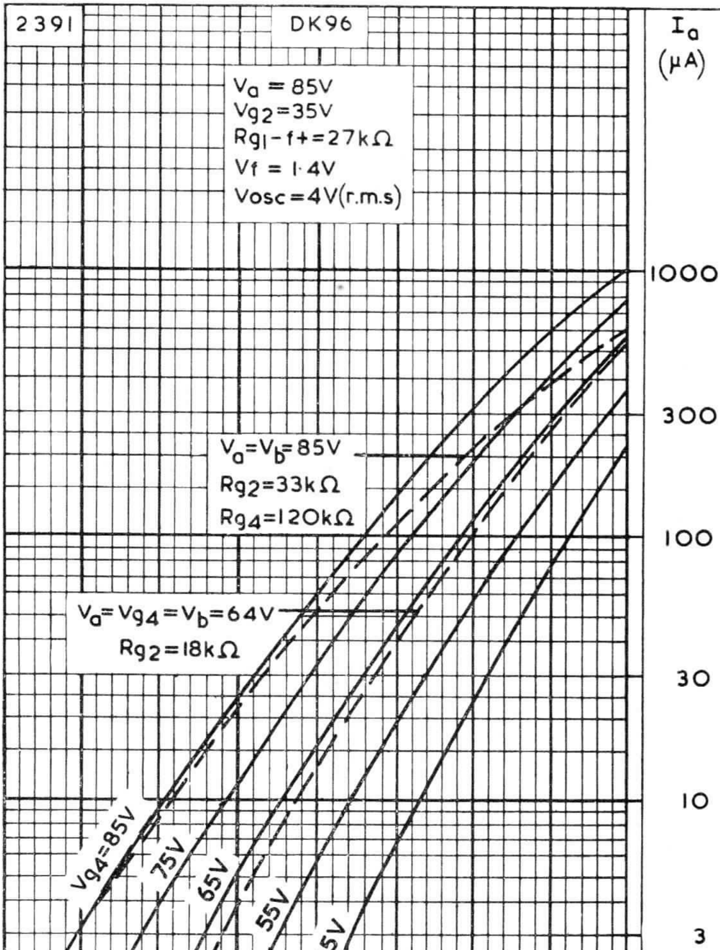
B7G Base



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.

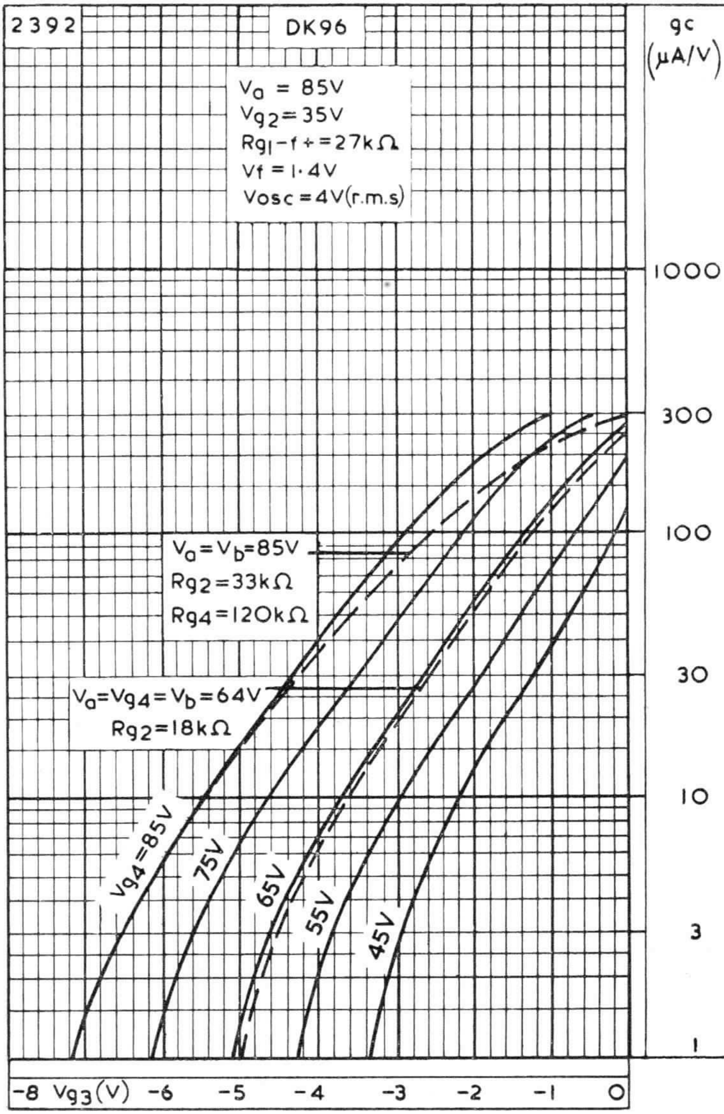


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

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.

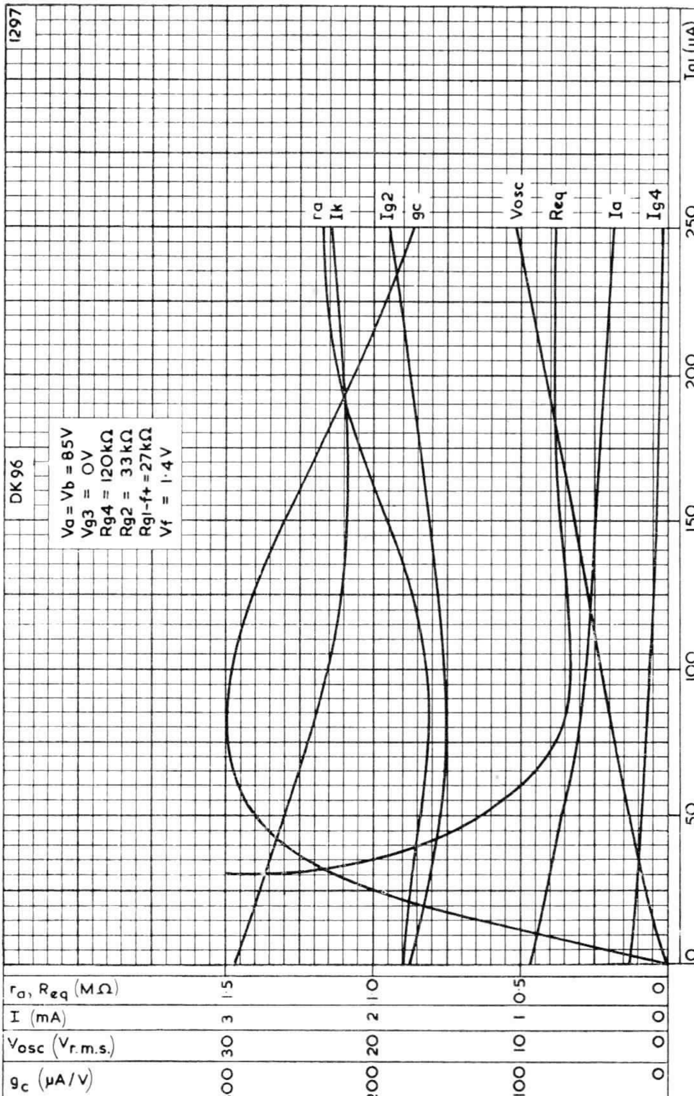


CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

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.

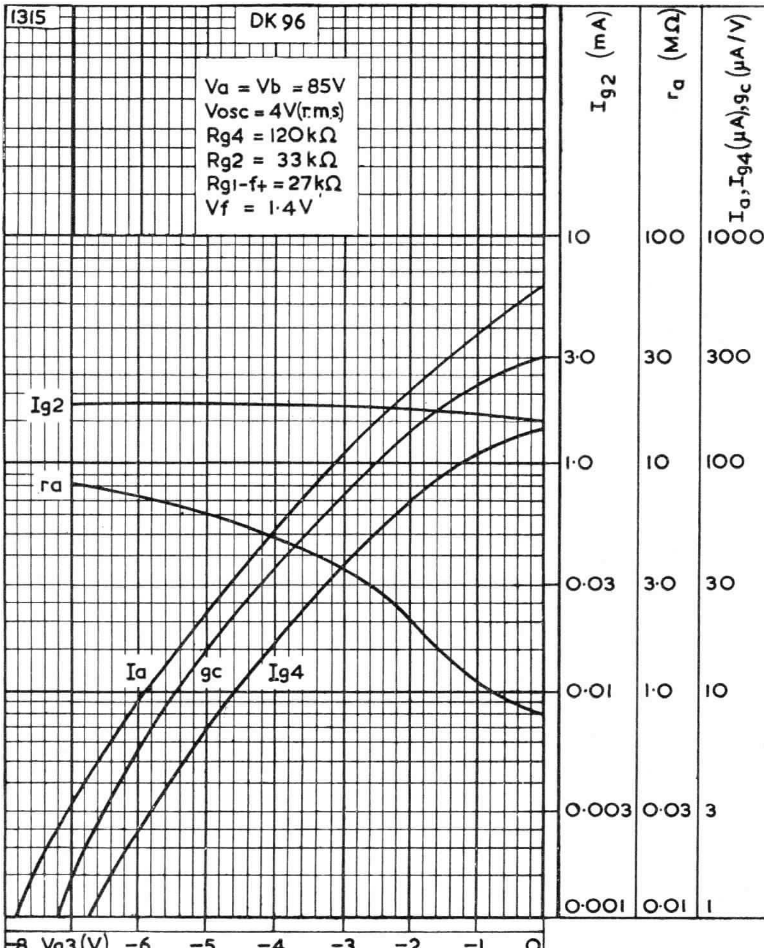


ELECTRODE CURRENTS, CONVERSION CONDUCTANCE, ANODE IMPEDANCE, EQUIVALENT NOISE RESISTANCE AND OSCILLATOR VOLTAGE PLOTTED AGAINST OSCILLATOR GRID CURRENT

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.

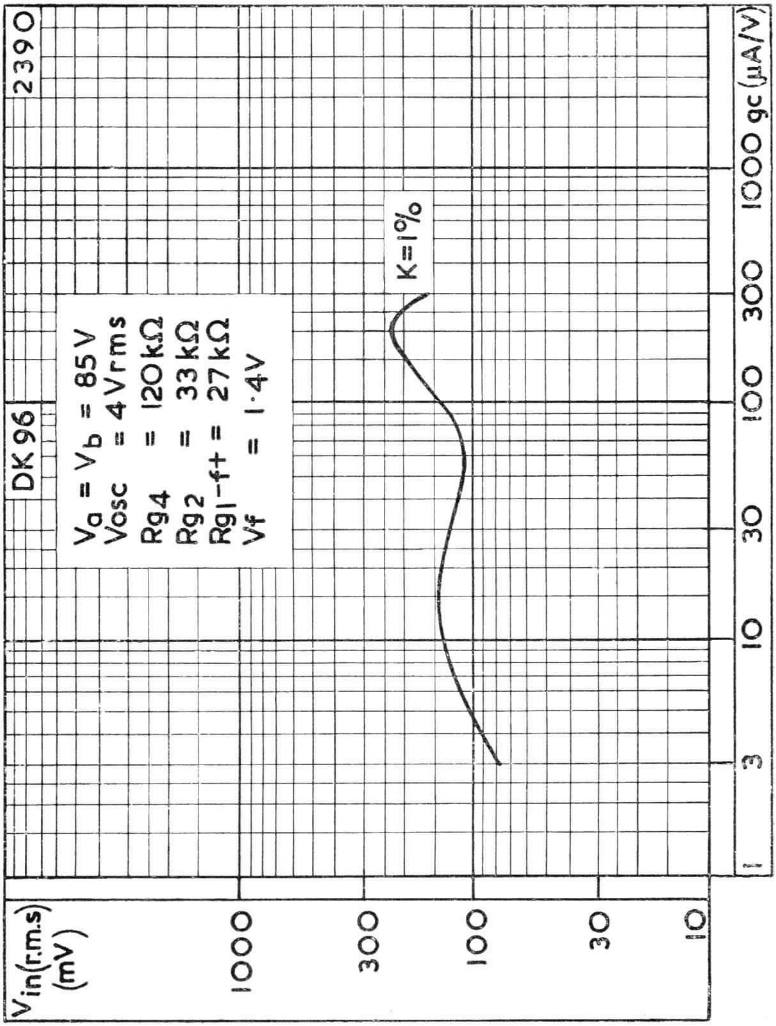


ELECTRODE CURRENTS, CONVERSION CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

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.



CROSS MODULATION CURVE

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
$I_{a(0)}$	3.8	7.2	7.4	10	mA
$I_{g2(0)}$	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
$I_{a(0)}$	3.8	5.0	mA
$I_{g2(0)}$	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
$I_{a(0)}$	2×1.5	2×1.5	2×2.0	mA
I_a (max. sig.)	2×5.6	2×7.0	2×8.4	mA
$I_{g2(0)}$	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	%

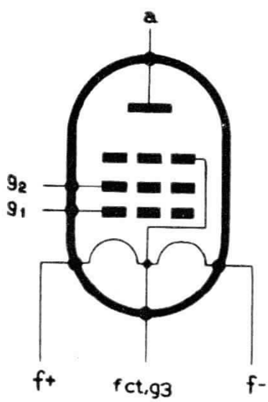
LIMITING VALUES

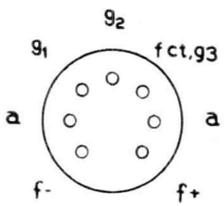
V_a max.	90	V
p_a max.	0.7	W
V_{g2} max.	90	V
p_{g2} max.	0.15	W
I_k max.	12	mA
R_{g1-f} max.	2.0	MΩ

MINIATURE OUTPUT PENTODE

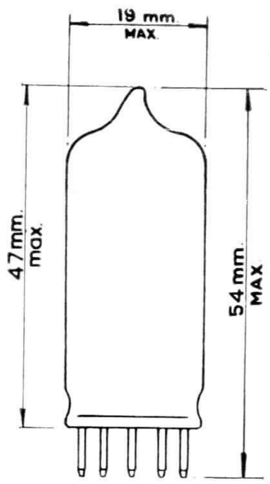
DL92

Output pentode with centre-tapped filament for use in battery operated equipment.





B7G BASE



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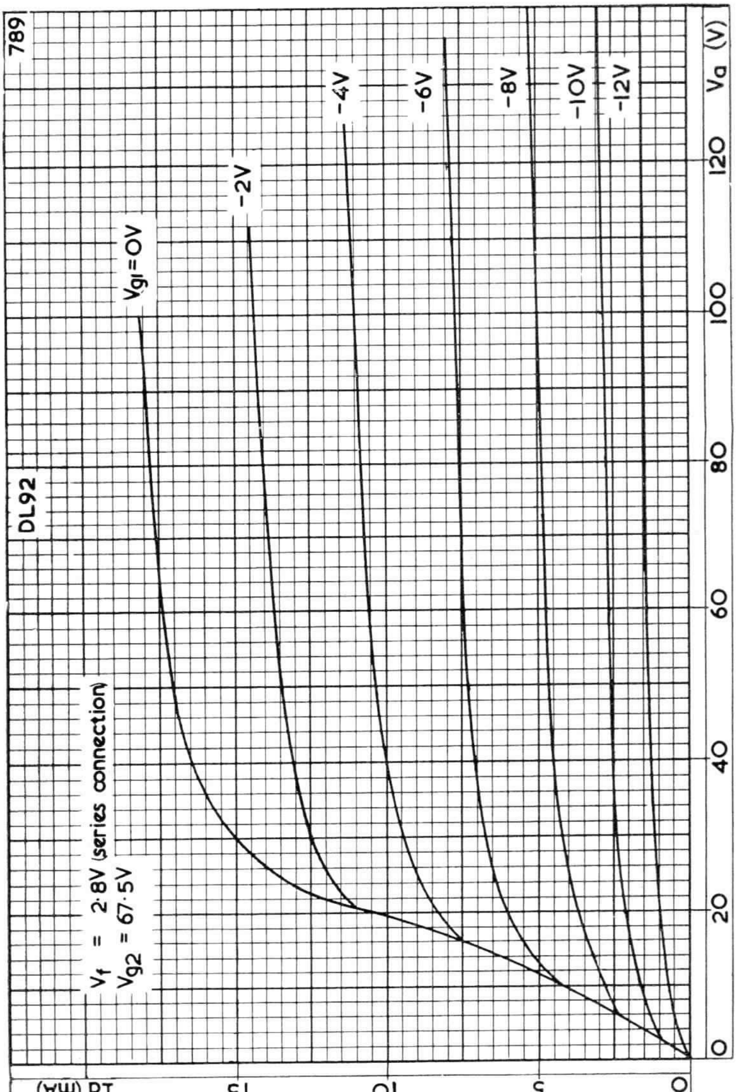
DL92

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

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	50	100	50	mA

MOUNTING POSITION Any

CAPACITANCES (Measured without external screening)

c_{a-g1}	0.2	pF
c_{in}	5.5	pF
c_{out}	3.8	pF

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	120	100	kΩ

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

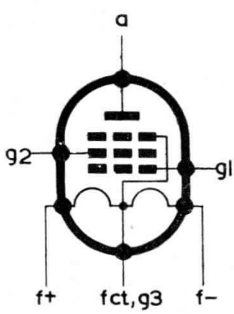
V_a max.	90	V
p_a max.	1	W
V_{g2} max.	90	V
p_{g2} max.	0.3	W
*I_k max.	12	mA
R_{g1-f} max.	1.0	MΩ

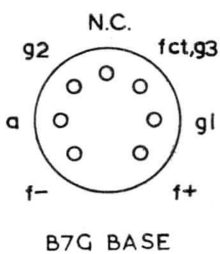
*I_k max. for each 1.4–volt section of filament is 6mA.

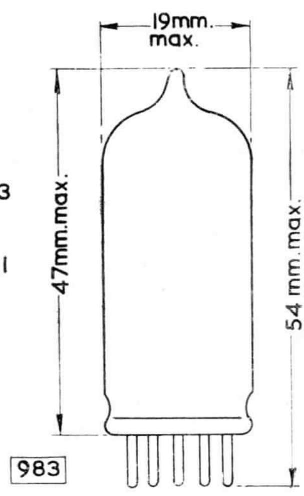
MINIATURE OUTPUT PENTODE

DL94

Output pentode with centre-tapped filament for use in battery operated equipment. Designed for operation with equal voltages on anode and screen-grid.



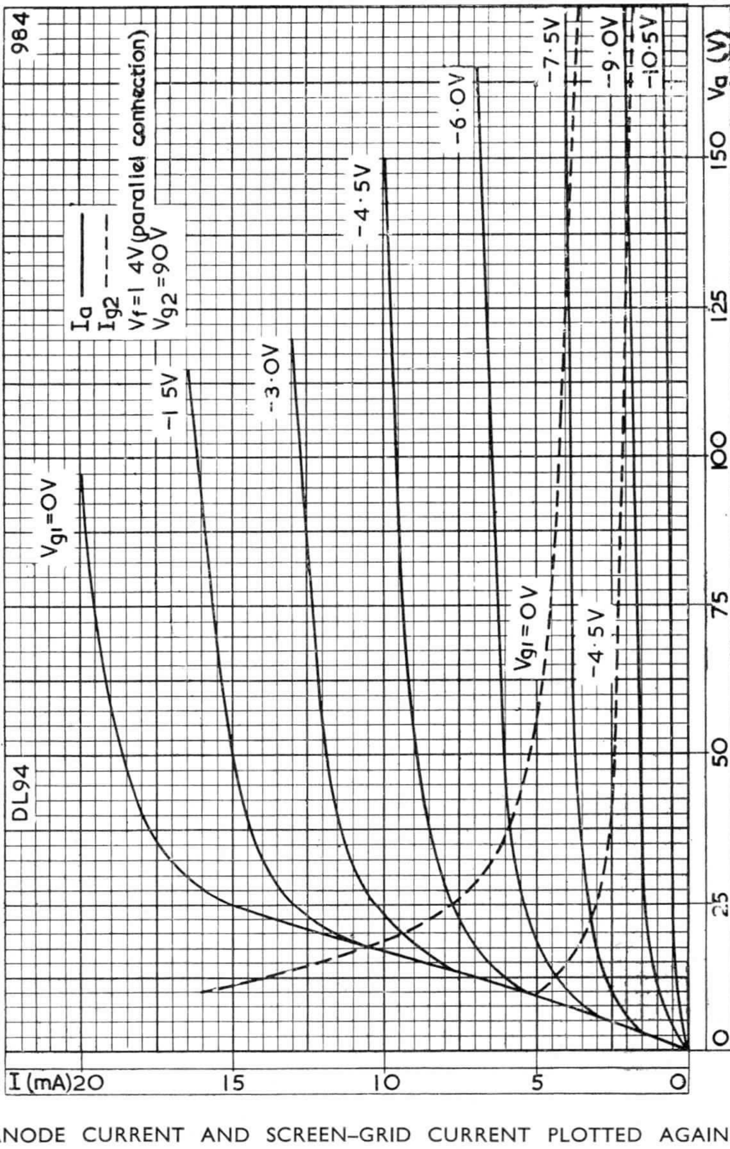




DL94

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

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

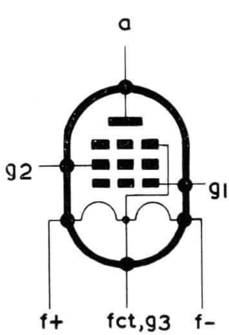
All filament sections in parallel

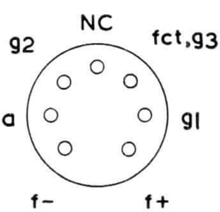
V_b	67.5	90	V
V_a	61.5	81.5	V
V_{g2}	61.5	81.5	V
V_{g1}	−5.8	−8.5	V
$I_{a(o)}$	2×0.75	2×1.0	mA
I_a (max. sig.)	2×3.4	2×5.0	mA
$I_{g2(o)}$	2×140	2×180	µA
I_{g2} (max. sig.)	2×0.95	2×1.3	mA
R_{a-a}	20	16	kΩ
$V_{in(g1-g1)r.m.s.}$	11.4	15.8	V
P_{out}	220	440	mW
D_{tot}	3.0	2.6	%

LIMITING VALUES

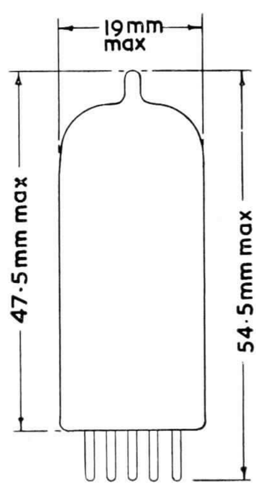
V_b max. (absolute)	110	V
V_b max.	90	V
V_a max.	90	V
p_a max.	600	mW
V_{g2} max.	90	V
p_{g2} max.	200	mW
*I_k max. (parallel filament connection)	6.0	mA
R_{g1-f} max.	2.0	MΩ

*I_k max. for each 1.4V section of the filament is 3mA.





B7G Base



3373

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

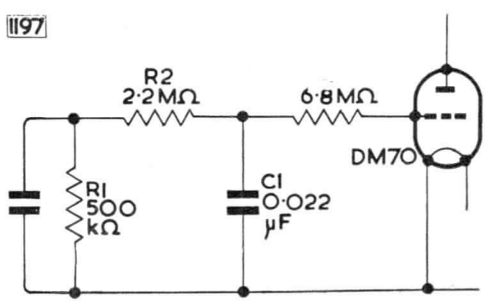
*Length of fluorescent column observed, measured from the top of the aperture. The maximum value is approximately 14 mm.

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.

1197



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

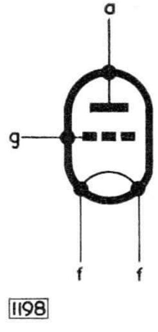
Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

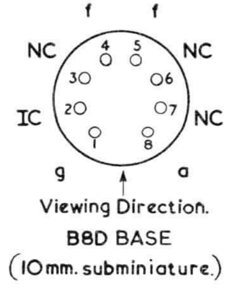
LIMITING VALUES

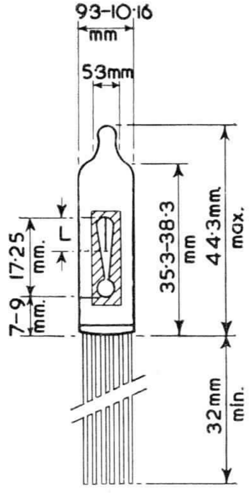
$V_{b(o)}$ max.	450	V
V_b max.	300	V
*V_a max.	90	V
V_a min	45	V
**p_a max. ($V_a \leqq 90$ V)	25	mW
**p_a max. ($V_a = 200$ V)	10	mW
I_k max.	300	μA
R_{g-f} max.	10	MΩ

*In circuits without anode series resistor.

**Values of p_a max. for intermediate values of V_a may be determined by linear interpolation.



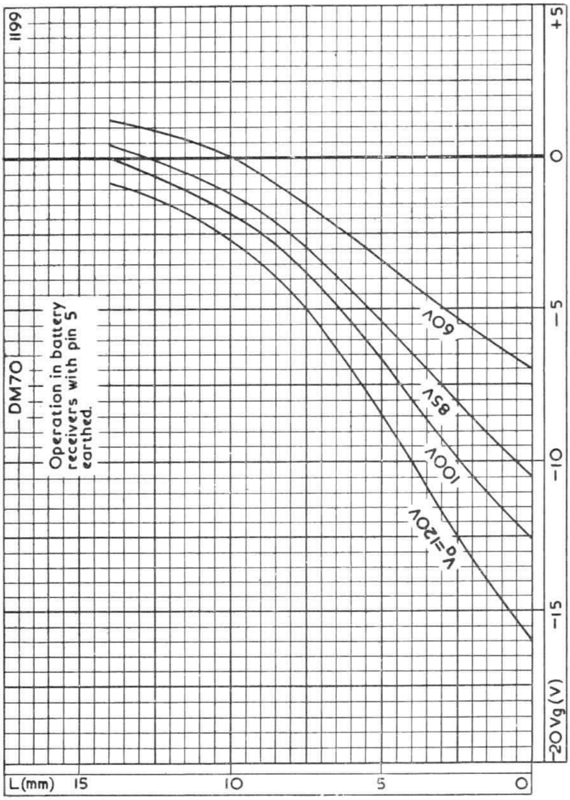




DM70

SUBMINIATURE TUNING INDICATOR

Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

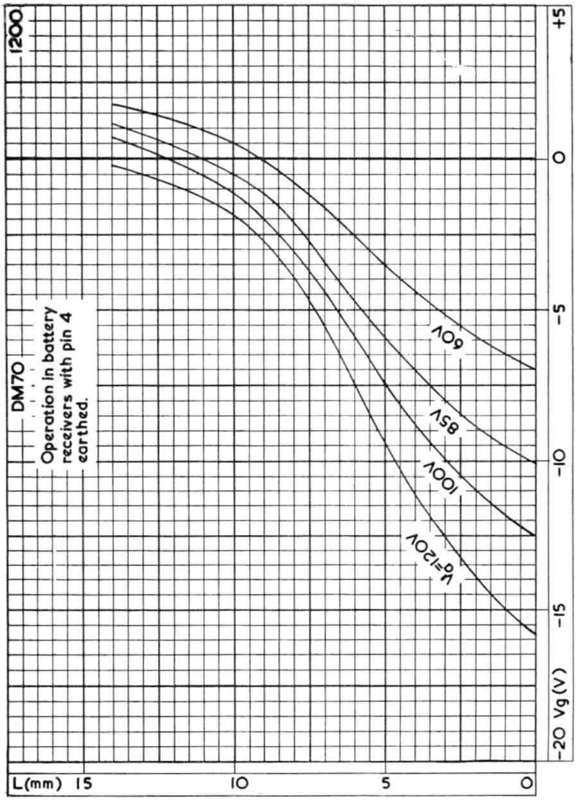


LENGTH OF FLUORESCENT COLUMN PLOTTED AGAINST GRID VOLTAGE AT VARIOUS VALUES OF ANODE VOLTAGE WHEN CONNECTED IN BATTERY-OPERATED RECEIVERS (PIN 5 EARTHED.)

SUBMINIATURE TUNING INDICATOR

DM70

Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

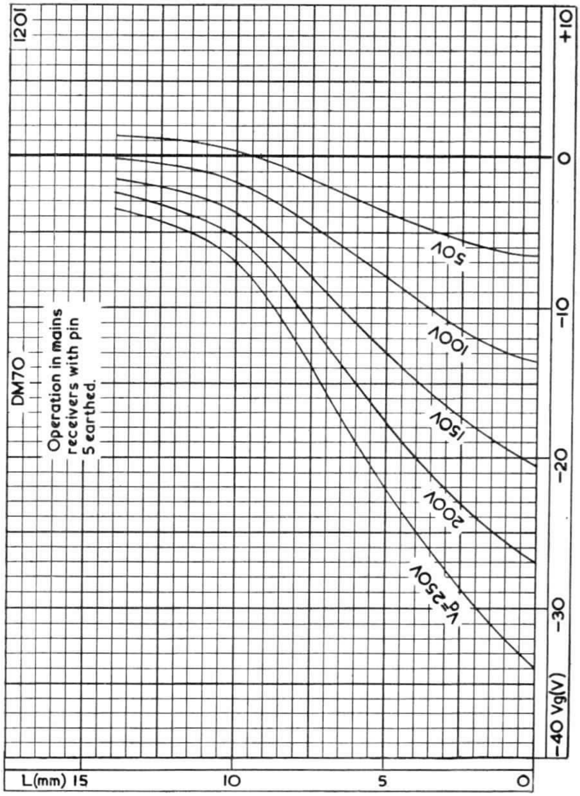


LENGTH OF FLUORESCENT COLUMN PLOTTED AGAINST GRID VOLTAGE AT VARIOUS VALUES OF ANODE VOLTAGE WHEN CONNECTED IN BATTERY-OPERATED RECEIVERS (PIN 4 EARTHED.)

DM70

SUBMINIATURE TUNING INDICATOR

Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

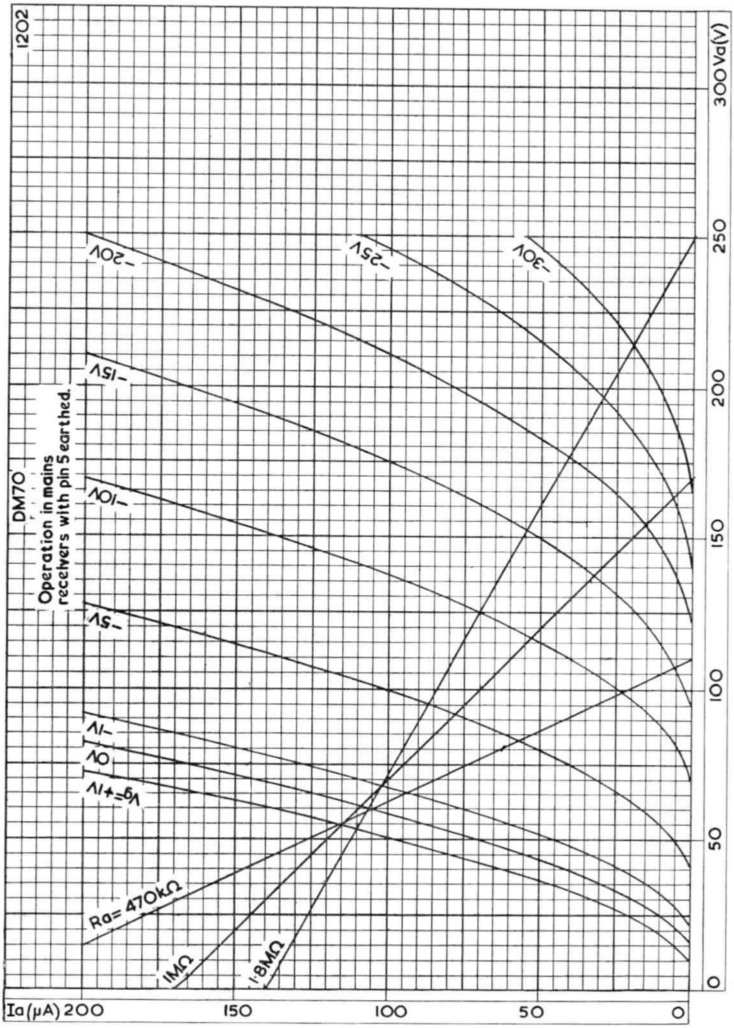


LENGTH OF FLUORESCENT COLUMN PLOTTED AGAINST GRID VOLTAGE AT VARIOUS VALUES OF ANODE VOLTAGE WHEN CONNECTED IN MAINS-OPERATED RECEIVERS (PIN 5 EARTHED.)

SUBMINIATURE TUNING INDICATOR

DM70

Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

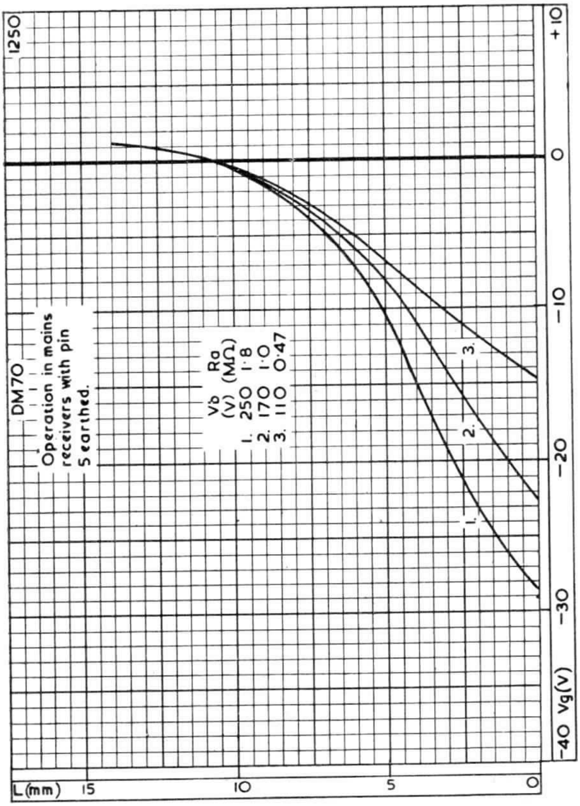


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER WHEN CONNECTED IN MAINS-OPERATED RECEIVERS (PIN 5 EARTHED.)

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 FOR VARIOUS VALUES OF ANODE LOAD RESISTOR WHEN CONNECTED IN MAINS-OPERATED RECEIVERS (PIN 5 EARTHED.)

SPECIAL QUALITY DOUBLE TRIODE

E80CC

Special quality double triode having separate cathodes, for use in industrial equipment where stability of characteristics and long life 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 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	300	600	mA

The maximum variation of heater current at $V_h = 6.3$V or 12.6V is $\pm 5\%$. In order to obtain a useful valve life with the heater fed from a parallel source the absolute maximum variation of heater voltage should be $\pm 5\%$. With the heater in a series connected chain the absolute maximum variation of heater current due to voltage fluctuations and component tolerances should be $< \pm 1.5\%$.

MOUNTING POSITION Any

CAPACITANCES[2]

	†*Shielded*	*Unshielded*	
$c_{a'-g'}$	3.0 ± 0.6	3.0	pF
*c_{in}	2.6 ± 0.7	2.4	pF
$c_{out'}$	3.0 ± 0.7	0.55	pF
*c_{g-h}	<0.23	<0.23	pF
$c_{a''-g''}$	3.0 ± 0.6	3.1	pF
$c_{out''}$	3.5 ± 0.7	0.45	pF
$c_{a'-a''}$	1.3 ± 0.4	1.45	pF
$c_{g'-g''}$	<0.013	<0.013	pF
$c_{a'-g''}$	<0.065	<0.065	pF
*c_{k-h}	4.8	4.8	pF
$c_{a''-g'}$	<0.1	<0.1	pF

*Each section

†Length of screening can 70mm, inner diameter 22mm.

E80CC SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTICS[3] (each section)

V_{a-k}	250	V
$*I_a$	6.0 ± 0.6	mA
R_k	920	Ω
$*g_m$	2.7 ± 0.5	mA/V
μ	27	
r_a	10	kΩ
r_a min.	7.0	kΩ
V_g ($I_g = +0.3\mu A$)	< -1.3	V
$*-I_g$ max. ($R_g = 100k\Omega$)	0.5	μA
Cathode heating time	16	s
Cathode heating time max.	23	s
Cathode cooling time min.	13	s

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

I_a	≤ 4.3	mA
g_m	≤ 1.8	mA/V
$-I_g$	≥ 1.0	μA

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER (each section)

With cathode bias

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	4.4	1.2	18.5	60	4.2	150
350	47	3.8	1.2	18.5	50	4.1	150
300	47	3.15	1.2	18.5	40	4.0	150
250	47	2.45	1.2	18.5	30	3.8	150
200	47	1.86	1.2	18.5	20	3.3	150
400	100	2.3	2.2	20	63	3.7	330
350	100	1.95	2.2	20	52	3.6	330
300	100	1.65	2.2	20	42	3.5	330
250	100	1.3	2.2	20	32	3.4	330
200	100	1.0	2.2	20	22	3.1	330
400	220	1.15	3.9	21	58	3.2	680
350	220	0.99	3.9	21	47	3.1	680
300	220	0.83	3.9	21	38	3.0	680
250	220	0.67	3.9	21	29	2.6	680
200	220	0.52	3.9	21	19	2.3	680

*Output voltage and distortion at start of positive grid current. At lower output voltages the distortion is approximately proportional to the output voltage.

†R_{g1} = grid resistance of following valve.

BALANCE AND CUT-OFF CHARACTERISTICS

$V_{a(b)}$	250	250	V
V_g	−5.5	<-17	V
I_a	—	15	μA
$I_{a'} \sim I_{a''}$	<3.0	—	mA
R_a	0	1.0	MΩ
R_k	0	920	Ω

INSULATION

Between heater and cathode

V_h	6.3	V
V_{h-k}	120	V
Leakage current	<12	μA

LIMITING VALUES[4] (each section)

$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
I_k max.	12	mA
* $i_{k(pk)}$ max.	150	mA
† $i_{k(pk)}$ max.	30	mA
$-V_g$ max.	200	V
I_g max.	300	μA
$i_{g(pk)}$ max.	30	mA
R_{g-k} max.	1.0	MΩ
V_{h-k} max.	120	V
R_{h-k} max.	100	kΩ
T_{bulb} max.	170	°C

* $i_{g(pk)} < 30$mA, max. duty cycle = 0.005, max. averaging time = 0.002s
† $i_{g(pk)} < 2$mA, max. duty cycle = 0.2, max. averaging time = 0.002s

SHOCK AND VIBRATION RATINGS

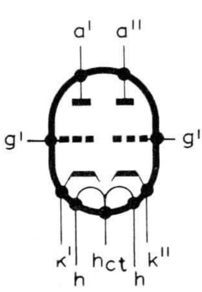
The E80CC can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 450g.

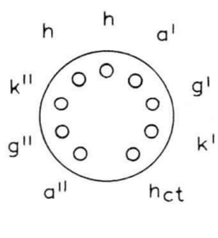
OPERATING NOTES

The hum voltage referred to either grid has a maximum value of 75μA, measured with a grid resistor of 500kΩ, and an anode current of 1.5mA.

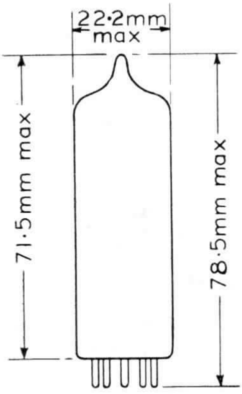
E80CC SPECIAL QUALITY DOUBLE TRIODE

5110





B9A Base



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

SPECIAL QUALITY A.F. AMPLIFYING PENTODE

E80F

Special quality a.f. amplifying pentode for use in 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

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

V_h[1]	6.3	V
I_h	300	mA

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

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

MOUNTING POSITION Any

CAPACITANCES[2] (measured with an external shield)

c_{in}	5.0 ± 0.5	pF
c_{out}	7.3 ± 0.5	pF
c_{a-g1}	<25	mpF
c_{g1-h}	<2.0	mpF
c_{h-k}	3.7	pF

CHARACTERISTICS[3]

V_{a-k}	250	V
V_{g3-k}	0	V
V_{g2-k}	100	V
R_k	550	Ω
†I_a	3.0 ± 0.5	mA
†I_{g2}	650 ± 200	μA
†g_m	1.85 ± 0.35	mA/V
r_a	1.5	MΩ
r_a min.	1.0	MΩ
μ_{g1-g2}	25	
*R_{eq} max.	40	kΩ
†$-I_{g1}$ max. ($R_{g1} = 100k\Omega$)	0.1	μA
V_{g1-k} for $I_a < 20\mu A$	−7.5	V

*Measured with $R_{g1} = 0\Omega$, f = 0 to 10kc/s.

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

I_a	2.0	mA
I_{g2}	350	μA
g_m	1.2	mA/V
$-I_{g1}$	0.2	μA

E80F

SPECIAL QUALITY A.F. AMPLIFYING PENTODE

OPERATING CONDITIONS

As r.c. coupled a.f. amplifier

V_b (V)	R_a (kΩ)	R_{g2} (MΩ)	R_{g1} (MΩ)	R_k (kΩ)	I_a (mA)	I_{g2} (μA)	$\frac{V_{out}}{V_{in}}$	V_{out}† ($V_{r.m.s.}$)	D_{tot} (%)	R_{g1}* (kΩ)
400	220	1.2	1.0	1.0	1.37	280	200	40	0.9	680
300	220	1.2	1.0	1.2	0.98	200	190	30	1.1	680
250	220	1.2	1.0	1.5	0.8	170	175	25	1.4	680
200	220	1.2	1.0	1.8	0.61	130	165	20	1.6	680
100	220	1.0	1.0	3.3	0.29	70	120	8.0	1.7	680

*Grid resistor of following valve.

†Output voltage measured at the start of positive grid current.

As an electrometer pentode

V_h	4.5	V
V_a	40	V
V_{g3}	0	V
V_{g2}	40	V
V_{g1}	−2.15	V
I_a	40	μA
I_{g2}	9.0	μA
I_{g1}	$< 10^{-10}$	A
R_k	0	Ω
g_m	140	μA/V ←
μ	22	←

INSULATION

Between heater and cathode

V_h	6.3	V
V_{h-k}	120	V
Leakage current	< 12	μA

SHOCK AND VIBRATION RATINGS

The E80F can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 300g.

LIMITING VALUES[4] (absolute ratings)

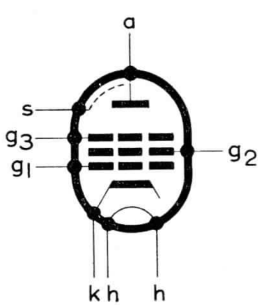
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	1.3	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	200	V
p_{g2} max.	400	mW
$-V_{g3}$ max.	100	V
$-V_{g1}$ max.	100	V
I_k max.	9.0	mA
R_{g1-k} max.	See page C7	
V_{h-k} max. (cathode positive)	120	V
V_{h-k} max. (cathode negative)	60	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	170	°C

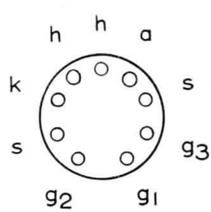
SPECIAL QUALITY A.F. AMPLIFYING PENTODE

E80F

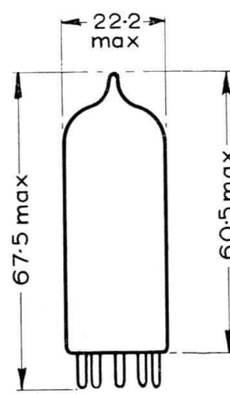
OPERATING NOTE

The hum voltage referred to g1 has a maximum value of 5μV with a grid leak of 1MΩ at 50c/s with one side of the heater earthed.





B9A Base



4747

All dimensions in mm

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

SPECIAL QUALITY OUTPUT PENTODE

E80L

Special quality output pentode designed for use in industrial equipment 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

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

V_h[1]	6.3	V
I_h	700	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 35mA$. 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 component tolerances should be $< \pm 1.5\%$.

MOUNTING POSITION

Any

CAPACITANCES[2]

	Minimum	*Average*	*Maximum*	
c_{a-g1}	—	—	150	mpF
c_{in}	9.2	10	10.8	pF
c_{out}	6.3	6.8	7.3	pF
c_{g1-h}	—	—	250	mpF
c_{h-k}	—	7.0	—	pF

CHARACTERISTICS[3]

V_a	200	V
V_{g3}	0	V
V_{g2}	200	V
V_{g1}	−4.4	V
I_a	30	mA
I_{g2}	4.1	mA
g_m	9.0	mA/V
r_a	52	kΩ
μ_{g1-g2}	21.5	
R_k	0	Ω

E80L SPECIAL QUALITY OUTPUT PENTODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of life**	
Anode current				
at $V_{a-e} = V_{g2-e} = 204.5V$, $V_{g3-k} = 0V$, $R_k = 130\Omega$	30	26.5 to 33.5	21	mA
at $V_{a-k} = V_{g2-k} = 200V$, $V_{g3-k} = 0V$, $V_{g1} = -14V$	—	< 200	—	μA
Screen-grid current				
at $V_{a-e} = V_{g2-e} = 204.5V$, $V_{g3-k} = 0V$, $R_k = 130\Omega$	4.1	2.7 to 5.5	2.0	mA
Control-grid current				
at $V_{a-e} = V_{g2-e} = 204.5V$, $V_{g3-k} = 0V$, $R_k = 130\Omega$	—	< 0.5	1.0	μA
Mutual conductance				
at $V_{a-e} = V_{g2-e} = 204.5V$, $V_{g3-k} = 0V$, $R_k = 130\Omega$	9.0	7.4 to 10.6	6.0	mA/V
Power output				
at $V_{a-k} = V_{g2-k} = 200V$, $V_{g3-k} = 0V$, $I_a = 30mA$	—	> 2.0	—	W

*To allow for valve deterioration during life, circuits should be designed to function with a valve whose characteristics have changed to the values stated.

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_{a-k}	200	250	V
V_{g3-k}	0	0	V
$V_{g2(b)}$	—	250	V
V_{g2-k}	200	—	V
R_k	130	270	Ω
R_a	7.0	10	kΩ
R_{g2}	—	1.0	kΩ
I_a	30	24	mA
I_{g2}	4.1	3.3	mA
$V_{in(r.m.s.)}$ ($P_{out} = 50mW$)	330	—	mV
$V_{in(r.m.s.)}$	3.0	3.0	V
P_{out}	2.7	2.8	W
D_{tot}	10	10	%

OPERATING CONDITIONS FOR TWO VALVES IN CLASS 'AB' PUSH-PULL

V_{a-k}	200	250	V
V_{g3-k}	0	0	V
V_{g2-k}	200	250	V
R_k (per valve)	130	270	Ω
R_{a-a}	9	9	kΩ
$I_{a(o)}$	2 × 20.6	2 × 23.5	mA
$I_{g2(o)}$	2 × 2.8	2 × 3.2	mA
$V_{in(g1-g1)r.m.s.}$	10.4	15.6	V
P_{out}	5.7	9.0	W
D_{tot}	3.0	4.5	%
$I_{a\ (max.\ sig.)}$	2 × 24.6	2 × 29.5	mA
$I_{g2\ (max.\ sig.)}$	2 × 4.9	2 × 6.6	mA

INSULATION

	Initial Range	*End of life**	
Between heater and cathode			
Measured at V_{h-k} = 120V			
(cathode positive) R_{lim} = 1.0MΩ			
Leakage current	< 15	20	μA
Between any two arbitrary electrodes			
Measured at 300V			
(cathode positive)	> 50	10	MΩ

*To allow for valve deterioration during life, circuits should be designed to function with a valve whose characteristics have changed to the values stated.

ABSOLUTE MAXIMUM RATINGS[4]

$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	8.0	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	300	V
p_{g2} max.	2.6	W
$-V_{g1}$ max.	100	V
$-V_{g3}$ max.	100	V
I_k max.	50	mA
R_{g1-k} max. (self bias)	1.0	MΩ
V_{h-k} max.	120	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	225	°C

SHOCK AND VIBRATION

The E80L can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 500g.

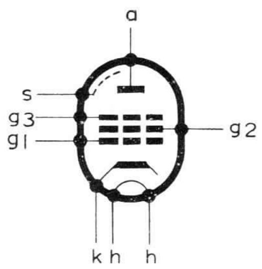
E80L SPECIAL QUALITY OUTPUT PENTODE

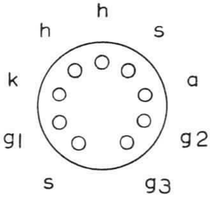
OPERATING NOTES

The hum voltage referred to g_1 has a maximum value of 250μV and is measured with the centre tap of the heater winding earthed, at a supply frequency of 50c/s and with a linear band-pass filter under the following conditions:

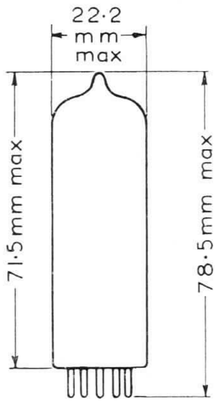
V_{a-k}	200	V
V_{g2-k}	200	V
R_a	1.0	kΩ
R_k	130	Ω

5263





B9A Base



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

SPECIAL QUALITY DOUBLE TRIODE

E90CC

Special quality double triode with common cathode for use in computers 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

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

V_h[1]	6.3	V
I_h	400	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 20mA$. 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 component tolerances should be $< \pm 1.5\%$.

CAPACITANCES[2] (measured without an external shield)

	Minimum	*Average*	*Maximum*	
*c_{a-g}	2.0	2.5	3.0	pF
*c_{in}	2.9	3.4	3.9	pF
$c_{out'}$	300	400	500	mF
$c_{out''}$	250	350	450	mF
$c_{g'-h}$	—	—	300	mpF
$c_{g''-h}$	—	—	150	mpF
$c_{a'-a''}$	—	—	1.4	pF
$c_{g'-g''}$	—	—	220	mpF
$c_{a'-g''}$	—	—	150	mpF
$c_{a''-g'}$	—	—	350	mpF
c_{k-h}	—	6.5	—	pF

*Each section

CHARACTERISTICS[3] (each section)

V_a	100	V
I_a	8.5	mA
V_g	−2.1	V
g_m	6.0	mA/V
μ	27	
R_k	0	Ω

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN ←

	Average	*Initial range*	*End of life**	
Anode current (each section)				
at $V_a = 100V$, $V_g = -2.1V$	8.5	4.5 to 12.5	—	mA
at $V_b = 150V$, $R_a = 20k\Omega$ $V_g = 0V$, $R_g = 47k\Omega$	—	5.0 to 6.2	4.5	mA
at $V_b = 150V$, $R_a = 20k\Omega$ $V_g = -10V$, $R_g = 47k\Omega$	—	<100	100	μA
Mutual conductance (each section)				
at $V_{a-k} = 100V$, $V_{g-e} = 0V$ $R_k = 250\Omega$ (decoupled)	6.0	4.5 to 7.5	3.0	mA/V
Balance ($Vg' \sim Vg''$)				
at $V_b = 150V$, $R_a = 20k\Omega$ $R_g = 47k\Omega$, $I_a = 100\mu A$	—	<2.0	2.0	V
Negative control-grid current (each section)				
at $V_{a-k} = 100V$, $V_{g-e} = 0V$ $R_k = 250\Omega$	—	<0.2	1.0	μA

INSULATION ←

	Initial range	*End of life**	
Between heater and cathode measured at $V_{h-k} = 100V$ (cathode positive), $R_{lim} = 1M\Omega$ Leakage current	<15	30	μA
Between any two electrodes measured at 300V	>100	20	$M\Omega$

*To allow for valve deterioration during life, circuits should be designed to function with a valve, any characteristic of which has reached the stated end of life value.

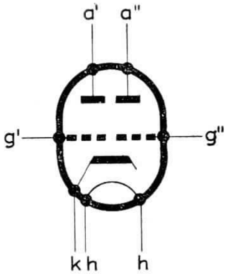
LIMITING VALUES[4] (absolute ratings) each section

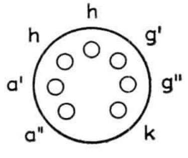
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
I_k max.	15	mA
$*i_{k(pk)}$ max.	75	mA
$-V_g$ max.	100	V
$*-v_{g(pk)}$ max.	200	V
$+V_g$ max.	0	V
I_g max.	250	μA
$*i_{g(pk)}$ max.	1.0	mA
R_{g-k} max. (cathode bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	500	kΩ
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

*Max. averaging time = 10ms.

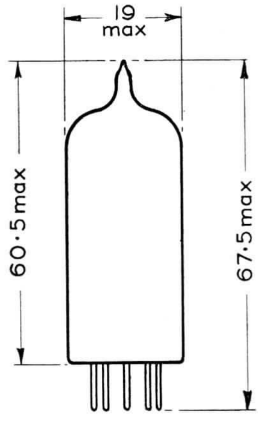
OPERATING NOTES

For stable operation it is advisable to restrict the cathode to heater resistor to values less than 20kΩ. The E90CC is not intended for applications which are critical with regard to microphony or hum.





B7G Base



5770

All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, section B7G.

SPECIAL QUALITY DOUBLE TRIODE

E92CC

Special quality double triode for use in computers 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

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

V_h[1]	6.3	V
I_h	400	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm$ 20mA

MOUNTING POSITION

Any

CAPACITANCES[2]

	Average	Minimum	Maximum	
$c_{a''-g''}$	2.2	1.8	2.6	pF
*c_{in}	3.1	2.2	4.0	pF
$c_{out''}$	0.32	0.22	0.42	pF
$c_{a'-g'}$	2.1	1.7	2.5	pF
$c_{out'}$	0.38	0.28	0.48	pF
$c_{a'-a''}$	—	—	2.0	pF
$c_{g'-g''}$	—	—	0.29	pF

*Each section

CHARACTERISTICS[3] (each section)

V_a	150	V
I_a	8.5	mA
V_g	−1.7	V
g_m	6.0	mA/V
r_a	7.5	kΩ
μ	45	
R_k	0	Ω

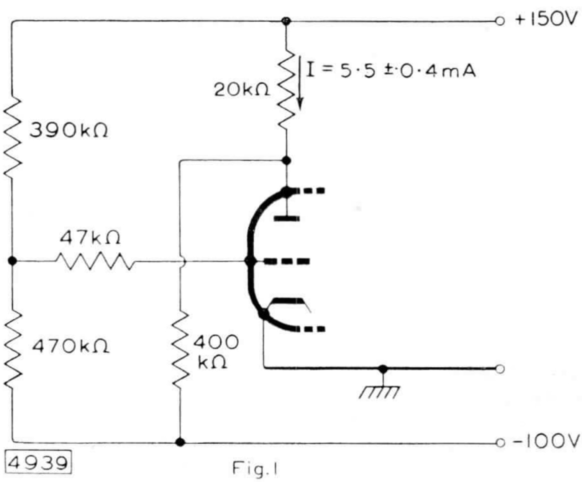


Fig.1

E92CC SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of life**	
I_a ($V_a = 150V$, $V_g = -1.7V$)	8.5	4.5 to 12.5	—	mA
g_m ($V_{a-k} = 150V$, $R_k = 200\Omega$)	6.0	4.5 to 7.5	—	mA/V
I_a ($V_b = 150V$, $V_g = -10V$, $R_a = 20k\Omega$, $R_g = 47k\Omega$)	—	<100	100	μA
$V_{g'} \sim V_{g''}$ ($V_b = 150V$, $I_a = 100\mu A$, $R_a = 20k\Omega$, $R_g = 47k\Omega$)	—	<2.0	2.0	V
$-I_g$ (Va $= 150V$, $V_g = -1.7V$)	—	<0.2	1.0	μA

INSULATION

		Initial range	*End of life**	
Leakage current. Measured at $V_{h-k} = 100V$ (cathode positive), $R_{lim} = 1.0M\Omega$		<15	30	μA
Insulation between any two arbitrary electrodes	>100	[redacted]	20	$M\Omega$

*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 end of life values.

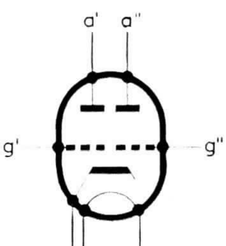
LIMITING VALUES[4] (absolute ratings) each section

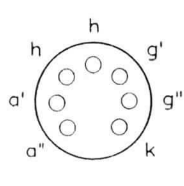
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
$+V_g$ max.	500	mV
$-V_g$ max.	100	V
†$-v_{g(pk)}$ max.	200	V
I_k max.	15	mA
†$i_{k(pk)}$ max.	75	mA
I_g max.	250	μA
†$i_{g(pk)}$ max.	1.0	mA
R_{g-k} max. (self bias)	1.0	$M\Omega$
R_{g-k} max. (fixed bias)	500	$k\Omega$
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

†Maximum duration = 10ms

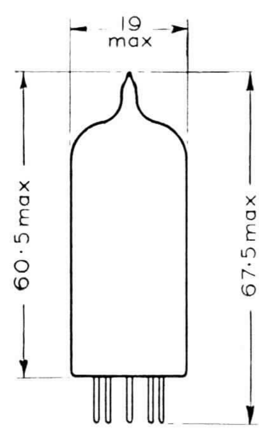
OPERATING NOTE

The E92CC will maintain its emission capabilities after long periods of operation under cut-off conditions. It is not intended to be used in circuits critical with regard to hum, microphony or noise.





B7G Base



5770

All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, Section B7G.

Special quality high slope output pentode intended for general industrial applications.

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, a.c. or d.c.

V_h [1]	6.3	V
I_h	1.7	A

The maximum variation of heater voltage at $I_h = 1.7A$ is ±5%.

CAPACITANCES[2]

c_{in}	35	pF
c_{out}	17	pF
c_{a-g1}	<2.0	pF

CHARACTERISTICS[3]

V_a	250	V
V_{g2}	150	V
V_{g1}	-15.5	V
I_a	100	mA
I_{g2}	4.0	mA
g_m	27.5	mA/V
μ_{g1-g2}	6.5	
r_a	10	kΩ

OPERATING CONDITIONS AS CLASS 'A' AMPLIFIER

V_a	250	V
V_{g2}	150	V
V_{g1}	-15.5	V
R_a	2.7	kΩ
$V_{in(r.m.s.)}$	3.82	V
$I_{a(o)}$	100	mA
$I_{g2(o)}$	4.0	mA
P_{out}	11.5	W
D_{tot}	10	%

OPERATING CONDITIONS AS CLASS 'AB' AMPLIFIER - PUSH-PULL

V_a	300	V
V_{g2}	150	V
V_{g1}	-17	V
R_{a-a}	1.6	kΩ
$V_{in(r.m.s.)}$	9.0	V
$I_{a(o)}$	2 × 80	mA
$I_{g2(o)}$	2 × 2.5	mA
P_{out}	60	W
D_{tot}	5	%
$I_{a(max.sig.)}$	2 × 182	mA
$I_{g2(max.sig.)}$	2 × 22	mA

RATINGS (ABSOLUTE MAXIMUM SYSTEM)[4]

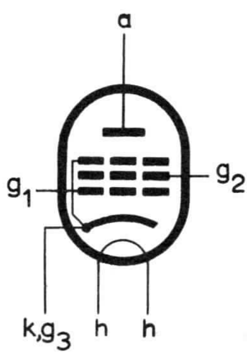
$V_{a(b)}$ max.	2.0	kV
V_a max.	900	V
V_{g2} max.	250	V
$-v_{a(pk)}$ max.	2.0	kV
$+v_{a(pk)}$ max.	8.0	kV
p_a max.	27.5	W
p_{a+g2} max.	27.5	W
$V_{g2(b)}$ max.	550	V

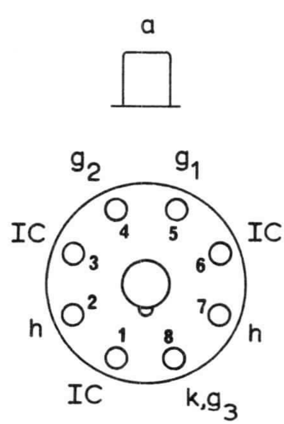
P_{g2} max.	5.0	W
$-V_{g1}$ max.	150	V
$+V_{g1}$ max.	15	V
$-p_{g1}$ max.	0.1	W
R_{g1} max.	0.5	MΩ
I_k max.	300	mA
*$i_{k(pk)}$ max.	1.5	A
**$i_{k(pk)}$ max.	4.6	A
V_{h-k} max. (cathode negative)	100	V
V_{h-k} max. (cathode positive)	200	V

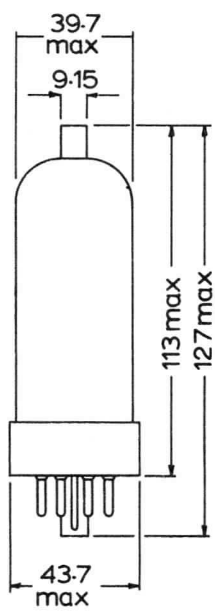
*Max. duration 4ms, I_k max. = 150mA.

**Max. duration 1.5μs, I_k max. = 14mA.

B4678



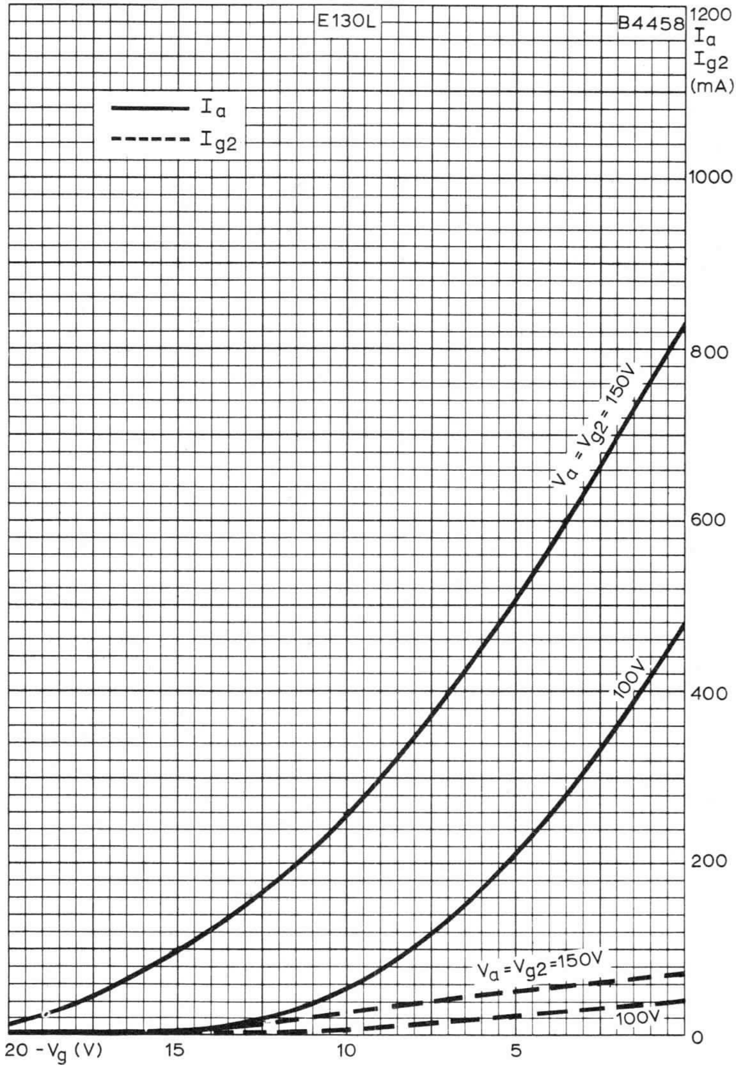




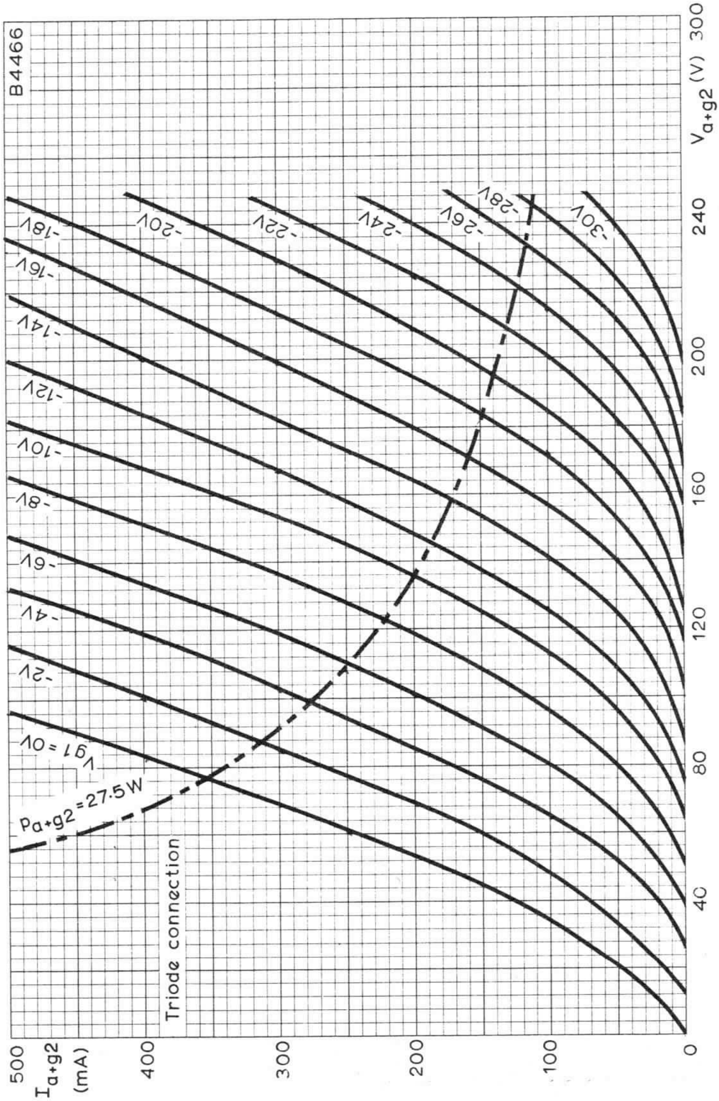
Octal Base

CT2 Top Cap

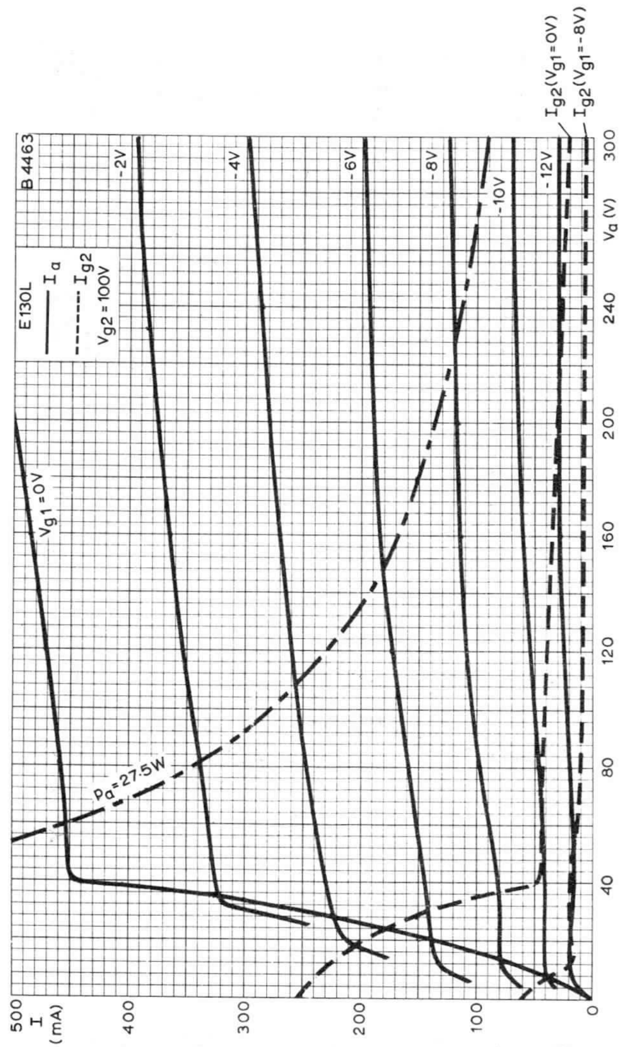
All dimensions in mm



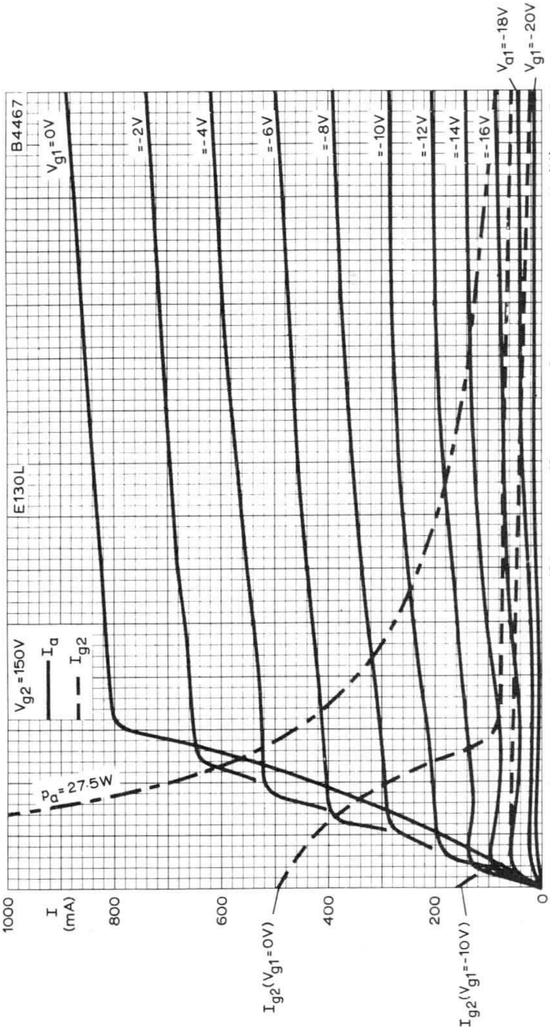
ANODE AND SCREEN CURRENTS PLOTTED AGAINST
CONTROL-GRID VOLTAGE WITH ANODE AND
SCREEN VOLTAGES AS PARAMETERS



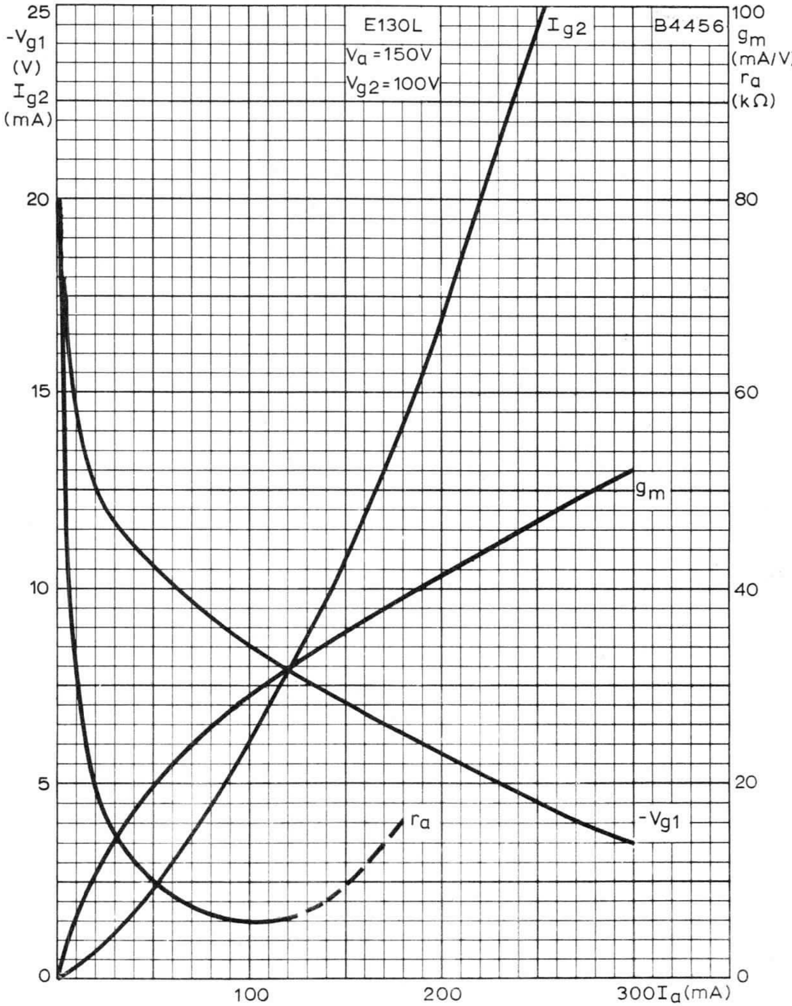
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



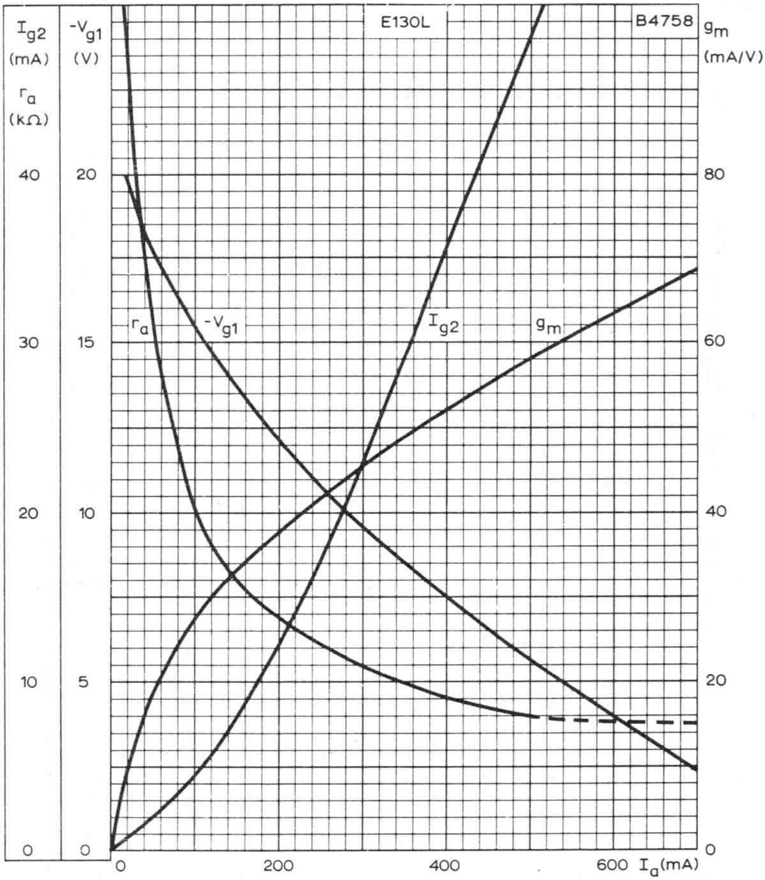
ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER
$V_{g2} = 100V$



ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER
$V_{g2} = 150V$



SCREEN CURRENT, CONTROL-GRID VOLTAGE,
MUTUAL CONDUCTANCE AND ANODE IMPEDANCE
PLOTTED AGAINST ANODE CURRENT
V_a =150V, V_{g2} =100V



SCREEN CURRENT, CONTROL-GRID VOLTAGE
MUTUAL CONDUCTANCE AND ANODE IMPEDANCE
PLOTTED AGAINST ANODE CURRENT
$V_a = 250V$, $V_{g2} = 150V$

SPECIAL QUALITY DOUBLE TRIODE

E180CC

Special quality double triode, with separate cathodes, for use in computer circuits. 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	200	400	mA

The maximum variation of heater current at $V_h = 6.3$V is ± 20mA and at $V_h = 12.6$V is ± 10mA.

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 component tolerances should be $< \pm 1.5\%$.

CAPACITANCES[2] (measured without an external shield)

	Minimum	*Average*	*Maximum*	
$c_{a'-g'}$	1.8	2.2	2.6	pF
$^*c_{in}$	3.0	3.5	4.0	pF
$c_{out'}$	300	500	700	mpF
$^*c_{h-k}$	—	3.5	—	pF
$c_{a''-g''}$	1.9	2.3	2.7	pF
$c_{out''}$	250	450	650	mpF
$c_{a'-a''}$	—	—	1.3	pF
$c_{g'-g''}$	—	—	60	mpF

*Each section

CHARACTERISTICS[3] (each section)

V_a	100	150	V
V_g	−0.8	−1.85	V
I_a	8.5	8 5	mA
g_m	7.8	6.4	mA/V
r_a	6.4	7.2	kΩ
μ	50	46	
R_k	0	0	Ω

E180CC SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of life**	
Anode current (each section)				
at $V_{a-e} = 150V$, $R_k = 220\Omega$	8.5	6.3 to 10.7	5.0	mA
at $V_a = 150V$, $V_g = -7.5V$	—	<150	150	µA
at $V_a = 100V$, $V_{g(b)} = 100V$ $R_g = 500k\Omega$	17.8	13.6 to 22	9.5	mA
Grid current (each section)				
at $V_{a-e} = 150V$, $R_k = 220\Omega$ $R_g = 100k\Omega$	—	<0.2	1.0	µA
Mutual conductance (each section)				
at $V_{a-e} = 150V$, $R_k = 220\Omega$	6.4	5.3 to 8.1	4.0	mA/V
Balance ($V_g' \sim V_g''$)				
at $V_a = 150V$, $I_a = 150\mu A$	—	<2.0	2.0	V

INSULATION

	Initial range	*End of life**	
Between heater and cathode measured at $V_{h-k} = 200V$ (cathode positive) $R_{lim} = 1.0M\Omega$			
Leakage current	<15	30	µA
Between any two electrodes measured at 275V	>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

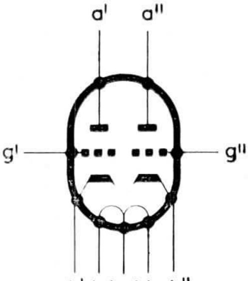
$V_{a(b)}$ max.	600	V
V_a max.	275	V
p_a max.	2.0	W
$+V_g$ max.	1.0	V
†$-v_{g(pk)}$ max.	200	V
$-V_g$ max.	100	V
†$i_{g(pk)}$ max.	50	mA
I_g max.	2.0	mA
†$i_{k(pk)}$ max.	200	mA
I_k max.	20	mA
R_{g-k} max. (fixed bias)	500	kΩ
V_{h-k} max. (cathode positive)	200	V
V_{h-k} max. (cathode negative)	100	V
**T_{bulb} max.	170	°C

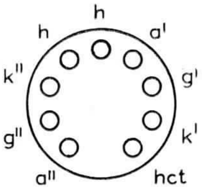
†Maximum duration = 10µs. Duty cycle = 1%

**In the interests of reliability, the bulb temperature should always be kept as low as possible.

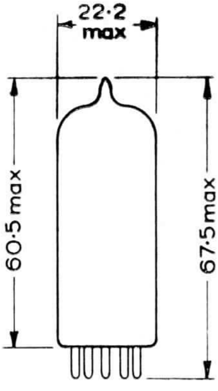
OPERATING NOTE

The E180CC will maintain its emission capabilities after long periods under cut-off conditions, but it is not intended to be used in circuits which are critical with regard to hum, microphony or noise.





B9A Base



5033

All dimensions in mm

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

SPECIAL QUALITY DOUBLE TRIODE

E182CC

Special quality double triode for use in computer circuits. 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, a.c. or d.c. The heater is centre-tapped and two sections may be operated in series or in parallel with one another.

	Series	*Parallel*	
V_h[1]	12.6	6.3	V
I_h	320	640	mA

The maximum variation of heater current at 6.3V is $\pm$35mA.

CAPACITANCES[2] (measured without an external shield)

	Minimum	*Average*	*Maximum*	
$c_{a'-g'}$	3.4	4.0	4.6	pF
$c_{a''-g''}$	3.4	4.1	4.8	pF
*c_{in}	5.3	6.0	6.7	pF
$c_{out'}$	0.75	1.1	1.45	pF
$c_{out''}$	0.65	1.0	1.35	pF
$c_{g'-g''}$	—	—	150	mpF
$c_{a'-a''}$	—	600	800	mpF
$c_{a'-g''}$	—	—	100	mpF
$c_{a''-g'}$	—	—	100	mpF
*c_{h-k}	—	4.0	—	pF

*Each section

CHARACTERISTICS[3] (each section)

V_a	120	V
I_a	36	mA
V_g	−2.0	V
g_m	15	mA/V
r_a	1.6	kΩ
μ	24	
R_k	0	Ω

E182CC

SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

(each section)

	Average	Initial range	End of life*	
Anode current				
at $V_a = 90V$, $I_g = 250\mu A$	52	41 to 62	24	mA
at $V_a = 120V$, $V_g = -2V$	36	26 to 45	—	mA
at $V_a = 150V$, $V_g = -14V$	—	<0.2	—	mA
Mutual conductance				
at $V_{a-k} = 120V$, $V_{g-e} = 0V$ $R_k = 55\Omega$	—	11.2 to 18.8	8.0	mA/V←
Negative control-grid current				
at $V_a = 120V$, $V_g = -2V$, $R_g = 100k\Omega$	—	<0.2	1.0	μA

INSULATION

	Initial range	End of life*	
Between heater and cathode measured at $V_{h-k} = 200V$ (cathode positive) $R_{lim} = 1M\Omega$ Leakage current	<15	30	μA
Between any two electrodes measured at 300V	>100	20	$M\Omega$

*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.	300	V
p_a max.	4.5	W
$p_{a'} + p_{a''}$ max.	8.0	W
$-V_g$ max.	100	V
$+V_g$ max.	1.0	V
*$-v_{g(pk)}$ max.	200	V
*$+v_{g(pk)}$ max.	30	V
I_g max.	8.0	mA
*$i_{g(pk)}$ max.	200	mA
I_k max.	60	mA
*$i_{k(pk)}$ max.	400	mA
R_{g-k} max. (fixed bias)	500	$k\Omega$
R_{g-k} max. (self bias)	1.0	$M\Omega$
V_{h-k} max.	120	V
$v_{h-k(pk)}$ max.	200	V
T_{bulb} max.	160	°C

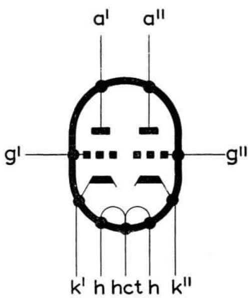
*Duty factor = 1%, max pulse duration = 10μs.

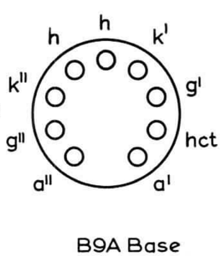
SPECIAL QUALITY
DOUBLE TRIODE

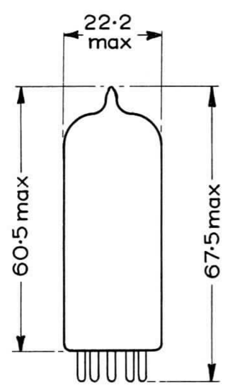
E182CC

OPERATING NOTE

The E182CC is not intended for applications which are critical with regard to microphony or hum.



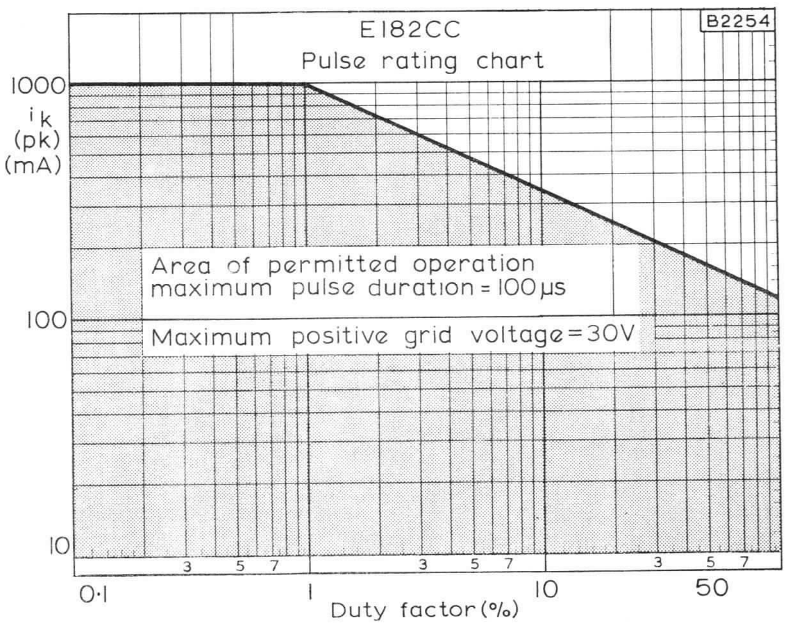




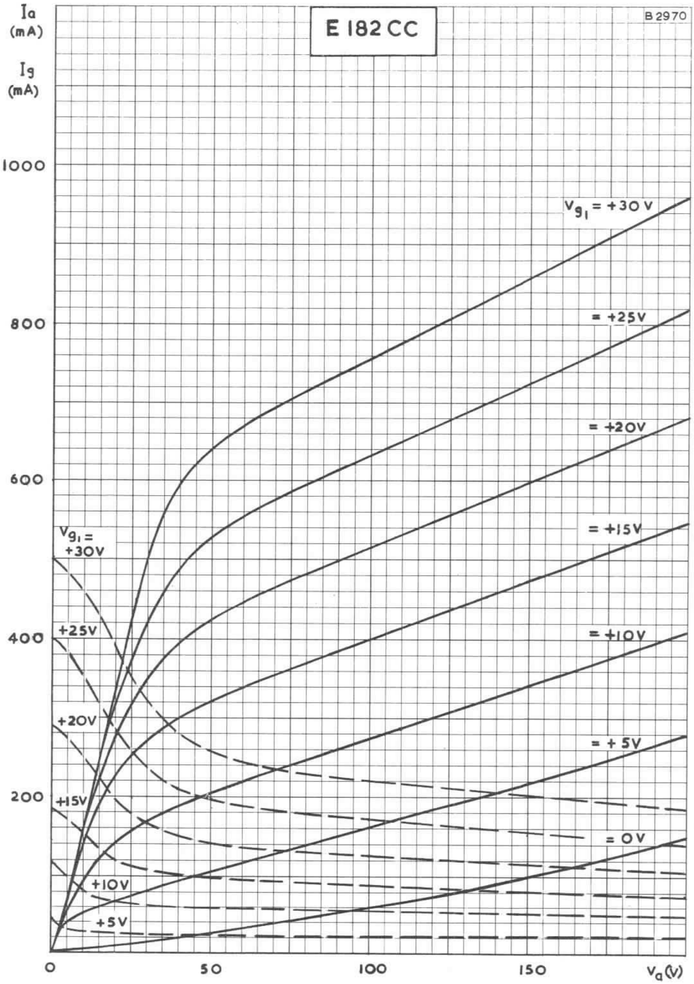
5032

All dimensions in mm

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



PULSE RATING CHART



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER.

GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY PENTODE

E186F

Special quality high slope pentode for use as a wide band amplifier 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

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

V_h[1]	6.3	V
I_h	320	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 20mA$.

CAPACITANCES[2] (shielded)

c_{a-g1} max.	30	mpF
c_{in}	7 6	pF
c_{out}	3·45	pF

CHARACTERISTICS[3]

V_a	180	V
V_{g3}	0	V
V_{g2}	150	V
V_{g1}	−1.25	V
I_a	13	mA
I_{g2}	3.3	mA
g_m	16.5	mA/V
μ_{g1-g2}	53	
r_a	100	kΩ
$-V_{g1}$ max. ($I_{g1} = +0.3\mu A$)	0.5	V

OPERATING CONDITIONS AS R.F. AMPLIFIER

V_{a-e}	180	190	V
V_{g3-k}	0	0	V
V_{g2-e}	150	160	V
V_{g1-e}	0	+9.0	V
R_k	100†	630	Ω
I_a	11.5	13	mA
I_{g2}	2.9	3.3	mA
g_m	15.9	16.5	mA/V
R_{eq} (r.f.)	—	330	Ω

†Recommended minimum value for $V_{g2-e} = 150V$.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of life**	
Anode current	13	12.2 to 13.8	> 11.5	mA
V_{a-e} = 190V, V_{g2-e} = 160V, V_{g1-e} = +9V, R_k = 630Ω				
Anode Current	—	< 0.8	—	mA
V_{a-k} = 180V, V_{g2-k} = 150V, V_{g1} = −4.5V				
Screen-grid current	3.3	2.9 to 3.7	—	mA
V_{a-e} = 190V, V_{g2-e} = 160V V_{g1-e} = +9V, R_k = 630Ω				
Mutual conductance	16.5	14.2 to 18.8	> 11	mA/V
V_{a-e} = 190V, V_{g2-e} = 160V, V_{g1-e} = +9V, R_k = 630Ω				
Negative control-grid current	—	< 0.2	< 0.5	μA
V_{a-e} = 190V, V_{g1-e} = +9V, V_{g2-e} = 160V, R_k = 630Ω, R_{g1-k} = 100kΩ				
Insulation resistance	—	> 100	> 50	MΩ
anode to all other electrodes $V_{d.c.}$ 300V				
grid to all other electrodes $V_{d.c.}$ 100V	—	> 100	> 50	MΩ
Heater-cathode insulation (I_{h-k})	—	< 10	< 20	μA
V_{h-k} = 100V				
Heater current	320	300 to 340	300 to 340	mA
V_h = 6.3V				

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

SHOCK AND VIBRATION RATINGS

The E186F can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 500g.

ABSOLUTE MAXIMUM RATINGS[4]

$V_{a(b)}$ max.	400	V
V_a max.	210	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	400	V
V_{g2} max.	175	V
p_{g2} max.	700	mW
$+V_{g1}$ max.	0	V
$-V_{g1}$ max.	50	V
$-v_{g1(pk)}$ max.	100	V
I_k max.	25	mA
R_{g1-k} max.	250	kΩ
V_{h-k} max.	60	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	165	°C
V_h max.	6.6	V
V_h min.	6.0	V

OPERATING NOTES

1. Hum

The hum voltage referred to g_1 has a maximum value of 100μV and is measured with the centre tap of the heater winding earthed, a supply frequency of 50c/s (including 3% at 500c/s) and a linear band-pass characteristic under the following conditions:

V_h	6.3	V
V_b	207	V
V_{g3}	0	V
V_{g2-e}	150	V
R_a	2.0	kΩ
R_k	78	Ω
C_k	1000	μF
R_{g1-k}	500	kΩ

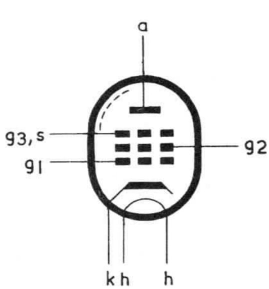
2. Microphony

The microphonic noise voltage measured at the anode has a maximum value of 500mV over the frequency range 50 to 2000c/s and has a maximum value of 200mV at a frequency of 50c/s measured under the following conditions:

V_h	6.3	V
V_b	216	V
V_{g3}	0	V
V_{g2-e}	160	V
V_{g1-e}	+9.0	V
R_a	2.0	kΩ
R_k	630	Ω
peak acceleration	10	g

E186F

SPECIAL QUALITY PENTODE



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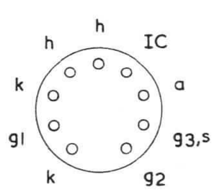
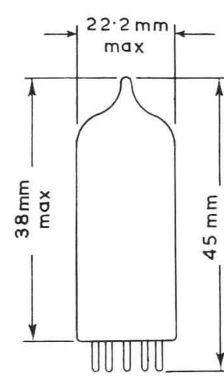
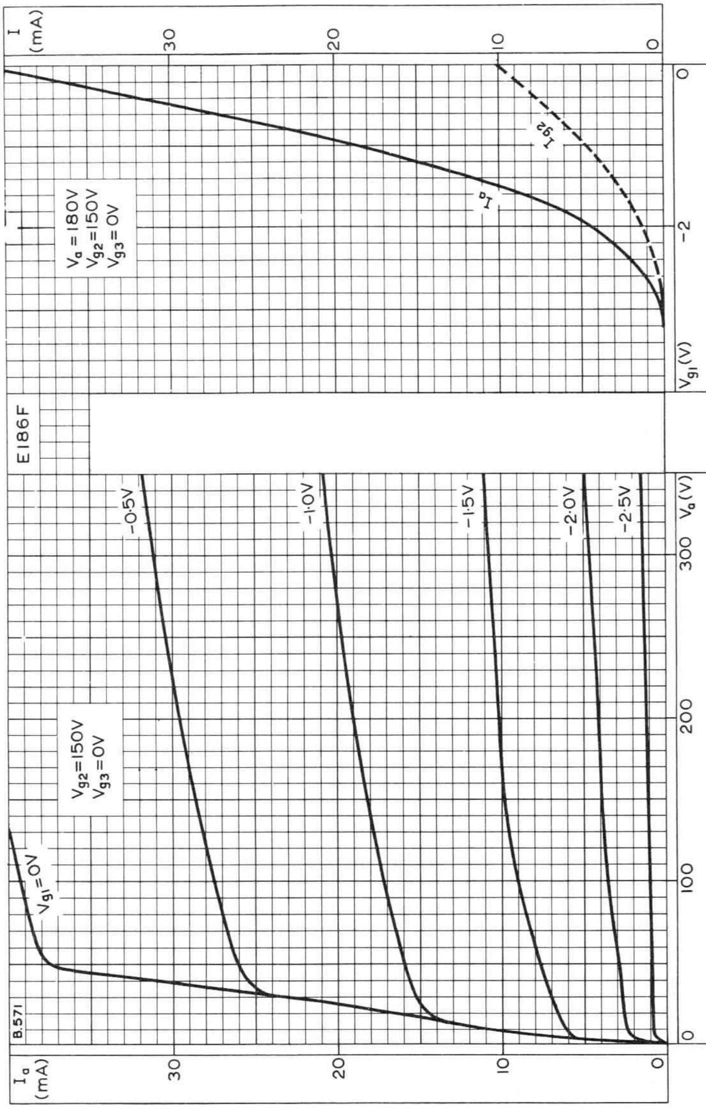


B9A Base





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

ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

SPECIAL QUALITY DOUBLE TRIODE

E188CC

Special quality double triode with separate cathodes, for use as a cascode amplifier and in pulse circuits, 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

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

V_h[1]	6.3	V
I_h	335	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 17mA$.

CAPACITANCES[2] (unshielded)

	Minimum	*Average*	*Maximum*	
$*c_{a-g}$	1.2	1.4	1.6	pF
$*c_{a-k}$	140	180	220	mpF
$*c_{a-s}$	1.1	1.3	1.5	pF
$c_{a'-k'+h+s}$	1.55	1.75	1.95	pF
$c_{a''-k''+h+s}$	1.45	1.66	1.85	pF
$c_{a'-k'+h}$	0.4	0.5	0.6	pF
$c_{a''-k''+h}$	0.3	0.4	0.5	pF
$*c_{g-k+h+s}$	2.7	3.3	3.9	pF
$*c_{g-k+h}$	2.7	3.3	3.9	pF
$c_{a'-a''}$	—	25	45	mpF
$c_{g'-g''}$	—	—	5.0	mpF
$c_{a'-g''}$	—	—	5.0	mpF
$c_{a''-g'}$	—	—	5.0	mpF
$c_{g'-k''}$	—	—	5.0	mpF
$c_{g''-k'}$	—	—	5.0	mpF
$c_{k'-h}$	—	2.6	—	pF
$c_{k''-h}$	—	2.7	—	pF

Grounded-grid operation

	Minimum	*Average*	*Maximum*	
$c_{a'-g'+h+s}$	2.7	3.0	3.3	pF
$c_{a''-g''+h+s}$	2.6	2.9	3.2	pF
$*c_{k-g+h+s}$	5.1	6.9	6.9	pF

*each section

CHARACTERISTICS[3] (each section)

V_a	90	V
I_a	15	mA
V_g	−1.2	V
g_m	12.5	mA/V
μ	33	

E188CC SPECIAL QUALITY DOUBLE TRIODE

OPERATING CONDITIONS AS R.F. AMPLIFIER (each section)

V_{a-e}	90	100	V
V_{g-e}	0	+9.0	V
R_k	120†	680	Ω
I_a	12	15	mA
g_m	11.5	12.5	mA/V
R_{eq} (r.f.)	—	300	Ω
r_{g1} (f = 50Mc/s)	—	6.0	kΩ
N.F. (f = 200Mc/s)	—	4.6	dB

†Recommended minimum value for V_{a-e} = 90V.

OPERATING CONDITIONS AS ADDITIVE MIXER

$V_{a(b)}$	60	90	150	V
R_a	0	1.0	3.9	kΩ
R_{g-k}	1.0	1.0	1.0	MΩ
$V_{osc(r.m.s.)}$	2.0	2.5	3.0	V
I_a	4.7	7.7	11	mA
g_c	2.9	3.5	4.1	mA/V
r_a	8.3	7.0	6.1	kΩ

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of Life**	
Anode current $V_{a(b)}$ = 100V, $V_{g(b)}$ = +9V, R_k = 680Ω	15	14.2 to 15.8	> 13.5	mA
Anode current $V_{a(b)}$ = 150V, V_g = −15V	—	< 5.0	—	μA
Mutual conductance $V_{a(b)}$ = 100V, $V_{g(b)}$ = +9V, R_k = 680Ω	12.5	10.5 to 14.5	> 9.0	mA/V
Negative grid current $V_{a(b)}$ = 100V, $V_{g(b)}$ = +9V, R_k = 680Ω, R_{g-k} = 1MΩ	—	< 0.1	< 1.0	μA
Insulation resistance between any two electrodes $V_{d.c.}$ = 200V	—	> 100	> 20	MΩ
Heater-cathode insulation (I_{h-k}) V_{h-k} (k positive = 120V) (k negative = 60V)	—	< 6.0	< 12	μA
Heater current V_h = 6.3V	335	318 to 352	318 to 352	mA

*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.

SHOCK AND VIBRATION

The E188CC can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 500g.

ABSOLUTE MAXIMUM RATINGS[4] (each section)

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.65	W
p_a max. ($p_{a'+pa''} \leq 2.2$W)	2.0	W
$p_{a'+pa''}$ max.	3.3	W
p_g max.	30	mW
$-V_g$ max.	110	V
*$-v_{g(pk)}$ max.	200	V
I_k max.	22	mA
$i_{k(pk)}$ max.	110	mA
V_{h-k} max. (k positive)	150	V
V_{h-k} max. (k negative)	100	V
R_{g-k} max.	500	kΩ
T_{bulb} max.	165	°C
V_h max.	6.6	V
V_h min.	6.0	V

*Maximum duty factor 0.1, maximum pulse duration = 200μs.

OPERATING NOTES

1. Hum

The hum voltage referred to g has a maximum value of 50μV and is measured with the centre tap of the heater earthed, at a supply frequency of 50c/s (including 3% at 500c/s), with a fully screened valve holder and a straight response curve filter under the following conditions:

V_b	90	V
I_a	15	mA
R_k	80	Ω
C_k	1000	μF
R_{g-k}	500	kΩ

2. Microphony

The microphonic noise voltage measured at the anode has a maximum value of 100mV over the frequency range 10 to 50c/s under the following conditions:

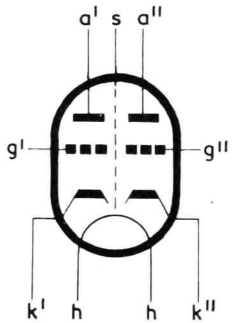
V_h	6.3	V
V_b	100	V
$V_{g(b)}$	+9.0	V
R_a	2.0	kΩ
R_k	680	Ω
C_k	1000	μF
Peak acceleration	2.5	g

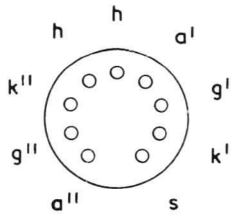
E188CC SPECIAL QUALITY DOUBLE TRIODE

The microphonic noise voltage measured at the anode has a maximum value of 140mV over the frequency range 50 to 5000c/s under the following conditions:

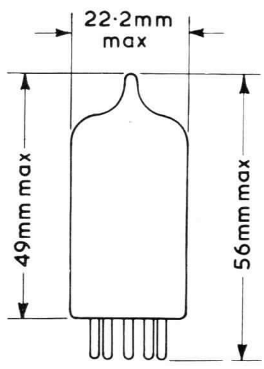
V_h	6.3	V
V_b	270	V
R_a	18	kΩ
R_{g-k}	1.0	MΩ
R_k	180	Ω
C_k	50	μF
Peak acceleration	0.5	g

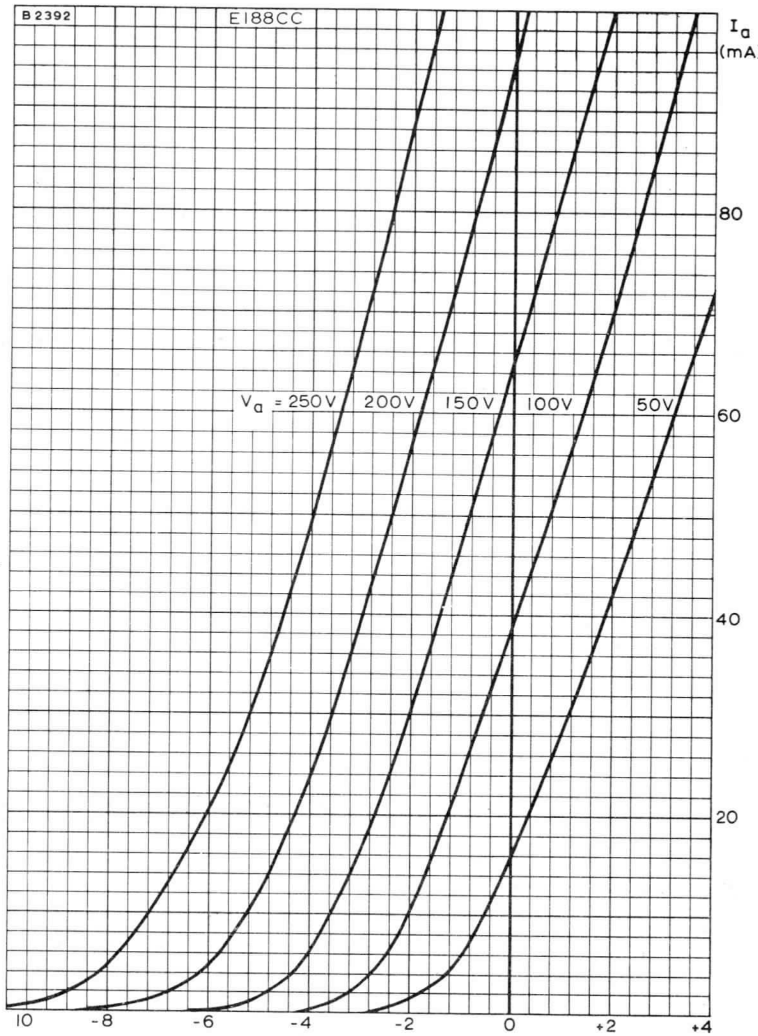
B560





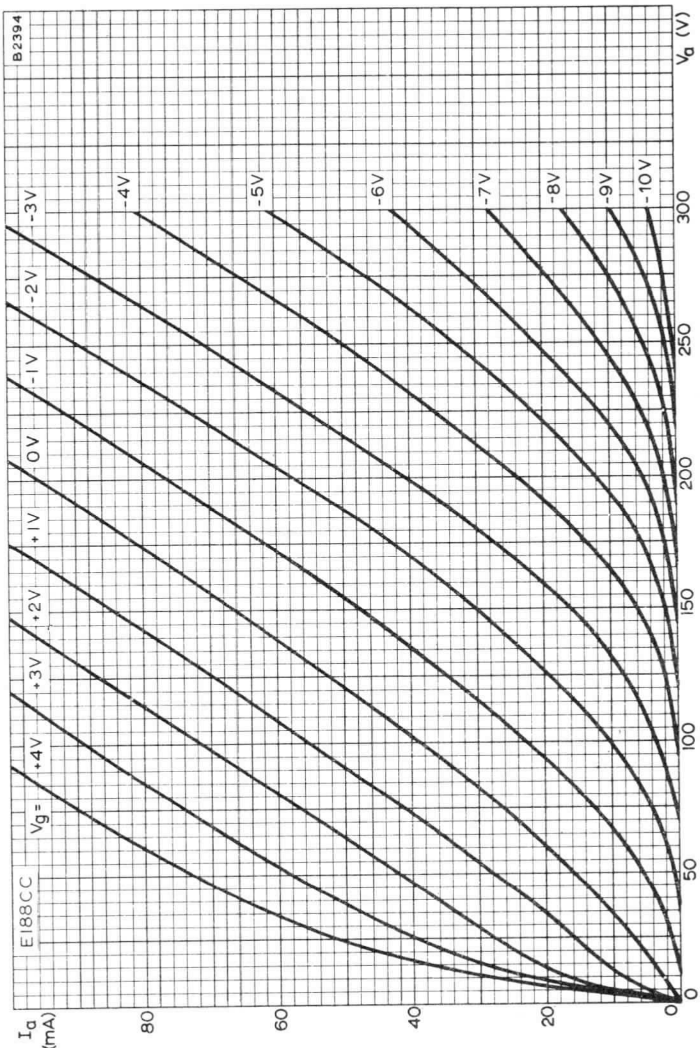
B9A Base



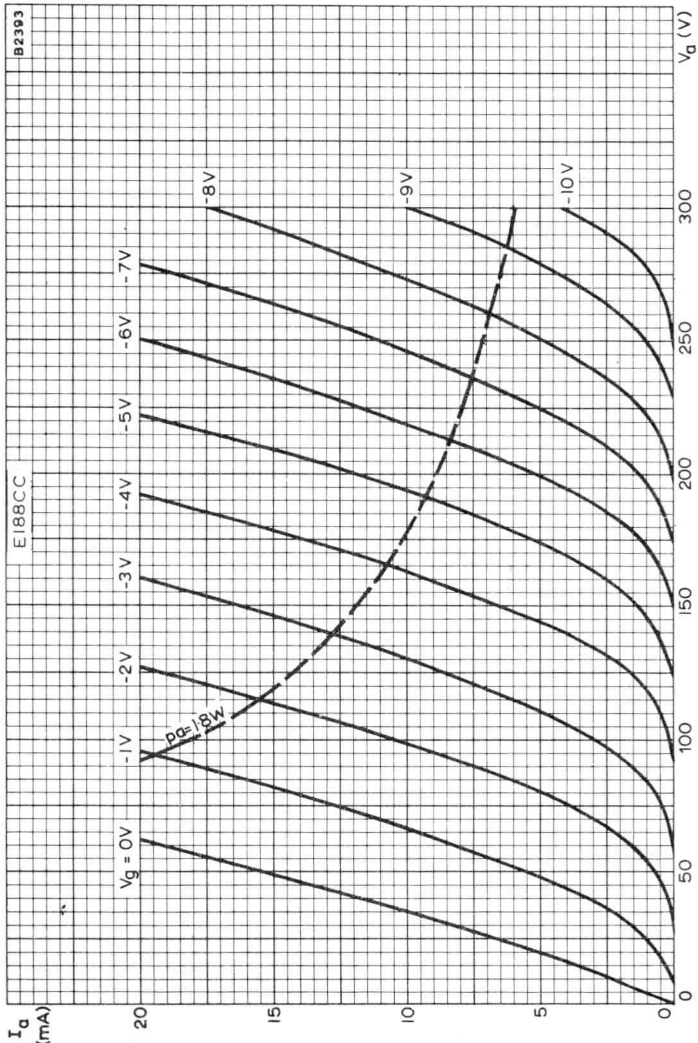


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER

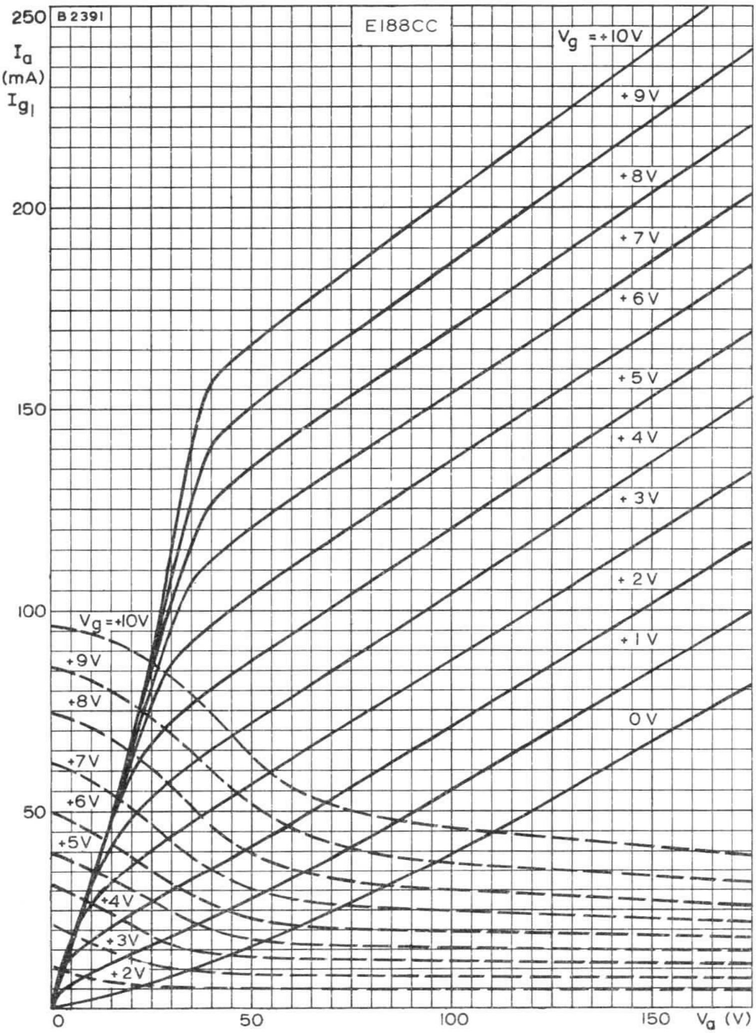
E188CC SPECIAL QUALITY DOUBLE TRIODE



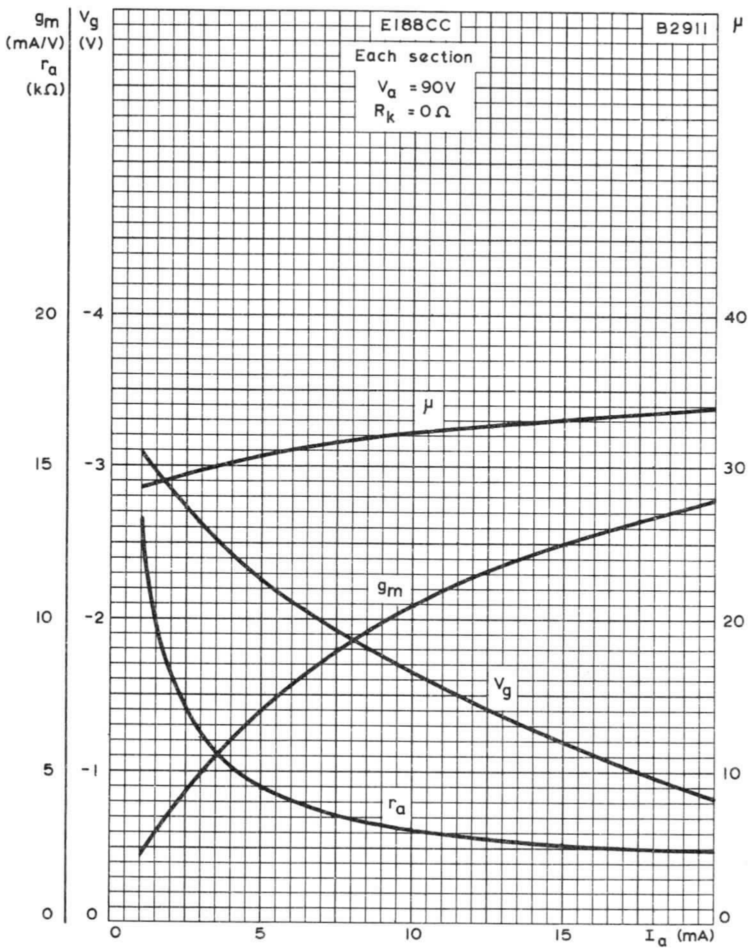
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



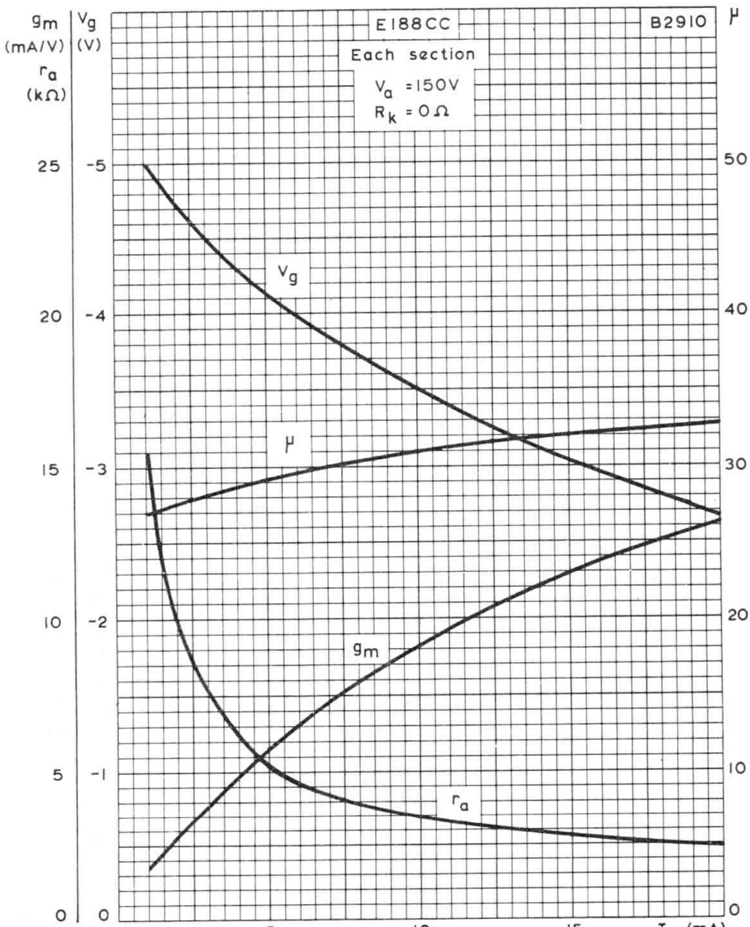
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER IN THE REGION OF THE ORIGIN.



ANODE AND GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH POSITIVE GRID VOLTAGE AS PARAMETER



AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. Va = 90V



AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. Va = 150V

SPECIAL QUALITY PENTODE

E280F

Special quality high slope pentode for use as a wideband amplifier 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

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

V_h[1]	6.3	V
I_h	315	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 16mA$.

CAPACITANCES[2]

	Minimum	*Average*	*Maximum*	
Unshielded				
c_{a-g1}	—	—	35	mpF
c_{in}	8.3	9.3	10.3	pF
$c_{in(w)}$ ($I_k = 26mA$)	—	15.5	—	pF
c_{out}	2.3	2.6	2.9	pF
Shielded				
c_{a-g1}	—	—	30	mpF
c_{in}	8.4	9.4	10.4	pF
$c_{in(w)}$ ($I_k = 26mA$)	—	15.6	—	pF
c_{out}	3.2	3.6	4.0	pF

CHARACTERISTICS[3]

Pentode connected

V_a	180	V
V_{g3}	0	V
V_{g2}	150	V
V_{g1}	−1.6	V
I_a	20	mA
I_{g2}	6.0	mA
g_m	26	mA/V
μ_{g1-g2}	60	
r_a	100	kΩ

Triode connected

(g_2 to a, g_3 to k)

V_a	150	V
V_{g1}	−1.8	V
I_a	24.5	mA
g_m	33	mA/V
r_a	1.8	kΩ

E280F

SPECIAL QUALITY PENTODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of Life**	
Anode current	20	18.8 to 21.2	$>$ 17	mA
$V_{a-e} = 190V$, $V_{g2-e} = 160V$, $V_{g1-e} = +8V$, $R_k = 370\Omega$				
Screen-grid current	6.0	5.3 to 6.7	—	mA
$V_{a-e} = 190V$, $V_{g2-e} = 160V$, $V_{g1-e} = +8V$, $R_k = 370\Omega$				
Mutual conductance	26	22 to 30	$>$ 17.5	mA/V
$V_{a-e} = 190V$, $V_{g2-e} = 160V$, $V_{g1-e} = +8V$, $R_k = 370\Omega$				
Negative control-grid current	—	$<$ 0.3	$<$ 1.0	µA
$V_{a-e} = 190V$, $V_{g2-e} = 160V$, $V_{g1-e} = +8V$, $R_k = 370\Omega$				

*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.

OPERATING CONDITIONS AS R.F. AMPLIFIER (pentode connected)

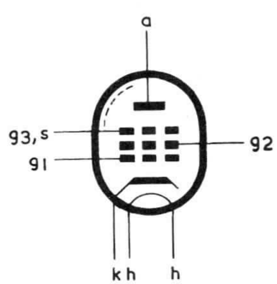
V_{a-e}		190		190	190	V
V_{g3}		0		0	0	V
V_{g2-e}		160		160	120	V
V_{g1-e}		+8.0		+9.0	+8.0	V
R_k	370	500	780	630	730	Ω
I_a	20	15	10	13.5	10	mA
I_{g2}	6.0	4.5	3.0	4.0	2.8	mA
g_m	26	23	19	22	20	mA/V
μ_{g1-g2}	60	58	56	58	56	
r_a	100	120	155	130	155	kΩ
*r_{g1} (f = 100Mc/s)	1.4	1.5	1.7	1.6	1.6	kΩ
R_{eq}	220	230	250	240	220	Ω
**$c_{in(w)}$	15.5	15	14.3	14.8	14.8	pF
†GB	180	162	138	156	142	Mc/s

*Pins 1 and 3 strapped together.
**Measured without external shield. ←

†Gain bandwidth product $= \dfrac{g_m}{2\pi(c_{in(w)} + c_{out} + 5pF)}$

ABSOLUTE MAXIMUM RATINGS[4]

$V_{a(b)}$ max.	400	V
V_a max.	220	V
p_a max.	4.0	W
$V_{g2(b)}$ max.	400	V
V_{g2} max.	180	V
p_{g2} max.	1.1	W
$-V_{g1}$ max.	50	V
$+V_{g1}$ max.	2.0	V
I_{g1} max.	5.0	mA
I_k max.	30	mA
R_{g1-k} max.	500	kΩ
V_{h-k} (k positive) max.	120	V
V_{h-k} (k negative) max.	60	V
T_{bulb} max.	180	°C
V_h max.	6.6	V
V_h min.	6.0	V



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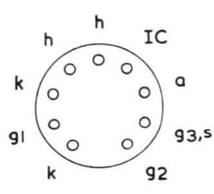
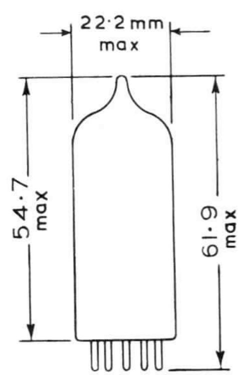


B9A Base



SPECIAL QUALITY TRIODE

E288CC

Special quality double triode with separate cathodes, for use as a cascode amplifier and in pulse circuits, where stability of characteristics and long life are required.

PRELIMINARY DATA

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, a.c. or d.c.

V_h[1]	6.3	V
I_h	475	mA

CAPACITANCES[2] (measured without external shield)

*c_{a-g}	1.8	pF
$c_{a'-k'+h+s}$	1.9	pF
$c_{a''-k''+h+s}$	1.8	pF
*$c_{g-k+h+s}$	4.7	pF
$c_{a'-g'+h+s}$	3.5	pF
$c_{a''-g''+h+s}$	3.4	pF
*c_{a-k}	250	mpF
*$c_{k-g+h+s}$	7.8	pF
$c_{a'-a''}$	$<$ 50	mpF
$c_{g'-g''}$	$<$ 5.0	mpF

*each section.

CHARACTERISTICS[3] (each section)

V_a	60	90	V
I_a	15	30	mA
V_g	−1.2	−1.5	V
g_m	14	18	mA/V
μ	25	25	
r_a	1.85	1.4	kΩ

OPERATING CONDITIONS AS R.F. AMPLIFIER (each section)

V_{a-e}	60	100	V
V_{g-e}	0	+9.0	V
R_k	80	350	Ω
I_a	15	30	mA
g_m	14	18	mA/V
R_{eq} (r.f.)	—	200	Ω
N.F. (f = 200Mc/s)	5.0	5.7	dB

E288CC

SPECIAL QUALITY TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	
Anode current $V_{a-e} = 100V$, $V_{g-e} = +9V$ $R_k = 350\Omega$	30	28 to 32	mA
Mutual conductance $V_{a-e} = 100V$, $V_{g-e} = +9V$ $R_k = 350\Omega$	18	15 to 21.5	mA/V
Negative grid current $V_{a-e} = 100V$, $V_{g-e} = +9V$ $R_k = 350\Omega$	—	< 0.3	μA

SHOCK AND VIBRATION

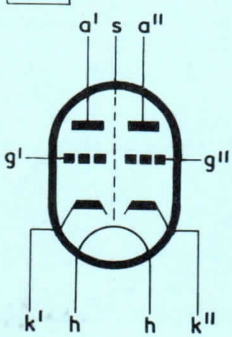
The E288CC can withstand vibrations of 2.5g and 50c/s for 96 hours, and is proof against impact accelerations of approximately 500g.

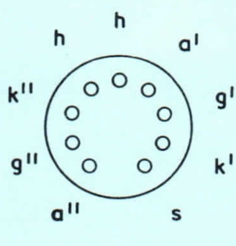
ABSOLUTE MAXIMUM RATINGS[4] (each section)

$V_{a(b)}$ max.	450	V
V_a max.	250	V
p_a max.	3.0	W
I_k max.	40	mA
$*i_{k(pk)}$ max.	400	mA
$-V_g$ max.	50	V
$*-v_{g(pk)}$ max.	150	V
R_{g-k} max.	500	kΩ
V_{h-k} max.	150	V
T_{bulb} max.	190	°C
V_h max.	6.6	V
V_h min.	6.0	V

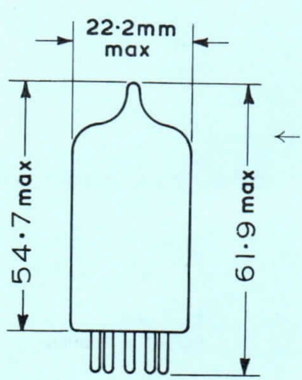
*Maximum duty factor 0.01, maximum pulse duration 10μs.

B1606





B9A Base



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

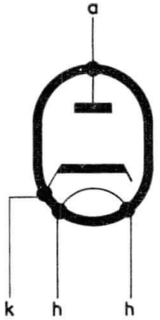
In operation this valve may become very hot and therefore, in the interests of long life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis.

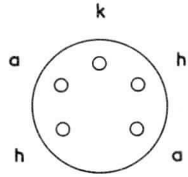
CAPACITANCES

	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

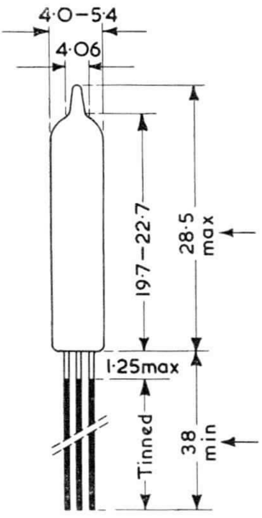
LIMITING VALUES

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



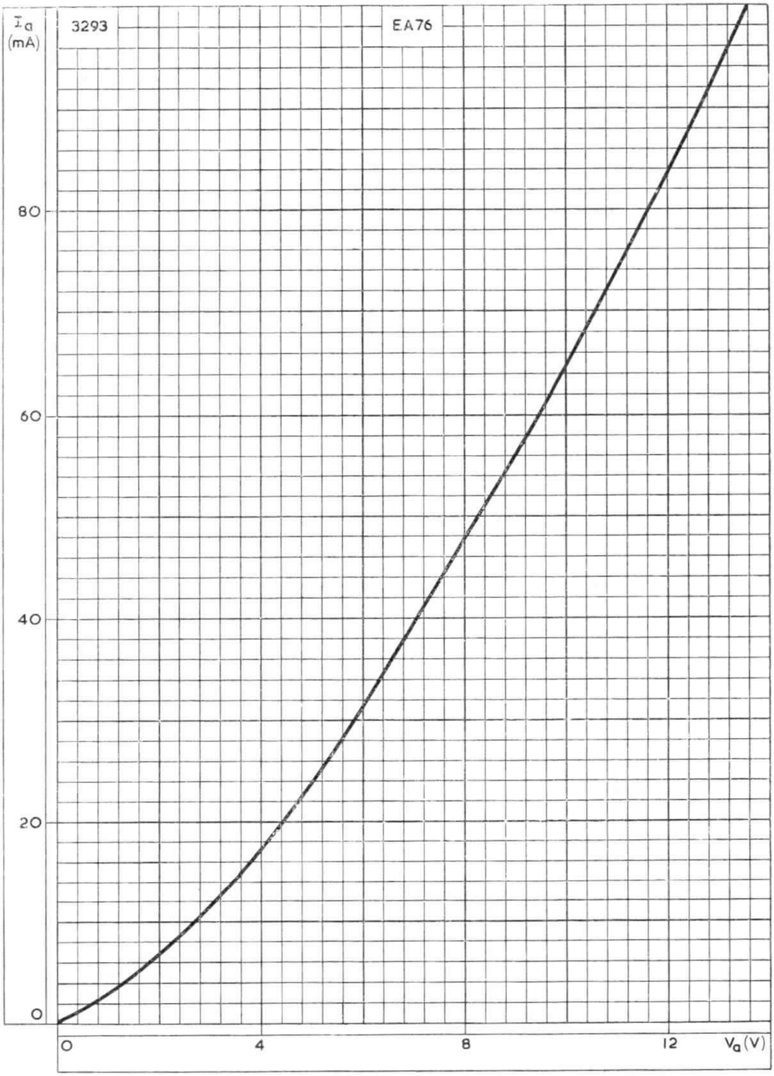
3274

All dimensions in mm

EA76

SUBMINIATURE SINGLE DIODE

Indirectly-heated subminiature diode with 6.3V heater.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SINGLE DIODE R.F. PENTODE

EAF42

Single diode R.F. pentode for use in A.C. mains operated equipment. The pentode section is suitable for automatic volume control.

HEATER

V_h	6.3	V
I_h	0.2	A

MOUNTING POSITION

Any

CAPACITANCES

c_{ad-g1}	<0.0015	μμF
c_{ad-ap}	<0.15	μμF
Pentode Section		
c_{a-g1}	<0.002	μμF
c_{out}	5.1	μμF
c_{in}	4.5	μμF
c_{g1-h}	<0.05	μμF
Diode Section		
c_{ad-k}	3.8	μμF
c_{ad-h}	<0.02	μμF

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

$V_a = V_b$	250	V
R_{g2}	110	kΩ
V_{g2}	85	V
R_k	310	Ω
V_{g1}	−2.0	V
I_a	5.0	mA
I_{g2}	1.5	mA
g_m	2.0	mA/V
r_a	1.4	MΩ
μ_{g1-g2}	18	
*V_{g1}	−43	V
R_{eq}	7.5	kΩ

* For 100 : 1 reduction in mutual conductance.

LIMITING VALUES

Pentode Section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_a < 2.5$ mA)	300	V
V_{g2} max. ($I_a = 5.0$ mA)	150	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} max. ($I_{g1} = +0.3$ μA)	−1.3	V
R_{g1-k} max.	3.0	MΩ
*R_{g3-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V

* For $v_{g3(pk)}$ not exceeding +10 V.

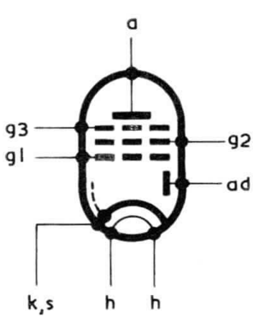
EAF42

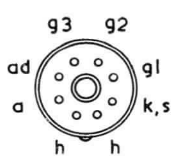
SINGLE DIODE R.F. PENTODE

Single diode R.F. pentode for use in A.C. mains operated equipment. The pentode section is suitable for automatic volume control.

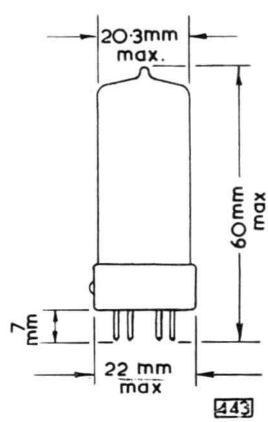
Diode Section

$v_{ad(pk)}$ max.	200	V
I_{ad} max.	0.8	mA
V_{ad} max. ($I_{ad} = +0.3\ \mu A$)	−1.3	V
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V





B8A BASE



DOUBLE DIODE TRIODE

EBC33

Medium gain triode for use as A.F. voltage amplifier and combined with twin diodes.

HEATER

This valve is suitable for DC/AC operation.

V_h	6.3	V
I_h	0.2	A

CAPACITANCES

$c_{ad'-k}$	2.6	μμF
$c_{ad''-k}$	3.2	μμF
$c_{ad'-ad''}$	<0.7	μμF
$c_{ad'-g}$	<0.001	μμF
$c_{ad''-g}$	<0.005	μμF

CHARACTERISTICS

V_a	100	200	250	V
I_a	2	4	5	mA
V_g	−2.1	−4.3	−5.5	V
μ	30	30	30	
g_m	1.6	2.0	2.0	mA/V
r_a	19	15	15	kΩ

OPERATING CONDITIONS AS RESISTANCE-COUPLED A.F. 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)
300	47	2.8	1.2	19.5	45	5.8	150
250	47	2.3	1.2	19.0	34	5.5	150
200	47	1.8	1.2	18.5	26	5.2	150
100	47	0.5	4.7	13.0	8	10.0	150
300	100	1.5	2.2	22.0	49	5.2	330
250	100	1.27	2.2	22.0	41	5.2	330
200	100	1.0	2.2	21.5	31	5.0	330
100	100	0.32	6.8	16.5	14	10.0	330
300	220	0.83	3.9	23.5	52	4.8	680
250	220	0.69	3.9	23.5	41	4.6	680
200	220	0.53	3.9	23.0	31	4.5	680
100	220	0.2	10	19.0	20	10.0	680

*V_{out} < Output voltage at start of I_g or $D_{tot}=10\%$.
R_{g1} = Grid resistance of **following valve.

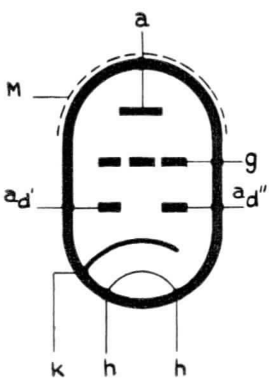
LIMITING VALUES

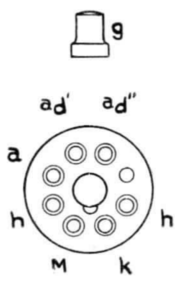
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.5	W
V_{ad} max.	200	V
I_{ad} max.	0.8	mA
I_k max.	10	mA
V_g max. ($I_g=0.3\mu$A)	−1.3	V
R_g max. (Self bias)	3.0	MΩ
R_g max. (Fixed bias)	1.0	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

EBC33

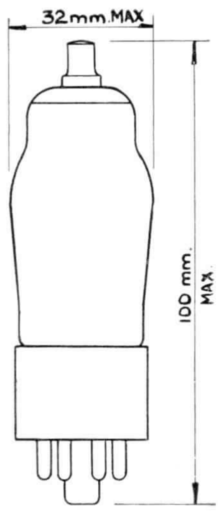
DOUBLE DIODE TRIODE

Medium gain triode for use as A.F. voltage amplifier and combined with twin diodes.





OCTAL BASE



DOUBLE DIODE TRIODE

EBC41

High gain triode for use as a.f. voltage amplifier, combined with twin diodes, for a.c. mains operation.

Except for capacitances, basing and dimensions, the EBC41 is identical to the EBC81.

CAPACITANCES

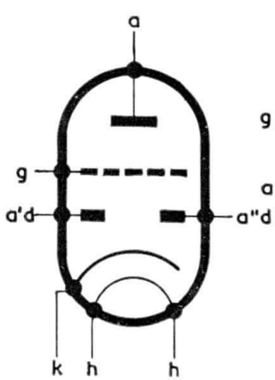
$c_{a'd-gt}$	<0.007	pF
$c_{a''d-gt}$	<0.03	pF
c_{ad-at}	<0.01	pF

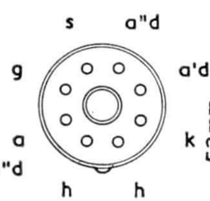
Triode section

c_{g-k}	2.75	pF
c_{a-k}	1.5	pF
c_{a-g}	1.3	pF
c_{g-h}	<0.05	pF

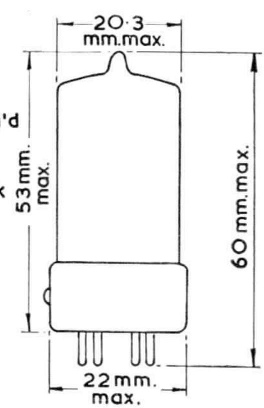
Diode sections

$c_{a'd-k}$	0.8	pF
$c_{a''d-k}$	0.7	pF
$c_{a'd-a''d}$	<0.3	pF
$c_{a'd-h}$	<0.1	pF
$c_{a''d-h}$	<0.05	pF





B8A BASE



633

DOUBLE DIODE PENTODE

EBF80

Double diode variable-mu pentode. The pentode section is suitable for use as an R.F., I.F., or A.F. amplifier.

