Mullard

TECHNICAL HANDBOOK

VOL. 2

RECEIVING VALVES FOR MAINTENANCE

Mullard

MAINTENANCE TYPE
RECEIVING VALVES AND
CATHODE RAY TUBES

2

VOLUME 2

Maintenance Types

receiving and amplifying valves
cathode ray tubes

Issued by
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TECHNICAL HANDBOOK SERVICE

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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.

Mullard Technical Handbook

GENERAL INDEX TO VOLUME TWO

GENERAL INDEX TO VOLUME TWO

MAINTENANCE TYPE
RECEIVING VALVES

FULL-WAVE RECTIFIER

AZ31

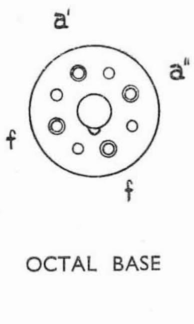
Directly-heated power rectifier for A.C. mains-operated equipment.

FILAMENT

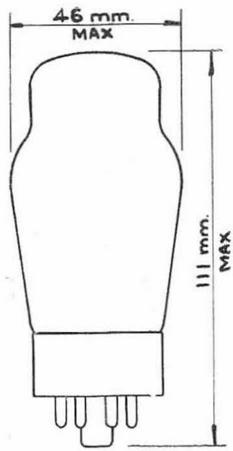
V_f	4.0	V
I_f	1.1	A

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



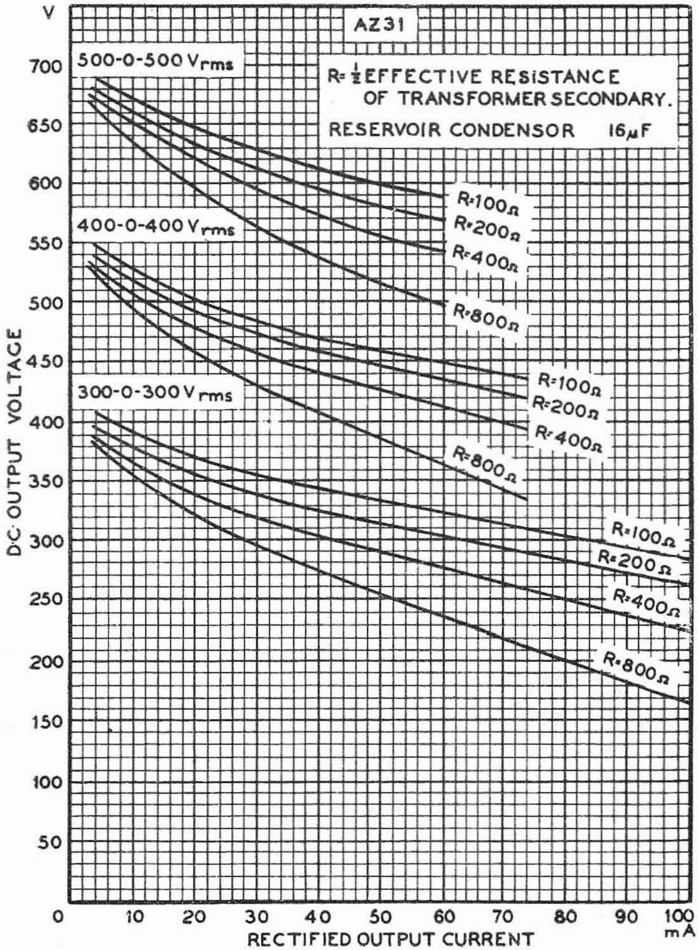
OCTAL BASE



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

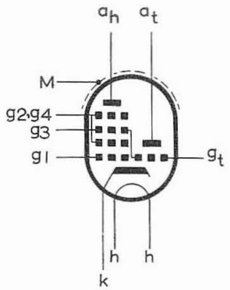
I_h	200	mA
V_h	7.0	V

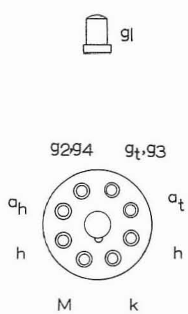
CHARACTERISTICS

For characteristics, curves and operating conditions, see data for type ECH35.

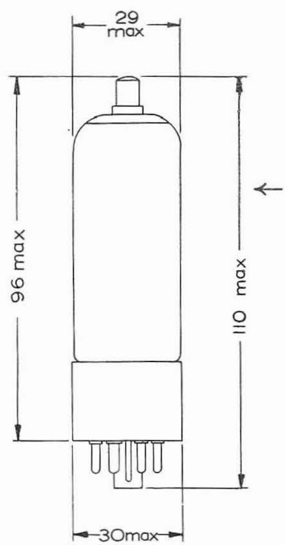
Except for the heater voltage and current, the ECH35 and CCH35 are identical.

6710





Octal base



All dimensions in mm

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).

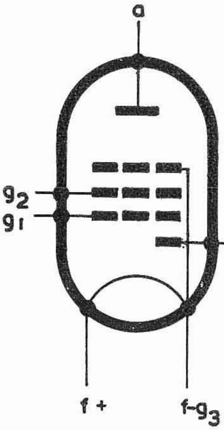
V_b (V)	R_a (k Ω)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} (V r.m.s.)	D_{tot} (%)	R_{g1}* (M Ω)
90	220	0.25	11.0	5	1.0	0.68
90	470	0.13	11.5	5	0.8	1.5

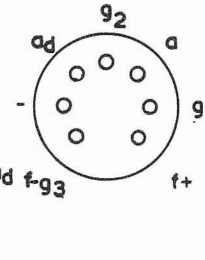
* Grid resistor of following valve.

MINIATURE DIODE PENTODE

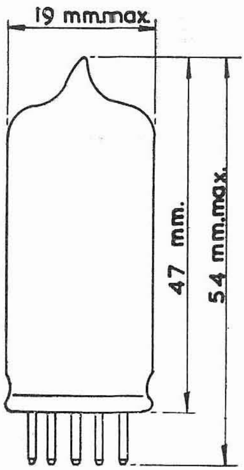
DAF91

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





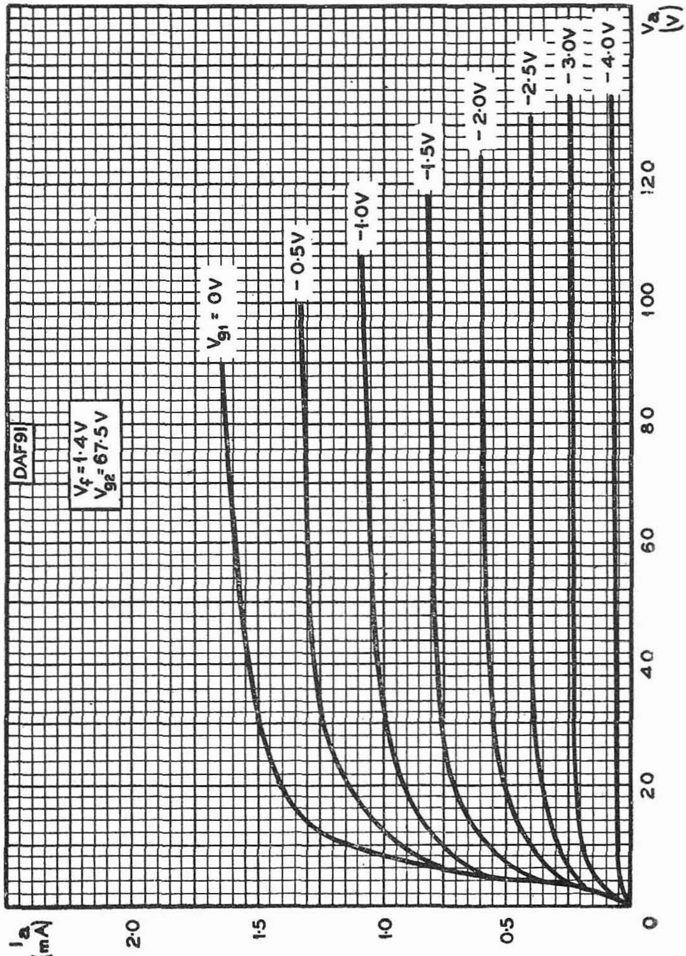
B7G BASE



DAF91

MINIATURE DIODE PENTODE

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

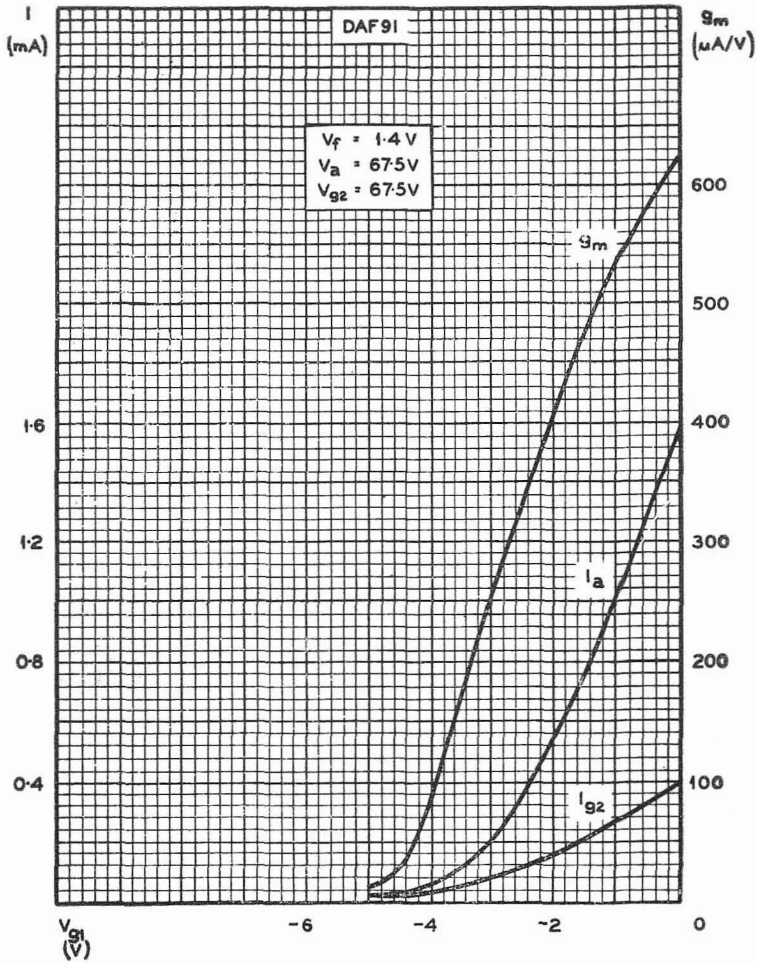


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

MINIATURE DIODE PENTODE

DAF91

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

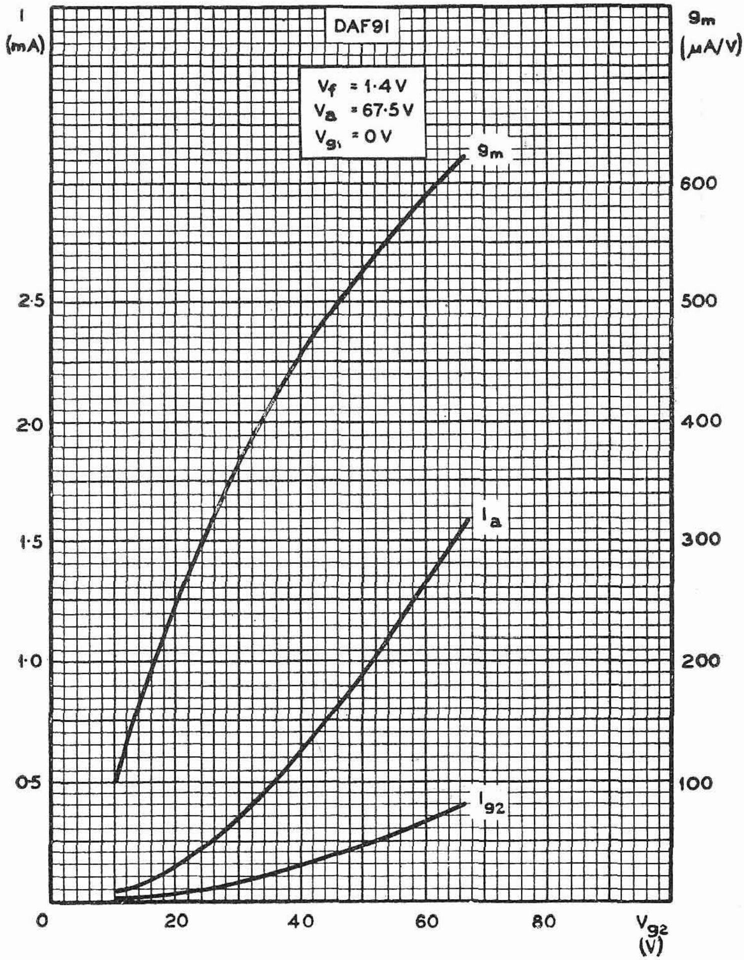


ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

DAF91

MINIATURE DIODE PENTODE

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

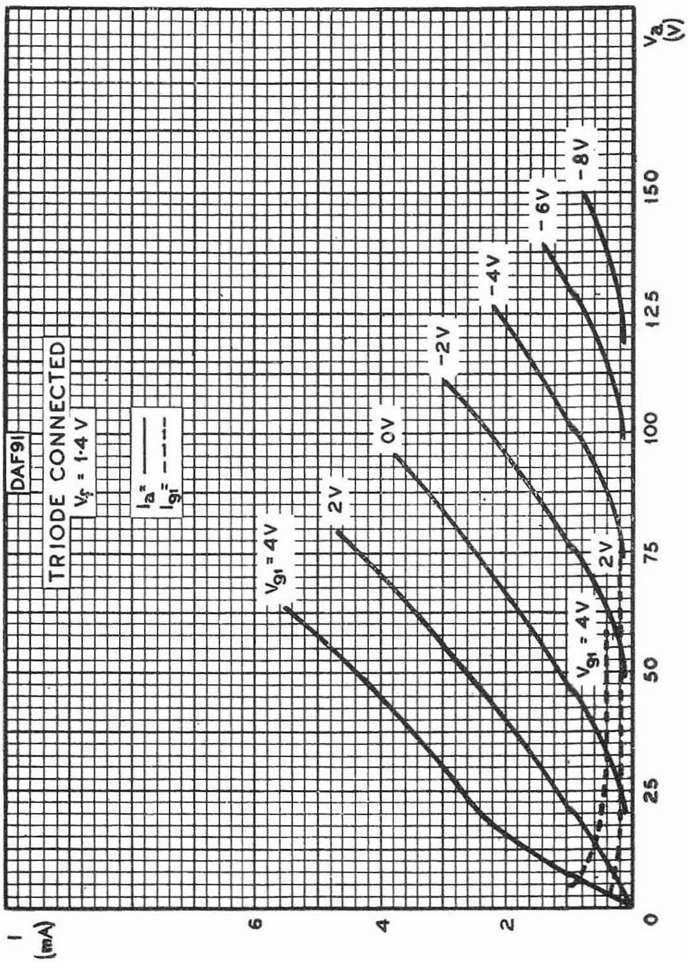


ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST SCREEN-GRID VOLTAGE

MINIATURE DIODE PENTODE

DAF91

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. CONNECTED AS TRIODE.

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

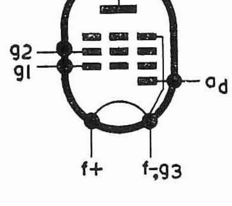
Pentode section

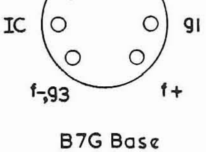
V_b max. (absolute)	110	V
V_a max.	90	V
p_a max.	30	mW
V_{g2} max.	90	V
p_{g2} max.	10	mW
I_k max.	250	μA
R_{g1-f} max. ($I_k < 250\mu A$)	3.0	MΩ
R_{g1-f} max. ($I_k < 100\mu A$)	22	MΩ

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.

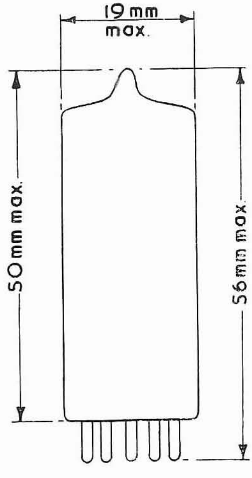
Diode section

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





B7G Base



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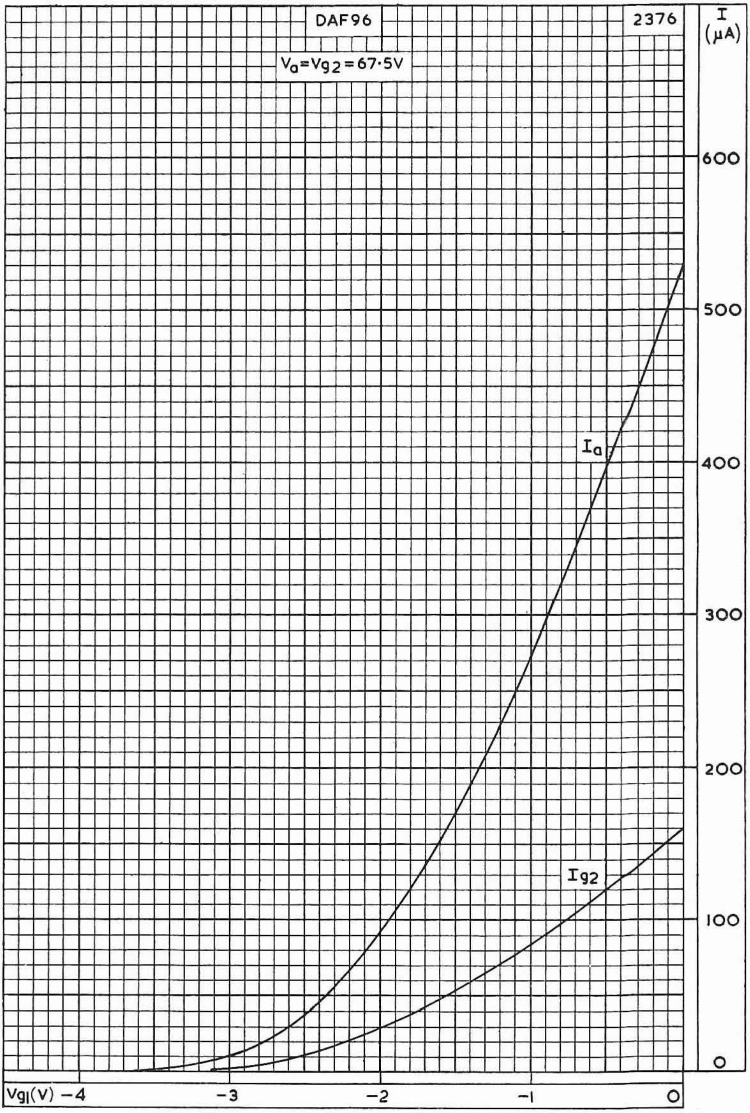
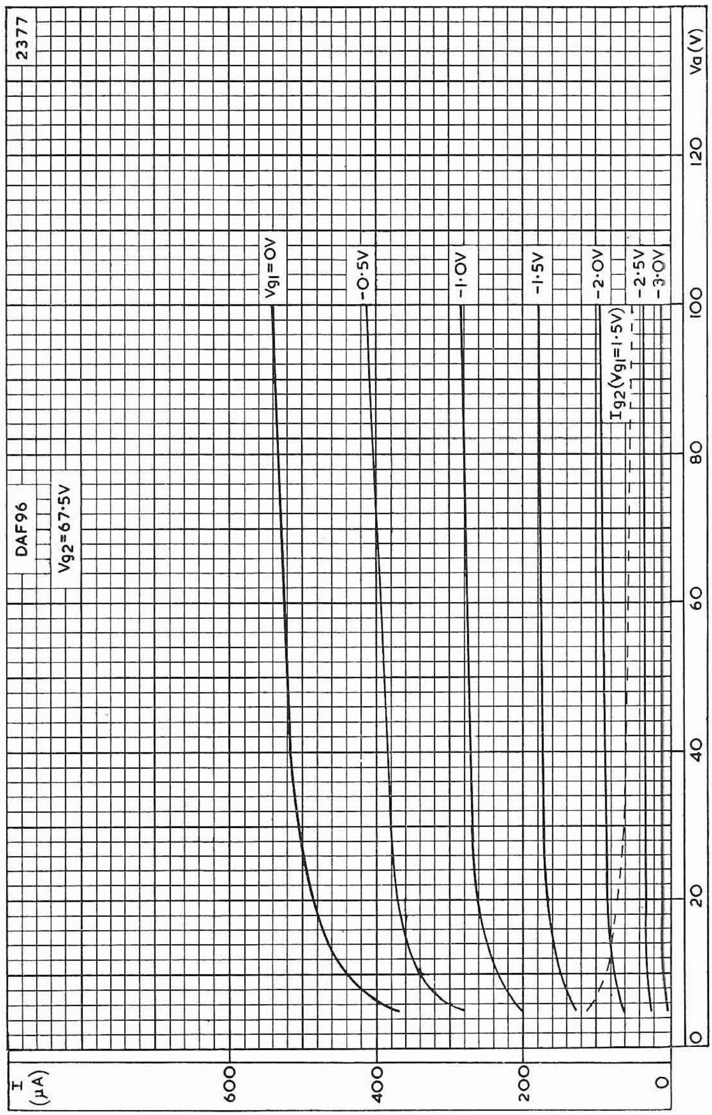


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

MINIATURE DOUBLE TRIODE

DCC90

R.F. double triode primarily intended for use in battery-operated portable transmitters.

FILAMENT

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

Series. V_f applied across two sections in series between pins 1 and 7. V_g referred to pin 1.

Parallel. V_f applied across the two filament sections in parallel between pin 4 and pins 1 and 7 connected together.
V_g referred to pins 1 and 7 connected together.

	Series	*Parallel*	
V_f	2.8	1.4	V
I_f	0.11	0.22	A

For series filament operation a shunting resistor must be connected across one filament section, between pins 1 and 4 to by-pass the excess cathode current in this section. The value of the resistor should be such that the voltage across the shunted section equals that across the other section.

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

$c_{a'-a''}$	0.32	μμF
c_{g-f} (each section)	0.9	μμF
c_{a-f} (each section)	1.0	μμF
c_{a-g} (each section)	3.2	μμF

CHARACTERISTICS (each section)

V_a	90	V
V_g	−2.5	V
I_a	3.7	mA
μ	15	
r_a	8.3	kΩ
g_m	1.8	mA/V

DCC90

MINIATURE DOUBLE TRIODE

R.F. double triode primarily intended for use in battery-operated portable transmitters.

OPERATING CONDITIONS AS PUSH PULL R.F. AMPLIFIER OR OSCILLATOR AT 40 Mc/s. (Intermittent operation)

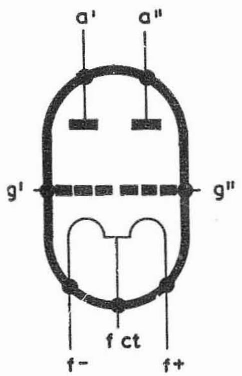
V_a	135	V
*V_g	–20	V
R_{g-f}	4.0	kΩ
R_k	570	Ω
$v_{in(pk)}$	2×45	mA
I_a	2×15	mA
I_g (approx.)	2×2.5	mV
p_g (approx.)	200	kW
P_{out} (approx.)	2.0	W

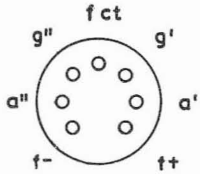
* Obtained from fixed supply, or by means of cathode or grid resistor of valve shown.

LIMITING VALUES (Intermittent operation)

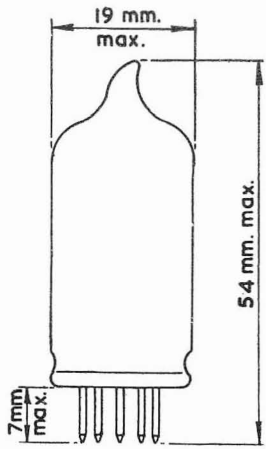
V_a max.	135	V
V_g max.	–30	V
I_a max.	2×15	mA
I_g max.	2×2.5	mA
p_a max.	2×1.0	W

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





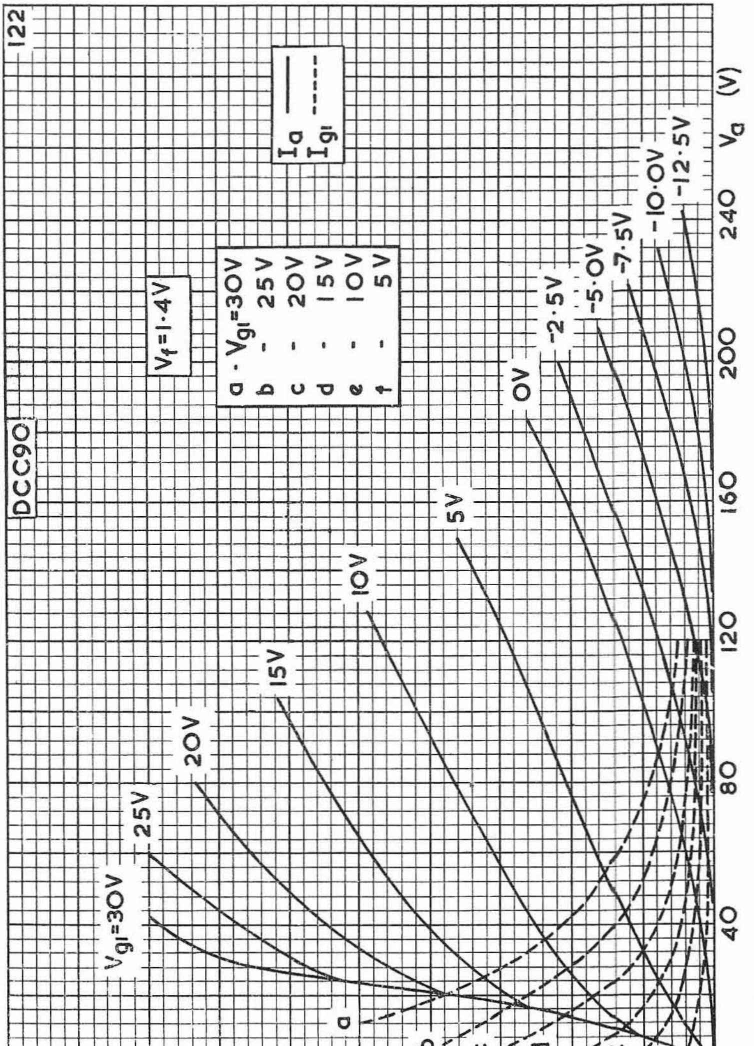
B7G BASE



MINIATURE DOUBLE TRIODE

DCC90

R.F. double triode primarily intended for use in battery-operated portable transmitters.



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

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

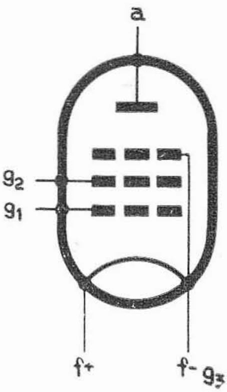
c_{a-g1}	<0.01	$\mu\mu F$
c_{in}	3.6	$\mu\mu F$
c_{out}	7.5	$\mu\mu F$

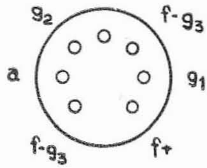
OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

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	$\mu A/V$
V_{g1} ($g_m = 10\ \mu A/V$)	−10	−16	−10	−16	V
r_a	350	250	800	500	kΩ

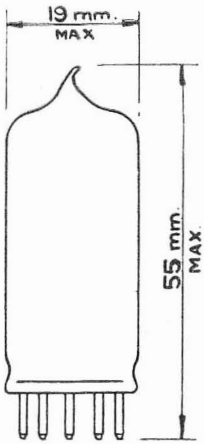
LIMITING VALUES

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





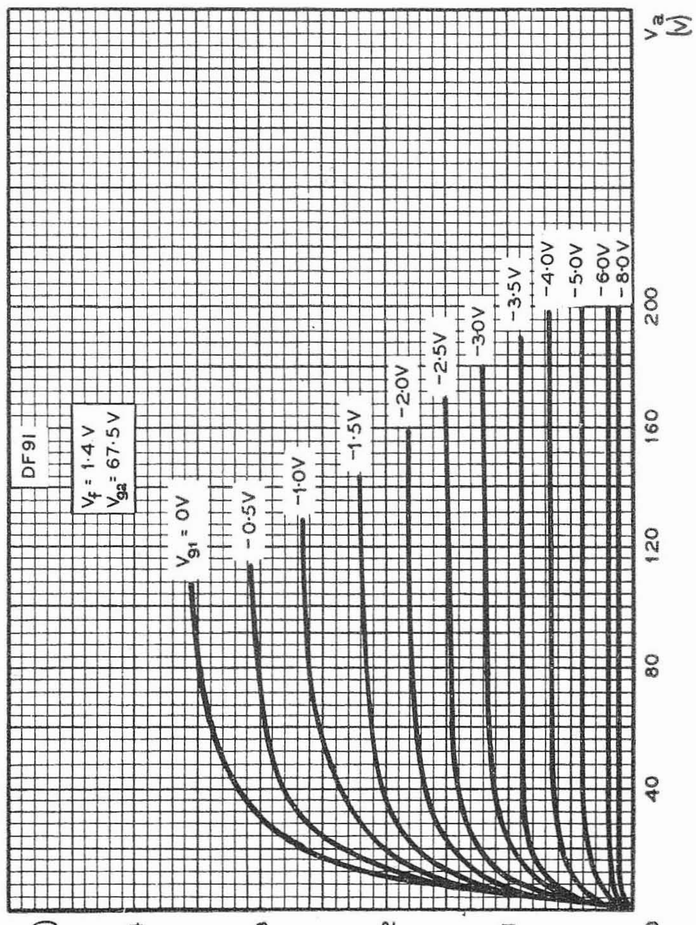
B7G BASE



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.

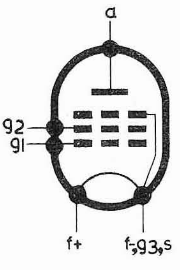
LIMITING VALUES

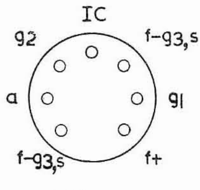
V_b max. (absolute)	110	V
V_a max.	90	V
p_a max.	250	mW
V_{g2} max.	90	V
p_{g2} max.	100	mW
I_k max.	2.2	mA
R_{g1-k} max.	3.0	MΩ
V_{g1} max. ($I_{g1} = +0.3\mu A$)	0	V

DF96

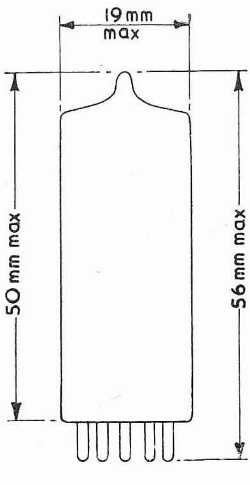
MINIATURE I.F. PENTODE

Variable-mu pentode for use as an i.f. amplifier in battery operated receivers.





B7G Base

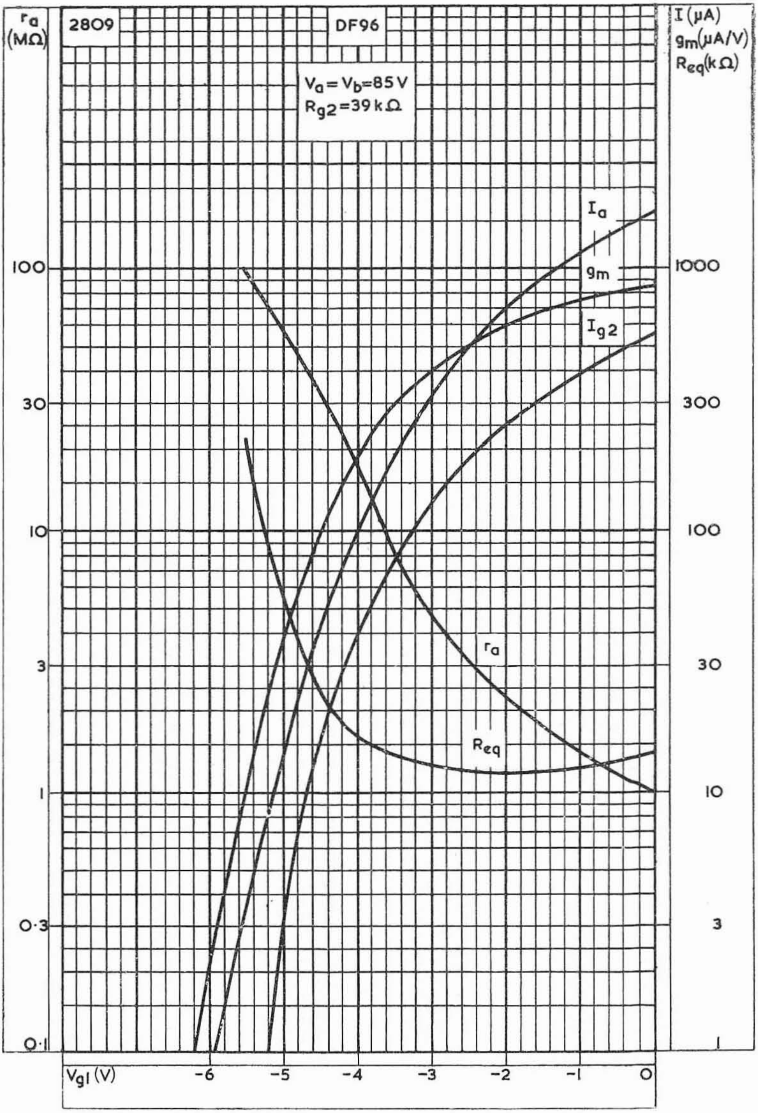


2380

MINIATURE I.F. PENTODE

DF96

Variable-mu pentode for use as an i.f. amplifier in battery operated receivers.

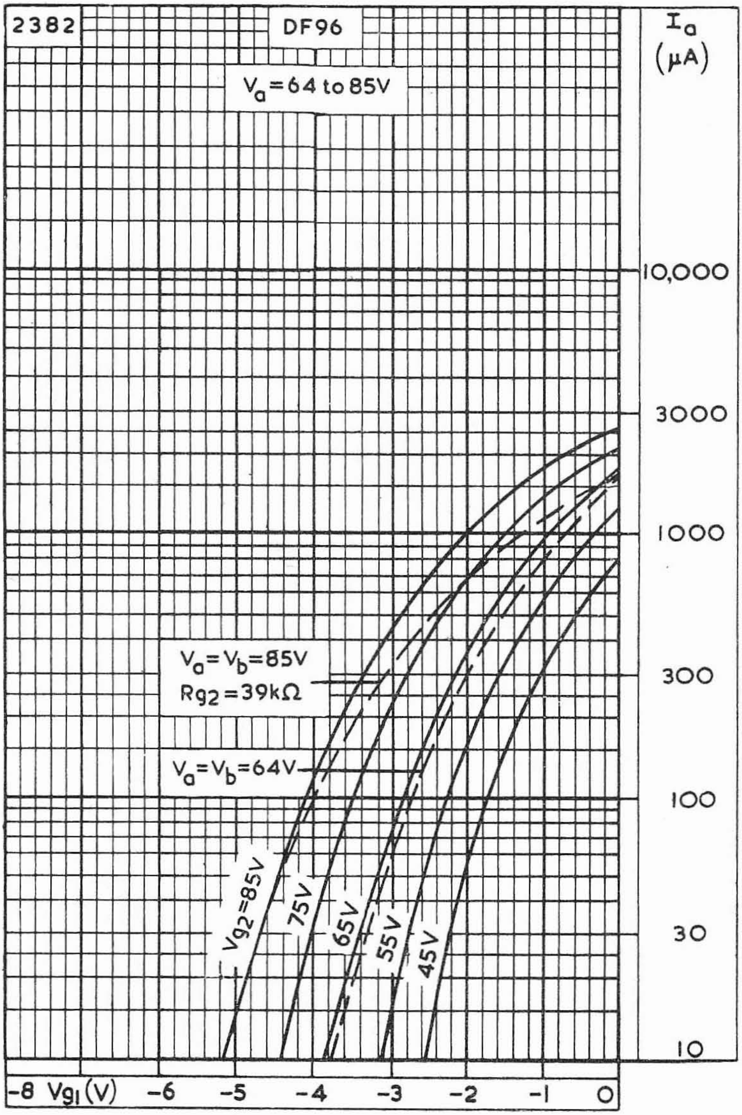


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

DF96

MINIATURE I.F. PENTODE

Variable-mu pentode for use as an i.f. amplifier in battery operated receivers.

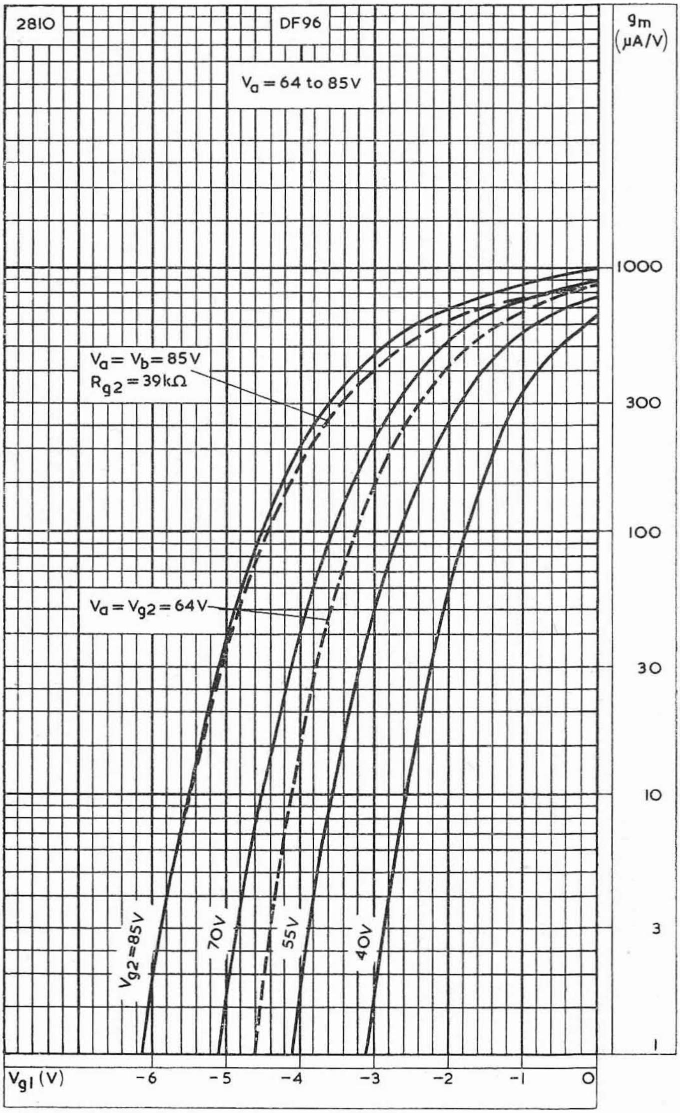


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

MINIATURE I.F. PENTODE

DF96

Variable-mu pentode for use as an i.f. amplifier in battery operated receivers.

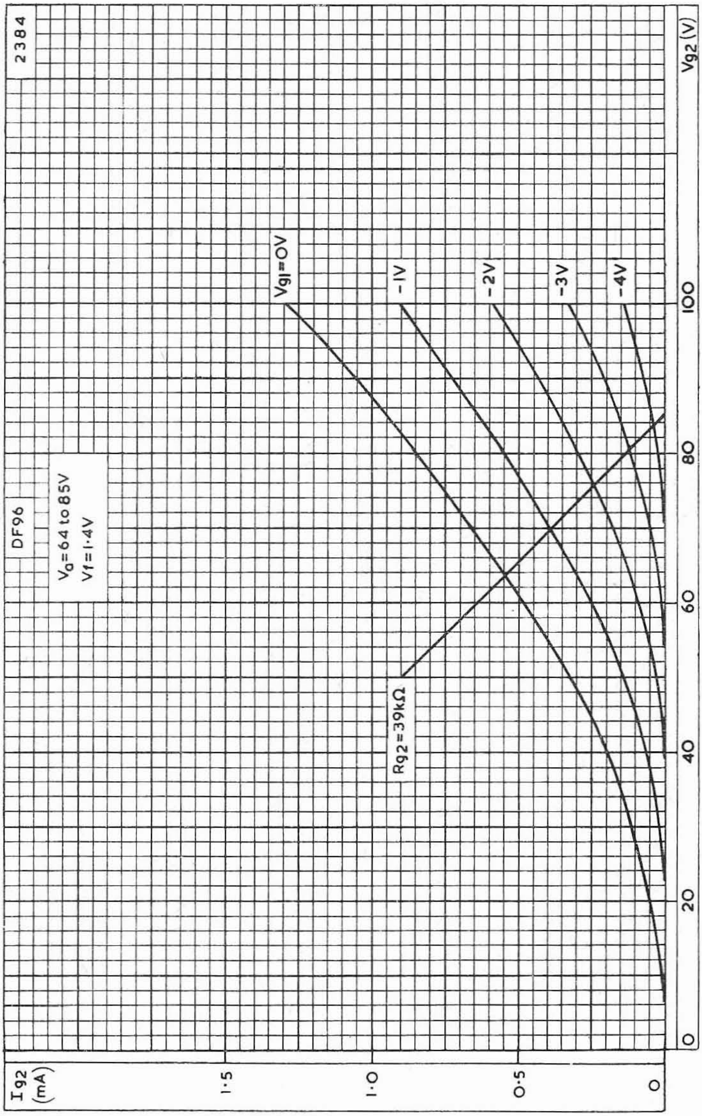


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

DF96

MINIATURE I.F. PENTODE

Variable-mu pentode for use as an i.f. amplifier in battery operated receivers.



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

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}	0.1	0.1	0.1	0.1	MΩ
r_a	0.6	0.5	0.8	0.6	MΩ
g_c	235	280	250	300	μA/V
V_{g3} ($g_c = 5$ μA/V)	−9	−14	−9	−14	V
I_a	0.7	1.4	0.8	1.6	mA
I_{g2+g4}	1.9	3.2	1.9	3.2	mA
I_{g1}	150	250	150	250	μA
I_k	2.75	5.0	2.75	5.0	mA

OSCILLATOR SECTION

$V_{g1} = V_{g3}$	0	V
$V_{g2} = V_{g4} = V_a$	67.5	V
$g_{m\,(g1-g2+g4+a)}$	1.4	mA/V

LIMITING VALUES

V_a max.	90	V
$V_{g2+g4(b)}$ max.	90	V
V_{g2+g4} max.	67.5	V
V_{g3} max.	0	V
$I_{k(o)}$ max.	5.5	mA

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

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

CIRCUITS

Frequency changer circuits employing the DK91, for a medium and long wave receiver and for an all-wave receiver are given on page 3.

In these circuits—

C designates a decoupling capacitor.

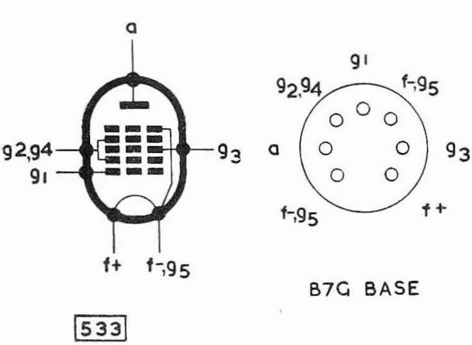
L_C is a filament choke of 12 μH inductance and with a D.C. resistance of less than 0.5 Ω.

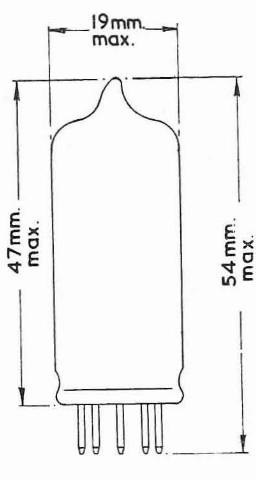
L_B is the booster coil which should be designed to resonate in conjunction with its associated capacitor at a frequency just below the lower limit of the short wave band. For a receiver covering the range 5.8 to 18.7 Mc/s and having an intermediate frequency of 465 Kc/s the booster circuit should resonate at 4.75 Mc/s. Suitable values are : $C=100$ μμF, $L_B=11$ μH.

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

DIMENSIONS

ARRANGEMENT OF ELECTRODES AND BASE CONNECTIONS



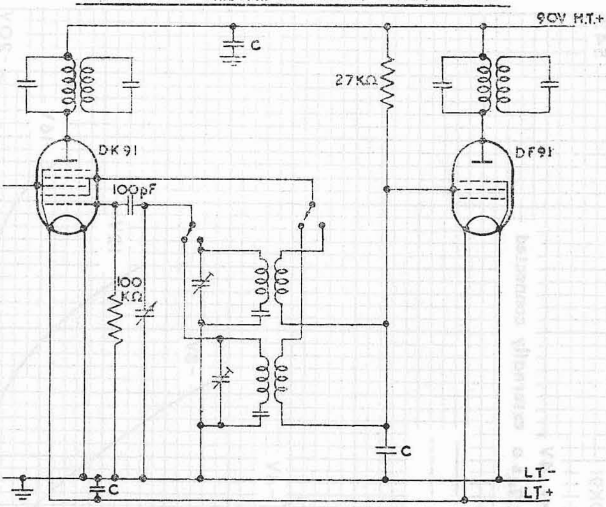


MINIATURE HEPTODE FREQUENCY CHANGER

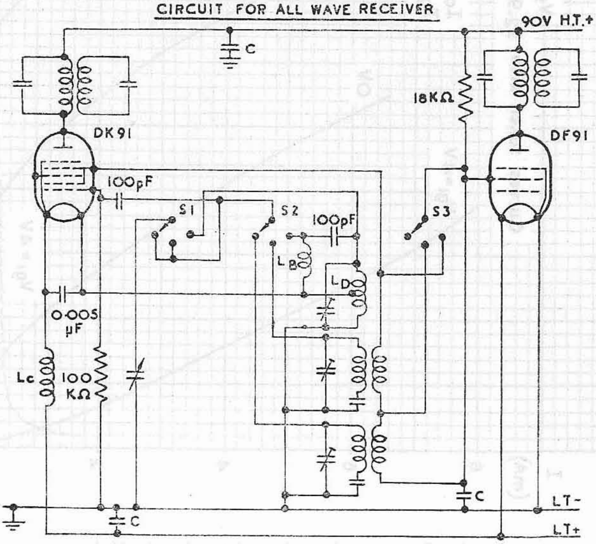
DK91

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

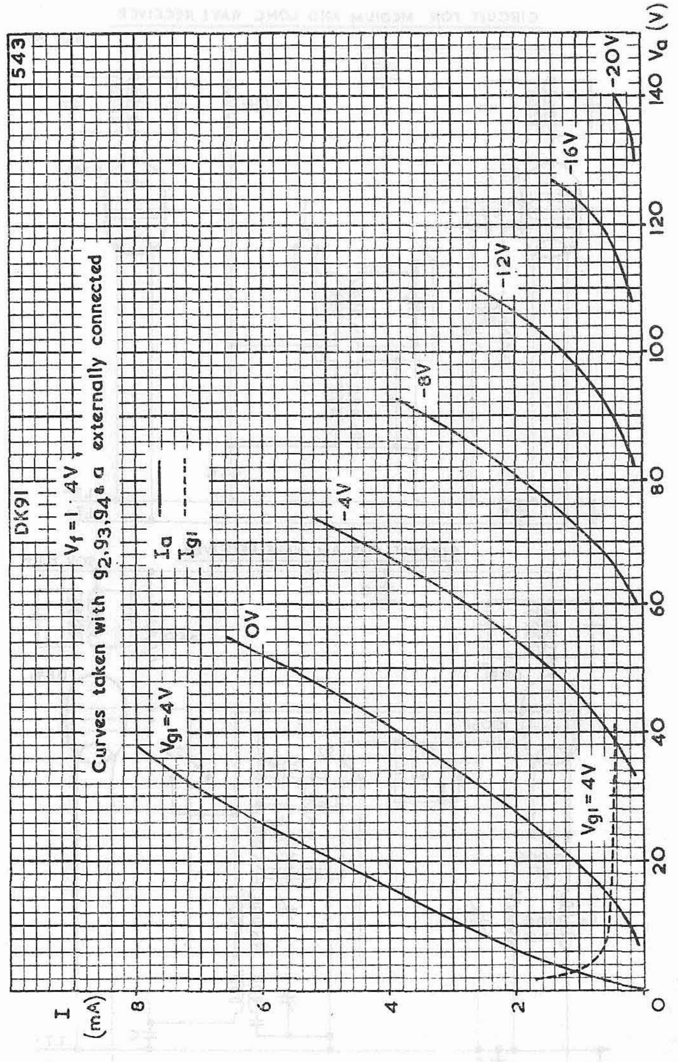


O63

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

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

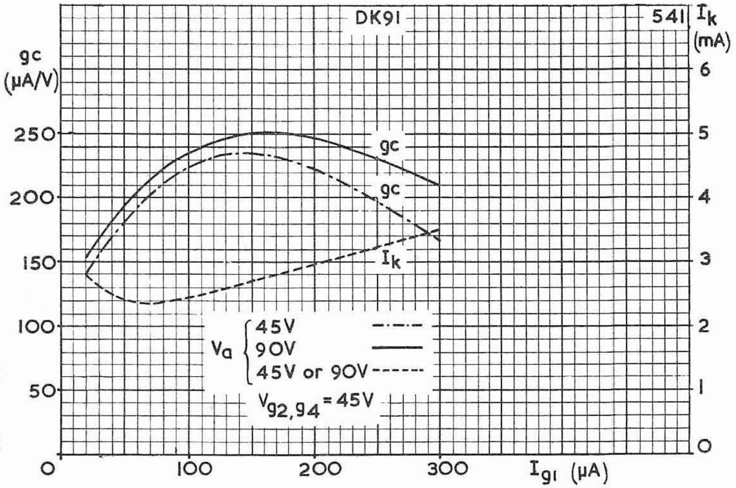


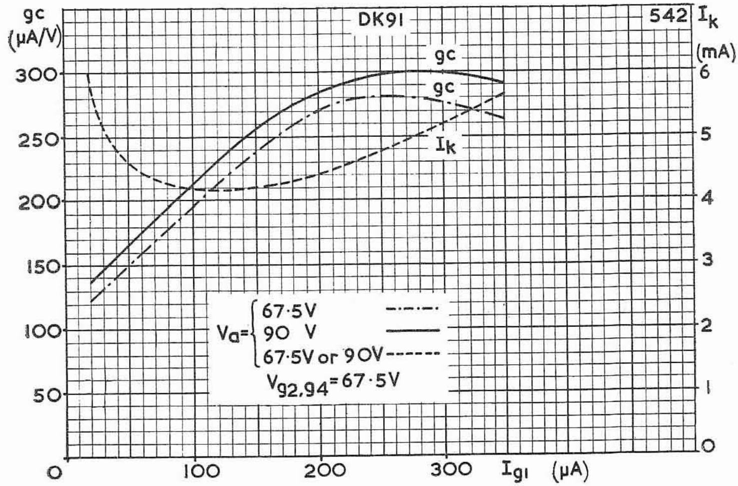
Anode Current plotted against Anode Voltage.

MINIATURE HEPTODE FREQUENCY CHANGER

DK91

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





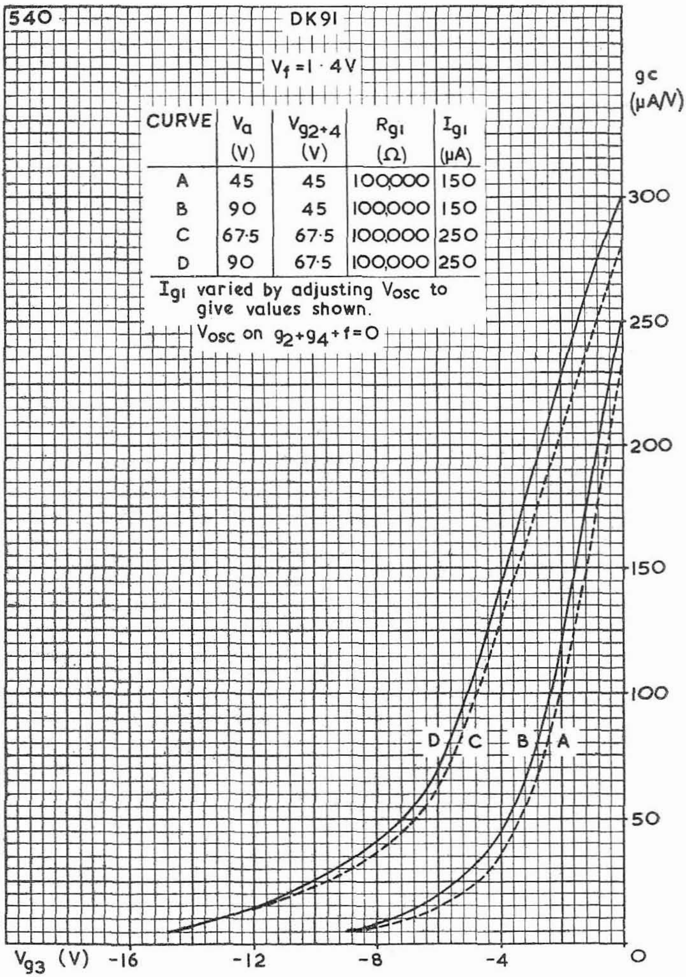
Conversion Conductance and Cathode Current plotted against Oscillator Grid Current

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

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

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



CURVE	V_a (V)	V_{g2+4} (V)	R_{g1} (Ω)	I_{g1} (µA)
A	45	45	100,000	150
B	90	45	100,000	150
C	67·5	67·5	100,000	250
D	90	67·5	100,000	250

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+)

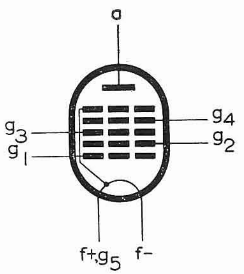
V_a	85	V
V_{g4}	60	V
V_{g3}	0	V
V_{g2}	30	V
I_{g2}	2.5	mA
$g_{m(g1-g2)}$	900	μA/V
μ_{g1-g2}	7.5	

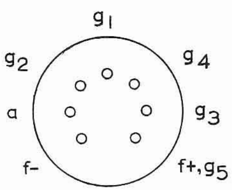
DK92

HEPTODE FREQUENCY CHANGER

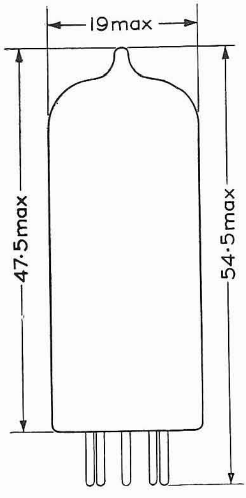
LIMITING VALUES

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



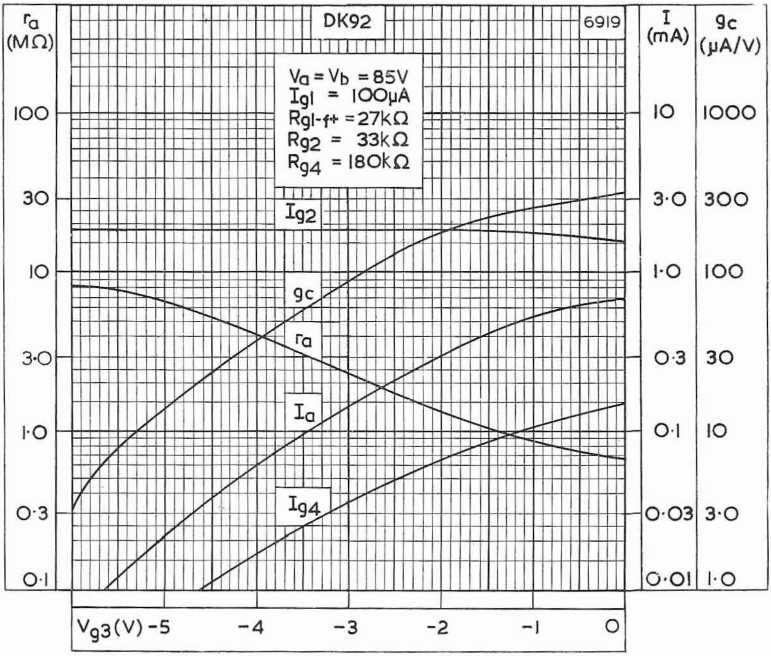


B7G Base



7081

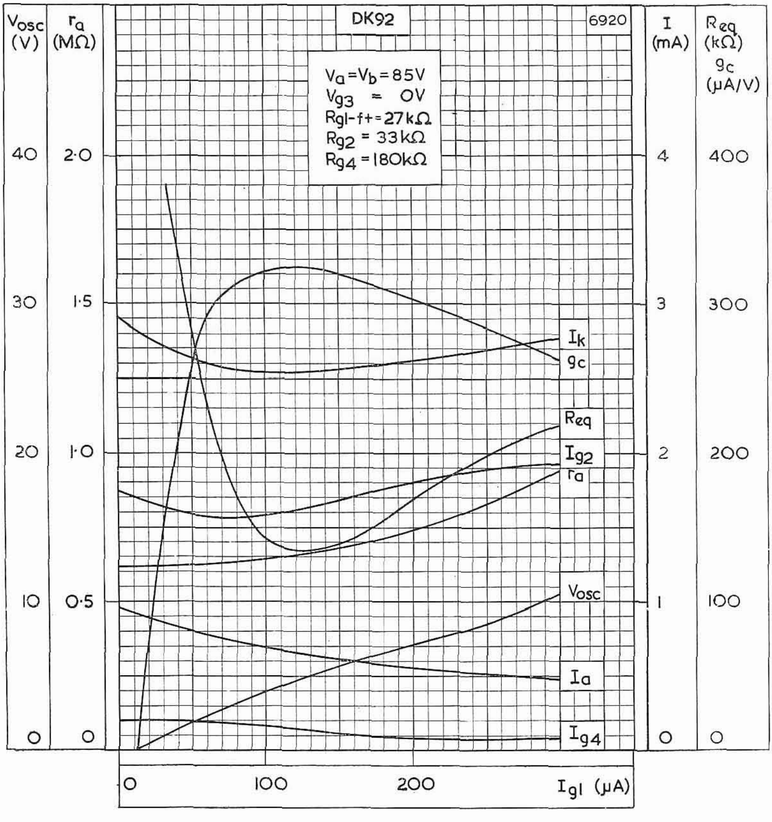
All dimensions in mm



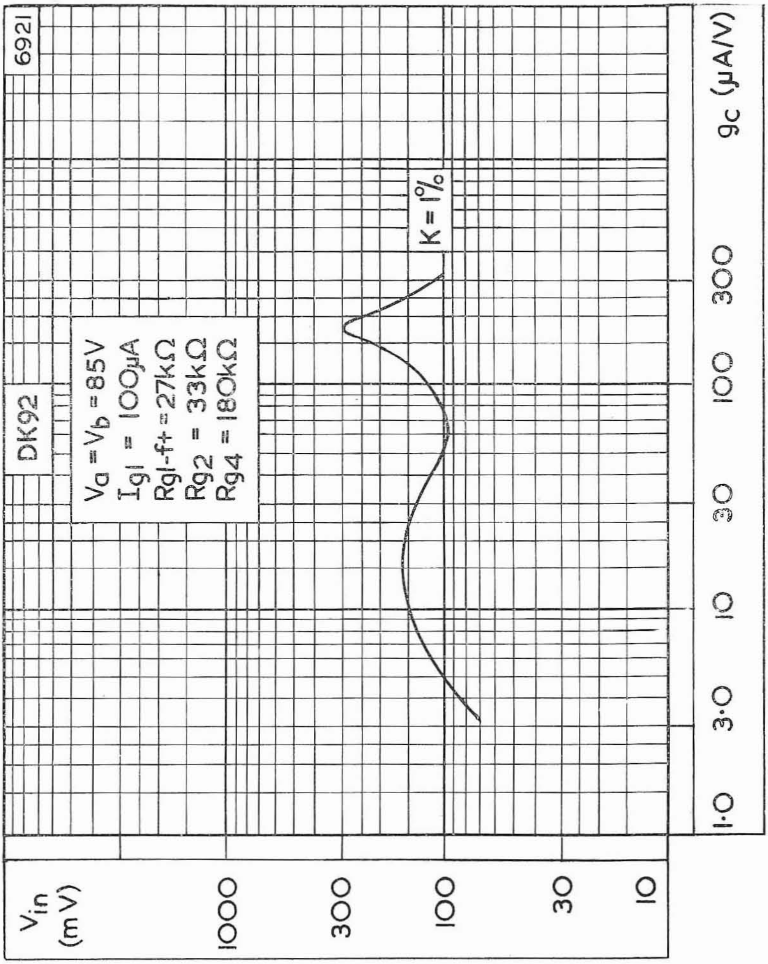
ELECTRODE CURRENTS, CONVERSION CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

DK92

HEPTODE FREQUENCY CHANGER



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



CROSS MODULATION CURVE

MINIATURE 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.

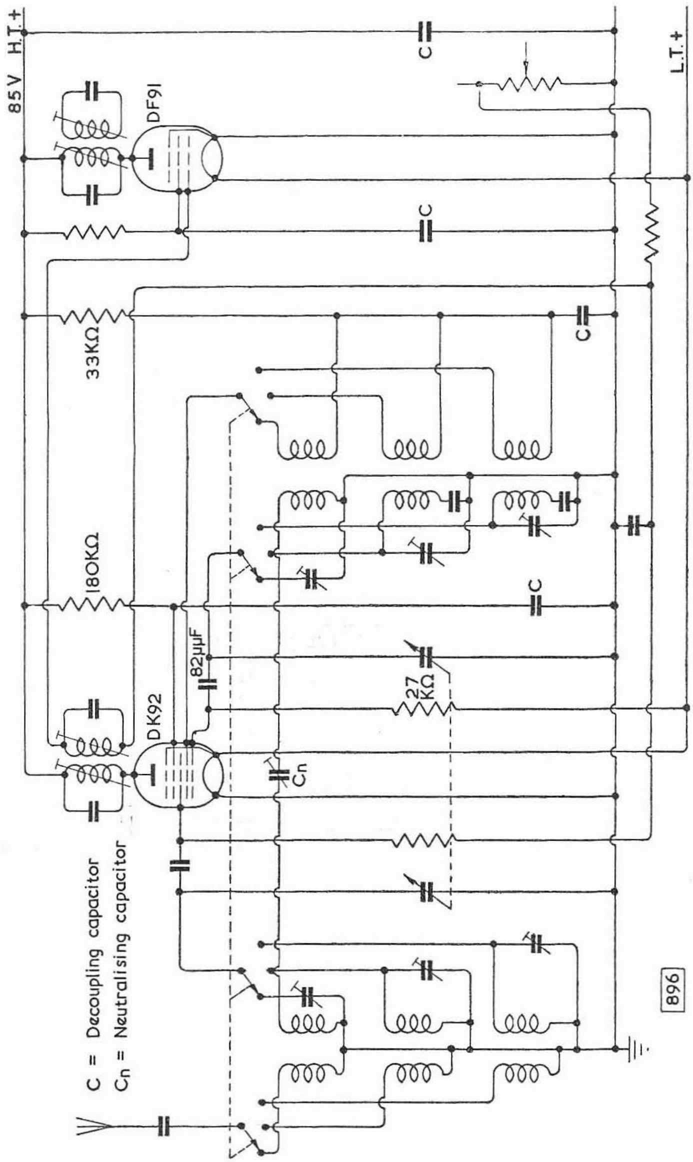
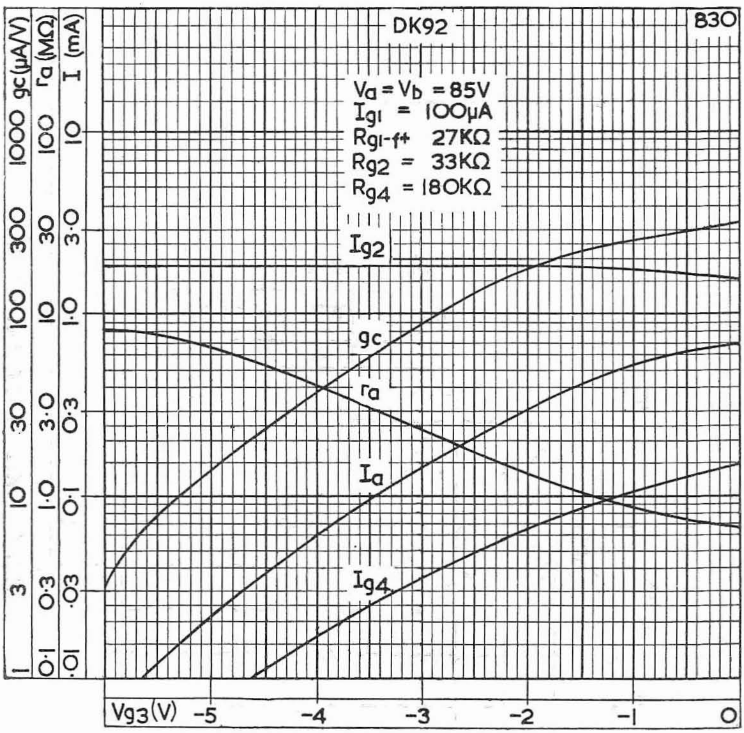


FIG. 1. DK92 AS FREQUENCY CHANGER

DK92

MINIATURE HEPTODE FREQUENCY CHANGER

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.



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.

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.

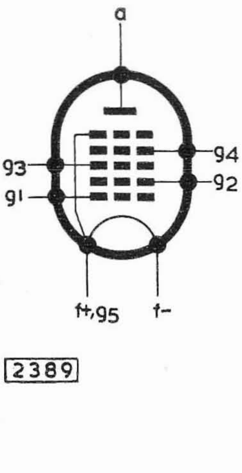
DK96

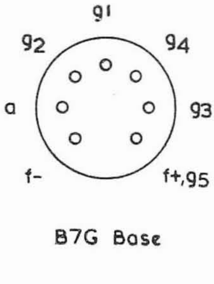
MINIATURE HEPTODE FREQUENCY CHANGER

Miniature heptode, primarily intended for use as a frequency changer in battery operated receivers and suitable for a.g.c.

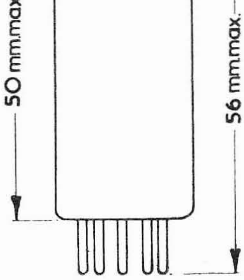
LIMITING VALUES

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





B7G Base

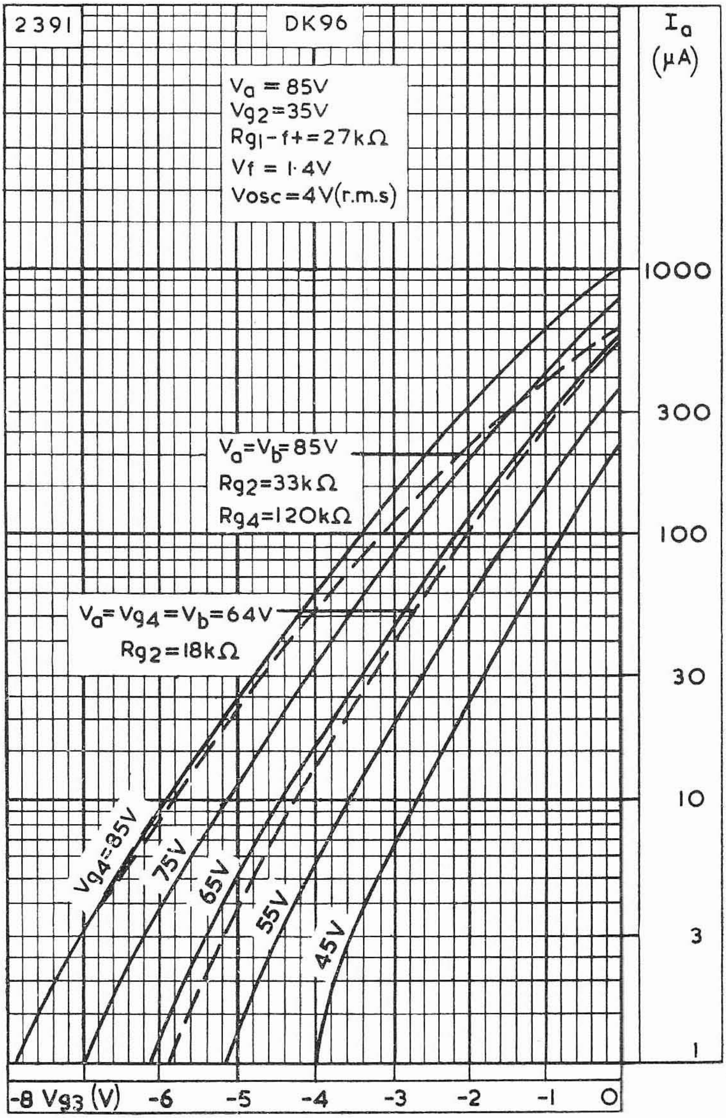


2389

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.

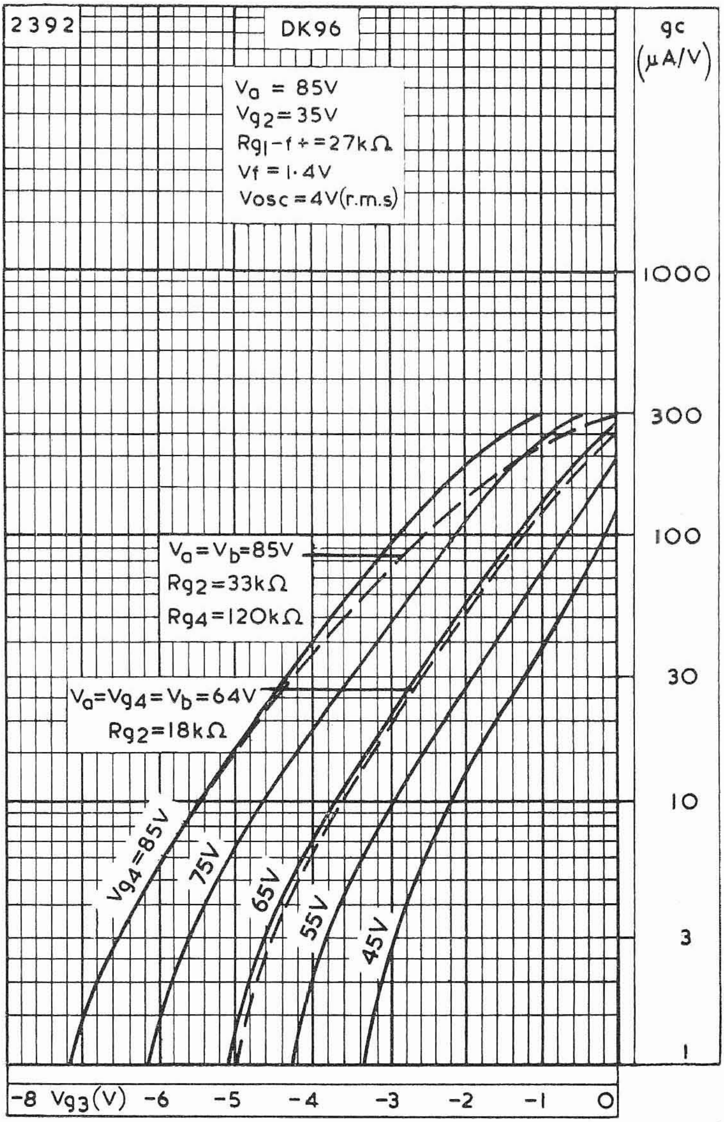


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

DK96

MINIATURE HEPTODE FREQUENCY CHANGER

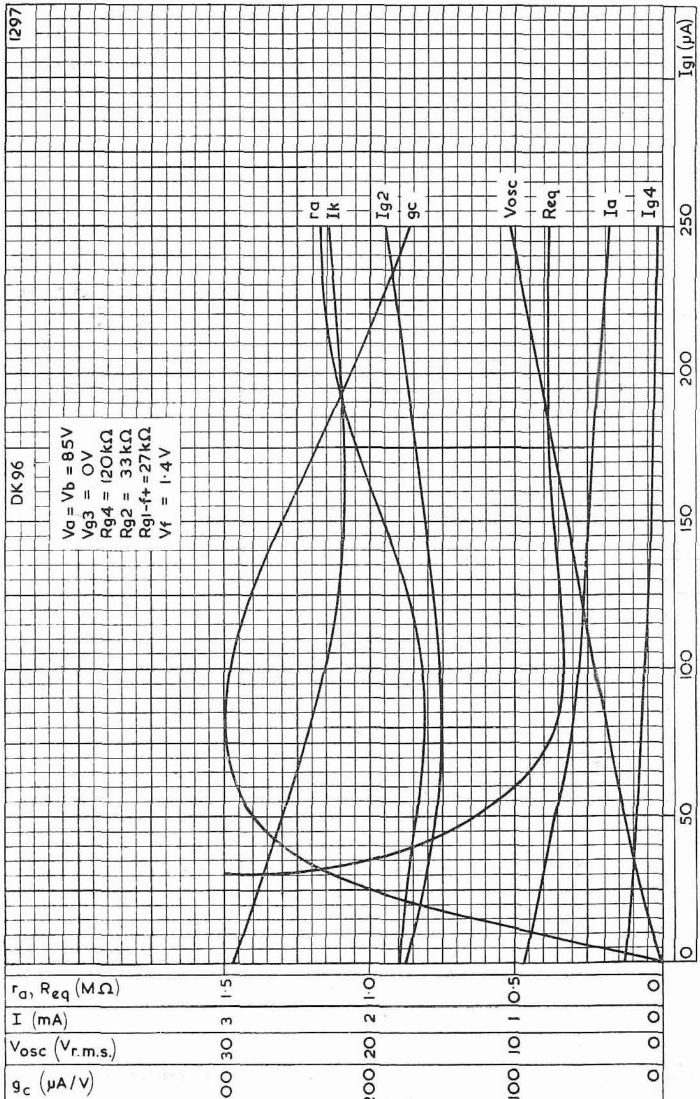
Miniature heptode, primarily intended for use as a frequency changer in battery operated receivers and suitable for a.g.c.