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

$c_{a'd-g1}$	<0.0008	μμF
$c_{a''d-g1}$	<0.001	μμF
$c_{a'd-a}$	<0.2	μμF
$c_{a''d-a}$	<0.05	μμF

Pentode Section

c_{a-g1}	<0.0025	μμF
c_{out}	4.9	μμF
c_{in}	4.2	μμF
c_{g1-h}	<0.07	μμF

Diode Sections

$c_{a'd-k}$	2.2	μμF
$c_{a''d-k}$	2.35	μμF
$c_{a'd-a''d}$	<0.35	μμF
$c_{a'd-h}$	<0.02	μμF
$c_{a''d-h}$	<0.005	μμF

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

$V_a = V_b$	250	V
R_{g2}	95	kΩ
V_{g2}	85	V
V_{g3}	0	V
R_k	300	Ω
I_a	5.0	mA
I_{g2}	1.75	mA
V_{g1}	−2.0	V
g_m	2.2	mA/V
r_a	1.4	MΩ
μ_{g1-g2}	18	
R_{eq}	6.8	kΩ
V_{g1} for 100 : 1 reduction in g_m	−41.5	V

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_{g2} (MΩ)	I_{g2} (mA)	R_k (kΩ)	R_{g1} (MΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	R_{g1}** (kΩ)
250	220	0.75	0.82	0.25	1.8	1.0	110	19	680
250	100	1.5	0.39	0.5	1.0	1.0	80	18	330
250	220	0.71	1.0	0.22	0	10	160	19	680
250	100	1.4	0.47	0.45	0	10	110	19	330

*$D_{tot} = 5\%$

**Grid resistor of following valve

EBF80

DOUBLE DIODE PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an R.F., I.F., or A.F. amplifier.

OPERATING CONDITIONS AS TRIODE CONNECTED RESISTANCE COUPLED A.F. AMPLIFIER ←

g_2 connected to a, g_3 connected to k.

V_b (V)	R_a (k Ω)	I_a (mA)	R_k (Ω)	R_{g1} (M Ω)	$\frac{V_{out}}{V_{in}}$	D_{tot}* (%)	R_{g1}** (k Ω)
250	100	2.08	820	1.0	14	2.5	330
250	47	4.1	560	1.0	13	2.0	150
250	100	2.16	0	10	15	3.1	330
250	47	4.5	0	10	15	2.7	150

*V_{out} = 5 $V_{(r.m.s.)}$.

**Grid resistor of following valve.

LIMITING VALUES

Pentode Section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. (I_a < 2.5 mA)	300	V
V_{g2} max. (I_a = 5 mA)	125	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} max. (I_{g1} = +0.3μA)	−1.3	V
*R_{g1-k} max.	3.0	M Ω
R_{h-k} max.	20	k Ω
V_{h-k} max.	100	V

*R_{g1-k} max. = 22 M Ω if grid current biasing is employed.

Diode Sections (each section) ←

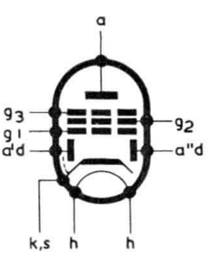
P.I.V.	350	V
I_{ad} max.	0.8	mA
$i_{ad(pk)}$ max.	5.0	mA
R_{h-k} max.	20	k Ω
V_{h-k} max.	100	V

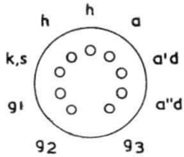
This valve can be used without special precautions against microphony if the input voltage, V_{in}, is not less than 25 mV for an output of 50 mW from the output valve.

DOUBLE DIODE PENTODE

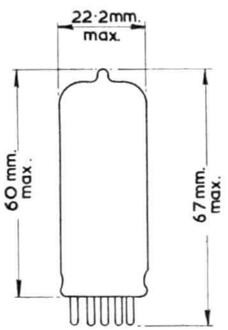
EBF80

Double diode variable-mu pentode. The pentode section is suitable for use as an R.F., I.F., or A.F. amplifier.





B9A (Noval) BASE

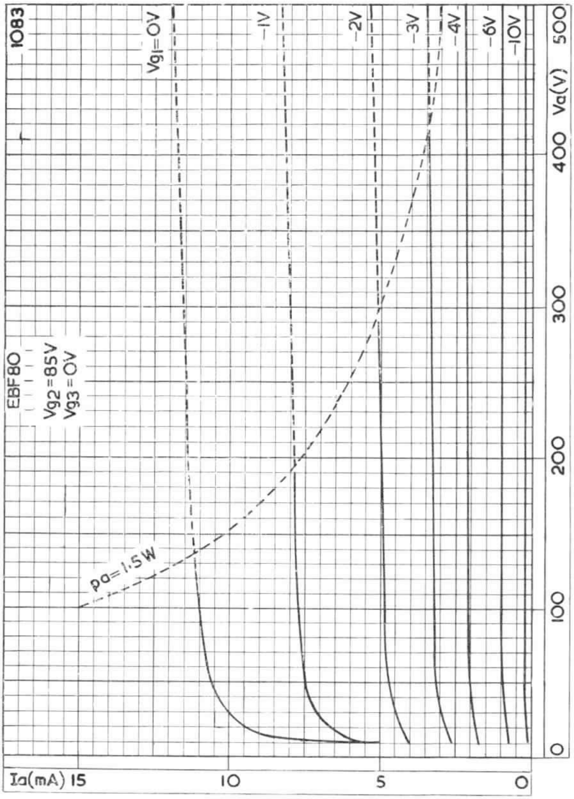


706

EBF80

DOUBLE DIODE PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an R.F., I.F., or A.F. amplifier.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL–GRID VOLTAGE AS PARAMETER

Frame-grid triode for use as grounded-grid amplifier or self-oscillating mixer in Bands IV and V.

HEATER

V_h	6.3	V
I_h	200	mA ←

CAPACITANCES ←

Unshielded

c_{a-g}	2.2	pF
c_{a-k}	240	mpF
c_{a-k+h}	350	mpF
c_{a-g+h}	2.3	pF
c_{g-k}	3.5	pF
c_{g-k} (I_a = 12mA)	5.6	pF
c_{g-k+h}	3.8	pF
c_{g-h}	270	mpF
c_{k-g+h}	6.3	pF

Shielded

$c_{h+k-g+s}$	4.1	pF
c_{a-g+s}	3.3	pF
c_{a-k+h}	300	mpF

CHARACTERISTICS

V_a	175	V
V_g	-1.5	V
I_a	12	mA
g_m	14	mA/V
r_a	4.85	kΩ
μ	68	
R_{eq}	230	Ω

OPERATING CONDITIONS

As grounded-grid amplifier

V_a	175	V
I_a	12	mA
R_k	125	Ω
g_m	14	mA/V

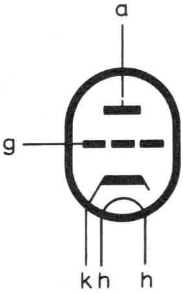
As self-oscillating mixer

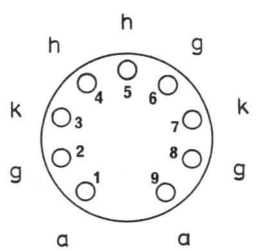
$V_{a\,(b)}$	220	V
R_a	5.6	kΩ
R_g	47	kΩ
I_a	12	mA
I_g	50	μA
v_{osc} (r.m.s.)	2.5	V
g_c	5.5	mA/V

DESIGN CENTRE RATINGS

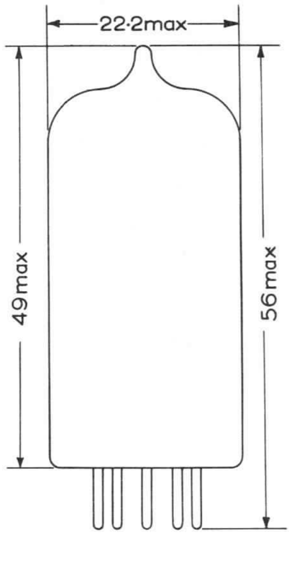
$V_{a\,(b)}$ max.	550	V
V_a max.	220	V
p_a max.	2.2	W
I_k max.	20	mA
$-V_g$ max.	50	V
R_{g-k} max.	1.0	MΩ
V_{h-k} max. (cathode positive)	100	V
V_{h-k} max. (cathode negative)	50	V

B4187





B9A Base



All dimensions in mm

U.H.F. TRIODE

Frame grid triode for use as a grounded-grid amplifier and mixer at frequencies up to 1000Mc/s.

EC88

HEATER

V_h	6.3	V
I_h	165	mA

CAPACITANCES (*measured with close fitting external shield connected to the grid*)

c_{a-g+S}	1.7	pF
c_{g-k}	3.3	pF
c_{a-k}	45	mpF
$c_{h-k-g+S}$	3.8	pF
c_{a-k+h}	55	mpF

CHARACTERISTICS

V_a	160	V
I_a	12.5	mA
V_g	−1.25	V
g_m	13.5	mA/V
r_a	4.8	kΩ
μ	65	
R_{eq}	240	Ω

OPERATING CONDITIONS AS AMPLIFIER $\left(\frac{\lambda}{4}\right.$ *trough line*$\left.\right)$

f	600	1000	Mc/s
V_b	200	200	V
R_a	3.3	3.3	kΩ
R_k	100	100	Ω
I_a	12.5	12.5	mA
g_m	13.5	13.5	mA/V
B	12	12	Mc/s
Power gain	18	17.5	dB
Noise factor (power matched)	9.0	12.5	dB

OPERATING CONDITIONS AS MIXER

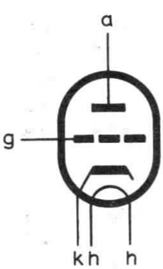
V_b	200	V
R_a	6.8	kΩ
I_a	9.0	mA
I_g	52	µA
$V_{osc(r.m.s.)}$	2.0	V
R_g	47	kΩ
g_c	5.4	mA/V
$g_{m(eff)}$	7.0	mA/V

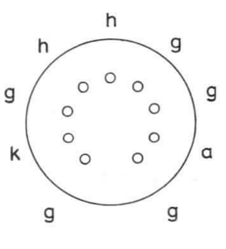
EC88

U.H.F. TRIODE

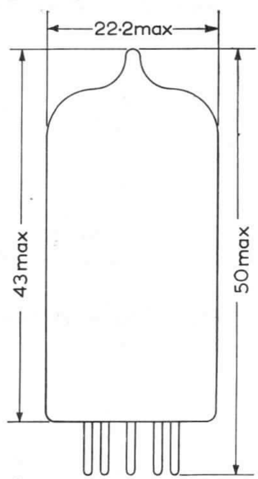
DESIGN CENTRE RATINGS

$V_{a(b)}$ max.	550	V
V_a max.	175	V
p_a max.	2.0	W
I_k max.	13	mA
$-V_g$ max.	50	V
R_{g-k} max.	1.0	MΩ
V_{h-k} max.	100	V





B9A Base



All dimensions in mm

8371

R.F. POWER TRIODE

EC90

Triode for use as r.f. power amplifier or oscillator.

HEATER

V_h	6.3	V
I_h	150	mA

CAPACITANCES ←

	Shielded	*Unshielded*	
c_{a-g}	1.3	1.4	pF
c_{in}	1.7	1.5	pF
c_{out}	2.6	1.2	pF

CHARACTERISTICS

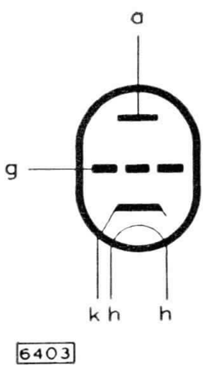
V_a	100	250	V
V_g	0	−8.5	V
I_a	11.8	10.5	mA
g_m	3.25	2.2	mA/V ←
μ	21.5	17	←
r_a	6.6	7.7	kΩ ←

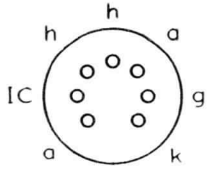
OPERATING CONDITIONS AS R.F. AMPLIFIER OR OSCILLATOR ←
(Class "C" Telegraphy or F.M.)

f	50	100	Mc/s
V_a	300	300	V
V_g	−27	−27	V
I_a	16.2	17.1	mA
I_g	3.8	2.9	mA
P_{out}	3.6	3.3	W
η	67	55	%

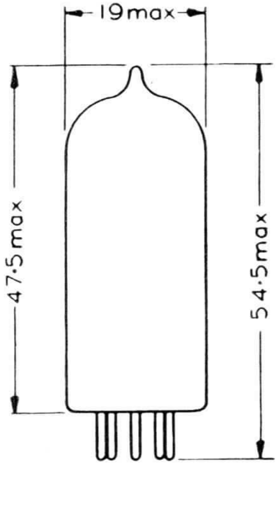
LIMITING VALUES ←

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.5	W
I_k max. (as r.f. oscillator or amplifier)	30	mA
I_k max. (as r.f. doubler or trebler)	20	mA
$-V_g$ max.	100	V
I_g max.	5.0	mA
R_{g-k} max.	250	kΩ
V_{h-k} max.	150	V
T_{bulb} max.	180	°C
f max.	150	Mc/s





B7G Base



6403

All dimensions in mm

GROUNDED GRID TRIODE

EC91

Grounded grid triode for use as an amplifier up to 250Mc/s.

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES ←

	*Shielded**	*Unshielded*	
c_{a-g}	3.4	2.6	pF
c_{a-k+h}	120	150	mpF
c_{g-k+h}	5.0	4.5	pF
c_{k-g+h}	7.5	7.0	pF

*External shield connected to grid.

CHARACTERISTICS

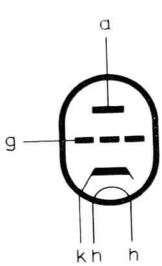
V_a	250	V
I_a	10	mA
V_g	−1.5	V
g_m	8.5	mA/V
μ	90	←
r_a	10.5	kΩ←
R_{eq}	400	Ω

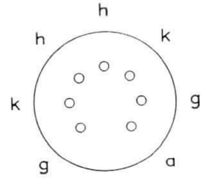
LIMITING VALUES

$V_{a(b)}$ max.	500	V←
V_a max.	250	V
p_a max.	2.5	W
$-V_g$ max.	100	V
I_k max.	15	mA
V_{h-k} max.	150	V
T_{bulb} max.	200	°C←

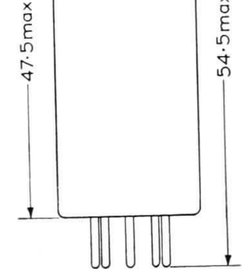
EC91

GROUNDED GRID TRIODE





B7G Base



All dimensions in mm

8665

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-a}	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.

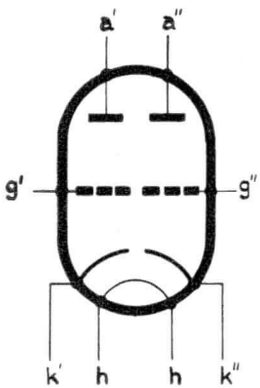
LIMITING VALUES (each section)

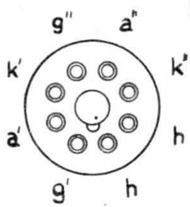
V_a max.	300	V
p_a max.	5	W
I_k max.	50	mA
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ

ECC32

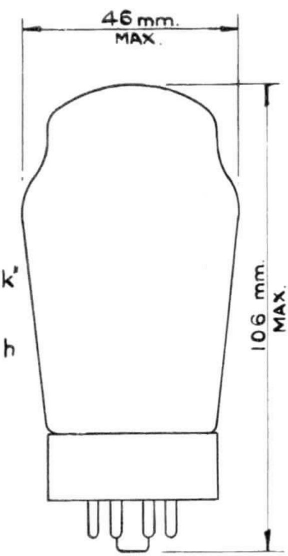
DOUBLE TRIODE

Double triode with separate cathodes for use as a paraphase A.F. amplifier and in phase inverters, multi-vibrators, etc.





OCTAL BASE



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

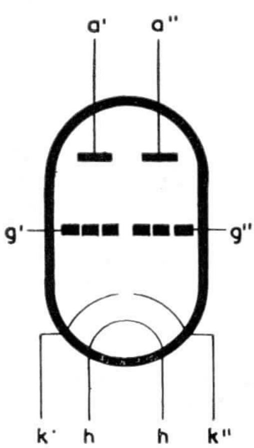
*Output voltage at the start of I_g. At output voltages lower than those shown the distortion is approximately proportional to voltage.

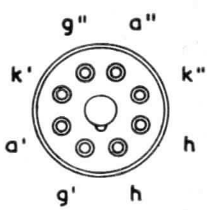
**Grid resistor of following valve.

ECC33

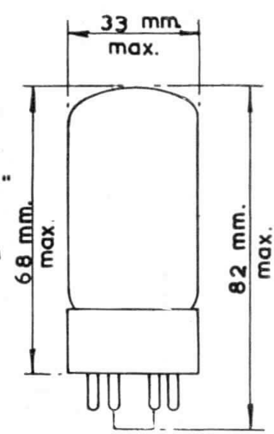
DOUBLE TRIODE

High slope, low impedance double triode with low heater consumption, primarily intended for use in flip-flop, scaling and computor circuits.





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	k Ω

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	M Ω
V_{h-k} max.	90	V

ECC35

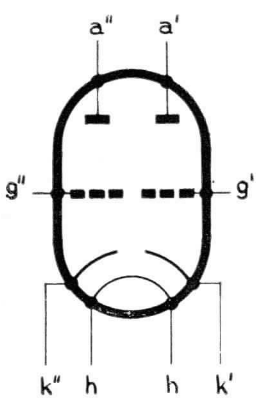
DOUBLE TRIODE

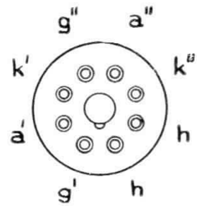
High-gain double triode with separate cathodes for use in paraphase A.F. voltage amplifiers.

OPERATING CONDITIONS AS R.C. COUPLED A.F. AMPLIFIER

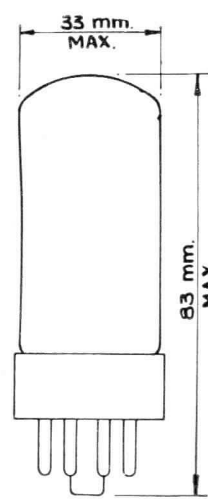
V_b (V)	R_a (k Ω)	I_a (mA)	R_k (k Ω)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	V_{out}† ($V_{r.m.s.}$)	D_{tot} (%)	R_{g1}‡ (k Ω)
400	100	1.3	2.7	40.5	37.5	66.2	10	330
350	100	1.1	2.7	40.5	32.2	57.0	10	330
300	100	1.0	2.7	40	28.0	48.7	10	330
250	100	0.8	2.7	40	23.2	41.1	10	330
200	100	0.65	2.7	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



DOUBLE TRIODE

ECC84

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers.

HEATER

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

V_h	6.3	V
I_h	330	mA

CAPACITANCES (measured without external shield)

$c_{a'-k'+h+g''}$	1.2	pF
$c_{a'-a''}$	<0.035	pF
$c_{g'-a''}$	<0.006	pF

Grounded cathode section

$c_{a'-g'}$	1.2	pF
$c_{in'}$	2.1	pF
$c_{out'}$	0.45	pF
$c_{g'-h}$	<0.25	pF

Grounded grid section

$c_{a''-g''}$	2.3	pF
$c_{a''-k''}$	0.16	pF
$c_{k''-g''+h}$	4.7	pF
$c_{a''-g''+h}$	2.5	pF
$c_{h-k''}$	2.7	pF

CHARACTERISTICS (each section)

V_a	90	V
I_a	12	mA
V_g	−1.5	V
g_m	6.0	mA/V
μ	24	
$^*R_{in}$	2.0	kΩ

*Measured at f = 200Mc/s with cathode connections pins 7 and 8 strapped.

ECC84

DOUBLE TRIODE

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers.

TYPICAL OPERATING CONDITIONS

V_b	250	V
R (see Fig. 1)	5.6	kΩ
I_a	12	mA
V_g	–1.5	V

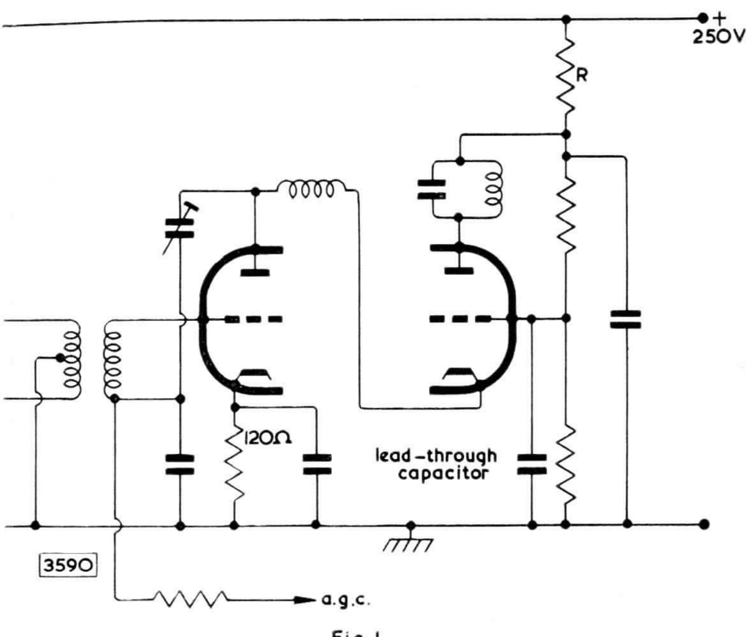


Fig 1

Noise figure (bandwidth of input circuit 7–8 Mc/s) 6.5

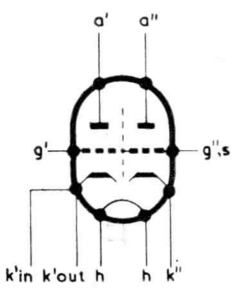
DOUBLE TRIODE

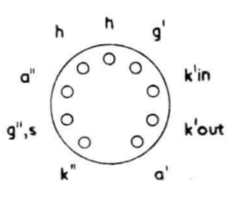
ECC84

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers.

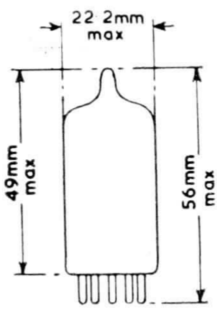
LIMITING VALUES (each section unless otherwise specified)

$V_{a(b)}$ max.	550	V
V_a max.	180	V
p_a max.	2.0	W
I_k max.	22	mA
$-V_g$ max.	50	V
$R_{g'-k'}$ max.	1.5	MΩ
$R_{g''-k''}$ max.	500	kΩ
$V_{h-k''}$ max. (cathode positive)	200	V
$V_{h-k'}$ max.	100	V
R_{h-k} max.	20	kΩ





B9A Base



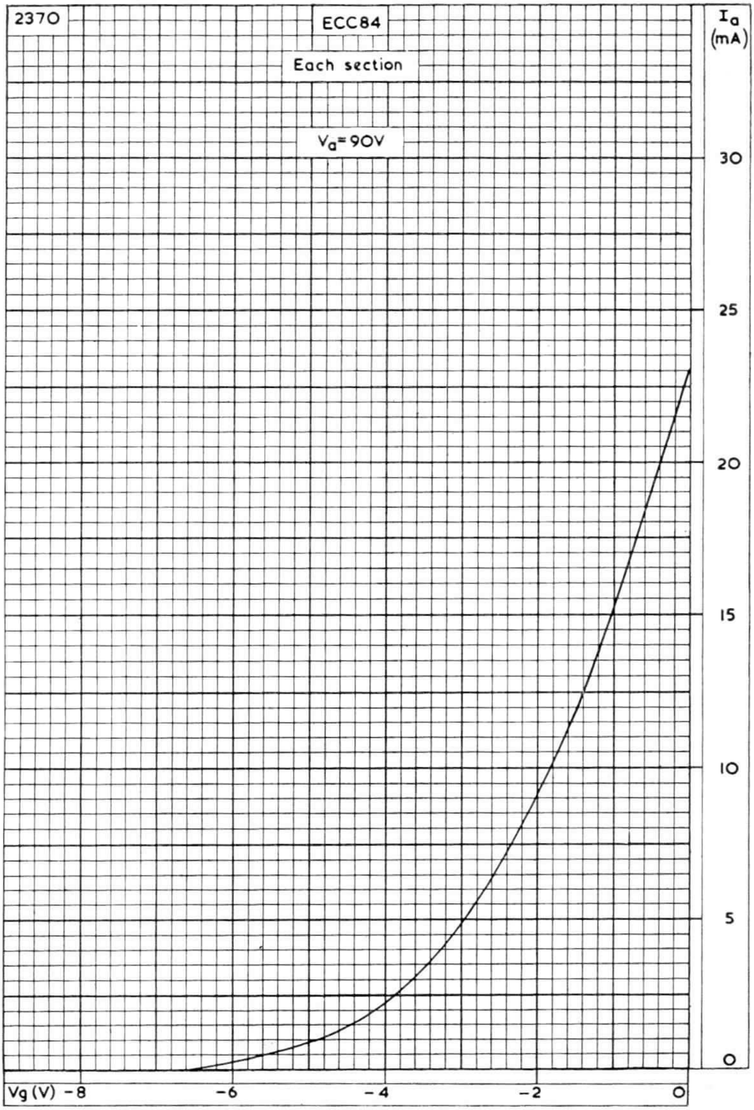
1390

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.

ECC84

DOUBLE TRIODE

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers.



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

R.F. DOUBLE TRIODE

ECC86

Double triode for use as an r.f. amplifier or self-oscillating mixer in equipment operating directly from a 6V, 12V or 24V battery on or off charge.

HEATER

V_h	6.3	V
I_h	330	mA

CAPACITANCES

*c_{a-g}	1.3	pF
*c_{in}	3.0	pF
*c_{out}	1.8	pF
$c_{a'-a''}$	<0.05	pF
$c_{g'-g''}$	<0.005	pF
$c_{a'-g''}$	<0.005	pF
$c_{a''-g'}$	<0.005	pF

*Each section

CHARACTERISTICS (each section)

V_a	6.3	V
I_a	900	μA
V_g	−0.4	V
g_m	2.6	mA/V
μ	14	
R_{eq}	1.0	kΩ

OPERATING CONDITIONS

As r.f. amplifier

V_a	6.3	12.6	25	V
‡$V_{g(b)}$	0	0	0	V
R_g	100	100	100	kΩ
I_a	0.9	2.5	7.5	mA
g_m	2.6	4.6	7.8	mA/V
r_a	5.0	3.4	2.1	kΩ

‡$V_{g(b)}$ is the voltage at "earthy" end of grid leak.

As self-oscillating mixer

$V_{a(b)}$	6.3	12.6	25	V
R_a	500	500	500	Ω
$V_{osc(r.m.s.)}$	0.7	1.0	1.5	V
I_a	0.4	1.0	2.6	mA
g_c	0.8	1.3	2.0	mA/V
R_g	220	220	220	kΩ
r_a	11	8.0	5.3	kΩ

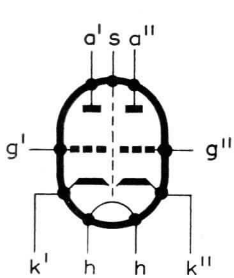
ECC86

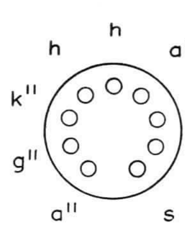
R.F. DOUBLE TRIODE

DESIGN CENTRE RATINGS

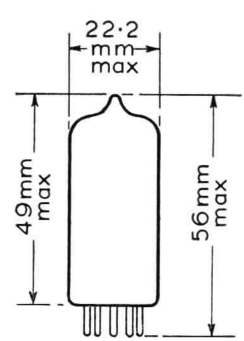
V_a max.	30	V
p_a max.	600	mW
I_k max.	20	mA
R_g max.	1.0	MΩ
V_{h-k} max.	30	V
R_{h-k} max.	20	kΩ

5242





B9A Base



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	450	mA

CAPACITANCES ←

	Unshielded	Shielded	
$*c_{a-g}$	1.6	1.6	pF
$c_{in'}$	2.1	2.6	pF
$c_{in''}$	2.1	2.8	pF
$c_{out'}$	0.45	1.5	pF
$c_{out''}$	0.35	1.0	pF
c_{h-k}	4.0	4.0	pF
$c_{a'-g''}$	140	60	mpF
$c_{a''-g'}$	40	20	mpF
$c_{a'-a''}$	220	160	mpF
$c_{g'-g''}$	430	400	mpF

*Each section.

CHARACTERISTICS (each section) ←

V_a	100	V
I_a	9.0	mA
g_m	5.6	mA/V
μ	38	
r_a	6.8	kΩ
V_g	–0.9	V

OPERATING CONDITIONS—CLASS "C" TELEGRAPHY PUSH-PULL ←

As r.f. amplifier

f	50	100	150	200	250	Mc/s
V_a	150	150	150	150	150	V
$*V_g$	–10	–10	–10	–10	–10	V
$I_{a(tot)}$	16.4	16.9	17.5	18	18.8	mA
$I_{g(tot)}$	5.6	5.1	4.5	4	3.2	mA
P_{load}	1.56	1.47	1.33	1.17	0.92	W
η_{load}	63.4	58	50.8	43.3	32.6	%

As a frequency trebler

f	50	100	150	200	250	Mc/s
V_a	150	150	150	150	150	V
$*V_g$	–100	–100	–100	–100	–100	V
$I_{a(tot)}$	16	16.7	17.2	17.7	18.2	mA
$I_{g(tot)}$	6	5.3	4.8	4.3	3.8	mA
P_{load}	0.95	0.89	0.82	0.72	0.56	W
η_{load}	39.6	35.5	31.8	27.1	20.5	%

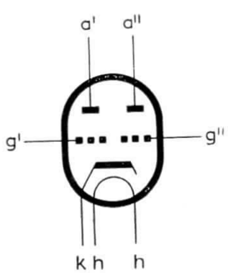
*This bias is obtained by grid current bias, or a combination of grid current and fixed or cathode bias.

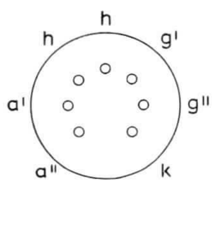
ECC91

V.H.F. DOUBLE TRIODE

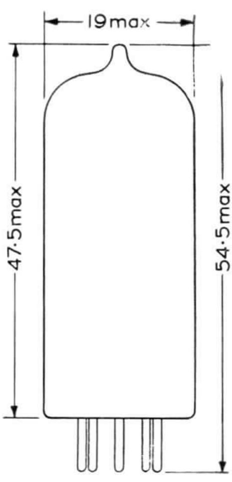
LIMITING VALUES

$V_{a(b)}$ max.	500	V
V_a max.	300	V
p_a max.	2 × 1.5	W
I_k max.	22	mA
V_g max.	–100	V
I_g max.	2 × 3	mA
V_{h-k}	100	V
R_{g-k} max.	250	kΩ
T_{bulb} max.	200	°C
f max.	250	Mc/s





B7G Base



All dimensions in mm

8417

V.H.F. DOUBLE TRIODE

ECC189

Variable-mu, low noise v.h.f. frame grid double triode with high mutual conductance for use as a cascode amplifier.

HEATER

V_h	6.3	V
I_h	365	mA

CAPACITANCES

	Shielded	Unshielded	
$c_{a'-a''}$	< 15	< 45	mpF
$c_{g'-a''}$	< 4.0	< 4.0	mpF
Grounded cathode section			←
$c_{a'-g'}$	1.9	1.9	pF
$c_{g'-k'+h+s}$	3.5	3.5	pF
$c_{a'-k'+h+s}$	2.3	1.7	pF
$c_{g'-h}$	< 280	< 280	mpF
Grounded grid section			
$c_{a''-g''}$	1.9	1.9	pF
$c_{k''-g''+h+s}$	6.0	6.0	pF←
$c_{a''-g''+h+s}$	4.0	3.4	pF←
$c_{k''-h}$	3.0	3.0	pF
$c_{a''-k''}$	170	180	mpF

CHARACTERISTICS (each section)

V_a	90	V
V_g	−1.4	V←
I_a	15	mA
g_m	12.5	mA/V
r_a	2.5	kΩ←
μ	34	
V_g (for 20 : 1 reduction in g_m)	−5.0	V
V_g (for 100 : 1 reduction in g_m)	−9.0	V

DESIGN CENTRE RATINGS (each section)

$V_{a(b)}$ max.	550	V
V_a max.	130	V
p_a max.	1.8	W
I_k max.	22	mA
$-V_g$ max.	50	V
$R_{g'-k}$ max.	1.0	MΩ
$R_{g''-k}$ max.	500	kΩ
$V_{h-k'}$ max.	50	V
$V_{h-k''}$ max. (cathode positive)	150	V
R_{h-k} max.	20	kΩ

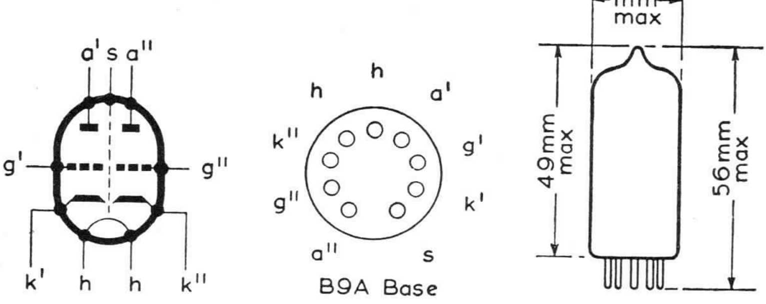
ECC189

V.H.F. DOUBLE TRIODE

NOTE

In order not to exceed the maximum permissible anode voltage when the cascode amplifier is controlled, it is necessary to use a voltage divider for the grid of the grounded grid section.

5242

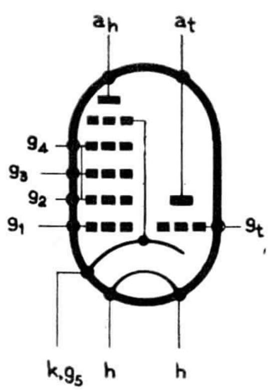


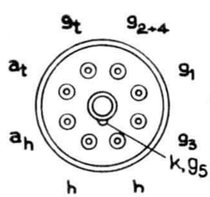
The triode on pins 6, 7, 8, should have the grounded cathode connection and that on pins 1, 2, 3, should have the grounded grid connection.

TRIODE HEPTODE

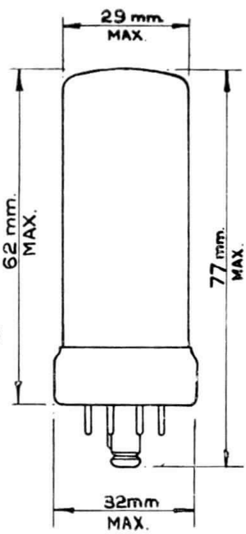
ECH21

Triode heptode frequency changer primarily intended for use in A.C. mains receivers. The heptode portion is designed for A.V.C.





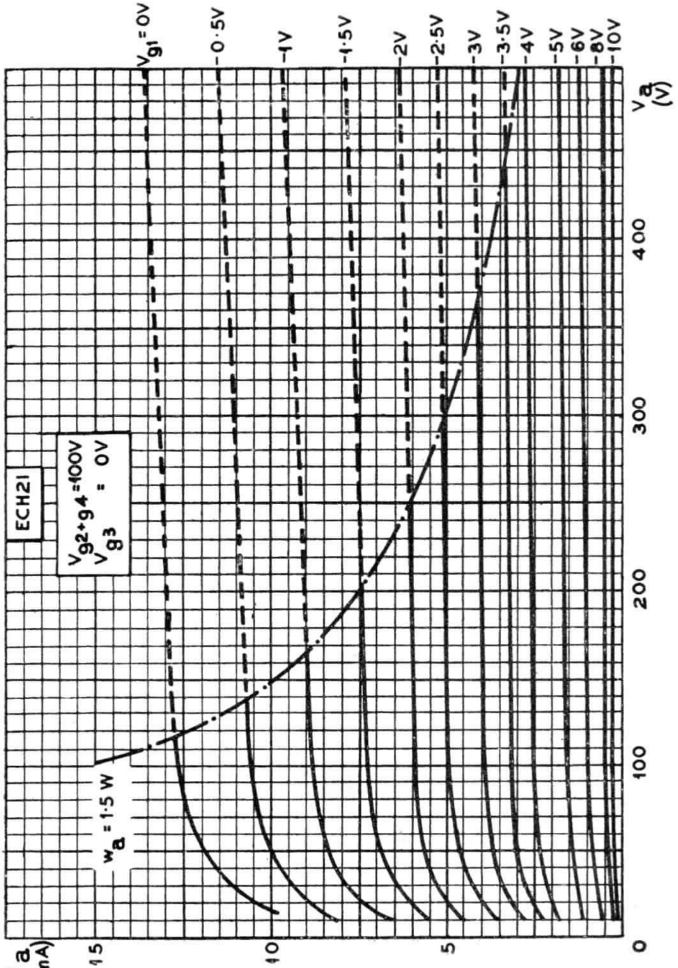
B8G BASE



ECH21

TRIODE HEPTODE

Triode heptode frequency changer primarily intended for use in A.C. mains receivers. The heptode portion 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.g.c.

HEATER

V_h	6.3	V
I_h	225	mA

CAPACITANCES

c_{gt-g1}	<300	mpF

Hexode section

c_{g1-k}	5.0	pF
c_{a-k}	10	pF
c_{a-g1}	<3.0	mpF

Triode section

c_{g-k}	9.0	pF
c_{a-k}	3.0	pF
c_{a-g1}	1.6	pF

OPERATING CONDITIONS

Hexode section

(a) With fixed screen-grid voltage

V_a	250	250	250	V
V_{g2+g4}	100	100	100	V
R_k	215	215	215	Ω
R_{g3+gt}	50	50	50	kΩ
I_{g3+gt}	200	200	200	μA
V_{g1}	−2.0	−17	−23	V
I_{ah}	3.0	—	—	mA
I_{g2+g4}	3.0	—	—	mA
g_c	650	6.5	1.5	μA/V
r_a	1.3	>5.0	>6.0	MΩ

(b) With screen grid fed by a potentiometer (See Fig. 1)

$V_a = V_b$	250	250	250	V
R_1	24	24	24	kΩ
R_2	33	33	33	kΩ
R_k	215	215	215	Ω
R_{g3+gt}	50	50	50	kΩ
I_{g3+gt}	200	200	200	μA
V_{g1}	−2.0	−23.5	−31	V
V_{g2+g4}	100	—	145	V
I_{ah}	3.0	—	—	mA
I_{g2+g4}	3.0	—	—	mA
g_c	650	6.5	1.5	μA/V
r_a	1.3	>3.0	>4.0	MΩ

V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
V_{g3} max. ($I_{g3} = +0.3\mu A$)	−1.3	V

OPERATING CONDITIONS

Triode section

V_b	100	250	V
R_a	—	45	kΩ
I_a (R_{gt} = 50kΩ, I_{gt} = 200μA)	3.3	3.3	mA
I_a (V_{gt} = 0V, V_{osc} = 0V)	10	4.5	mA
g_m (V_{gt} = 0V, V_{osc} = 0V)	2.8	2.2	mA/V
μ (V_{gt} = 0V, V_{osc} = 0V)	24	24	
V_{gt} max. (I_{g1} = +0.3μA)		−1.3	V

LIMITING VALUES

Hexode section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_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
p_{g2+g4} max.	600	mW
I_k max.	15	mA
R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	100	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

Triode section

$V_{a(b)}$ max.	550	V
V_a max.	100	V
p_a max.	1.5	W
R_{gt} max.	100	kΩ

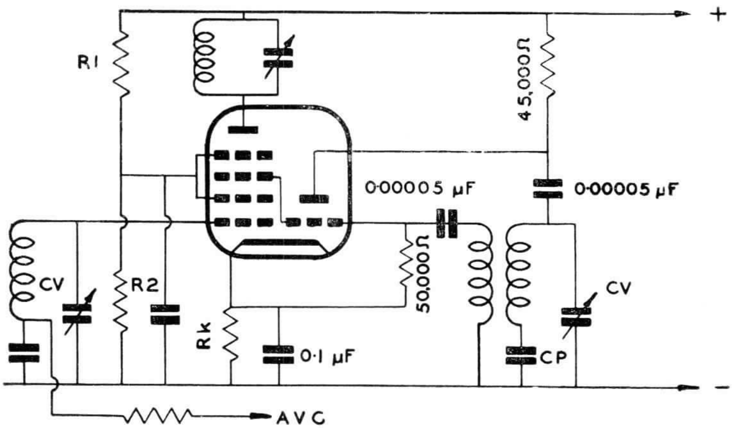
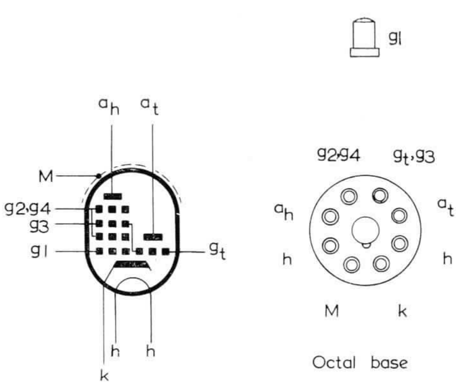
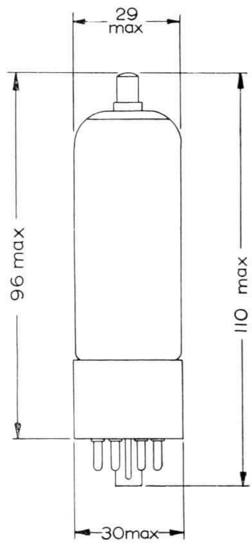


Fig. 1.—ECH35 as frequency changer with screen grid fed by a potentiometer.

6710





All dimensions in mm

TRIODE HEXODE FREQUENCY CHANGER

ECH42

Triode hexode primarily intended for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C. operation. The valve may also be employed as a phase inverter.

HEATER

V_h	6.3	V
I_h	0.23	A

MOUNTING POSITION Any

CAPACITANCES

c_{gt-g1}	<0.35	μμF
c_{gt-ah}	<0.2	μμF

Hexode Section

$c_{g1-h+k+g2+g4+skirt}$	4.0	μμF
$c_{a-h+k+g2+g4+skirt}$	9.2	μμF
c_{a-g1}	<0.1	μμF
c_{g1-h}	<0.15	μμF

Triode Section

$c_{gt-h+k+g2+g4+skirt}$	5.5	μμF
$c_{at-h+k+g2+g4+skirt}$	2.3	μμF
c_{at-gt}	1.2	μμF

OPERATING CONDITIONS AS FREQUENCY CHANGER

With Screen Grid fed from a potentiometer (see Fig. 1)

Hexode Section

$V_a = V_b$	250	V
R_1	27	kΩ
R_2	27	kΩ
R_k	180	Ω
R_{g3+gt}	47	kΩ
I_{g3+gt}	200	μA
V_{g1}	−2	V
V_{g2+g4}	85	V
I_a	3.0	mA
I_{g2+g4}	3.0	mA
g_c	750	μA/V
r_a	>1.0	MΩ
R_{eq}	75	kΩ
V_{g1} for 100 : 1 reduction in g_c	−29	V

Triode Section

V_b	250	V
R_a	33	kΩ
R_{gt+g3}	47	kΩ
I_{gt+g3}	200	μA
I_a	4.8	mA

The effective mutual conductance under the above conditions is approximately 550 μA/V

ECH42

TRIODE HEXODE FREQUENCY CHANGER

Triode hexode primarily intended for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C. operation. The valve may also be employed as a phase inverter.

CHARACTERISTICS

Triode Section

V_a	100	V
V_g	0	V
I_a	10	mA
g_m	2.8	mA/V
μ	22	

TYPICAL OPERATING CONDITIONS AS PHASE INVERTER
(see Fig. 2)

V_b (V)	I_b (mA)	V_{g-g}* ($V_{r.m.s.}$)	$\frac{V_{g-g}}{V_{in}}$	D_{tot}* (%)
200	2.6	33.2	25.2	2.6
300	4.0	56.7	25.7	2.8
400	5.3	78.6	26.1	3.0

*Output voltage and distortion at the start of positive grid current. At lower output voltage the distortion is approximately proportional to the voltage.

LIMITING VALUES

Hexode Section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.5	W
$V_{g2+g4(b)}$ max.	550	V
V_{g2+g4} (I_a=3 mA)	125	V
V_{g2+g4} max. (I_a<1 mA)	250	V
p_{g2+g4} max.	0.3	W
V_{g1} (I_{g1}=+0.3 μA) max.	−1.3	V
I_k max.	7.0	mA
R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	50	V

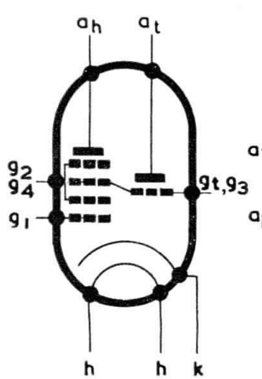
Triode Section

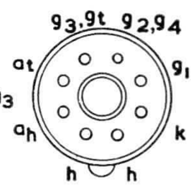
$V_{a(b)}$ max.	550	V
V_a max.	175	V
p_a max.	0.8	W
V_{gt} max. (I_{gt}=+0.3 μA)	−1.3	V
I_k max.	6.0	mA
R_{gt-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	50	V

TRIODE HEXODE FREQUENCY CHANGER

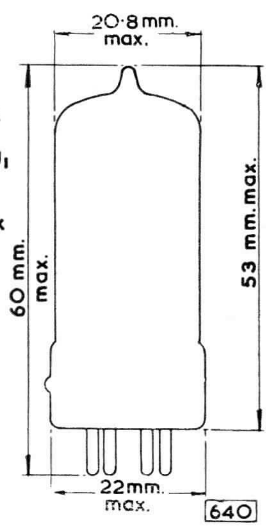
ECH42

Triode hexode primarily intended for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C. operation. The valve may also be employed as a phase inverter.





B8A BASE



ECH42

TRIODE HEXODE FREQUENCY CHANGER

Triode hexode primarily intended for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C. operation. The valve may also be employed as a phase inverter.

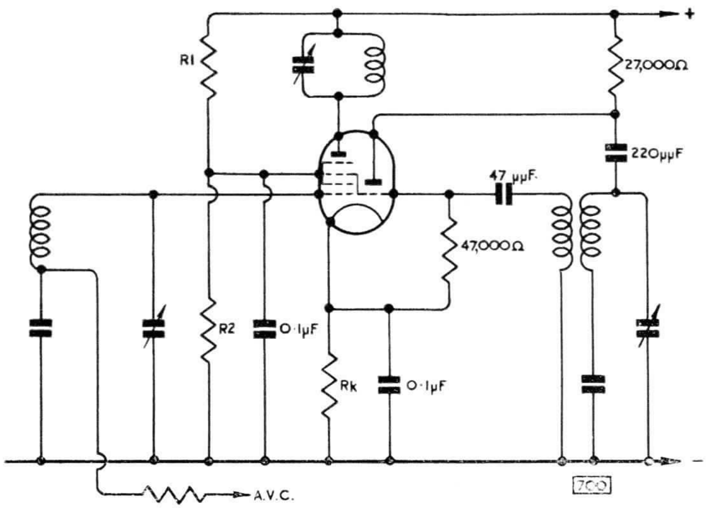


Fig. 1—ECH42 as Frequency Changer

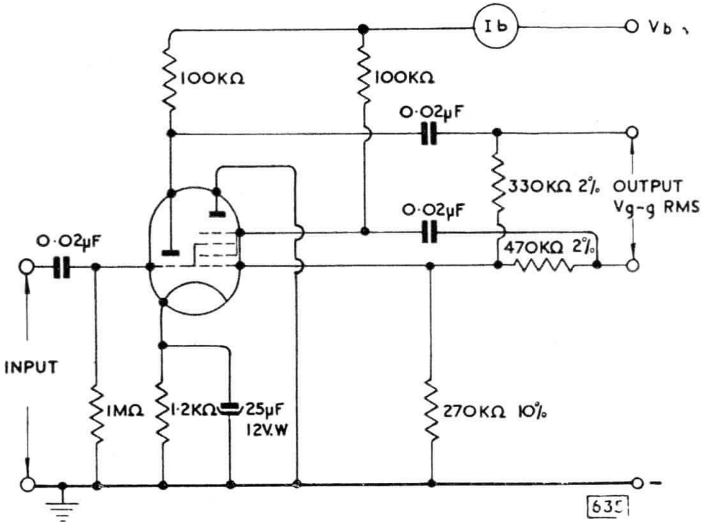


Fig. 2—ECH42 as Phase Inverter

Triode 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	300	mA

CAPACITANCES

c_{ah-at}	200	mpF
c_{ah-gt}	<90	mpF
$c_{ah-(g3+gt)}$	<350	mpF
c_{g1-at}	<60	mpF
c_{g1-gt}	<170	mpF
$c_{g1-(g3+gt)}$	<450	mpF

Heptode section

$c_{in(g1)}$	4.8	pF
$c_{in(g3)}$	6.0	pF
c_{out}	7.9	pF
c_{a-g1}	<6.0	mpF
c_{g1-g3}	<300	mpF
c_{g1-h}	<170	mpF
c_{g3-h}	<60	mpF

Triode section

c_{in}	2.6	pF
c_{out}	2.1	pF
c_{a-g}	1.0	pF
c_{g-h}	<20	mpF

OPERATING CONDITIONS OF HEPTODE SECTION AS R.F. OR I.F. AMPLIFIER ←

V_b	250	250	V
V_a	160	248	V
V_{g3}	0	0	V
R_{g2+g4}	22	22	kΩ
*V_{g1}	-	-35	V
V_{g2+g4}	96	245	V
I_a	11	-	mA
I_{g2+g4}	7	-	mA
I_{g1}	0.5	-	μA
g_m	4500	45	μA/V
r_a	0.24	>10	MΩ
μ_{g2-g1}	25	-	
R_{eq}	4.5	-	kΩ
R_a	8.2	8.2	kΩ
R_{g2+g4}	22	22	kΩ

*Operating with grid current bias as obtained with R_{g1-k} = 1MΩ and with zero a.g.c. volts; resulting V_{g1} = -500mV.

OPERATING CONDITIONS OF HEPTODE SECTION AS A.M. FREQUENCY CHANGER* ←

V_b	250	250	V
V_a	225	240	V
R_{g2+g4}	22	22	kΩ
R_{g3+gt}	47	47	kΩ
V_{g1}	-	-28	V
V_{g2+g4}	78	235	V
I_a	3.3	-	mA
I_{g2+g4}	7.8	-	mA
I_{g3+gt}	200	200	μA
**I_{g1}	0.5	-	μA
g_c	1100	11	μA/V
R_a	8.2	8.2	kΩ
R_{eq}	30	-	kΩ

*Triode operating with V_b = 250V, R_a = 33kΩ and $V_{osc\ (r.m.s.)}$ = 8V.

**Operating with grid current bias as obtained with R_{g1-k} = 1MΩ and with a.g.c. volts; resulting V_{g1} = -500mV.

CHARACTERISTICS

Triode section

V_a	100	V
I_a	13.5	mA
V_g	0	V
g_m	3.7	mA/V
μ	22	
r_a	6.0	kΩ
V_g max. (I_g = +0.3μA)	-1.3	V

Heptode section

←

V_a	160	V
V_{g3}	0	V
V_{g2+g4}	100	V
I_{g1}	0.5	μA
V_{g1}	-0.5	V
I_a	11	mA
I_{g2+g4}	7	mA
g_m	4.5	mA/V
μ_{g2-g1}	25	

OPERATING CONDITIONS OF TRIODE SECTION AS R.F. OSCILLATOR

V_b	250	V
R_{at}	33	kΩ
R_{gt+g3}	47	kΩ
I_{gt+g3}	200	μA
I_{at}	4.5	mA
g_m (eff)	650	μA/V

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

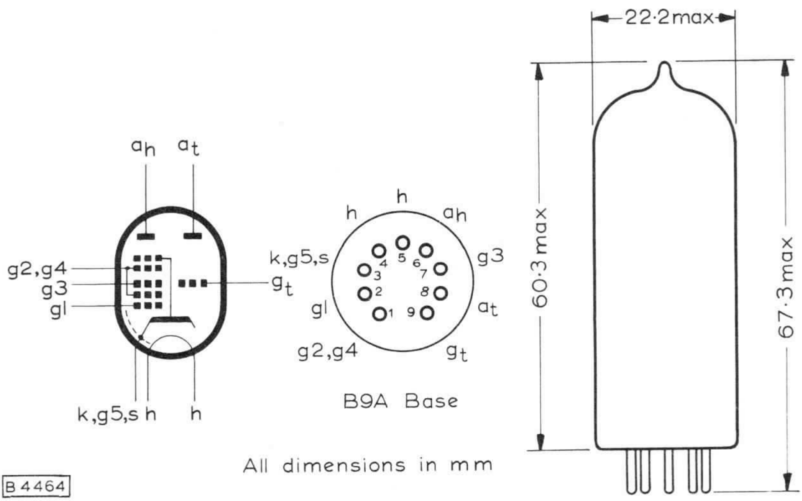
Triode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	800	mW
I_k max.	6.5	mA
R_{g-k} max.	3.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

Heptode section

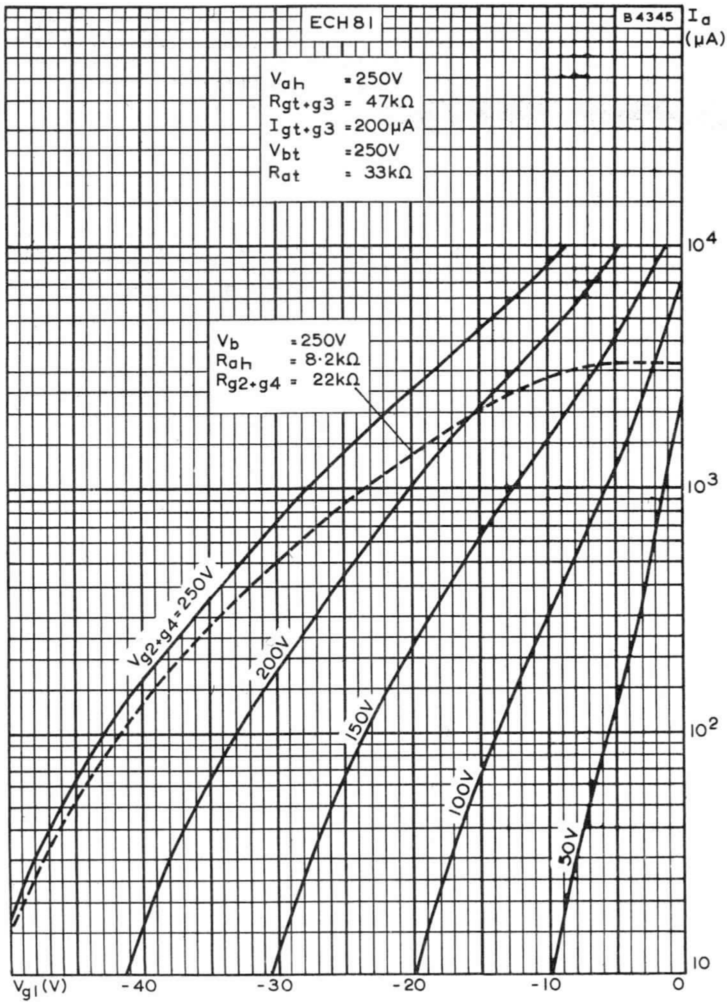
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.0	W←
$V_{g2+g4(b)}$ max.	550	V
V_{g2+g4} max.	125	V
V_{g2+g4} max. (I_a <1mA)	300	V
p_{g2+g4} max.	0.8	W←
I_k max.	18	mA←
R_{g1-k} max.	3.0	MΩ
*R_{g3-k} max.	3.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

*If the two sections of the valve are switched during operation so that there is no direct connection between g_3 and g_t, as may occur in f.m./a.m. receivers, then R_{g3-k} max. = 20kΩ.

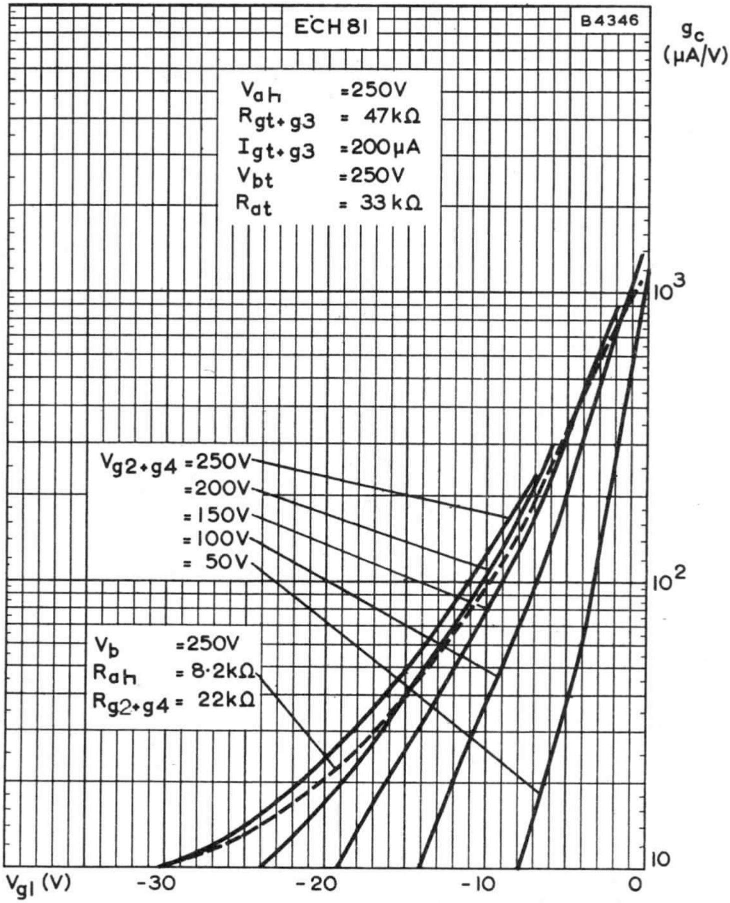


All dimensions in mm

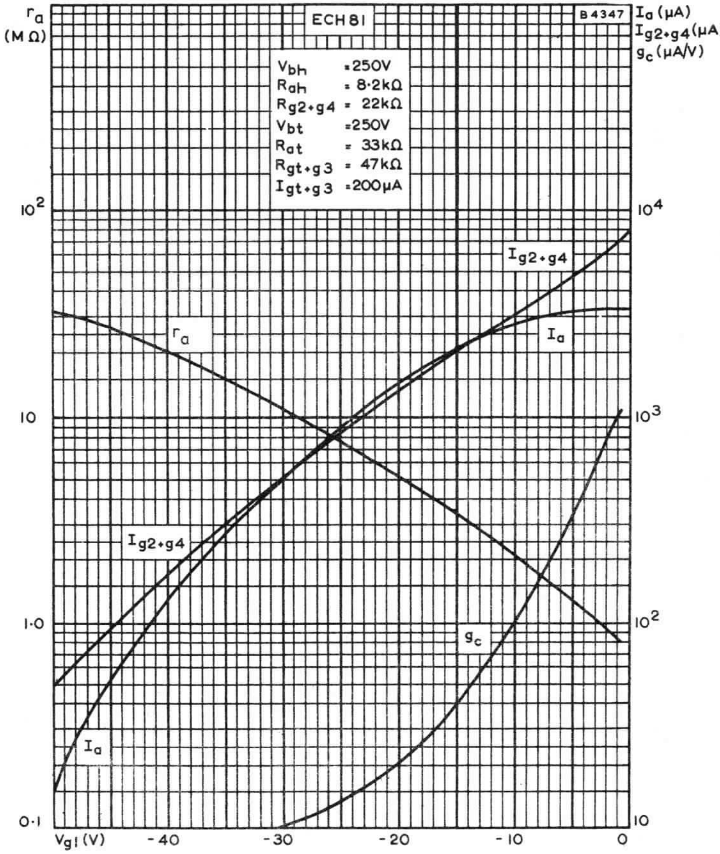
B4464



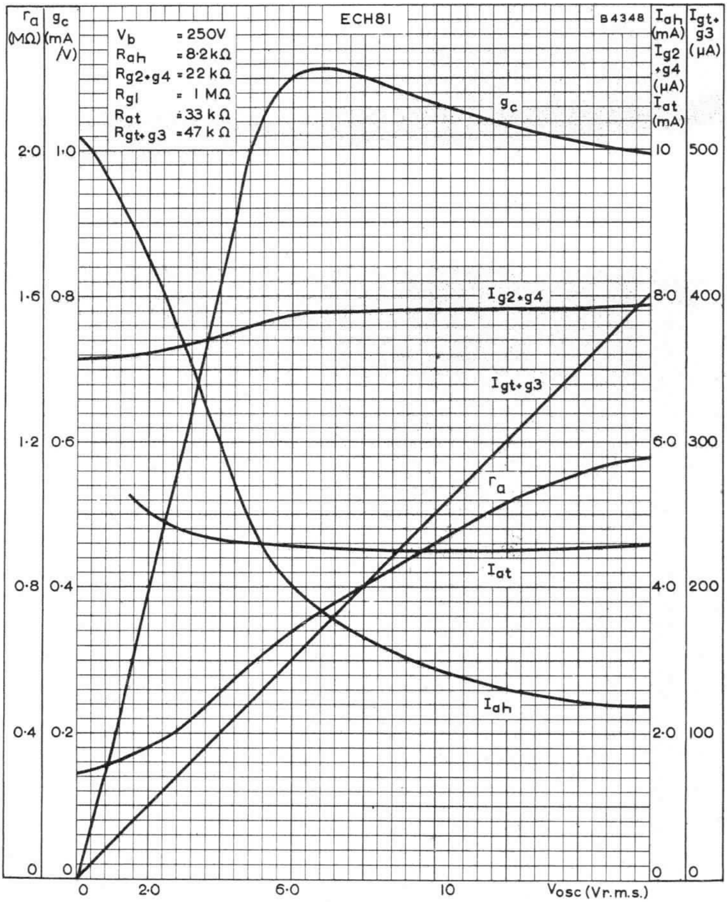
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



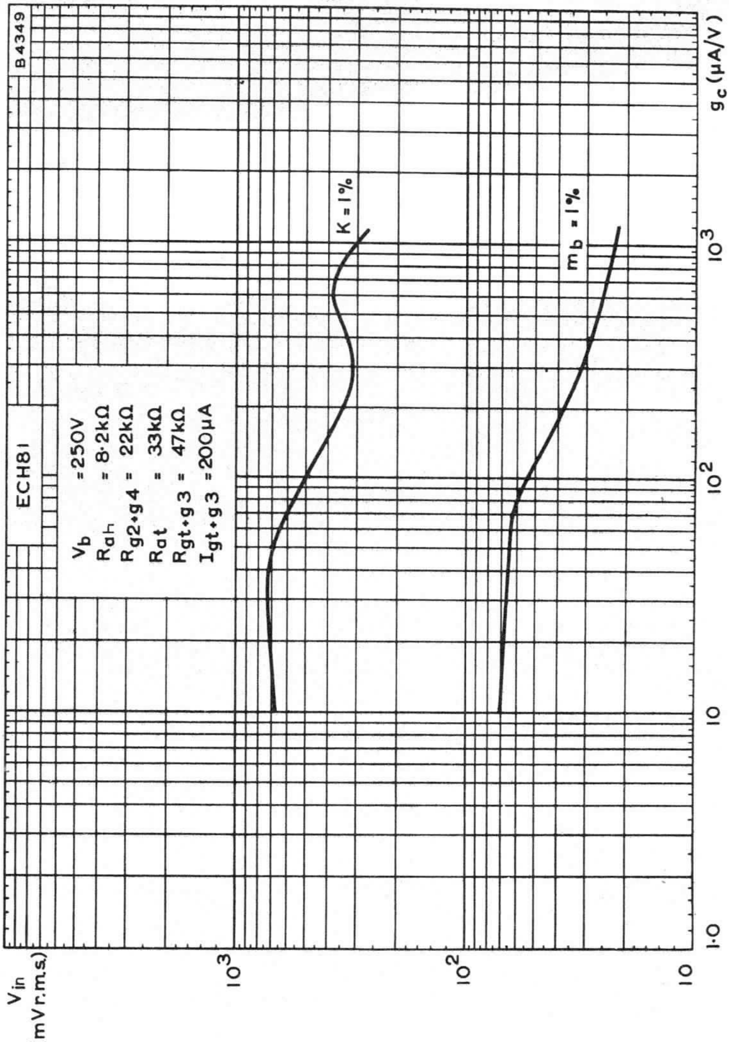
CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



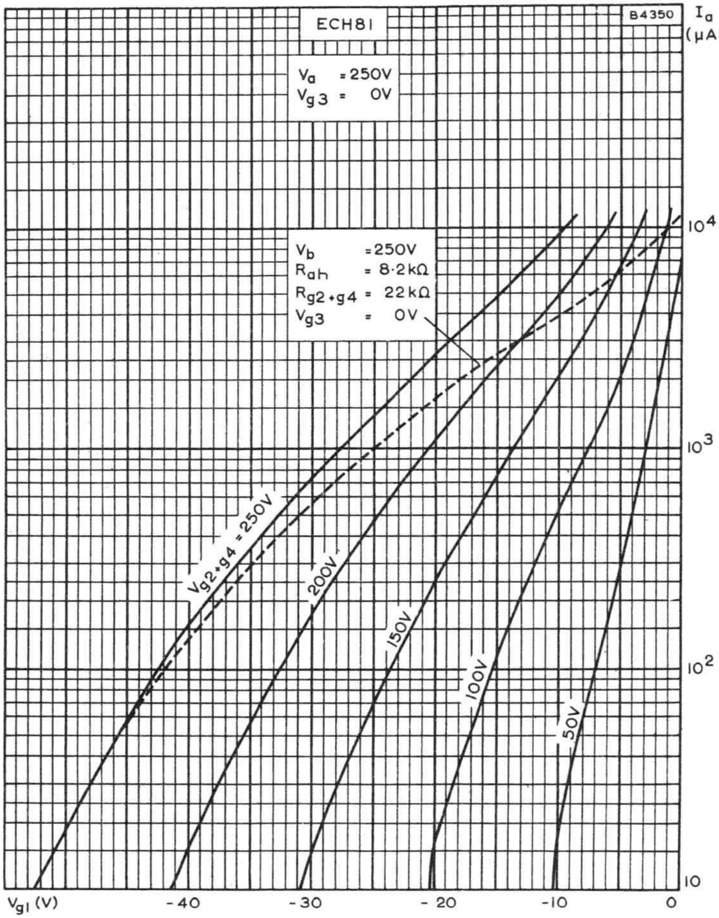
ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



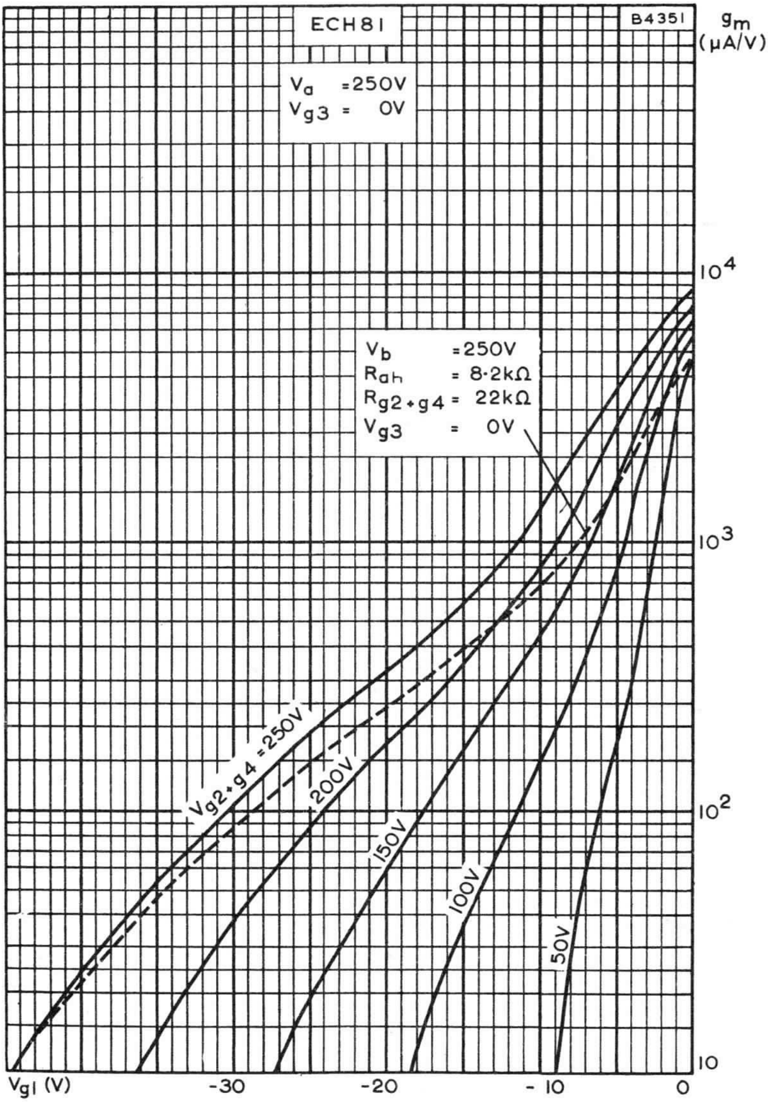
ANODE, SCREEN AND OSCILLATOR GRID CURRENTS, CONVERSION CONDUCTANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST OSCILLATOR VOLTAGE



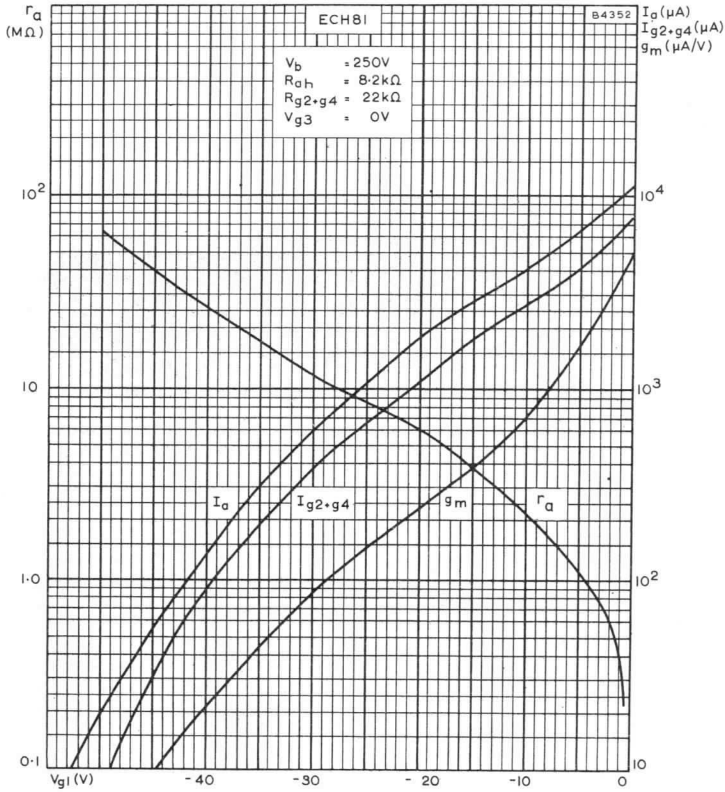
INDICATING THE R.M.S. VALUE OF THE VOLTAGE OF AN INTERFERING SIGNAL AT THE GRID PRODUCING 1% CROSS AND HUM MODULATION AS A FUNCTION OF THE CONVERSION CONDUCTANCE



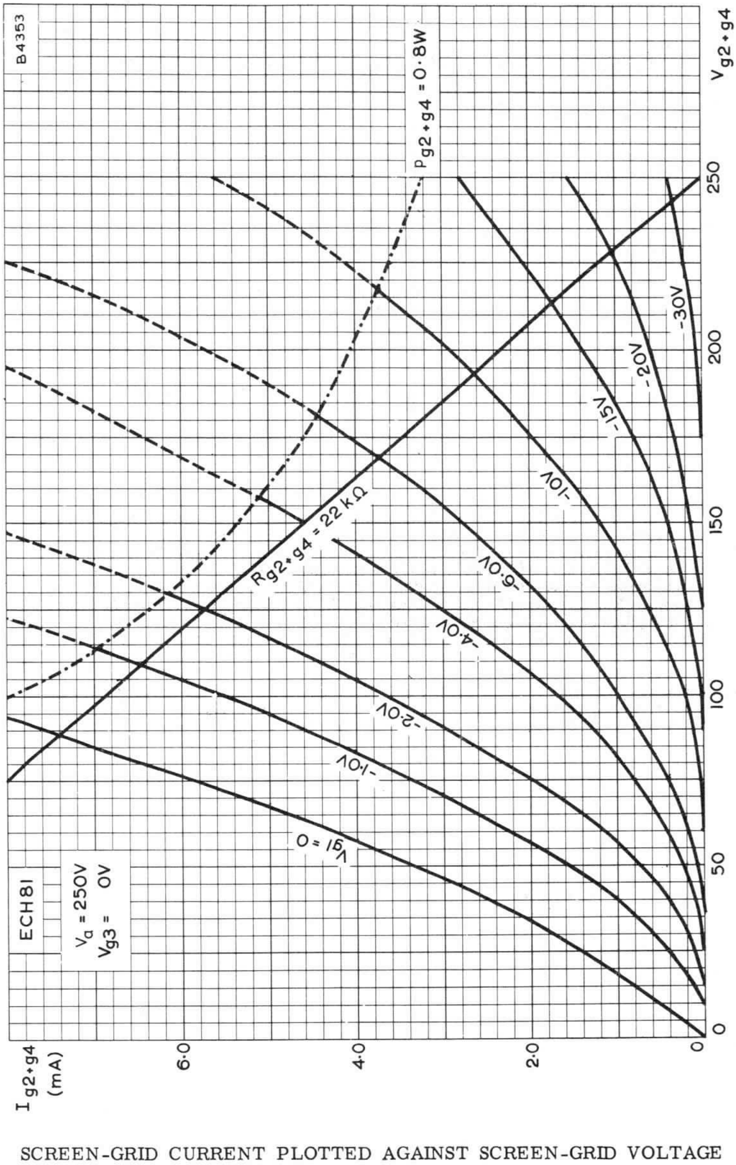
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



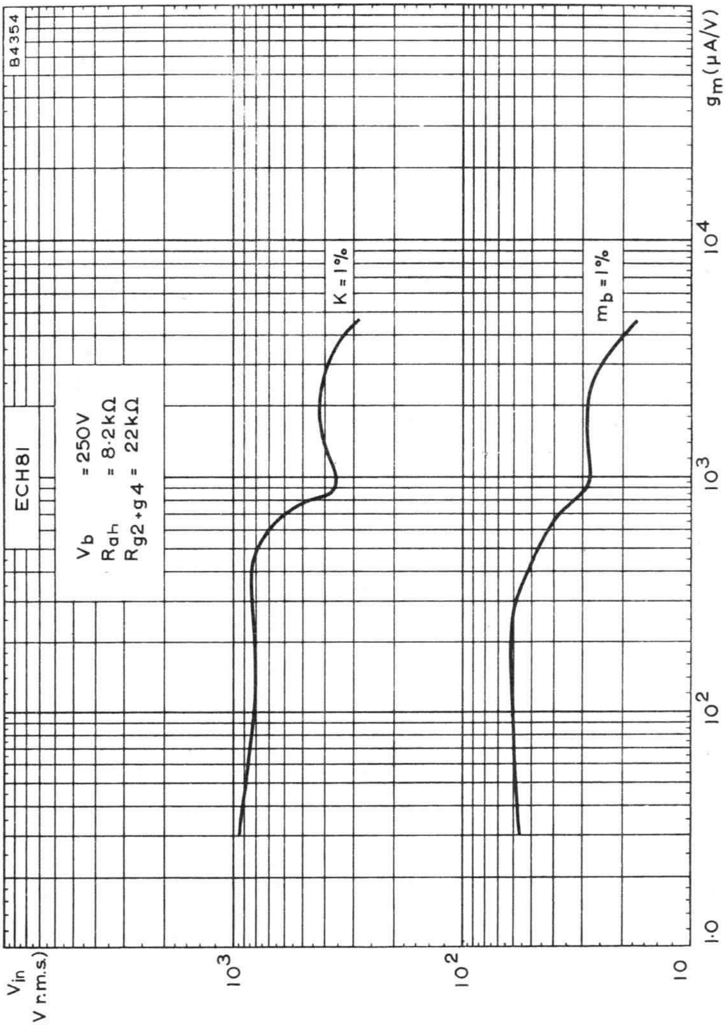
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



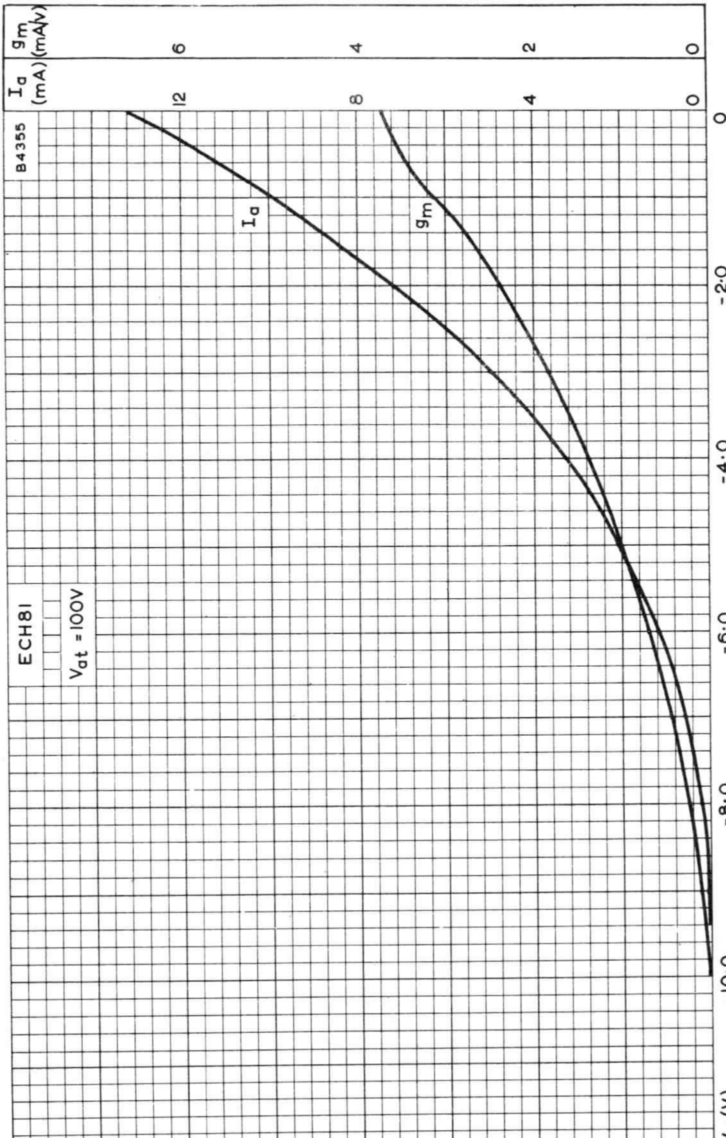
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



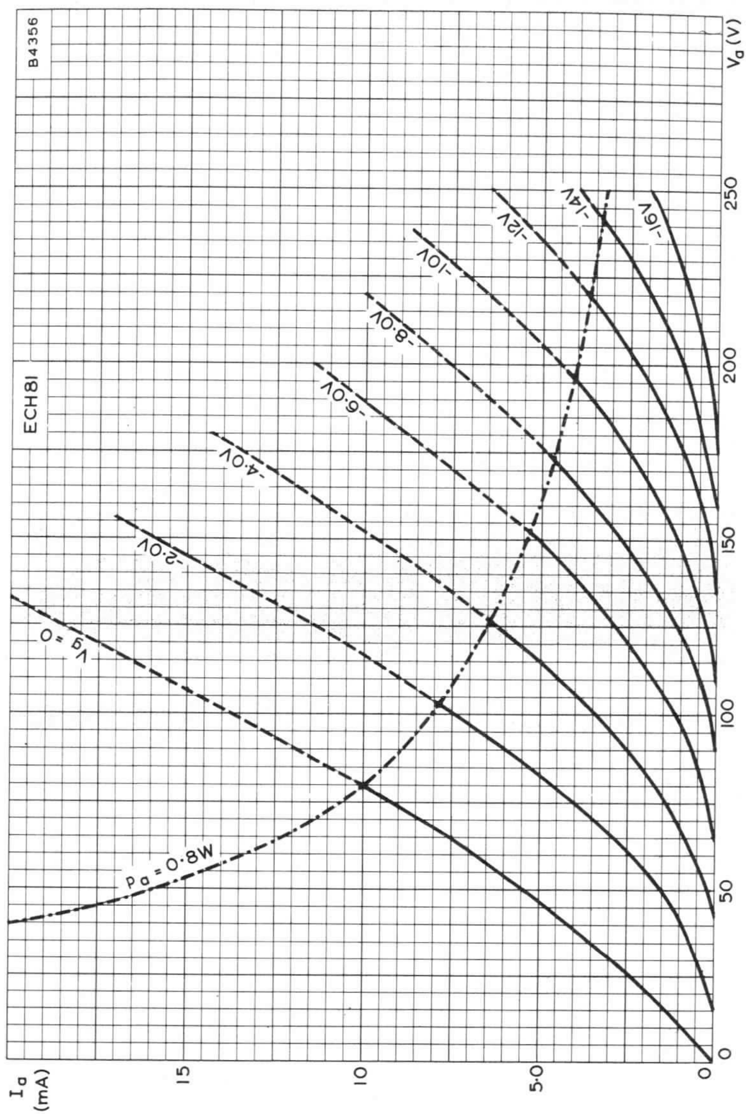
SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER FOR HEPTODE SECTION



INDICATING THE R.M.S. VALUE OF THE VOLTAGE OF AN INTERFERING SIGNAL AT THE GRID PRODUCING 1% CROSS AND HUM MODULATION AS A FUNCTION OF THE MUTUAL CONDUCTANCE



ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE FOR TRIODE SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER FOR TRIODE SECTION

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

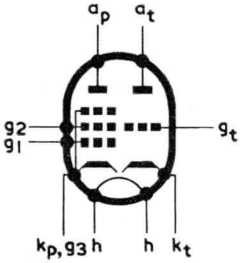
Pentode section

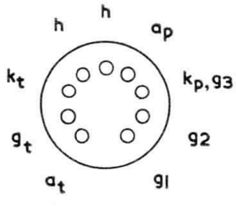
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	5.4	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.2	W
p_{g2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g1-k} max. (self-bias)	500	kΩ
R_{g1-k} max. (fixed bias)	250	kΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

Triode section

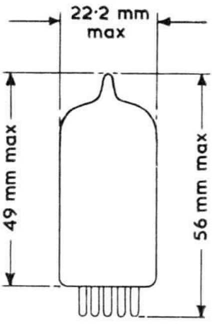
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k} max. (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

3749





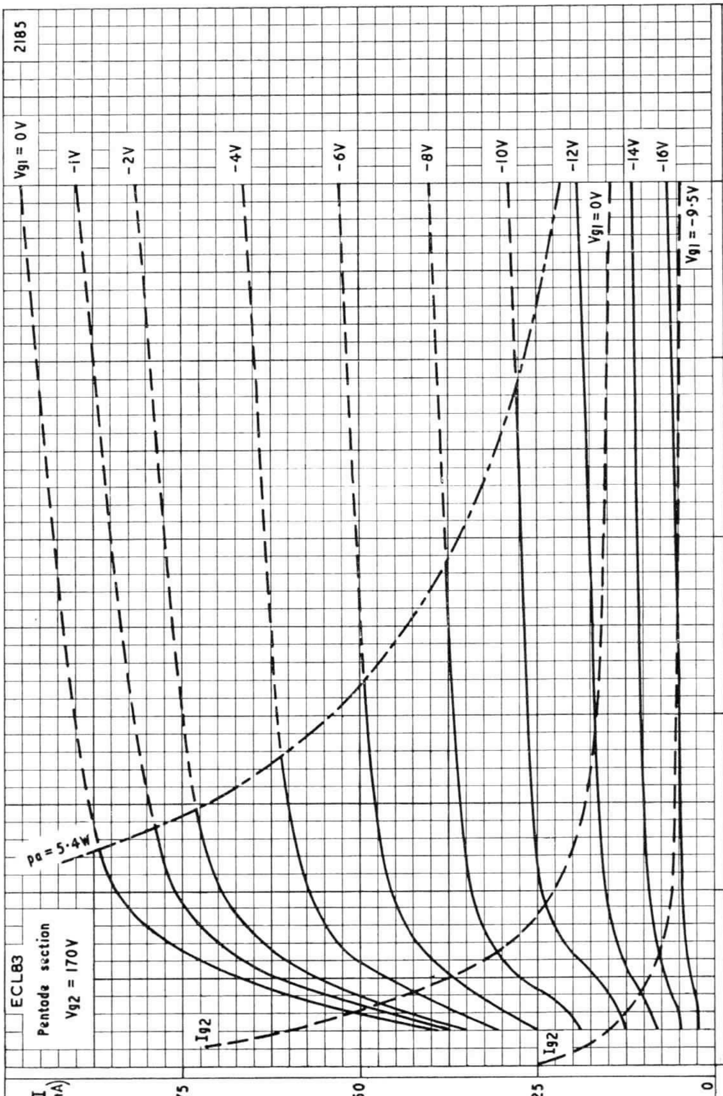
B9A Base



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_{g2} = 170V

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

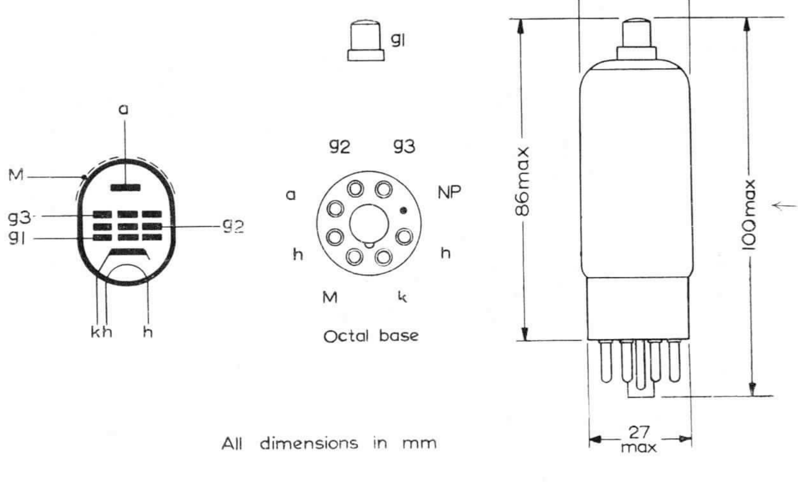
* Output voltage and distortion at the start of positive grid current. At lower output voltages the distortion is approximately proportional to the voltage.

** R_{g1} is the grid resistance of the following valve.

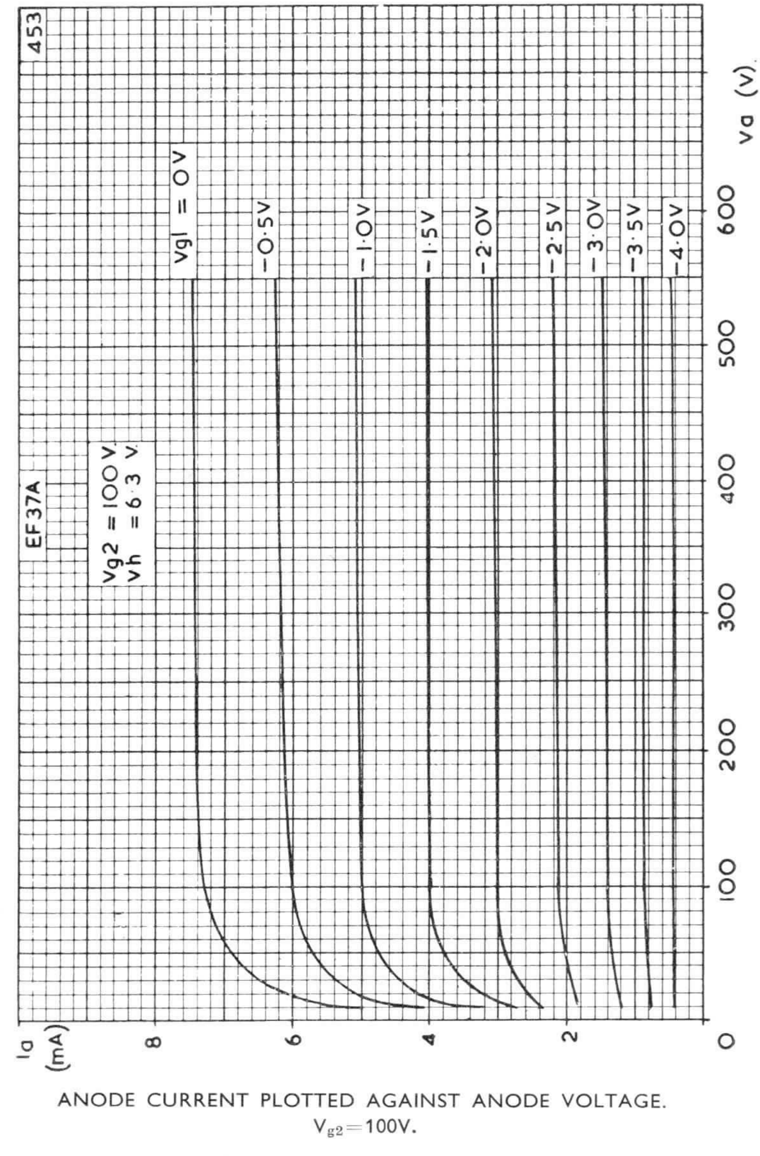
LIMITING VALUES

$V_{a(b)}$ 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.
$V_{g2} = 100V$.

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

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

V_h	6.3	V
I_h	200	mA

CAPACITANCES

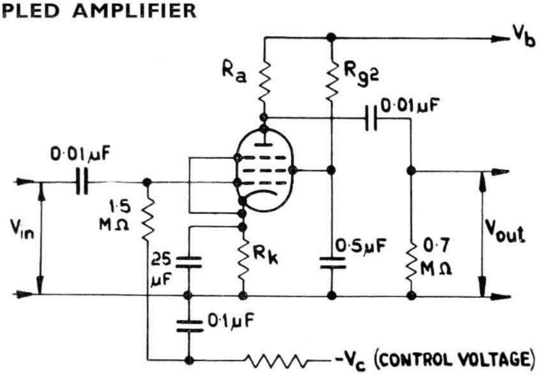
c_{a-g1}	<3.0	mpF
c_{in}	5.5	pF
c_{out}	7.2	pF

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

$V_b = V_a$	200	200	250	250	V
R_{g2}	60	60	90	90	kΩ
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

V_{g1} max. ($I_{g1} = +0.3\mu A$) −1.3 V

OPERATING CONDITIONS AS CONTROLLED GAIN R.C. COUPLED AMPLIFIER



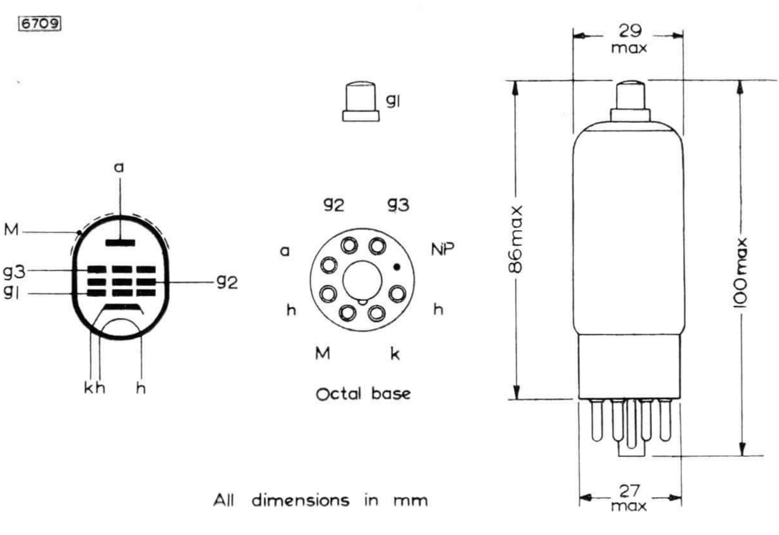
V_b (V)	R_a (kΩ)	R_{g2} (kΩ)	I_a (mA)	I_{g2} (mA)	R_k (kΩ)	$-V_c$ (V)	V_{out} ($V_{r.m.s.}$)	$\frac{V_{out}}{V_{in}}$	D_{tot} (%)
250	200	800	0.87	0.26	1.75	0	10	106	2.7
250	200	800	0.69	0.21	1.75	5	10	40	2.7
250	200	800	0.55	0.17	1.75	10	10	23	3.7
250	200	800	0.37	0.11	1.75	18	10	11.6	4.8
250	200	800	0.17	0.05	1.75	25	10	6.7	8.8
250	100	400	1.6	0.45	1.0	0	10	85	2.5
250	100	400	1.22	0.36	1.0	5	10	36	2.7
250	100	400	0.92	0.28	1.0	10	10	20	4.1
250	100	400	0.57	0.18	1.0	18	10	9.2	6.1
250	100	400	0.36	0.11	1.0	25	10	5.5	9.5

EF39

VARIABLE-MU R.F. PENTODE

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_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
p_{g2} max.	300	mW
R_{g1-k} max.	3.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ



All dimensions in mm

VOLTAGE AMPLIFYING PENTODE

EF40

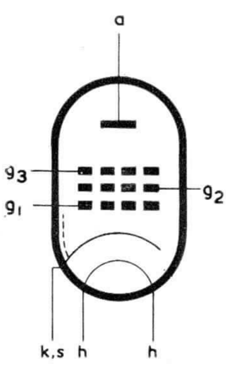
Low noise pentode primarily intended for use in high gain r.c. coupled a.f. voltage amplifier stages.

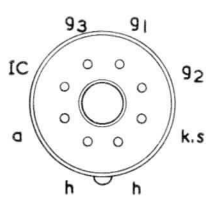
EF41
OVERLEAF

Except for heater to cathode voltage ratings, basing and dimensions, the EF40 is identical to the EF86.

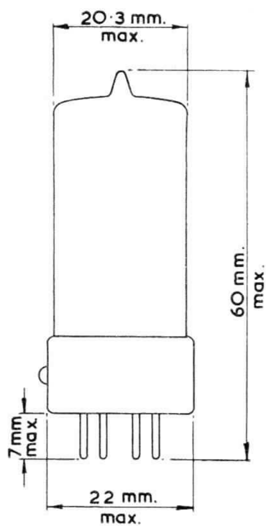
LIMITING VALUE

V_{h-k} max.	50	V





BBA BASE



EF41

VARIABLE-MU R.F. PENTODE

Variable-mu pentode for use as r.f. or i.f. amplifier.

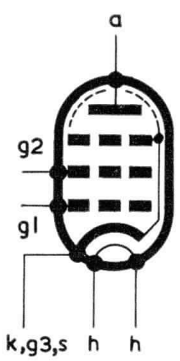
Except for capacitances, basing, dimensions and heater to cathode voltage ratings the EF41 is identical to the EF39.

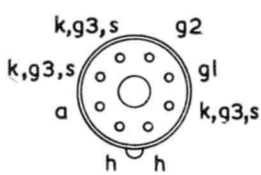
CAPACITANCES

c_{a-g1}	<0.002	pF
c_{g1-h}	<0.05	pF
c_{in}	4.7	pF
c_{out}	8.0	pF

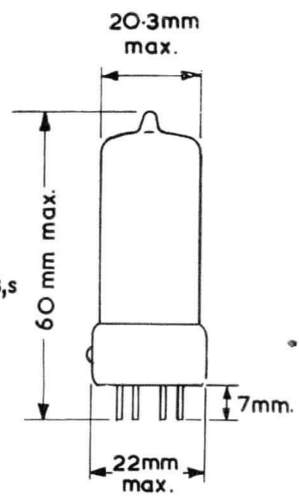
LIMITING VALUE

$V_{h-k\ max}$	50	V





B8A Base



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Although pins 3, 4 and 7 are internally connected together, it is recommended that the external connection be made to pin 7, as the cathode lead inductance to this pin is lowest.

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-e}	−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
μ_{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

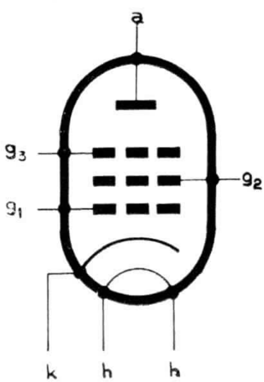
* Valve not controlled by a.g.c.

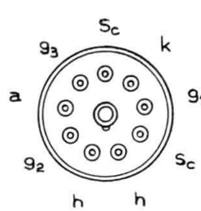
** V_{g1} is obtained from V_{g3} by means of a potentiometer of 50kΩ and 3kΩ.

†† V_{g1} is obtained from V_{g3} by means of a potentiometer of 50kΩ and 4kΩ.

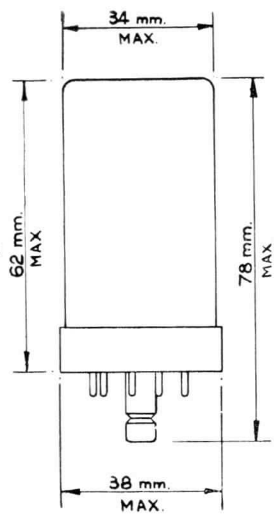
LIMITING VALUES

$V_{a(b)}$ 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. ($I_{g1} = +0.3\mu A$)	–1.3	V
V_{g3} max. ($I_{g3} = +0.3\mu A$)	–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



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	Ω
g_m	12.0	7.0	mA/V
μ_{g1-g2}	28	27	
r_a	55	100	kΩ

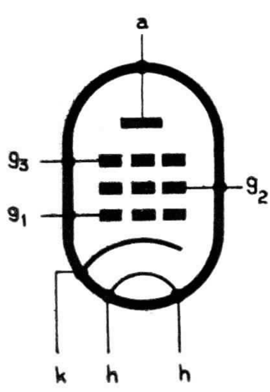
LIMITING VALUES

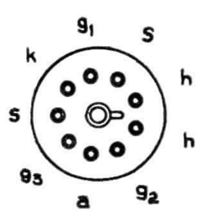
$V_{a(b)}$ max.	500	V
V_a max.	300	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	250	V
p_a max.	10	W
p_{g2} max.	2.0	W
V_{h-k} max.	150	V
R_{g1-k} max.	700	kΩ
$i_{k(pk)}$ max. (with 50 μ sec. pulse, 500 pp.s.)	1.5	A

EF55

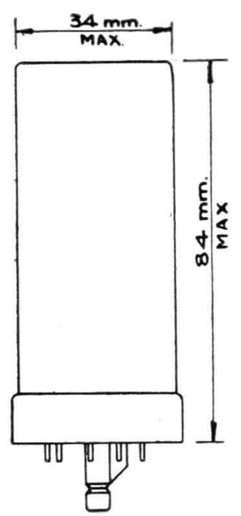
VIDEO FREQUENCY PENTODE

Single-ended R.F. pentode with very high mutual conductance and sharp cut-off.





B9G BASE



Note : If mounted horizontally, Pins 4 and 8 must be in a vertical plane.

VARIABLE-MU A.F. PENTODE

EF83

Variable-mu a.f. pentode for use as a controlled-gain audio amplifier.

HEATER

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

V_h	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

c_{in}	4.0	pF
c_{out}	5.0	pF
c_{a-g1}	<50	mpF
c_{g1-h}	<2.5	mpF

CHARACTERISTICS

V_a	250	V
V_{g3}	0	V
V_{g2}	50	V
V_{g1}	−1.6	V
I_a	4.0	mA
I_{g2}	1.15	mA
g_m	1.6	mA/V
r_a	1.25	MΩ
μ_{g1-g2}	10	
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V

OPERATING CONDITIONS

V_b	250		V
R_a	100		kΩ
V_{g3}	0		V
R_{g2}	390		kΩ
R_{g1}	3.0		MΩ
$*R_{g1}$	1.0		MΩ
R_{source}	$\leqq 200$		kΩ
$V_{out(r.m.s.)}$	8.0		V
V_{g1}	−1.0	−20	V
I_a	1.8	1.65	mA
I_{g2}	550	250	µA
V_{out}/V_{in}	105	16	
D_{tot}	1.5	2.3	%

*Grid resistor of the following valve.

Under these operating conditions, the following total distortion figures apply.

$V_{out(r.m.s.)}$	3.0	5.0	8.0	15	V
D_{tot} ($-V_{g1}$ = 1 to 3V)	0.8	1.0	1.5	2.5	%
D_{tot} ($-V_{g1}$ = 3 to 20V)	1.0	1.5	2.3	3.5	%

EF83

VARIABLE-MU A.F. PENTODE

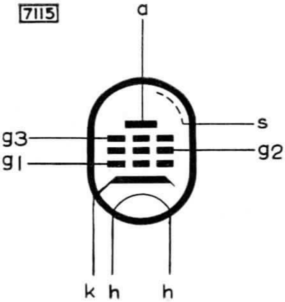
LIMITING VALUES

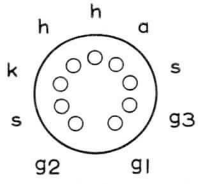
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	200	mW
I_k max.	6.0	mA
R_{g3-k} max.	10	kΩ
R_{g1-k} max.	3.0	MΩ
V_{h-k} max. (cathode positive)	100	V
V_{h-k} max. (cathode negative)	50	V
R_{h-k} max.	20	kΩ

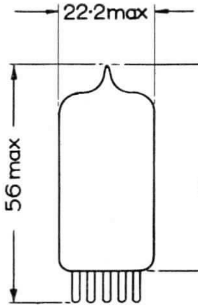
MICROPHONY AND HUM

This valve can be used without special precautions against microphony and hum in circuits in which the input voltage is $\geqq$2mV at f = 1kc/s and $-V_{g1} \leqq$ 1V for an output of 50mW from the output stage.

7115







B9A Base
All dimensions in mm

VARIABLE-MU R.F. PENTODE

EF89

Variable-mu pentode for use as r.f. or i.f. amplifier in f.m./a.m. receivers.

HEATER

V_h	6.3	V
I_h	200	mA

CAPACITANCES

c_{in}	5.5	pF
c_{out}	5.1	pF
c_{a-g1}	<2	mpF
c_{g1-g2}	2.1	pF
c_{g1-h}	50	mpF

CHARACTERISTICS

V_a	250	250	V
V_{g3}	0	0	V
V_{g2}	85	100	V
V_{g1}	–1.0*	–2.0	V
I_a	9.0	9.0	mA
I_{g2}	3.2	3.0	mA
g_m	4.0	3.6	mA/V
r_a	>0.8	1.0	MΩ
μ_{g1-g2}	19	—	

*At this voltage grid current may occur. If this is not acceptable the negative bias voltage should be increased to –2.0V.

OPERATING CONDITIONS

$V_a = V_b$	250	250	250	250	V
V_{g3}	0	0	0	0	V
R_{g2}	62	51	18†	18†	kΩ
V_{g1}	–0.5*	–2.0	–0.5*	–2.0	V
R_k	—	160	—	190	Ω
R_{g1}	10	—	10	—	MΩ
I_a	8.5	9.0	8.0	8.7	mA
I_{g2}	2.8	3.0	2.6	2.9	mA
g_m	4.4	3.5	4.2	3.5	mA/V
r_a	1.0	1.0	1.05	1.0	MΩ
R_{eq}	2.4	4.2	2.3	4.1	kΩ
g_m (V_{g1} = –20V)	220	240	230	230	µA/V
r_{g1} (f = 50Mc/s)	—	10	—	10	kΩ

*This voltage is produced by the grid current flowing through the grid resistor and the steady current of the diode. If this condition is not acceptable the negative grid bias should be increased to –2.0V.

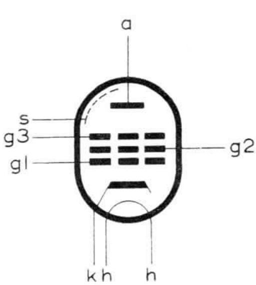
†Common screen-grid resistor for EF89 and ECH81 used as a frequency changer. The current through this resistor is 8.6mA at V_{g1} = –2.0V and 9.8mA at V_{g1} = –0.5V.

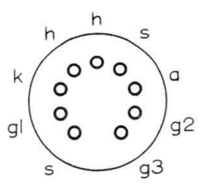
EF89

VARIABLE-MU R.F. PENTODE

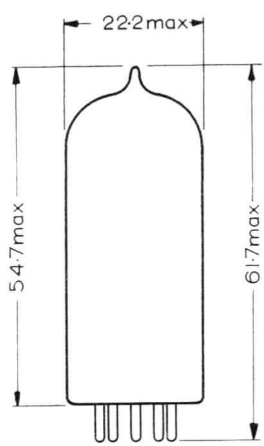
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.25	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	450	mW
I_k max.	16.5	mA
R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	10	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ



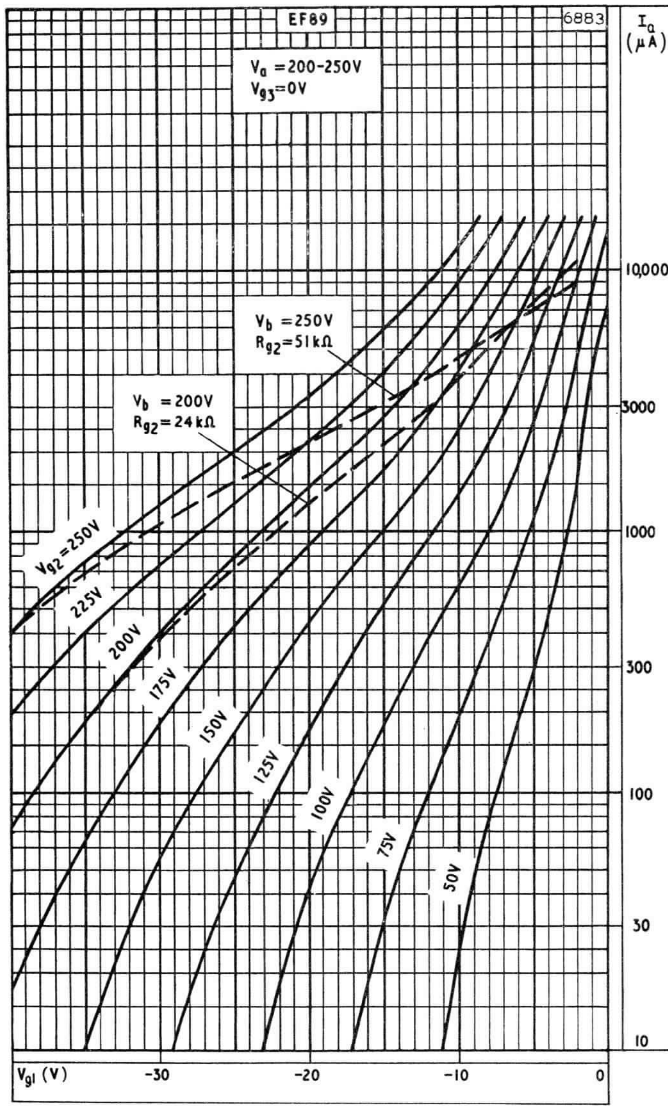


B9A Base

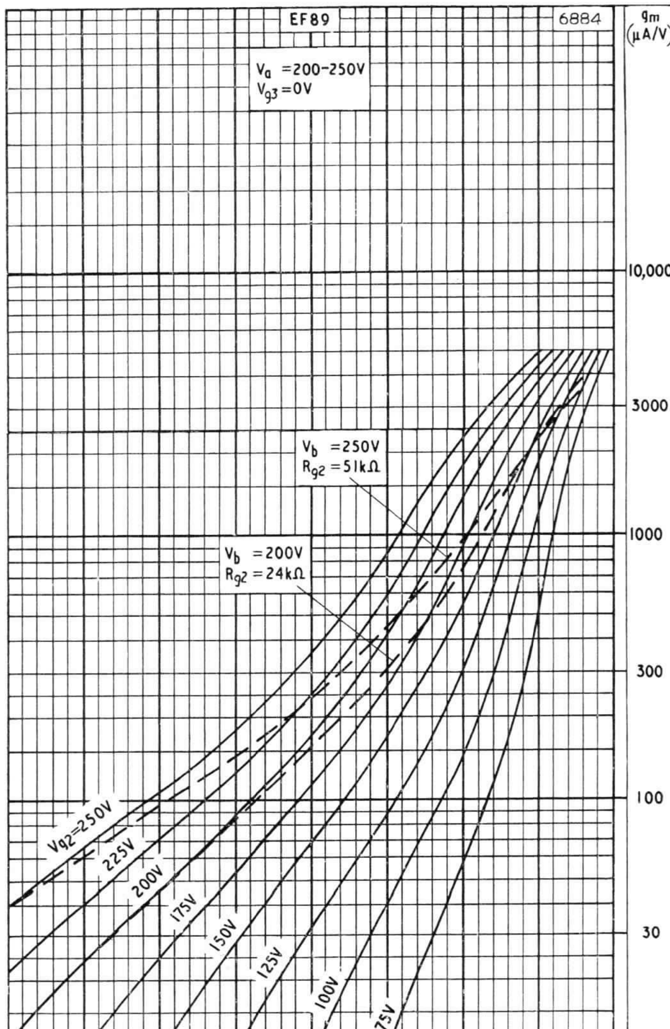


6394

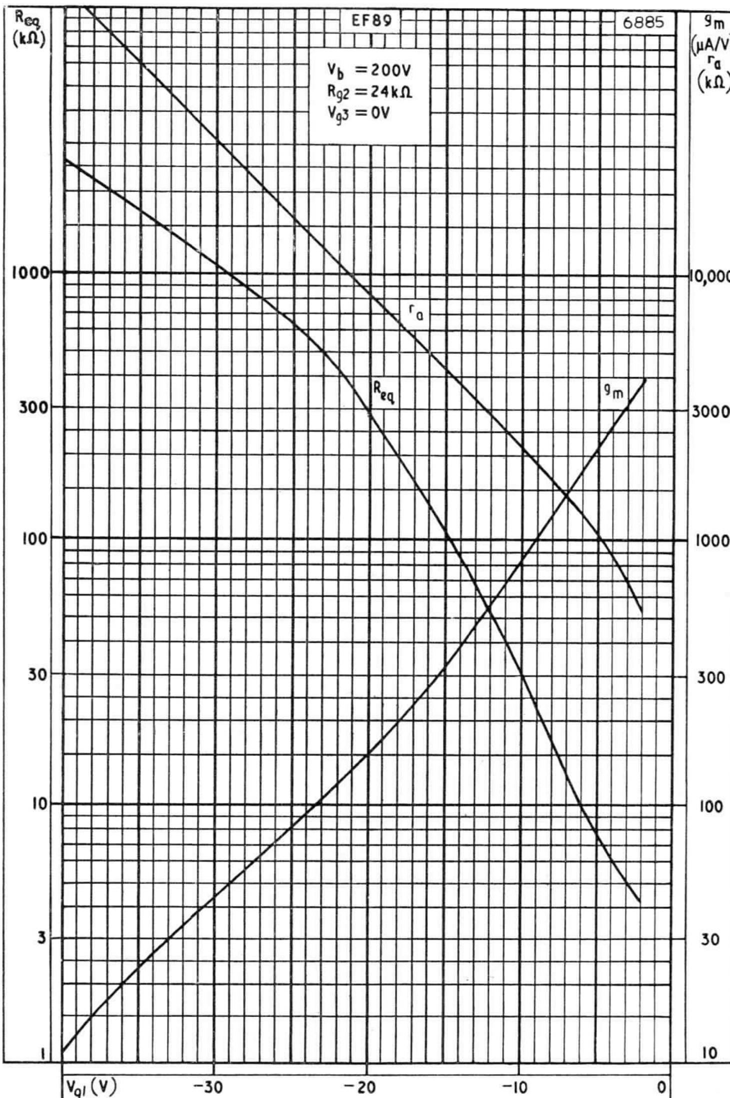
All dimensions in mm



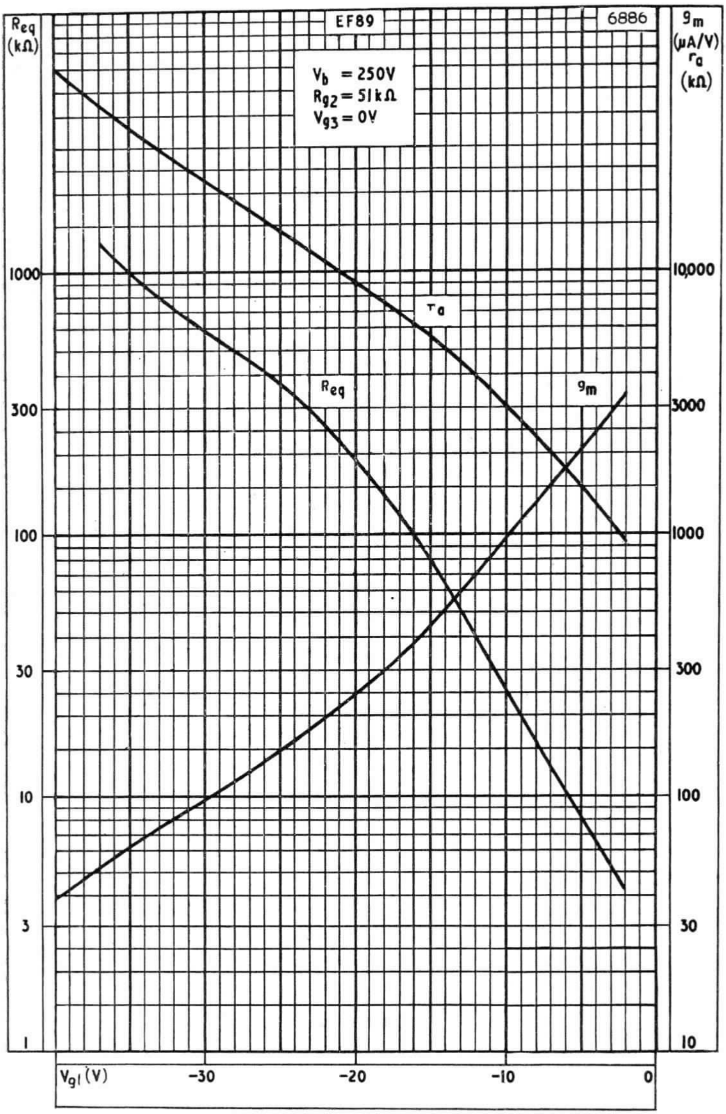
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



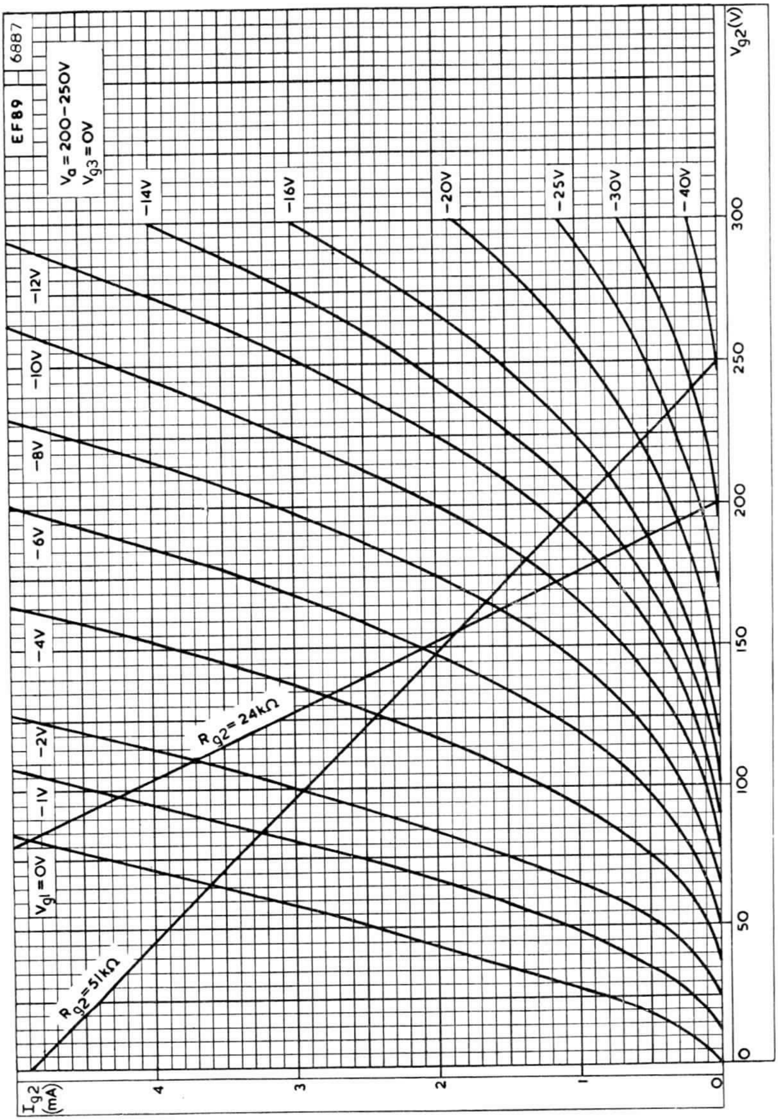
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



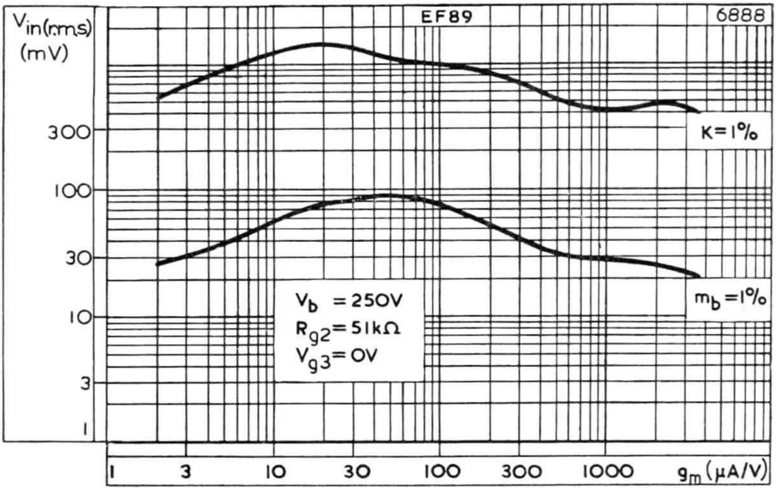
MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. V_b = 200V.

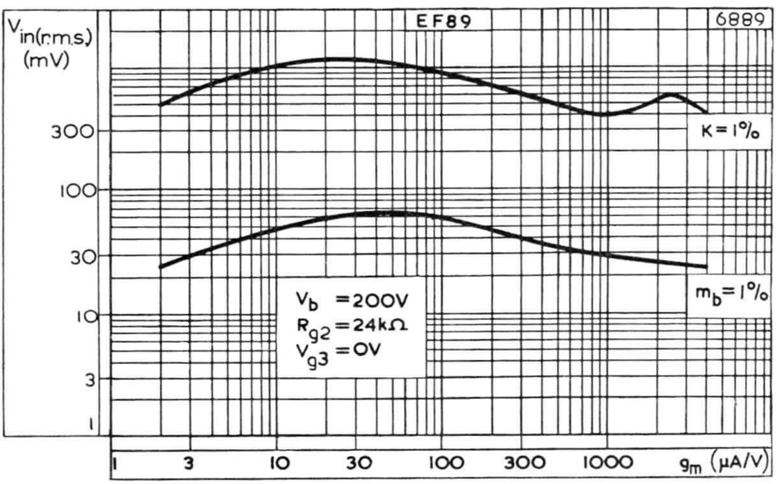


MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_b = 250V$.



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER





CROSS MODULATION AND MODULATION HUM CURVES

R.F. PENTODE

EF97

Pentode with variable mutual conductance for use as r.f. amplifier, i.f. amplifier and mixer in equipment operating directly from a 6V, 12V or 24V battery, on or off charge.

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{out}	4.0	pF
c_{in}	6.5	pF
c_{a-g1}	15	mpF
c_{g1-g2}	3.0	pF

CHARACTERISTICS

V_a	6.3	6.3	12.6	12.6	25	V
V_{g3}	0	0	0	0	0	V
V_{g2}	1.6	3.2	3.2	6.3	6.3	V
V_{g1}	†	†	†	†	†	V
I_a	0.4	1.0	1.0	3.0	3.3	mA
I_{g2}	0.15	0.4	0.35	1.1	0.95	mA
g_m	0.5	1.0	1.1	1.9	2.1	mA/V
r_a	200	70	200	150	50	kΩ
*V_{g1}	−2.5	−2.5	−2.5	−3.5	−3.5	V
**V_{g1}	−3.5	−4.0	−4.0	−5.0	−5.0	V
R_{eq}	15	8.0	7.0	5.5	5.0	kΩ

†Obtained by grid current biasing, $R_{g1} = 10M\Omega$
*For 10 : 1 reduction in g_m
**For 20 : 1 reduction in g_m

OPERATING CONDITIONS AS R.F. MIXER (r.f. voltage on g_1, oscillator voltage on g_3)

V_b	6.3	12.6	25	V
R_{g2}	4.7	3.9	12	kΩ
R_{g3}	100	100	100	kΩ
$V_{osc(r.m.s.)}$	5.0	10	10	V
V_{g1}	†	†	†	V
I_a	0.42	1.1	1.5	mA
I_{g2}	0.6	1.6	1.5	mA
I_{g3}	27	62.5	50	µA
g_c	300	550	655	µA/V
r_a	49	47	47	kΩ
R_{eq}	55	40	40	kΩ
*V_{g1}	−2.5	−3.5	−3.0	V
**V_{g1}	−3.5	−5.0	−4.0	V

†Obtained by grid current biasing, $R_{g1} = 10M\Omega$
*For 10 : 1 reduction in g_m
**For 20 : 1 reduction in g_m

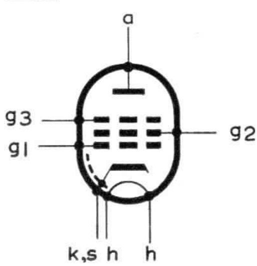
EF97

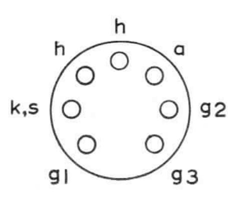
R.F. PENTODE

LIMITING VALUES

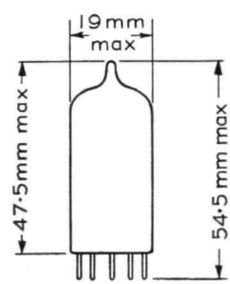
V_a max.	50	V
p_a max.	500	mW
V_{g3} max.	50	V
V_{g2} max.	50	V
p_{g2} max.	500	mW
I_k max.	15	mA
R_{g1} max.	22	MΩ
R_{g3} max.	5.0	MΩ
V_{h-k} max.	50	V

5101





B7G Base



PENTODE

EF98

Pentode for use as an oscillator, r.f. or i.f. amplifier or as a transistor driver, in equipment operating directly from a 6V, 12V or 24V battery, on or off charge.

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{out}	4	pF
c_{in}	6.7	pF
c_{a-g1}	15	mpF
c_{g1-g2}	3	pF

CHARACTERISTICS

V_a	6.3	12.6	25	V
V_{g3}	0	0	0	V
V_{g2}	3.2	6.3	6.3	V
*V_{g1}	*	*	*	V
I_a	0.6	2.0	2.2	mA
I_{g2}	200	700	600	µA
g_m	1.0	2.0	2.1	mA/V
r_a	100	200	90	kΩ
μ_{g1-g2}	3.2	4.1	4.1	

*Obtained by grid current biasing $R_{g1} = 10M\Omega$

OPERATING CHARACTERISTICS AS A TRANSISTOR DRIVER STAGE

Tetrode connection (g3 connected to anode)

V_a	6.3	12.6	25	V
V_{g3}	6.3	12.6	25	V
V_{g2}	6.3	12.6	12.6	V
V_{g1}	*	*	*	V
R_a	5.8	6.0	8.0	kΩ
$I_{a+g3(max.\ sig.)}$	1.1	2.1	3.0	µA
$V_{in(r.m.s.)}$	0.4	1.0	1.2	V
P_{out} ($D_{tot} = 10\%$)	1.2	11	30	mW

*Obtained by grid current biasing $R_{g1} = 10M\Omega$

OPERATING CONDITIONS AS A TRANSISTOR DRIVER STAGE

(driven by triode section of ECH83)

Tetrode connection (g_3 connected to a) with grid current biasing.

V_a	12	V
V_{g3}	12	V
V_{g2}	12.6	V
R_{g1}	10	MΩ
R_a	4.5	kΩ
$I_{a+g3(0)}$	5.5	mA
$I_{a+g3(max.\ sig.)}$	3.0	mA
$I_{g2(0)}$	2.1	mA
$I_{g2(max.\ sig.)}$	1.6	mA
†V_{in}	155	mV
P_{out} (D_{tot} = 10%)	13	mW

†Input voltage for triode section of ECH83 operated under the following conditions:

V_b	12.6	V
R_a	150	kΩ
R_{g1}	10	MΩ
V_{out}/V_{in}	8	

OPERATING CONDITIONS AS R.F. MIXER (r.f. voltage on g_1, oscillator ← voltage on g_3)

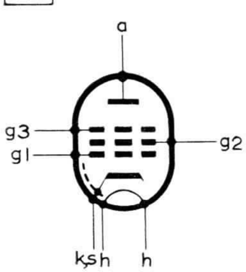
$V_a = V_b$	6.3	12.6	25	V
R_{g3}	100	100	100	kΩ
R_{g2}	12	6.8	22	kΩ
$V_{osc(r.m.s.)}$	6.0	6.0	12	V
V_{g1}	*	*	*	V
I_a	0.25	1.05	1.1	mA
I_{g2}	300	950	900	μA
g_c	310	675	705	μA/V
r_a	80	45	65	kΩ

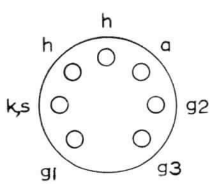
*Obtained by grid current biasing, R_{g1} = 10MΩ.

LIMITING VALUES

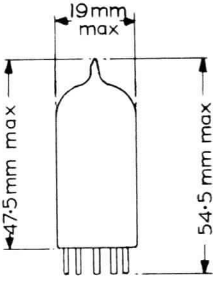
V_a max.	50	V
p_a max.	500	mW
V_{g3} max.	50	V
V_{g2} max.	50	V
p_{g2} max.	500	mW
I_k max.	15	mA
R_{g1} max.	22	MΩ
R_{g3} max.	100	kΩ
V_{h-k} max.	50	V

5101





B7G Base



DUAL-CONTROL HEPTODE

EH90

Dual-control heptode for use in television receivers.

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{a-g1}	<70	mpF
c_{a-g3}	<360	mpF
$c_{in(g1)}$	5.5	pF
$c_{in(g3)}$	7.0	pF
c_{out}	7.5	pF
c_{g1-g3}	<220	mpF

CHARACTERISTICS

V_a	10	100	100	V
V_{g2+g4}	30	30	30	V
V_{g1}	0	0	–1.0	V
V_{g3}	0	–1.0	0	V
I_a	2.0	0.8	0.75	mA
I_{g2+g4}	3.5	4.0	1.1	mA
$g_{m(g1-a)}$	—	—	1.2	mA/V
$g_{m(g3-a)}$	—	1.55	—	mA/V
r_a	—	400	900	kΩ
V_{g1} ($I_a = 50\mu A$)	—	—	–2.5	V
V_{g3} ($I_a = 50\mu A$)	—	–2.2	—	V

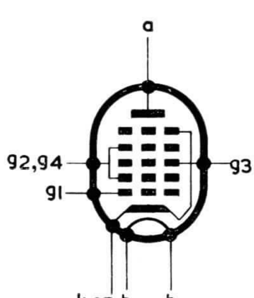
DESIGN CENTRE RATINGS

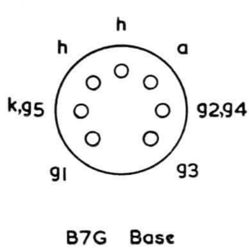
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2+g4(b)}$ max.	300	V
V_{g2+g4} max.	100	V
p_{g2+g4} max.	1.0	W
I_k max.	14	mA
R_{g1-k} max.	470	kΩ
R_{g3-k} max.	2.2	MΩ
R_{g3-k} max. ($V_{g2+g4} \leqslant 30V$)	5.0	MΩ
V_{h-k} max. (cathode positive)	200	V
V_{h-k} max. (cathode negative)	100	V

EH90

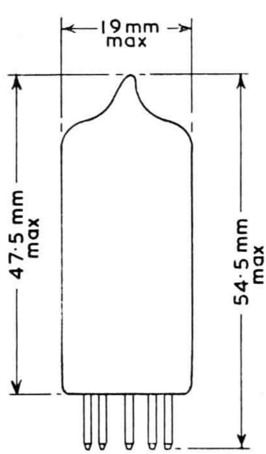
DUAL-CONTROL HEPTODE

6642

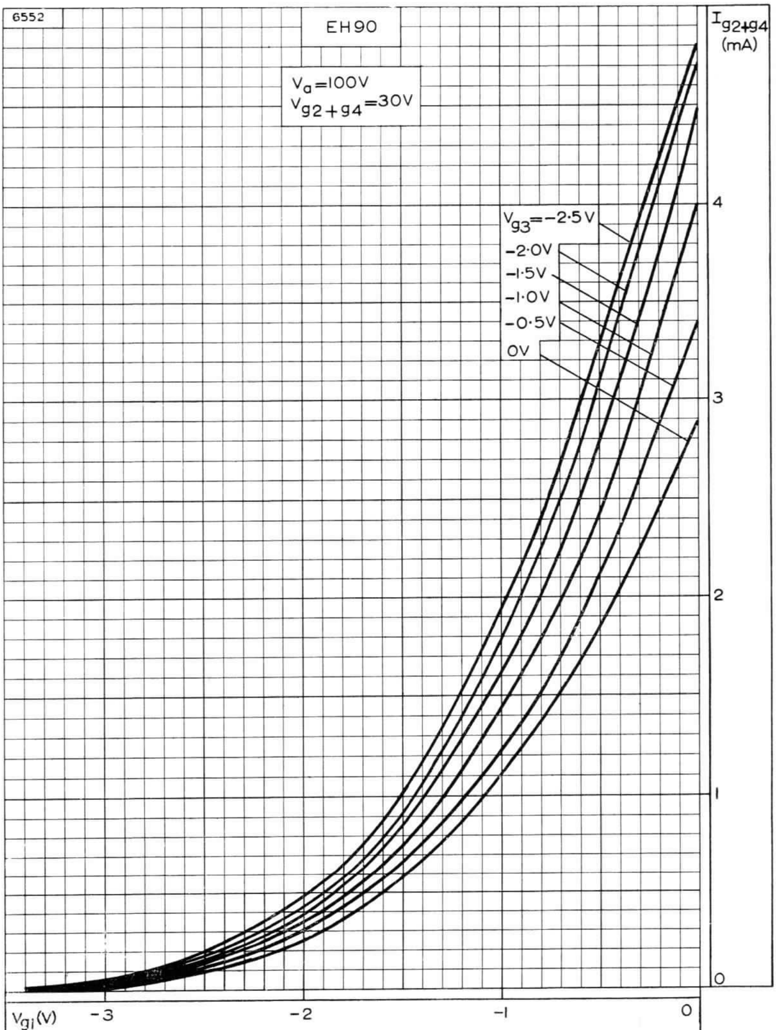




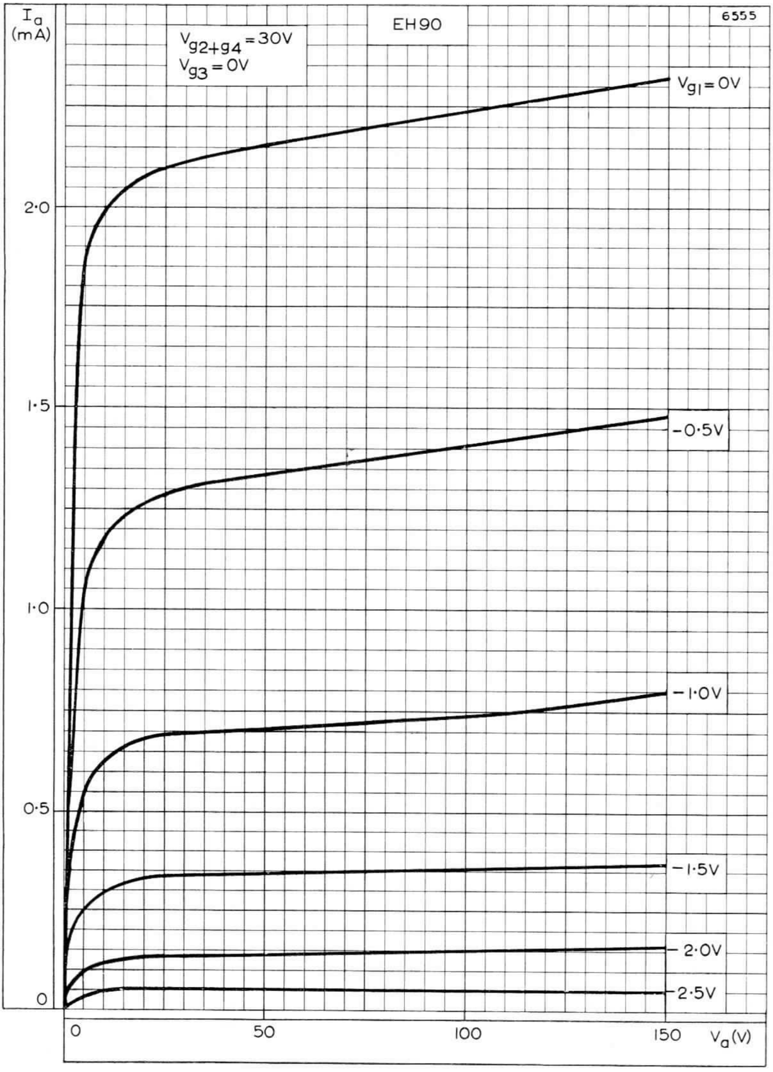
B7G Base



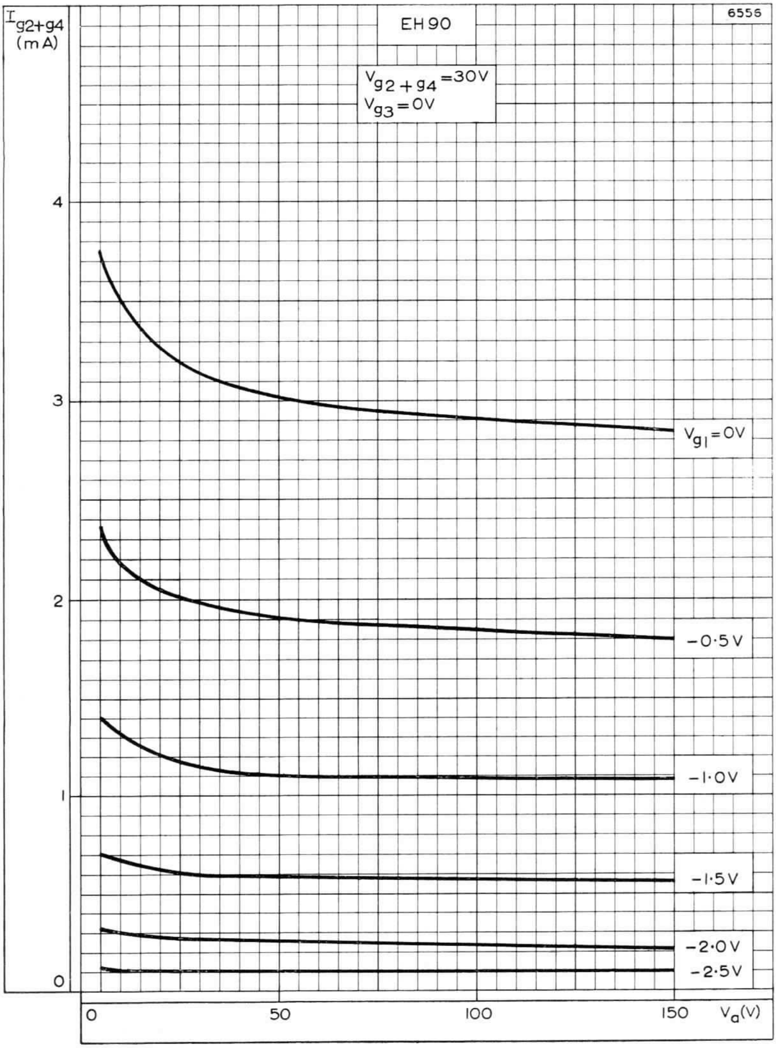
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID (g_1) VOLTAGE WITH CONTROL-GRID (g_3) VOLTAGE AS PARAMETER



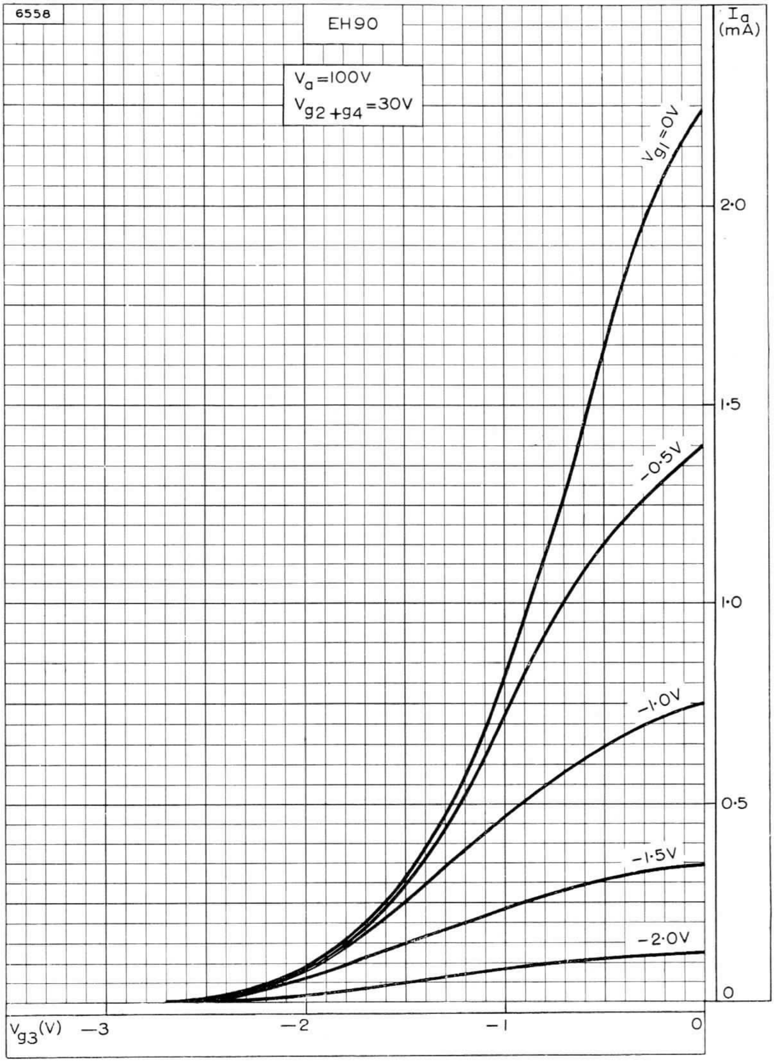
SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID (g_1) VOLTAGE WITH CONTROL-GRID (g_3) VOLTAGE AS PARAMETER



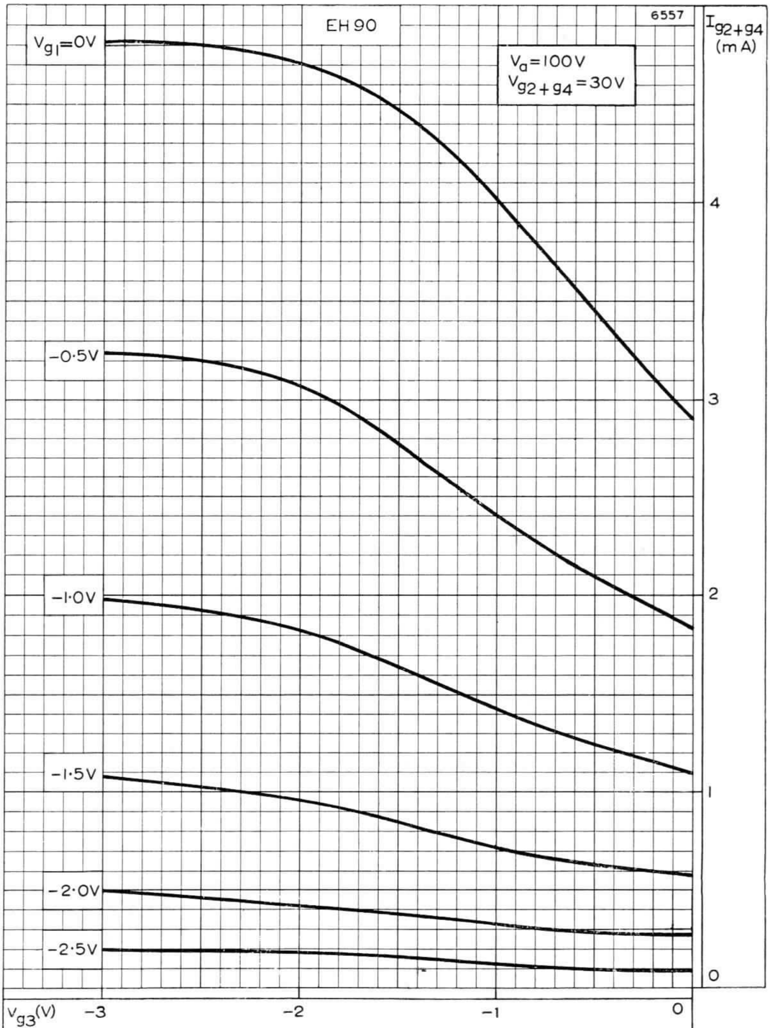
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER



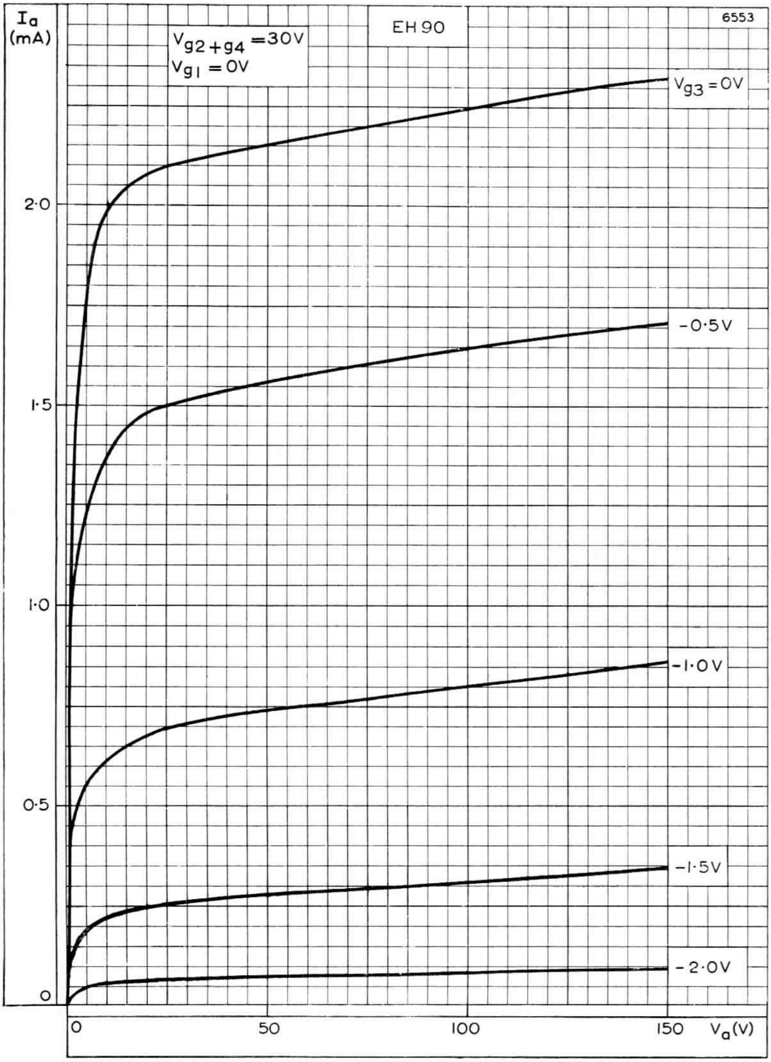
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER



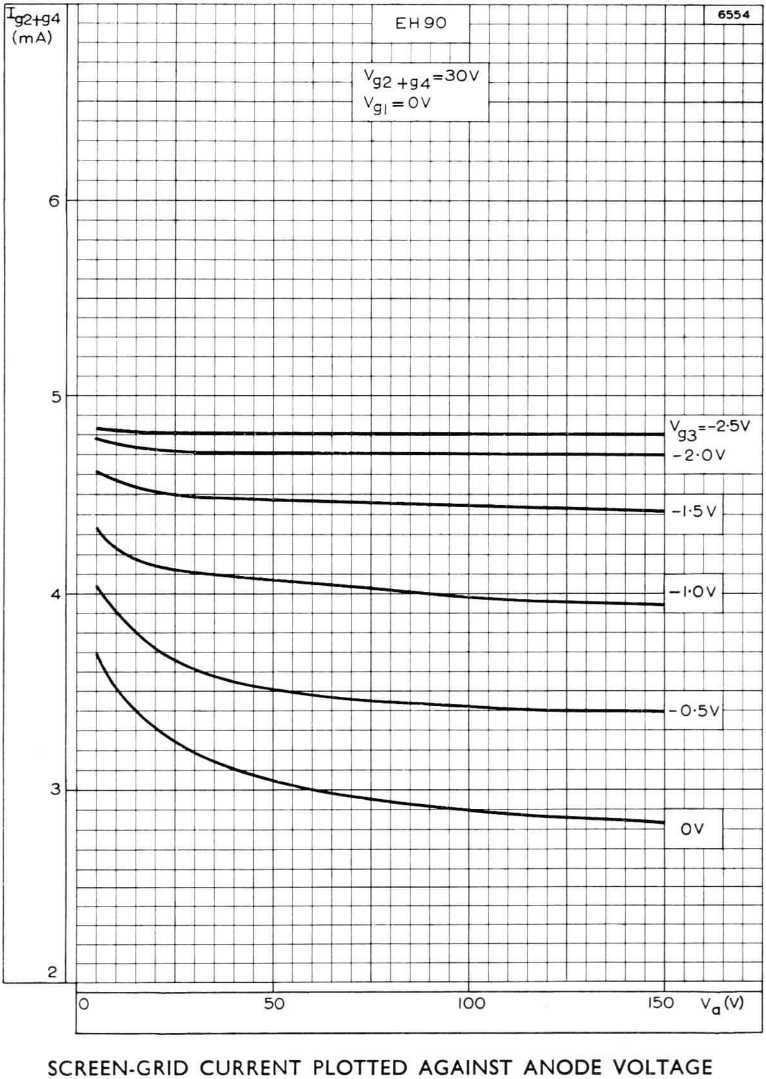
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID (g_3) VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER



SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID (g_3) VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_3) VOLTAGE AS PARAMETER



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_3) VOLTAGE AS PARAMETER

OUTPUT PENTODE

EL33

High-sensitivity output pentode for use in A.C. mains-operated equipment.

HEATER

V_h	6.3	V
I_h	0.9	A

CAPACITANCE

c_{a-g1}	1.0	μμF

OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_a	250	V
V_{g2}	250	V
I_a	36	mA
V_{g1}	−6.0	V
I_{g2}	4.0	mA
g_m	9.0	mA/V
r_a	50	kΩ
μ_{g1-g2}	23	
P_{out}	4.0	W
R_a	7.0	kΩ
$V_{in(r.m.s.)}$	4.2	V
$V_{in(r.m.s.)}$ (P_{out}=50 mW)	0.33	V
D_{tot}	10	%
R_k	150	Ω

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

V_a	250	V
V_{g2}	250	V
$I_{a(o)}$	2×24	mA
I_a max.	2×28.5	mA
$I_{g2(o)}$	2×2.8	mA
I_{g2} max.	2×4.6	mA
R_k	140	Ω
R_{a-a}	10	kΩ
P_{out}	8.2	W
$V_{in(r.m.s.)}$	6.7	V
D_{tot}	3.1	%

OPERATING CONDITIONS AS TRIODE (g_2 connected to a)

V_a	250	V
I_a	20	mA
V_g	−8.5	
g_m	6.5	mA/V
μ	20	
r_a	3.0	kΩ
R_k	425	Ω
R_a	7.0	kΩ
P_{out}	1.1	W
D_{tot}	5.0	%
$V_{in(r.m.s.)}$	5.9	V
$V_{in(r.m.s.)}$ (P_{out}=50 mW)	1.1	V

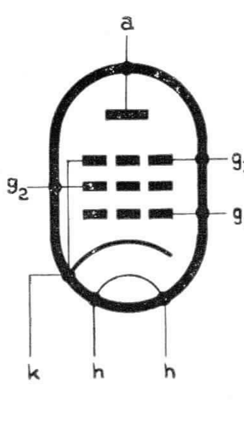
EL33

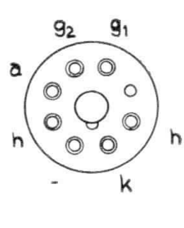
OUTPUT PENTODE

High-sensitivity output pentode for use in A.C. mains-operated equipment.

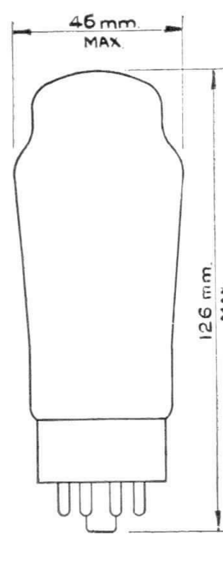
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	9.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max. (zero 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.	1.0	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	5.0	kΩ





OCTAL BASE



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. ($I_{g1} = +0.3\mu A$)	–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%.

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.

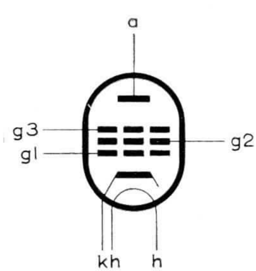
DESIGN CENTRE RATINGS

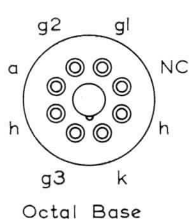
$V_{a(b)}$ max.	2.0	kV
V_a max.	800	V
p_a max.	25	W
$V_{g2(b)}$ max.	800	V
V_{g2} max.	500	V
p_{g2} max.	8.0	W
I_k max.	150	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

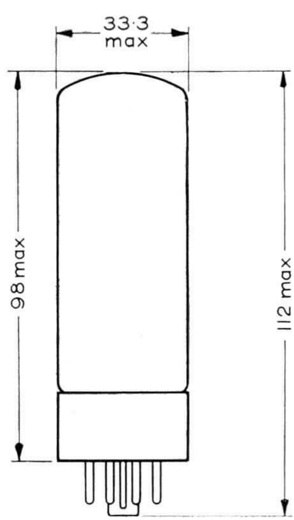
Triode connected

V_a max.	600	V
p_{a+g2} max. (V_a = 500V)	30	W
p_{a+g2} max. (V_a = 600V)	15	W

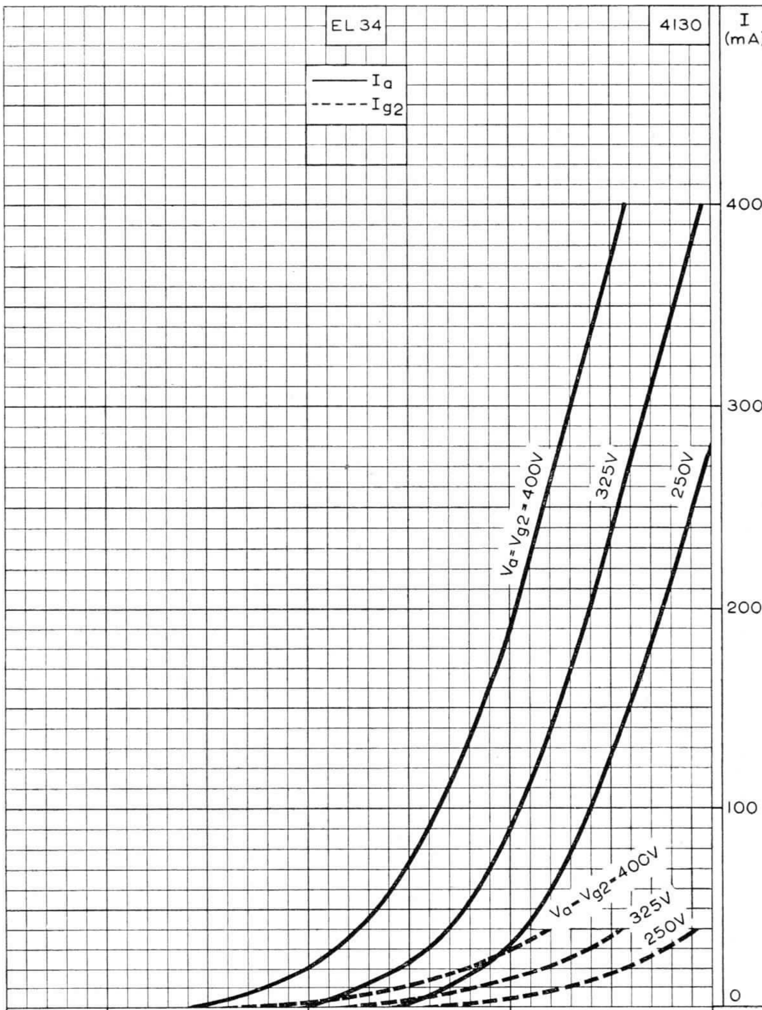
6299







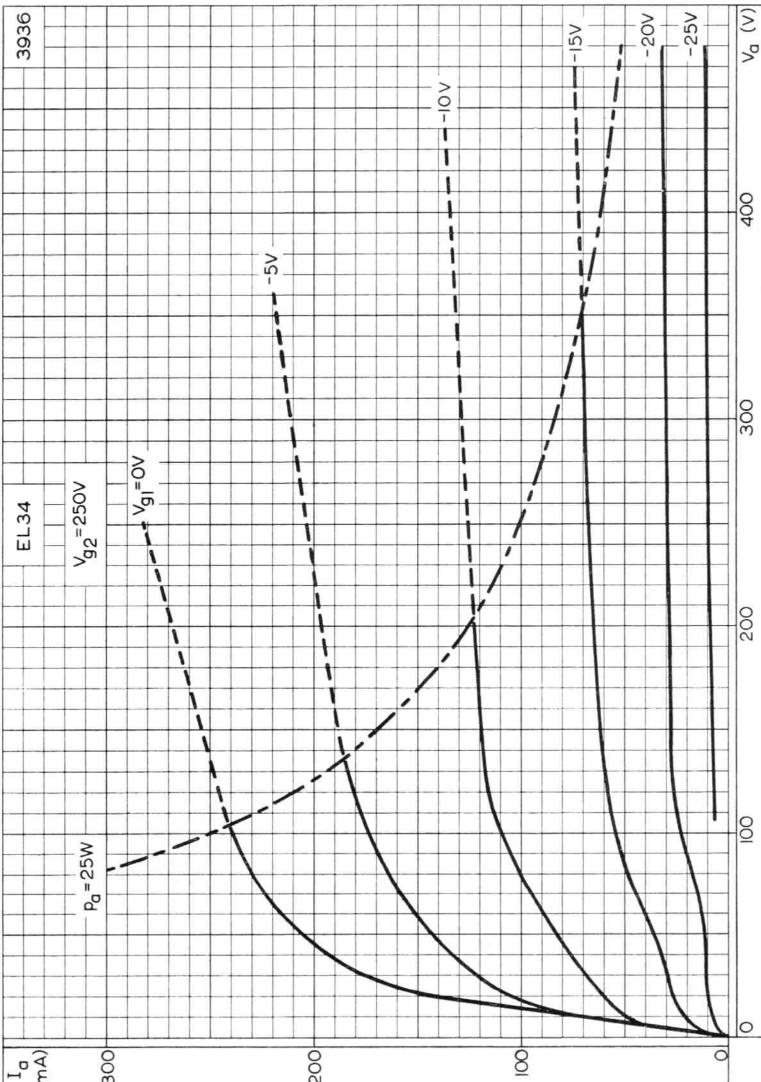
All dimensions in mm



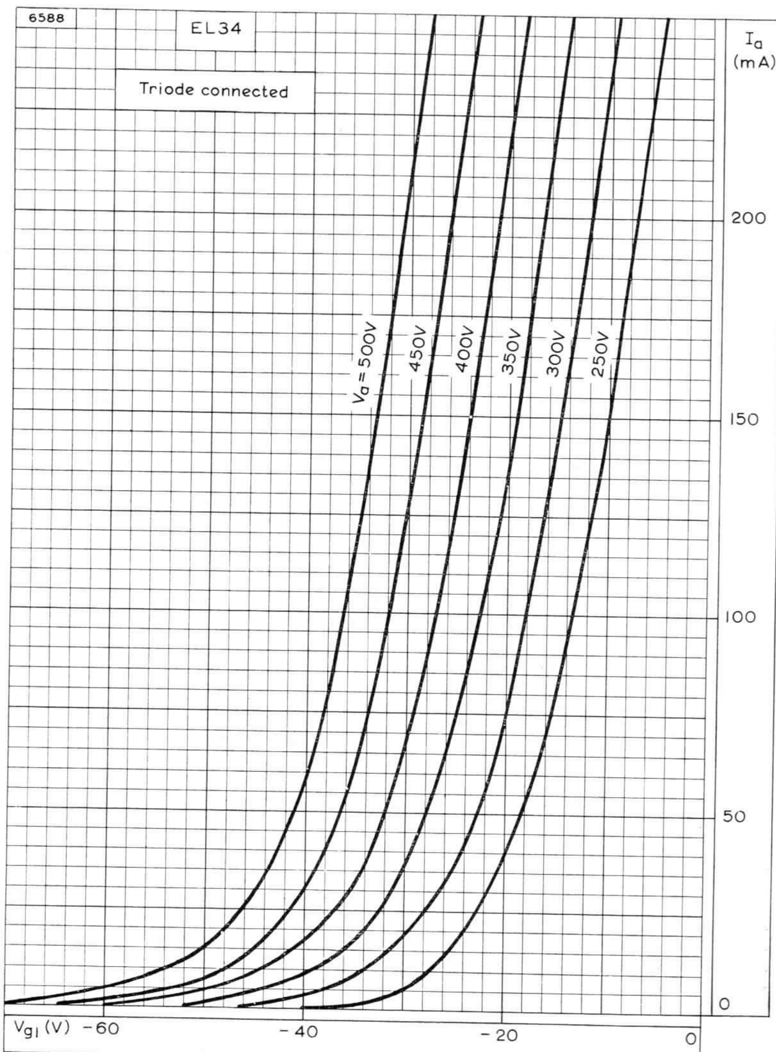
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS

EL34

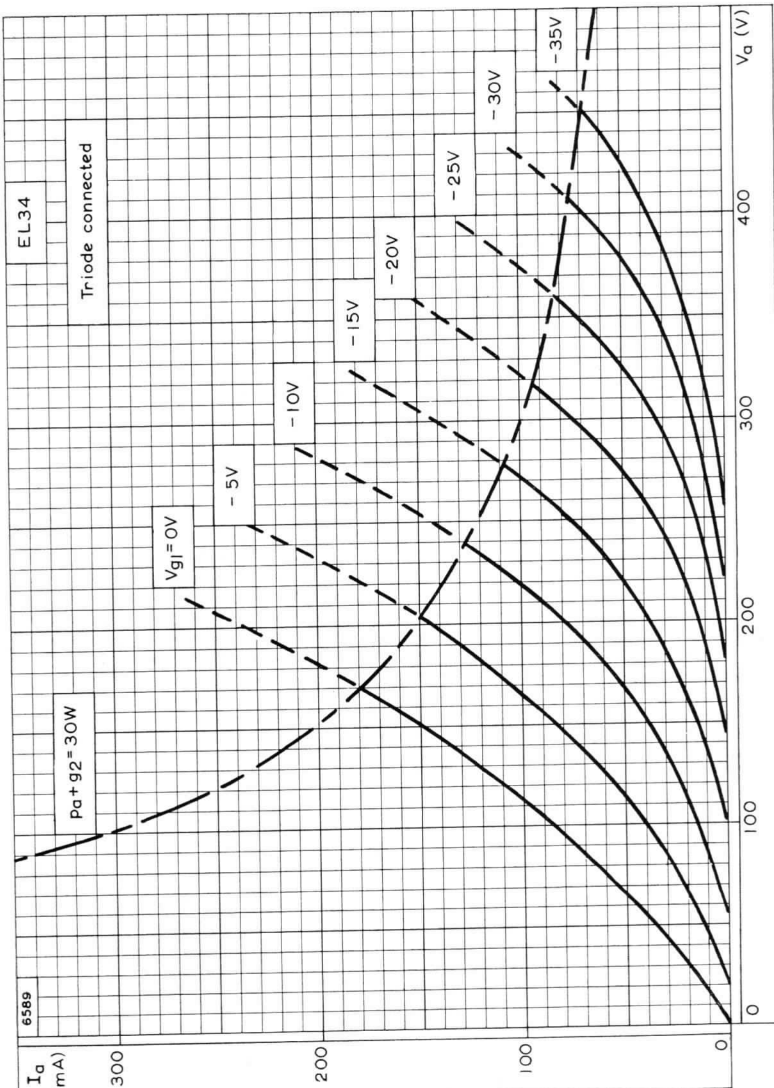
OUTPUT PENTODE



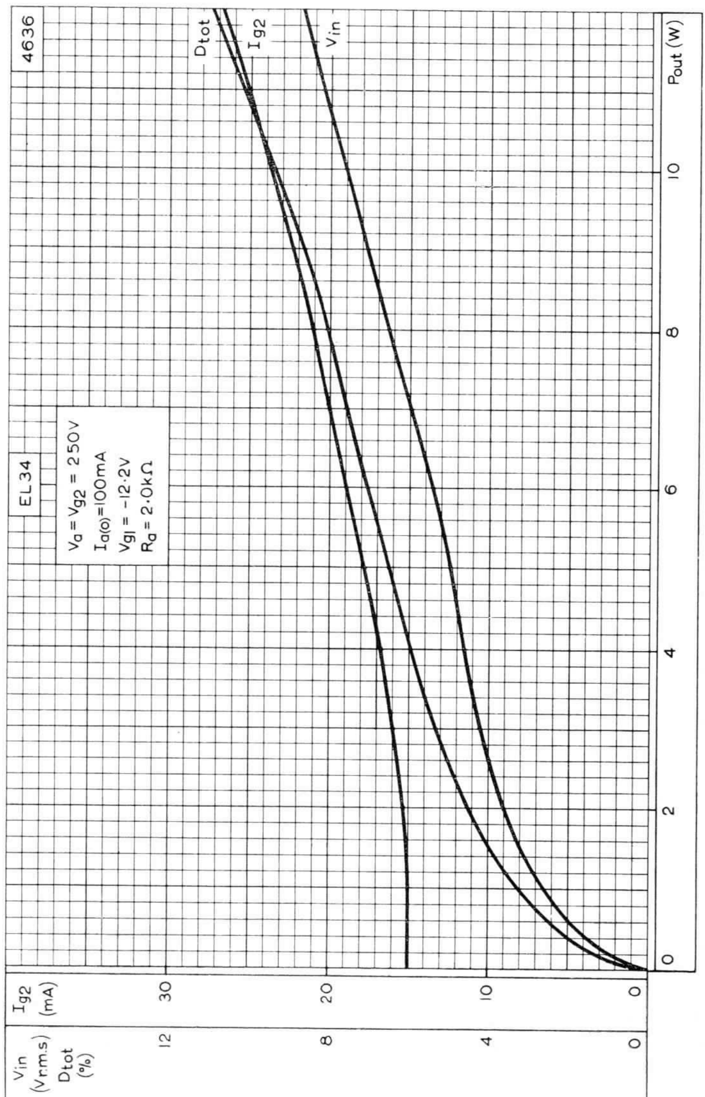
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



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



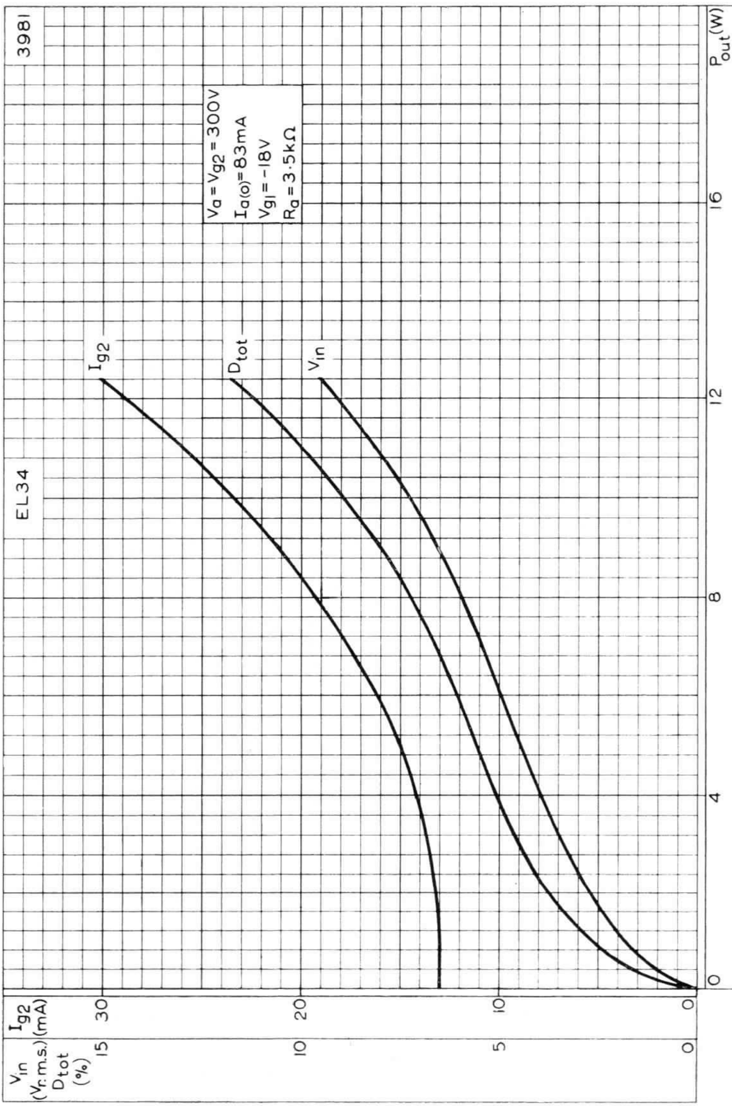
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED



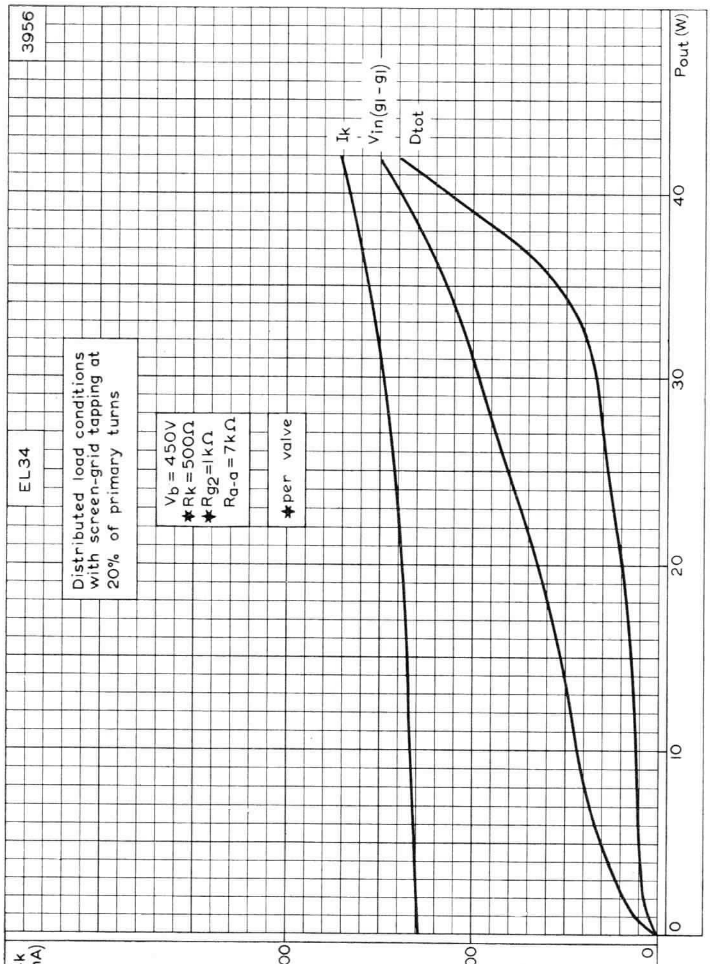
PERFORMANCE OF EL34 WHEN USED AS A SINGLE VALVE CLASS 'A' AMPLIFIER. $V_a = 250V$

EL34

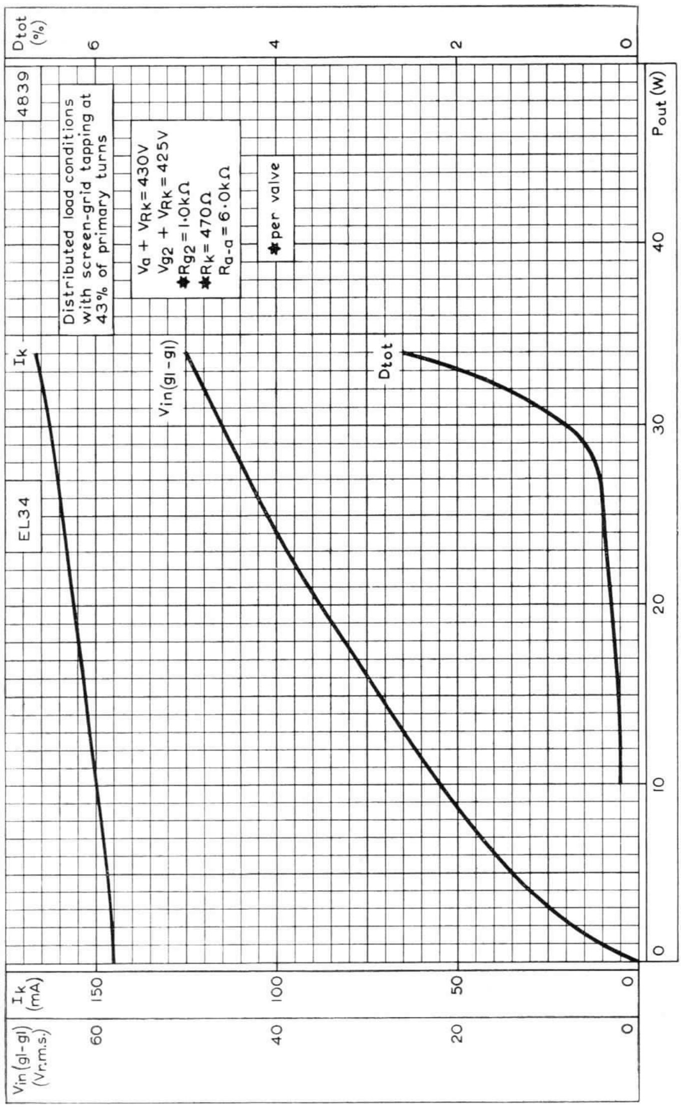
OUTPUT PENTODE



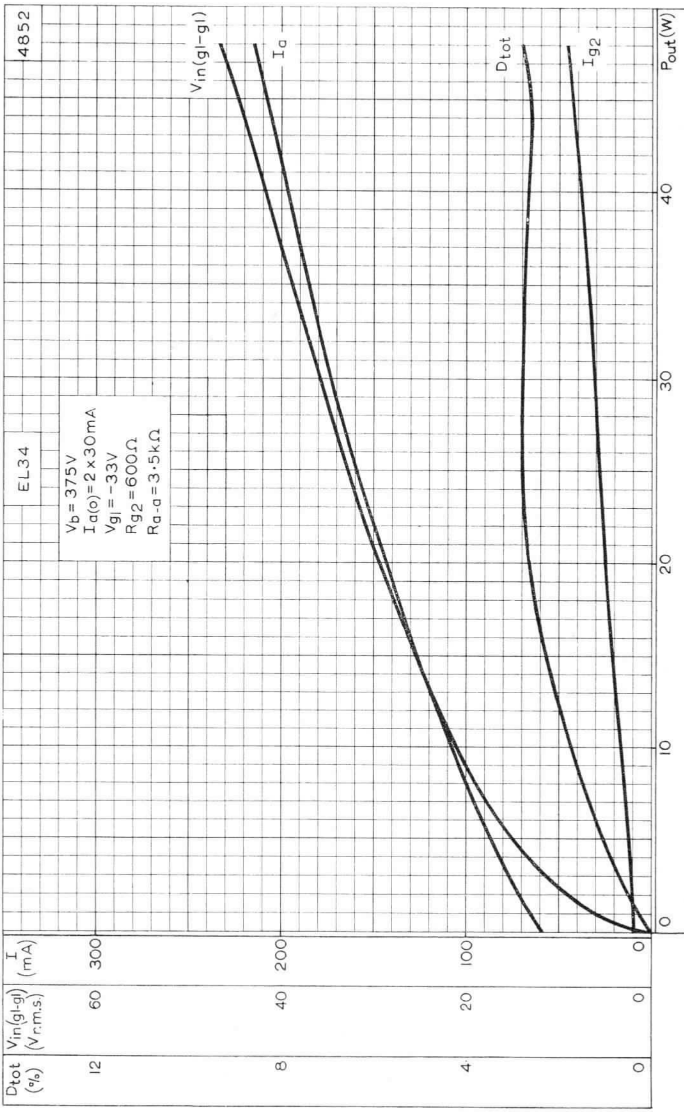
PERFORMANCE OF EL34 WHEN USED AS A SINGLE VALVE CLASS 'A' AMPLIFIER. $V_a = 300V$



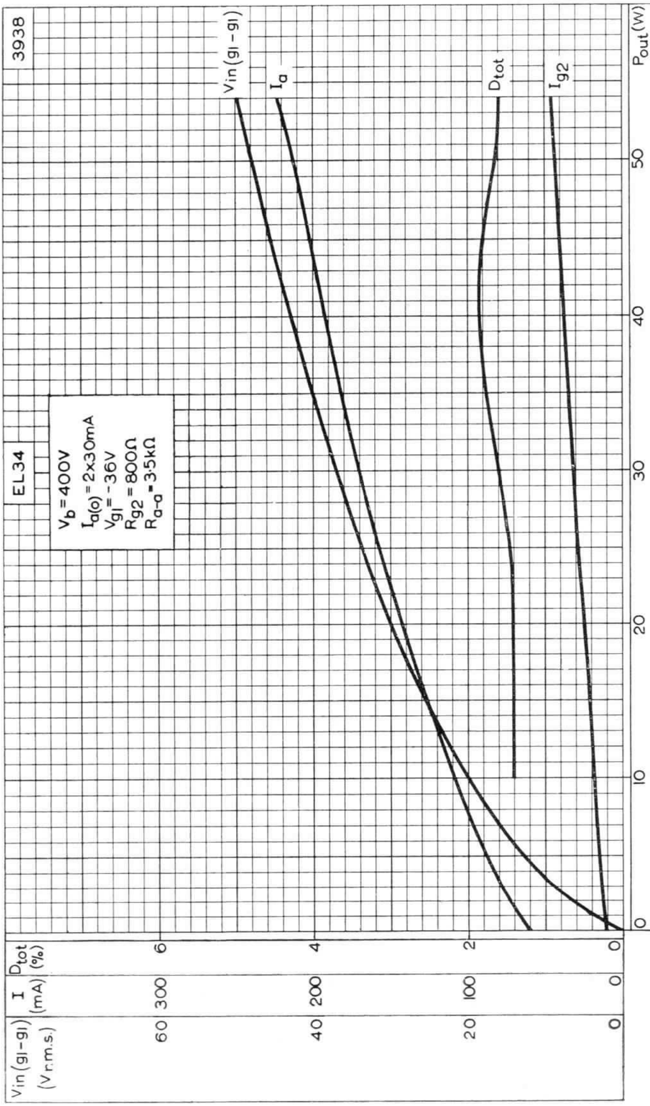
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS



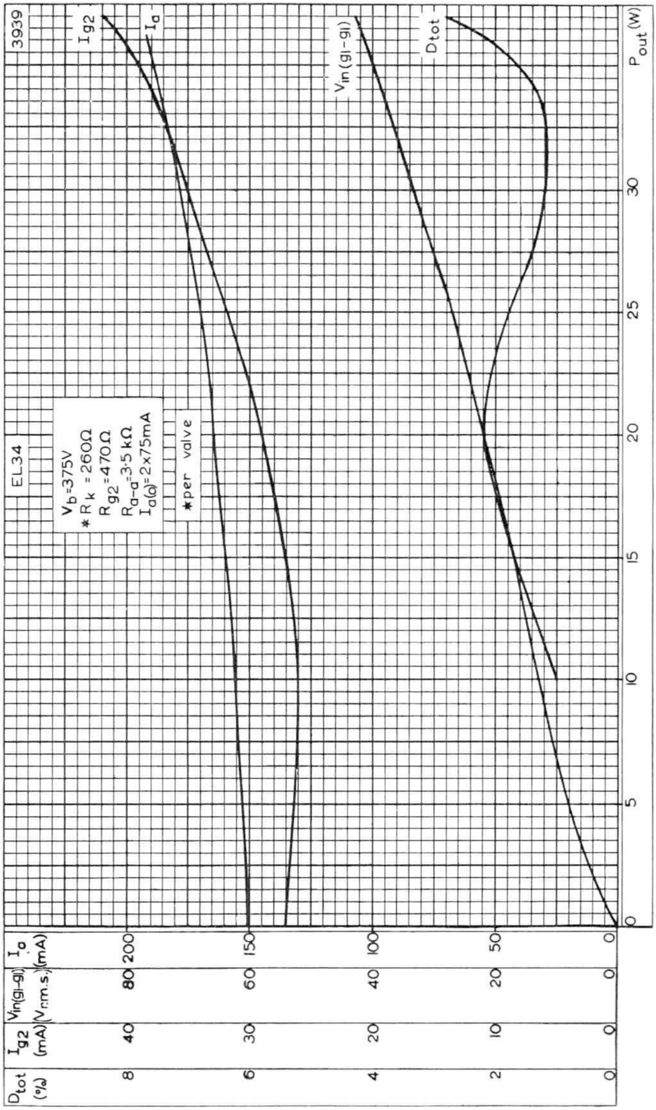
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS



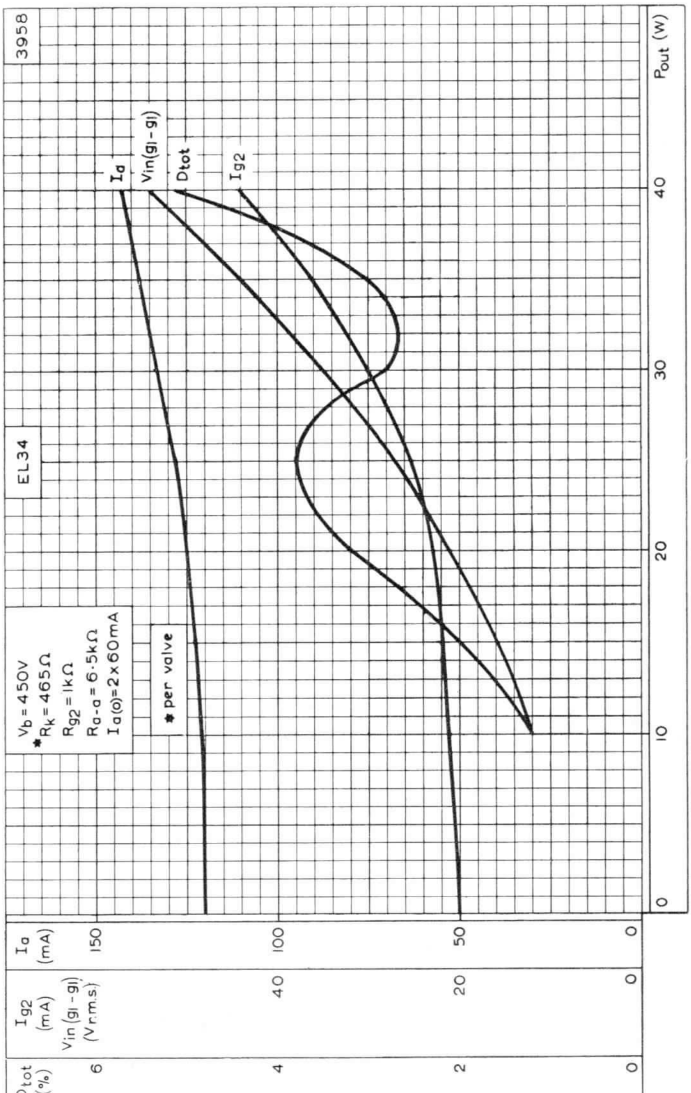
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH FIXED BIAS
$V_b = 375V$



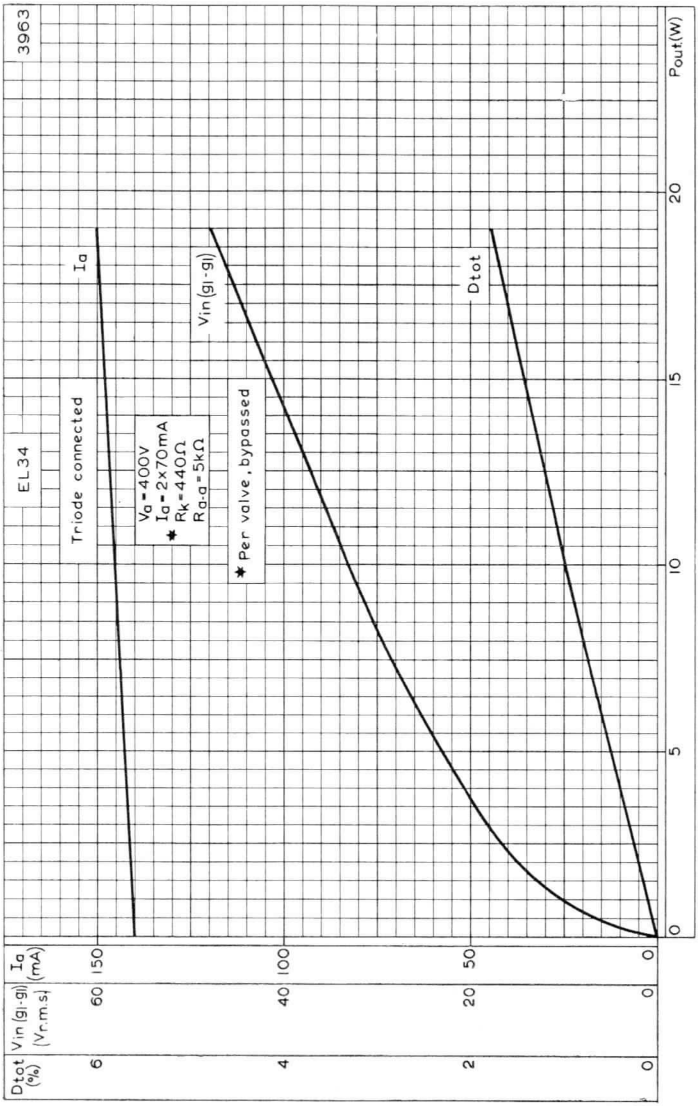
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH FIXED BIAS
$V_b = 400V$



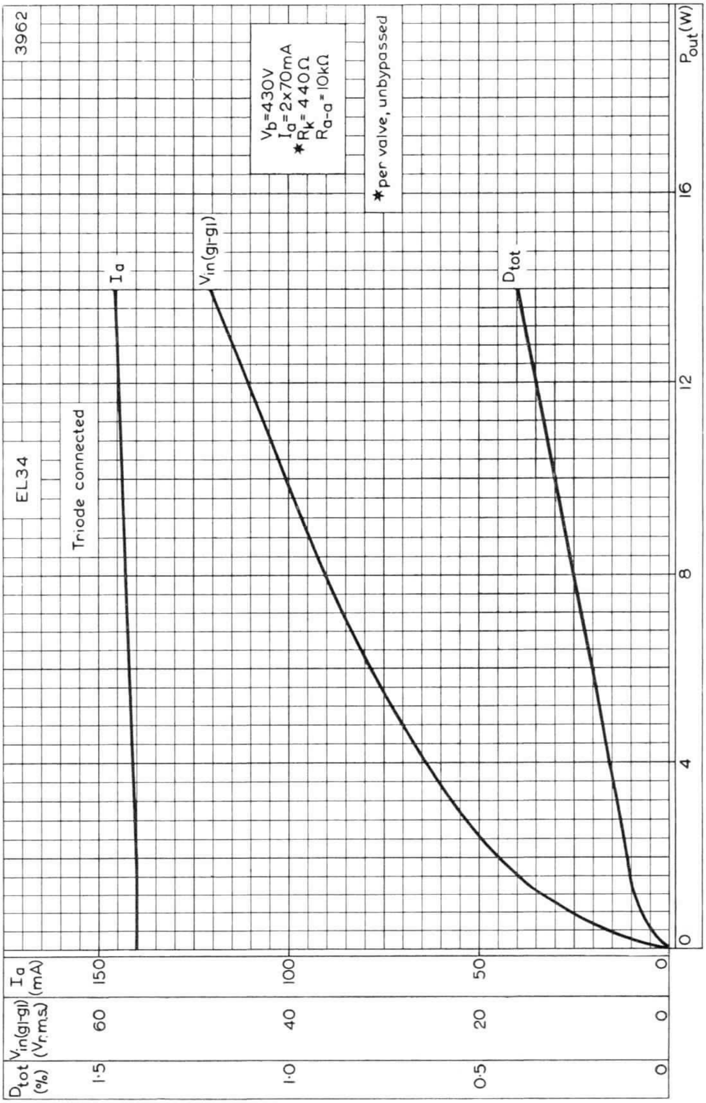
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH CATHODE BIAS
$V_b = 375V$



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

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.

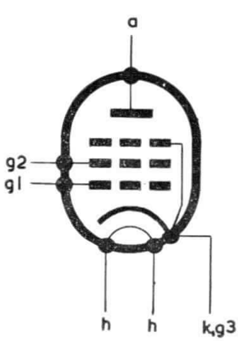
R_{g1-k} max. (cathode bias)	500	k Ω
R_{g1-k} max. (fixed bias)	100	k Ω
p_a max.	25	W
p_{g2} max.	6.0	W
I_k max.	200	mA

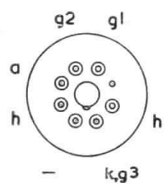
LIMITING VALUES — TRIODE CONNECTED (NORMAL APPLICATIONS)

V_{a+g2} max.	400	V
p_{a+g2} max.	28	W

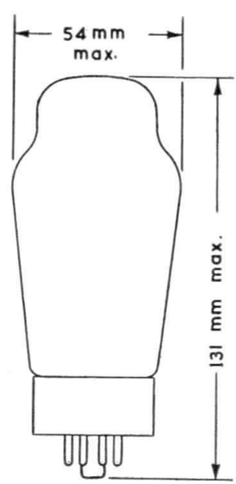
LIMITING VALUES — TRIODE CONNECTED (IN CATHODE-COUPLED PUSH-PULL DRIVER STAGE FOR LARGE POWER TRIODES)

V_{a+g2} max.	500	V
p_{a+g2} max.	12.5	W





OCTAL BASE



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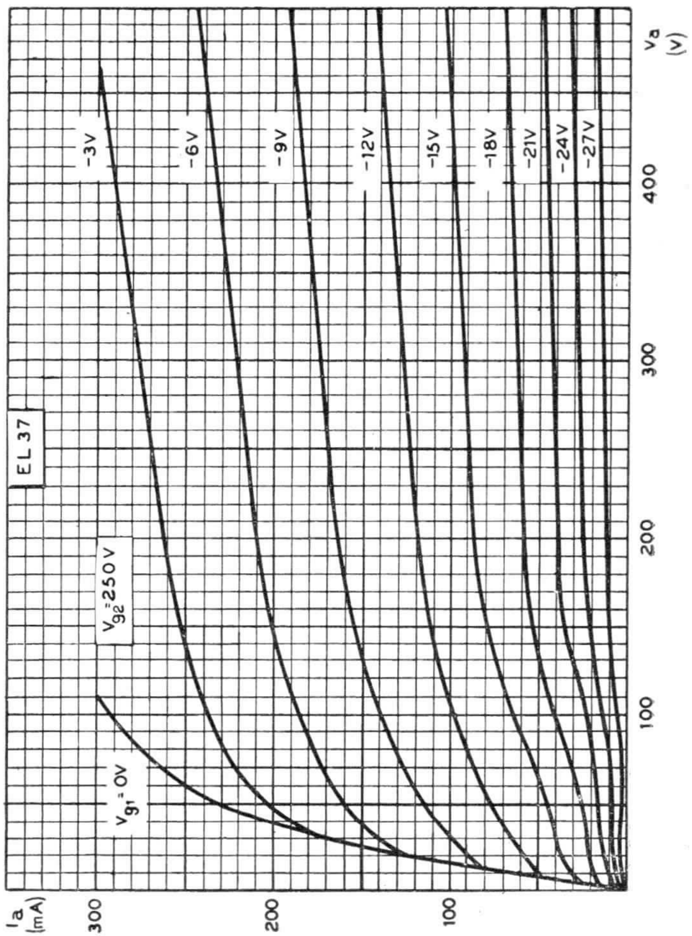
EL37

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 $\nless$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.

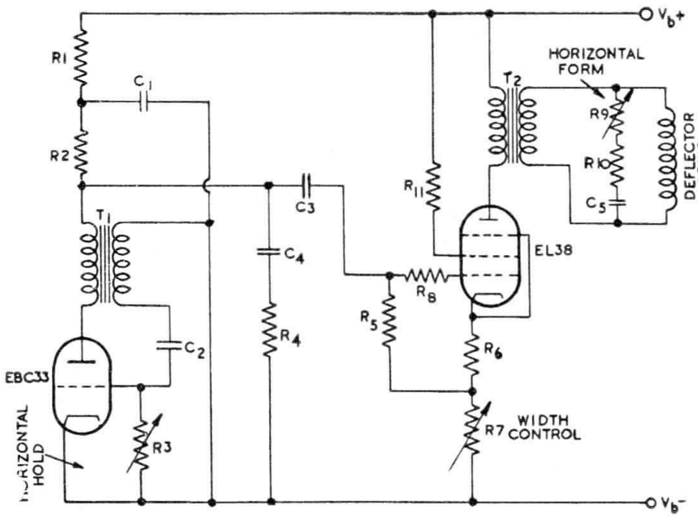
(ii) The decoupling components (R_1 C_1) in the anode circuit of the EBC33 are necessary only if there is ripple on the H.T. line.

(iii) All potentiometers should be linear components to provide smooth control.

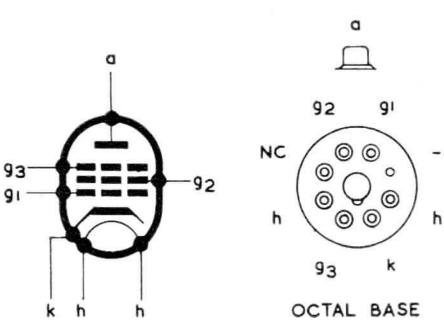
OUTPUT PENTODE

EL38

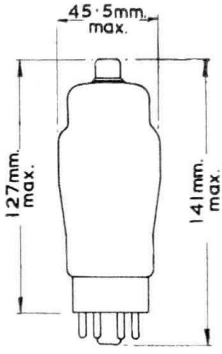
Output pentode primarily intended for use as line time base output valve in A.C. television receivers.



LINE TIME BASE CIRCUIT



OCTAL BASE

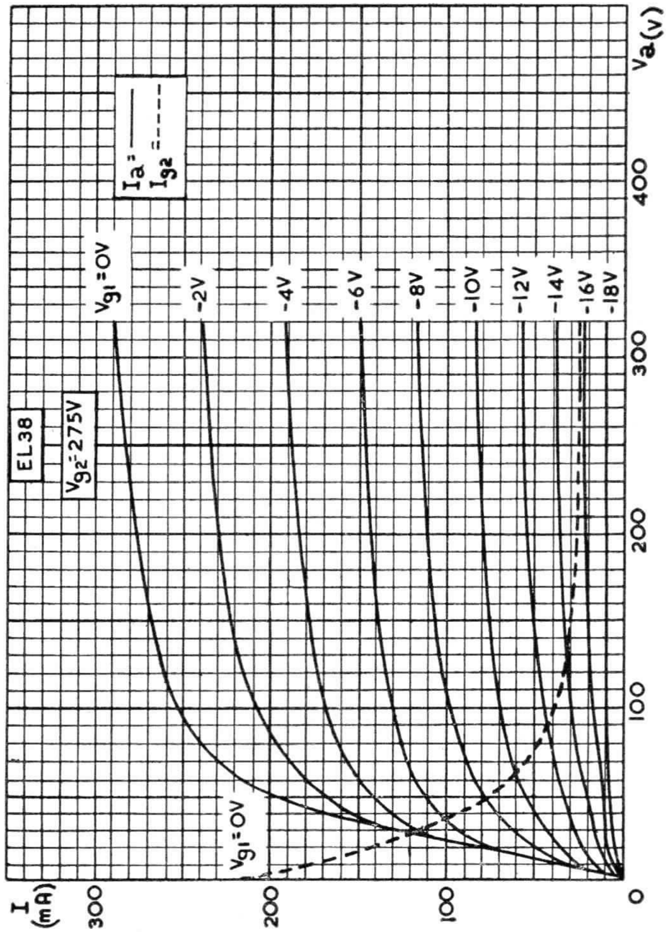


732

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	k Ω
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	k Ω
$V_{in\ (r.m.s.)}$ (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	k Ω
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_{g2}	250	300	V
$I_{a(0)}$	2×25	2×30	mA
I_a (max. sig.)	2×30	2×36	mA
$I_{g2(0)}$	2×3.5	2×4	mA
I_{g2} (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
$I_{a\ (0)}$	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	%

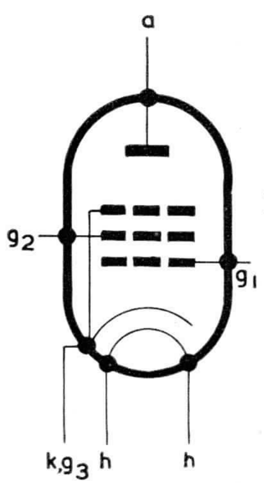
LIMITING VALUES

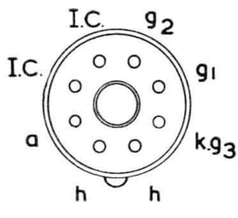
$V_{a\ (b)}$ max.	550	V
V_a max.	300	V
p_a max.	9	W
$V_{g2\ (b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} (zero sig.) max.	1.4	W
p_{g2} (max. sig.) max.	3.3	W
I_k max.	55	mA
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
R_{g1-k} max.	1	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ

OUTPUT PENTODE

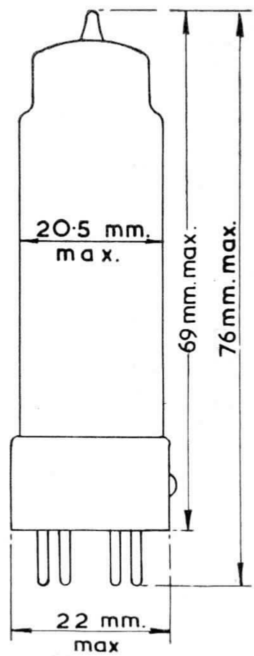
EL41

Output pentode rated for 9W anode dissipation, primarily intended for use in A.C. mains operated equipment.





B8A BASE

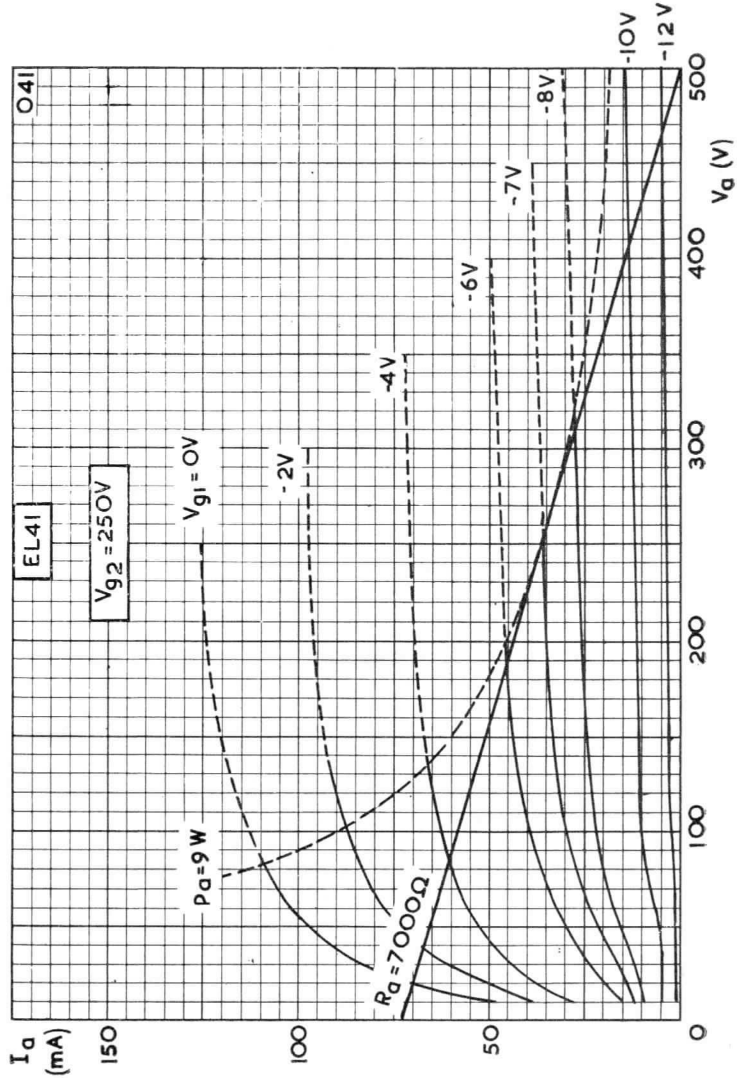


852

EL41

OUTPUT PENTODE

Output pentode rated for 9W anode dissipation, primarily intended for use in A.C. mains operated equipment.



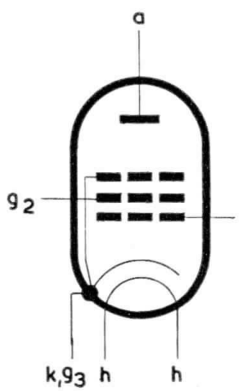
ANODE CURRENT PLOTTED AGAINST ANODE VOLTS

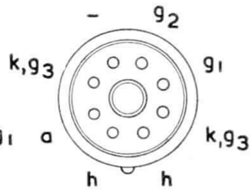
OUTPUT PENTODE

EL42

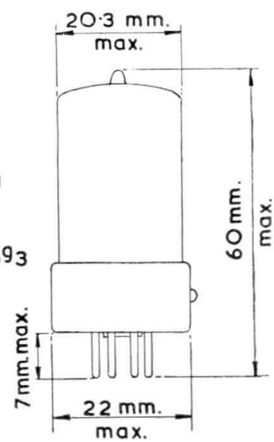
Output pentode with an anode dissipation of 6W, suitable for use in car radio receivers.

The limiting values, characteristics and audio performance of the EL42 and EL85 are identical. The basing and dimensions of the EL42 are shown below.





B8A BASE



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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

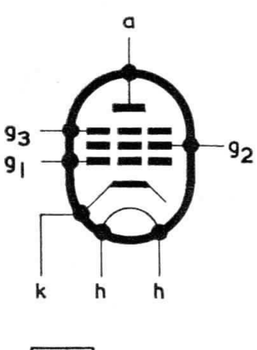
OUTPUT PENTODE

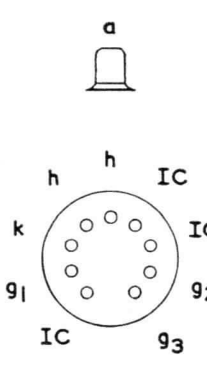
Output pentode suitable for use in the line time base of television receivers or as a series regulator valve in stabilised power supply units.

LIMITING VALUES

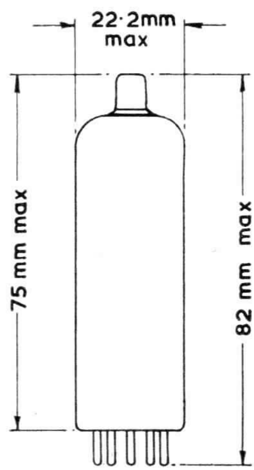
$V_{a(b)}$ max.	550	V
V_a max.	300	V
*$v_{a(pk)}$ max.	7.0	kV
p_a max.	8.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	4.5	W
p_{a+g2} max.	10	W
I_k max.	180	mA
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	185	°C

*Max. pulse duration 18% of one cycle, with a maximum of 18μs





B9A Base



2710

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

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
$I_{a(0)}$	2×31	2×36	mA
$I_{g2(0)}$	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
$I_{k(0)}$	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
$I_{k(0)}$	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
$I_{a(0)}$	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.

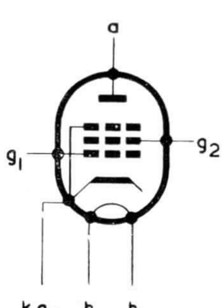
LIMITING VALUES

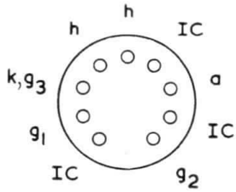
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	2.0	W
I_k max.	65	mA
$-V_g$ max.	100	V
R_{g1-k} max.	300	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

EL84

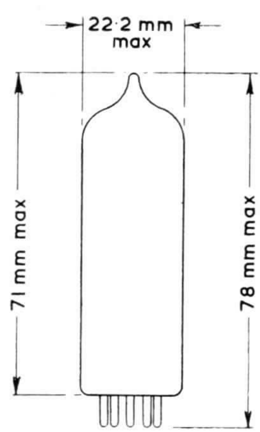
OUTPUT PENTODE

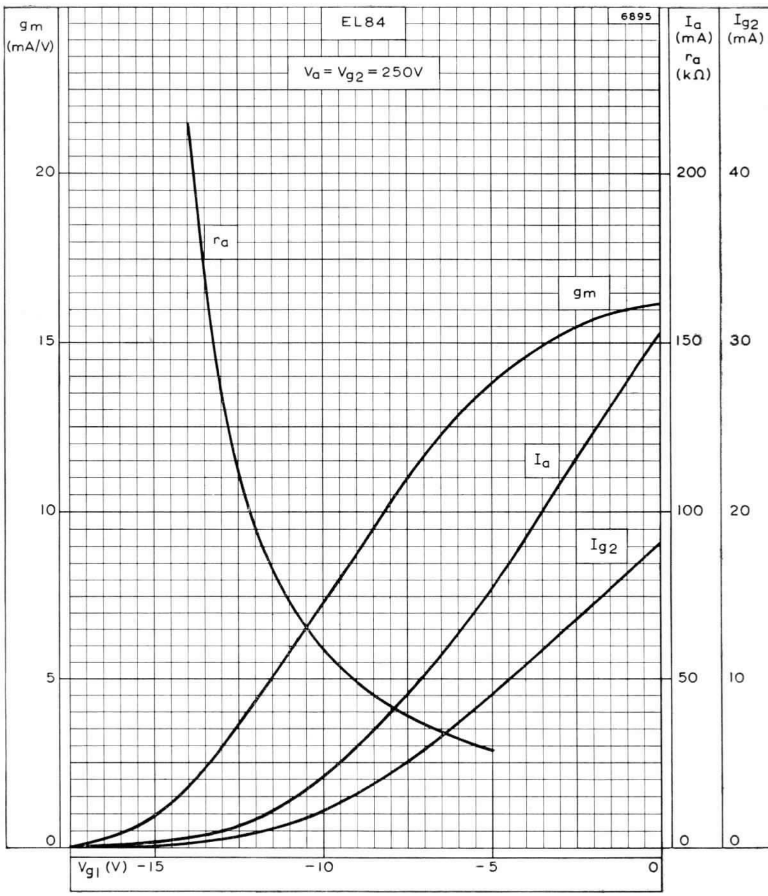
2834



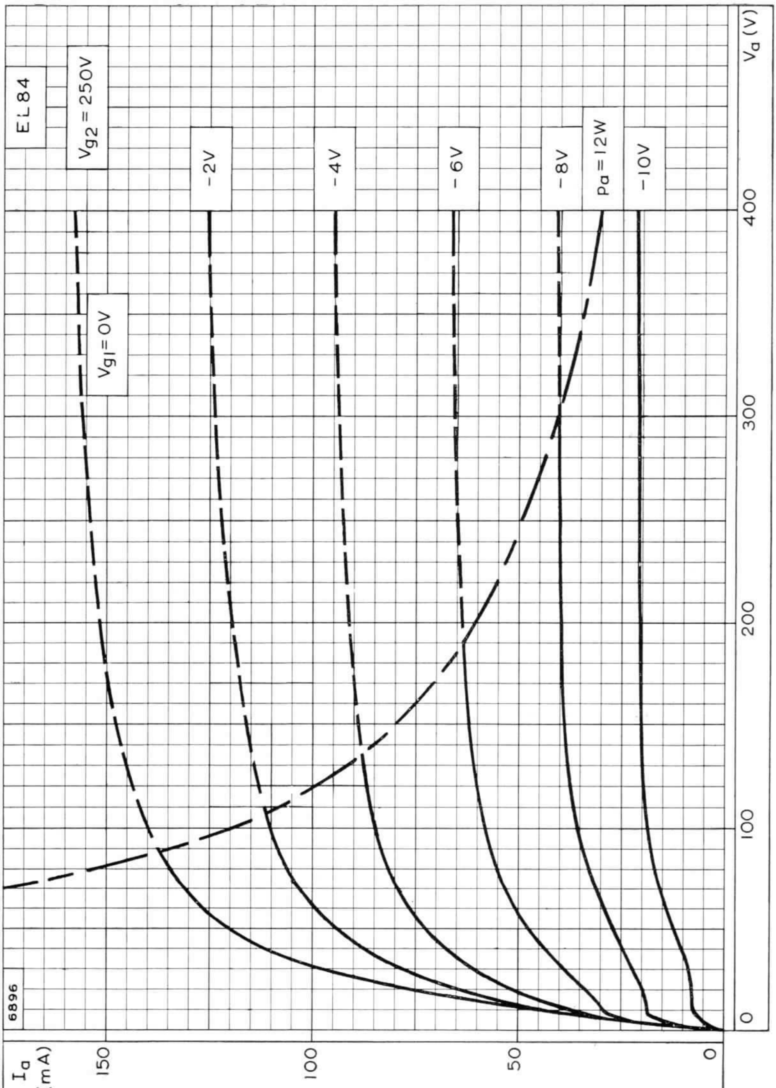


B9A Base

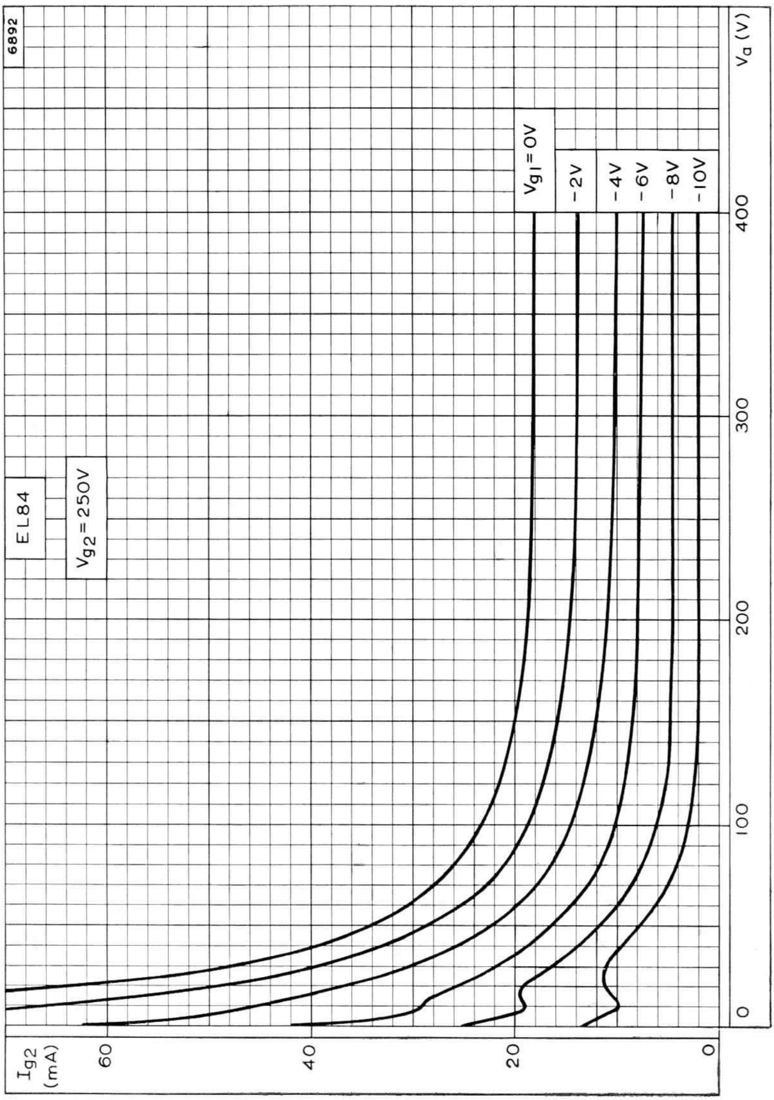




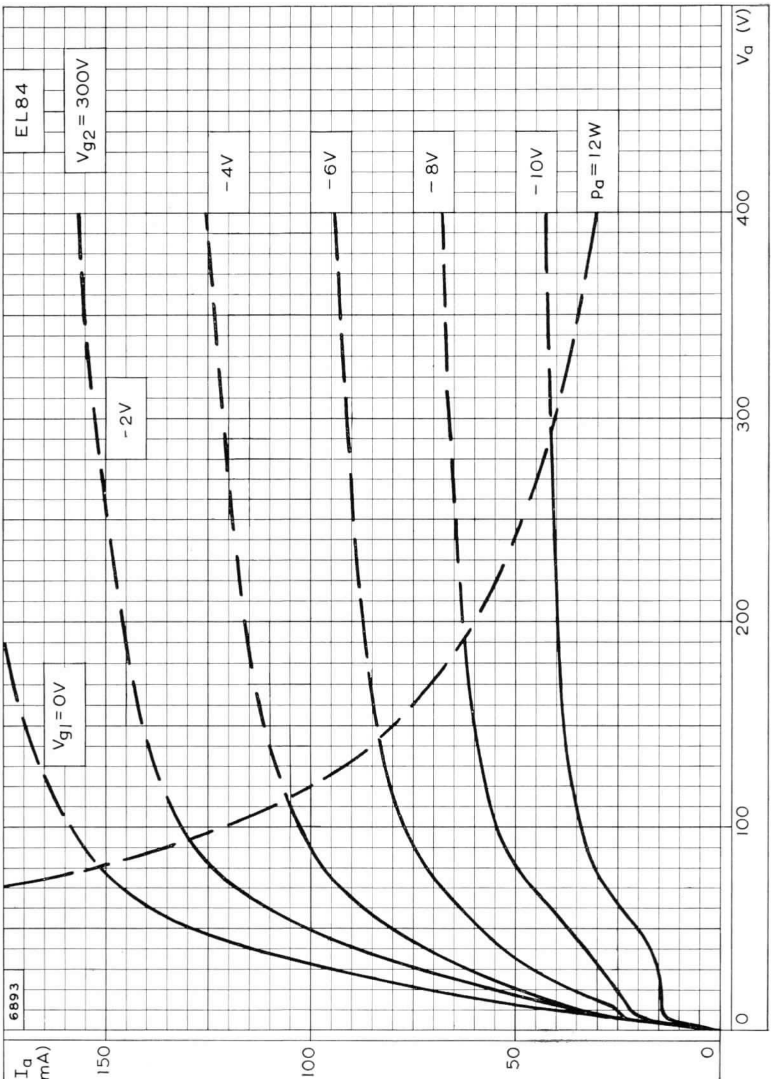
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



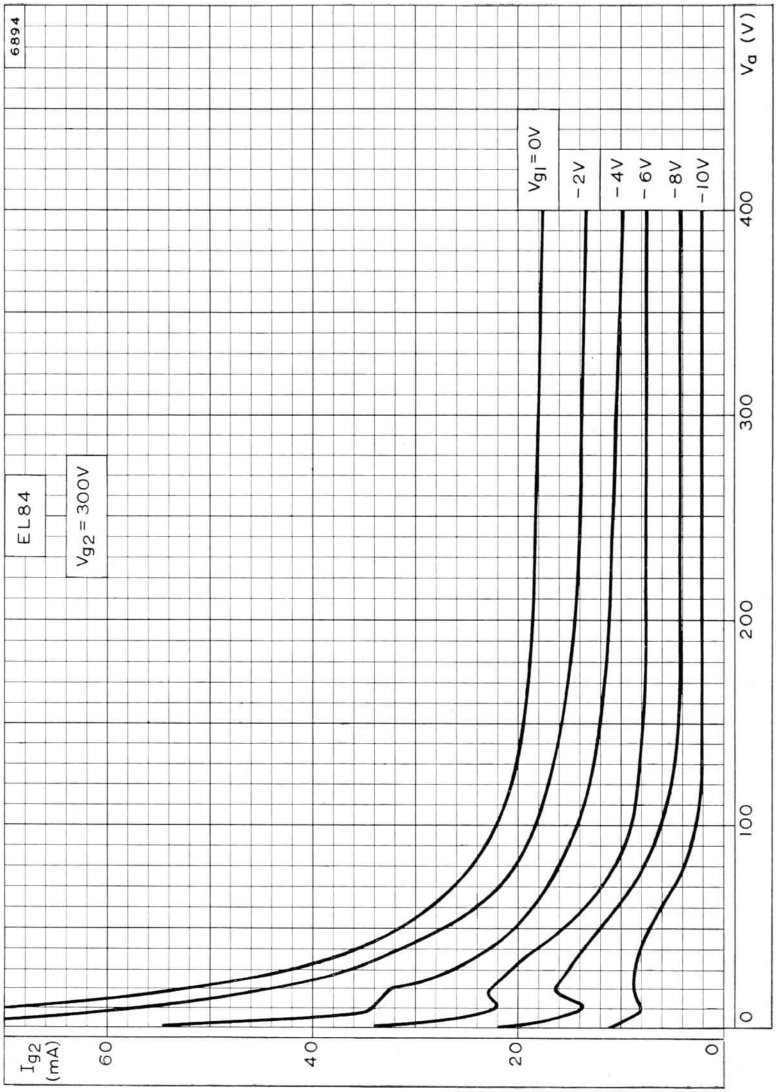
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



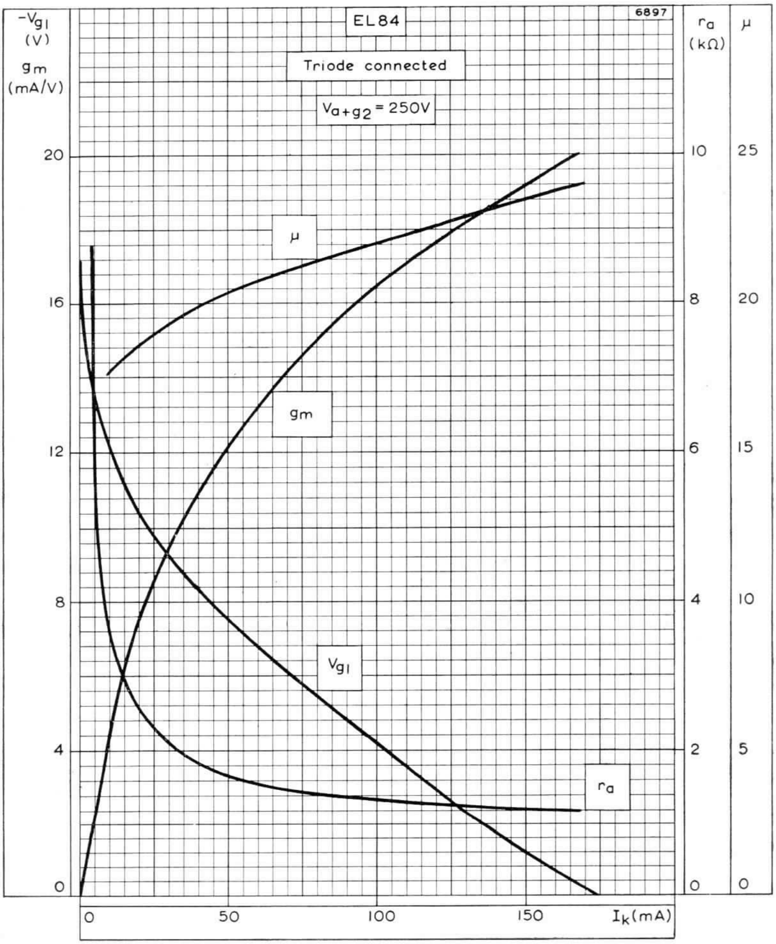
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



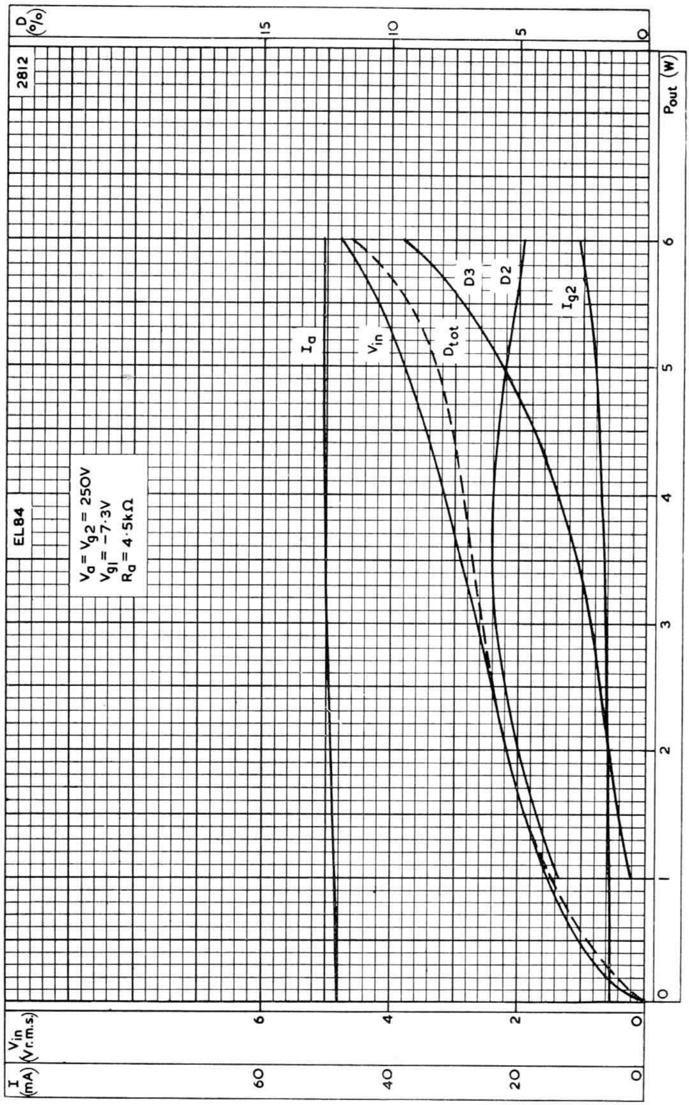
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 300V$



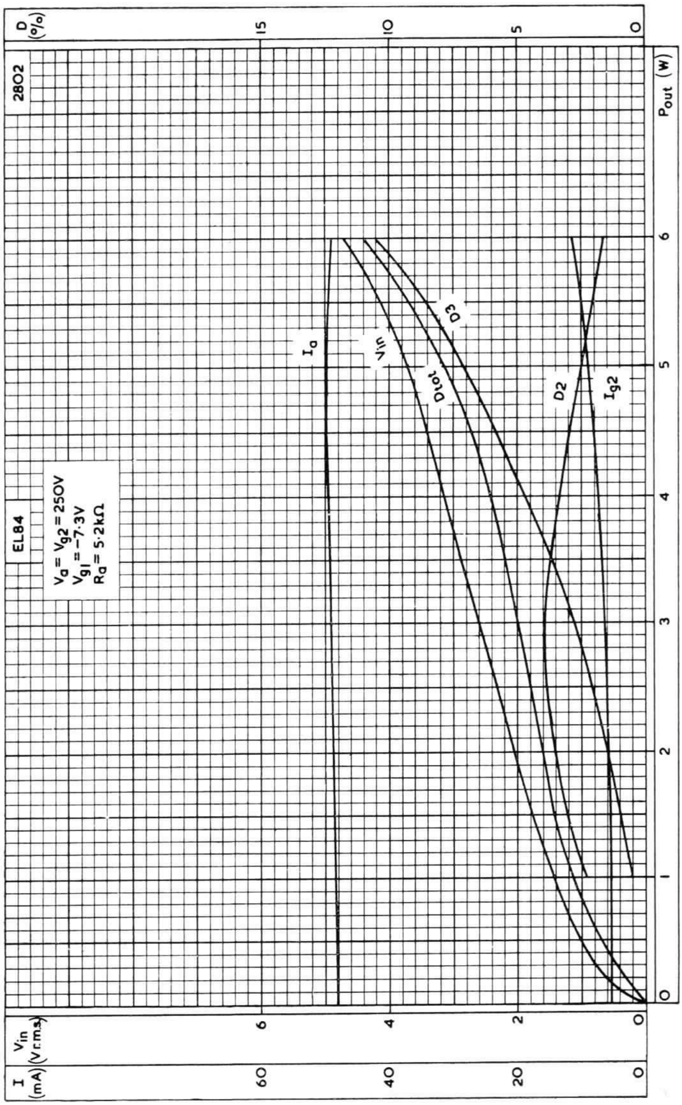
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 300V$



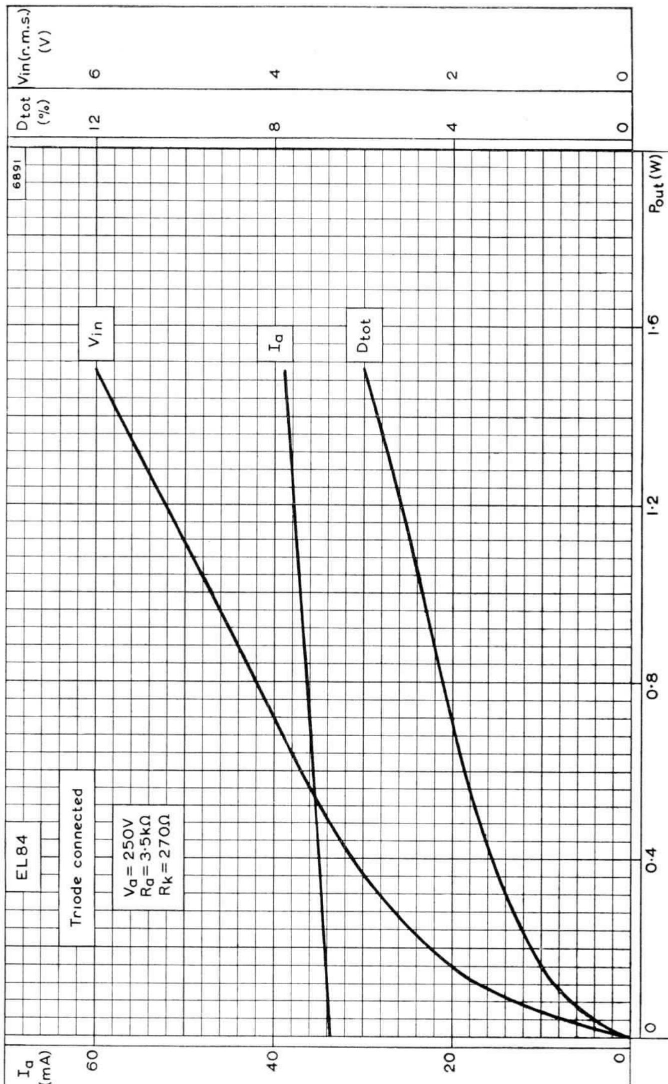
CONTROL-GRID VOLTAGE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CATHODE CURRENT WHEN TRIODE CONNECTED



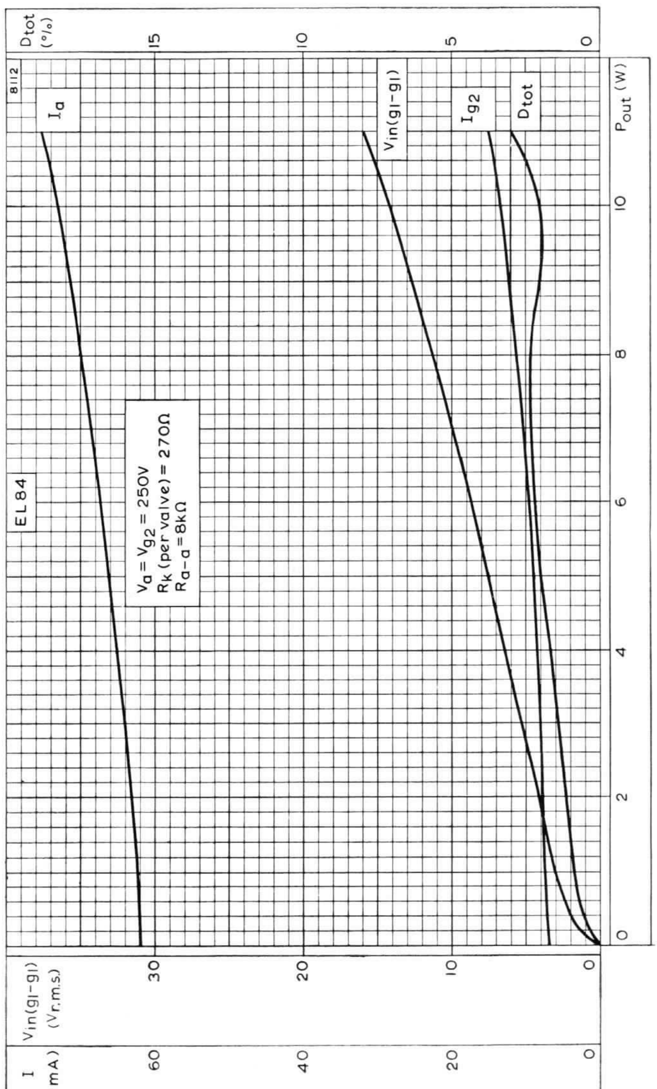
PERFORMANCE OF EL84 WHEN USED AS A SINGLE VALVE AMPLIFIER WITH A LOAD OF 4.5kΩ



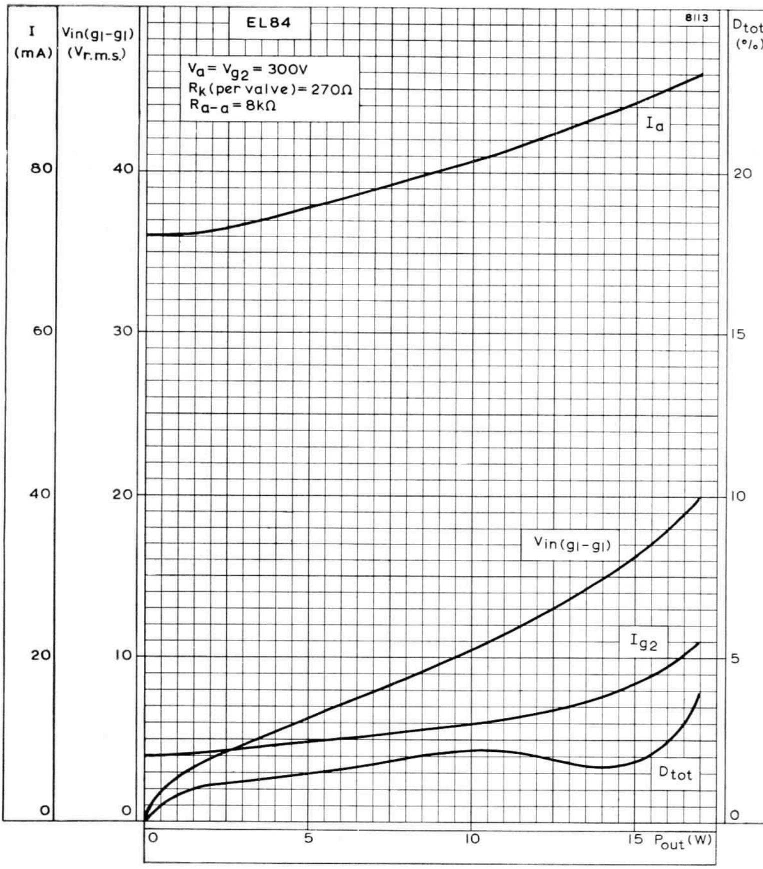
PERFORMANCE OF EL84 WHEN USED AS A SINGLE VALVE AMPLIFIER WITH A LOAD OF 5.2kΩ



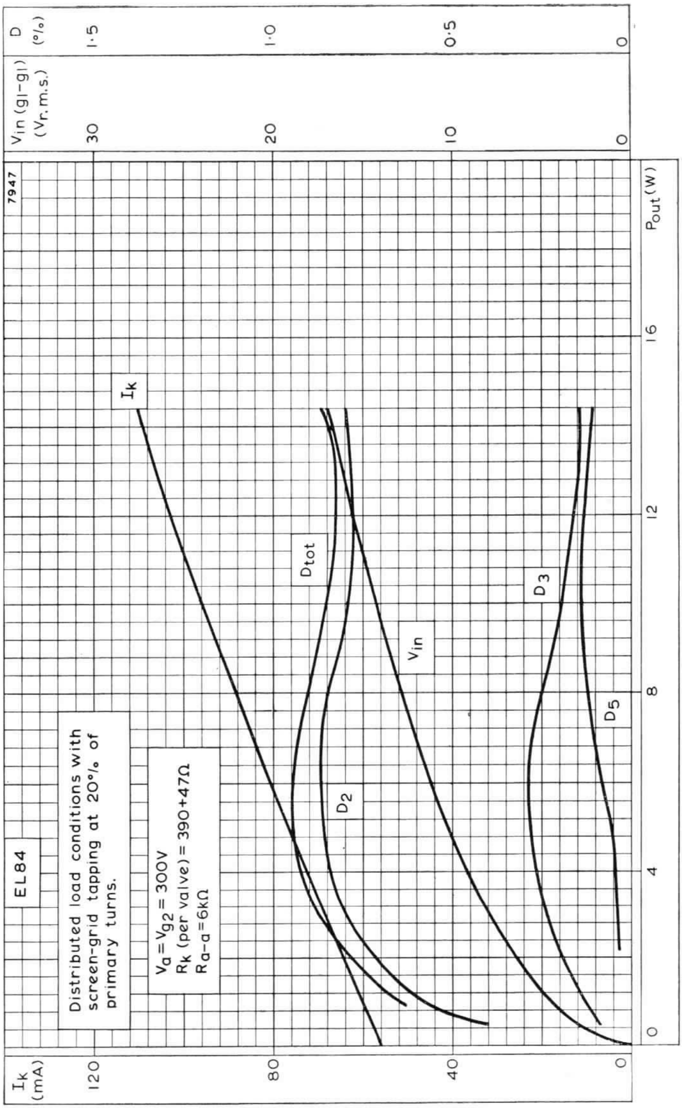
PERFORMANCE OF EL84 TRIODE CONNECTED AS A SINGLE VALVE AMPLIFIER



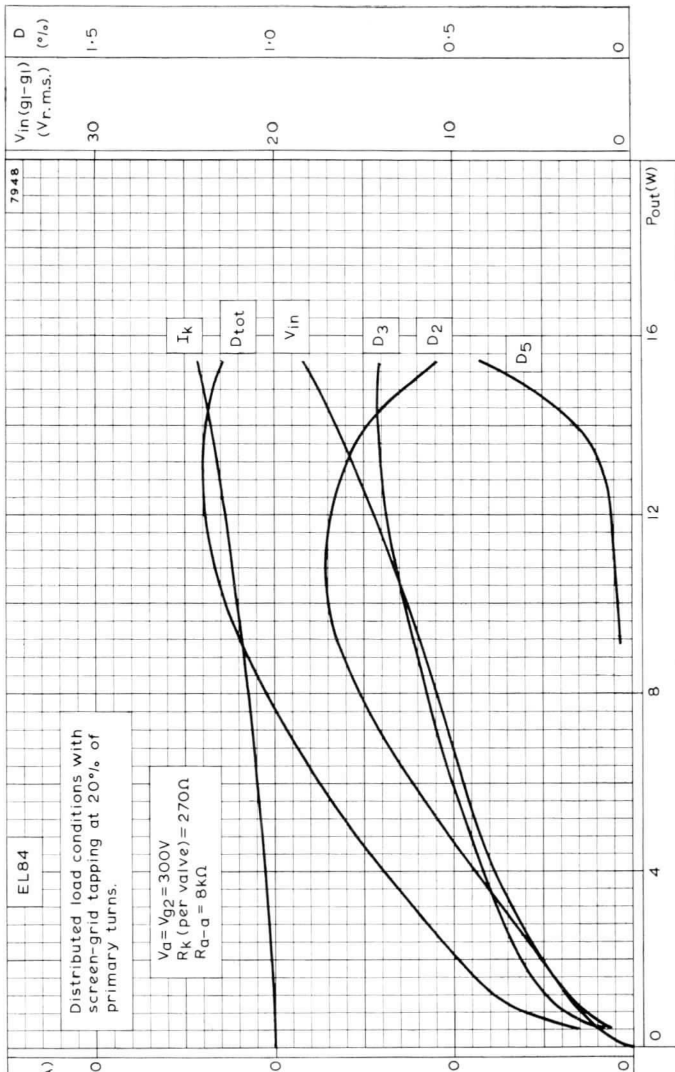
PERFORMANCE OF TWO EL84 IN PUSH-PULL
$V_a = V_{g2} = 250V$



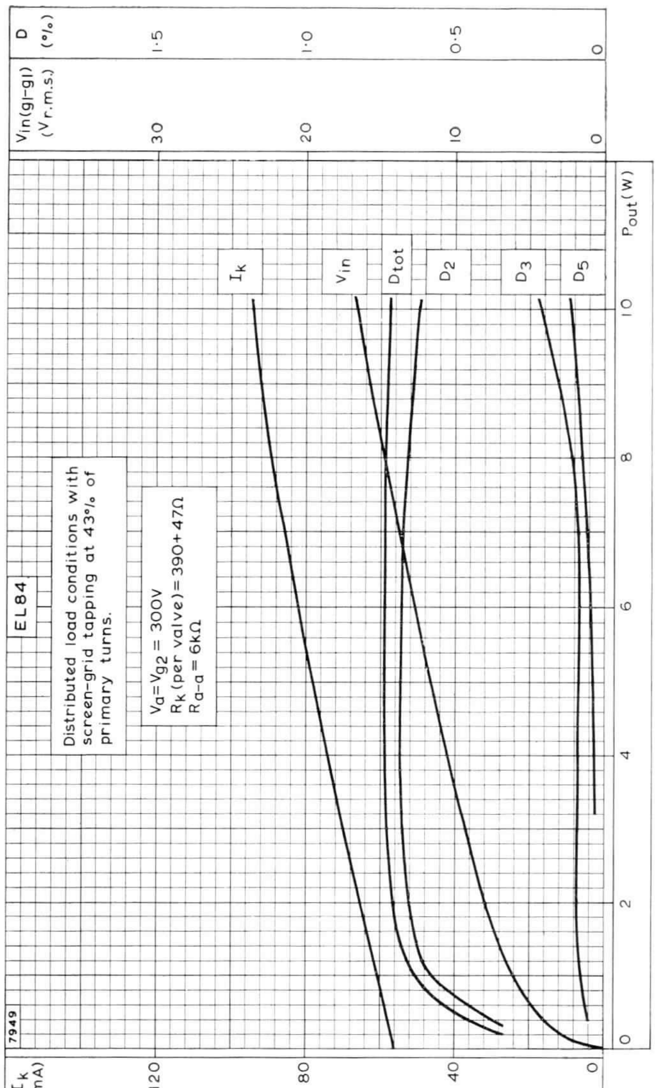
PERFORMANCE OF TWO EL84 IN PUSH-PULL
$V_a = V_{g2} = 300V$



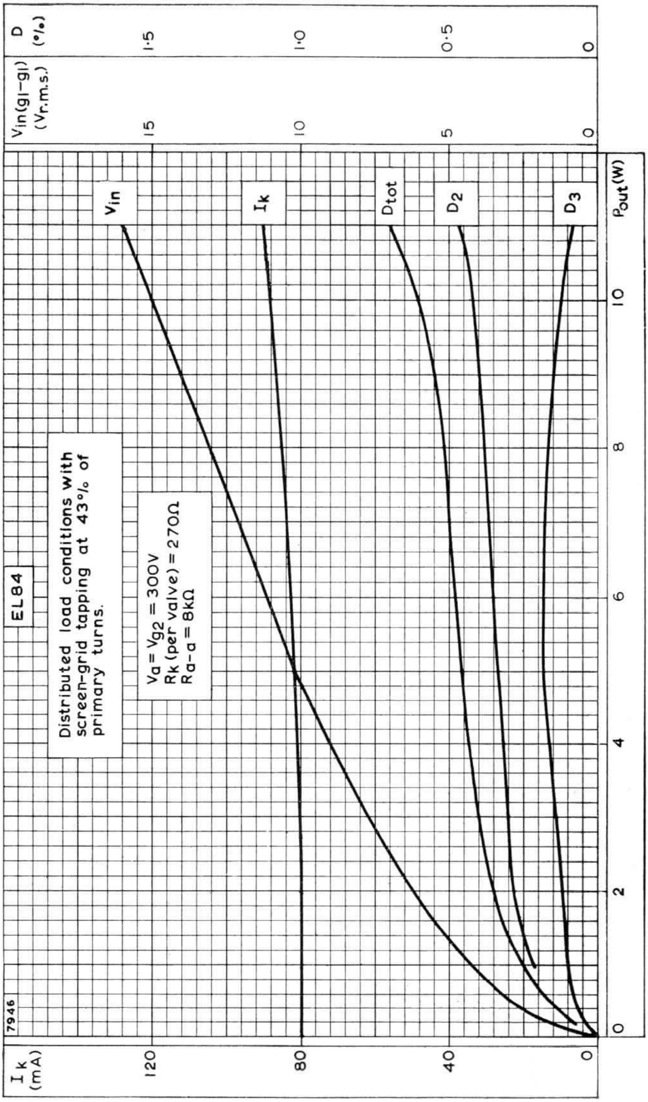
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS. $R_{a-a} = 6k\Omega$



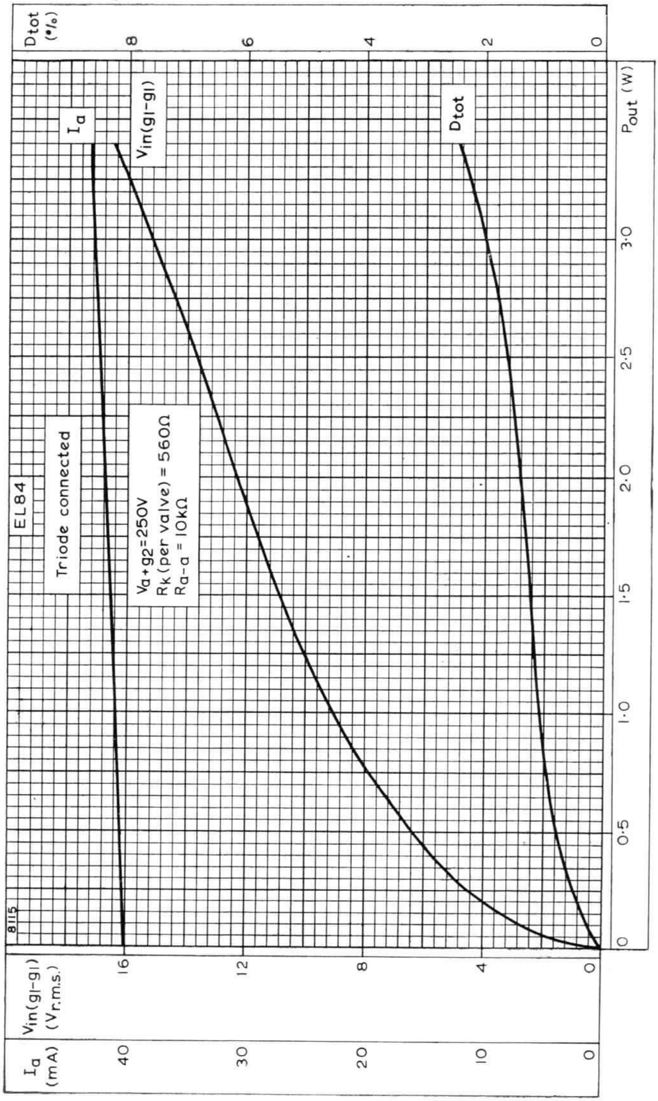
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS.
$R_{a-a} = 8k\Omega$



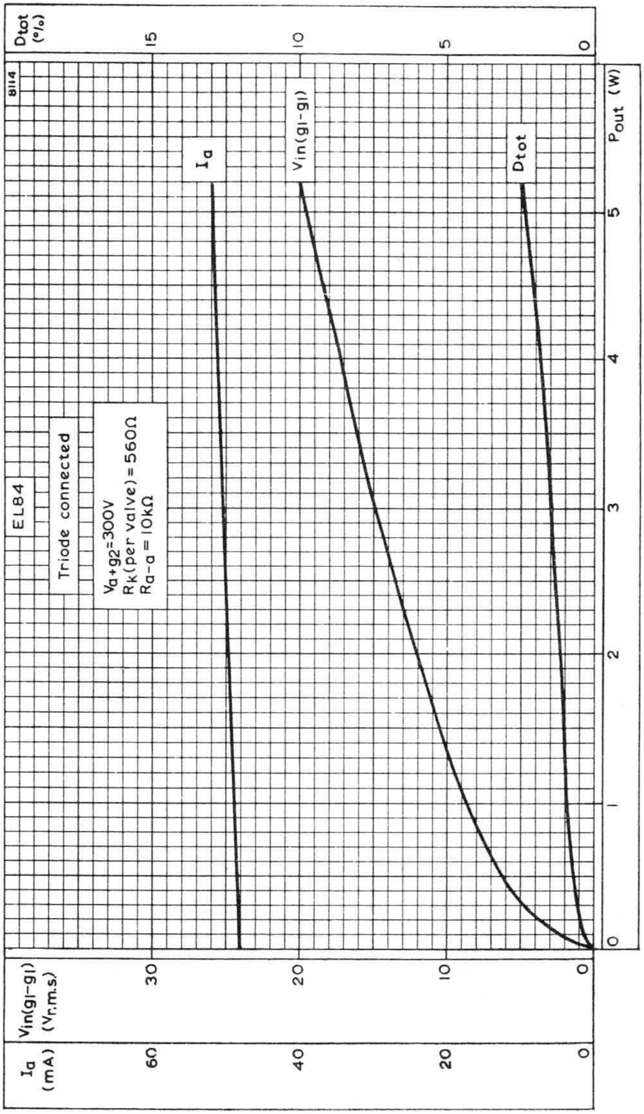
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS. $R_{a-a} = 6k\Omega$



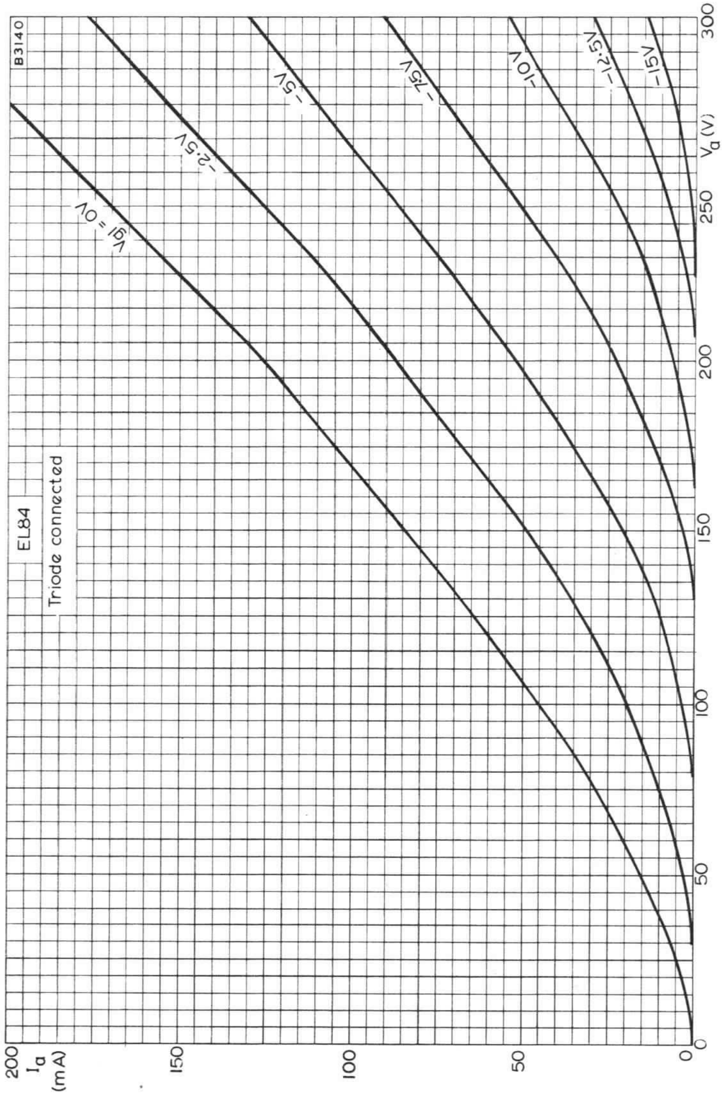
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS. $R_{a-a} = 8k\Omega$



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
$I_{a(0)}$	2×5.0	2×5.0	mA
I_a (max. sig.)	2×15	2×19	mA
$I_{g2(0)}$	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	%

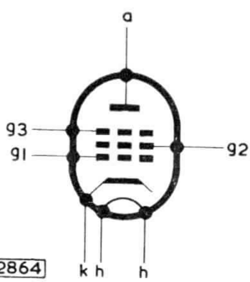
OUTPUT PENTODE

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



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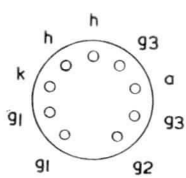
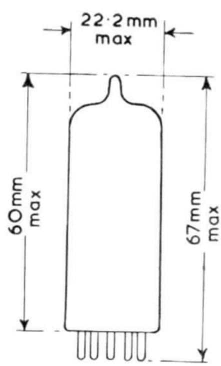


B9A Base

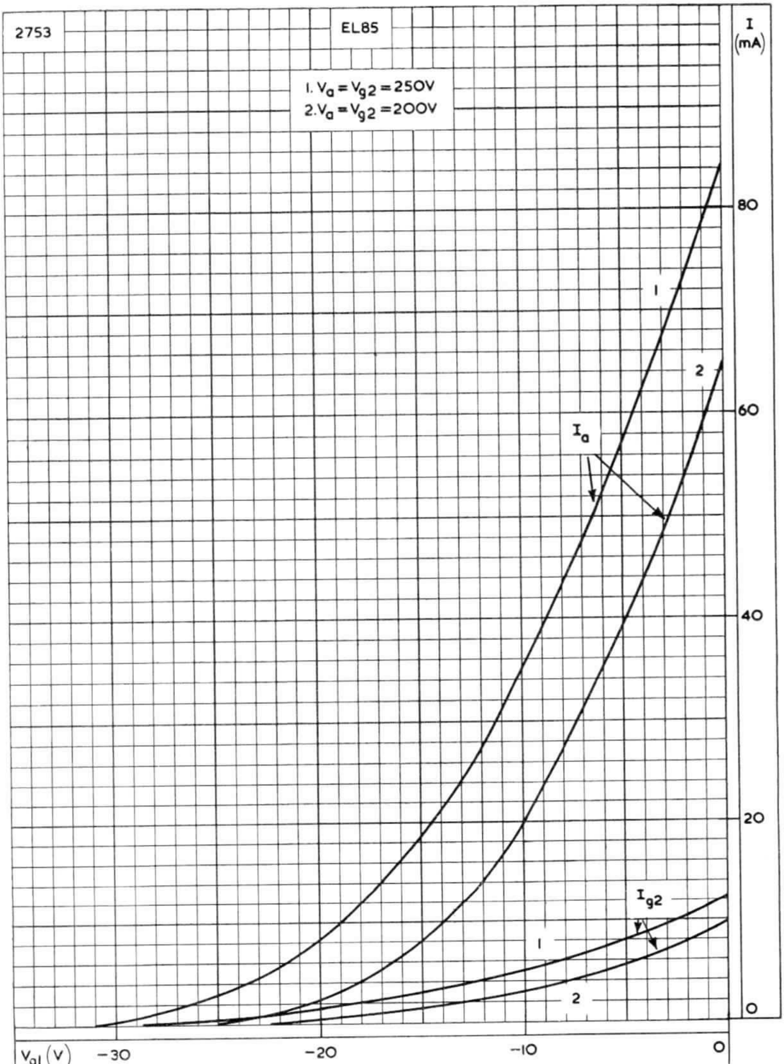


FOR R.F. APPLICATIONS IT IS RECOMMENDED THAT PINS 1 AND 2 SHOULD BE STRAPPED TOGETHER AND PINS 6 AND 8 BE CONNECTED SEPARATELY TO THE CHASSIS

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

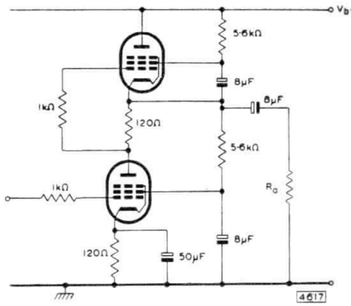
Triode connection (g_2 connected to a)

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

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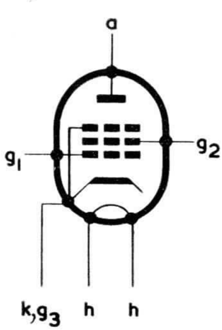
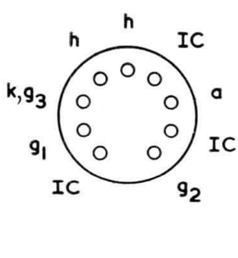
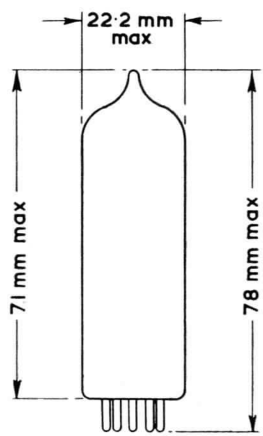




B9A Base



OUTPUT PENTODE

EL91

Output pentode rated for 4W anode dissipation suitable for use as an r.f. or a.f. amplifier.

HEATER

V_h	6.3	V
I_h	200	mA

CAPACITANCES

	Unshielded	*Shielded*	
c_{in}	3.7	3.8	pF
c_{out}	4.0	6.5	pF
c_{a-g1}	<300	<300	mpF

CHARACTERISTICS

Pentode connection

V_a	250	V
V_{g3}	0	V
V_{g2}	250	V
I_a	16	mA
I_{g2}	2.3	mA
V_{g1}	–13.5	V
g_m	2.5	mA/V
r_a	130	kΩ
μ_{g1-g2}	12	

Triode connection (g_2 connected to a)

V_a	250	V
I_a	18.3	mA
V_{g1}	–13.5	V
g_m	2.7	mA/V
r_a	4.3	kΩ
μ	12	

OPERATING CONDITIONS AS SINGLE VALVE AMPLIFIER

Pentode connection

V_{a-k}	250	V
$V_{g2(b)-k}$	250	V
R_{g2}	470	Ω
R_k	700	Ω
R_a	18	kΩ
$I_{a(o)}$	16	mA
$I_{g2(o)}$	2.3	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	820	mV
$V_{in(r.m.s.)}$	5.8	V
P_{out}	1.7	W
D_{tot}	10	%
$I_{g2(max.\ sig.)}$	6.3	mA

OPERATING CONDITIONS FOR 2 VALVES IN PUSH-PULL

Pentode connection

Cathode bias

V_{a-k}	250	V
V_{g2-k}	250	V
R_k (per valve)	820	Ω
R_{a-a}	15	kΩ
$I_{a(o)}$	2×14.5	mA
$I_{g2(o)}$	2×2.0	mA
$V_{in(g1-g1)r.m.s.}$ (P_{out} = 50mW)	1.8	V
$V_{in(g1-g1)r.m.s.}$	19.8	V
P_{out}	5.8	W
D_{tot}	2.5	%
$I_{a(max.\ sig.)}$	2×21.5	mA
$I_{g2(max.\ sig.)}$	2×5.0	mA

Fixed bias

V_{a-k}	250	V
V_{g2-k}	250	V
V_{g1}	–16	V
R_{a-a}	15	kΩ
$I_{a(o)}$	2×10	mA
$I_{g2(o)}$	2×1.4	mA
$V_{in(g1-g1)r.m.s.}$ (P_{out} = 50mW)	2.1	V
$V_{in(g1-g1)r.m.s.}$	21.5	V
P_{out}	5.6	W
D_{tot}	1.7	%
$I_{a(max.\ sig.)}$	2×19.5	mA
$I_{g2(max.\ sig.)}$	2×4.7	mA

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 re-adjust itself as a result of the increased anode and screen-grid currents. This will result in approximately 10% reduction in power output.

OPERATING CONDITIONS AS R.F. AMPLIFIER

f	50	100	Mc/s
V_a	250	250	V
$V_{g2(b)}$	250	250	V
R_{g2}	33	33	kΩ
V_{g1}	–14	–14	V
R_{g1-k}	10	12	kΩ
R_k	470	470	Ω
I_a	16.6	16.8	mA
I_{g2}	2.9	2.8	mA
I_{g1}	500	400	μA
P_{load}	2.4	1.85	W
η_{load}	59	44	%

OPERATING CONDITIONS AS FREQUENCY DOUBLER

f_{out}	50	100	Mc/s
V_a	250	250	V
$V_{g2(b)}$	250	250	V
R_{g2}	33	33	kΩ
V_{g1}	–40	–40	V
R_{g1-k}	27	27	kΩ
R_k	470	470	Ω
I_a	16	16.3	mA
I_{g2}	2.8	2.6	mA
I_{g1}	1.2	1.1	mA
P_{load}	1.6	1.3	W
η_{load}	41	32	%

OPERATING CONDITIONS AS FREQUENCY TREBLER

f_{out}	50	100	Mc/s
V_a	250	250	V
$V_{g2(b)}$	250	250	V
R_{g2}	33	39	kΩ
V_{g1}	–75	–75	V
R_{g1-k}	39	39	kΩ
R_k	470	470	Ω
I_a	15	16	mA
I_{g2}	2.6	2.3	mA
I_{g1}	1.7	1.7	mA
P_{load}	1.25	1.0	W
η_{load}	32	25	%

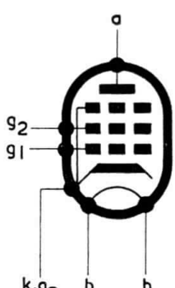
EL91

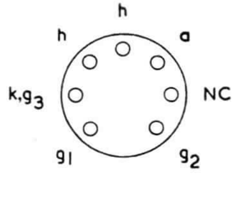
OUTPUT PENTODE

DESIGN CENTRE RATINGS

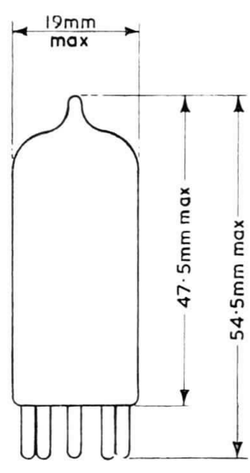
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	4.0	W
p_{a+g2} max.	4.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	600	mW
$-V_{g1}$ max.	100	V
I_{g1} max.	3.0	mA
I_k max.	20	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	150	V

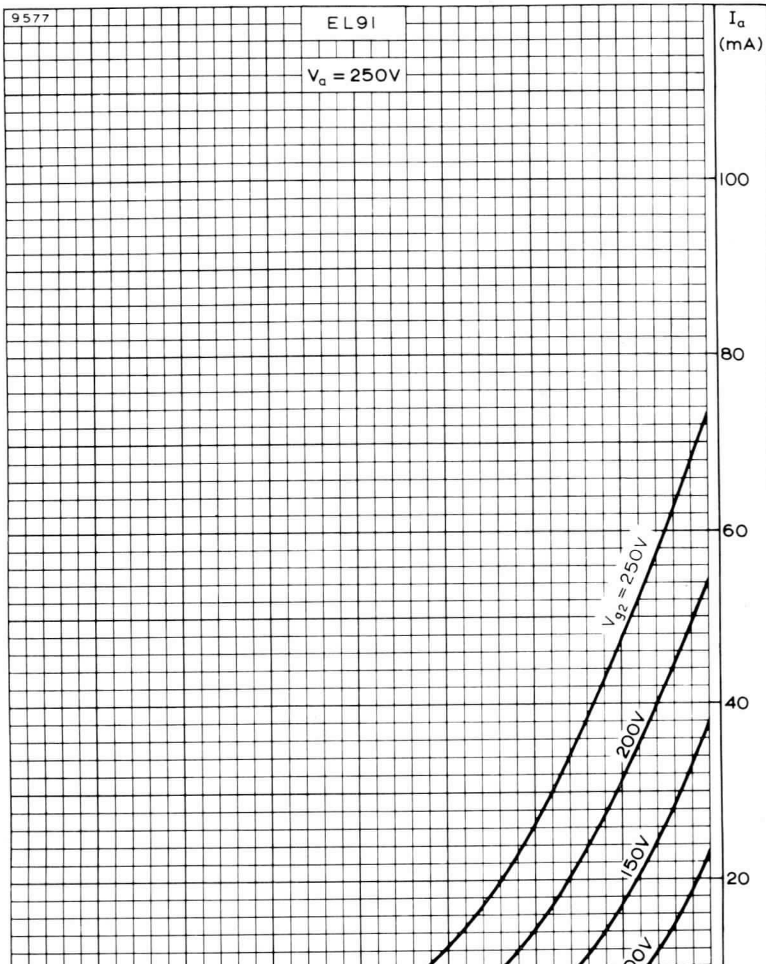
2831





B7G Base

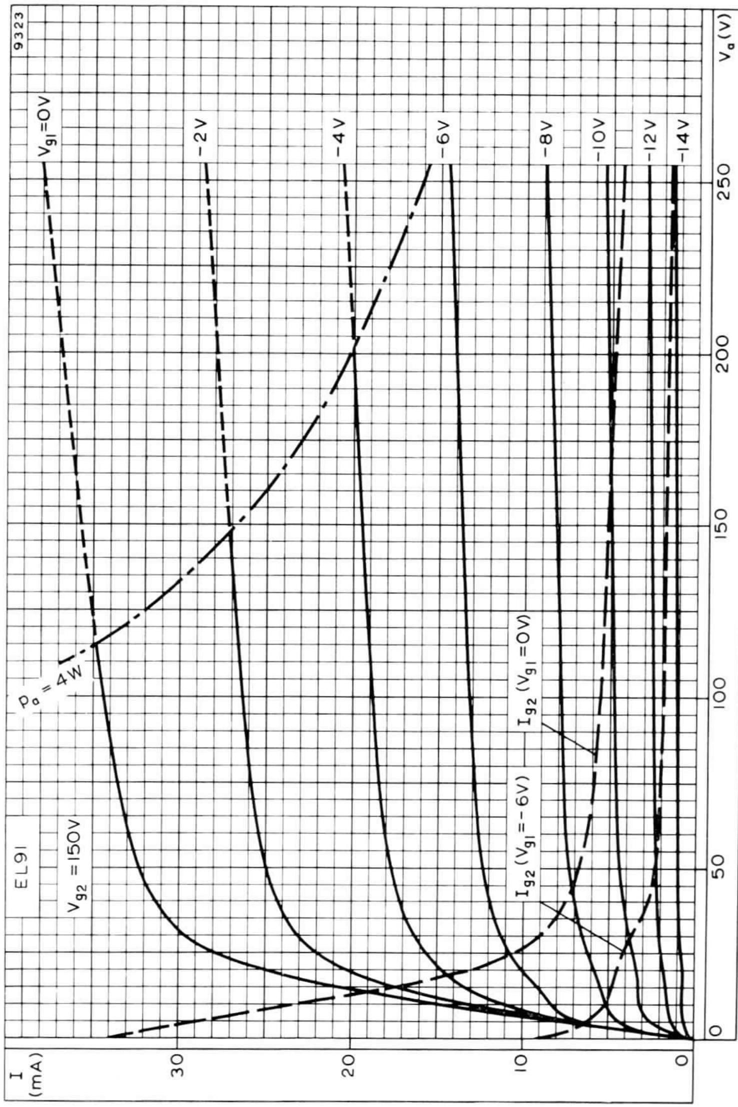




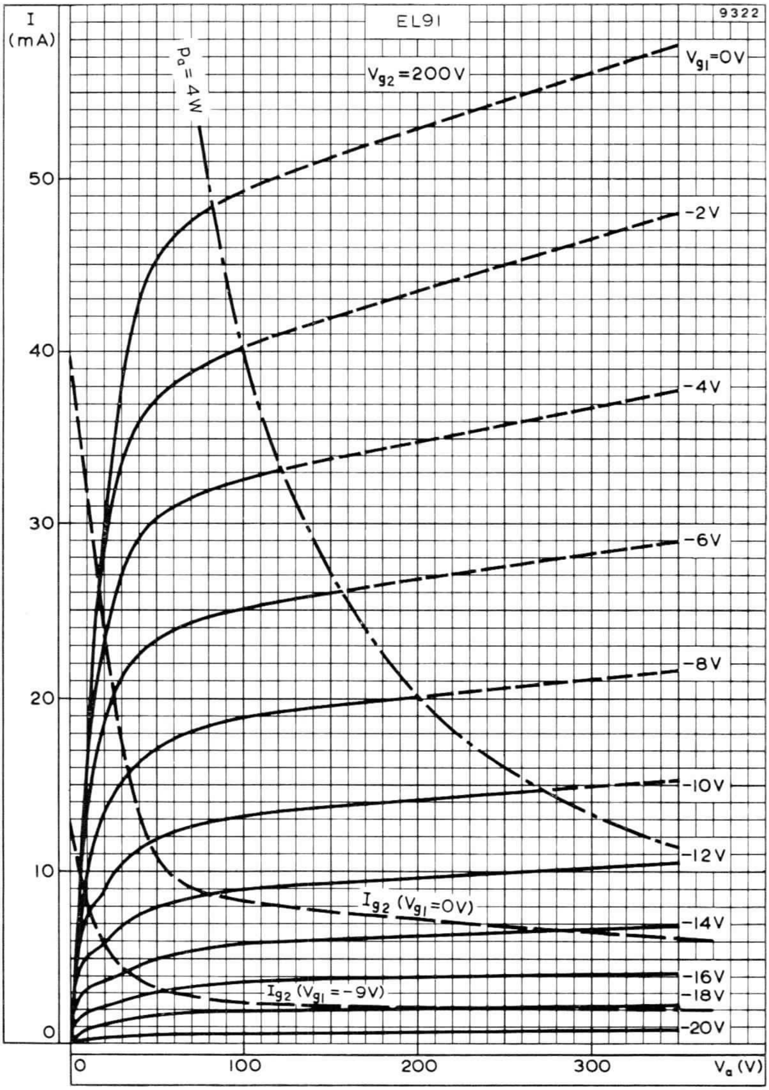
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

EL91

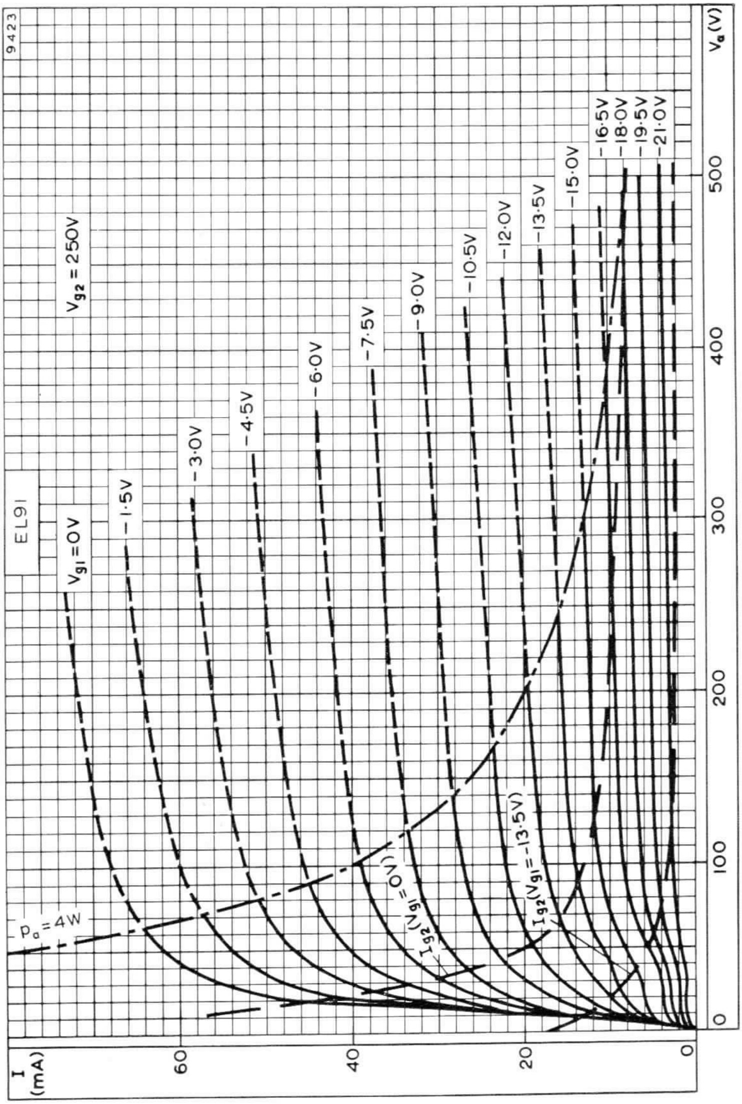
OUTPUT PENTODE



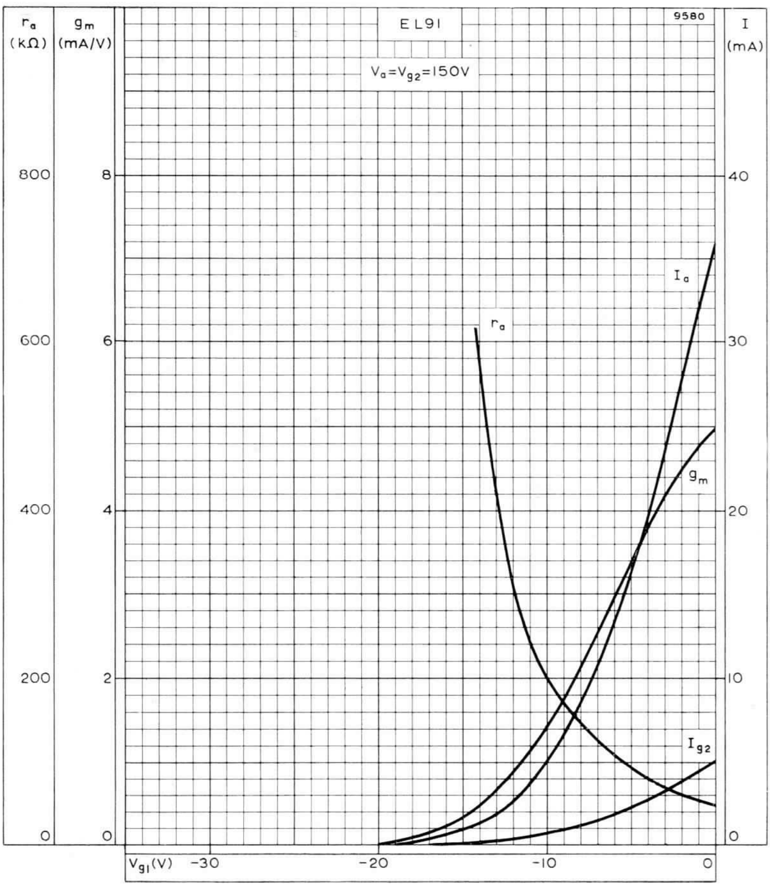
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



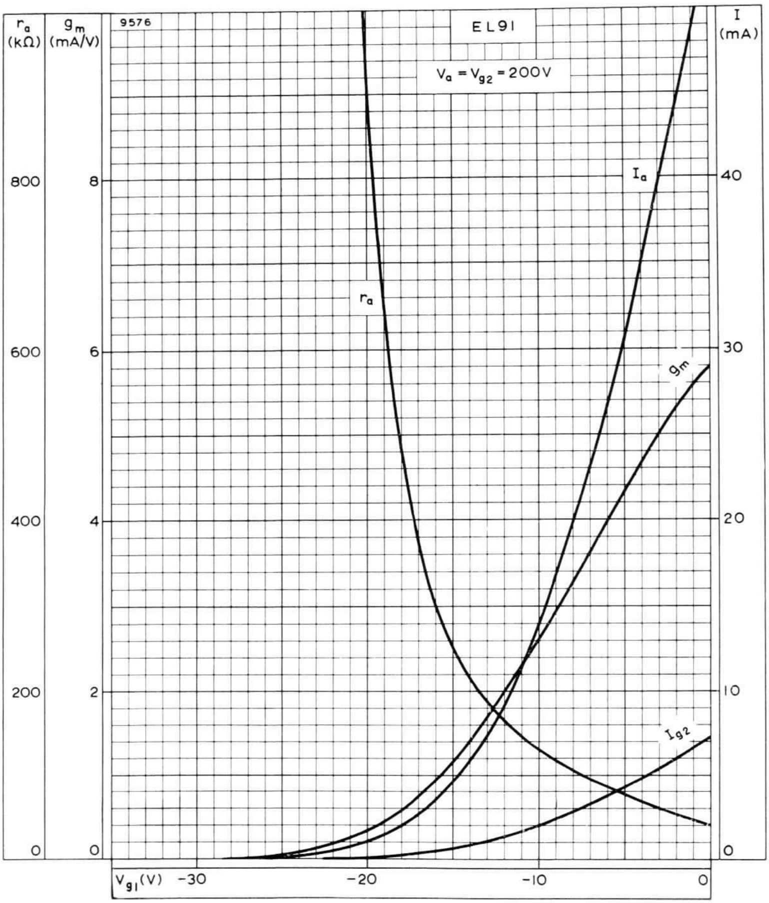
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



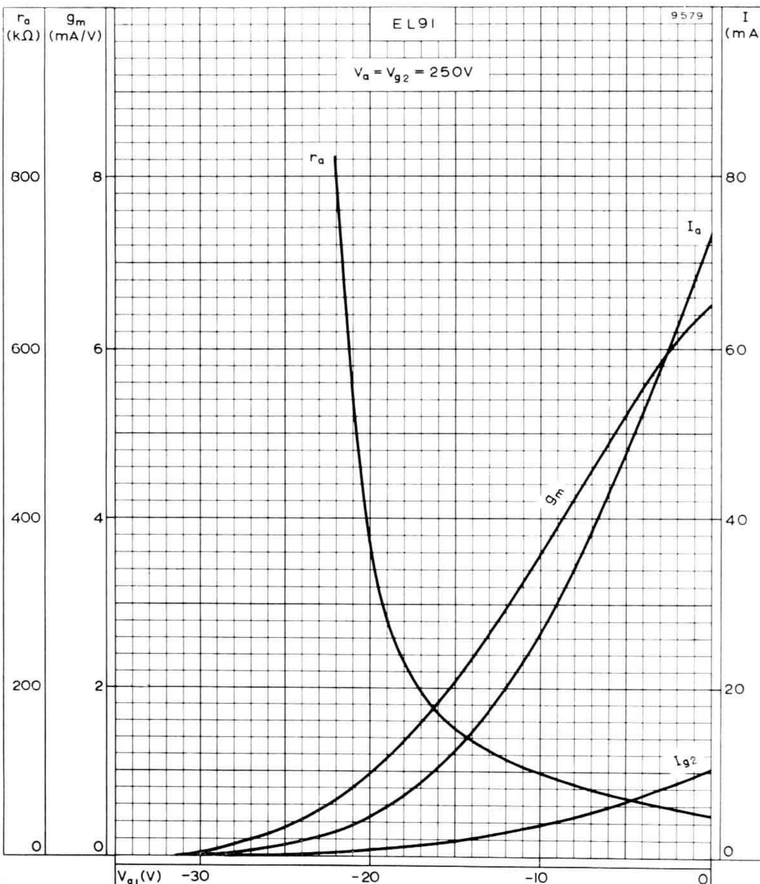
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



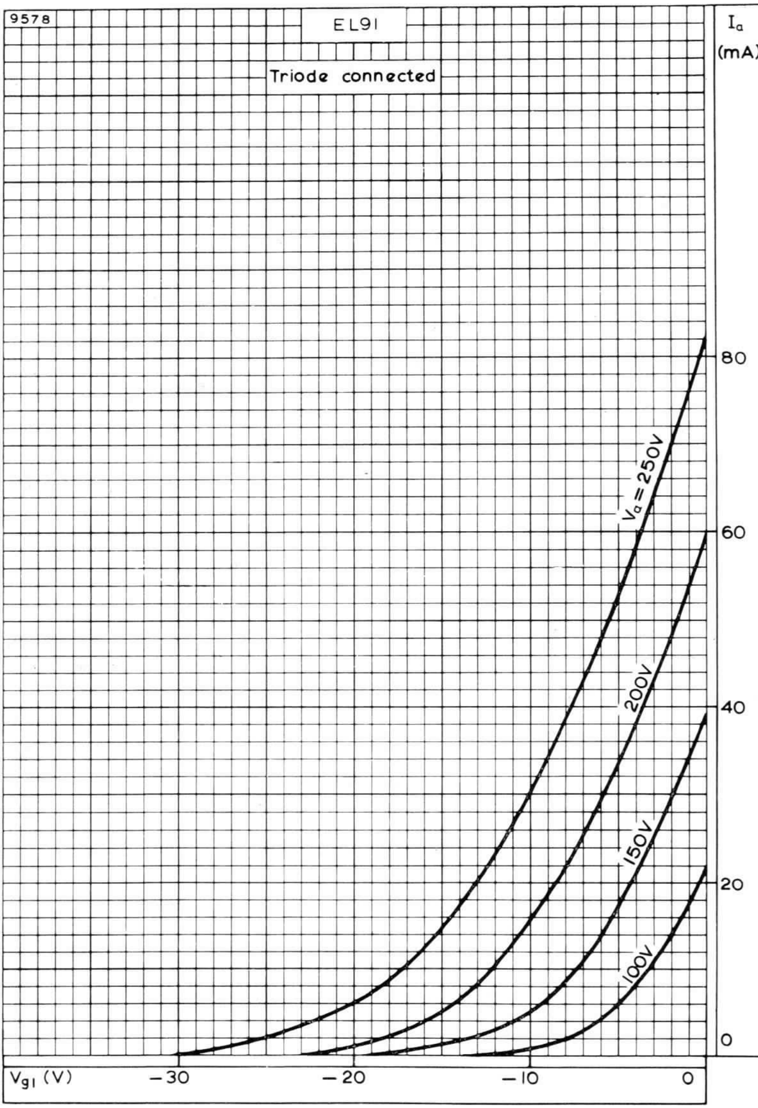
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 150V$



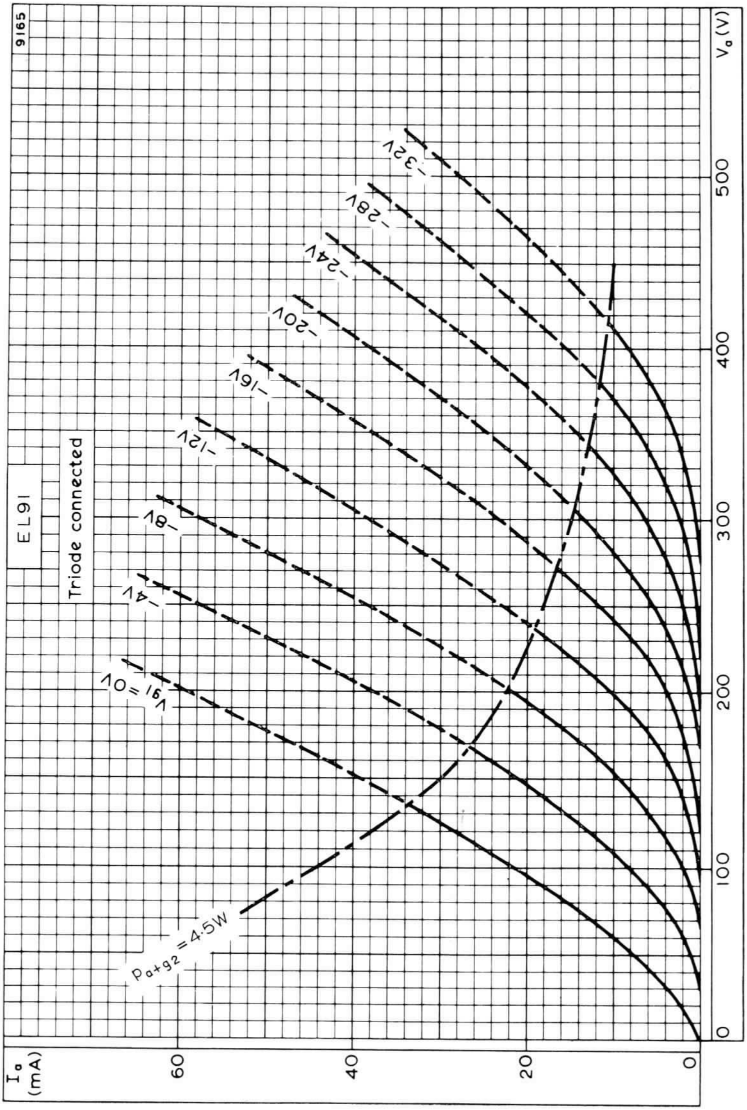
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 200V$



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



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

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_{g3}	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

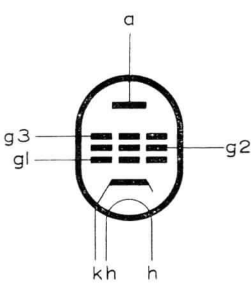
*At 20°C ambient, in free air at normal atmospheric pressure and without external screening can.