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

MINIATURE HEPTODE FREQUENCY CHANGER

Miniature heptode, primarily intended for use as a frequency changer in battery operated receivers and suitable for a.g.c.

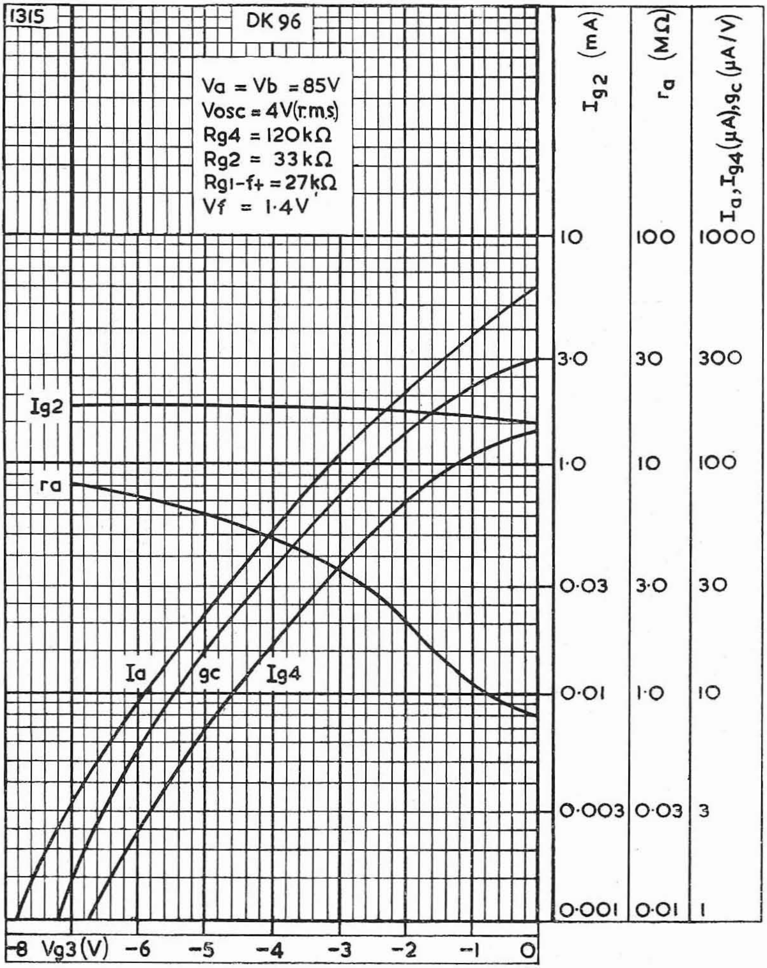


ELECTRODE CURRENTS, CONVERSION CONDUCTANCE, ANODE IMPEDANCE, EQUIVALENT NOISE RESISTANCE AND OSCILLATOR VOLTAGE PLOTTED AGAINST OSCILLATOR GRID CURRENT

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.

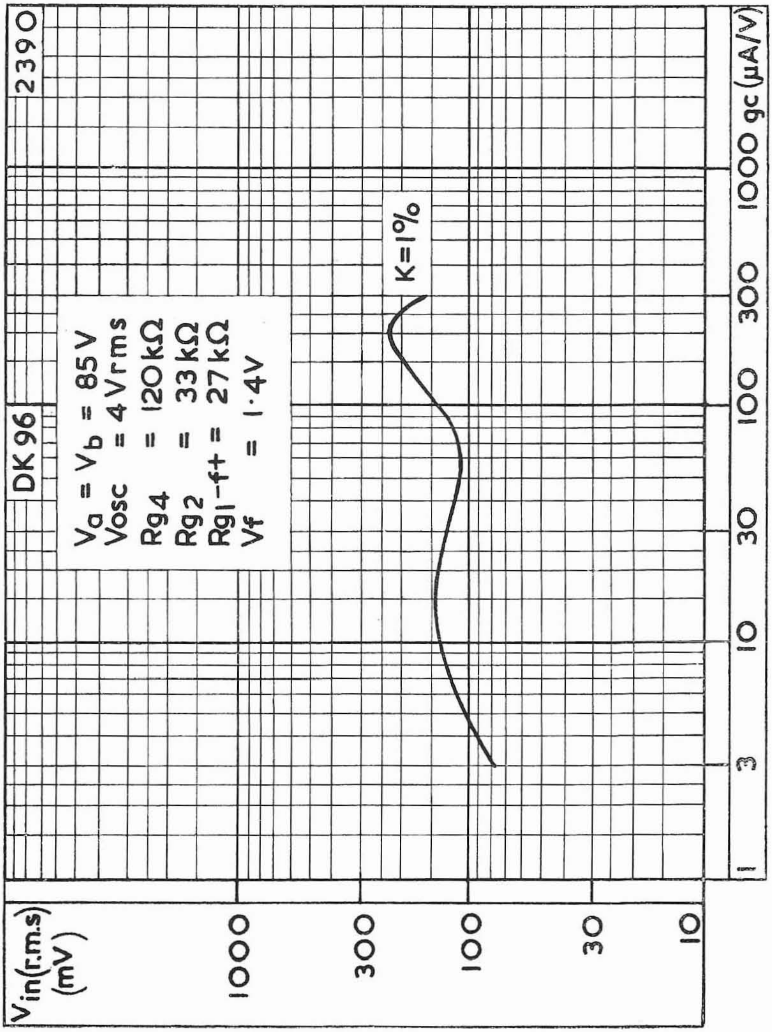


ELECTRODE CURRENTS, CONVERSION CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

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
$I_{a(0)}$	3.0	6.0	6.1	mA
$I_{g2(0)}$	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	%

Mullard

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	%

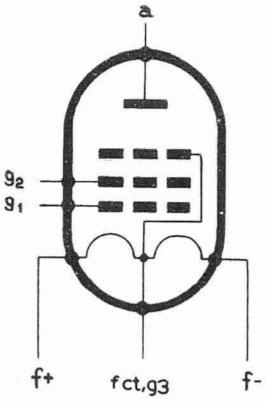
LIMITING VALUES

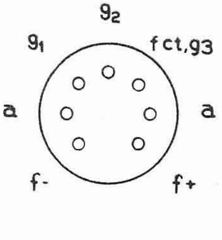
V_a max.	90	V
p_a max.	0.7	W
V_{g2} max.	90	V
p_{g2} max.	0.15	W
I_k max.	12	mA
R_{g1-f} max.	2.0	MΩ

MINIATURE OUTPUT PENTODE

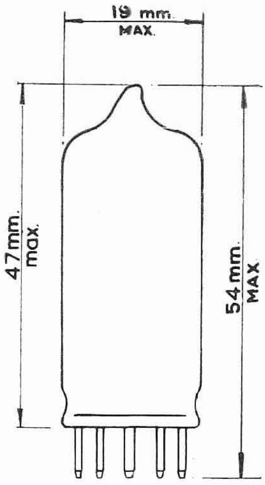
DL92

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





B7G BASE



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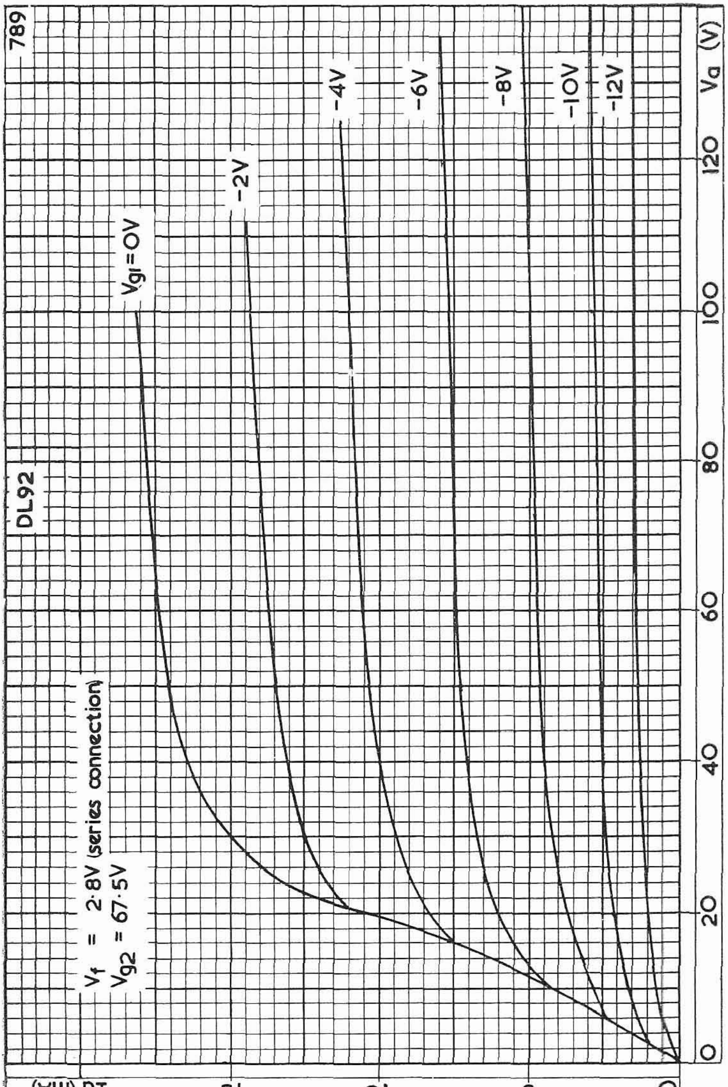
DL92

MINIATURE OUTPUT PENTODE

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

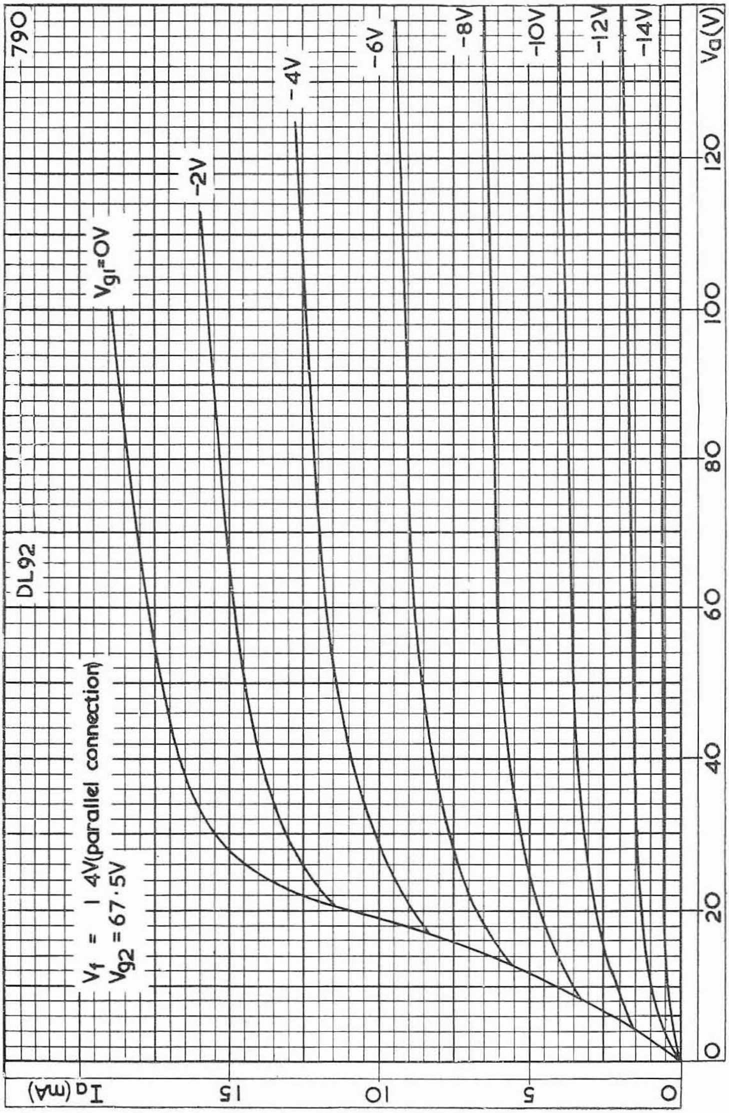


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER FOR BOTH SECTIONS OF FILAMENT IN SERIES

MINIATURE OUTPUT PENTODE

DL92

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

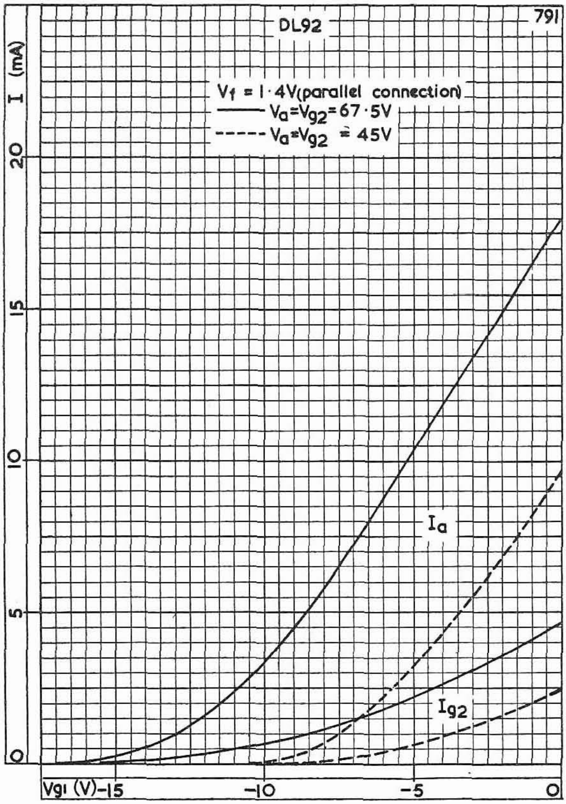


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER FOR BOTH SECTIONS OF FILAMENT IN PARALLEL

DL92

MINIATURE OUTPUT PENTODE

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

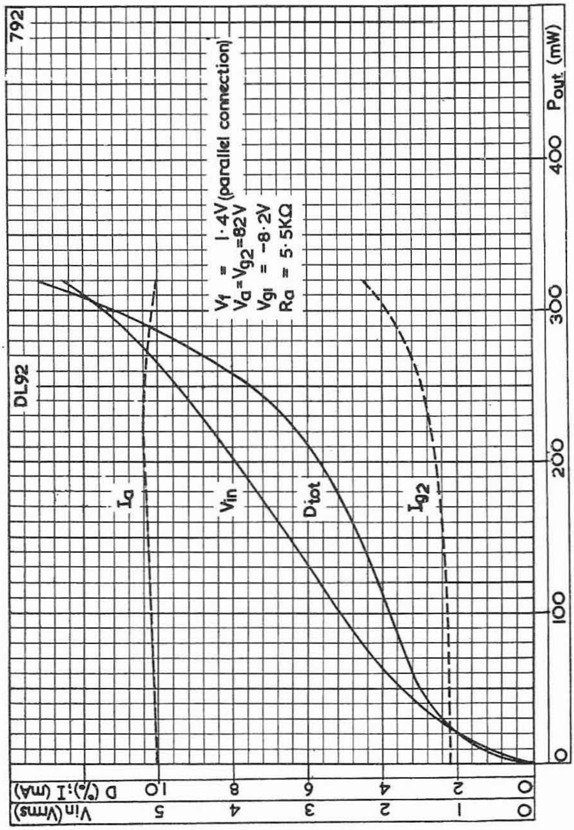


ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR BOTH SECTIONS OF FILAMENT IN PARALLEL

MINIATURE OUTPUT PENTODE

DL92

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

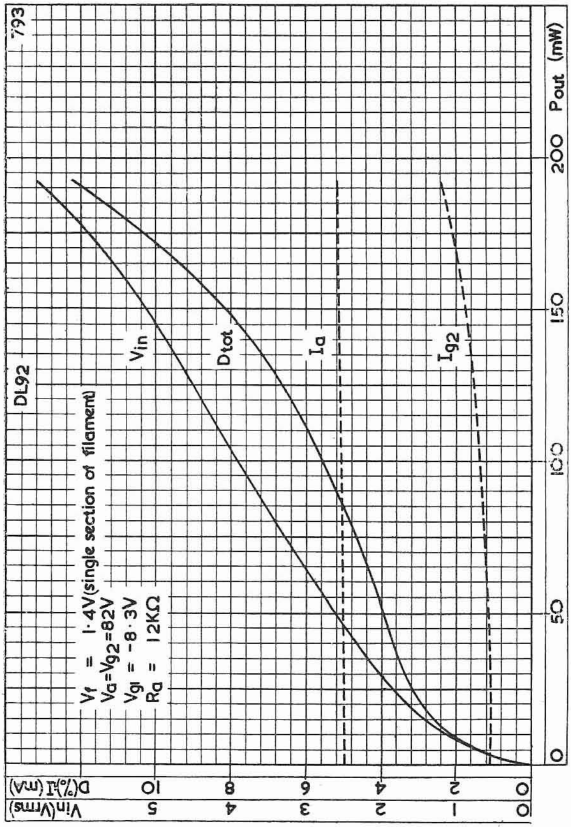


ANODE CURRENT, SCREEN-GRID CURRENT, INPUT VOLTAGE AND TOTAL DISTORTION PLOTTED AGAINST OUTPUT POWER WITH BOTH SECTIONS OF FILAMENT IN PARALLEL. FOR USE WITH 90 V H.T. SUPPLY

DL92

MINIATURE OUTPUT PENTODE

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



ANODE CURRENT, SCREEN-GRID CURRENT, INPUT VOLTAGE AND TOTAL DISTORTION PLOTTED AGAINST OUTPUT POWER USING SINGLE SECTION OF FILAMENT. FOR USE WITH 90V H.T. SUPPLY

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

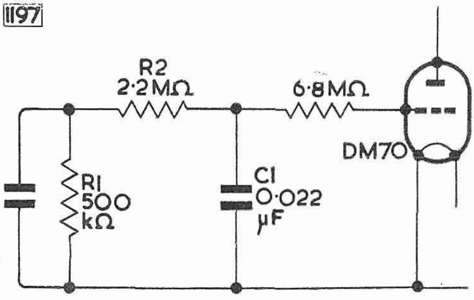
*Length of fluorescent column observed, measured from the top of the aperture. The maximum value is approximately 14 mm.

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**

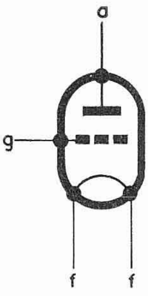
Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

LIMITING VALUES

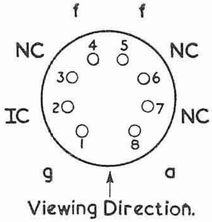
$V_{b(o)}$ max.	450	V
V_b max.	300	V
*V_a max.	90	V
V_a min	45	V
**p_a max. ($V_a \leq 90$ V)	25	mW
**p_a max. ($V_a = 200$ V)	10	mW
I_k max.	300	μA
R_{g-f} max.	10	MΩ

*In circuits without anode series resistor.

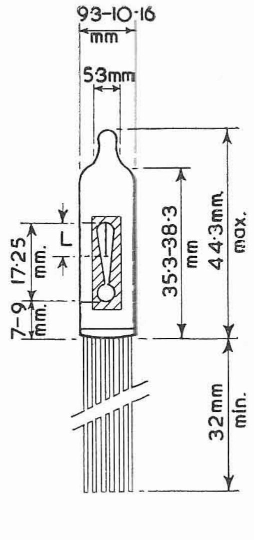
**Values of p_a max. for intermediate values of V_a may be determined by linear interpolation.



1198



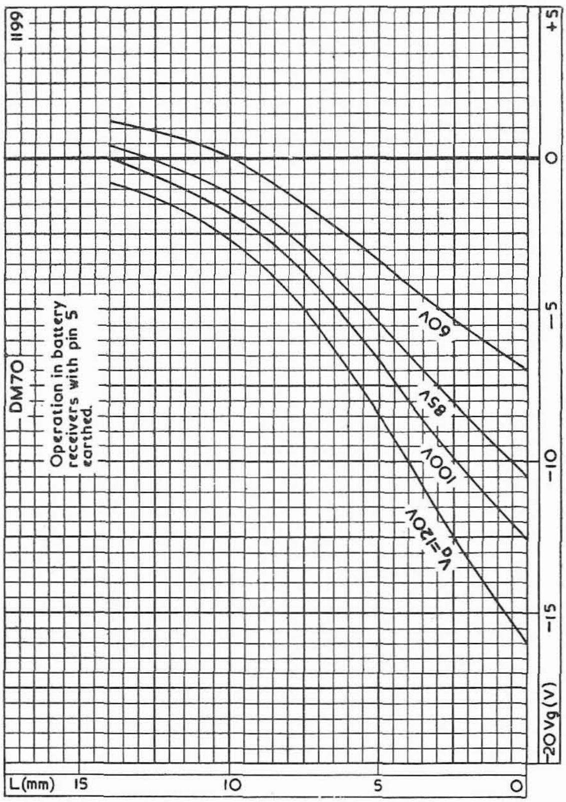
Viewing Direction.
B8D BASE
(10mm. subminiature.)



DM70

SUBMINIATURE TUNING INDICATOR

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

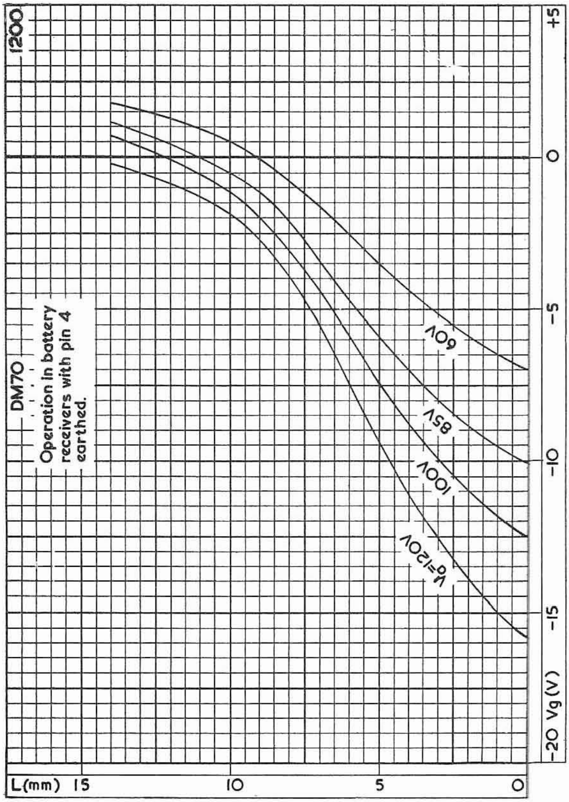


LENGTH OF FLUORESCENT COLUMN PLOTTED AGAINST GRID VOLTAGE AT VARIOUS VALUES OF ANODE VOLTAGE WHEN CONNECTED IN BATTERY-OPERATED RECEIVERS (PIN 5 EARTHED.)

SUBMINIATURE TUNING INDICATOR

DM70

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

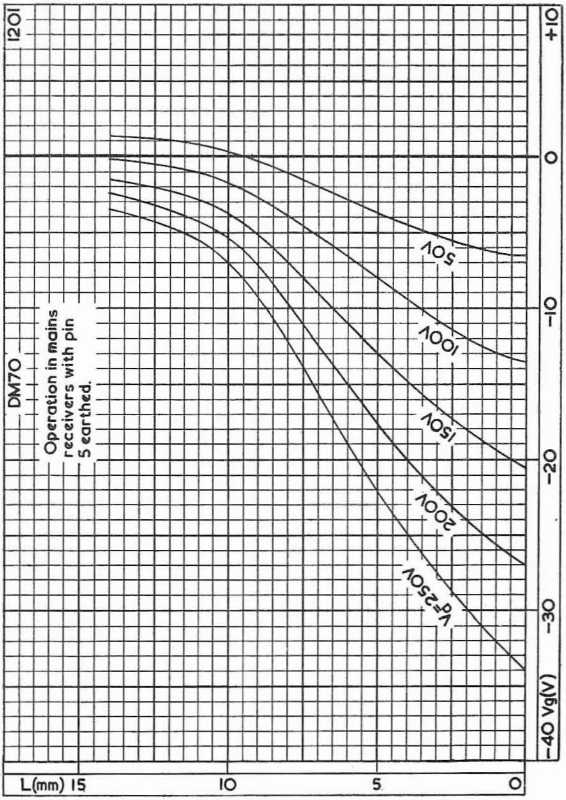


LENGTH OF FLUORESCENT COLUMN PLOTTED AGAINST GRID VOLTAGE AT VARIOUS VALUES OF ANODE VOLTAGE WHEN CONNECTED IN BATTERY-OPERATED RECEIVERS (PIN 4 EARTHED.)

DM70

SUBMINIATURE TUNING INDICATOR

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

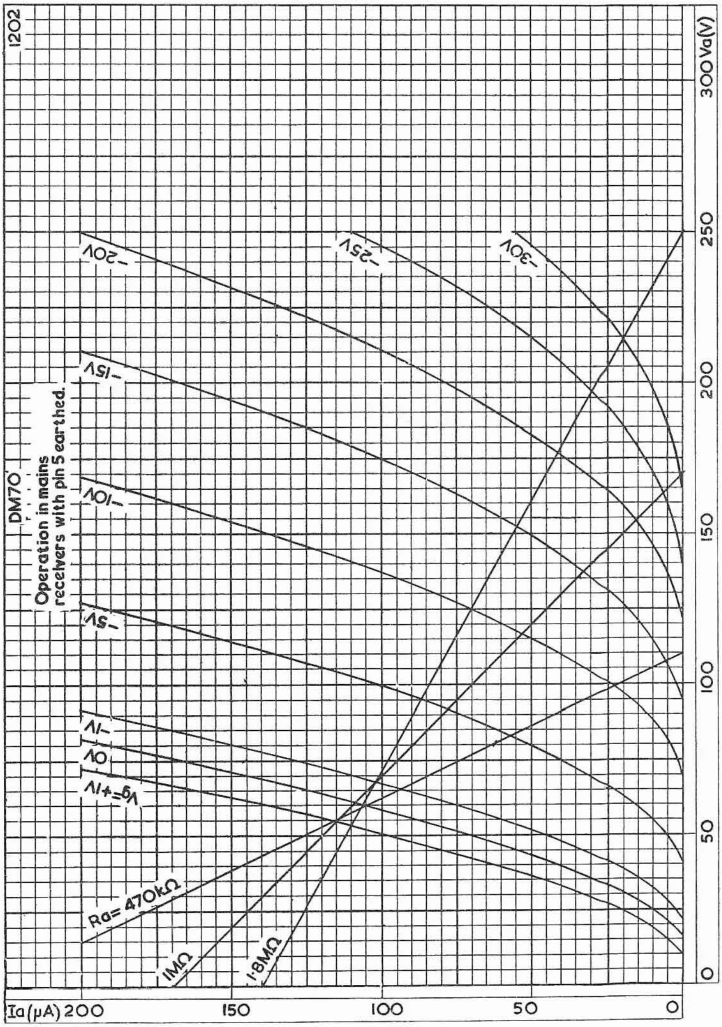


LENGTH OF FLUORESCENT COLUMN PLOTTED AGAINST GRID VOLTAGE AT VARIOUS VALUES OF ANODE VOLTAGE WHEN CONNECTED IN MAINS-OPERATED RECEIVERS (PIN 5 EARTHED.)

SUBMINIATURE TUNING INDICATOR

DM70

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

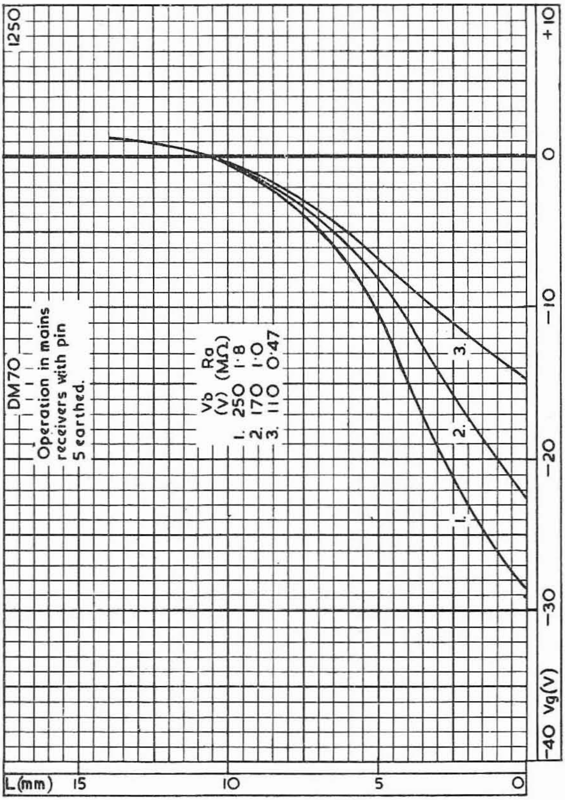


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER WHEN CONNECTED IN MAINS-OPERATED RECEIVERS (PIN 5 EARTHED.)

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 $V_h = 6.3V$ 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.

SPECIAL QUALITY DOUBLE TRIODE E80CC

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

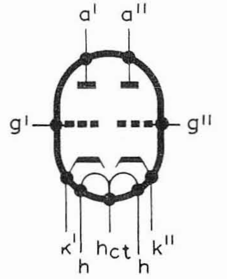
The E80CC can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 450g.

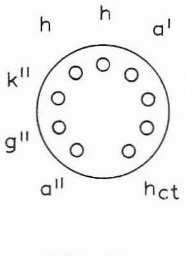
OPERATING NOTES

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.

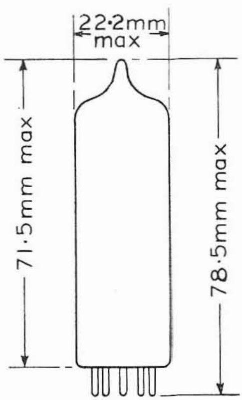
E80CC SPECIAL QUALITY DOUBLE TRIODE

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 $V_h = 6.3$V is ± 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. ($R_{g1} = 100$kΩ)	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

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

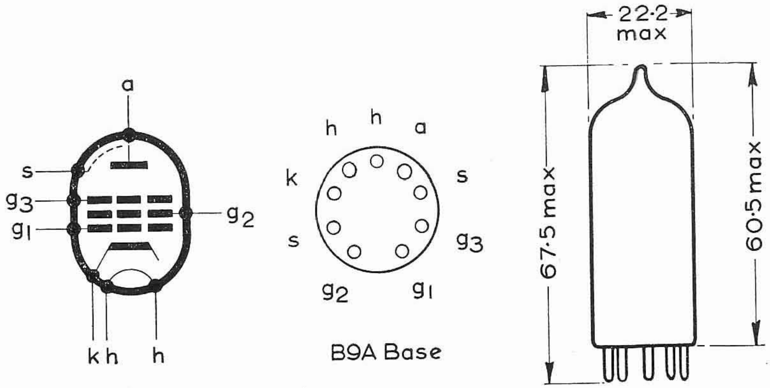
The E80F can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 300g.

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

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.



4747

All dimensions in mm

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	MΩ

*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.

SPECIAL QUALITY
DOUBLE TRIODE

E90CC

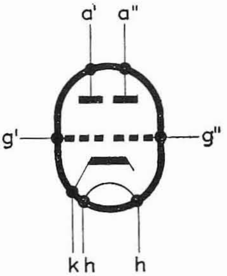
LIMITING VALUES[4] (absolute ratings) each section

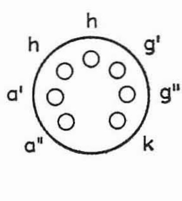
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
I_k max.	15	mA
$*i_{k(pk)}$ max.	75	mA
$-V_g$ max.	100	V
$*-v_{g(pk)}$ max.	200	V
$+V_g$ max.	0	V
I_g max.	250	μA
$*i_{g(pk)}$ max.	1.0	mA
R_{g-k} max. (cathode bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	500	kΩ
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

*Max. averaging time = 10ms.

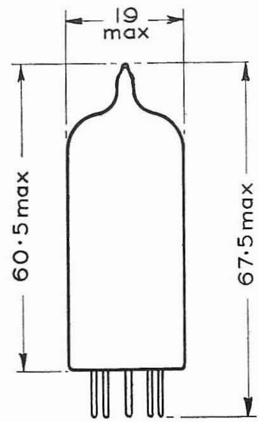
OPERATING NOTES

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

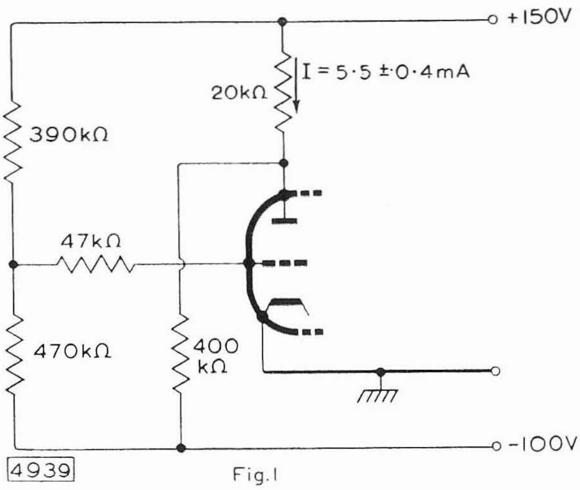


Fig.1

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.

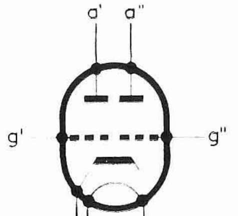
LIMITING VALUES[4] (absolute ratings) each section

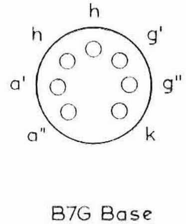
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
$+V_g$ max.	500	mV
$-V_g$ max.	100	V
†$-v_{g(pk)}$ max.	200	V
I_k max.	15	mA
†$i_{k(pk)}$ max.	75	mA
I_g max.	250	μA
†$i_{g(pk)}$ max.	1.0	mA
R_{g-k} max. (self bias)	1.0	$M\Omega$
R_{g-k} max. (fixed bias)	500	$k\Omega$
V_{h-k} max.	100	V
T_{bulb}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

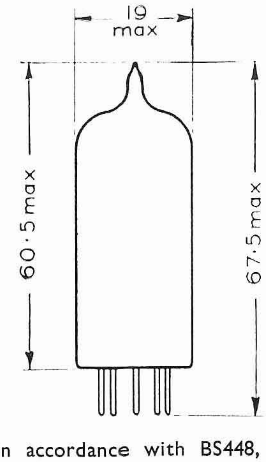
†Maximum duration = 10ms

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.







5770

All dimensions in mm

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

SPECIAL QUALITY OUTPUT PENTODE

E130L

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 $\pm 5\%$.

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]

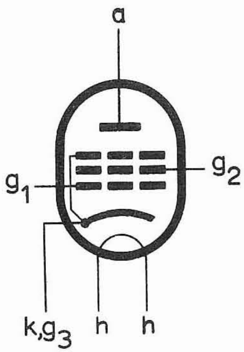
$V_{a(b)}$ max.	2.0	kV
V_a max.	900	V
V_{g2} max.	250	V
$-v_{a(pk)}$ max.	2.0	kV
$+v_{a(pk)}$ max.	8.0	kV
p_a max.	27.5	W
p_{a+g2} max.	27.5	W
$V_{g2(b)}$ max.	550	V

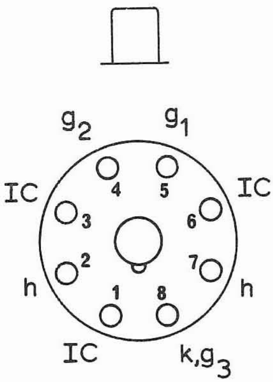
P_{g2} max.	5.0	W
$-V_{g1}$ max.	150	V
$+V_{g1}$ max.	15	V
$-p_{g1}$ max.	0.1	W
R_{g1} max.	0.5	MΩ
I_k max.	300	mA
$*i_{k(pk)}$ max.	1.5	A
$**i_{k(pk)}$ max.	4.6	A
V_{h-k} max. (cathode negative)	100	V
V_{h-k} max. (cathode positive)	200	V

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

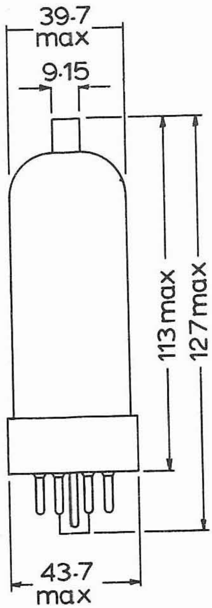
**Max. duration 1.5μs, I_k max. = 14mA.

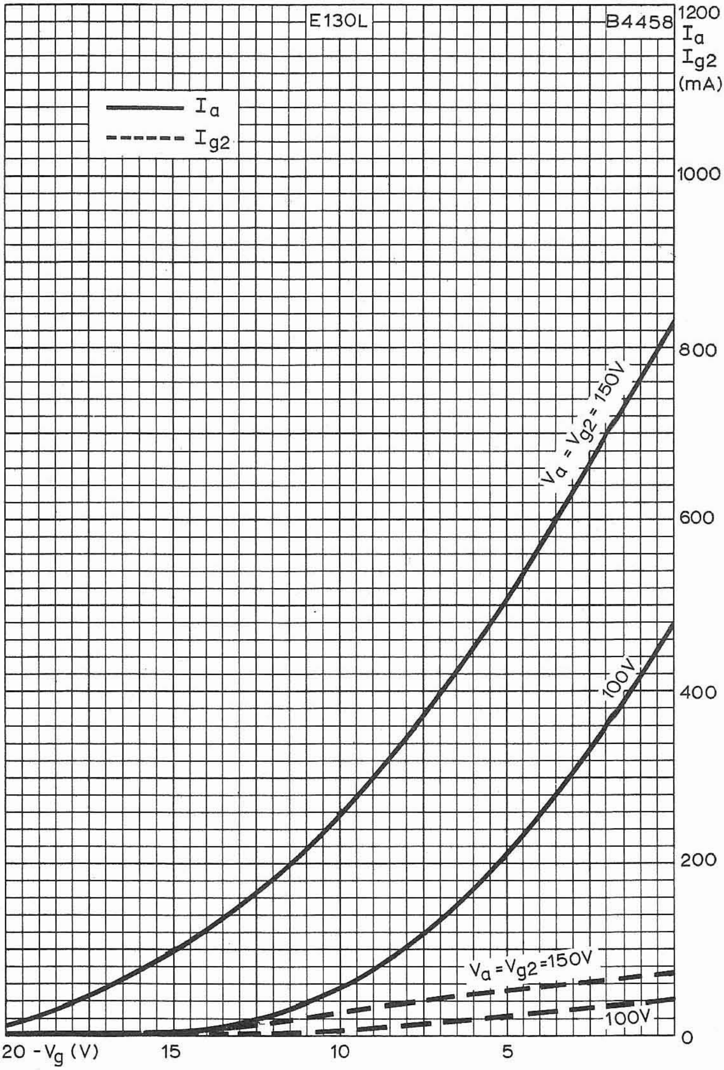
B4678



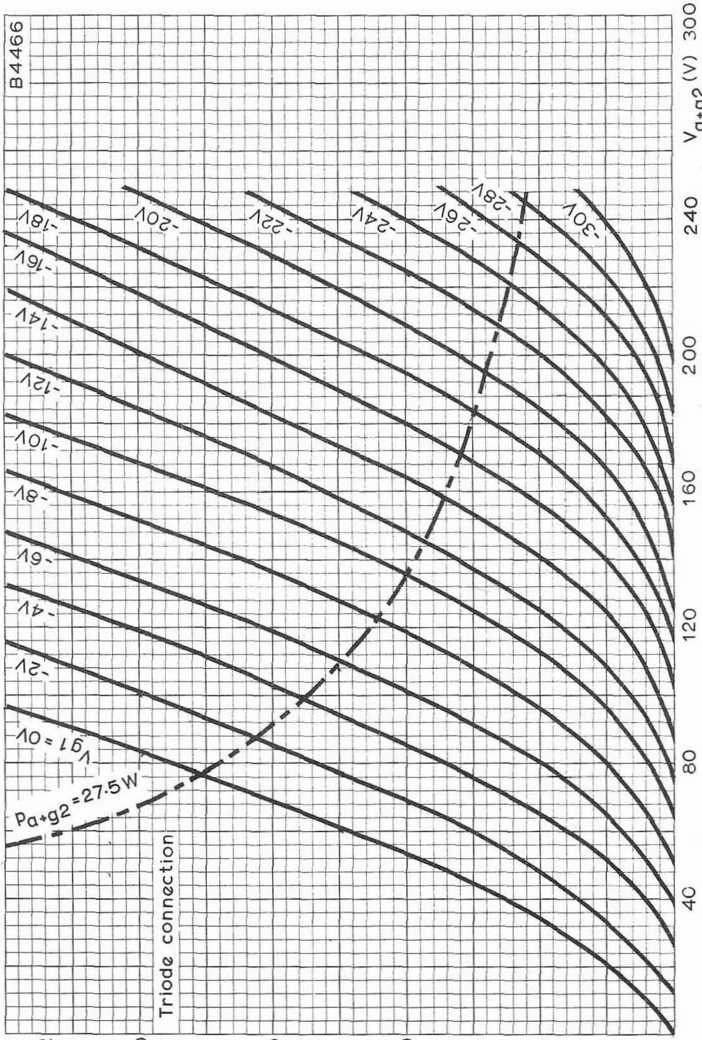


Octal Base
CT2 Top Cap
All dimensions in mm

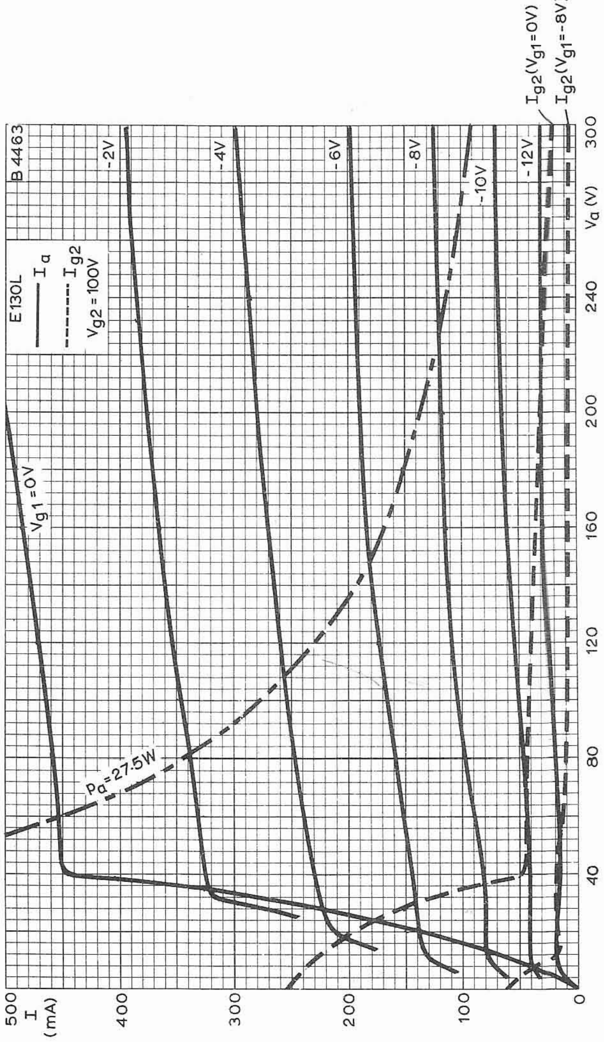




ANODE AND SCREEN CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN VOLTAGES AS PARAMETERS

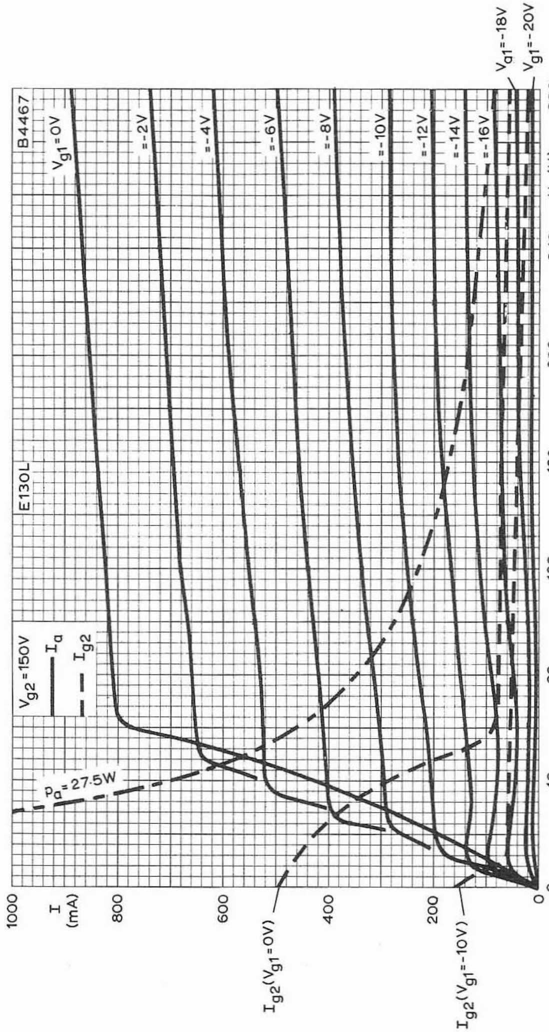


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



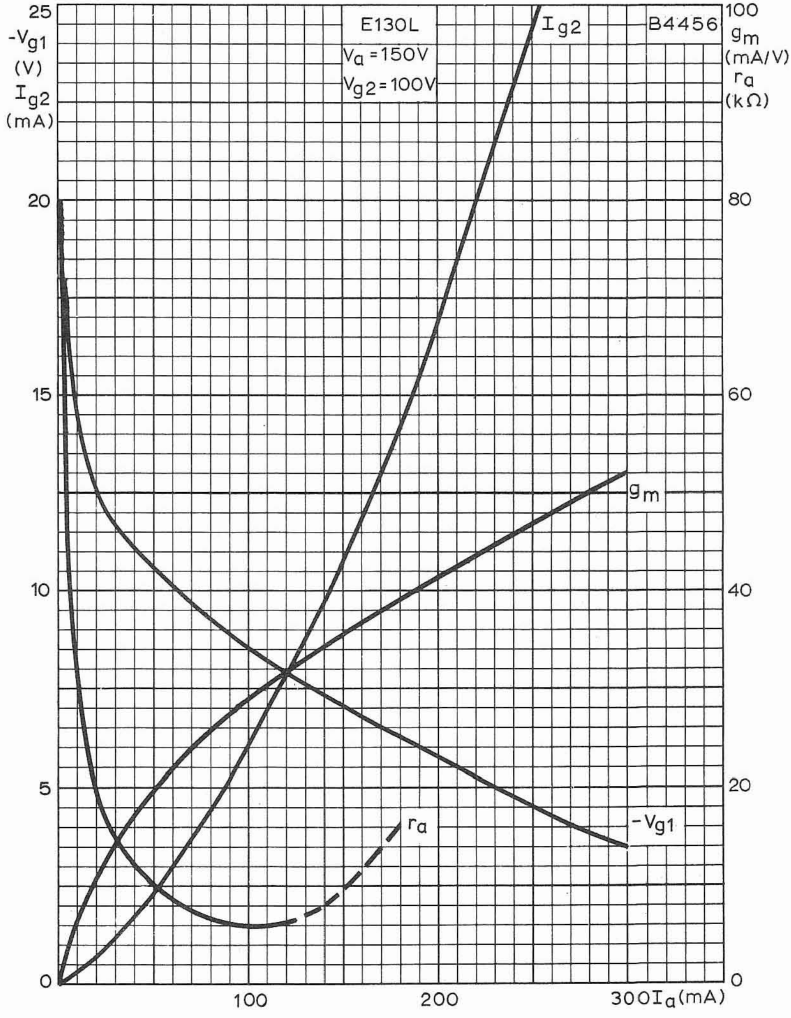
ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

$V_{g2} = 100V$

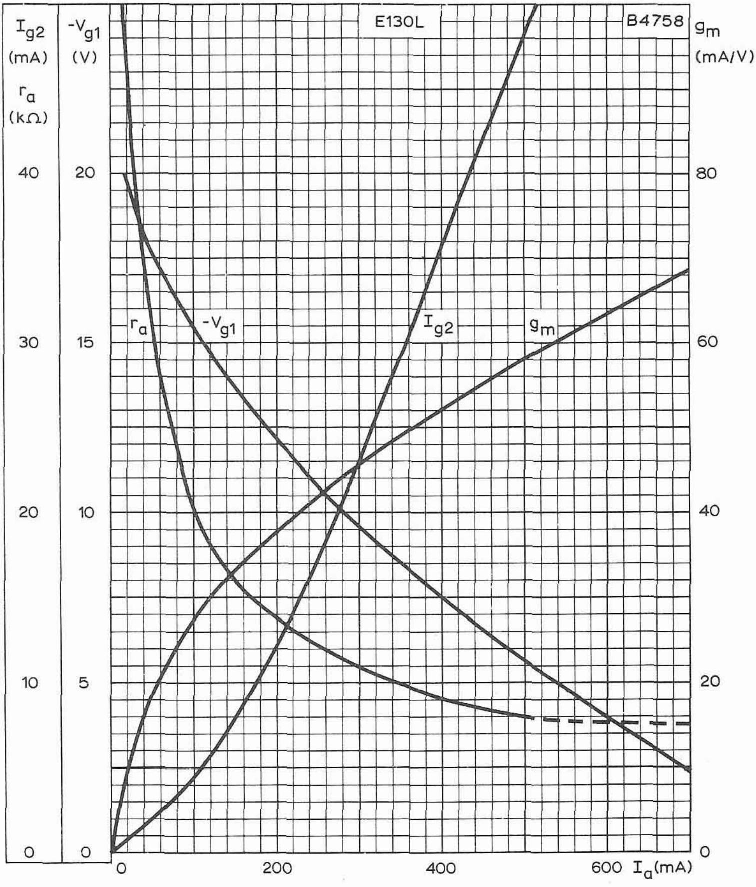


ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

$V_{g2}=150V$



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 $V_h = 6.3V$ is $\pm 20mA$ and at $V_h = 12.6V$ is $\pm 10mA$.

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

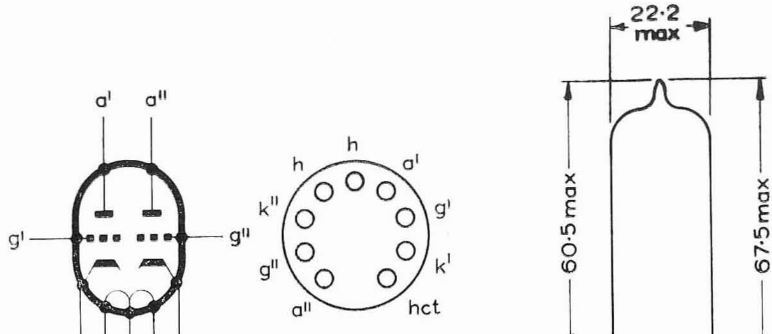
†Maximum duration = 10μs. Duty cycle = 1%

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

SPECIAL QUALITY DOUBLE TRIODE E180CC

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.



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	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.	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	kΩ
R_{g-k} max. (self bias)	1.0	MΩ
V_{h-k} max.	120	V
$v_{h-k(pk)}$ max.	200	V
T_{bulb} max.	160	°C

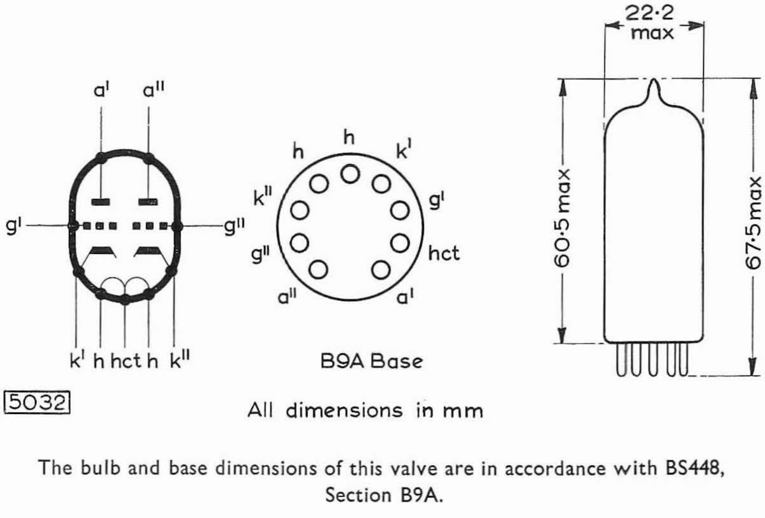
*Duty factor = 1%, max pulse duration = 10μs.

SPECIAL QUALITY
DOUBLE TRIODE

E182CC

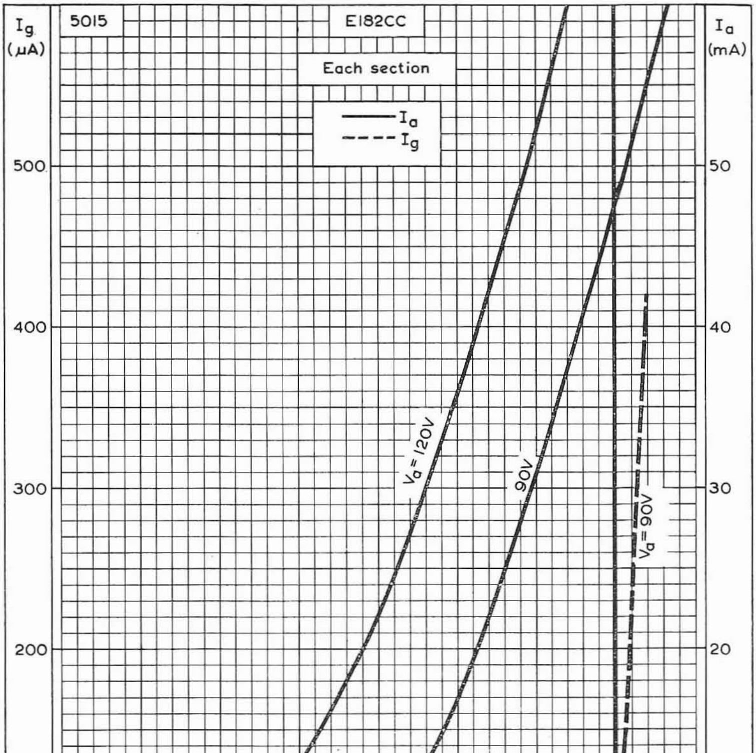
OPERATING NOTE

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



All dimensions in mm

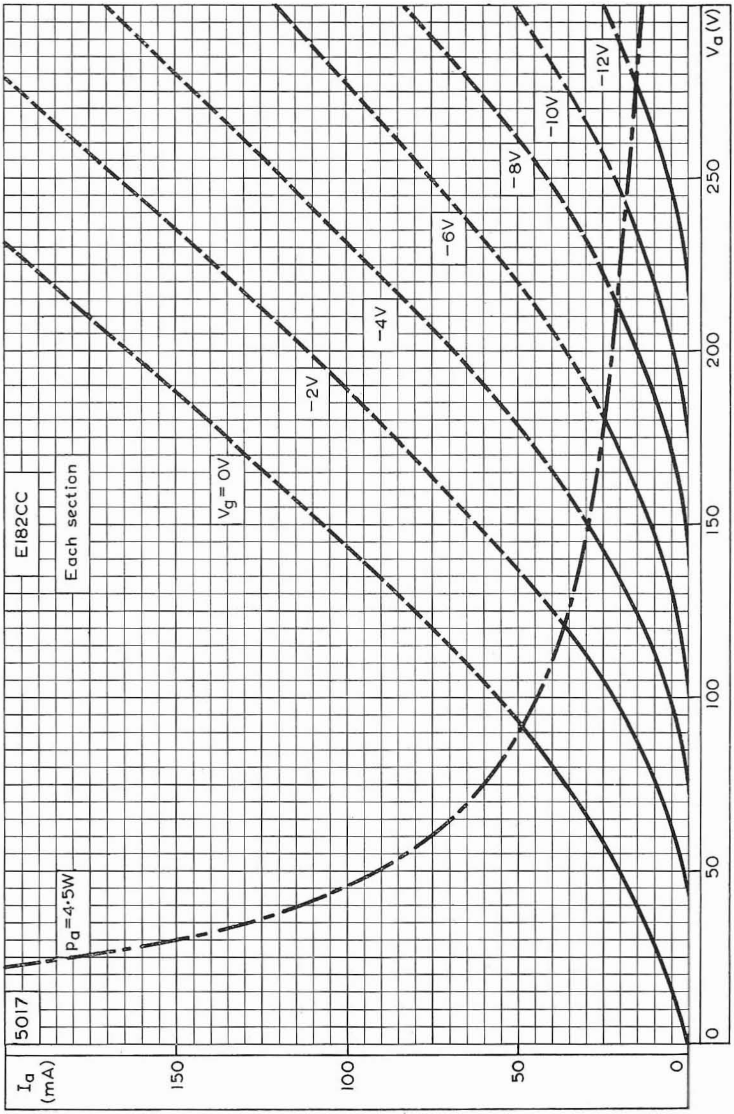
The bulb and base dimensions of this valve are in accordance with BS448, Section B9A.



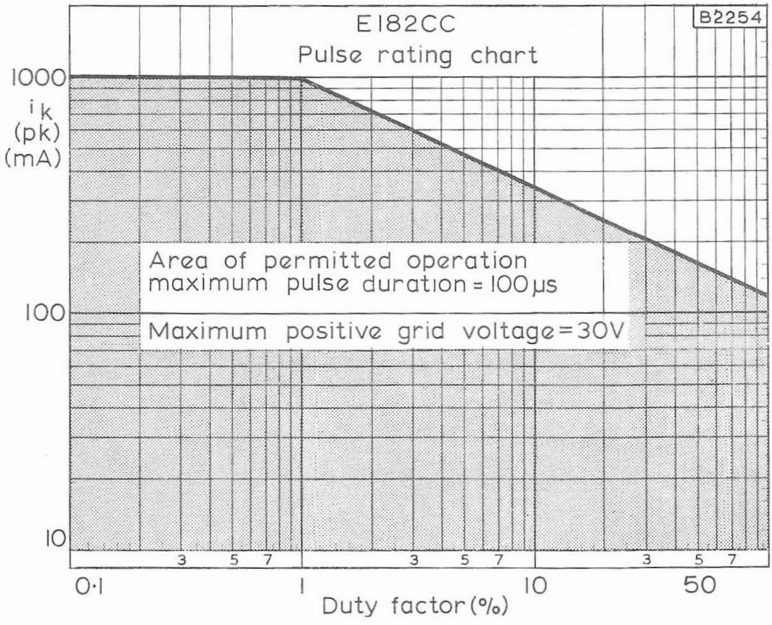
ANODE AND GRID CURRENTS PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER.

E182CC

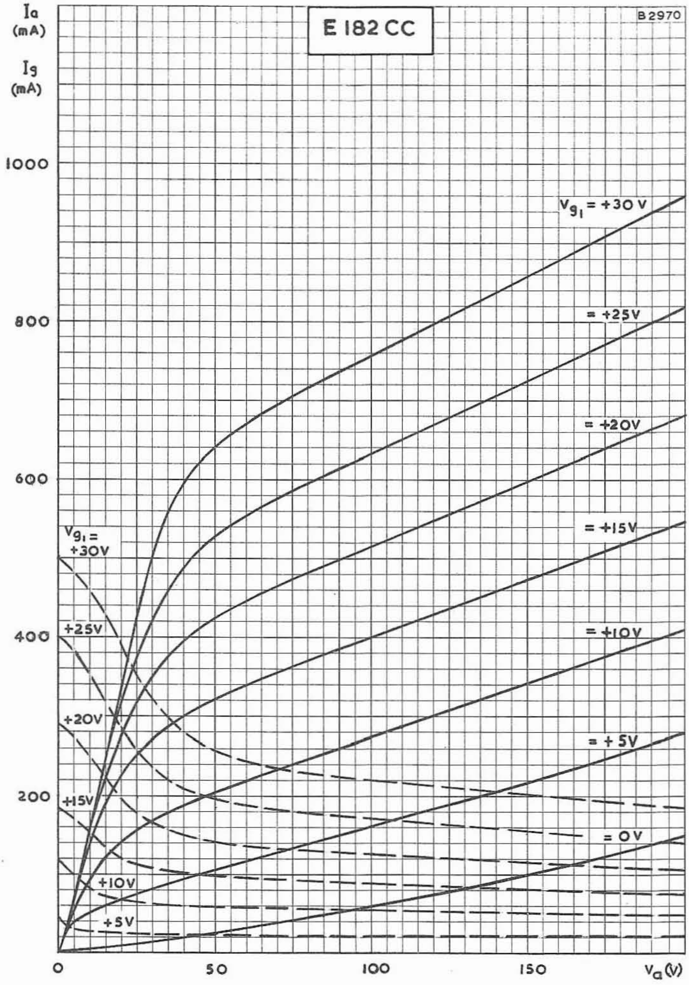
SPECIAL QUALITY DOUBLE TRIODE



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



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 $V_{g2-e} = 150V$.

E186F

SPECIAL QUALITY PENTODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of life**	
Anode current	13	12.2 to 13.8	> 11.5	mA
$V_{a-e} = 190V$, $V_{g2-e} = 160V$, $V_{g1-e} = +9V$, $R_k = 630\Omega$				
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
$V_{a-e} = 190V$, $V_{g2-e} = 160V$ $V_{g1-e} = +9V$, $R_k = 630\Omega$				
Mutual conductance	16.5	14.2 to 18.8	> 11	mA/V
$V_{a-e} = 190V$, $V_{g2-e} = 160V$, $V_{g1-e} = +9V$, $R_k = 630\Omega$				
Negative control-grid current	—	< 0.2	< 0.5	µA
$V_{a-e} = 190V$, $V_{g1-e} = +9V$, $V_{g2-e} = 160V$, $R_k = 630\Omega$, $R_{g1-k} = 100k\Omega$				
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

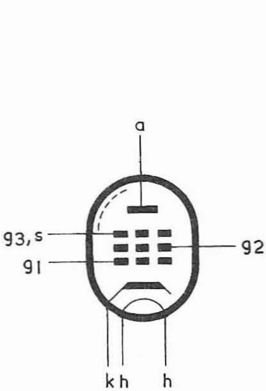
2. Microphony

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:

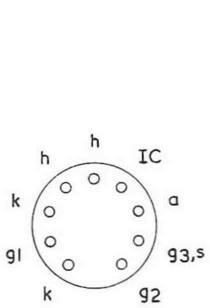
V_h	6.3	V
V_b	216	V
V_{g3}	0	V
V_{g2-e}	160	V
V_{g1-e}	+9.0	V
R_a	2.0	kΩ
R_k	630	Ω
peak acceleration	10	g

E186F

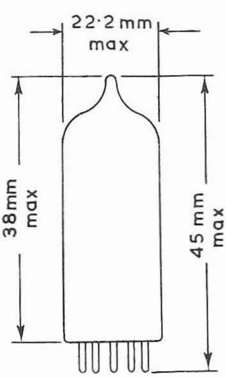
SPECIAL QUALITY PENTODE

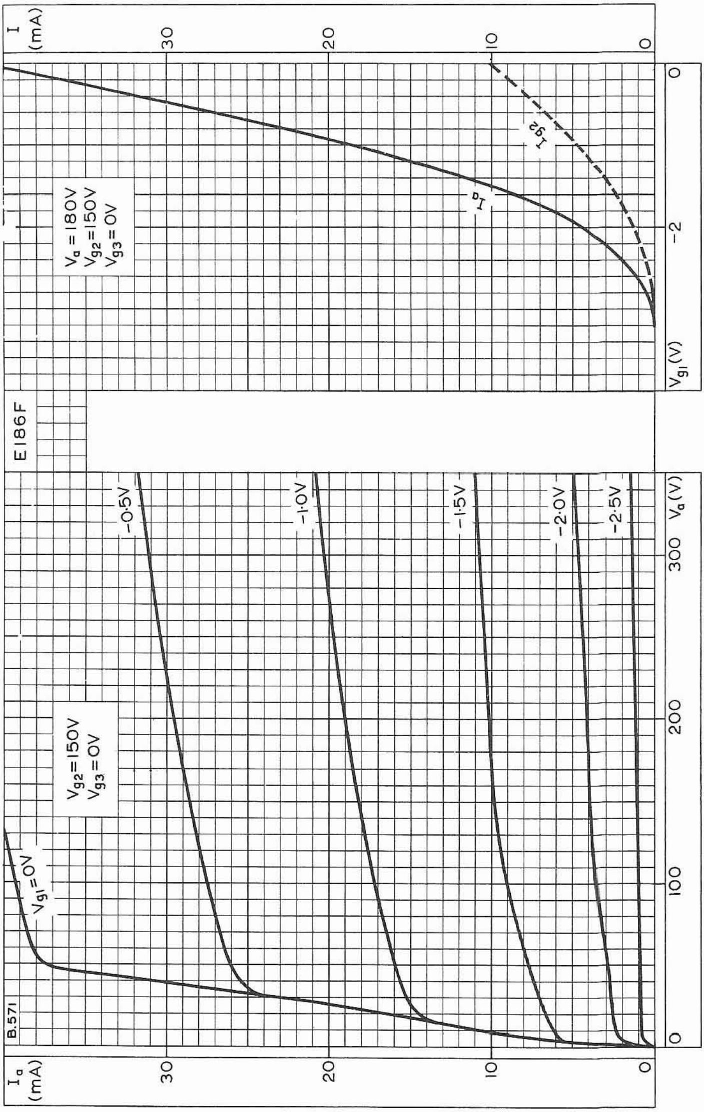


B562



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

$c_{a'-g'+h+s}$	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:

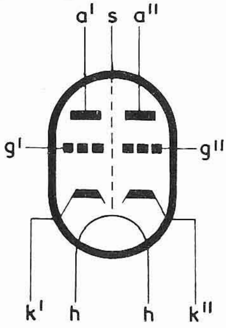
V_h	6.3	V
V_b	100	V
$V_{g(b)}$	+9.0	V
R_a	2.0	kΩ
R_k	680	Ω
C_k	1000	μF
Peak acceleration	2.5	g

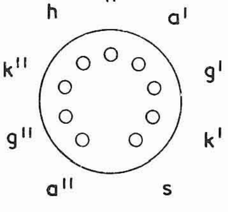
E188CC SPECIAL QUALITY DOUBLE TRIODE

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:

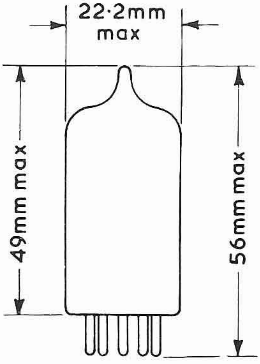
V_h	6.3	V
V_b	270	V
R_a	18	kΩ
R_{g-k}	1.0	MΩ
R_k	180	Ω
C_k	50	μF
Peak acceleration	0.5	g

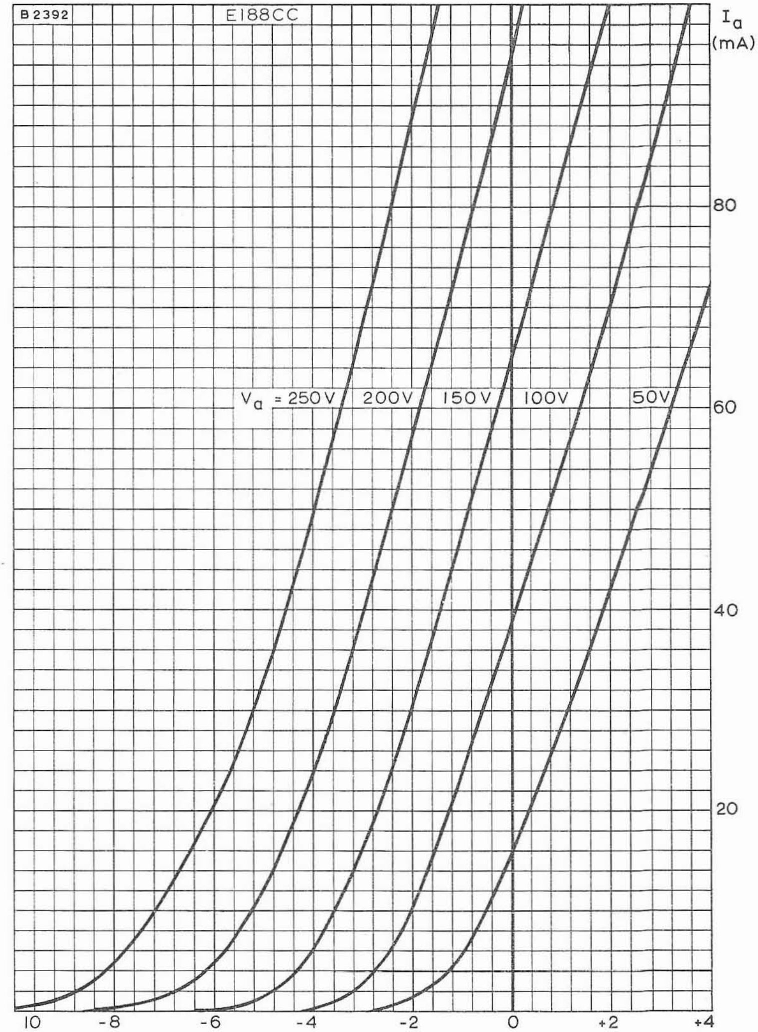
B560



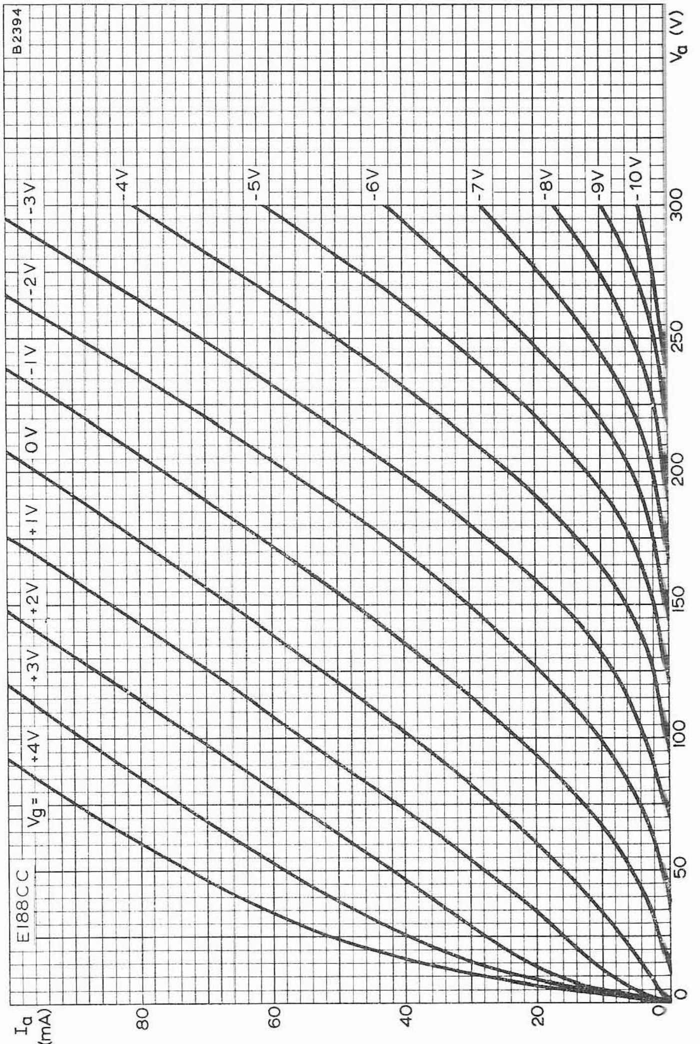


B9A Base

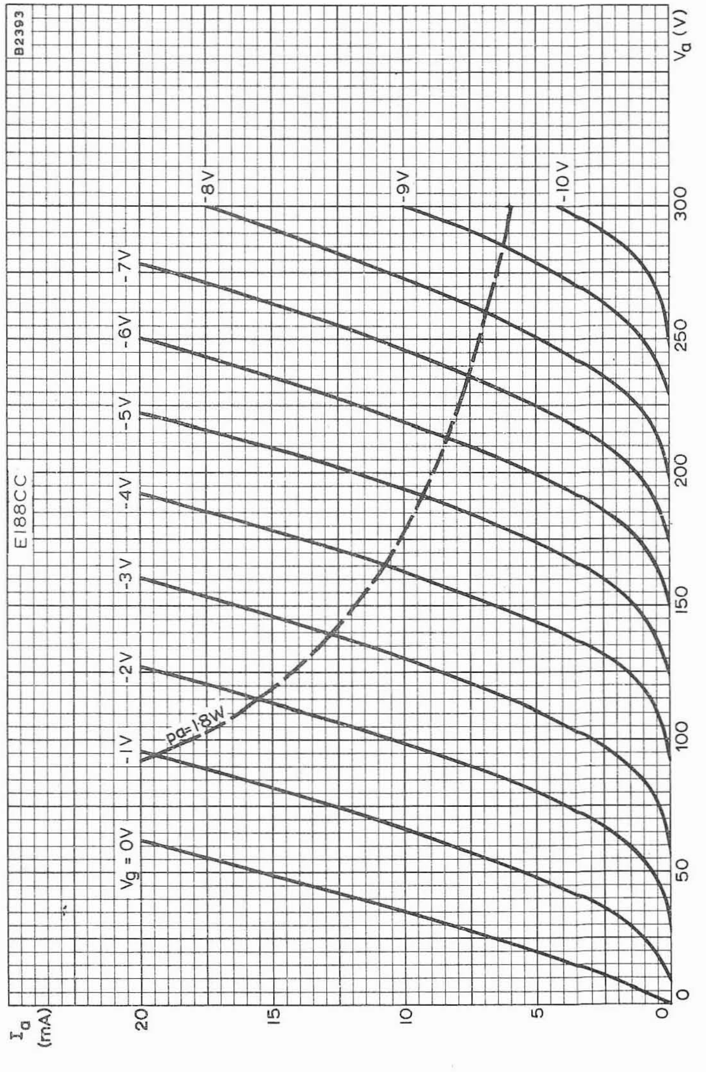




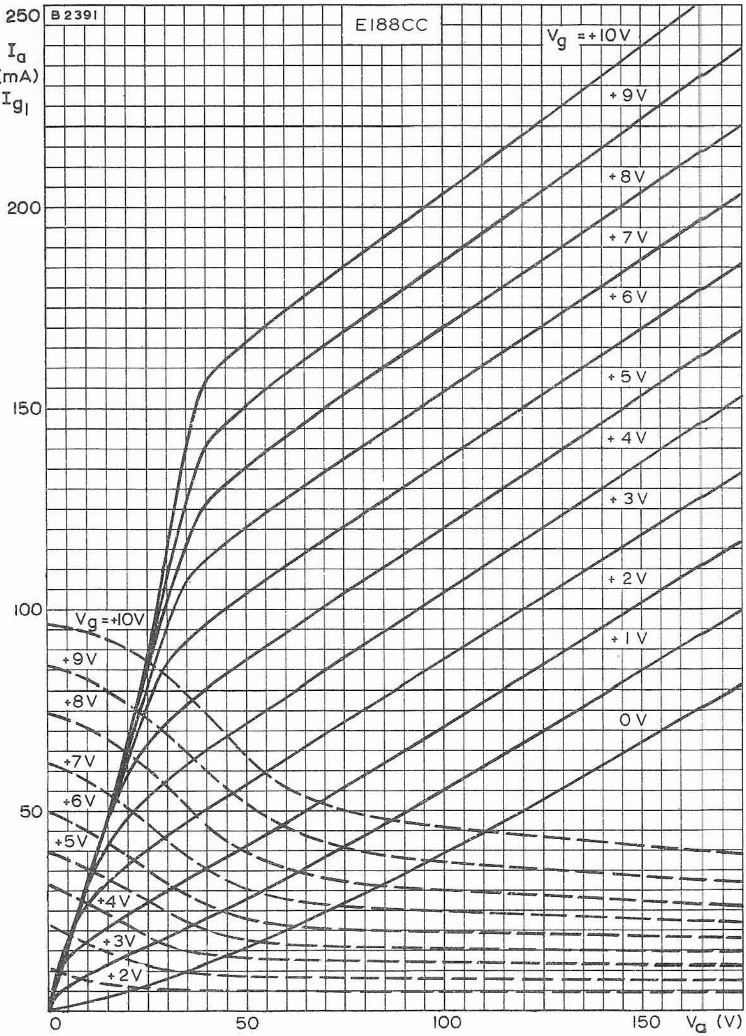
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER



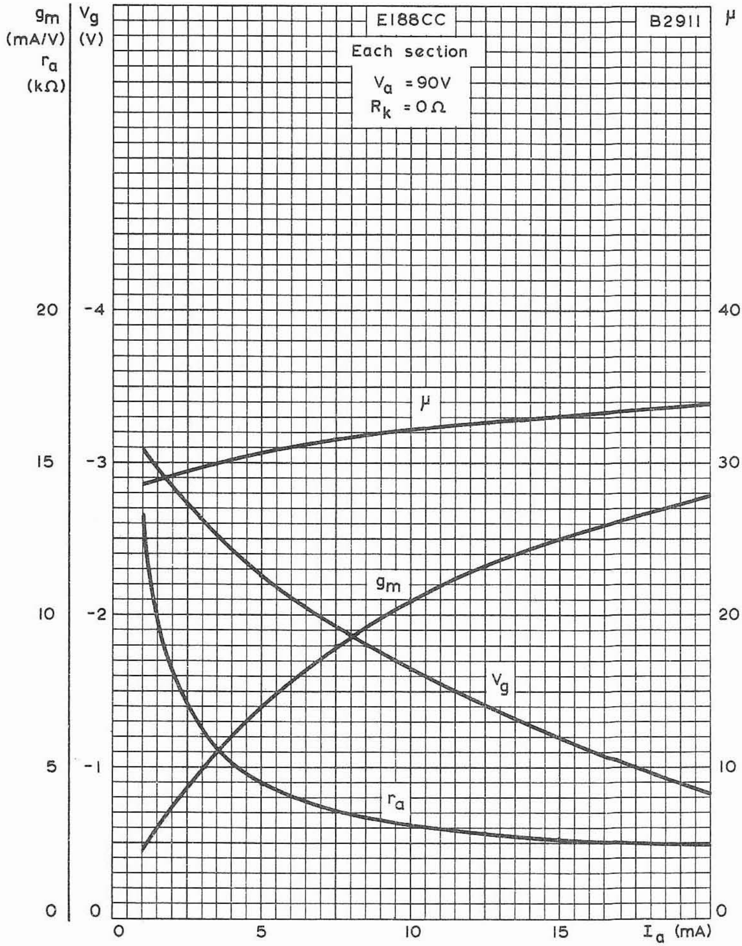
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



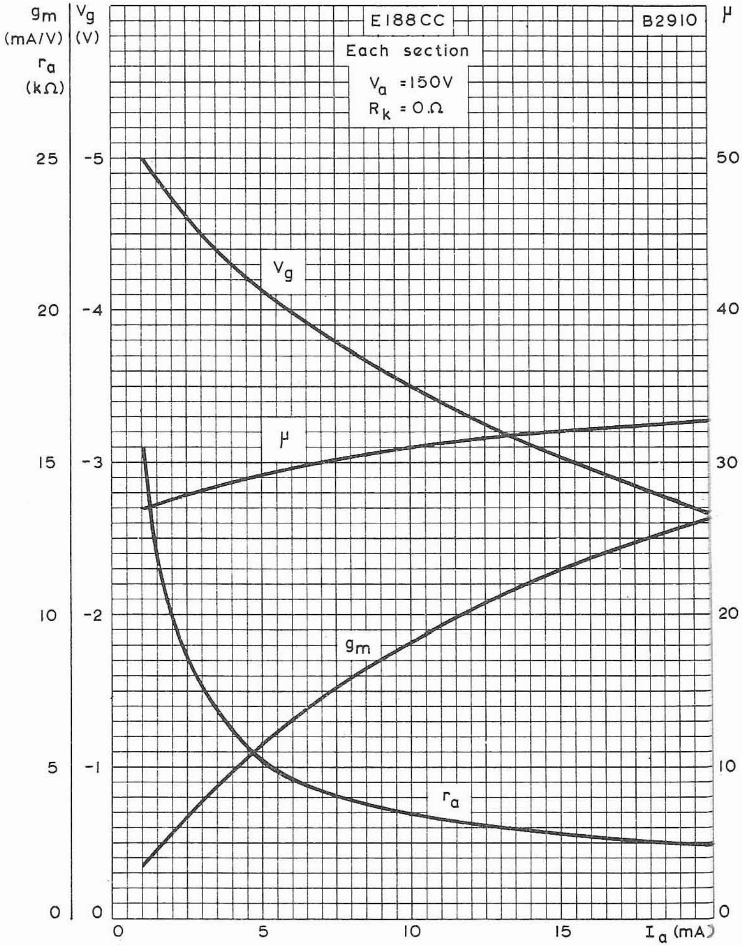
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER IN THE REGION OF THE ORIGIN.