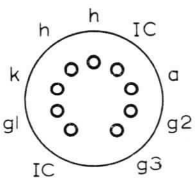
LIMITING VALUES

$V_{a(b)}$ 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

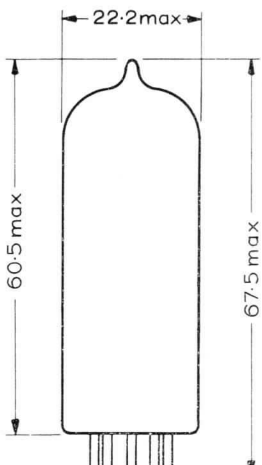
EL821

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)

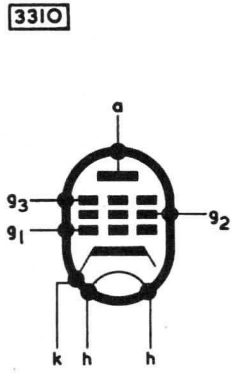
V_a	150	V
I_a	45	mA
V_{g1}	−2.5	V
g_m	14.6	mA/V
r_a	1.56	kΩ
μ	23	

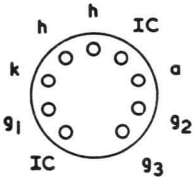
EL822

VIDEO OUTPUT PENTODE

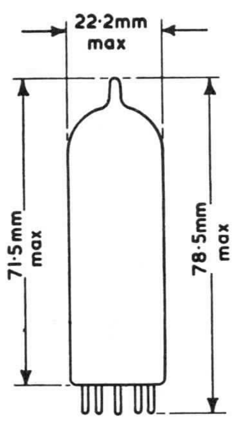
DESIGN CENTRE RATINGS

$V_{a(b)}$ 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





B9A Base



ELECTRON BEAM INDICATOR

EM34

Electron beam tube for use as tuning indicator in radio receivers or as null indicator in test equipment.

HEATER

This valve is suitable for DC/AC operation.

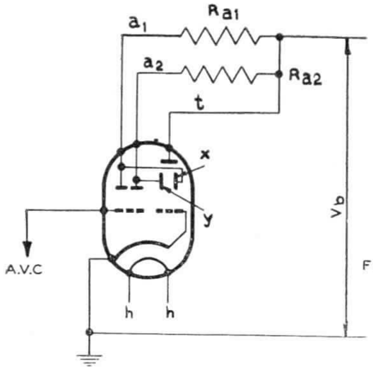
V_h	6.3	V
I_h	0.2	A

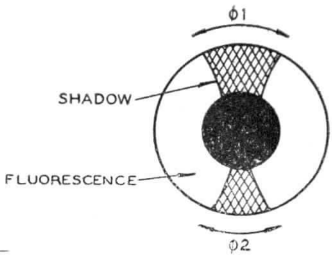
OPERATING CONDITIONS

V_b	200	250	V
R_{a1}	1.0	1.0	MΩ
R_{a2}	1.0	1.0	MΩ
I_t	0.55	0.75	mA
V_g ($\varnothing_1$ max.) (1)	0	0	V
V_g ($\varnothing_2$ max.) (2)	0	0	V
V_g ($\varnothing_1$ min.) (5)	−4.2	−5.0	V
V_g ($\varnothing_2$ 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.





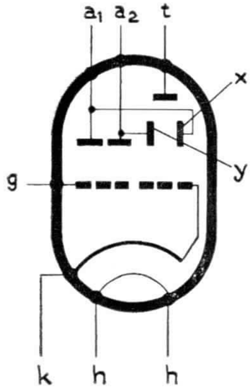
EM34

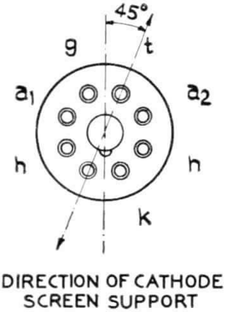
ELECTRON BEAM INDICATOR

Electron beam tube for use as tuning indicator in radio receivers or as null indicator in test equipment.

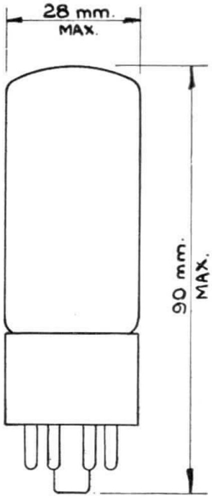
LIMITING VALUES

$V_{a1(b)}$ 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	kΩ
R_{g-k} max.	3.0	MΩ





OCTAL BASE



VOLTAGE INDICATOR

EM84

Electron beam tube for use as a voltage indicator in broadcast receivers and tape recorders.

HEATER

V_h	6.3	V
I_h	210	mA

MOUNTING POSITION

Any

TYPICAL OPERATING CONDITIONS

(deflection electrode connected to anode)

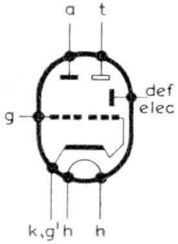
V_b		250		V
V_t		250		V
R_a		470		kΩ
R_{g-k}		3.0		MΩ
V_g	0		–22	V
I_a	450		60	μA
I_t	1.0		1.8	mA
*L	21±5		0	mm←

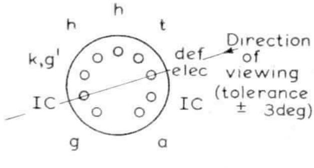
*Length of column

DESIGN CENTRE RATINGS

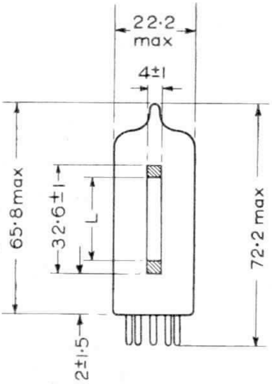
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	500	mW
$V_{t(b)}$ max.	550	V
V_t max.	300	V
V_t min.	170	V
I_k max.	3.0	mA
V_g max. ($I_g = +0.3\mu A$)	–1.3	V
R_{g-k} max.	3.0	MΩ
V_{h-k} max.	100	V
T_{bulb} max.	120	°C

4678

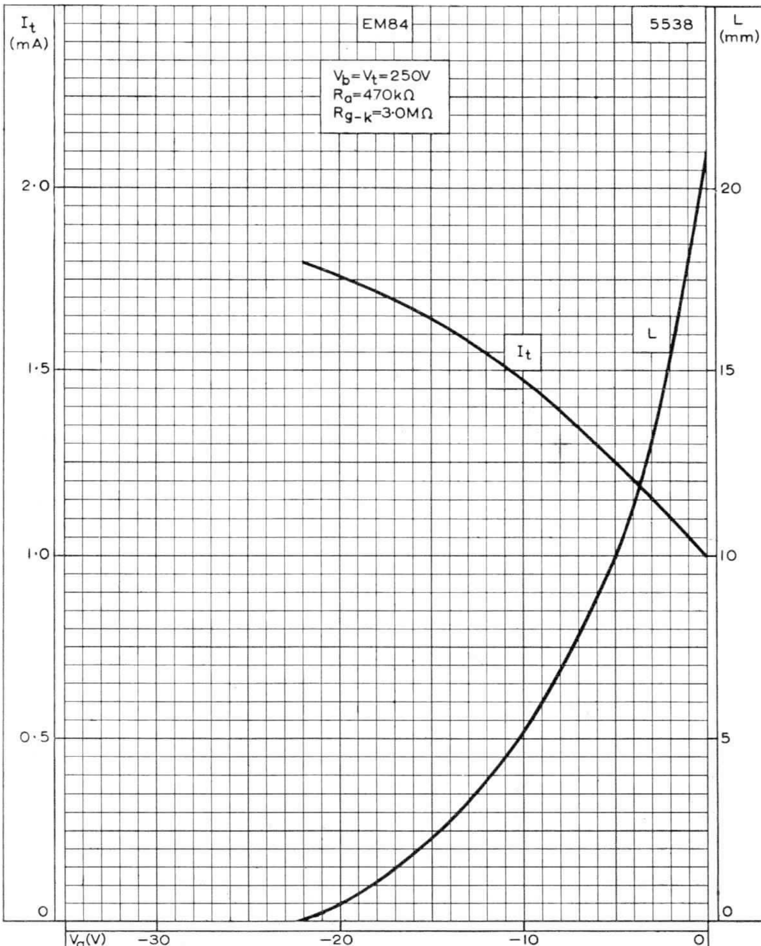




B9A Base



All dimensions in mm



LENGTH OF COLUMN AND TARGET CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

HALF-WAVE RECTIFIER

EY51

High voltage half-wave rectifier with wired-in connections. Its low heater wattage renders the valve particularly suitable for use in cathode ray tube e.h.t. supply units deriving their input from the line time base fly-back pulse.

HEATER

V_h	6.3	V
I_h	90	mA
Heater voltage tolerances		
$I_{out} \leqq 200\mu A$	±15	%
$I_{out} = 500\mu A$	±7.0	%

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 10mm from the seal and care should be taken not to bend the leads near the seal

CAPACITANCE

c_{a-k}	0.8	pF

LIMITING VALUES

(1) *Sinusoidal input* (50c/s)		
$V_{in(r.m.s.)}$ max.	5.0	kV
I_{out} max.	3.0	mA
C max.	0.1	μF
R_{lim} min.	100	kΩ
(2) *Sinusoidal input* (10 to 500kc/s)		
P.I.V. max.	17	kV
I_{out} max.	3.0	mA←
C max.	0.01	μF
(3) *Pulsed input*		
P.I.V. max.	17	kV
I_{out} max.	350	μA
$^*i_{k(pk)}$ max.	80	mA
C max.	0.005	μF

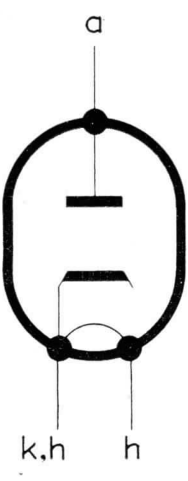
*Max. pulse duration 5.0% of a line scanning cycle with a maximum of 5.0μs

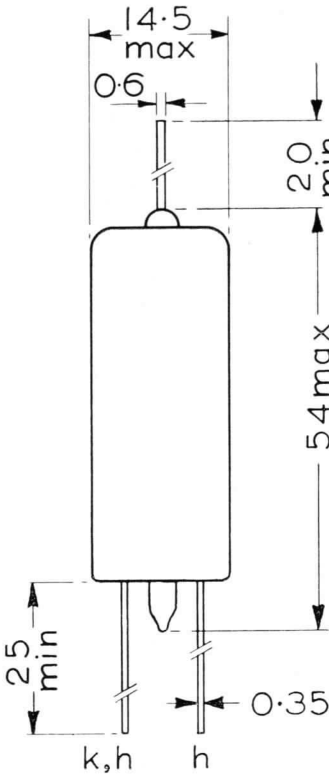
EY51

HALF-WAVE RECTIFIER

High voltage half-wave rectifier with wired-in connections. Its low heater wattage renders the valve particularly suitable for use in cathode ray tube e.h.t. supply units deriving their input from the line time base fly-back pulse.

4778





All dimensions in mm

FULL-WAVE RECTIFIER

EZ35

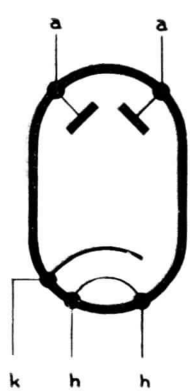
Indirectly-heated power rectifier with 6.3 V. heater for use in A.C. mains-operated equipment.

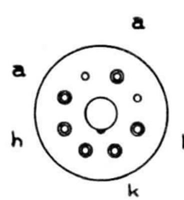
HEATER

V_h	6.3	V
I_h	0.6	A

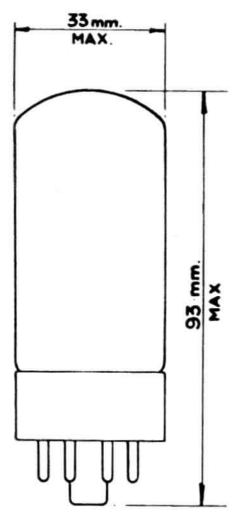
LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×325	V
I_{out} max.	70	mA
$v_{h-k(pk)}$ max.	350	V
C max.	16	μF
R_{lim} min. (per anode) (C=16μF)	350	Ω





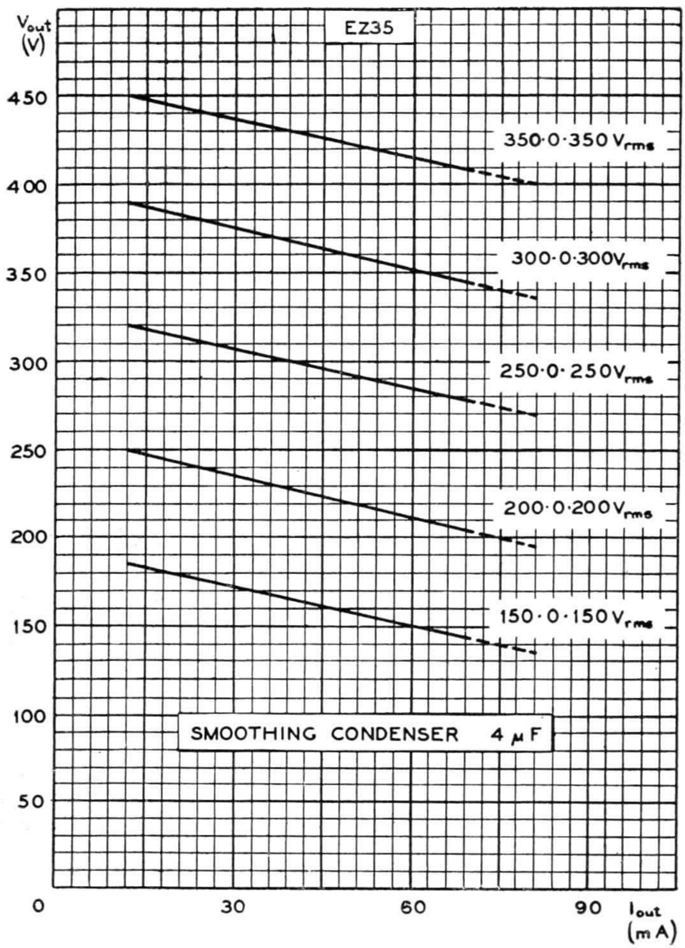
OCTAL BASE



EZ35

FULL-WAVE RECTIFIER

Indirectly-heated power rectifier with 6.3 V. heater for use in A.C. mains-operated equipment



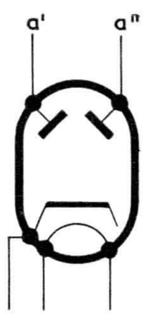
OUTPUT VOLTAGE PLOTTED AGAINST INPUT CURRENT WITH ANODE VOLTAGES AS PARAMETER

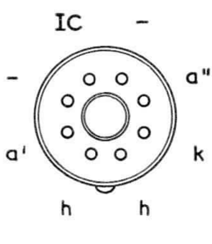
FULL-WAVE RECTIFIER

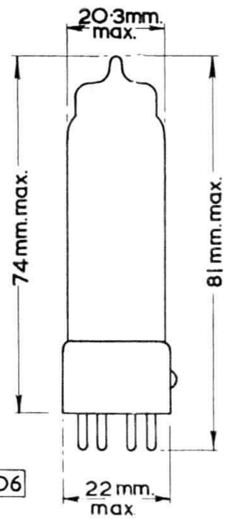
EZ40

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

Except for basing and dimensions, the EZ40 is identical to the EZ80.







906

FULL-WAVE RECTIFIER

EZ41

Indirectly-heated full-wave rectifier primarily intended for use in car radio receivers.

HEATER

V_h	6.3	V
I_h	0.4	A

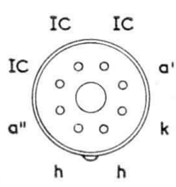
MOUNTING POSITION

Any

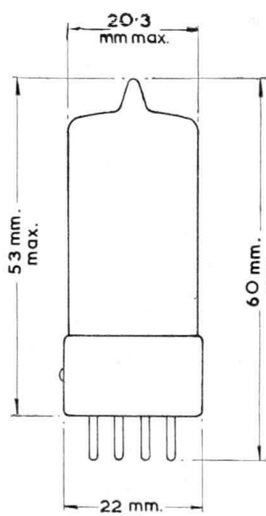
LIMITING VALUES

$V_{a\,(r.m.s.)}$ max.	2×250	V
I_{out} max.	60	mA
$v_{h-k\,(pk)}$ max.	350	V

C max.	8	16	32	50	μF
$R_{lim.}$ min. (each anode)	150	250	300	325	Ω



B8A BASE



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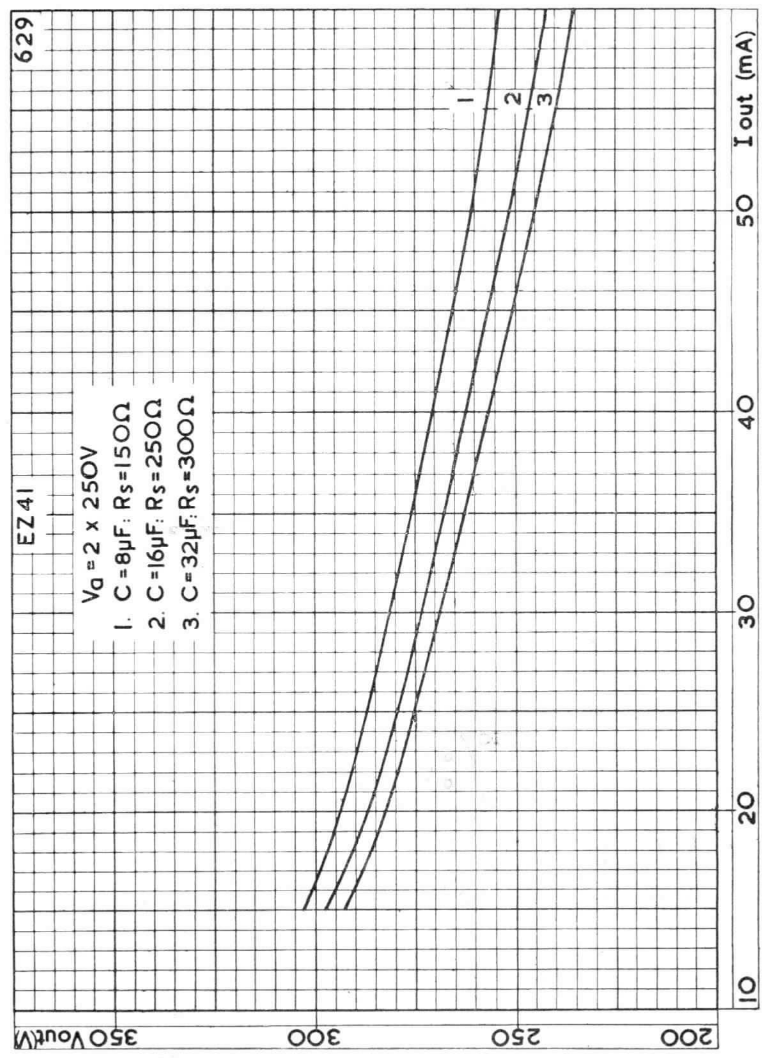
EZ41

FULL-WAVE RECTIFIER

Indirectly-heated full-wave rectifier primarily intended for use in car radio receivers.



FULL-WAVE RECTIFIER

EZ81

Indirectly heated full-wave rectifier with 6.3V heater.

HEATER

V_h	6.3	V
I_h	1.0	A

LIMITING VALUES

P.I.V. max.	1.3	kV ←
$i_{a(pk)}$ max.	500	mA ←
$i_{a(surge)}$ max.	1.8	A ←
V_{h-k} max. (cathode positive)	500	V

Capacitor input

I_{out} max., $V_{in(r.m.s.)}$ max. — See rating chart 1

R_{lim} min. — See rating charts 2 and 3 and capacitor input regulation curves.

Choke input

I_{out} max., $V_{in(r.m.s.)}$ max. — See rating chart 1

L_{min} (at 50c/s) — See choke regulation curves

CHARACTERISTIC

Anode voltage drop (I_{out} = 150mA)	19.8	V

OPERATING CONDITIONS ←

Capacitor input

$V_{in(r.m.s.)}$	2 × 250	2 × 350	2 × 450	V
R_{lim} (per anode)	150	230	310	Ω
C	50	50	50	μF
I_{out}	160	150	100	mA
V_{out}	245	352	497	V

Choke input

$V_{in(r.m.s.)}$	2 × 250	2 × 350	2 × 450	V
L	10	10	10	H
I_{out}	180	180	150	mA
V_{out}	199	288	378	V

OPERATING NOTES

The design of a power circuit starts with a knowledge of the output conditions and from this information the transformer and secondary or input voltage can be chosen. Reference to the rating charts will indicate whether a rectifier is suitable for a particular application.

Rating chart 1

This shows all the combinations of input voltage and output current considered safe for both capacitor and choke input filters.

Rating chart 2

This chart shows the minimum series resistor per anode necessary to restrict the maximum switching surge in a capacitor input filter, to its limiting value over the range of supply voltages.

Rating chart 3

This shows the relationship between the maximum rectification efficiency and output current.

Capacitor input filter curcuits

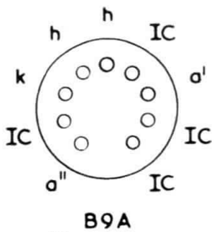
Reference should be made to rating charts 2 and 3 and the regulation curves. The circuit is set up and the input and output voltage and output current are measured. If the operating conditions lie within the boundary lines of the regulation curves, an improvement in the rectification efficiency may be effected by reducing the value of the limiting resistance. Rating chart 2 gives the minimum value of the limiting resistance against open circuit secondary voltage; this resistance will guard against excessive switching currents.

Comparison of the calculated rectification efficiency $\frac{V_{out}}{\sqrt{2} \times V_{in(r.m.s.)}}$ with rating chart 3 will show whether the limiting resistance must be increased to lower the rectification efficiency to the area of safe operation. Operation within this area indicates that the limiting value $i_{a(pk)}$ has not been exceeded.

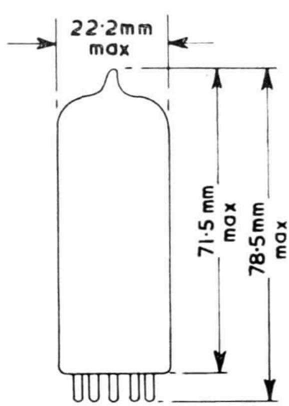
Choke input circuit

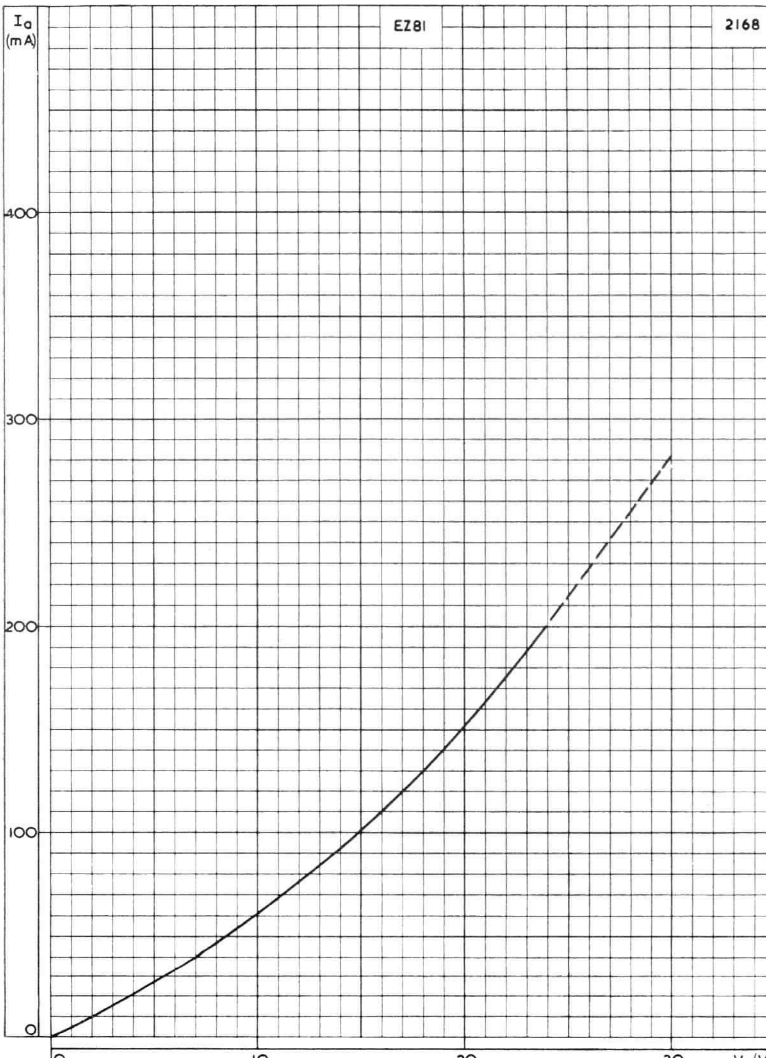
Reference should be made to rating chart 1. A suitable value of choke can be obtained from the choke regulation curves.

2170

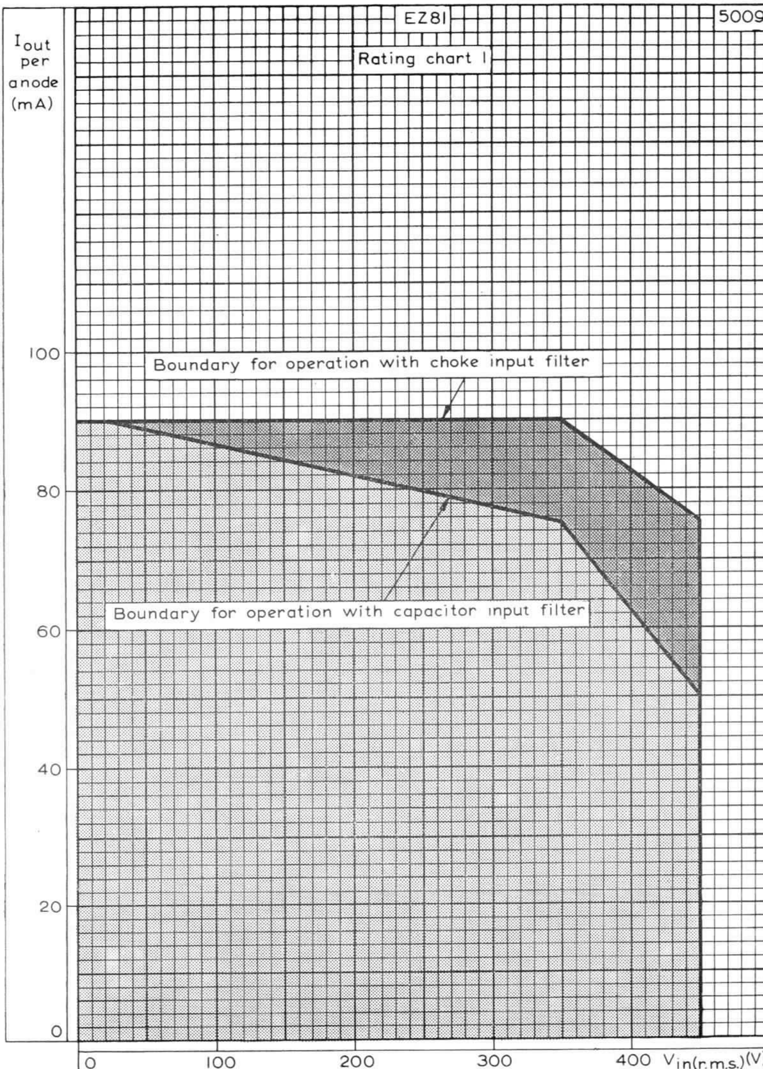


B9A
Noval Base

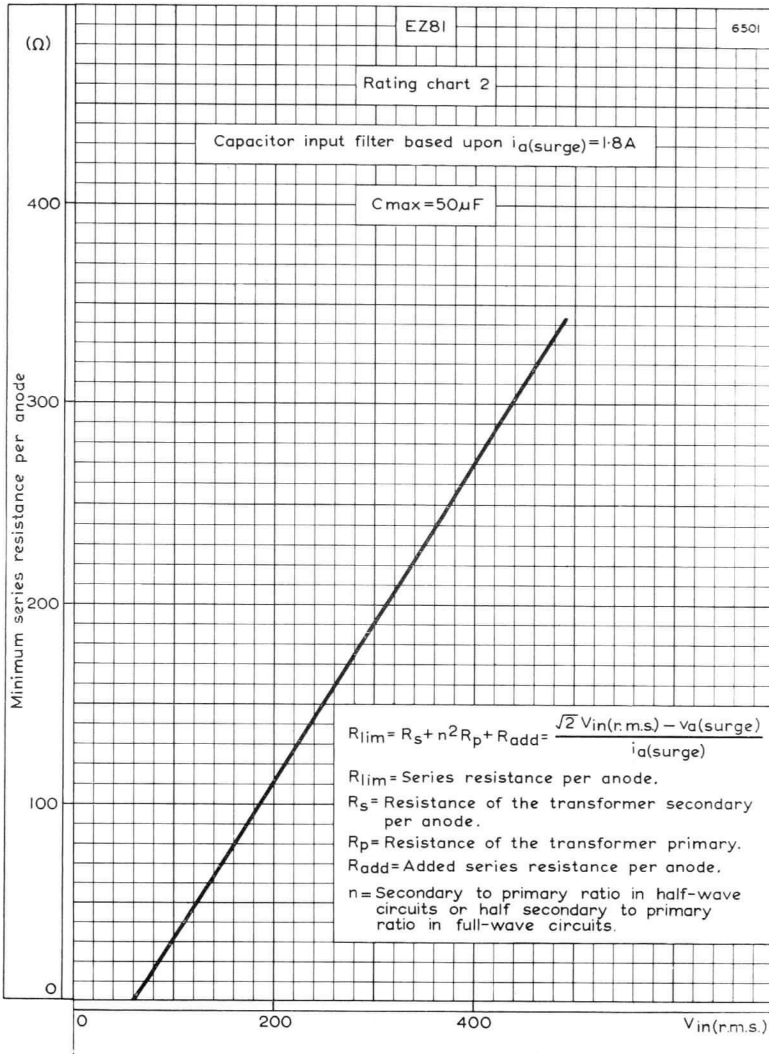




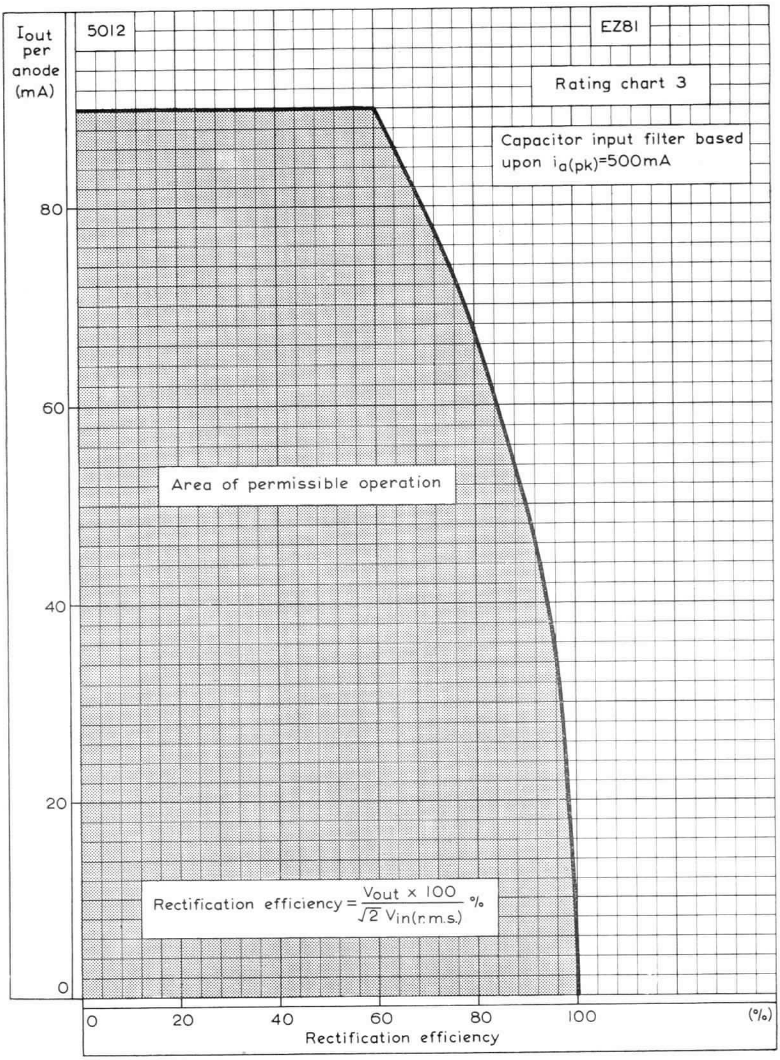
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



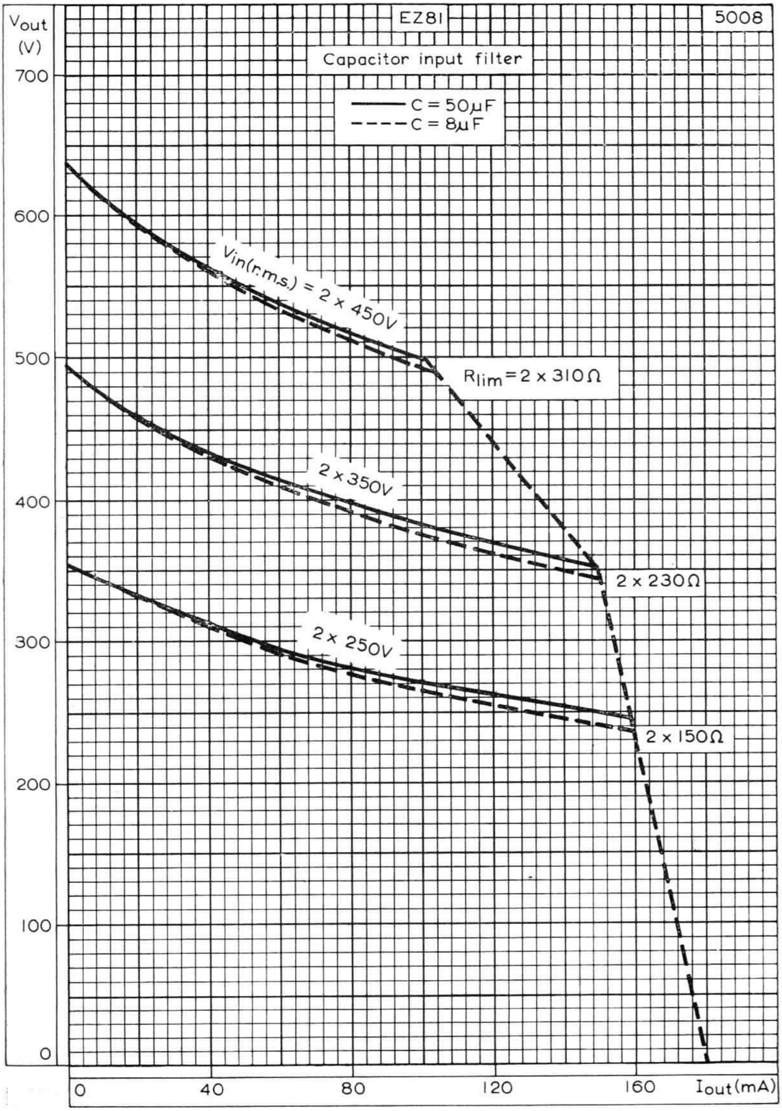
BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER



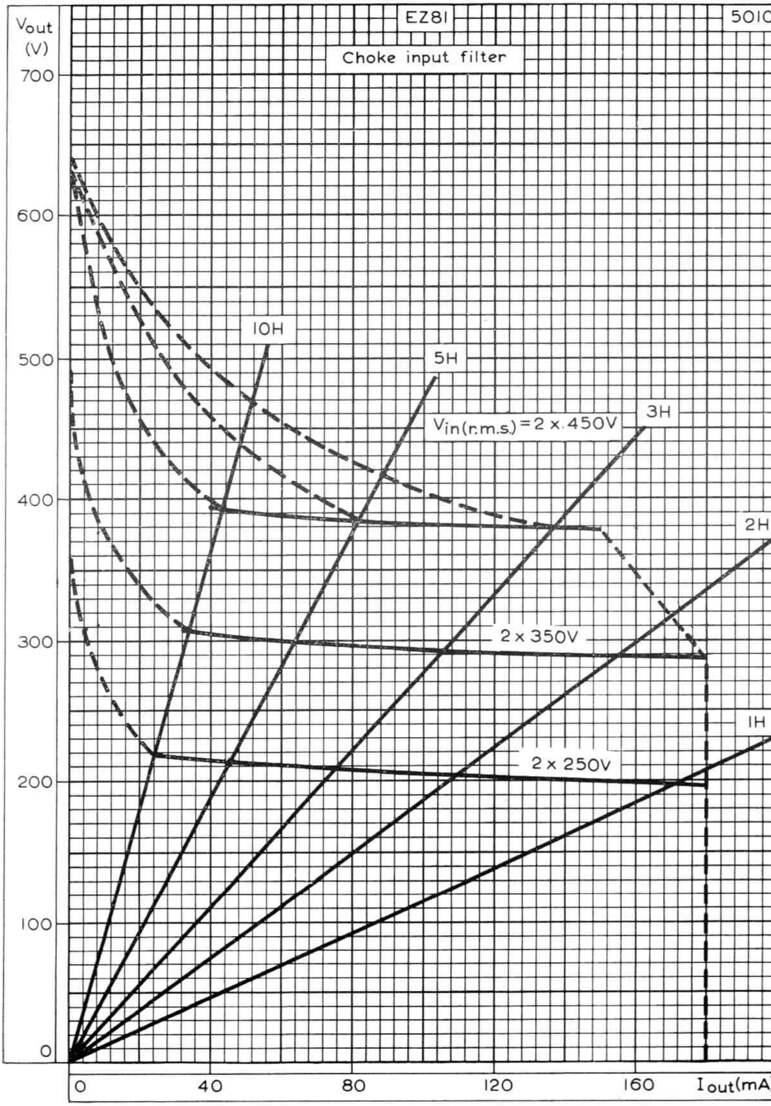
MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST OPEN CIRCUIT SECONDARY VOLTAGE



OUTPUT CURRENT PER ANODE PLOTTED AGAINST RECTIFICATION EFFICIENCY



CAPACITOR INPUT FILTER REGULATION CURVES



CHOKE INPUT FILTER REGULATION CURVES

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

$V_{a(r.m.s.)}$	I_{out}	C	R_{lim} min. (per anode)	V_{out}
(V)	(mA)	(μF)	(Ω)	(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

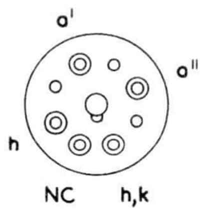
$V_{a(r.m.s.)}$	I_{out}	L	V_{out}
(V)	(mA)	(H)	(V)
2×250	125	10	205
2×300	125	10	249
2×350	125	10	295
2×400	125	10	340
2×450	125	10	384
2×500	125	10	429

GZ30

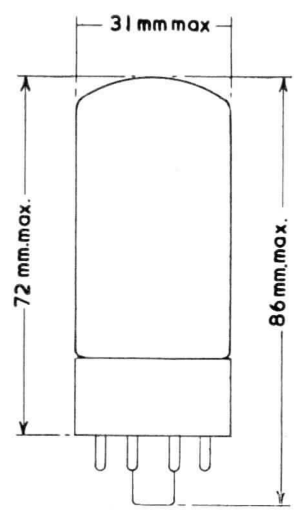
FULL-WAVE RECTIFIER

Indirectly-heated full-wave rectifier with 5-volt heater.

1332



Octal Base.



FULL-WAVE RECTIFIER

GZ32

Indirectly-heated full-wave rectifier with 5-volt heater.

HEATER

V_h	5.0	V
I_h	2.3	A
Heating Time (approx.)	25	secs.

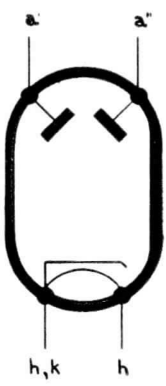
LIMITING VALUES—CAPACITOR INPUT

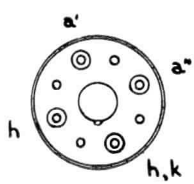
$V_{a\ (r.m.s.)}$ max.	2×300	2×350	2×500	V
I_{out} max.	300	250	125	mA

C (μF)	R_{lim} min. (Ω)
60	150
32	100
16	50

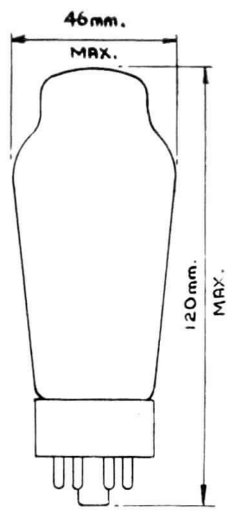
LIMITING VALUES—CHOKE INPUT

$V_{a\ (r.m.s.)}$ max.	2×400	2×500	V
I_{out} max.	300	250	mA





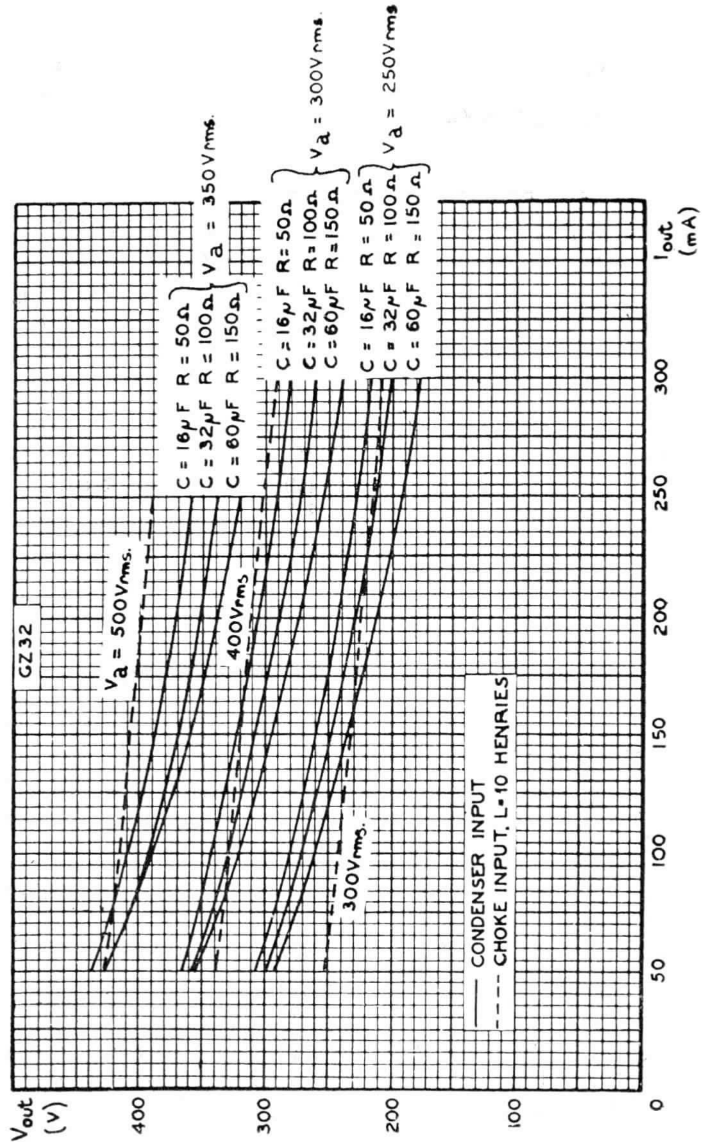
OCTAL BASE



GZ32

FULL-WAVE RECTIFIER

Indirectly-heated full-wave rectifier with 5-volt heater.



OUTPUT VOLTAGE PLOTTED AGAINST OUTPUT CURRENT

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)	$R_{lim.}$ 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

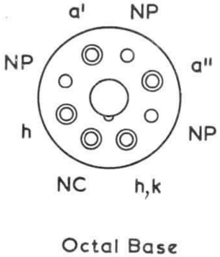
$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	V_{out} (V)
2×300	300	10	242
2×400	300	10	332
2×500	300	10	421

GZ33

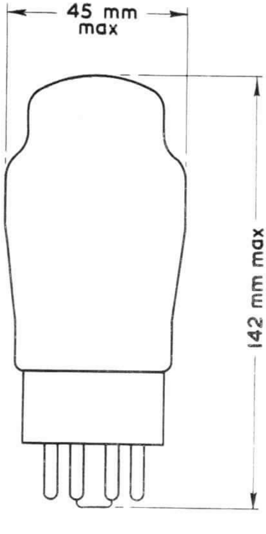
FULL-WAVE RECTIFIER

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_{lim} min. (per anode)	50	75	100	125	150	175	Ω
Choke input							
I_{out} max.	250	250	250	250	250	225	mA
R_{lim} min. (per anode)	0	0	0	0	0	0	Ω

TYPICAL OPERATING CONDITIONS ←

Capacitor input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	C (μF)	R_{lim} (per anode) (Ω)	V_{out} (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

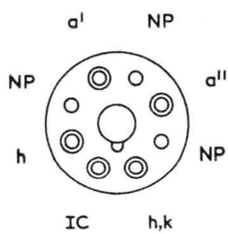
$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	R_{lim} (per anode) (Ω)	V_{out} (V)
2×300	250	10	0	250
2×350	250	10	0	290
2×400	250	10	0	330
2×450	250	10	0	375
2×500	250	10	0	420
2×550	225	10	0	465

GZ34

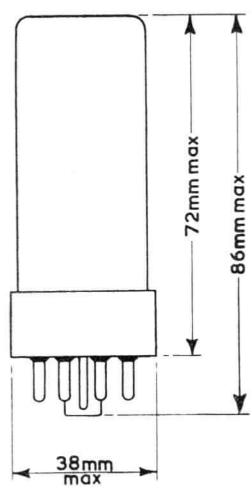
FULL-WAVE RECTIFIER

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

5305



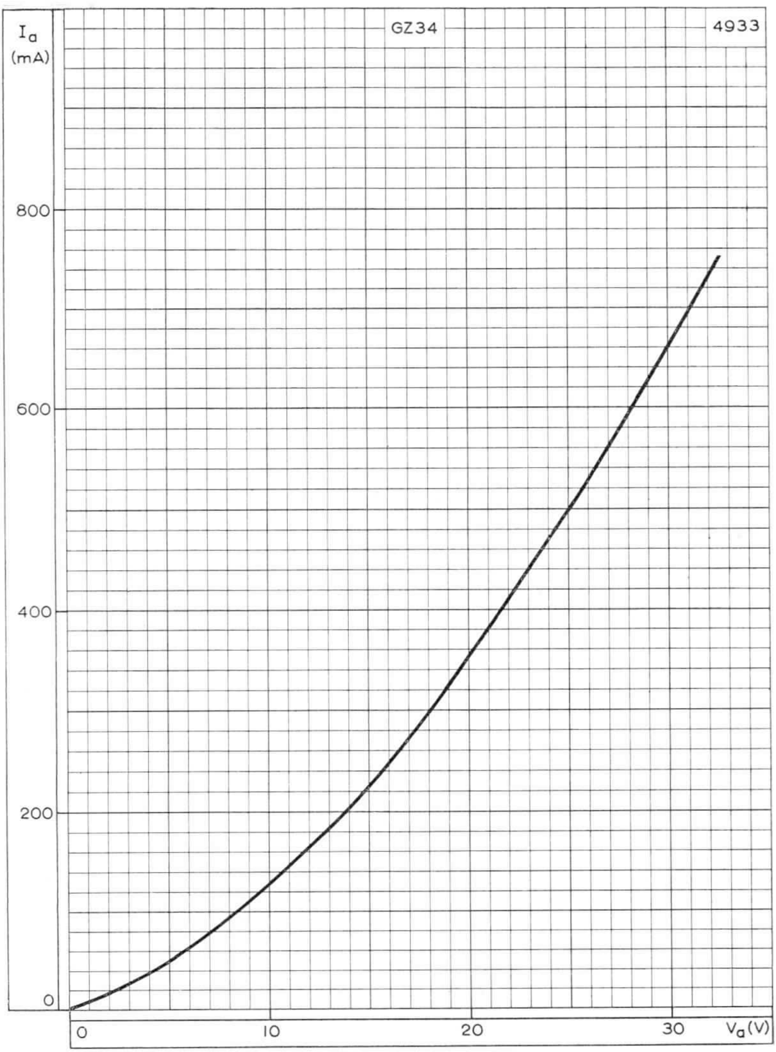
Octal Base



FULL-WAVE RECTIFIER

GZ34

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

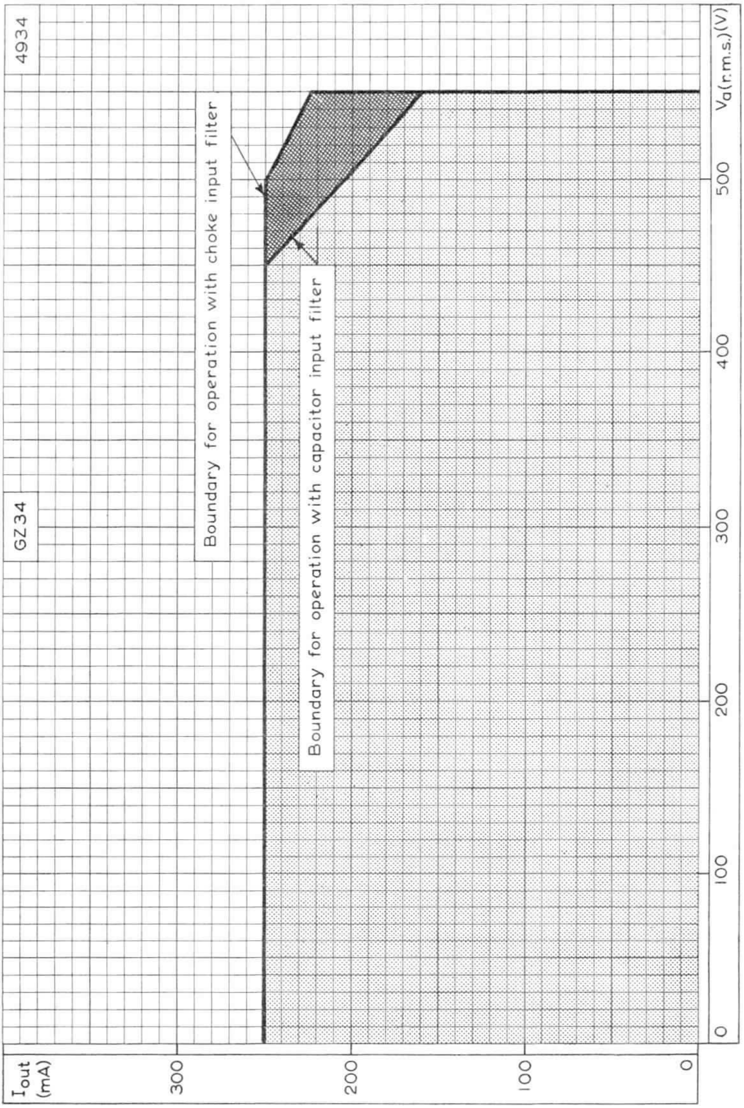


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

GZ34

FULL-WAVE RECTIFIER

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

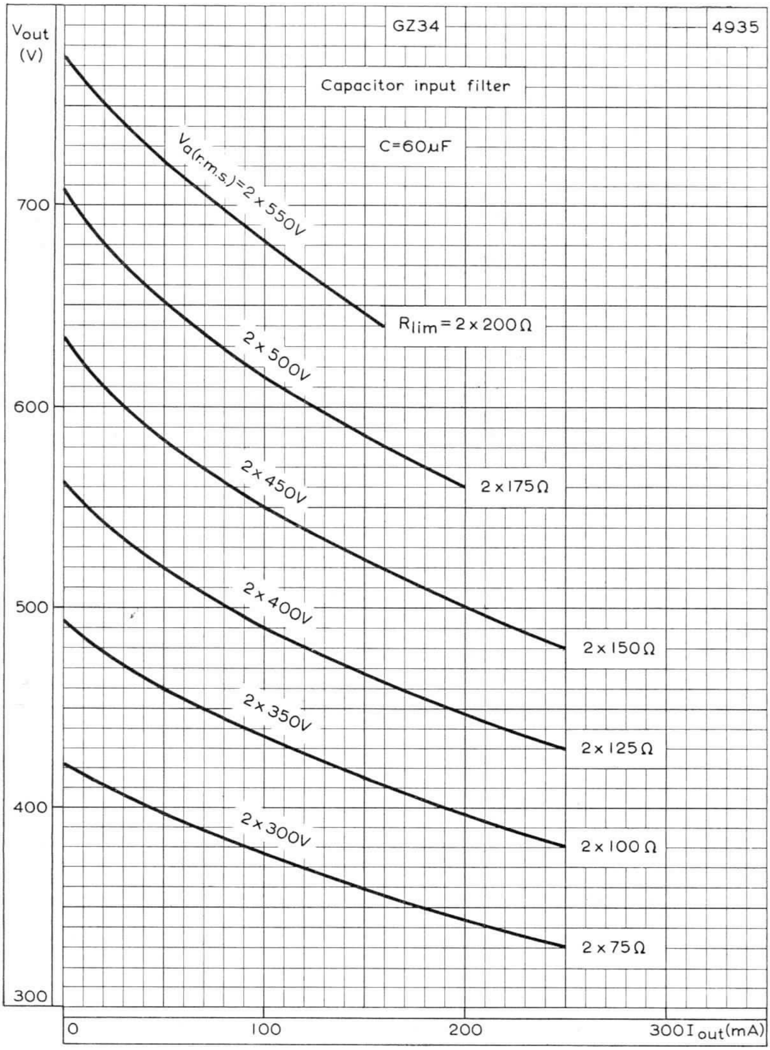


BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER

FULL-WAVE RECTIFIER

GZ34

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

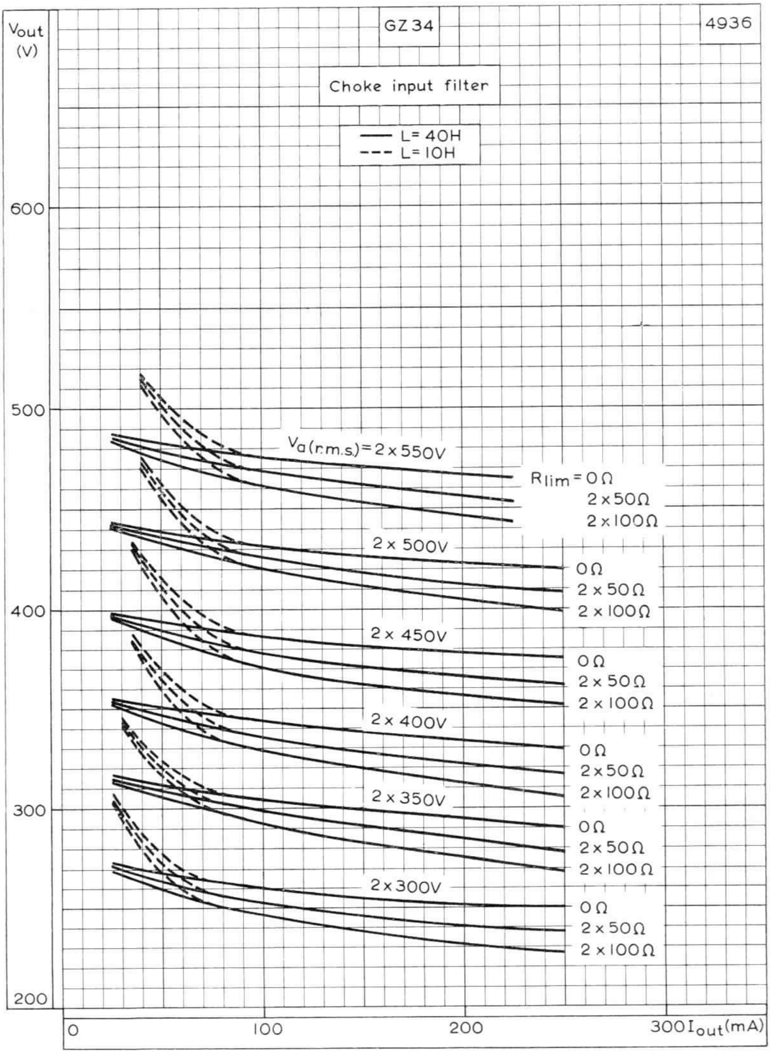


CAPACITOR INPUT FILTER REGULATION CURVES

GZ34

FULL-WAVE RECTIFIER

Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.



CHOKE INPUT FILTER REGULATION CURVES

FULL-WAVE RECTIFIER

GZ37

Indirectly heated full-wave rectifier with a 5 volt heater.

HEATER

V_h	5.0	V
I_h	2.8	A

LIMITING VALUES

Capacitor input

P.I.V. max.	1.6	kV
$i_{a(pk)}$ max. (per anode)	750	mA
I_{out} max.	250	mA

Choke input

P.I.V. max.	1.85	kV
I_{out} max.	350	mA

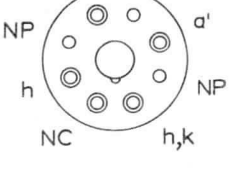
TYPICAL OPERATING CONDITIONS

Capacitor input

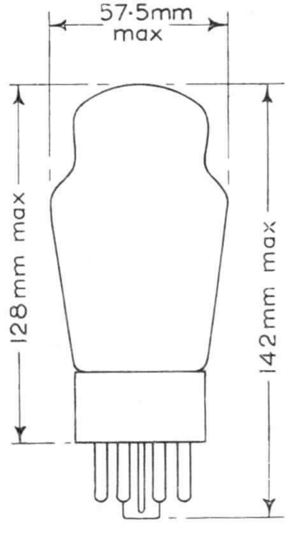
$V_{a(r.m.s.)}$	2×300	2×400	2×500	V
I_{out}	250	250	250	mA
C	4	4	4	μF
R_{lim} min (per anode)	75	75	75	Ω
V_{out} approx.	238	358	486	V

Choke input

$V_{a(r.m.s.)}$	2×300	2×400	2×500	V
I_{out}	350	350	350	mA
L	10	10	10	H
R_{choke}	100	100	100	Ω
V_{out} approx.	207	298	381	V



Octal Base



4651

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

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]	*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_{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. $V_h = 6.9V$, $V_{a-e} = 250V$ $V_{g-e} = 0V$, $R_k = 810\Omega$	2.5	—	—	1.0	—	—	—	µA
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration, $V_b = 250V$, $R_a = 2k\Omega$, $V_{g-e} = 0V$, $R_k = 810\Omega$, $C_k = 1000\mu F$	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. $V_a = 300V$, $R_g = 8.5k\Omega$, $f = 150Mc/s$	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 $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current $R_g max. = 500k\Omega$	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 $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current $R_g max. = 500k\Omega$	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. $V_{a-e} = 250V$, $R_k = 500\Omega$, $V_{h-k} = 150V$ (cathode negative)

Stability life test end point

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

Intermittent life test

Running conditions. $V_{a-e} = 250V$, $R_k = 500\Omega$, $V_{h-k} = 150V$ (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 $V_{h-k} = \pm 100V$	500 hours	2.5	—	20	µA
	1000 hours	4.0	—	20	µA
Reverse grid current. R_g max. $= 500k\Omega$	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	—	—	

	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_g max. = 500kΩ	0.5	—	0.5	μA

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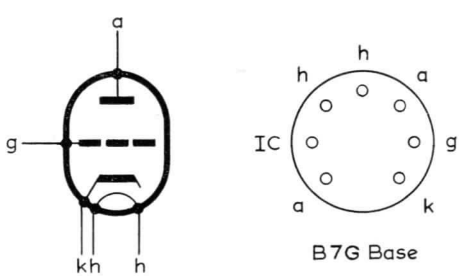
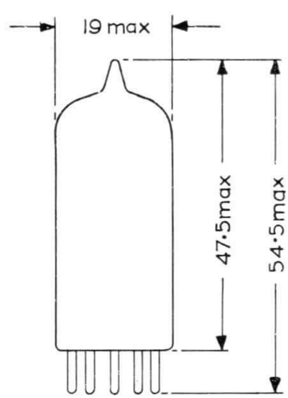




All dimensions in mm

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]	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, 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

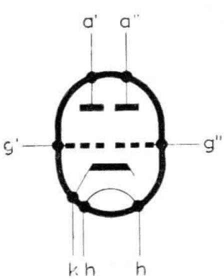
Change in mutual conductance after 1 hour	1.0	—	—	15	—	—	—	%

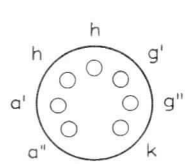
Intermittent life test

Running conditions: $V_{a-e} = 125V$, $R_k = 50\Omega$, $V_{h-k} = 180V$ (cathode negative)

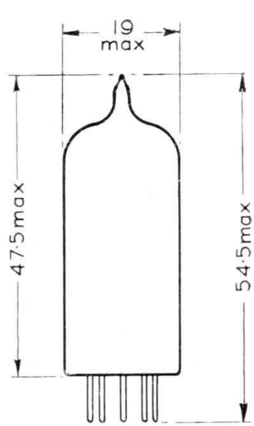
Intermittent life test end points		A.Q.L.[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	420	480	mA
Heater to cathode leakage current. $V_{h-k} = \pm100V$	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse grid current 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	—	—	

	A.Q.L.[5] (%)	Min.	Max.	
GROUP G				
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



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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
μ_{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

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. $V_{h-k} = \pm 100V$	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. $V_{h-k} = \pm 100V$	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 $= 500k\Omega$	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	—	—	

M8082

SPECIAL QUALITY OUTPUT PENTODE

	A.Q.L.[5] (%)	Min.	Max.	
Dynamic life test 100 hours				
Running conditions as a trebler. $V_b = 300V$, decoupling resistor $= 1.0k\Omega$, $I_a + I_{g2} = 20mA$, $I_{g1} = 1.6mA$, $f = 70$ to $75Mc/s$, $P_{out} = 900mW$				
Dynamic life test end point				
Change in P_{out}	—	—	20	%

GROUP G

	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. $= 500k\Omega$	0.5	—	0.75	μA

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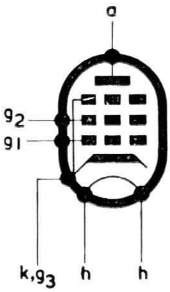
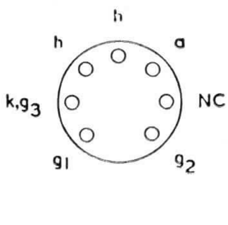
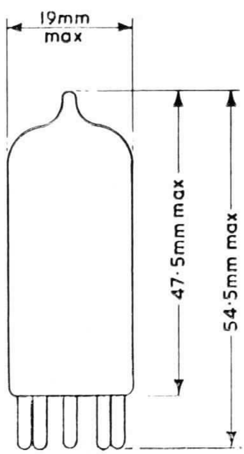
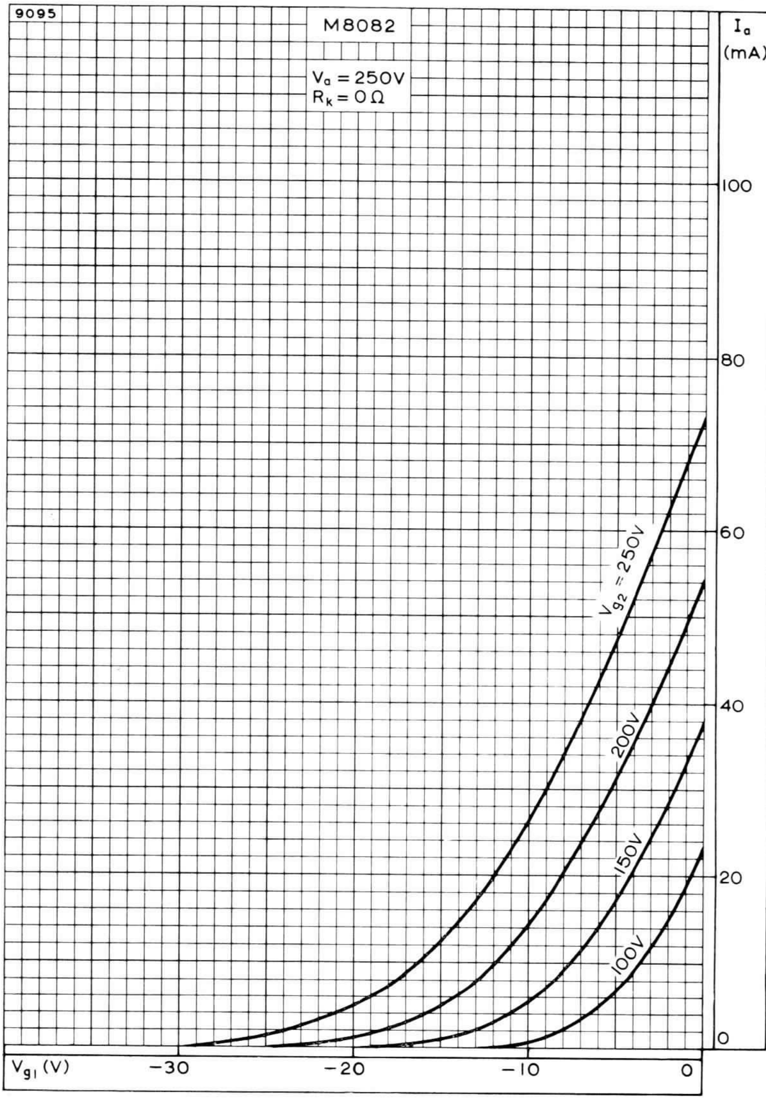




B7G Base



The bulb and base dimensions of this valve are in accordance with BS448, Section B7G



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

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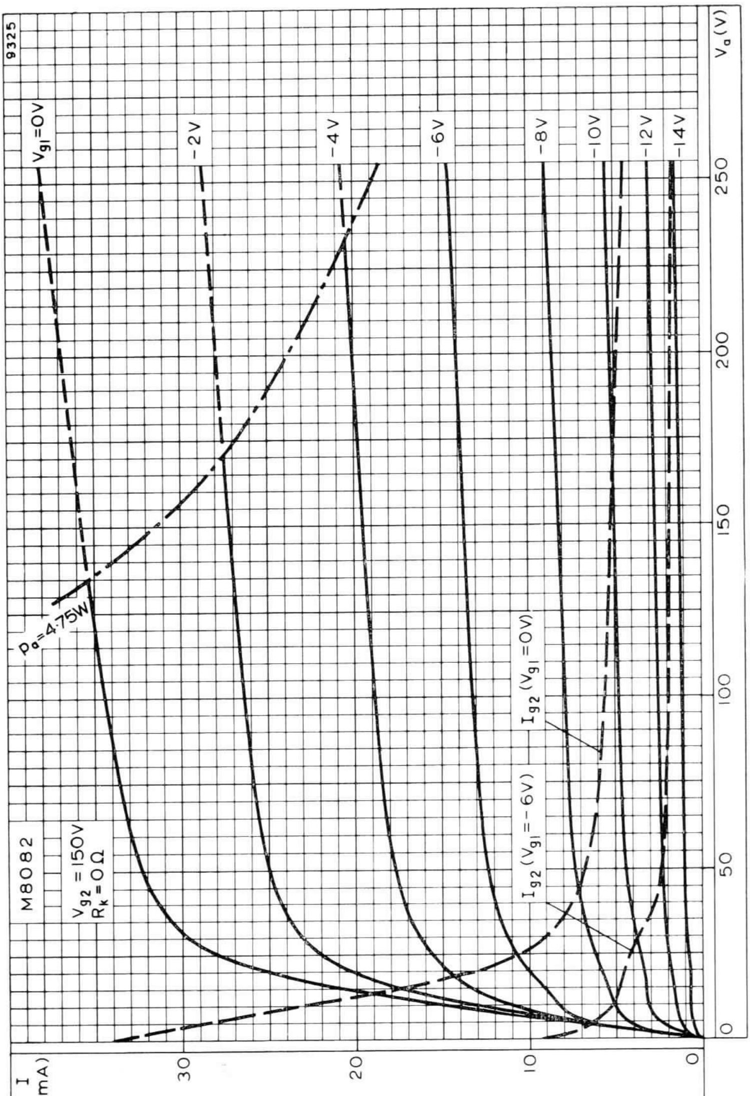
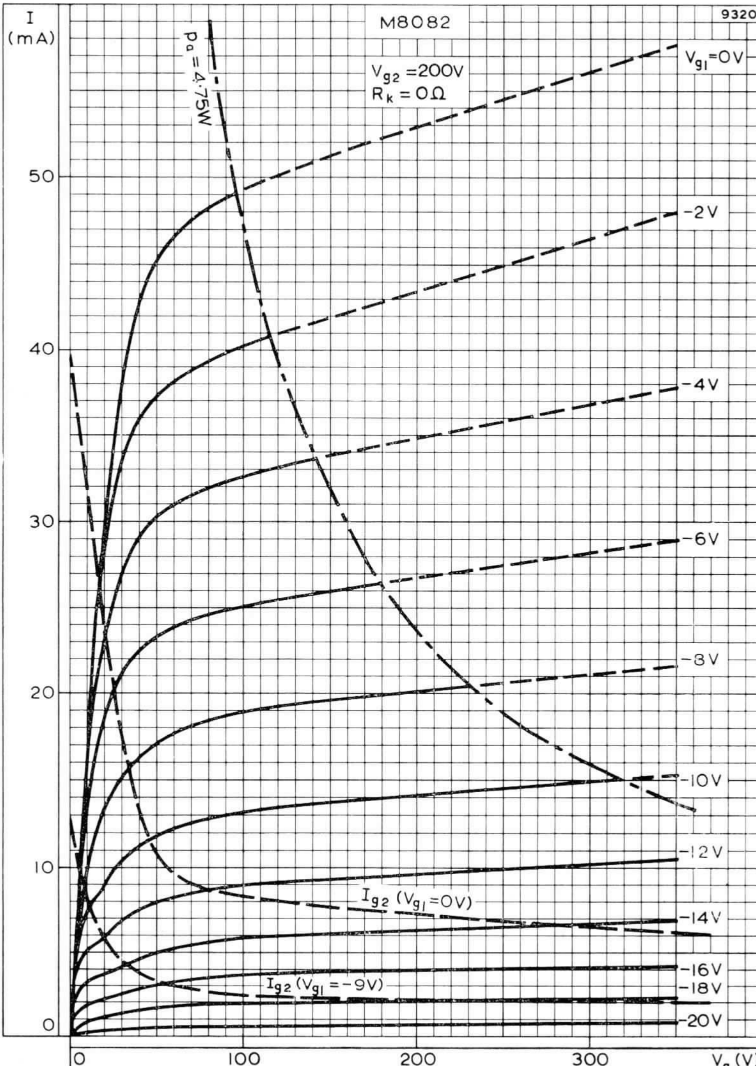
SPECIAL QUALITY OUTPUT PENTODE



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. $V_{g2} = 200V$

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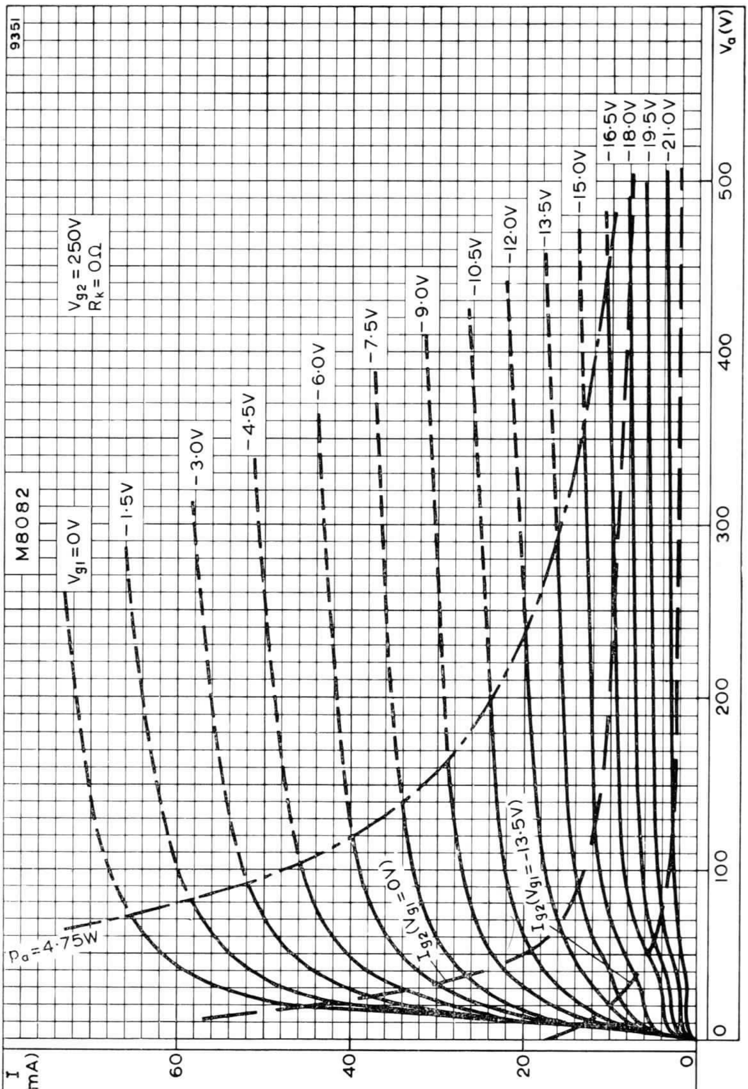
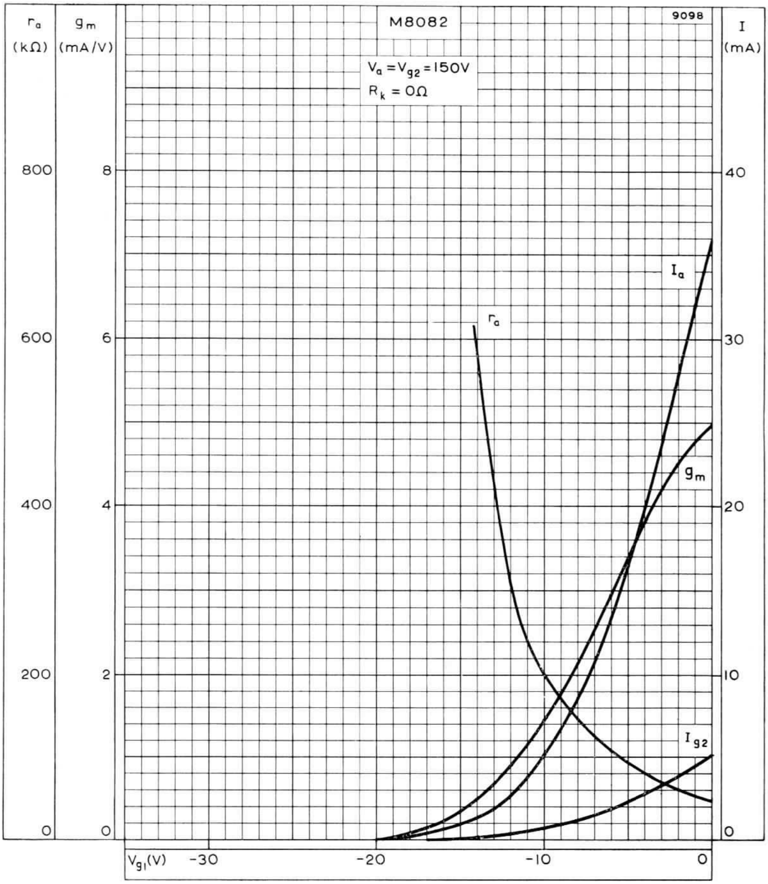
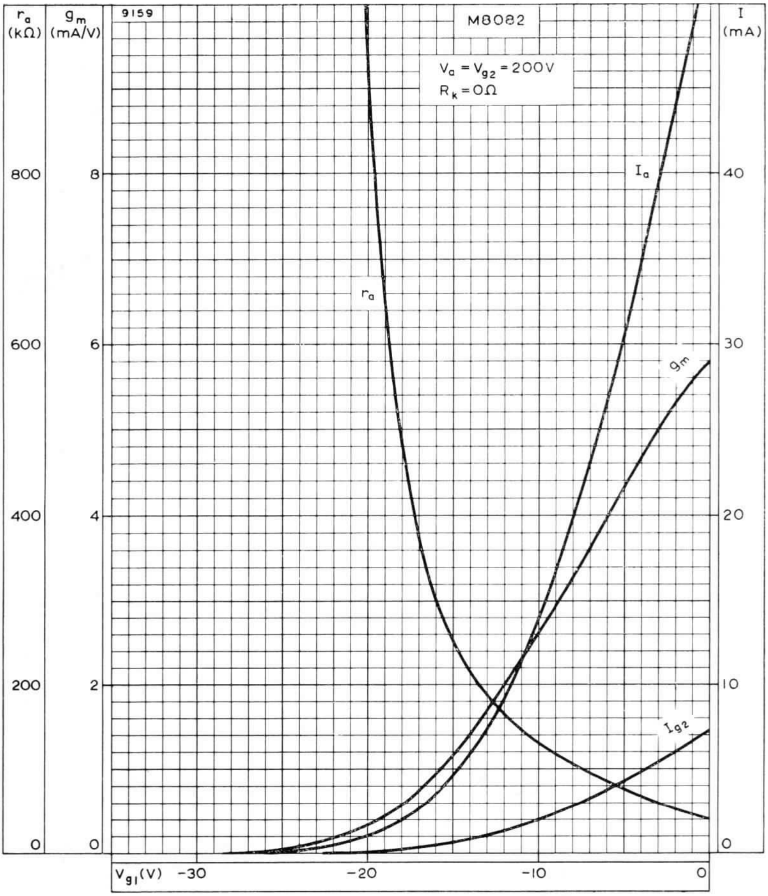
SPECIAL QUALITY OUTPUT PENTODE



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



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.
$V_a = V_{g2} = 200V$

SPECIAL QUALITY OUTPUT PENTODE

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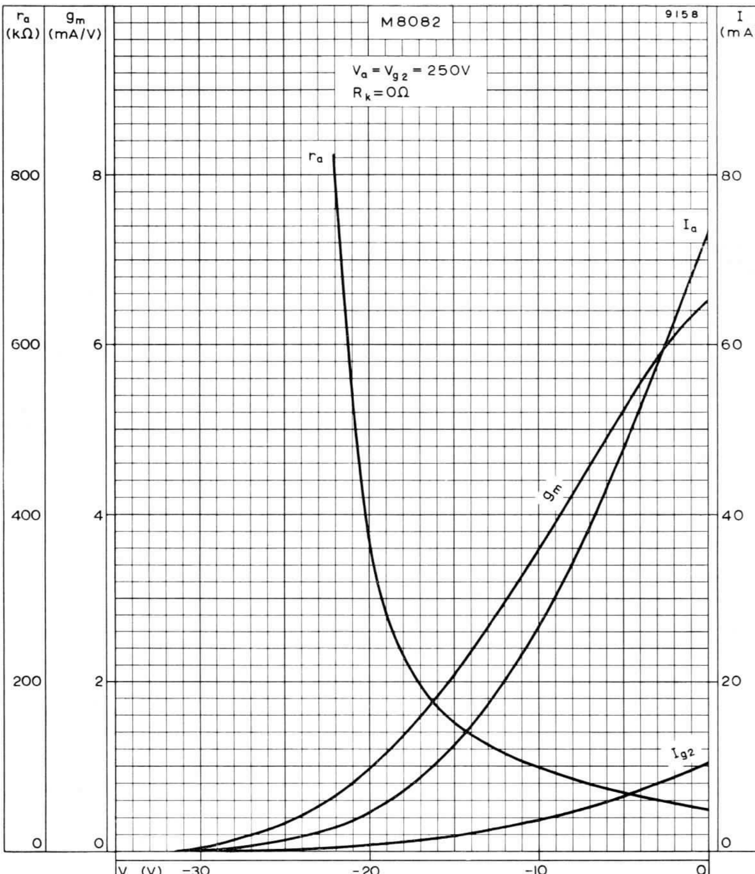
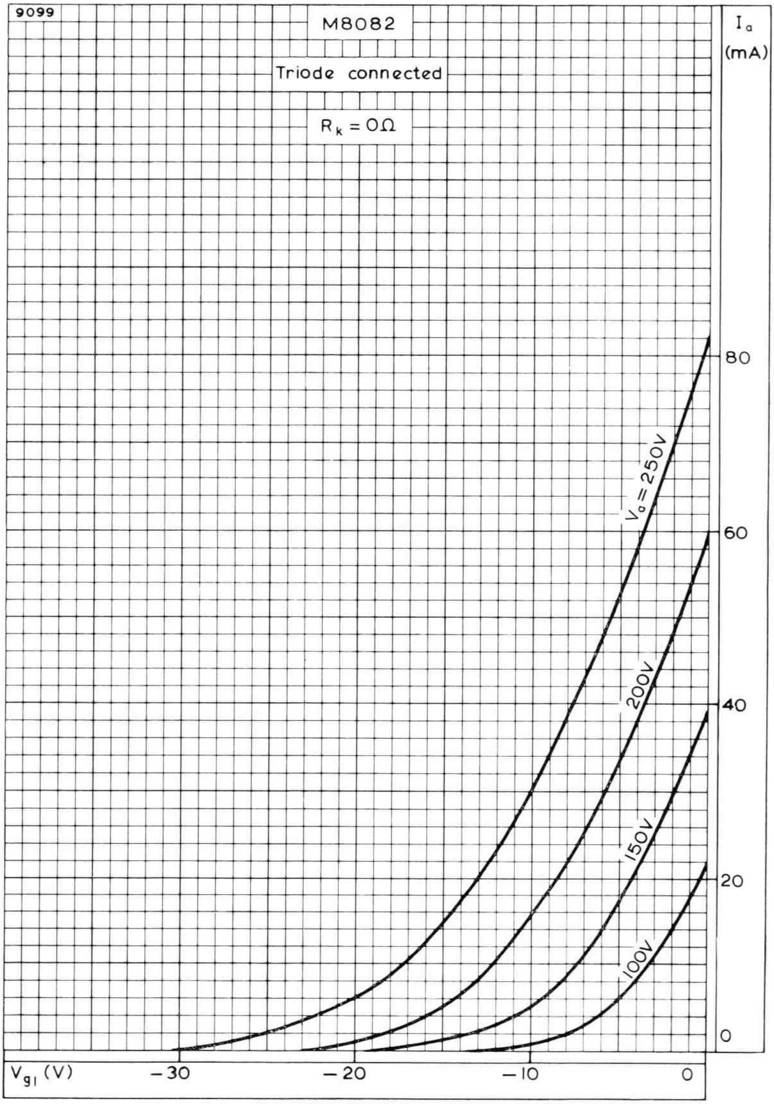
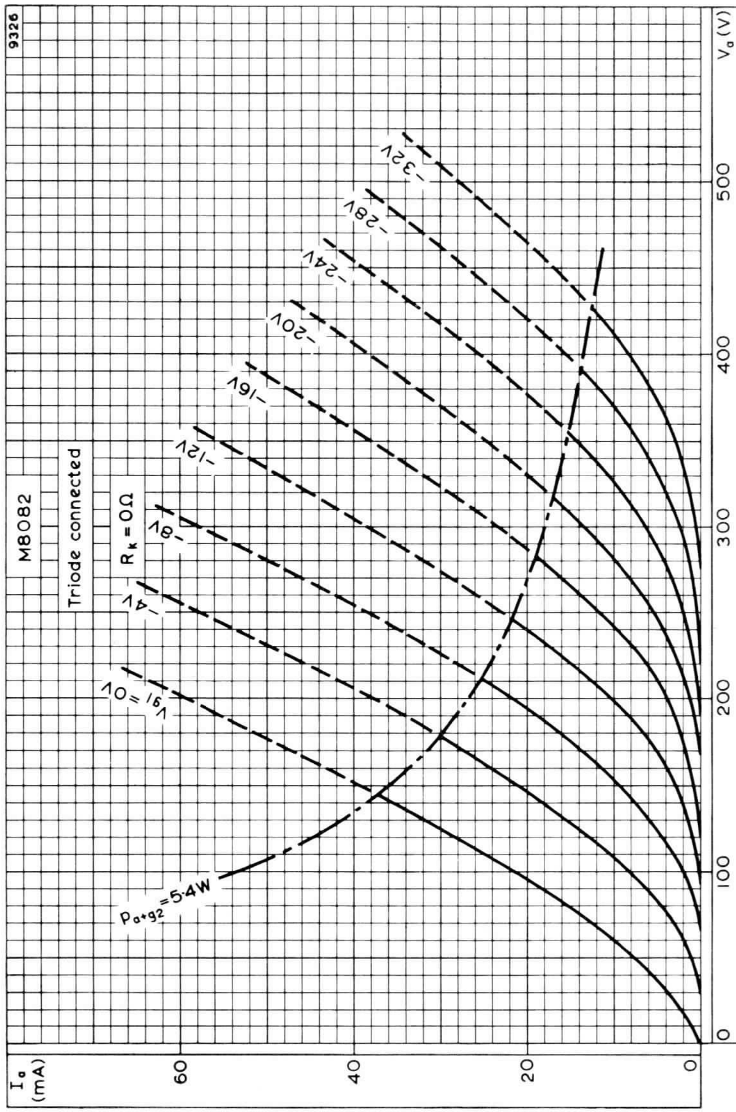


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 250V$



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



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

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

TEST CONDITIONS (unless otherwise specified)

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

TESTS	A.Q.L.[5]	Individuals[6]			Lot average[7]		Lot standard deviation[8]	
	(%)	Bogey[9]	Min.	Max.	Min.	Max.	Max.	
GROUP A								
Heater current	0.65	400	375	425	—	—	—	mA
Heater-cathode leakage current $V_{h-k} \pm 100V$	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 $V_g = -15V$, $R_k = 0\Omega$	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	2.5	—	200	—	—	—	—	MΩ
g-rest measured at –100V		—	200	—	—	—	—	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.)

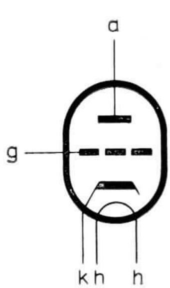
TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
***Fatigue*[14]**								
V_h = 6.3V. No other voltages applied. 2.5g minimum peak acceleration, fixed frequency. f = 25c/s min., 60c/s max. for 32 hours in each of 3 mutually perpendicular planes.								
Post Fatigue Tests								
Heater to cathode leakage current $V_{h-k}\pm100V$	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 $V_{h-k}\pm100V$	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	—	—	—	—	—	—	

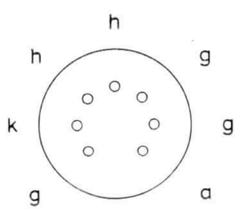
GROUP D

Heater cycling life test
V_h = 7.0V. V_{h-k} +100V d.c.
1 minute on 4 minutes off. No other voltages.

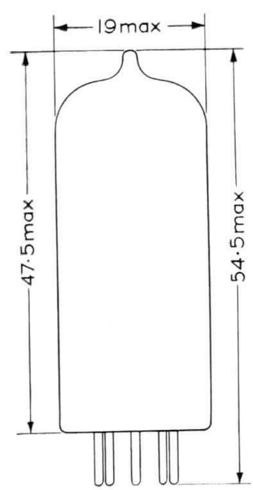
Heater cycling life end points								
Heater to cathode leakage								
$V_{h-k} \pm 100V$ d.c.	1.0	—	—	20	—	—	—	μA
Insulation as in Group B	2.5	—	30	—	—	—	—	MΩ
Stability life test[14]								
Running conditions, $V_{h-k}+100V$ d.c. $R_g = 250\ k\Omega$								
$T_{ambient}$ = Room temperature.								
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[10]	10.0							

M8248 SPECIAL QUALITY U.H.F. TRIODE





B7G Base



All dimensions in mm

7824

TRIPLE DIODE TRIODE

PABC80

Triple diode triode with 300mA heater and one diode having a separate cathode. Primarily intended for use in f.m./a.m. receivers.

HEATER

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

I_h	300	mA
V_h	9.5	V

For limiting values, characteristics, operating conditions and base connections see data sheets UABC80.

R.F. TRIODE

PC97

Triode with low anode-to-grid capacitance intended for use as an r.f. amplifier in V.H.F. television tuners.

HEATER

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

I_h	300	mA
V_h	4.5	V

CAPACITANCES

	Shielded	*Unshielded*	
c_{a-g}	480	500	mpF
c_{g-k}	3.2	3.2	pF
c_{a-k}	210	250	mpF
$c_{g-k+h+S}$	5.0	5.0	pF
$c_{a-k+h+S}$	4.2	3.3	pF
c_{g-h}	280	280	mpF
c_{k-h}	2.5	2.5	pF

CHARACTERISTICS

V_a	135	V
V_g	−1.0	V
I_a	11	mA
g_m	13	mA/V
μ	65	
r_a	5.0	kΩ
V_g for $I_a = 100\mu A$	−5.0	V
V_g for 20 : 1 reduction in g_m	−3.1	V
V_g for 100 : 1 reduction in g_m	−5.0	V

OPERATING CONDITIONS

Condition	*1*	*2*	*3*	*4*	
V_b	135	135	135	135	V
R_a	1.0	1.0	2.2	2.2	kΩ
R_k	82	0	0	0	Ω
R_g	0	1.0	0.22	1.0	MΩ
R_{g-a}	—	—	22	22	MΩ
I_a	10.5	13	14	14	mA
g_m	13	15.5	16	16	mA/V
V_g for 100 : 1 reduction in g_m	−5.0	−4.8	−6.0	−11	V

PC97

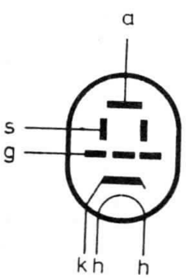
R.F. TRIODE

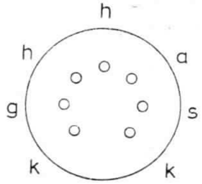
Condition	5	6	7	8	
V_b	200	200	200	200	V
R_a	5.6	5.6	6.8	6.8	kΩ
R_k	82	0	0	0	Ω
R_g	0	1.0	0.22	0.56	MΩ
R_{g-a}	—	—	22	22	MΩ
I_a	12	13	14	14	mA
g_m	14	15.5	16	16	mA/V
V_g for 100 : 1 reduction in g_m	–7.5	–7.3	–9.0	–12.5	V

I_a and g_m curves corresponding to conditions 1 to 4 are given on pages C2 and C3, and for conditions 5 to 8 on pages C4 and C5.

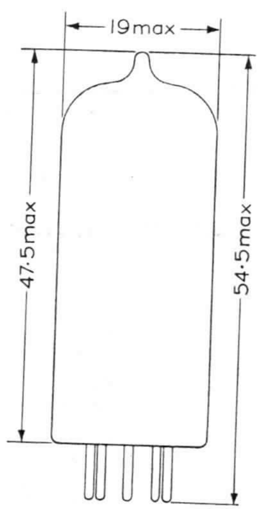
DESIGN CENTRE RATINGS

$V_{a(b)}$ max.	550	V
V_a max.	200	V
p_a max.	2.2	W
I_k max.	20	mA
$-V_g$ max.	50	V
R_{g-k} max.	1.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ





B7G Base



7438

All dimensions in mm

DOUBLE TRIODE

PCC84

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers with series connected heaters.

HEATER

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

I_h	300	mA
V_h	7.0	V

CAPACITANCES (measured without external shield)

$c_{a'-k'+h+g''}$	1.2	pF
$c_{a'-a''}$	$<$0.035	pF
$c_{g'-a''}$	$<$0.006	pF

Grounded cathode section

$c_{a'-g'}$	1.2	pF←
$c_{in'}$	2.1	pF←
$c_{out'}$	0.45	pF
$c_{g'-h}$	$<$0.25	pF

Grounded grid section

$c_{a''-g''}$	2.3	pF
$c_{a''-k''}$	0.16	pF
$c_{k''-g''+h}$	4.7	pF
$c_{a''-g''+h}$	2.5	pF
$c_{h-k''}$	2.7	pF

CHARACTERISTICS (each section)

V_a	90	V
I_a	12	mA
V_g	−1.5	V
g_m	6.0	mA/V
μ	24	
*R_{in}	2.0	kΩ

*Measured at $f = 200$Mc/s with cathode connections pins 7 and 8 strapped.

PCC84

DOUBLE TRIODE

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers with series-connected heaters.

TYPICAL OPERATING CONDITIONS

V_a	180	V
I_a	12	mA
V_g	−1.5	V

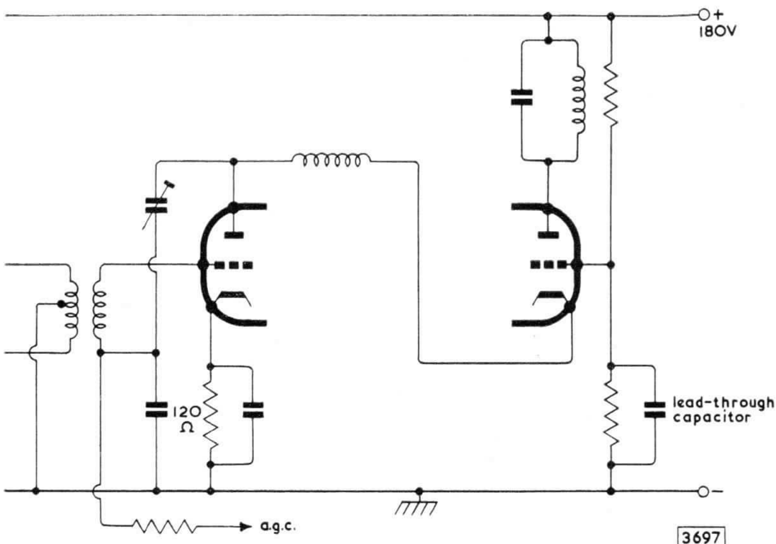


Fig.1

Noise figure (bandwidth of input circuit 7 to 8Mc/s) 6.5

DOUBLE TRIODE

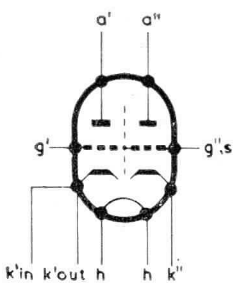
PCC84

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers with series-connected heaters.

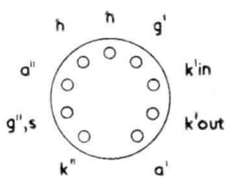
LIMITING VALUES (each section unless otherwise specified)

$V_{a(b)}$ max.	550	V
V_a max.	180	V
p_a max.	2.0	W
I_k max.	18	mA
$-V_g$ max.	50	V
$R_{g'-k'}$ max.	1.0	MΩ←
$R_{g''-k''}$ max.	500	kΩ←
*$v_{h-k''\,(pk)}$ max. (cathode positive)	250	V
$V_{h-k''}$ max. (cathode negative)	90	V
$V_{h-k'}$ max.	90	V
R_{h-k} max.	20	kΩ

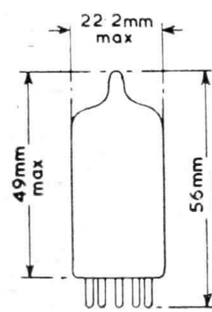
*Max. d.c. component = 180V.



1390



B9A Base

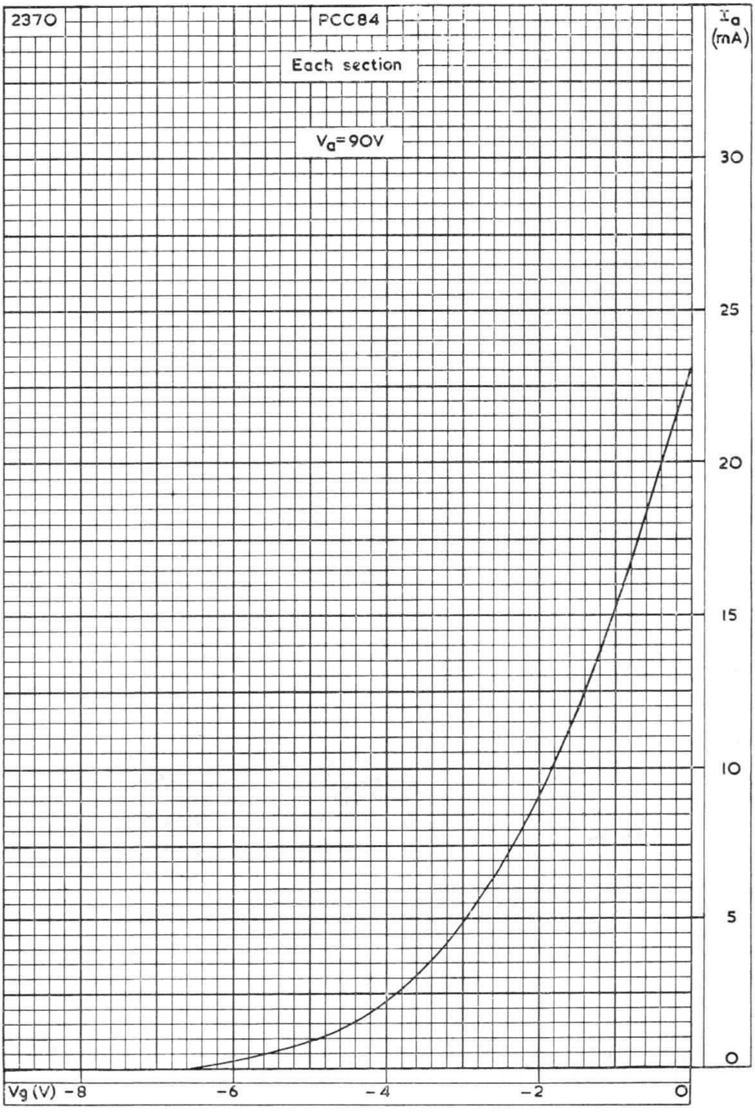


The triode on pins 6, 7, 8, 9 should have grounded-cathode connection and that on pins 1, 2, 3 should have grounded-grid connection.

PCC84

DOUBLE TRIODE

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers with series-connected heaters.



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

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

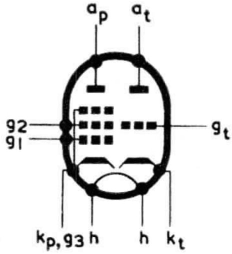
$V_{a(b)}$ max.	550	V
V_a max.	250	V
$+v_{a(pk)}$ max.	2.0	kV
$-v_{a(pk)}$ max.	500	V
p_a max.	5.4	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.2	W
p_{g2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g1-k} max. (self bias)	500	kΩ
R_{g1-k} max. (fixed bias)	250	kΩ
R_{g1-k} max. (timebase 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

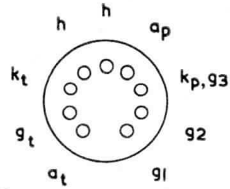
Triode Section

$V_{a(b)}$ 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

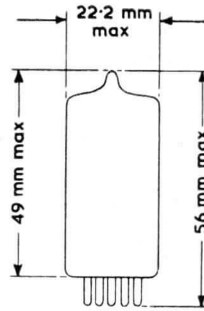
*Max. pulse duration 400μsec.

2224





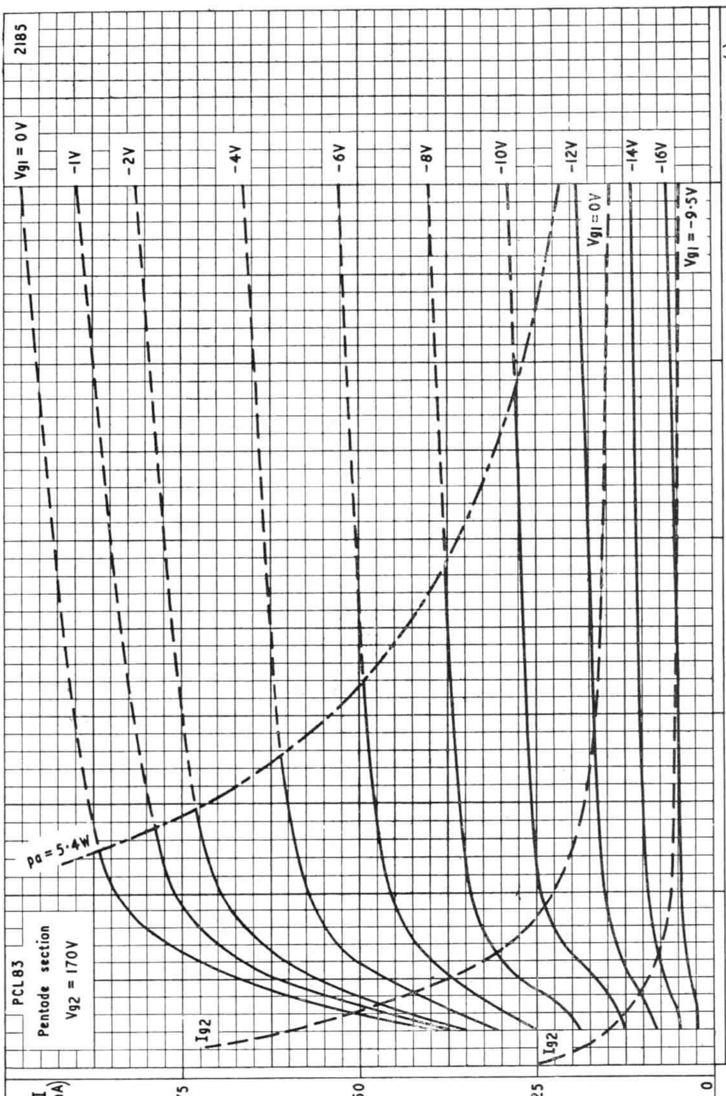
B9A
Noval Base



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. $V_{g2} = 170V$

LINE OUTPUT PENTODE

PL81

Output pentode primarily intended for use in the line timebase of television receivers.

HEATER

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

I_h	300	mA
V_h	21.5	V

CAPACITANCES

c_{in}	14.7	pF
c_{out}	6.4	pF
c_{a-g1}	<800	mpF
c_{g1-h}	<200	mpF
c_{a-k}	<100	mpF

CHARACTERISTICS

V_a	170	V
V_{g3}	0	V
V_{g2}	170	V
V_{g1}	–24	V
I_a	45	mA
I_{g2}	3.0	mA
g_m	6.5	mA/V
r_a	15	kΩ
μ_{g1-g2}	5.5	
V_{g1} max. ($I_g = +0.3\mu A$)	–1.3	V

OPERATION AS LINE OUTPUT PENTODE

Circuit Design

In calculating the peak anode current for circuit design purposes the knee is taken as the reference point. Operation so that the anode potential of the output valve at the end of scan is above the knee of the anode characteristic is not recommended, unless an effective feedback stabilising circuit is employed.

For operation below the knee of the characteristic the nomogram on page C1 should be used.

LIMITING VALUES

$V_{a(b)}$ max.	650	V
V_a max.	250	V
p_a max.	8.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
**p_{g2} max.	4.5	W
$p_a + p_{g2}$ max.	8.5	W
I_k max.	180	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	240	°C

PL81

LINE OUTPUT PENTODE

Line output applications

*+$v_{a(pk)}$ max.	6.0	kV
p_a max.	7.0	W
**p_{g2} max.	4.5	W
$p_{a+}p_{g2}$ max.	8.5	W
*+$v_{g1(pk)}$ max.	3.0	V
*–$v_{g1(pk)}$ max.	1.0	kV
R_{g1-k} max.	3.3	MΩ
Min. drive at $v_{a(pk)}$ = 4kV	80	V
Min. drive at $v_{a(pk)}$ = 6kV	95	V

*Max. pulse duration 22% of one cycle, with a maximum of 18μs.

**Max. average p_{g2} is 6W during the period between the commencement of I_{g2} and the instant when I_a attains one half of its normal operating value.

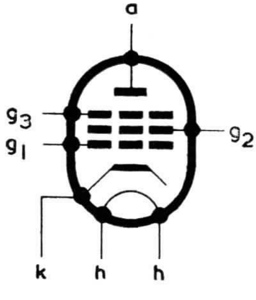
PEAK ANODE CURRENT NOMOGRAM

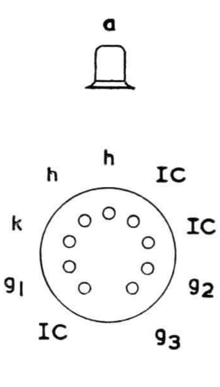
The nomogram shown on the following pages gives directly the recommended peak values of anode current, i_a(design), for a wide range of h.t. line potentials and screen-grid resistors.

It assumes 'below the knee' operation (which is recommended for all cases except when a stabilising circuit is used), undecoupled screen-grid resistor (excluding capacitors of a few hundred picofarad), and control-grid potential of +1V. The last condition is normally fulfilled by driven time bases having the control-grid resistor returned to chassis.

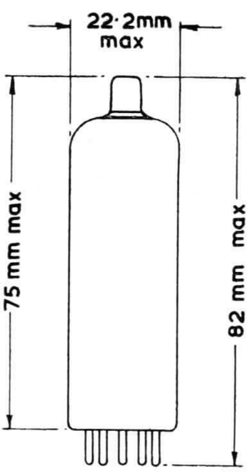
The use of the nomogram does not exempt the designer from checking that the valve is operating within its limiting values. During measurements of the operating conditions in a line timebase a valve whose characteristic is close to that of a nominal valve and a nominal screen-grid resistor should be used.

In receivers designed for a range of declared values of mains voltages, 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 adjusted to 300μA.





B9A Base



2710

OUTPUT PENTODE

PL82

Output pentode with a maximum anode dissipation of 9W suitable for use as frame timebase or audio output valve.

HEATER

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

I_h	300	mA
V_h	16.5	V

CAPACITANCES

c_{in}	11	pF
c_{out}	6.2	pF←
c_{a-g1}	<1.0	pF
c_{g1-h}	<0.15	pF

CHARACTERISTICS

V_a	170	200	V
V_{g2}	170	200	V
I_a	53	45	mA
I_{g2}	10	8.5	mA
V_{g1}	−10.4	−14.2	V
g_m	9	7.6	mA/V←
r_a	20	24	kΩ
μ_{g1-g2}	10	10	

OPERATING CONDITIONS AS AUDIO OUTPUT VALVE ←

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−10.4	−13.9	V
R_a	3	4	kΩ
$I_{a(o)}$	53	45	mA
$I_{g2(o)}$	10	8.5	mA
$V_{in\ (r.m.s.)}$ (P_{out}=50 mW)	0.5	0.55	V
$V_{in\ (r.m.s.)}$ (D_{tot}=10%)	6.0	7.0	V
P_{out} (D_{tot}=10%)	4.0	4.2	W

PL82

OUTPUT PENTODE

Output pentode with a maximum anode dissipation of 9W suitable for use as frame timebase or audio output valve.

OPERATION AS FRAME OUTPUT VALVE

To allow for valve spread and for deterioration during life, the frame output stage should be designed around the following values:—

V_a	50	60	V
V_{g2}	170	200	V
I_a	90	120	mA

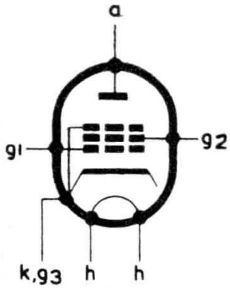
For an average new valve the following figures will apply:—

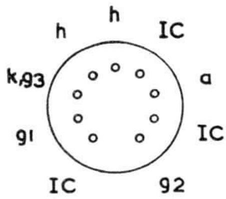
V_a	50	60	V
V_{g2}	170	200	V
V_{g1}	−1	−1	V
I_a	140	175	mA

LIMITING VALUES

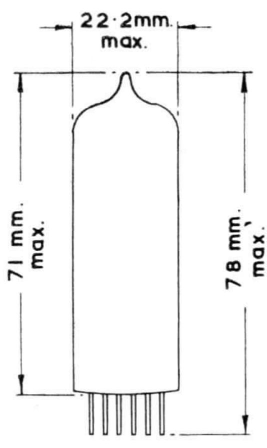
$V_{a(b)}$ max.	550	V
V_a max.	250	V
* $+v_{a\ (pk)}$ max.	2.5	kV
$-v_{a\ (pk)}$ max.	500	V
p_a max.	9	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	2.5	W
I_k max.	75	mA
V_{g1} max. ($I_{g1} = +0.3\ \mu A$)	−1.3	V
R_{g1-k} max. (audio output valve)	1.0	MΩ
R_{g1-k} max. (frame output valve)	2.2	MΩ
V_{h-k} max.	200	V ←
R_{h-k} max.	20	kΩ

*Max. pulse duration 10% of one cycle, with a maximum of 2 msec.





B9A
Noval Base



558

HALF-WAVE RECTIFIER

PY33

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

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$V_{r.m.s.}$

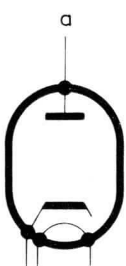
OPERATING CONDITIONS*

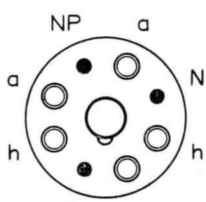
$V_{in(r.m.s.)}$	200	210	220	230	240	250	V
I_{out}	325	325	295	270	240	220	mA
C	200	200	200	200	200	200	μF
R_{lim} min.	15	17	19	21	23	25	Ω
V_{out}	209	219	234	249	264	280	V

*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.

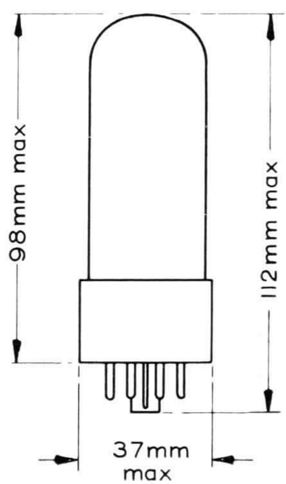
PY33

HALF-WAVE RECTIFIER





Octal Base



7575

HALF-WAVE RECTIFIER

PY82

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	19	V

LIMITING VALUES

P.I.V. max.	700	V
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	180	mA
$i_{a(pk)}$ max.	1.12	A ←
$i_{a(surge)}$ max.	5.0	A ←
C max. (single valve)	60	μF
C max. (two valves in parallel)	100	μF
*$v_{h-k(pk)}$ max. (cathode positive)	550	V

*Maximum d.c. component = 250V. Maximum a.c. component = 220V r.m.s.

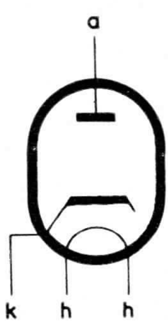
OPERATING CONDITIONS FOR TWO PY82 IN PARALLEL* ←

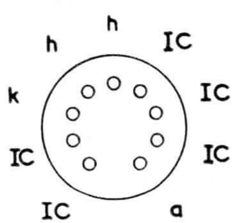
$V_{in(r.m.s.)}$	200	210	220	230	240	250	V
R_{lim} min. (per anode)	30	33	36	39	42	45	Ω
C	100	100	100	100	100	100	μF
I_{out}	350	328	306	284	262	240	mA
V_{out}	198	212	226	242	256	270	V

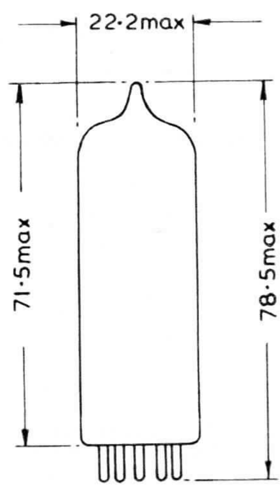
*For television receivers, where a constant output voltage is required for different input voltages, the values of limiting resistors required can be obtained from the curves on pages C4 and C5.

PY82

HALF-WAVE RECTIFIER







7102

B9A Base
All dimensions in mm

SINGLE DIODE R.F. PENTODE

UAF42

Single diode R.F. pentode with 100 mA. heater for use in D.C./A.C. mains-operated equipment. The pentode section is suitable for automatic volume control.

HEATER This valve is suitable for series operation, D.C. or A.C.

I_h	0.1	A
V_h	12.6	V

MOUNTING POSITION

Any

CAPACITANCES

c_{ad-g1}	<0.0015	μμF
c_{ad-ap}	<0.15	μμF

Pentode Section

c_{a-g1}	<0.002	μμF
c_{out}	5.1	μμF
c_{in}	4.5	μμF
c_{g1-h}	<0.05	μμF

Diode Section

c_{ad-k}	3.8	μμF
c_{ad-h}	<0.02	μμF

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

$V_a=V_b$	100	170	200	V
R_{g2}	56	56	76	kΩ
V_{g2}	50	85	85	V
R_k	310	310	310	Ω
V_{g1}	−1.2	−2.0	−2.0	V
I_a	2.8	5.0	5.0	mA
I_{g2}	0.9	1.5	1.5	mA
g_m	1.7	2.0	2.0	mA/V
r_a	0.85	0.9	1.0	MΩ
μ_{g1-g2}	18	18	18	
* V_{g1}	−16	−28	−34	V
R_{eq}	5.8	7.5	7.5	kΩ

* For 100 : 1 reduction in mutual conductance.

UAF42

SINGLE DIODE R.F. PENTODE

Single diode R.F. pentode with 100 mA. heater for use in D.C./A.C. mains-operated equipment. The pentode section is suitable for automatic volume control.

LIMITING VALUES

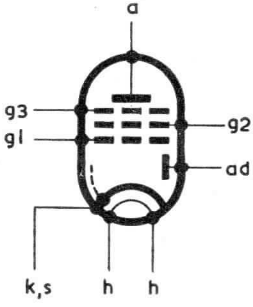
Pentode Section

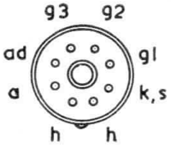
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
$V_{g2}(I_a < 2.5\text{ mA})$ max.	250	V
V_{g2} $(I_a = 5.0\text{ mA})$ max.	125	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} $(I_{g1} = +0.3\mu\text{A})$ max.	−1.3	V
R_{g1-k} max.	3.0	M Ω
*R_{g3-k} max.	3.0	M Ω
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

* For $v_{g3(pk)}$ not exceeding +10 V.

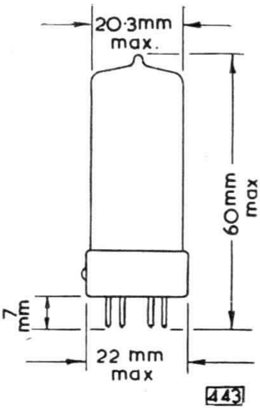
Diode Section

$v_{ad(pk)}$ max.	200	V
I_{ad} max.	0.8	mA
V_{ad} max. $(I_{ad} = +0.3\ \mu\text{A})$	−1.3	V
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V





B8A BASE



DOUBLE DIODE

UB41

Double diode with separate cathodes and with electrostatic screening between sections.

UBC41
OVERLEAF

Except for heater ratings the UB41 is identical to the EB41.

HEATER

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

I_h	100	mA
V_h	19	V

UBC41

DOUBLE DIODE TRIODE

High gain triode for use as a.f. voltage amplifier, combined with twin diodes, for d.c./a.c. mains operation.

Except for capacitances, basing and dimensions the UBC41 is identical to the UBC81.

CAPACITANCES

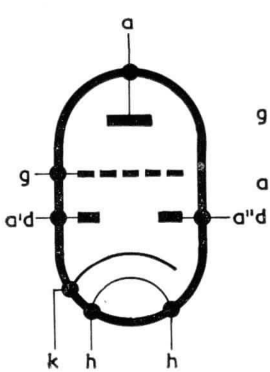
$c_{a'd-gt}$	<0.007	pF
$c_{a''d-gt}$	<0.03	pF
c_{ad-at}	<0.01	pF

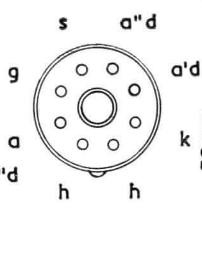
Triode section

c_{g-k}	2.75	pF
c_{a-k}	1.5	pF
c_{a-g}	1.3	pF
c_{g-h}	<0.05	pF

Diode sections

$c_{a'd-k}$	0.8	pF
$c_{a''d-k}$	0.7	pF
$c_{a'd-a''d}$	<0.3	pF
$c_{a'd-h}$	<0.1	pF
$c_{a''d-h}$	<0.05	pF





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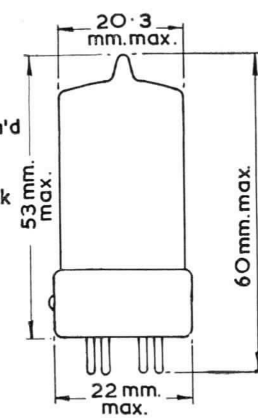


634

DOUBLE DIODE TRIODE

UBC81

High gain triode for use as a.f voltage amplifier, combined with twin diodes, for use in equipment with series connected heaters.

HEATER

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

I_h	100	mA
V_h	14	V

MOUNTING POSITION

Any

CAPACITANCES

$c_{a'd-g}$	<0.007	pF
$c_{a''d-g}$	<0.007	pF
$c_{a'd-at}$	<0.005	pF
$c_{a''d-at}$	<0.01	pF

Triode section

c_{g-k}	2.3	pF
c_{a-k}	2.3	pF
c_{a-g}	1.2	pF
c_{g-h}	<0.05	pF

Diode sections

$c_{a'd-k}$	0.9	pF
$c_{a''d-k}$	0.9	pF
$c_{a'd-a''d}$	<0.2	pF
$c_{a'd-h}$	<0.25	pF
$c_{a''d-h}$	<0.25	pF

CHARACTERISTICS

V_a	100	170	V
V_g	–1.0	–1.6	V
I_a	0.8	1.5	mA
g_m	1.4	1.65	mA/V
μ	70	70	
r_a	50	42	kΩ

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER (with cathode bias)

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}=5%)	V_{out} ($V_{r.m.s.}$) (D_{tot}=10%)	R_{g1}† (kΩ)
350	100	1.18	2.2	43	30.5	54	330
300	100	1.0	2.2	42.5	25.5	46	330
250	100	0.85	2.2	42	21	38	330
200	100	0.7	2.2	41	16	28.5	330
150	100	0.5	2.2	40	12	19.5	330
100	100	0.28	3.3	33.5	6.0	10.5	330
350	220	0.67	3.9	47.5	34.5	64	680
300	220	0.56	3.9	47	27	54	680
250	220	0.48	3.9	46.5	24.5	44.5	680
200	220	0.4	3.9	46	19	34	680
150	220	0.32	3.9	44	16.5	24	680
100	220	0.18	5.6	38	8.0	13.5	680

UBC81

DOUBLE DIODE TRIODE

High gain triode for use as a.f. voltage amplifier, combined with twin diodes, for use in equipment with series connected heaters.

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER* (with grid current bias)

V_b (V)	R_a (kΩ)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$) (D_{tot}=2.5%)	V_{out} ($V_{r.m.s.}$) (D_{tot}=5%)	R_{g1}† (kΩ)
350	100	2.0	55	27	43	330
300	100	1.95	53.5	22	35	330
250	100	1.3	51	17	27	330
200	100	0.95	48.5	12	19	330
150	100	0.6	44	7.0	11	330
100	100	0.3	35.5	3.0	5.0	330
350	220	1.1	61.5	29	47	680
300	220	0.9	59.5	23	38	680
250	220	0.7	57	17	29.5	680
200	220	0.5	54	12.5	21	680
150	220	0.33	49	8.0	14	680
100	220	0.18	40	4.0	7.0	680

*Measured with grid resistor of 20MΩ and signal source impedance $Z_s = 0$. The distortion figures quoted hold good for values of Z_s not exceeding 200kΩ. At this value of Z_s the gain will be reduced by 10%.

†R_{g1} = Grid resistor of following valve.

LIMITING VALUES

Triode section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	500	mW
I_k max.	5.0	mA
V_g max. ($I_g = +0.3\mu A$)	–1.3	V
R_{g-k} max. (cathode bias)	3.0	MΩ
R_{g-k} max. (grid current biasing)	22	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

Diode sections (each section)

$v_{ad(pk)}$ max.	200	V
I_{ad} max.	800	µA
$i_{ad(pk)}$ max.	5.0	mA

MICROPHONY

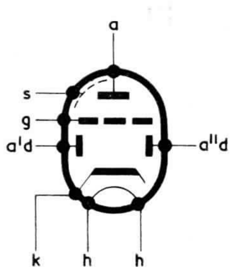
This valve can be used without special precautions against microphony in circuits in which the input voltage is >10mV (r.m.s.) for an output of 50mW from the output valve.

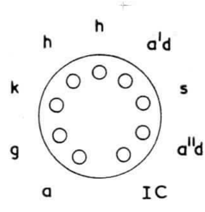
DOUBLE DIODE TRIODE

UBC81

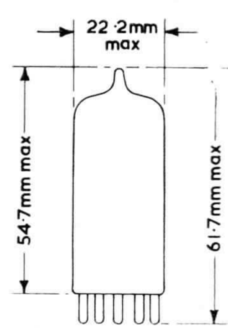
High gain triode for use as a.f. voltage amplifier, combined with twin diodes, for use in equipment with series connected heaters.

3684





B9A Base

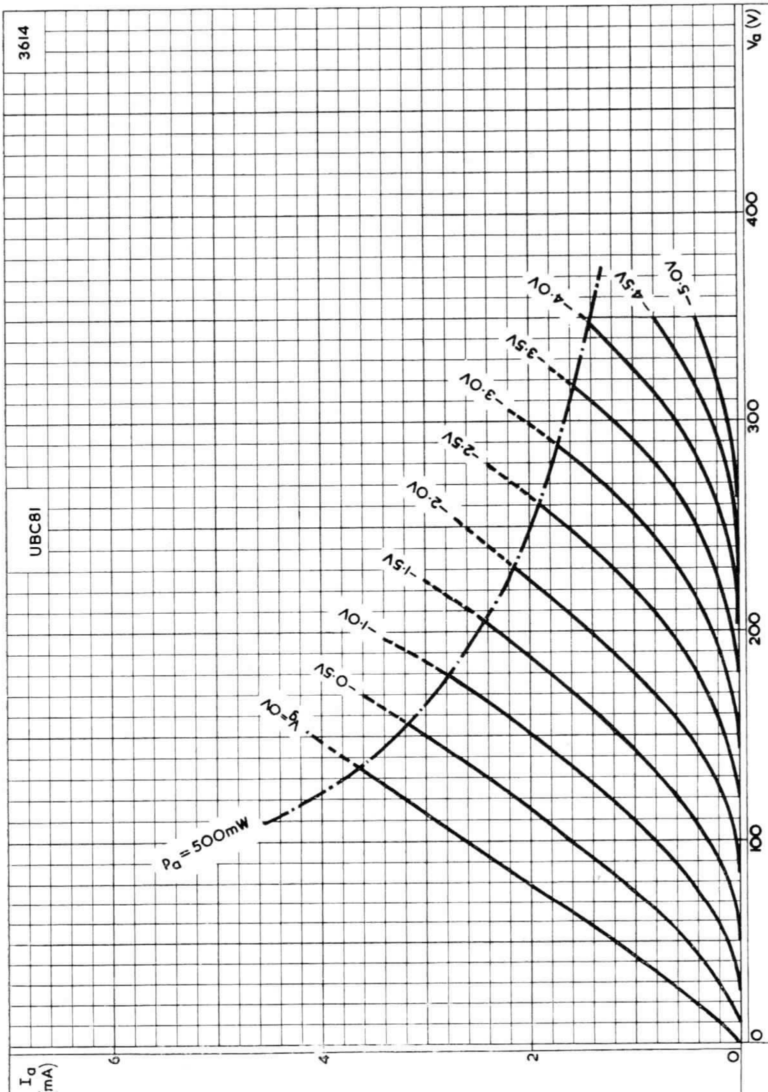


Pin 4 should be connected to the earthed side of the heater circuit

UBC81

DOUBLE DIODE TRIODE

High gain triode for use as a.f. voltage amplifier, combined with twin diodes, for use in equipment with series connected heaters.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

DOUBLE DIODE PENTODE

UBF80

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f., i.f., or a.f. amplifier.

HEATER

This valve is suitable for series operation a.c. or d.c.

I_h	100	mA
V_h	17	V

MOUNTING POSITION

Any

CAPACITANCES

$c_{a'd-g1}$	<0.0008	pF
$c_{a'd-a}$	<0.2	pF
$c_{a''d-g1}$	<0.001	pF
$c_{a''d-a}$	<0.05	pF
Pentode Section		
c_{a-g1}	<0.0025	pF
c_{out}	4.9	pF
c_{in}	4.2	pF
c_{g1-h}	<0.07	pF
Diode Sections		
$c_{a'd-k}$	2.2	pF
$c_{a''d-k}$	2.35	pF
$c_{a'd-a''d}$	<0.35	pF
$c_{a'd-h}$	<0.02	pF
$c_{a''d-h}$	<0.005	pF

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

$V_a = V_b$	100	170	200	V
R_{g2}	47	47	68	k Ω
V_{g2}	50	85	85	V
V_{g3}	0	0	0	V
R_k	300	300	300	Ω
I_a	2.8	5.0	5.0	mA
I_{g2}	1.0	1.75	1.75	mA
V_{g1}	–1.2	–2.0	–2.0	V
g_m	1.9	2.2	2.2	mA/V
r_a	0.9	0.9	1.0	M Ω
μ_{g1-g2}	18	18	18	
R_{eq}	4.6	6.2	6.2	k Ω
V_{g1} for 100 : 1 reduction in g_m	–15.5	–26.5	–31.5	V

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

V_b (V)	R_a (k Ω)	I_a (mA)	R_{g2} (k Ω)	I_{g2} (mA)	R_k (k Ω)	R_{g1} (M Ω)	$\frac{V_{out}}{V_{in}}$	D_{tot}* (%)	R_{g1}** (k Ω)
100	220	0.32	680	0.12	2.7	1.0	82	1.9	680
100	100	0.73	270	0.29	1.0	1.0	67	1.8	330
100	220	0.32	820	0.11	0	10	100	3.0	680
100	100	0.66	330	0.25	0	10	70	3.2	330
170	220	0.56	680	0.2	2.7	1.0	85	1.5	680
170	100	1.25	270	0.5	1.0	1.0	70	1.6	330
170	220	0.56	820	0.19	0	10	140	1.0	680
170	100	1.16	330	0.46	0	10	100	1.4	330

*$V_{out} = 5\ V_{(r.m.s.)}$

**Grid resistor of following valve

UBF80

DOUBLE DIODE PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f., i.f., or a.f. amplifier.

OPERATING CONDITIONS AS TRIODE CONNECTED RESISTANCE COUPLED A.F. AMPLIFIER ←

g_2 connected to a, g_3 connected to k

V_b (V)	R_a (k Ω)	I_a (mA)	R_k (k Ω)	R_{g1} (M Ω)	$\frac{V_{out}}{V_{in}}$	D_{tot}* (%)	R_{g1}** (k Ω)
100	100	0.74	1.8	1.0	11	4.9	330
100	47	1.4	1.0	1.0	11	4.8	150
100	100	0.8	0	10	12	4.7	330
100	47	1.5	0	10	12	4.8	150
170	100	1.25	1.8	1.0	11	3.5	330
170	47	2.4	1.0	1.0	11	3.1	150
170	100	1.4	0	10	14	3.8	330
170	47	2.8	0	10	14	3.4	150

*$V_{out}=5\ V_{(r.m.s.)}$

**Grid resistor of following valve.

LIMITING VALUES

Pentode Section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_a<2$mA)	250	V
V_{g2} max. ($I_a=5$mA)	125	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} max. ($I_{g1}=+0.3\ \mu$A)	−1.3	V
*R_{g1-k} max.	3	M Ω
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

*R_{g1-k} max. = 22 M Ω if grid current biasing is employed.

Diode Sections (each section)

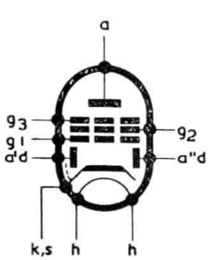
P.I.V.	350	V
I_{ad} max.	0.8	mA
$i_{ad(pk)}$ max.	5	mA
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

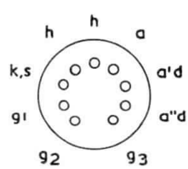
This valve can be used without special precautions against microphony if the input voltage, V_{in}, is not less than 25 mV for an output of 50 mW from the output valve.

DOUBLE DIODE PENTODE

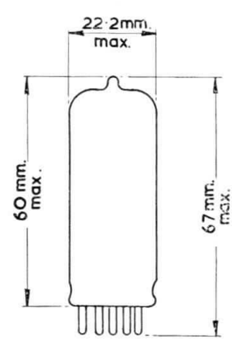
UBF80

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f., i.f., or a.f. amplifier.





B9A (Noval) BASE



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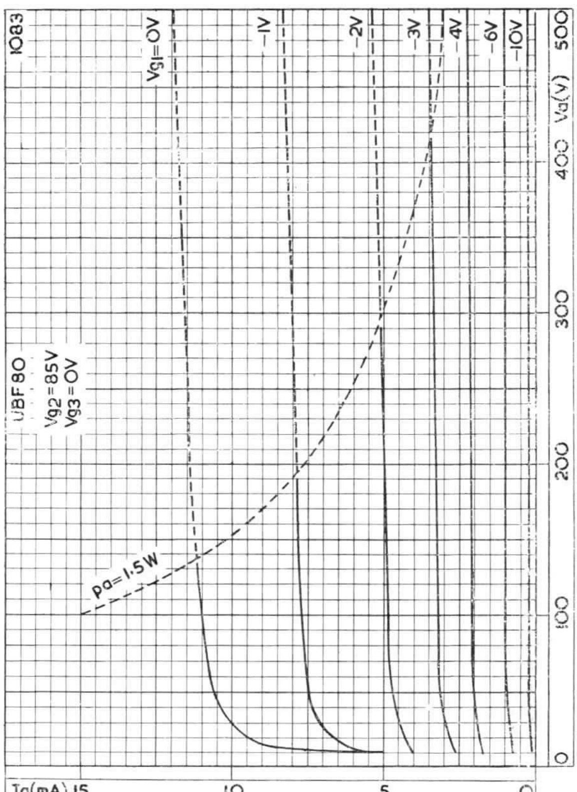
UBF80

DOUBLE DIODE PENTODE

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f., i.f., or a.f. amplifier.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

TRIODE HEXODE FREQUENCY CHANGER

UCH42

Triode hexode primarily intended for use as frequency changer in d.c./a.c. mains-operated receivers. The hexode section is designed for a.g.c. operation. The valve may also be employed as a phase inverter.

HEATER (Suitable for series operation, a.c. or d.c.)

I_h	100	mA
V_h	14	V

MOUNTING POSITION

Any

CAPACITANCES

c_{gt-g1}	<0.35	pF
c_{gt-ah}	<0.2	pF

Hexode Section

$c_{g1-h+k+g2+g4+skirt}$	3.8	pF
$c_{a-h+k+g2+g4+skirt}$	9.2	pF
c_{a-g1}	<0.1	pF
c_{g1-h}	<0.15	pF

Triode Section

$c_{gt-h+k+g2+g4+skirt}$	5.5	pF
$c_{at-h+k+g2+g4+skirt}$	2.3	pF
c_{at-gt}	1.2	pF

OPERATING CONDITIONS AS FREQUENCY CHANGER

With screen grid fed from a potentiometer (see fig. 1)

Hexode Section

$V_a = V_b$	100	170	200	V
R_1	18	18	18	kΩ
R_2	27	27	27	kΩ
R_k	180	180	180	Ω
R_{g3+gt}	47	47	47	kΩ
I_{g3+gt}	100	200	200	µA
V_{g1}	−1.0	−1.85	−2.0	V
V_{g2+g4}	43	70	85	V
I_a	1.2	2.1	3.0	mA
I_{g2+g4}	1.5	2.6	3.0	mA
g_c	530	670	750	µA/V
r_a	>1.0	>1.0	>1.0	MΩ
R_{eq}	60	65	75	kΩ
V_{g1} (for 100:1 reduction in g_c)	−13.5	−25	−27.5	V

Triode Section

V_b	100	170	200	V
R_a	10	10	22	kΩ
R_{gt+g3}	47	47	47	kΩ
I_{gt+g3}	100	200	200	µA
I_a	3.1	5.7	5.2	mA
g_m (approx.)	0.6	0.65	0.55	mA/V

UCH42

TRIODE HEXODE FREQUENCY CHANGER

Triode hexode primarily intended for use as frequency changer in d.c./a.c. mains-operated receivers. The hexode section is designed for a.g.c. operation. The valve may also be employed as a phase inverter.

CHARACTERISTICS

Triode Section

V_a	100	V
V_g	0	V
I_a	10	mA
g_m	2.8	mA/V
μ	22	

TYPICAL OPERATING CONDITIONS AS PHASE INVERTER

(See Fig. 2)

V_b (V)	I_b (mA)	V_{g-g}* ($V_{r.m.s.}$)	$\frac{V_{g-g}}{V_{in}}$	D_{tot}* (%)
200	2.6	33.2	25.2	2.6
300	4.0	56.7	25.7	2.8
400	5.3	78.6	26.1	3.0

*Output voltage and distortion at the start of positive grid current. At lower output voltage the distortion is approximately proportional to the voltage.

LIMITING VALUES

Hexode Section

$V_{a\ (b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.5	W
$V_{g2+g4(b)}$ max.	550	V
V_{g2+g4} max. (I_a=3mA)	125	V
V_{g2+g4} max. (I_a<1mA)	250	V
p_{g2+g4} max.	0.3	W
V_{g1} max. ($I_{g1}=+0.3\mu A$)	–1.3	V
I_k max.	7.0	mA
R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

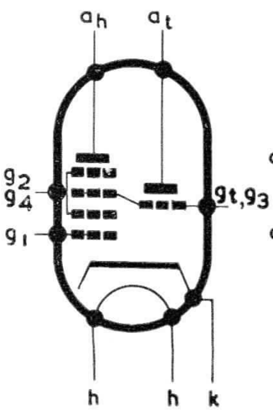
Triode Section

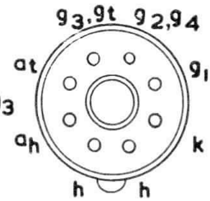
$V_{a(b)}$ max.	550	V
V_a max.	175	V
p_a max.	0.8	W
V_g max. ($I_g=+0.3\mu A$)	–1.3	V
I_k max.	6.0	mA
R_{gt-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

TRIODE HEXODE FREQUENCY CHANGER

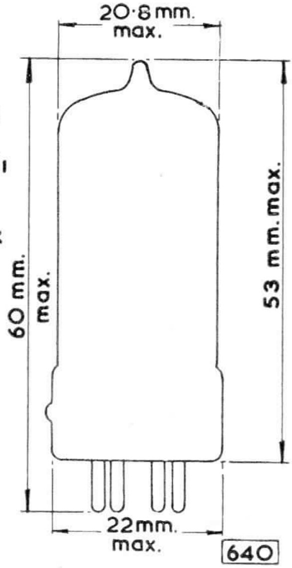
UCH42

Triode hexode primarily intended for use as frequency changer in d.c./a.c. mains-operated receivers. The hexode section is designed for a.g.c. operation. The valve may also be employed as a phase inverter.





B8A BASE



UCH42

TRIODE HEXODE FREQUENCY CHANGER

Triode hexode primarily intended for use as frequency changer in d.c./a.c. mains-operated receivers. The hexode section is designed for a.g.c. operation. The valve may also be employed as a phase inverter.

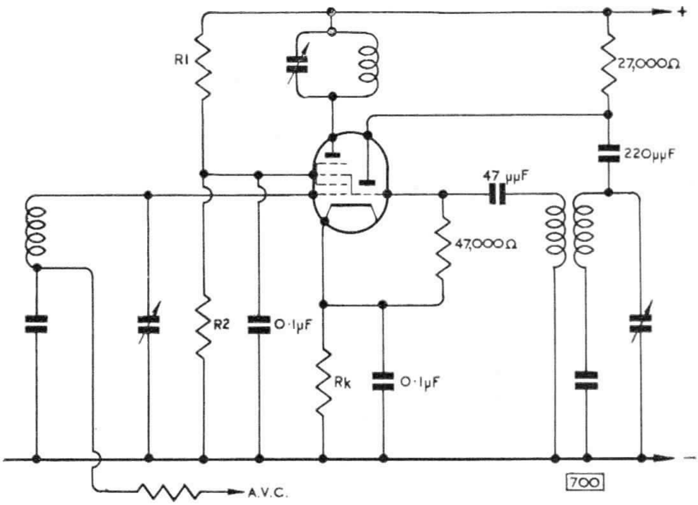


FIG. 1. UCH42 AS FREQUENCY CHANGER

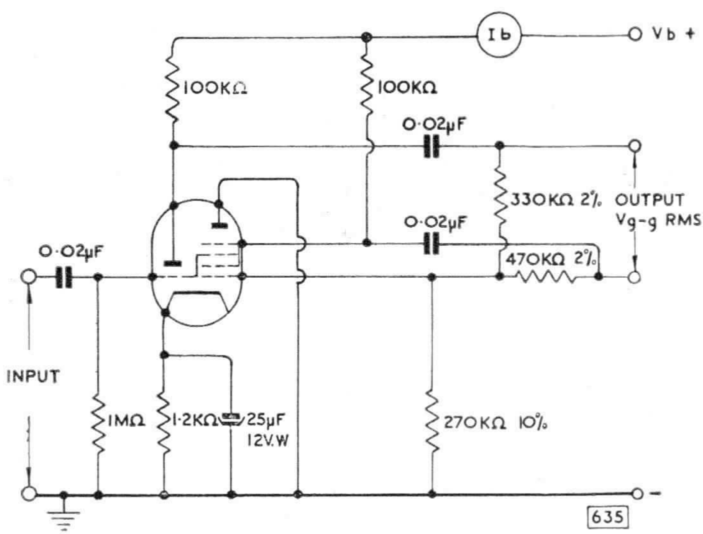


FIG. 2. UCH42 AS PHASE INVERTER

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_{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_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 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.

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. (r.m.s. or d.c. cathode positive)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

TRIODE PENTODE

UCL83

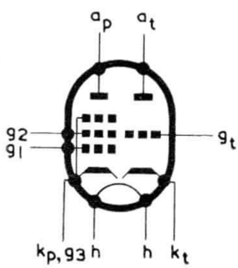
Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

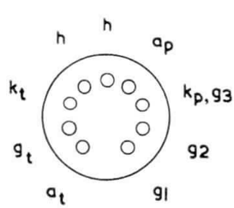
LIMITING VALUES

Triode Section

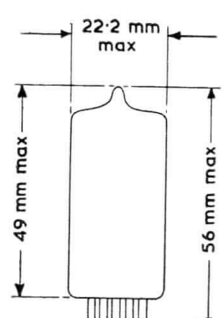
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k}max (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

2224





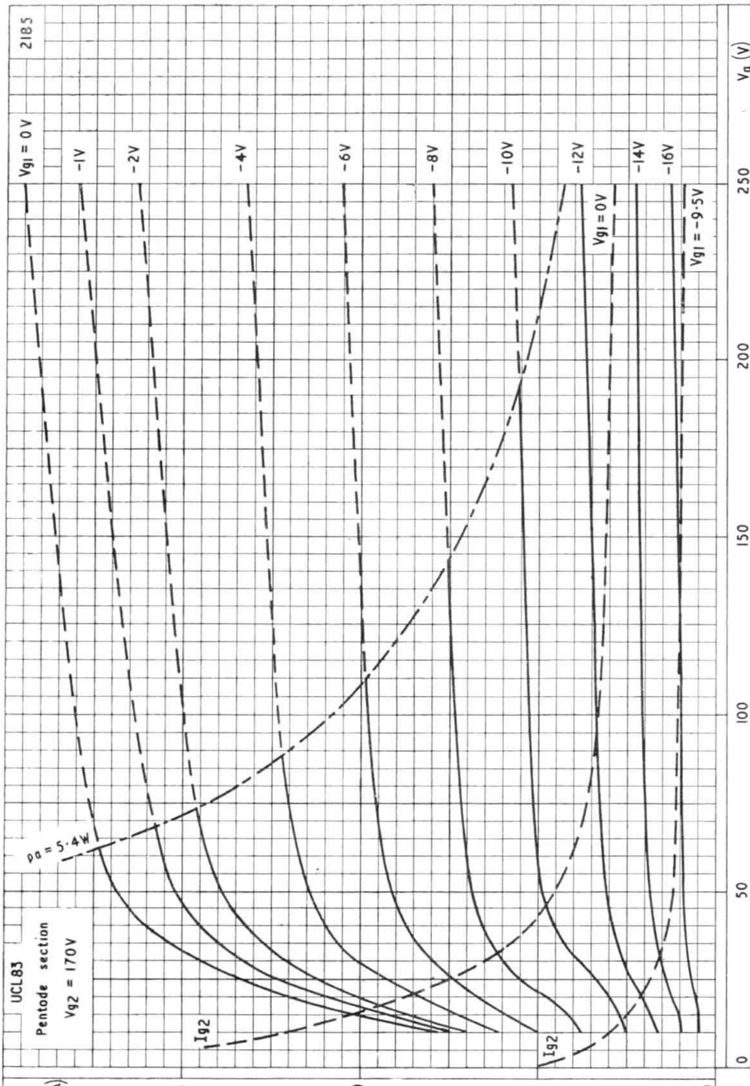
B9A
Noval Base



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. $V_{g2}=170V$

VARIABLE-MU R.F. PENTODE

UF41

Variable-mu pentode suitable for use as R.F. or I.F. amplifier in D.C./A.C. mains operated receivers.

HEATER

This valve is suitable for series operation, D.C. or A.C.

I_h	0.1	A
V_h	12.6	V

CAPACITANCES

c_{a-g1}	0.002	μμF
c_{out}	7.0	μμF
c_{in}	5.0	μμF
c_{g1-h}	0.05	μμF

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

$V_a = V_b$	100	170	200	V
R_{g2}	40	40	40	k Ω
R_k	330	330	330	Ω
I_a	3.3	6.0	7.2	mA
I_{g2}	1.0	1.75	2.1	mA
V_{g1}	–1.4	–2.5	–3.0	V
g_m	1.9	2.2	2.3	mA/V
r_a	0.8	1.0	1.0	M Ω
μ_{g1-g2}	18	18	18	
R_{eq}	5.5	6.5	7.0	k Ω
V_{g1} for 100 : 1 reduction in g_m	–17	–28	–34	V

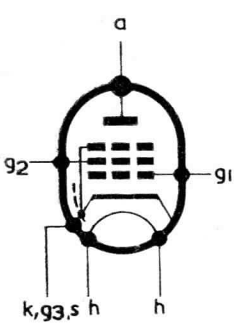
LIMITING VALUES

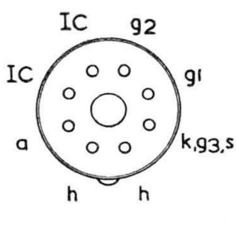
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_a < 4$mA)	250	V
V_{g2} max. ($I_a = 7.2$mA)	150	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} max. ($I_{g1} = +0.3\mu$A)	–1.3	V
R_{g1-k} max.	3	M Ω
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

UF41

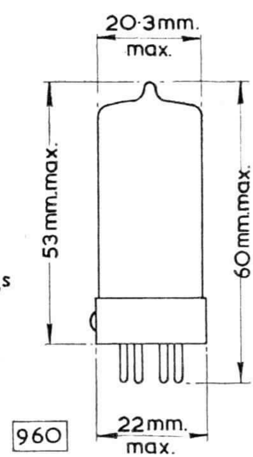
VARIABLE-MU R.F. PENTODE

Variable-mu pentode suitable for use as R.F. or I.F. amplifier in D.C./A.C. mains operated receivers.





B8A BASE



OUTPUT PENTODE

UL41

Output pentode rated for a maximum anode dissipation of 9W, and with 100mA heater for use with D.C./A.C. mains operated equipment.

HEATER

This valve is suitable for series operation, D.C. or A.C.

I_h	0.1	A
V_h	45	V

CAPACITANCES

c_{a-g1}	<1.0	μμF
c_{in}	11.0	μμF
c_{out}	8.3	μμF

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

V_a	100	170	200	V
V_{g2}	100	170	200	V
V_{g1}	−5.7	−10.4	−14.2	V
I_a	29	53	45	mA
I_{g2}	5.5	10	8.5	mA
g_m	8.0	9.5	8.2	mA/V
r_a	18	20	24	kΩ
μ_{g1-g2}	10	10	10	
R_a	3.0	3.0	4.3	kΩ
P_{out}	1.35	4.2	4.2	W
$V_{in\ (r.m.s.)}$	3.75	6.0	6.3	V
D_{tot}	10	10	10	%
$V_{in\ (r.m.s.)}$ (P_{out} = 50mW)	0.55	0.5	0.54	V

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

V_a	100	170	200	V
V_{g2}	100	170	200	V
$I_{a(o)}$	2×24	2×44	2×45	mA
I_a (max. sig.)	2×27	2×49	2×53	mA
$I_{g2(o)}$	2×4.6	2×8.8	2×9	mA
I_{g2} (max. sig.)	2×6.8	2×16.5	2×19	mA
R_k	100	100	130	Ω
R_{a-a}	4.0	4.0	4.0	kΩ
P_{out}	2.2	9.0	12.5	W
$V_{in(g-g)\ (r.m.s.)}$	9.2	18.6	24.5	V
D_{tot}	3.5	4.0	4.0	%

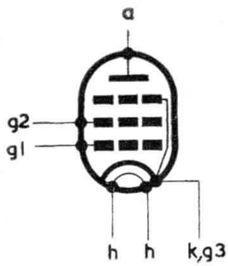
UL41

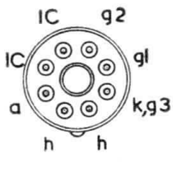
OUTPUT PENTODE

Output pentode rated for a maximum anode dissipation of 9W, and with 100mA heater for use in D.C./A.C. mains operated equipment.

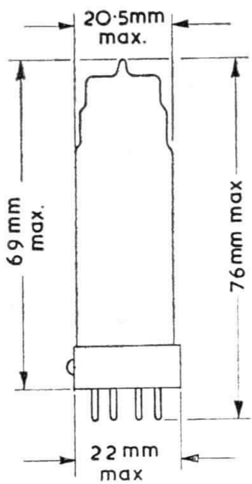
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	9	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max. (zero signal)	1.75	W
p_{g2} max. (max. signal)	4.0	W
I_k max.	75	mA
V_{g1} max. ($I_{g1} = +0.3\ \mu A$)	-1.3	V
R_{g1-k} max.	1.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V





B8A BASE



610

HALF-WAVE RECTIFIER

UY41

Indirectly heated half-wave rectifier with 100 mA heater for use in d.c./a.c. mains-operated equipment.

HEATER

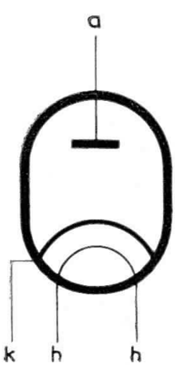
Suitable for series operation a.c. or d.c.

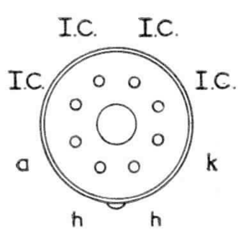
I_h	100	mA
V_h	31	V

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	100	mA
$v_{h-k\ (pk)}$ max.	550	V
C max.	50	µF

$V_{a(r.m.s.)}$ (V)	C (µF)	R_{lim} min. (Ω)
250	50	210
220	50	160
127	50	0
250	32	140
220	32	125
127	32	0
250	16	100
220	16	90
127	16	0





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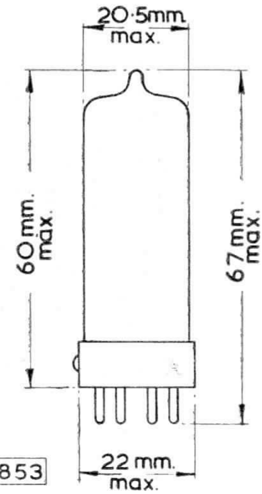
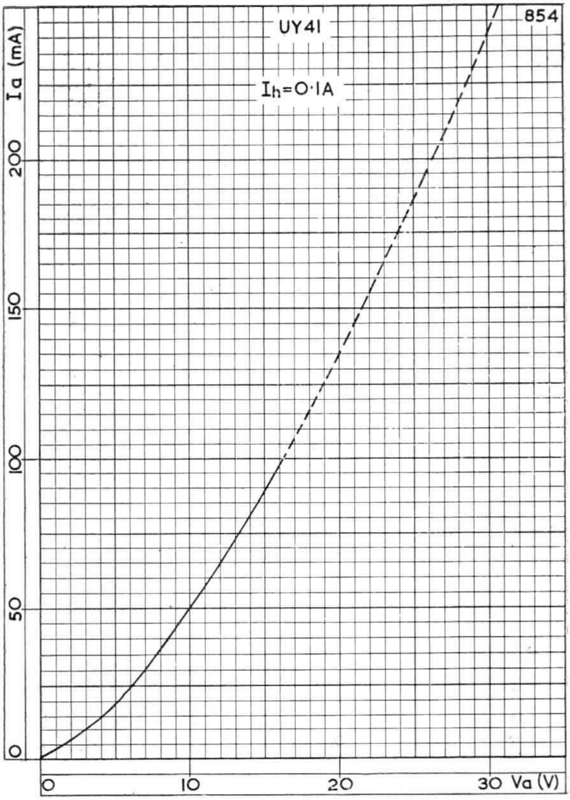


853

UY41

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier with 100 mA heater for use in d.c./a.c. mains-operated equipment.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

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

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

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

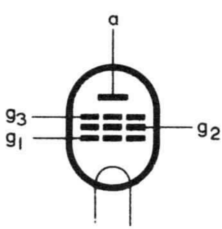
Maximum carrier conditions for anode and screen-grid modulation for various modulation depths. f = 175Mc/s

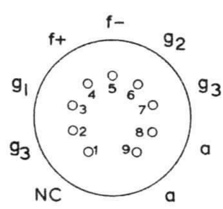
m (%)	V_a (V)	I_a (mA)	p_a (max.) (W)	p_{g2} (max.) (W)	P_{load}* (W)	Output tuned circuit
100	200	31	3.3	0.67	2.65	Parallel
	200	32	3.3	0.67	3.05	Series
	200	64	2×3.3	2×0.67	6.2	Push-Pull
75	220	34	3.9	0.78	3.2	Parallel
	220	35	3.9	0.78	3.65	Series
	220	70	2×3.9	2×0.78	7.4	Push-Pull
50	235	35	4.45	0.89	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





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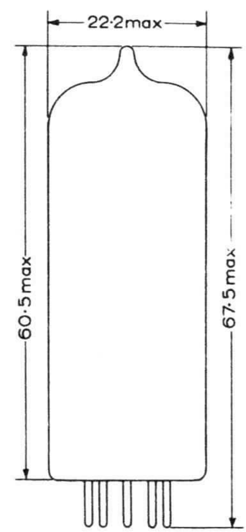
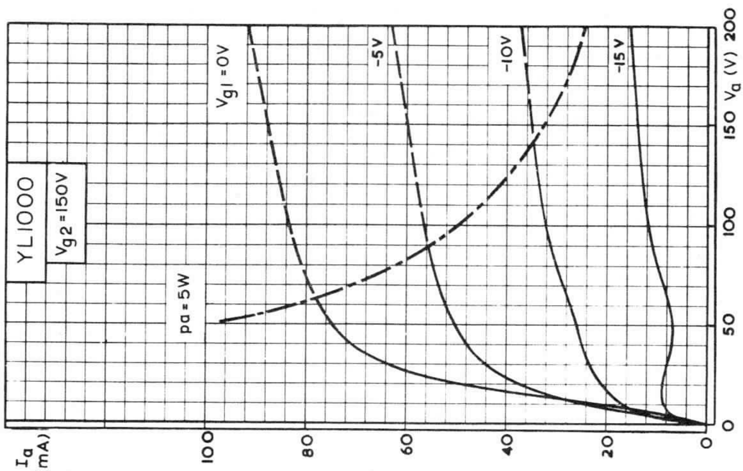
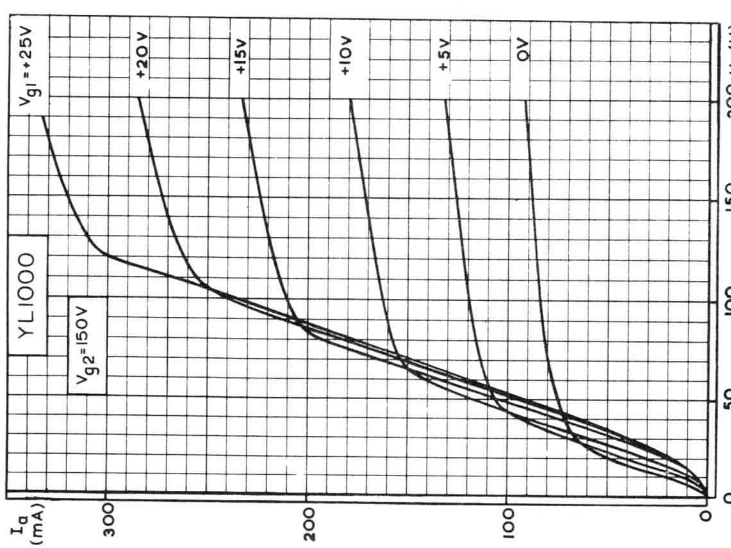


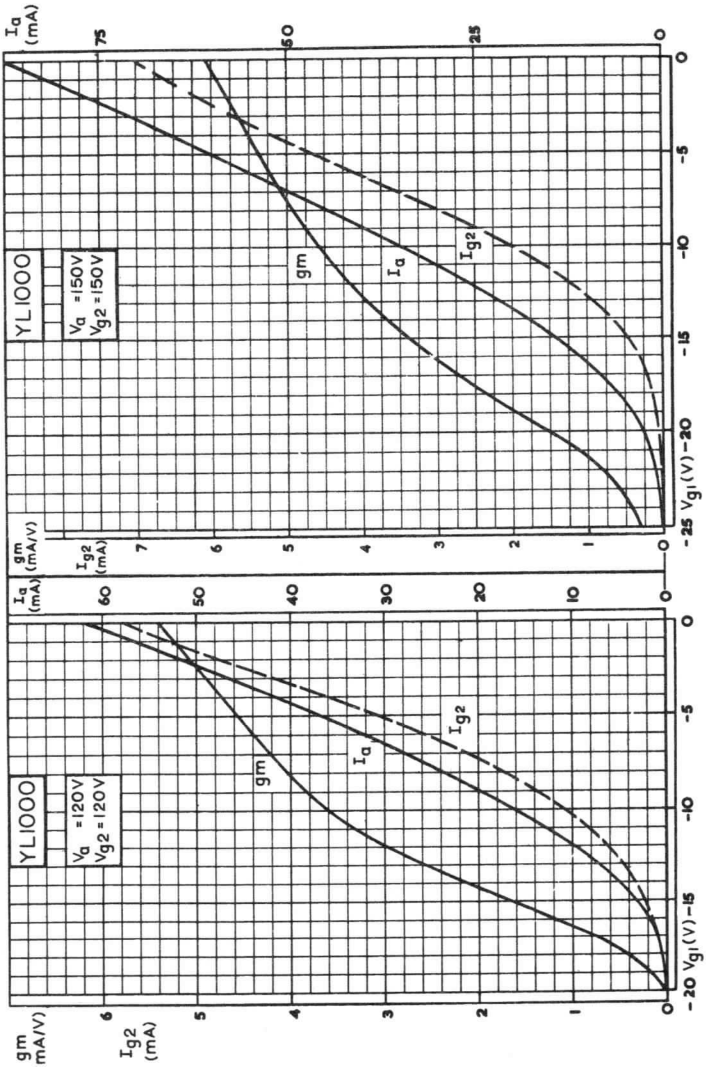
All dimensions in mm

B4662

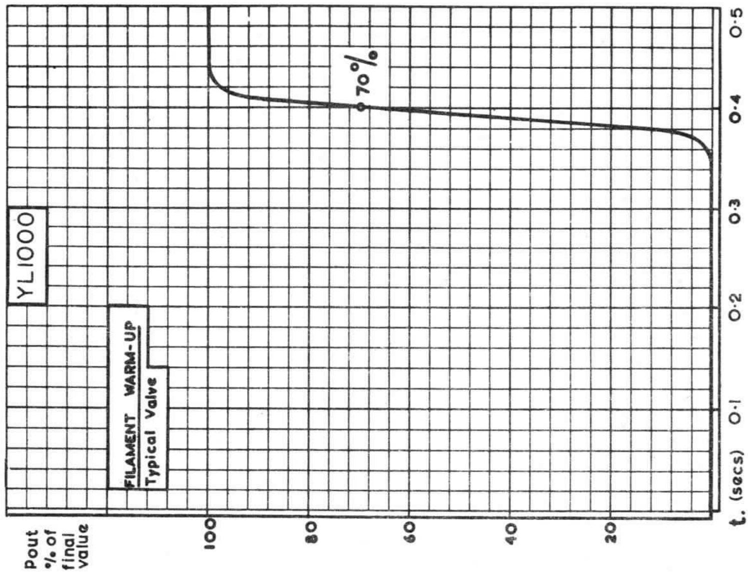


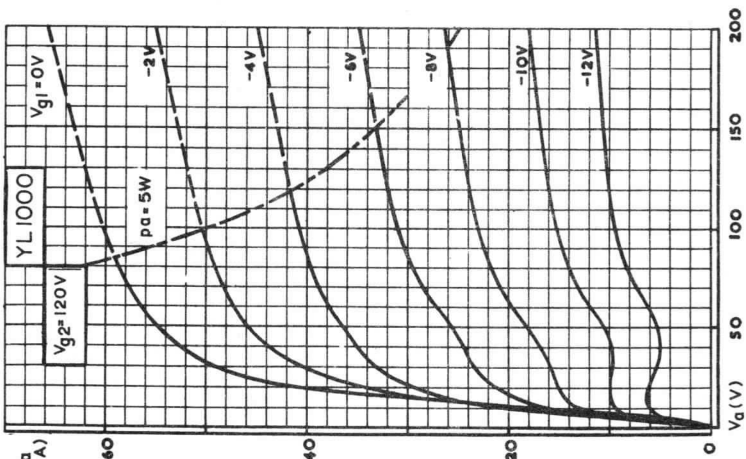


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=150V



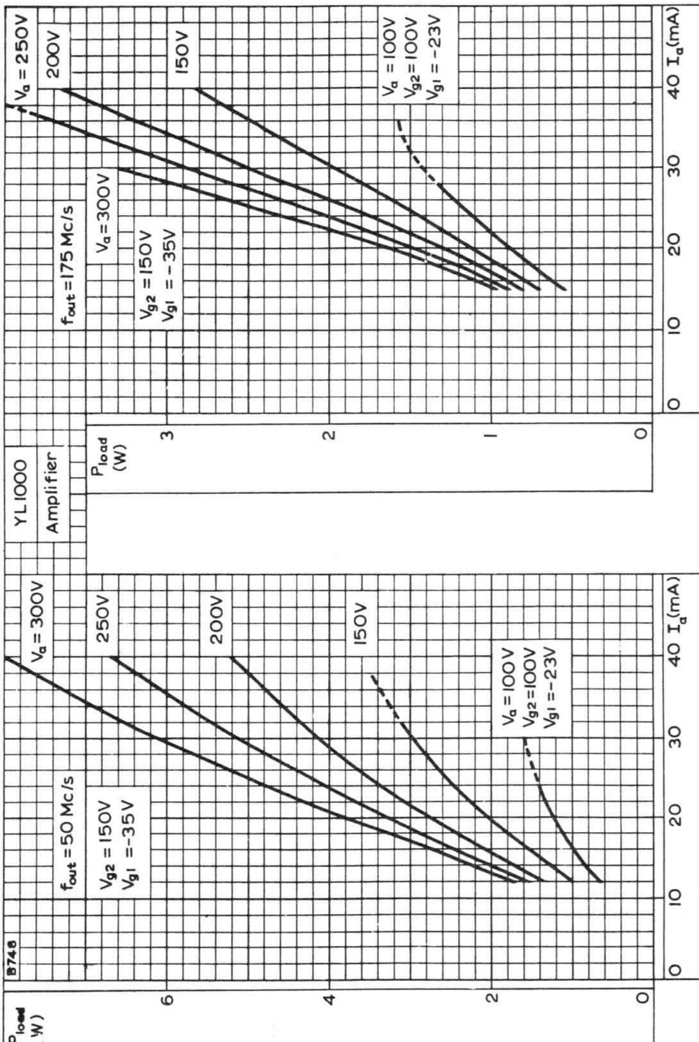
ANODE CURRENT, SCREEN-GRID CURRENT, AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



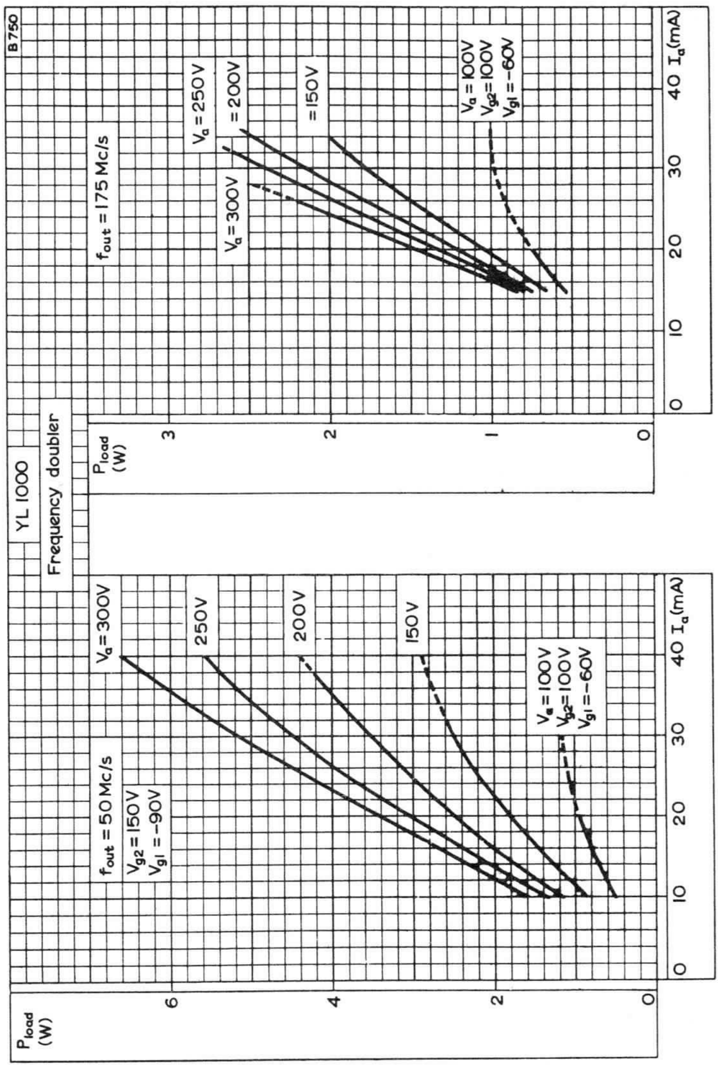


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER $V_{g2}=120V$

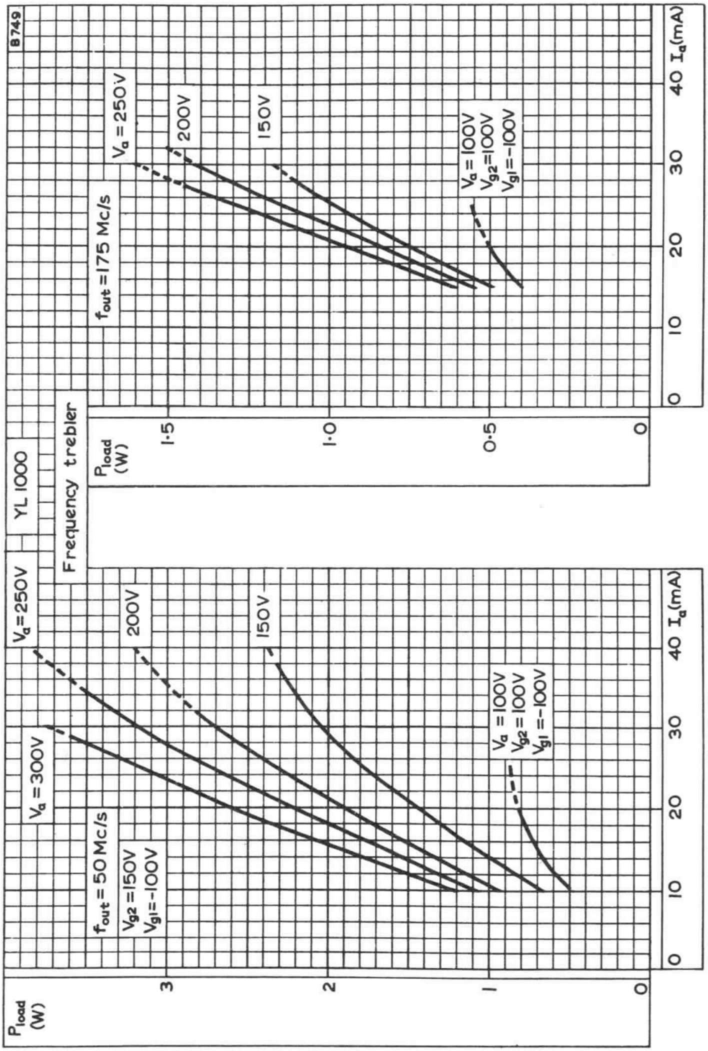
FILAMENT WARM-UP TIME



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

DOUBLE DIODE

6AL5

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	300	mA

MOUNTING POSITION

Any

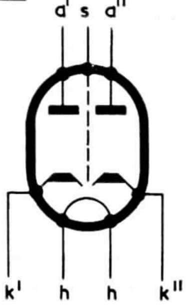
CAPACITANCES

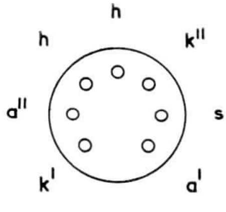
	Shielded	Unshielded	
$c_{a'-k'+h+s}$	3.1	2.5	pF
$c_{a''-k''+h+s}$	3.1	2.5	pF
$c_{k'-a'+h+s}$	3.9	3.4	pF
$c_{k''-a''+h+s}$	3.9	3.4	pF
$c_{a'-a''}$	<0.026	<0.068	pF

LIMITING VALUES (each section)

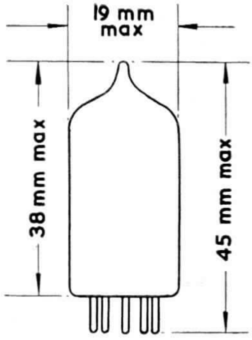
P.I.V. max.	330	V
I_a max.	9.0	mA
$i_{a(pk)}$ max.	54	mA
V_a max. ($I_a = +0.3\mu A$)	–1.3	V
$v_{h-k(pk)}$ max.	330	V

3577





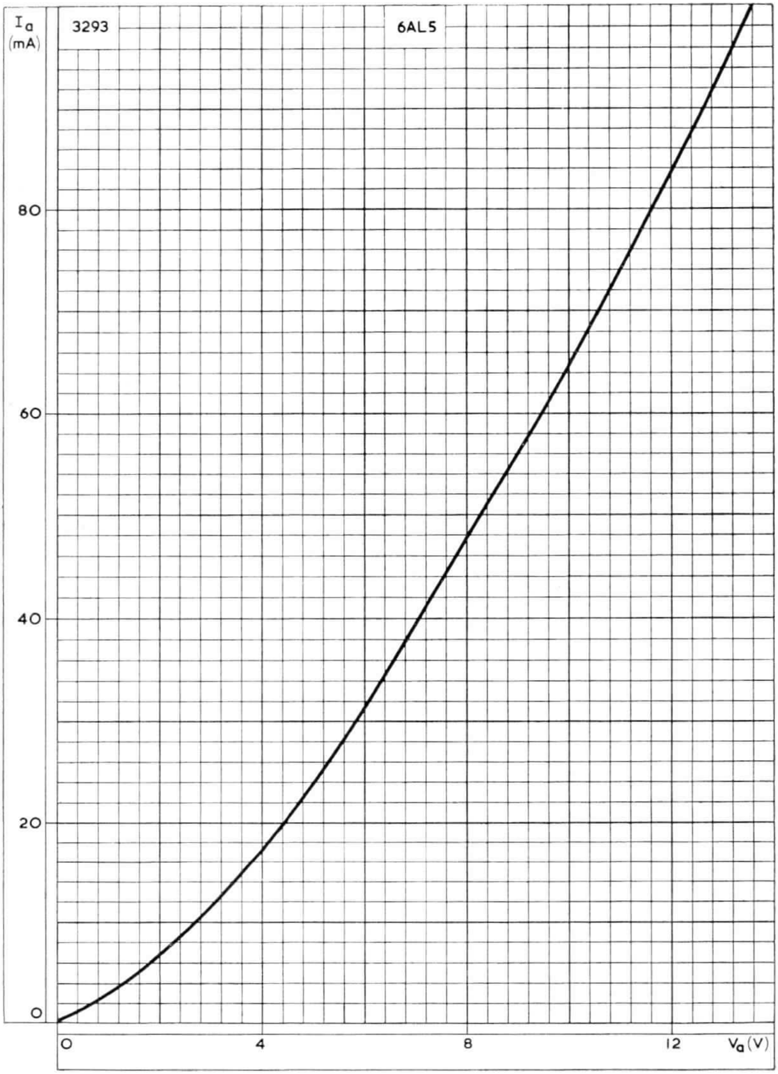
B7G Base



6AL5

DOUBLE DIODE

Double diode with separate cathodes and internal screening between sections.

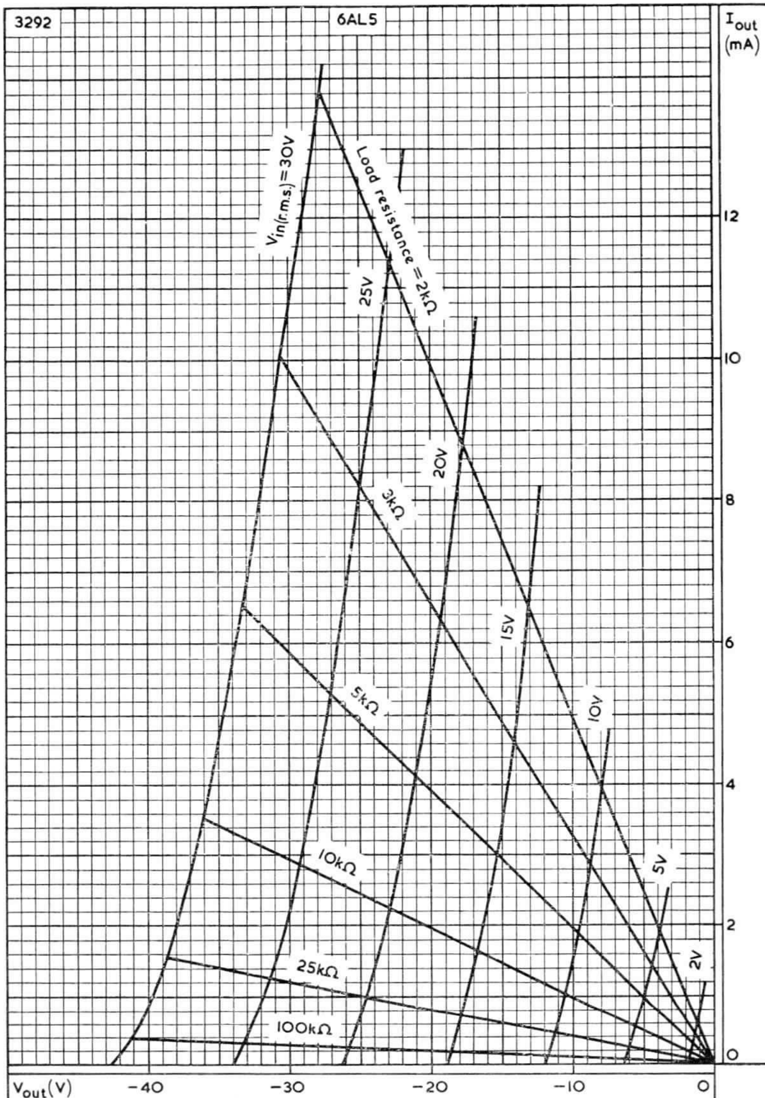


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

DOUBLE DIODE

Double diode with separate cathodes and internal screening between sections.

6AL5



OUTPUT CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE AS PARAMETER

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

	Shielded	Unshielded	
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

	Shielded	Unshielded	
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} ($I_a = 10\mu A$)	−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

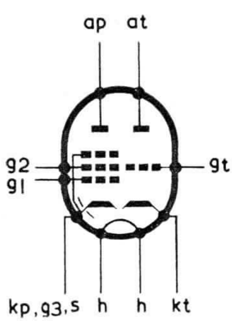
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.7	W
I_k max.	20	mA
R_{g-k} max.	1.0	MΩ
V_{h-k} max. (cathode negative)	90	V
V_{h-k} max. (cathode positive)	90	V
R_{h-k} max.	20	kΩ

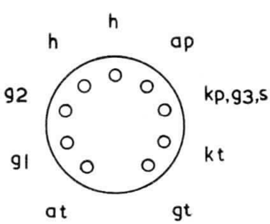
TRIODE PENTODE

6U8

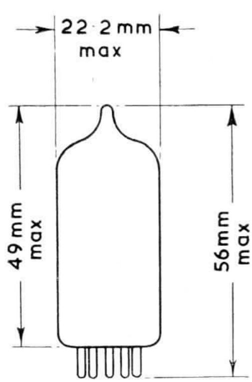
Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

3222





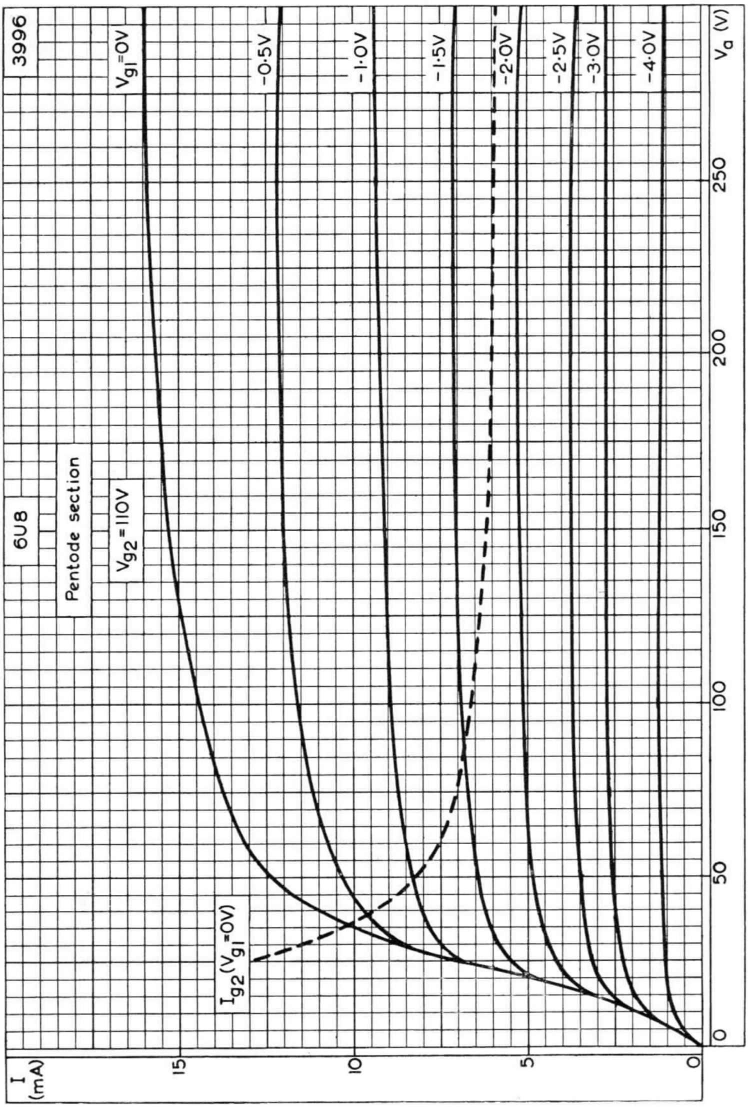
B9A Base



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

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} ($I_a < 100\mu A$)	−7.5	V
V_{g3} ($I_a < 100\mu A$)	−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

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]	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	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 $= 55 \pm 5$mm 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.

GROUP C

	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.	
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 $V_{h-k} = \pm 100V$	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), $R_{g1} = 100k\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	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	—	—	—	—	—	—	

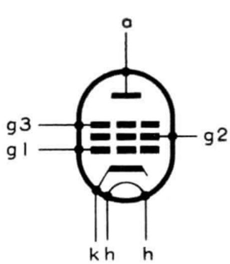
GROUP D

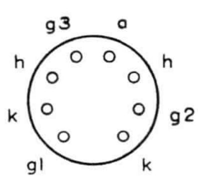
Heater cycling life test								
$V_h = 7.0V$ 1 minute on, 4 minutes off								
$V_{h-k} = 140V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	15	—	—	—	%
Survival rate life test[14]								
Running conditions $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (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

Intermittent life test

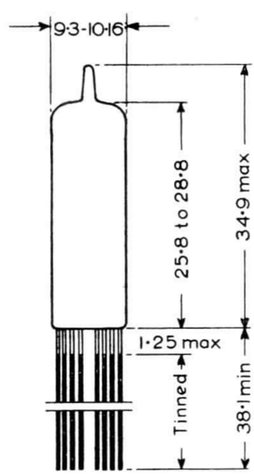
Running conditions, $R_{g1} = 1.0M\Omega$,
$V_{h-k} = 200V$ (cathode negative),
T_{bulb} min = 220°C

Intermittent life test end points (500 hours)	*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Inoperatives[16]	4.0	—	—	
Heater current	6.5	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	6.5	—	10	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	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	—	—	





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.

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

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]	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 $R_g = 1.0M\Omega$ $V_{a-e} = 150V$, $R_k = 380\Omega$	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 preheat 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]	*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 $V_{h-k} = \pm 100V$.	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), $R_g = 100k\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	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

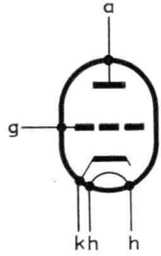
Heater cycling life test								
$V_h = 7.0V$. 1 minute on, 4 minutes off $V_{h-k} = 140V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions $R_g = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions $R_g = 1.0M\Omega$ $V_{h-k} = 200V$ (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

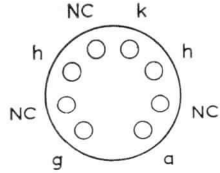
Intermittent life test
Running conditions, Rg = $1.0M\Omega$,
$V_{h-k} = 200V$ (cathode negative),
T_{bulb} min. = 220°C

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 $V_{h-k} = \pm 100V$	4.0	—	10	μA
Reverse grid current $R_g = 1.0M\Omega$	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	—	—	

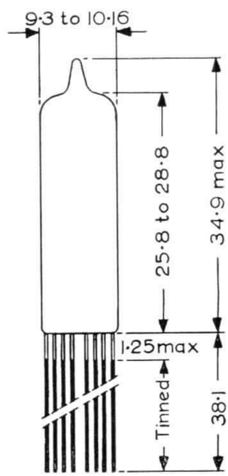
SPECIAL QUALITY U.H.F. TRIODE

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.

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

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]	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	7.2	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 $V_{g1} = -14V$, $R_k = 0\Omega$	2.5	—	1.0	75	—	—	—	μA/V
Reverse grid current $V_h = 7.5V$, $V_{g1} = -14V$, $R_{g1} = 1.0M\Omega$, $R_k = 0\Omega$. 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	4.5	—	—	—	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, $R_a = 10k\Omega$	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.

GROUP C

	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.	
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
$V_h = 6.3$V. 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 $V_{h-k} = \pm 100$V	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]								
$V_{h-k} = 100$V (cathode negative), $R_{g1} = 100\text{k}\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100$V	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								
$V_{h-k} = 140V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions $R_{g1} = 1.0M\Omega$								
$V_{h-k} = 200V$ (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 $R_{g1} = 1.0M\Omega$								
$V_{h-k} = 200V$ (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

Intermittent life test

Running conditions, $R_{g1} = 1.0M\Omega$

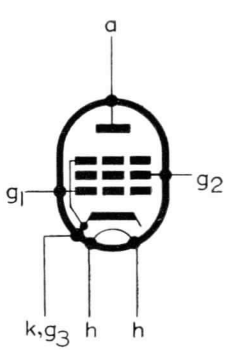
$V_{h-k} = 200V$, T_{bulb} min = 220°C

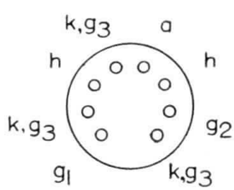
Intermittent life test end points (500 hours)	*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Inoperatives[16]	4.0	—	—	
Heater current	6.5	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm100V$	6.5	—	10	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	4.0	0	0.8	μA
Change in mutual conductance (individuals)	4.0	—	20	%
Change in mutual conductance $V_h = 5.7V$	6.5	—	15	%
Insulation as in group B	6.5	50	—	$M\Omega$
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

5899

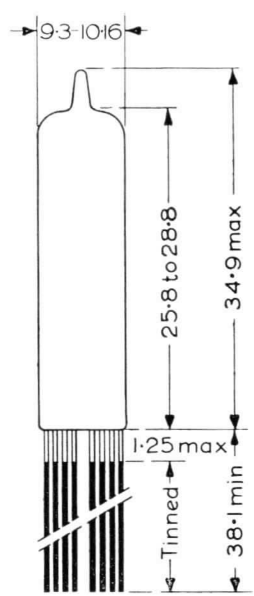
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

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.

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

TESTS

	A.Q.L.[5]	Individuals[6]			Lot average[7]		Lot standard deviation[8]	
	(%)	Bogey[9]	Min.	Max.	Min.	Max.	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.)

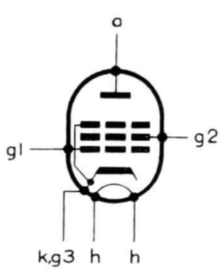
†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

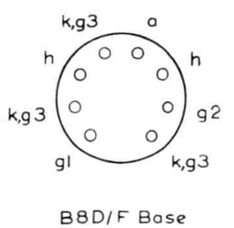
TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B]. 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14] $V_h = 6.3V$. No other voltages applied. 2.5g min. peak acceleration, 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 $V_{h-k} = \pm 100V$	6.5	—	—	40	—	—	—	μA
Change in power output	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	300	—	—	—	mV (r.m.s.)
Shock[15] $V_{h-k} = 100V$ (cathode negative), $R_{g1} = 100k\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	20	—	—	40	—	—	—	μA
Change in power output	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	300	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

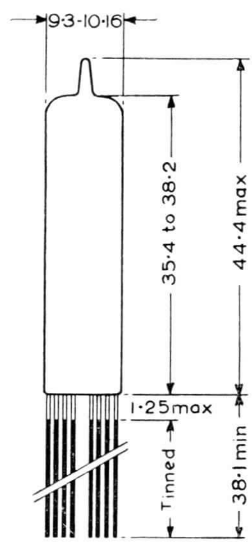
					A.Q.L.[5] (%)	Min.	Max.	
Heater cycling life test								
V_h = 7.0V, 1 minute on, 4 minutes off								
V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Heater cycling life test end point								
Heater-to-cathode leakage current $V_{h-k}=\pm100$V	—	—	—	40	—	—	—	µA
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
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 $V_{h-k}=\pm100$V					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.

A low-μ power double triode with separate cathodes intended for use as a series regulator valve in d.c. power supplies, in servo applications or as a booster triode.

HEATER

V_h	6.3	V
I_h	2.5	A

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

$*c_{a-g}$	8.6	pF
$*c_{in}$	5.5	pF
$*c_{out}$	2.5	pF
$*c_{h-k}$	7.0	pF
$c_{a''-a'}$	2.2	pF
$c_{g''-g'}$	0.5	pF

*Each section

CHARACTERISTICS

		†	
V_b	-	135	V
V_a	100	-	V
I_a	100	125	mA
R_k	300	250	Ω
g_m	6.5	7.0	mA/V
r_a	300	280	Ω
μ	2.0	2.0	

†This condition represents operation at the absolute limit of anode current and dissipation.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current at $V_h = 6.3V$	2.26	2.74	A
*Amplification factor at $V_b = 135V$, $R_k = 250\Omega$	1.4	2.6	

*Mutual Conductance			
at V_b = 135V, R_k = 250Ω	5.8	8.2	mA/V
**Negative control grid current			
at V_b = 135V, R_k = 250Ω, R_{g1} = 1MΩ	-	4.0	μA
Anode current			
at V_b = 135V, R_k = 250Ω	100	150	mA

Under these conditions the Absolute Maximum Ratings can be exceeded.

*Each section

**Two sections in parallel

SHOCK AND VIBRATION

The 6080 can withstand vibrations of 2.5g at 25c/s for 32 hours and is proof against impact accelerations of 450g.

LOW FREQUENCY VIBRATION PERFORMANCE

R.M.S. output voltage max.	200	mV

Two sections in parallel with V_h = 6.3V, V_b = 135V, V_{g1} = -7V, R_a = 2kΩ and vibrational acceleration of 2.5g at 25c/s.

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (each section)

$V_{a(b)}$ max.	550	V
V_a max.	250	V
†P.I.V. max. (booster scanning service)	3.0	kV
†$-v_{g\,(pulse)}$ max. (booster scanning service)	2.3	kV
I_k max.	125	mA
p_a max.	13	W
R_{g-k} max. (cathode bias)	1.0	MΩ
*R_{g-k} max. (fixed bias)	100	kΩ
v_{h-k} (pk) max.	300	V
T_{bulb} max.	260	°C

†Max. pulse duration 15% of one cycle with a maximum duration of 10μs.

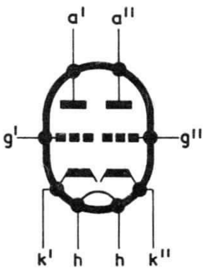
*With fixed bias the anode circuit should contain a protective resistance to provide a minimum drop of 15V d.c. at the normal operating conditions. When two or more sections are used in parallel at dissipations approaching the rated maximum, separate anode and cathode resistors must be used to assist load sharing.

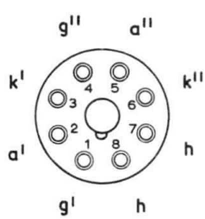
When combined fixed and cathode bias is used, the cathode bias portion should have a minimum value of 7.5V d.c. at the normal operating conditions and R_{g-k} max. = 100kΩ.

It is not recommended that fixed bias be used when the valve is used in a booster scanning circuit.

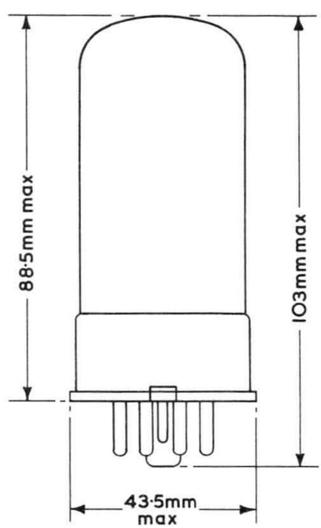
DOUBLE TRIODE 6080

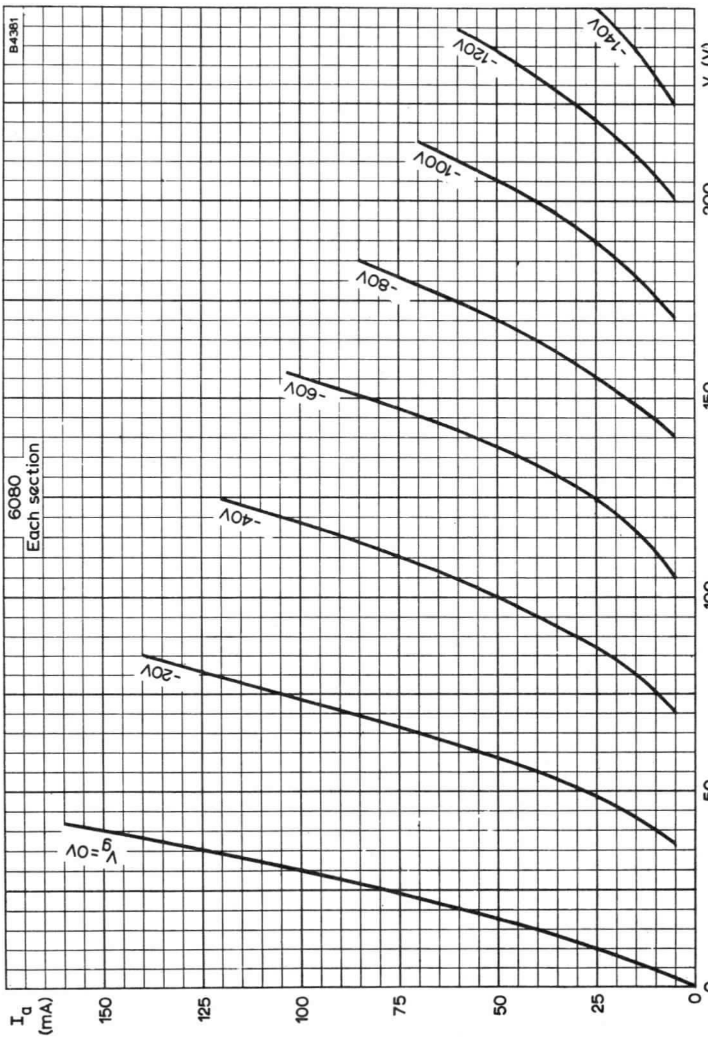
3761





Octal Base





ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH 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 < 50\mu A$)	−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

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 $V_{h-k} = \pm 100$V	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_{g1} = 1.0\text{M}\Omega$	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 $V_{g1} = -9.0$V, $R_k = 0\Omega$	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 $= 55 \pm 5$mmHg 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 $V_{h-k} = \pm 100V$	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), $R_{g1} = 100k\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	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

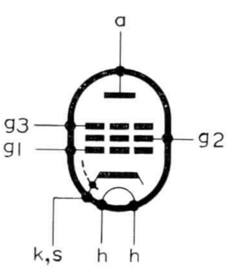
Heater cycling life test								
$V_h = 7.0V$ 1 minute on, 4 minutes off, 2000 switchings. $V_{h-k} = 140V_{r.m.s.}$ (continuous)								
No other applied voltages	2.5	—	—	—	—	—	—	
Stability life[14]								
Running conditions: $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Stability life end points								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions $R_{g1}=1.0M\Omega$, $V_{h-k}=200V$ (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

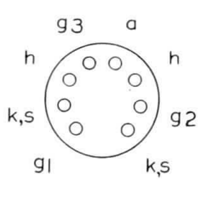
Intermittent life test

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

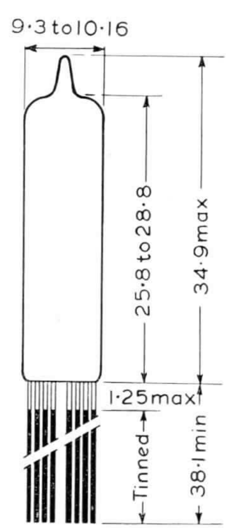
Intermittent life test end points(500 hours)	A.Q.L.[5] (%)	Min.	Max.	
Inoperatives[16]	2.5	—	—	
Heater current	4.0	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm100V$	4.0	—	10	µA
Reverse grid current $R_{g1} = 1.0M\Omega$	2.5	0	0.8	µA
Change in mutual conductance (individuals)	2.5	—	20	%
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	—	—	

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.

MAINTENANCE TYPE
CATHODE RAY TUBES

QUICK REFERENCE DATA

21 cm (8.5 in) rectangular television tube with metal-backed screen primarily intended for use in portable transistor television receivers.

Deflection	90	deg
Focusing	electrostatic	
Maximum overall length	222	mm

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

* Vh	11.5	V
Ih	60	mA

* The heater supply must be designed to provide a nominal voltage of 11.5 V. The maximum variation due to all factors, including power source variation must not exceed ± 20 %.

TYPICAL OPERATING CONDITIONS

Va2 + a4	12	kV
* Va3	0 to 400	V
Va1	400	V
Vk (for visual extinction of focused raster)	29 to 62	V
Vg (for visual extinction of focused raster)	-32 to -69	V

* With the small change in focus spot size with variation of focus voltage, the limit of 0 to 400 V 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 -100 V to +500 V will be required.

SCREEN

Metal backed	
Fluorescent colour	white
Minimum useful screen area	See drawing on page D5

FOCUSING

Electrostatic

The range of focus voltage shown in typical operating conditions results in optimum focus at a beam current of 100 μA.

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 D4, and should provide a pull back of 5 mm on a nominal tube.

CAPACITANCES

cg - all	< 9.0	pF
ck - all	< 5.0	pF
ca2 + a4 - M	375	pF

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.

REFERENCE LINE GAUGE

See Page D4.

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.

ABSOLUTE MAXIMUM RATINGS

** Va2 + a4 max.	16	kV
Va2 + a4 min.	9.0	kV
+ Va3 max.	1.0	kV
- Va3 max.	500	V
Va1 max.	800	V
* - Vg max.	180	V
± Ia3 max.	25	µA
± Ia1 max.	5.0	µA
Ra1 max.	1.0	MΩ
Vh - k		
Cathode positive or negative		
d.c. max.	80	V
pk max.	130	V
Rh - k max.	1.0	MΩ
Zk - e max. (f = 50 c/s)	100	kΩ
Rg - k max.	1.5	MΩ.
Zg - k max. (f = 50 c/s)	500	kΩ

** Adequate precautions should be taken to ensure that the associated equipment is protected from damage, which may be caused by a possible high voltage flashover within the cathode ray tube. (For details see Mullard Technical Communications, Volume 6, Number 51).

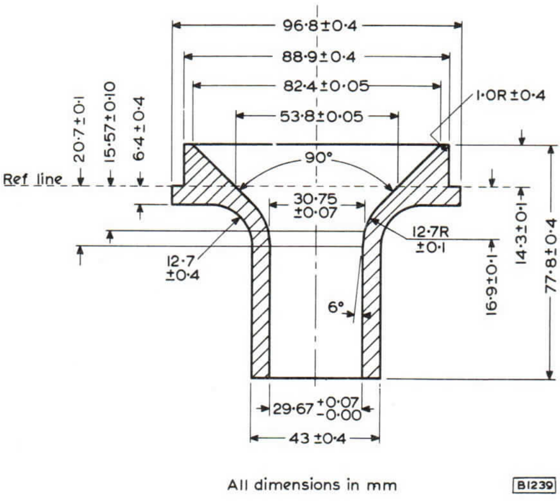
* The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to + 1 V. The maximum positive excursion of the video signal must not exceed + 2 V, and at this voltage the grid current may be expected to be approximately 2 mA.

MOUNTING POSITION Any

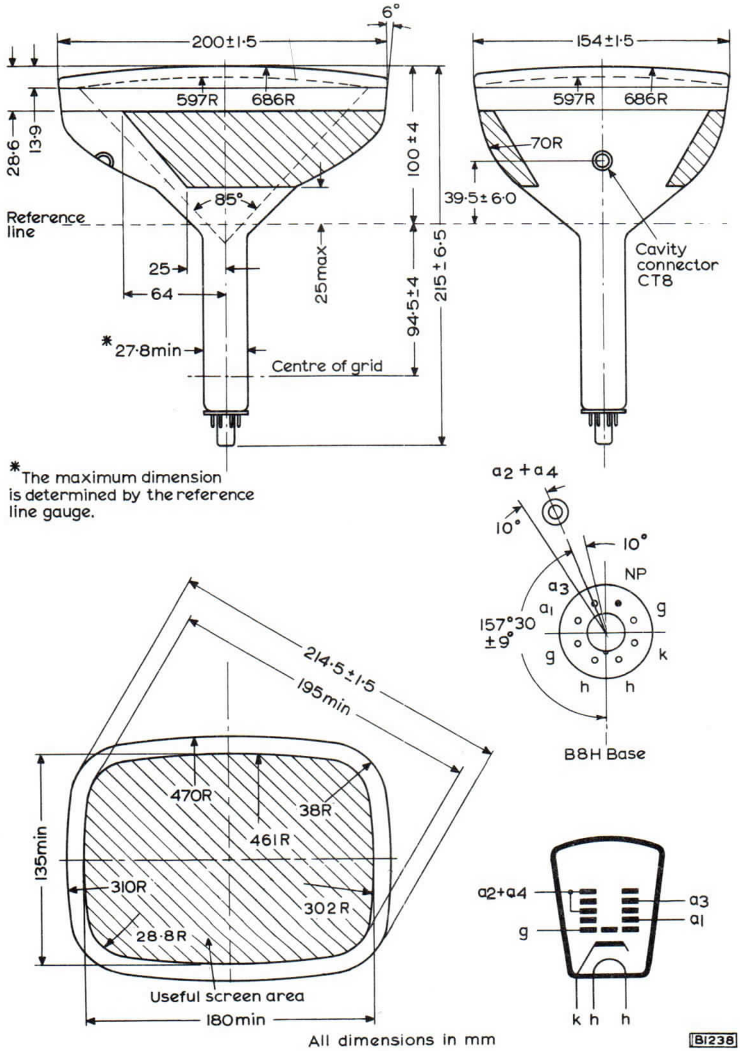
The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40 mm diameter which is centred upon the perpendicular from the centre of the face.

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 handling the tube.

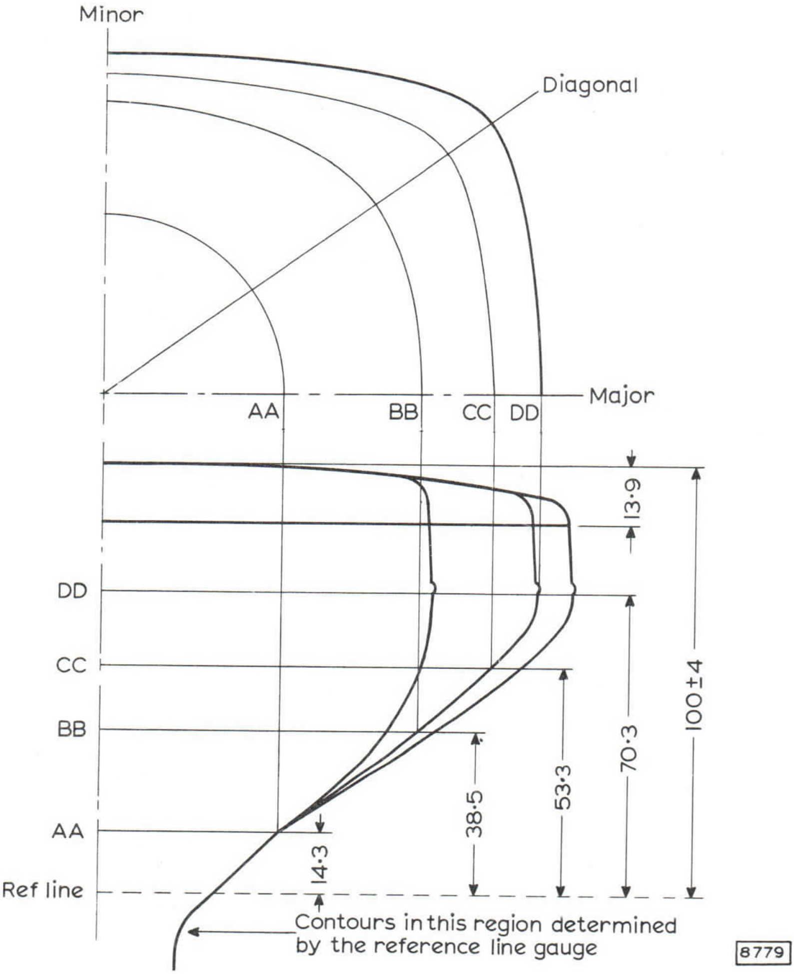
It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

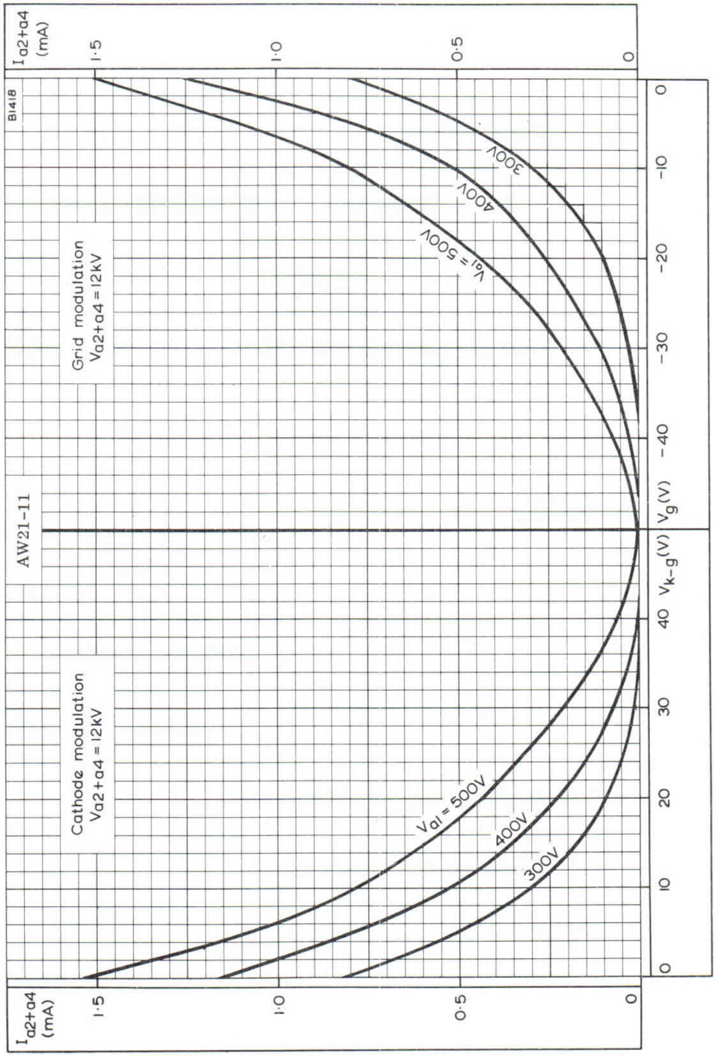


REFERENCE LINE GAUGE


6°
200±1·5
154±1·5
597R
686R
28·6
13·9
100±4
70R
39·5±6·0
85°
Reference line
25
64
25max
94·5±4
215±6·5
Cavity connector CT8
*27·8min
Centre of grid
*The maximum dimension is determined by the reference line gauge.
a2+a4
10°
10°
NP
a3
a1
g
157°30
±9°
g
k
h
h
B8H Base
214·5±1·5
195min
470R
38R
461R
135min
310R
302R
28·8R
Useful screen area
180min
a2+a4
a3
a1
g
k h h
All dimensions in mm
B1238

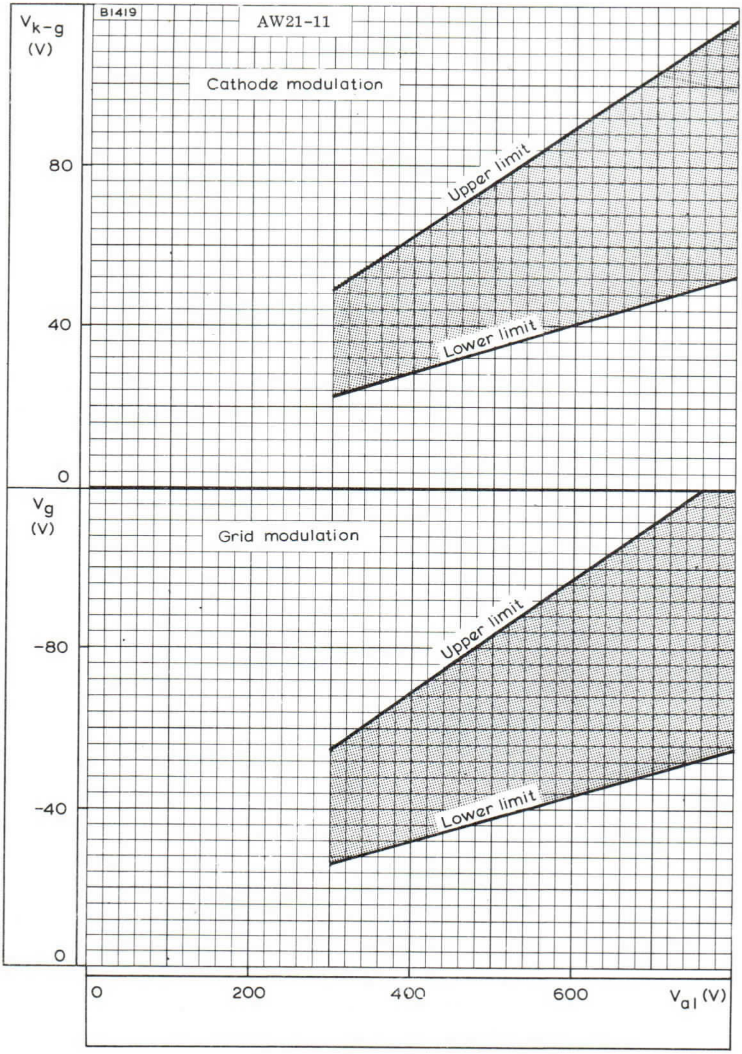
Section	Nominal height above reference line (mm)	Major (mm)	Minor (mm)	Diagonal (mm)
AA	14·3	Circle 87·4 mm dia		
BB	38·5	151	139	158
CC	53·3	185	154	198
DD	70·3	206	160	221





FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE.

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



LIMITS OF CATHODE-TO-GRID VOLTAGE FOR FIRST ANODE VOLTAGES OF 300 V to 800 V. CATHODE MODULATION.

LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES OF 300 V TO 800 V. GRID MODULATION.

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.

AW36-20Z

TELEVISION TUBE

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_{a3+a5}	12	kV
V_{a2+a4} (focus electrode)	−55 to +145	V
V_{a1}	300	V
V_g for cut-off	−40 to −80	V

LIMITING VALUES (design centre ratings)

**V_{a3+a5} max.	14	kV
V_{a3+a5} min.	9.0	kV
$+V_{a2+a4}$ max.	500	V
$-V_{a2+a4}$ max.	500	V
V_{a1} max.	410	V
V_{a1} min.	200	V
*$-V_g$ max.	150	V
$\pm I_{a2+a4}$ 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

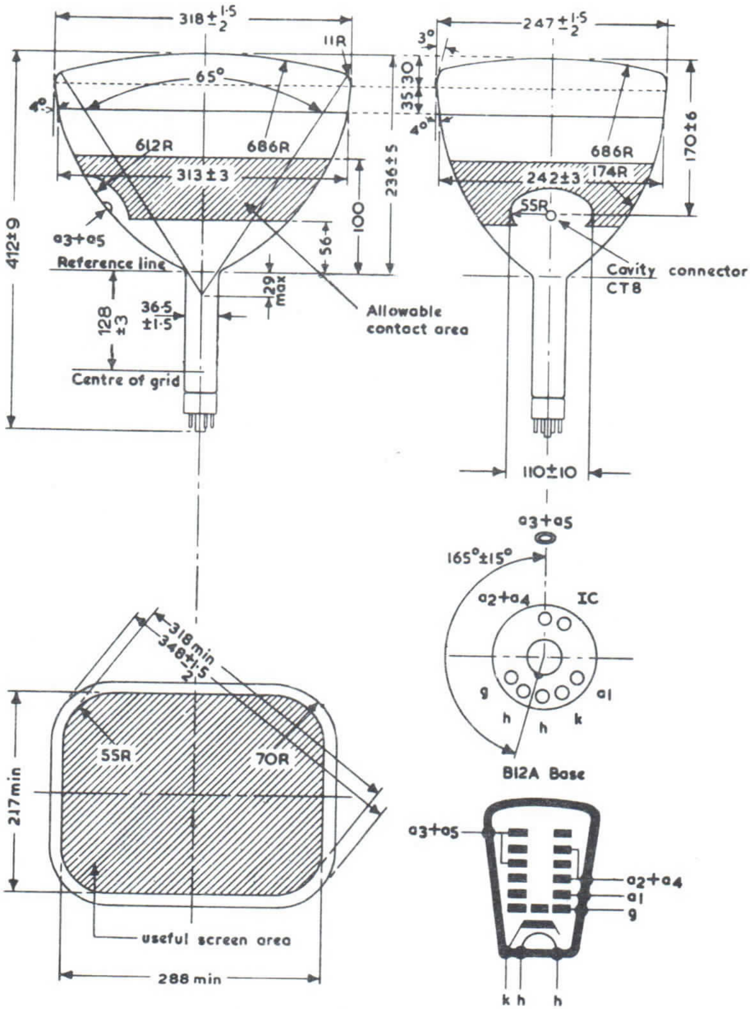
*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{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.



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.'

AW43-80Z

TELEVISION TUBE

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
$\pm I_{a2+a4}$ 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.

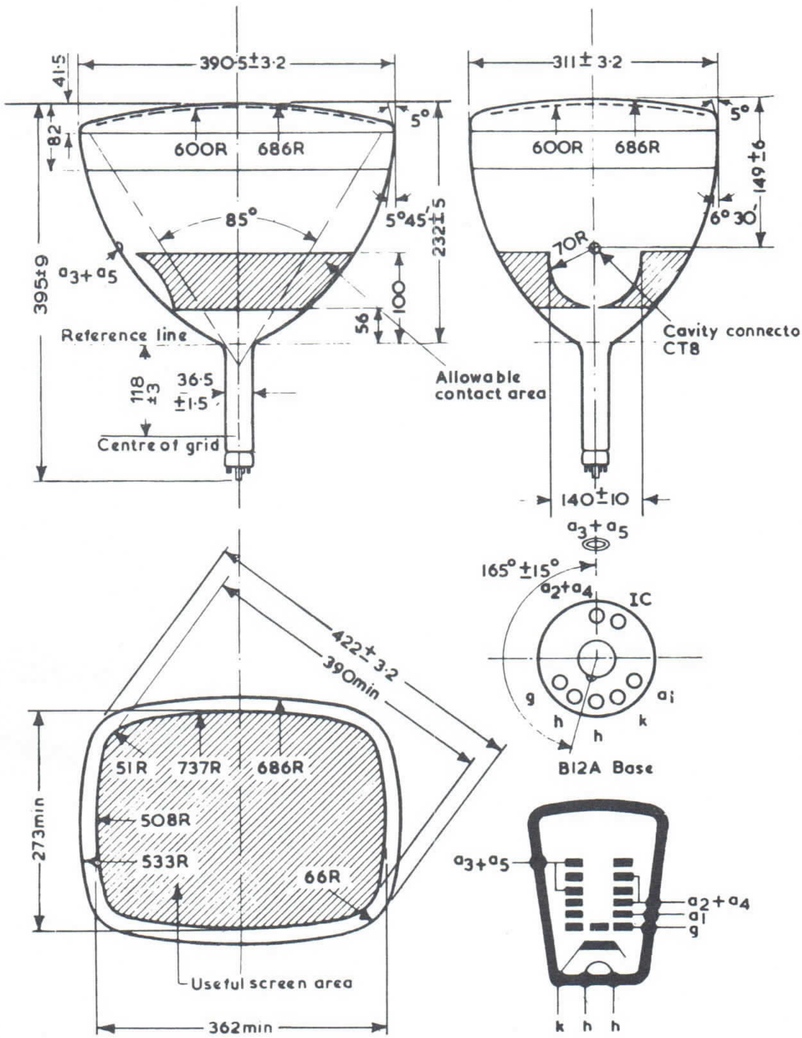
**The product of V_{a3+a5} and I_t (average value for the whole screen) must not exceed 6W.

†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

AW43-88

Direct viewing television tube with 17in. 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
$c_{a2+a4-M}$	1100	pF

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission	75	%
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 100μA.

DEFLECTION

Double magnetic

For timebase designs, the following spreads in the useful screen area should be considered.

	Min.	*Max.*	
Picture height	295	302	mm ←
Picture width	374.5	381	mm
Picture diagonal	400	407	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.

AW43-88

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.

OPERATING CONDITIONS

V_{a2+a4}	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.	16	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

*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.

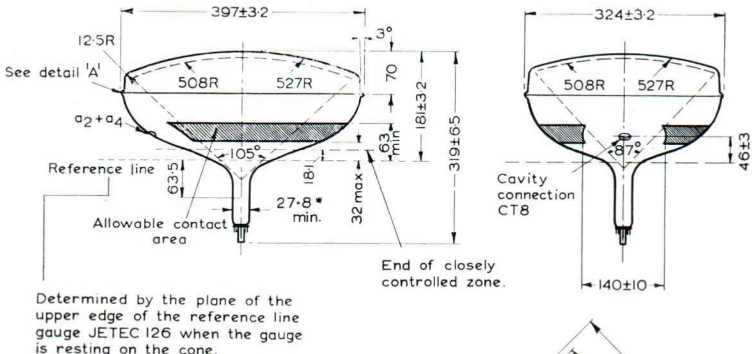
**Maximum pulse duration 22% of a cycle with a maximum of 1.5ms.

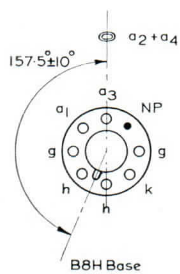
WEIGHT

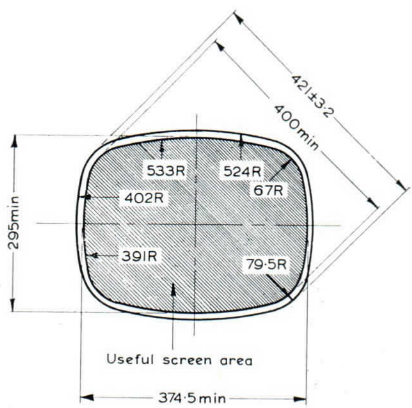
Tube alone	5	kg
	11	lb

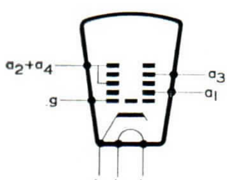
AW43-88

TELEVISION TUBE









All dimensions in mm

5939

*The maximum value is determined by the reference line gauge.

TELEVISION TUBE

AW43-89

Direct viewing television tube with 17in. 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.

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 connection 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}	1100	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	295	302	mm
Picture width	374.5	381	mm
Picture diagonal	400	407	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 note 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 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.

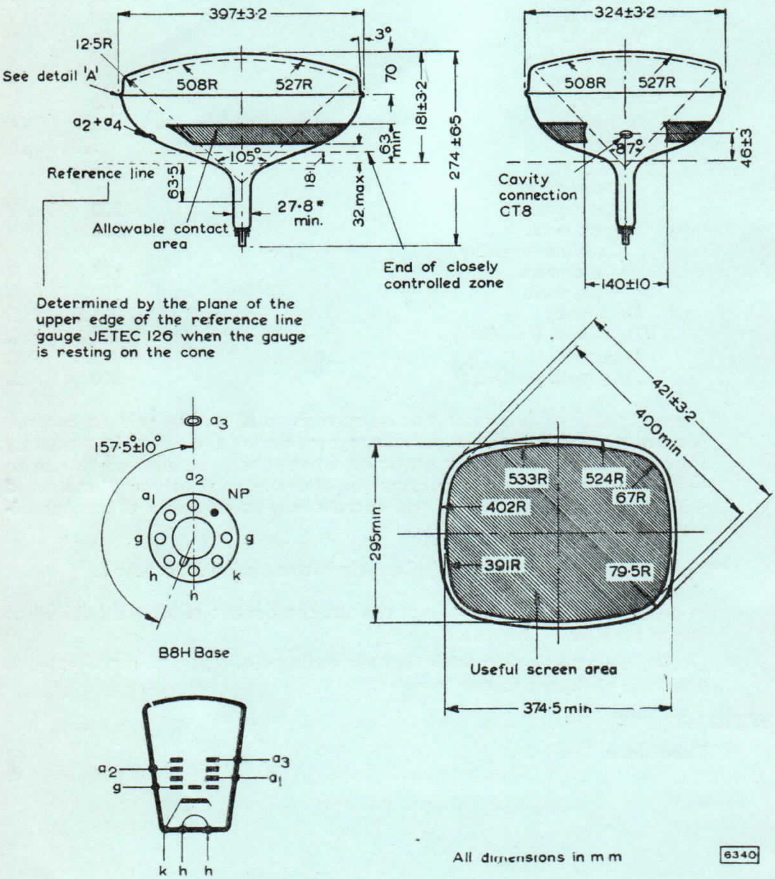
**Maximum pulse duration 22% of a cycle with a maximum of 1.5ms.

†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	5	kg
	11	lb



*The maximum value is determined by the reference line gauge

TELEVISION TUBE

AW47-91

Direct viewing television tube with 19in diagonal metal-backed 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 drawings 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.

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 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.

TYPICAL OPERATING CONDITIONS

V_{a2+a4}	16	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 grid modulation all voltages are measured with respect to the cathode; for cathode modulation, all voltages are measured with respect to the grid.

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
**$+v_{a3(pk)}$ max.	2·5	kV←
V_{a1} max.	550	V
$v_{a1(pk)}$ min.	400	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 ($<20V_{r.m.s.}$).

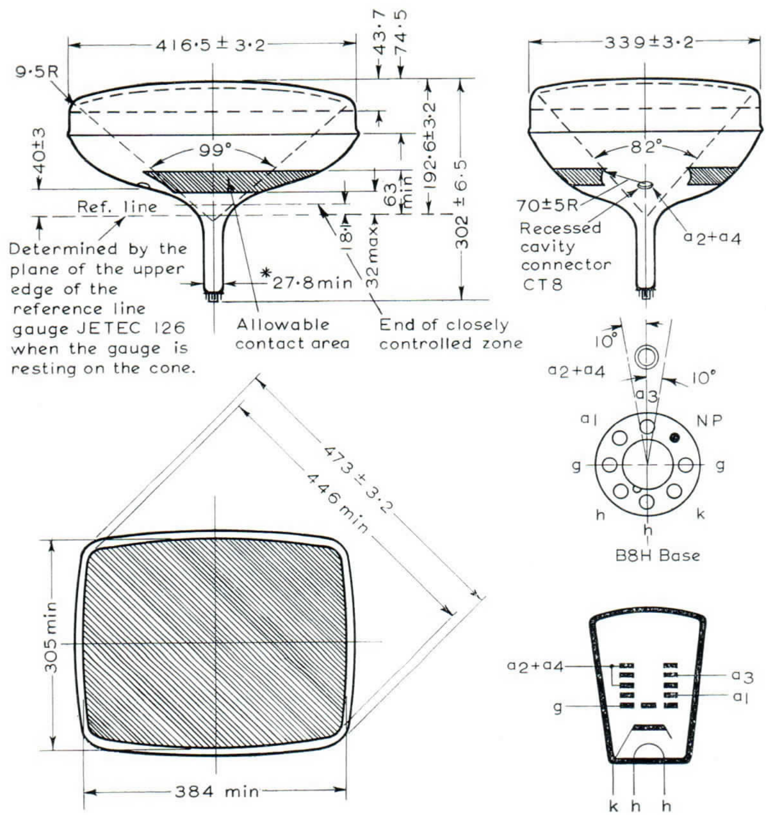
During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

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 16kV.

WEIGHT

Tube alone	7	kg
	15	lb



All dimensions in mm

*The maximum value is determined by the reference line gauge

8807

TELEVISION TUBE

AW53-80

Direct viewing television tube with 21-in. metal-backed diagonal rectangular grey glass screen.
This tube has electrostatic focusing 90° magnetic deflection and incorporates an ion trap.

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}	7.0	pF
c_{k-all}	4.0	pF
$c_{a3+a5-M}$	1500	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 in the curves 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

Ion trap magnet field intensity	63 to 78	G

The space between a point 75mm from the reference line along the neck of the tube and the edge of the base should be kept clear for the ion trap magnet. The direction of the field of the ion trap magnet should be such that the south pole is adjacent to the spigot. The procedure for adjusting the ion trap magnet is given in the 'General operational recommendations—cathode ray tubes' preceding this section of the handbook. The ion trap magnet assembly should be earthed.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'.

AW53-80

TELEVISION TUBE

Direct viewing television tube with 21-in. metal-backed diagonal rectangular grey glass screen. This tube has electrostatic focusing 90° magnetic deflection and incorporates an ion trap.

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)	See curves	
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
$\pm I_{a2+a4}$ 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 = 50c/s)	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 ($<20V_{r.m.s.}$).

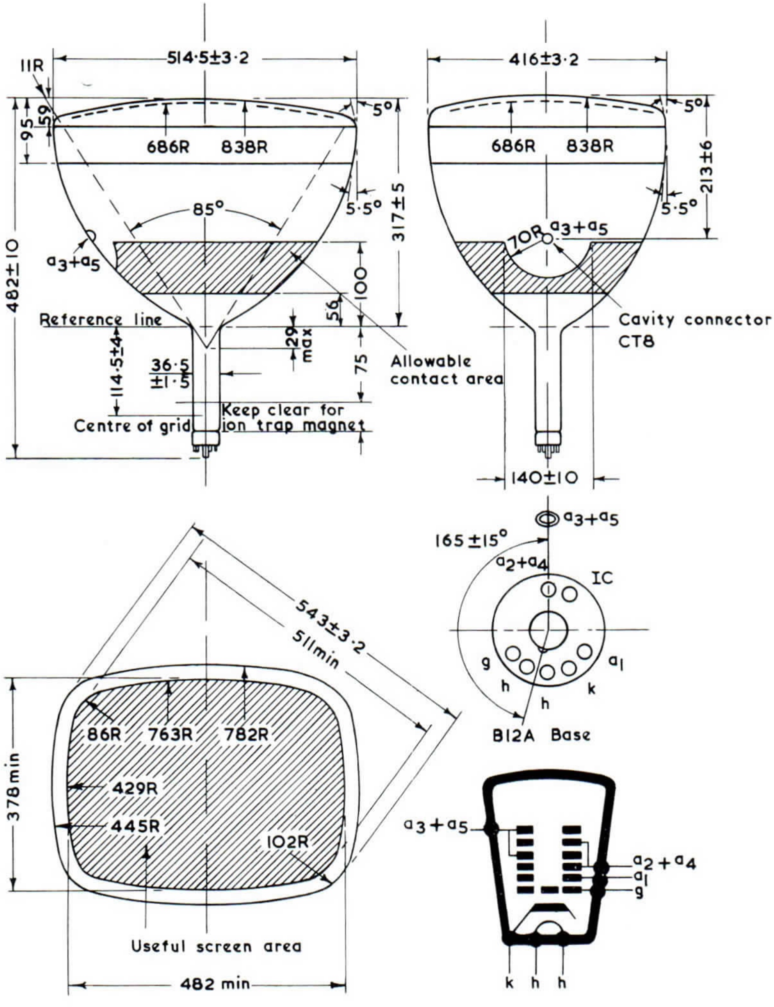
‡During a warming-up period not exceeding 45s.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50c/s impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1.0MΩ.

TELEVISION TUBE

AW53-80

Direct viewing television tube with 21-in. metal-backed diagonal rectangular grey glass screen. This tube has electrostatic focusing 90° magnetic deflection and incorporates an ion trap.



3160

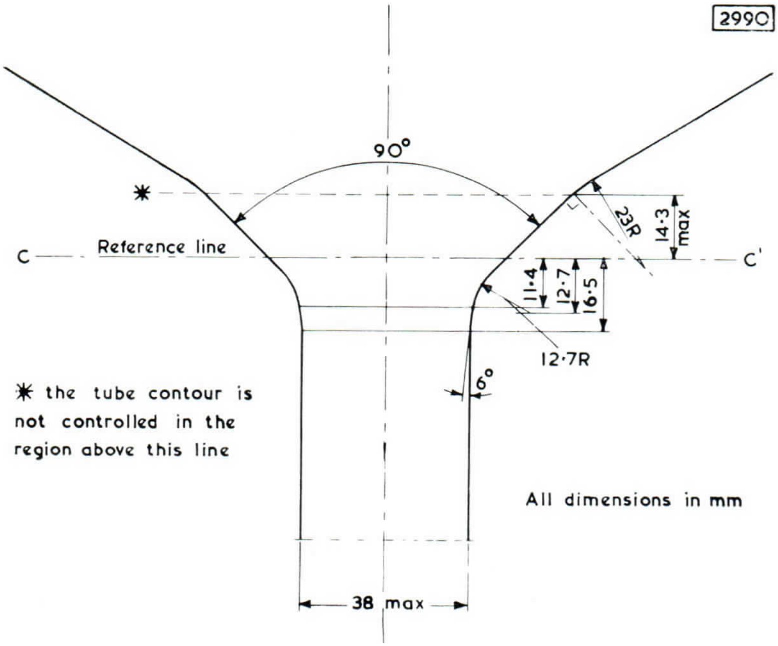
All dimensions in mm

The indicated radius of the faceplate curvature is not an exact but an average value.

AW53-80

TELEVISION TUBE

Direct viewing television tube with 21-in. metal-backed diagonal rectangular grey glass screen. This tube has electrostatic focusing 90° magnetic deflection and incorporates an ion trap.



Deflection coil dimensions

The mechanical design of the deflection coils is governed by the bulb shape at the junction of the neck and cone. The profile of the AW53-80 in this region is shown above. No production tube will impose more severe limitations on coil design than those given in the figure.

TELEVISION TUBE

AW53-88

Direct viewing television tube with 21 in. diagonal rectangular metal-backed 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
$c_{a2+a4-M}$	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 'operating conditions' results in optimum overall 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.

AW53-88

TELEVISION TUBE

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations – cathode ray tubes'.

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 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.

OPERATING CONDITIONS

V_{a2+a4}	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.	16	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

*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.

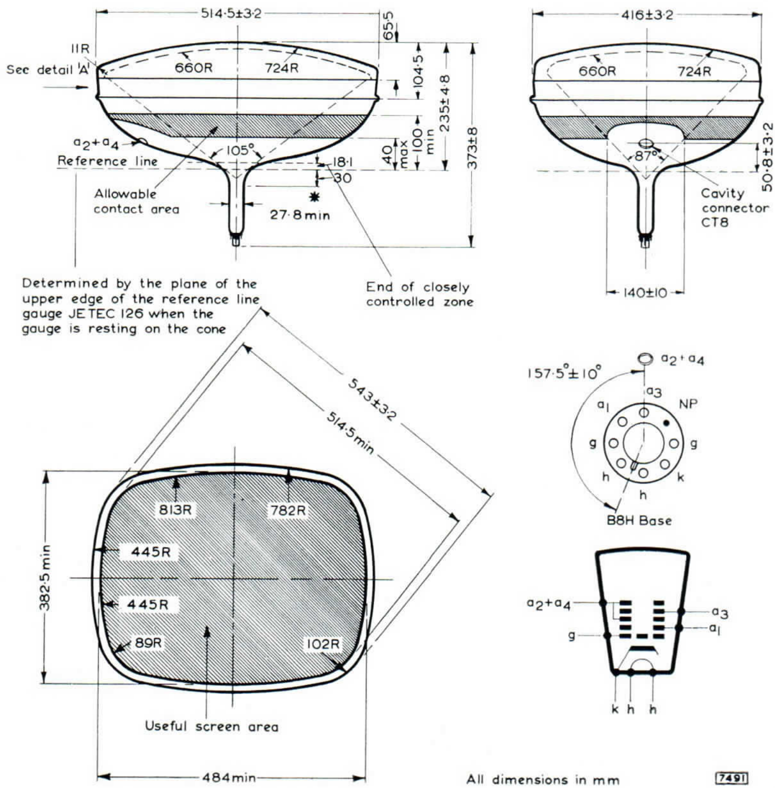
**Maximum pulse duration 22% of a cycle with a maximum of 1.5ms.

WEIGHT

Tube alone	10	kg
	22	lb

AW53-88

TELEVISION TUBE



*The maximum value is determined by the reference line gauge

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.

AW53-89

TELEVISION TUBE

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 drawin g. 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 ($<20V_{r.m.s.}$).

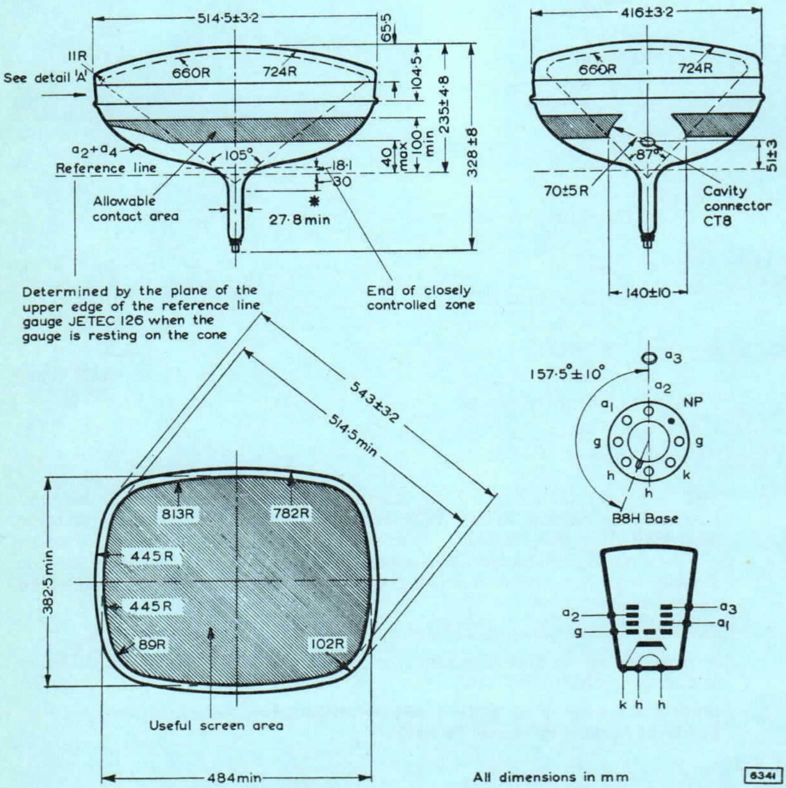
During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WEIGHT

Tube alone	10 22	kg lb

AW53-89

TELEVISION TUBE



*The maximum value is determined by the reference line gauge.

QUICK REFERENCE DATA		
5in diameter, flat-faced precision oscilloscope tube with helical p.d.a. and side connections to the x and y plates. This tube is suitable for high quality wide band oscilloscopes.		
Final anode voltage (p.d.a.)	10	kV
Display area (at $V_{a4} = 6V_{a3}$)	6.0×10	cm
Deflection factor y	10.9	V/cm
Deflection factor x	30	V/cm

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

HEATER

Suitable for parallel operation only

V_h	6.3	V
I_h	300	mA

OPERATING CONDITIONS

Beam forming

Final anode + luminescent screen	V_{a4}	10	kV
Astigmatism control electrode	V_{a3}	1670 ± 85	V
Focus electrode	V_{a2}	320 to 500	V
First accelerator	V_{a1}	1670	V
Geometry control electrode	V_{s2}	1670 ± 170	V
Deflection plate shield	V_{s1}	1670 ± 85	V
Control grid (for visual cut-off)	V_g	-53 to -82	V

Raster distortion

A graticule, consisting of concentric rectangles 10 × 6.0cm and 9.81 × 5.82cm is aligned with the electrical x-axis of the tube. The edges of a raster will fall between these rectangles, with optimum correction potentials applied.

Line width (GH screen)

V_{a4}	10	kV
V_{a3}	1.67	kV
V_{a1}	1.67	kV
I_t	10	µA
*Line width	0.4	mm

*Measured by the shrinking raster method in the centre of the screen

DEFLECTION

Double electrostatic

Mean y-plate voltage	V_y mean	1.67	kV
Mean x-plate voltage	V_x mean	1.67	kV
Vertical deflection factor	S_y	9.5 to 12.4	V/cm
Horizontal deflection factor	S_x	27 to 33	V/cm
Angle between x and y traces		90 ± 1	deg

If use is made of the full deflection capabilities of the tube, the deflection plates will intercept part of the electron beam near the edge of the scan. Therefore a low impedance deflection plate drive is necessary.
Both x and y plates are intended for symmetrical deflection.

Linearity of deflection

The sensitivity at a deflection of less than 75% of the useful scan will not differ from the sensitivity at a deflection of 25% of the useful scan by more than 2%.

CORRECTION POTENTIAL RANGES

Astigmatism control range	V_{a3}	1.58 to 1.76	kV
Geometry control range	V_{s2}	1.5 to 1.84	kV

SCREEN

Phosphor	BE	GH	GM	GP
Fluorescent colour	blue	green	purplish blue	bluish green
Phosphorescent colour	blue	green	yellowish green	green
Persistence	medium short	medium short	long	medium short

Minimum useful screen diameter	11.4	cm
Minimum useful scan (at $V_{a4} = 6V_{a3}$)		
y1-y2	6.0	cm
x1-x2	10	cm

The useful scan may be shifted vertically to a maximum of 3.0mm with respect to the geometric centre of the tube face.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{a4} max. (p.d.a.)	12	kV
V_{a4} min.	6.0	kV
V_{a3} max.	2.1	kV
V_{a3} min.	1.0	kV
Ratio V_{a4}/V_{a3} max.	6.0	
V_{a2} max.	1.5	kV
V_{a1} max.	2.1	kV
V_{a1} min.	1.0	kV
V_{s2} max.	2.2	kV
V_{s1} max.	2.1	kV
$-V_{g}$ max.	200	V
$+V_{g}$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$v_{x-a3(pk)}$ max.	500	V
$v_{y-a3(pk)}$ max.	500	V
$I_{k(av.)}$ max.	300	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_{g-k} max.	1.5	MΩ
R_{y-a3} max.	1.0	MΩ
R_{x-a3} max.	1.0	MΩ
$-I_{a2}$ max.	15	μA
$+I_{a2}$ max.	10	μA
p_{t} max.	3.0	mW/cm^2

HELIX RESISTANCE

Minimum post deflection helix resistance	200	MΩ

CAPACITANCES (measured on three terminal capacitance bridge)

High potential	Low potential	Earthed	Capacitance (pF)
k	all	-	3.5
g	all	-	6.0
x1	all	x2	3.0
x2	all	x1	3.0
y1	all	y2	3.0
y2	all	y1	3.0
x1	x2	all	1.9
y1	y2	all	1.0

EQUIPMENT DESIGN RANGE

Focusing voltage	V_{a2}	190 to 300	V/kV of V_{a3}
Grid cut-off voltage	V_g	-32 to -49	V/kV of V_{a1}
Deflection factor ($V_{a4} = 6V_{a3}$)			
Vertical	S_y	5.7 to 7.4	V/cm/kV of V_{a3}
Horizontal	S_x	16 to 20	V/cm/kV of V_{a3}

MOUNTING POSITION

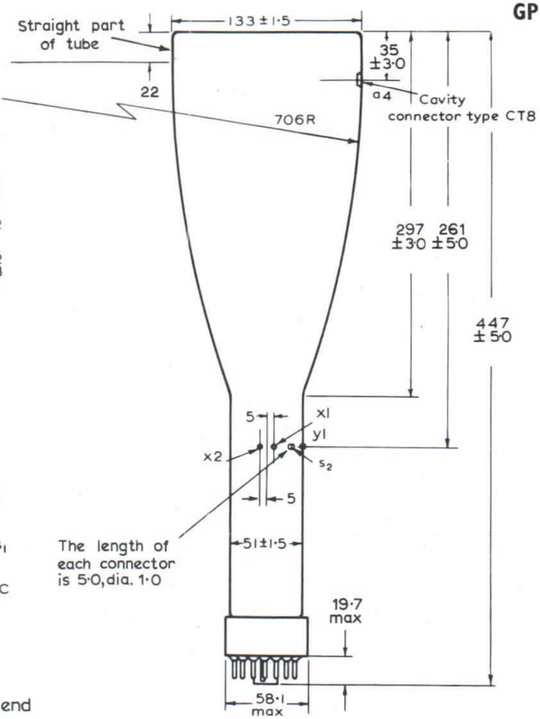
The tube should not be supported by the base alone and under no circumstances should the socket be allowed to support the tube.

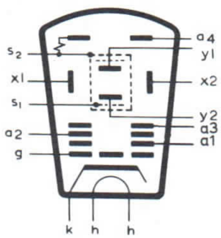
WEIGHT

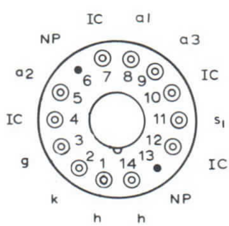
Tube alone (approx.)	910	g

ACCESSORIES

Socket	5914/20
Final accelerator contact connector (CT8)	55563
Side contact connector	55561
Mu-metal shield	55551

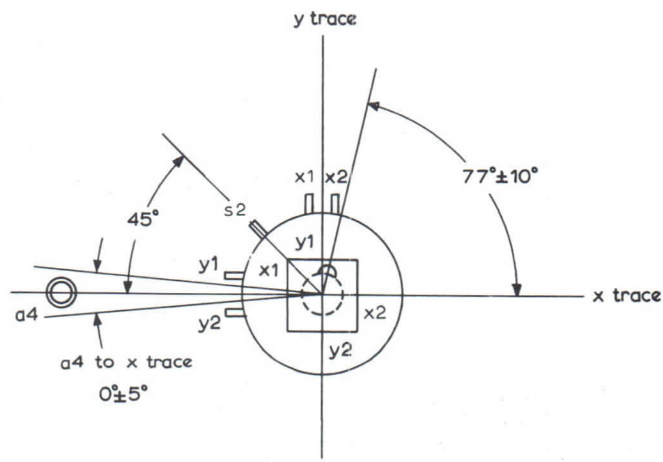






B 14 A Base
As viewed from base end

All dimensions in mm



Orientation of axes of deflection as viewed from screen end

OSCILLOSCOPE TUBES D13-21 BE GH GM GP

QUICK REFERENCE DATA

5in diameter, flat-faced precision oscilloscope tube with helical p.d.a. and side connections to the x and y plates. This tube is suitable for high quality wide band oscilloscopes.

Final anode voltage (p.d.a.)	10	kV
Display area (at $V_{a4} = 6V_{a3}$)	4×10	cm
Deflection factor y	6.4	V/cm
Deflection factor x	30	V/cm

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

HEATER

Suitable for parallel operation only

V_h	6.3	V
I_h	300	mA

OPERATING CONDITIONS

Beam forming

Final anode + luminescent screen	V_{a4}	10	kV
Astigmatism control electrode	V_{a3}	1670± 85	V
Focus electrode	V_{a2}	320 to 500	V
First accelerator	V_{a1}	1670	V
Geometry control electrode	V_{s2}	1670± 170	V
Deflection plate shield	V_{s1}	1670± 85	V
Control grid (for visual cut-off)	V_g	-50 to -80	V

Raster distortion

A graticule, consisting of concentric rectangles 10×4cm and 9.88×3.9cm is aligned with the electrical x-axis of the tube. The edges of a raster will fall between these rectangles, with optimum correction potentials applied.

Line width (GH screen)

V_{a4}	10	kV
V_{a3}	1.67	kV
V_{a1}	1.67	kV
I_t	10	μA
*Line width	0.4	mm

*Measured by the shrinking raster method in the centre of the screen.

DEFLECTION

Double electrostatic

Mean y-plate voltage	V_y mean	1.67	kV
Mean x-plate voltage	V_x mean	1.67	kV
Vertical deflection factor	S_y	5.7 to 7.1	V/cm
Horizontal deflection factor	S_x	27 to 33	V/cm

If use is made of the full deflection capabilities of the tube, the deflection plates will intercept part of the electron beam near the edge of the scan. Therefore a low impedance deflection plate drive is necessary.
Both x and y plates are intended for symmetrical deflection.

Linearity of deflection

The sensitivity at a deflection of less than 75% of the useful scan will not differ from the sensitivity at a deflection of 25% of the useful scan by more than 1.5% horizontally and 1.0% vertically.

CORRECTION POTENTIAL RANGES

Astigmatism control range	V_{a3}	1.59 to 1.75	kV
Geometry control range	V_{s2}	1.5 to 1.84	kV
Linearity of vertical deflection	V_{s1}	1.59 to 1.75	kV

SCREEN

	BE	GH	GM	GP
Phosphor	BE	GH	GM	GP
Fluorescent colour	blue	green	purplish blue	bluish green
Phosphorescent colour	blue	green	yellow-green	green
Persistence	medium short	medium short	long	medium short

Minimum useful screen diameter	11.4 cm
Minimum useful scan (at $V_{a4} = 6V_{a3}$)	
y1-y2	4.0 cm
x1-x2	10 cm

The useful scan may be shifted vertically to a maximum of 3.0mm with respect to the geometric centre of the tube face.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{a4} max. (p.d.a.)	12	kV
V_{a4} min.	6.0	kV
V_{a3} max.	2.1	kV
V_{a3} min.	1.0	kV
Ratio V_{a4}/V_{a3} max.	6.0	
V_{a2} max.	1.5	kV
V_{a1} max.	2.1	kV
V_{a1} min.	1.0	kV
V_{s2} max.	2.2	kV
V_{s1} max.	2.1	kV
$-V_g$ max.	200	V
$+V_g$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$v_{x-a3(pk)}$ max.	500	V
$v_{y-a3(pk)}$ max.	500	V
$I_{k(av)}$ max.	300	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_{g-k} max.	1.5	MΩ
R_{y-a3} max.	1.0	MΩ
R_{x-a3} max.	1.0	MΩ
$-I_{a2}$ max.	15	μA
$+I_{a2}$ max.	10	μA
p_t max.	3.0	mW/cm^2

HELIX RESISTANCE

Minimum post deflection helix resistance	200	MΩ

CAPACITANCES (measured on three terminal capacitance bridge)

High potential	Low potential	Earthed	Capacitance (pF)
k	all	-	3.5
g	all	-	6.0
x1	all	x2	2.8
x2	all	x1	2.8
y1	all	y2	2.8
y2	all	y1	2.8
x1	x2	all	1.9
y1	y2	all	1.5

EQUIPMENT DESIGN RANGE

Focusing voltage	V_{a2}	190 to 300	V/kV of V_{a3}
Grid cut-off voltage	V_g	-30 to -48	V/kV of V_{a1}
Deflection factor ($V_{a4} = 6V_{a3}$)			
Vertical	y	3.4 to 4.25	V/cm/kV of V_{a3}
Horizontal	x	16.2 to 19.8	V/cm/kV of V_{a3}

MOUNTING POSITION	Any

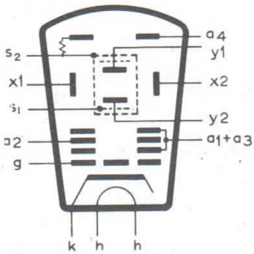
The tube should not be supported by the base alone and under no circumstances should the socket be allowed to support the tube.

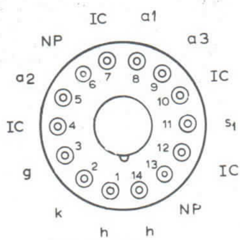
WEIGHT

Tube alone (approx.)	910	g

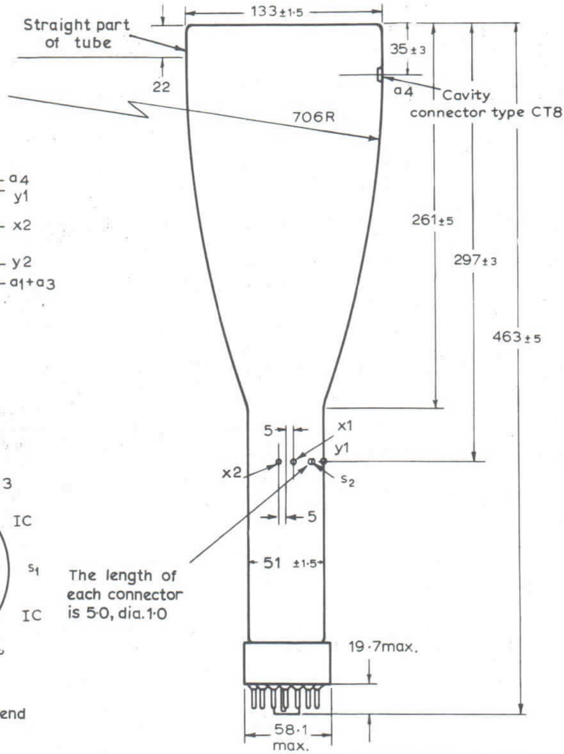
ACCESSORIES

Socket	5914/20
Final accelerator contact connector (CT8)	55563
Side contact connector	55561
Mu-metal shield	55551

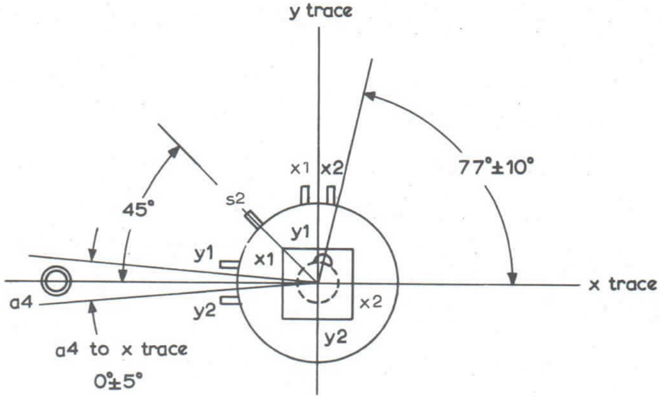




B14A Base
As viewed from base end



All dimensions in mm



Orientation of axes of deflection as viewed from screen end

OSCILLOSCOPE TUBES

DB7-5 DG7-5 DP7-5

Direct viewing oscilloscope tubes with $2\frac{3}{4}$ in. diameter screen. Intended for symmetrical deflection.

HEATER

Suitable for parallel operation only.

V_h	6.3	V
I_h	310	mA

CAPACITANCES

c_{g-all}	10	pF
$c_{x'-all}$ (x″ earthed)	4.5	pF
$c_{x''-all}$ (x′ earthed)	4.5	pF
$c_{y'-all}$ (y″ earthed)	5.3	pF
$c_{y''-all}$ (y′ earthed)	5.3	pF
$c_{x'x''-all}$	8.0	pF←
$c_{y'y''-all}$	6.0	pF←
$c_{x'x''-y'y''}$	0.2	pF←

SCREEN

Fluorescent colour :—

DB7–5	blue
DG7–5	green
DP7–5	blue with green afterglow

Persistence :—

DB7–5	short
DG7–5	medium
DP7–5	long

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

Both x and y plates are suitable for symmetrical operation.
It is recommended that a_2 be earthed.

MOUNTING POSITION

Any

These tubes should not be supported by the base alone.

TYPICAL OPERATING CONDITIONS

V_{a2}	800	V
V_{a1}	200 to 300	V
* V_g	0 to −50	V
I_{a2}	0 to 205	μA←
I_{a1}	0 to 500	μA
S_x	0.16	mm/V
S_y	0.25	mm/V←
** Line width	0.7	mm

* In no circumstances must the grid be allowed to become positive with respect to the cathode.

** Measured on a circle of 50mm. diameter with $I_t = 0.5\mu A$

DB7-5
DG7-5
DP7-5

OSCILLOSCOPE TUBES

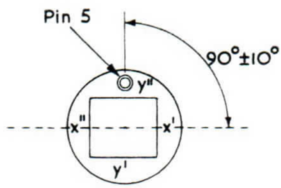
Direct viewing oscilloscope tubes with $2\frac{3}{4}$ in. diameter screen. Intended for symmetrical deflection.

DEFLECTION SENSITIVITY LIMITS ←

S_x	0.13 to 0.19	mm/V
S_y	0.21 to 0.28	mm/V

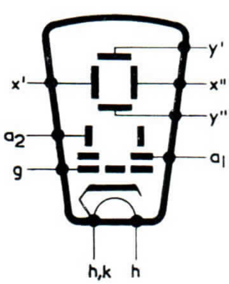
LIMITING VALUES (Design centre ratings)

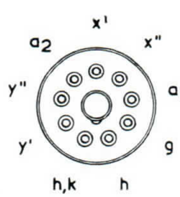
V_{a_2} max.	1.0	kV
V_{a_2} min.	800	V
V_{a_1} max.	400	V
$-V_g$ max.	100	V
$v_{x'-x''\,(pk)}$ max.	750	V
$v_{y'-y''\,(pk)}$ max.	450	V
$p_{t(av)}$ max.	3.0	mW/cm^2
R_{x-a_2} max.	5.0	MΩ
R_{y-a_2} max.	5.0	MΩ
R_{g-k} max.	500	kΩ



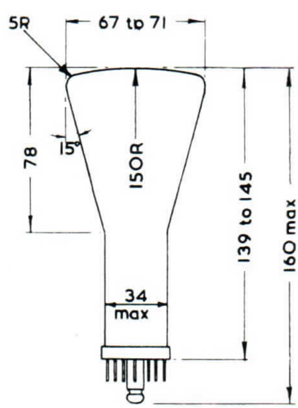
Orientation of axes of deflection as viewed from screen end.

2336



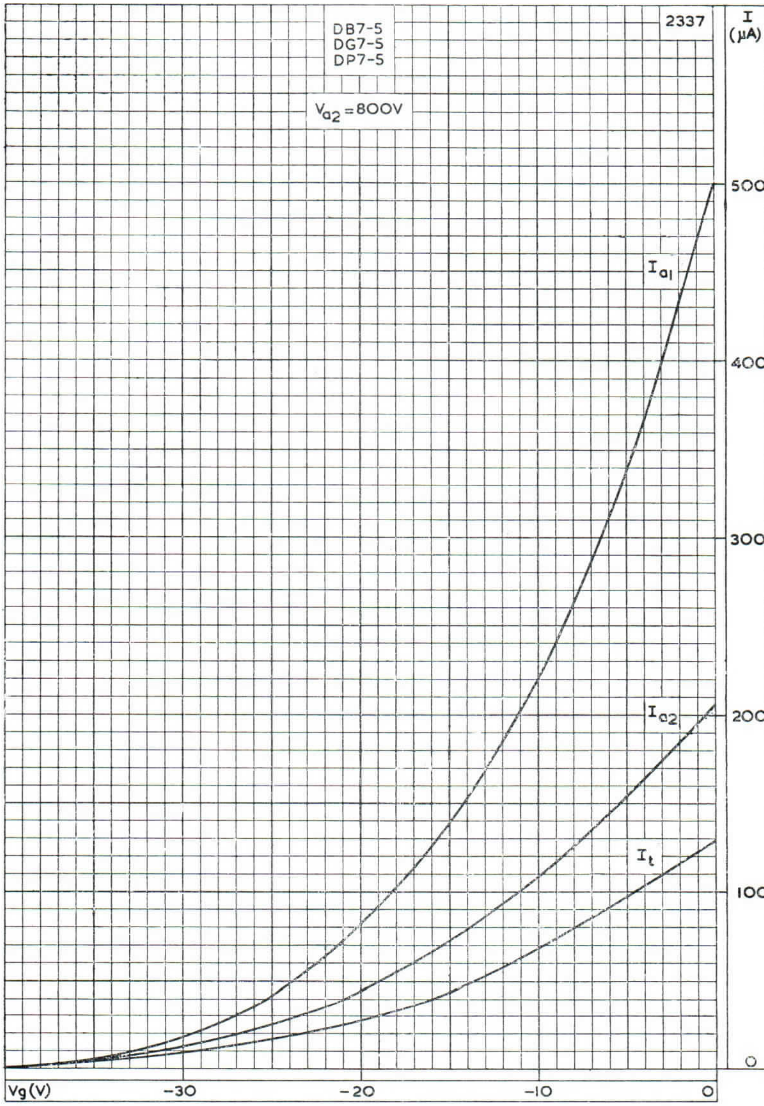


B9G Base



All dimensions in mm

Direct viewing oscilloscope tubes with $2\frac{3}{4}$ in. diameter screen. Intended for symmetrical deflection.



FIRST AND SECOND ANODE AND SCREEN CURRENTS PLOTTED AGAINST GRID VOLTAGE

OSCILLOSCOPE TUBES

Direct viewing oscilloscope tubes with $2\frac{3}{4}$ in. diameter screen. Intended for asymmetrical deflection.

DB7-6
DG7-6
DP7-6

HEATER

Suitable for parallel operation only

V_h	6.3	V
I_h	310	mA

CAPACITANCES

c_{g-all}	10	pF
$c_{x'-all}$ (x″ earthed)	4.5	pF
$c_{x''-all}$ (x′ earthed)	4.5	pF
$c_{y'-all}$ (y″ earthed)	5.3	pF
$c_{y''-all}$ (y′ earthed)	5.3	pF
$c_{x'x''-all}$	8.0	pF←
$c_{y'y''-all}$	6.0	pF←
$c_{x'x''-y'y''}$	0.2	pF←

SCREEN

Fluorescent colour:—

DB7–6	blue
DG7–6	green
DP7–6	blue with green afterglow

Persistence:—

DB7–6	short
DG7–6	medium
DP7–6	long

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

x plates suitable for asymmetrical operation

y plates suitable for symmetrical operation

Plate x′ must be connected to a_2 and it is recommended that a_2 be earthed.

MOUNTING POSITION

Any

These tubes should not be supported by the base alone.

TYPICAL OPERATING CONDITIONS

V_{a2}	800	V
V_{a1}	200 to 300	V
* V_g	0 to −50	V
I_{a2}	0 to 205	μA←
I_{a1}	0 to 500	μA
S_x	0.16	mm/V
S_y	0.25	mm/V←
** Line width	0.7	mm

* In no circumstances must the grid be allowed to become positive with respect to the cathode.

** Measured on a circle of 50 mm. diameter with $I_t = 0.5\mu A$

DB7-6
DG7-6
DP7-6

OSCILLOSCOPE TUBES

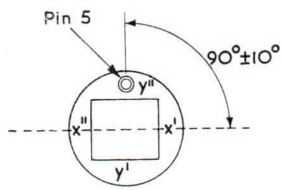
Direct viewing oscilloscope tubes with $2\frac{3}{4}$ in. diameter screen. Intended for asymmetrical deflection.

DEFLECTION SENSITIVITY LIMITS ←

S_x	0.13 to 0.19	mm/V
S_y	0.21 to 0.28	mm/V

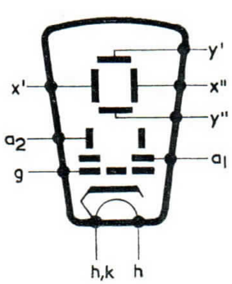
LIMITING VALUES (Design centre ratings)

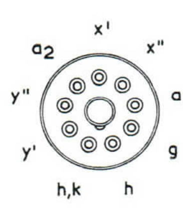
V_{a2} max.	1.0	kV
V_{a2} min.	800	V
V_{a1} max.	400	V
$-V_g$ max.	100	V
$v_{x'-x''\ (pk)}$ max.	750	V
$v_{y'-y''\ (pk)}$ max.	450	V
$p_{t\ (av)}$ max.	3.0	mW/cm²
R_{x-a2} max.	5.0	MΩ
R_{y-a2} max.	5.0	MΩ
R_{g-k} max.	500	kΩ



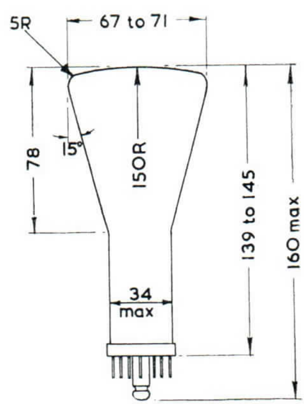
Orientation of axes of deflection as viewed from screen end.

2336





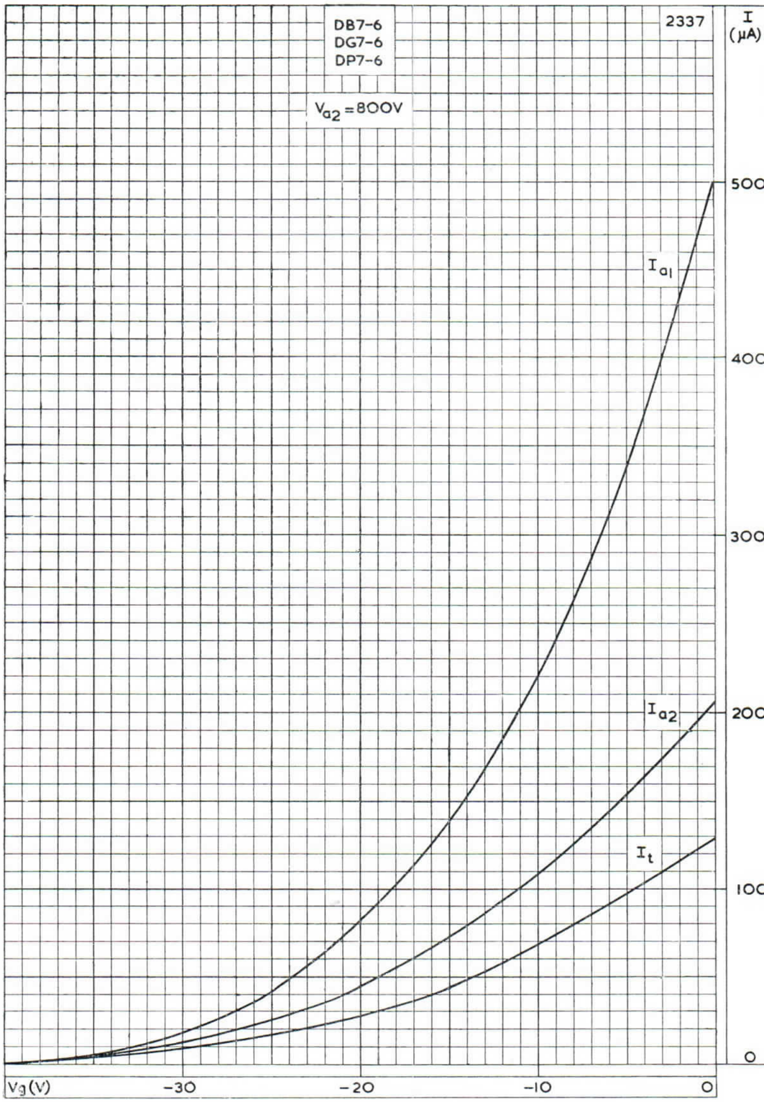
B9G Base



All dimensions in mm

Direct viewing oscilloscope tubes with $2\frac{3}{4}$ in. diameter screen. Intended for asymmetrical deflection.

DB 7-6
DG 7-6
DP 7-6



FIRST AND SECOND ANODE AND SCREEN CURRENTS PLOTTED AGAINST GRID VOLTAGE

OSCILLOSCOPE TUBE

Direct viewing oscilloscope tube with 4-in. diameter screen. This tube is fitted with a post-deflection accelerator.

DB 10-78
DH 10-78
DP 10-78

The only difference between the DB10-78, DH10-78 and DP10-78 is in the screen properties (see appropriate section of 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 only, a.c. or d.c.