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. ←

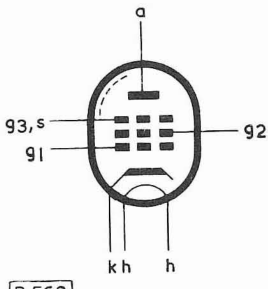
†Gain bandwidth product $= \dfrac{g_m}{2\pi(c_{in(w)} + c_{out} + 5pF)}$

E280F

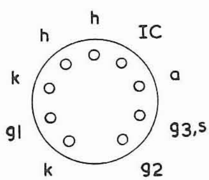
SPECIAL QUALITY PENTODE

ABSOLUTE MAXIMUM RATINGS[4]

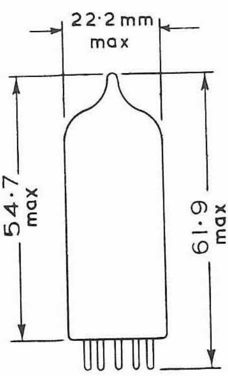
$V_{a(b)}$ max.	400	V
V_a max.	220	V
p_a max.	4.0	W
$V_{g2(b)}$ max.	400	V
V_{g2} max.	180	V
p_{g2} max.	1.1	W
$-V_{g1}$ max.	50	V
$+V_{g1}$ max.	2.0	V
I_{g1} max.	5.0	mA
I_k max.	30	mA
R_{g1-k} max.	500	kΩ ←
V_{h-k} (k positive) max.	120	V
V_{h-k} (k negative) max.	60	V
T_{bulb} max.	180	°C
V_h max.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



B 563



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

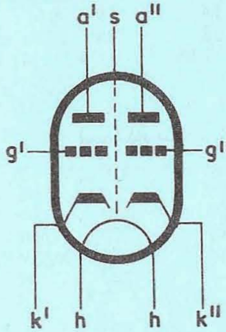
The E288CC can withstand vibrations of 2.5g and 50c/s for 96 hours, and is proof against impact accelerations of approximately 500g.

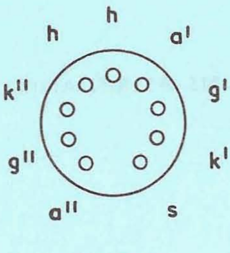
ABSOLUTE MAXIMUM RATINGS[4] (each section)

$V_{a(b)}$ 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

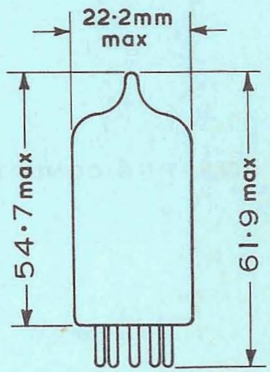
*Maximum duty factor 0.01, maximum pulse duration 10µs.

B1606





B9A Base



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	$\mu\mu$F
c_{ad-ap}	<0.15	$\mu\mu$F

Pentode Section

c_{a-g1}	<0.002	$\mu\mu$F
c_{out}	5.1	$\mu\mu$F
c_{in}	4.5	$\mu\mu$F
c_{g1-h}	<0.05	$\mu\mu$F

Diode Section

c_{ad-k}	3.8	$\mu\mu$F
c_{ad-h}	<0.02	$\mu\mu$F

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. ($I_{g1} = +0.3\ \mu$A)	−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.

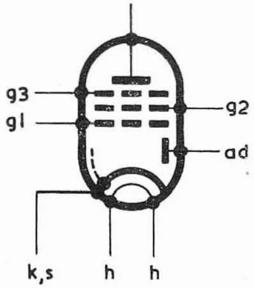
EAF42

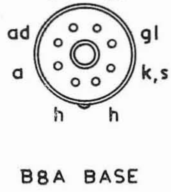
SINGLE DIODE R.F. PENTODE

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

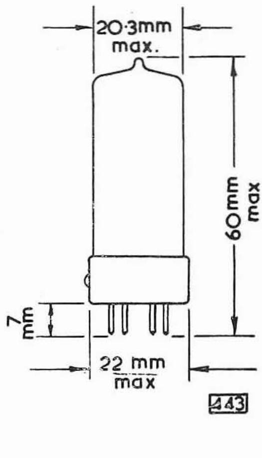
Diode Section

$V_{ad(pk)}$ 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	k Ω
V_{h-k} max.	100	V





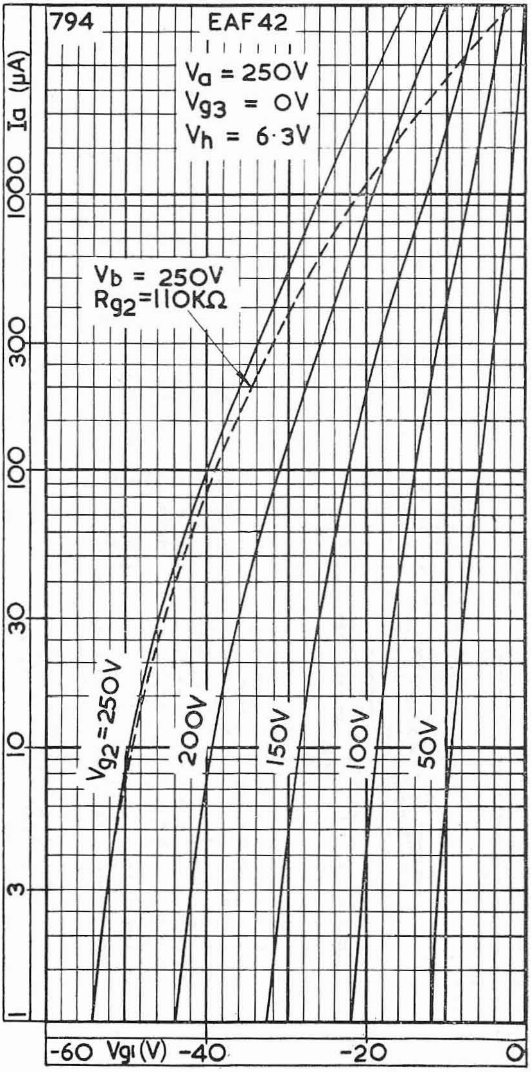
B8A BASE



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.

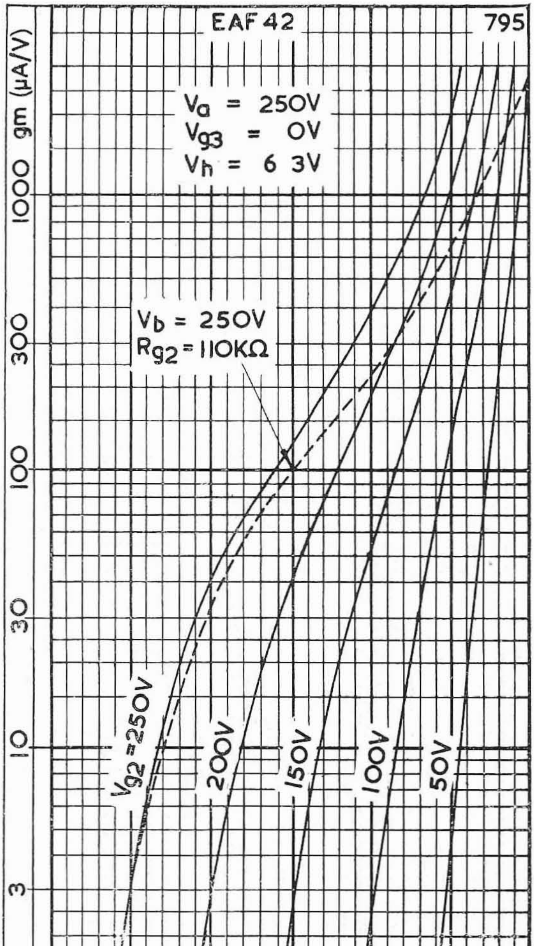


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

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.

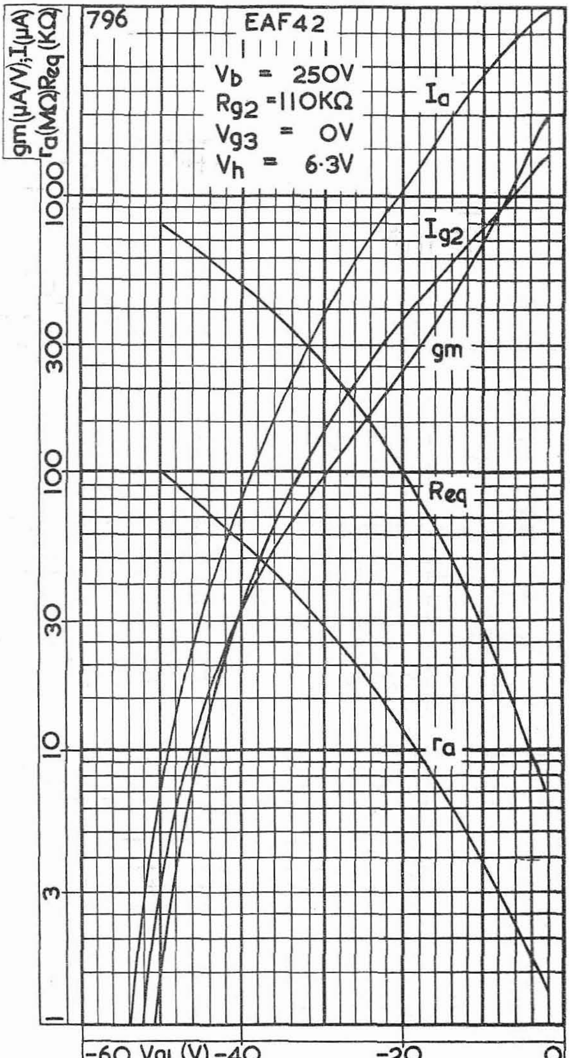


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

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.

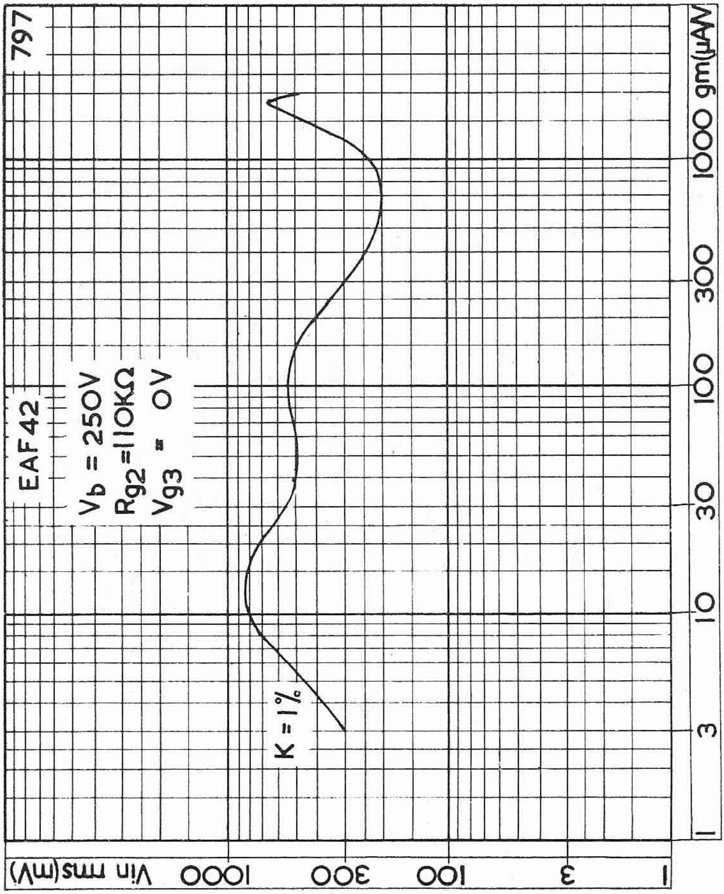


ANODE CURRENT, SCREEN GRID CURRENT, MUTUAL CONDUCTANCE, EQUIVALENT NOISE RESISTANCE AND INTERNAL RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

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.



CROSS MODULATION CURVE

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.

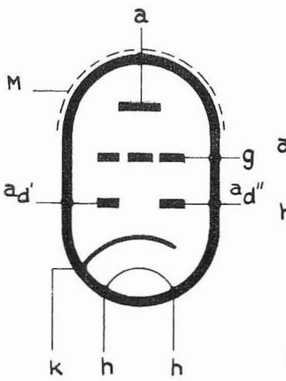
LIMITING VALUES

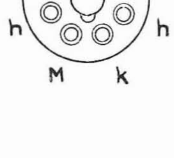
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.5	W
V_{ad} max.	200	V
I_{ad} max.	0.8	mA
I_k max.	10	mA
V_g max. ($I_g = 0.3\mu A$)	−1.3	V
R_g max. (Self bias)	3.0	MΩ
R_g max. (Fixed bias)	1.0	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

EBC33

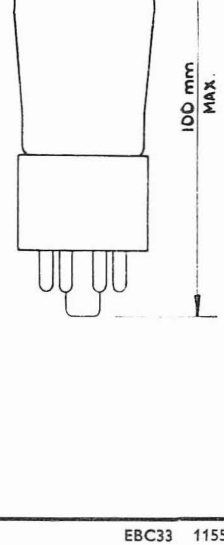
DOUBLE DIODE TRIODE

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





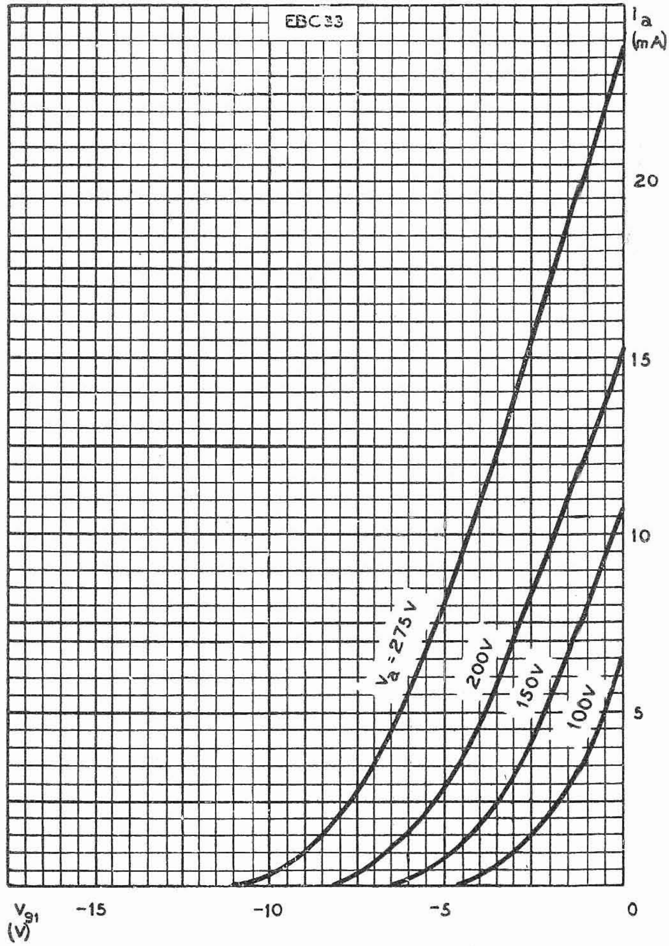
OCTAL BASE



DOUBLE DIODE TRIODE

EBC33

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

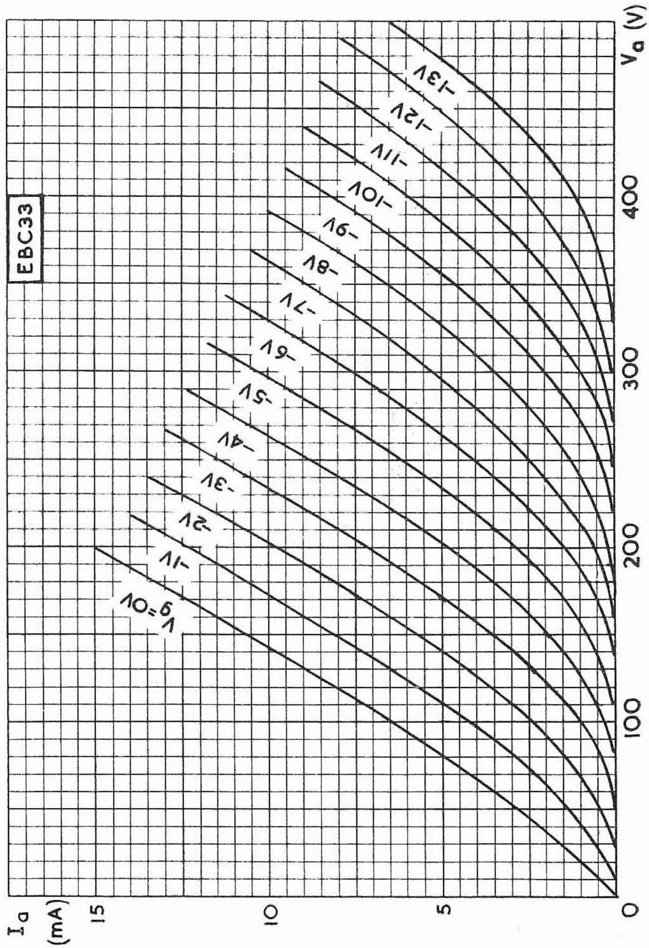


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

EBC33

DOUBLE DIODE TRIODE

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

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

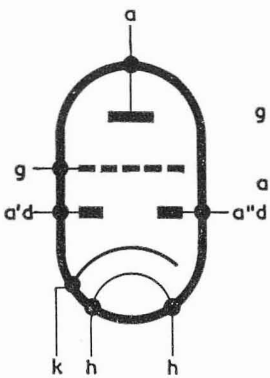
$c_{a'd-gt}$	<0.007	pF
$c_{a''d-gt}$	<0.03	pF
c_{ad-at}	<0.01	pF

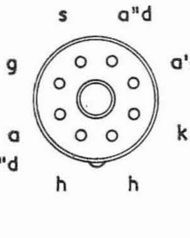
Triode section

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

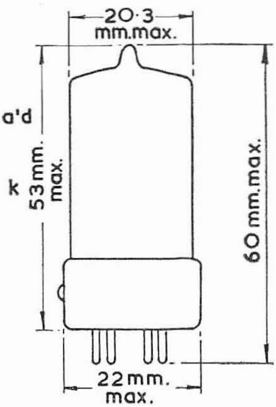
Diode sections

$c_{a'd-k}$	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

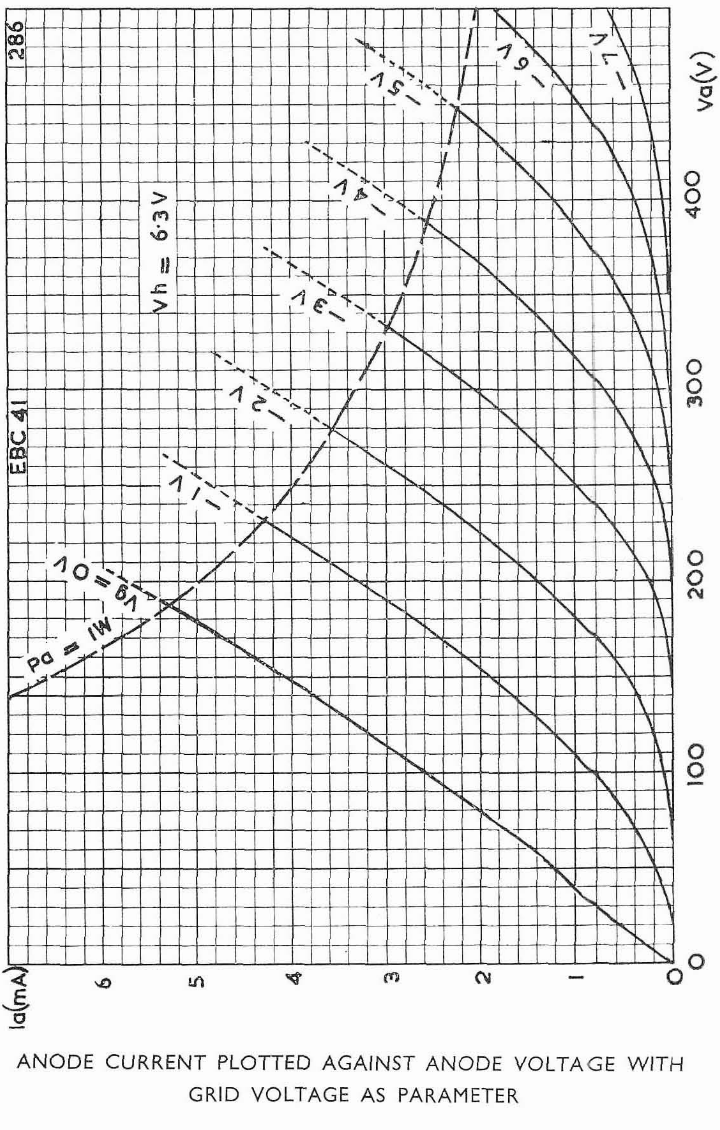


633

DOUBLE DIODE TRIODE

EBC41

High gain triode for use as A.F. voltage amplifier, combined with twin diodes, for A.C. mains operation.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

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. ($I_{g1}=+0.3\mu A$)	−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) ←

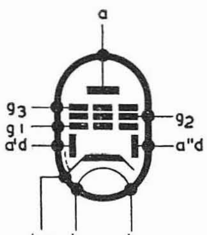
P.I.V.	350	V
I_{ad} max.	0.8	mA
$i_{ad(pk)}$ max.	5.0	mA
R_{h-k} max.	20	k Ω
V_{h-k} max.	100	V

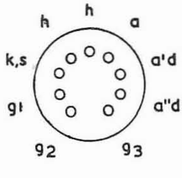
This valve can be used without special precautions against microphony if the input voltage, V_{in}, is not less than 25 mV for an output of 50 mW from the output valve.

DOUBLE DIODE PENTODE

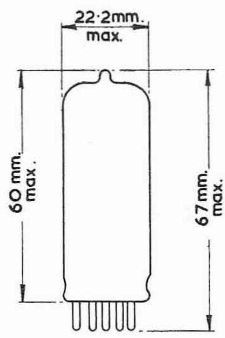
EBF80

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

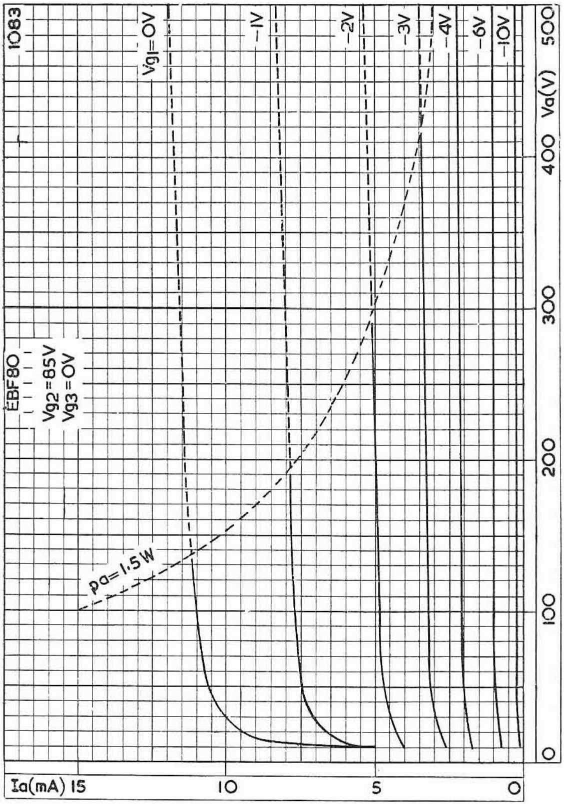


706

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.

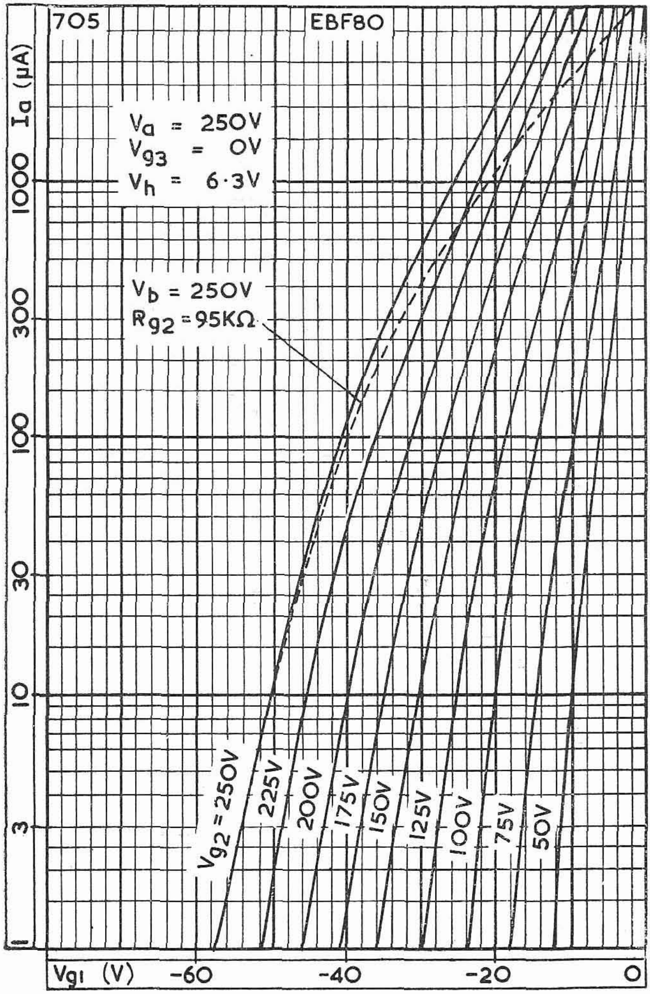


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

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.

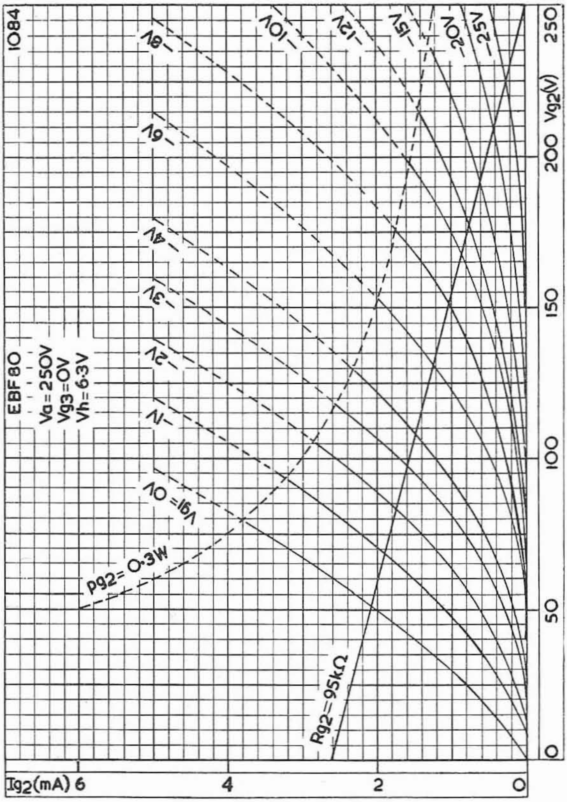


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

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.

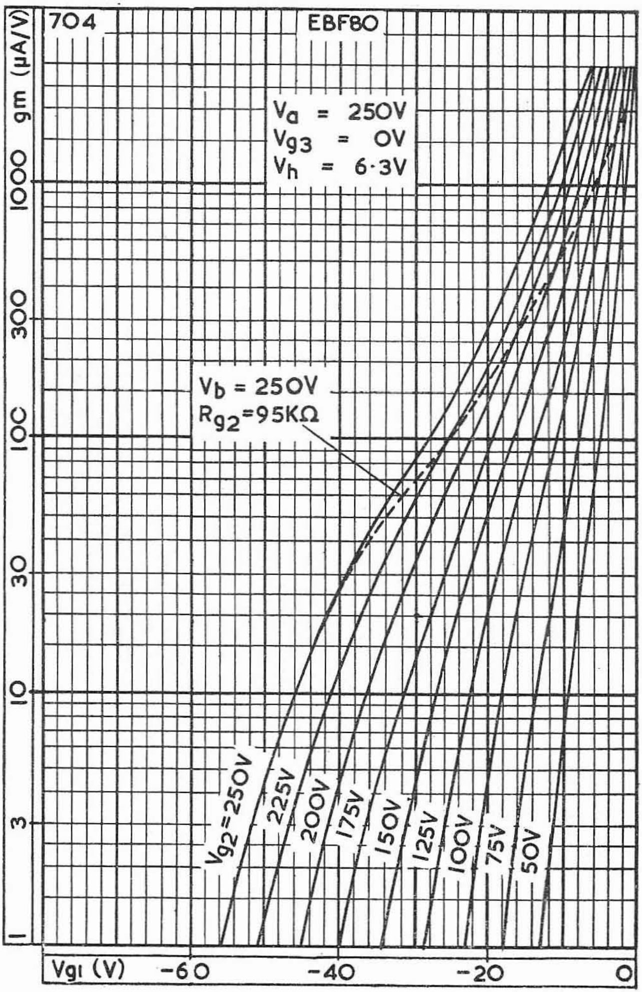


SCREEN–GRID CURRENT PLOTTED AGAINST SCREEN–GRID VOLTAGE WITH CONTROL–GRID VOLTAGE AS PARAMETER

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.

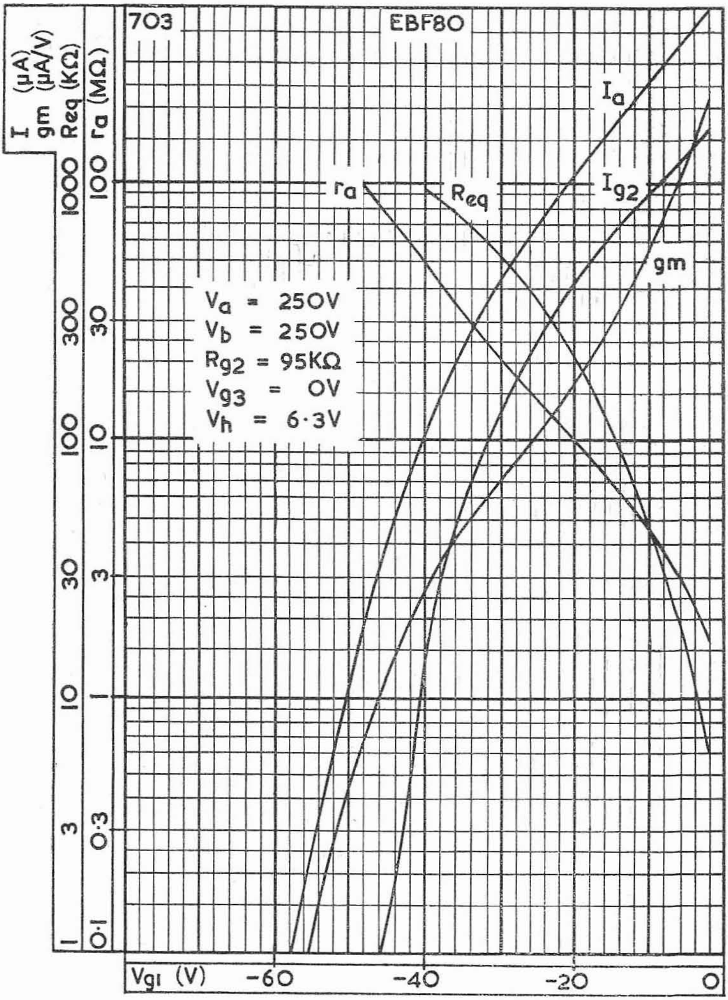


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

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.

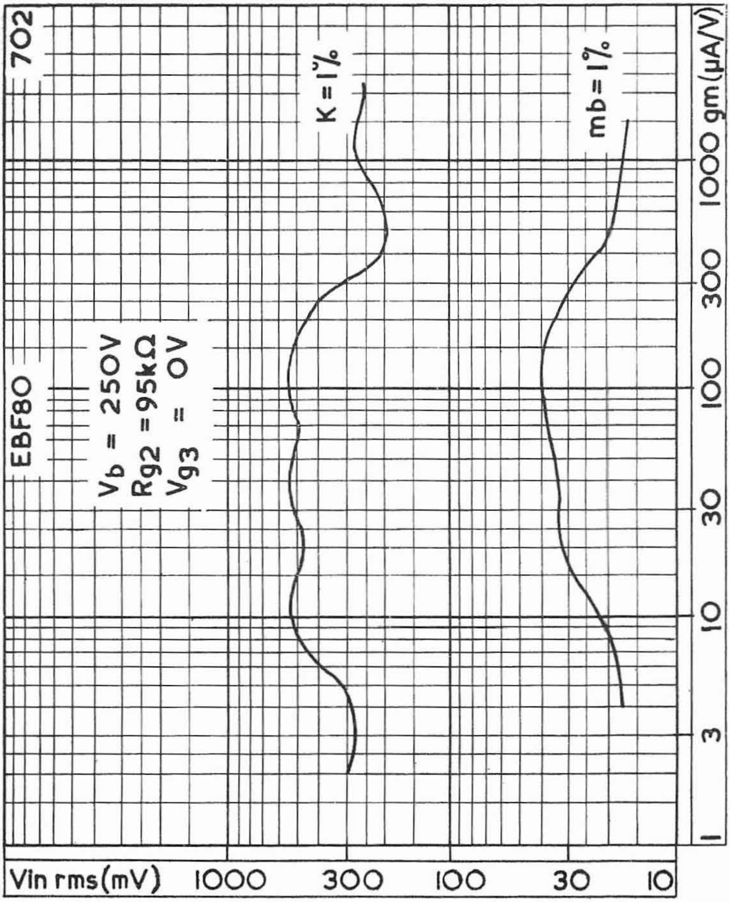


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE, ANODE RESISTANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

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.



CROSS MODULATION AND MODULATION HUM CURVES

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

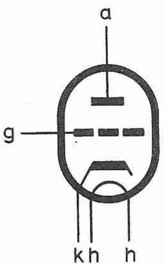
V_b	200	V
R_a	6.8	kΩ
I_a	9.0	mA
I_g	52	µA
$V_{osc(r.m.s.)}$	2.0	V
R_g	47	kΩ
g_c	5.4	mA/V
$g_{m(eff)}$	7.0	mA/V

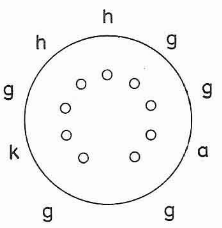
EC88

U.H.F. TRIODE

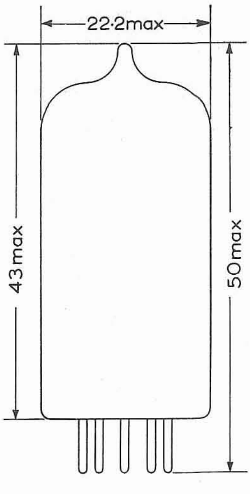
DESIGN CENTRE RATINGS

$V_{a(b)}$ 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. TRIODE

EC97

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

HEATER

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

V_h	6.3	V
I_h	215	mA

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

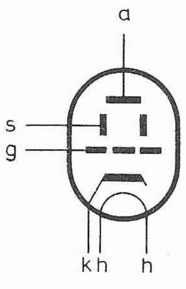
Condition	*1*	*2*	*3*	*4*	
V_b	135	135	135	135	V
R_a	1.0	1.0	2.2	2.2	kΩ
R_k	82	0	0	0	Ω
R_g	0	1.0	0.22	1.0	MΩ
R_{g-a}	—	—	22	22	MΩ
I_a	10.5	13	14	14	mA
g_m	13	15.5	16	16	mA/V
V_g for 100 : 1 reduction in g_m	−5.0	−4.8	−6.0	−11	V

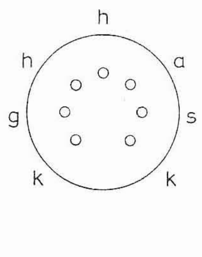
Condition	*5*	*6*	*7*	*8*	
V_b	200	200	200	200	V
R_a	5.6	5.6	6.8	6.8	kΩ
R_k	82	0	0	0	Ω
R_g	0	1.0	0.22	0.56	MΩ
R_{g-a}	—	—	22	22	MΩ
I_a	12	13	14	14	mA
g_m	14	15.5	16	16	mA/V
V_g for 100 : 1 reduction in g_m	−7.5	−7.3	−9.0	−12.5	V

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.

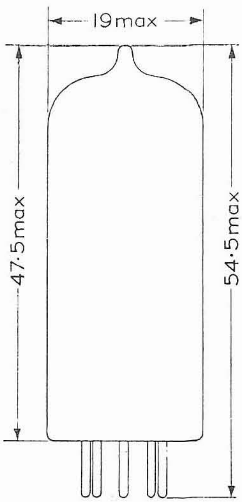
DESIGN CENTRE RATINGS

$V_{a(b)}$ 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



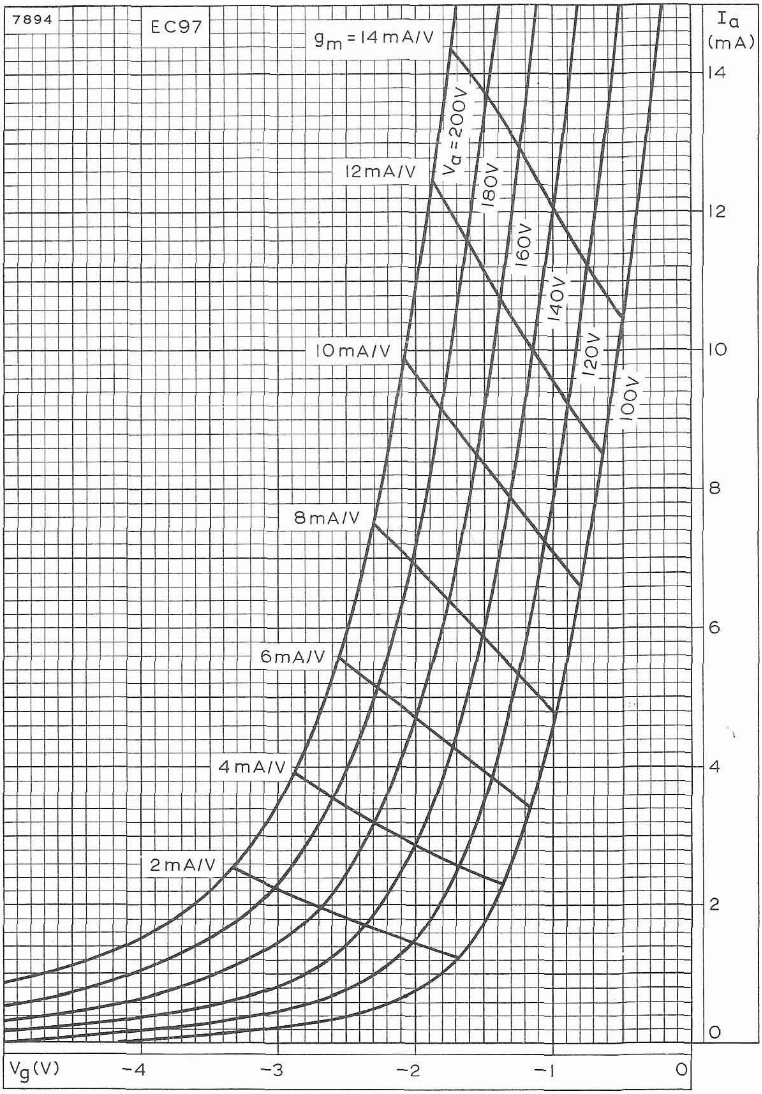


B7G Base

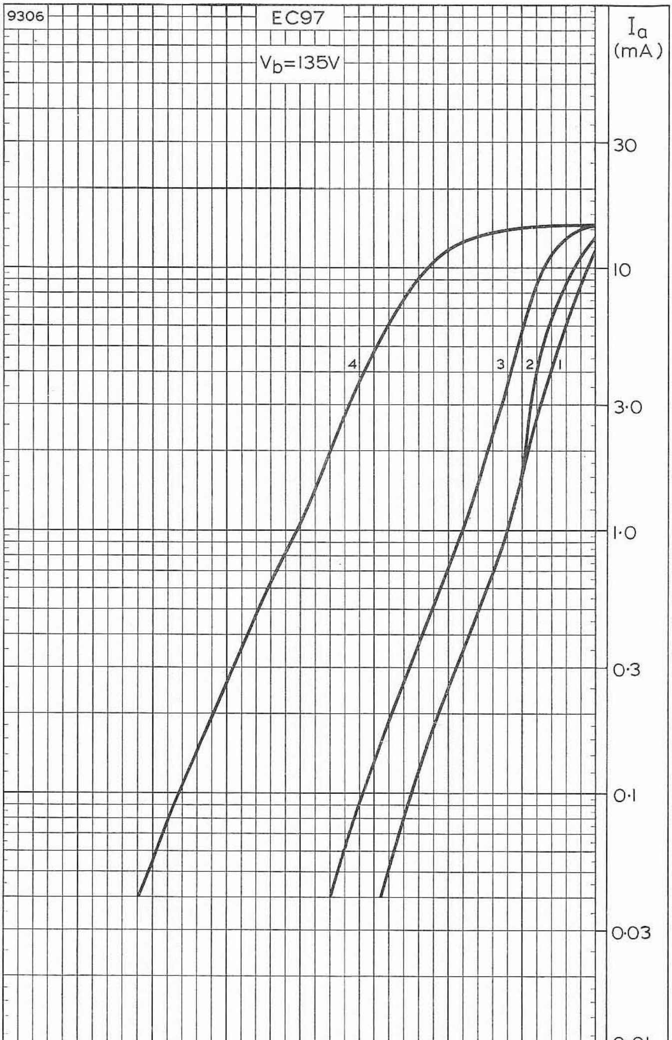


7438

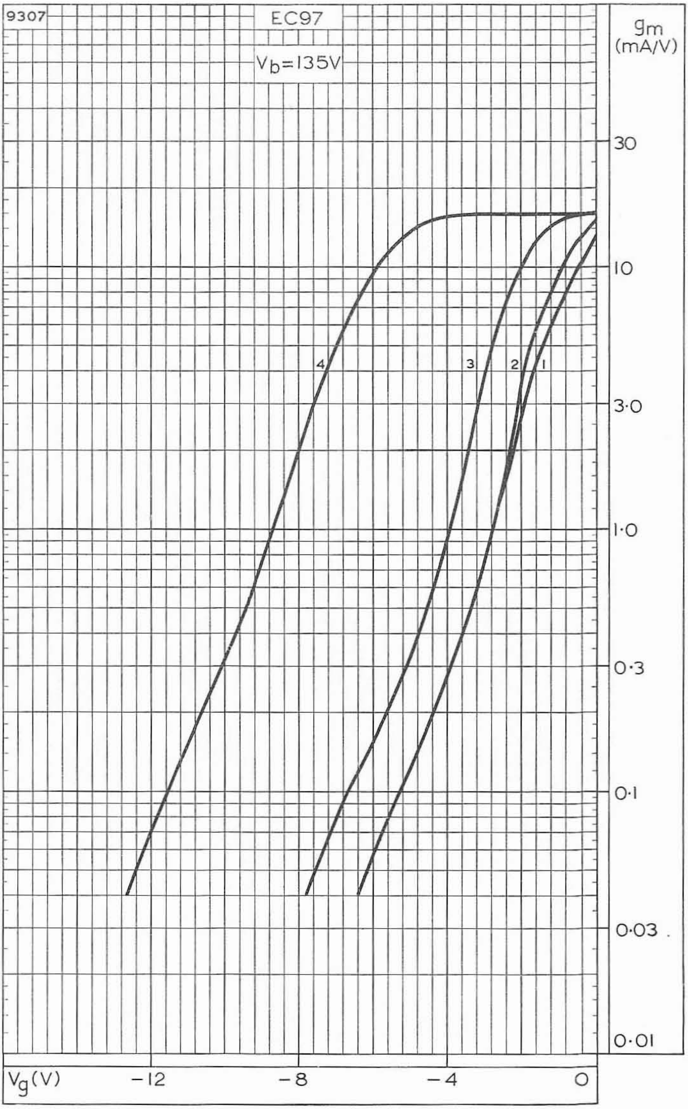
All dimensions in mm



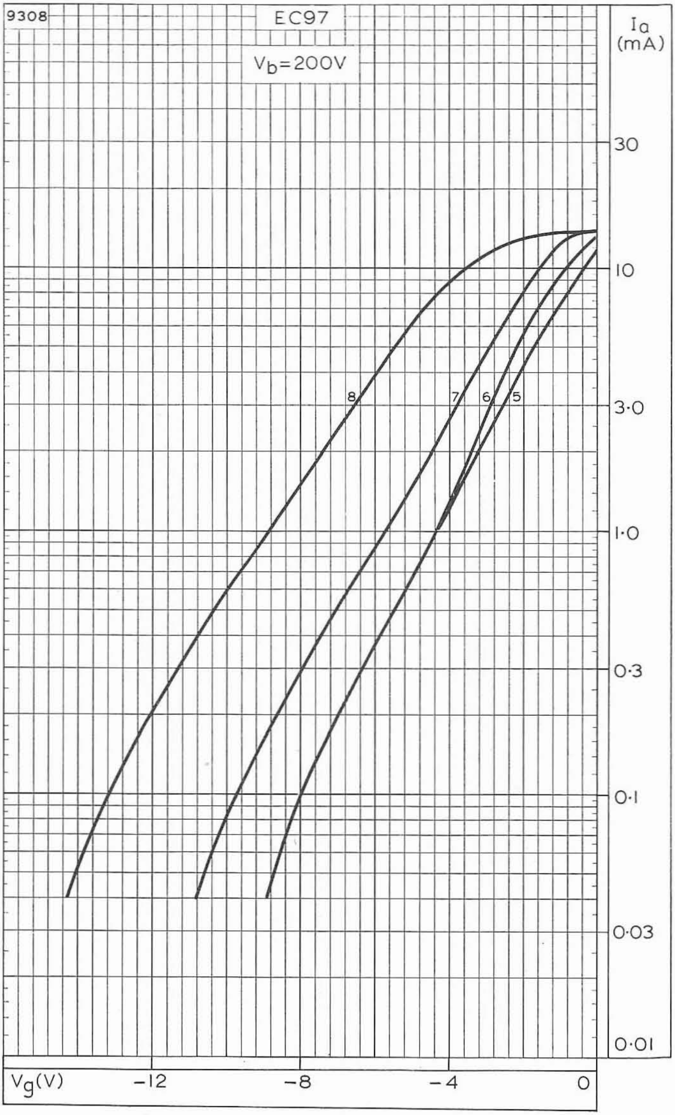
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER AND WITH MUTUAL CONDUCTANCE CONTOURS



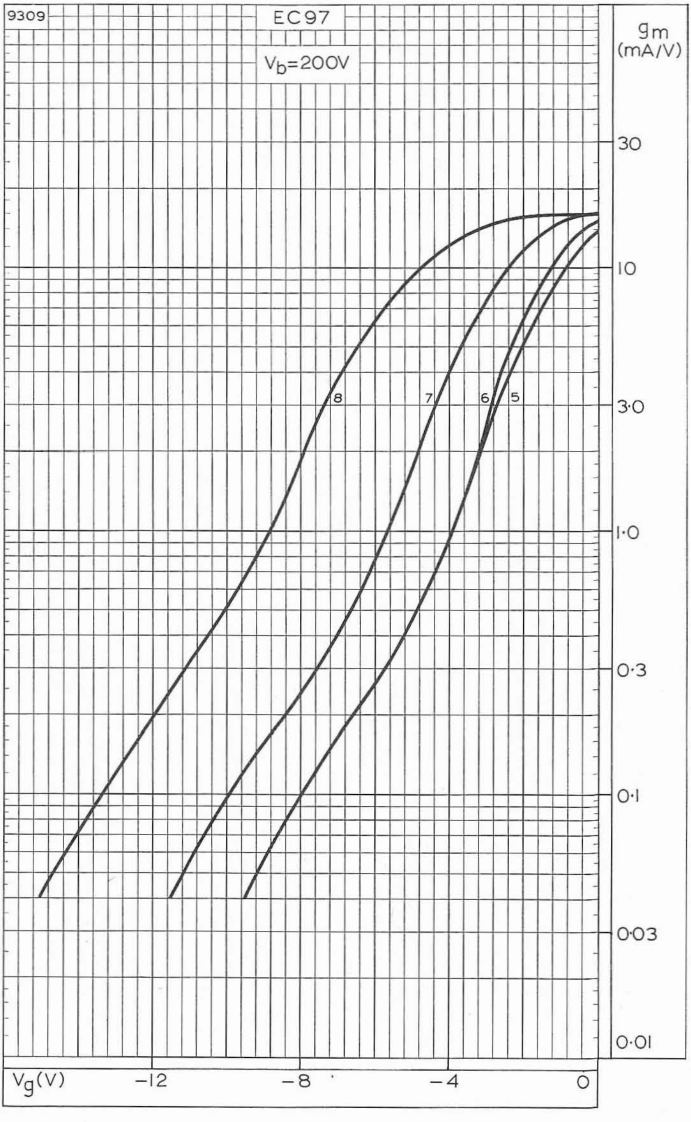
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE. $V_b = 135V$
Curve numbers refer to Operating Conditions on page D1.



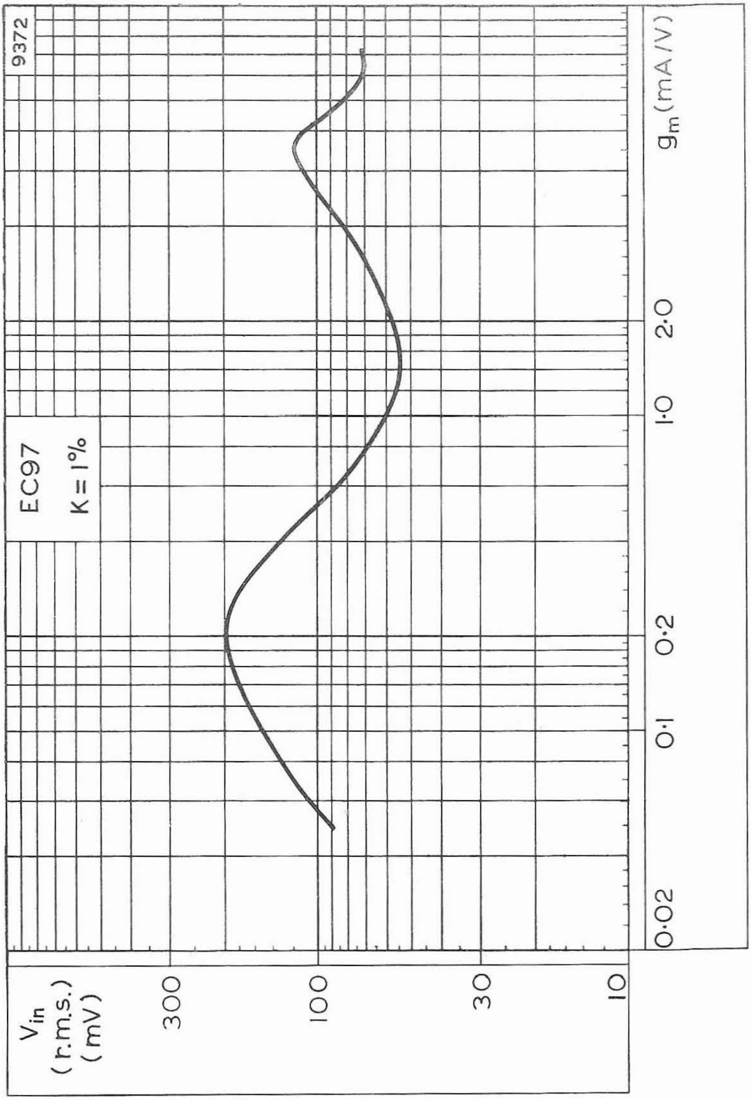
MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE. V_b=135V
Curve numbers refer to Operating Conditions on page D1.



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE. $V_b = 200V$
Curve numbers refer to Operating Conditions on page D2.



MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE. $V_b = 200V$
Curve numbers refer to Operating Conditions on page D2.



CROSS-MODULATION CURVE

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.

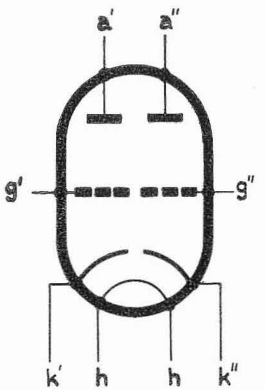
LIMITING VALUES (each section)

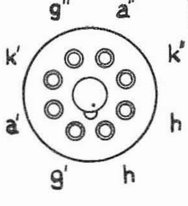
V_a max.	300	V
p_a max.	5	W
I_k max.	50	mA
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ

ECC32

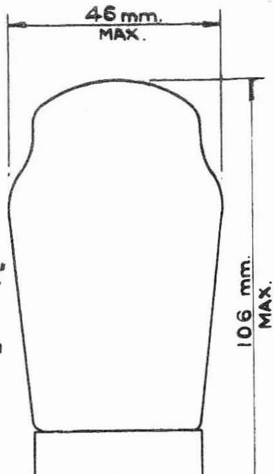
DOUBLE TRIODE

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





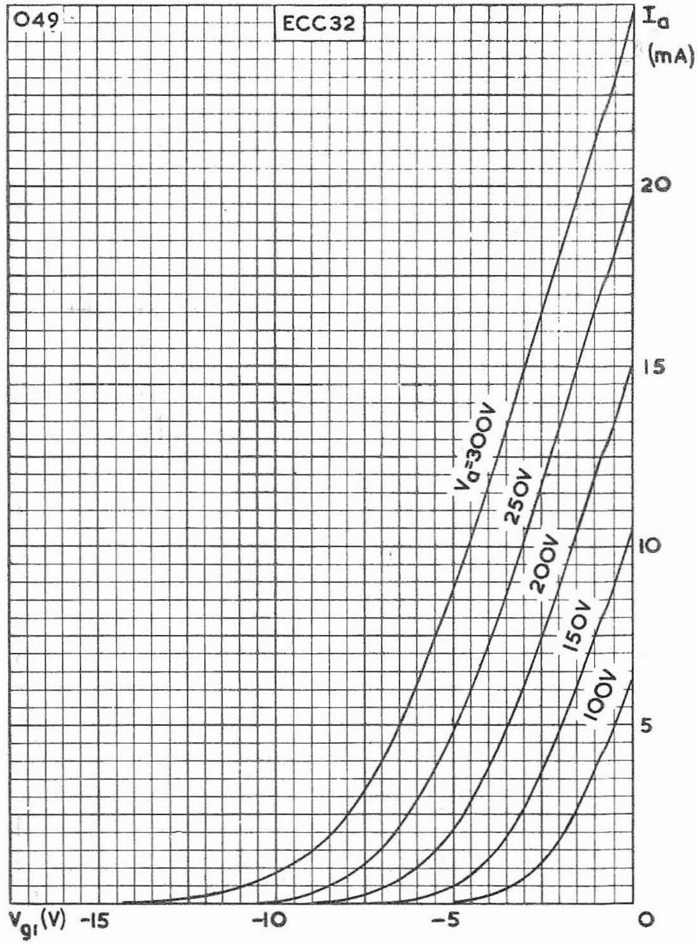
OCTAL BASE



DOUBLE TRIODE

ECC32

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

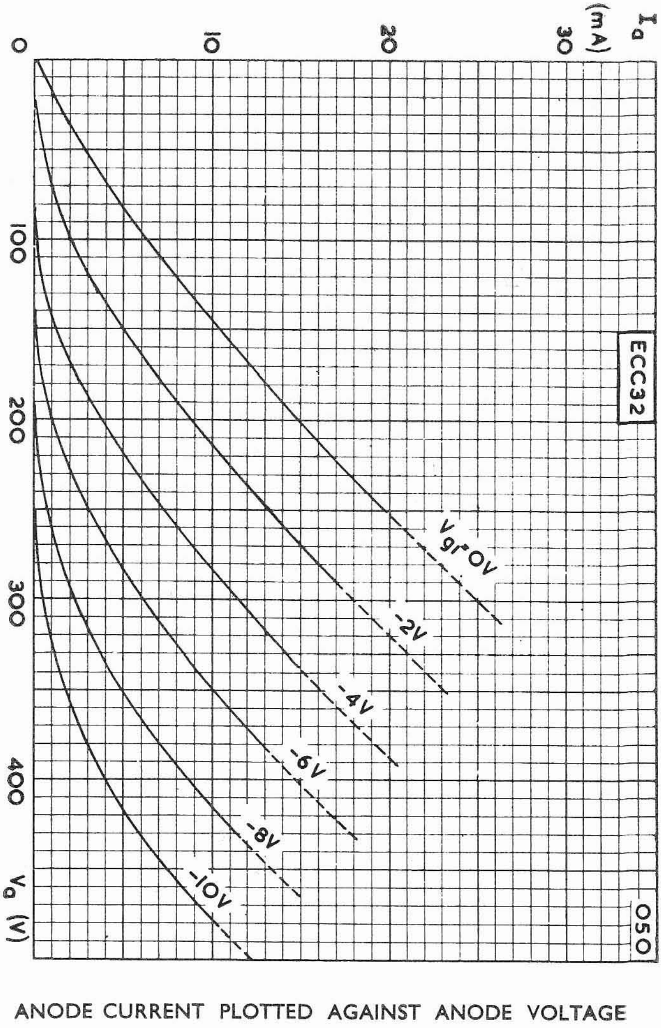


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR EACH SECTION

ECC32

DOUBLE TRIODE

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
FOR EACH SECTION

DOUBLE TRIODE

ECC33

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

HEATER (The heaters of the two cathodes are connected in series)

V_h	6.3	V
I_h	0.4	A

CAPACITANCES

$c_{a'-a''}$	0.75	μμF
c_{a-g} (each section)	2.5	μμF
c_{g-k} (each section)	3.5	μμF
$c_{a'-k'}$	1.2	μμF
$c_{a''-k''}$	1.5	μμF

CHARACTERISTICS (each section)

V_a	250	V
V_g	−4.0	V
I_a	9.0	mA
g_m	3.6	mA/V
μ	35	
r_a	9.7	kΩ

LIMITING VALUES (each section)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
I_k max.	20	mA
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

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

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	*V_{out} ($V_{r.m.s.}$)	D_{tot} (%)	**R_{g1} (kΩ)
400	47	4.0	1.2	25.5	74	6.1	150
350	47	3.5	1.2	25	62.5	5.9	150
300	47	3.0	1.2	25	50	5.6	150
250	47	2.5	1.2	25	41	5.6	150
200	47	2.0	1.2	24.5	30.5	5.3	150
400	100	2.05	2.2	28	78.5	5.7	330
350	100	1.8	2.2	27.5	66.5	5.6	330
300	100	1.55	2.2	27	54.5	5.6	330
250	100	1.3	2.2	27	43	5.4	330
200	100	1.05	2.2	26.5	32	5.2	330
400	220	1.1	3.9	28	74.5	5.1	680
350	220	0.98	3.9	28	63	5.0	680
300	220	0.83	3.9	28	51	5.0	680
250	220	0.7	3.9	27.5	41	4.8	680
200	220	0.53	3.9	27	30.5	4.8	680

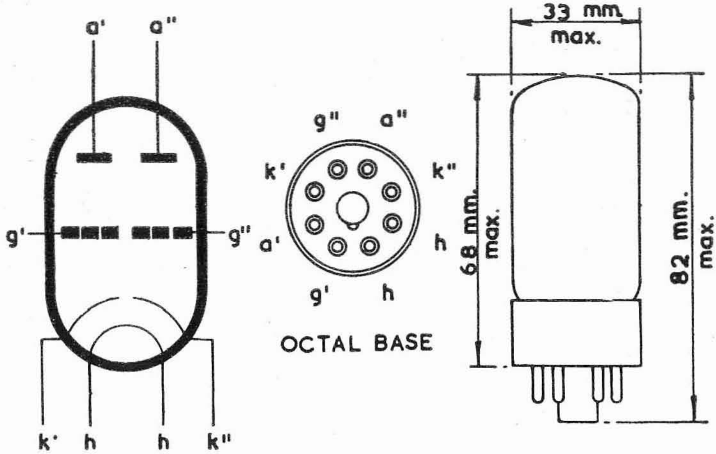
*Output voltage at the start of I_g. At output voltages lower than those shown the distortion is approximately proportional to voltage.

**Grid resistor of following valve.

ECC33

DOUBLE TRIODE

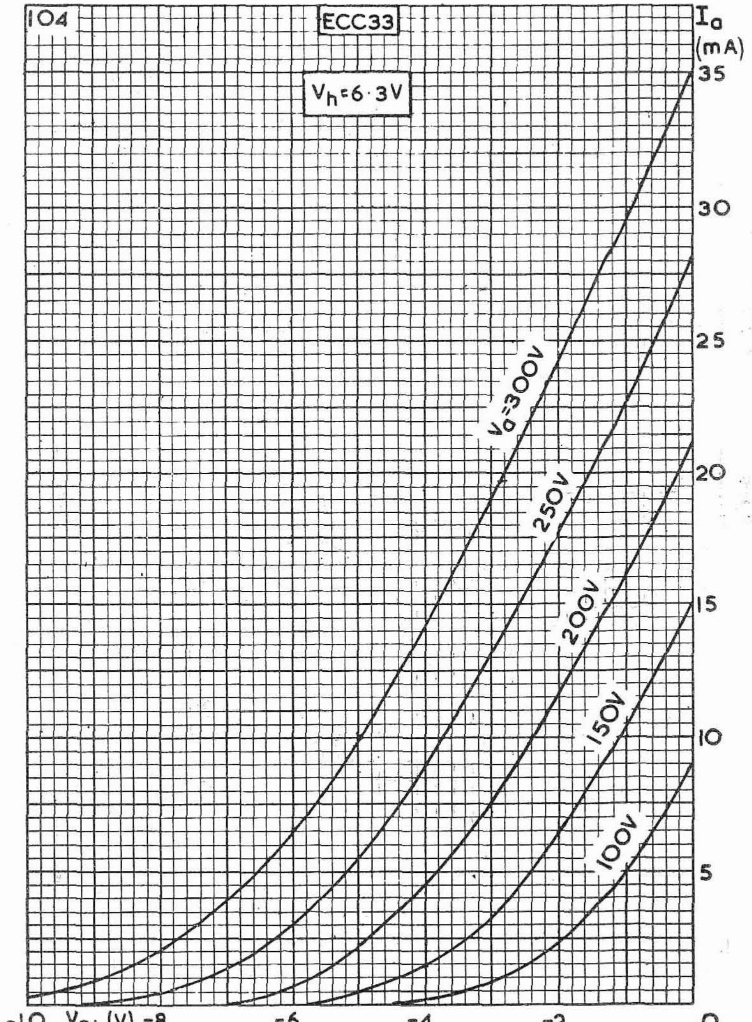
High slope, low impedance double triode with low heater consumption, primarily intended for use in flip-flop, scaling and computor circuits.