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{g-all}	5.0	pF
c_{k-all}	3.4	pF
$c_{x'-all}$ (x″ earthed)	4.5	pF
$c_{x''-all}$ (x′ earthed)	4.5	pF
$c_{y'-all}$ (y″ earthed)	3.5	pF
$c_{y''-all}$ (y′ earthed)	3.5	pF
$c_{x'-x''}$	2.1	pF
$c_{y'-y''}$	1.7	pF

SCREEN

	DB10-78	*DH10-78*	*DP10-78*	
Fluorescent colour	blue	blue-green	blue with green afterglow	
Persistence	short	medium	long	
Minimum useful scan				
	$V_{a4} = V_{a1+a3}$	$V_{a4} = 2V_{a1+a3}$	$V_{a4} = 4V_{a1+a3}$	
x′–x″	90	90	75	mm
y′–y″	75	65	55	mm

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

Both x and y plates are intended for symmetrical deflection. For optimum focus the average potentials of the deflection plates and a_1+a_3 should be equal. For optimum focus it may be necessary to apply a small potential difference (max. $\pm 5\%$ of V_{a1+a3}) between the y plates and a_1+a_3 by varying the a_1+a_3 potential.

DB 10-78
DH 10-78
DP 10-78

OSCILLOSCOPE TUBE

Deviation of linearity of deflection

The sensitivity (for both x′–x″ and y′–y″ plate pairs separately) for a deflection of less than 75% of the useful scan will not differ from the sensitivity for a deflection of 25% of the useful scan by more than 2%.

Raster distortion

With a raster pattern the size of which is adjusted so that the widest points of the raster just touch the sides of a square of side 51mm, no point on these raster sides will lie within a square of side 49mm the squares being placed concentrically.

Angle between x and y deflection $90^\circ \pm 1^\circ$

Inter-plate shield

The fourth anode forms an electrostatic shield between the x and y plates, and is connected to the low potential end of the helix. The inter-plate shield voltage and the average potential of the deflection plates should be equal. Variation of the inter-plate shield voltage serves to correct pincushion and barrel raster distortion.

HELIX RESISTANCE

Minimum post deflection acceleration helix resistance	50	MΩ

MOUNTING POSITION

Any

The tube should not be supported by the base alone. The socket should under no circumstances be used to support the tube.

OPERATING CONDITIONS

V_{a4}	2.0	4.0	4.0	kV
$V_{i.p.s.}$	2.0	2.0	1.0	kV
V_{a1+a3}	2.0	2.0	1.0	kV
V_{a2}	400 to 700	400 to 700	200 to 350	V
*V_g	−45 to −75	−45 to −75	−22.5 to −37.5	V
S_x	0.26	0.2	0.3	mm/V
S_y	0.63	0.55	0.93	mm/V
**Line width	0.45	0.35	0.45	mm

*For visual extinction of focused spot.
In no circumstances must the d.c. value of the grid bias be allowed to become positive with respect to the cathode.

**Measured on a circle of 50mm diameter with $I_t = 0.5\mu A$.

DEFLECTION SENSITIVITY LIMITS

	Without acceleration ($V_{a4} = V_{a1+a3}$)	With acceleration ($V_{a4} = 2V_{a1+a3}$)	With acceleration ($V_{a4} = 4V_{a1+a3}$)	
S_x	$\frac{460 \text{ to } 580}{V_{a1+a3}}$	$\frac{360 \text{ to } 460}{V_{a1+a3}}$	$\frac{260 \text{ to } 330}{V_{a1+a3}}$	mm/V
S_y	$\frac{1140 \text{ to } 1380}{V_{a1+a3}}$	$\frac{1000 \text{ to } 1200}{V_{a1+a3}}$	$\frac{840 \text{ to } 1020}{V_{a1+a3}}$	mm/V

EQUIPMENT DESIGN RANGE

Focusing voltage (V_{a2})		200 to 350V per kV of accelerator voltage (V_{a1+a3})
Grid cut-off voltage		−22.5 to −37.5V per kV of accelerator voltage (V_{a1+a3})
Deflection factor		
$V_{a4} = V_{a1+a3}$	(x′−x″)	1.72 to 2.17V/mm per kV of accelerator voltage (V_{a1+a3})
	(y′−y″)	0.72 to 0.89V/mm per kV of accelerator voltage (V_{a1+a3})
$V_{a4} = 2V_{a1+a3}$	(x′−x″)	2.17 to 2.78V/mm per kV of accelerator voltage (V_{a1+a3})
	(y′−y″)	0.83 to 1.00V/mm per kV of accelerator voltage (V_{a1+a3})
$V_{a4} = 4V_{a1+a3}$	(x′−x″)	3.03 to 3.85V/mm per kV of accelerator voltage (V_{a1+a3})
	(y′−y″)	0.98 to 1.19V/mm per kV of accelerator voltage (V_{a1+a3})

Grid to cathode circuit resistance (R_{g-k})	1.5	MΩ
Deflection plate resistance	5.0	MΩ
Focusing anode current (I_{a2})	−30 to +15	μA

DB 10-78
DH 10-78
DP 10-78

OSCILLOSCOPE TUBE

LIMITING VALUES (design centre ratings)

V_{a4} max.	8.0	kV
V_{a4} min.	1.5	kV
$V_{i.p.s.}$ max.	2.2	kV
V_{a1+a3} max.	2.1	kV←
V_{a1+a3} min.	1.0	kV
V_{a2} max.	1.5	kV
$-V_g$ max.	200	V
$+V_g$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$v_{x-a1+a3(pk)}$ max.	500	V
$v_{y-a1+a3(pk)}$ max.	500	V
p_{a1+a3} max.	6.0	W
$p_{t(av)}$ max.	3.0	mW/cm^2
V_{h-k} max.	180	V
Max. ratio of V_{a4}/V_{a1+a3}	4.0	

WEIGHT Tube alone

660		g
1 lb		7 oz

CIRCUIT NOTES FOR DH10-78

1. With a post accelerator voltage (V_{a4}) of 2.6kV and an accelerator voltage (V_{a1+a3}) of 1.1kV, the ratio of $V_{a4}/V_{a1+a3} = 2.36$. From page C1 it can be seen that the useful scan is:

   $x'-x'' = 90\text{mm}$
   $y'-y'' = 63\text{mm}$

2. Without post acceleration and with $V_{a1+a3} = 1.1\text{kV}$, the sensitivity of $x'-x'' = 0.485\text{mm/V}$ and of $y'-y'' = 1.15\text{mm/V}$.

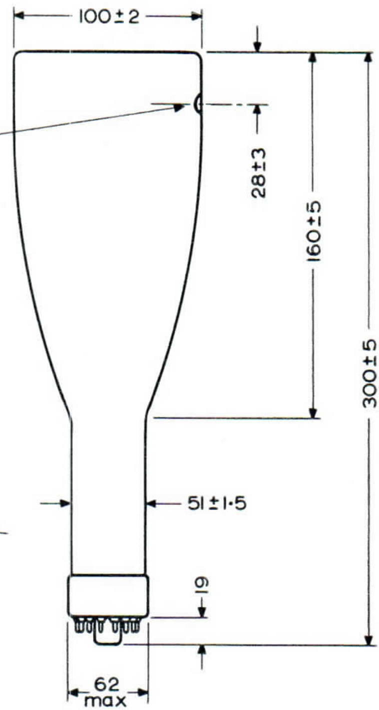
3. Due to the influence of post acceleration, a correction factor on the sensitivities is necessary. With $V_{a4}/V_{a1+a3} = 2.36$ the correction factor is 0.73 for $x'-x''$ and 0.84 for $y'-y''$. The sensitivity with post acceleration therefore becomes:

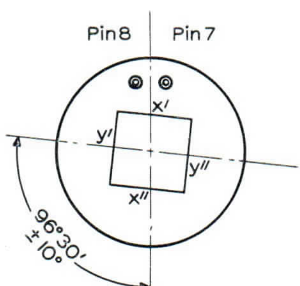
   $x'-x'' = 0.73 \times 0.485 = 0.354\text{mm/V}$
   $y'-y'' = 0.84 \times 1.15 = 0.966\text{mm/V}$

   Thus at $V_{a4} = 2.6\text{kV}$ and $V_{a1+a3} = 1.1\text{kV}$ the following values can be found with reference to pages C1 and C2:

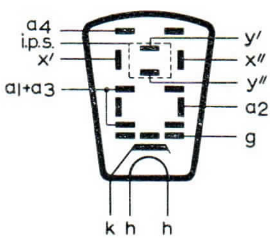
The useful scan	$x'-x'' = 90\text{mm}$
	$y'-y'' = 63\text{mm}$
The sensitivity	$x'-x'' = 0.354\text{mm/V}$
	$y'-y'' = 0.966\text{mm/V}$

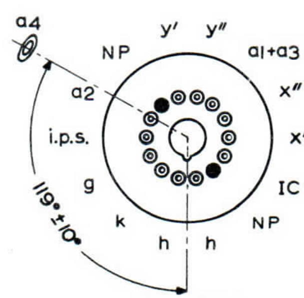
DB 10-78
DH10-78
DP 10-78





Orientation of axes of deflection as viewed from screen end.



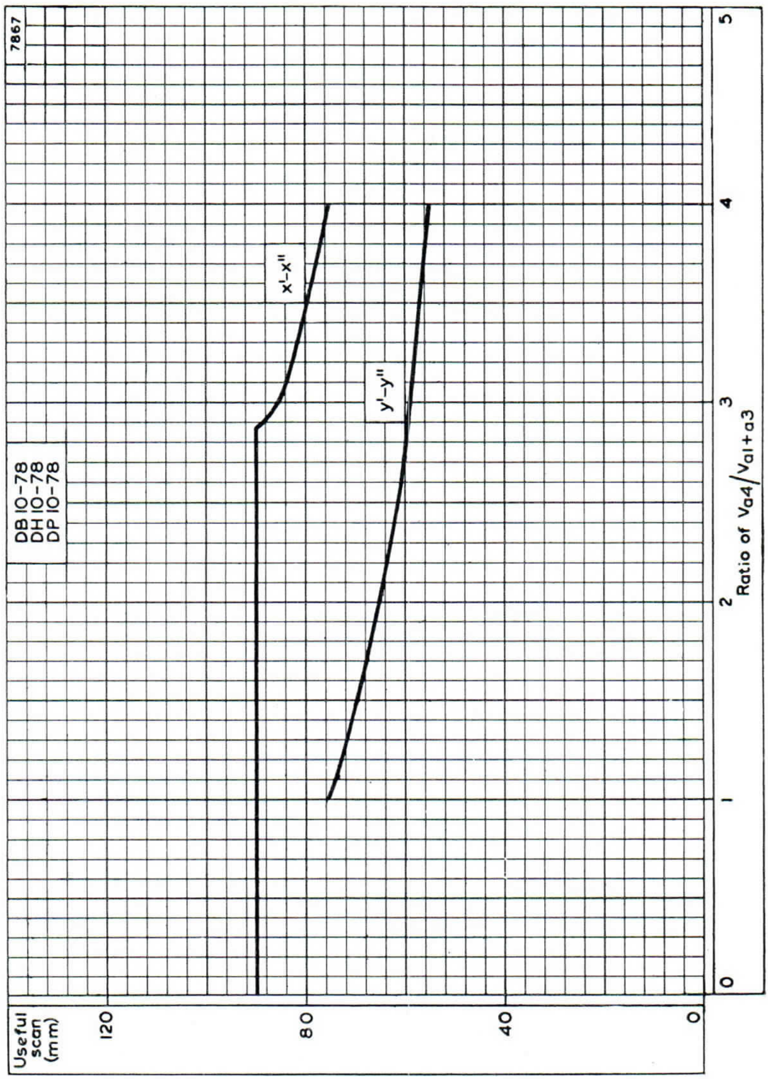


B14A Base

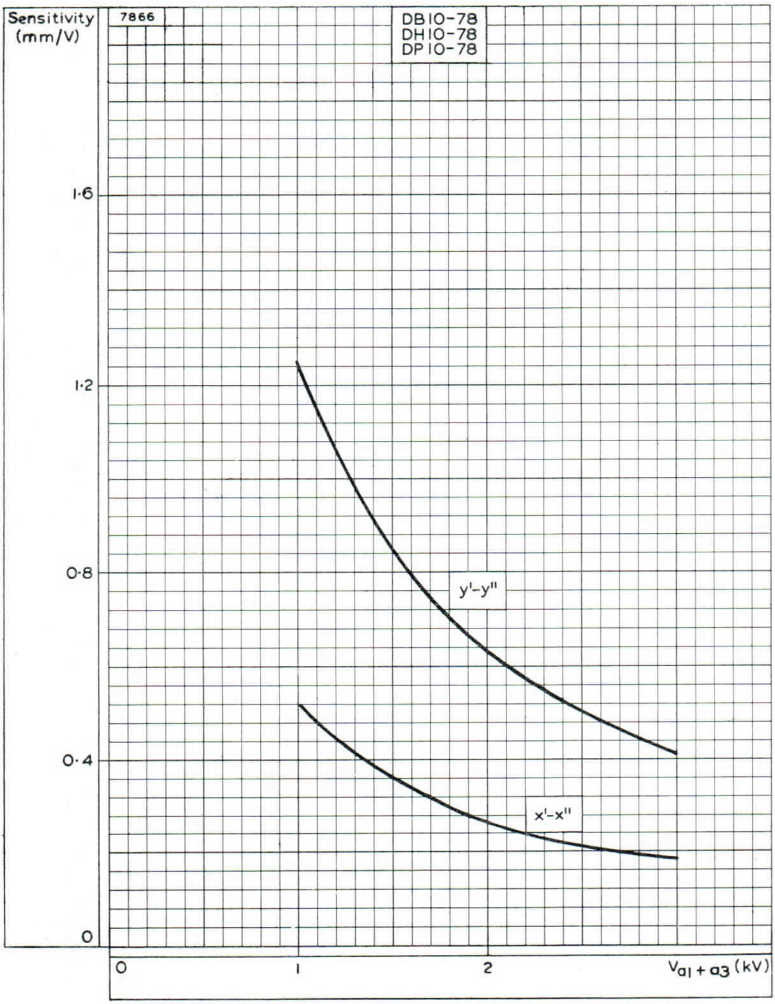
All dimensions in mm

7847

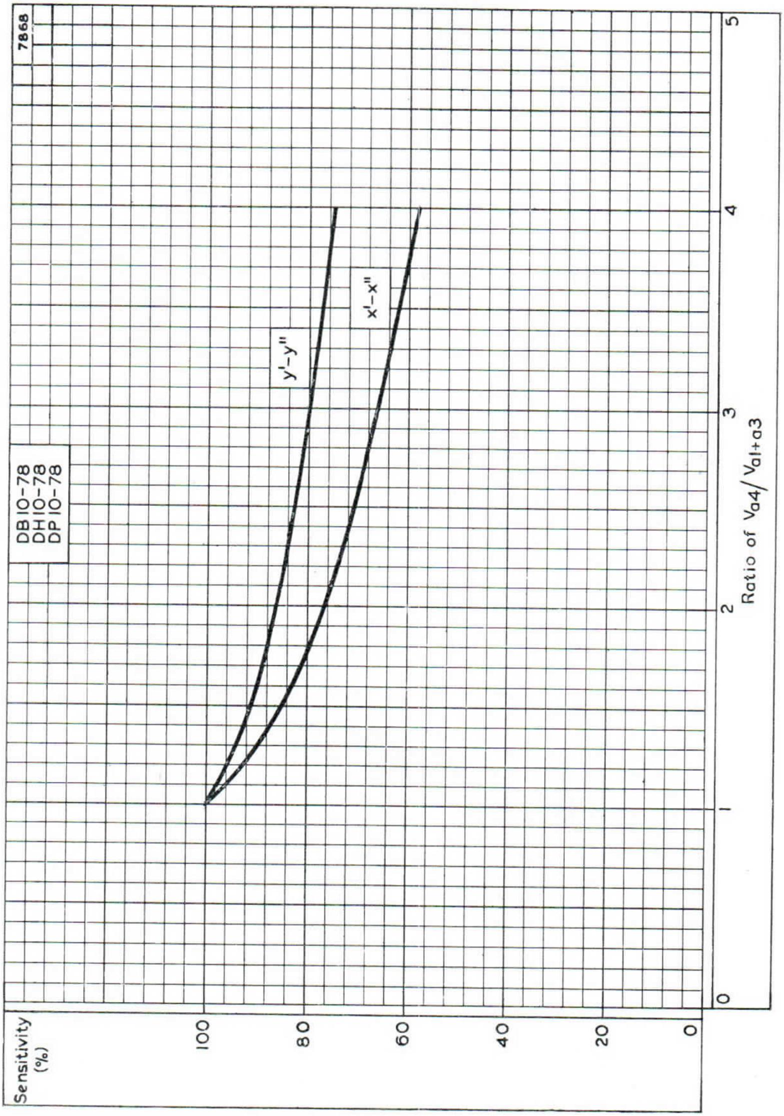
DB 10-78
DH10-78
DP 10-78



USEFUL SCAN PLOTTED AGAINST RATIO OF V_{a4} to V_{a1+a3}



SENSITIVITY PLOTTED AGAINST FIRST AND THIRD ANODE VOLTAGE



RELATIVE SENSITIVITY PLOTTED AGAINST RATIO OF V_{a4} to V_{a1+a3}

OSCILLOSCOPE TUBE

DG7-36

Direct viewing high sensitivity oscilloscope tube with 3-in. flat face screen.

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

HEATER

Suitable for parallel operation only

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{g-all}	5.7 ± 1.0	pF
c_{k-all}	3.3 ± 0.8	pF
$c_{x'-all}$ (x'' earthed)	6.0 ± 1.0	pF
$c_{x''-all}$ (x' earthed)	6.0 ± 1.0	pF
$c_{y'-all}$ (y'' earthed)	4.7 ± 1.0	pF
$c_{y''-all}$ (y' earthed)	4.7 ± 1.0	pF
$c_{x'-x''}$	1.9 ± 0.5	pF
$c_{y'-y''}$	1.7 ± 0.5	pF

SCREEN

Fluorescent colour	green	
Persistence	medium	
Minimum useful scan from the centre of the tube face ($y'-y''$)	± 28.5	mm
Minimum useful scan from the centre of the tube face ($x'-x''$)	± 34	mm

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic
Both x and y plates are for symmetrical operation.
For optimum focus the average potentials of the deflection plates and $a_1 + a_3$ should be equal.

Pattern distortion

The length of the edges of a raster whose mean dimensions are less than 75% of the useful scan will not deviate from these mean dimensions by more than 2.5%.

Deviation of linearity of deflection

The sensitivity (for both $x'-x''$ and $y'-y''$ plate pairs separately) for deflection of less than 75% of the uesful scan will not differ from the sensitivity of a deflection of 25% of the useful scan by more than $\pm 2\%$.

Angle between x and y deflection $90° \pm 1\ 0°$

MOUNTING POSITION Any

This tube should not be supported by the base alone. The socket should under no circumstances be used to support the tube.

DG7-36

OSCILLOSCOPE TUBE

TYPICAL OPERATING CONDITIONS

V_{a1+a3}	1.5	kV
V_{a2}	247 to 397	V
*V_g	−40 to −80	V
I_{a2}	−15 to +10	μA
S_x	0.37	mm/V
S_y	0.54	mm/V
**Line width	0.4	mm

*In no circumstances must the d.c. value of the grid bias be allowed to become positive with respect to the cathode.

**Measured on a circle of 50mm diameter with $I_t = 0.5\mu A$.

DEFLECTION SENSITIVITY

S_x	$\dfrac{495 \text{ to } 615}{V_{a1+a3}}$	mm/V
S_y	$\dfrac{735 \text{ to } 885}{V_{a1+a3}}$	mm/V

EQUIPMENT DESIGN RANGE

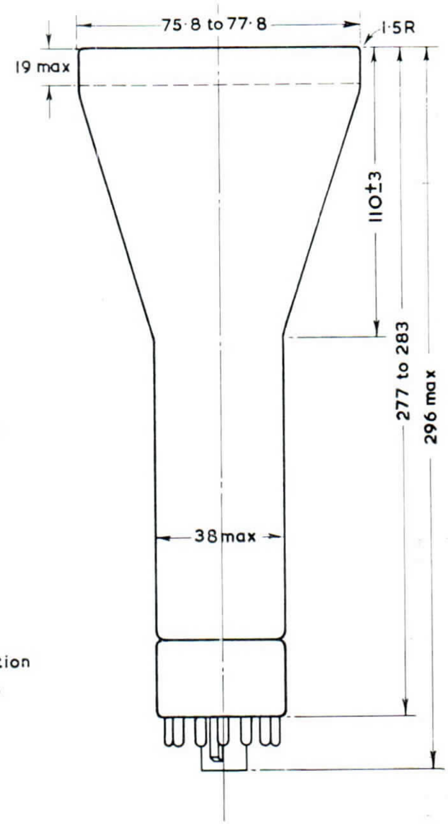
Focusing voltage (V_{a2})	165 to 265V per kV of final anode voltage
Grid cut-off voltage (V_g)	−27 to −53V per kV of final anode voltage
Deflection factor ($_{y'-y''}$)	11.2 to 13.7V/cm per kV of final anode voltage
Deflection factor ($_{x'-x''}$)	16.2 to 20V/cm per kV of final anode voltage

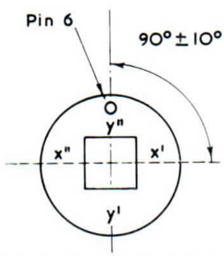
LIMITING VALUES (design centre ratings)

V_{a1+a3} max.	2.5	kV
V_{a1+a3} min.	1.0	kV
p_{a1+a3} max.	6.0	W
V_{a2} max.	1.0	kV
$-V_g$ max.	200	V
$v_{g(pk)}$ max.	2.0	V
$p_{t(av)}$ max.	3.0	mW/cm^2
†$R_{x-a1+a3}$ max.	5.0	MΩ
†$R_{y-a1+a3}$ max.	5.0	MΩ
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	180	V
$v_{a1+a3-x(pk)}$ each plate	500	V
$v_{a1+a3-y(pk)}$ each plate	500	V

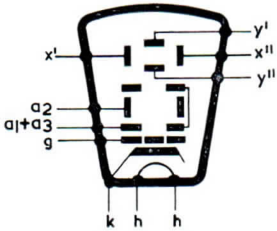
†It is recommended that the deflector plate resistances should be approximately equal.

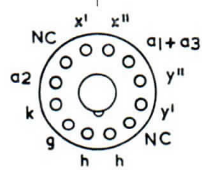
3166





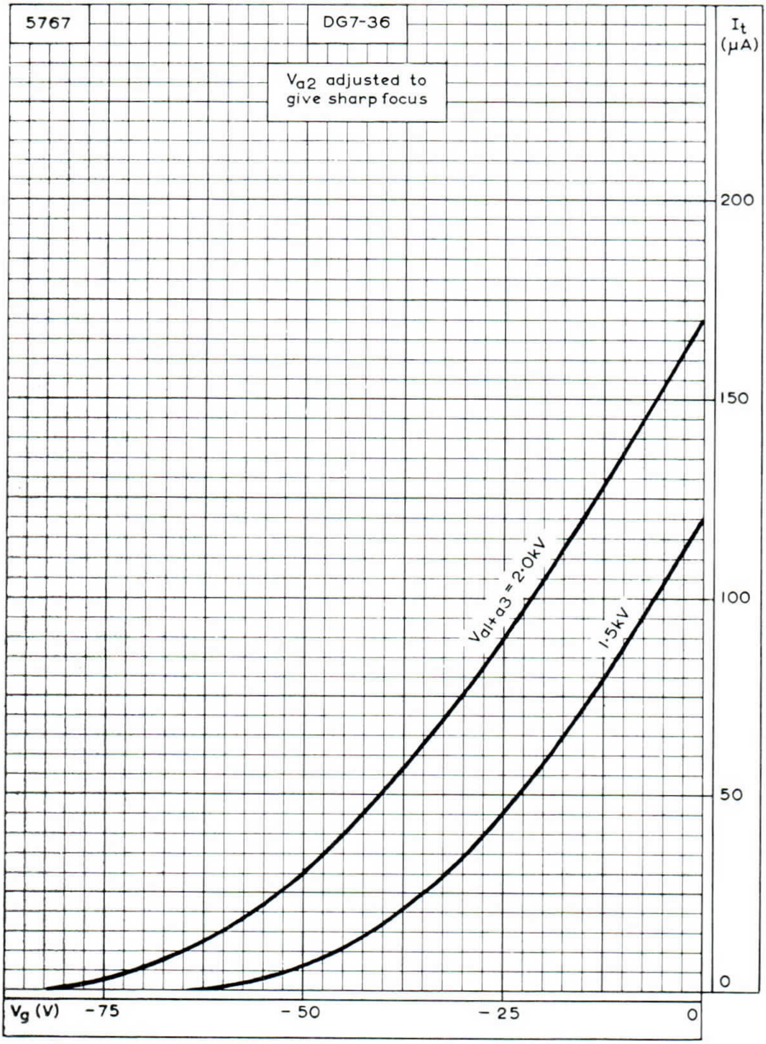
Orientation of axes of deflection as viewed from screen end.



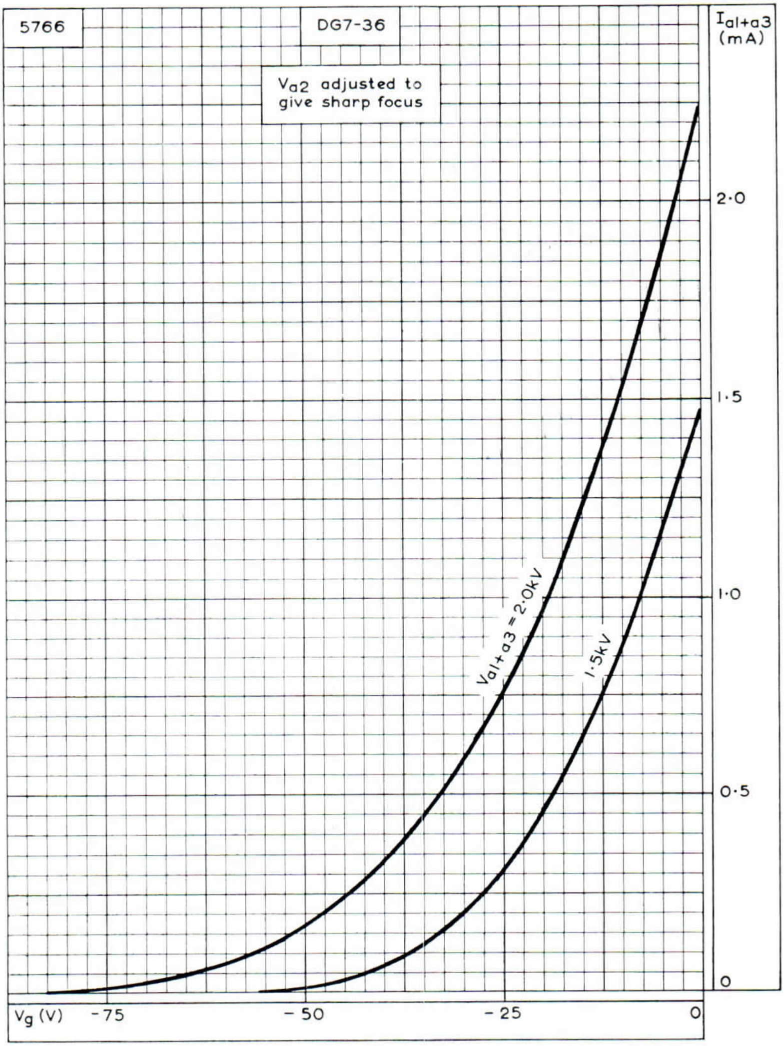


B12A Base

All dimensions in mm



SCREEN CURRENT PLOTTED AGAINST GRID VOLTAGE



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

OSCILLOSCOPE TUBE

DG13-34

Direct-viewing oscilloscope tube with 5-in. flat face screen. This tube is fitted with a post-deflection accelerator.

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 only

V_h	6.3	V
I_h	600	mA

CAPACITANCES

c_{g-all}	<7.9	pF
c_{k-all}	<5.8	pF
$c_{x'-all(x''earthed)}$	<6.1	pF
$c_{x''-all(x'earthed)}$	<6.1	pF
$c_{y'-all(y''earthed)}$	<5.0	pF
$c_{y''-all(y'earthed)}$	<5.0	pF
$c_{x'-x''}$	<3.1	pF
$c_{y'-y''}$	1.3	pF

SCREEN

Fluorescent colour	green	
Persistence	medium	
Minimum useful scan from the centre of the tube face	($y'-y''$) ±54	mm
Minimum useful scan from the centre of the tube face	($x'-x''$) ±54	mm

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

Both x and y plates are intended for symmetrical deflection.
For optimum focus the average potentials of the deflection plates and a_1+a_3 should be equal.

Deviation of linearity of deflection

The sensitivity (for both $x'-x''$ and $y'-y''$ plate pairs separately) for a deflection of less than 75% of the useful scan will not differ from the sensitivity for a deflection of 25% of the useful scan by more than 2%.

Pattern distortion

With a raster pattern the size of which is adjusted so that the widest points of the pattern just touch the sides of a square 3.075 in. on a side, no point on these pattern sides will lie within an inscribed square 2.925 in. on a side.

Angle between x and y deflection — 90°±1°

MOUNTING POSITION — Any

This tube should not be supported by the base alone.
The socket should under no circumstances be used to support the tube.

DG13-34

OSCILLOSCOPE TUBE

OPERATING CONDITIONS

V_{a4}	3.0	kV
V_{a1+a3}	1.5	kV
$**V_{a2}$	345 to 515	V
$*V_g$	–34 to –56	V
I_{a2}	–15 to +10	μA
S_x	0.57	mm/V
S_y	0.76	mm/V

*In no circumstances must the d.c. value of the grid bias be allowed to become positive with respect to the cathode.

**At 75% of V_g cut-off value.

DEFLECTION SENSITIVITY LIMITS

	Without acceleration ($V_{a4} = V_{a1+a3}$)	*With acceleration* ($V_{a4} = 2V_{a1+a3}$)	
S_x	$\frac{965 \text{ to } 1170}{V_{a1+a3}}$	$\frac{765 \text{ to } 950}{V_{a1+a3}}$	mm/V
S_y	$\frac{1245 \text{ to } 1560}{V_{a1+a3}}$	$\frac{1020 \text{ to } 1260}{V_{a1+a3}}$	mm/V

EQUIPMENT DESIGN RANGE

Focus voltage (V_{a2})	200 to 345V per kV of accelerator voltage (V_{a1+a3})
Grid cut-off voltage	–22.7 to –37.5V per kV of accelerator voltage (V_{a1+a3})
*Deflection factor (y′ –y″)	6.4 to 7.9V/cm per kV of accelerator voltage (V_{a1+a3})
*Deflection factor (x′ –x″)	8.5 to 10.4V/cm per kV of accelerator voltage (V_{a1+a3})

$*V_{a4} = V_{a1+a3}$

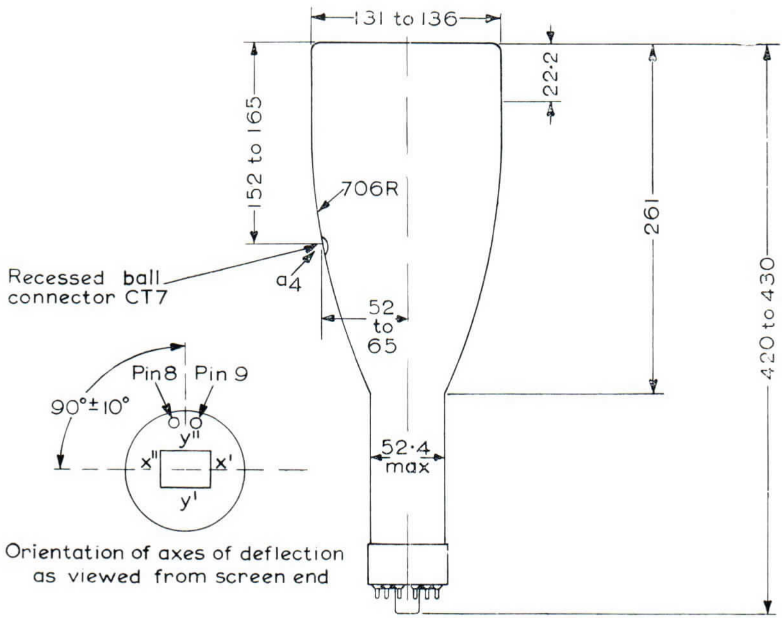
LIMITING VALUES (absolute ratings)

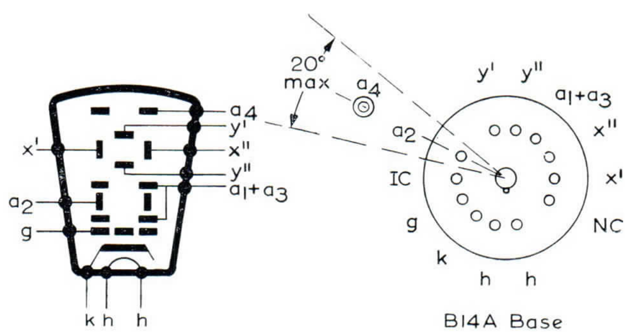
V_{a4} max.	6.6	kV
V_{a4} min.	1.5	kV
V_{a1+a3} max.	2.85	kV
V_{a1+a3} min.	1.5	kV
V_{a2} max.	1.1	kV
$-V_g$ max.	200	V
$v_{x'-x''(pk)}$ max.	550	V
$v_{y'-y''(pk)}$ max.	550	V
R_{x-a3} max.	5.0	MΩ
R_{y-a3} max.	5.0	MΩ
R_{g-k} max.	1.5	MΩ
V_{h-k} max. (cathode positive)	180	V
Max. ratio of V_{a4}/V_{a1+a3}	2.3	

WEIGHT

840	g
1lb	14oz

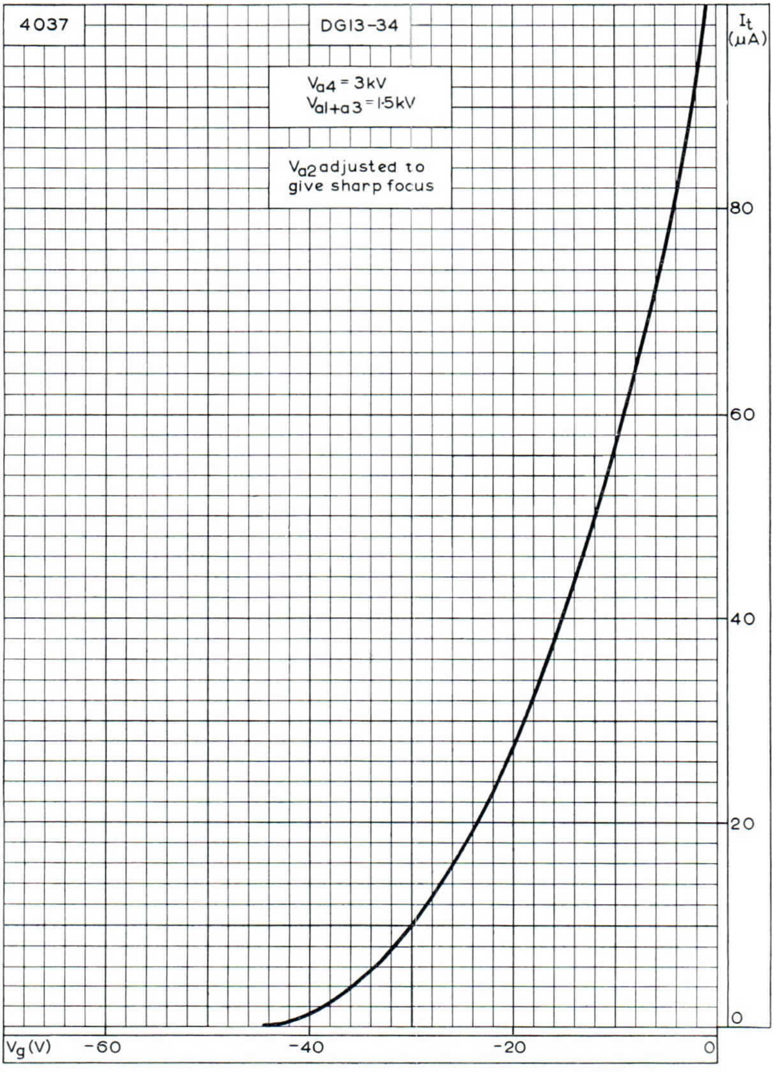
DG13-34





4075

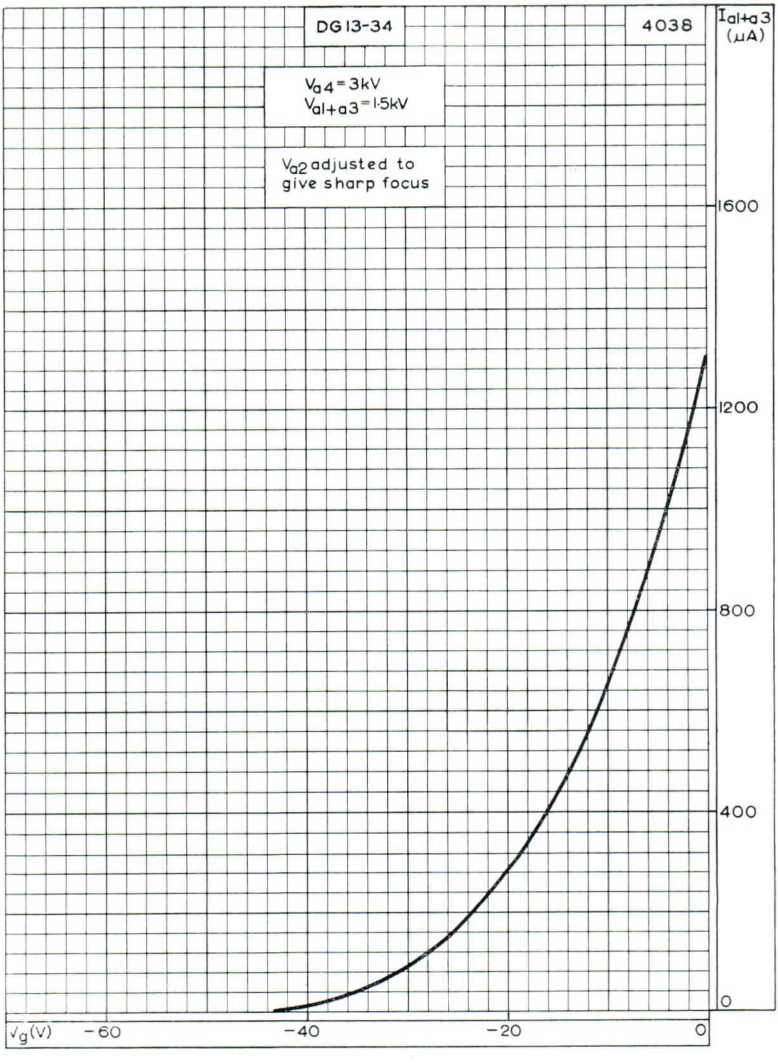
All dimensions in mm



SCREEN CURRENT PLOTTED AGAINST GRID VOLTAGE

DG13-34

OSCILLOSCOPE TUBE



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

OSCILLOSCOPE TUBE

DH13-78
DN13-78

Direct viewing oscilloscope tube with 5in. flat face metal-backed screen, helical post-deflection accelerator, and side connections to the x and y plates. Intended for applications where high sensitivity, high writing speed and low pattern distortion are required.

The only difference between the DH13-78 and DN13-78 is in the screen properties (see appropriate section of data)

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 only, a.c. or d.c.

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{g-all}	6.7	pF←
c_{k-all}	3.9	pF←
$c_{y'-all}$ (y″ earthed)	2.8	pF
$c_{y''-all}$ (y′ earthed)	2.8	pF
$c_{x'-all}$ (x″ earthed)	3.0	pF
$c_{x''-all}$ (x′ earthed)	3.0	pF
$c_{y'-y''}$	1.5	pF
$c_{x'-x''}$	2.0	pF

SCREEN

	H	N	
Fluorescent colour	blue-green	green	
Persistence	medium	medium	
Minimum useful screen diameter	10.8	10.8	cm
Minimum useful scan from the centre of the tube face			
x′–x″		±5.0	cm
y′–y″		±2.0	cm

The midpoint of the useful scan will be within 3mm of the geometric centre of the faceplate with $V_{a4} = 6V_{a1+a3}$.

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic.
Both x and y plates are intended for symmetrical deflection

Deviation of linearity of deflection

The sensitivity (for both x′–x″ and y′–y″ plate pairs separately) for a deflection of less than 75% of the useful scan will not differ from the sensitivity for a deflection of 25% by more than 2%.

Raster distortion

With a raster pattern the size of which is adjusted so that the widest points of the raster just touch the sides of a rectangle 40mm × 100mm, no point on these raster sides will lie within a rectangle 38.8mm × 97mm, the rectangles being placed concentrically, i.e. maximum total raster distortion is ±1.5%.

Angle between x and y deflection $90° \pm 1°$

Inter-plate shield (i.p.s.)

In general the voltage on i.p.s. and the average voltage on the deflection plates should be equal. Adjustment of $V_{i.p.s.}$ up to a maximum of $\pm 10\%$ of the $a_1 + a_3$ potential serves to correct pincushion and barrel raster distortion. This screen is also internally connected to the lower end of the helical post-deflection accelerator.

Deflection-plate shield (d.p.s.)

In general the voltages on d.p.s. and $a_1 + a_3$ and the average voltage on the deflection plates should be equal. Variation of $V_{d.p.s.}$ up to a maximum of $\pm 5\%$ of $a_1 + a_3$ potential serves to correct pincushion and barrel raster distortion.

Deflection plates x′–x″ and y′–y″

In general the average voltage on the deflection plates and the voltage on $a_1 + a_3$ should be equal. To provide some measure of astigmatic control it may be desirable to apply a small potential difference between the y plates and $a_1 + a_3$. ←
A low impedance deflection voltage source is desirable, as if the tube is fully deflected the deflection plates will intercept part of the electron beam near the edge of scan.

Spot position

With the tube shielded the undeflected spot will lie within a radius of 5mm from the geometric centre of the tube face.

HELICAL RESISTANCE

Minimum post-deflection acceleration helix resistance 300 MΩ

MOUNTING POSITION

Any

This tube should not be supported by the base alone. The socket should under no circumstances be used to support the tube.

OPERATING CONDITIONS

V_{a4}	10	12	kV
$V_{i.p.s.}$	1.67	2.0	kV
$V_{d.p.s.}$	1.67	2.0	kV
V_{a1+a3}	1.67	2.0	kV
V_{a2}	180 to 590	220 to 710	V
V_g for visual cut-off	−50 to −80	−60 to −96	V
S_x	0.3 to 0.36	0.25 to 0.3	mm/V
S_y	1.32 to 1.78	1.08 to 1.47	mm/V

LINE WIDTH

V_{a4}	10	kV
V_{a1+a3}	1.67	kV
I_{a4}	500	nA
*Line width	0.4	mm

*Measured on a circle of 30mm diameter.

DEFLECTION SENSITIVITY LIMITS

($V_{a4}=6V_{a1+a3}$)

S_x	$\frac{50 \text{ to } 60}{V_{a1+a3}}$	cm/V
S_y	$\frac{216 \text{ to } 294}{V_{a1+a3}}$	cm/V

EQUIPMENT DESIGN RANGE

Focusing voltage (V_{a2})	110 to 355V per kV of accelerator voltage (V_{a1+a3})
Grid cut-off voltage (V_g)	–30 to –48V per kV of accelerator voltage (V_{a1+a3})
Deflection factor	
y′–y″ ($V_{a4}=6V_{a1+a3}$)	3.4 to 4.6V/cm per kV of accelerator voltage (V_{a1+a3})
x′–x″ ($V_{a4}=6V_{a1+a3}$)	16.7 to 20V/cm per kV of accelerator voltage (V_{a1+a3})
Focus electrode current (I_{a2})	–15 to +10μA
Grid circuit resistance (R_g max.)	1.5MΩ ←

LIMITING VALUES (design centre ratings)

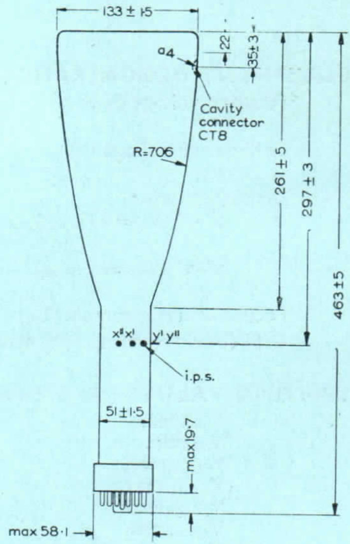
V_{a4} max.	12	kV
V_{a4} min.	6.0	kV
$V_{d.p.s.}$ max.	2.1	kV ←
$V_{i.p.s.}$ max.	2.2	kV ←
V_{a1+a3} max.	2.1	kV ←
V_{a1+a3} min.	1.0	kV ←
Max. ratio of V_{a4}/V_{a1+a3}	6.0	
V_{a2} max.	1.5	kV
$-V_g$ max.	200	V
$+V_g$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$v_{x-a1+a3(pk)}$ max.	500	V
$v_{y-a1+a3(pk)}$ max.	500	V
p_{a1+a3} max.	6.0	W
$p_{t(av)}$ max.	3.0	mW/cm²
V_{h-k} max. (cathode negative)	125	V
V_{h-k} max. (cathode positive)	200	V

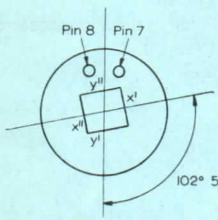
WEIGHT

Tube alone	910	g
	32	oz

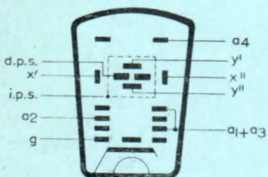
DH13-78
DN13-78

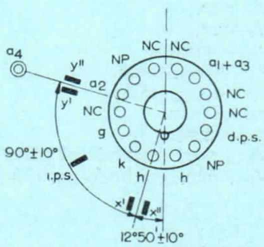
OSCILLOSCOPE TUBE





Orientation of axes of deflection as viewed from screen end





B14A Base

All dimensions in mm

8011

TELEVISION
MONITOR TUBE

M21-10W

(Formerly AW21-10)

PRELIMINARY DATA

QUICK REFERENCE DATA

$8\frac{1}{2}$ in rectangular television tube with metal-backed, grey glass screen primarily intended for use as a precision monitor.

Deflection angle	90°
Focusing	electrostatic
Resolution	>650 lines
Maximum overall length	247 mm

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

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.

SCREEN

Metal backed	
Fluorescent colour	white
Maximum useful screen area	see drawing on page D5

TYPICAL OPERATING CONDITIONS

V_{a2+a4}	14	kV
*V_{a3}	0 to 400	V
V_{a1}	600	V
V_g (for visual extinction of focused spot)	−35 to −67	V

*With the small change in focus spot size with variation of focus voltage, the limit of 0 to 400V 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 −100V to +500V will be required.

M21-10W

TELEVISION MONITOR TUBE

(Formerly AW21-10)

RESOLUTION

Resolution over whole of screen	$>$ 650	lines
With V_{a2+a4}	14	kV
V_{a1}	600	V

This tube will resolve 650 lines measured at a brightness of 343 nits (100 ft.-lamberts). The focus voltage is adjusted to obtain the smallest roundest spot. For optimum overall resolution an external centring magnet may be required.

CAPACITANCES

c_{g-all}	6.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	250 to 350	pF

FOCUSING

Electrostatic

The range of focus voltage shown in typical operating conditions results in optimum focus at a beam current of 100μA.

DEFLECTION

Double magnetic

REFERENCE LINE GAUGE

See page D4

MOUNTING POSITION

Any, except vertical with the screen downward and the axis of the tube making an angle less than 20° with the vertical.

TELEVISION
MONITOR TUBE

M21-10W

(Formerly AW21-10)

ABSOLUTE MAXIMUM RATINGS

‡V_{a2+a4} max.	18	kV
V_{a2+a4} min.	10	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	1.0	kV
V_{a1} min.	400	V
$-V_g$ max.	150	V
*$-V_g$ min.	0	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	5	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_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	100	kΩ
R_{h-k} max.	See note †	
Z_{k-e} max. (f = 50c/s)	500	kΩ

‡Adequate precautions should be taken to ensure that the associated equipment is protected from damage, which may be caused by a possible high voltage flashover within the cathode ray tube. (For details see Mullard Technical Communications, Volume 6, Number 51.)

*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.

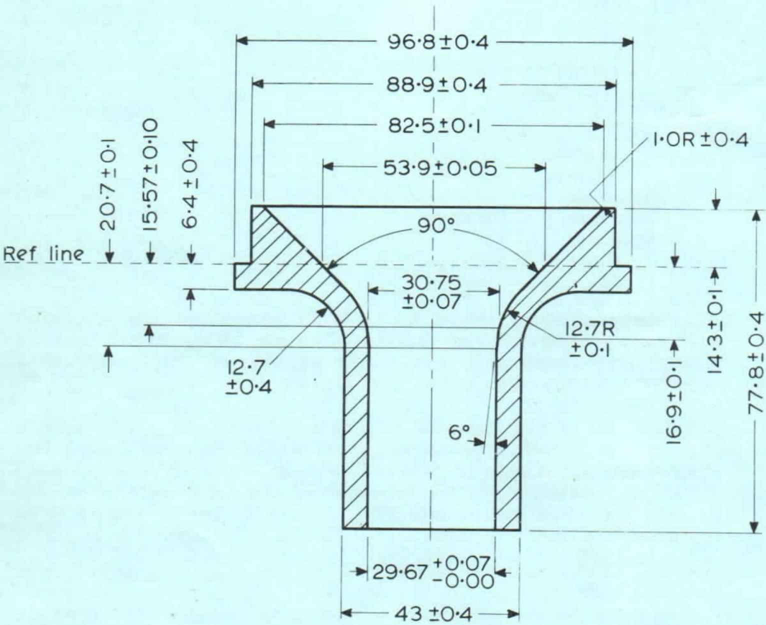
†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($< 20V_{r.m.s.}$).
During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.
When the heater is in a series chain, or earthed, Z_k max. is 100kΩ, where Z_k is the 50c/s impedance between earth and cathode. When the heater is supplied from a separate transformer R_{h-k} is 1MΩ.

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.

WEIGHT

Tube alone approx. $\begin{cases}\text{2 lb 12 oz} \\ \text{1.25 kg}\end{cases}$



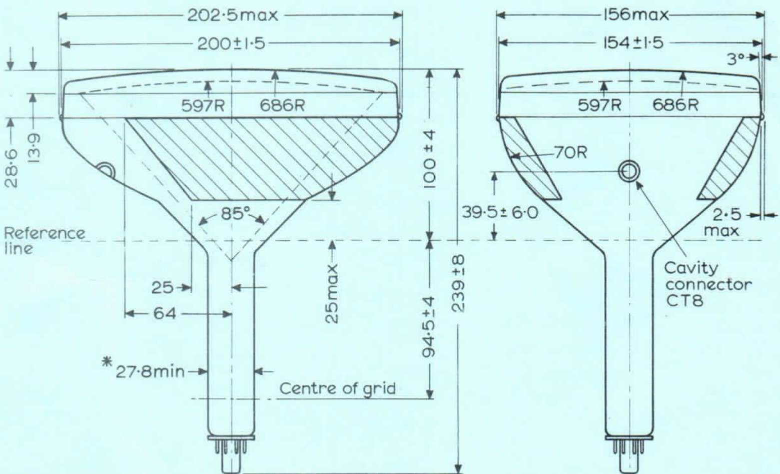
All dimensions in mm

8343

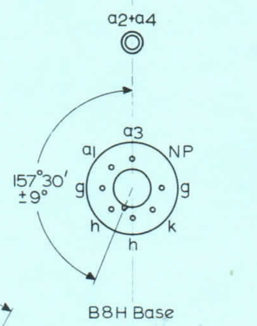
REFERENCE LINE GAUGE

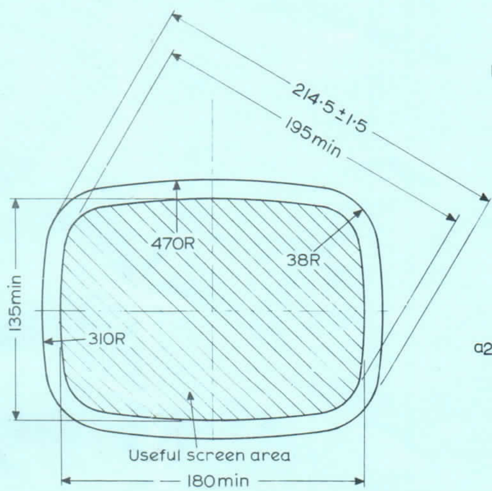
M21-10W

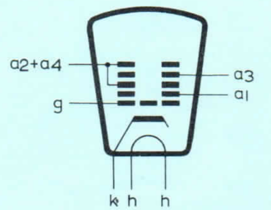
(Formerly AW21-10)



*The maximum dimension is determined by the reference line gauge.







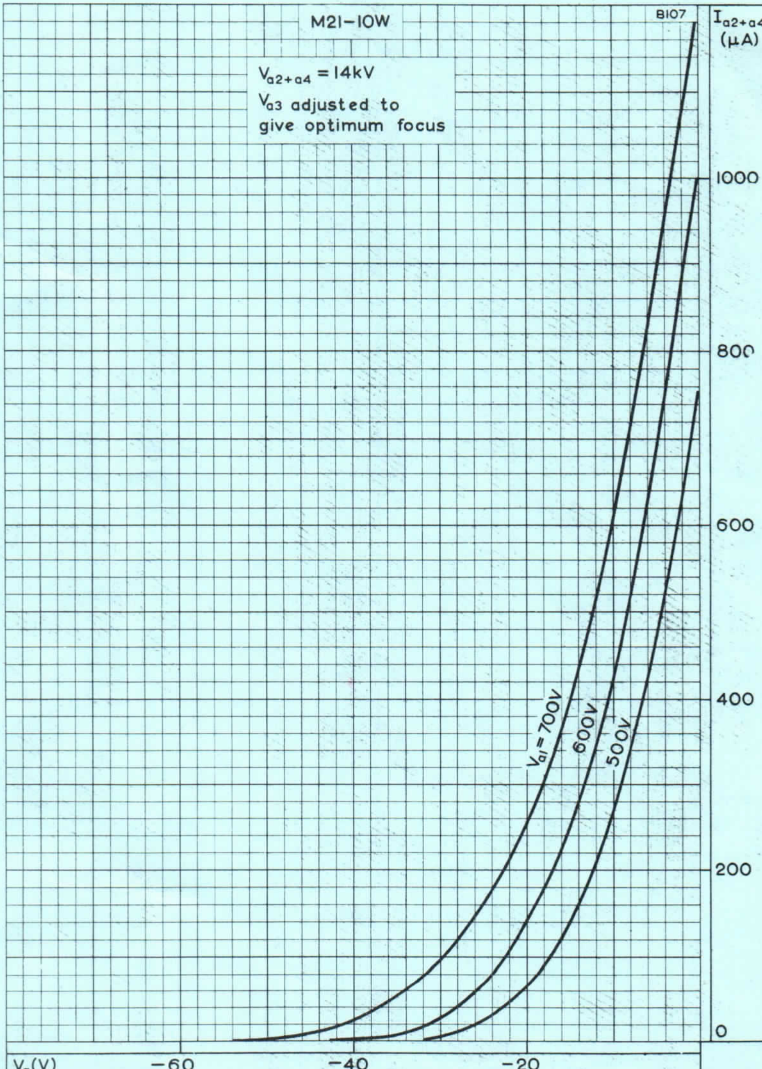
All dimensions in mm

8927

TELEVISION
MONITOR TUBE

M21-10W

(Formerly AW21-10)

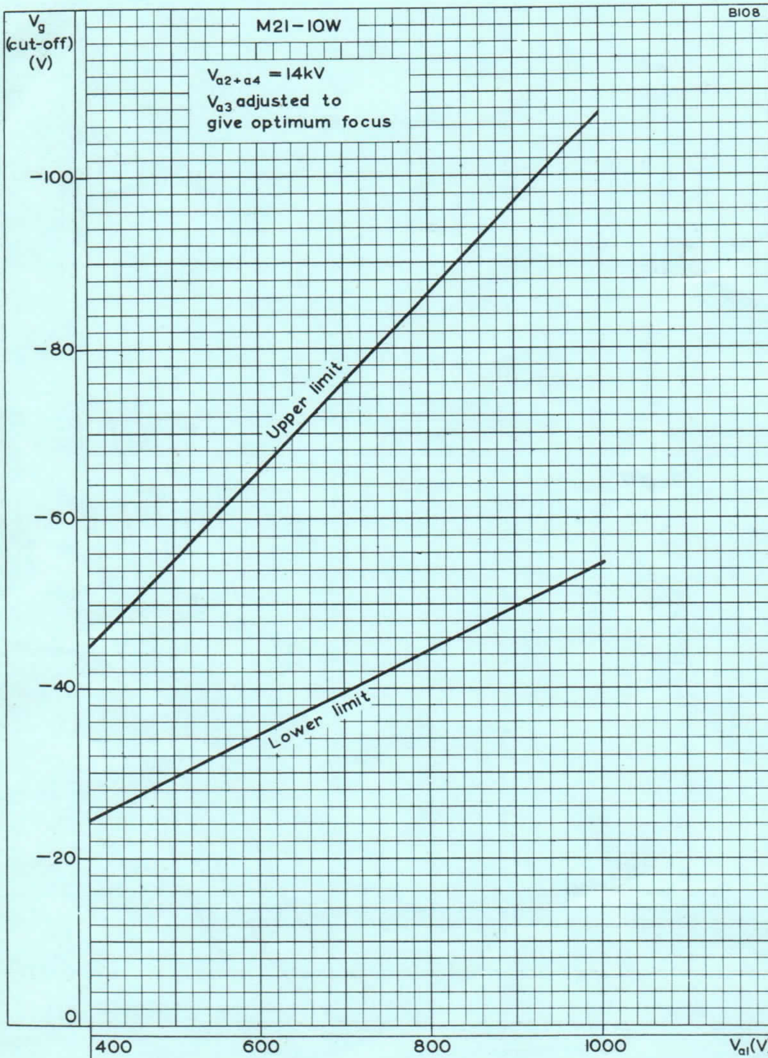


FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
GRID MODULATION

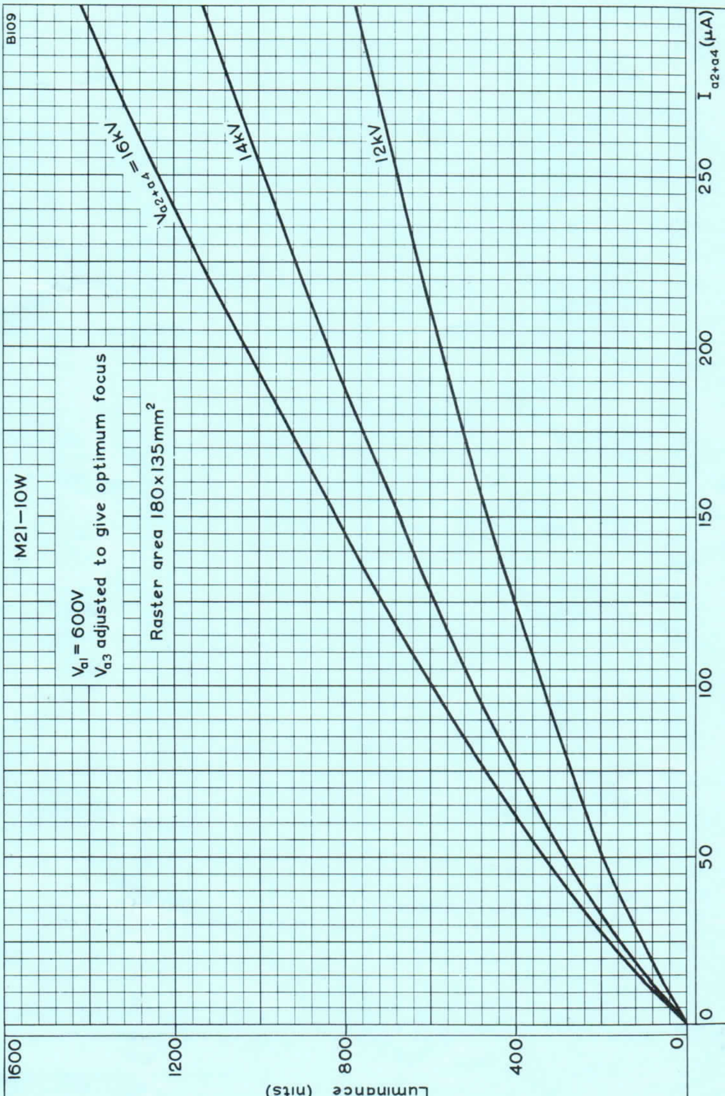
M21-10W

TELEVISION MONITOR TUBE

(Formerly AW21-10)



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



LIGHT OUTPUT PLOTTED AGAINST FINAL ANODE CURRENT
(1 nit = 0.292 foot-lamberts = 0.292 e.f.c.)

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+a_2-all}	<11	pF
c_{a_3-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.

MW43-69Z

TELEVISION TUBE

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.

TYPICAL OPERATING CONDITIONS

V_{a3}	14	kV
V_{a2}	0	V
V_{a1}	300	V
*V_g for cut-off	–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} 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_{a3} and I_t (average value for the whole screen) must not exceed 6W.

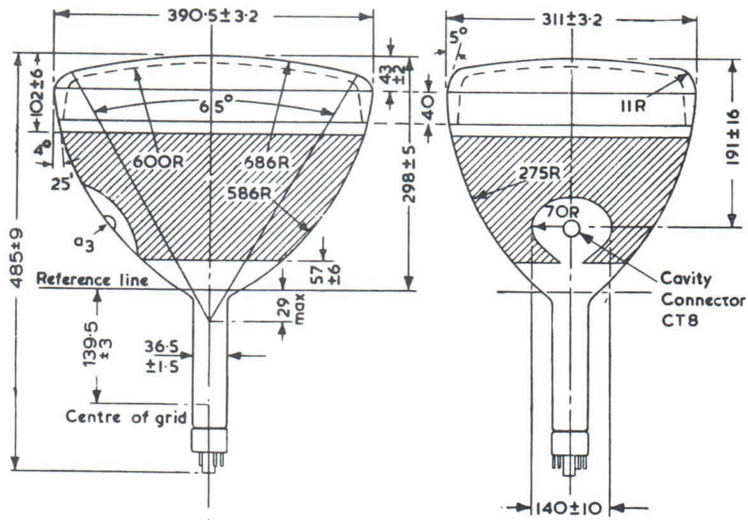
†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

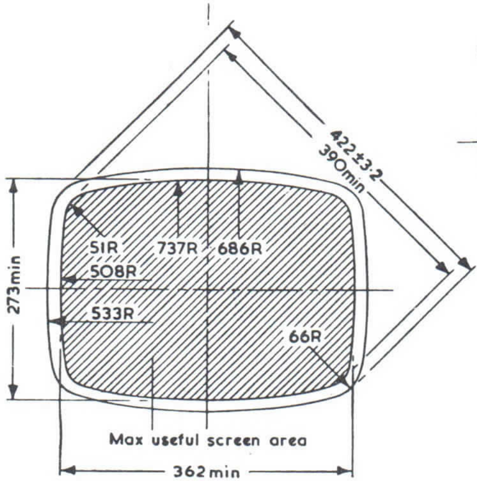
††During a warming-up period not exceeding 45 sec.

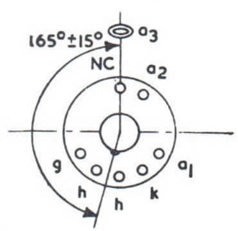
§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50Hz impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max is 1.0MΩ.

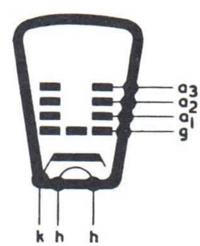
WEIGHT Tube alone 7.5 kg / 17 lb

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-e} 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.

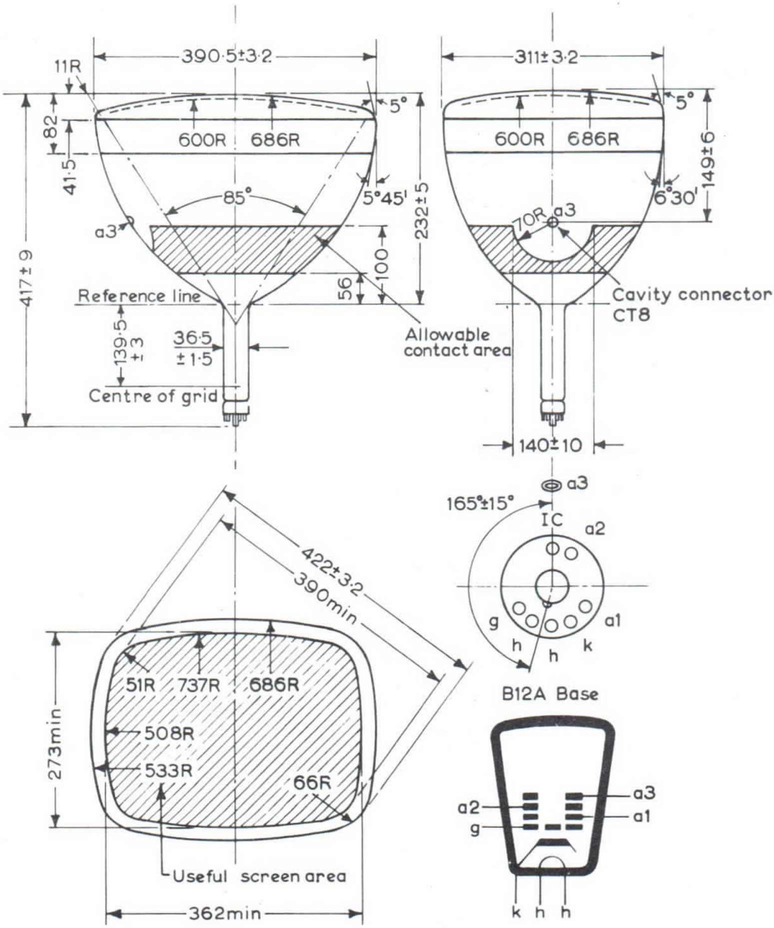
†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).
During a warming-up period not exceeding 45s $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WEIGHT

Tube alone	6.4	kg
	14	lb

MW43-80Z

TELEVISION TUBE



All dimensions in mm

TELEVISION TUBE

MW53-20

Direct viewing television tube with 21-in. diagonal rectangular metal-backed grey glass screen and having a 70° deflection angle. This tube incorporates an ion-trap and the electron gun is designed to give uniform focus over the whole screen.

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.

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	5.0	pF
c_{k+a_2-all}	9.0	pF
c_{a_3-M}	1500	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

Ion trap magnet field intensity	63 to 78	G

The space between a point 112mm from the reference line along the neck of the tube and the edge of the base should be kept clear for the ion trap magnet. The direction of the field of the ion trap magnet should be such that the south pole is adjacent to the spigot. The procedure for adjusting the ion trap magnet is given in the 'General operational recommendations—cathode ray tubes' preceding this section of the handbook.

The ion trap magnet assembly should be earthed.

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.

MW53-20

TELEVISION TUBE

Direct viewing television tube with 21-in. diagonal rectangular metal-backed grey glass screen and having a 70° deflection angle. This tube incorporates an ion-trap and the electron gun is designed to give uniform focus over the whole screen.

PREFOCUSING

The spot size and uniformity of focus depends 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 edge of the screen.
With increased V_{a2}, the power of the external focusing magnet has to be increased.

TYPICAL OPERATING CONDITIONS

V_{a3}	16	kV
V_{a2}	0	V
V_{a1}	300	V
*V_g (for cut-off)	−40 to −80	V

LIMITING VALUES (Design centre ratings)

†V_{a3} max.	18	kV
V_{a3} min.	12	kV
V_{a2} max.	500	V
V_{a2} min.	−100	V
V_{a1} max.	500	V
V_{a1} 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=50c/s)	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_{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 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 heater and cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1.0MΩ.

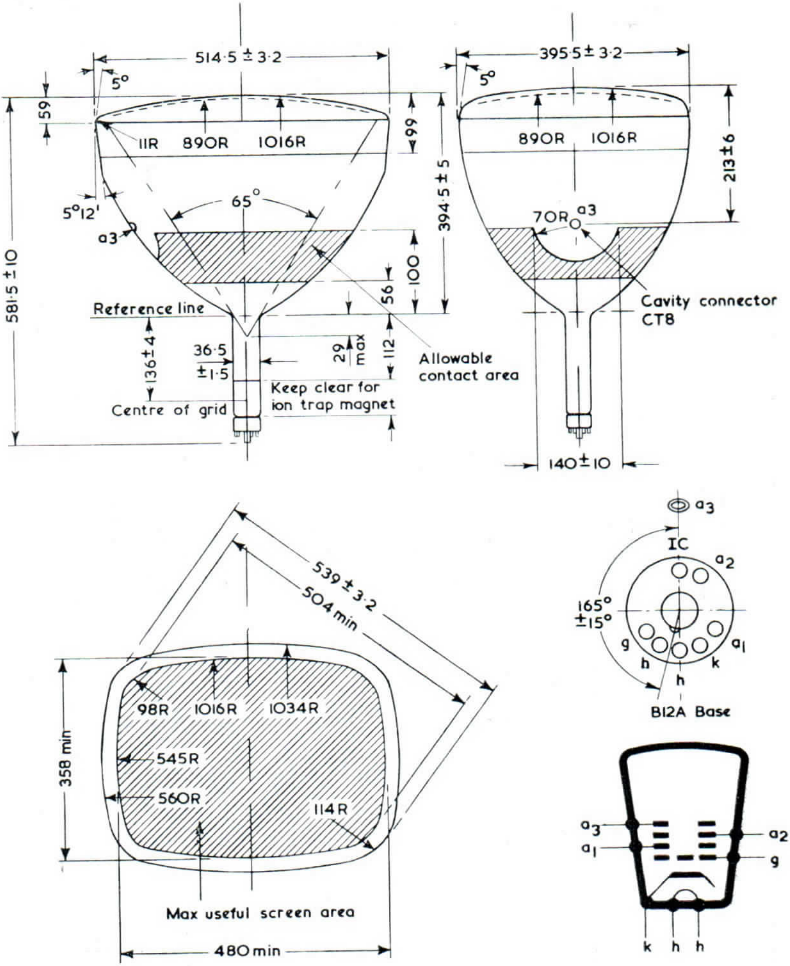
WEIGHT

Tube alone	11.8 kg 26 lb

TELEVISION TUBE

MW53-20

Direct viewing television tube with 21-in. diagonal rectangular metal-backed grey glass screen and having a 70° deflection angle. This tube incorporates an ion-trap and the electron gun is designed to give uniform focus over the whole screen.



2713

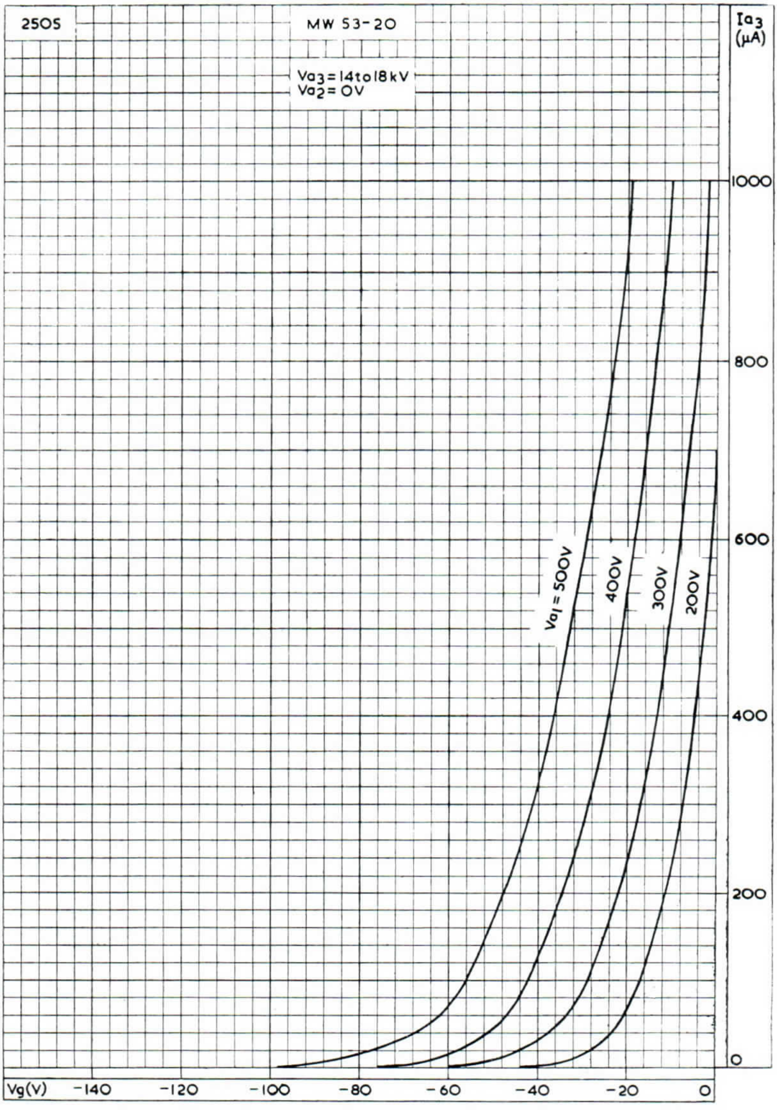
All dimensions in mm

The indicated radius of curvature of the faceplate is not an exact but an average value.

MW53-20

TELEVISION TUBE

Direct viewing television tube with 21-in. diagonal rectangular metal-backed grey glass screen and having a 70° deflection angle. This tube incorporates an ion-trap and the electron gun is designed to give uniform focus over the whole screen.



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

TELEVISION TUBE

MW53-80

Direct-viewing television tube with 21-in. diagonal rectangular metal-backed grey-glass screen having a 90° deflection angle. This tube incorporates an ion trap.

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, 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 coating.

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	4.0	pF←
$c_{k+a2-all}$	9.0	pF
c_{a3-M}	1500	pF

SCREEN

Metal backed		
Fluorescent colour	white	
Light transmission	75	%←
Useful screen area	see drawing on page D4	

FOCUSING

Magnetic

DEFLECTION

Double magnetic

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.

ION TRAP

Ion trap magnet field intensity	63 to 78	G

The space between a point 112mm from the reference line along the neck of the tube and the edge of the base should be kept clear for the ion trap magnet. The direction of the field of the ion trap magnet should be such that the south pole is adjacent to the spigot. The procedure for adjusting the ion trap magnet is given in the 'General operational recommendations—cathode ray tubes' which precede this section of the handbook.

The ion trap magnet assembly should be earthed.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'.

PREFOCUSING

The spot size and uniformity of focus depends 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 edge of the screen.

With increased V_{a2}, the power of the external focusing magnet has to be increased.

OPERATING CONDITIONS

V_{a3}	16	kV
V_{a2}	0	V
V_{a1}	300	V
*V_g for visual extinction of focused raster	−40 to −80	V

LIMITING VALUES (design centre ratings)

†V_{a3} max.	18	kV
V_{a3} min.	12	kV
V_{a2} max.	500	V
V_{a2} min.	−100	V
V_{a1} max.	500	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-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	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.

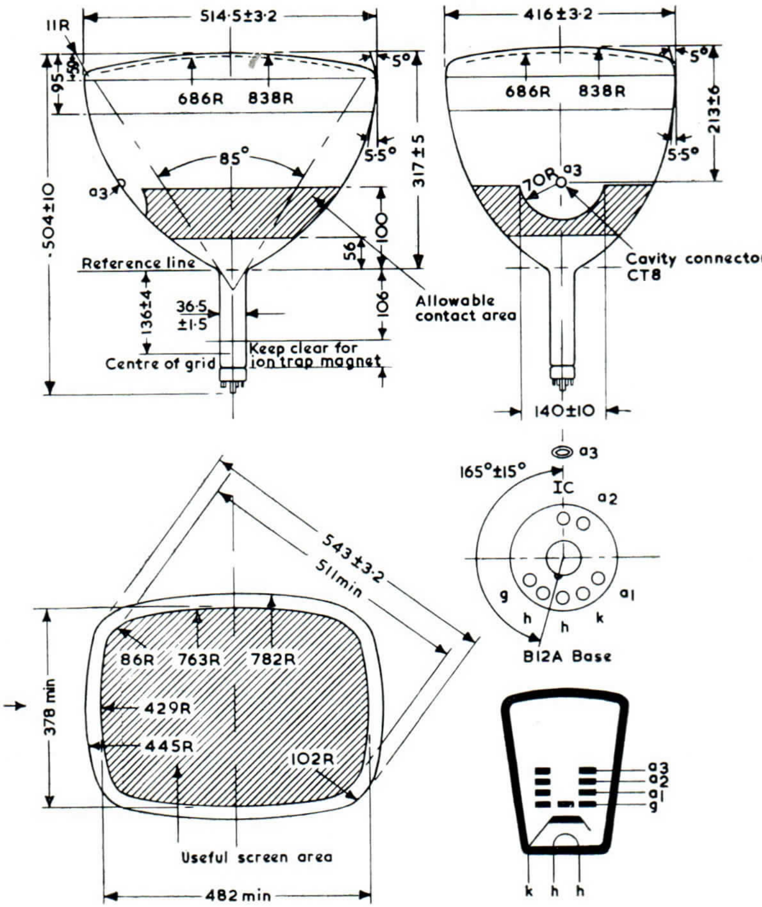
†The product of V_{a3} and I_t (average value for the whole screen) must not exceed 6.0W.

‡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	11.25	kg
	25	lb



All dimensions in mm

7884

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

AN1

TRIODE THYRATRON

Triode inert-gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

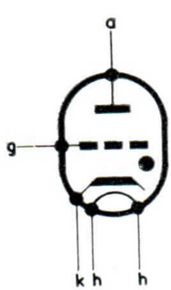
CHARACTERISTICS

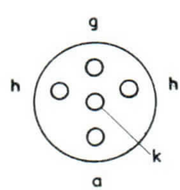
Electrical

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	

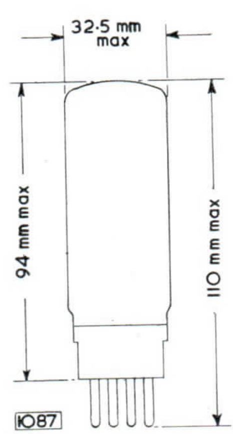
Mechanical

Type of cooling	Convection	
Mounting position	Any	
Max. net weight	1.4	oz
	40	g





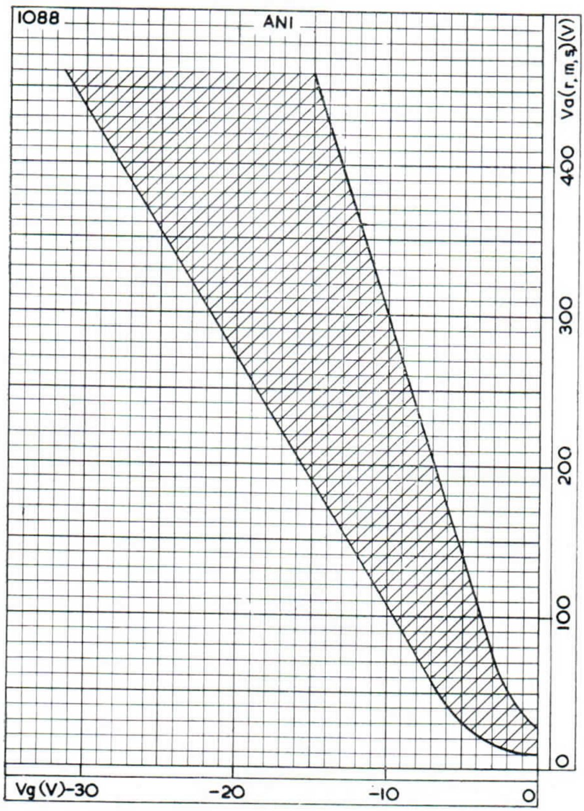
British 5-Pin Base



TRIODE THYRATRON

AN1

Triode inert-gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.

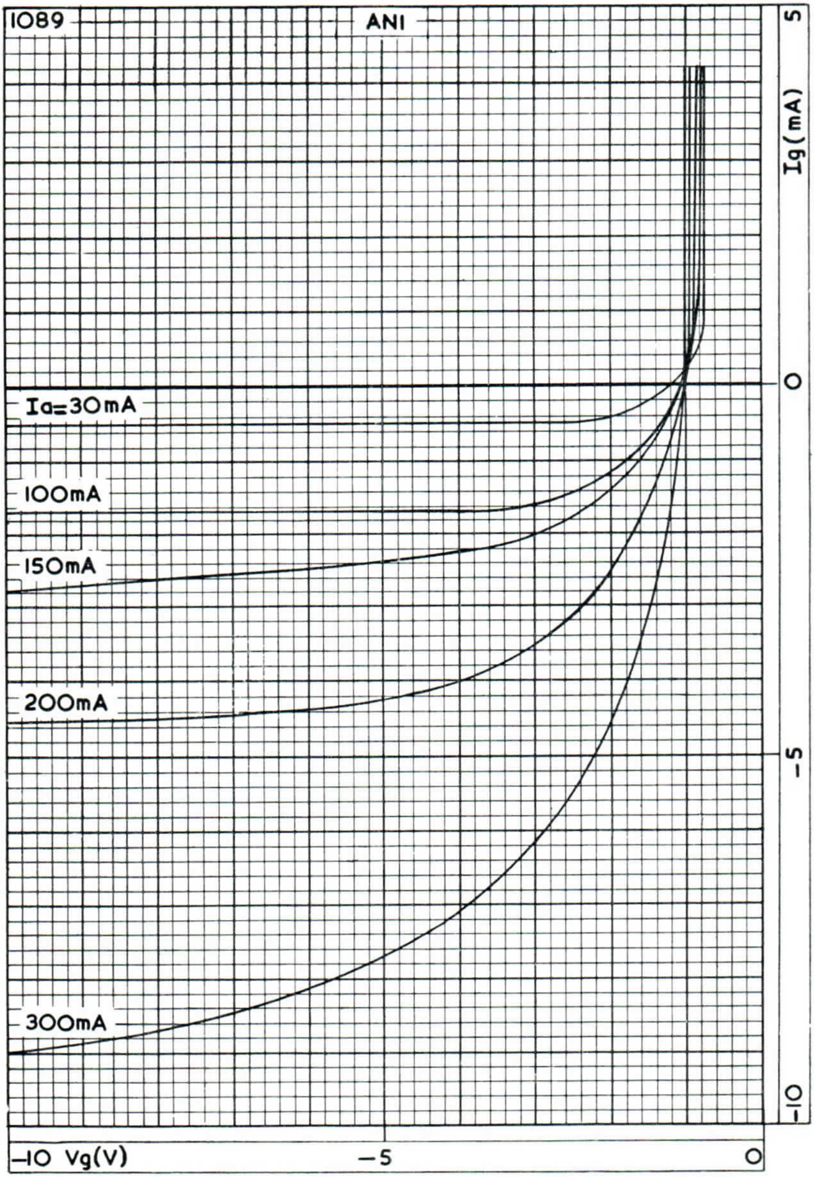


CONTROL CHARACTERISTIC

AN1

TRIODE THYRATRON

Triode inert-gas-filled thyratron with negative control characteristic. Primarily designed for industrial control applications.



GRID ION CURRENT CHARACTERISTIC

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			
$f = 7.5$Gc/s	380	410	V
$f = 11.5$Gc/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

$c_{h,k-all}$	$<$ 10	pF
c_{g-all}	$<$ 13	pF
c_{a-all}	$<$ 6.0	pF
$c_{delay\ structure-all}$	$<$ 8.0	pF

TYPICAL OPERATION

f	7.5	9.0	11	Gc/s
$V_{delay\ structure}$	0.39	0.64	1.2	kV
$I_{delay\ structure}$	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.

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 3ft^3/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.

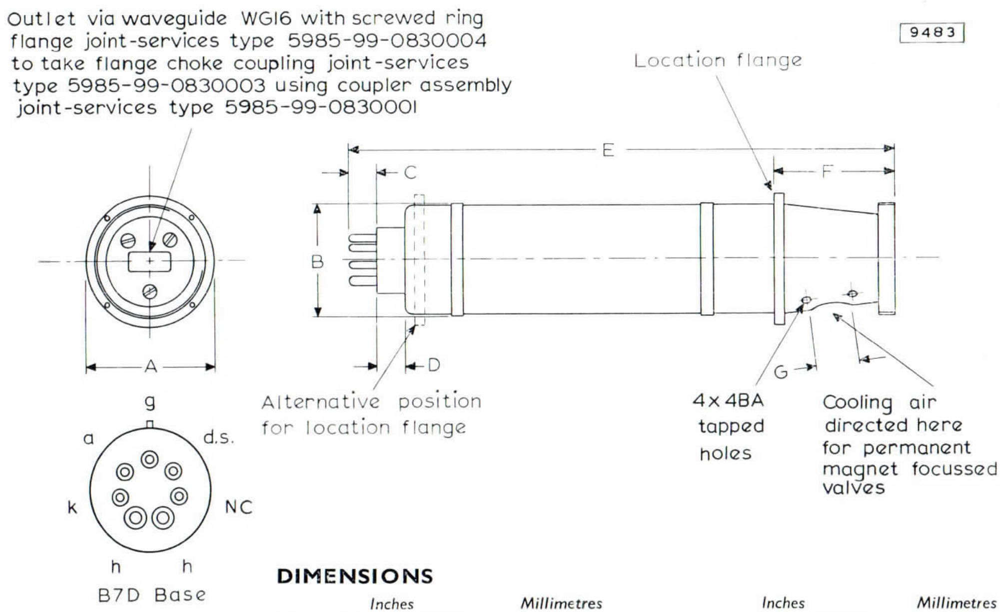
ACCESSORIES

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.

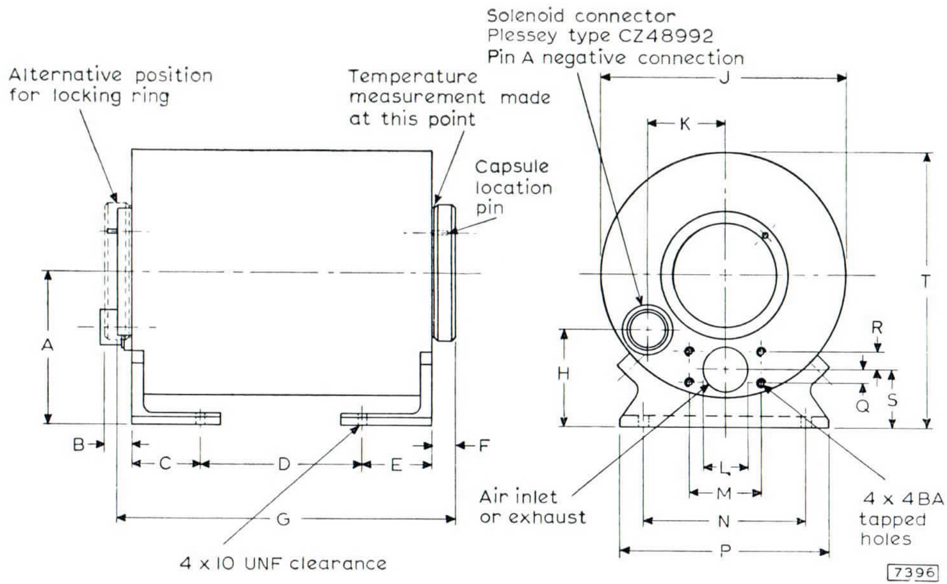
	SB–1	SB–2	
Current	7.5	13	A
Voltage	26	17	V
T_{amb}	25	25	°C
Cooling	Forced-air	Forced-air	



DIMENSIONS

	Inches	Millimetres
A	2.717 ± 0.020	69.0 ± 0.5
B	2.284 ± 0.002	58.00 ± 0.05
C	0.591	15 max.
D	$0.591\,^{+0.000}_{-0.197}$	$15\,^{+0}_{-5}$
E	$11.142\,^{+0.000}_{-0.394}$	$283\,^{+0}_{-10}$
F	2.461 ± 0.039	62.5 ± 1.0
G	1.000 ± 0.008	25.4 ± 0.2

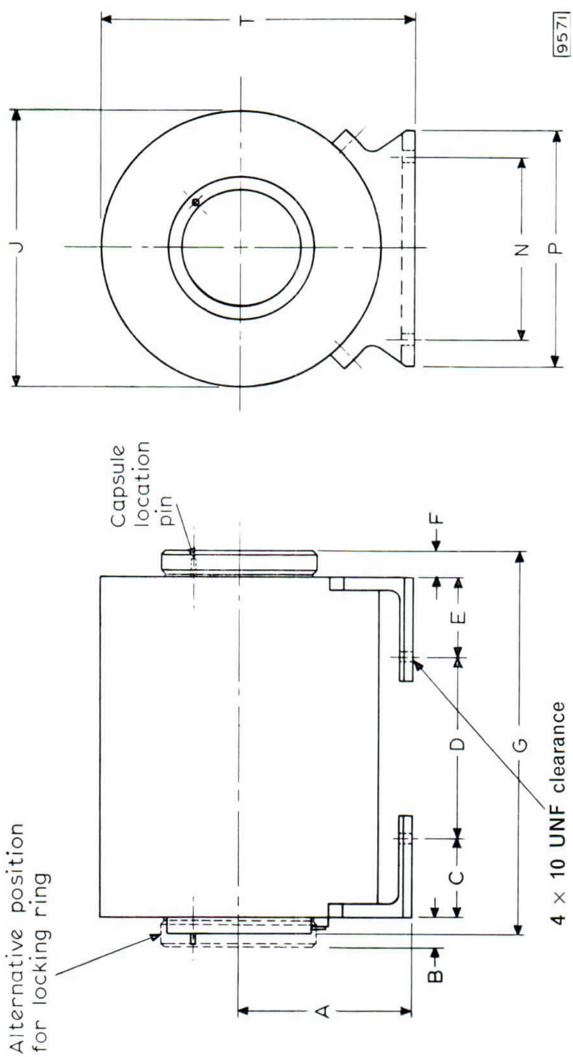
OUTLINE AND DIMENSIONS OF MOUNTS SB–1 AND SB–2



DIMENSIONS

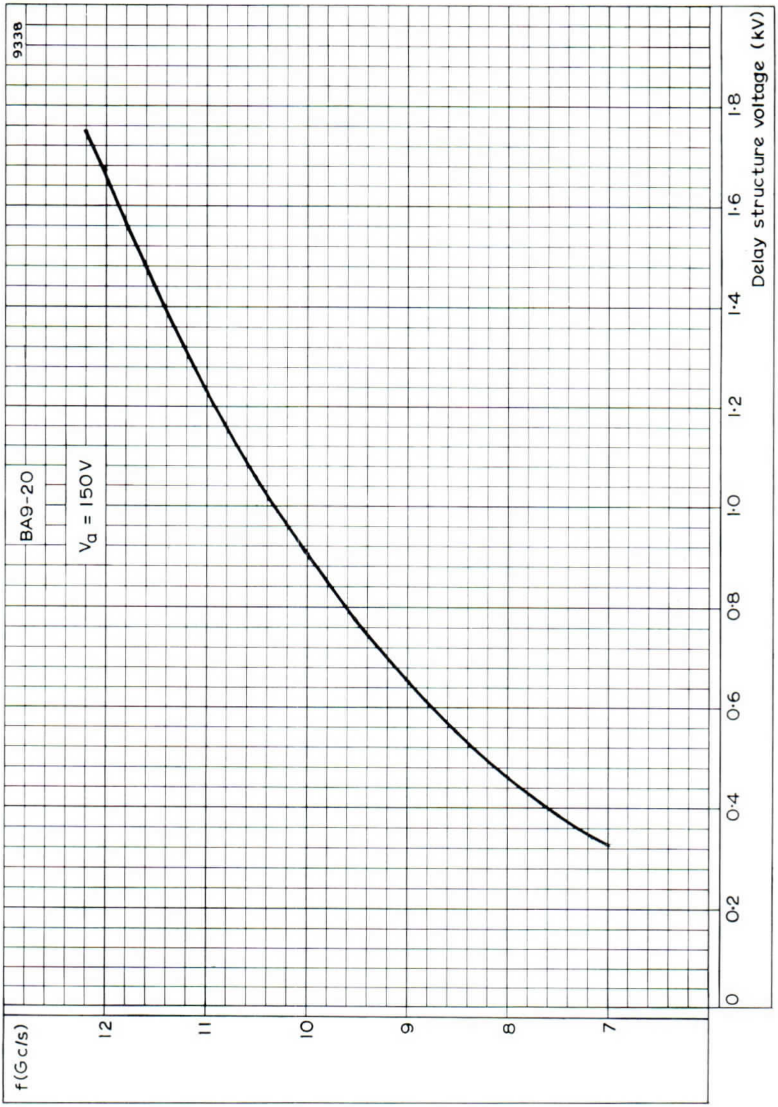
	Inches	Millimetres		Inches	Millimetres		Inches	Millimetres
A	3.248 ± 0.197	82.5 ± 5	G	7.520 ± 0.079	191 ± 2	N	3.543 ± 0.008	90.0 ± 0.2
B	0.591 ± 0.039	15 ± 1	H	2.283 ± 0.197	58 ± 5	P	4.606 ± 0.020	117.0 ± 0.5
C	1.535 ± 0.039	39 ± 1	J	5.354	136 max.	Q	0.276 ± 0.004	7.0 ± 0.1
D	3.543 ± 0.008	90.0 ± 0.2	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



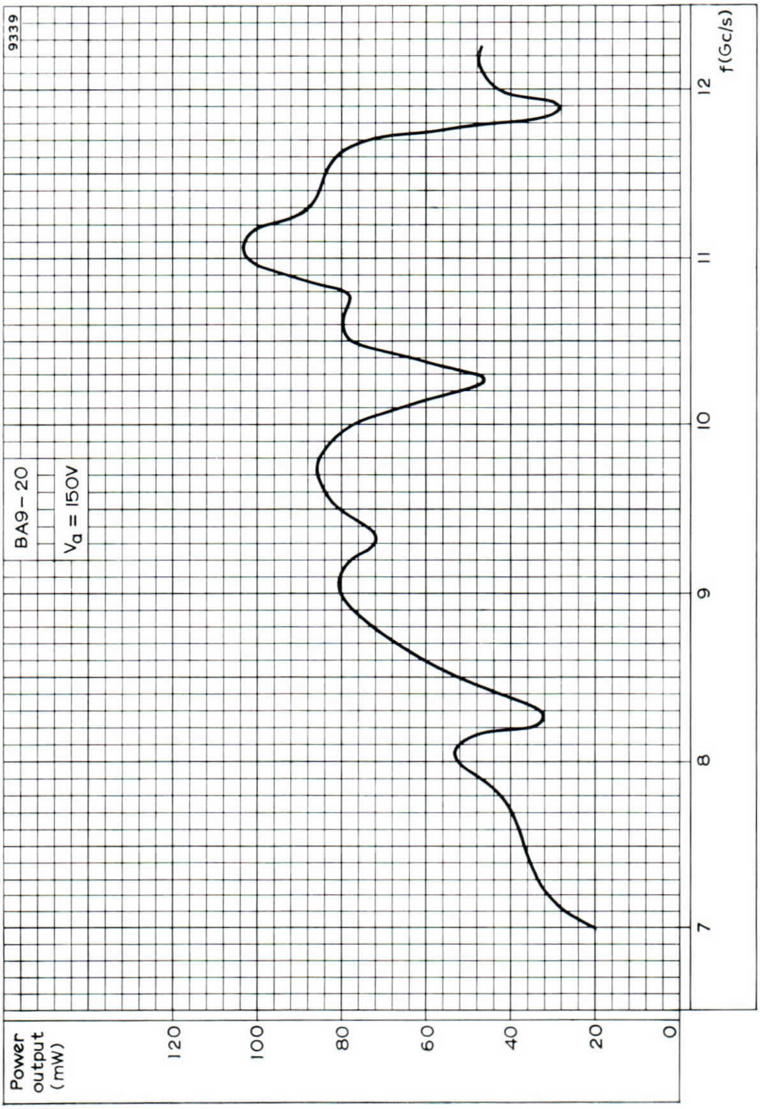
DIMENSIONS

	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
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.

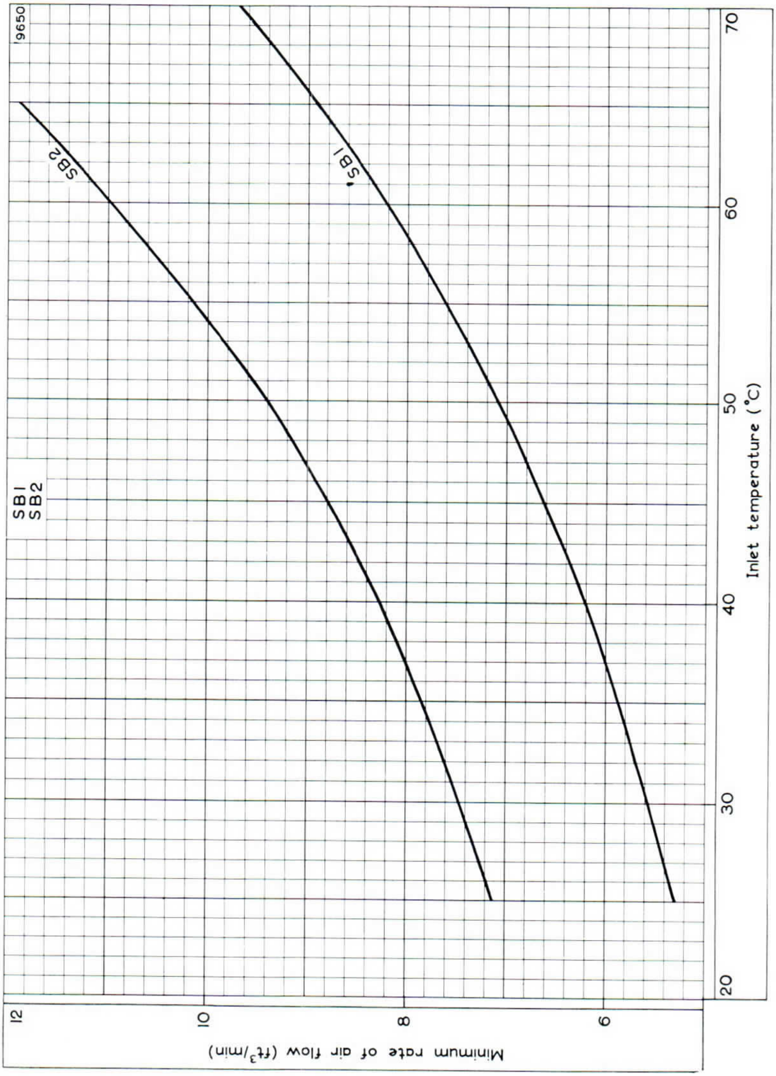


FREQUENCY PLOTTED AGAINST DELAY STRUCTURE VOLTAGE

BA9-20 BACKWARD-WAVE OSCILLATOR



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

OSCILLOSCOPE TUBES

DB13-2 DG13-2 DP13-2

Direct viewing oscilloscope tubes with 5-in. diameter screen. These tubes are fitted with a post-deflection accelerator.

HEATER

Suitable for parallel operation only.

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{g-all}	4.6	pF
c_{k-all}	6.0	pF
$c_{x'-all}$ (x'' earthed)	5.5	pF
$c_{x''-all}$ (x' earthed)	5.5	pF
$c_{y'-all}$ (y'' earthed)	4.7	pF
$c_{y''-all}$ (y' earthed)	4.7	pF
$c_{x'-x''}$	2.5	pF
$c_{y'-y''}$	1.9	pF
$c_{x'x''-y'y''}$	0.2	pF
$c_{g-(x'+x''+y'+y'')}$	0.15	pF
$c_{k-(x'+x''+y+'+y'')}$	0.35	pF

Fluorescent colour—

DB13–2	blue
DG13–2	green
DP13–2	blue with green afterglow

Persistence—

DB13–2	short
DG13–2	medium
DP13–2	long

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

Both x and y plates are suitable for symmetrical deflection only.

For optimum spot quality the mean deflector plate potential should be the same as $a_1 + a_3$ potential. ←

DB13-2
DG13-2
DP13-2

OSCILLOSCOPE TUBES

Direct viewing oscilloscope tubes with 5-in. diameter screen. These tubes are fitted with a post-deflection accelerator.

MOUNTING POSITION

Any

These tubes should not be supported by the base alone

TYPICAL OPERATING CONDITIONS

	Without acceleration	With acceleration	
V_{a_4}	2.0	4.0	kV
$V_{a_1+a_3}$	2.0	2.0	kV ←
V_{a_2}	400 to 720	400 to 720	V
$*V_g$	–45 to –100	–45 to –100	V
$I_{a_1+a_3}$	0 to 1.6	0 to 1.6	mA
I_{a_2}	–15 to +10	–15 to +10	µA
S_x	0.37 to 0.45	0.29 to 0.37	mm/V ←
S_y	0.43 to 0.51	0.34 to 0.42	mm/V ←
**Line width	0.4	0.3	mm

*In no circumstances must the grid be allowed to become positive with respect to the cathode.

**Measured on a circle of 50mm diameter with $I_t = 0.5\mu A$.

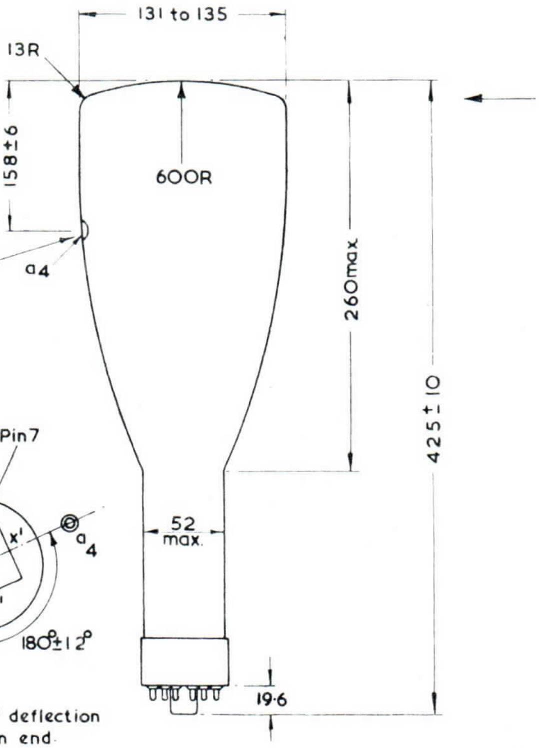
LIMITING VALUES (Design centre ratings)

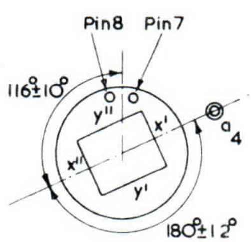
V_{a_4}	5.0	kV
$V_{a_1+a_3}$ max.	2.5	kV
$p_{a_1+a_3}$ max.	4.0	W
V_{a_2} max.	1.0	kV
$-V_g$ max.	150	V
$v_{x'-x''(pk)}$ max.	450	V
$v_{y'-y''(pk)}$ max.	450	V
$p_{t(av)}$ max.	3.0	mW/cm²
R_{x-a_3} max.	5.0	MΩ
R_{y-a_3} max.	5.0	MΩ
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	125	V ←

OSCILLOSCOPE TUBES

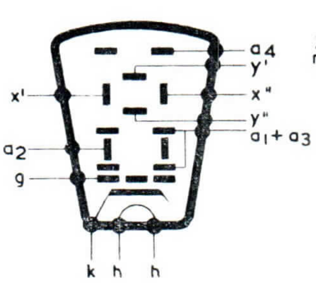
DB13-2
DG13-2
DP13-2

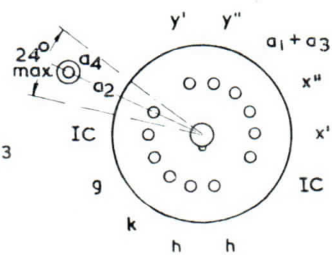
Direct viewing oscilloscope tubes with 5-in. diameter screen. These tubes are fitted with a post-deflection accelerator.





Orientation of axes of deflection as viewed from screen end



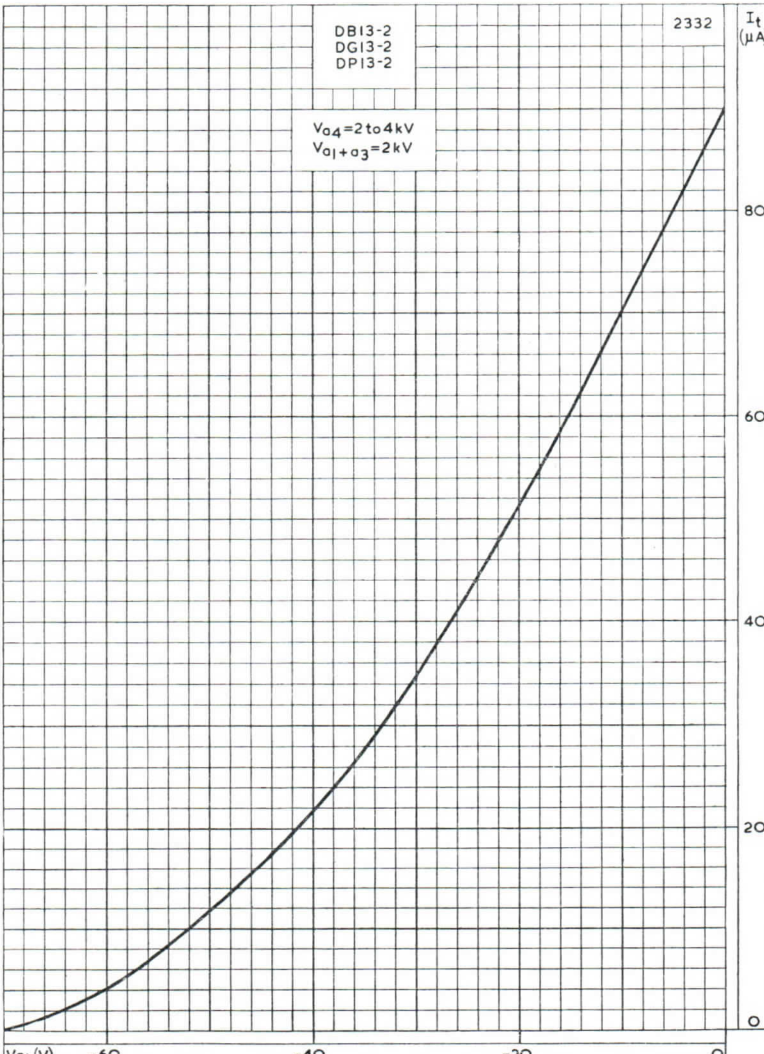


B14A (Diheptal) Base

2335

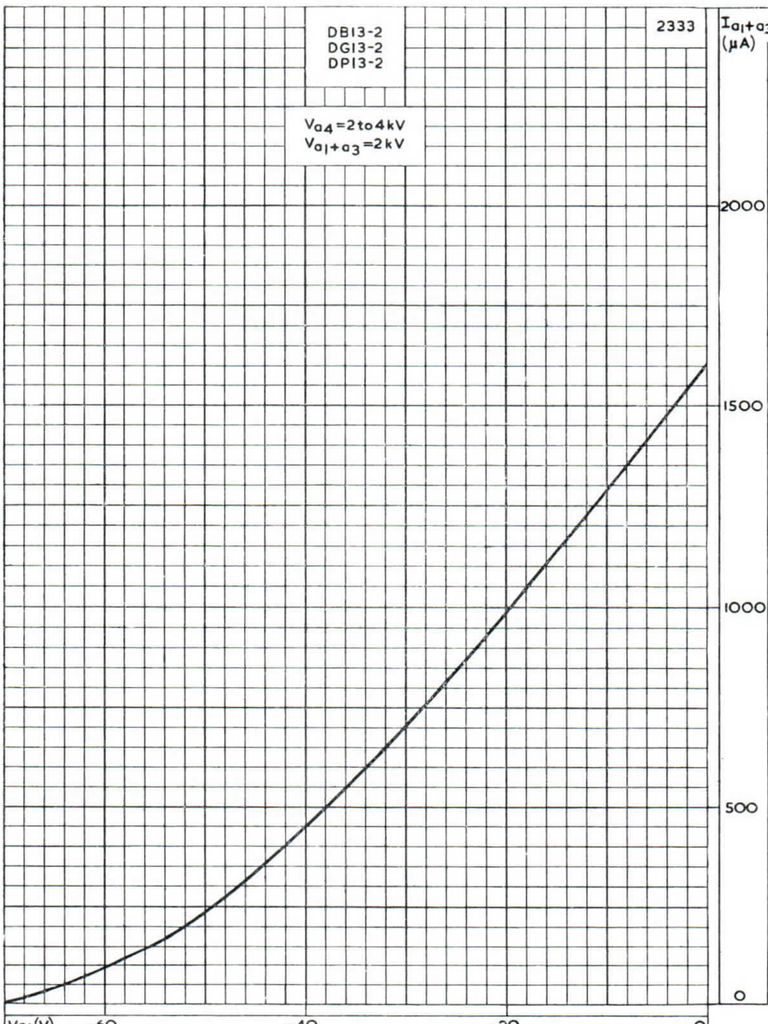
All dimensions in mm

Direct viewing oscilloscope tubes with 5-in. diameter screen. These tubes are fitted with a post-deflection accelerator.



SCREEN CURRENT PLOTTED AGAINST GRID VOLTAGE

Direct viewing oscilloscope tubes with 5-in. diameter screen. These tubes are fitted with a post-deflection accelerator.



FIRST AND THIRD ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

OSCILLOSCOPE TUBE

DG7-32

Direct viewing low voltage oscilloscope tube with 3-in. diameter screen.

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}	7.6	pF←
c_{k-all}	3.2	pF←
$c_{x'-all}$ (x'' earthed)	3.7	pF
$c_{x''-all}$ (x' earthed)	3.0	pF←
$c_{y'-all}$ (y'' earthed)	2.5	pF←
$c_{y''-all}$ (y' earthed)	2.5	pF←
$c_{x'-x''}$	1.7	pF←
$c_{y'-y''}$	1.0	pF

SCREEN

Fluorescent colour	green
Persistence	medium

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

Both x and y plates are intended for symmetrical deflection

MOUNTING POSITION Any

This tube should not be supported by the base alone. The socket should under no circumstances be used to support the tube.

DG7-32

OSCILLOSCOPE TUBE

Direct viewing low voltage oscilloscope tube with 3-in. diameter screen.

TYPICAL OPERATING CONDITIONS

V_{a1+a3}	500	V
V_{a2}	0 to 120	V
*V_g	−50 to −100	V
I_{a2}	−15 to +10	μA
S_y	0.39	mm/V
S_x	0.27	mm/V ←
†Line width	0.5	mm

*In no circumstances must the grid be allowed to become positive, with respect to the cathode.

†Measured on a circle of 50mm diameter with $V_{a1+a3} = 500V$ and $I_t = 0.5\mu A$.

A transparent conductive coating connected to a_1+a_3 is present between the glass and fluorescent layer. This makes possible applications of the tube with a_1+a_3 at high potential with respect to earth without the raster being distorted if the faceplate is touched.

DEFLECTION SENSITIVITY LIMITS

S_x	$\frac{120 \text{ to } 150}{V_{a1+a3}}$	mm/V ←
S_y	$\frac{175 \text{ to } 215}{V_{a1+a3}}$	mm/V

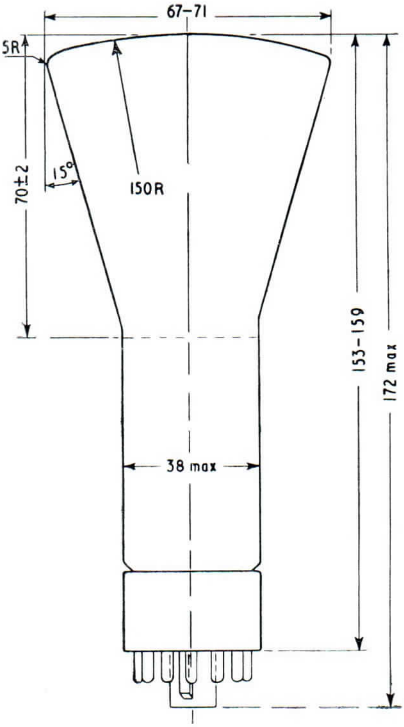
LIMITING VALUES (design centre ratings)

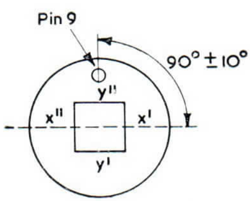
V_{a1+a3} max.	800	V
V_{a1+a3} min.	400	V
p_{a1+a3} max.	500	mW
V_{a2} max.	200	V
$-V_g$ max.	160	V
$v_{x'-x''(pk)}$ max.	750	V
$v_{y'-y''(pk)}$ max.	450	V
$p_{t(av)}$ max.	3.0	mW/cm²
R_{x-a3} max.	5.0	MΩ
R_{y-a3} max.	5.0	MΩ
R_{g-k} max.	500	kΩ
V_{h-k} max.	125	V

OSCILLOSCOPE TUBE

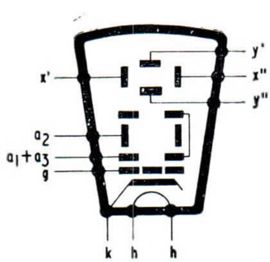
DG7-32

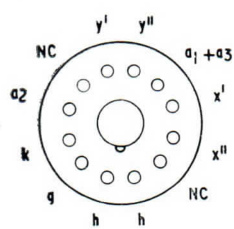
Direct viewing low voltage oscilloscope tube with 3-in. diameter screen.





Orientation of axes of deflection as viewed from screen end





B12A Base

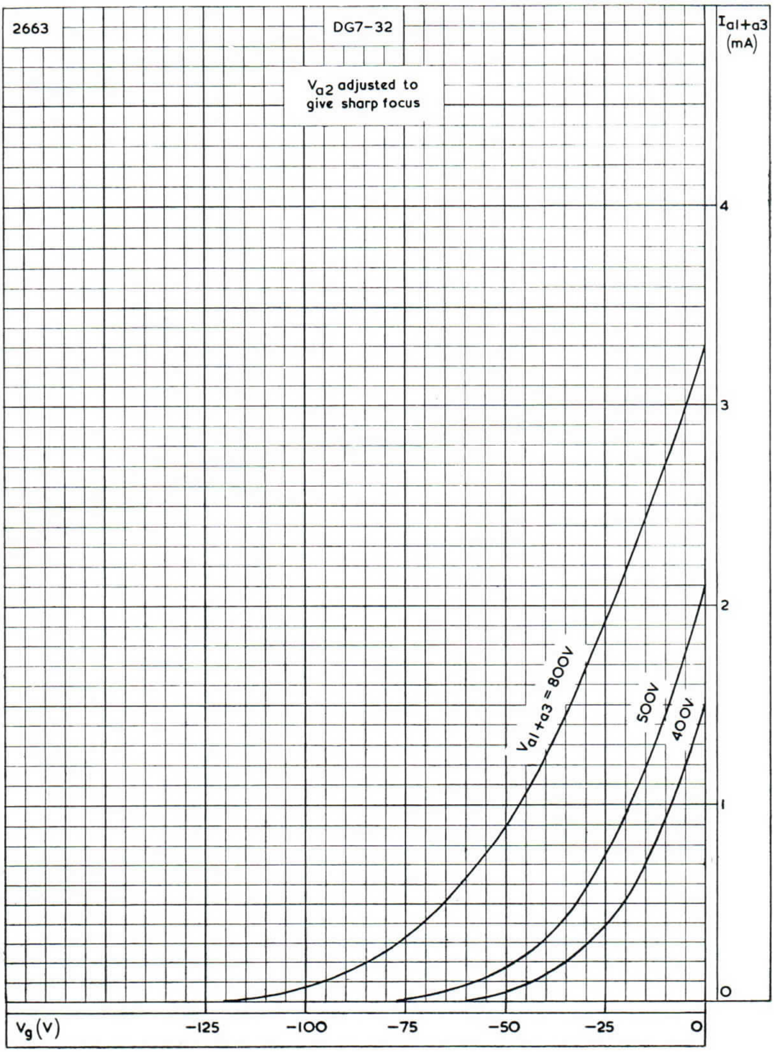
1883

All dimensions in mm

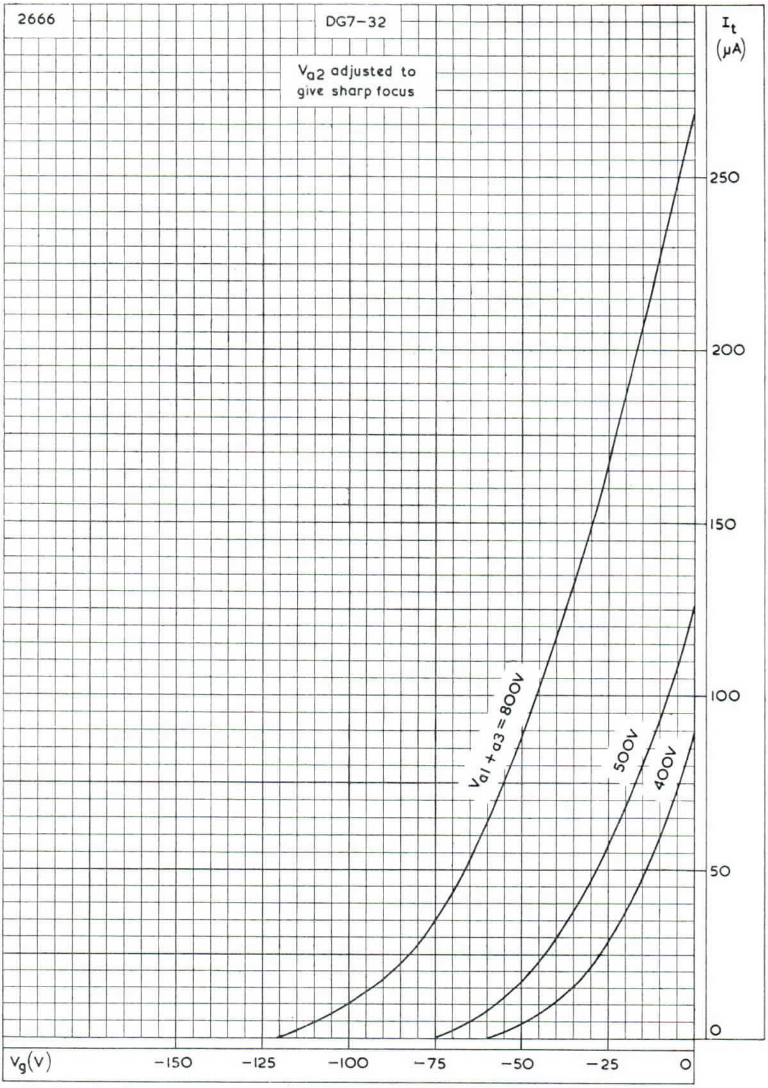
DG7-32

OSCILLOSCOPE TUBE

Direct viewing low voltage oscilloscope tube with 3-in. diameter screen.



FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE



SCREEN CURRENT PLOTTED AGAINST GRID VOLTAGE

OSCILLOSCOPE TUBE

DH10-94

Direct viewing oscilloscope tube with 4-in. flat-face screen. This tube is fitted with a post deflection accelerator, and has side connections to the x and y plates.

HEATER

Suitable for parallel operation only

V_h	6.3	V
I_h	550	mA

CAPACITANCES

c_{g-all}	3.8 to 5.6	pF
c_{k-all}	3.2 to 4.8	pF
$c_{x'-all}$ (x″ earthed)	2.9 to 4.4	pF
$c_{x''-all}$ (x′ earthed)	2.9 to 4.4	pF
$c_{y'-all}$ (y″ earthed)	2.4 to 3.6	pF
$c_{y''-all}$ (y′ earthed)	2.4 to 3.6	pF
$c_{x'-x''}$	1.2 to 1.8	pF
$c_{y'-y''}$	1.3 to 1.9	pF
$c_{x'+x''-y'+y''}$	<0.1	pF
$c_{x'+x''-g+k}$	<0.1	pF
$c_{y'+y''-g+k}$	<0.1	pF

SCREEN

Fluorescent colour	green
Persistence	medium

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

Both x and y plates are for symmetrical operation.

For optimum focus, the average potentials of the deflection plates should not differ from V_{a3} by more than 50V.

Pattern distortion

The length of the edges of a raster pattern whose **mean** dimensions are less than 65% of the useful scan will not deviate from these mean dimensions by more than 2.5% providing $V_{a4}/V_{a3} \ngtr 2$.

Angle between x and y deflection 90°±1.5°

MOUNTING POSITION

Any

This tube should not be supported by the base alone. The socket should under no circumstances be used to support the tube.

TYPICAL OPERATING CONDITIONS

V_{a4}	4.0	kV
V_{a3}	2.0	kV
V_{a2}	460 to 530	V
V_{a1}	2.0	kV
V_g	−28 to −60	V
*$V_{x'-a3}$	220 to 340	V
†I_{a2}	−50	μA
S_x	0.27	mm/V
S_y	0.435	mm/V

*Beam trapping voltage. In order to obviate the necessity for pulsing the grid when displaying pulse or single stroke phenomena, a beam trap is provided on the x′ plate. When a positive voltage of suitable magnitude is applied to the x′ plate, the beam is contained on that plate, and a state of minimum brilliance exists.

†With V_{a2} set for focus, and at $V_g = -1.0$V

DH10-94

OSCILLOSCOPE TUBE

Direct viewing oscilloscope tube with 4-in. flat-face screen. This tube is fitted with a post deflection accelerator, and has side connections to the x and y plates.

LINE WIDTH (measured under d.c. conditions)

V_{a4}	4.0	kV
V_{a3}	2.0	kV
V_{a2}	adjusted for focus	
V_{a1}	2.0	kV
V_g	value corresponding to 0.05	candelas
Writing speed	0.6	km/s ←
Repetition period	10	ms ←
Distance from screen centre (any direction)	0	mm
Line resolution (min.)	30	lines/cm ←

DEFLECTION SENSITIVITY

	Without acceleration ($V_{a4} = V_{a3}$)	With acceleration ($V_{a4} = 2V_{a3}$)	
S_x	$\frac{600}{V_{a3}}$	$\frac{480 \text{ to } 625}{V_{a3}}$	mm/V
S_y	$\frac{1000}{V_{a3}}$	$\frac{790 \text{ to } 985}{V_{a3}}$	mm/V

With $V_{a4} = V_{a3}$, an undeflected spot will lie within 8.0mm of the screen centre.

LIMITING VALUES

V_{a4} max.	10	kV
V_{a4} min.	1.0	kV
V_{a3} max.	5.0	kV
V_{a2} max.	1.5	kV
V_{a1} max.	5.0	kV
V_{a4-a3} max.	5.0	kV
$p_{a(tot)}$ max.	3.0	W
$-V_g$ max.	200	V
$-V_g$ min.	1.0	V
V_{x-a3} max.	1.0	kV
V_{y-a3} max.	1.0	kV
$p_{t(av.)}$ max.	3.0	mW/cm²
R_{x-a3} max.	5.0	MΩ
R_{y-a3} max.	5.0	MΩ
R_{g-k} max.	1.0	MΩ
$v_{h-k(pk)}$ max.	250	V
Max. ratio of V_{a4}/V_{a3} for full screen x deflection	2.0	

WEIGHT

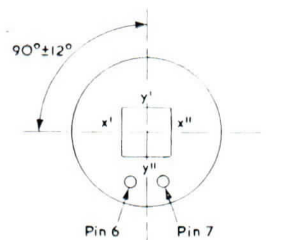
WEIGHT	560	g
	20	oz

OSCILLOSCOPE TUBE

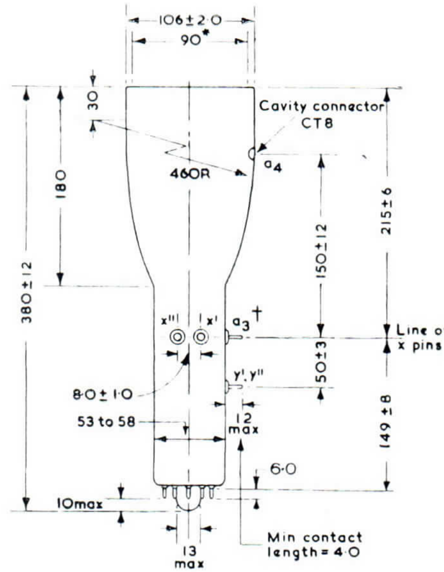
DH10-94

Direct viewing oscilloscope tube with 4-in. flat-face screen. This tube is fitted with a post deflection accelerator, and has side connections to the x and y plates.

5163



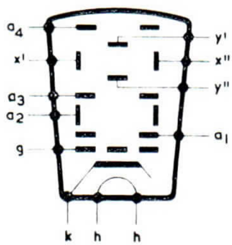
Orientation of axes of deflection as viewed from screen end.

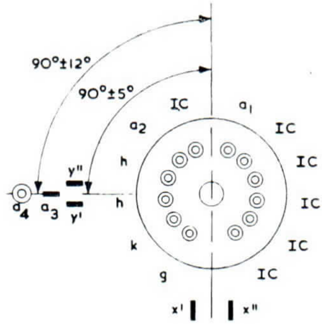


Notes

*This face flat over a minimum area of 90 mm diameter.

†The axial distance between the radial planes of the x pins and the a_3 pin ≯ 2·0 mm
Side connectors = 1·27dia





B12F Base

All dimensions in mm

OSCILLOSCOPE TUBE

Direct viewing oscilloscope tube with 5-in. diameter flat screen, helical post-deflection accelerator, and side connections to the x and y plates. Intended for applications where high sensitivity and low raster distortion are required.

DH13-76
DN13-76

The only difference between the DH13-76 and DN13-76 is in the screen properties (see appropriate section of data).

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 only, a.c. or d.c.

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{g-all}	6.7	pF
c_{k-all}	3.9	pF
$c_{x'-all}$ (x″ earthed)	3.0	pF
$c_{x''-all}$ (x′ earthed)	3.0	pF
$c_{y'-all}$ (y″ earthed)	2.8	pF
$c_{y''-all}$ (y′ earthed)	2.8	pF
$c_{x'-x''}$	2.0	pF
$c_{y'-y''}$	1.5	pF

SCREEN

	DH13–76	*DN13–76*	
Fluorescent colour	blue-green	green	
Persistence	medium	long	
Minimum useful screen diameter	108	108	mm
Minimum useful scan	$V_{a4} = 2V_{a1+a3}$	$V_{a4} = 4V_{a1+a3}$	
x′–x″	100	100	mm
y′–y″	60	50	mm

The midpoint of the useful scan will be within 3mm of the geometric centre of the faceplate.

FOCUSING

Electrostatic.

DEFLECTION

Double electrostatic.
Both x and y plates are intended for symmetrical deflection. For optimum focus, the average potentials of the deflection plates and $a_1 + a_3$ should be equal.

Deviation of linearity of deflection

The sensitivity (for both x′–x″ and y′–y″ plate pairs separately) for a deflection of less than 75% of the useful scan will not differ from the sensitivity for a deflection of 25% by more than 2%.

Raster distortion

With a raster pattern the size of which is adjusted so that the widest points of the raster just touch the side of a rectangle 100mm × 50mm, no point of these raster sides will be within a rectangle 97mm × 48.5mm, the rectangles being placed concentrically, i.e., maximum total raster distortion is ±1.5%.

Angle between x and y deflection — 90° ± 1°

Inter-plate shield

In general, the voltage on i.p.s. and the average voltage on the deflection plates should be equal. Adjustment of $V_{i.p.s.}$ up to a maximum of ±10% of the a_1+a_3 potential serves to correct pincushion and barrel raster distortion. This screen is also internally connected to the lower end of the helical post deflection accelerator.

Deflection-plate shield

In general, the voltages on d.p.s. and a_1+a_3 and the average voltage on the deflection plates should be equal. Variation of $V_{d.p.s.}$ up to a maximum of ±5% of a_1+a_3 potential serves to correct pincushion and barrel raster distortion.

Deflection plates x′–x″ and y′–y″

In general, the average voltage on the deflection plates and the voltage on a_1+a_3 should be equal. To provide some measure of astigmatism control it may be desirable to apply a small potential difference between the x plates and a_1+a_3. A low impedance voltage source is desirable, as if the tube is fully deflected, the deflection plates will intercept part of the electron beam near the edge of scan.

Spot position

With the tube shielded, the undeflected spot will lie within a radius of 5mm from the geometric centre of the tube face.

HELICAL RESISTANCE

Minimum post-deflection acceleration helix resistance	300	MΩ

MOUNTING POSITION — Any

This tube should not be supported by the base alone. Under no circumstances should the socket be used to support the tube.

OPERATING CONDITIONS

V_{a4}	4.0	6.0	kV
$V_{i.p.s.}$	2.0	1.5	kV
$V_{d.p.s.}$	2.0	1.5	kV
V_{a1+a3}	2.0	1.5	kV
V_{a2}	220 to 710	165 to 540	V
V_g for visual cut-off	−60 to −96	−45 to −72	V
S_y	1.7	1.9	mm/V
S_x	0.46	0.49	mm/V

LINE WIDTH

V_{a4}	4.0	6.0	kV
V_{a1+a3}	2.0	1.5	kV
I_{a4}	0.5	0.5	μA
*Line width	0.45	0.45	mm

*Measured on a circle of 40mm diameter.

DEFLECTION SENSITIVITY LIMITS

	$(V_{a4} = 2V_{a1+a3})$	$(V_{a4} = 4V_{a1+a3})$	
S_y	$\frac{2880 \text{ to } 3920}{V_{a1+a3}}$	$\frac{2415 \text{ to } 3300}{V_{a1+a3}}$	mm/V
S_x	$\frac{820 \text{ to } 1000}{V_{a1+a3}}$	$\frac{660 \text{ to } 795}{V_{a1+a3}}$	mm/V

EQUIPMENT DESIGN RANGE

Focusing voltage (V_{a2})	110 to 355V per kV of accelerator voltage (V_{a1+a3})
Grid cut-off voltage (V_g)	−30 to −48V per kV of accelerator voltage (V_{a1+a3})
Deflection factor	
$y'-y''$ ($V_{a4} = 4V_{a1+a3}$)	3.0 to 4.15V/cm per kV of accelerator voltage (V_{a1+a3})
$x'-x''$ ($V_{a4} = 4V_{a1+a3}$)	12.6 to 15.2V/cm per kV of accelerator voltage (V_{a1+a3})
$y'-y''$ ($V_{a4} = 2V_{a1+a3}$)	2.55 to 3.45V/cm per kV of accelerator voltage (V_{a1+a3})
$x'-x''$ ($V_{a4} = 2V_{a1+a3}$)	10 to 12.2V/cm per kV of accelerator voltage (V_{a1+a3})
Focus electrode current (I_{a1+a3})	−15 to +10μA

DH13-76
DN13-76

OSCILLOSCOPE TUBE

LIMITING VALUES (design centre ratings)

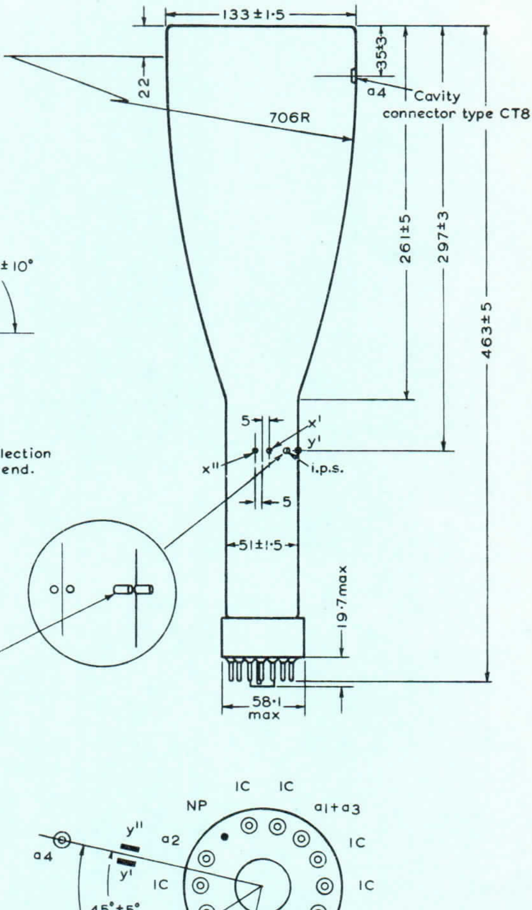
V_{a4} max.	8.0	kV
V_{a4} min.	1.5	kV
$V_{i.p.s.}$ max.	2.2	kV
$V_{d.p.s.}$ max.	2.1	kV
V_{a1+a3} max.	2.1	kV
V_{a1+a3} min.	1.0	kV
Maximum ratio of V_{a4}/V_{a1+a3}	4.0	
V_{a2} max.	1.5	kV
$-V_g$ max.	200	V
$+V_g$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$v_{x-a1+a3(pk)}$ max.	500	V
$v_{y-a1+a3(pk)}$ max.	500	V
p_{a1+a3} max.	6.0	W
$p_{t(av.)}$ max.	3.0	mW/cm^2
$R_{x-a1+a3}$ max.	5.0	MΩ
$R_{y-a1+a3}$ max.	5.0	MΩ
R_{g-k} max.	1.5	MΩ
V_{h-k} max. (cathode negative)	125	V
V_{h-k} max. (cathode positive)	200	V

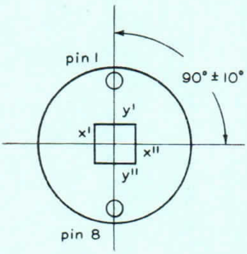
WEIGHT

Tube alone	910	g
	2	lb

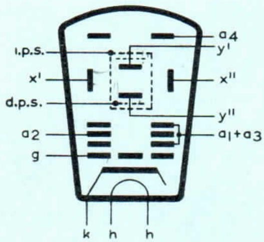
DH13-76
DN13-76

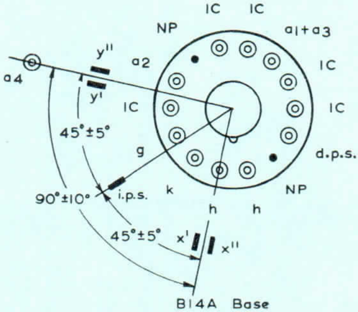
6939





Orientation of axes of deflection as viewed from screen end.





All dimensions in mm

OSCILLOSCOPE TUBE

DH13-97

Direct viewing precision oscilloscope tube with 5in. diameter flat screen. This tube is fitted with two stages of distributed post deflection acceleration and the deflection plates are brought out to side connections.

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 only, a.c. or d.c.

V_h	6.3	V
I_h	550	mA

CAPACITANCES

c_{g-all}	7.4	pF
c_{k-all}	4.1	pF
$c_{x'-all}$ (x″ earthed)	3.6	pF
$c_{x''-all}$ (x′ earthed)	3.6	pF
$c_{y'-all}$ (y″ earthed)	1.6	pF
$c_{y''-all}$ (y′ earthed)	1.7	pF
$c_{x'-x''}$	2.3	pF
$c_{y'-y''}$	1.7	pF
$c_{x'+x''-y'+y''}$	<100	mpF
$c_{x'+x''-g+k}$	<100	mpF
$c_{y'+y''-g+k}$	<100	mpF

SCREEN

Fluorescent colour	blue-green	
Persistence	medium	
*Minimum useful scan from the centre of the tube face		
x′–x″	±4.75	cm
y′–y″	±3.0	cm

*With $V_{a5}/V_{a3} = 5.5$, $V_{a4}/V_{a3} = 2.2$

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

x plates are suitable for symmetrical operation only.

y plates are suitable for both symmetrical and asymmetrical operation.

Vertical deflection, defocusing and linearity may be a little worse with asymmetrical operation.

Raster distortion and deviation of linearity of deflection

Compared with a normal post deflector accelerator the use of a distributed system enables much greater p.d.a. ratios to be used, with a consequent gain in sensitivity before serious raster pattern distortion occurs.

With $V_{a5}/V_{a3} = 5.5$, $V_{a4}/V_{a3} = 2.2$ and the mean potential of the x and y plates being equal to the potential of a_3, the inter-plate shield and the external conductive coating, the following figures apply:

(a) With a raster pattern the size of which is adjusted so that the widest points of the raster just touch the sides of a rectangle 76.5mm × 45.9mm, no point on these raster sides will lie within a rectangle 73.5mm × 44.1mm, the rectangles being placed concentrically, i.e. maximum total raster distortion is ±2%.

(b) The sensitivity (for both x′–x″ and y′–y″ plate pairs separately) for a deflection of less than 75% of the useful scan will not differ from the sensitivity for a deflection of 25% by more than 2%.

Angle between x and y deflection 90±1.5°

MOUNTING POSITION

Any

This tube should not be supported by the base alone. The socket should under no circumstances be used to support the tube.

OPERATING CONDITIONS

V_{a5}	10	kV
V_{a4}	4.0	kV
V_{a3}	1.8	kV
†$V_{i.p.s.}$	1.8	kV
V_{a2}	440 to 560	V
V_{a1}	1.4	kV
V_g for cut-off	–45 to –90	V
*Grid drive	20	V
I_{a5}	25	µA
**I_{a2}	–100	µA
S_x	0.38	mm/V
S_y	0.8	mm/V

*For intensity of 0.45cd

**With V_{a2} set for focus and V_{g1} = –1.0V

†Inter-plate shield (i.p.s.) connected to a_3.

DEFLECTION SENSITIVITY LIMITS

S_x	$\frac{59 \text{ to } 77}{V_{a3}}$	cm/V
S_y	$\frac{126 \text{ to } 160}{V_{a3}}$	cm/V

The sensitivities vary inversely with V_{a5} provided that the p.d.a. ratios remain constant.

EQUIPMENT DESIGN RANGE

Deflection factor

x′–x″	12.9 to 16.9V/cm per kV of accelerator voltage (V_{a3})
y′–y″	6.2 to 7.9V/cm per kV of accelerator voltage (V_{a3})

LIMITING VALUES (absolute ratings)

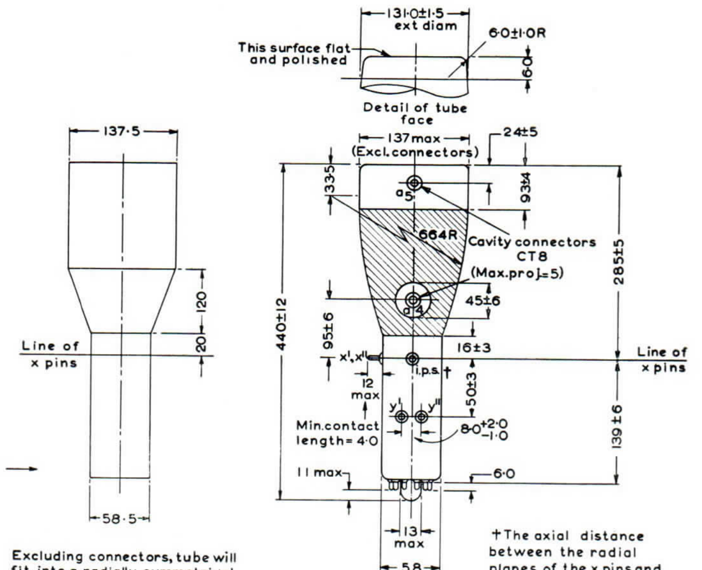
V_{a5} max.	12	kV
V_{a5} min.	6.0	kV
V_{a4} max.	5.5	kV
V_{a3} max.	2.0	kV
V_{a2} max.	750	V
V_{a1} max.	1.5	kV
V_{a5}–V_{a4} max.	8.0	kV
V_{a4}–V_{a3} max.	3.5	kV
V_{a3}–V_{a2} max.	2.2	kV
V_{a2}–V_{a1} max.	1.5	kV
$-V_g$ max.	200	V
$-V_g$ min.	1.0	V
p_{a1+a3} max.	2.0	W
V_{x-a3} max.	500	V
V_{y-a3} max.	500	V
$p_{t(av.)}$ max.	5.0	mW/cm^2
R_{x-a3} max.	5.0	MΩ
R_{y-a3} max.	5.0	MΩ
R_{g-k} max.	1.0	MΩ
r_{a5-a3} min.	80	MΩ
$v_{h-k(pk)}$ max.	250	V
Max. ratio of V_{a5}/V_{a3} (for scan size of 60mm × 95mm $V_{a4}/V_{a3} = 2.2$)	5.5	

WEIGHT

Tube alone	1.25	kg
	44	oz

DH13-97

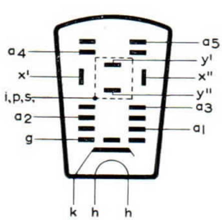
OSCILLOSCOPE TUBE

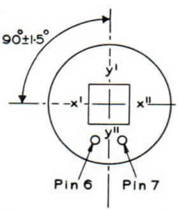


Excluding connectors, tube will fit into a radially symmetrical housing of the above internal dimensions.

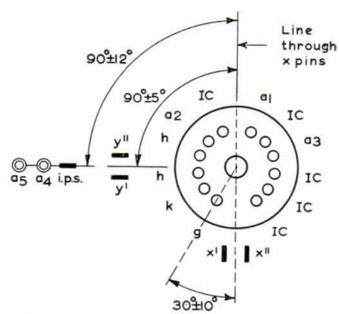
Side connectors 1·27 diam

† The axial distance between the radial planes of the x pins and the i.p.s. pin ≯ 2·0mm





Orientation of axes of deflection as viewed from screen end.



B12F Base

All dimensions in mm

8012

DUAL TRACE OSCILLOSCOPE TUBE

DHM10-93

Direct viewing dual trace oscilloscope tube with 4in. flat-face screen, and independent signal deflections. This tube is fitted with a post deflection accelerator and has side connections to the x and y plates.

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 only

V_h	6.3	V
I_h	550	mA

CAPACITANCES

c_{g-all}	4.2 to 5.9	pF
c_{k-all}	3.5 to 4.9	pF
c_{x1-all} (x2 earthed)	2.7 to 3.8	pF
c_{x2-all} (x1 earthed)	2.7 to 3.8	pF
c_{y1-all} (y2 earthed)	2.5 to 3.8	pF
c_{y2-all} (y1 earthed)	2.5 to 3.8	pF
c_{x1-x2}	1.4 to 2.0	pF
c_{y1-y2}	$<$100	mpF
$c_{y1-x1+x2}$	$<$100	mpF
$c_{y2-x1+x2}$	$<$100	mpF

SCREEN

Fluorescent colour	green
Persistence	medium

FOCUSING

Electrostatic

DEFLECTION

Double electrostatic

The x plates are intended for symmetrical deflection only. The y plates may be used for asymmetrical deflection only, since the two plates are separated by a common beam dividing plate internally connected to a_3.

Raster distortion

The length of the edges of a raster pattern whose mean dimensions are less than 65% of the useful scan will not deviate from these mean dimensions by more than 2.5% providing $V_{a4}/V_{a3} > 2$.

Angle between x and y deflection	$90° \pm 1.5°$
Angle between the two y deflections	$<1.0°$

Spot centrality

With $V_{a4} = V_{a3}$, both undeflected spots will be within 8.0mm of the screen centre.

Beam equality

With both beams superimposed and V_g adjusted to give a light output of 0.1 candela, the intensity of either beam will not be less than 0.02 candela.

By using a suitable magnet, it is possible to equalise the intensities of both beams.

DHM10-93 DUAL TRACE OSCILLOSCOPE TUBE

MOUNTING POSITION

Any

This tube should not be supported by the base alone. The socket should under no circumstances be used to support the tube.

OPERATING CONDITIONS

V_{a4}	3.0	kV
V_{a3}	1.5	kV
$*V_{a2}$	320 to 420	V
V_{a1}	1.5	kV
V_{g}	−40 to −95	V
$**V_{x1-a3}$	170 to 290	V
$\dagger I_{a2}$	0 to 200	µA
S_x	0.37	mm/V
S_{y1}	0.37	mm/V
S_{y2}	0.37	mm/V

*For focus with V_g set for light intensity of 0.1cd. To accommodate a wide range of V_g settings it is recommended that the available range of V_{a2} should be 150 to 450V with $V_{a1} = V_{a3} = 1.5$kV, $V_{a4} = 3$kV.

**Beam trapping voltage. In order to obviate the necessity for pulsing the grid when displaying pulse or single stroke phenomena, a beam trap is provided on the x_1 plate. When a positive voltage of suitable magnitude is applied to the x_1 plate, the beam is contained on that plate, and a state of minimum brilliance exists.

†With V_{a2} set for focus, and at $V_g = -1.0$V.

RESOLUTION (measured under d.c. conditions)

V_{a4}	3.0	kV
V_{a3}	1.5	kV
V_{a2}	adjusted for focus	
V_{a1}	1.5	kV
V_g	Value corresponding to 0.08cd	
Writing speed	0.6	km/s
Repetition period	10	ms
Line resolution	35	lines/cm

DEFLECTION SENSITIVITY LIMITS

	With acceleration ($V_{a4} = 2V_{a3}$)	
S_x	$\frac{47.5 \text{ to } 65}{V_{a3}}$	cm/V
S_{y1}	$\frac{47.5 \text{ to } 65}{V_{a3}}$	cm/V
S_{y2}	$\frac{47.5 \text{ to } 65}{V_{a3}}$	cm/V

EQUIPMENT DESIGN RANGE

Focusing voltage (V_{a2})	100 to 300V per kV of accelerator voltage (V_{a3})
Grid cut-off voltage (V_g)	–26.7 to –63.3V per kV of accelerator voltage (V_{a3})
Deflection factor ($V_{a4} = 2V_{a3}$)	
x_1–x_2	15.4 to 21.1V/cm per kV of accelerator voltage (V_{a3})
y_1–y_2	15.4 to 21.1V/cm per kV of accelerator voltage (V_{a3})

ABSOLUTE MAXIMUM RATINGS

V_{a4} max.	8.0	kV
V_{a4} min.	1.0	kV
V_{a3} max.	4.0	kV
V_{a3} min.	600	V
V_{a2} max.	1.2	kV
V_{a1} max.	1.7	kV
V_{a1} min.	600	V
V_{a4-a3} max.	4.0	kV
$p_{a(tot)}$ max.	3.0	W
$-V_g$ max.	200	V
$-V_g$ min.	1.0	V
V_{x-a3} max.	1.0	kV
V_{y1-a3} max.	1.0	kV
V_{y2-a3} max.	1.0	kV
$p_{t(av)}$ max.	3.0	mW/cm^2
R_{x-a3} max.	2.0	MΩ
R_{y1-a3} max.	1.0	MΩ
R_{y2-a3} max.	1.0	MΩ
R_{g-k}	1.0	MΩ
$V_{h-k(pk)}$ max.	150	V ←
Max. ratio of V_{a4}/V_{a3} for full screen x deflection	2.0	

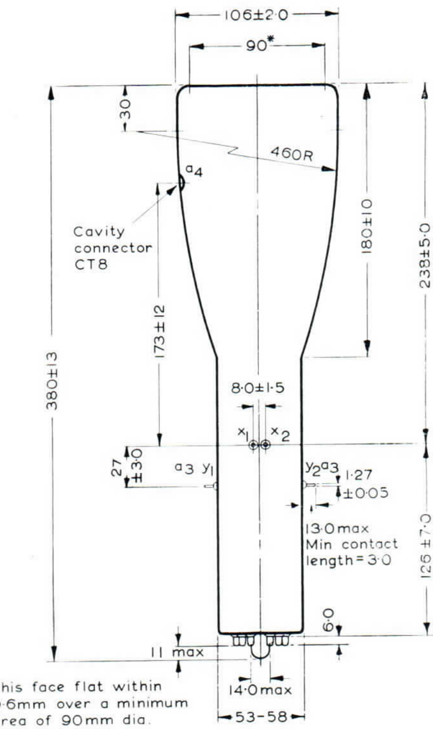
WEIGHT

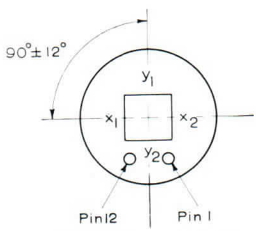
Tube alone	650	g
	23	oz

DHM10-93

DUAL TRACE OSCILLOSCOPE TUBE

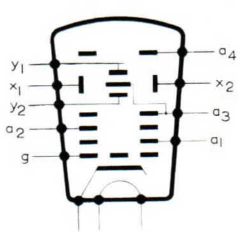
9572

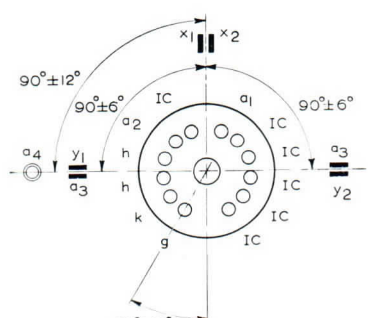




Orientation of axes of deflection as viewed from screen end.

*This face flat within 0·6mm over a minimum area of 90mm dia.





All dimensions in mm

B12F Base

DISC SEAL TRIODE

EC56

Indirectly heated disc seal triode rated for a maximum anode dissipation of 10W. Intended for use in concentric line circuits at frequencies up to 2500Mc/s as a low noise preamplifier or as a low-level power amplifier up to 4000Mc/s.

PRELIMINARY DATA

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—TRANSMITTING VALVES included in this volume of the handbook.

HEATER

$^*V_h$	6.3	V
I_h	650	mA

*The absolute maximum variation of heater voltage should be less than ±2%.

MOUNTING POSITION

Any

CAPACITANCES (measured with V_h=6.3V, I_k=0mA)

c_{a-g}	1.6	pF
c_{a-k}	0.04	pF
c_{g-k}	3.3	pF

CHARACTERISTICS (measured at V_a=180V, I_a=30mA, V_g=−2.8V)

g_m	19	mA/V
μ	43	

COOLING

In order to keep within the seal temperatures a low velocity air flow may be required.

$T_{anode\ seal}$ max.	150	°C
$T_{grid\ seal}$ max.	75	°C
$T_{cathode\ seal}$ max.	75	°C

INSULATION

Between heater and cathode

V_h	6.3	V
V_{h-k} (cathode positive)	50	V
Leakage current	<100	µA

LIMITING VALUES (absolute ratings)

$V_{a(b)}$ max.	500	V
V_a max.	300	V
p_a max.	10	W
I_k max.	35	mA
I_g max.	10	mA
p_g max.	200	mW
$^*P_{load\ (driver)}$ max.	500	mW
$+V_g$ max.	0	V
$-V_g$ max.	50	V
V_{h-k} max. (cathode positive)	50	V
R_{g-k} max.	50	kΩ
R_{h-k} max.	20	kΩ

*Grounded grid connection (f = 4000Mc/s)

EC56

DISC SEAL TRIODE

Indirectly heated disc seal triode rated for a maximum anode dissipation of 10W. Intended for use in concentric line circuits at frequencies up to 2500Mc/s as a low noise preamplifier or as a low-level power amplifier up to 4000Mc/s.

TYPICAL OPERATING CONDITIONS

f	4000	Mc/s
$V_{a(b)}$	220	V
$V_{g(b)}$	+20	V
I_a	30	mA
*R_k	1	kΩ
Bandwidth (–0.1dB)	50	Mc/s
Gain (P_{out} = 1mW)	12	dB
P_{load} (Gain = 6dB)	500	mW

*R_k should consist of a variable resistor and be adjusted to give the required anode current.

DISC SEAL TRIODE

EC56

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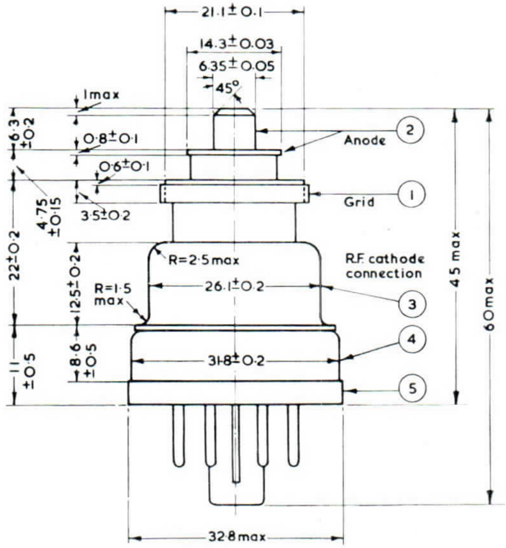


1. The eccentricities are given with respect to the axis of the threaded hole shown in Fig.1, the grid disc of the tube being screwed firmly against the flange (with inner diameter of 17mm.)
2. Maximum eccentricity of the anode 0·15mm.
3. Maximum eccentricity of the R.F. cathode connection 0·20mm.
4. The tolerance of the eccentricity of the base is such that this base fits into a hole with a diameter of 32·5mm, providing this hole is correctly centred with respect to axis of the hole specified in Fig. 1.
5. The tolerance of the eccentricity of the base flange is such that this base flange fits into a hole with a diameter of 33·5mm, providing this hole is correctly centred with respect to the axis of the hole specified in Fig. 1.

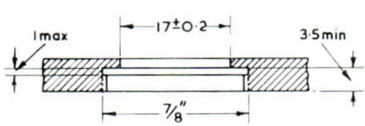
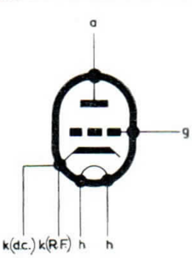
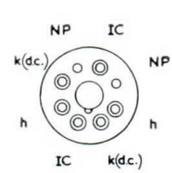


Fig 1

All dimensions in mm unless otherwise shown





Octal Base

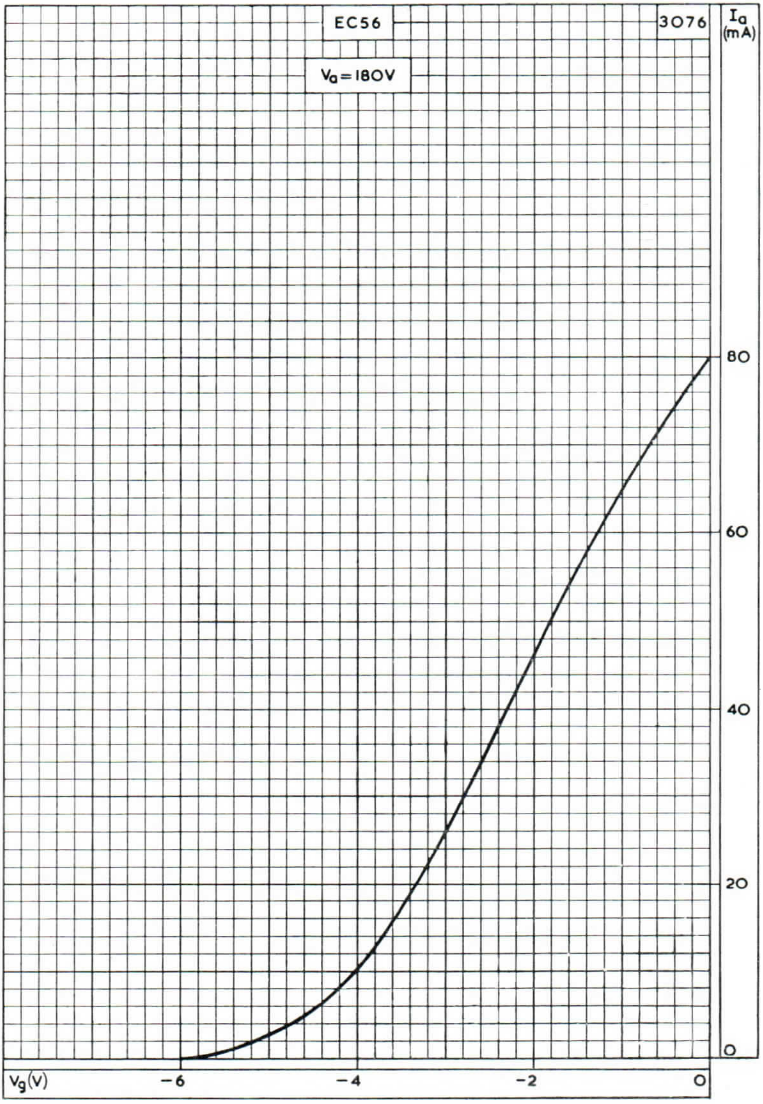
Pins 3 and 8 are connected internally to the cathode disc terminal

2578

EC56

DISC SEAL TRIODE

Indirectly heated disc seal triode rated for a maximum anode dissipation of 10W. Intended for use in concentric line circuits at frequencies up to 2500Mc/s as a low noise preamplifier or or as a low-level power amplifier up to 4000Mc/s.

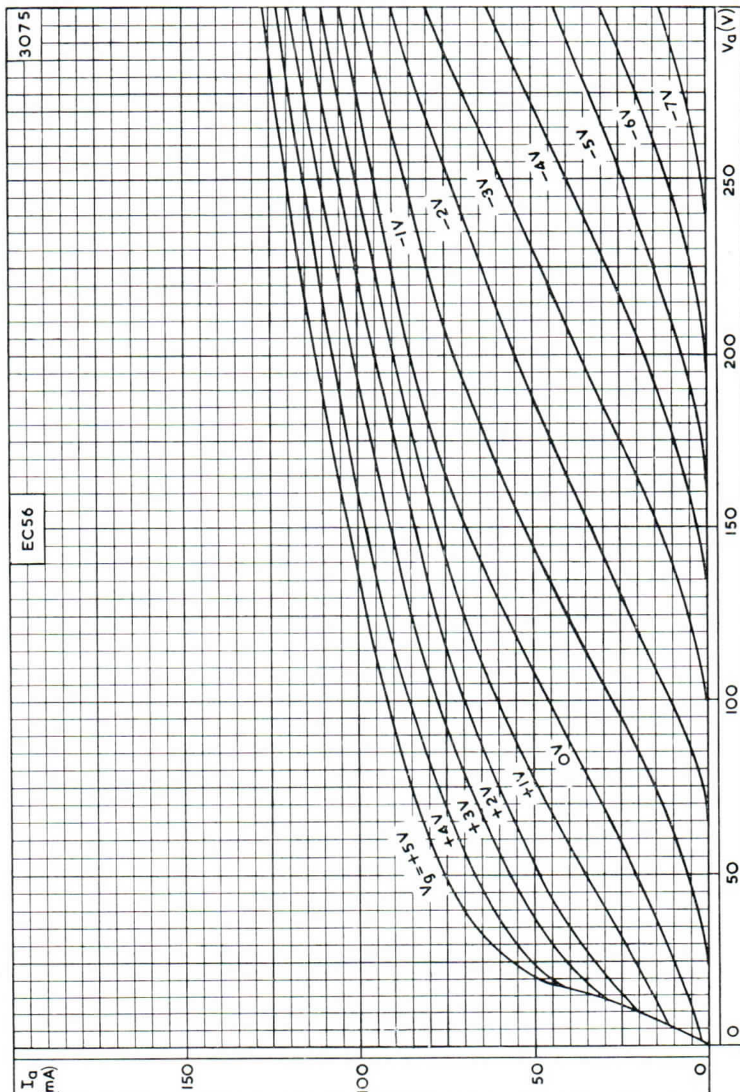


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

DISC SEAL TRIODE

EC56

Indirectly heated disc seal triode rated for a maximum anode dissipation of 10W. Intended for use in concentric line circuits at frequencies up to 2500Mc/s as a low noise preamplifier or as a low-level power amplifier up to 4000Mc/s.

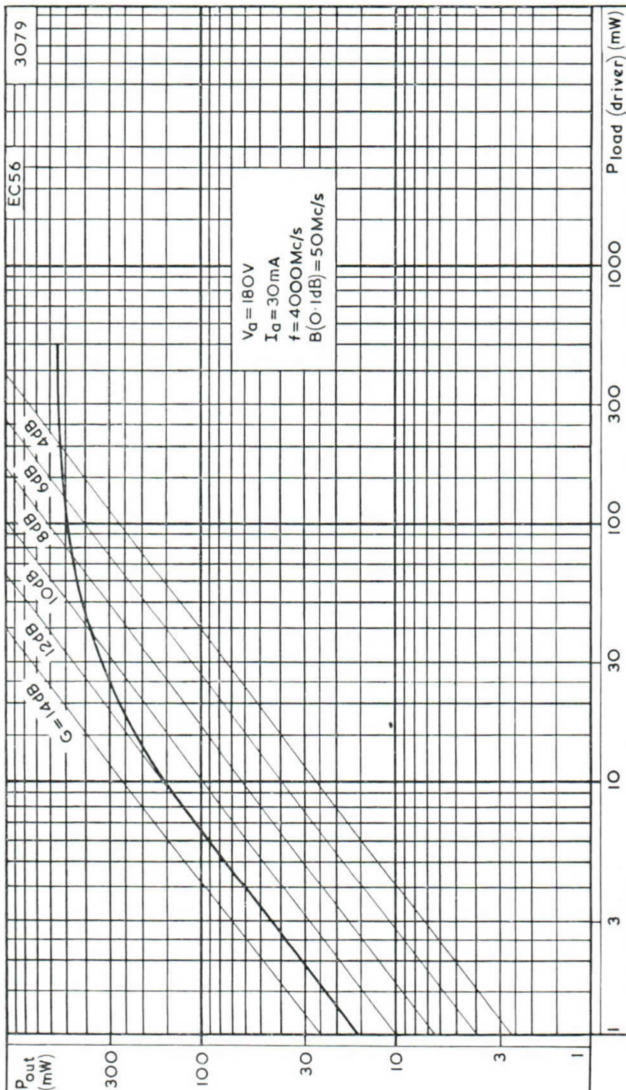


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

EC56

DISC SEAL TRIODE

Indirectly heated disc seal triode rated for a maximum anode dissipation of 10W. Intended for use in concentric line circuits at frequencies up to 2500Mc/s as a low noise preamplifier or as a low-level power amplifier up to 4000Mc/s.



POWER GAIN AT 4000Mc/s

GAS-FILLED TRIODE

EN31

Thyratron for use in h.f. time bases and control equipment.

HEATER

V_h	6.3	V
I_h	1.3	A

CAPACITANCES

c_{in}	6.1	pF
c_{out}	4.2	pF
c_{a-g}	2.3	pF
c_{g-h}	<1.5	pF

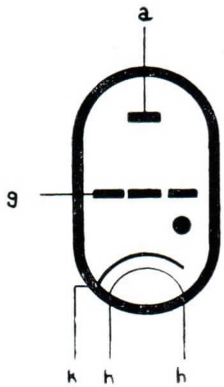
OPERATING CONDITIONS AS TRIODE

$v_{a-g\ (pk)}$ max.	1.5	kV
$v_{a\ (pk)}$ max.	1.0	kV
I_a max.	10	mA
$i_{a\ (pk)}$ max.	750	mA
R_{g-k} min.	750	Ω/V
R_{g-k} max.	750	kΩ
V_{h-k} max. (cathode positive)	100	V
V_{h-k} max. (cathode negative)	0	V
Valve voltage drop	33	V
Control ratio	35	
f max.	150	kc/s

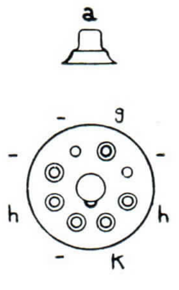
OPERATING CONDITIONS AS HALF WAVE RECTIFIER

(Grid connected to cathode)

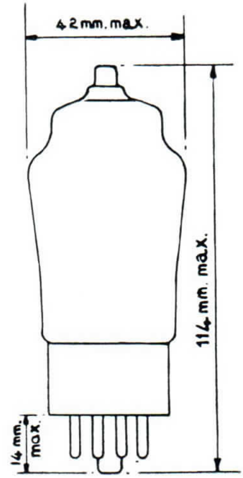
V_a max.	350	V
I_{out} max.	40	mA
R_{lim} min.	100	Ω
C max.	6	μF
V_{h-k} max.	100	V



a
g
k
h
h

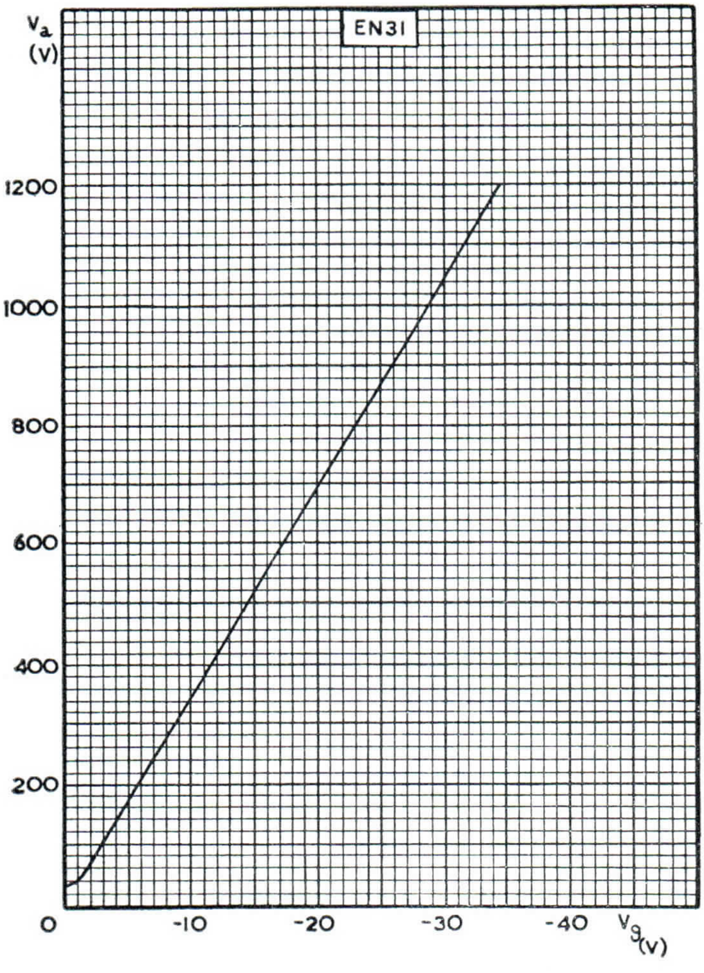


a
g
h
h
K



42 mm. max.
114 mm. max.
14 mm. max.

Thyratron for use in H.F. time bases and control equipment.

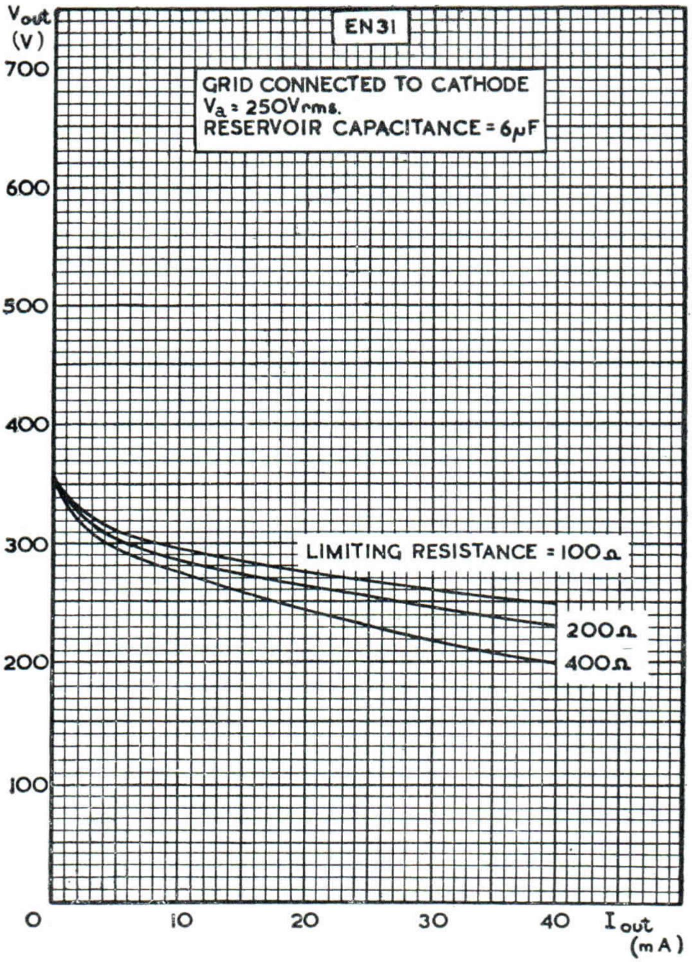


CONTROL CHARACTERISTIC

EN31

GAS-FILLED TRIODE

Thyratron for use in H.F. time bases and control equipment.



OUTPUT VOLTAGE PLOTTED AGAINST OUTPUT CURRENT

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.

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

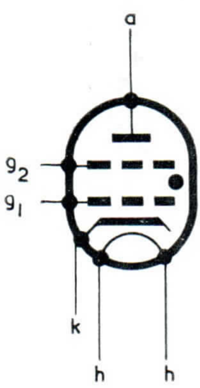
Heater voltage	6.3	V
R.M.S. anode voltage	150	V
Shield-grid voltage	0	V
R.M.S. control-grid voltage (180° out of phase with anode voltage)	5.0	V
*Peak control-grid signal voltage	5.0	V
Control-grid circuit resistance	1.0	MΩ
Anode circuit resistance	3.75	kΩ

*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.



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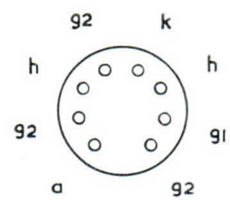
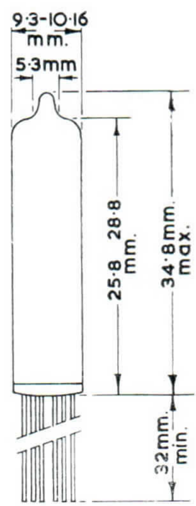


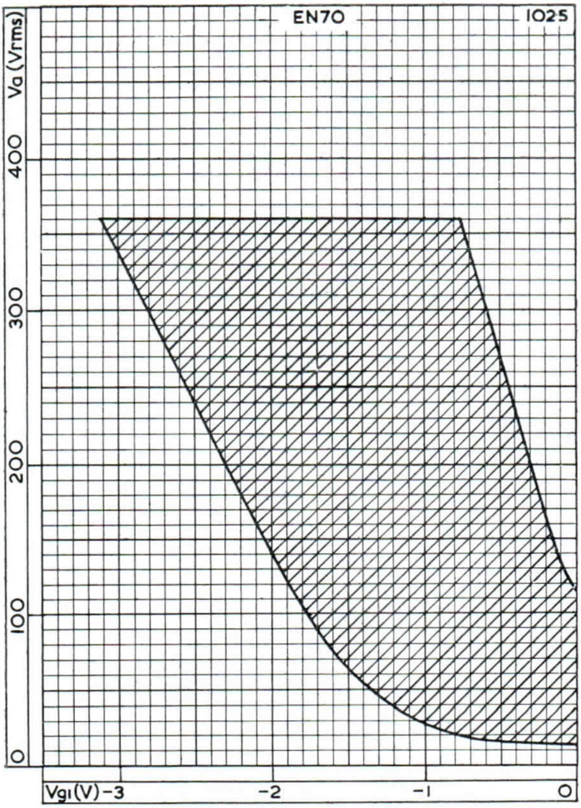
B8D BASE
(10mm. subminiature)



EN70

SUBMINIATURE TETRODE THYRATRON

Subminiature tetrode inert gas-filled thyratron with negative control characteristic.

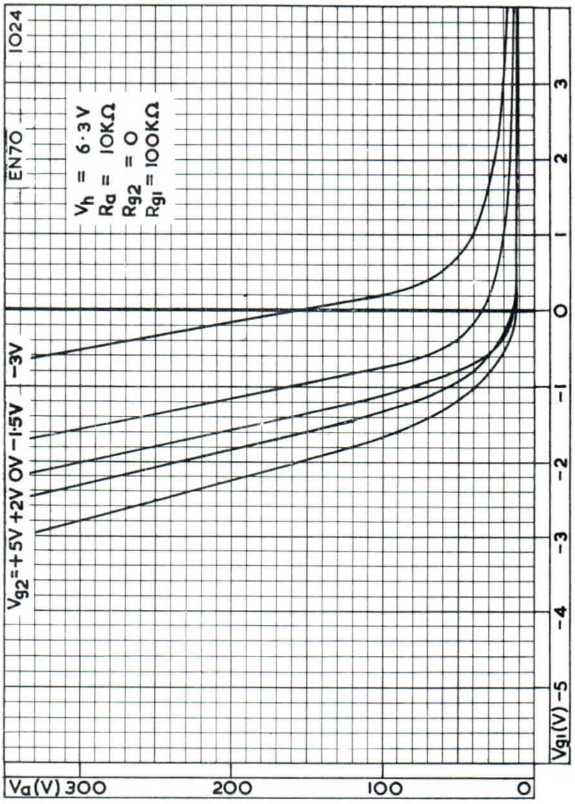


CONTROL CHARACTERISTIC

SUBMINIATURE TETRODE THYRATRON

EN70

Subminiature tetrode inert gas-filled thyratron with negative control characteristic.

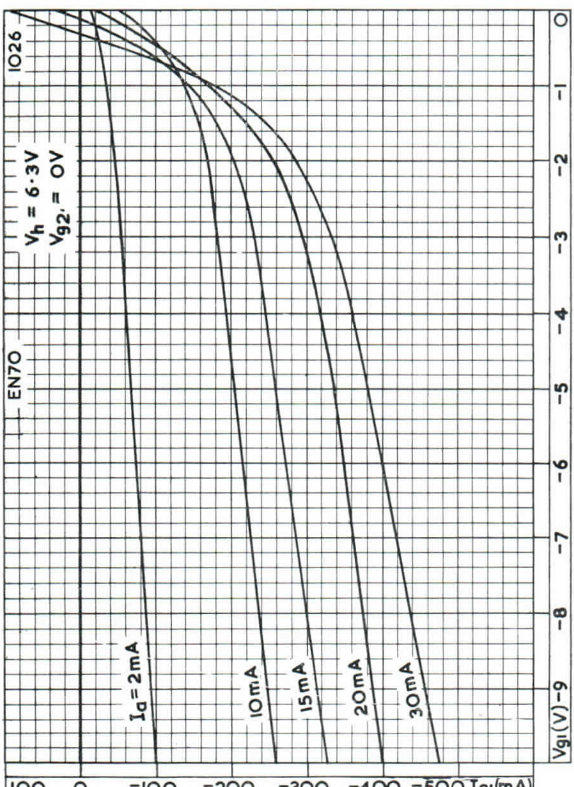


SPREAD OF CONTROL CHARACTERISTIC

EN70

SUBMINIATURE TETRODE THYRATRON

Subminiature tetrode inert gas-filled thyratron with negative control characteristic.



GRID ION CURRENT CHARACTERISTIC

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_{lim} 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_{lim} (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.

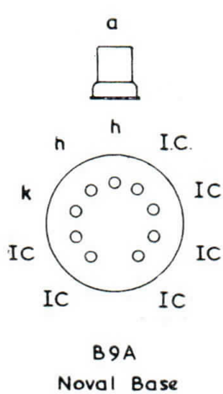
CHOKE INPUT

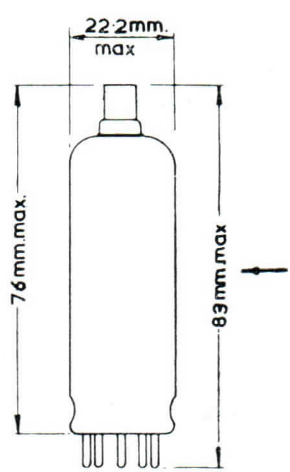
$V_{in(r.m.s.)}$	700–0–700	V
L	5	H
I_{out}	350	mA
V_{out}	550	V

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

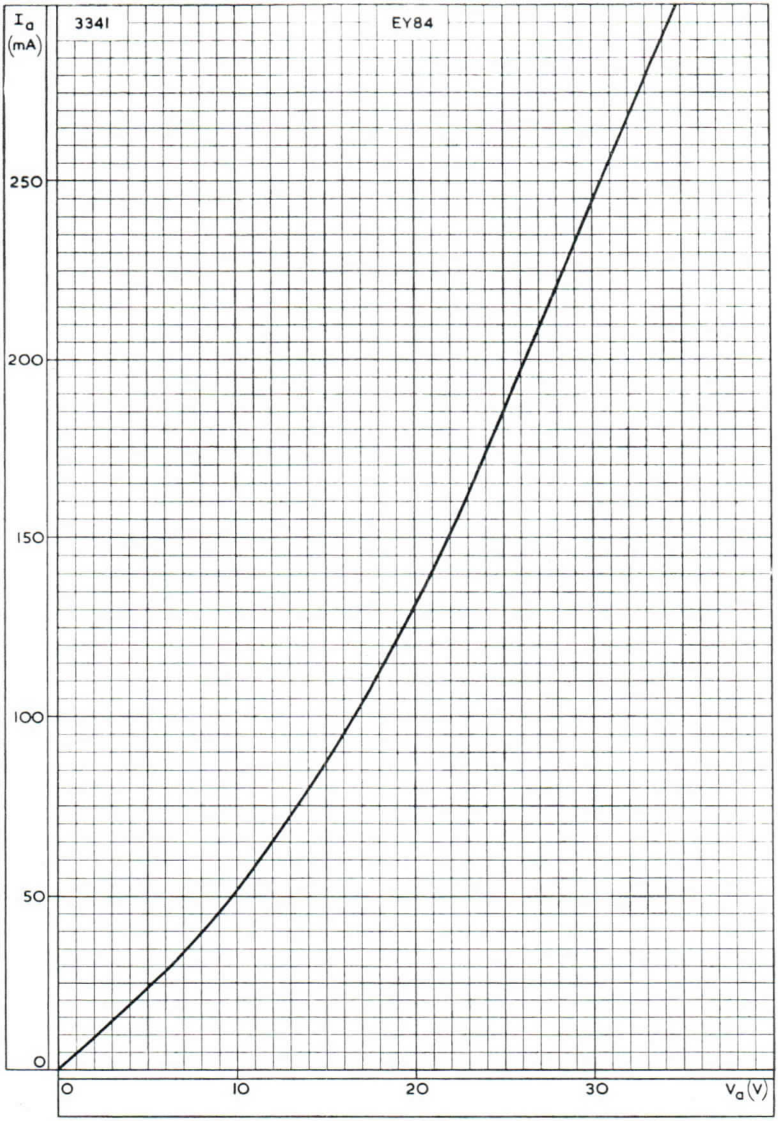




HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

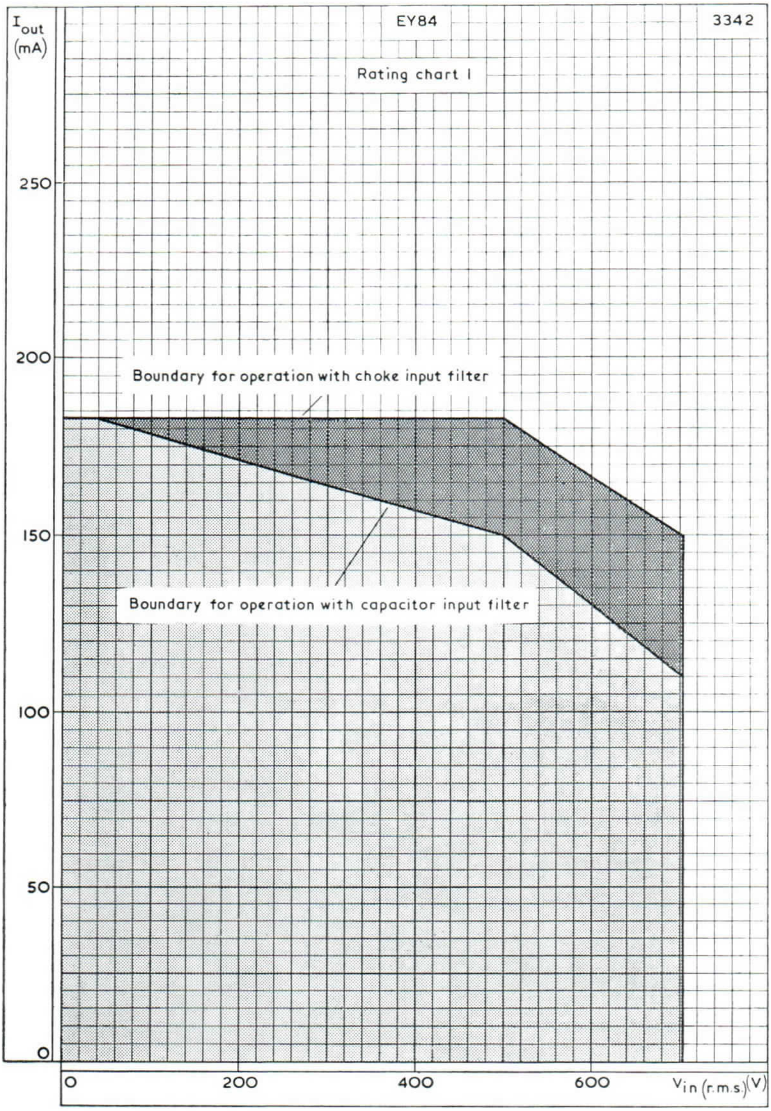


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

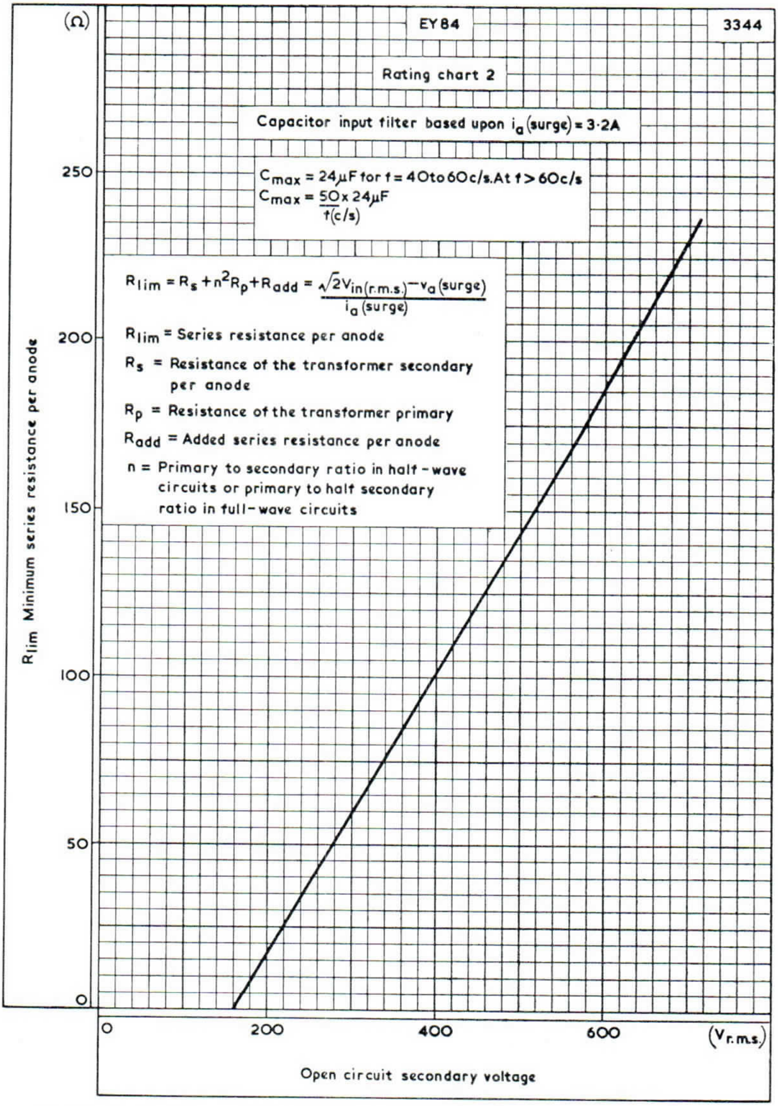


BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER

HALF-WAVE RECTIFIER

EY84

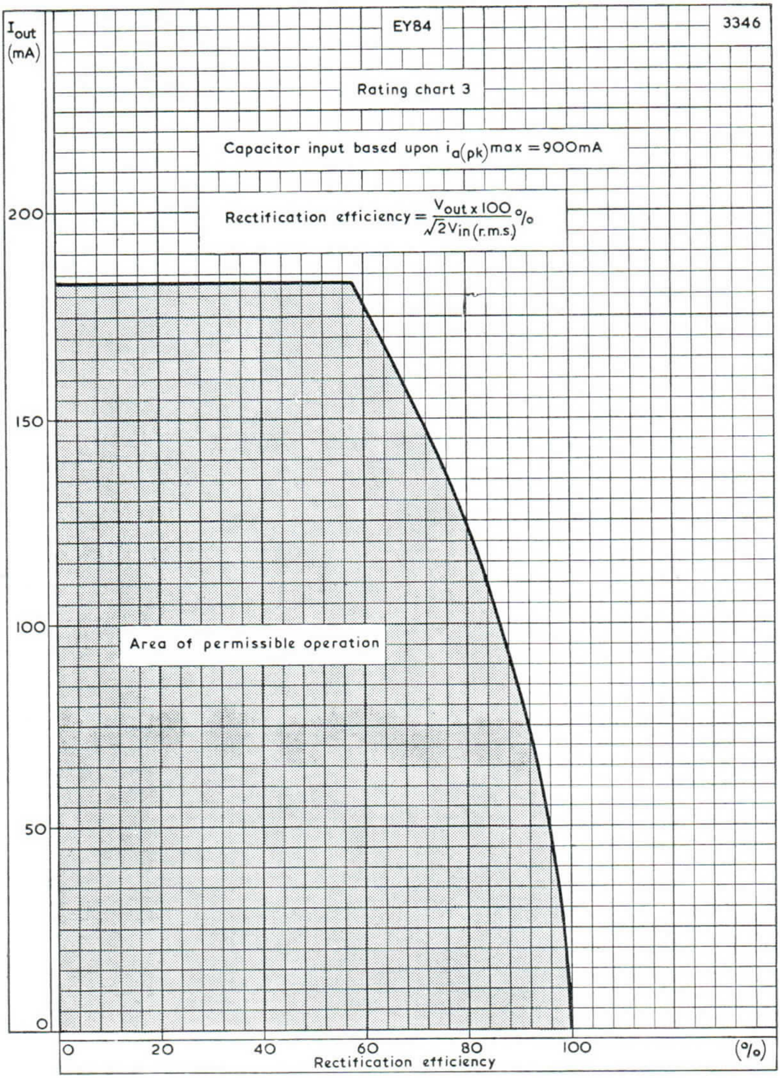
Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.



MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST OPEN CIRCUIT SECONDARY VOLTAGE

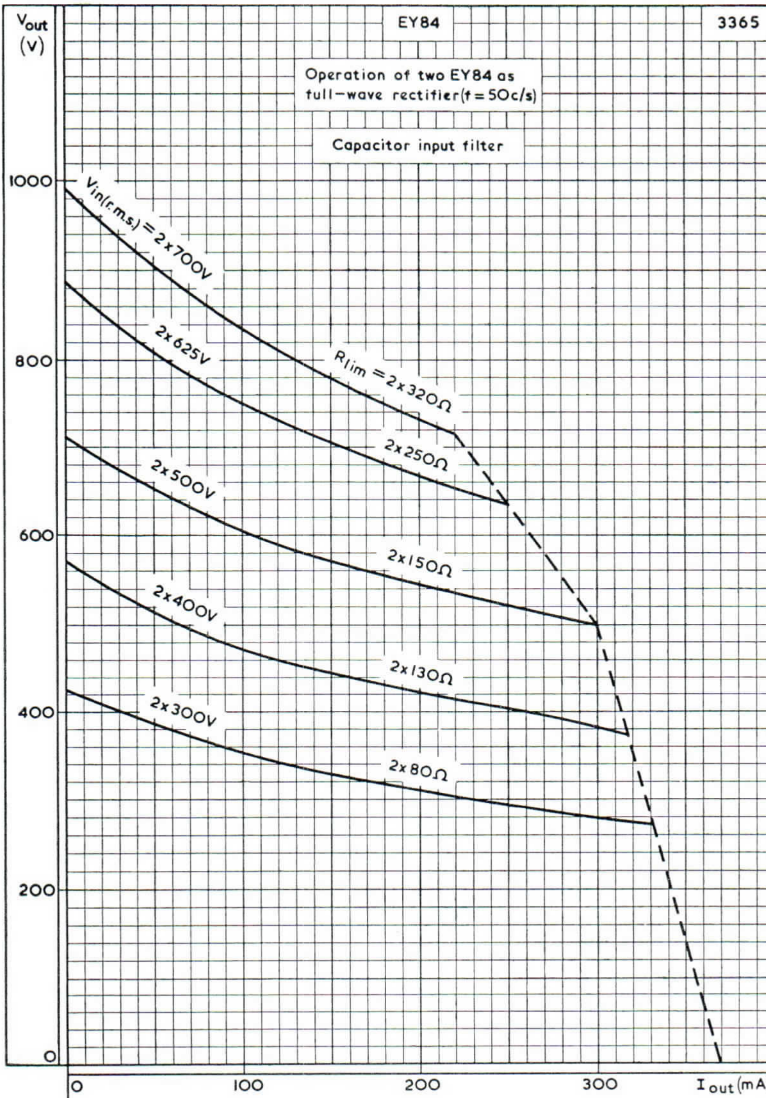
HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.



OUTPUT CURRENT PLOTTED AGAINST RECTIFICATION EFFICIENCY

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

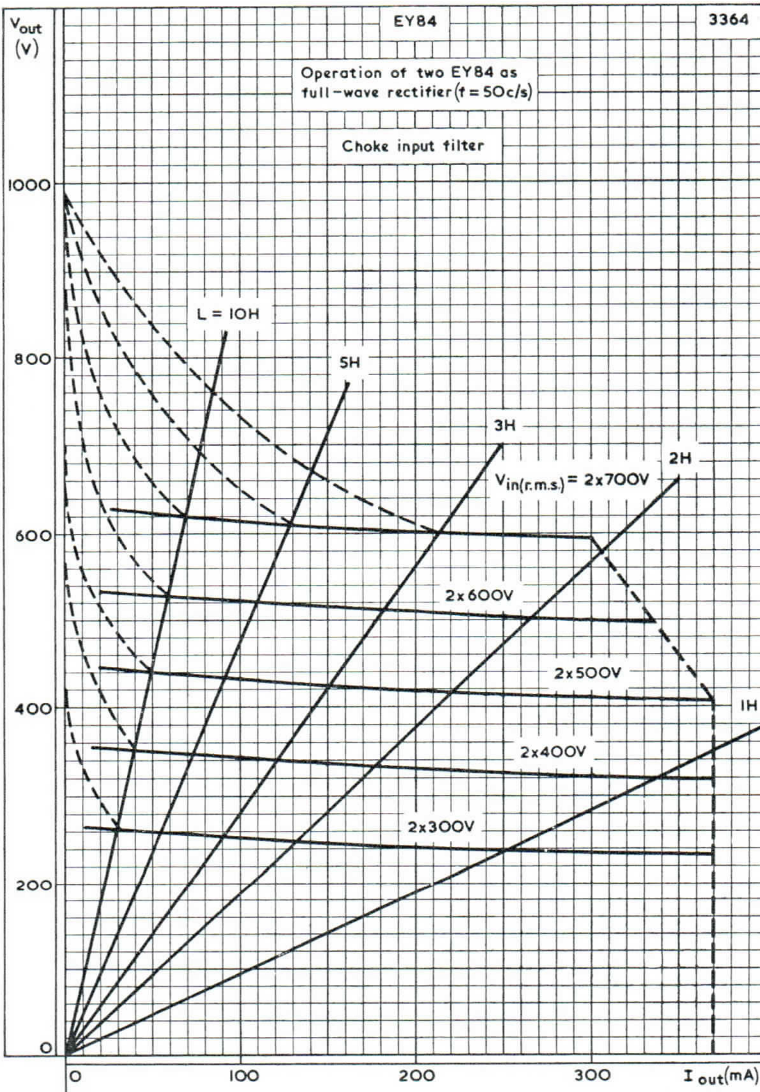


CAPACITOR INPUT FILTER REGULATION CURVES

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.



CHOKE INPUT FILTER REGULATION CURVES

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

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

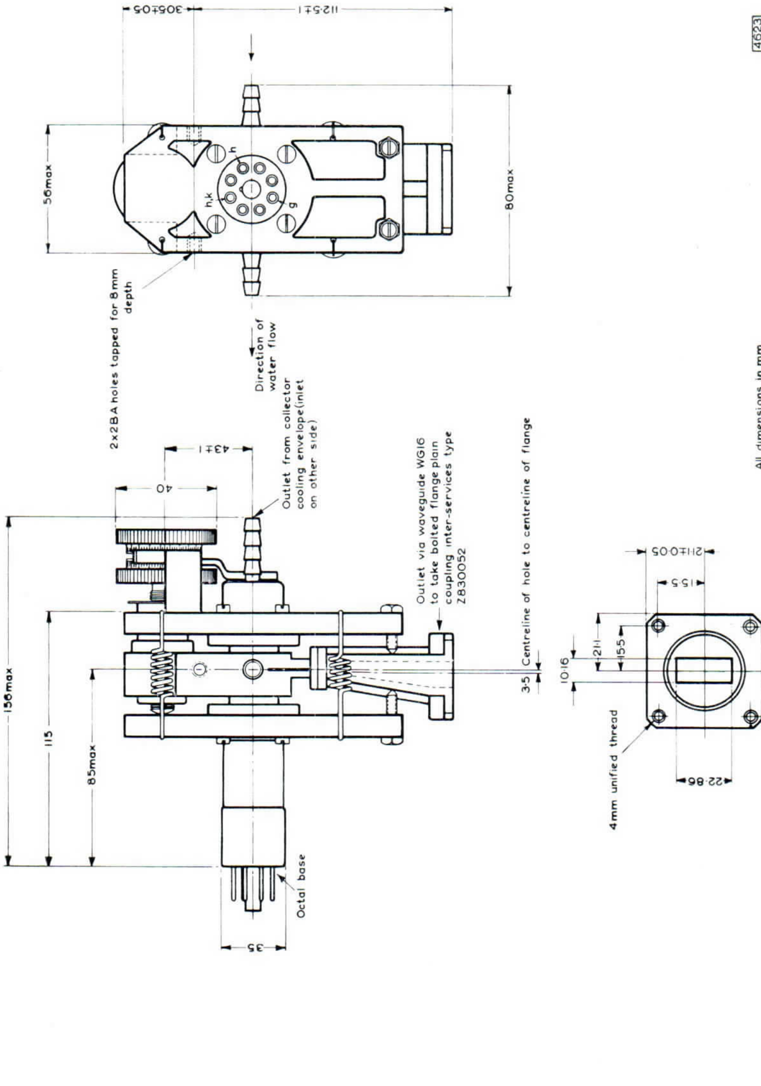
Frequency	9.3	Gc/s
Resonators/collector voltage	4.3	kV
Grid voltage	−50	V
Collector current	65	mA
Power input	280	W
Resonators/collector dissipation	262	W
Power output	>18	W

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


30±0.5
112.5±1
56max
80max
h
h,k
g
2×2BA holes tapped for 8mm depth
Direction of water flow
43±1
40
Outlet from collector cooling envelope (inlet on other side)
Outlet via waveguide WG16 to take bolted flange plain coupling inter-services type Z830052
Centreline of hole to centreline of flange
158max
115
85max
3.5
10.16
21.1
15.5
21±0.05
15.5
22.86
4mm unified thread
Octal base
35
All dimensions in mm
4623

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.

MAINTENANCE TYPE

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.

LA9-3

FORWARD WAVE AMPLIFIER

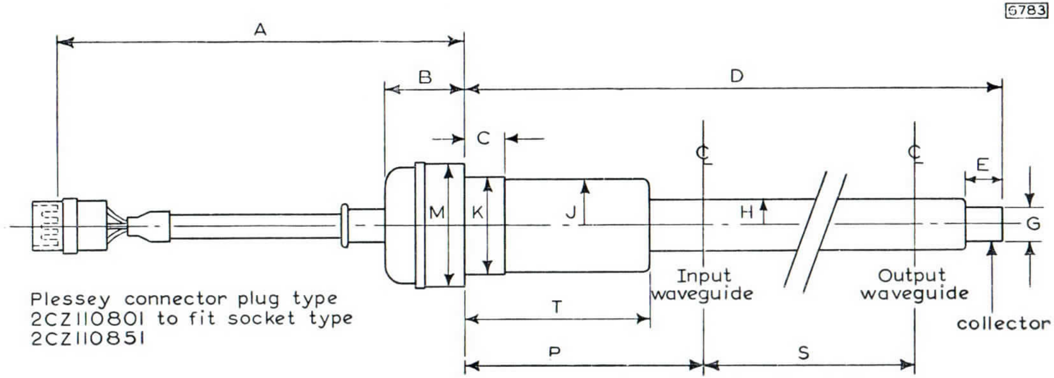
ABSOLUTE MAXIMUM RATINGS

$V_{collector}$ 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

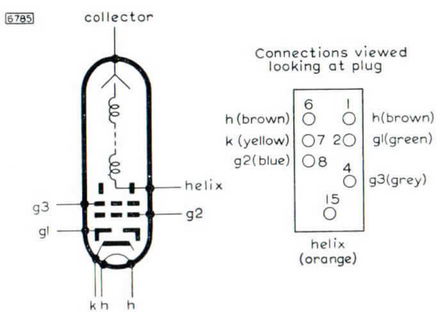
MOUNTING POSITION Any

ACCESSORIES

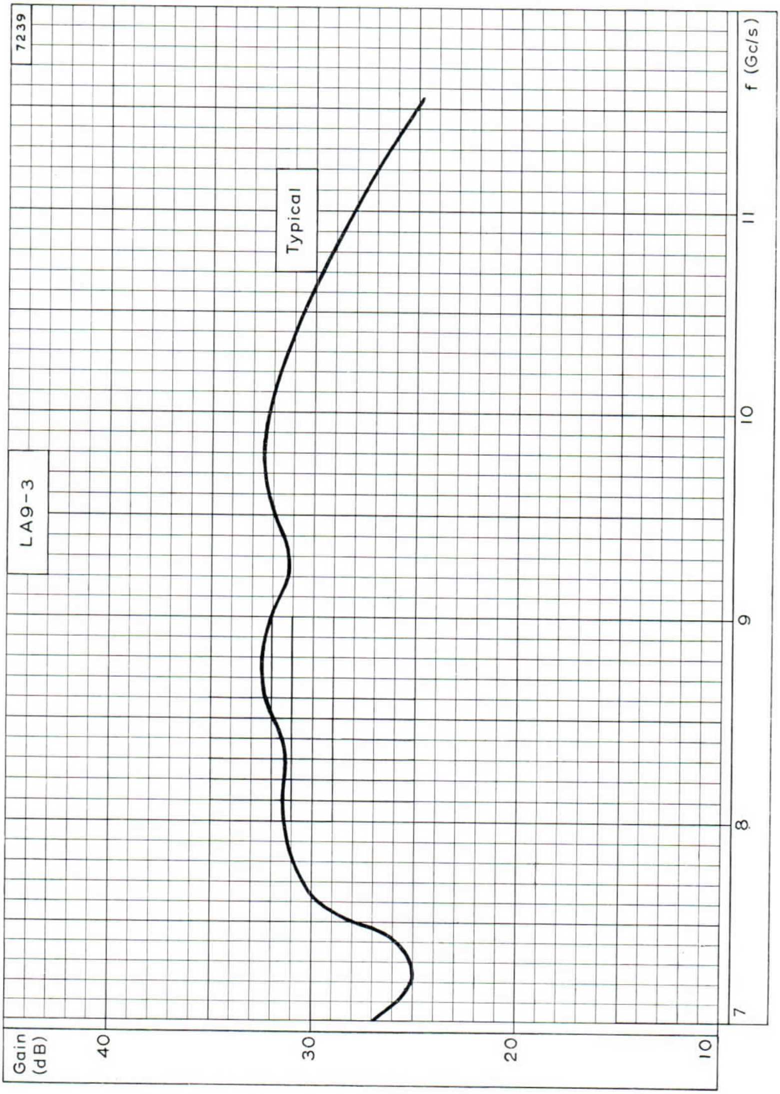
Mount	Permanent magnet	P9L-1
	Solenoid	S9L-1



Waveguide dimensions 0.900 × 0.079 inches, 22.86 × 2.00 millimetres



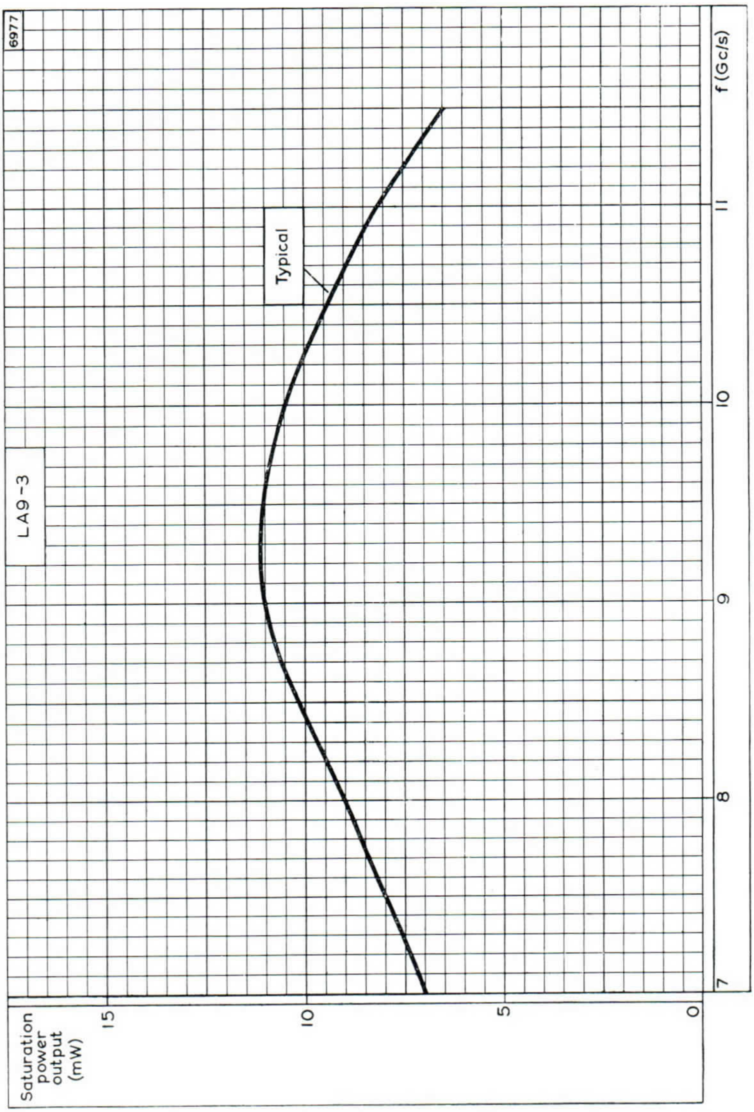
	Inches	Millimetres	
A	4.331	110	min.
B	1.299	33	max.
C	0.650	16.5	max.
D	12.638	316	max.
E	0.394	10	
G	0.167 ± 0.002	5.0 ± 0.05	
H	0.125	3.17	max.
J	0.472	12	max.
K	1.063	27	max.
M	1.260	32	max.
P	2.835 ± 0.008	72 ± 0.2	
S	8.150 ± 0.004	207 ± 0.1	
T	2.126	54	max.



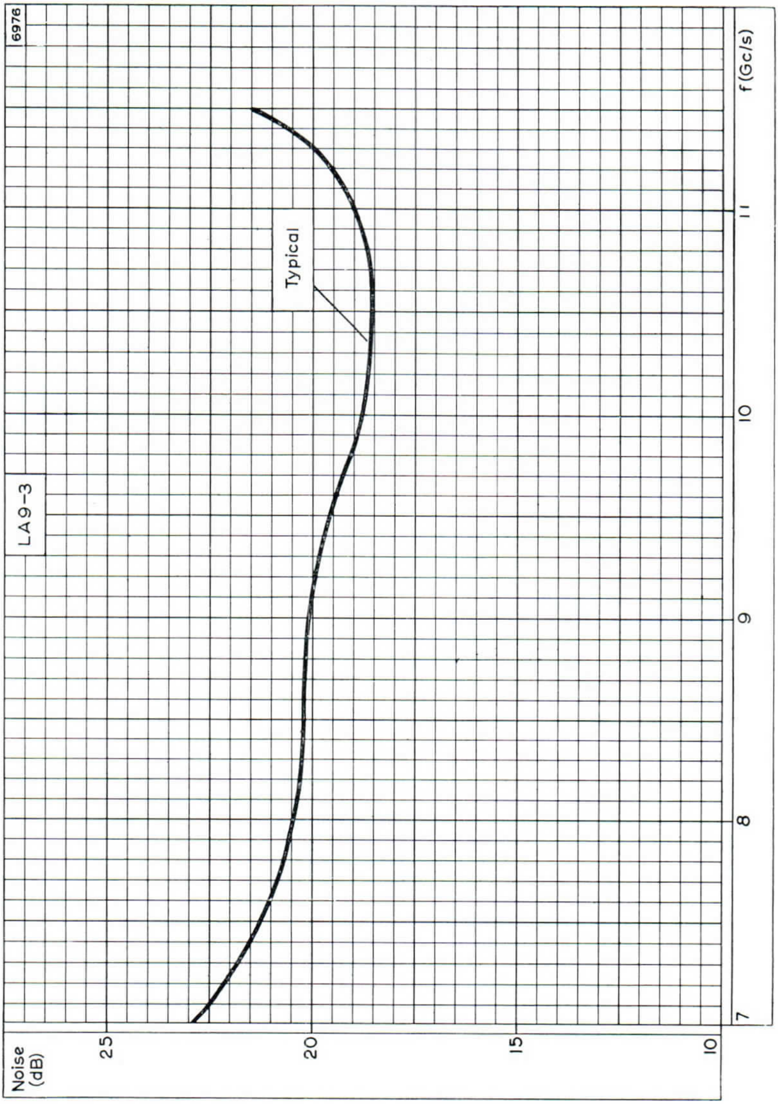
TYPICAL GAIN PLOTTED AGAINST FREQUENCY

LA9-3

FORWARD WAVE AMPLIFIER



SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



TYPICAL NOISE FACTOR PLOTTED AGAINST FREQUENCY USING A PERMANENT-MAGNET MOUNT

FORWARD WAVE AMPLIFIER

LA9-3B

Application:	*Broadband low power amplifier.*
Frequency:	*'X' 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	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 $I_k = 0$mA)	40		—	dB
Input match—broadband (v.s.w.r.)	—		3.5	
Output match—broadband (v.s.w.r.)	—		3.5	

CATHODE

Indirectly heated

V_h	6.3	V
I_h	500	mA
t_{h-k}	5.0	min

TYPICAL OPERATION

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 (v.s.w.r.)	3.0	
Output match (v.s.w.r.)	3.0	

LA9-3B

FORWARD WAVE AMPLIFIER

ABSOLUTE MAXIMUM RATINGS

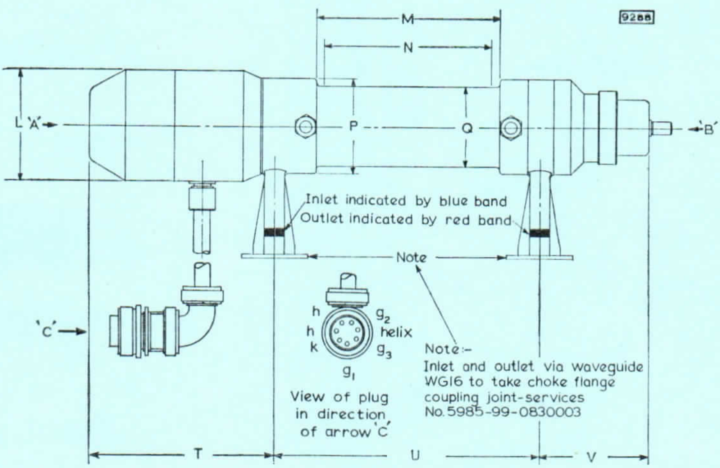
$V_{collector}$ max.	1.55	kV
$I_{collector}$ max.	600	μA
$p_{collector}$ max.	900	mW
V_{helix} max.	1.45	kV
I_{helix} max.	50	μA
V_{g3} max.	400	V
I_{g3} max.	10	μA
V_{g2} max.	200	V
I_{g2} max.	10	μA
$-V_{g1}$ max.	100	V
I_{g1} max.	10	μA
$P_{in(signal)}$ max.	500	mW
V_{h-k} max.	50	V

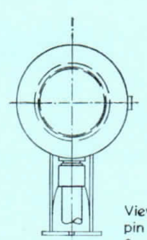
MOUNTING POSITION

Any

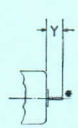
DIMENSIONS

	Inches	*Millimetres*	
L	2.39	86	max.
M	5.275 ± 0.039	134 ± 1	
N	5.00	127	min.
P	2.795 ± 0.039	71 ± 1	
Q	2.401 ± 0.008	61 ± 0.2	
T	5.40 ± 0.12	137 ± 3	
U	7.828 ± 0.008	198.84 ± 0.2	
V	3.11 ± 0.08	79 ± 2	
W	1.77	45	max.
X	3.976 ± 0.020	101 ± 0.5	
Y	0.398 ± 0.08	10 ± 2	



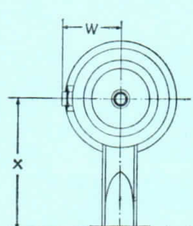


View in direction of arrow 'A'

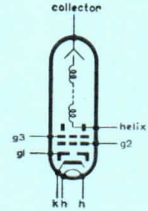


View of collector socket-pin with protector removed

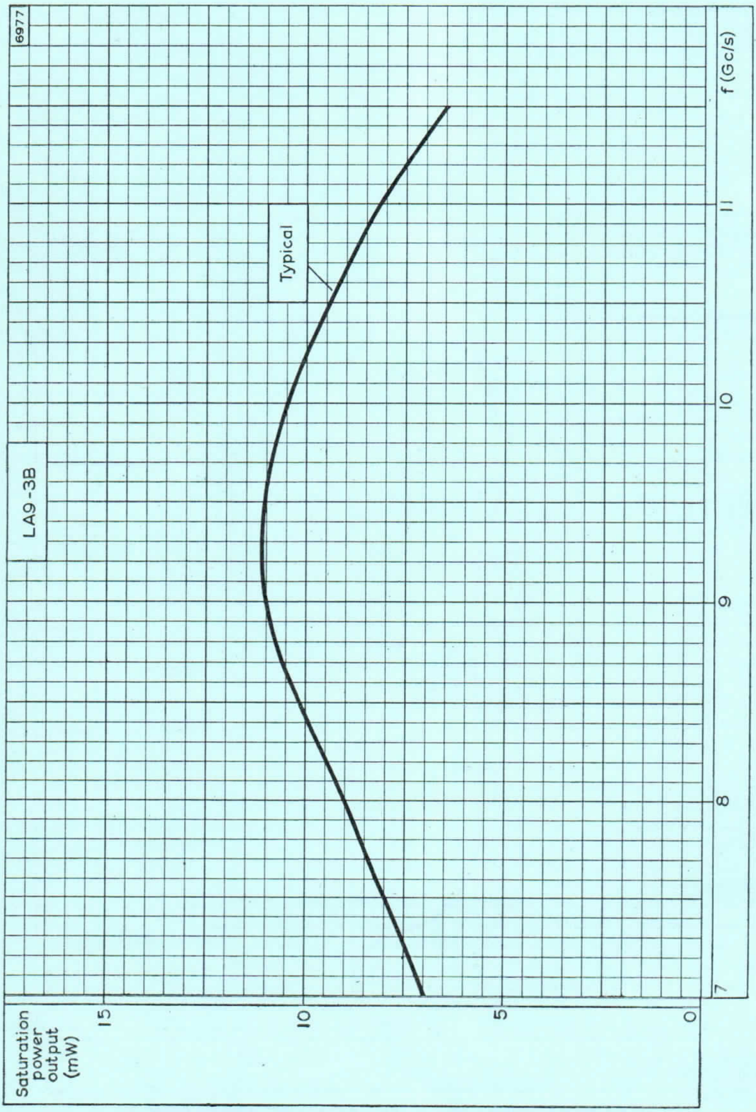
* This collector socket-pin is silver-plated and is intended for a soldered connection



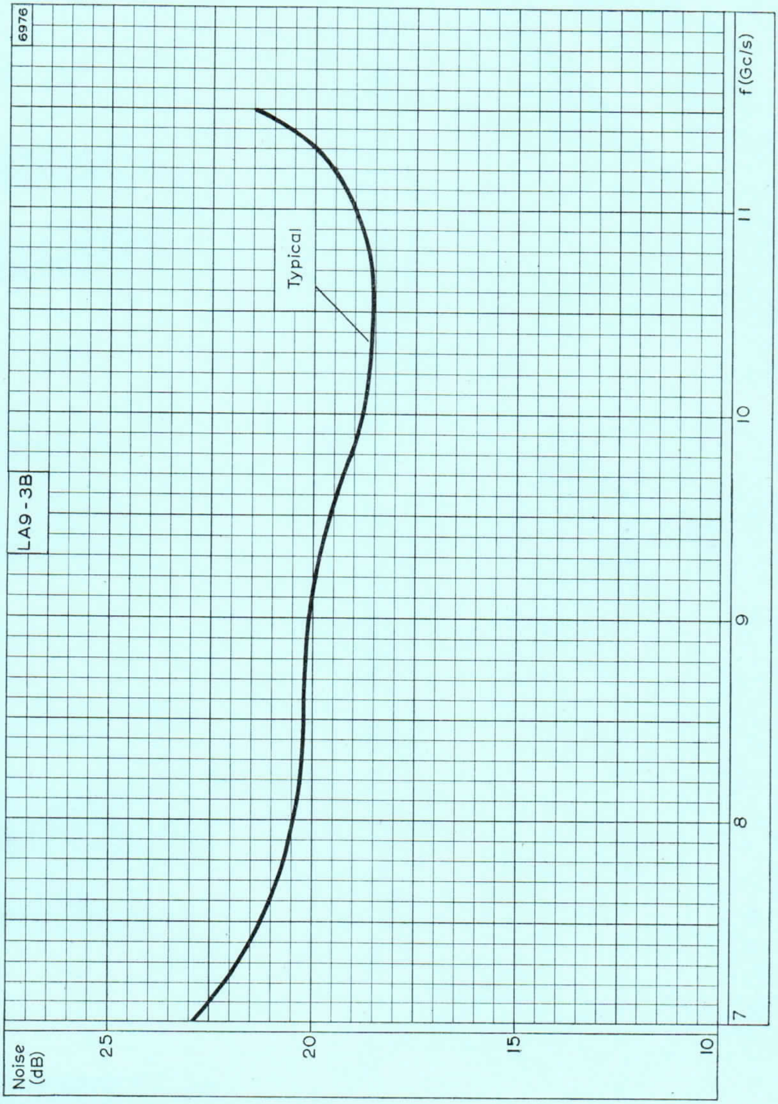
View in direction of arrow 'B'



TYPICAL GAIN PLOTTED AGAINST FREQUENCY



SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



TYPICAL 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

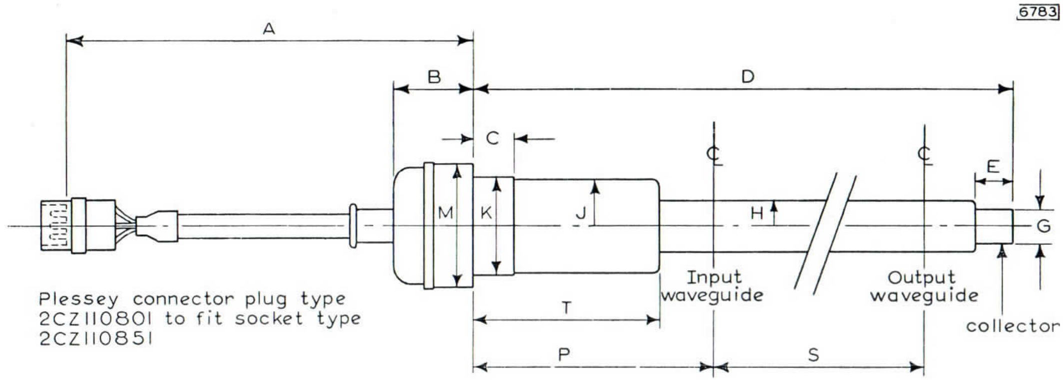
$V_{collector}$ max.	1.85	kV
$I_{collector}$ max.	500	μA
$P_{collector}$ max.	800	mW
V_{helix} max.	1.75	kV
I_{helix} max.	60	μA
V_{g3} max.	200	V
I_{g3} max.	20	μA
V_{g2} max.	450	V
I_{g2} max.	20	μA
$-V_{g1}$ max.	150	V
I_{g1} max.	10	μA
$P_{in\ (signal)}$ max.	300	mW
V_{h-k} max.	50	V

MOUNTING POSITION

Any

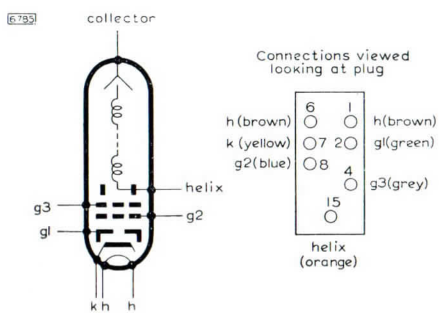
ACCESSORIES

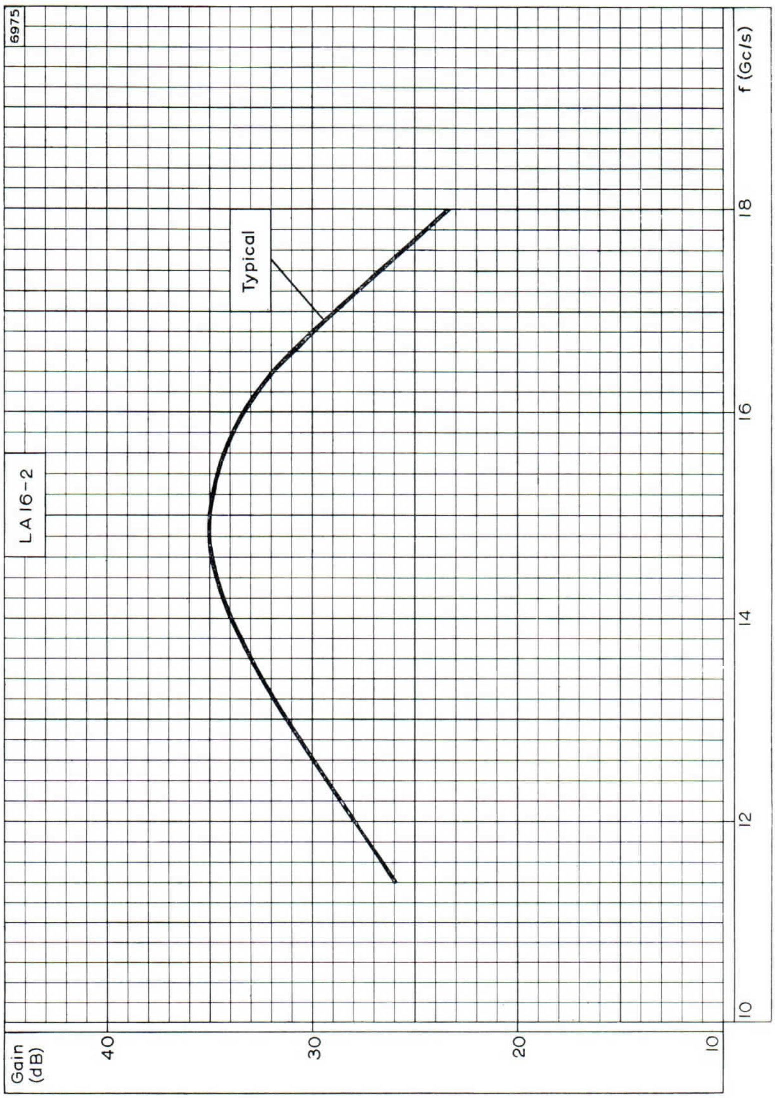
Mount	Permanent magnet	P16L–1
	Solenoid	S16L–1



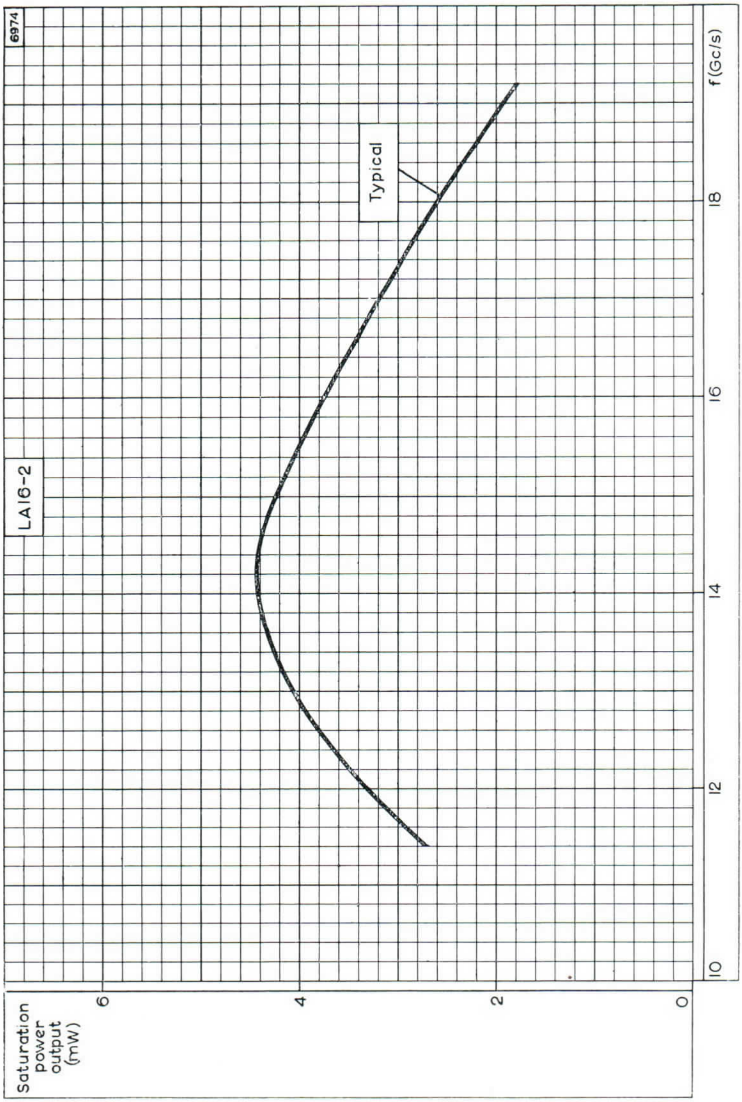
Waveguide dimensions 0.622 × 0.311 in., 15.78 × 7.90 mm.

	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.

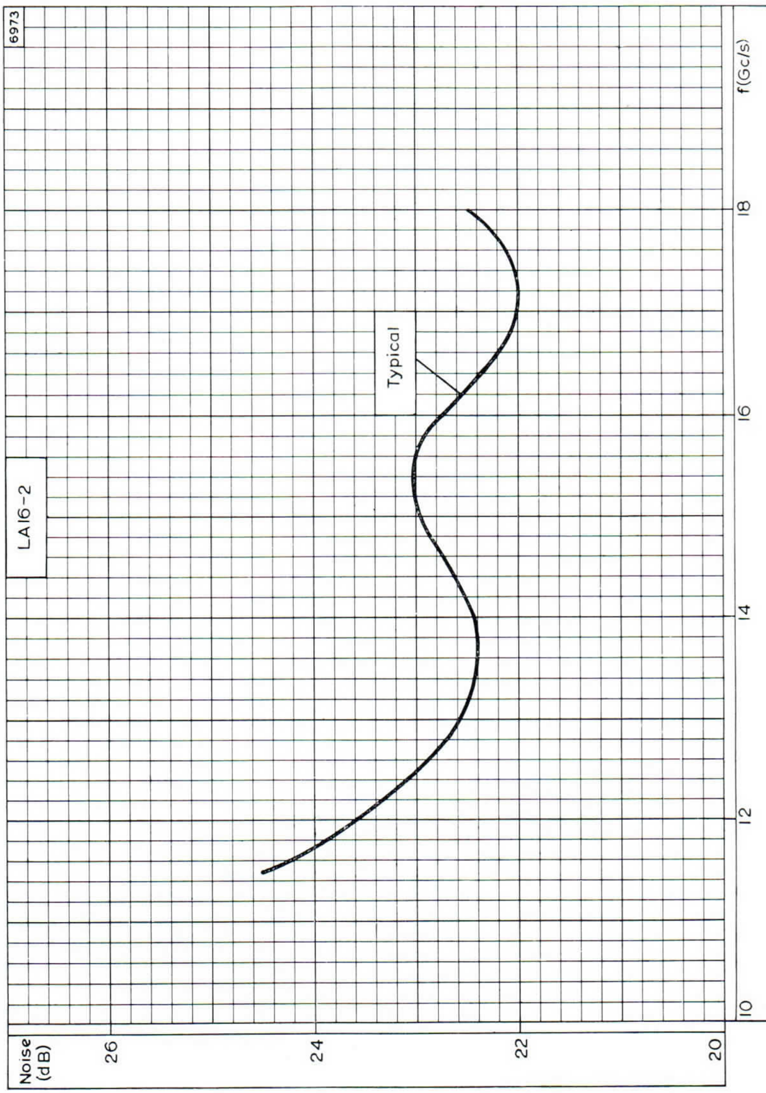




TYPICAL GAIN PLOTTED AGAINST FREQUENCY



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 $I_k = 0$mA)	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

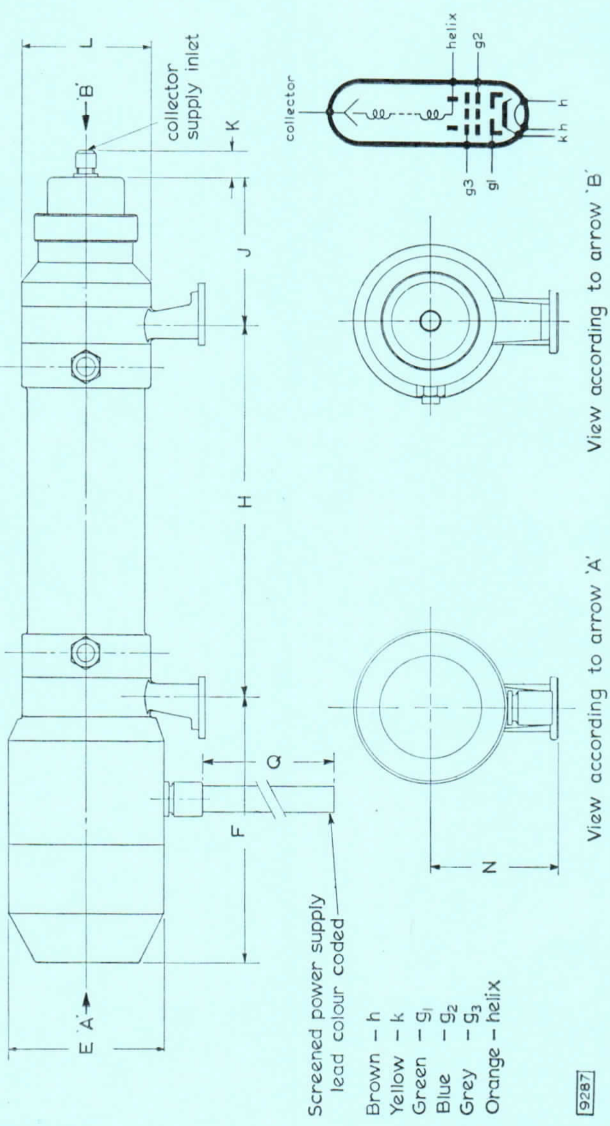
$V_{collector}$ max.	1.85	kV
$I_{collector}$ max.	500	μA
$p_{collector}$ max.	800	mW
V_{helix} max.	1.75	kV
I_{helix} max.	60	μA
V_{g3} max.	200	V
I_{g3} max.	20	μA
V_{g2} max.	450	V
I_{g2} max.	20	μA
$-V_{g1}$ max.	150	V
I_{g1} max.	10	μA
$P_{in\ (signal)}$ max.	300	mW
V_{h-k} max.	50	V

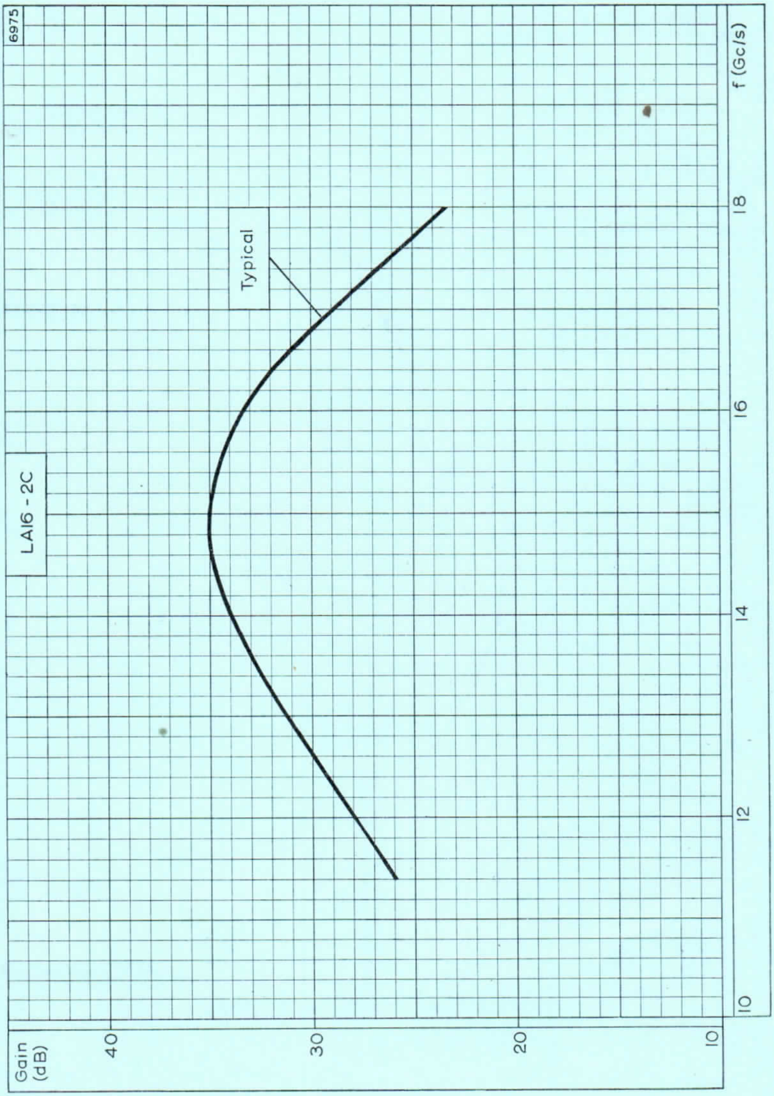
MOUNTING POSITION

Any

DIMENSIONS

	Inches	*Millimetres*	
E	2.39	86	max.
F	5.39 $\pm$ 0.12	137 $\pm$ 3	
H	7.828 $\pm$ 0.008	198.84 $\pm$ 0.2	
J	3.11 $\pm$ 0.08	79 $\pm$ 2	
K	0.47	12	
L	2.80	71	dia.
N	3.976 $\pm$ 0.020	101 $\pm$ 0.5	
Q	12	305	

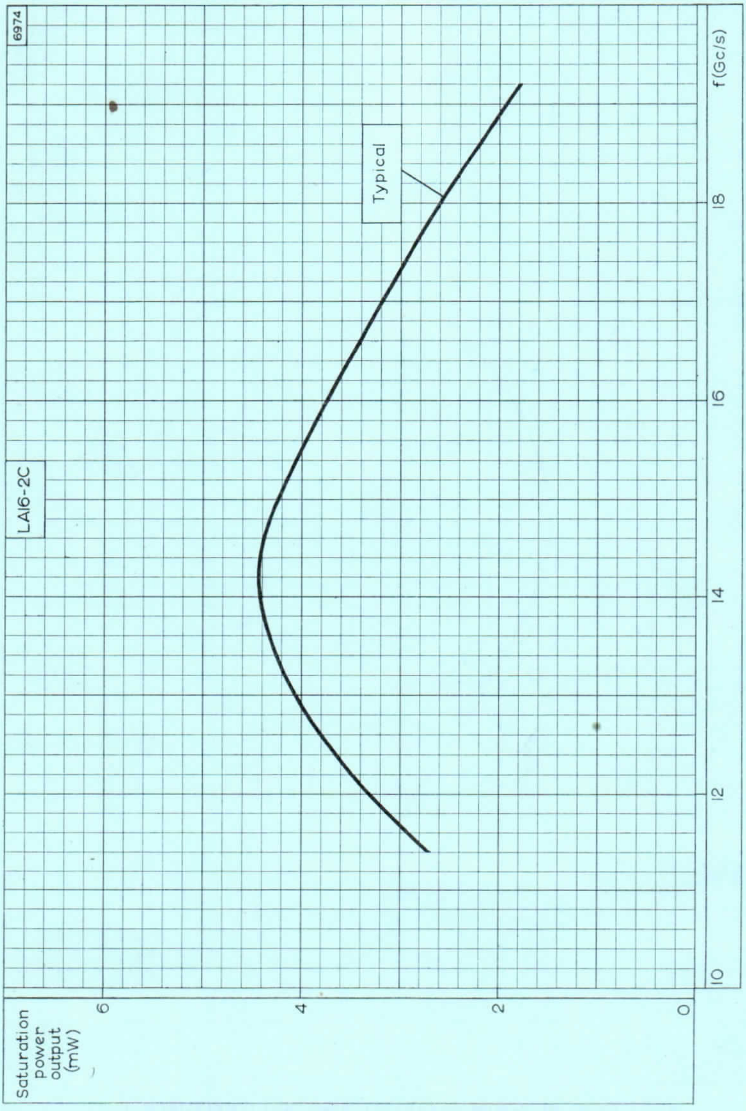

L
'B'
collector supply inlet
K
J
H
F
Q
E
'A'
N
collector
helix
g2
h
k h
g3
gl
View according to arrow 'B'
View according to arrow 'A'
Screened power supply lead colour coded
Brown – h
Yellow – k
Green – g_1
Blue – g_2
Grey – g_3
Orange – helix
9287



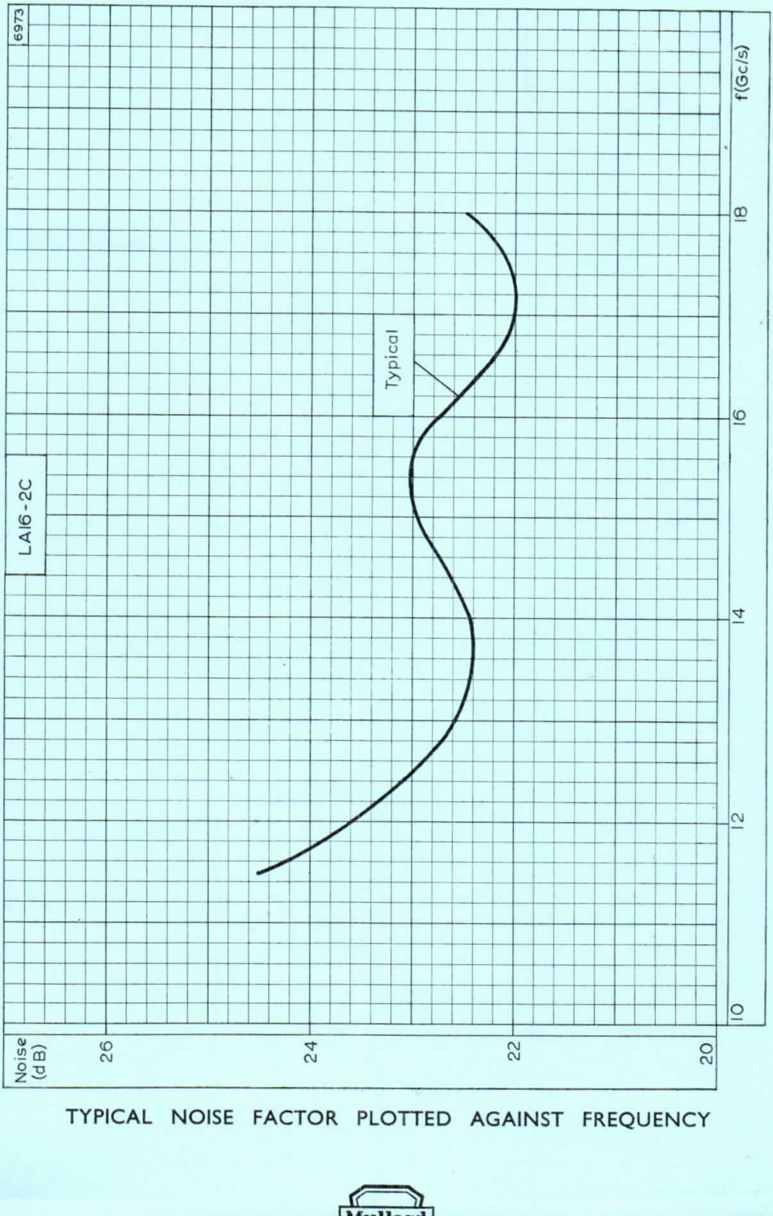
TYPICAL GAIN PLOTTED AGAINST FREQUENCY

LA16-2C

FORWARD WAVE AMPLIFIER



SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



TYPICAL NOISE FACTOR PLOTTED AGAINST FREQUENCY

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)

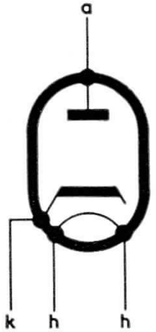
P.I.V. max.	2.0	kV
$i_{a(pk)}$ max.	900	mA
V_{h-k} max.	650	V
Maximum altitude for full P.I.V. rating	60,000	ft
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

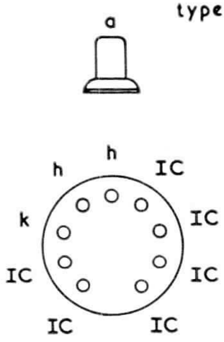
TYPICAL OPERATION OF TWO M8091 AS FULL-WAVE RECTIFIER

Capacitor input

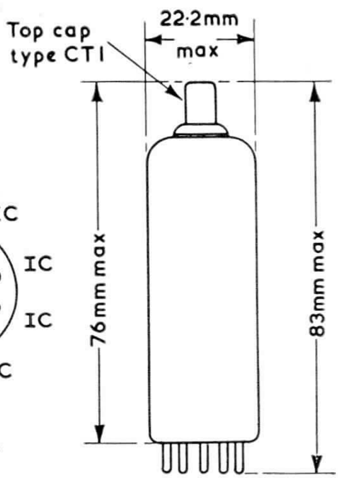
$V_{in(r.m.s.)}$	2 × 500	2 × 625	V
R_{lim} min. (per anode)	150	250	Ω
C max.	16	16	μF
I_{out} max.	300	250	mA

3367





B9A Base



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. $V_{in(r.m.s.)} = 500V$, $R_{load} = 3k\Omega$	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

Life[14]

Running conditions. $V_{in(r.m.s.)} = 500V$, $R_{load} = 3k\Omega$
$V_{h-k} = V_{out} + 150V$ r.m.s., $C = 8\mu F$

Stability life test end point

	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	
Change in anode voltage after 1 hour. $I_a = 150mA$	1.0	—	—	10	%

Intermittent life test

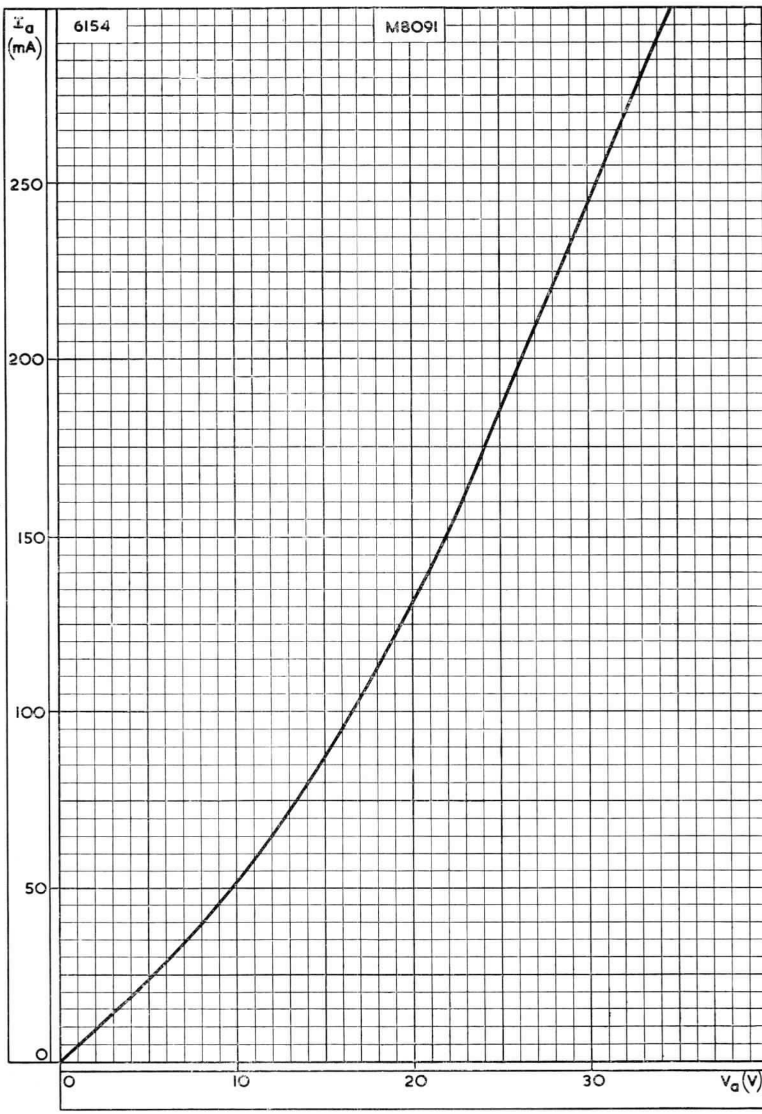
Running conditions. $V_{in(r.m.s.)} = 500V$, $R_{load} = 3k\Omega$
$V_{h-k} = V_{out} + 150V$ r.m.s., $C = 8\mu F$

Intermittent life test end points

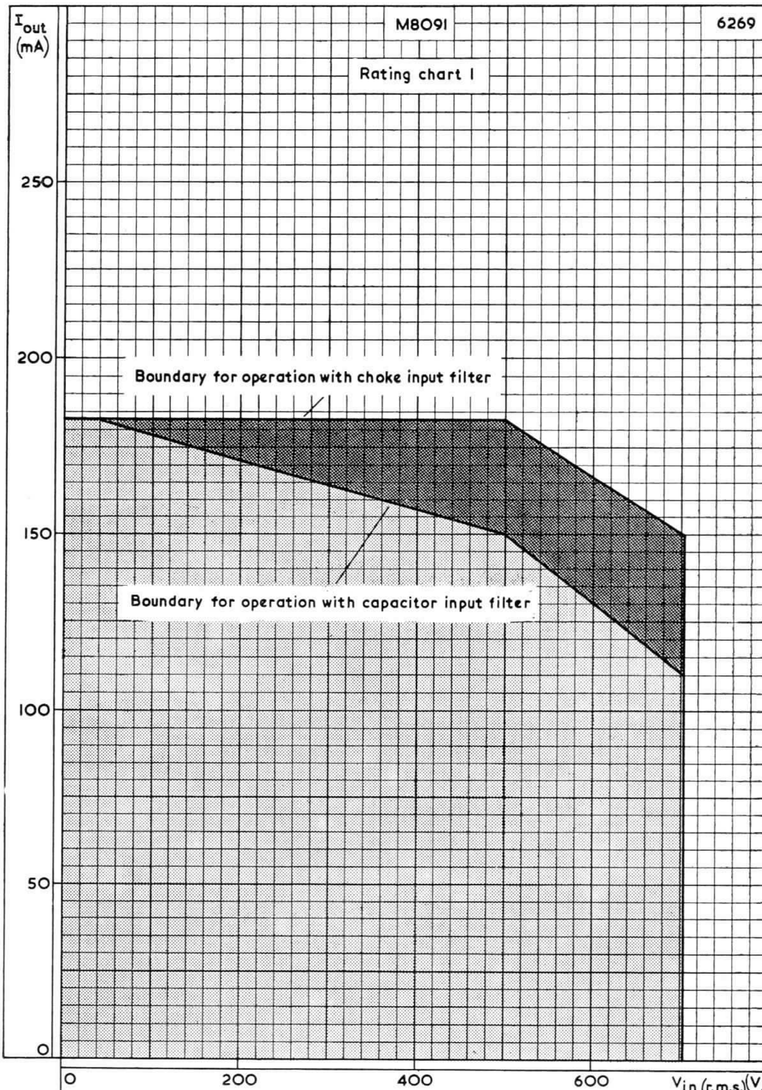
		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	0.9	1.4	A
Heater to cathode leakage current. $V_{h-k} = 300V$ (cathode positive)	500 hours	2.5	—	150	µA
	1000 hours	4.0	—	150	µA
Sub-group (b)					
Output current	500 hours	4.0	120	—	mA
	1000 hours	6.5	120	—	mA
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

GROUP G

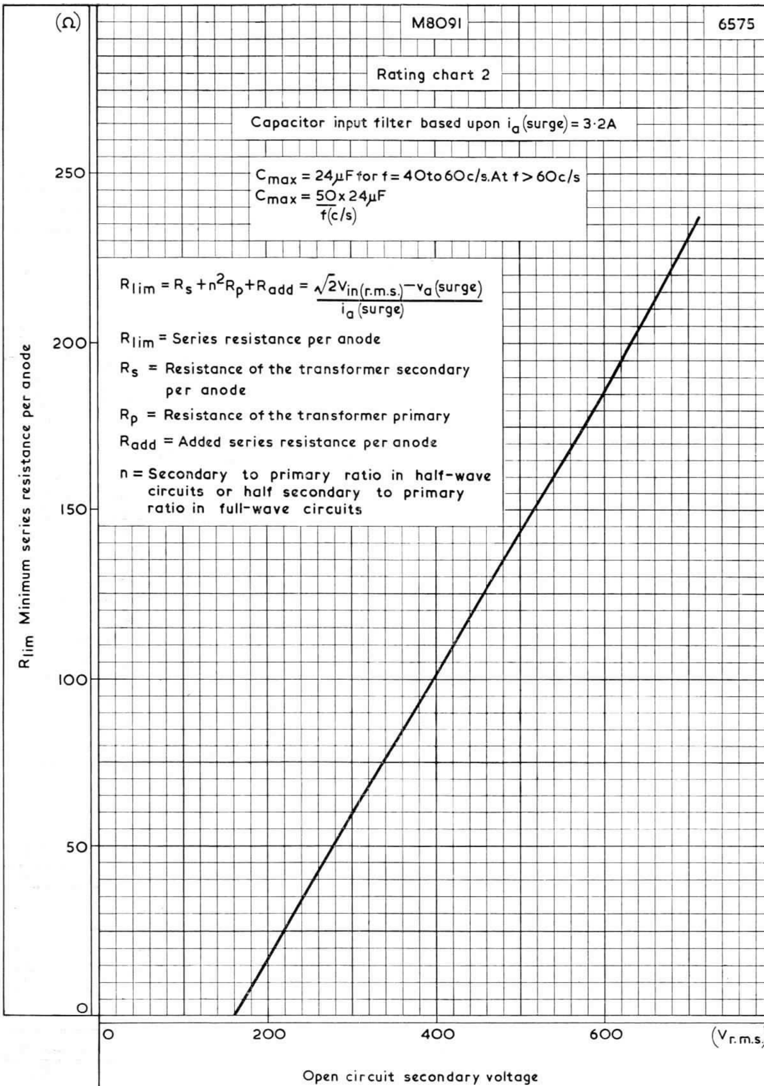
	A.Q.L. (%)	Min.	Max.
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—



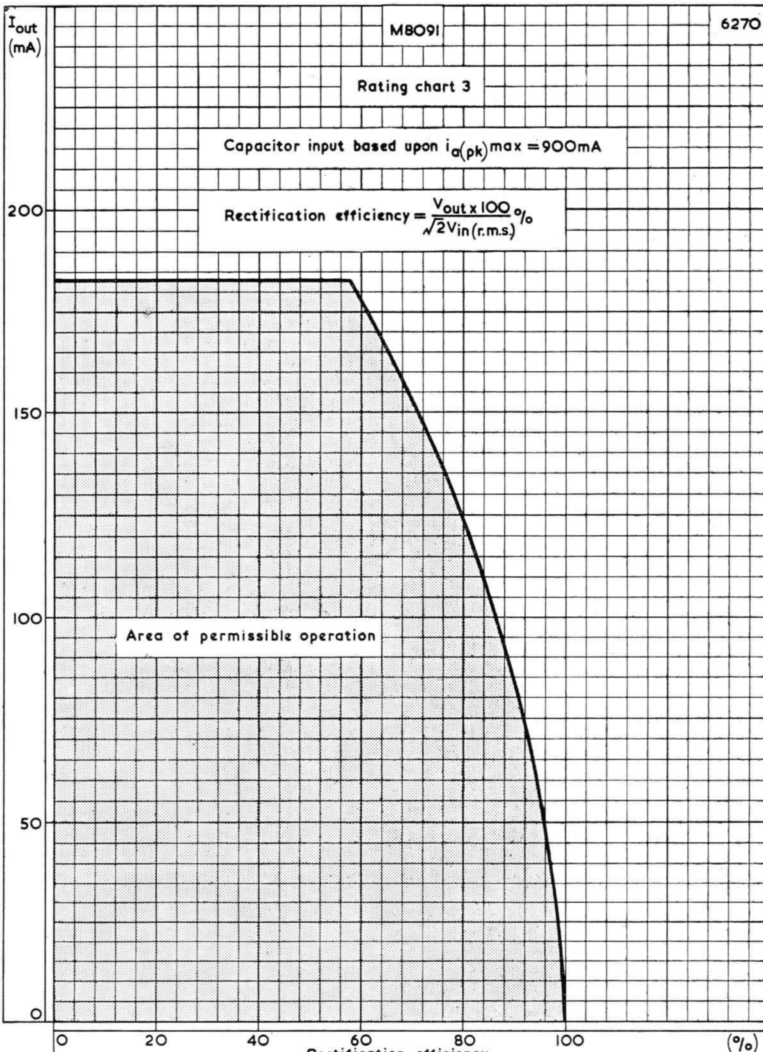
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



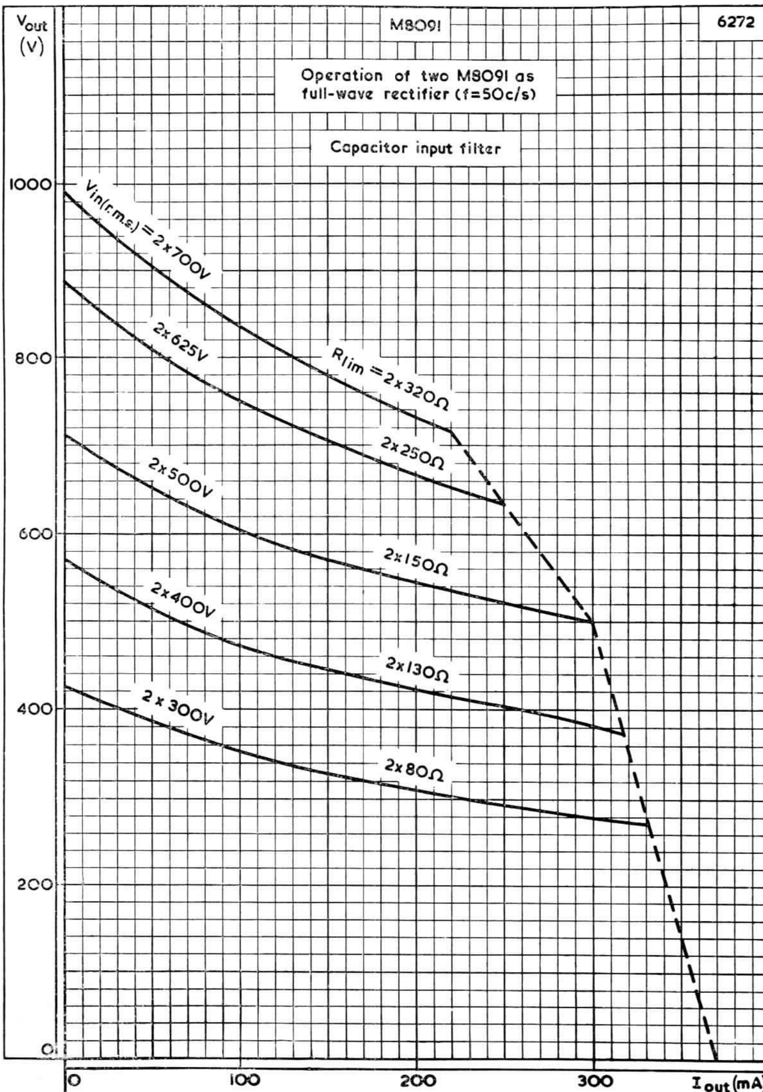
BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER



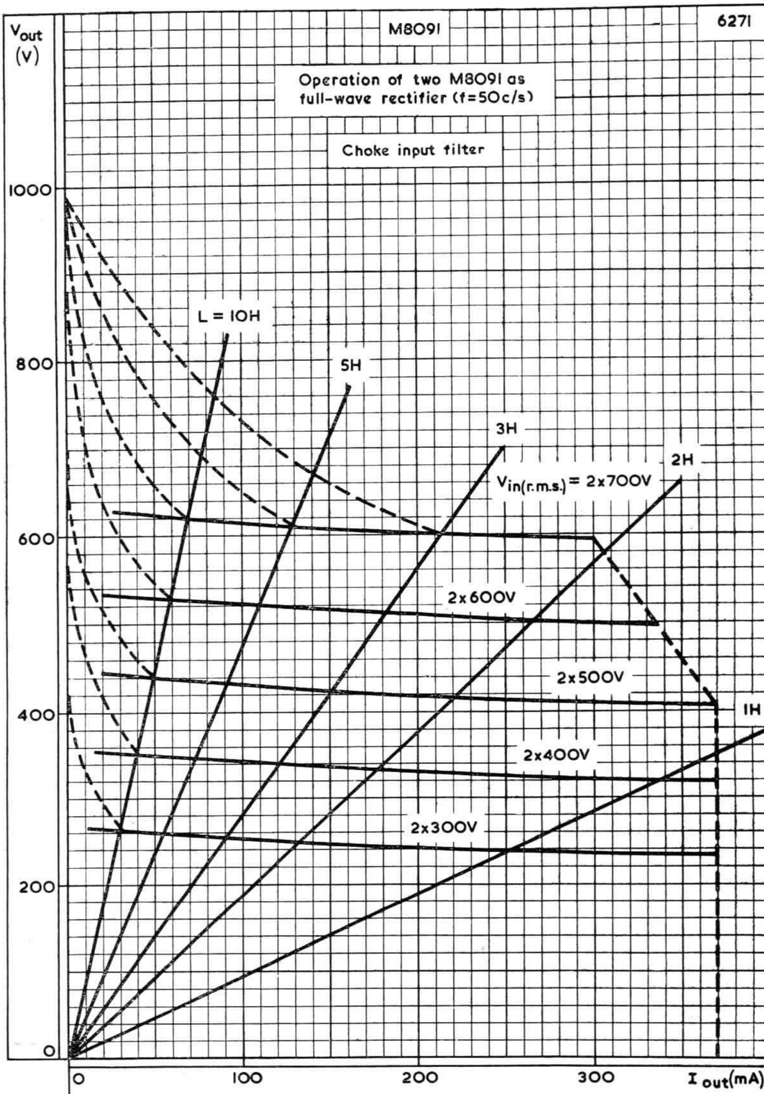
MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST
OPEN CIRCUIT SECONDARY VOLTAGE



OUTPUT CURRENT PLOTTED AGAINST RECTIFICATION EFFICIENCY



CAPACITOR INPUT FILTER REGULATION CURVES



CHOKE INPUT FILTER REGULATION CURVES

SPECIAL QUALITY 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

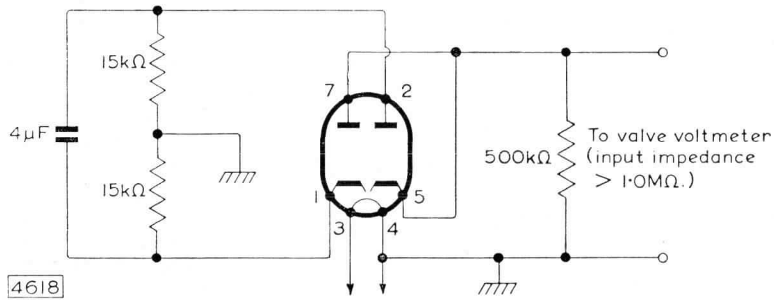
TEST CONDITIONS (unless otherwise specified)

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. $V_a = 0V$, $R_a = 40k\Omega$	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	—	—	—	—	—	—	



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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]	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 = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
***Shock*[15]**								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	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.

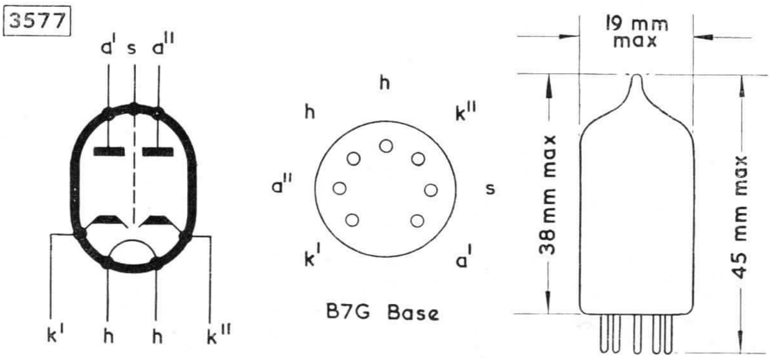
The cathode to heater voltage is provided by the output voltage in series with 117Vr.m.s.

		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	—	$M\Omega$
	1000 hours	6.5	50	—	$M\Omega$
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

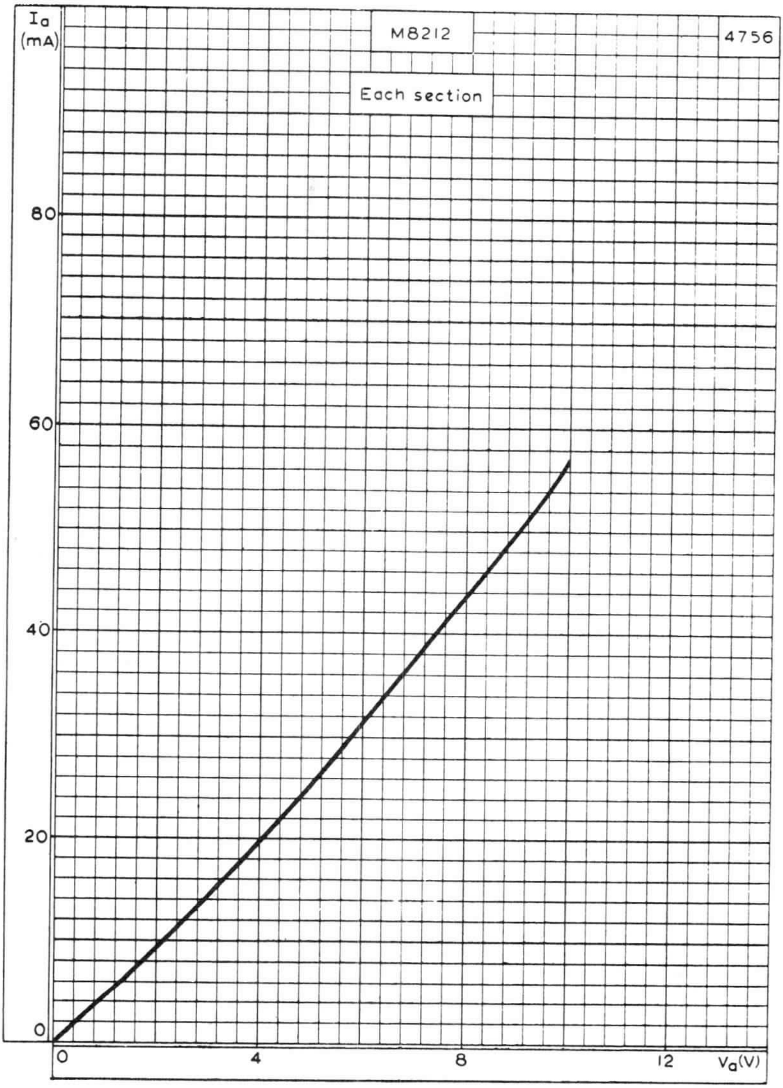
GROUP G

	A.Q.L.[5] (%)	Min.	Max.
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—

M8212 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

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 $V_a = 2.0$kV, $I_a = 160$mA)

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.

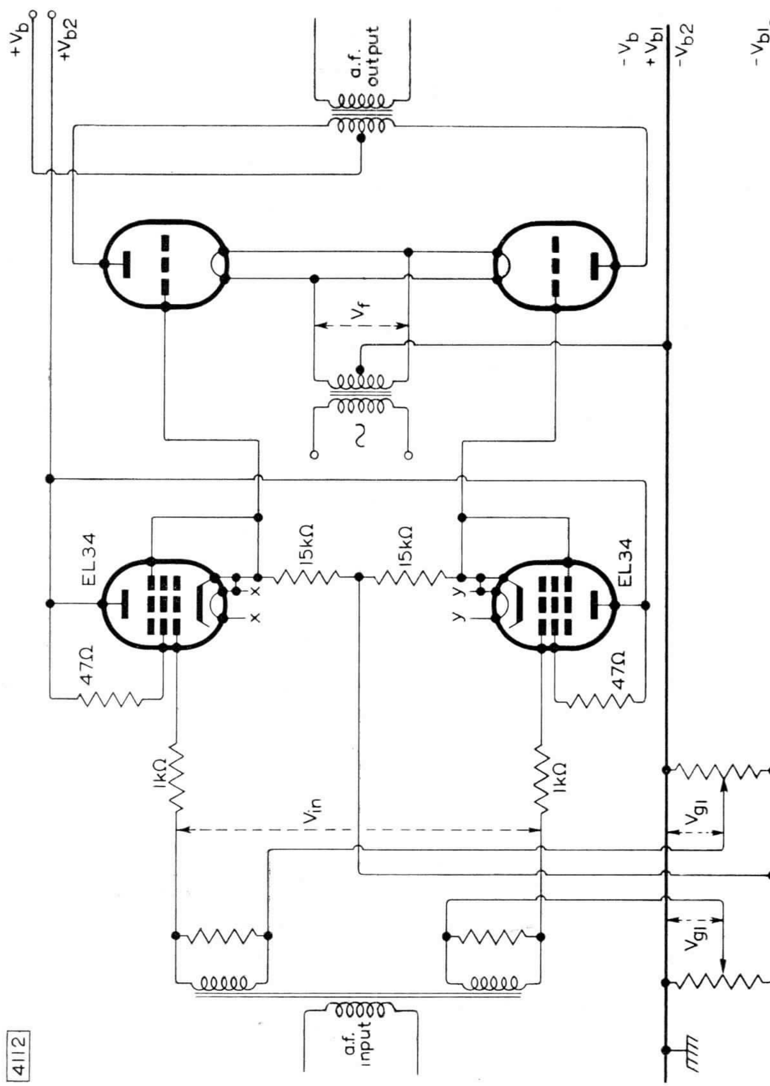
WEIGHT

	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.

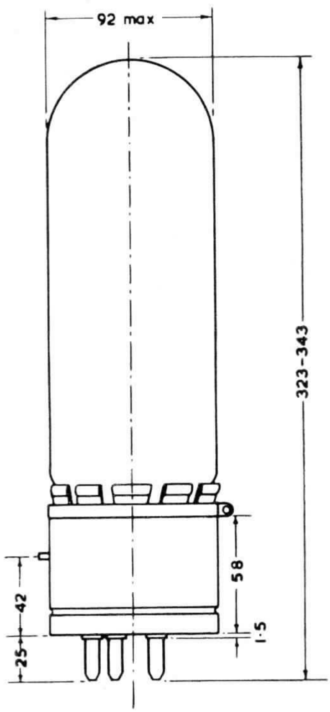


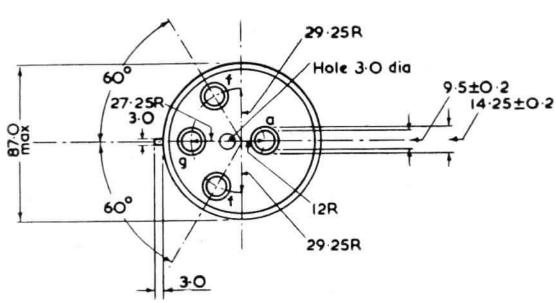
The heaters 'x x' and 'y y' must be supplied from separate windings on the mains transformer

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.





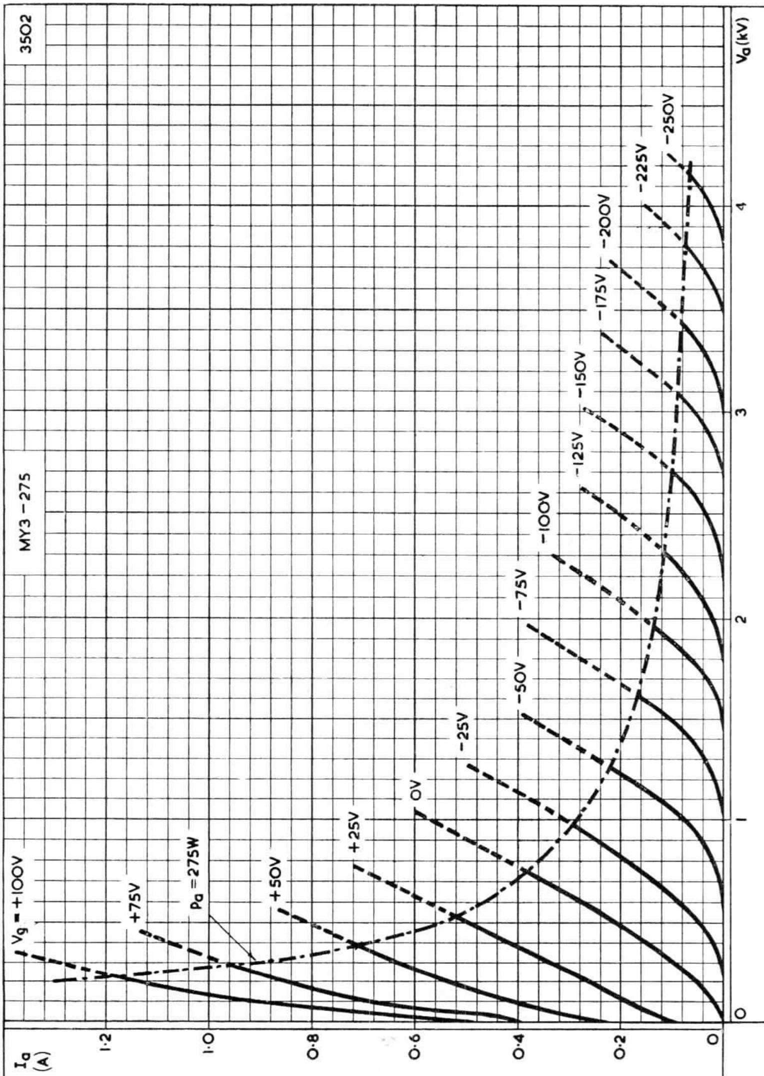
All dimensions in mm

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.

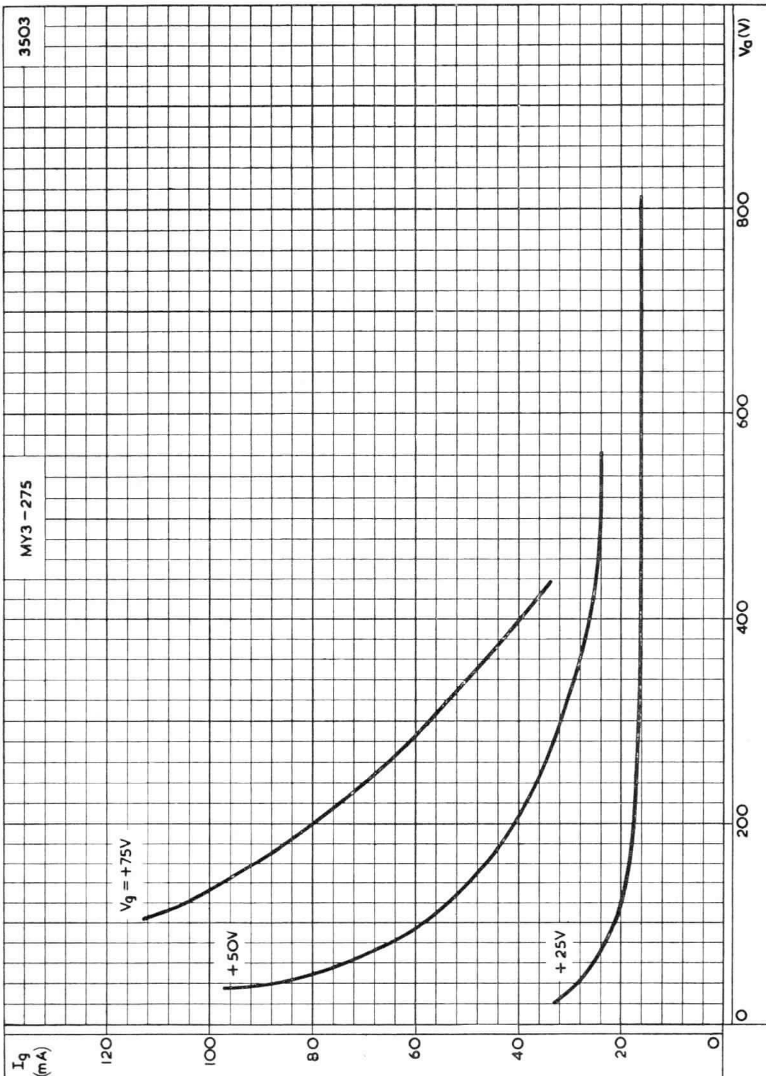


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

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.