DOUBLE TRIODE

ECC33

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

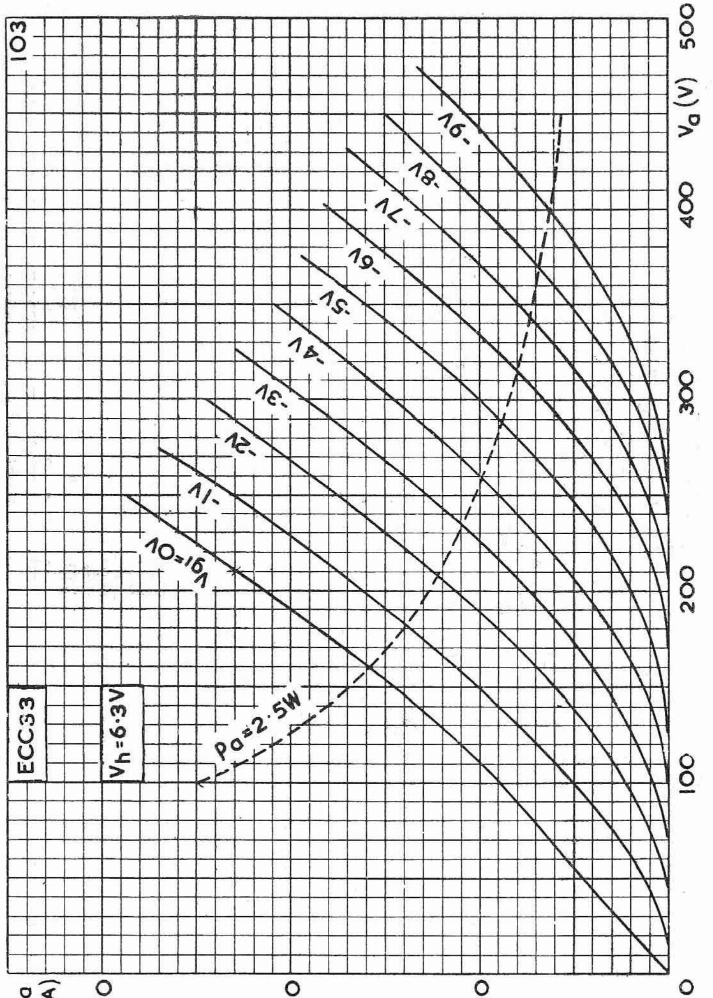


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR EACH SECTION

ECC33

DOUBLE TRIODE

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

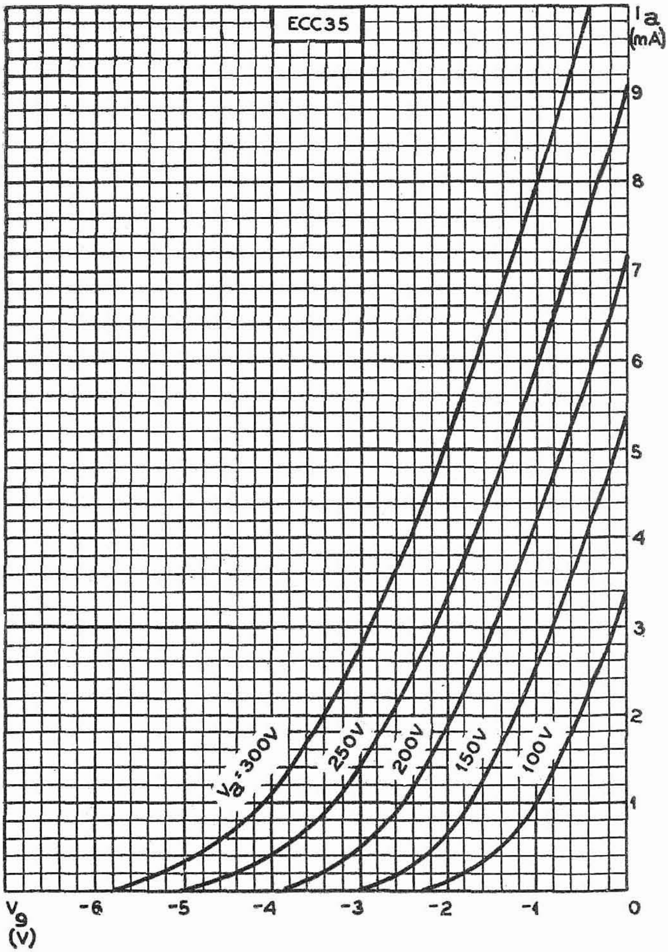


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
FOR EACH SECTION

DOUBLE TRIODE

ECC35

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

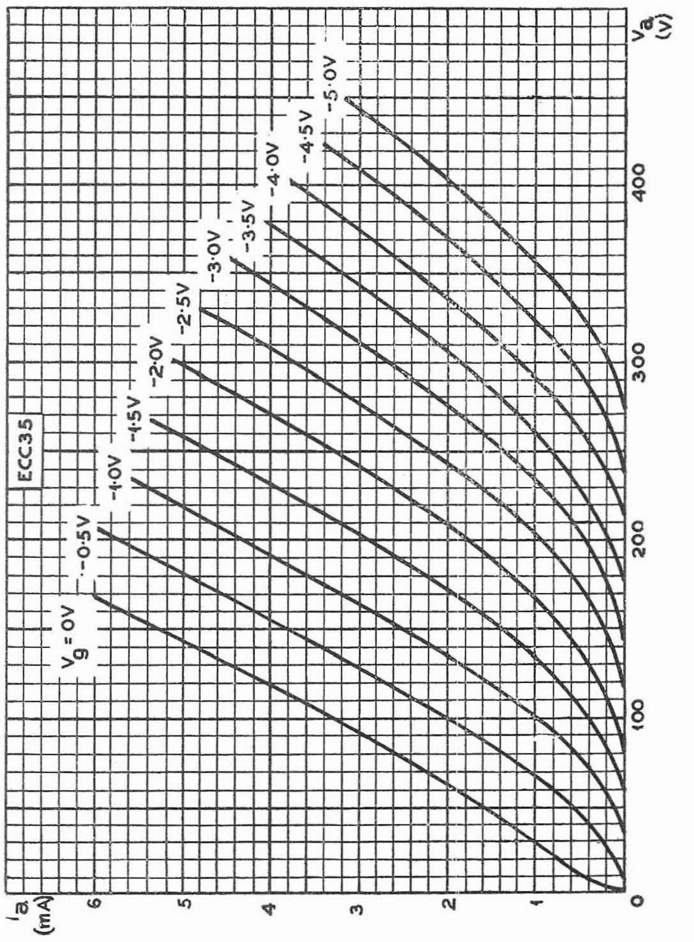


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
(EACH SECTION)

ECC35

DOUBLE TRIODE

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
(EACH SECTION)

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 $f = 200$Mc/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

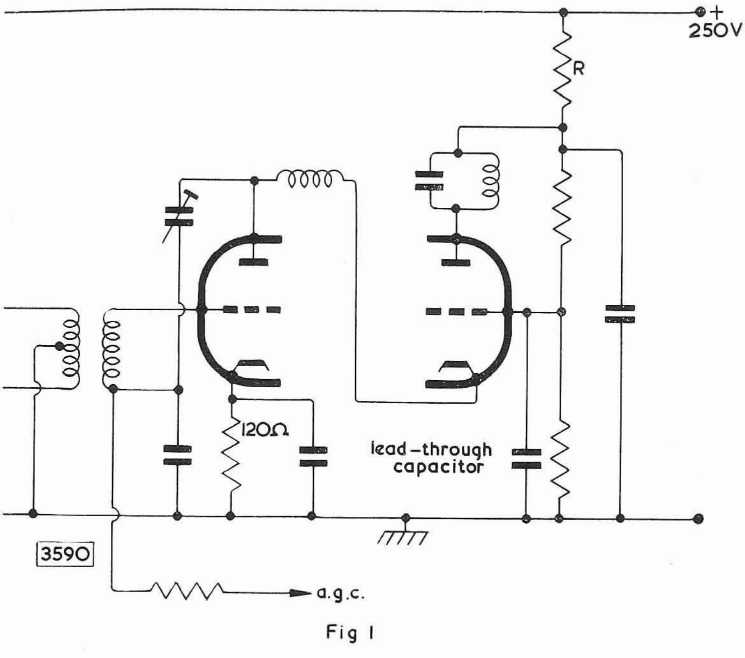


Fig 1

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

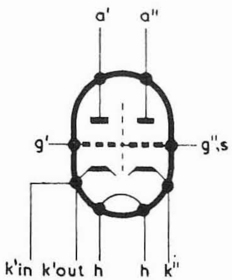
DOUBLE TRIODE

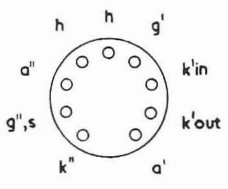
ECC84

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

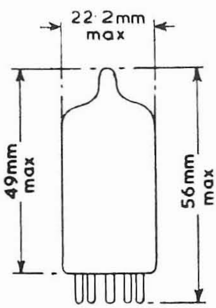
LIMITING VALUES (each section unless otherwise specified)

$V_{a(b)}$ 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



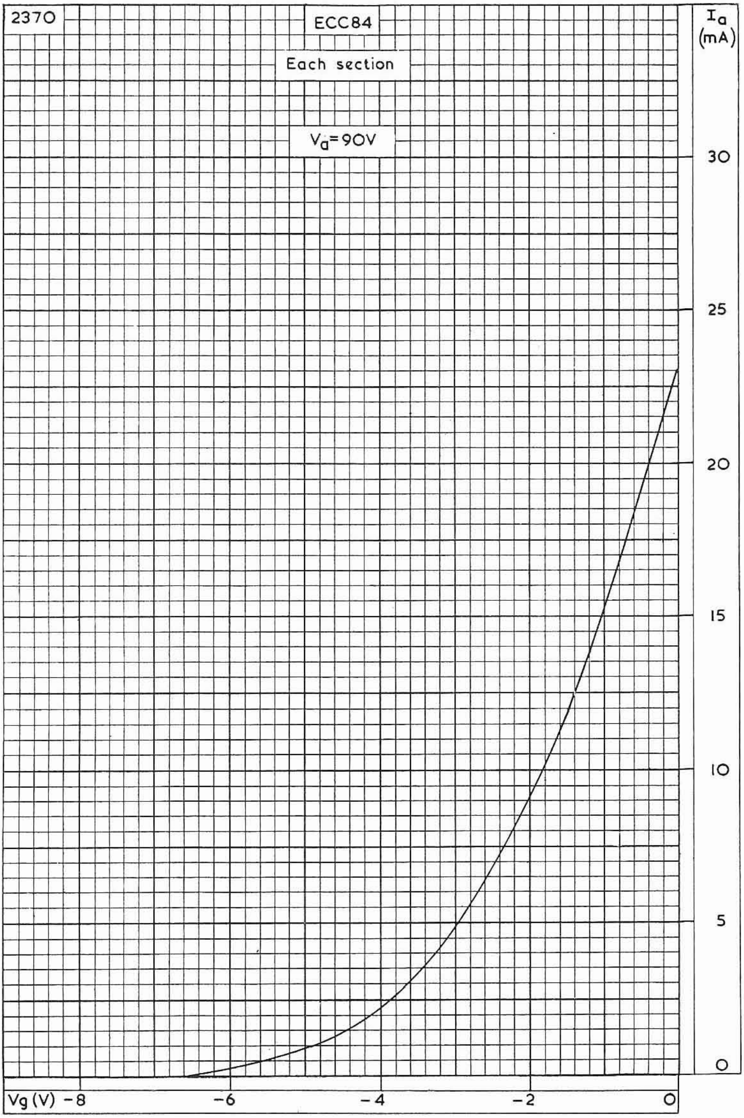
1390

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.

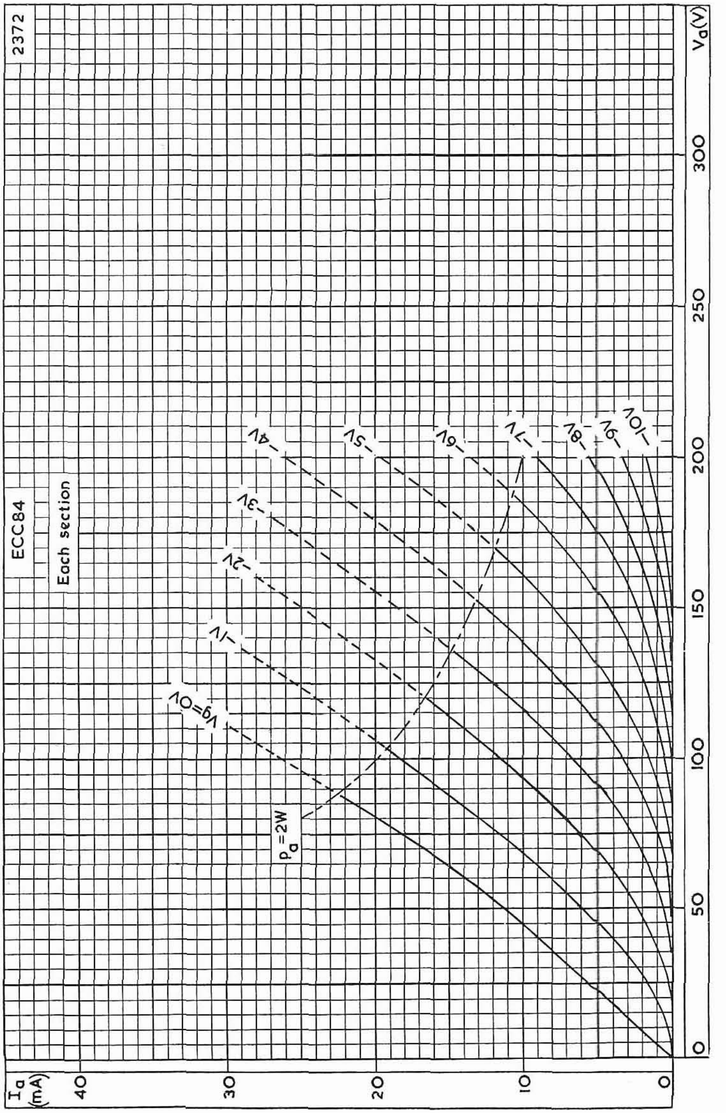


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

DOUBLE TRIODE

ECC84

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

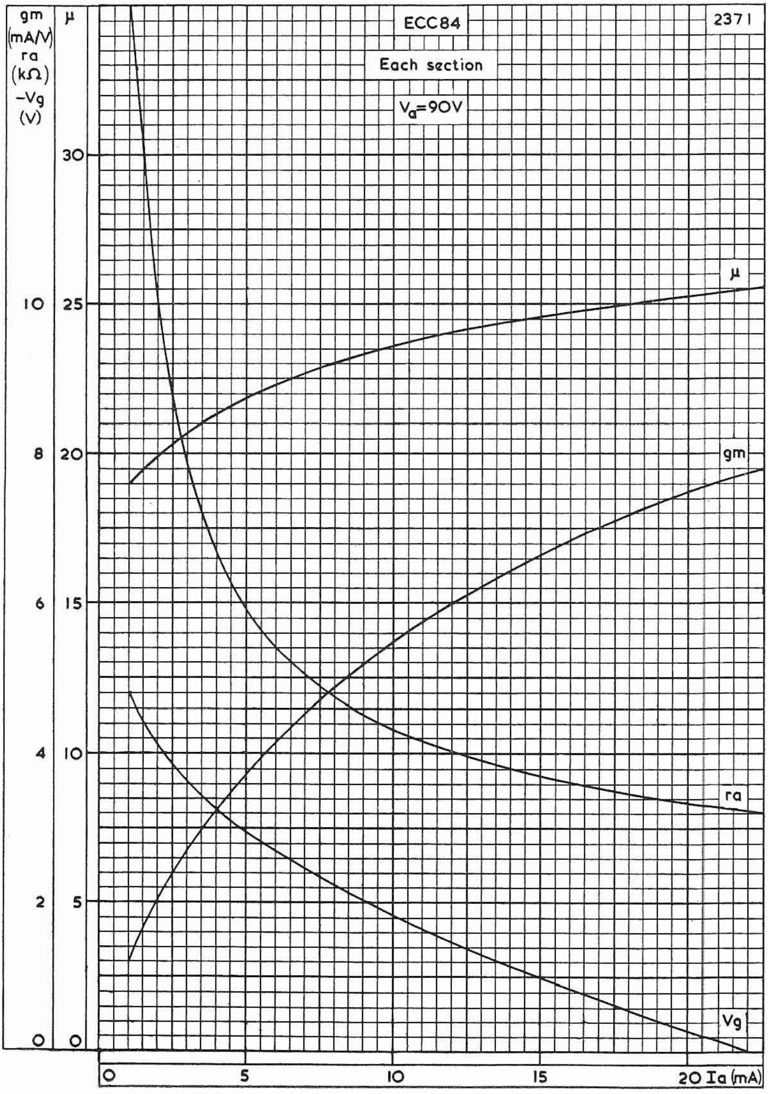


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

ECC84

DOUBLE TRIODE

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



AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND CONTROL-GRID BIAS PLOTTED AGAINST ANODE CURRENT

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

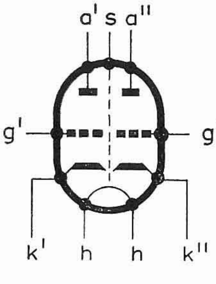
ECC86

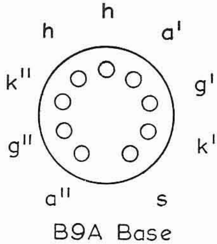
R.F. DOUBLE TRIODE

DESIGN CENTRE RATINGS

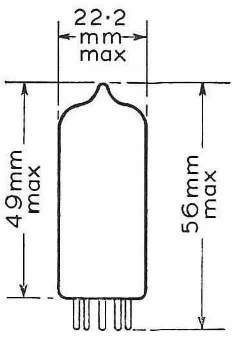
V_a max.	30	V
p_a max.	600	mW
I_k max.	20	mA
R_g max.	1.0	MΩ
V_{h-k} max.	30	V
R_{h-k} max.	20	kΩ

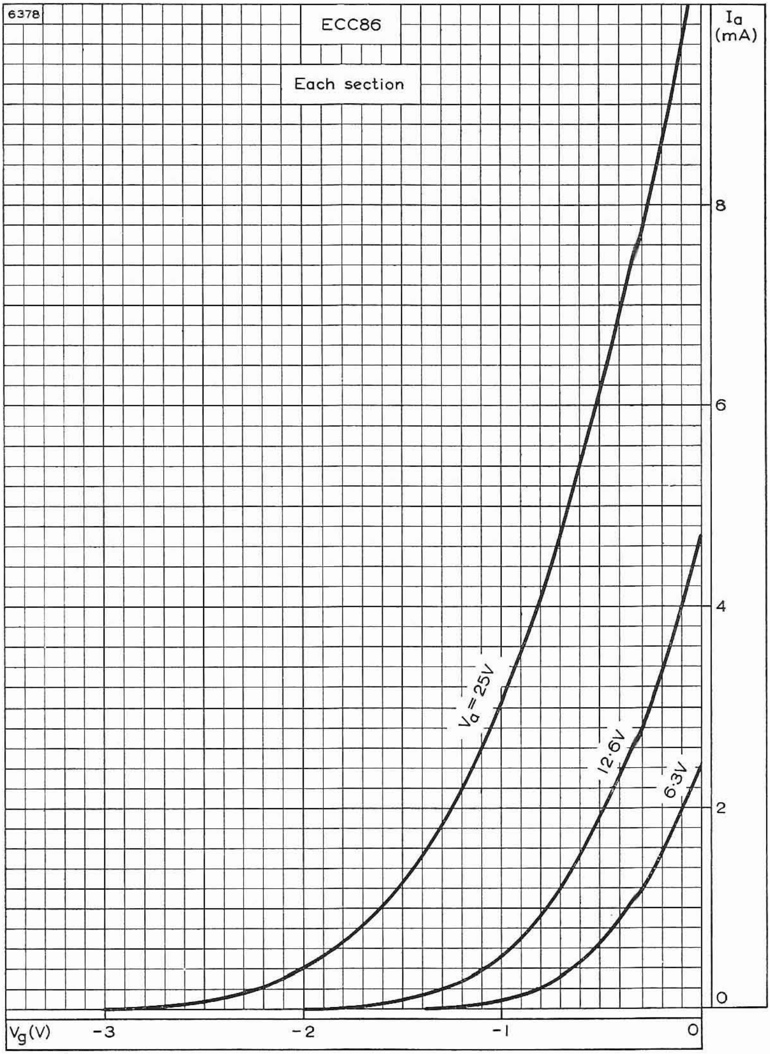
5242



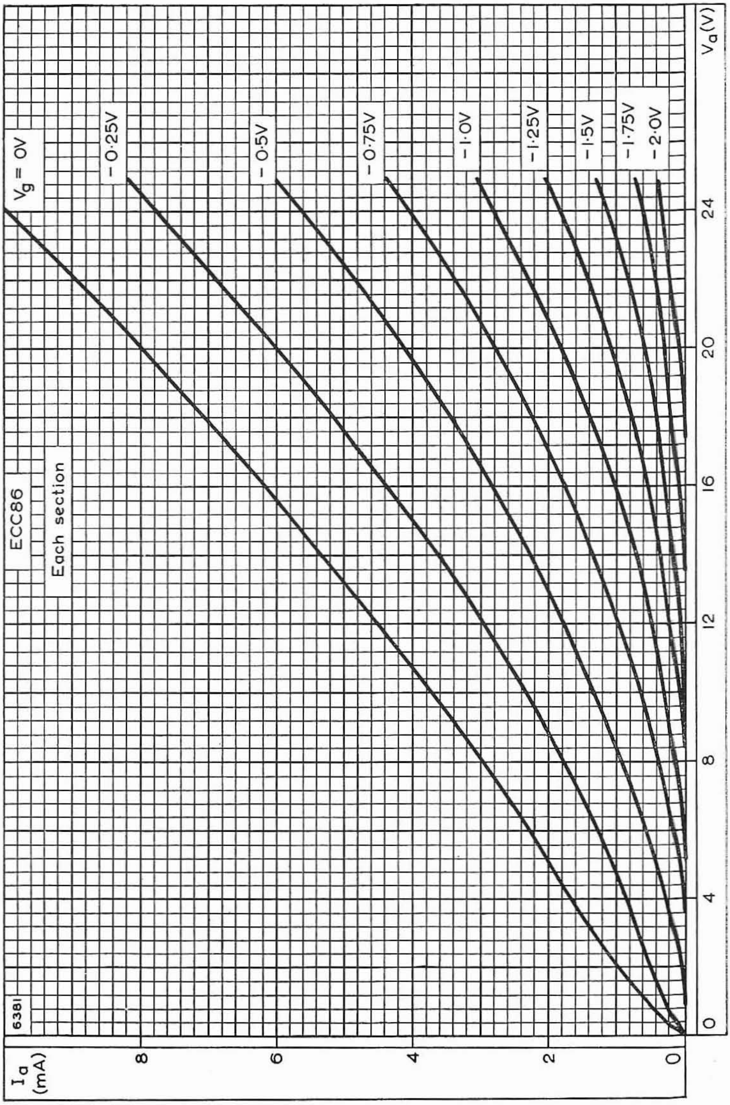


B9A Base

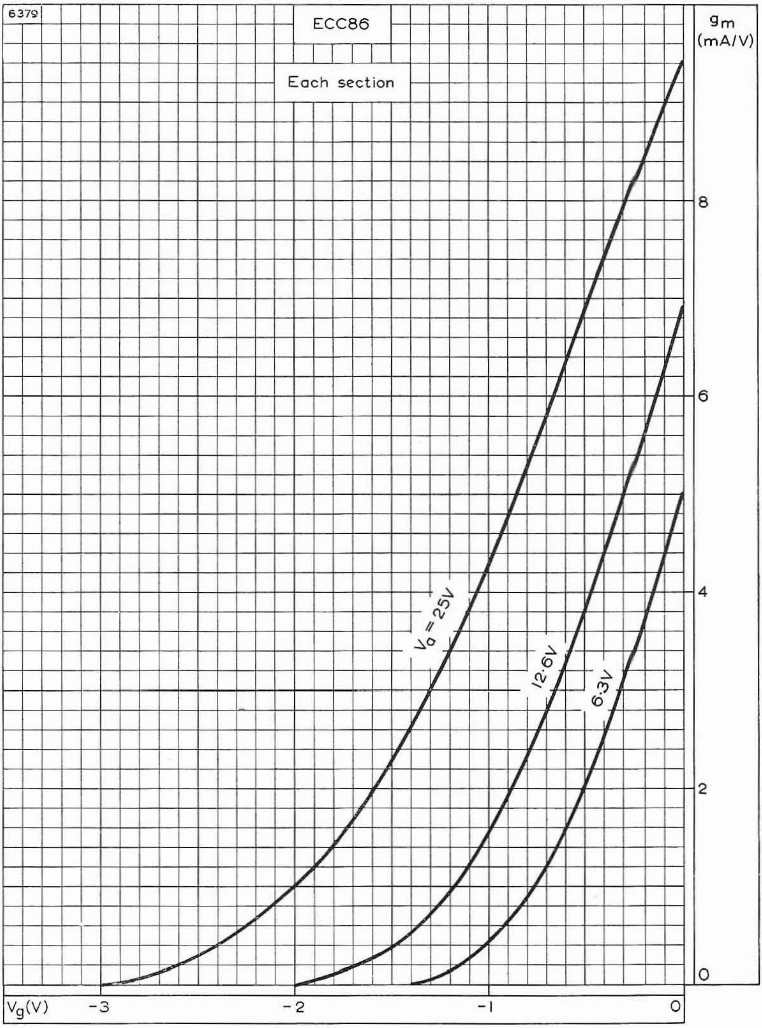




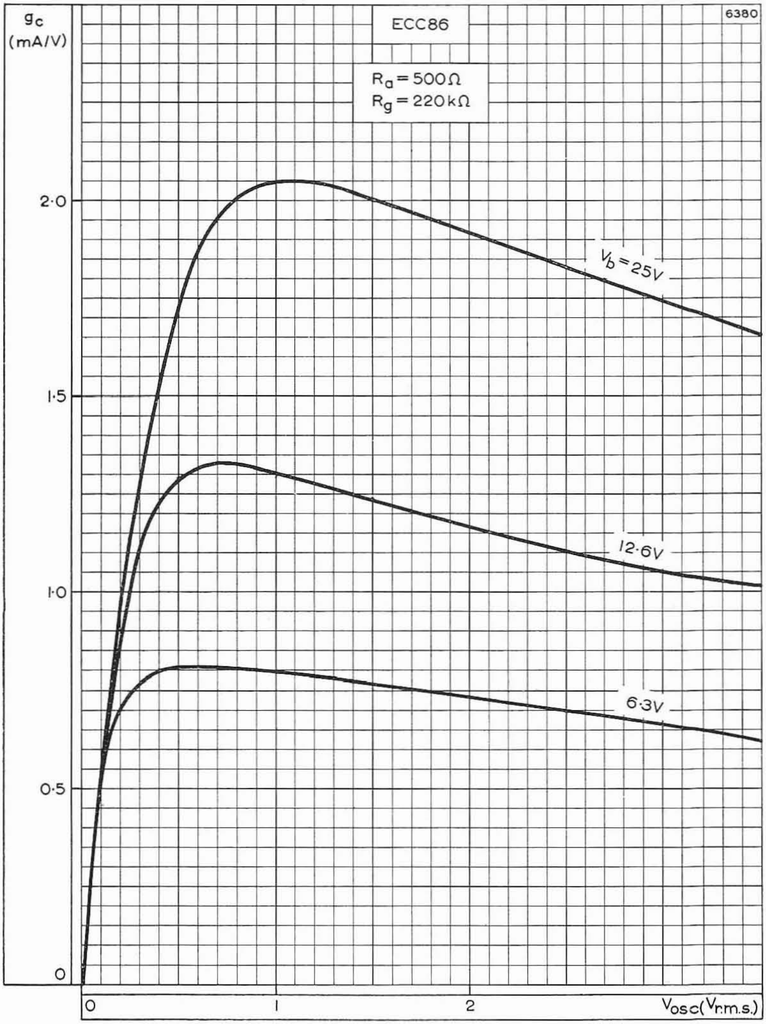
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER



CONVERSION CONDUCTANCE PLOTTED AGAINST OSCILLATOR VOLTAGE WHEN USED AS A SELF-OSCILLATING MIXER

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.

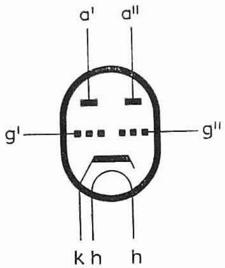
ECC91

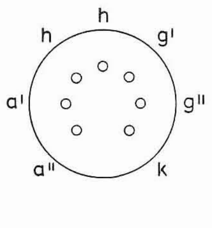
V.H.F. DOUBLE TRIODE

LIMITING VALUES

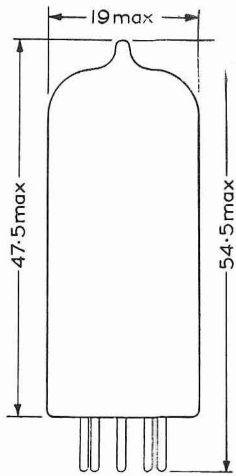
←

$V_{a(b)}$ 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

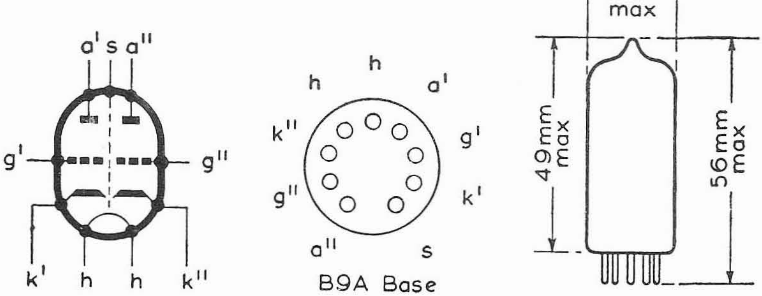
DESIGN CENTRE RATINGS (each section)

$V_{a(b)}$ 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

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 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

ECH35

TRIODE HEXODE

OPERATING CONDITIONS

Triode section

V_b	100	250	V
R_a	—	45	kΩ
I_a ($R_{gt} = 50k\Omega$, $I_{gt} = 200\mu A$)	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. ($I_{g1} = +0.3\mu A$)		–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

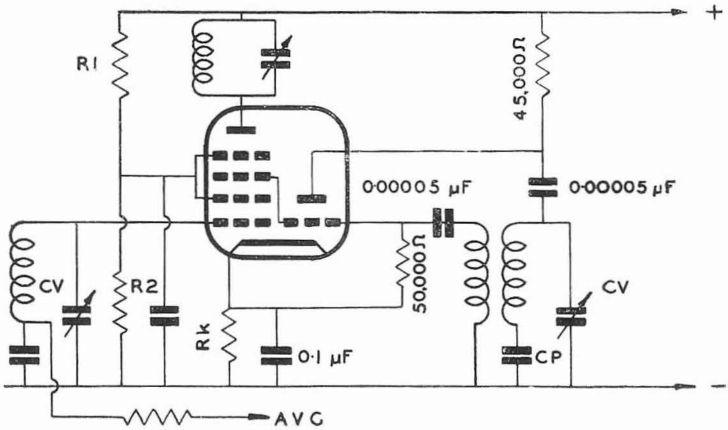
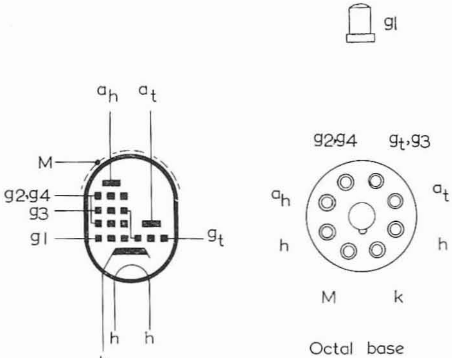
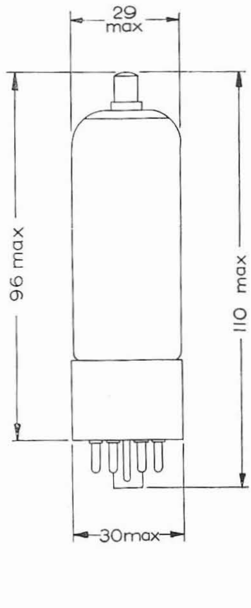


Fig. 1.—ECH35 as frequency changer with screen grid fed by a potentiometer.

6710





All dimensions in mm

TRIODE HEXODE

ECH35

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

HEATER

V_h	6.3	V
I_h	0.225	A ←

CAPACITANCES

c_{gt-g1}	<0.3	μμF

Hexode Section

c_{g1-k}	5.0	μμF
c_{a-k}	10.0	μμF
c_{a-g1}	<0.003	μμF

Triode Section

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

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_{g+3gt}	50	50	50	k Ω
I_{g3+gt}	200	200	200	μA
V_{g1}	−2	−17	−23	V
I_{ah}	3	–	–	mA
I_{g2+g4}	3	–	–	mA
g_c	650	6.5	1.5	μA/V
r_a	1.3	>5.0	>6.0	M Ω

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

$V_a = V_b$	250	250	250	V
R_1	24	24	24	k Ω
R_2	33	33	33	k Ω
R_k	215	215	215	Ω
R_{g3+gt}	50	50	50	k Ω
I_{g3+gt}	200	200	200	μA
V_{g1}	−2	−23.5	−31	V
V_{g2+g4}	100	–	145	V
I_{ah}	3	–	–	mA
I_{g2+g4}	3	–	–	mA
g_c	650	6.5	1.5	μA/V
r_a	1.3	>3.0	>4.0	M Ω

ECH35

TRIODE HEXODE

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

OPERATING CONDITIONS

Triode Section

V_b	100	250	V
R_a	–	45	k Ω
I_a (R_{gt}=50 k Ω, I_{gt}=200 μA)	3.3	3.3	mA
I_a (V_{gt}=0 V, V_{osc}=0 V)	10	4.5	mA
g_m (V_{gt}=0 V, V_{osc}=0 V)	2.8	2.2	mA/V
μ (V_{gt}=0 V, V_{osc}=0 V)	24	24	

LIMITING VALUES

Hexode Section

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.2	W
$V_{g2+g4\,(b)}$ max.	550	V
V_{g2+g4} max. (I_a=4.5 mA)	125	V
V_{g2+g4} max. (I_a=<0.5 mA)	200	V
p_{g2+g4} max.	0.6	W
V_{g1} max. (I_{g1}=+0.3 μA)	–1.3	V
V_{g3} max. (I_{g3}=+0.3 μA)	–1.3	V
I_k max.	15	mA
R_{g1-k} max.	3.0	M Ω
R_{h-k} max.	20	k Ω
V_{h-k} max.	100	V
R_{g3-k} max.	100	k Ω

Triode Section

$V_{a\,(b)}$ max.	550	V
V_a max.	100	V
p_a max.	1.5	W
V_{gt} max. (I_{g1}=+0.3 μA)	–1.3	V
R_{gt} max.	100	k Ω

TRIODE HEXODE

ECH35

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

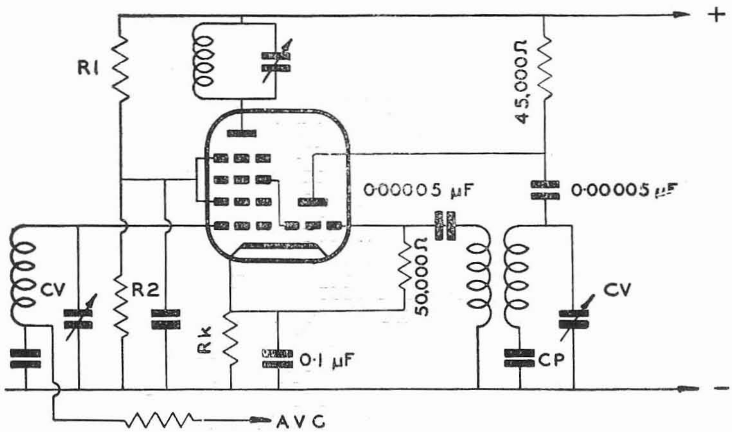
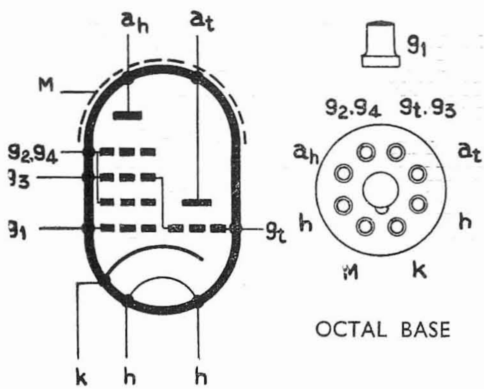
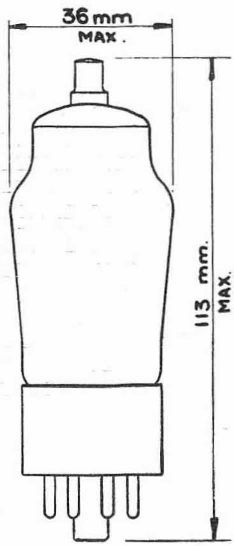


Fig. 1.—ECH35 as frequency changer with screen grid fed by a potentiometer



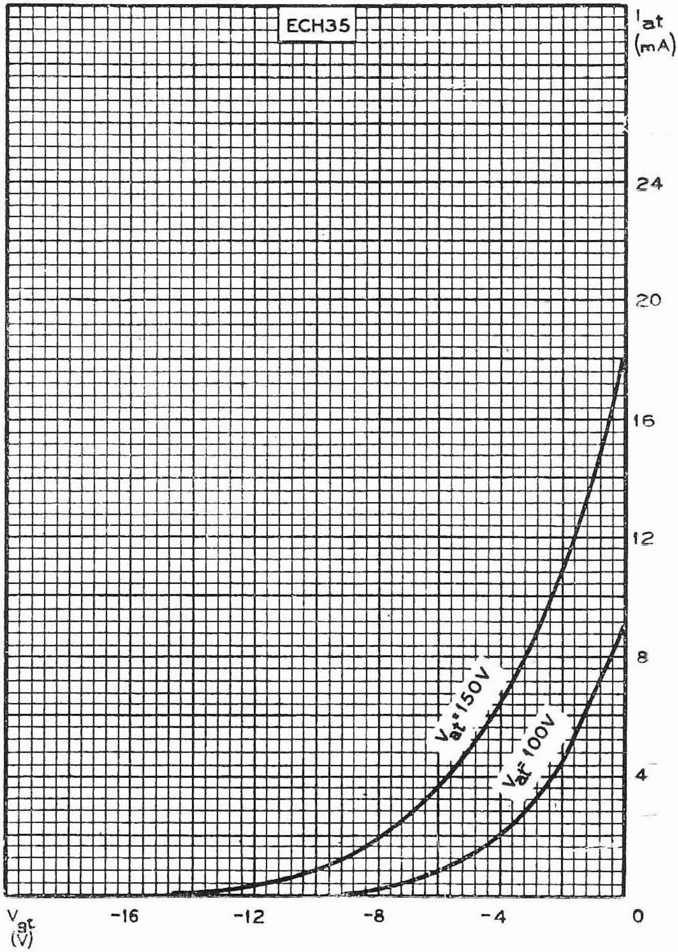
OCTAL BASE



ECH35

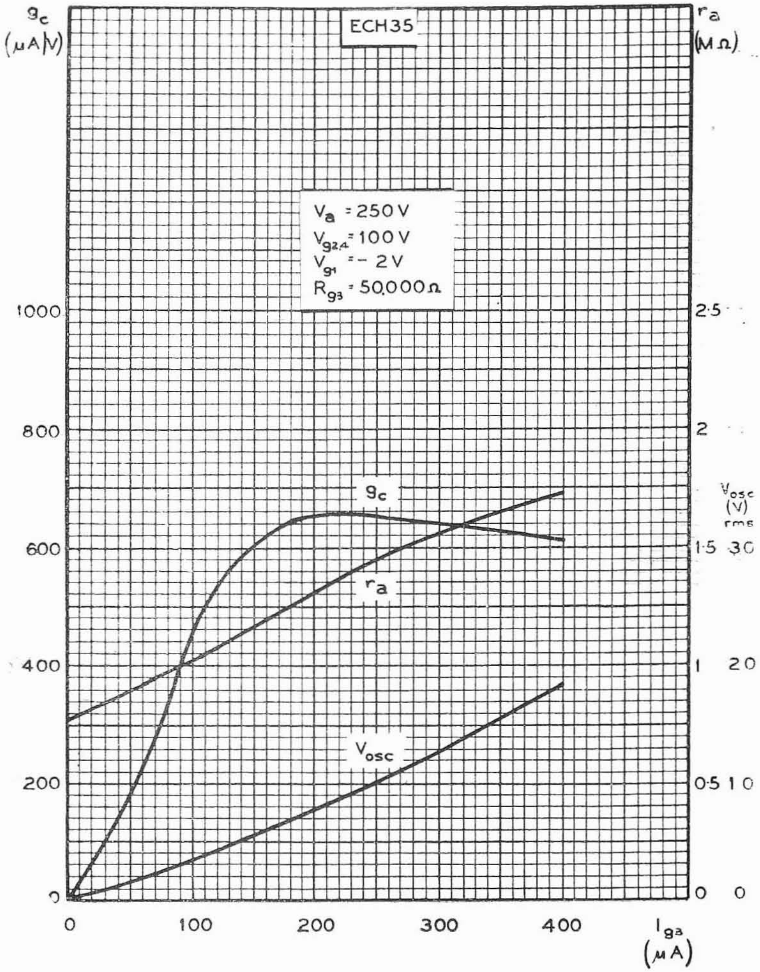
TRIODE HEXODE

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.



TRIODE-ANODE CURRENT PLOTTED AGAINST TRIODE-GRID VOLTAGE

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

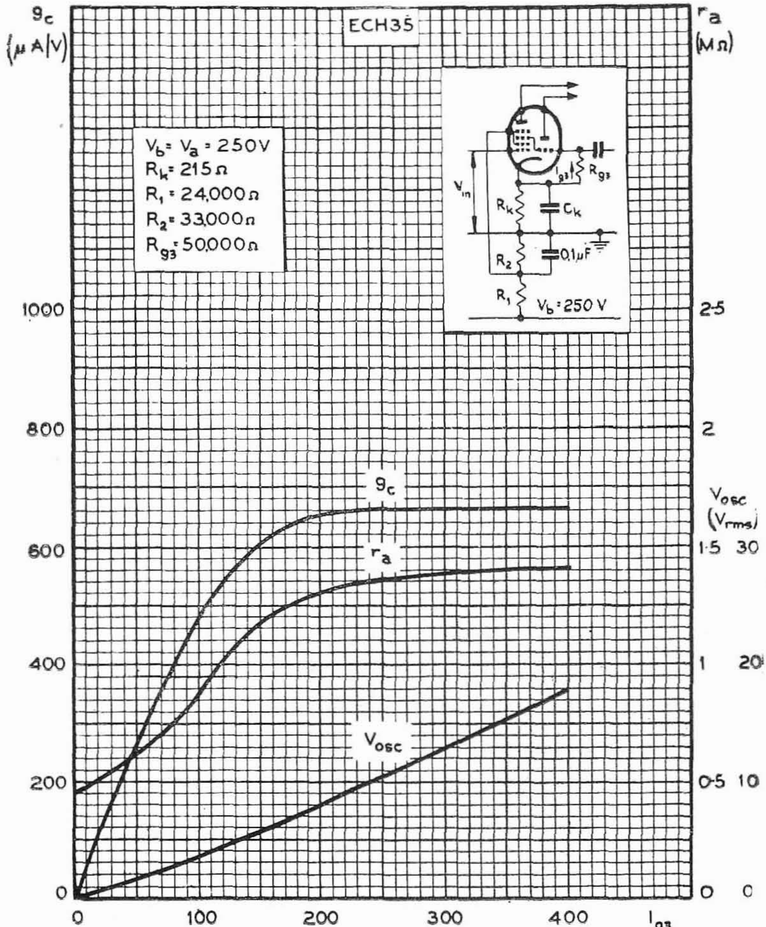


CONVERSION CONDUCTANCE, INTERNAL RESISTANCE AND OSCILLATOR VOLTAGE PLOTTED AGAINST OSCILLATOR-GRID CURRENT WITH V_{g2+g4} = 100 V

ECH35

TRIODE HEXODE

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.

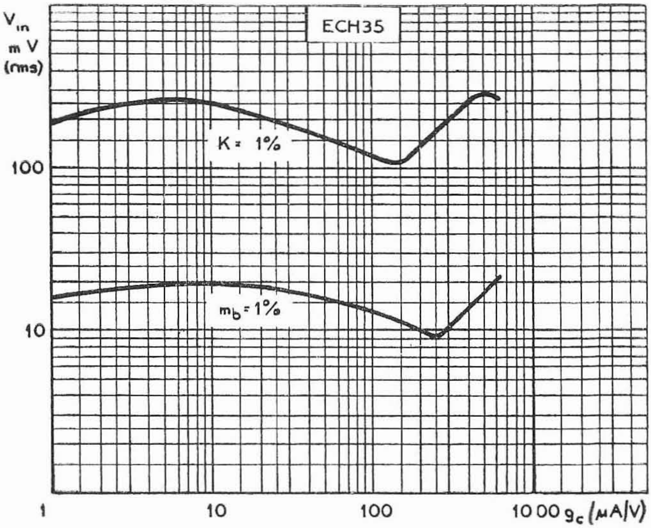


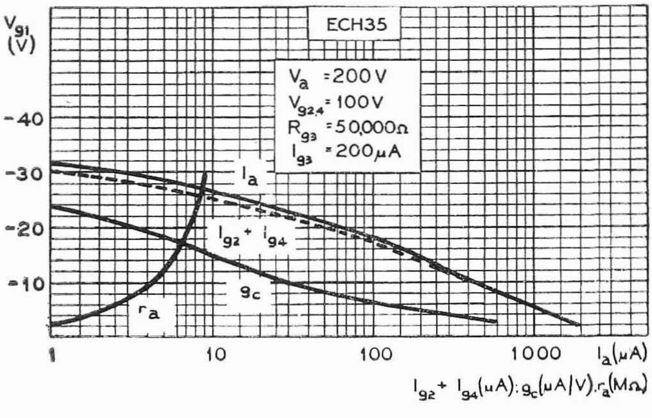
CONVERSION CONDUCTANCE, INTERNAL RESISTANCE AND OSCILLATOR VOLTAGE PLOTTED AGAINST OSCILLATOR-GRID VOLTAGE WITH SCREEN-GRID FED VIA A POTENTIOMETER

TRIODE HEXODE

ECH35

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.



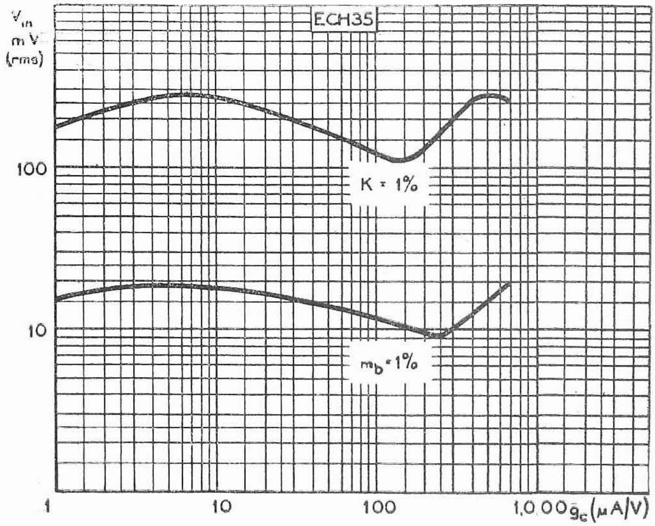


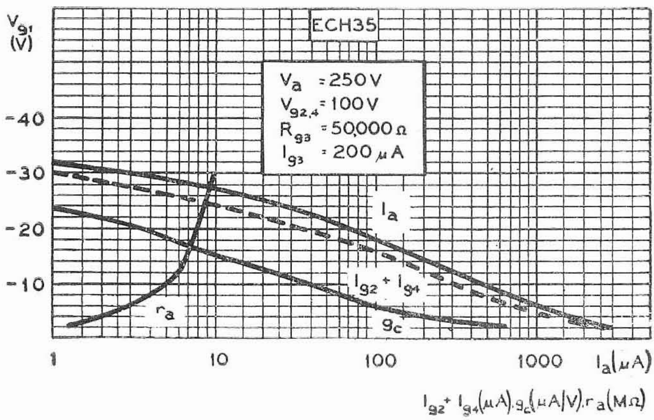
CROSS MODULATION CURVES AND CONTROL CHARACTERISTIC FOR $V_a = 200$ V, $V_{g2+g4} = 100$ V

ECH35

TRIODE HEXODE

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.



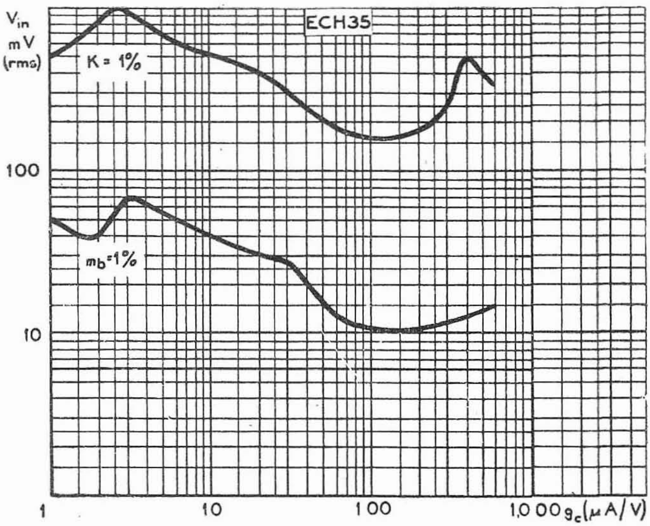


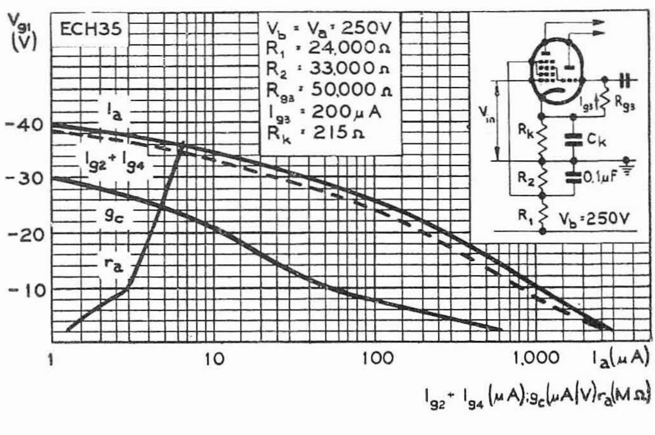
CROSS MODULATION CURVES AND CONTROL CHARACTERISTIC FOR
$V_a = 250$ V, $V_{g2+g4} = 100$ V

TRIODE HEXODE

ECH35

Triode hexode for use as frequency changer in A.C. mains-operated receivers. The hexode section is designed for A.V.C.





CROSS MODULATION CURVES AND CONTROL CHARACTERISTIC FOR V_b=250V AND SCREEN-GRID FED VIA A POTENTIOMETER

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-gl}	<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

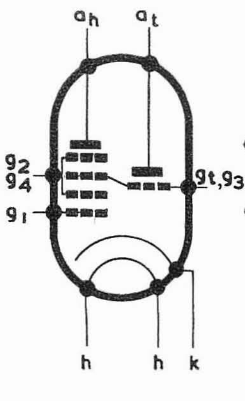
Triode Section

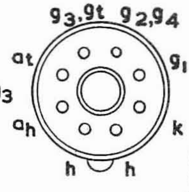
$V_{a(b)}$ max.	550	V
V_a max.	175	V
p_a max.	0.8	W
V_{gt} max. (I_{gt}=+0.3 μA)	−1.3	V
I_k max.	6.0	mA
R_{gt-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	50	V

TRIODE HEXODE FREQUENCY CHANGER

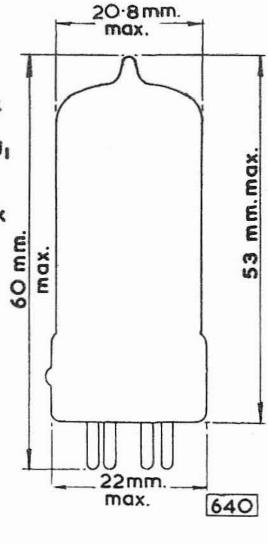
ECH42

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.

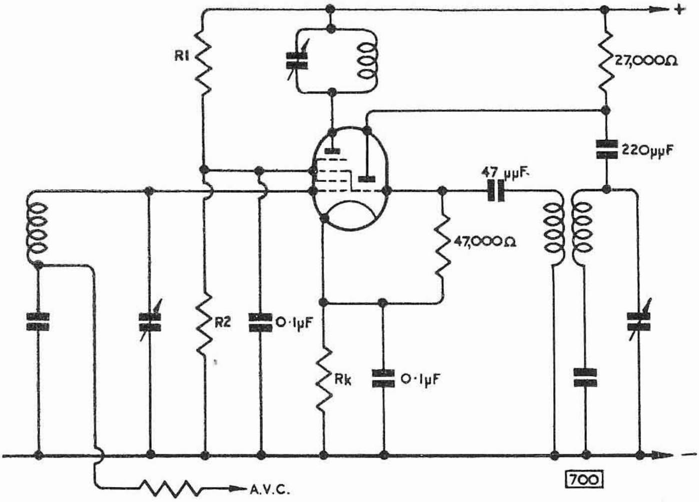


Fig. 1—ECH42 as Frequency Changer

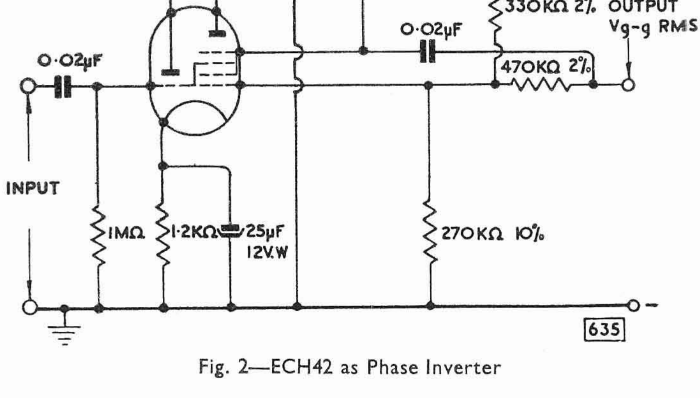
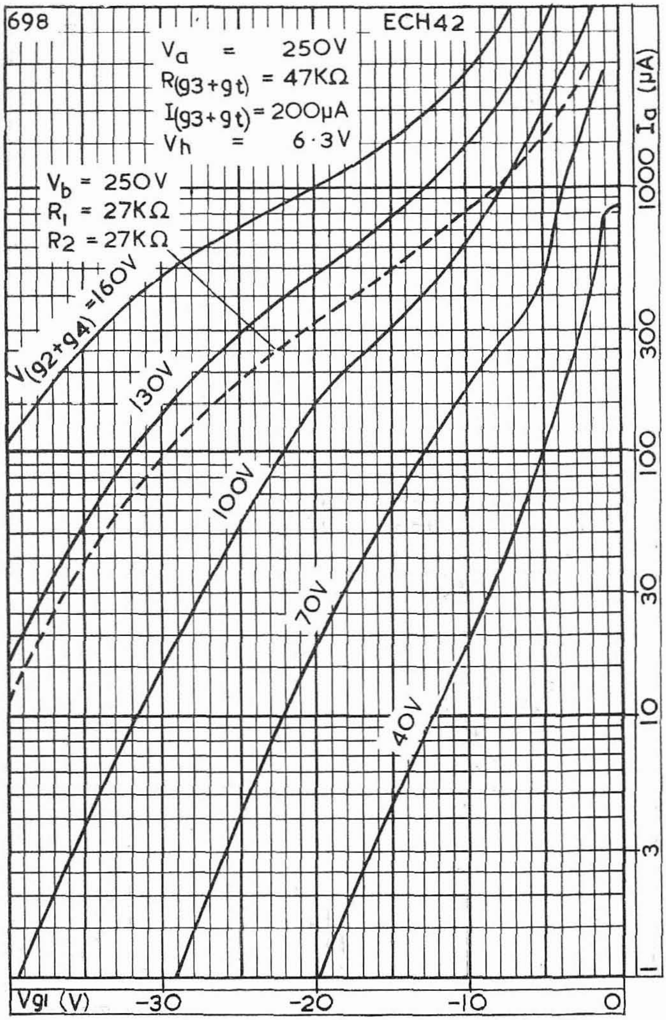


Fig. 2—ECH42 as Phase Inverter

TRIODE 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.

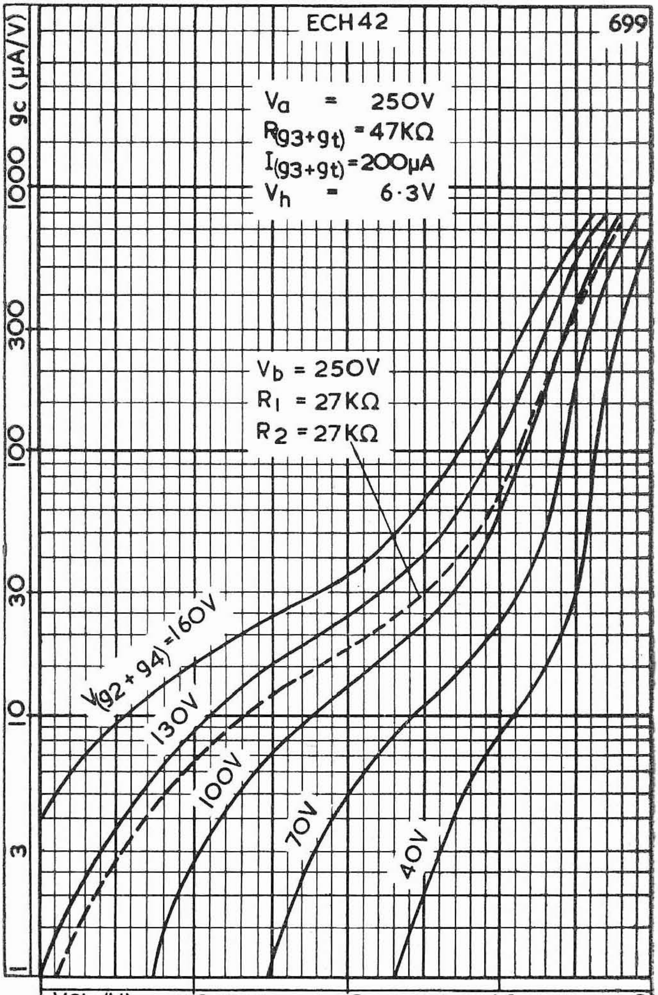


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR ANODE VOLTAGE OF 250 V

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.

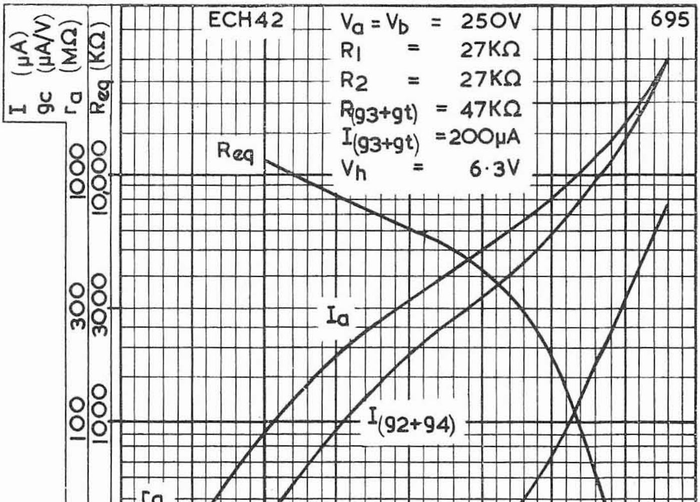


CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR ANODE VOLTAGE OF 250 V

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.

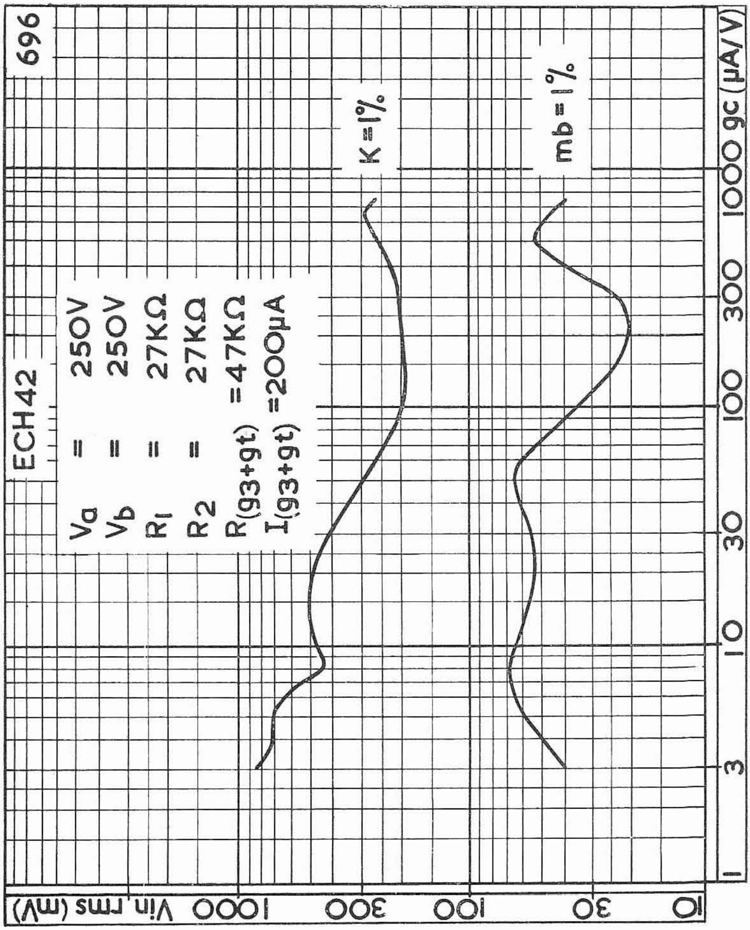


ANODE CURRENT, SCREEN-GRID CURRENT, CONVERSION CONDUCTANCE, ANODE IMPEDENCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR LINE VOLTAGE OF 250 V

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.

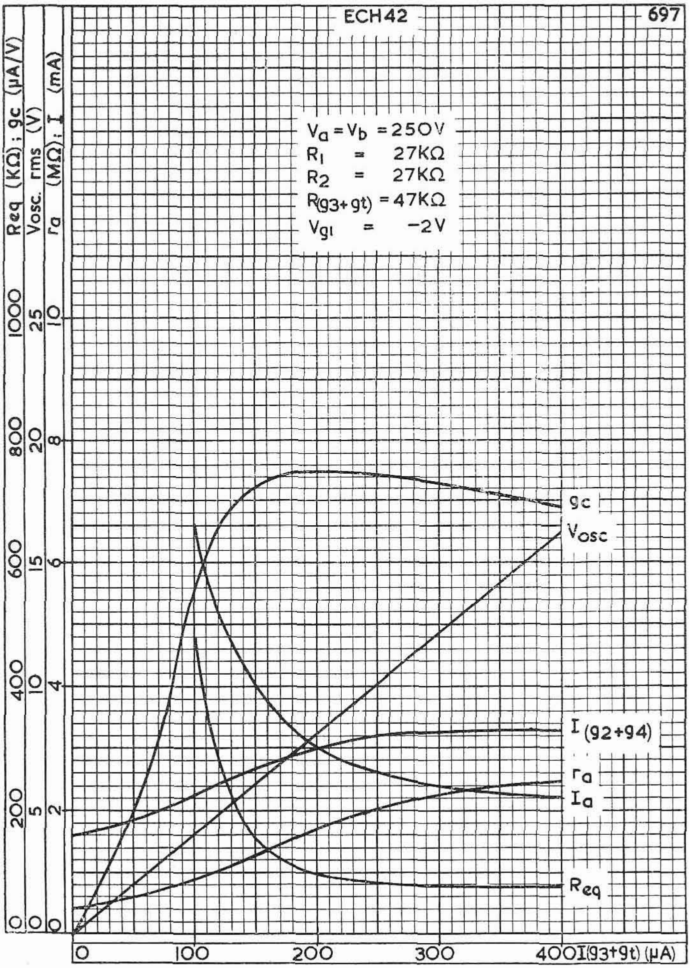


CROSS MODULATION AND MODULATION HUM PLOTTED AGAINST CONVERSION CONDUCTANCE FOR LINE VOLTAGE OF 250 V

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.



ANODE CURRENT, SCREEN-GRID CURRENT, CONVERSION CONDUCTANCE, OSCILLATOR-GRID VOLTAGE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST OSCILLATOR-GRID CURRENT FOR LINE VOLTAGE OF 250V

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

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

Heptode section

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

Triode section

c_{in}	2.6	pF
c_{out}	2.1	pF
$c_{a\text{-}g}$	1.0	pF
$c_{g\text{-}h}$	<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.

TRIODE HEPTODE

ECH81

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)

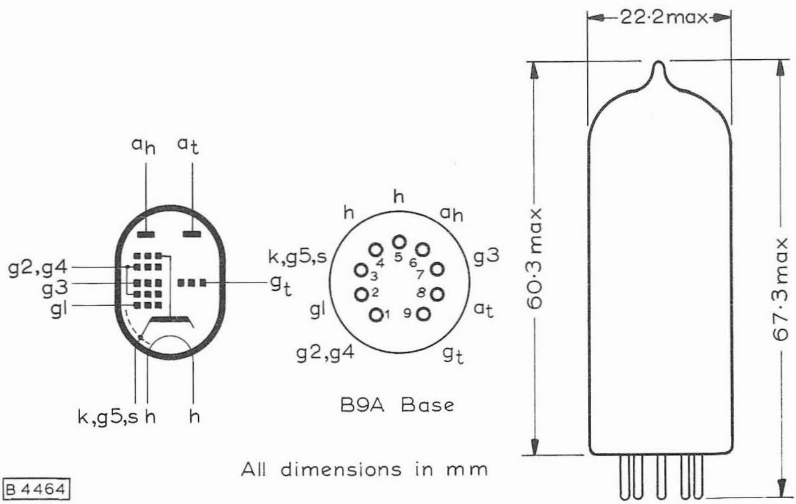
Triode section

$V_{a(b)}$ 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

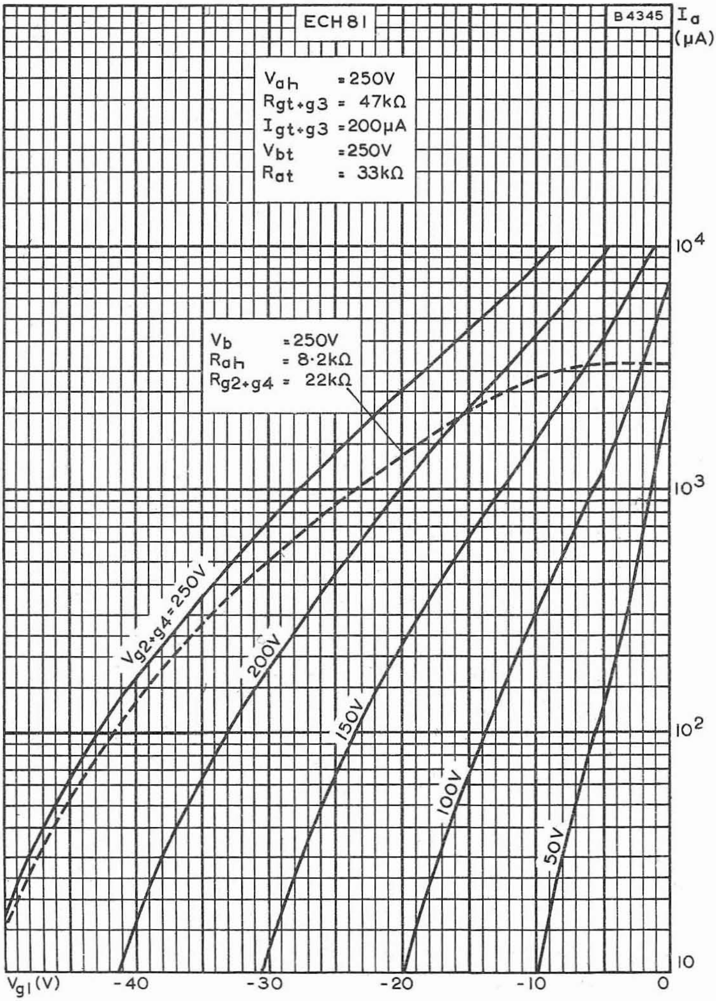
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.0	W ←
$V_{g2+g4(b)}$ max.	550	V
V_{g2+g4} max.	125	V
V_{g2+g4} max. (I_a <1mA)	300	V
p_{g2+g4} max.	0.8	W ←
I_k max.	18	mA ←
R_{g1-k} max.	3.0	MΩ
*R_{g3-k} max.	3.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

*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.