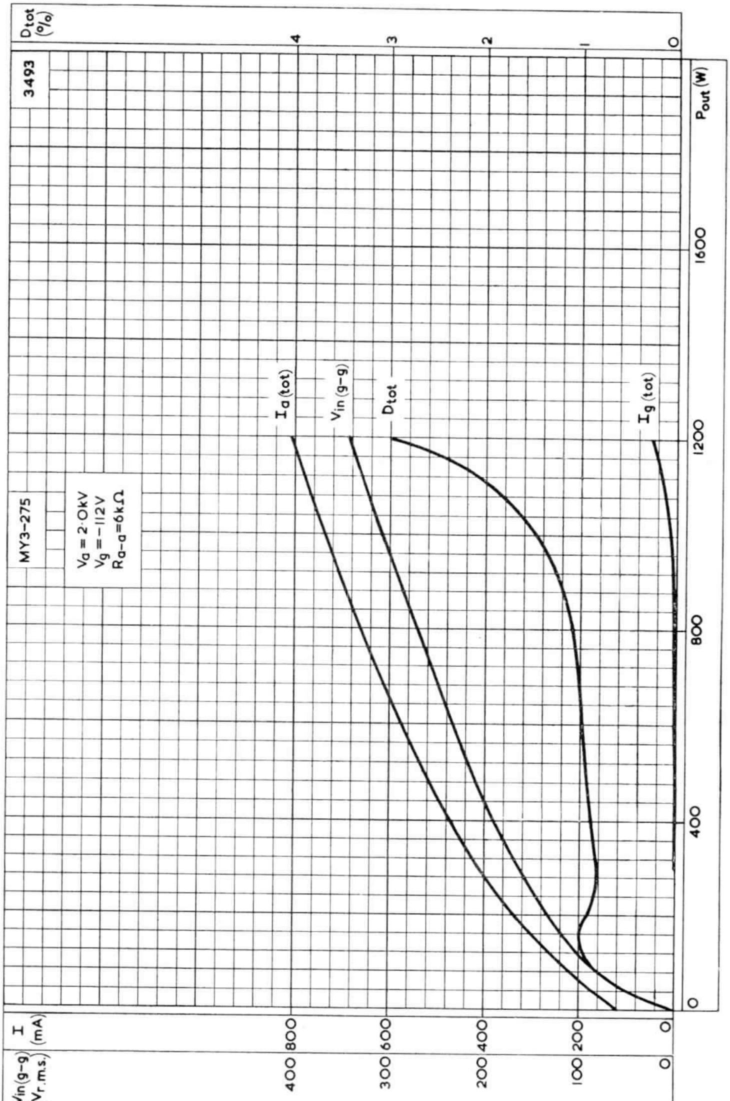


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

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.

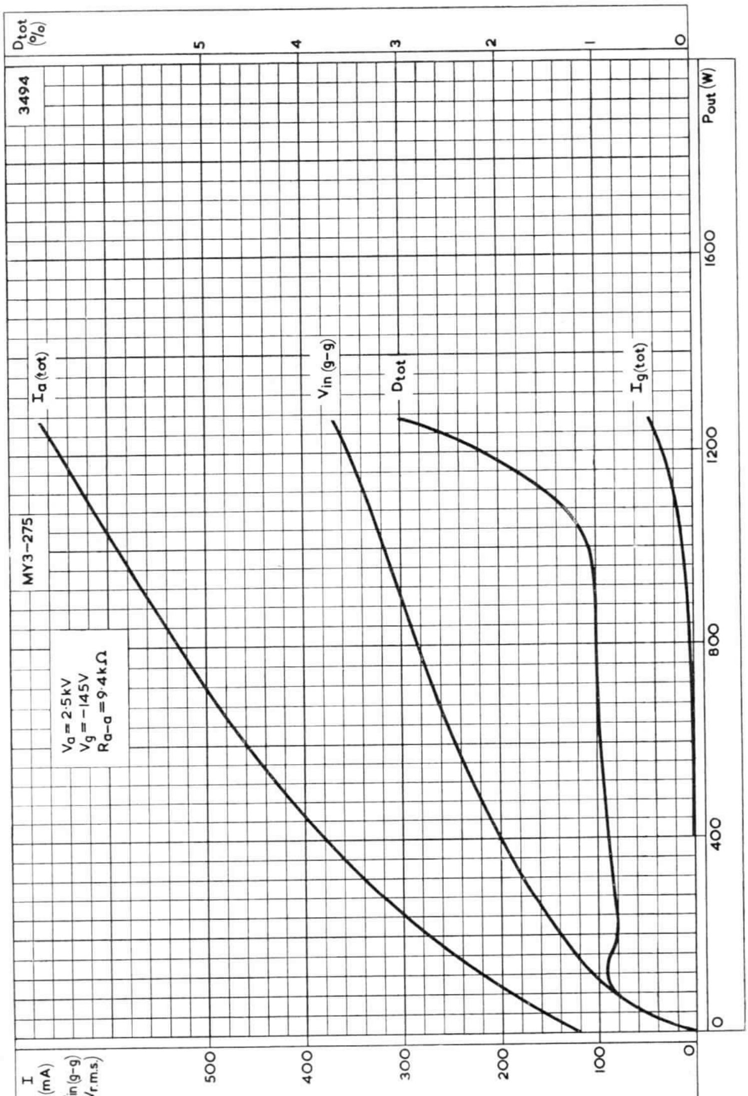


PERFORMANCE OF TWO VALVES AS CLASS 'B' A.F. AMPLIFIER OR MODULATOR. $V_a = 2.0kV$

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.

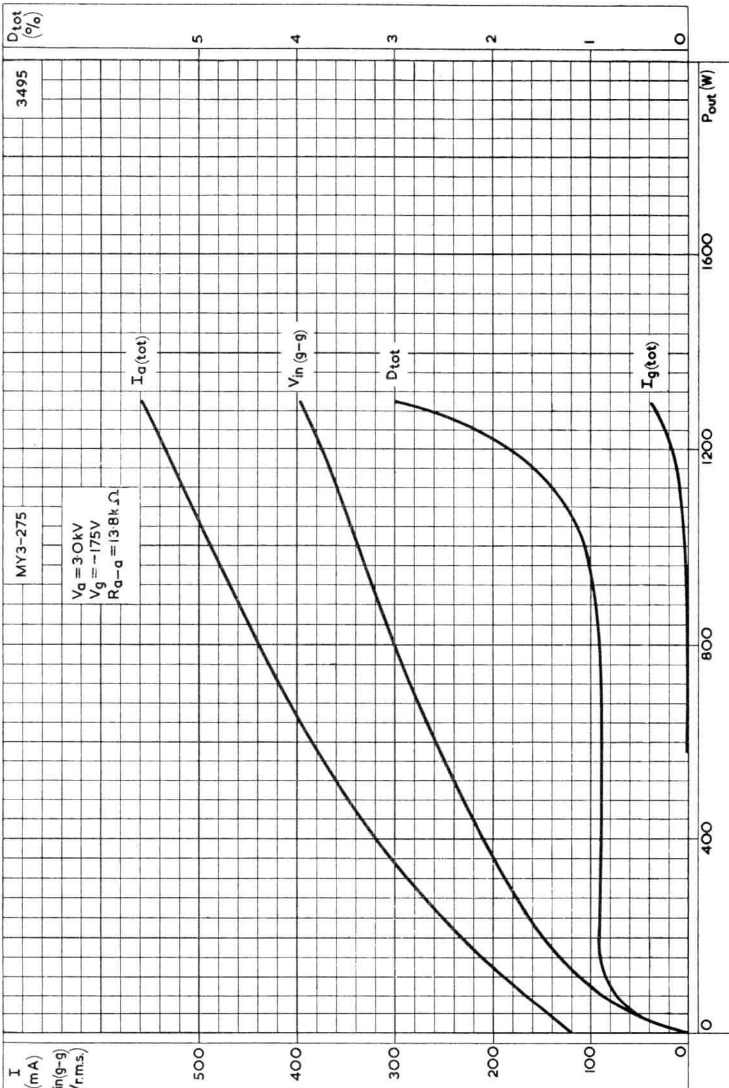


PERFORMANCE OF TWO VALVES AS CLASS 'B' A.F. AMPLIFIER OR MODULATOR. $V_a = 2.5$kV

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. $V_a = 3.0$kV

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.

This data sheet should be read in conjunction with "Operating Notes, Part I—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
$I_{a(o)}$	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	%

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
$I_{a(o)}$	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.

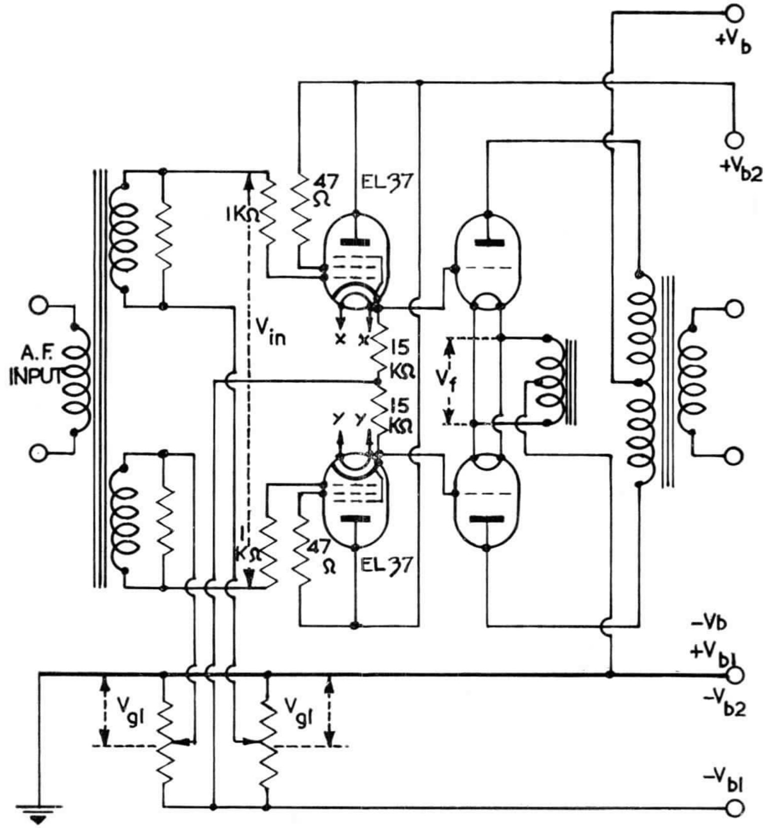
3. With no signal input, the bias potientiometers should be adjusted to set the anode currents of the corresponding output valves at the specified no-signal values. The correct driver conditions will then be automatically secured by the specified values of components and supply voltages.

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.



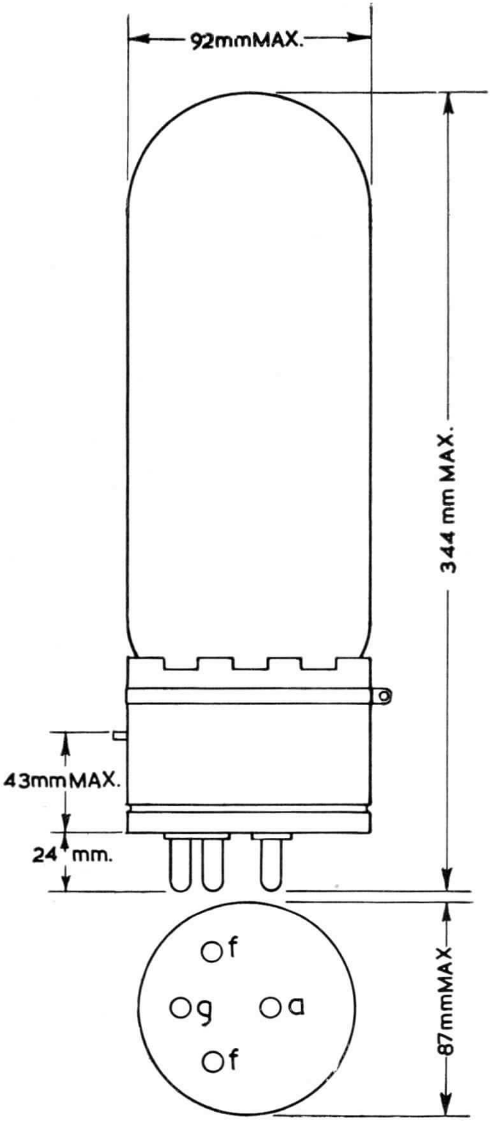
CIRCUIT DIAGRAM FOR OUTPUT STAGE WITH DIRECT-COUPLED DRIVER STAGE.

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.

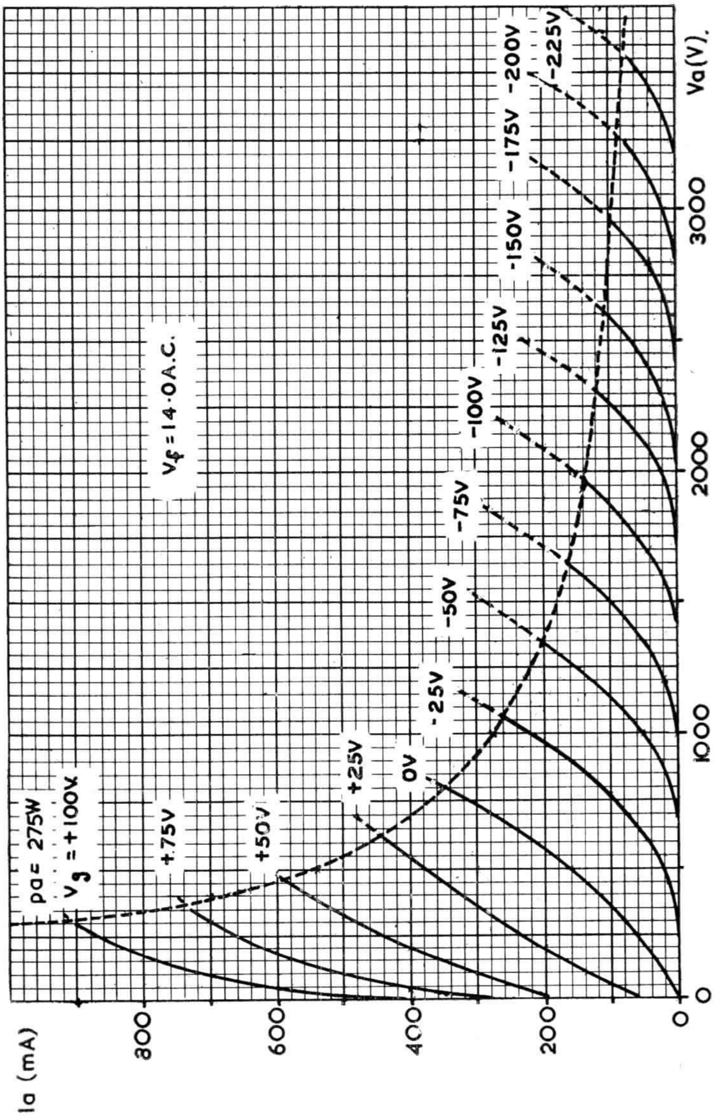


BASE : Large 4-pin bayonet base holder, Type MVH16, available from Mullard Ltd.

POWER TRIODE

MZ2-200

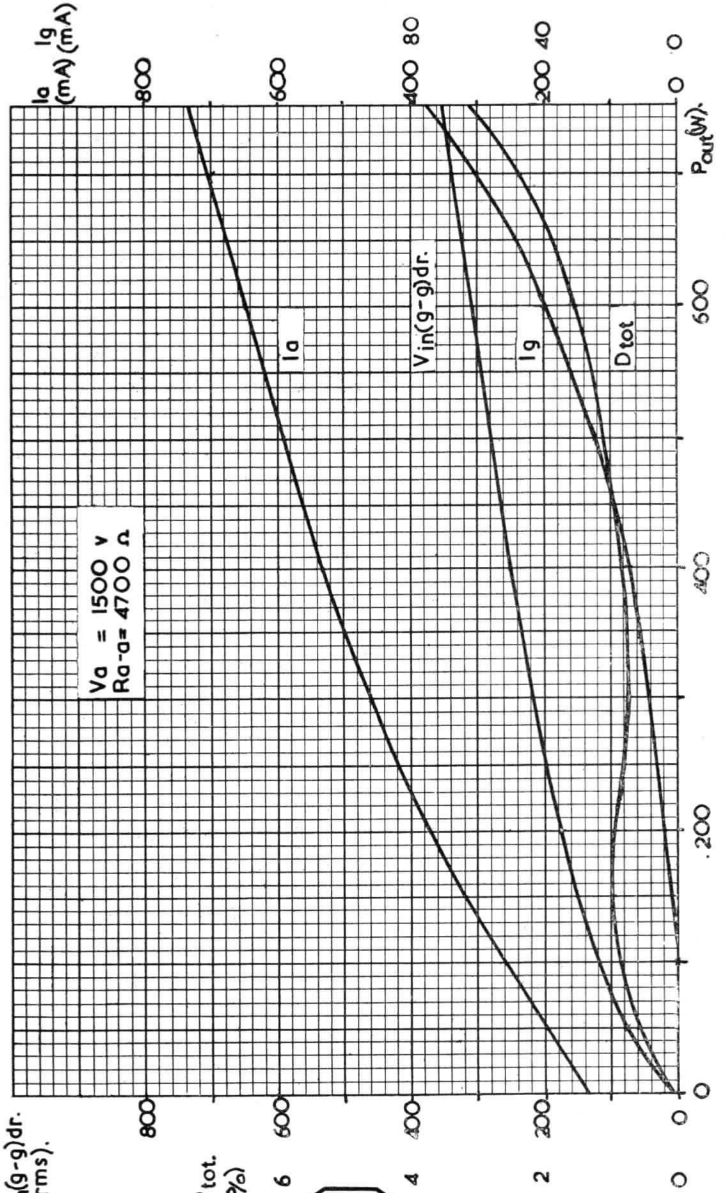
Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



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.

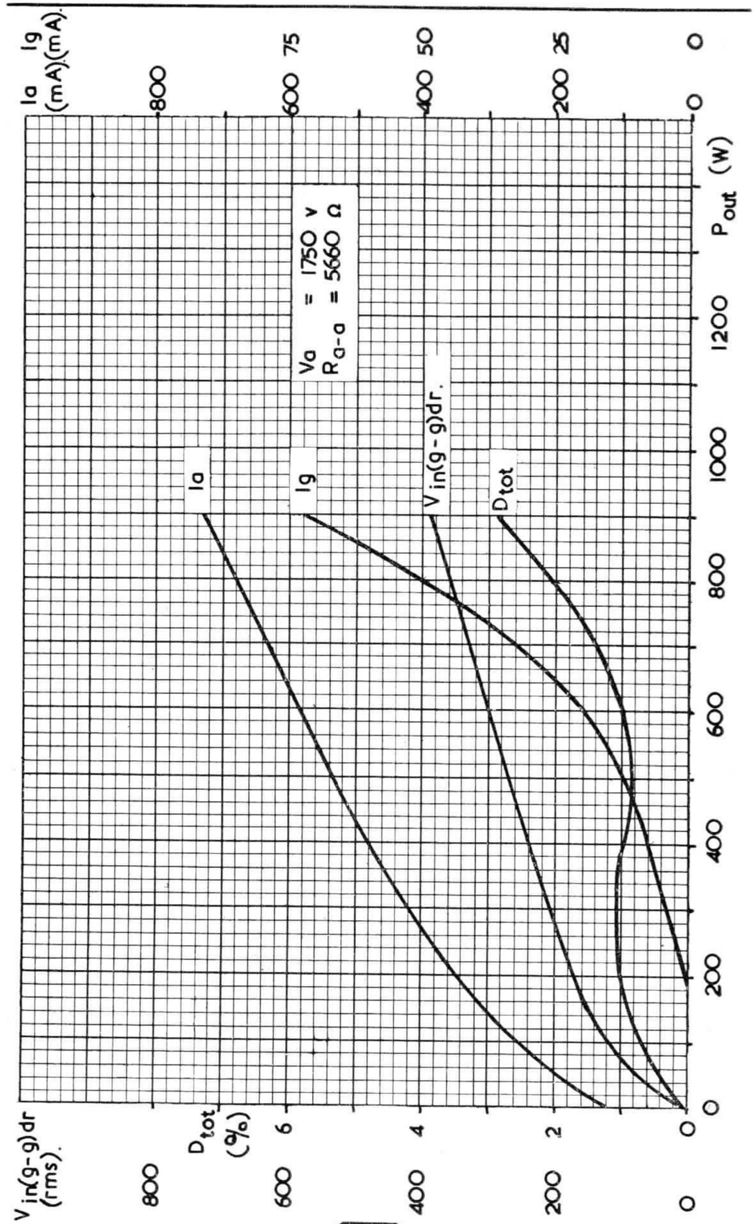


Mullard

POWER TRIODE

MZ2-200

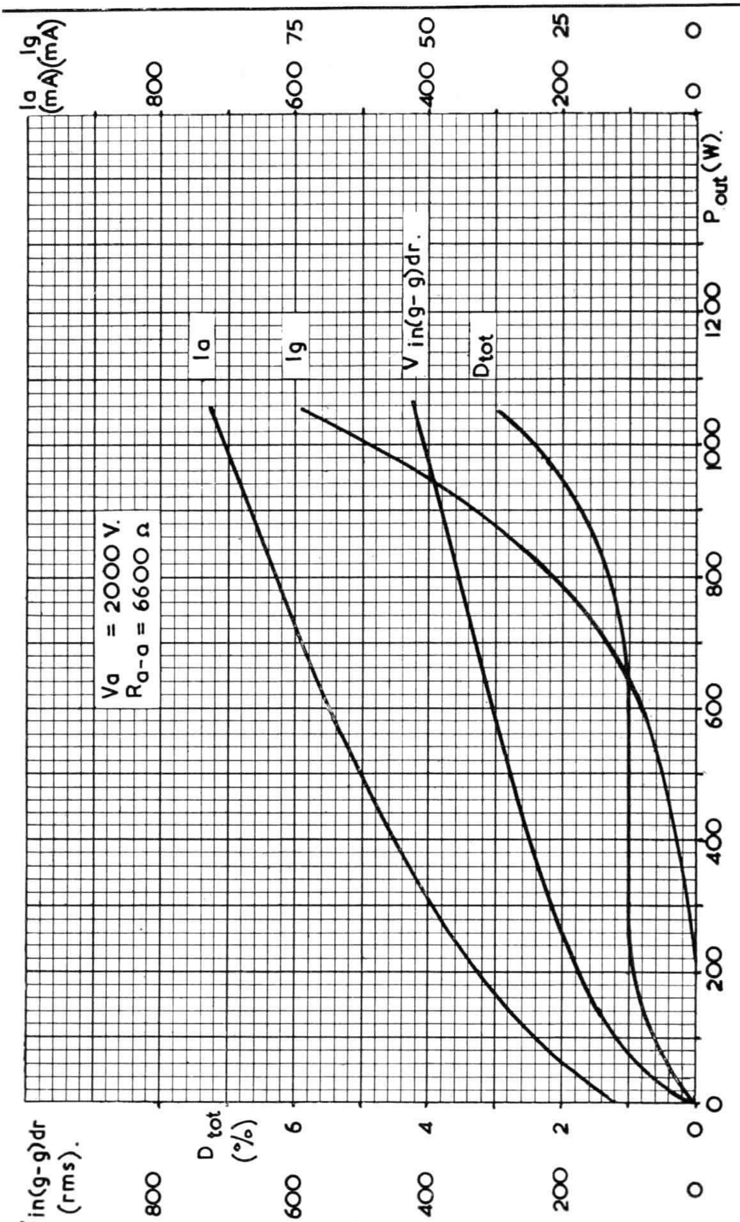
Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



MZ2-200

POWER TRIODE

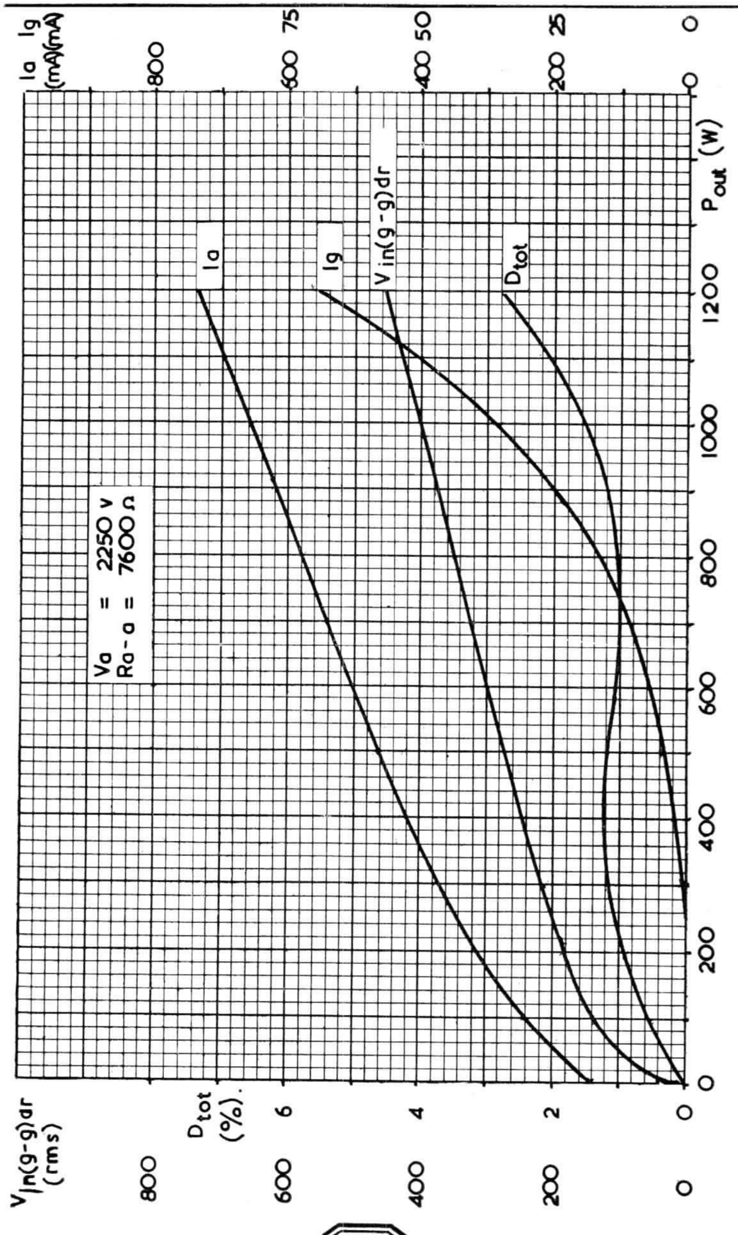
Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



POWER TRIODE

MZ2-200

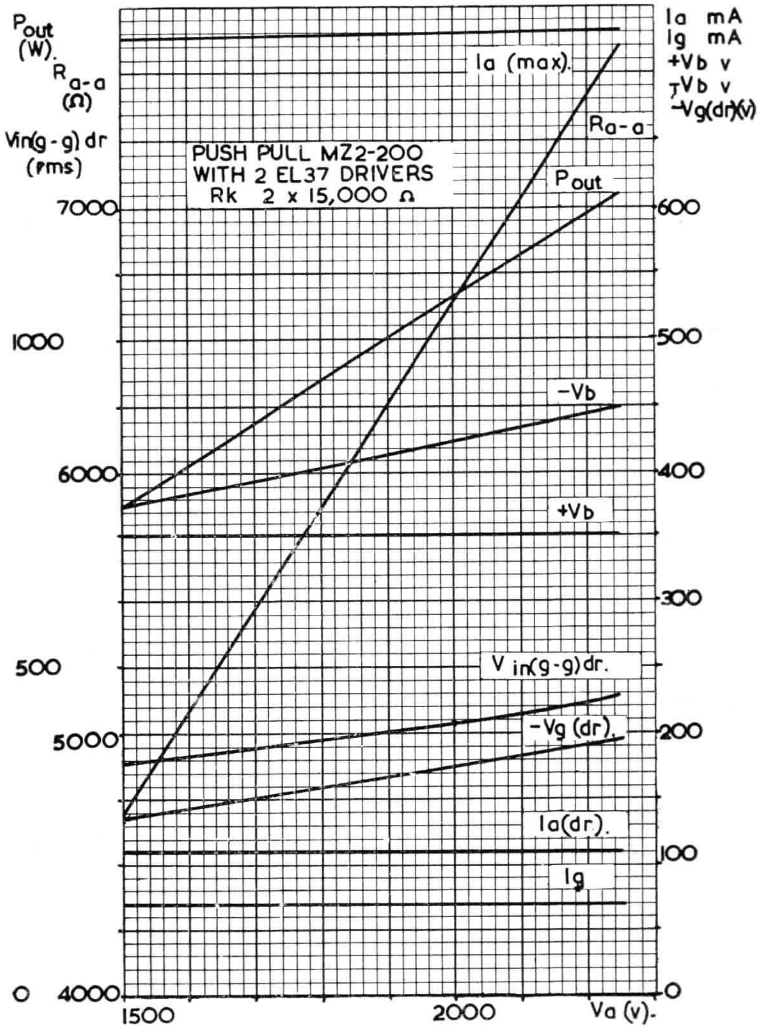
Directly-heated power triode rated for a maximum anode dissipation of 275 watts, and primarily intended for use as a low frequency power valve or as a modulator in transmitting equipment.



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.



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 $I_a = 30$mA)

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

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

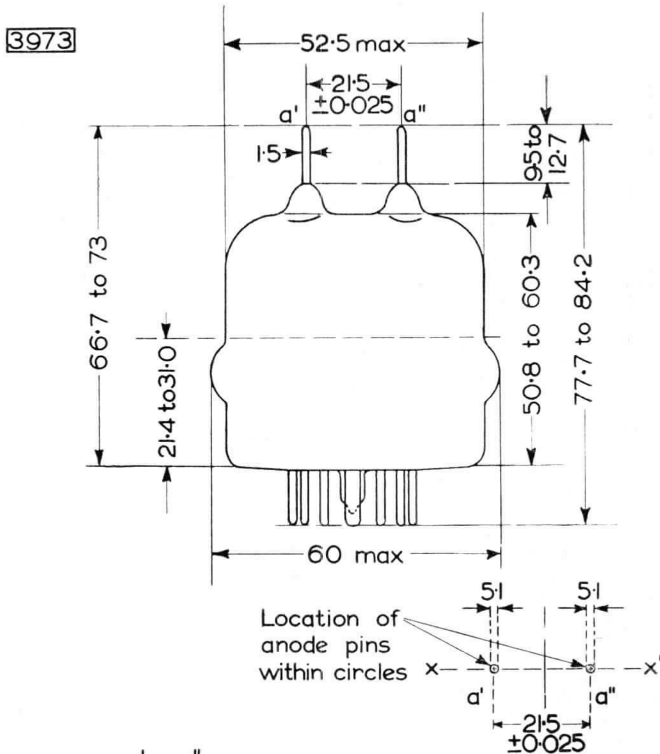
Typical operating conditions

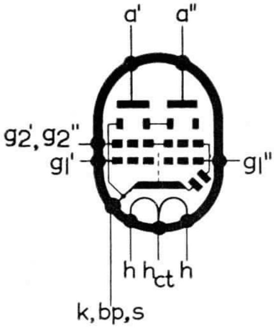
f	200	200	Mc/s
V_a	425	600	V
V_{g2}	200	200	V
V_{g1}	−60	−65	V
I_a	2×26	2×18	mA
I_{g2}	16	16	mA
I_{g1} (approx.)	2×1.2	2×1.3	mA
$v_{in(g1-g1)}$ pk	140	150	V
$P_{load(driver)}$	500	500	mW
p_a	2×3.0	2×2.3	W
P_{out}	16	17	W
η	72	79	%
P_{load}	13	14	W
For 100% modulation			
P_{mod}	12.5	12.5	W
$v_{g2(pk)}$	140	140	V

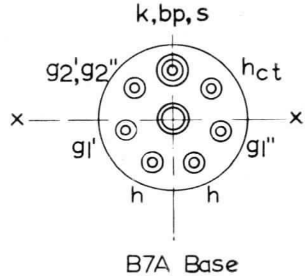
V.H.F. POWER DOUBLE TETRODE

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.





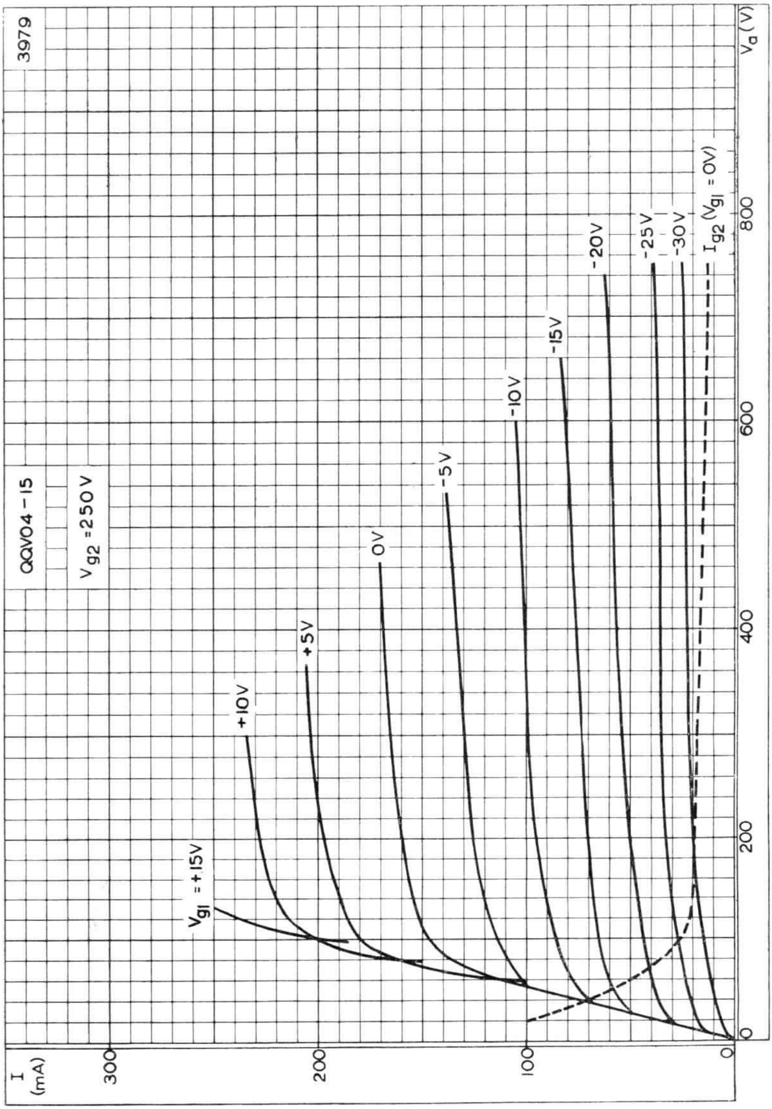


All dimensions in mm

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.

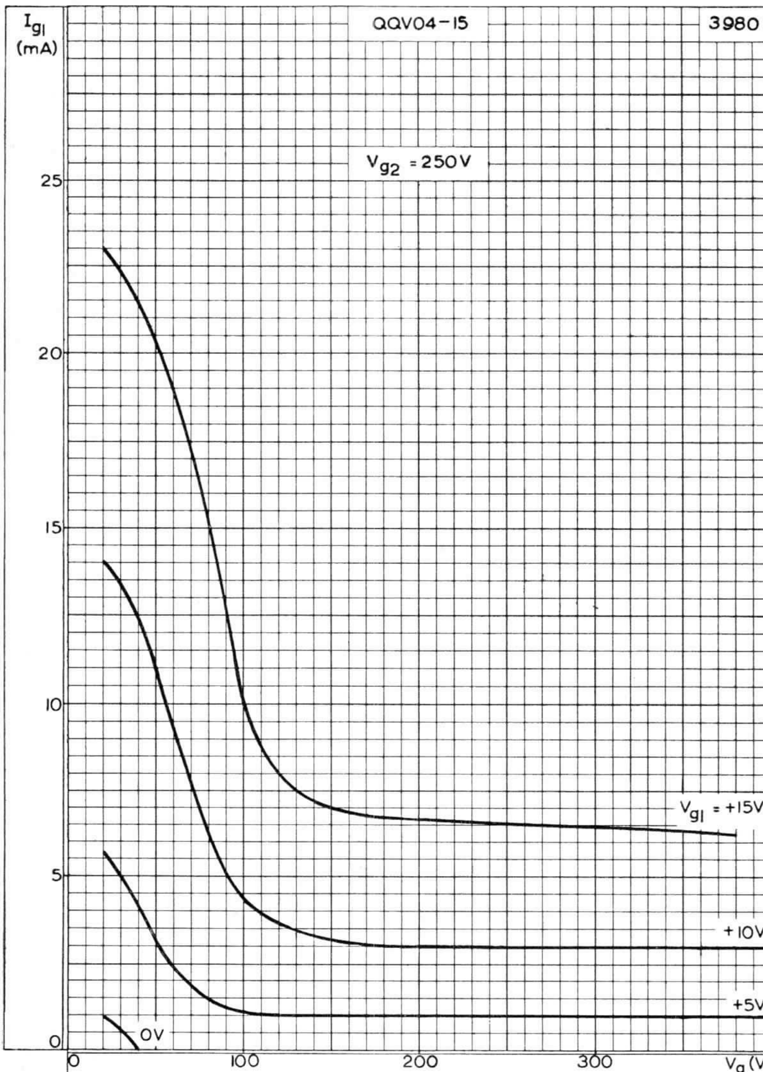


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

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

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 I, 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	$\mu\mu$F
c_{out}	7.0	$\mu\mu$F
*c_{a-g1}	<0.12	$\mu\mu$F
c_{g2-k} (including internal by-pass capacitor)	65	$\mu\mu$F 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.

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.

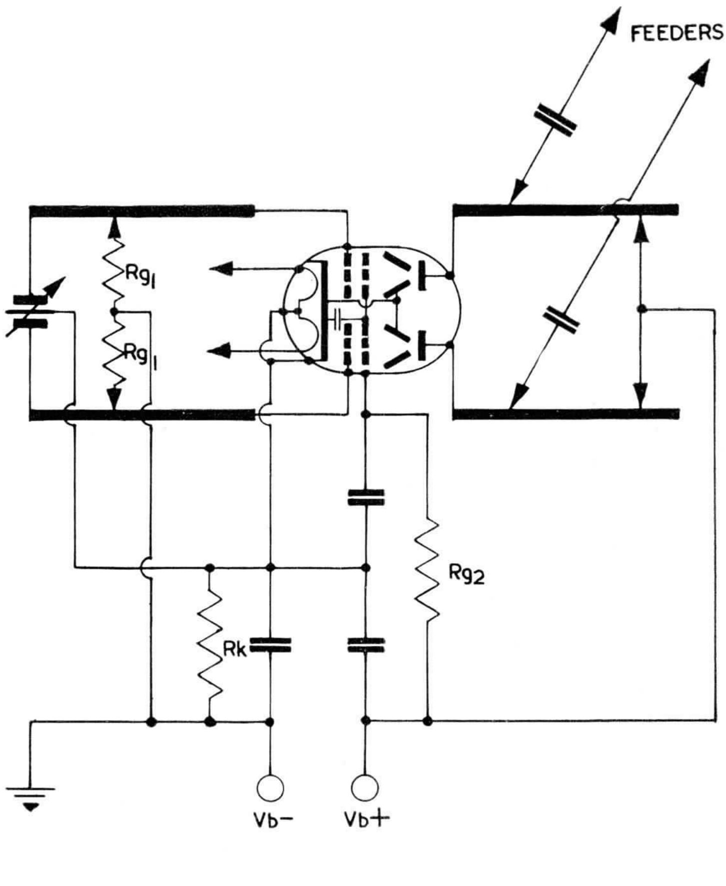
*May be obtained from a separate supply, or from the anode supply through series resistor (R_{g2}) of value shown, in which case provision must be made to ensure that $V_{g2(b)}$ does not exceed 600 V.

**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.



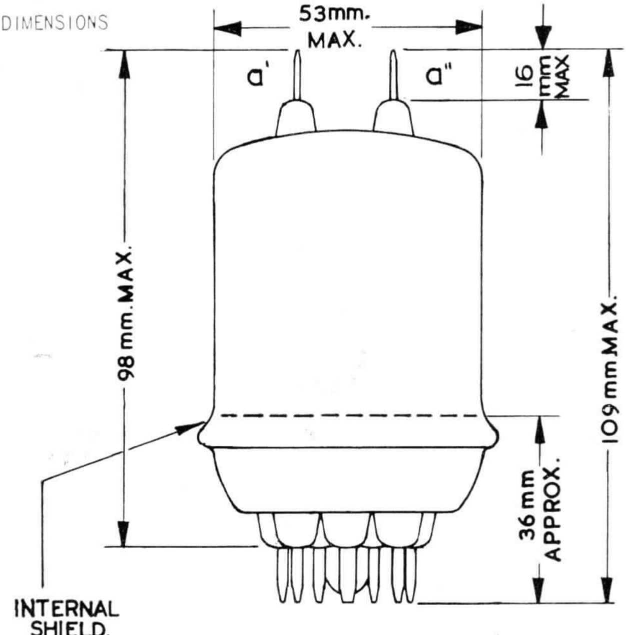
CIRCUIT DIAGRAM FOR QQV07-40 AS V.H.F. PUSH-PULL R.F. POWER AMPLIFIER

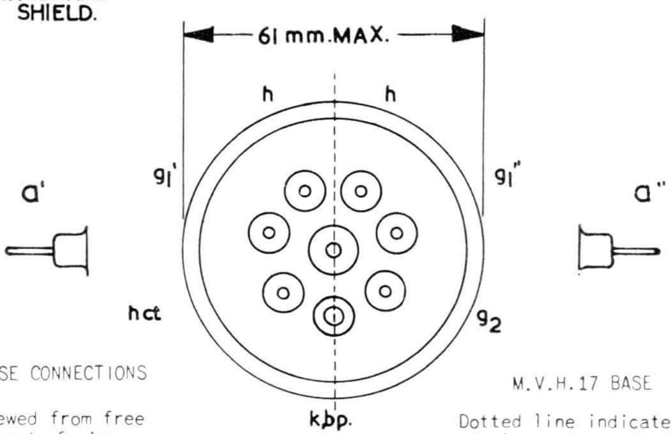
QQV07-40

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.*

DIMENSIONS





BASE CONNECTIONS

Viewed from free end of pins

M.V.H.17 BASE

Dotted line indicates plane of anodes

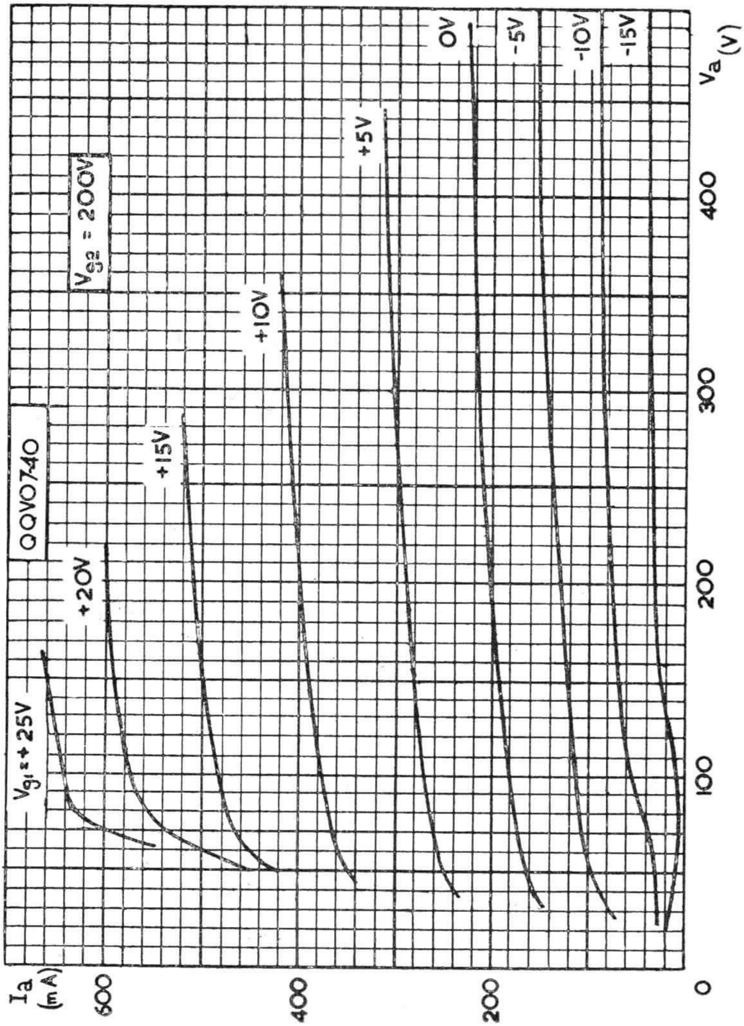
WEIGHT

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.

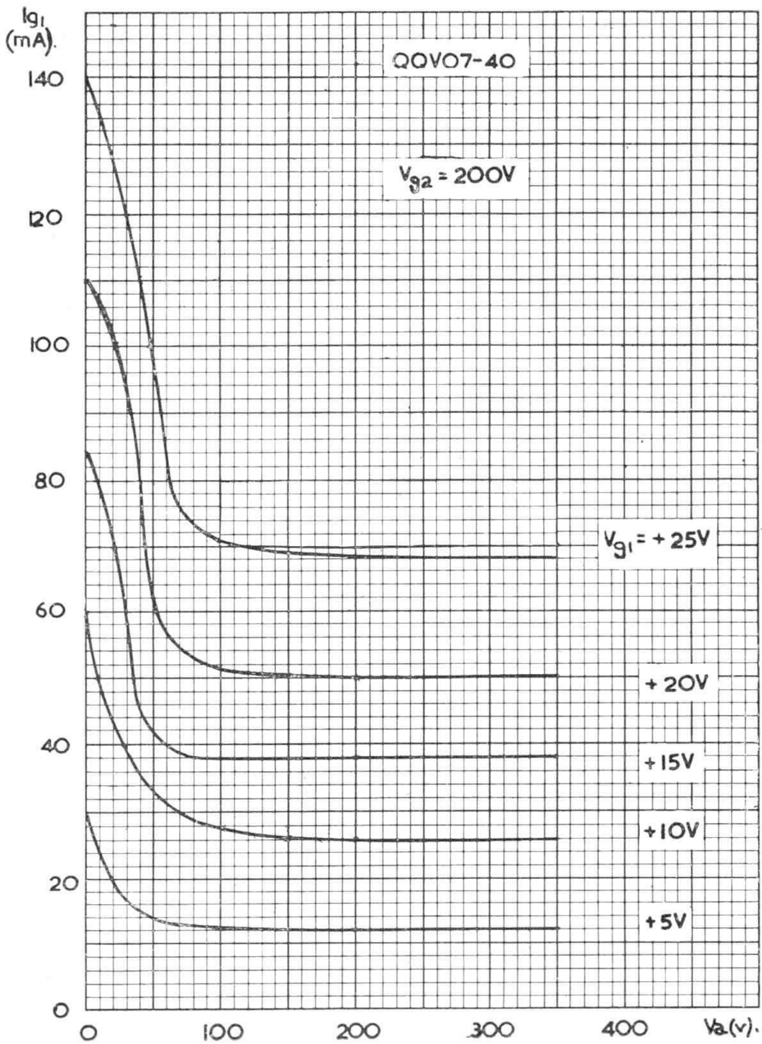


ANODE CURRENT PLOTTED AGAINST
ANODE VOLTAGE

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

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.

This data sheet should be read in conjunction with "Operating Notes Part 1—Power Valves" included in this volume of the Handbook.

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
μ_{g1-g2}	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_{g2} max.	250	250	V
p_{g2} max.	2×2.0	2×2.5	W
I_{g1} max.	2×5	2×5	mA
p_{g1} 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_{g1} max.	–250	–250	V
R_{g1-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	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

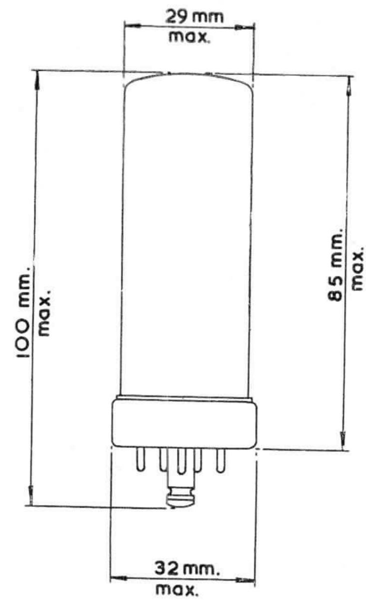
	f=62–186 Mc/s		f=33–100 Mc/s		
	Intermittent operation	Continuous operation	Intermittent operation	Continuous operation	
V_a	250	250	350	350	V
V_{g2}	200	200	200	200	V
V_{g1}	–180	–180	–180	–180	V
I_a	2×40	2×30	2×30	2×24	mA
I_{g2}	6	6	6	6	mA
I_{g1}	2×1.5	2×1.5	2×1.5	2×1.5	mA
P_{out}	5	3.75	6	4.8	W
P_{load}‡	3.5	3	5	3.8	W

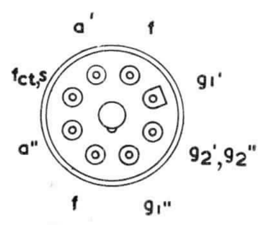
‡These figures assume normal circuit efficiencies

WEIGHT Value only $1\frac{1}{2}$ 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.



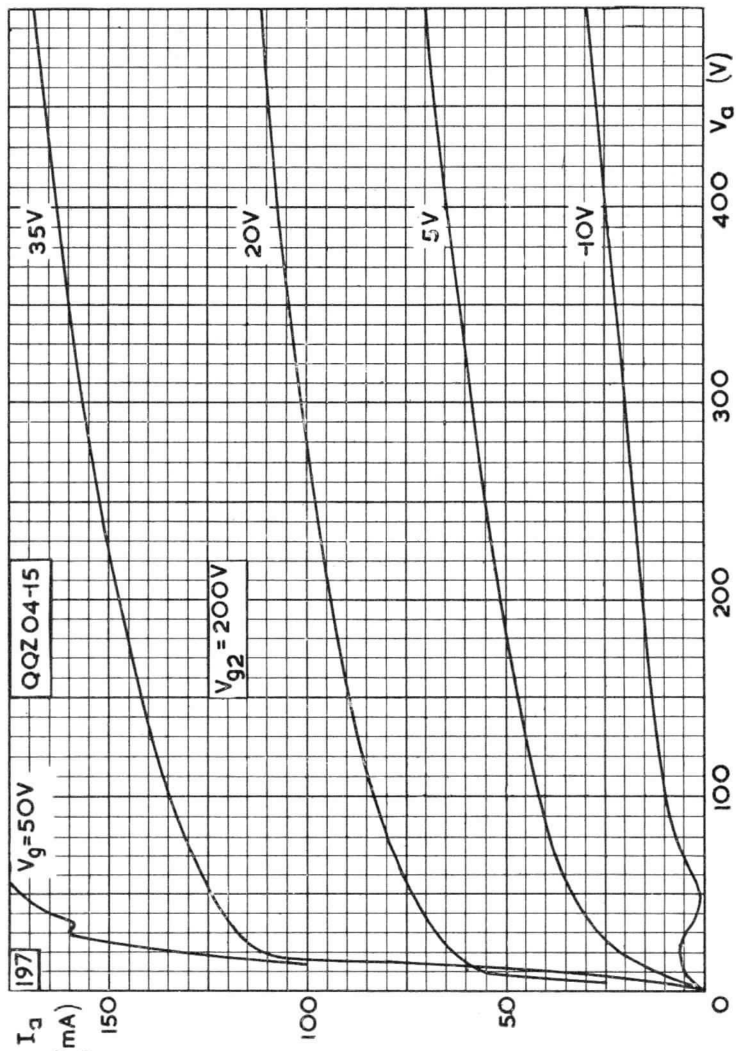


B8G BASE

170

QQZ04-15 R.F. POWER DOUBLE TETRODE

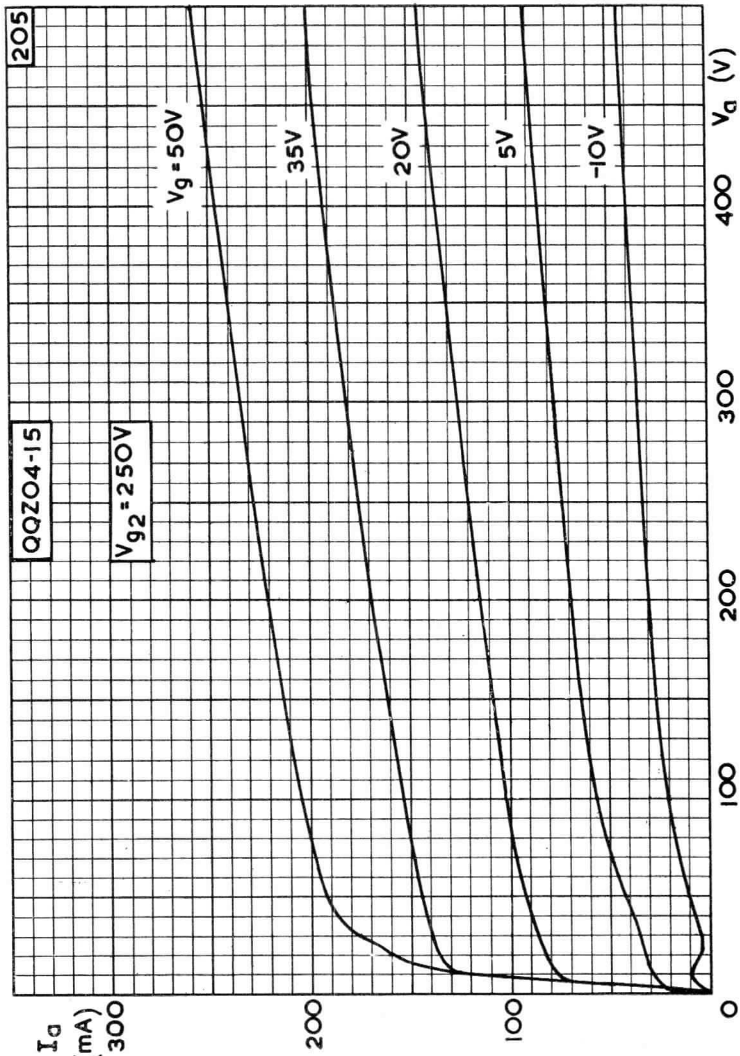
A quick-heating, directly-heated double tetrode rated to dissipate 8 W at each anode and primarily intended for use in mobile equipment at frequencies up to 186 Mc/s.



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.



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

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	kΩ
$**V_{g1}$	−45	−45	−45	V
R_{g1-k}	12.8	12.8	12.8	kΩ
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.

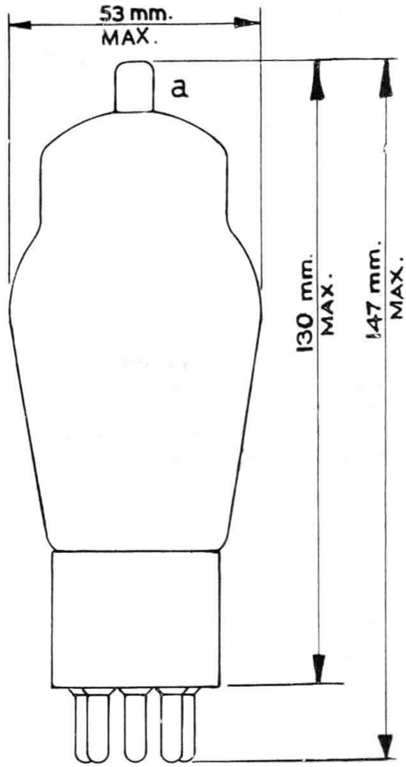
** May be obtained from a separate supply, or from a grid or cathode resistor of value shown, or by a combination of these methods.

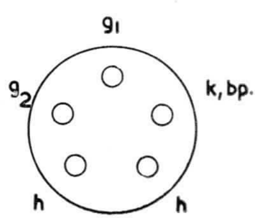
WEIGHT Valve only ; 2½ oz. (0.08 kg.)

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.



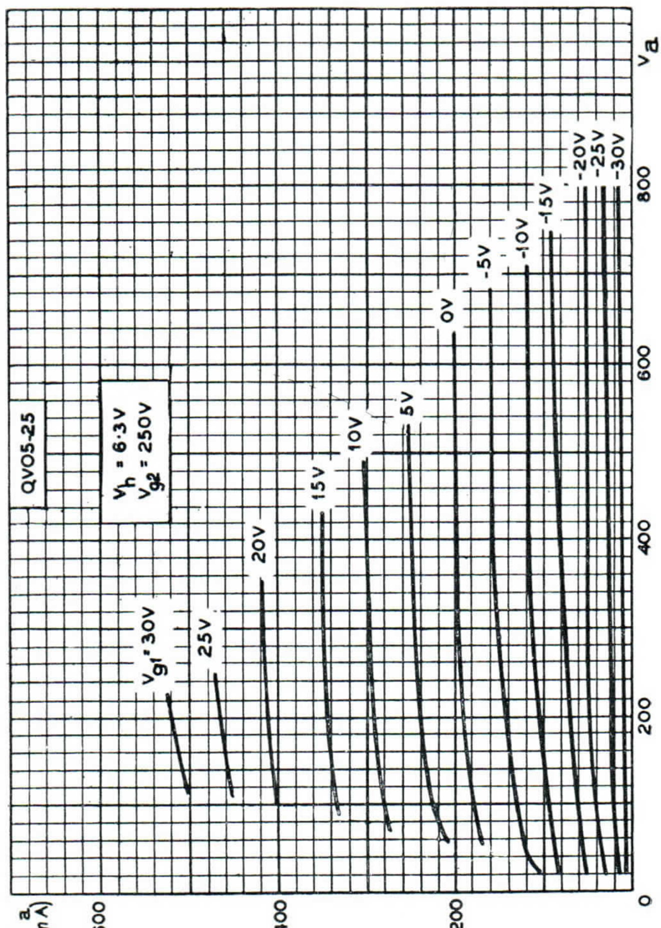


AMERICAN MEDIUM 5-PIN BASE

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.

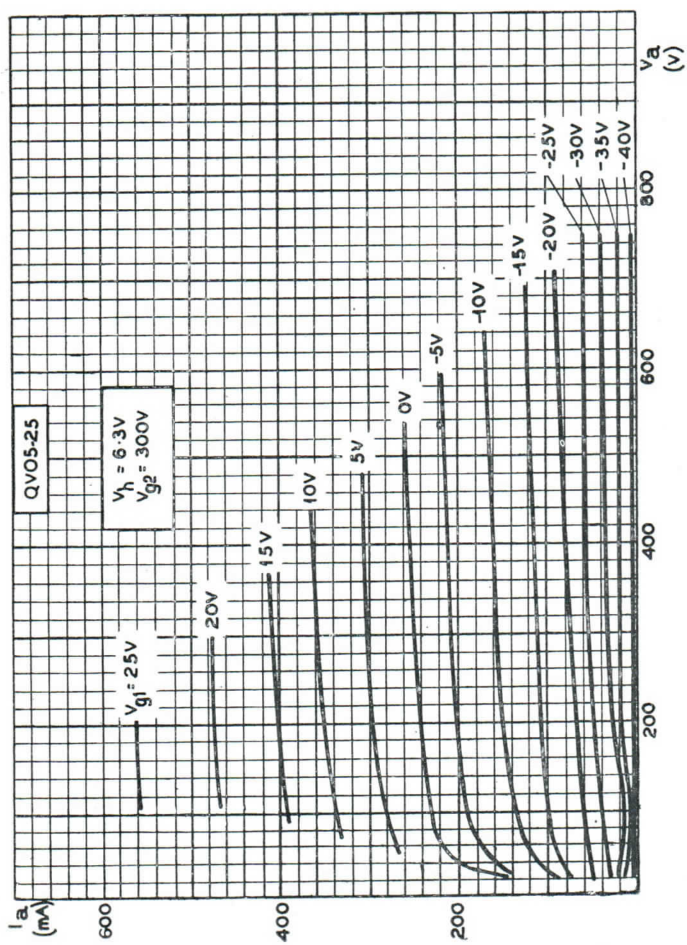


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
FOR SCREEN VOLTAGE = 250V

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.

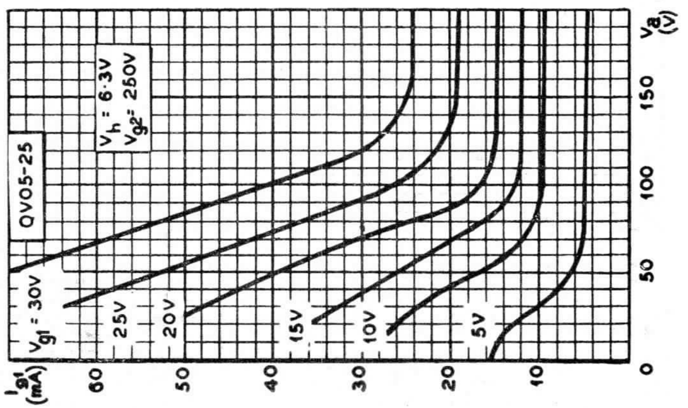


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
FOR SCREEN VOLTAGE = 300V

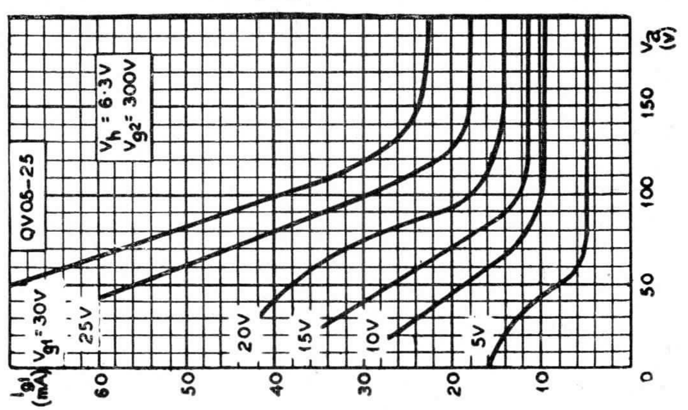
R.F. POWER TETRODE

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

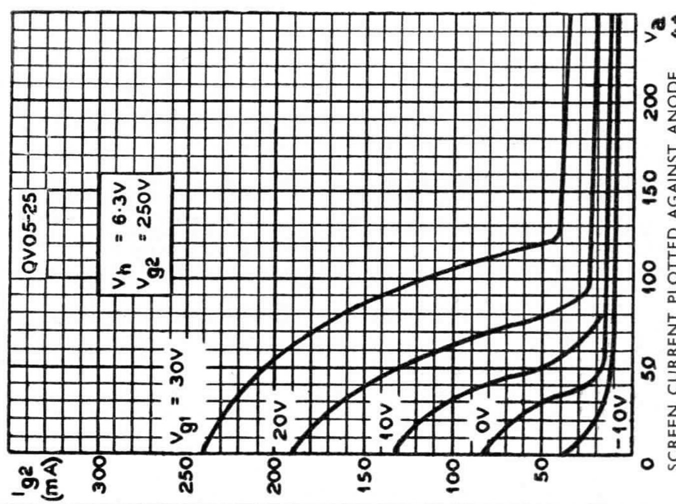


CONTROL GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
FOR SCREEN VOLTAGE = 300V

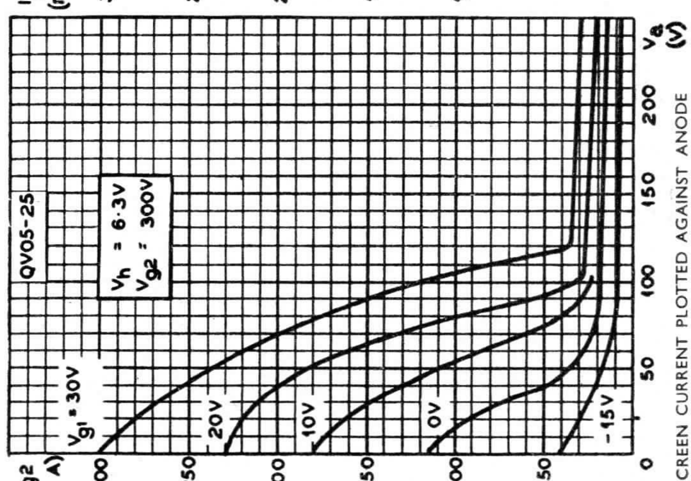
QV05-25

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.



SCREEN CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN VOLTAGE = 250V



SCREEN CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN VOLTAGE = 300V

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.

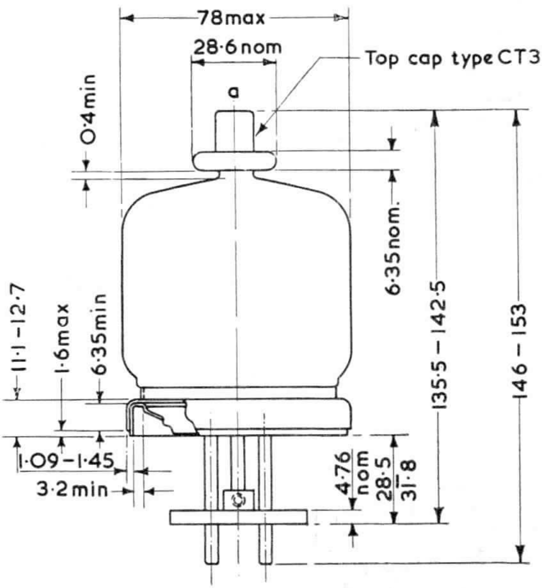
Typical Operating Conditions

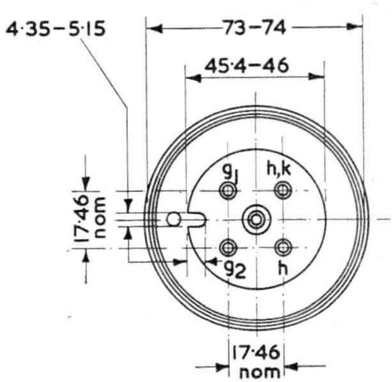
t_p	2	2	μsec
P.R.F.	500	500	p/s
V_a	15.8	20	kV
V_{g2}	1.25	1.25	kV
V_{g1}	−600	−600	V
$v_{g1(pulse)}$	700	700	V
$i_{a(pulse)}$	14	16	A
I_a	14	16	mA
$i_{g2(pulse)}$	4.0	3.0	A
I_{g2}	4.0	3.0	mA
$i_{g1(pulse)}$	1.1	1.1	A
I_{g1}	1.1	1.1	mA
$p_{in(pulse)}$	220	320	kW
R_a	1.0	1.2	kΩ
$P_{out(pulse)}$	210	305	kW
$V_{a(out)}$	15	19	kV

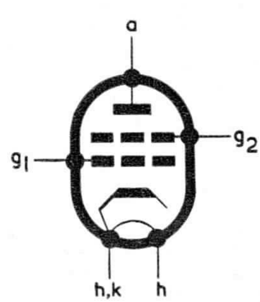
PULSE TETRODE MODULATOR

QV20-P18

Tetrode for pulsed applications having ratings of 20kV and 18A.





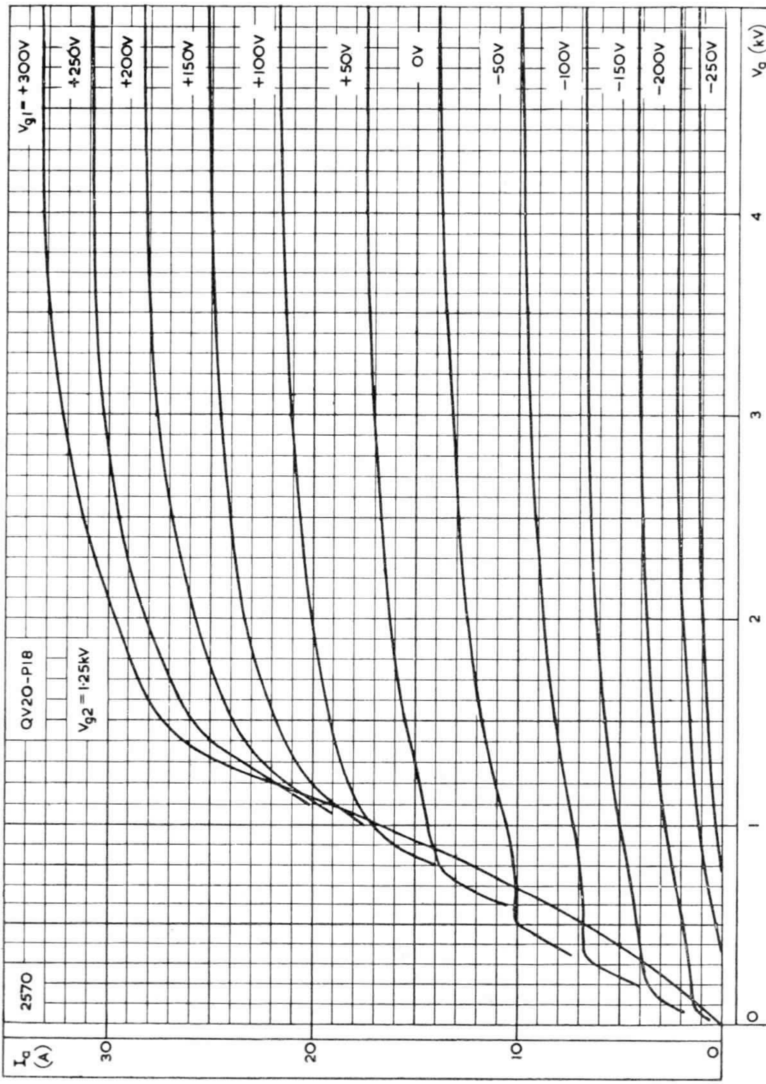


2610 | B4A Base | All dimensions in mm.

QV20-P18

PULSE TETRODE MODULATOR

Tetrode for pulsed applications having ratings of 20kV and 18A.

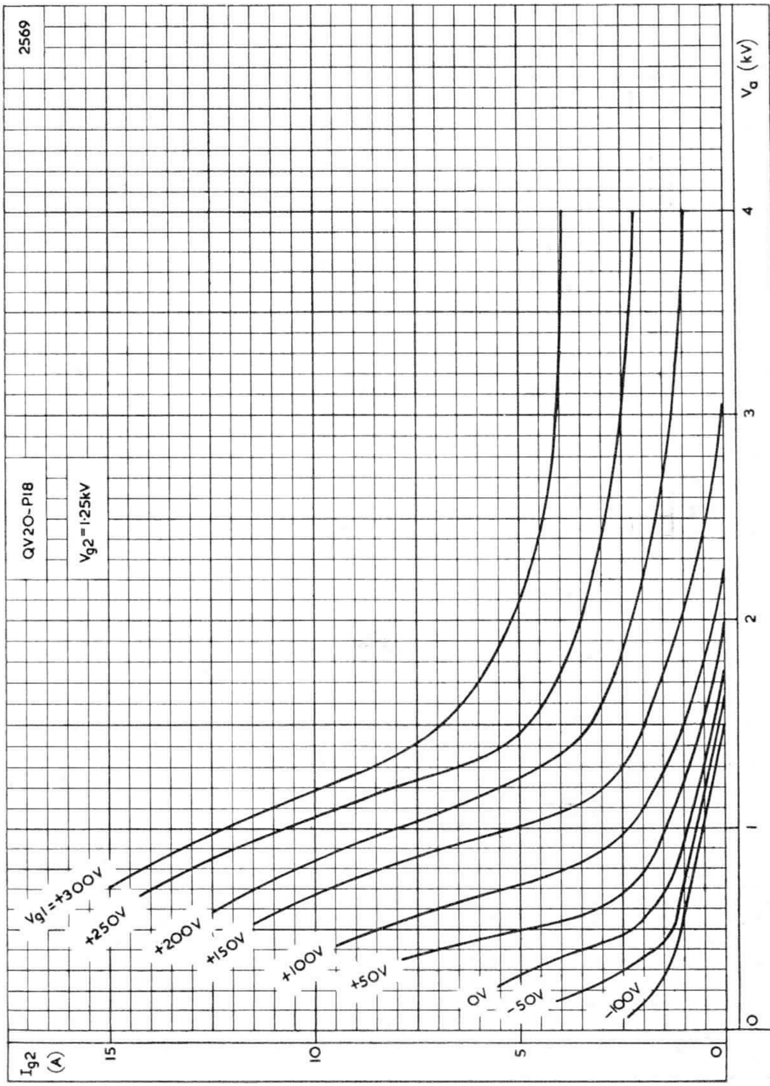


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

PULSE TETRODE MODULATOR

QV20-P18

Tetrode for pulsed applications having ratings of 20kV and 18A.

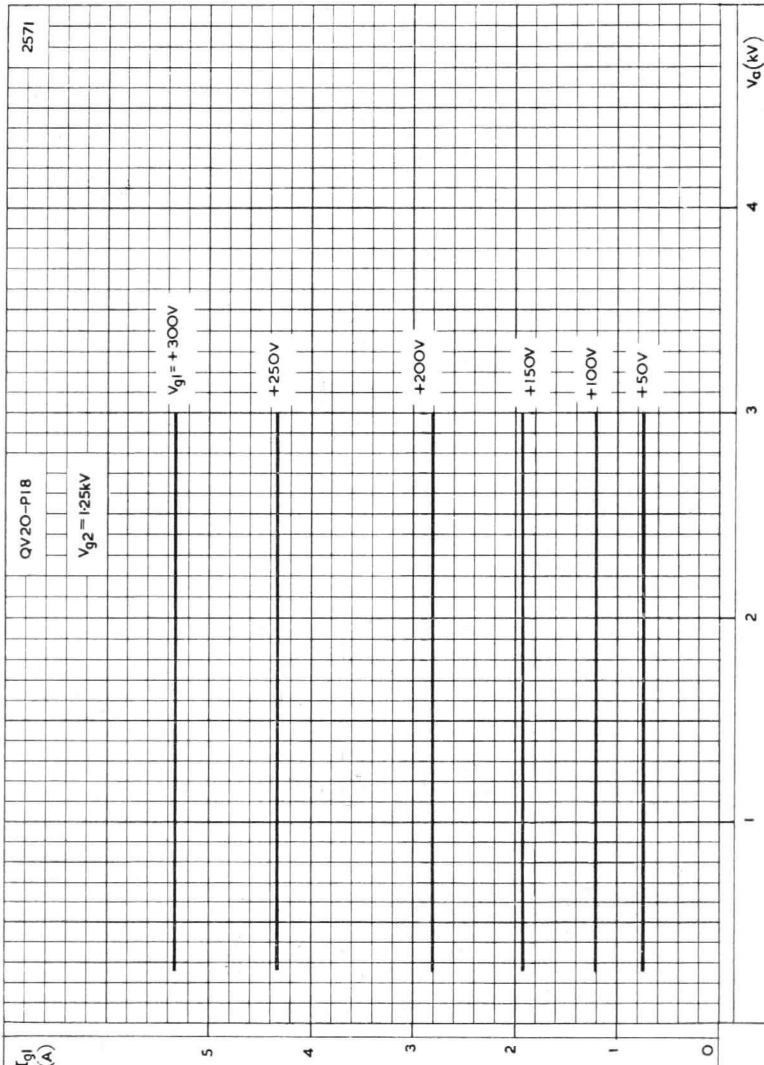


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

QV20-P18

PULSE TETRODE MODULATOR

Tetrode for pulsed applications having ratings of 20kV and 18A.



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE

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

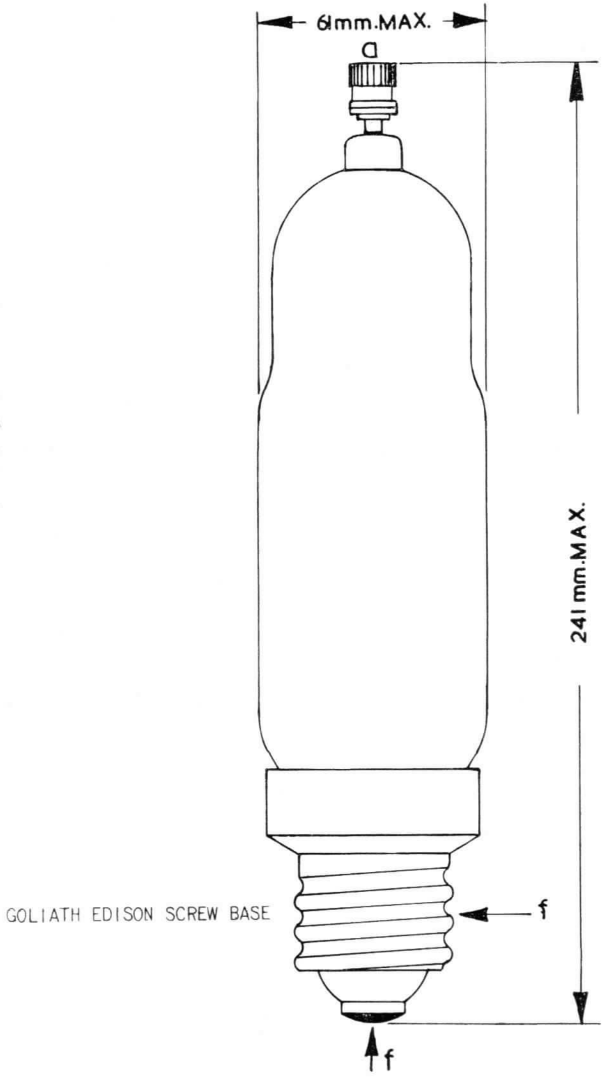
Max. Peak Inverse Voltage (150c/s max.)	13,000	V
Max. Peak Anode Current	5	A
Max. Mean Anode Current	1.25	A
Voltage Drop across Valve (approx.)	16	V
Ambient Temperature	10 to 40	°C
Condensed Mercury Temperature	25 to 65	°C

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.)

WATER-COOLED R.F. TRIODE

TX12-12W

High-power water-cooled triode, intended for R.F. heating applications.

This data should be read in conjunction with "Operating Notes, Part 1—Power Valves" included in this volume of the Handbook.

FILAMENT

Pure Tungsten, suitable for a.c. or d.c. operation.

Marked V_f	19±1.0	V
I_f (approx.)	72	A

(Marked volts give 10 amps emission for 90% saturation.)

CAPACITANCES (Measured without water jacket)

c_{g-f}	25	µµF
c_{a-f}	2.2	µµF
c_{a-g}	30	µµF

CHARACTERISTICS (At V_a=10 kV, V_g=0V)

g_m	9.0	mA/V
μ	45	
r_a	5.0	k Ω

LIMITING VALUES

*V_a max. (f=15 Mc/s)	12	kV
p_a max.	12	kW
p_g max.	350	W
$I_{g\ (R.F.)}$ max.	30	A
Min. rate of flow of water	3.0	gal/min
Max. water outlet temperature	65	°C

*At higher frequencies the permissible anode voltage is reduced to the following percentages of the maximum:

f	20	25	40	Mc/s
% of V_a max.	85	65	35	%

MAXIMUM OPERATING CONDITIONS AS SINGLE VALVE R.F POWER OSCILLATOR

V_a	8.0	10	12	kV
V_g	−290	−460	−375	V
I_a	2.4	2.5	2.6	A
I_g (approx.)	250	130	140	mA
$V_{in\ (pk)}$	1.3	1.5	1.4	kV
P_{drive} (approx.)	320	200	200	W
R_a	1.6	1.9	2.3	k Ω
P_{out}	13	16.7	21.5	kW
P_a	6.2	8.3	9.7	kW

TX12-12W

WATER-COOLED R.F. TRIODE

High-power water-cooled triode, intended for R.F. heating applications.

R.F. HEATING APPLICATIONS

For these applications, individual requirements should be discussed with Industrial Technical Service Department, Mullard Limited.

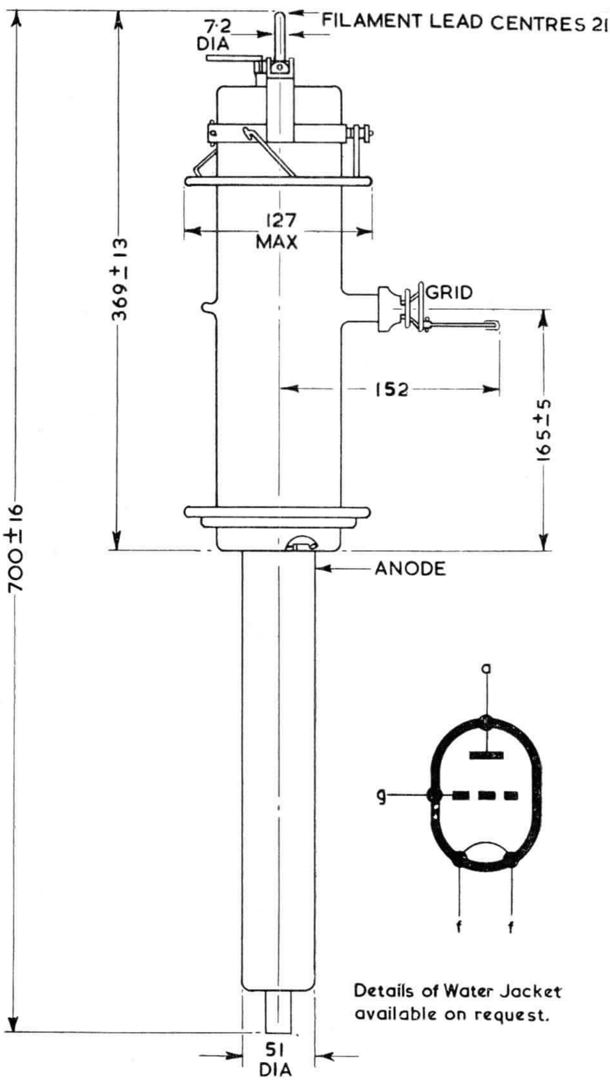
OPERATING NOTES

(a) It is essential that the filament seal be cooled with a blast of air. All cooling supplies should commence before the application of any voltage.

(b) The resistance of the filament when cold is 0.021 Ω. The filament current must never be allowed to exceed 105 amps.
If the valve is operated for periods greater than 15 minutes without the applied anode voltage, the filament voltage must be reduced to one half its normal value during the stand-by period.

WATER-COOLED R.F. TRIODE TX12-12W

High-power water-cooled triode, intended for R.F. heating applications.



Details of Water Jacket available on request.

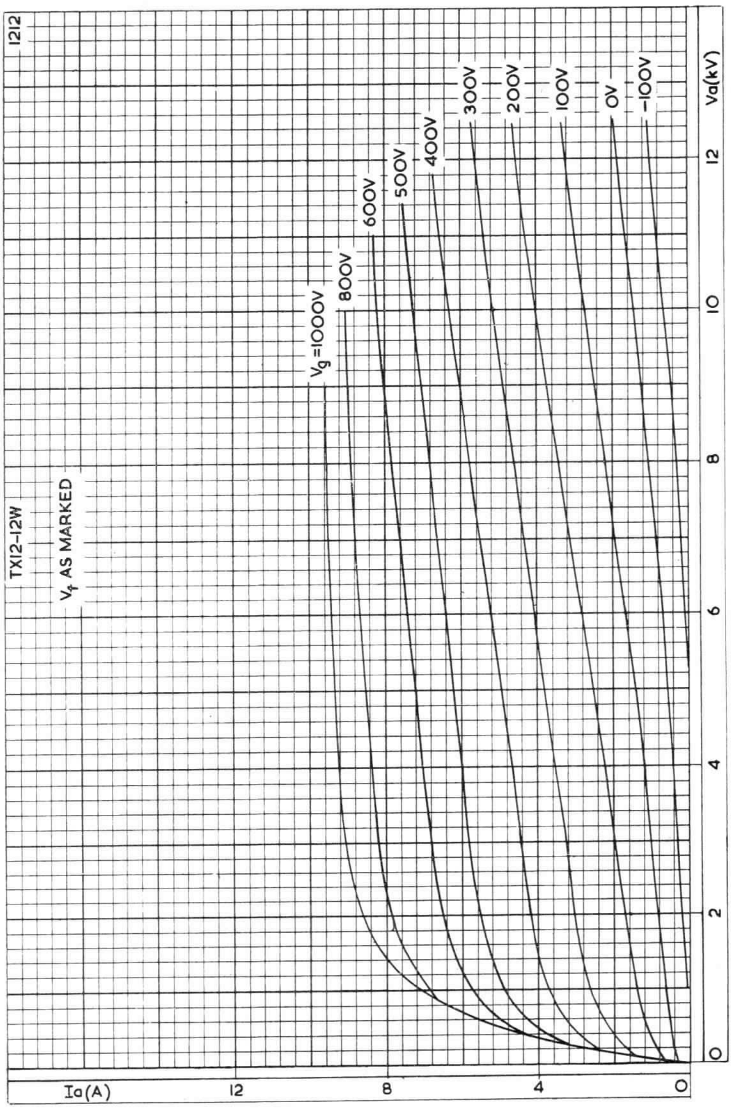
All dimensions in mm.

1211

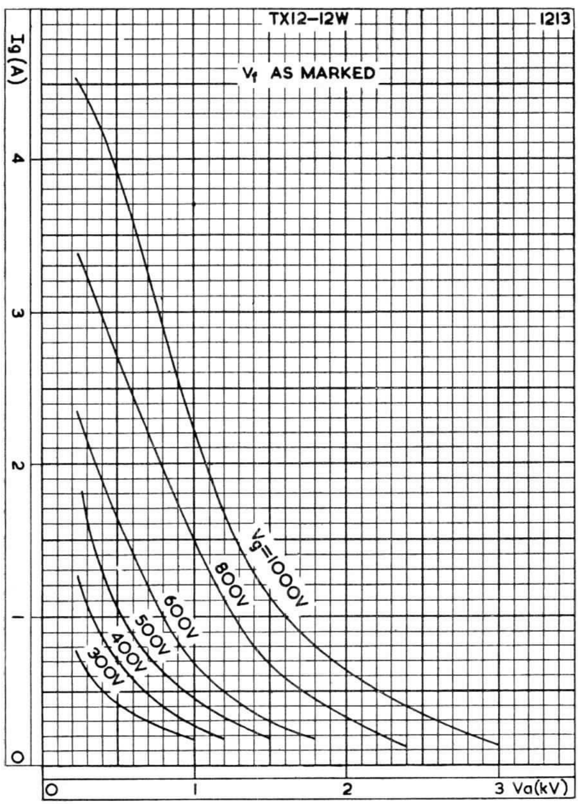
TX12-12W

WATER-COOLED R.F. TRIODE

High-power water-cooled triode, intended for R.F. heating applications.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

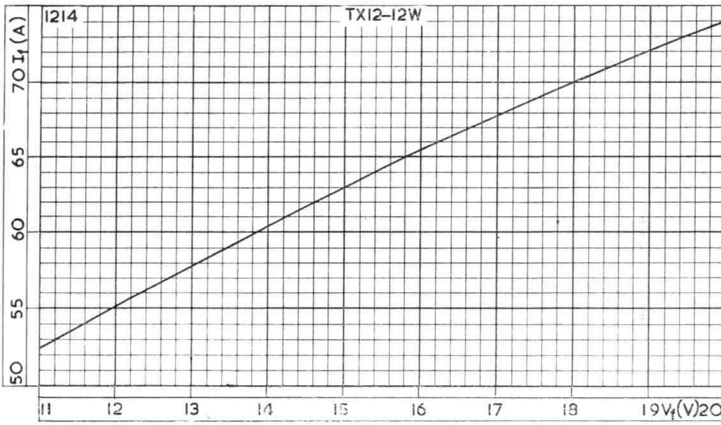


GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

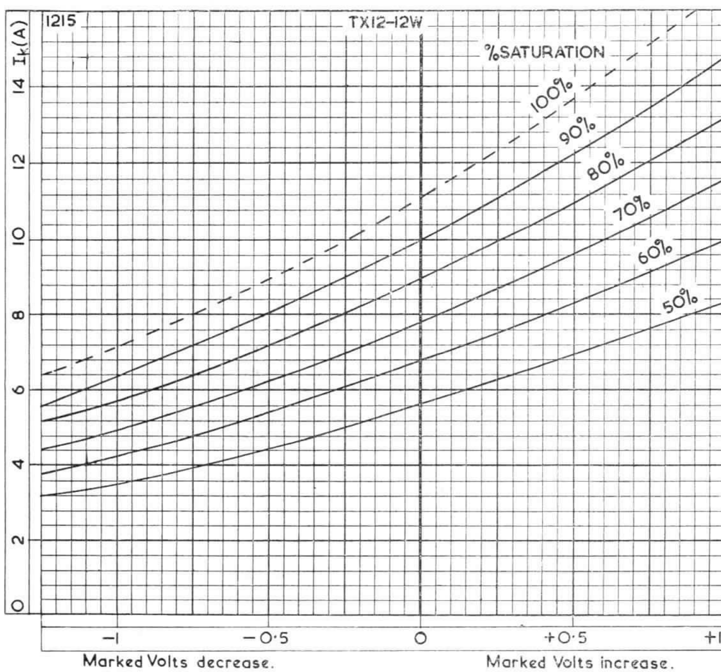
TX12-12W

WATER-COOLED R.F. TRIODE

High-power water-cooled triode, intended for R.F. heating applications.



VARIATION OF FILAMENT CURRENT WITH FILAMENT VOLTAGE



VARIATION OF CATHODE EMISSION WITH DEVIATION OF FILAMENT VOLTAGE FROM MARKED VALUE SHOWING VARIOUS DEGREES OF SATURATION

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.

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

TY12-25A

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

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.

OPERATING NOTE

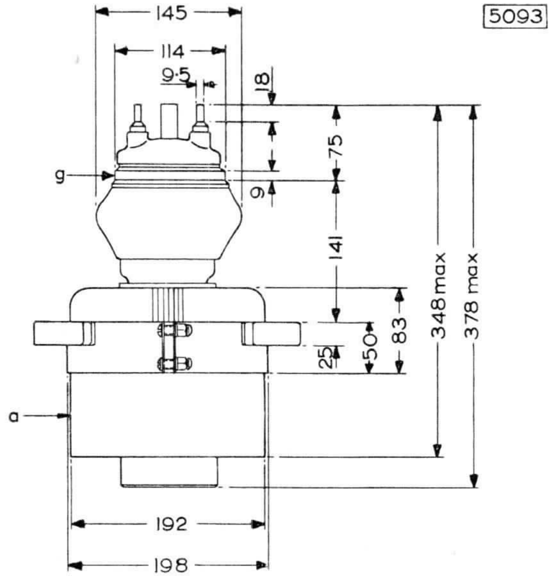
To ensure a uniform r.f. current distribution in the grid seal, especially at higher frequencies, the grid lead should be connected to the middle wing nut of the grid bracket.

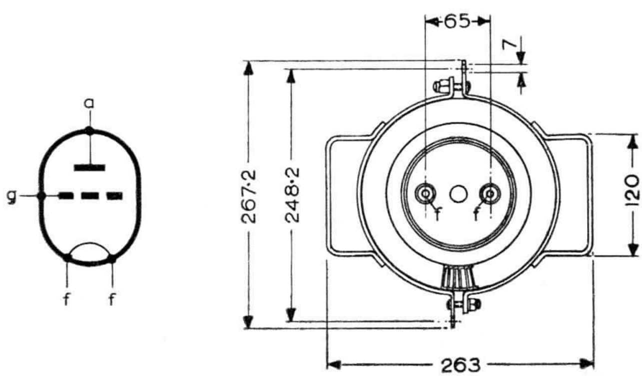
ACCESSORIES

Information on these items can be obtained from the Government and Industrial Valve Division, Mullard Limited.

WEIGHT

Valve only	17.5	kg
	38.5	lb
Shipping weight	85.5	kg
	188	lb

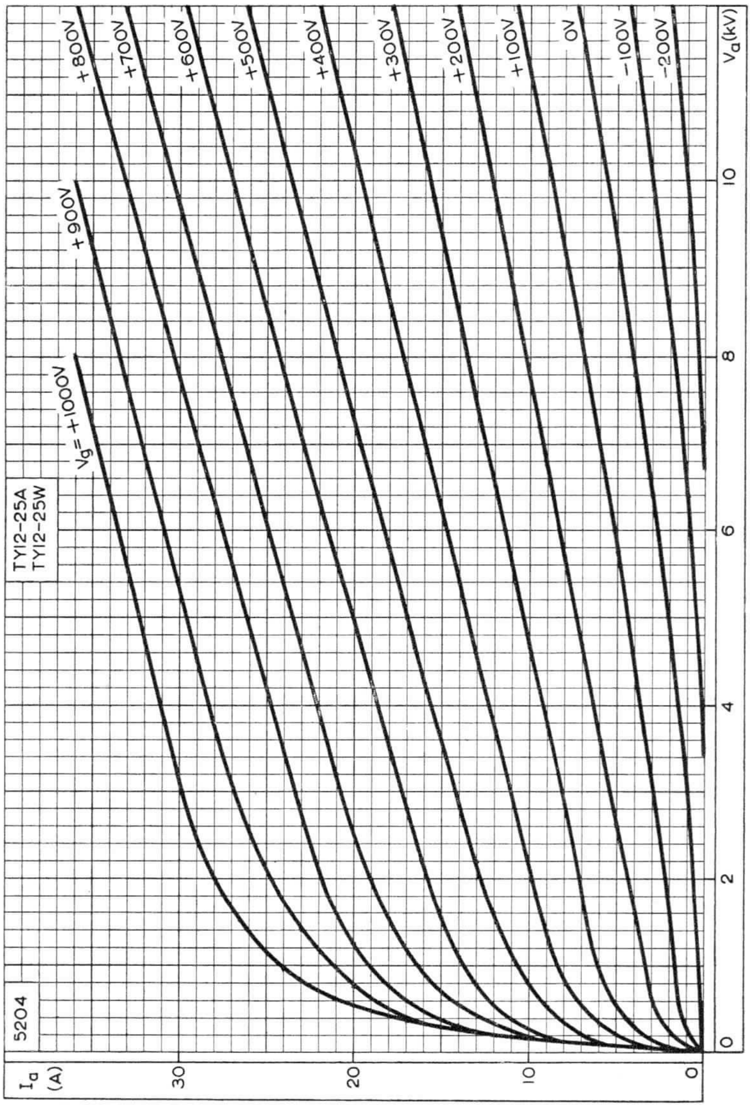




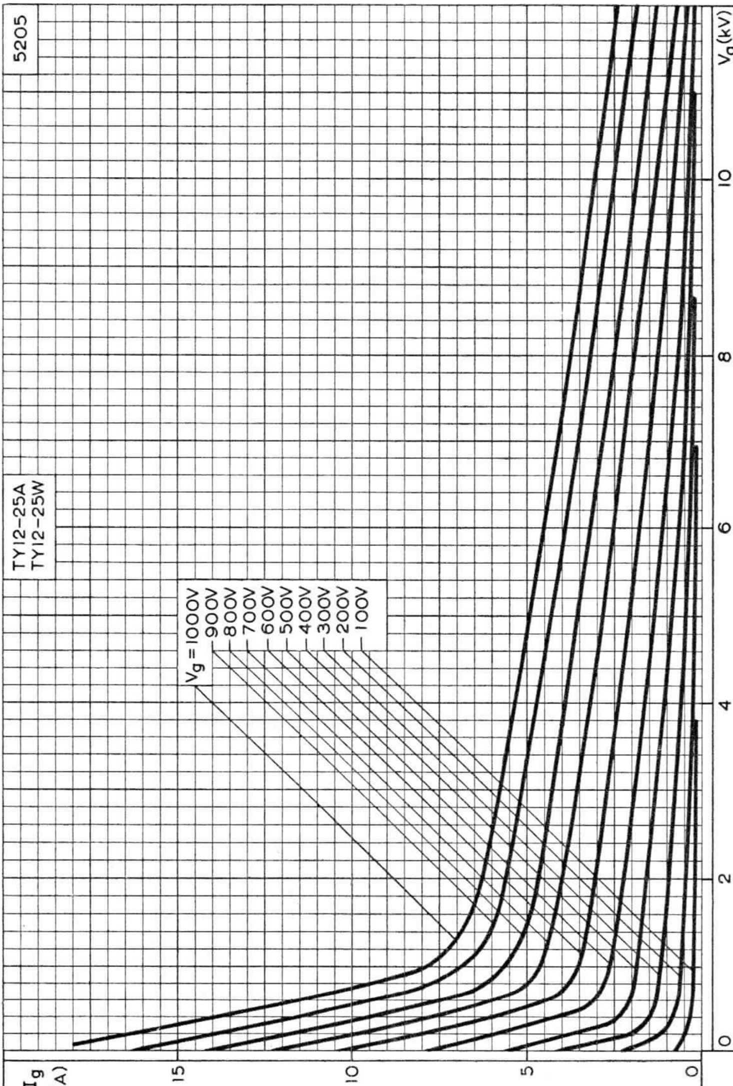
All dimensions in mm

TY12-25A

TRIODE



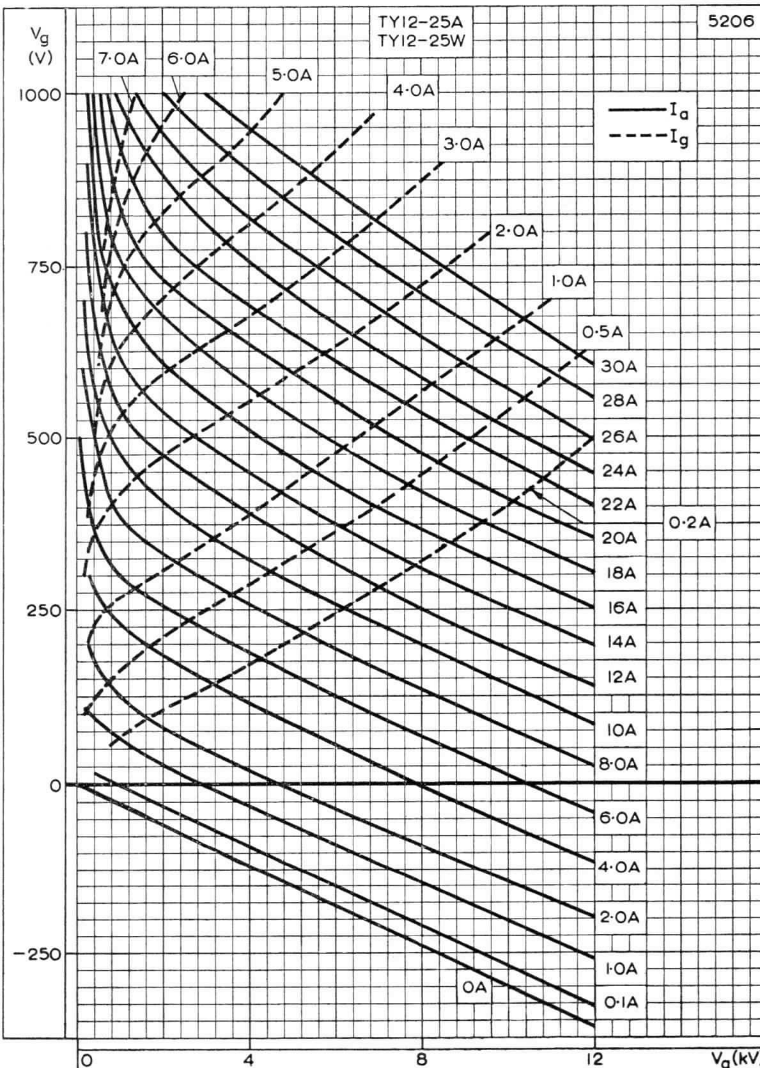
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



CONTROL-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

TY12-25A

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 p_a (kW)	Inlet temperature T_{in} (°C)	Rate of flow of water (Litres/min.)	Difference in pressure between inlet and outlet (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

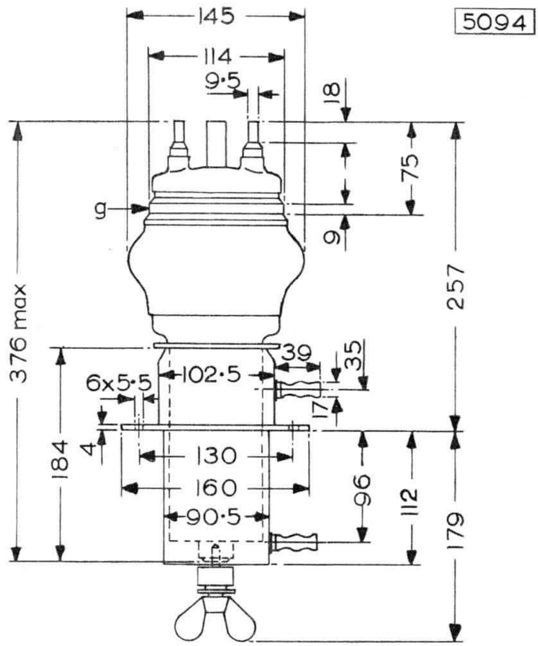
To ensure a uniform r.f. current distribution in the grid seal, especially at higher frequencies, the grid lead should be connected to the middle wing nut of the grid bracket.

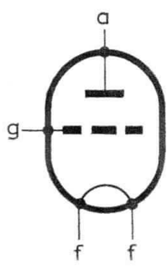
ACCESSORIES

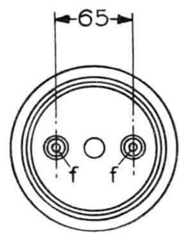
Information on these items can be obtained from the Government and Industrial Valve Division, Mullard Limited.

WEIGHT

Valve only	2.8	kg
	6.2	lb
Shipping weight	37.5	kg
	82.5	lb







All dimensions in mm

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	100	kΩ
(Recommended min. control-grid resistor 10kΩ)		
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

XGQ2-6400 TETRODE THYRATRON

(MT105)

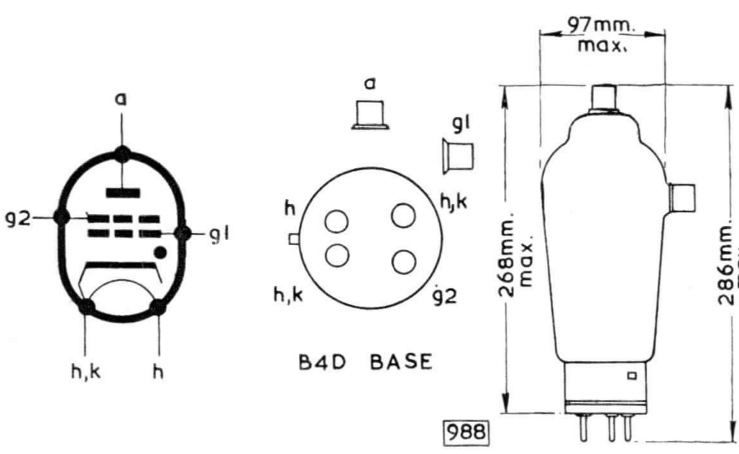
CHARACTERISTICS

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

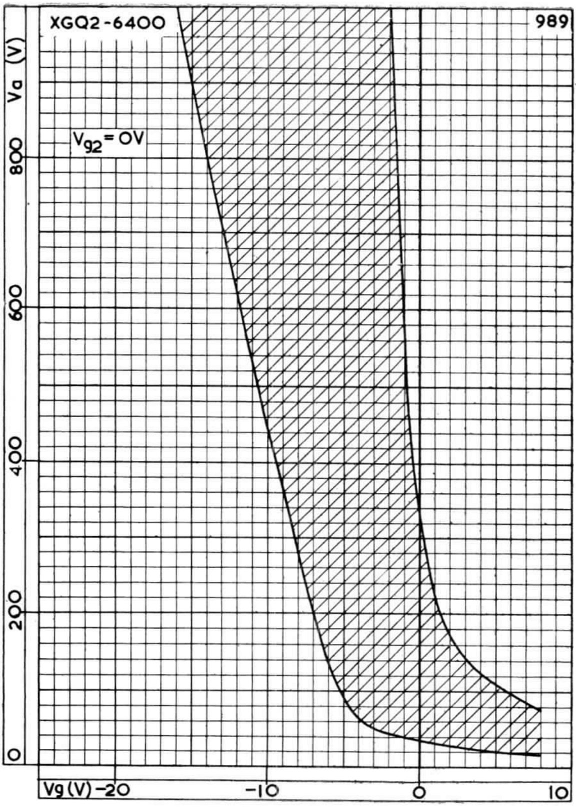


TETRODE THYRATRON

XGQ2-6400

(MT105)

Tetrode, mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.



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.

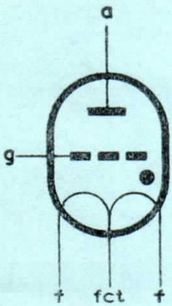
Mechanical

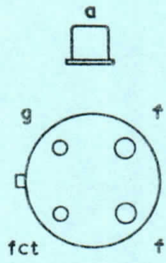
Type of cooling	Convection	
Recommended mounting position	Any between horizontal and vertical with base down.	
Maximum net weight	96	g
	3.4	oz

TRIODE THYRATRON

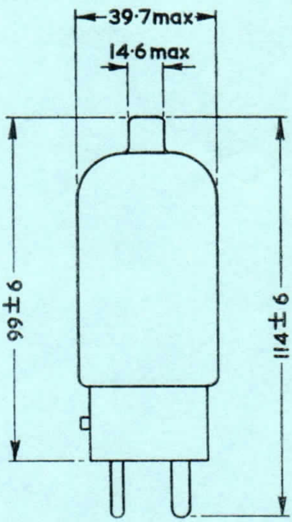
XR1-1600

6460

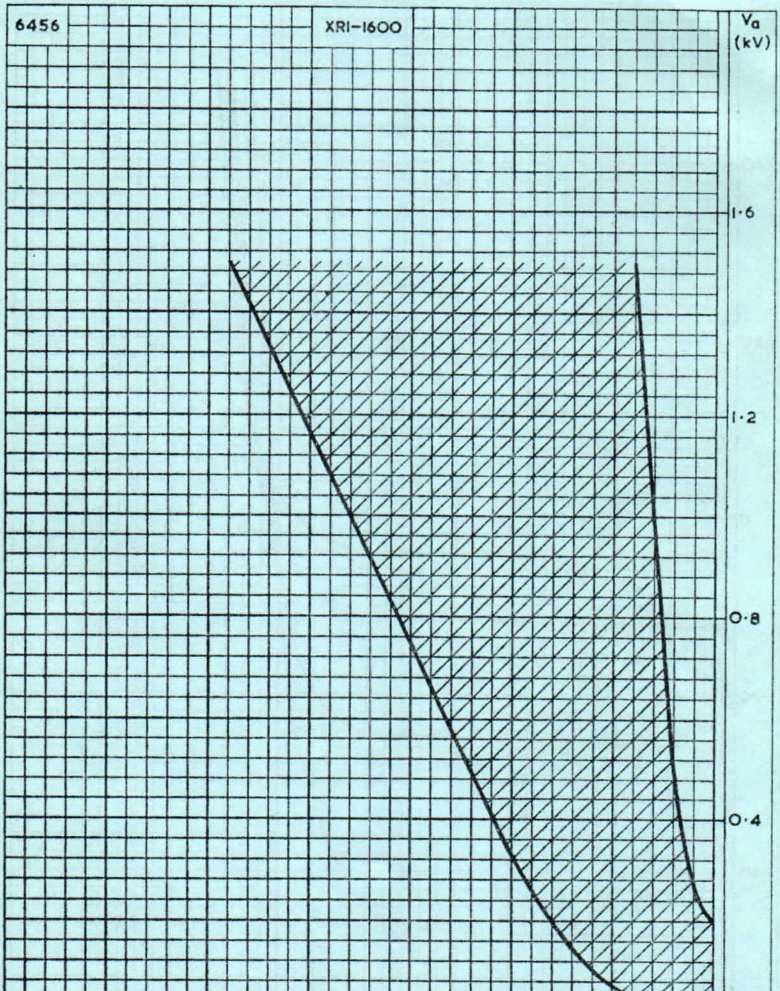




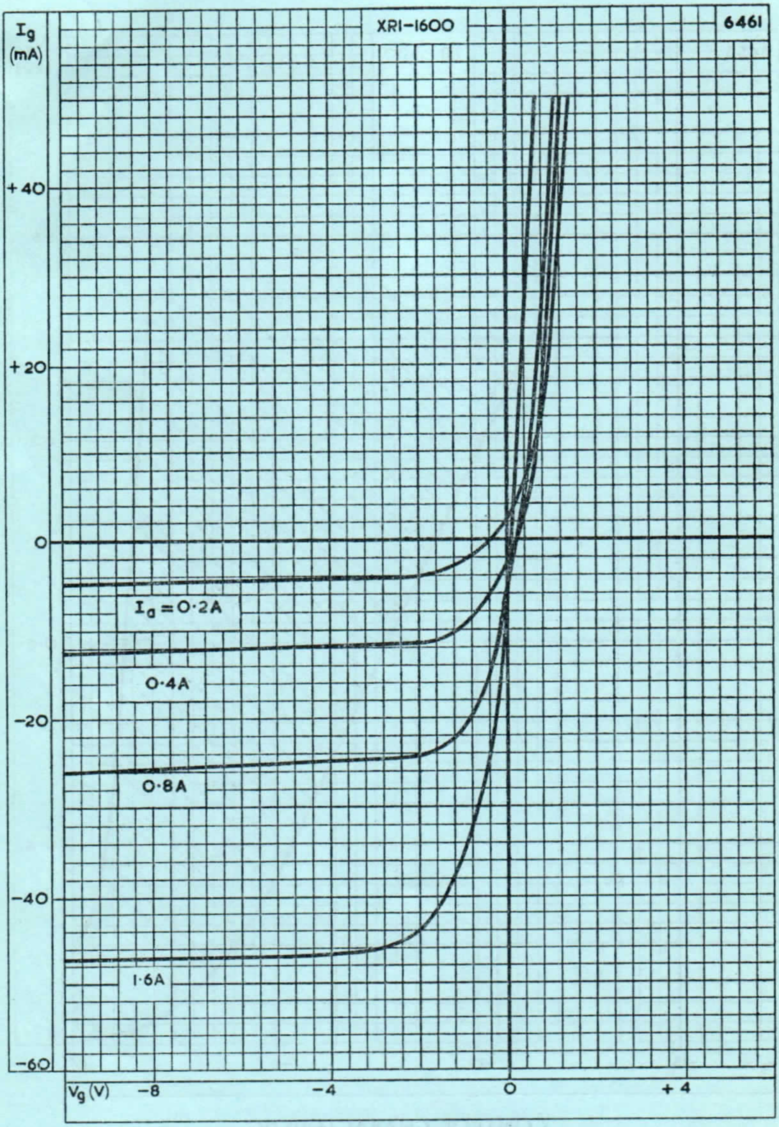
Medium 4-pin base
with bayonet catch



All dimensions in mm



CONTROL CHARACTERISTIC



GRID ION CURRENT CHARACTERISTIC

TRIODE THYRATRON

XR1-6400

(5545)

6.4A inert gas-filled triode thyratron with negative control characteristic. Primarily designed for motor control applications.

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	100	kΩ
(Recommended min. grid resistor 500Ω)		
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

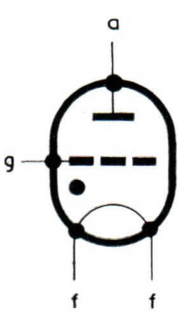
Filament voltage	2.5	V
Filament current at 2.5V		
Average	21	A
Maximum	23	A
Anode to control-grid capacitance	0.8	pF
Control-grid to cathode capacitance	45	pF
Deionisation time (approx.)		
(a) $V_g = -250V$	50	µs
(b) $V_g = -12V$	500	µs
Ionisation time (approx.)	10	µs
Anode voltage drop (approx.)	16	V
Critical grid current at $V_a = 1.5$ kV	<20	µA

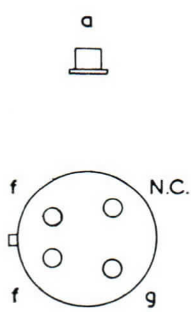
XR1-6400
(5545)

TRIODE THYRATRON

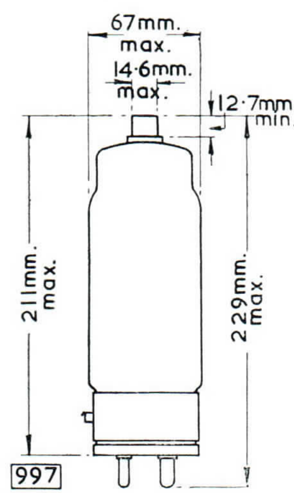
Mechanical

Type of cooling	Convection
Mounting position	Any position between horizontal and vertical with base downwards
Max. net weight	12 oz. / 340 g





B4D BASE

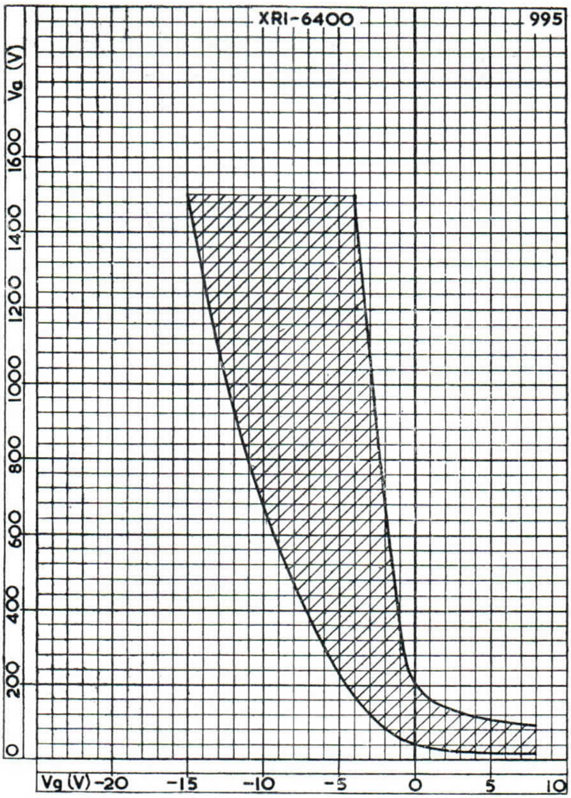


TRIODE THYRATRON

Triode, inert gas-filled thyratron with negative control characteristic. Primarily designed for motor control applications.

XR1-6400

(5545)



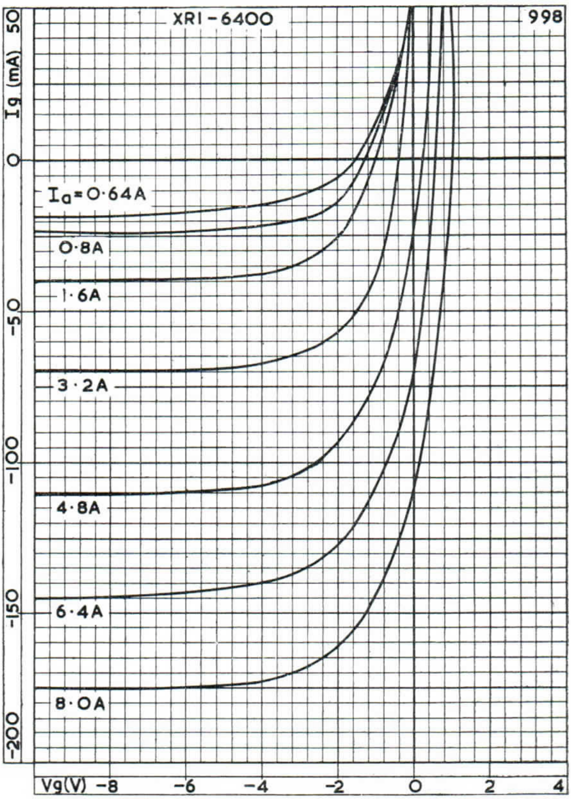
CONTROL CHARACTERISTIC

XR1-6400

(5545)

TRIODE THYRATRON

Triode, inert gas-filled thyratron with negative control characteristic. Primarily designed for motor control applications.



GRID ION CURRENT CHARACTERISTICS

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 250Vr.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.

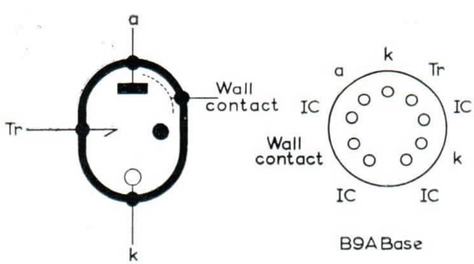
The forward and inverse voltages applied to the valve must not exceed the quoted values. Capacitor C connected across the relay provides a smooth relay current, thus avoiding 'chatter'. It should be remembered that the steady voltage across this capacitor adds to the a.c. inverse voltage across the tube but subtracts from the forward voltage.

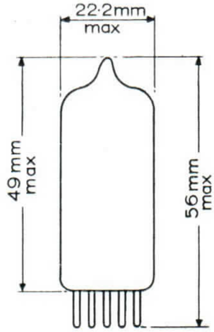
The trigger circuit

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



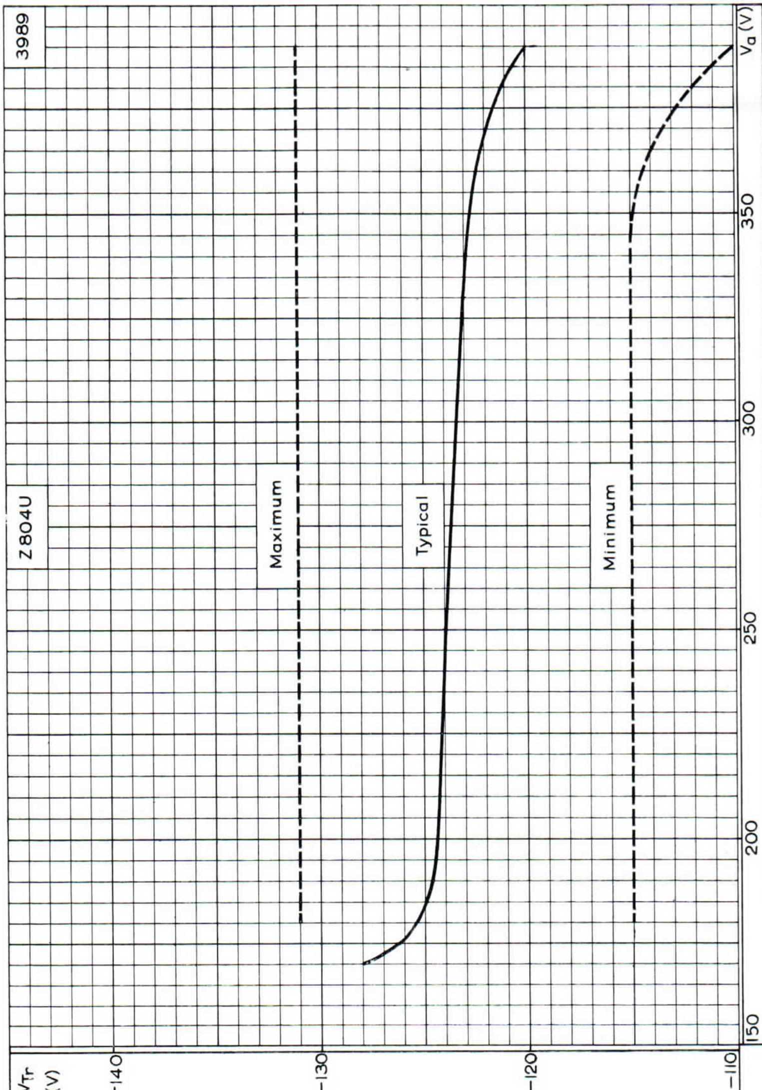


Wall contact (pin 2) must be connected to cathode via a 2MΩ resistor.

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.

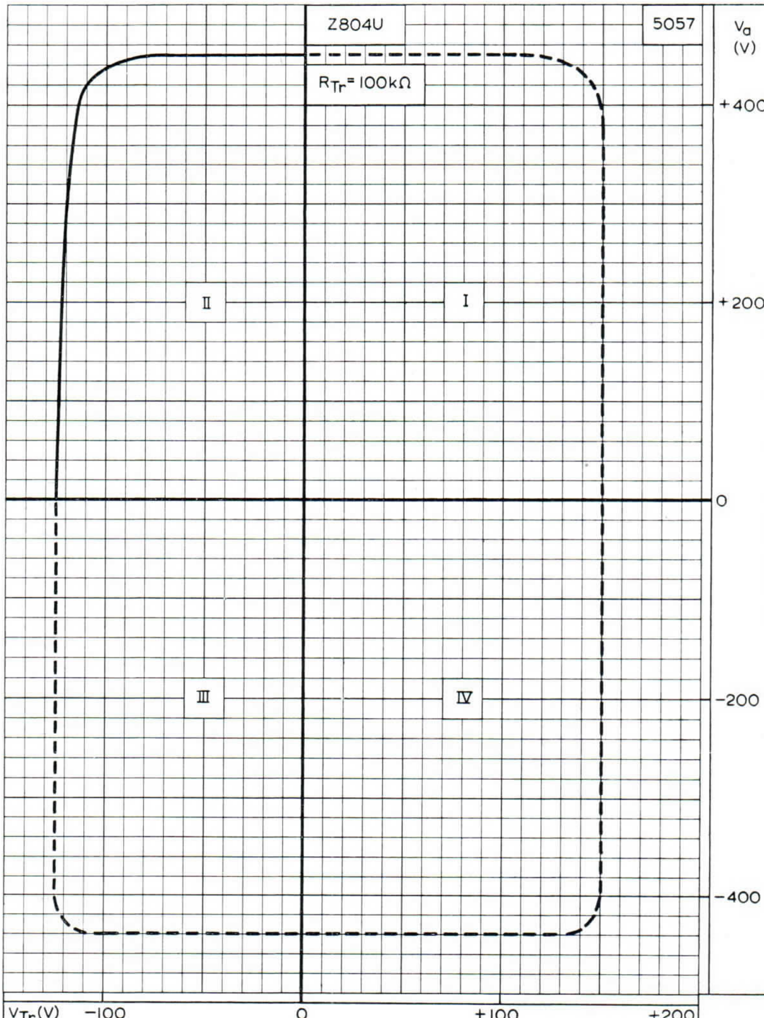


TRIGGER VOLTAGE PLOTTED AGAINST ANODE VOLTAGE FOR ALL TUBES OVER LIFE

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).

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.

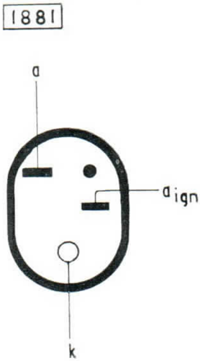
2. The maximum ignition voltage quoted is the greatest voltage which is necessary to ignite any tube in the presence of an ambient illumination of 5 to 50 foot-candles. A voltage of at least this value must be available if reliability of ignition is to be obtained. In complete darkness there may be some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

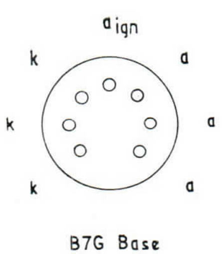
3. The noise generated by the tube over the frequency range (50 to 5,000 c/s) and at a constant current (2 to 20mA) is less than $15mV_{r.m.s.}$

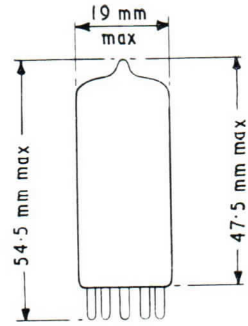
75B1

STABILISING TUBE

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







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 ($\leq$ 100 hours) variation of maintaining voltage after the first 300 hours of life	0.1	%

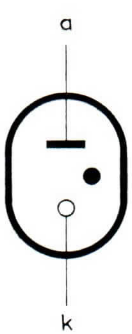
*After initial warming-up period of 3 minutes.

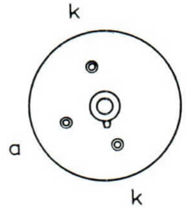
85A1 VOLTAGE REFERENCE TUBE

NOTES

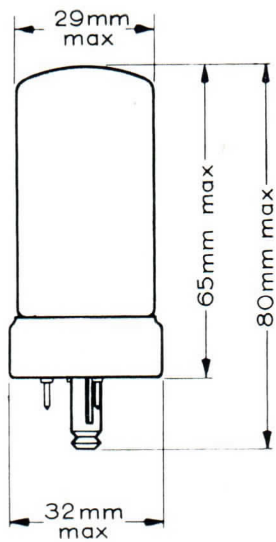
1. Equilibrium conditions are normally reached after 3 minutes' operation.
2. Over life, the incremental resistance will remain sensibly constant but the temperature coefficient of the maintaining voltage can be expected to decrease slightly.
3. The noise generated by the tube over a frequency band of 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.

6130





B8G Base



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.

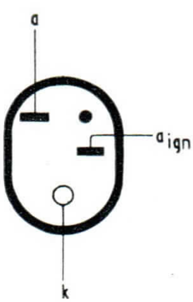
3. The noise generated by the tube over the frequency range (50 to 5,000 c/s) and at a constant current (2 to 10mA) will be less than $15mV_{r.m.s.}$

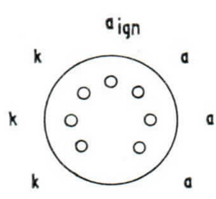
95A1

STABILISING TUBE

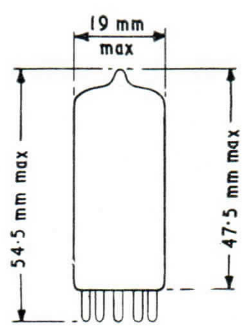
Miniature gas-filled tube with auxiliary ignition electrode (priming anode) and intended for use as a voltage stabiliser.

1881





B7G Base



STABILISING TUBE

150B3

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

PRELIMINARY DATA

MAINTENANCE TYPE

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.

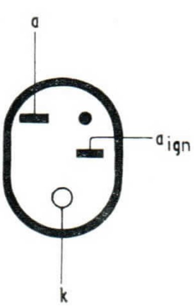
4. The noise generated by the tube over a frequency range (50 to 5,000 c/s) and at any constant current (2 to 20mA) is less than $15mV_{r.m.s.}$

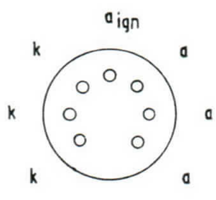
150B3

STABILISING TUBE

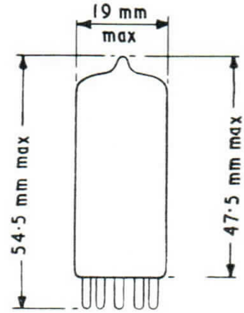
Miniature gas-filled tube with auxiliary ignition electrode (priming anode) and intended for use as a voltage stabiliser.

1881





B7G Base



STABILISING TUBE

4687

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

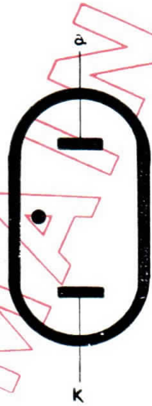
This data should be read in conjunction with the 'GENERAL OPERATION RECOMMENDATIONS—VOLTAGE STABILISER AND REFERENCE LEVEL TUBES' which precede this section of the handbook.

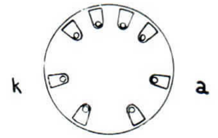
LIMITING VALUES (absolute ratings)

Minimum voltage necessary for ignition	130	V
Burning current		
Maximum	40	mA
Minimum	10	mA

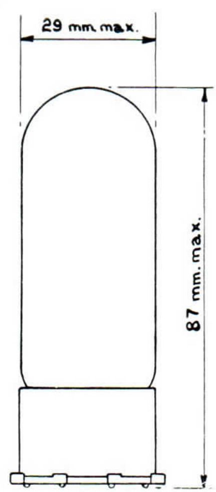
CHARACTERISTICS (measured at 20mA)

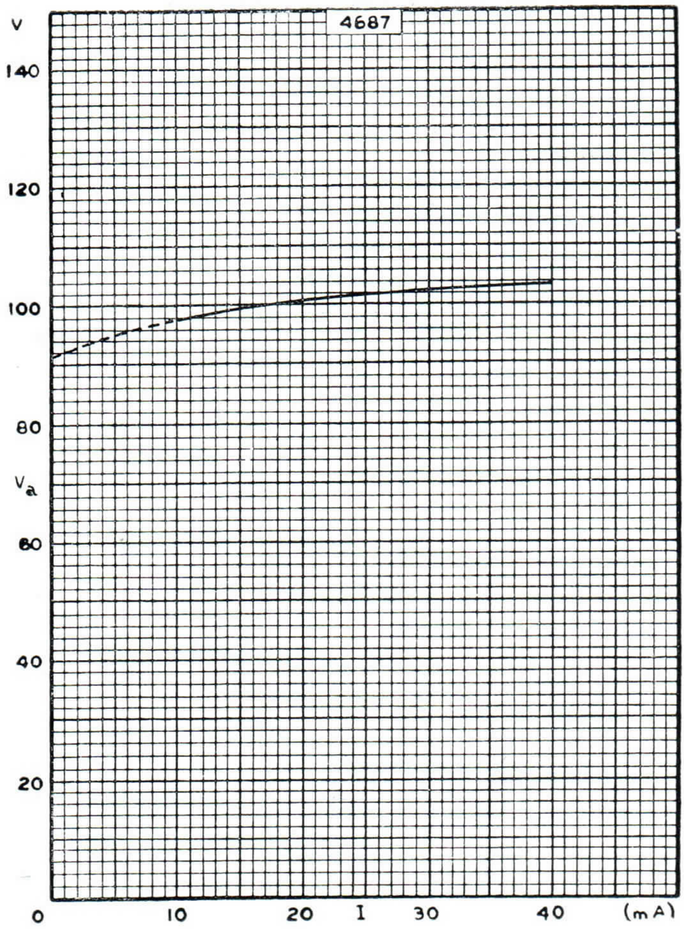
Maintaining voltage (variation from tube to tube)	90 to 110	V
Maximum incremental resistance	250	Ω





SIDE CONTACT BASE





MAINTAINING VOLTAGE PLOTTED AGAINST BURNING CURRENT

STABILISING TUBE

7475

Neon-filled voltage stabiliser.

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.

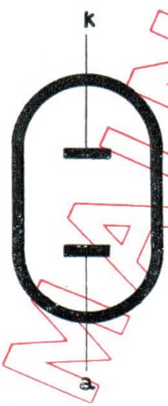
LIMITING VALUES (absolute ratings)

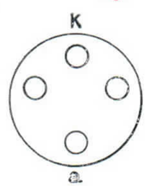
Minimum voltage necessary for ignition	140	V
Burning current		
Maximum	8.0	mA
Minimum	1.0	mA

CHARACTERISTICS (measured at 4mA)

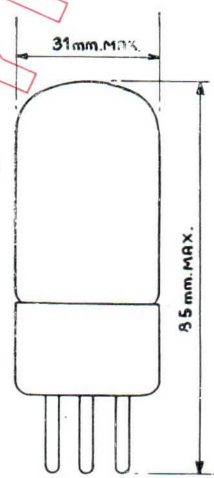
Maintaining voltage (variation from tube to tube)	90 to 110	V
Incremental resistance	300	Ω

MAINTENANCE TYPE



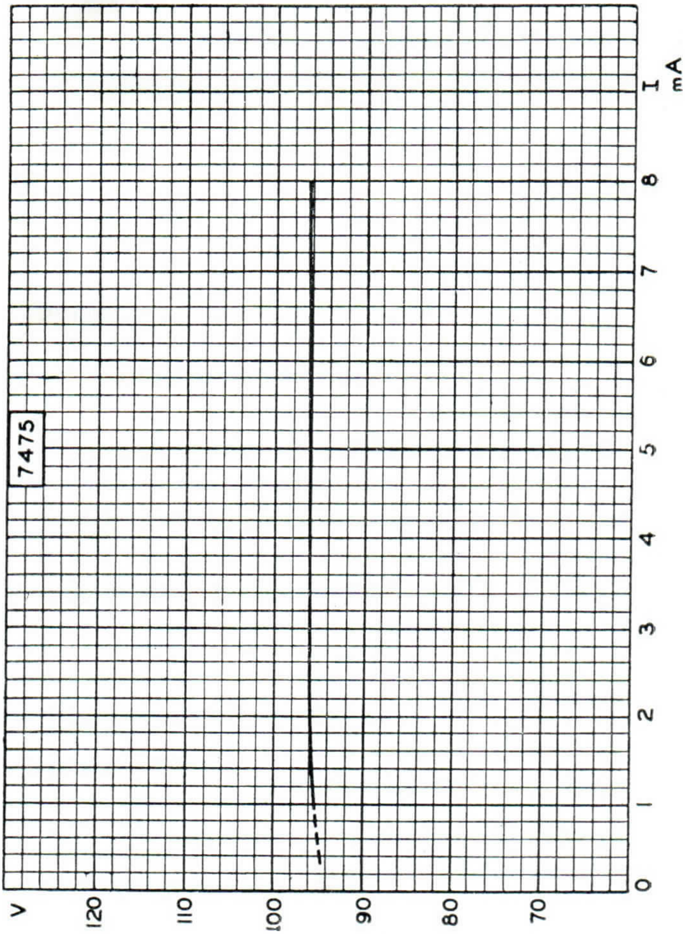


British 4-pin base



7475

STABILISING TUBE



MAINTAINING VOLTAGE PLOTTED AGAINST BURNING CURRENT