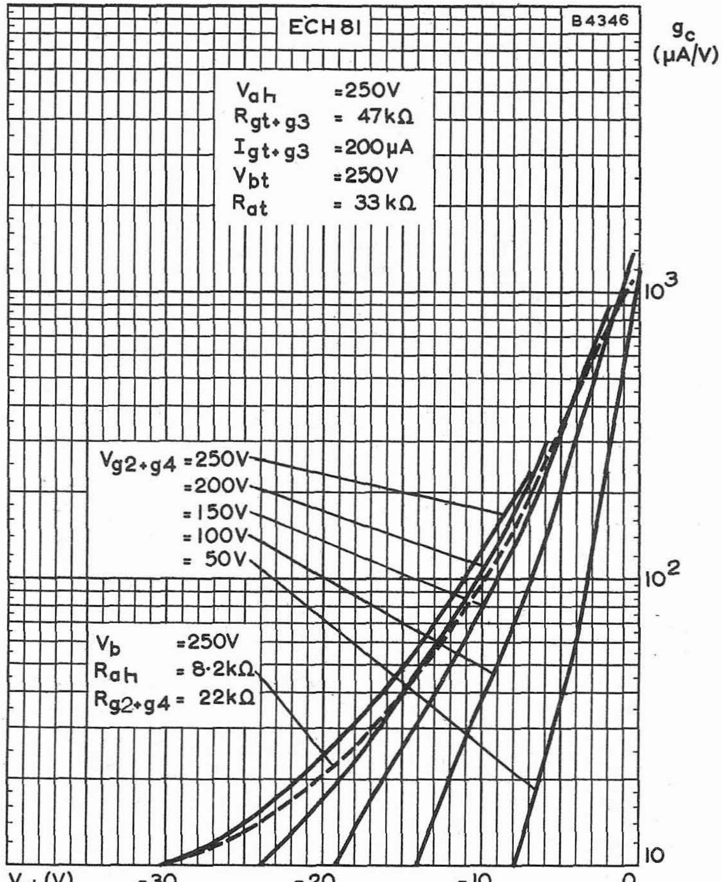


All dimensions in mm

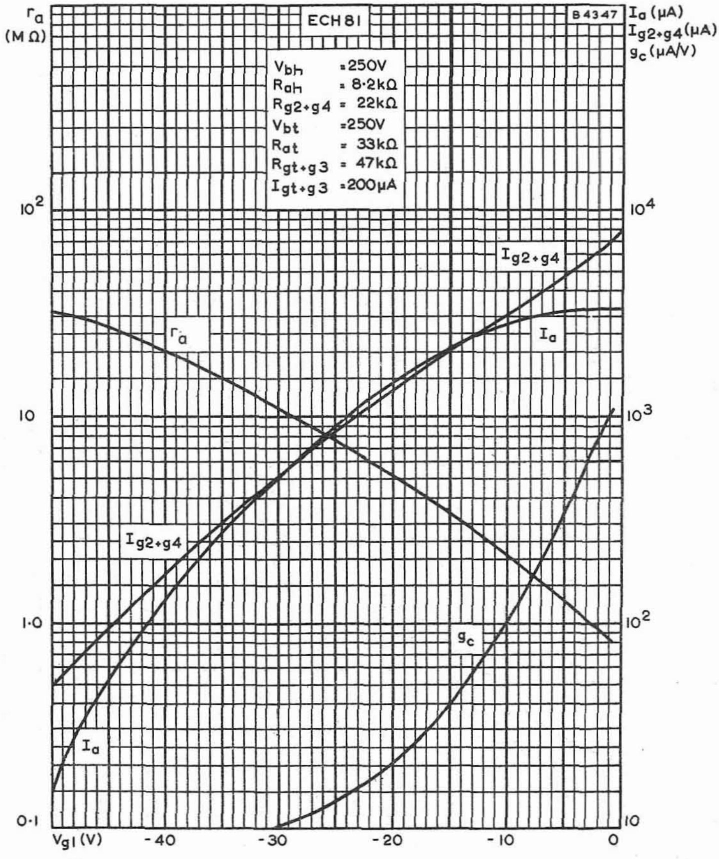
B4464



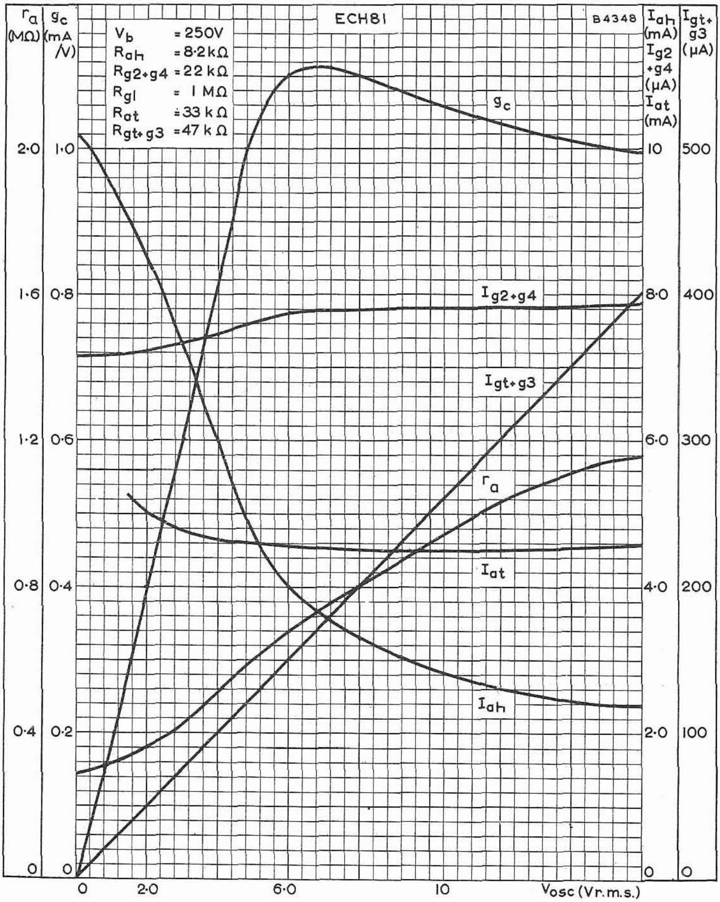
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



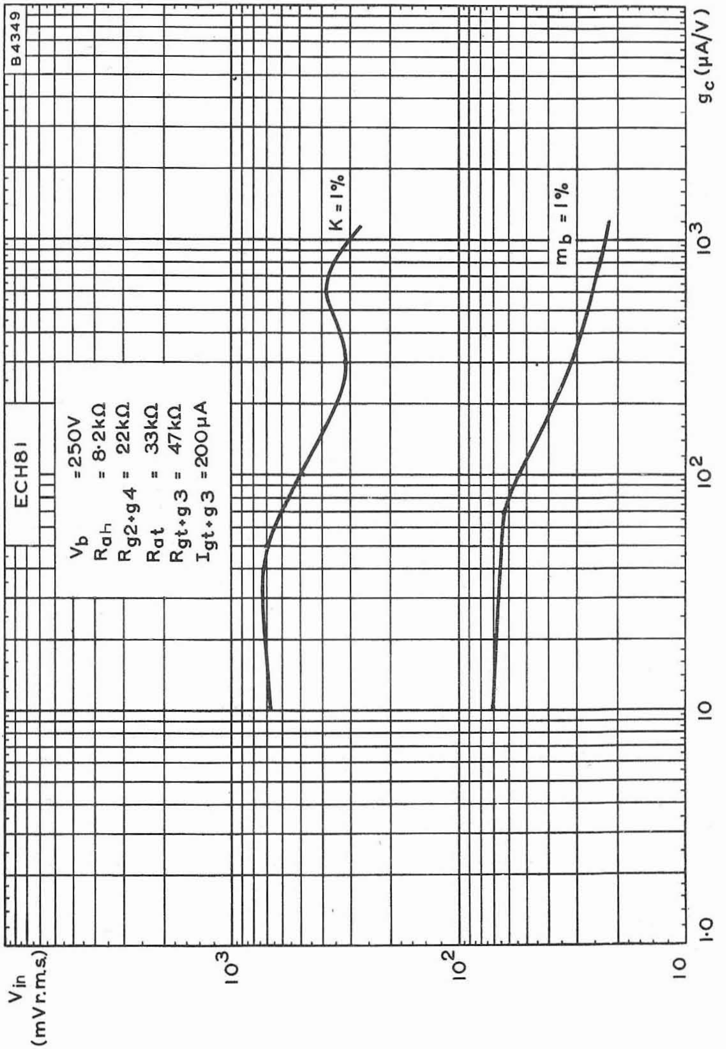
CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



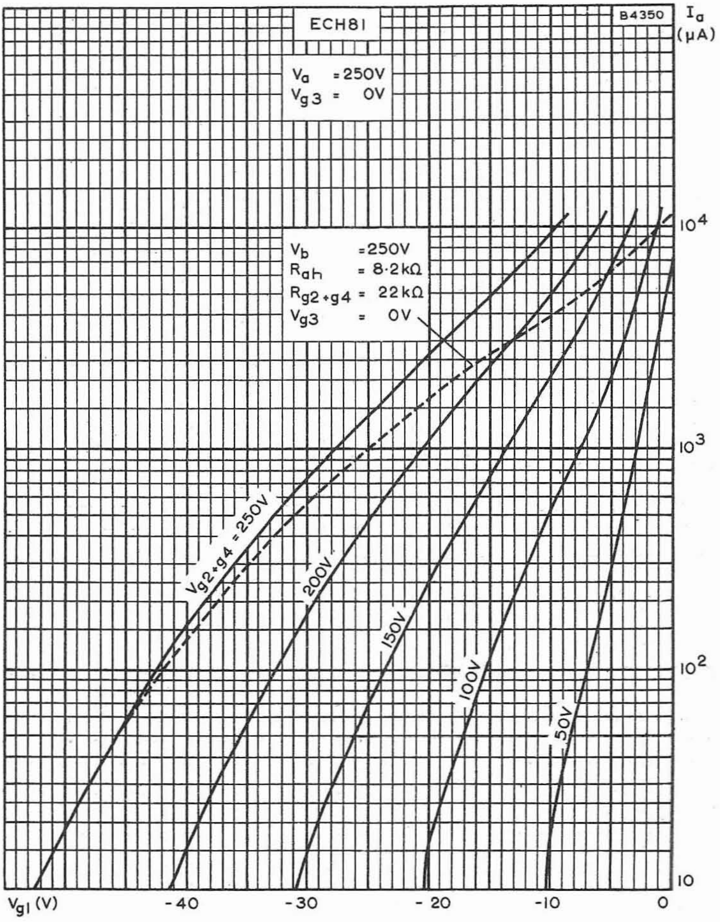
ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



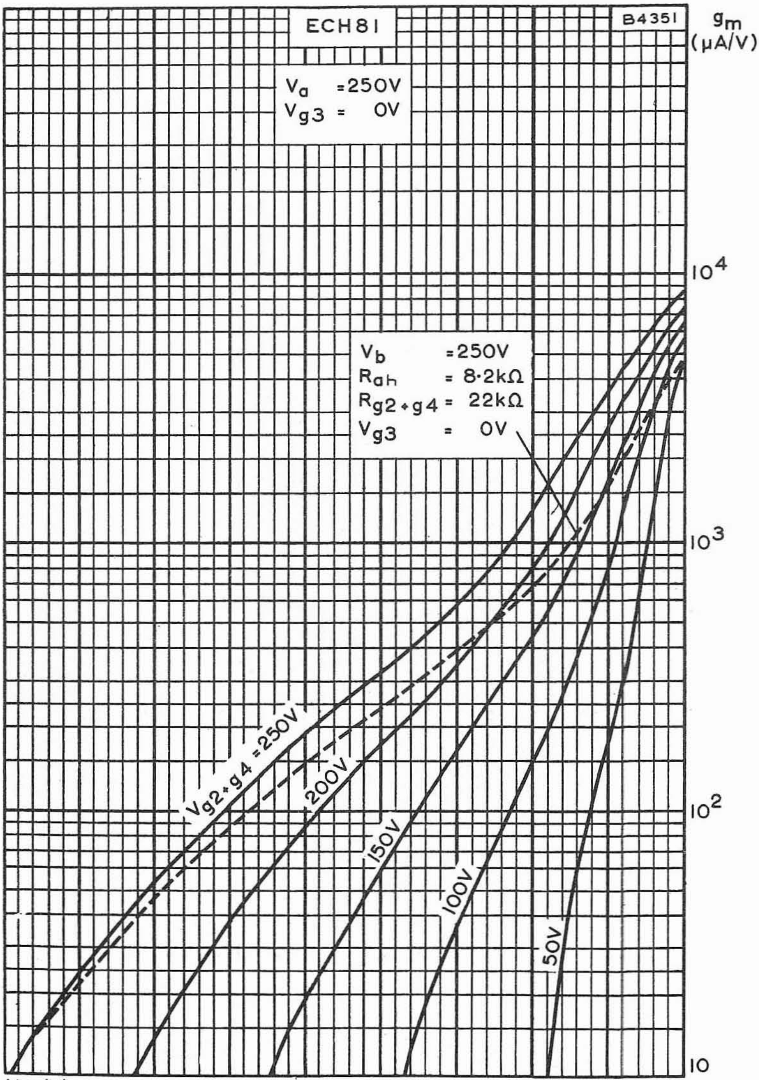
ANODE, SCREEN AND OSCILLATOR GRID CURRENTS, CONVERSION CONDUCTANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST OSCILLATOR VOLTAGE



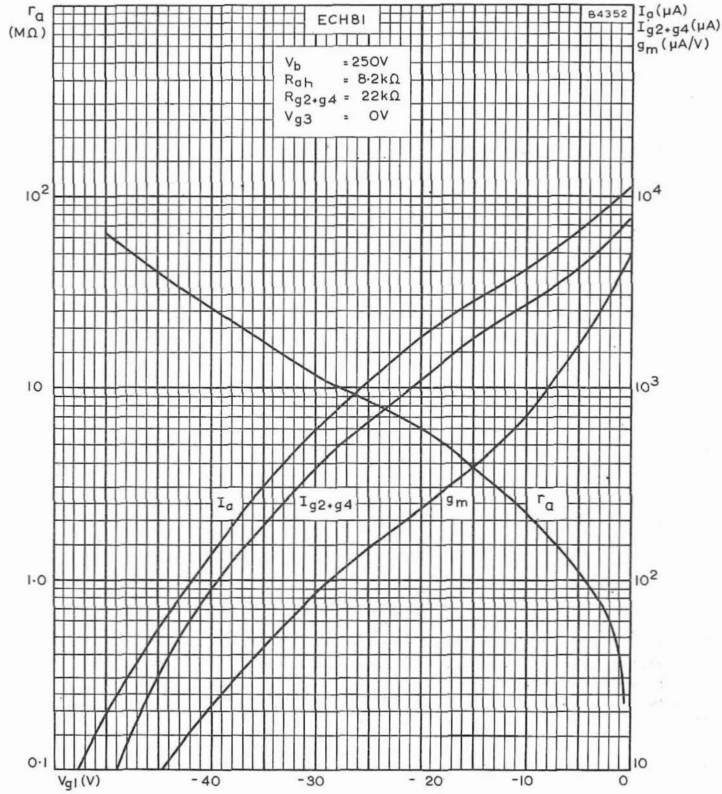
INDICATING THE R.M.S. VALUE OF THE VOLTAGE OF AN INTERFERING SIGNAL AT THE GRID PRODUCING 1% CROSS AND HUM MODULATION AS A FUNCTION OF THE CONVERSION CONDUCTANCE



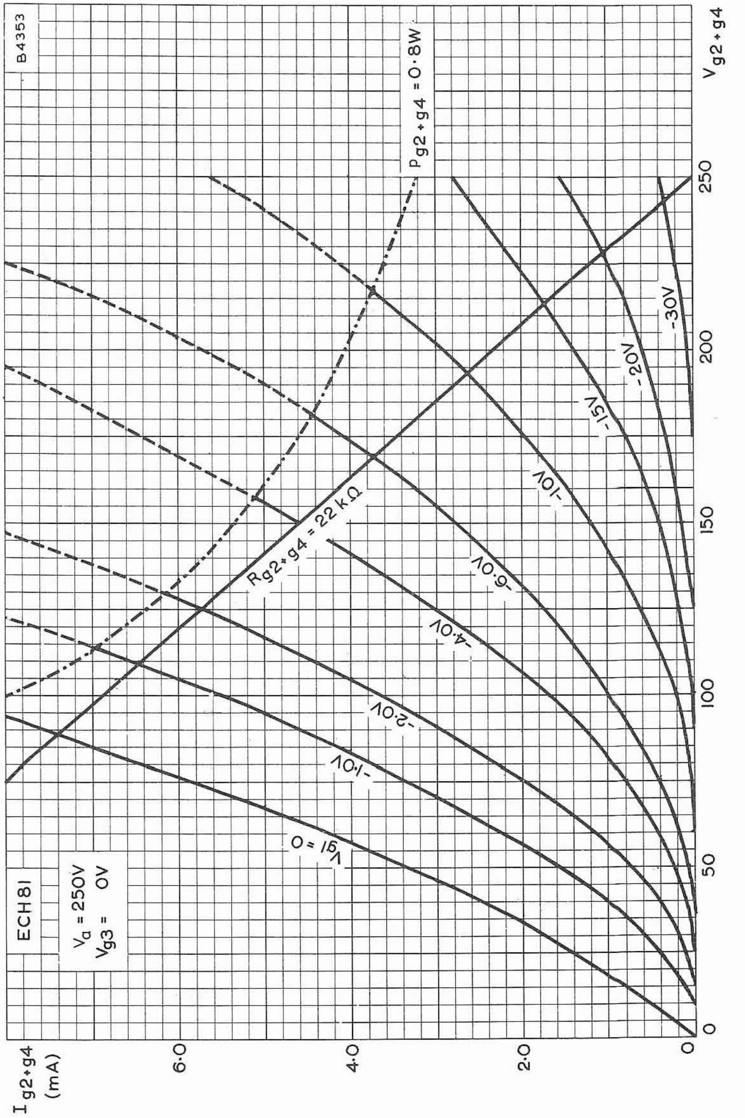
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



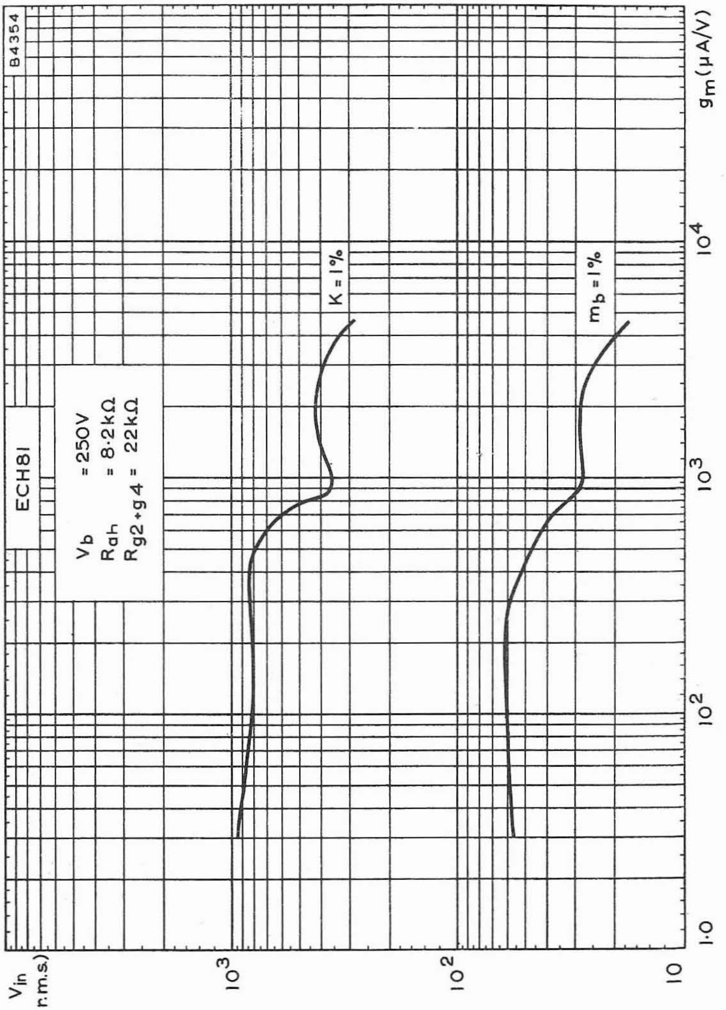
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



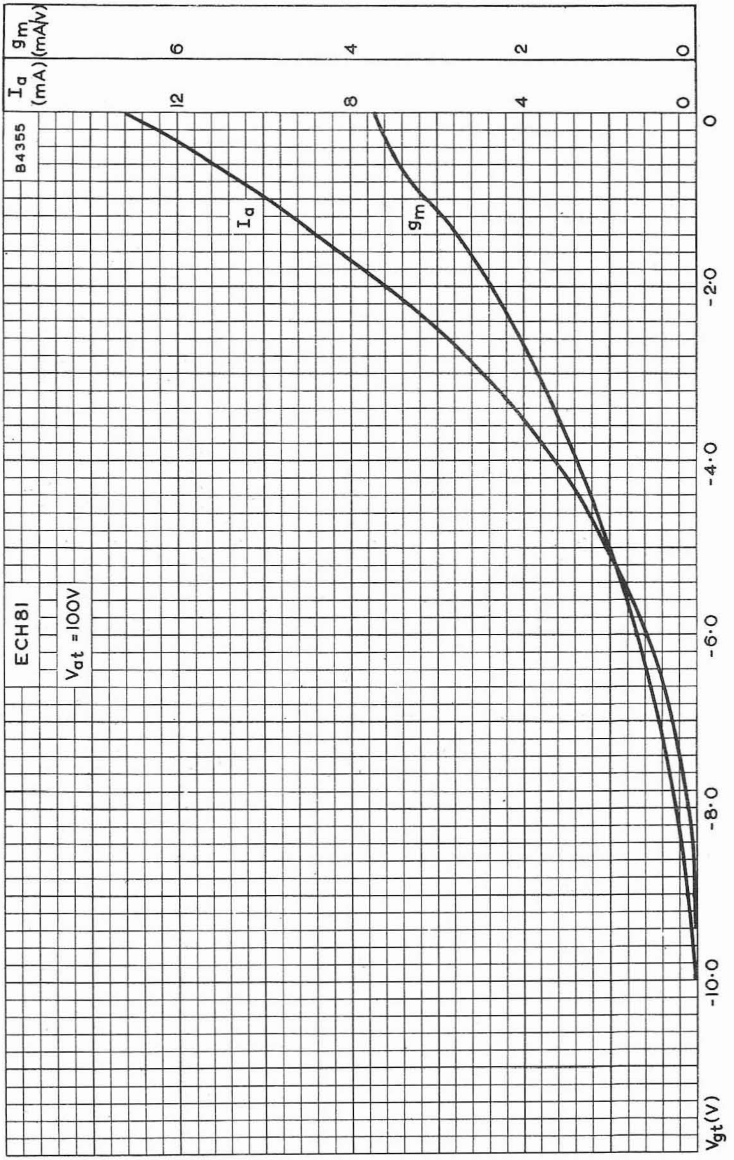
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



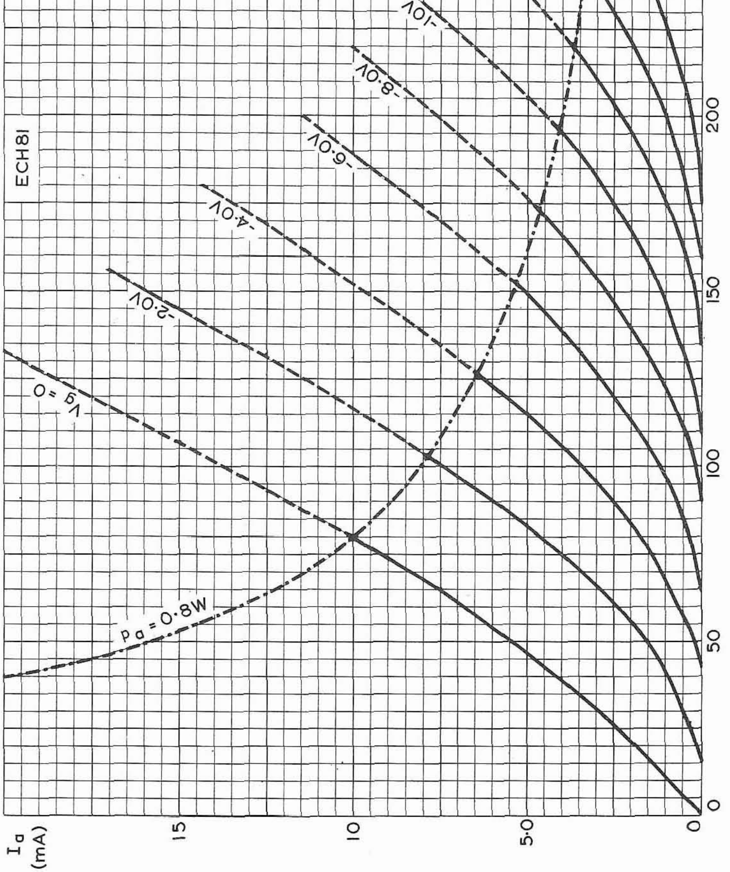
SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER FOR HEPTODE SECTION



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

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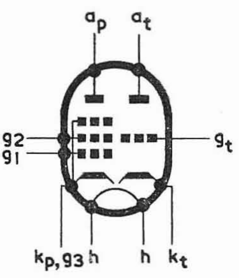
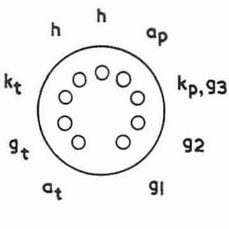
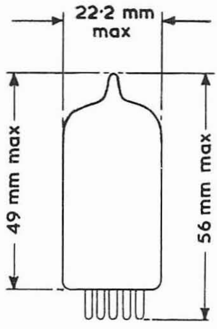




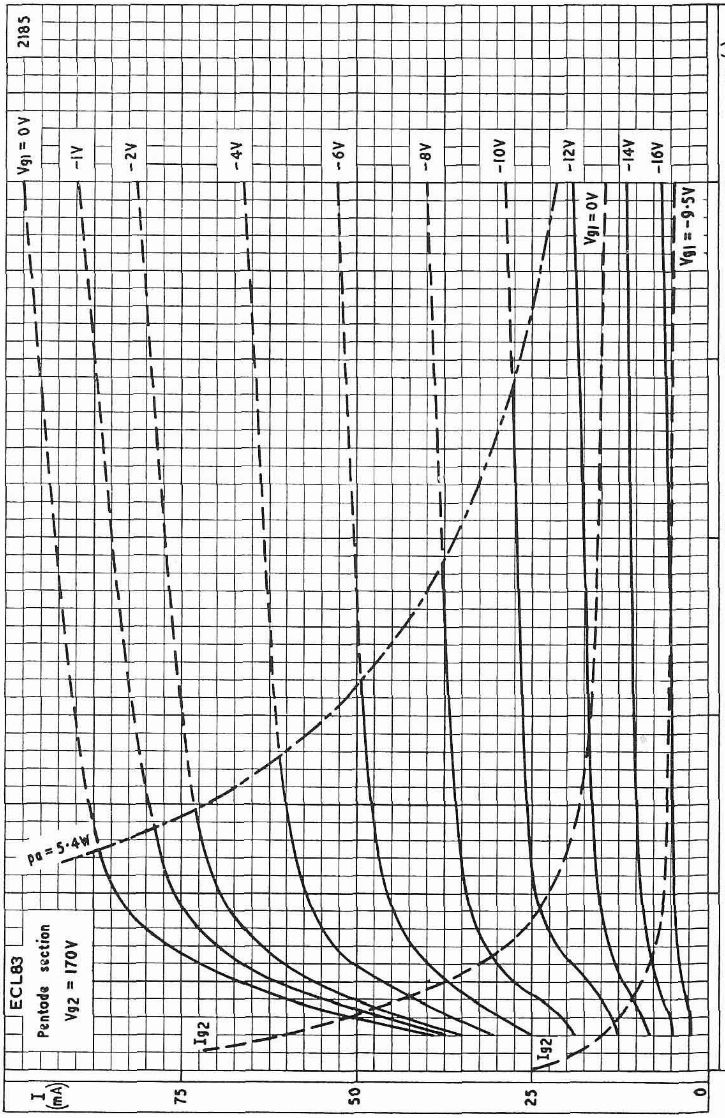
B9A Base



ECL83

TRIODE PENTODE

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

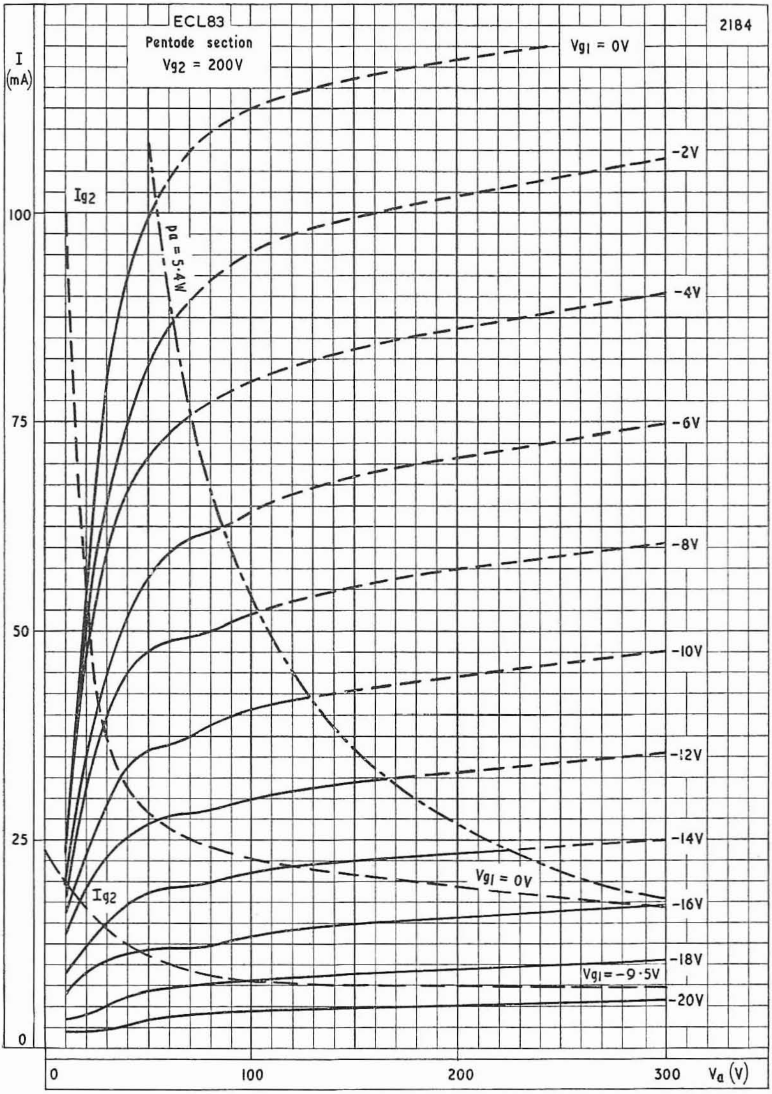


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 170V$

TRIODE PENTODE

ECL83

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

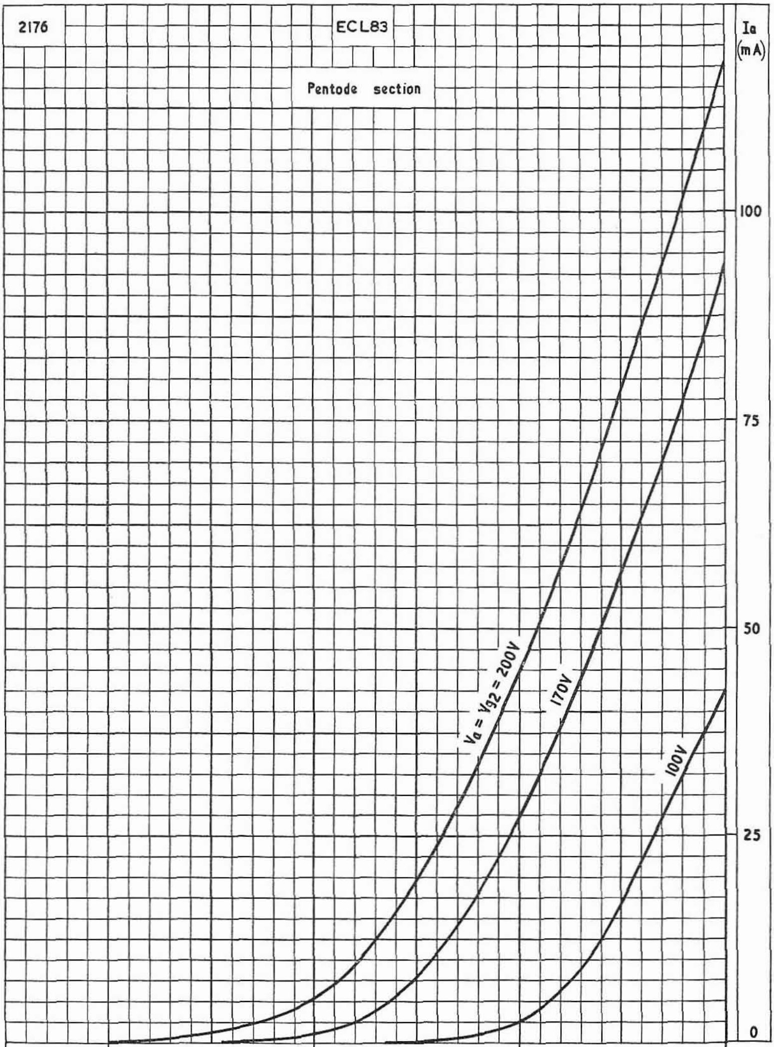


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$

ECL83

TRIODE PENTODE

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

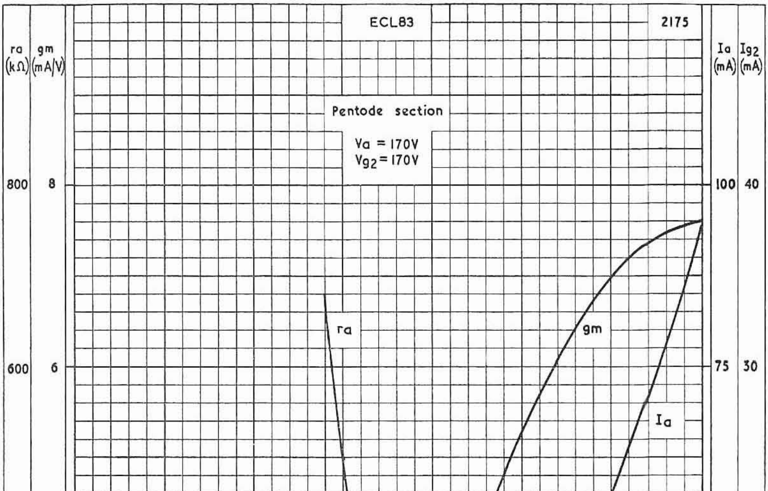


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR VARIOUS ANODE AND SCREEN-GRID VOLTAGES

TRIODE PENTODE

ECL83

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

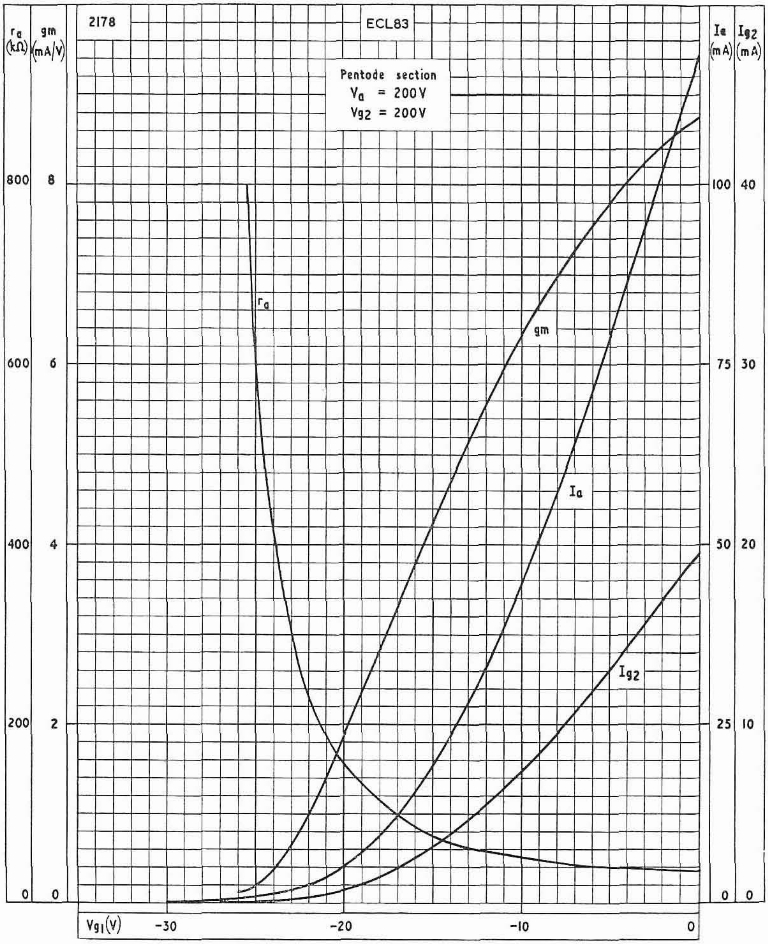


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 170V$

ECL83

TRIODE PENTODE

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

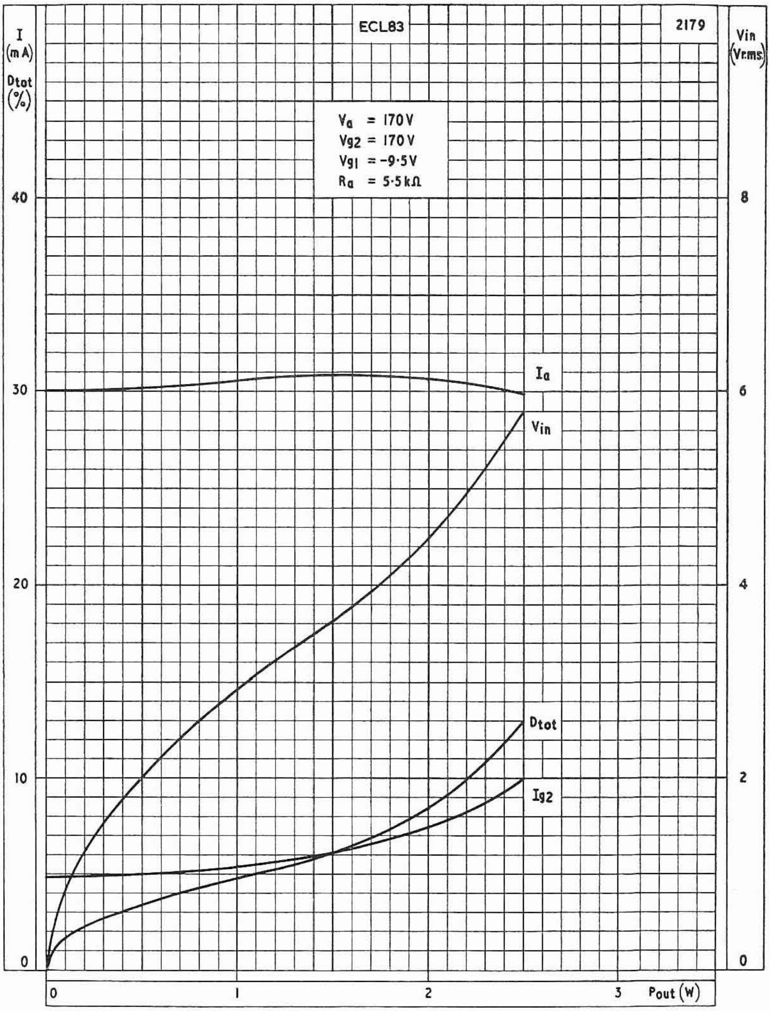


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 200V$

TRIODE PENTODE

ECL83

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

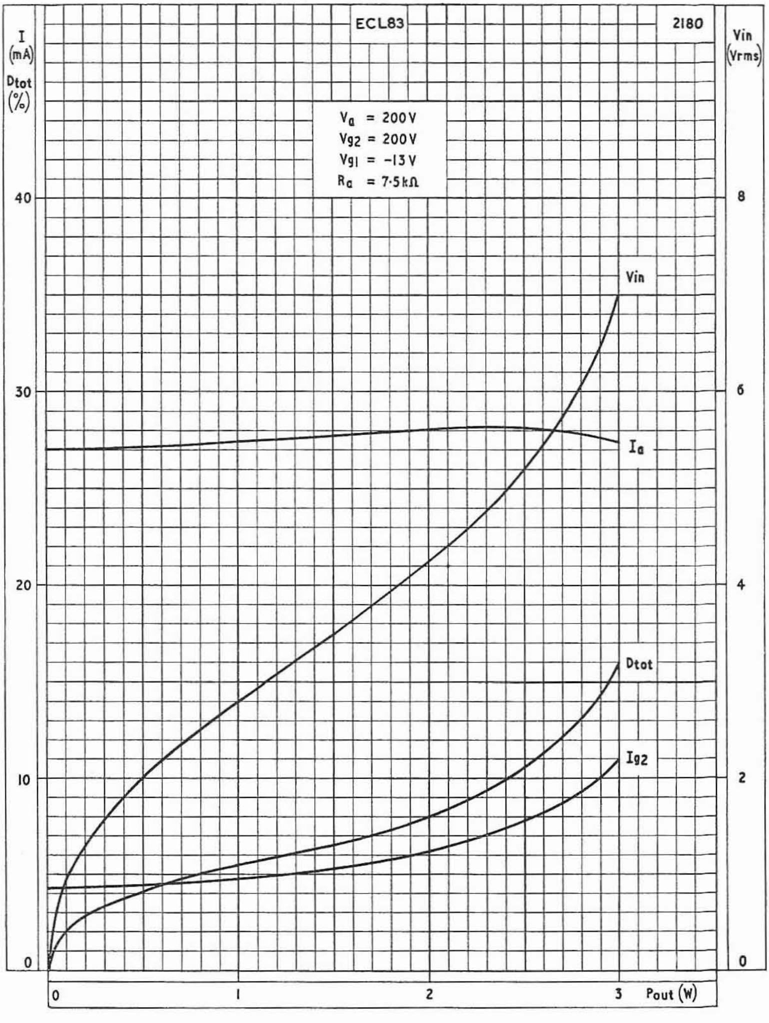


PERFORMANCE OF PENTODE SECTION AS CLASS 'A' AMPLIFIER WITH FIXED BIAS. V_a=170V

ECL83

TRIODE PENTODE

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

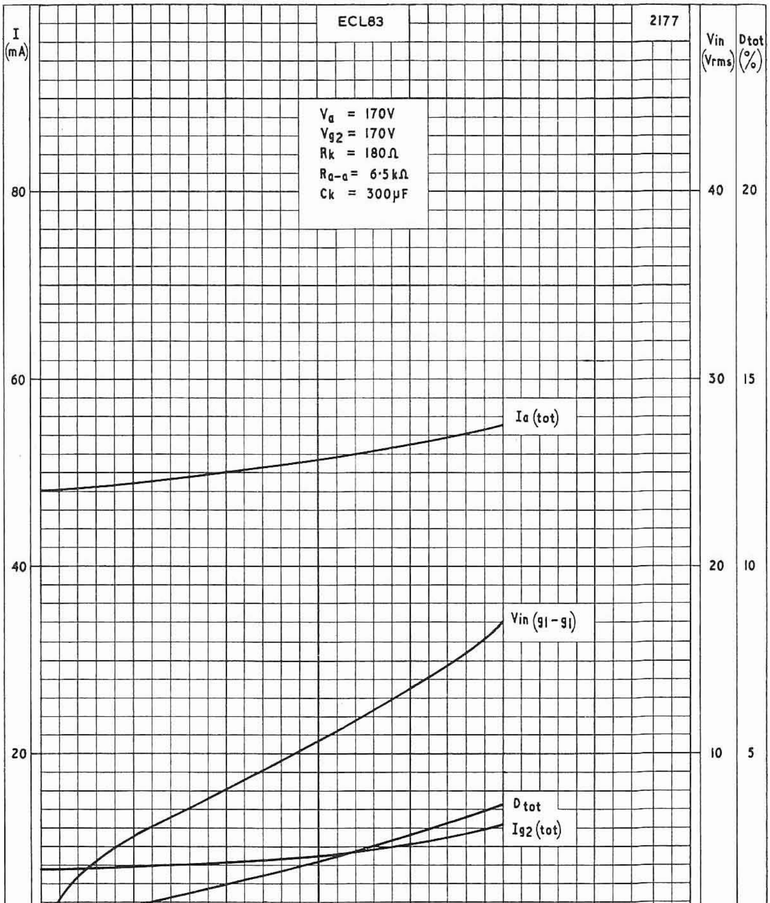


PERFORMANCE OF PENTODE SECTION AS CLASS 'A' AMPLIFIER WITH FIXED BIAS. $V_a = 200V$

TRIODE PENTODE

ECL83

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

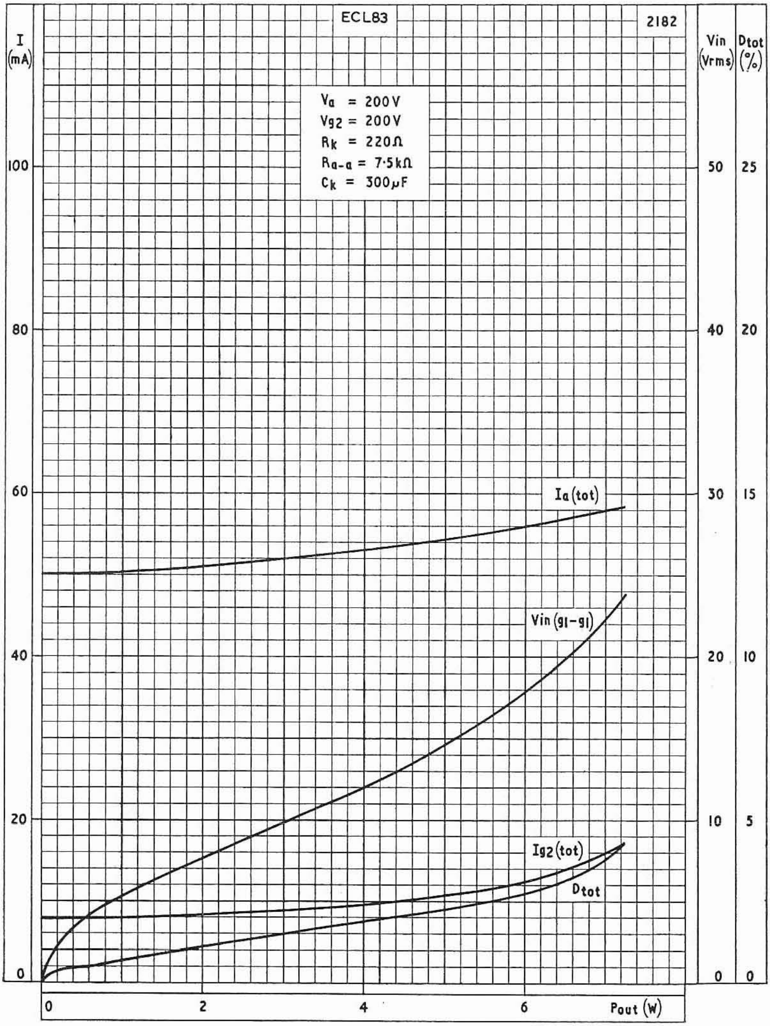


PERFORMANCE OF ECL83 IN PUSH-PULL. $V_a = 170V$

ECL83

TRIODE PENTODE

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

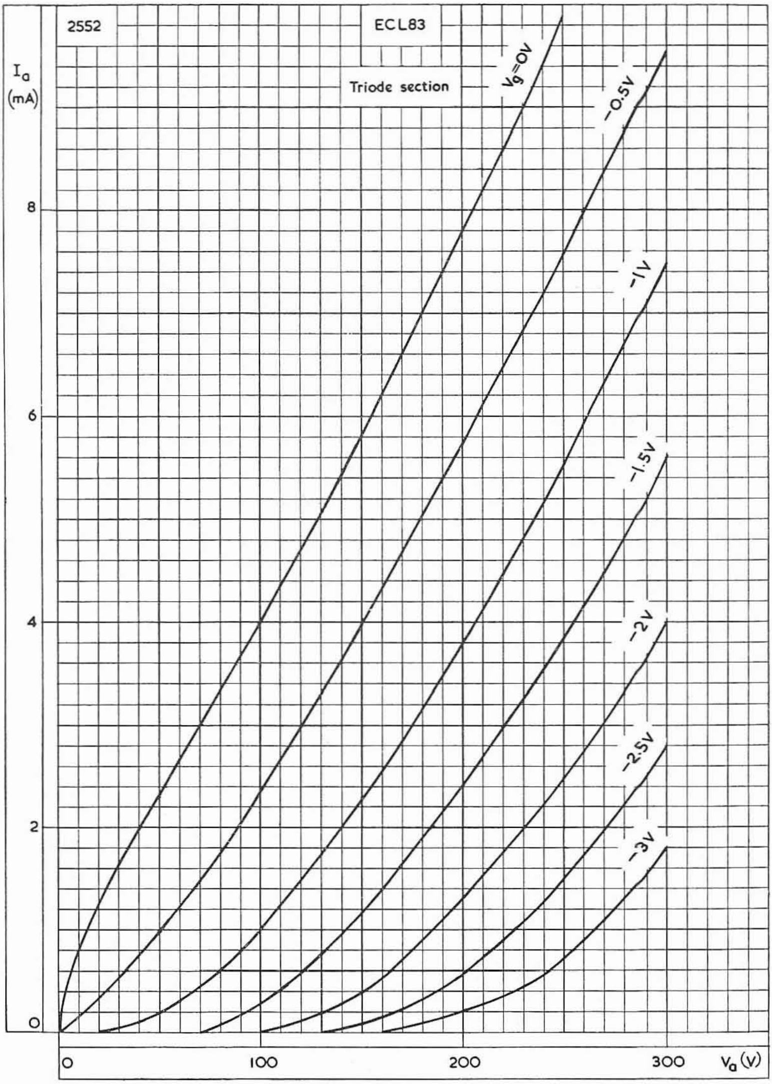


PERFORMANCE OF ECL83 IN PUSH-PULL. $V_a = 200V$

TRIODE PENTODE

ECL83

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

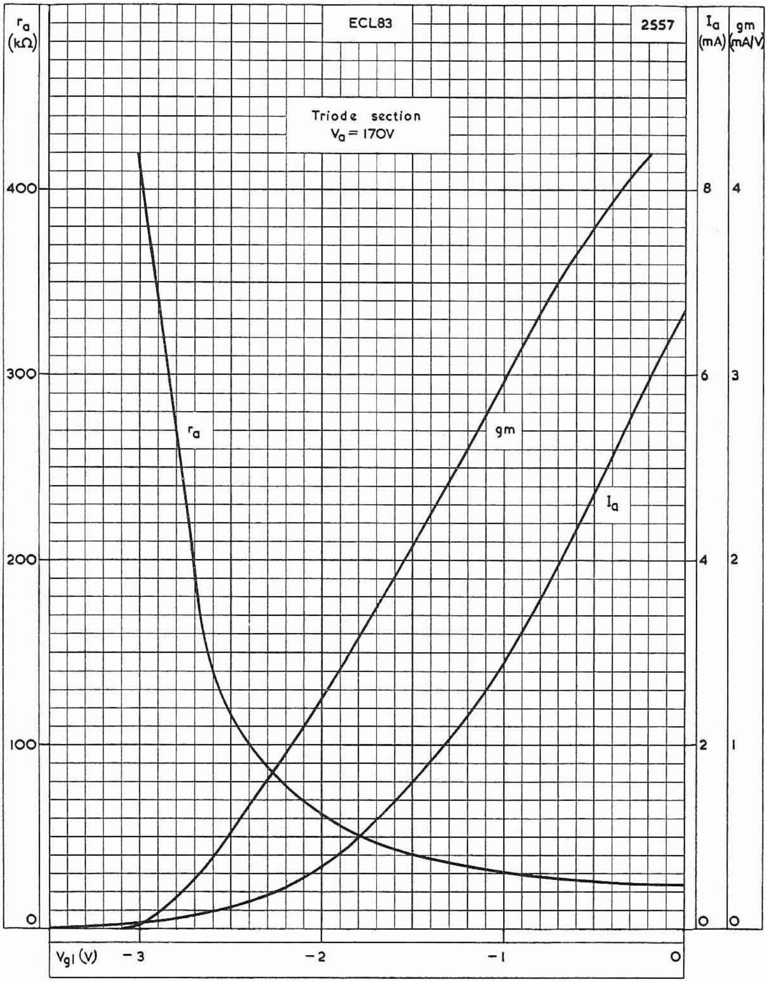


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

ECL83

TRIODE PENTODE

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

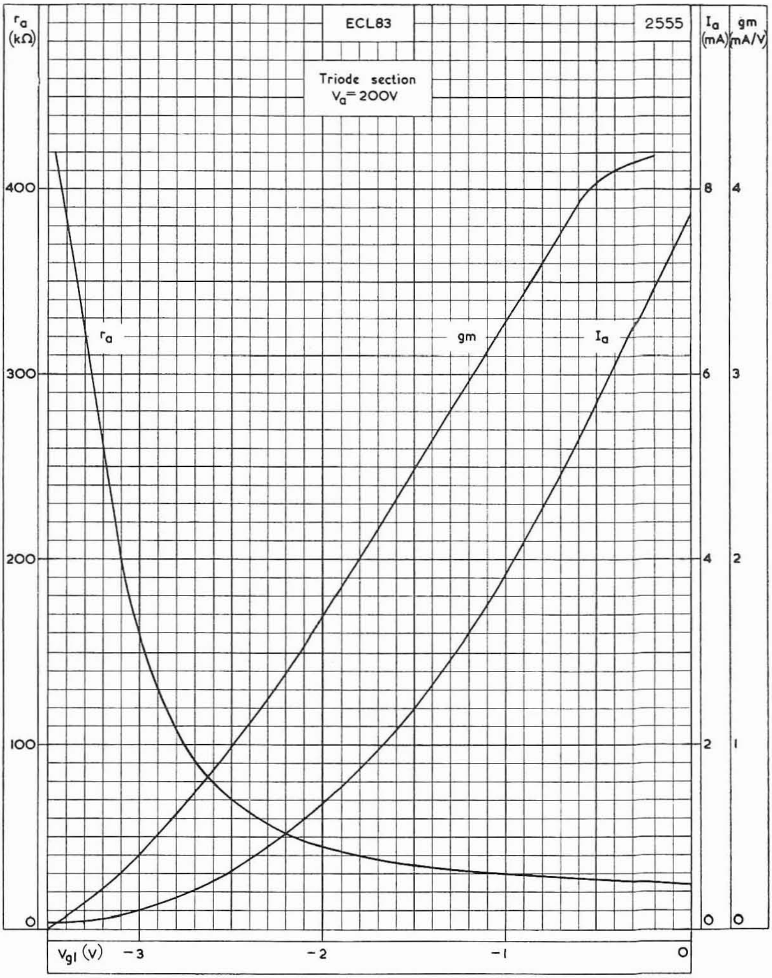


ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE. V_a=170V

TRIODE PENTODE

ECL83

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



ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE. $V_a = 200V$

R.F. PENTODE

EF22

Variable-mu R.F. pentode primarily intended for use as an R.F. or I.F. voltage amplifier in A.C. or D.C./A.C. mains-operated equipment.

HEATER

This valve is suitable for AC/DC operation.

V_h	6.3	V
I_h	0.2	A

CAPACITANCES

c_{a-g1}	<0.002	µµF
c_{in}	5.5	µµF
c_{out}	6.4	µµF

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

V_a	250	250	250	V
V_{g3}	0	0	0	V
R_{g2}	90	90	90	kΩ
R_k	325	325	325	Ω
V_{g1}	−2.5	−46	−58	V
V_{g2}	100	—	250	V
I_a	6	—	—	mA
I_{g2}	1.7	—	—	mA
g_m	2,200	22	4.5	µA/V
r_a	1.2	>10	>10	MΩ
μ_{g1-g2}	17	—	—	
R_{eq}	6.2	—	—	kΩ

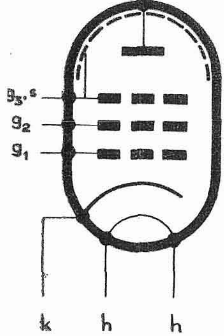
LIMITING VALUES

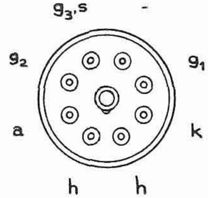
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} ($I_a = <3.0$ mA) max.	300	V
V_{g2} ($I_a = 6.0$ mA) max.	125	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} ($I_{g1} = +0.3\mu$A) max.	−1.3	V
R_{g1-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	50	V

EF22

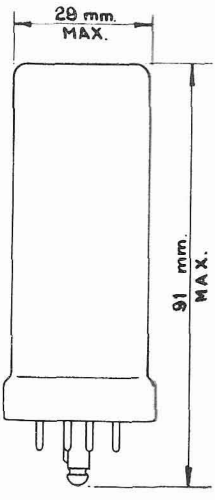
R.F. PENTODE

Variable-mu R.F. pentode primarily intended for use as an R.F. or I.F. voltage amplifier in A.C. or D.C./A.C. mains-operated equipment.





B8G BASE



A.F. PENTODE

EF36

TYPE EF36 is a high impedance pentode for use as a general purpose A.F. voltage amplifier, and in phase inverters, etc.

For ratings, characteristics and operating conditions, see data sheets EF37A, Issue 3.

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

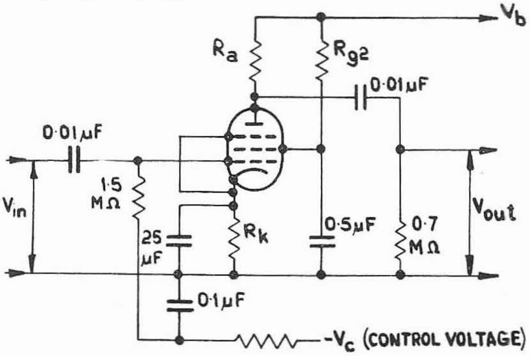
c_{a-g1}	<3.0	mpF
c_{in}	5.5	pF
c_{out}	7.2	pF

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

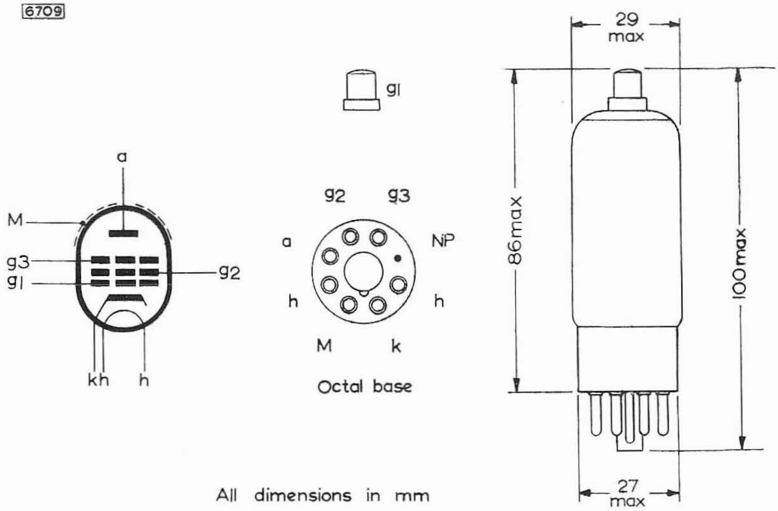
EF39

VARIABLE-MU R.F. PENTODE

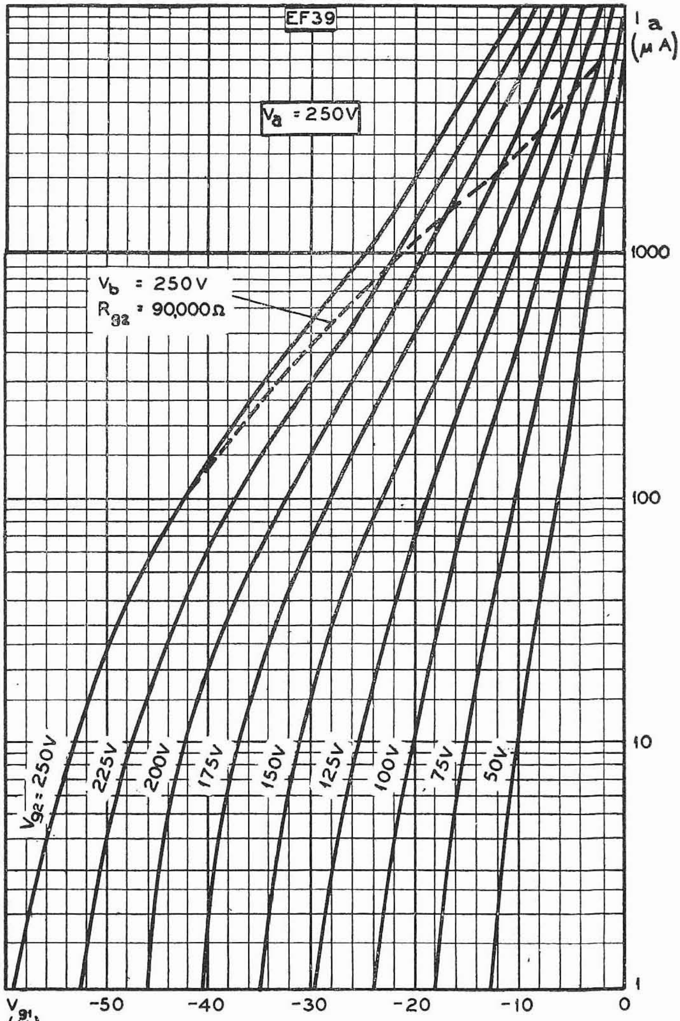
LIMITING VALUES

$V_{a(b)}$ 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. ($I_a = 6$mA)	125	V
V_{g2} max. ($I_a = 3$mA)	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

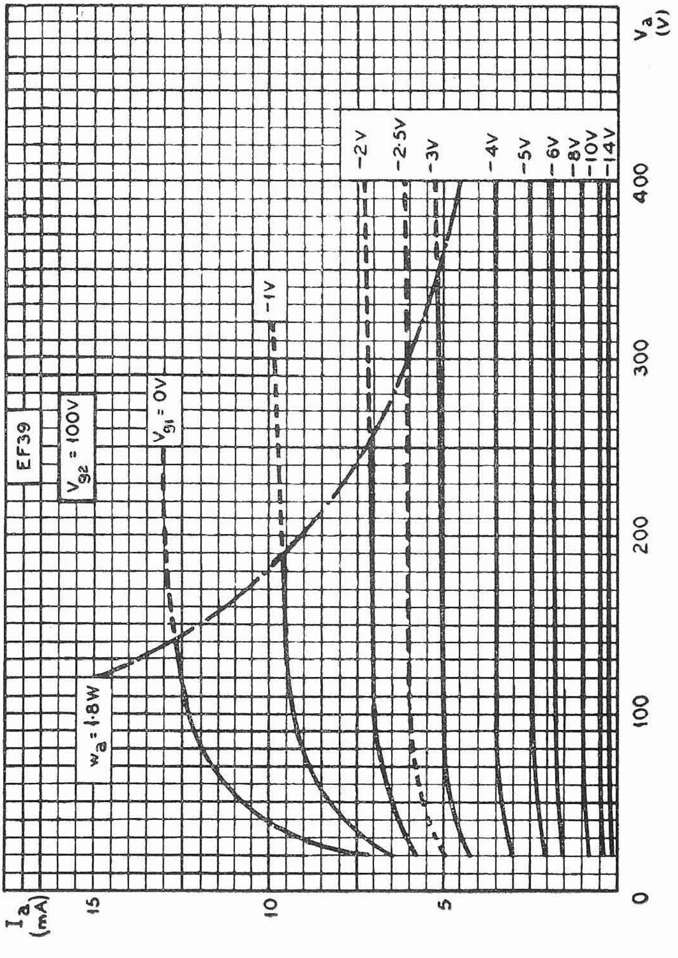
6709



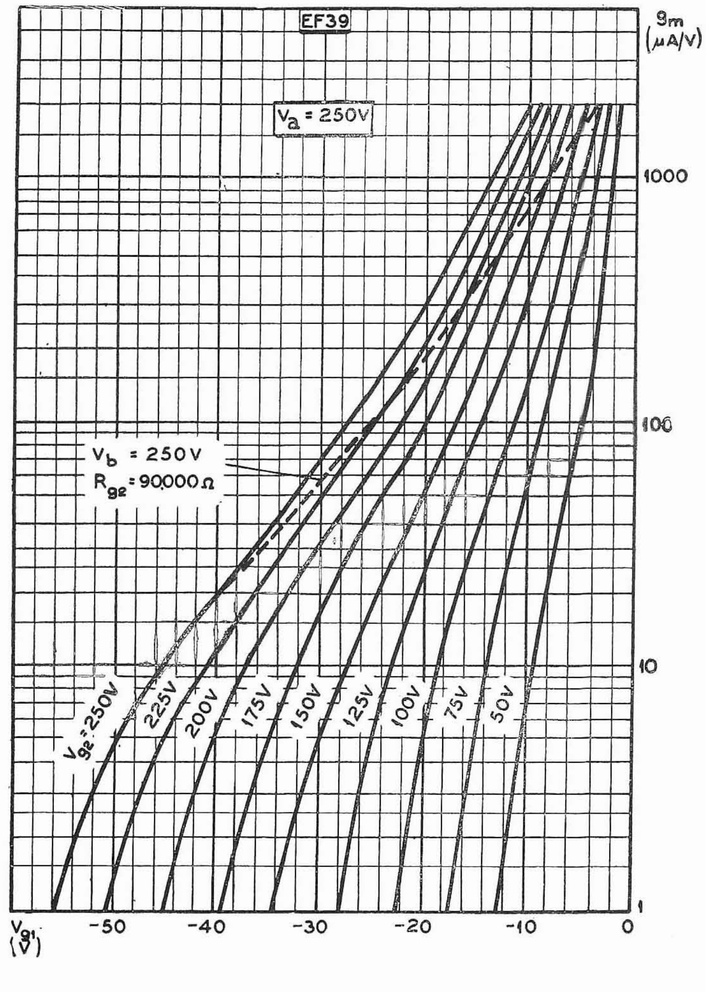
All dimensions in mm



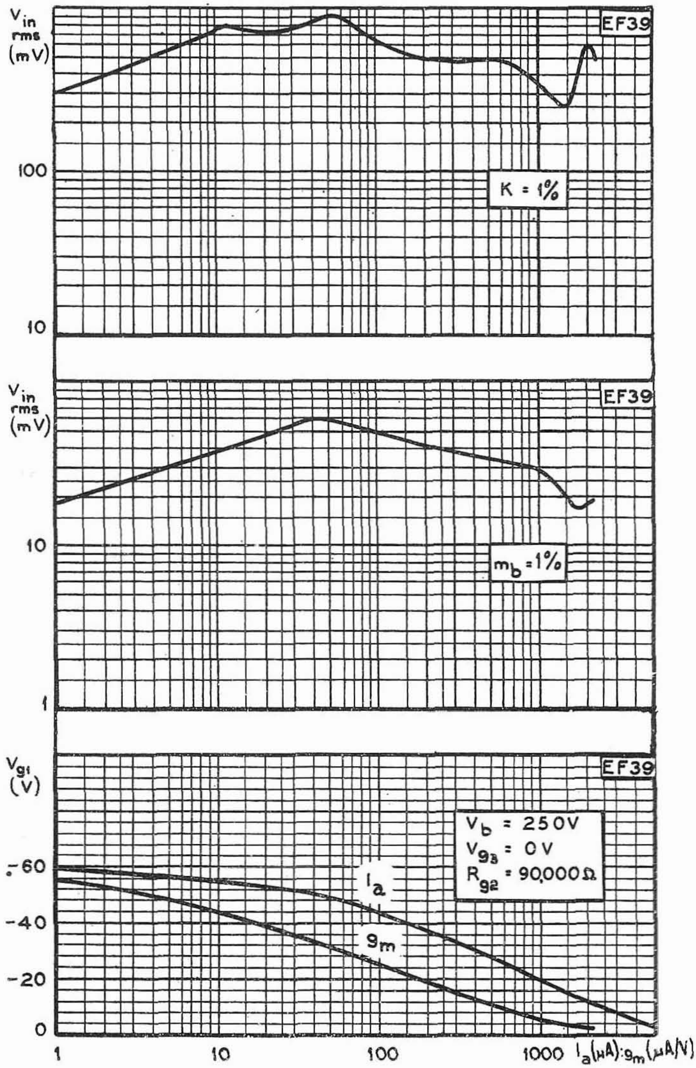
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



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



MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER FOR ANODE VOLTAGE OF 250V



CROSS MODULATION, MODULATION HUM AND CONTROL CHARACTERISTICS FOR $V_b = 250V$

VOLTAGE AMPLIFYING PENTODE

EF40

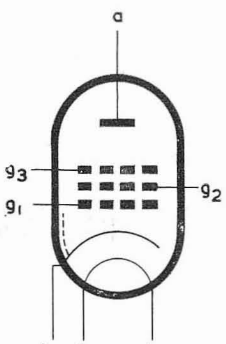
Low noise pentode primarily intended for use in high gain r.c. coupled a.f. voltage amplifier stages.

EF41 OVERLEAF

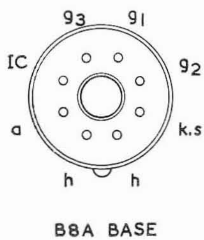
Except for heater to cathode voltage ratings, basing and dimensions, the EF40 is identical to the EF86.

LIMITING VALUE

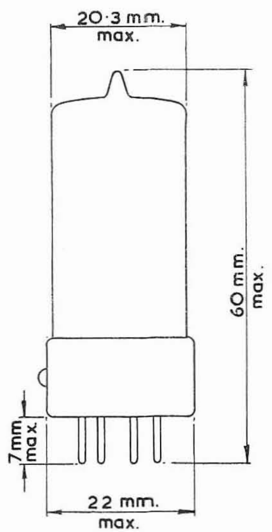
V_{h-k} max.	50	V



277



B8A BASE



EF41

VARIABLE-MU R.F. PENTODE

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

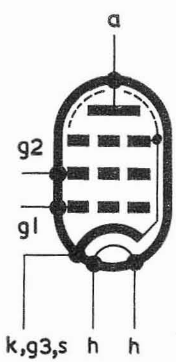
Except for capacitances, basing, dimensions and heater to cathode voltage ratings the EF41 is identical to the EF39.

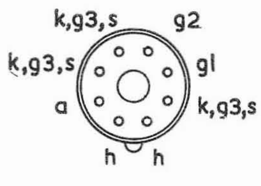
CAPACITANCES

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

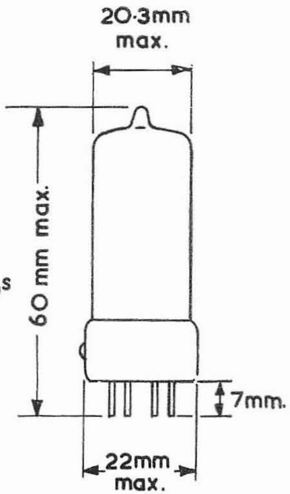
LIMITING VALUE

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





B8A Base



106

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.

VARIABLE-MU R.F. PENTODE

EF41

Variable-mu pentode for use as R.F. or I.F. amplifier.

HEATER

V_h	6.3	V
I_h	0.2	A

MOUNTING POSITION

Any

CAPACITANCES

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

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

V_a		250		V
R_{g2}		90		kΩ
R_k		325		Ω
V_{g1}	−2.5		−39	V
I_a	6		—	mA
I_{g2}	1.7		—	mA
g_m	2,200		22	μA/V
r_a	1		>10	MΩ
μ_{g1-g2}	18		—	
R_{eq}	7.4		—	kΩ

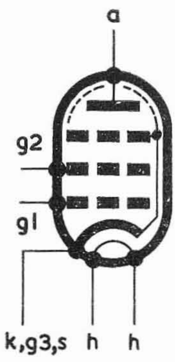
LIMITING VALUES

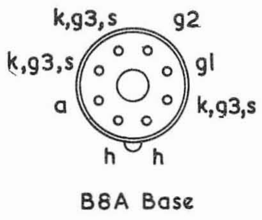
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2	W
I_k max.	10	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max. (I_a<3 mA)	300	V
V_{g2} max. (I_a=6 mA)	125	V
p_{g2} max.	0.3	W
V_{g1} max. (I_{g1}=+0.3μA)	−1.3	V
R_{g1-k} max.	3	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	50	V

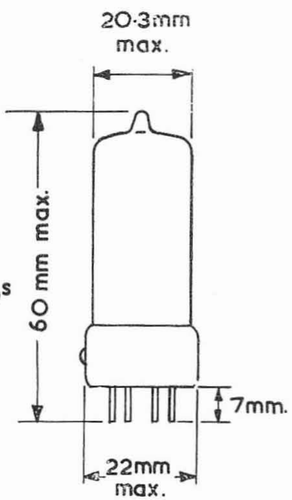
EF41

VARIABLE-MU R.F. PENTODE

Variable-mu pentode for use as R.F. or I.F. amplifier.







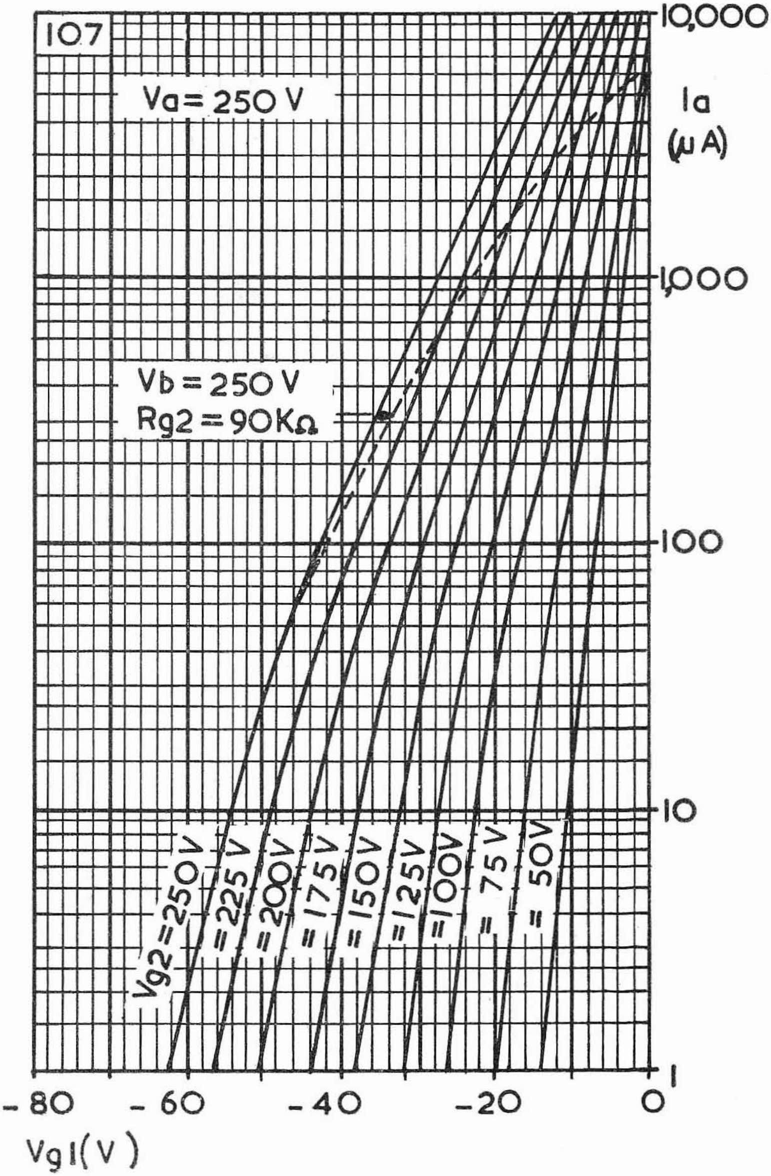
106

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.

VARIABLE-MU R.F. PENTODE

Variable pentode for use as R.F. or I.F. amplifier

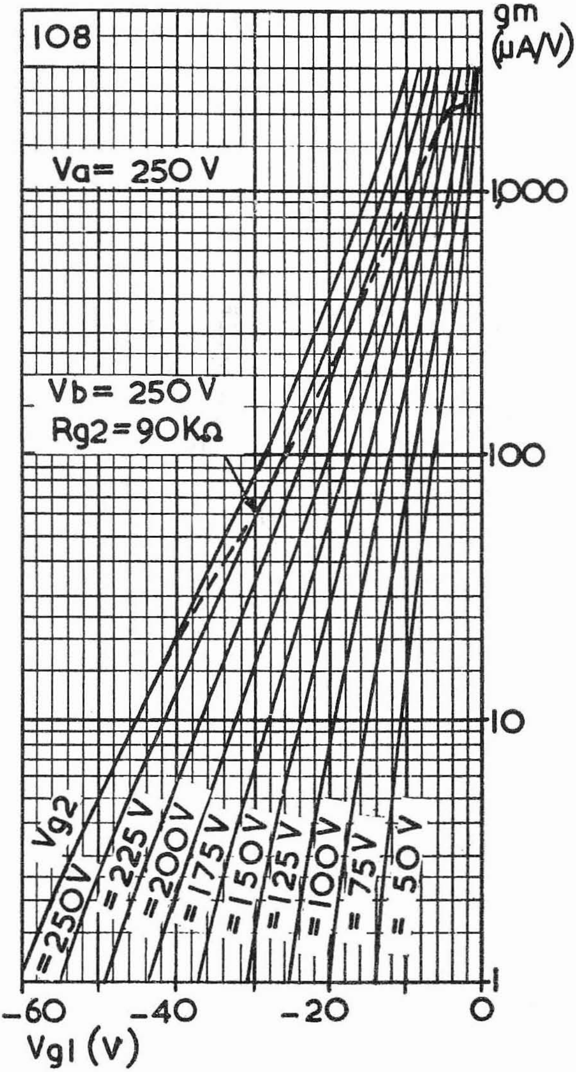
EF41



EF41

VARIABLE-MU R.F. PENTODE

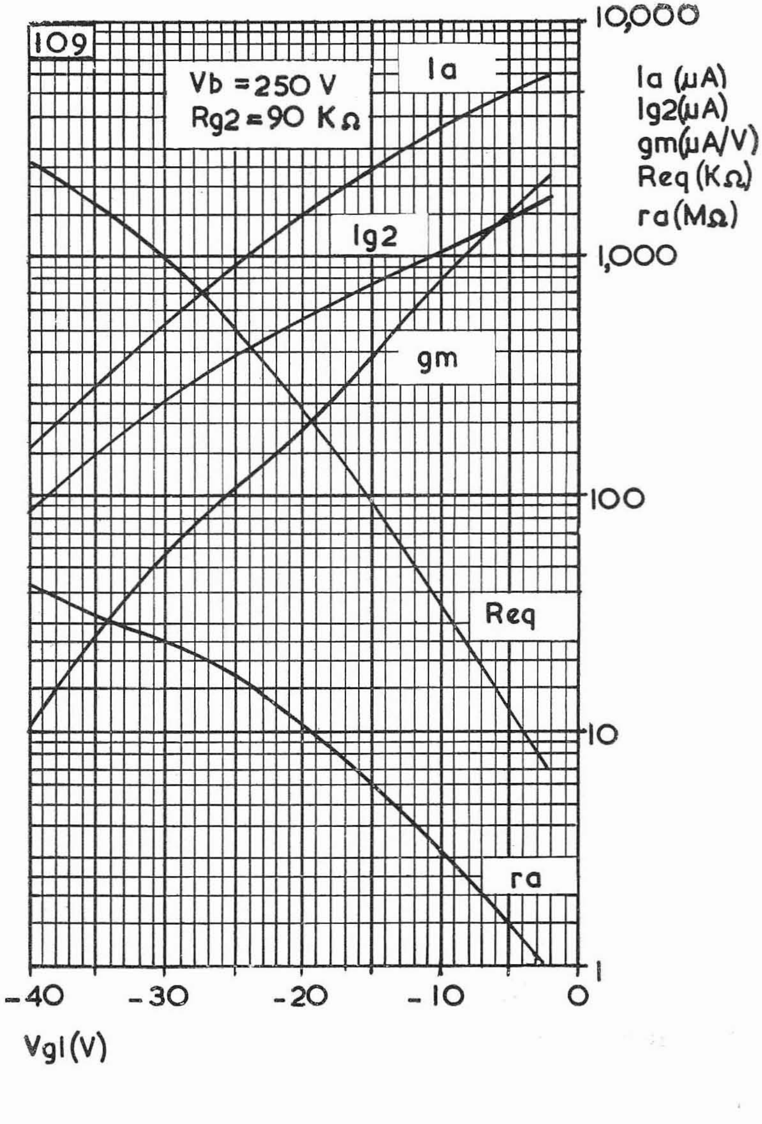
Variable-mu pentode for use as R.F. or I.F. amplifier



VARIABLE-MU R.F. PENTODE

EF41

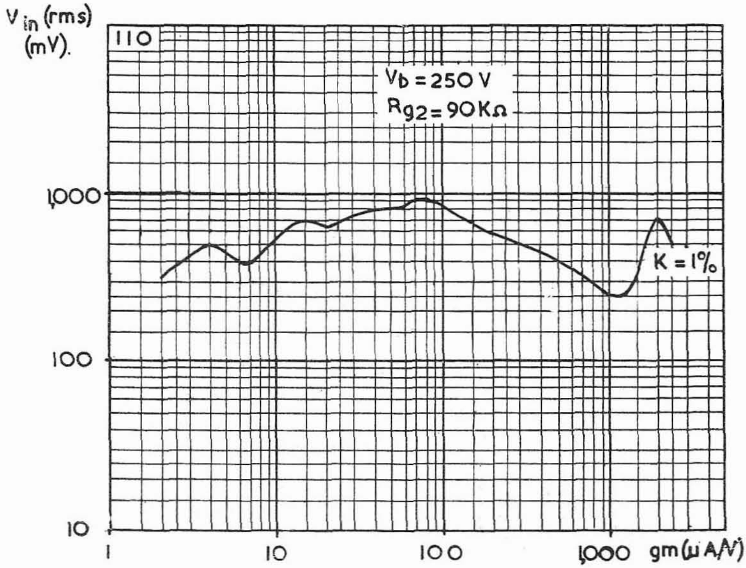
Variable-mu pentode for use as R.F. or I.F. amplifier.

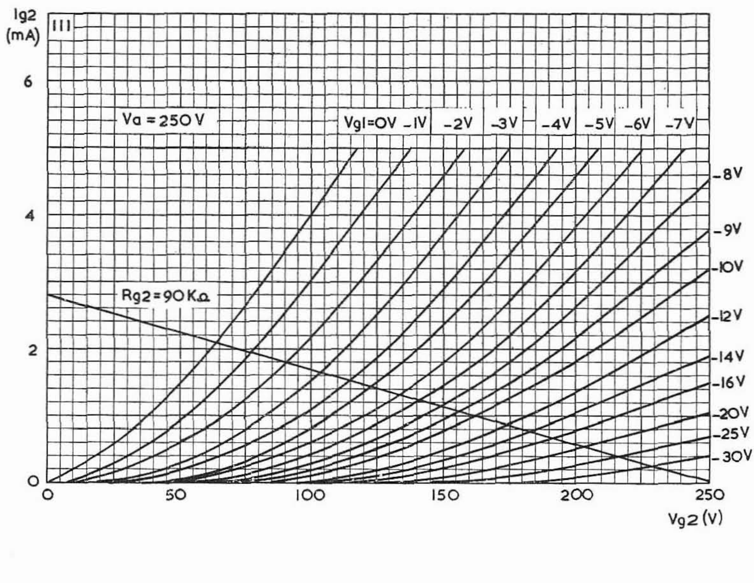


EF41

VARIABLE-MU R.F. PENTODE

Variable-mu pentode for use as R.F. or I.F. amplifier.





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

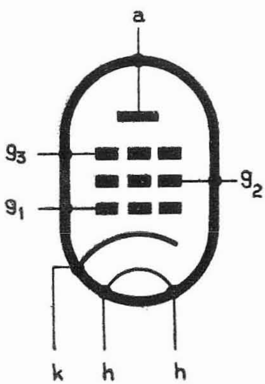
LIMITING VALUES

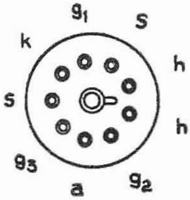
$V_{a(b)}$ max.	500	V
V_a max.	300	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	250	V
p_a max.	10	W
p_{g2} max.	2.0	W
V_{h-k} max.	150	V
R_{g1-k} max.	700	kΩ
$i_{k(pk)}$ max. (with 50 μ sec. pulse, 500 pp.s.)	1.5	A

EF55

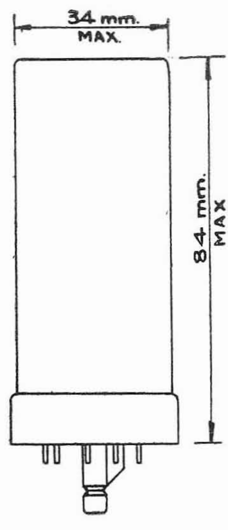
VIDEO FREQUENCY PENTODE

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





B9G BASE

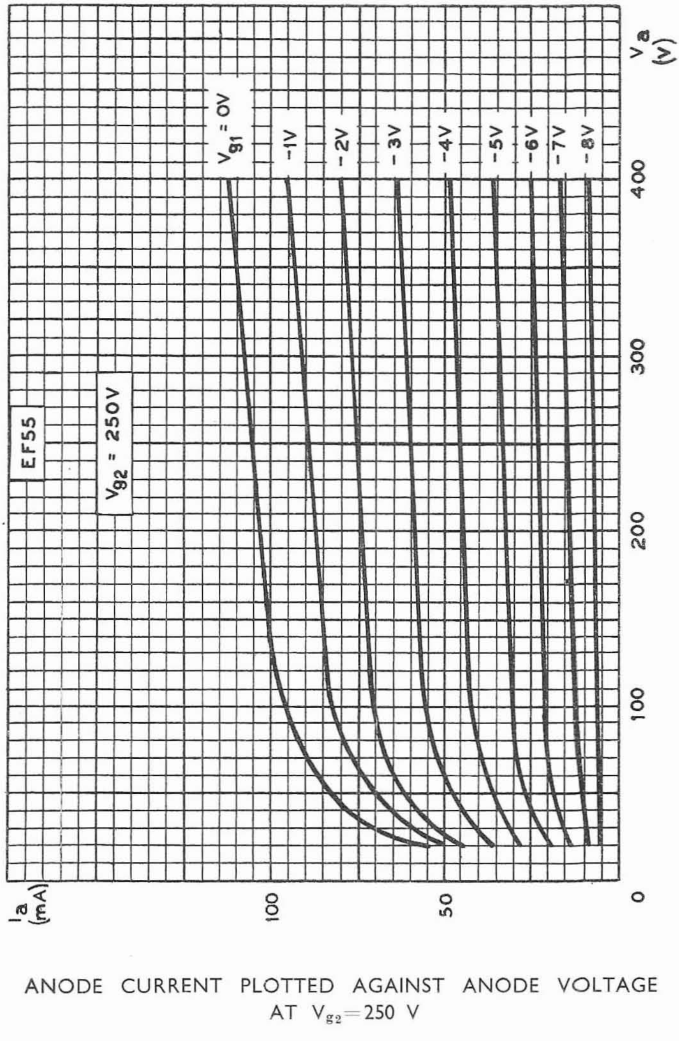


Note : If mounted horizontally, Pins 4 and 8 must be in a vertical plane.

VIDEO FREQUENCY PENTODE

EF55

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

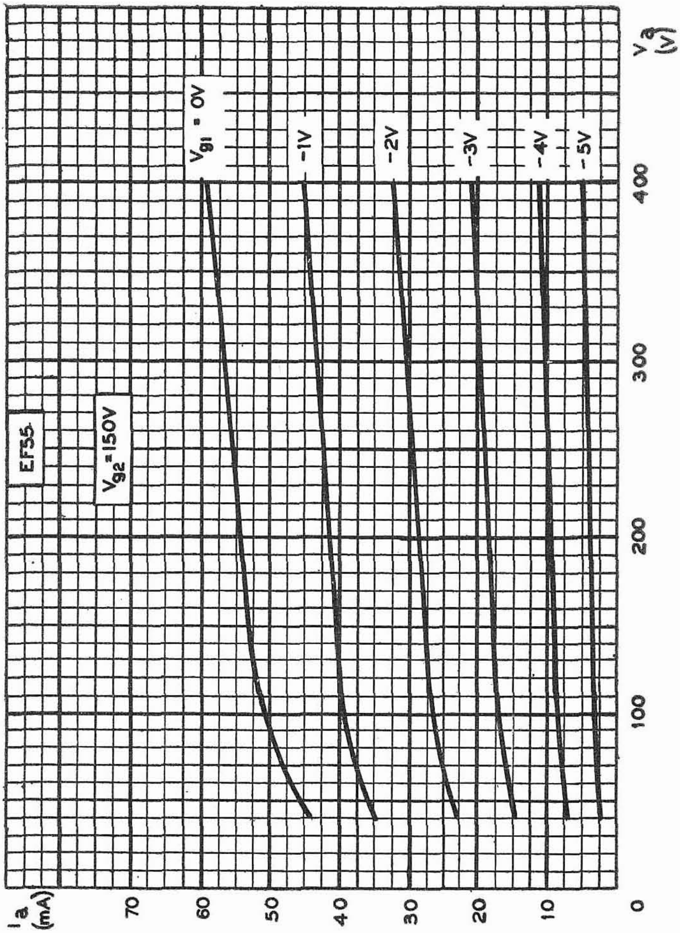


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
AT $V_{g2} = 250$ V

EF55

VIDEO FREQUENCY PENTODE

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

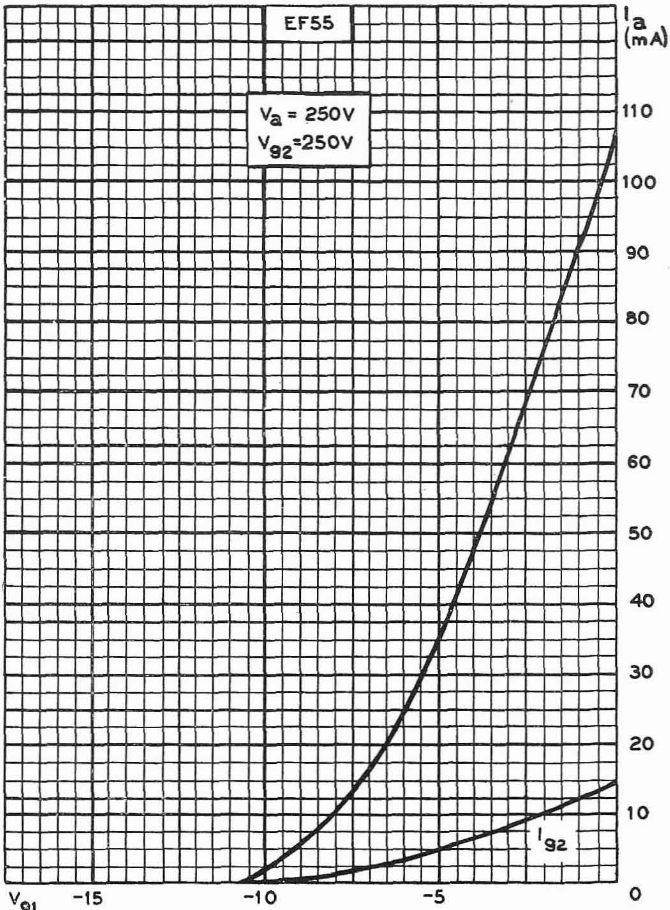


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE AT $V_{g2}=150$ V

VIDEO FREQUENCY PENTODE

EF55

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

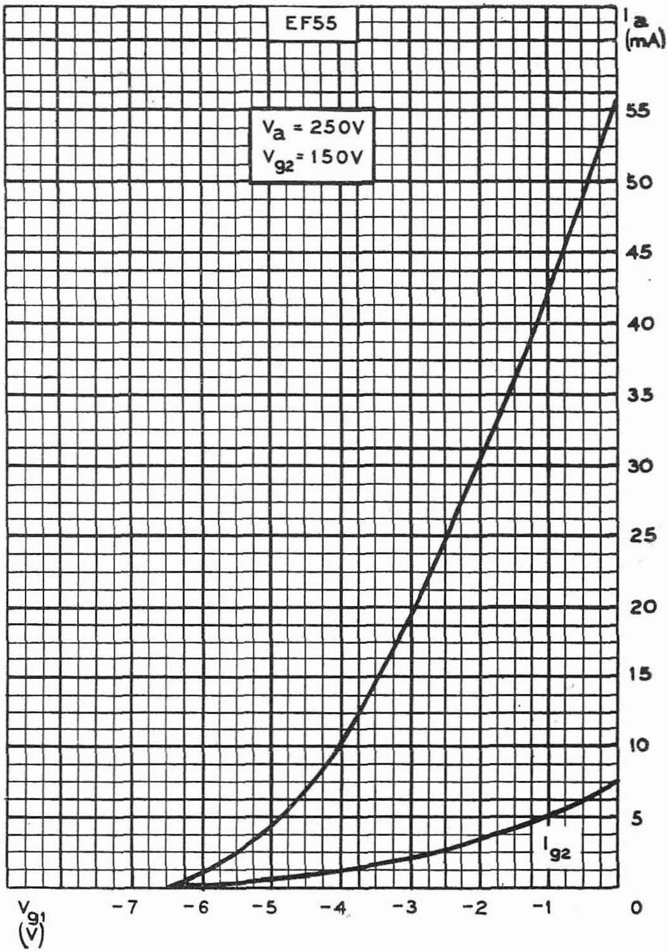


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE AT V_{g2}=250 V

EF55

VIDEO FREQUENCY PENTODE

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



ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE AT V_{g2}=150 V

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.

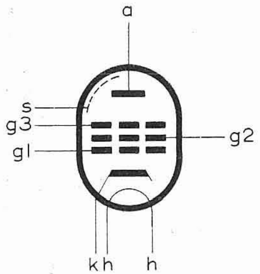
†Common screen-grid resistor for EF89 and ECH81 used as a frequency changer. The current through this resistor is 8.6mA at V_{g1} = −2.0V and 9.8mA at V_{g1} = −0.5V.

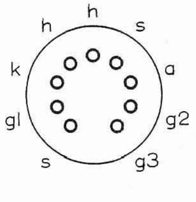
EF89

VARIABLE-MU R.F. PENTODE

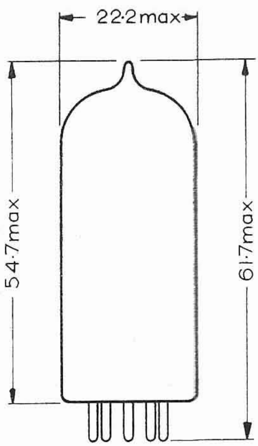
LIMITING VALUES

$V_{a(b)}$ 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



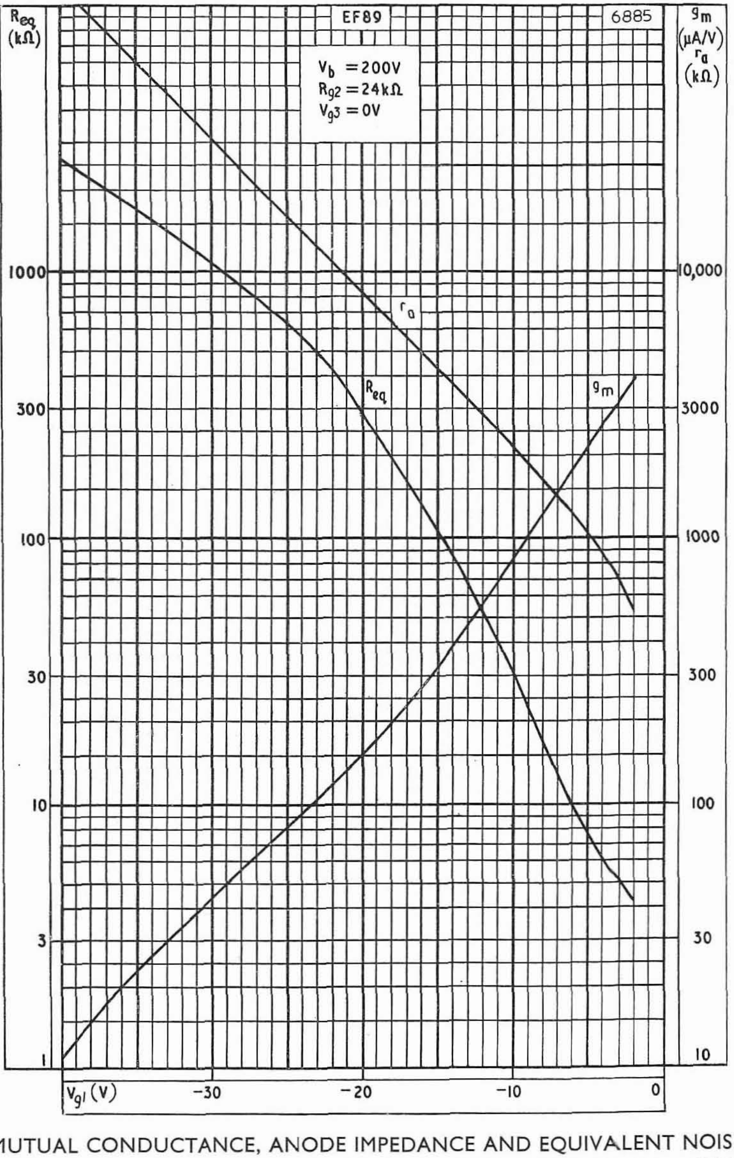


B9A Base

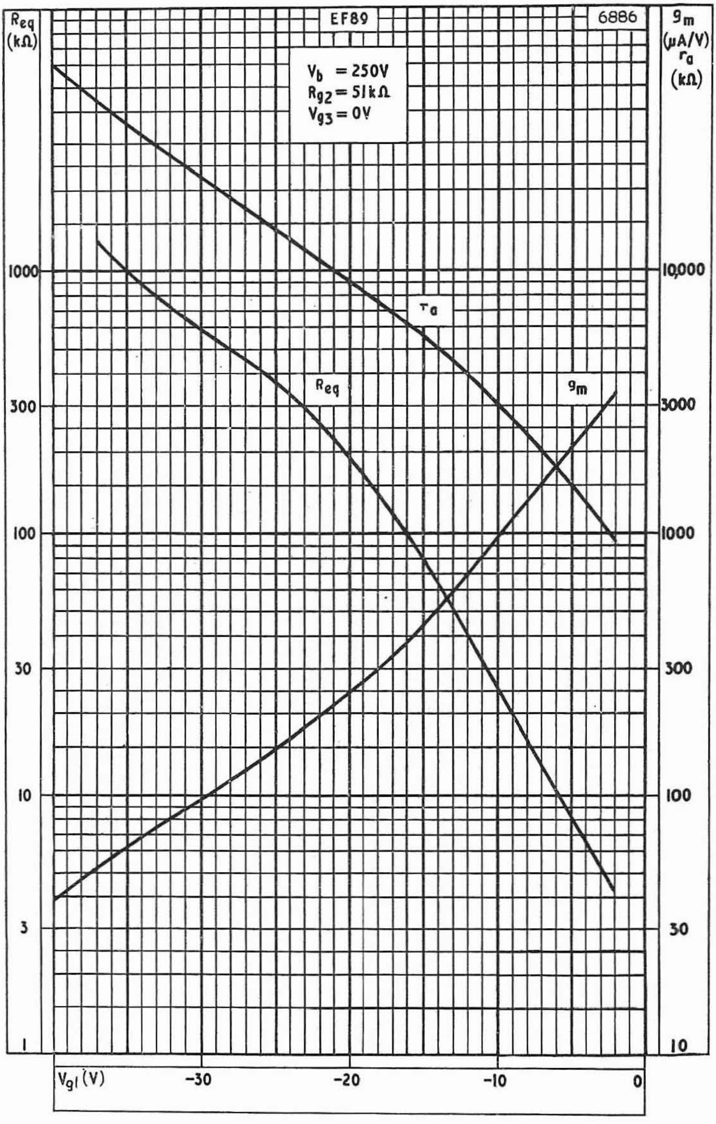


6394

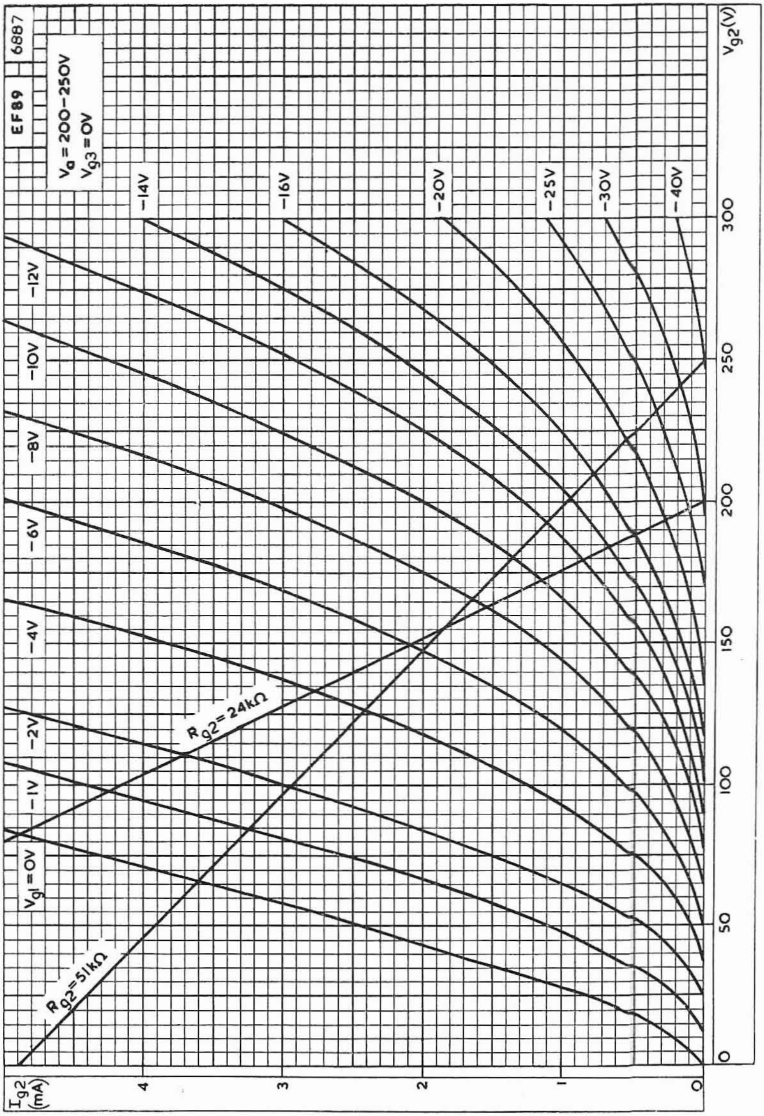
All dimensions in mm



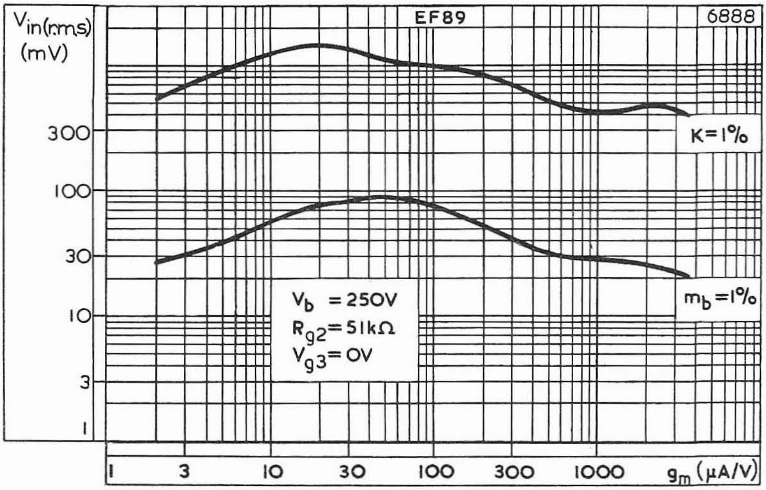
MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_b = 200V$.

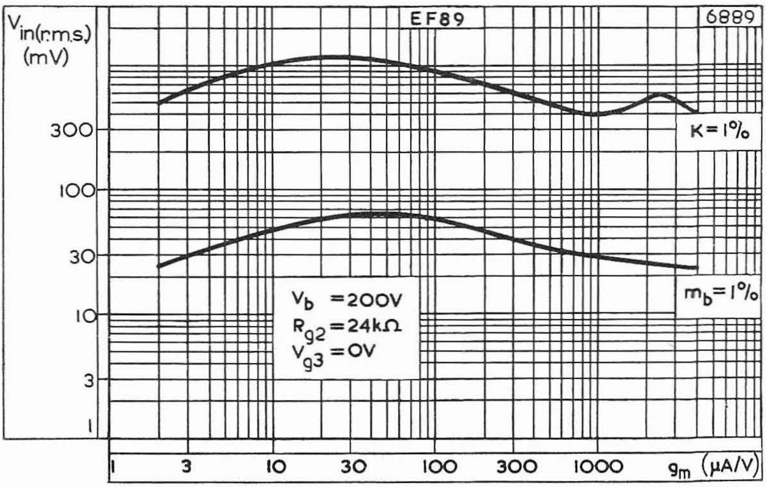


MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_b = 250V$.

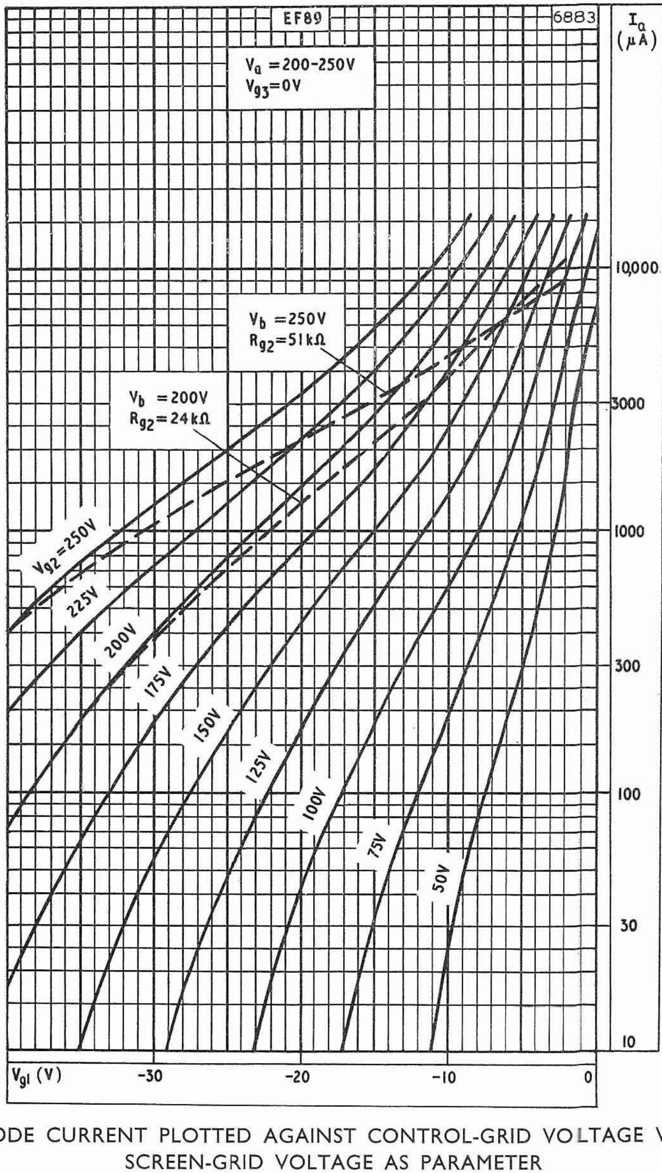


SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

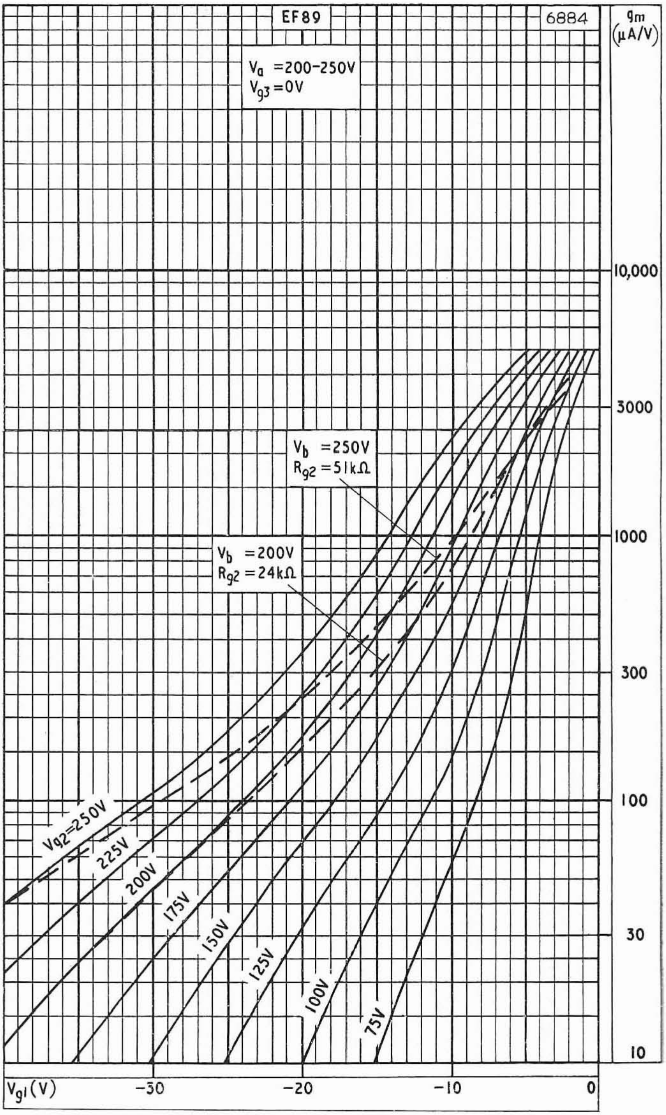




CROSS MODULATION AND MODULATION HUM CURVES



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

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 $R_{g1} = 10M\Omega$

EF98

PENTODE

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) ←

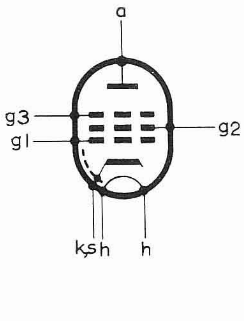
$V_a = V_b$	6.3	12.6	25	V
R_{g3}	100	100	100	kΩ
R_{g2}	12	6.8	22	kΩ
$V_{osc(r.m.s.)}$	6.0	6.0	12	V
V_{g1}	*	*	*	V
I_a	0.25	1.05	1.1	mA
I_{g2}	300	950	900	μA
g_c	310	675	705	μA/V
r_a	80	45	65	kΩ

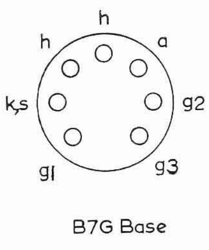
*Obtained by grid current biasing, R_{g1} = 10MΩ.

LIMITING VALUES

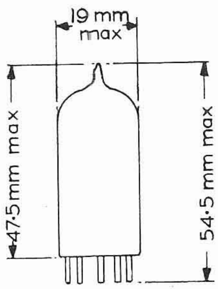
V_a max.	50	V
p_a max.	500	mW
V_{g3} max.	50	V
V_{g2} max.	50	V
p_{g2} max.	500	mW
I_k max.	15	mA
R_{g1} max.	22	MΩ
R_{g3} max.	100	kΩ
V_{h-k} max.	50	V

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

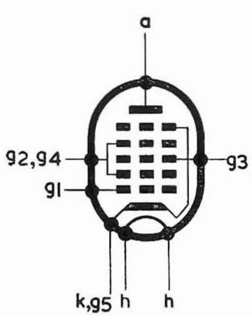
DESIGN CENTRE RATINGS

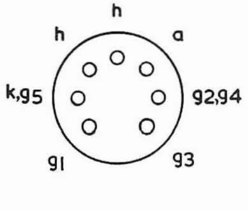
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2+g4(b)}$ max.	300	V
V_{g2+g4} max.	100	V
p_{g2+g4} max.	1.0	W
I_k max.	14	mA
R_{g1-k} max.	470	kΩ
R_{g3-k} max.	2.2	MΩ
R_{g3-k} max. ($V_{g2+g4} \leqslant 30V$)	5.0	MΩ
V_{h-k} max. (cathode positive)	200	V
V_{h-k} max. (cathode negative)	100	V

EH90

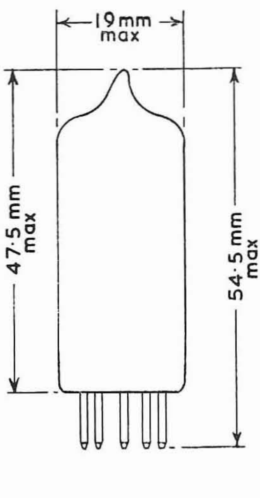
DUAL-CONTROL HEPTODE

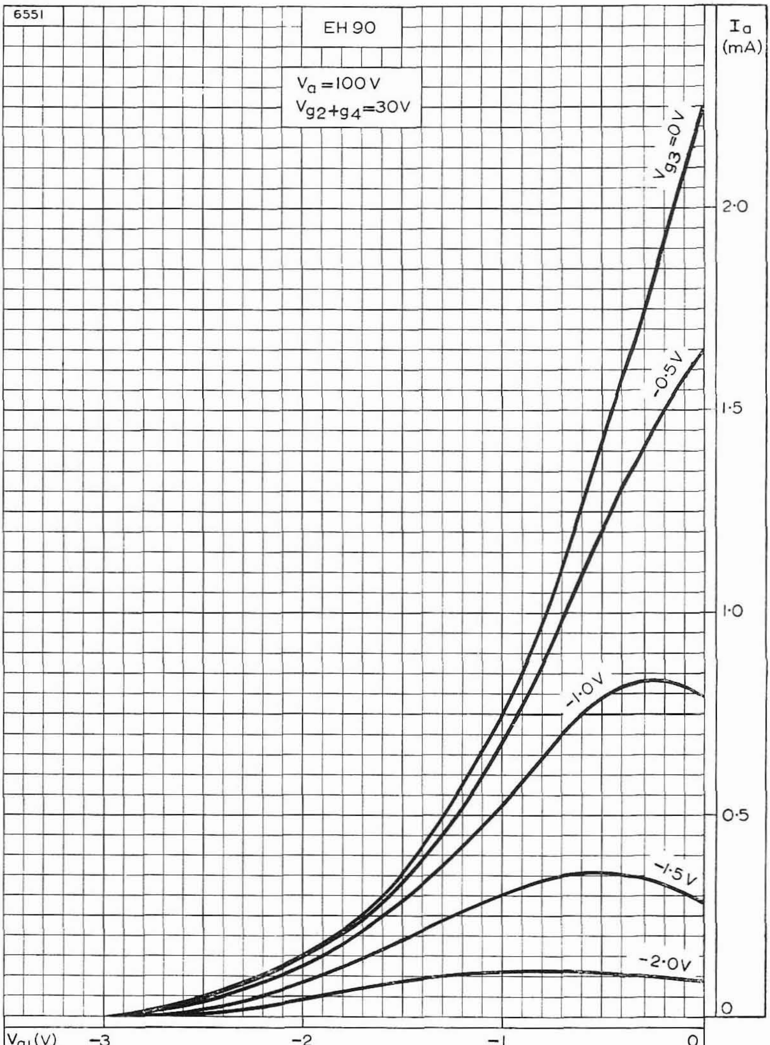
6642



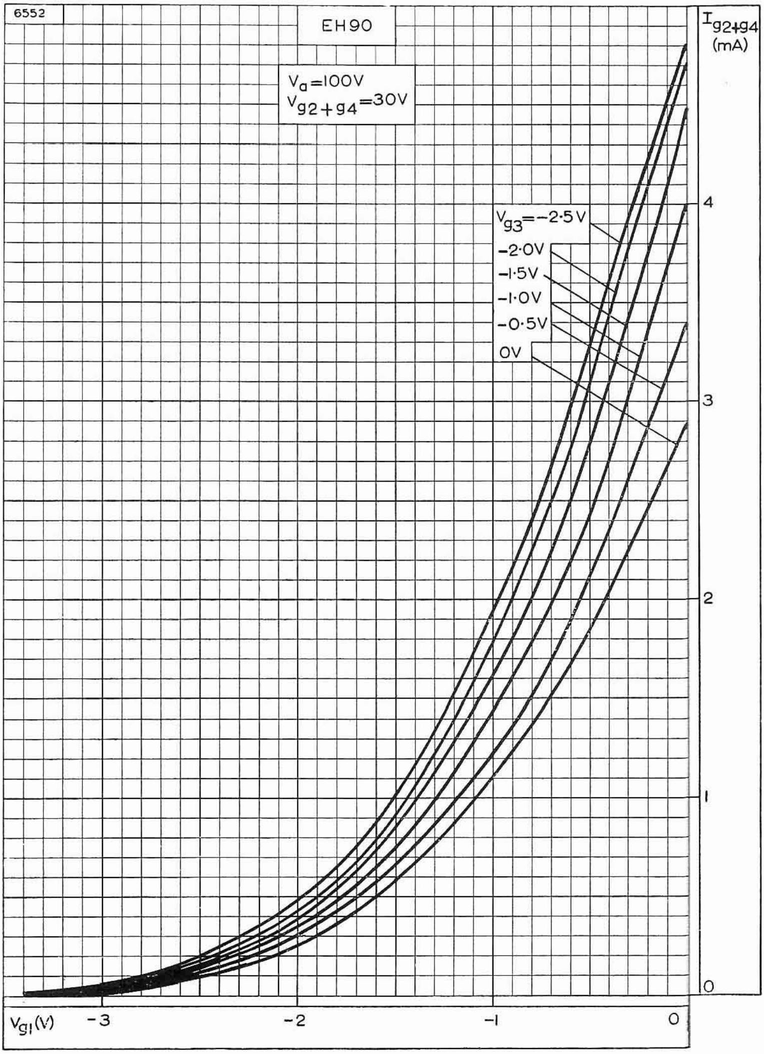


B7G Base

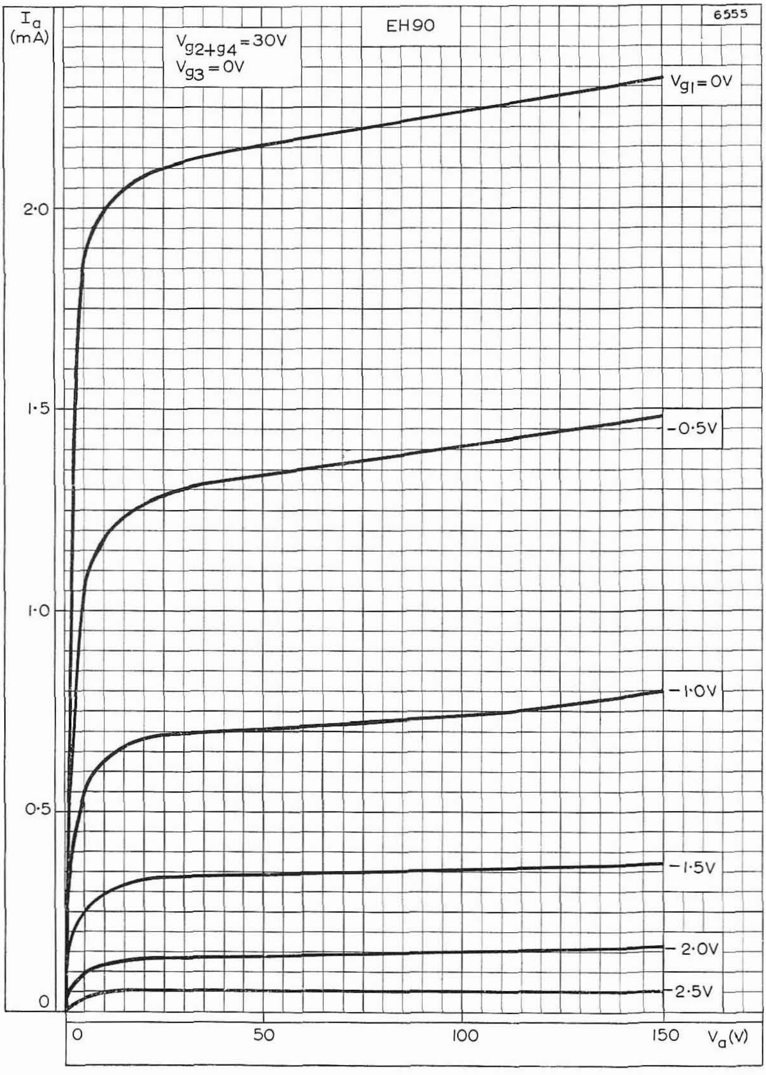




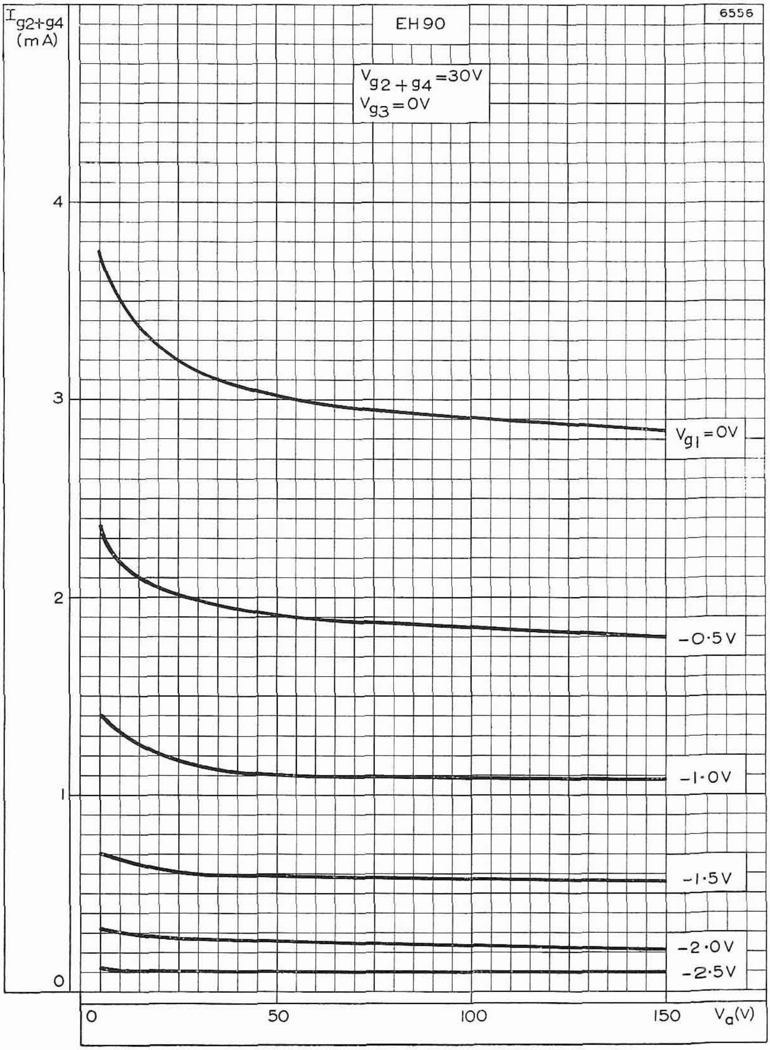
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID (g_1) VOLTAGE WITH CONTROL-GRID (g_3) VOLTAGE AS PARAMETER



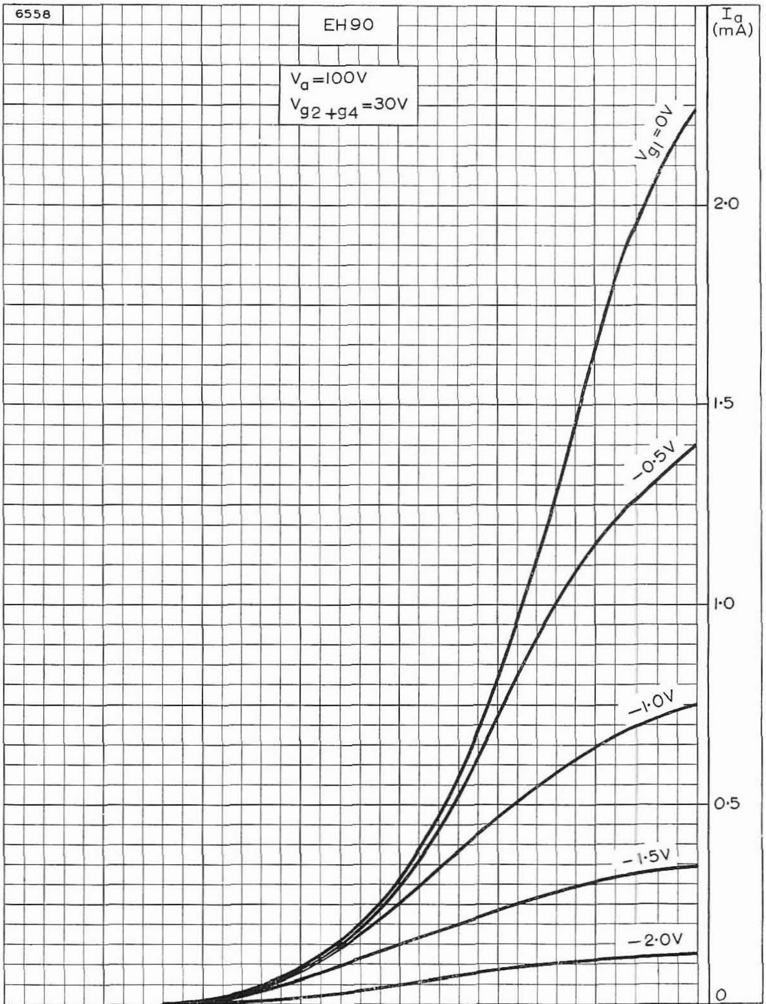
SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID (g_1) VOLTAGE WITH CONTROL-GRID (g_3) VOLTAGE AS PARAMETER



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

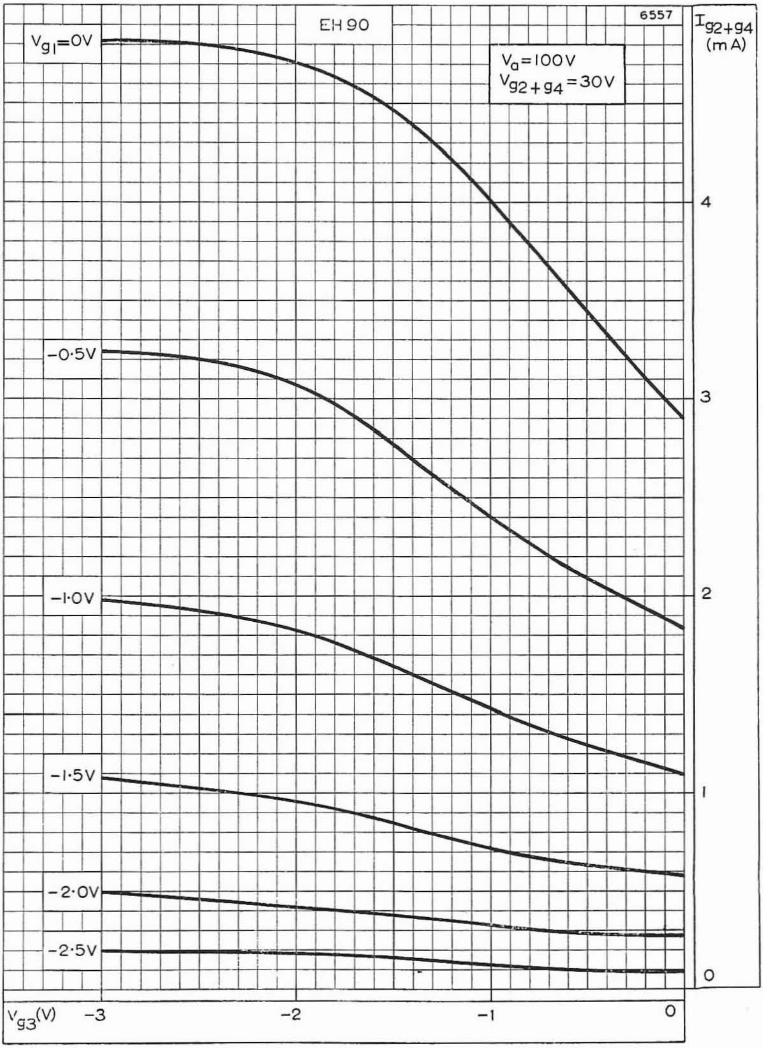


SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER

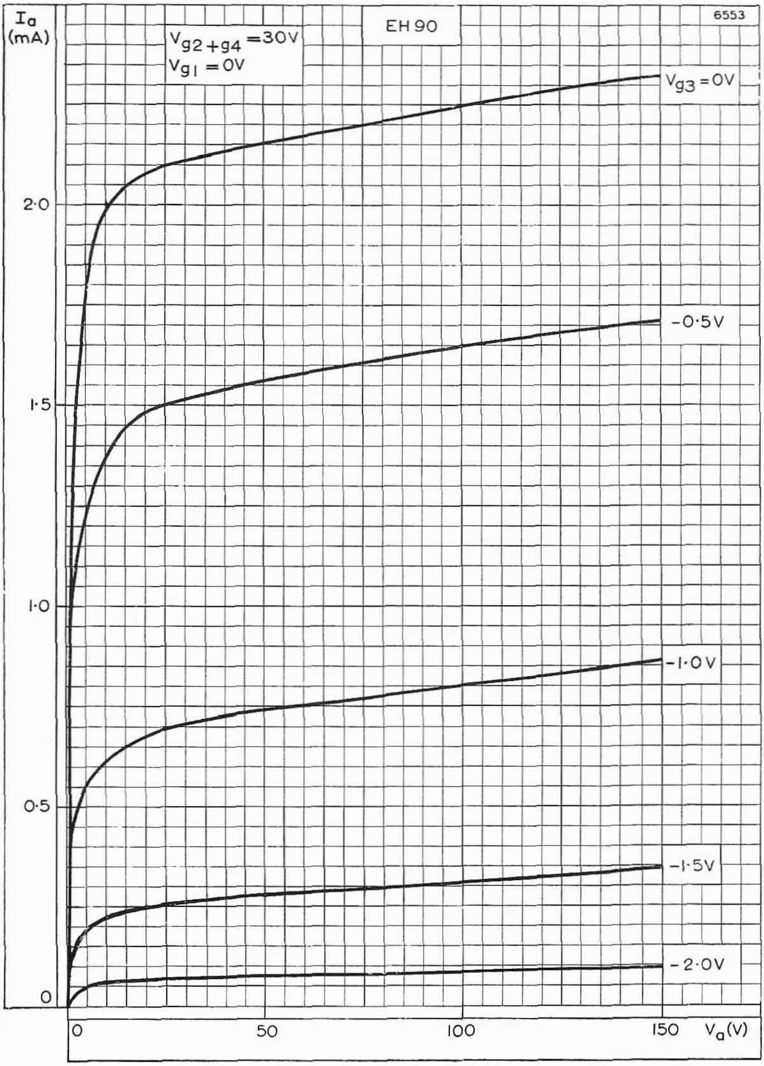


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID (g_3) VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER

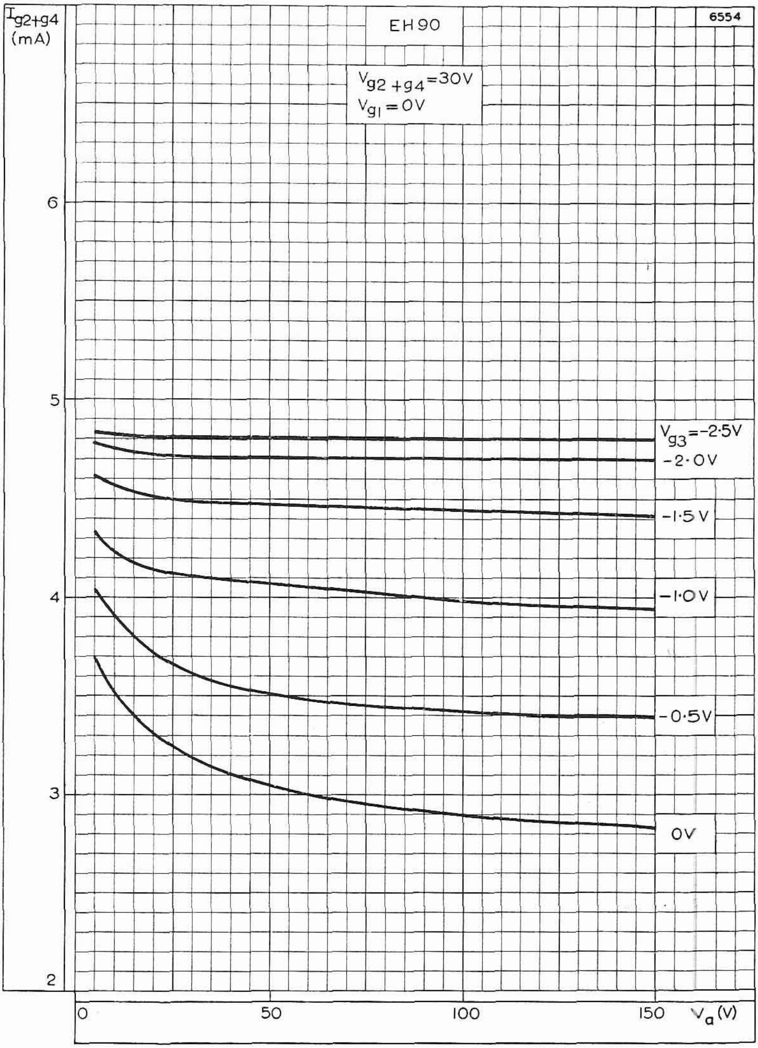
DUAL-CONTROL HEPTODE



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	$\mu\mu F$

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

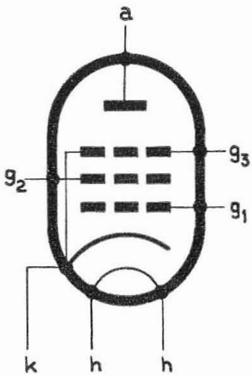
EL33

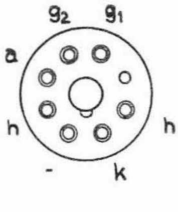
OUTPUT PENTODE

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

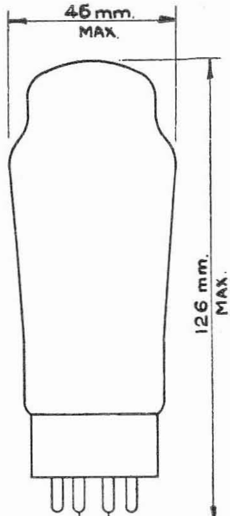
LIMITING VALUES

$V_{a(b)}$ 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	M Ω
V_{h-k} max.	50	V
R_{h-k} max.	5.0	k Ω





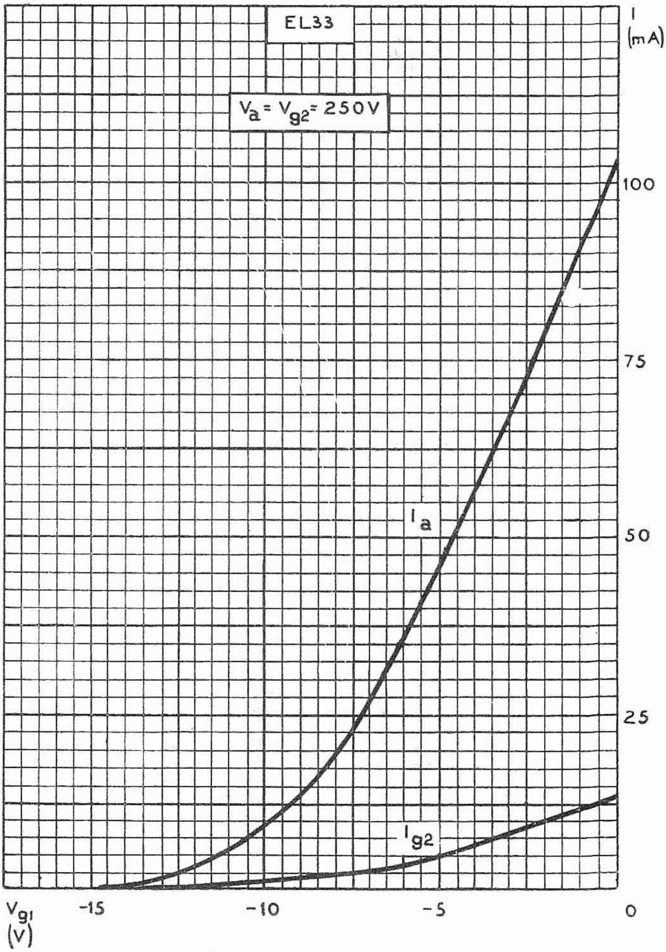
OCTAL BASE



OUTPUT PENTODE

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

EL33

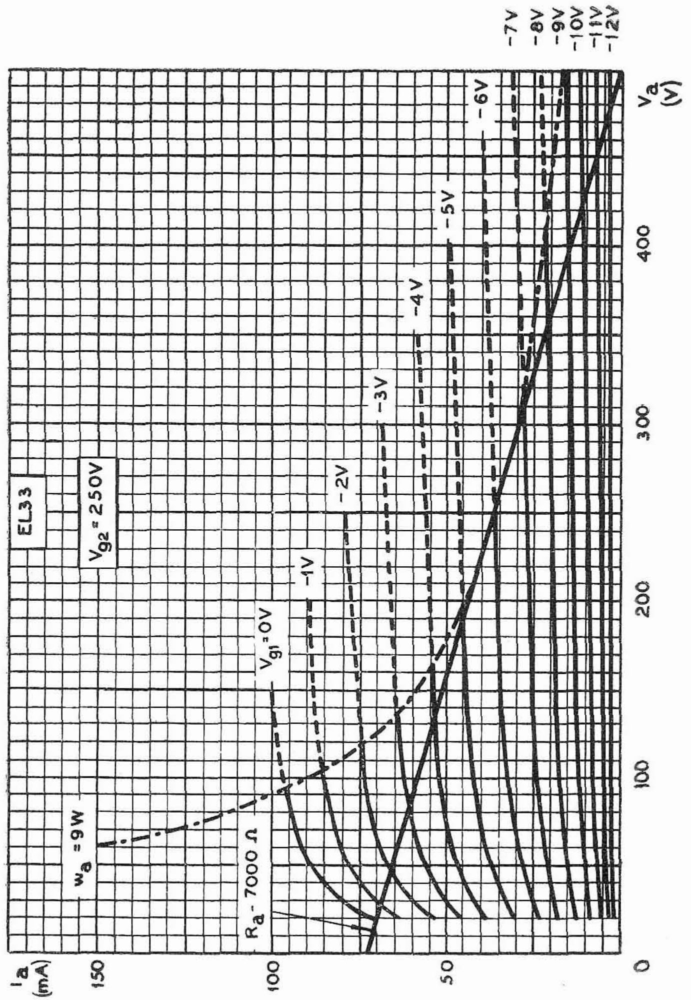


ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

EL33

OUTPUT PENTODE

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



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

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%.

EL34

OUTPUT PENTODE

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Distributed load conditions for maximum output (screen-grid tapping at 20% of primary turns)

V_b	450	V
R_{g2} (per valve)	1.0	kΩ
R_k (per valve)	500	Ω
R_{a-a}	7.0	kΩ
$I_{a(o)}$	2×55	mA←
$I_{g2(o)}$	2×9.0	mA←
$V_{in(g1-g1)r.m.s.}$	55.2	V
P_{out}	40	W
D_{tot}	4.5	%
$I_{a(max.\ sig.)}$	2×74	mA
$I_{g2(max.\ sig.)}$	2×9.0	mA

Distributed load conditions for minimum distortion (with screen-grid tapping at 43% of primary turns)

V_b	430	430	V
R_{g2} (per valve)	1.0	1.0	kΩ
R_k (per valve)	470	470	Ω
R_{a-a}	6.0	6.0	kΩ
$I_{a(o)}$	2×62.5	2×62.5	mA
$I_{g2(o)}$	2×10	2×10	mA
$V_{in(g1-g1)r.m.s.}$	35	50	V
P_{out}	20	34	W
D_{tot}	0.35	2.5	%
$I_{a\ (max.\ sig.)}$	2×65	2×70	mA
$I_{g2(max.\ sig.)}$	2×10.2	2×14	mA

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Fixed bias

V_b	375	400	V
V_{g3}	0	0	V
*R_{g2}	600	800	Ω
V_{g1}	−33	−36	V
R_{a-a}	3.5	3.5	kΩ
$I_{a(o)}$	2×30	2×30	mA
$I_{g2(o)}$	2×4.7	2×4.5	mA
$V_{in(g1-g1)r.m.s.}$	46.7	50	V
P_{out}	48	54	W
D_{tot}	2.8	1.6	%
$I_{a(max.\ sig.)}$	2×107.5	2×110.5	mA
$I_{g2\ (max.\ sig.)}$	2×23.5	2×23	mA

*Screen-grid resistor common to both valves.

Cathode bias

V_b	375	450	V
V_{g3}	0	0	V
$^*R_{g2}$	0.47	1.0	kΩ
R_k (per valve)	260	465	Ω
R_{a-a}	3.5	6.5	kΩ
$I_{a(o)}$	2×75	2×60	mA
$I_{g2(o)}$	2×12.5	2×10	mA
$V_{in(g1-g1)r.m.s.}$	40	54	V
P_{out}	35	40	W
D_{tot}	1.7	5.1	%
$I_{a(max.\ sig.)}$	2×94	2×71.5	mA
$I_{g2(max.\ sig.)}$	2×19.5	2×22	mA

*Screen-grid resistor common to both valves.

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Triode connection (g_2 connected to a, g_3 to k) with separate cathode bias resistors.

With R_k bypassed

V_b	430	V
V_a	400	V
V_{g3}	0	V
R_k (per valve)	440	Ω
R_{a-a}	5.0	kΩ
$I_{a(o)}$	2×70	mA
$V_{in(g1-g1)r.m.s.}$	48	V
P_{out}	19	W
D_{tot}	1.8	%
$I_{a(max.\ sig.)}$	2×75	mA

With R_k unbypassed

V_b	430	V
V_a	400	V
V_{g3}	0	V
R_k (per valve)	440	Ω
R_{a-a}	10	kΩ
$I_{a(o)}$	2×70	mA
$V_{in(g1-g1)r.m.s.}$	48	V
P_{out}	14	W
D_{tot}	0.4	%
$I_{a(max.\ sig.)}$	2×73	mA

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL WITH CONTINUOUS SINE WAVE DRIVE

Fixed bias

V_b	375	400	V
V_{g3}	0	0	V
R_{g2}	1.0	1.5	kΩ
V_{g1}	−32	−35.5	V
R_{a-a}	3.5	3.5	kΩ
$I_{a(o)}$	2×30	2×30	mA
$I_{g2(o)}$	2×4.4	2×4.4	mA
$V_{in(g1-g1)r.m.s.}$	45	50	V
P_{out}	42	51	W
D_{tot}	3.0	1.8	%
$I_{a(max.\ sig.)}$	2×98	2×106	mA
$I_{g2(max.\ sig.)}$	2×19	2×21	mA

Cathode bias

Any of the cathode bias conditions published in this data sheet are suitable for continuous sine wave drive.

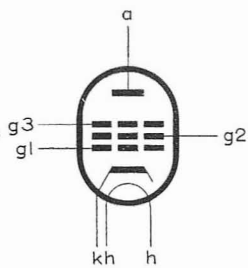
DESIGN CENTRE RATINGS

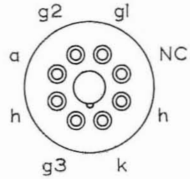
$V_{a(b)}$ max.	2.0	kV
V_a max.	800	V
p_a max.	25	W
$V_{g2(b)}$ max.	800	V
V_{g2} max.	500	V
p_{g2} max.	8.0	W
I_k max.	150	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

Triode connected

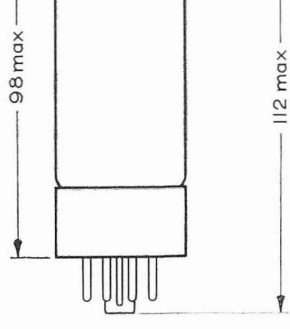
V_a max.	600	V
p_{a+g2} max. ($V_a = 500V$)	30	W
p_{a+g2} max. ($V_a = 600V$)	15	W

6299

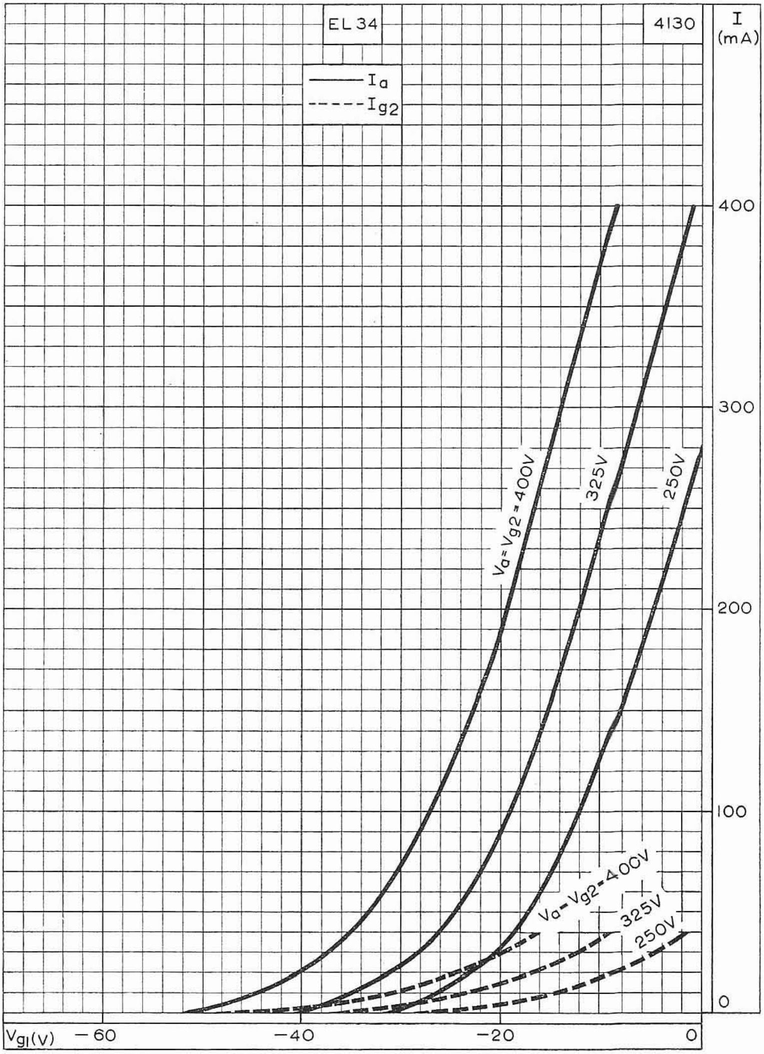




Octal Base



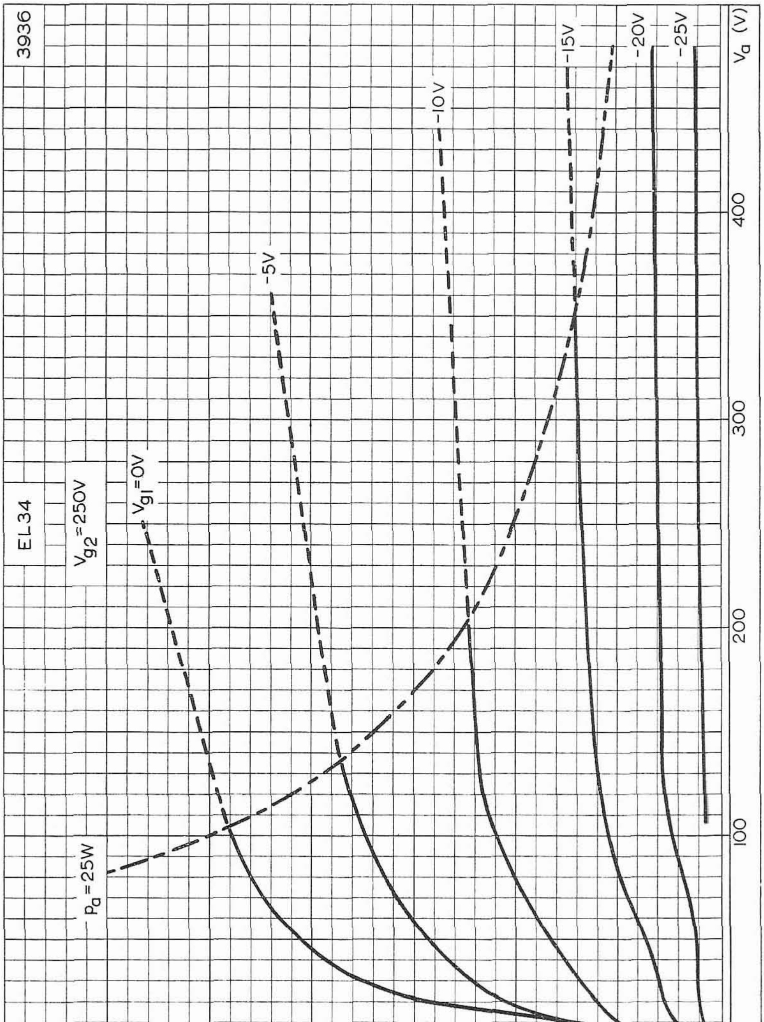
All dimensions in mm



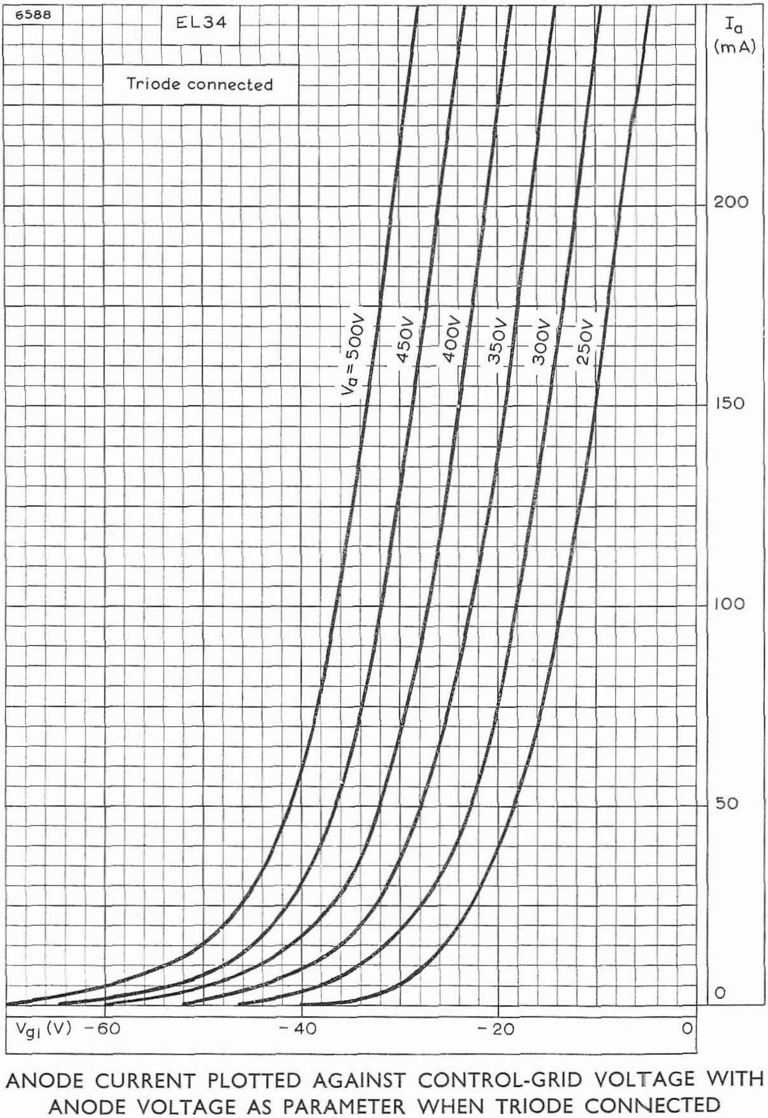
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE AND SCREEN-GRID VOLTAGES AS PARAMETERS

EL34

OUTPUT PENTODE



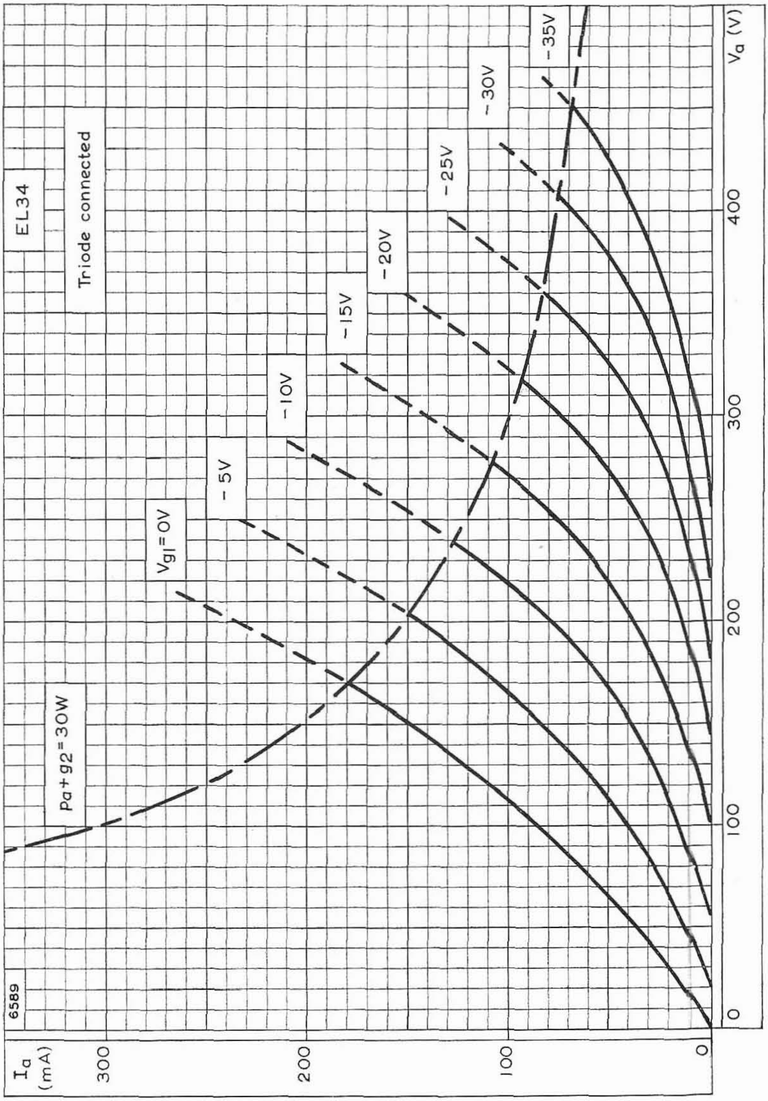
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



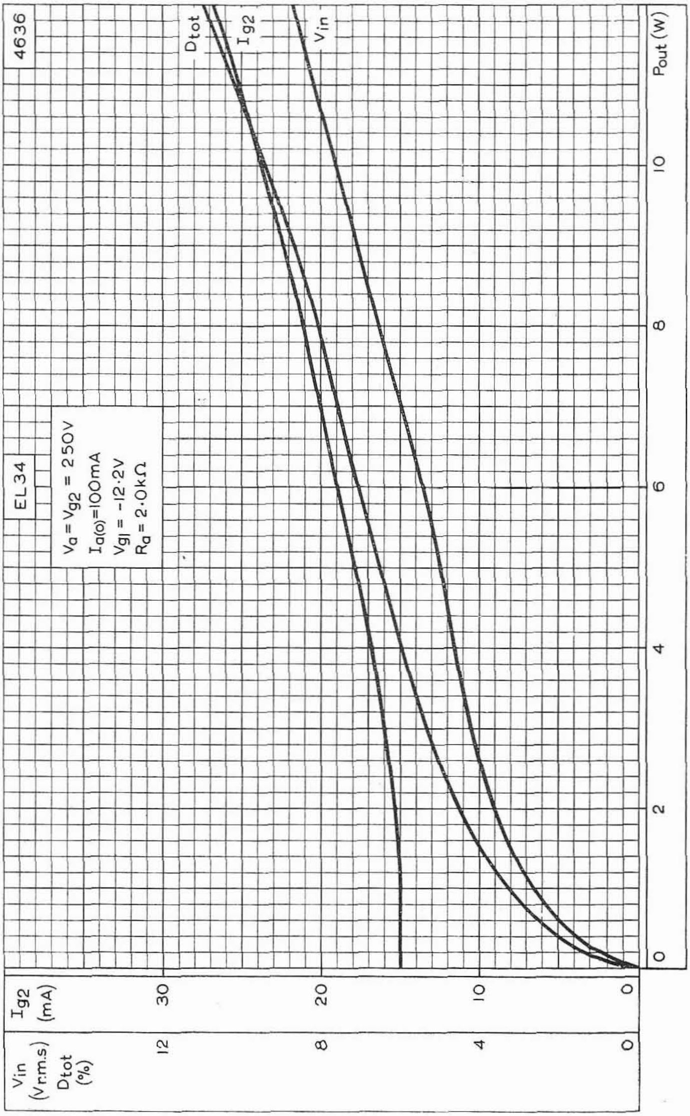
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED

EL34

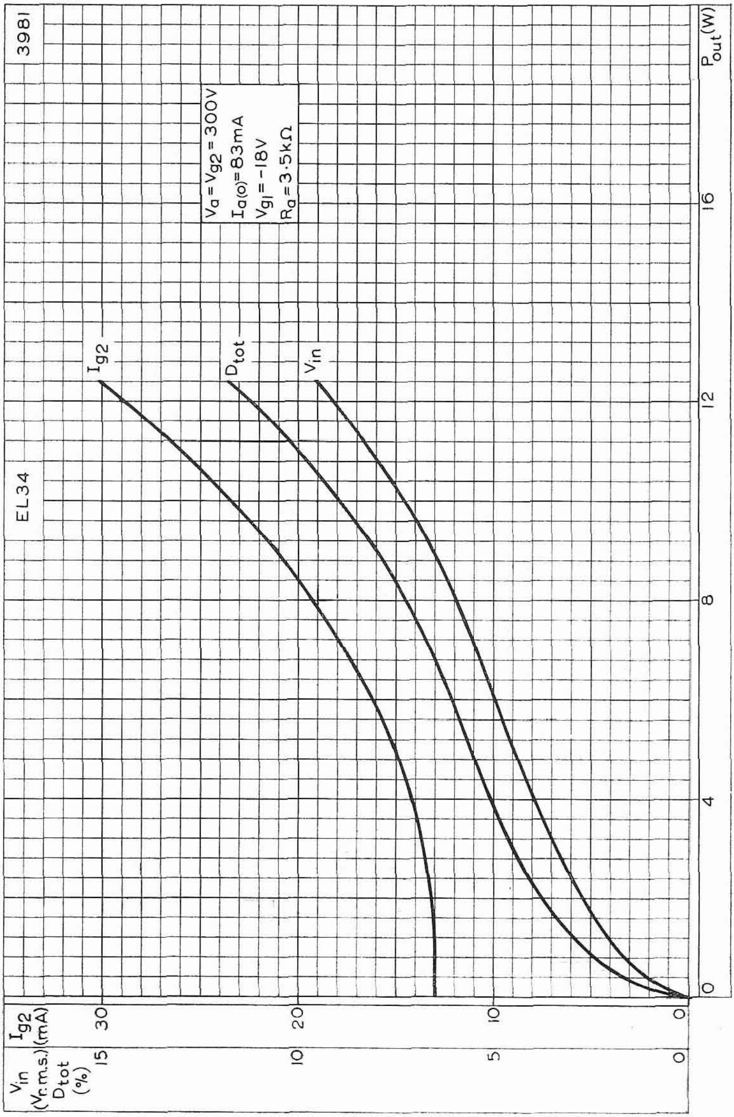
OUTPUT PENTODE



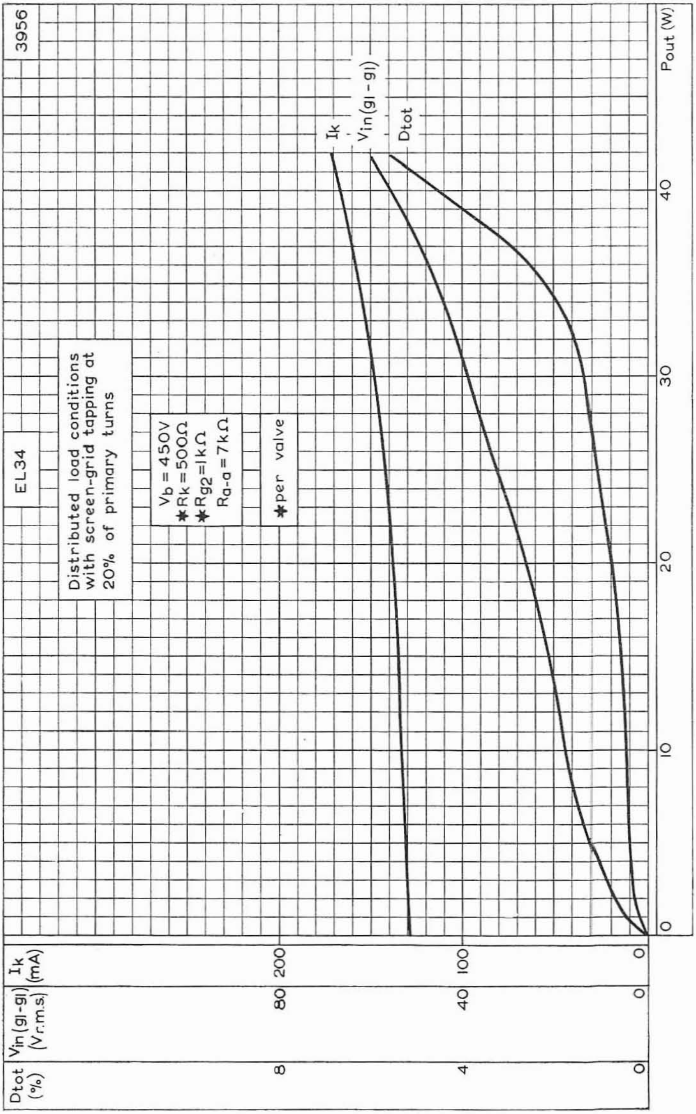
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED



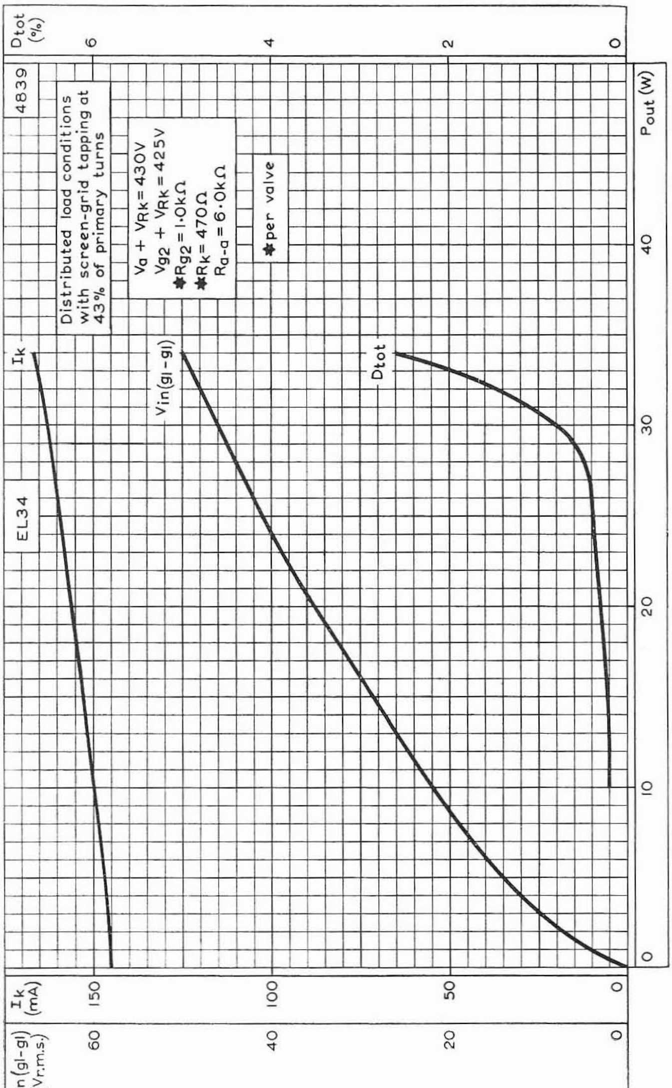
PERFORMANCE OF EL34 WHEN USED AS A SINGLE VALVE CLASS 'A' AMPLIFIER. $V_a = 250V$



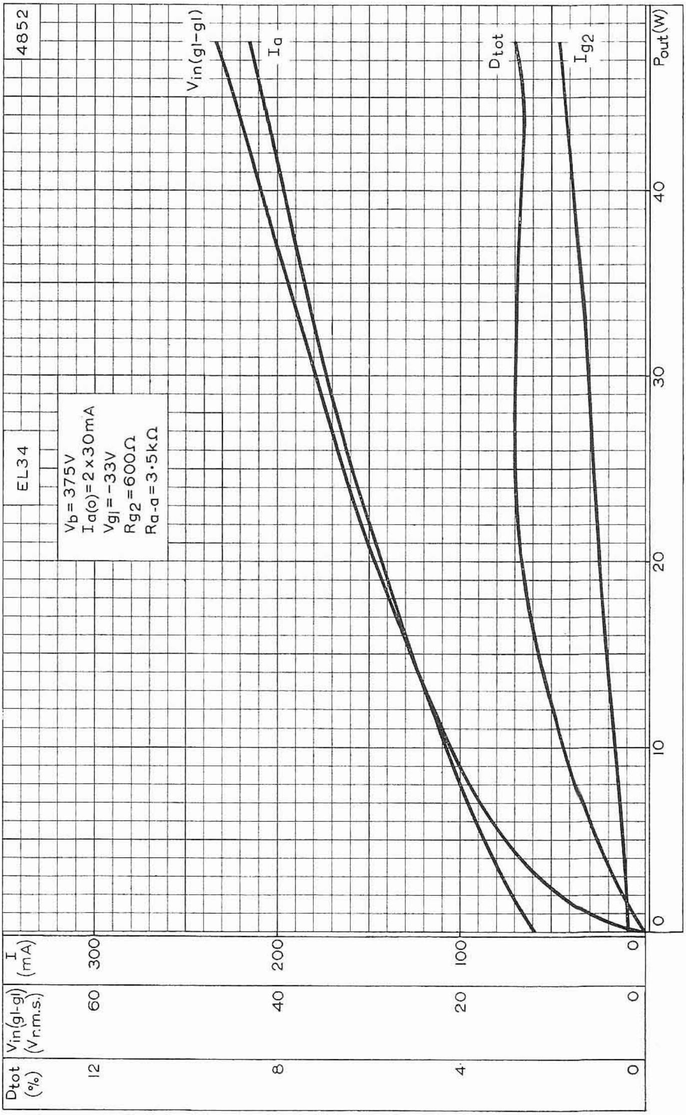
PERFORMANCE OF EL34 WHEN USED AS A SINGLE VALVE CLASS 'A' AMPLIFIER. $V_a = 300V$



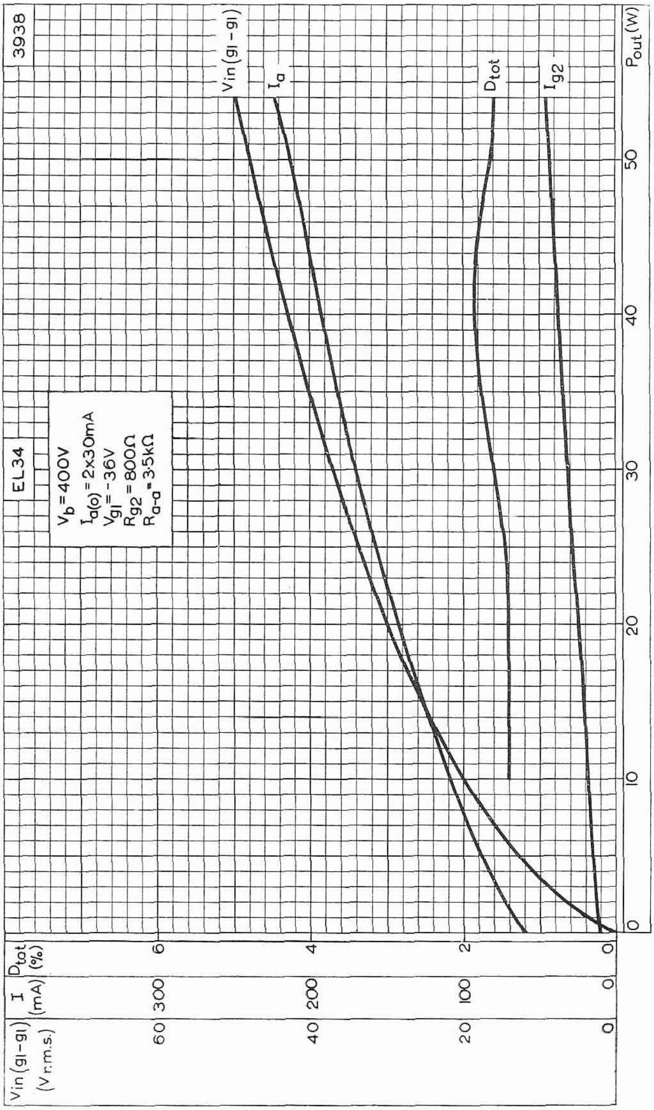
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS



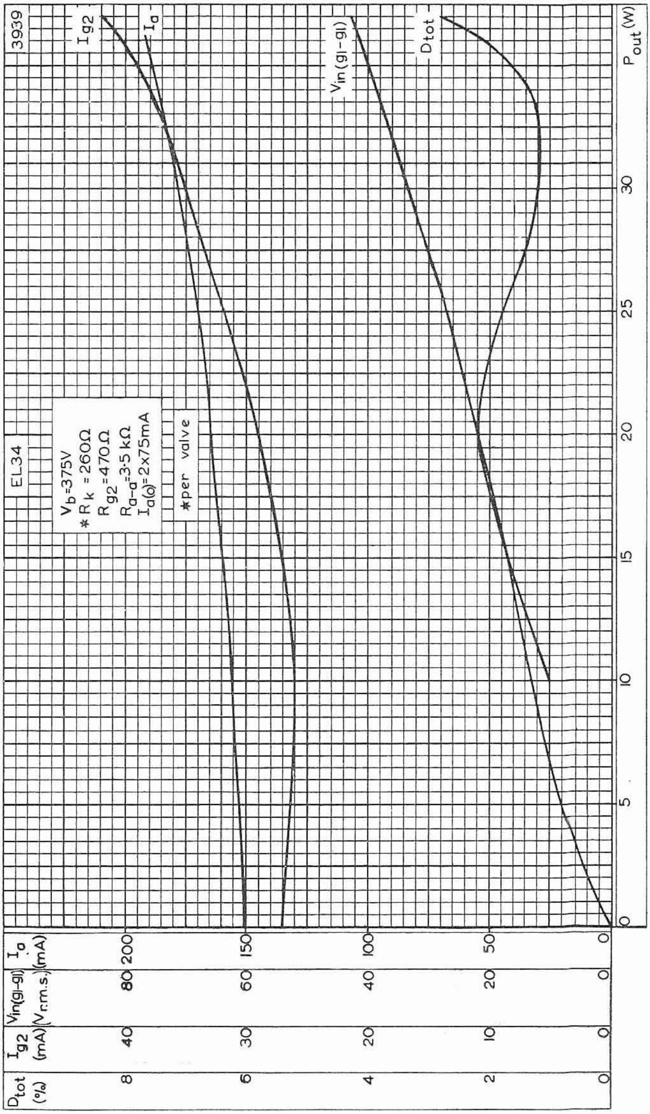
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS



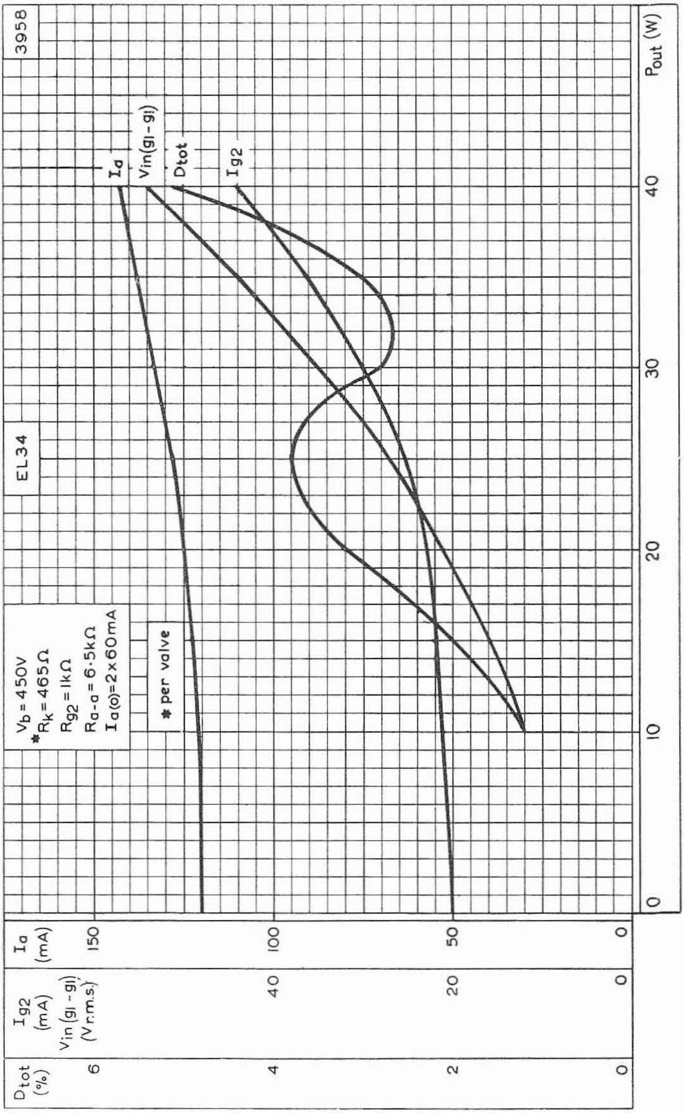
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH FIXED BIAS
$V_b = 375V$



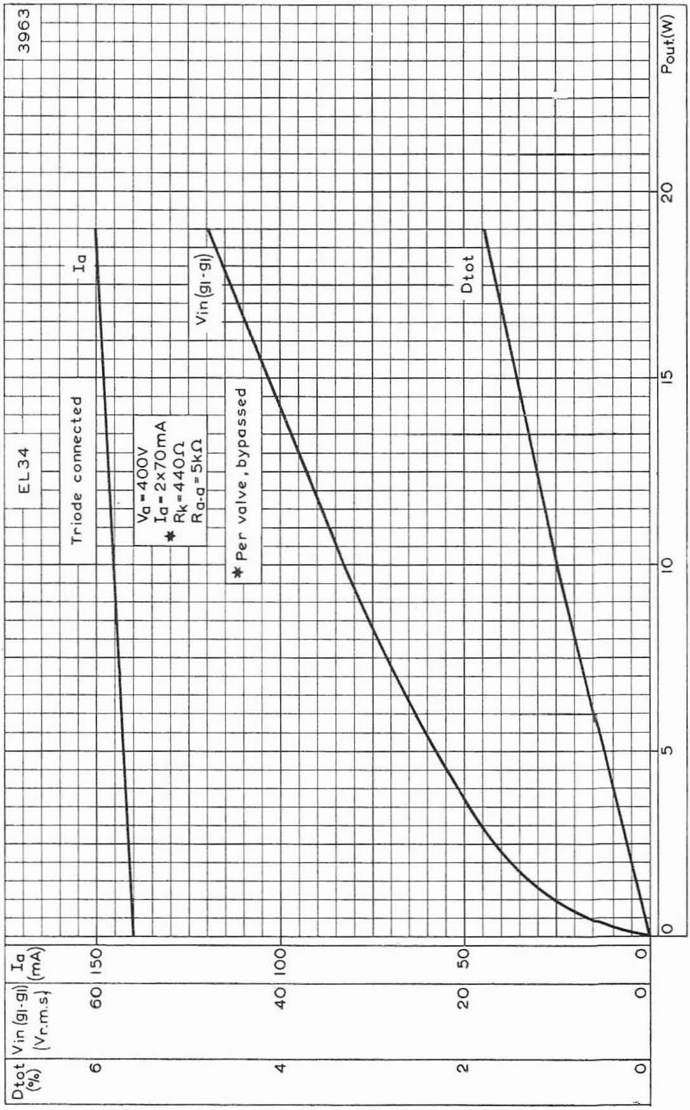
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH FIXED BIAS
$V_b = 400V$



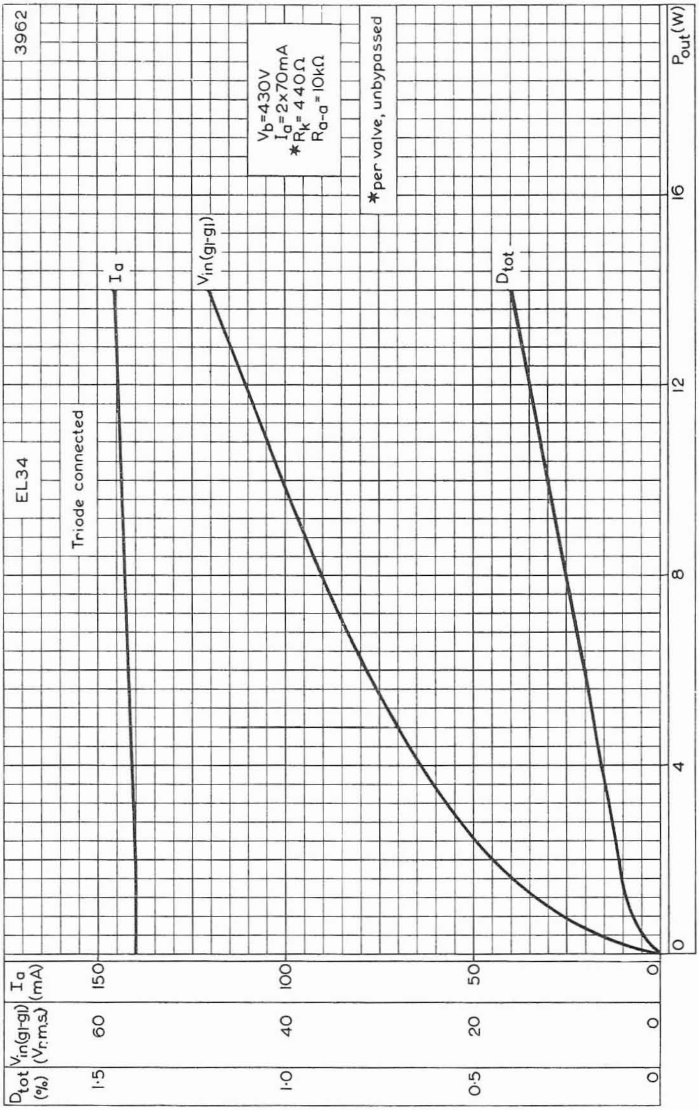
PERFORMANCE OF TWO EL34 IN PUSH-PULL WITH CATHODE BIAS
$V_b = 375V$



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
$I_{a(o)}$	2×40	2×50	mA
I_a (max. sig.)	2×118	2×138	mA
$I_{g2(o)}$	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
$I_{a+g2(o)}$	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.

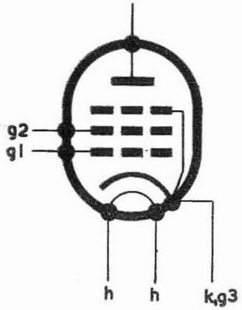
R_{g1-k} max. (cathode bias)	500	kΩ
R_{g1-k} max. (fixed bias)	100	kΩ
p_a max.	25	W
p_{g2} max.	6.0	W
I_k max.	200	mA

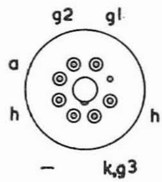
LIMITING VALUES — TRIODE CONNECTED (NORMAL APPLICATIONS)

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

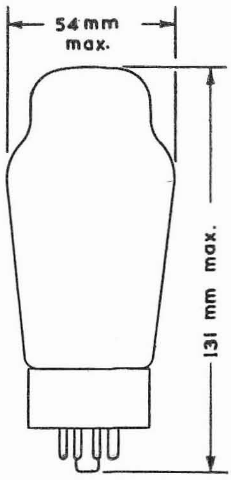
LIMITING VALUES — TRIODE CONNECTED (IN CATHODE-COUPLED PUSH-PULL DRIVER STAGE FOR LARGE POWER TRIODES)

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





OCTAL BASE



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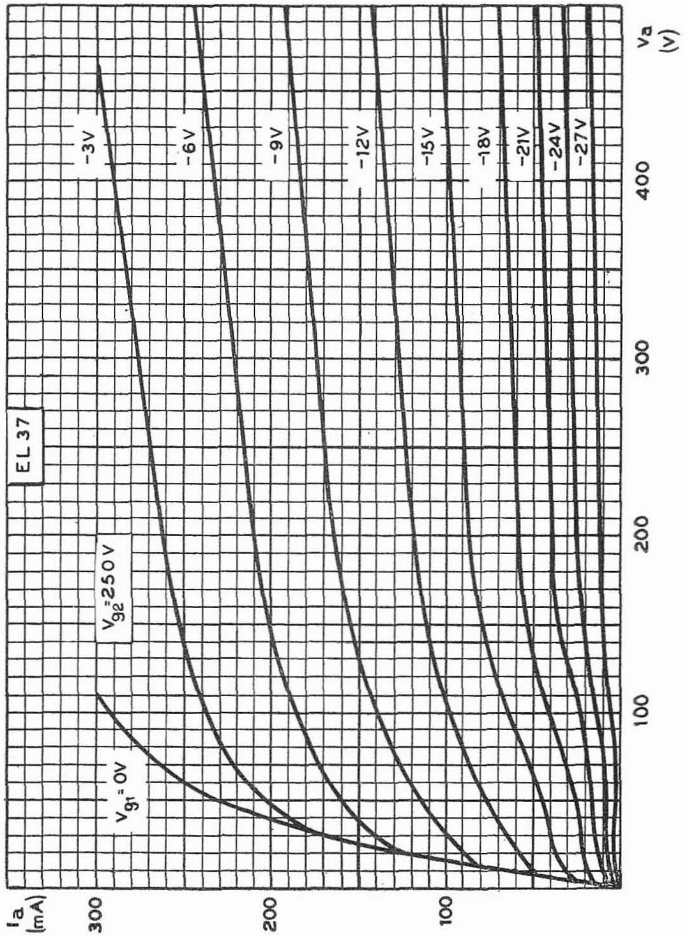
EL37

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.

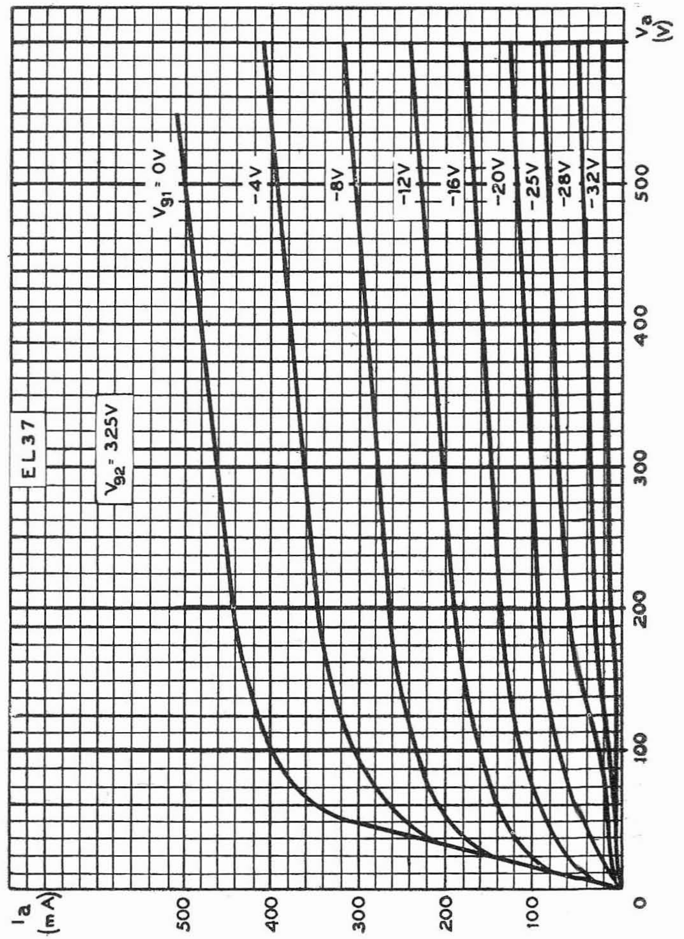


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE OF 250 V

OUTPUT PENTODE

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.

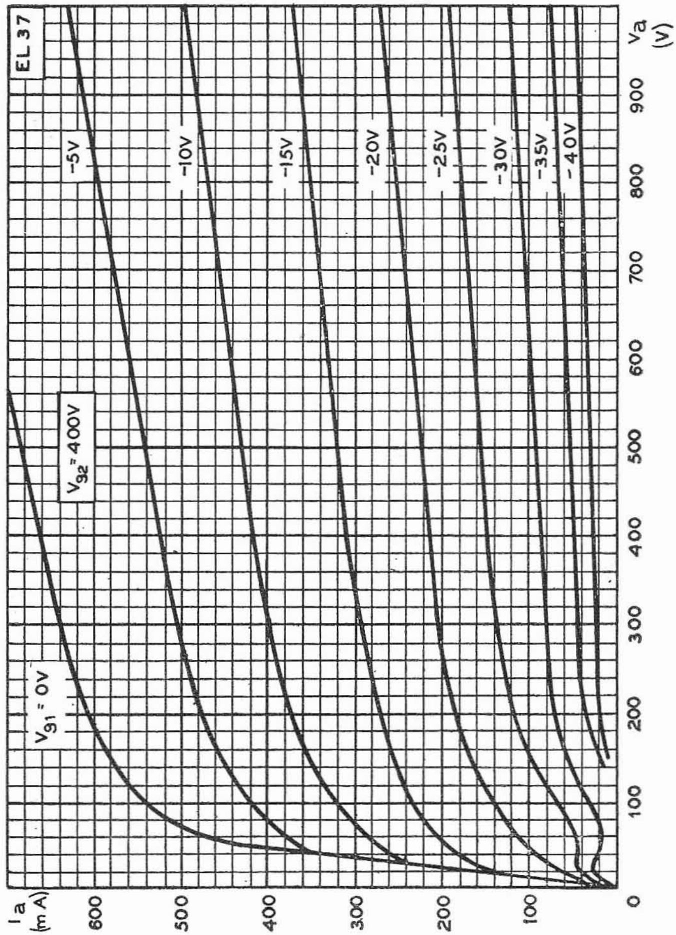


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE OF 325V

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.

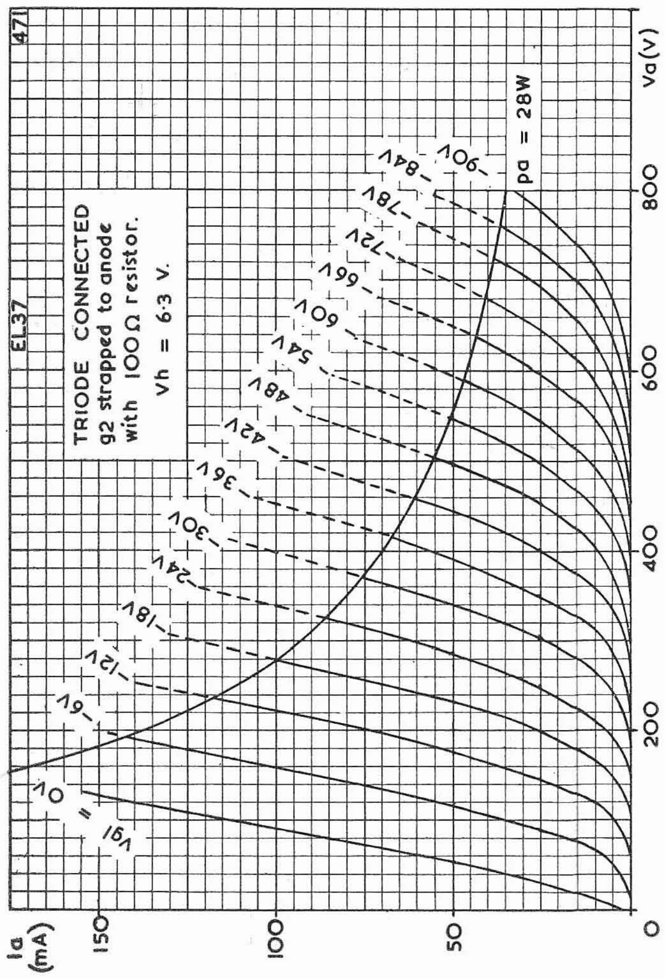


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE OF 400V

OUTPUT PENTODE

EL37

25-watt pentode, particularly suitable for use in push-pull combination for outputs up to 69W, or as drivers for large power triode push-pull output stage.

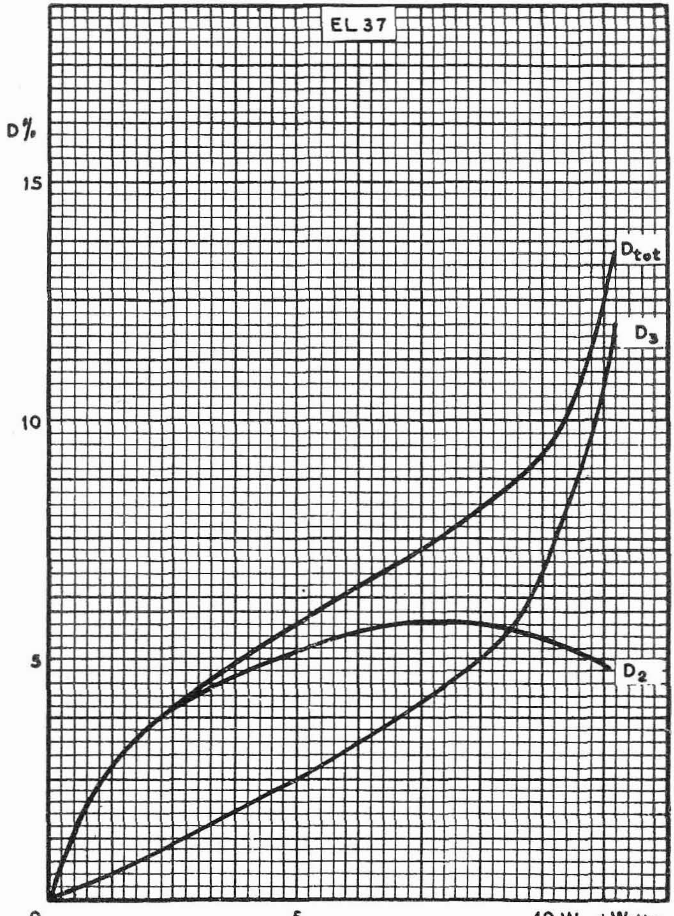


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WHEN CONNECTED AS A TRIODE WITH SCREEN-GRID CONNECTED TO ANODE WITH 100Ω RESISTOR

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.

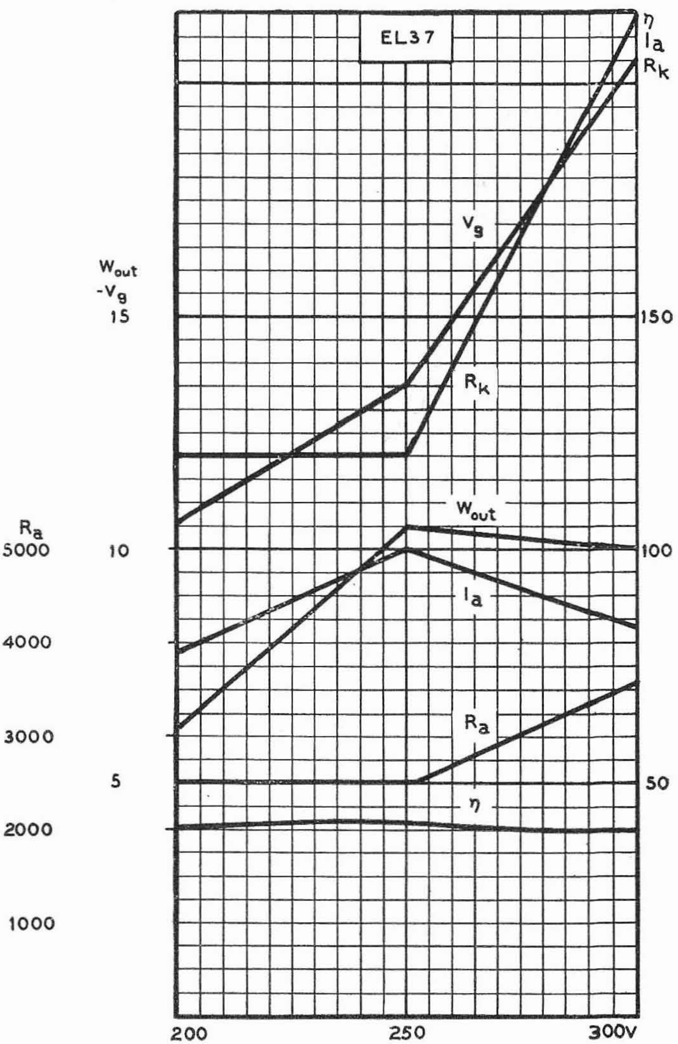


DISTORTION PLOTTED AGAINST OUTPUT POWER FOR SINGLE VALVE OPERATION AT $V_a = V_{g2} = 250V$

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.

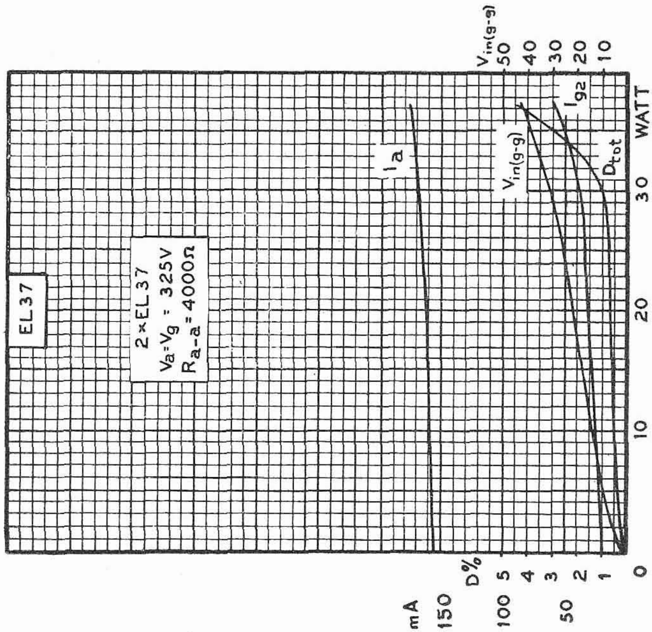


OPERATING CONDITIONS AS SINGLE VALVE FOR ANODE AND SCREEN-GRID VOLTAGES BETWEEN 200 V AND 300 V

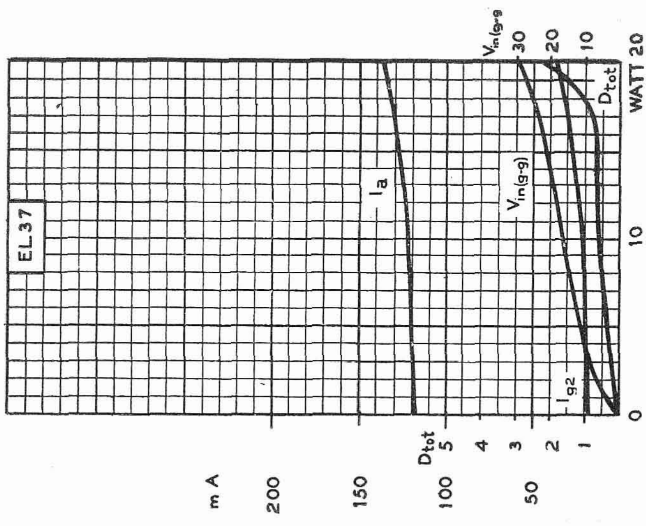
EL37

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.



DISTORTION AND INPUT VOLTAGE PLOTTED AGAINST OUTPUT POWER FOR PUSH-PULL OPERATION WITH SELF-BIAS AT $V_a = V_{g2} = 325$ V

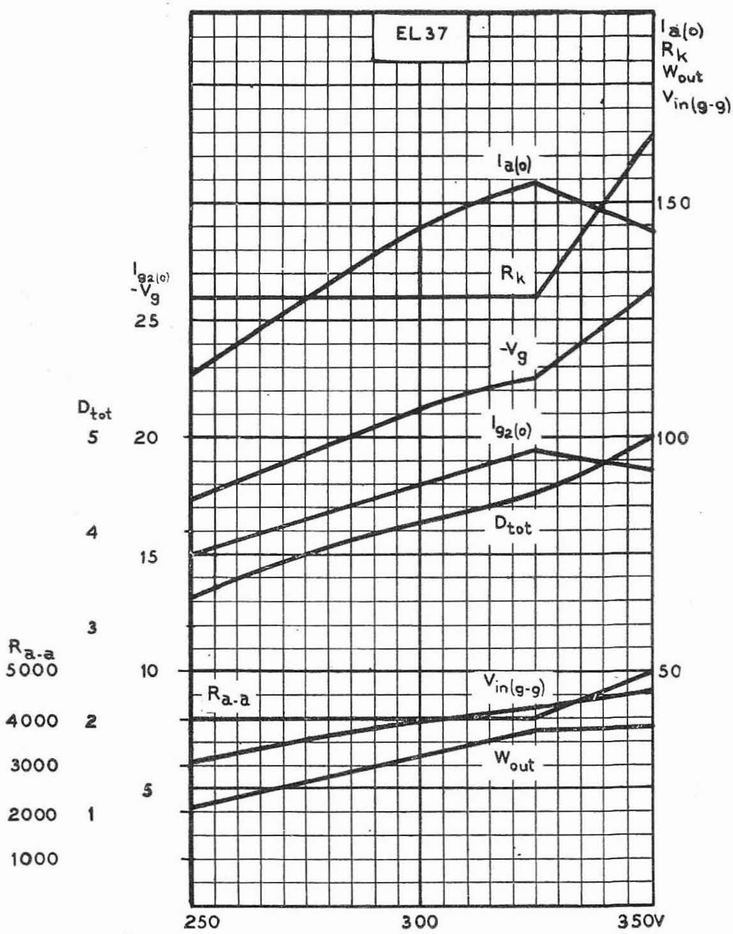


DISTORTION AND INPUT VOLTAGE PLOTTED AGAINST POWER OUTPUT FOR PUSH-PULL OPERATION WITH SELF-BIAS AT $V_a = V_{g2} = 250$ V

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.

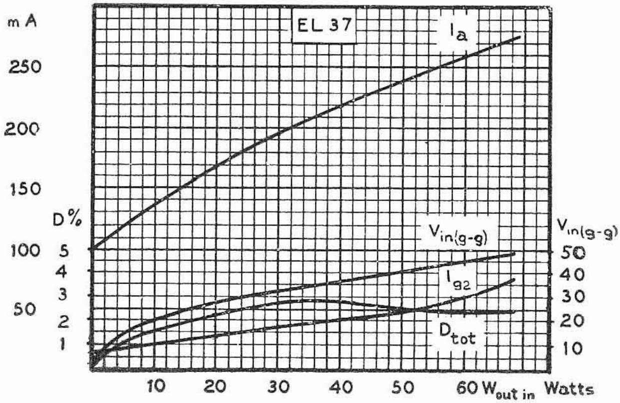


SELF BIAS PUSH-PULL OPERATING CONDITIONS FOR ANODE AND SCREEN-GRID VOLTAGES BETWEEN 250 AND 350V

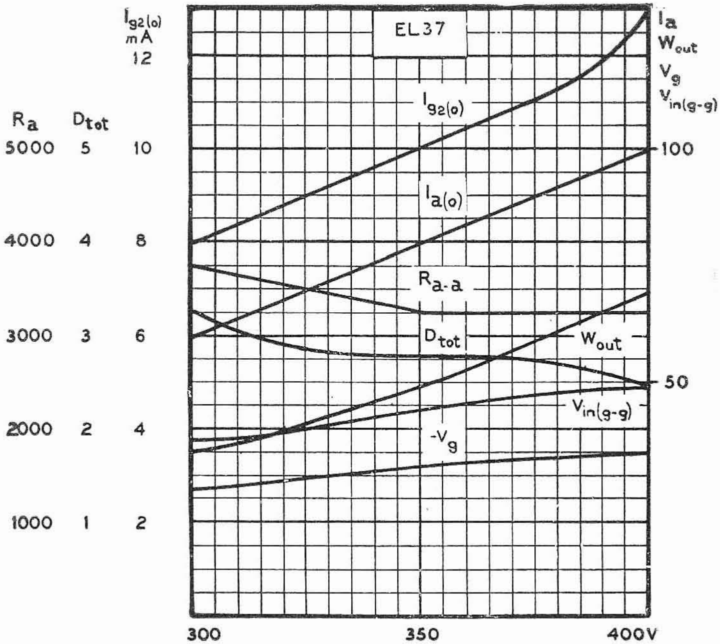
EL37

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.



DISTORTION AND INPUT VOLTAGE PLOTTED AGAINST OUTPUT POWER FOR PUSH-PULL OPERATION WITH FIXED BIAS AT $V_a = V_{g2} = 400V$



FIXED BIAS PUSH-PULL OPERATING CONDITIONS FOR ANODE AND SCREEN-GRID VOLTAGES BETWEEN 300 AND 400V

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 $\not<$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.

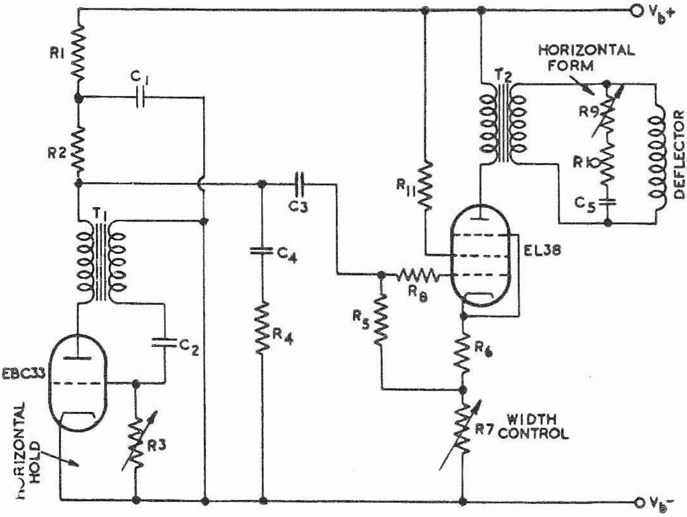
(ii) The decoupling components (R_1 C_1) in the anode circuit of the EBC33 are necessary only if there is ripple on the H.T. line.

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

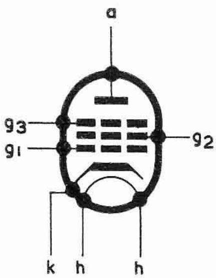
OUTPUT PENTODE

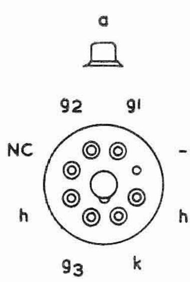
EL38

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

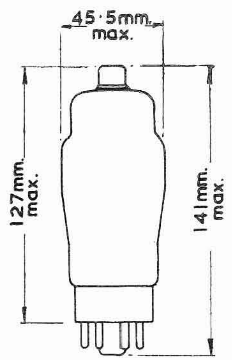


LINE TIME BASE CIRCUIT





OCTAL BASE



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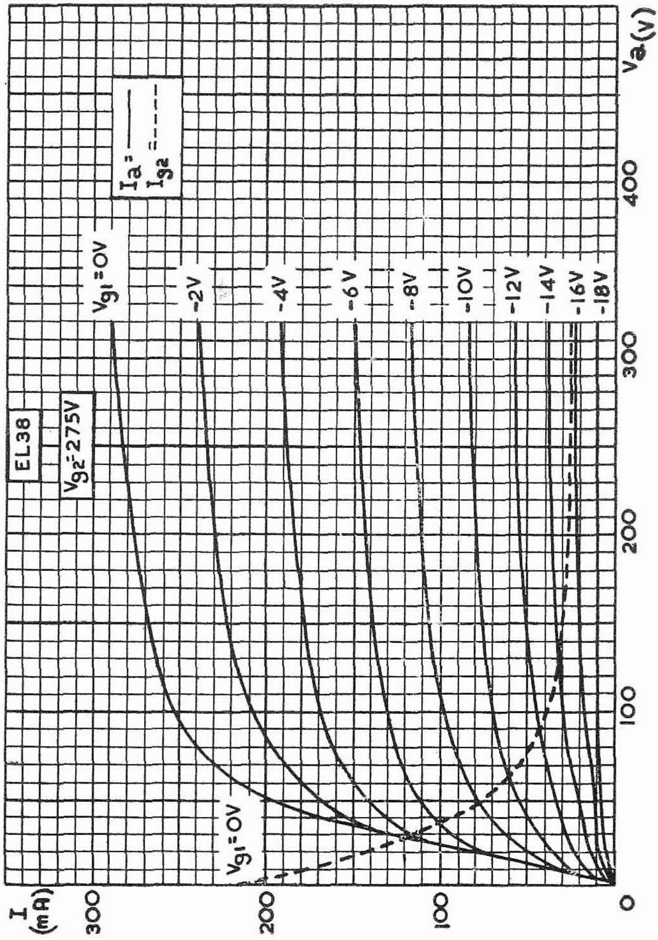
EL38

OUTPUT PENTODE

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



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

OUTPUT PENTODE

EL41

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

HEATER

V_h	6.3	V
I_h	0.7	A

MOUNTING POSITION — Any

CAPACITANCES

c_{out}	7.8	pF
c_{in}	10.2	pF
c_{a-g1}	<1.0	pF
c_{g1-h}	<0.15	pF

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
I_a	36	mA
I_{g2}	5.2	mA
V_{g1}	–7	V
g_m	10	mA/V
r_a	40	kΩ
μ_{g1-g2}	22	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Pentode connection

V_a	250	V
V_{g2}	250	V
V_{g1}	–7	V
R_k	170	Ω
I_a	36	mA
I_{g2}	5.2	mA
R_a	7	kΩ
$V_{in\ (r.m.s.)}$ (P_{out}=50mW)	0.32	V
P_{out} (D_{tot}=10%)	4.2	W
$V_{in\ (r.m.s.)}$ (D_{tot}=10%)	3.7	V
P_{out} (η=50%)	4.5	W
$V_{in\ (r.m.s.)}$ (P_{out}=4.5W)	4.0	V
D_{tot} (P_{out}=4.5W)	11.5	%

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Triode connection (g_2 connected to a)

V_a	250	V
R_k	250	Ω
R_a	3.5	kΩ
I_a	33	mA
P_{out}	1.55	W
$V_{in\ (r.m.s.)}$	6	V
D_{tot}	8	%

EL41

OUTPUT PENTODE

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

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Pentode connection

V_a	250	300	V
V_{g2}	250	300	V
$I_{a(o)}$	2×25	2×30	mA
I_a (max. sig.)	2×30	2×36	mA
$I_{g2(o)}$	2×3.5	2×4	mA
I_{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
$I_{a\ (o)}$	2×27.5	2×33	mA
R_k	150	150	Ω
R_{a-a}	10	10	kΩ
P_{out}	2.5	4	W
$V_{in\ (g-g)\ (r.m.s.)}$	5.4	6.7	V
D_{tot}	1	1	%

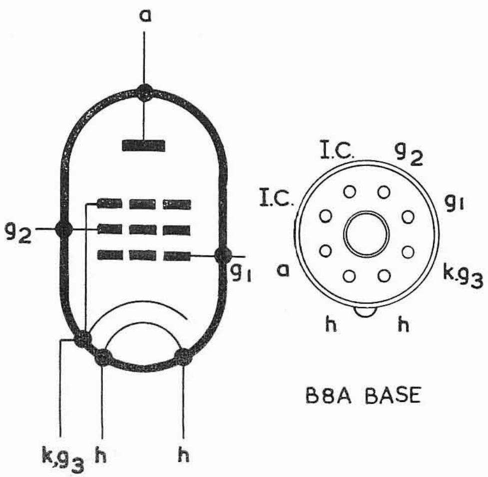
LIMITING VALUES

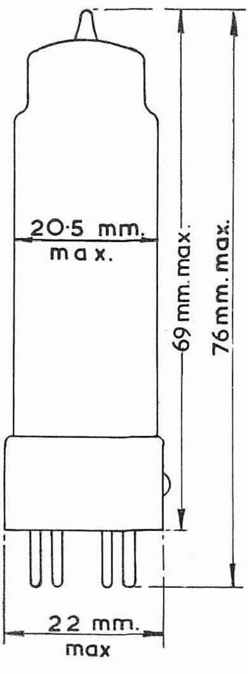
$V_{a\ (b)}$ max.	550	V
V_a max.	300	V
p_a max.	9	W
$V_{g2\ (b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} (zero sig.) max.	1.4	W
p_{g2} (max. sig.) max.	3.3	W
I_k max.	55	mA
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
R_{g1-k} max.	1	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ

OUTPUT PENTODE

EL41

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





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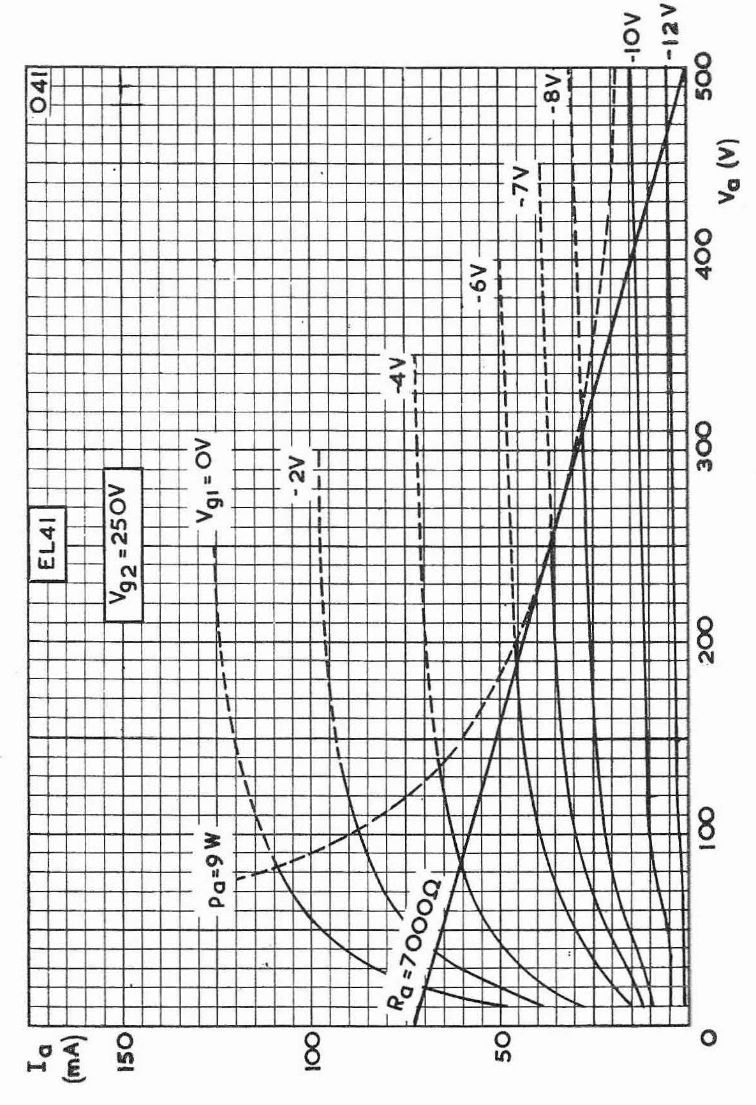
EL41

OUTPUT PENTODE

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

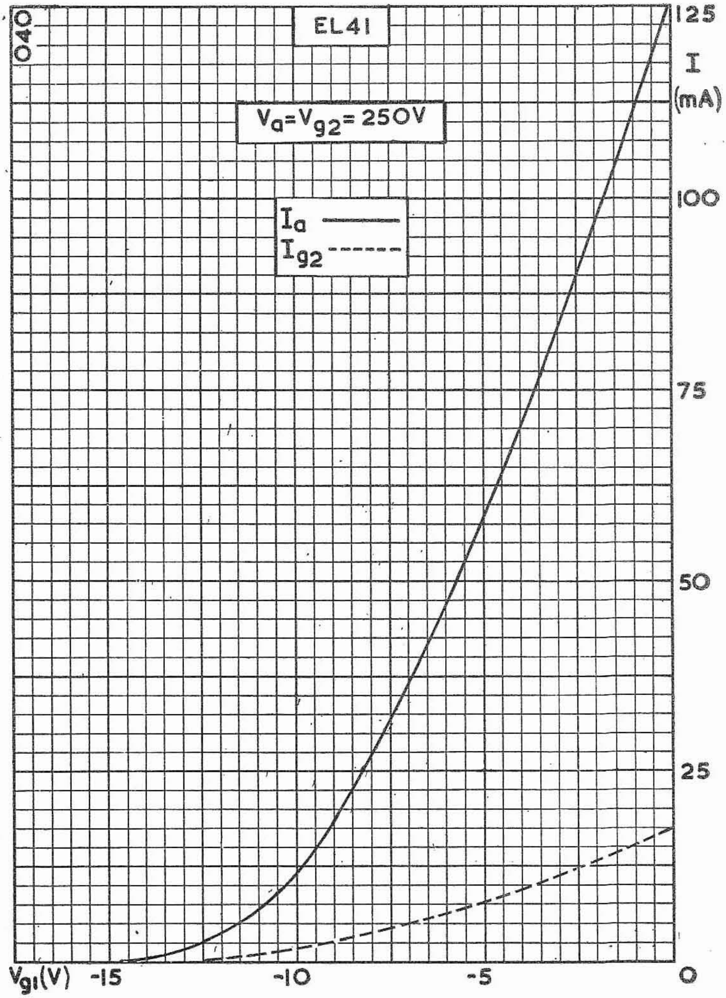


ANODE CURRENT PLOTTED AGAINST ANODE VOLTS

OUTPUT PENTODE

EL41

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

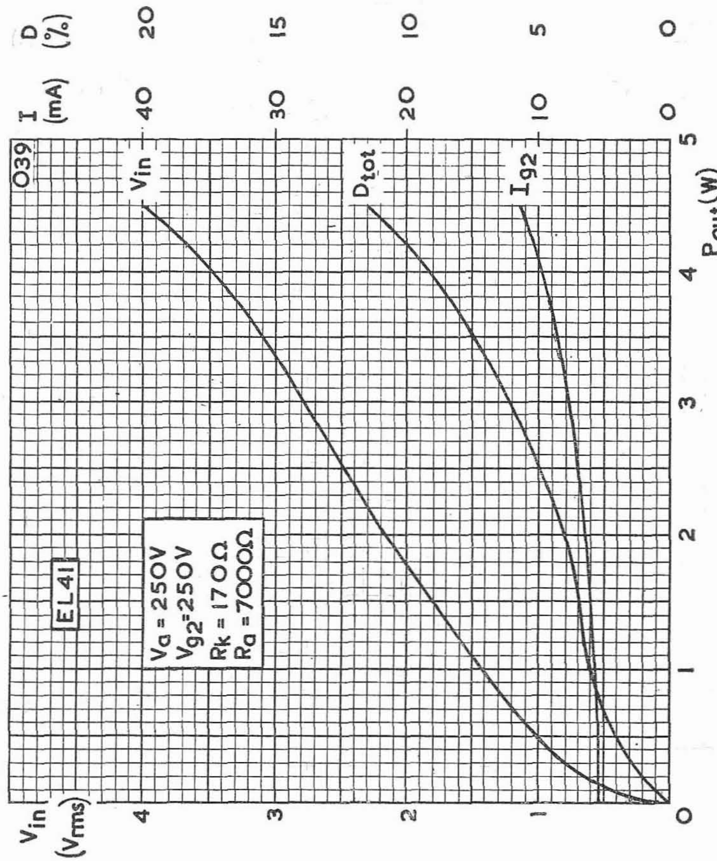


ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTS

EL41

OUTPUT PENTODE

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



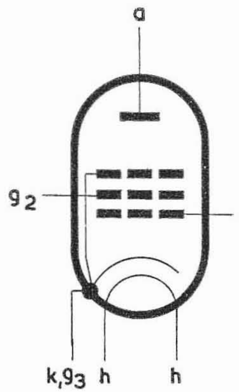
DRIVE VOLTAGE, SCREEN-GRID CURRENT AND TOTAL DISTORTION PLOTTED AGAINST OUTPUT POWER FOR SINGLE VALVE CLASS "A" AMPLIFIER

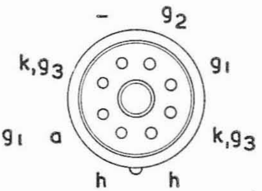
OUTPUT PENTODE

EL42

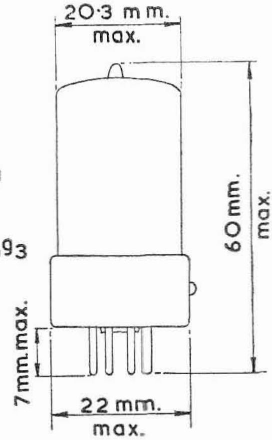
Output pentode with an anode dissipation of 6 W, suitable for use in car radio receivers.

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



128

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

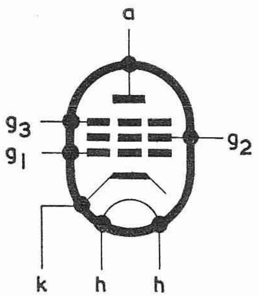
OUTPUT PENTODE

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

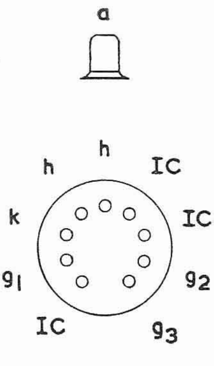
LIMITING VALUES

$V_{a(b)}$ 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

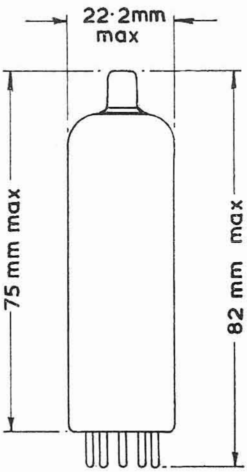
*Max. pulse duration 18% of one cycle, with a maximum of 18μs



2710



B9A Base



OUTPUT PENTODE

EL84

Output pentode rated for 12W anode dissipation, primarily intended for use in a.c. mains operated equipment.

HEATER

V_h	6.3	V
I_h	760	mA

CAPACITANCES

c_{in}	10.8	pF
c_{out}	6.5	pF
c_{a-g1}	$<$500	mpF
c_{g1-h}	$<$250	mpF

CHARACTERISTICS

Pentode connection

V_a	250	V
V_{g2}	250	V
I_a	48	mA
I_{g2}	5.5	mA
V_{g1}	−7.3	V
g_m	11.3	mA/V
r_a	38	kΩ
μ_{g1-g2}	19	

Triode connection
(g_2 connected to a)

V_a	250	V
I_a	34	mA
V_{g1}	−9.0	V
g_m	10	mA/V
r_a	2.0	kΩ
μ	19.5	

OPERATING CONDITIONS AS SINGLE VALVE AMPLIFIER

Pentode connection

V_a	250	250	V
V_{g2}	250	250	V
R_a	5.2	4.5	kΩ
V_{g1}	−7.3	−7.3	V
I_a	48	48	mA
I_{g2}	5.5	5.5	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	300	300	mV
$V_{in(r.m.s.)}$ (D_{tot} = 10%)	4.3	4.4	V
P_{out} (D_{tot} = 10%)	5.7	5.7	W
D_3	9.5	8.0	%
D_2	2.0	5.0	%

Triode connection (g_2 connected to a)

V_a	250	V
R_a	3.5	kΩ
V_{g1}	−9.0	V
$I_{a(o)}$	34	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	1.0	V
$V_{in(r.m.s.)}$	6.0	V
P_{out}	1.5	W
D_{tot}	6.0	%
$I_{a(max.sig.)}$	39	mA

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.

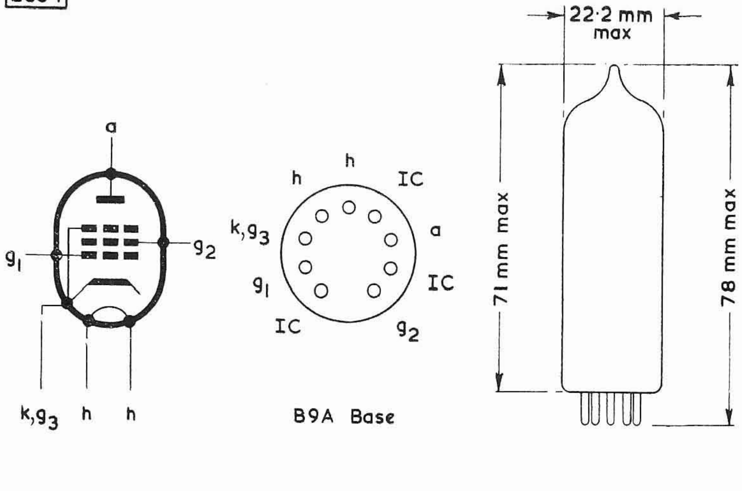
LIMITING VALUES

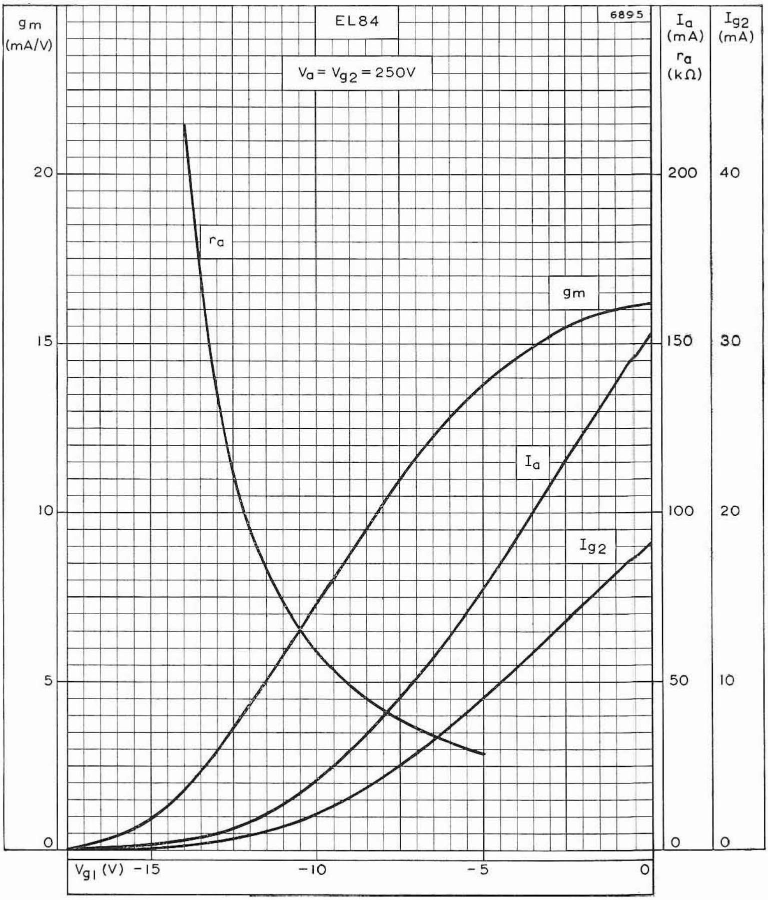
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	2.0	W
I_k max.	65	mA
$-V_g$ max.	100	V
R_{g1-k} max.	300	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

EL84

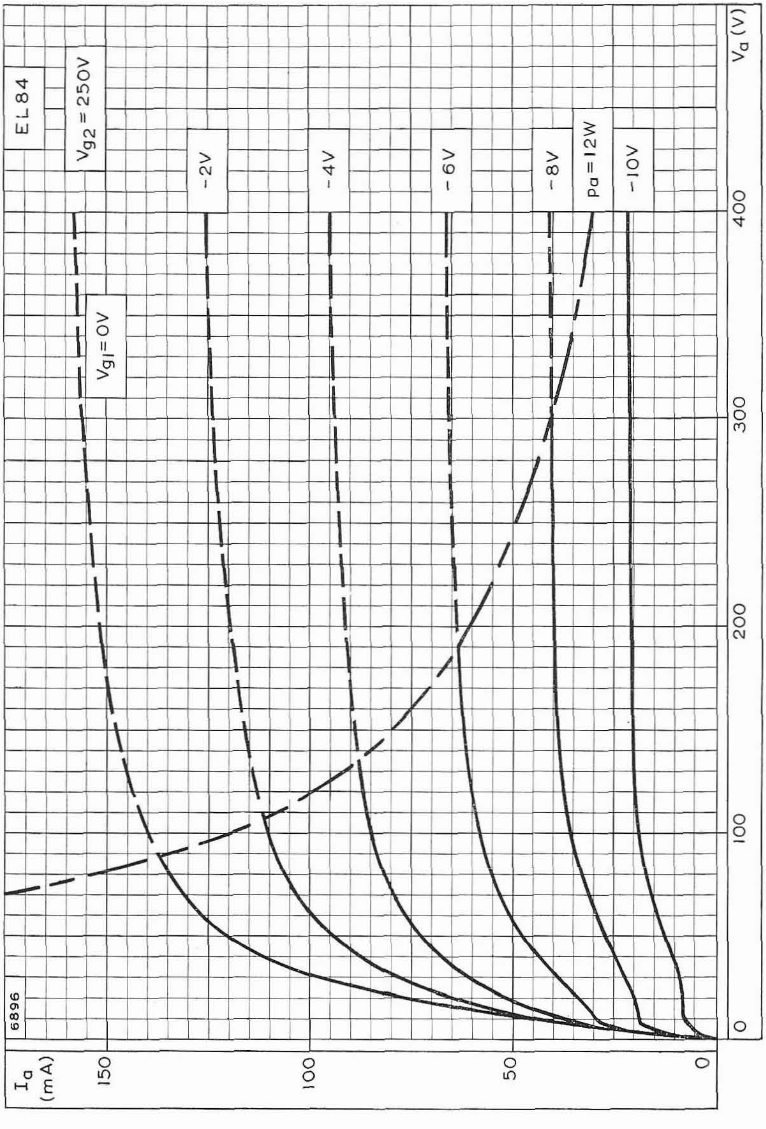
OUTPUT PENTODE

2834

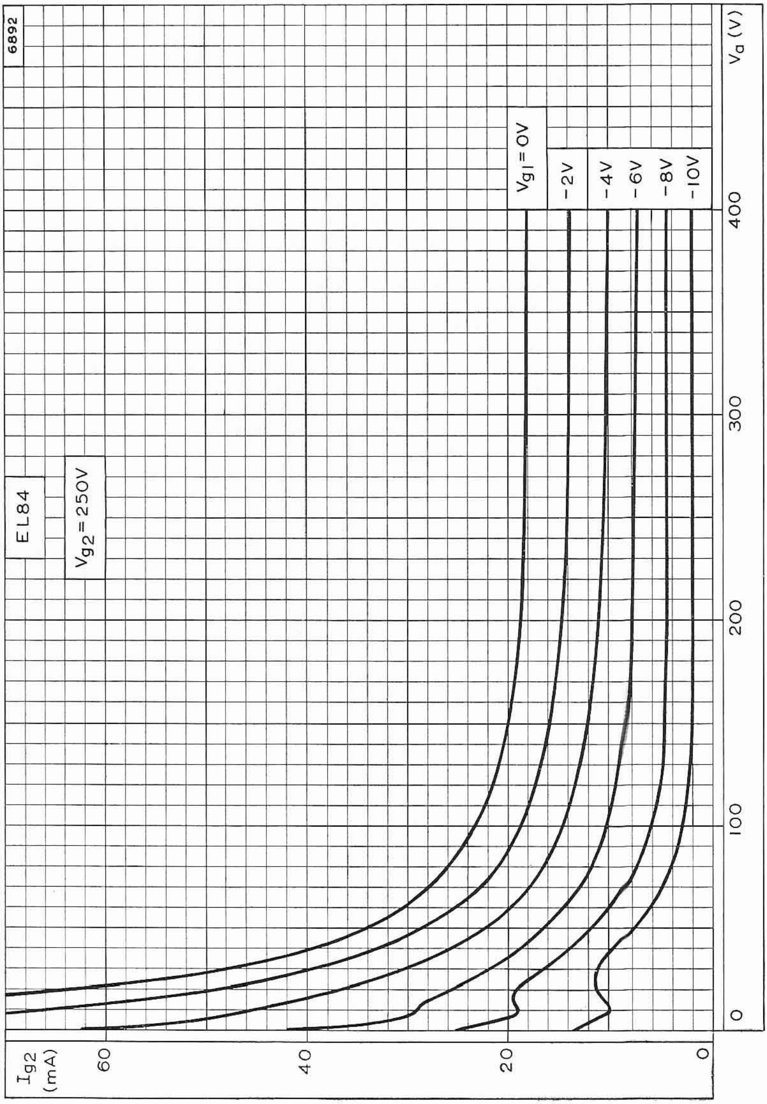




ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



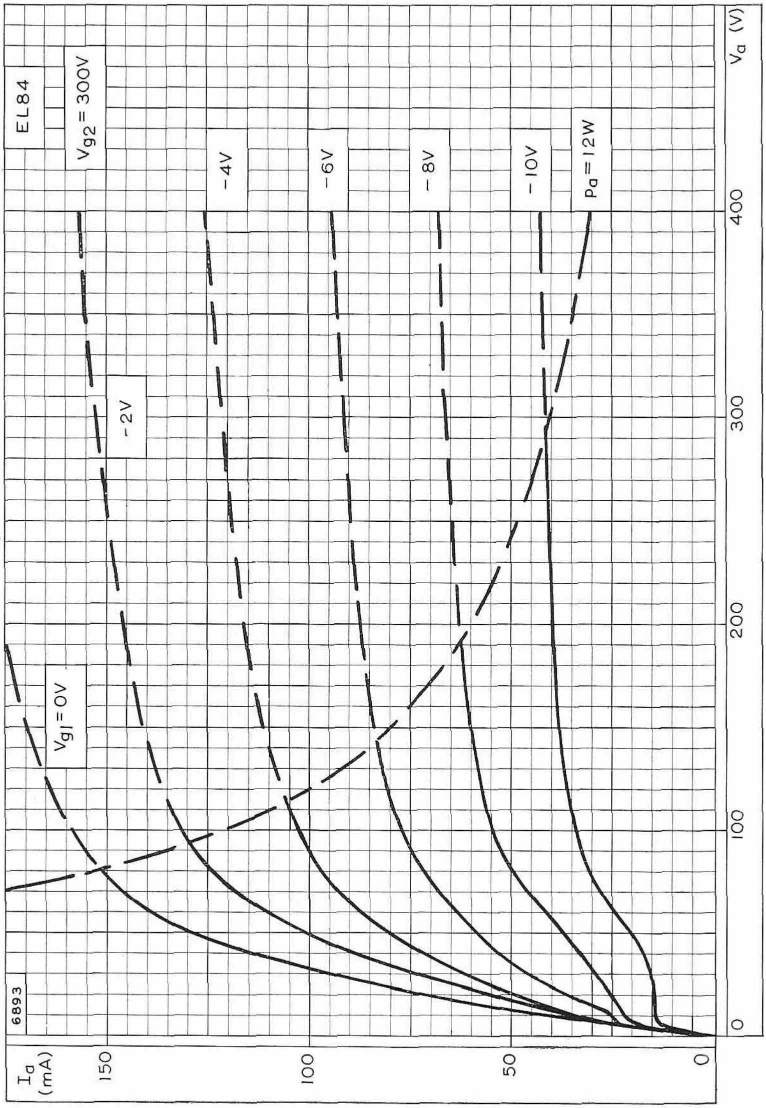
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



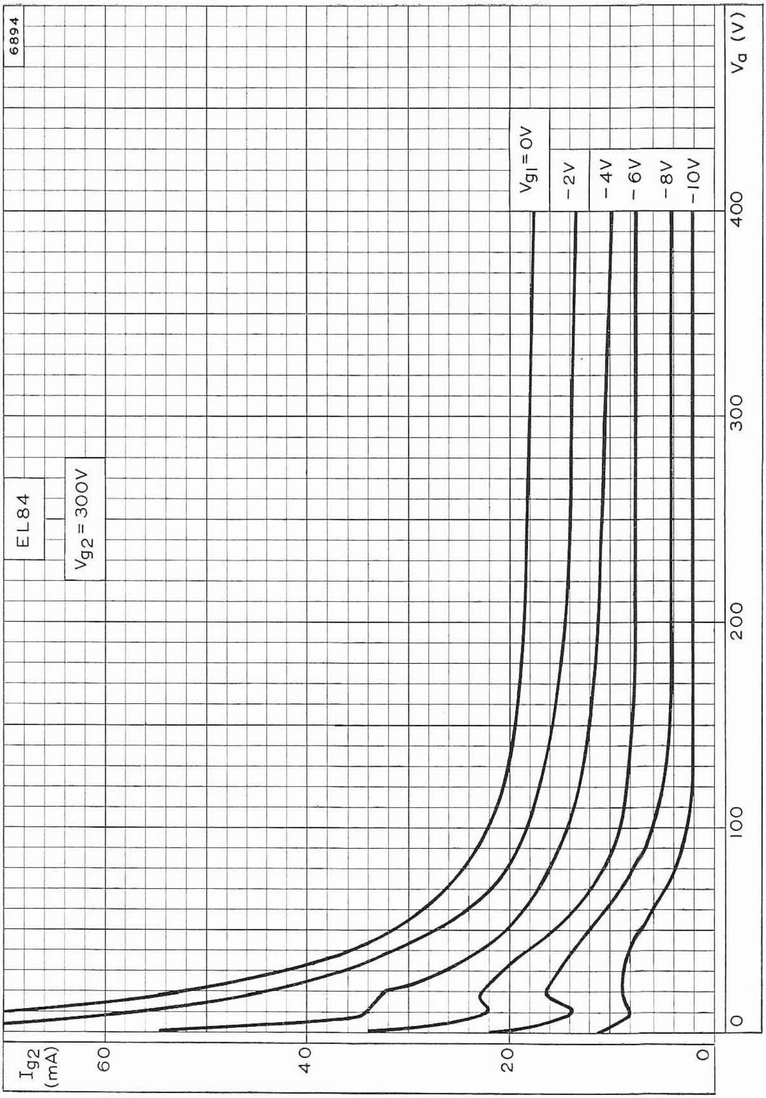
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$

EL84

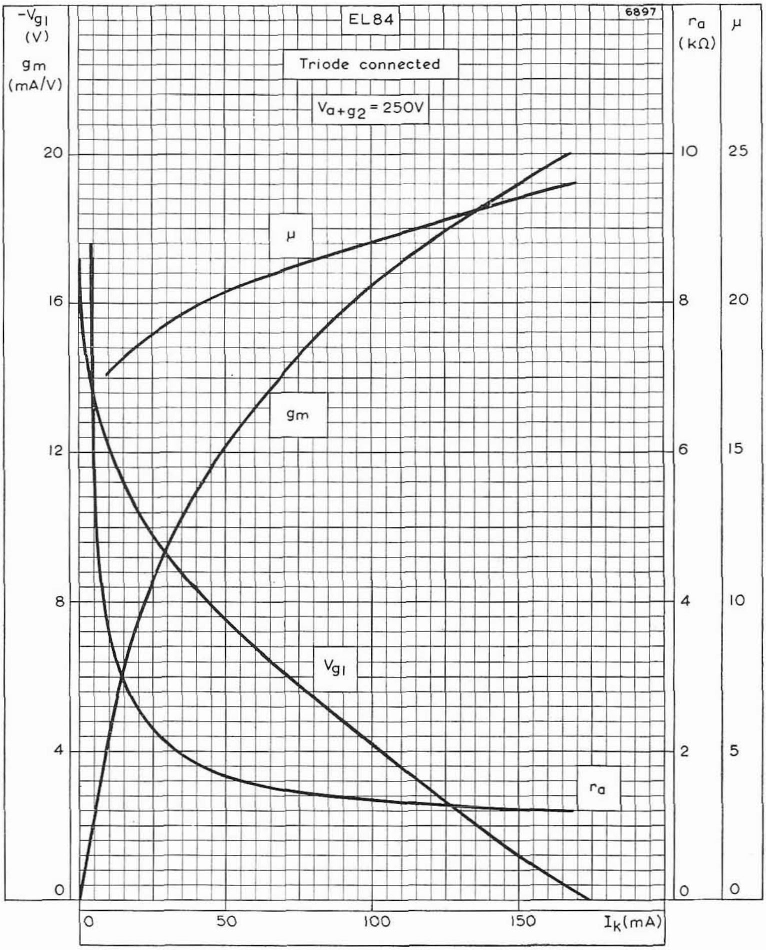
OUTPUT PENTODE



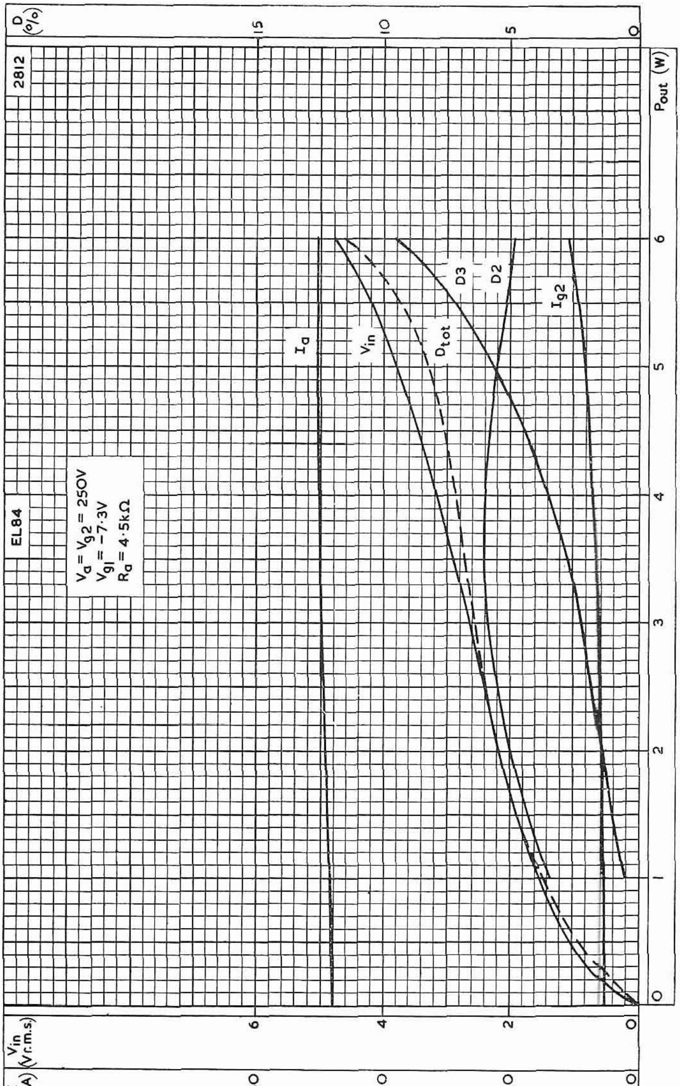
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 300V$



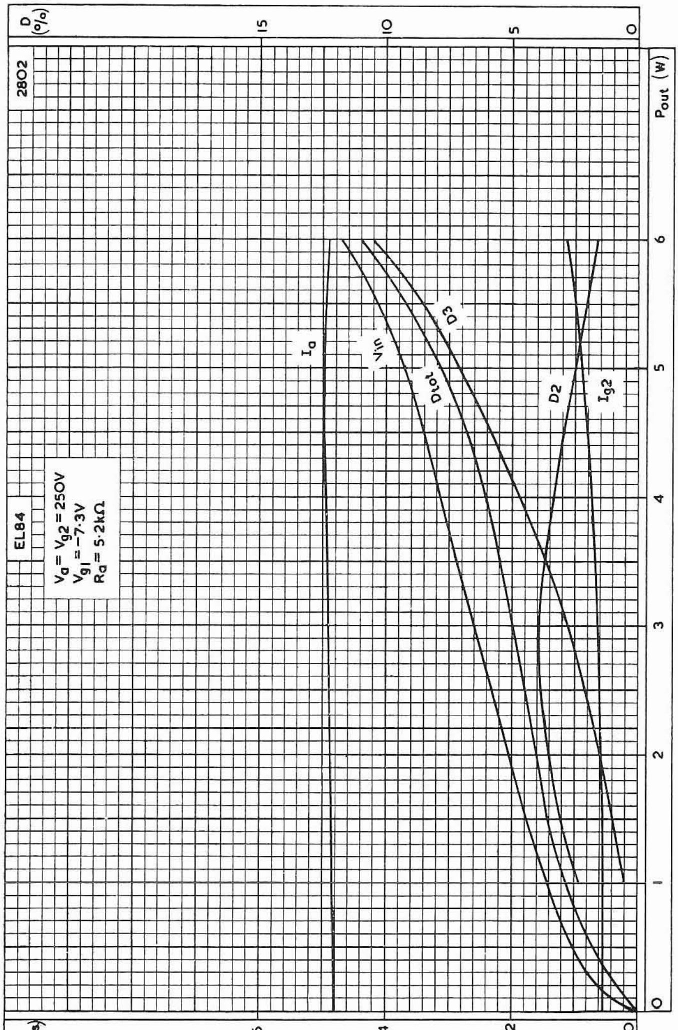
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 300V$



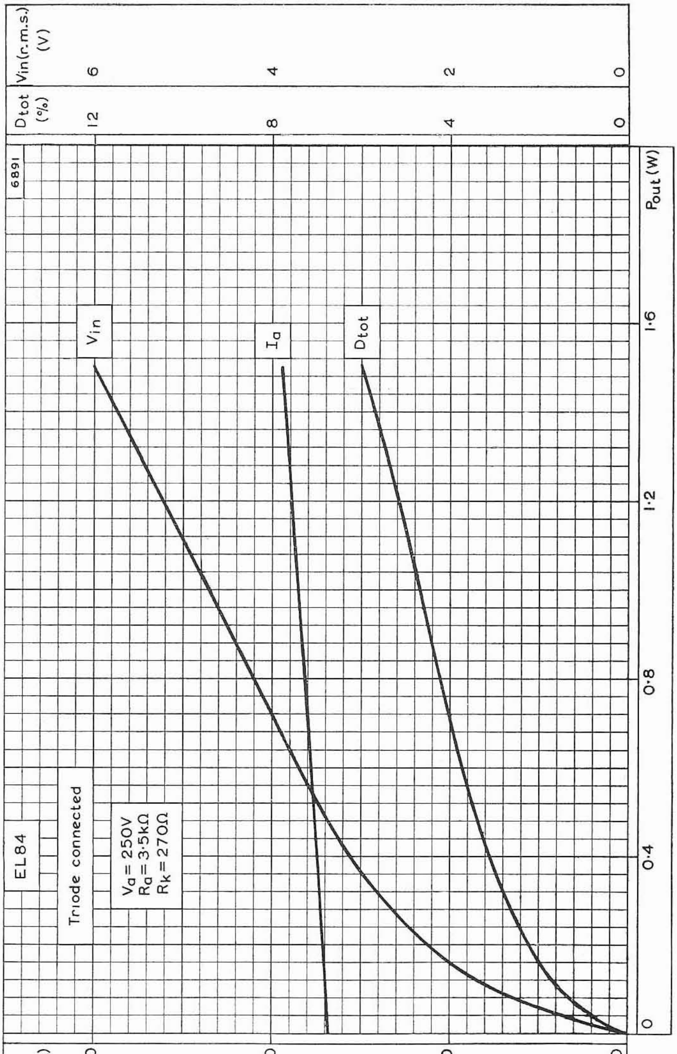
CONTROL-GRID VOLTAGE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CATHODE CURRENT WHEN TRIODE CONNECTED



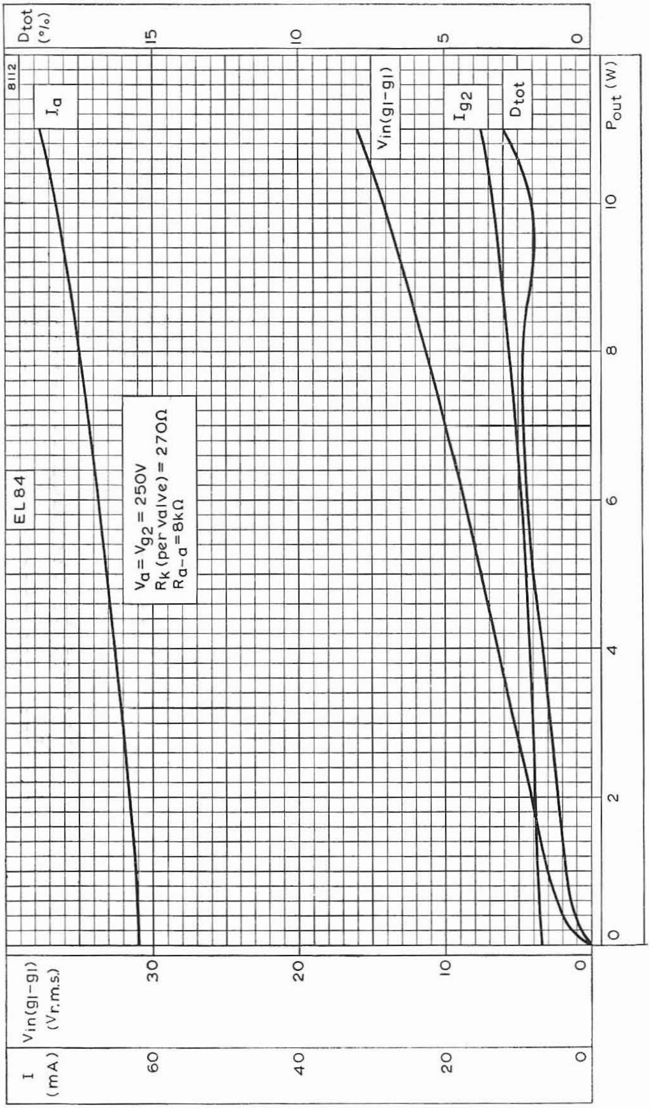
PERFORMANCE OF EL84 WHEN USED AS A SINGLE VALVE AMPLIFIER WITH A LOAD OF 4.5kΩ



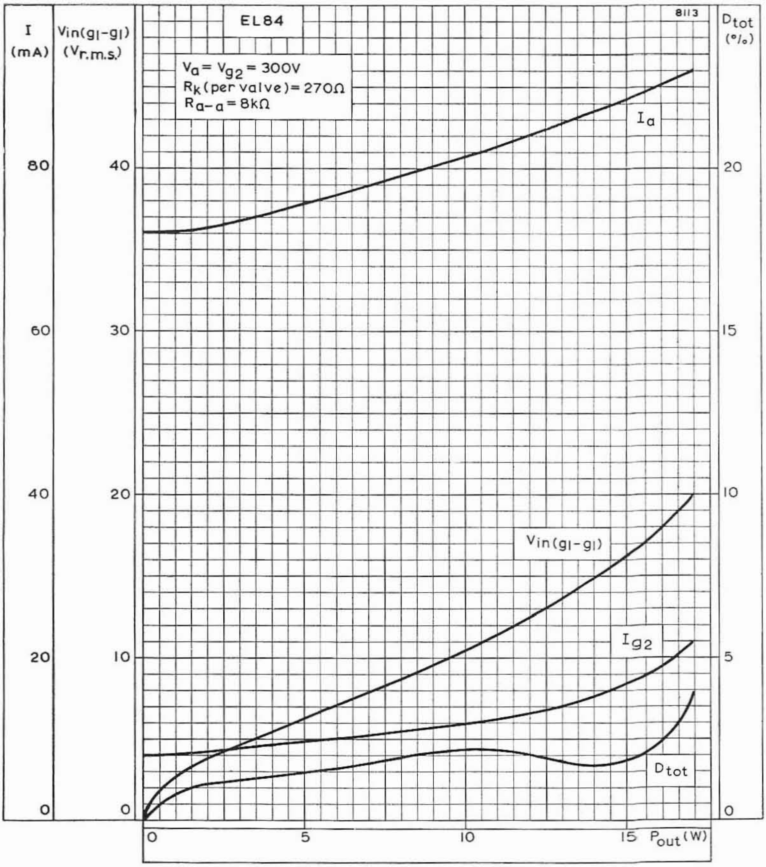
PERFORMANCE OF EL84 WHEN USED AS A SINGLE VALVE AMPLIFIER WITH A LOAD OF 5.2kΩ



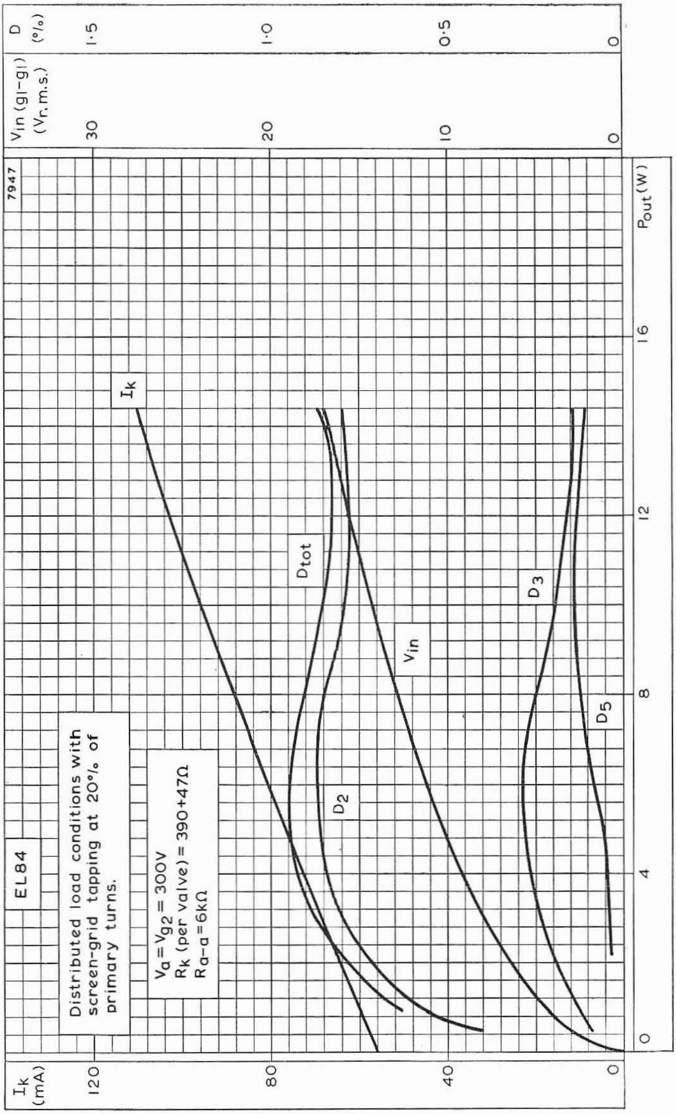
PERFORMANCE OF EL84 TRIODE CONNECTED AS A SINGLE VALVE AMPLIFIER



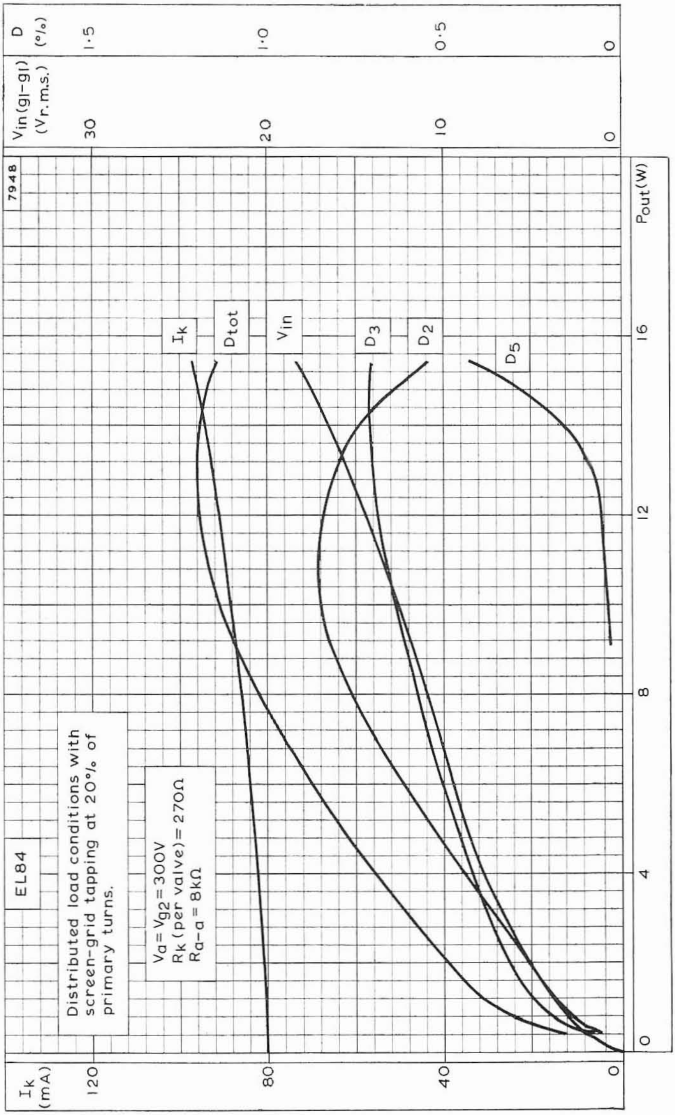
PERFORMANCE OF TWO EL84 IN PUSH-PULL
$V_a = V_{g2} = 250V$



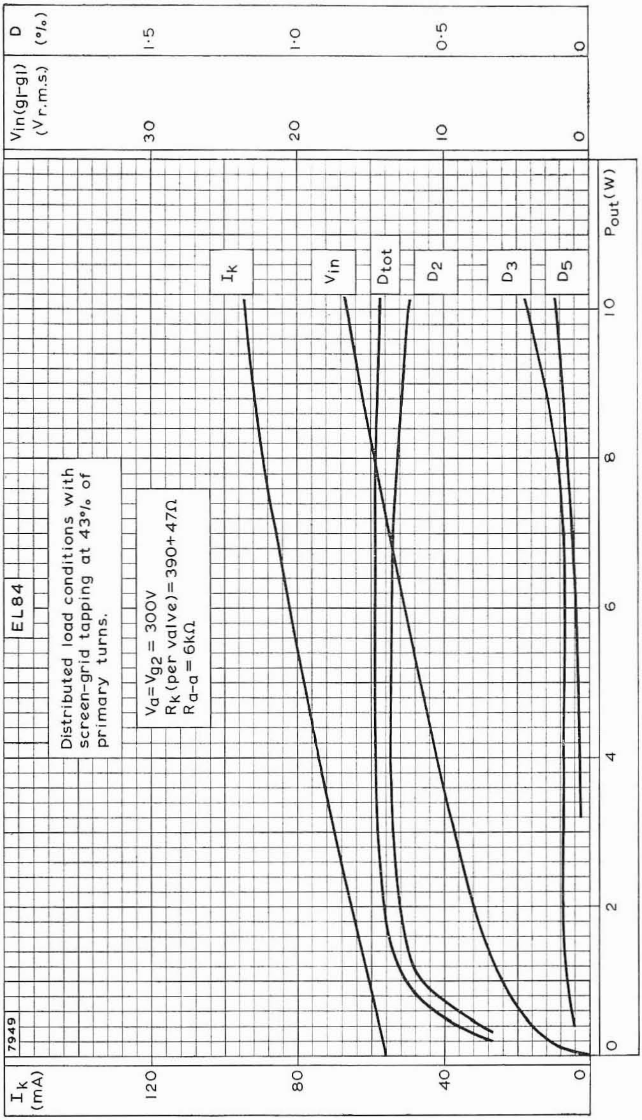
PERFORMANCE OF TWO EL84 IN PUSH-PULL
$V_a = V_{g2} = 300V$



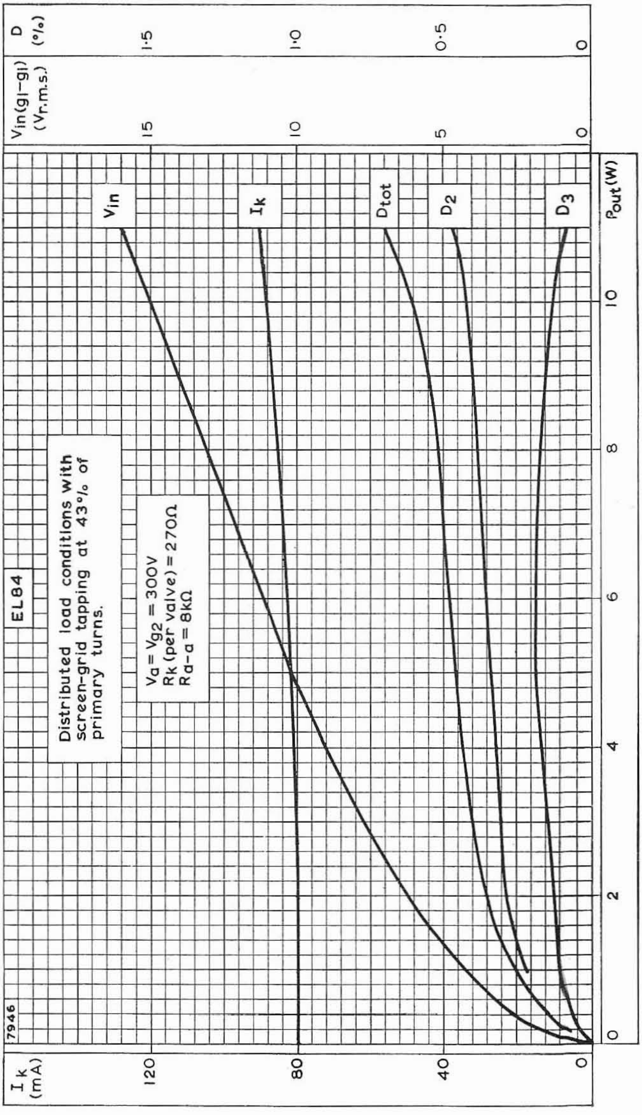
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS. $R_{a-a} = 6k\Omega$



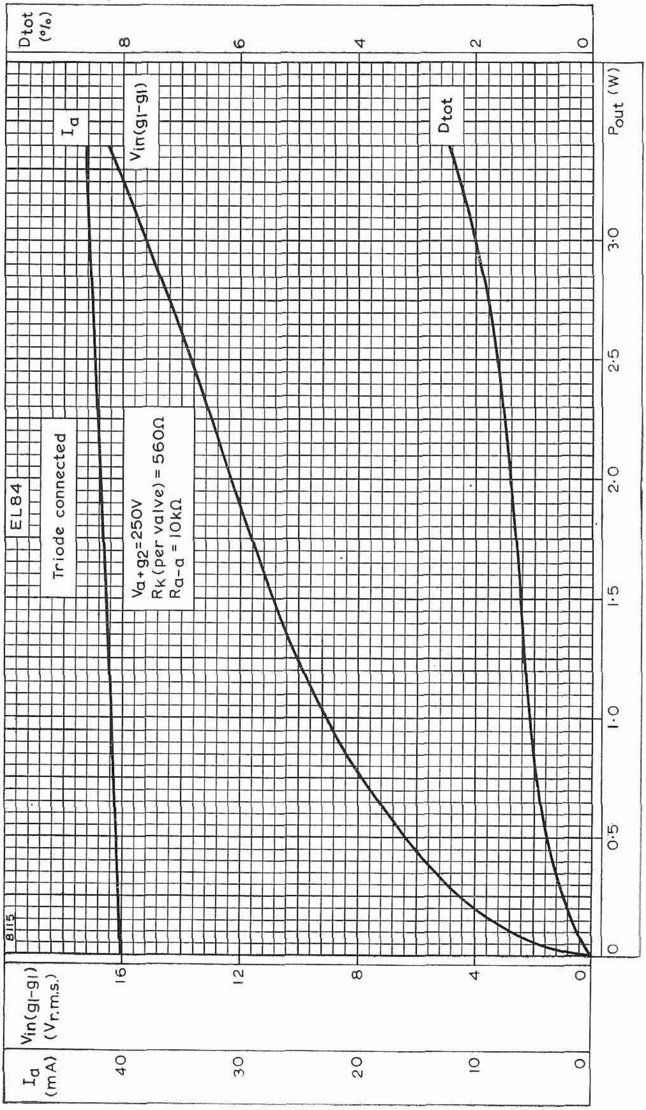
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 20% OF PRIMARY TURNS. $R_{a-a} = 8k\Omega$



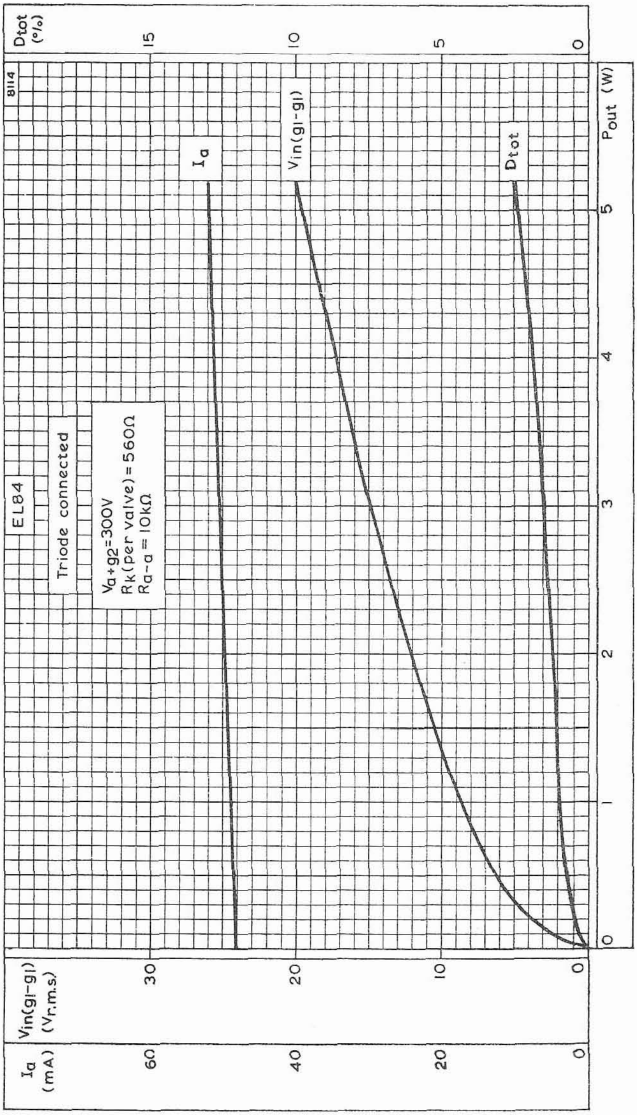
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS.
$R_{a-a} = 6k\Omega$



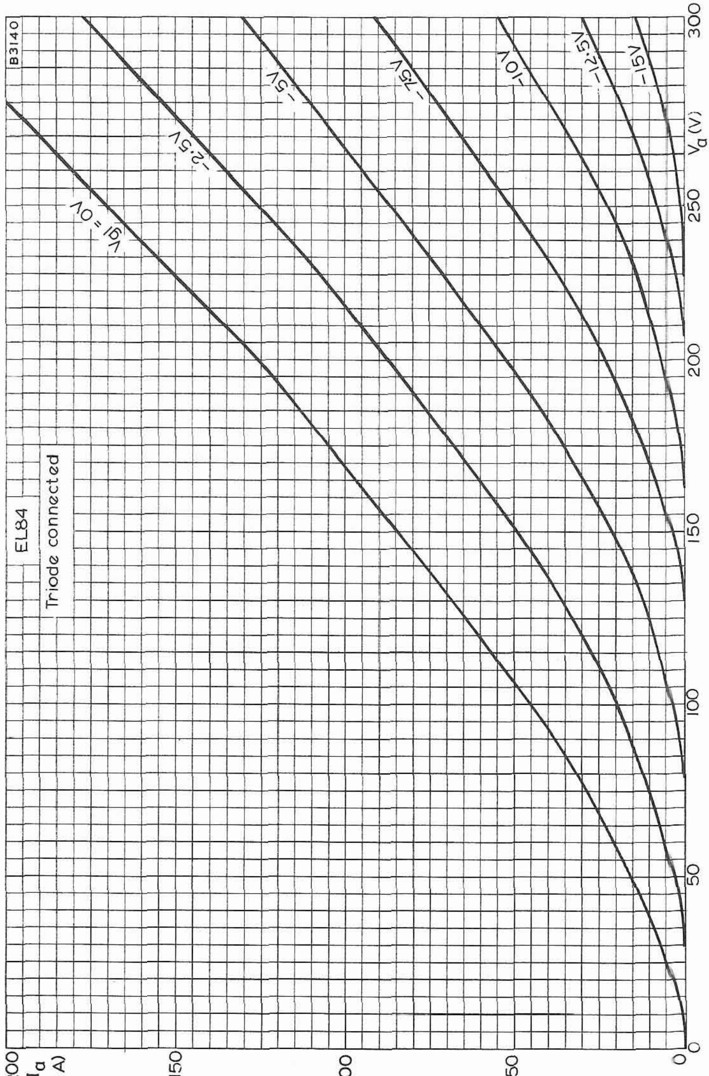
PERFORMANCE OF TWO EL84 IN PUSH-PULL WITH DISTRIBUTED LOAD CONDITIONS. SCREEN-GRID TAPPING AT 43% OF PRIMARY TURNS. $R_{a-a} = 8k\Omega$



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
$I_{a(0)}$	2×16	2×20	mA
I_a (max. sig.)	2×17.5	2×22.1	mA
$I_{g2(0)}$	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	%

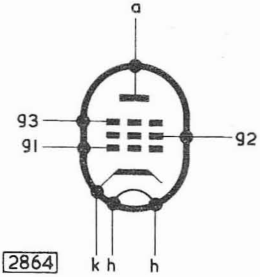
OUTPUT PENTODE

EL85

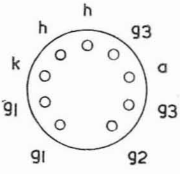
Output pentode rated for 6W anode dissipation intended for use in mobile equipment as a r.f. amplifier at frequencies up to 120Mc/s or as an a.f. output valve.

LIMITING VALUES

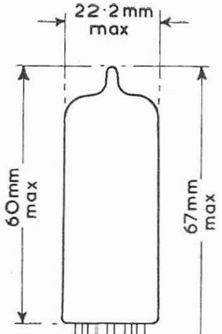
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	6.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max. (zero sig.)	1.0	W
p_{g2} max. (max. sig. speech and music)	2.0	W
$-V_{g1}$ max.	100	V
$-v_{g1(pk)}$ max.	250	V
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
I_k max. (a.f. operation)	35	mA
I_k max. (r.f. operation)	25	mA
R_{g1-k} max.	2.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ



2864



B9A Base

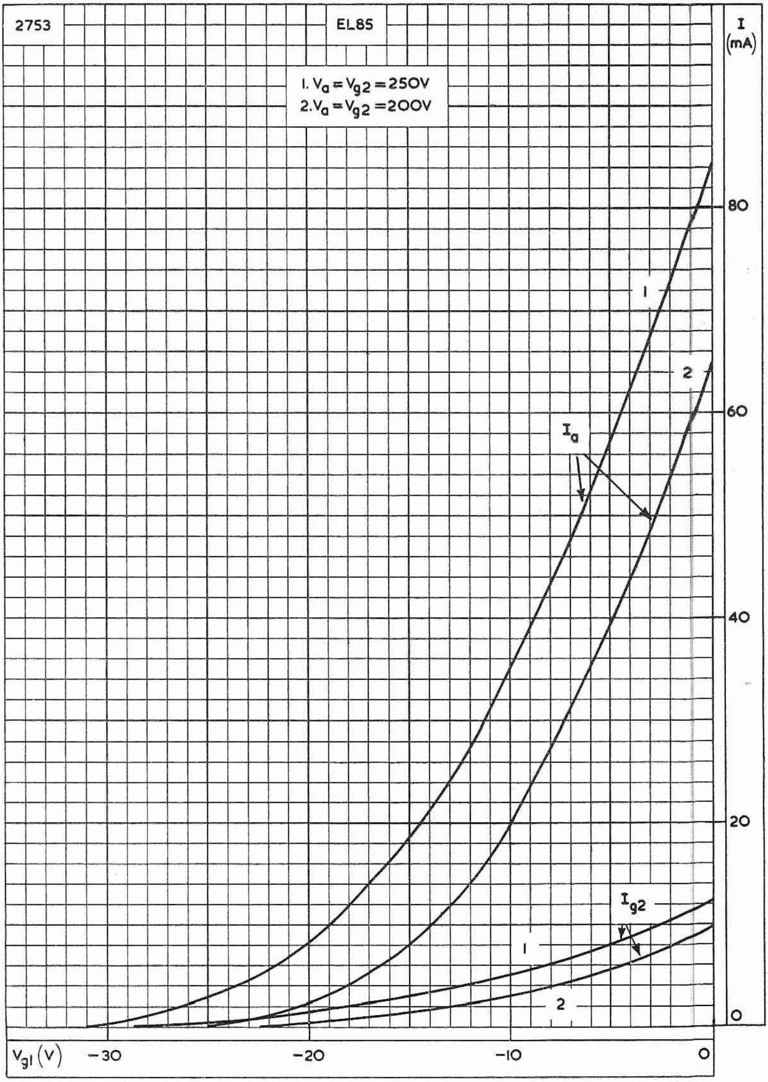


FOR R.F. APPLICATIONS IT IS RECOMMENDED THAT PINS 1 AND 2 SHOULD BE STRAPPED TOGETHER AND PINS 6 AND 8 BE CONNECTED SEPARATELY TO THE CHASSIS

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

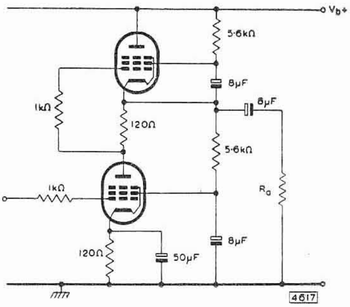
OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

$V_{a(b)}$	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

EL86

OUTPUT PENTODE

OPERATING CONDITIONS FOR TWO VALVES IN SINGLE ENDED PUSH–PULL



V_b	300	V
R_a	1.0	kΩ
$I_{b(o)}$	66	mA
I_b (max. sig.)	64	mA
$V_{in(r.m.s.)}$	5.4	V
P_{out}	4.5	W
D_{tot}	9.3	%

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

Speech and music

V_{a-k}	250	V
V_{g2-k}	200	V
R_k (per valve)	300	Ω
R_{a-a}	5.5	kΩ
$I_{a(o)}$	2×50	mA
I_a (max. sig.)	2×55	mA
$I_{g2(o)}$	2×2.0	mA
I_{g2} (max. sig.)	2×13	mA
$V_{in(g1-g1)r.m.s.}$	26	V
P_{out}	18.5	W
D_{tot}	4.5	%

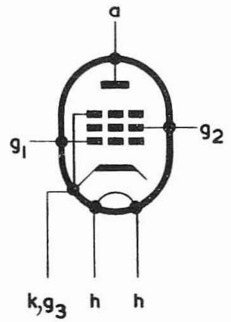
Continuous sine wave drive

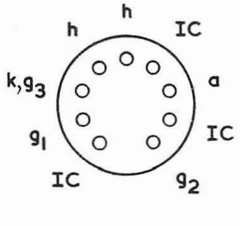
V_{a-e}	190	220	250	V
$V_{g2(b)}$	190	220	250	V
R_k (per valve)	220	270	390	Ω
R_{g2} (common)	330	1000	1800	Ω
$I_{a(o)}$	2×61	2×59	2×51	mA
$I_{g2(o)}$	2×2.8	2×2.7	2×2.4	mA
R_{a-a}	2.6	3.0	3.5	kΩ
P_{out}	13.3	15.7	17.4	W
$V_{in(g1-g1)r.m.s.}$	24	29	39	V
D_{tot}	2.3	3.3	4.2	%
I_a (max. sig.)	2×69	2×69	2×64	mA
I_{g2} (max. sig.)	2×10	2×9.7	2×8.7	mA
$V_{in(g1-g1)r.m.s.}$ (P_{out} = 50mW)	930	920	960	mV

LIMITING VALUES

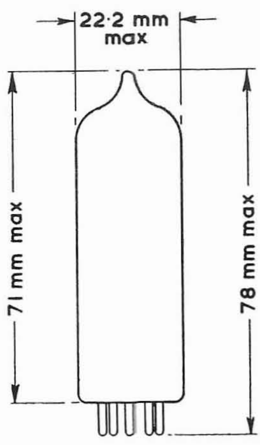
$V_{a(b)}$ max.	550	V
V_a max.	250	V
V_{a+g2} max.	250	V
p_a max.	12	W
p_{a+g2} max.	13	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.75	W
I_k max.	100	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

2834





B9A Base



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
$V_{in(r.m.s.)}$ ($P_{out} = 50$mW)	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	%

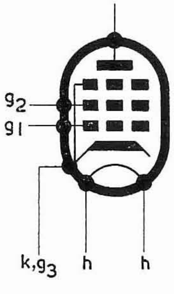
EL91

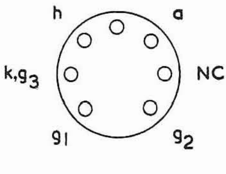
OUTPUT PENTODE

DESIGN CENTRE RATINGS

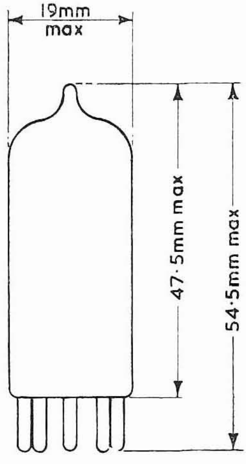
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	4.0	W
p_{a+g2} max.	4.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	600	mW
$-V_{g1}$ max.	100	V
I_{g1} max.	3.0	mA
I_k max.	20	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	150	V

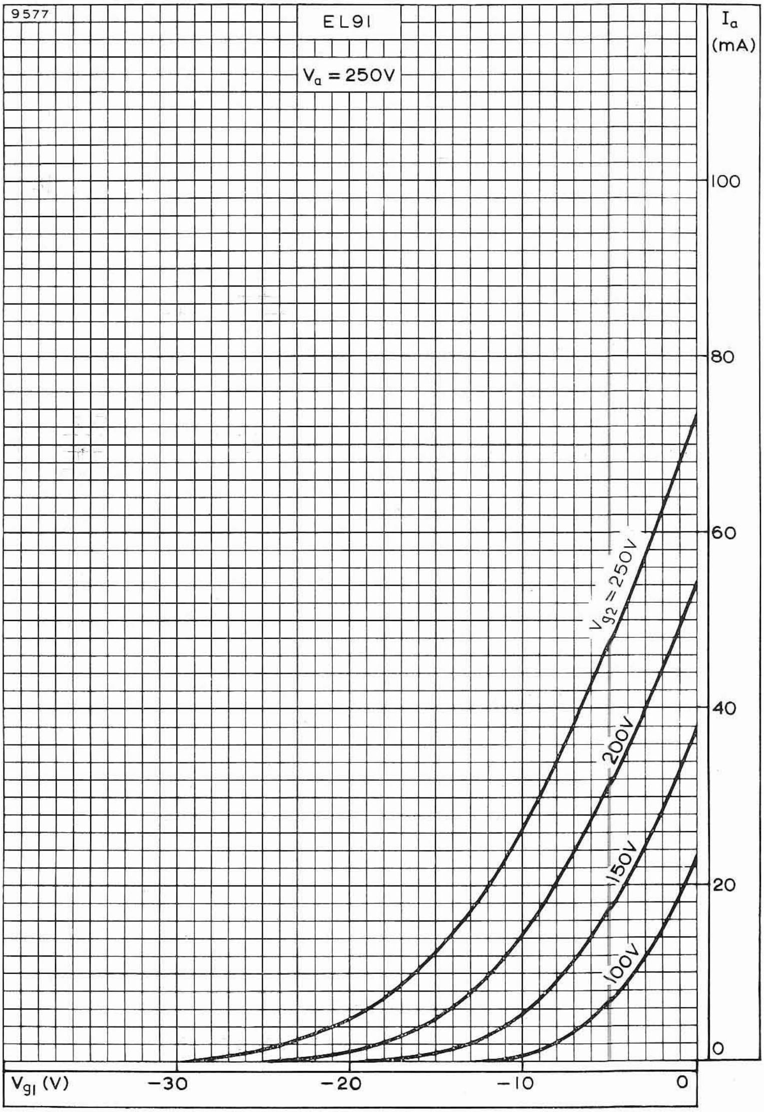
2831



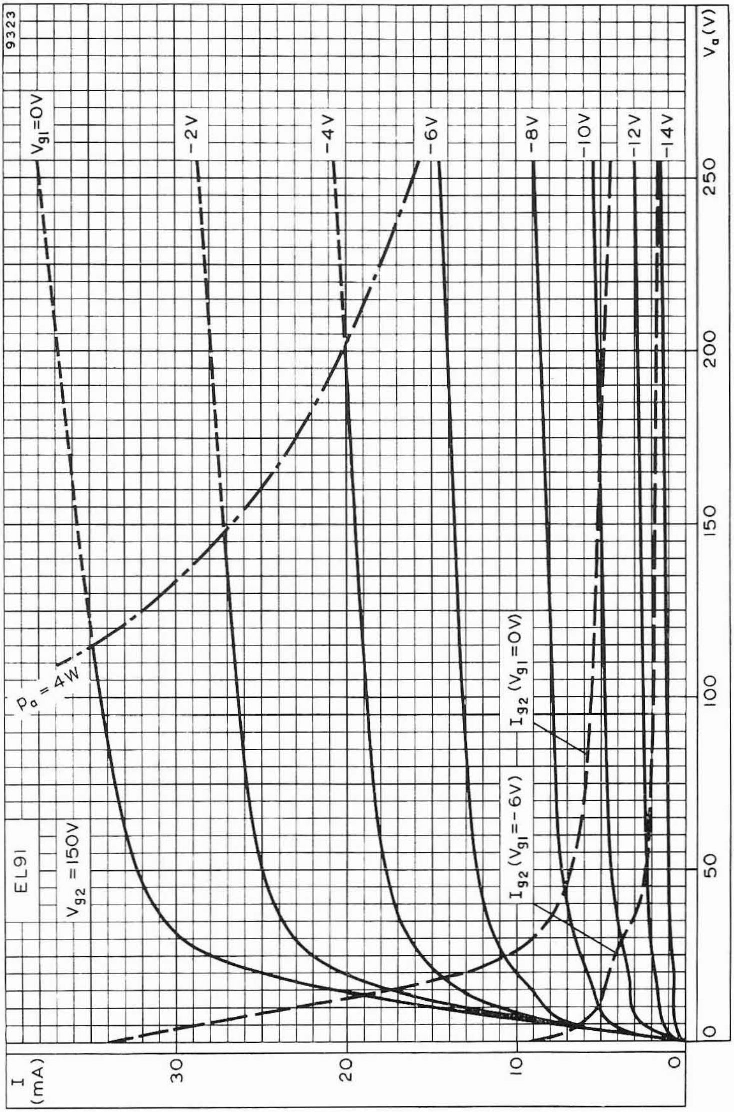


B7G Base

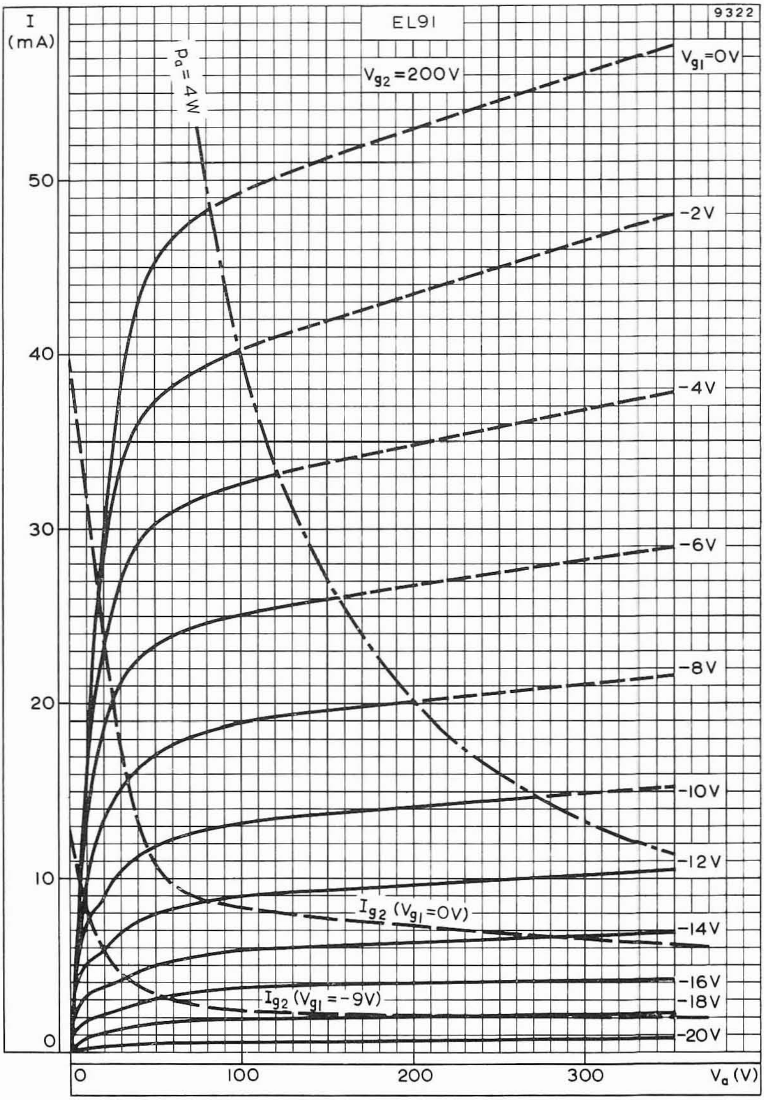




ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



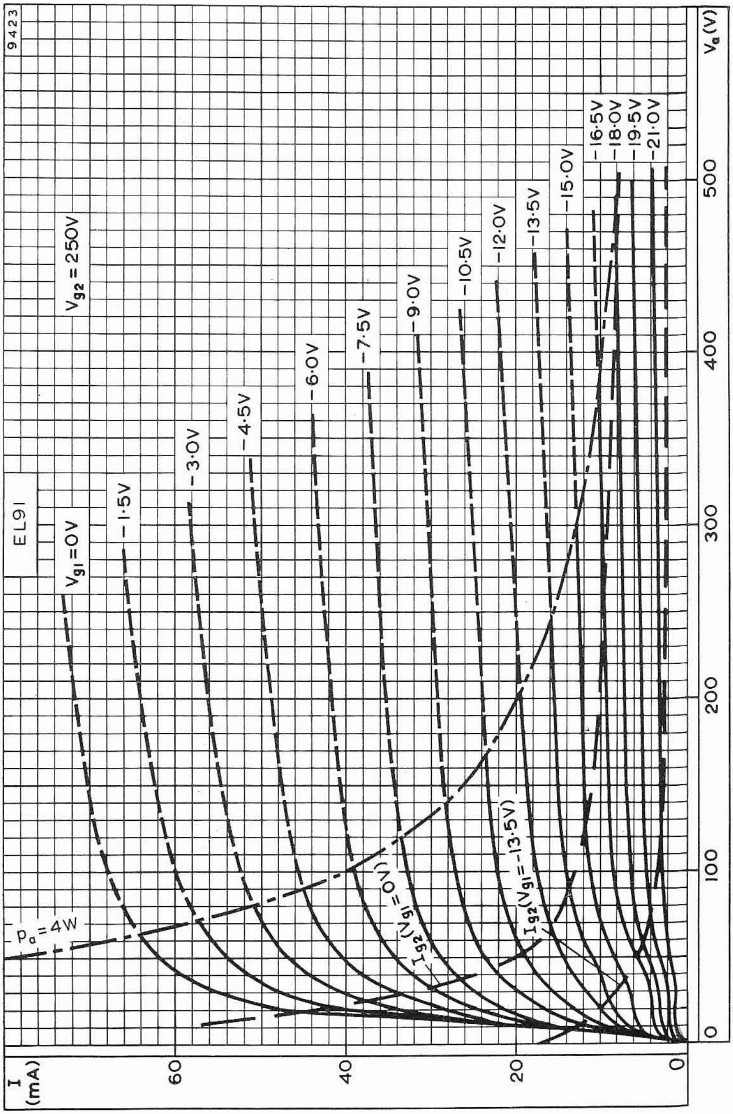
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



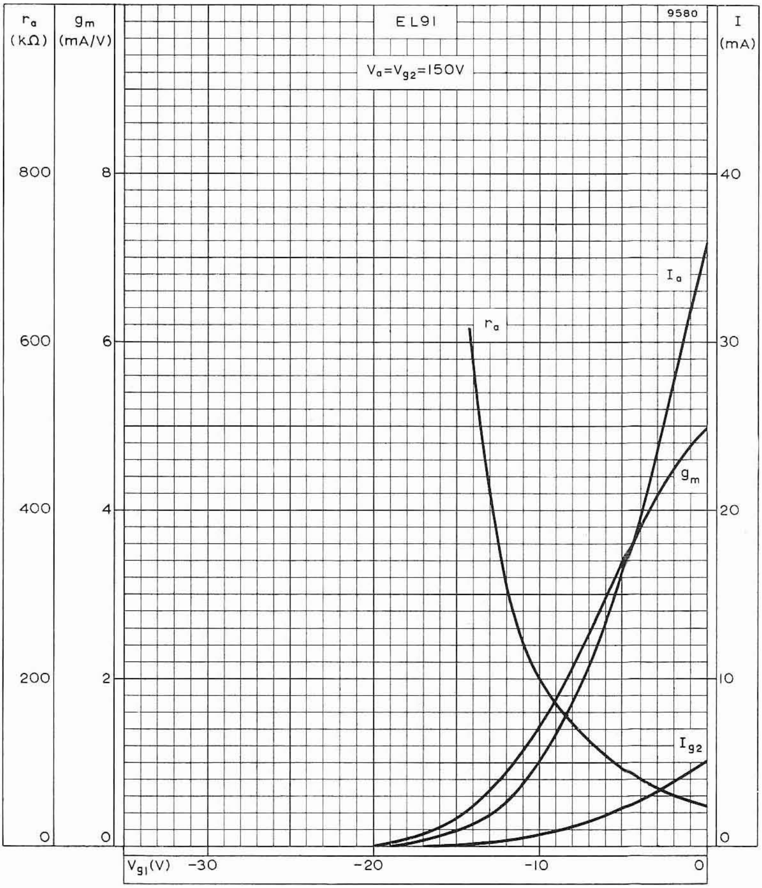
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$

EL91

OUTPUT PENTODE



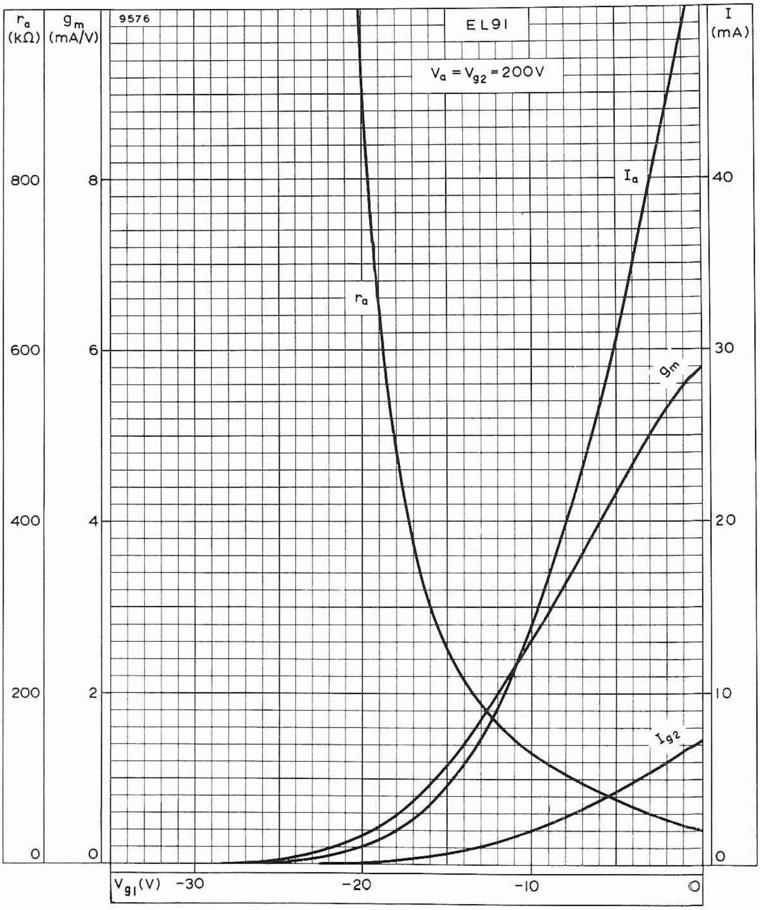
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



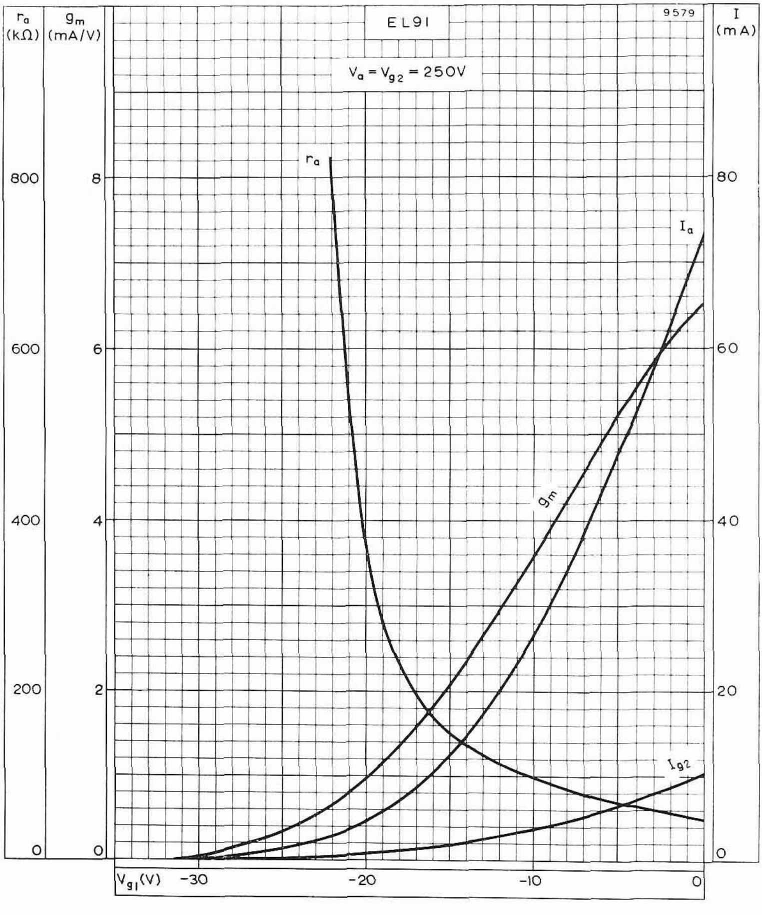
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 150V$

EL91

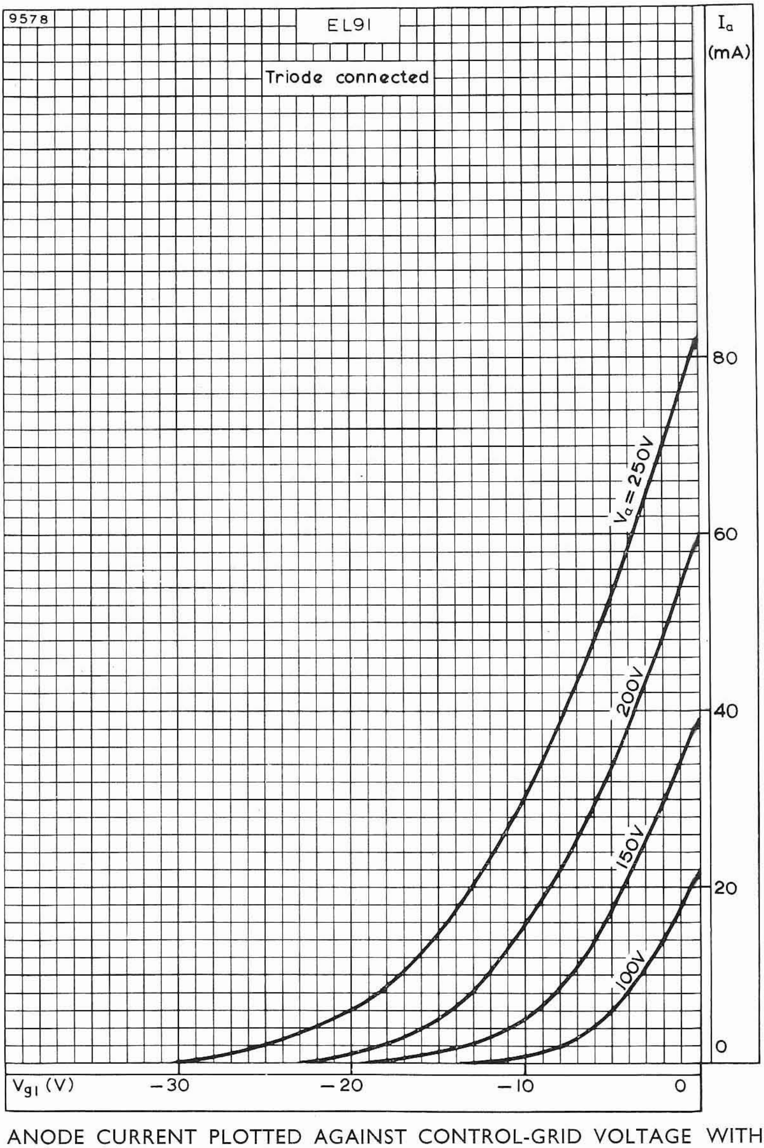
OUTPUT PENTODE



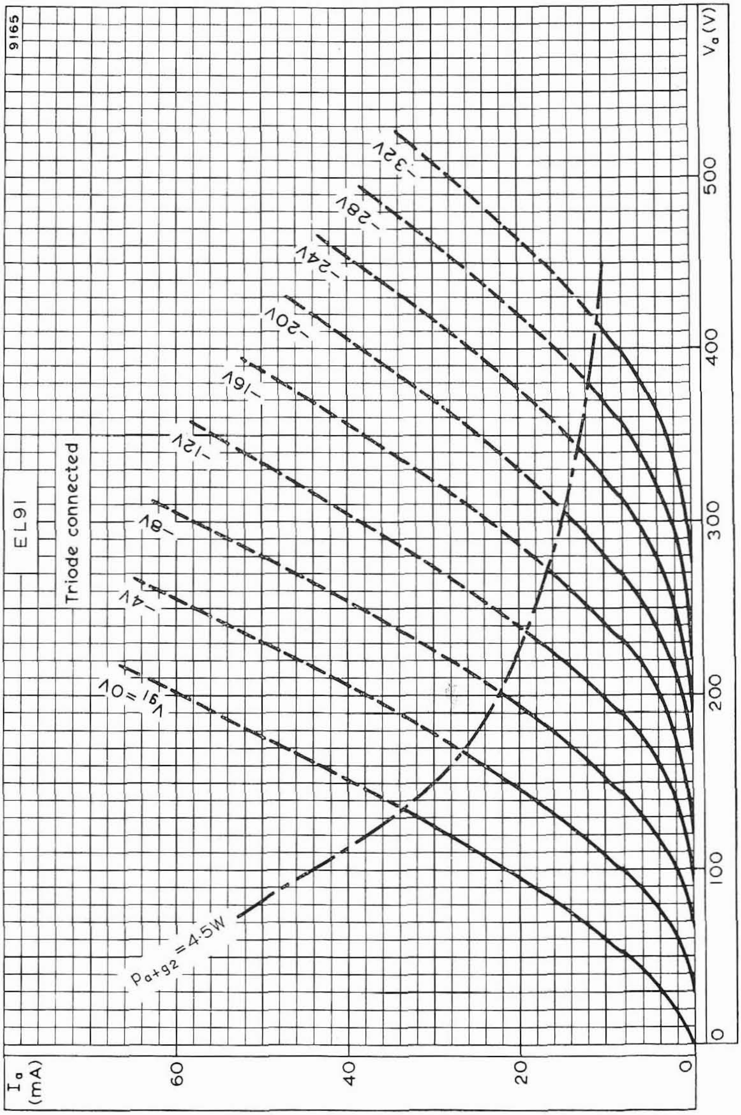
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 200V$



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

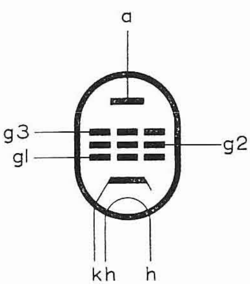
*At 20°C ambient, in free air at normal atmospheric pressure and without external screening can.

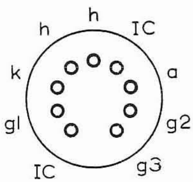
LIMITING VALUES

$V_{a(b)}$ 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

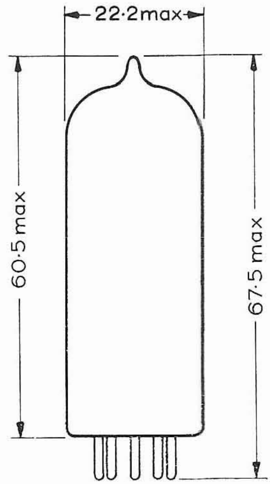
EL821

VIDEO OUTPUT PENTODE





B9A Base



All dimensions in mm

6396

VIDEO OUTPUT PENTODE

Video output pentode having a high mutual conductance.

EL822

HEATER

V_h	6.3	V
I_h	750	mA

CAPACITANCES (unshielded)

c_{in}	12	pF
c_{out}	6.0	pF
c_{a-g1}	<0.1	pF

CHARACTERISTICS

Pentode connection

V_a	250	250	250	V
V_{g3}	0	0	0	V
V_{g2}	150	200	250	V
V_{g1}	−2.5	−5.0	−7.0	V
I_a	40	37.5	42.5	mA
I_{g2}	5.0	4.8	4.8	mA
g_m	13	12.2	12.5	mA/V
μ_{g1-g2}	23	23	23	
r_a	100	90	90	kΩ
T_{bulb}	190	200	220	°C

Triode connection (g_2 connected to a)

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

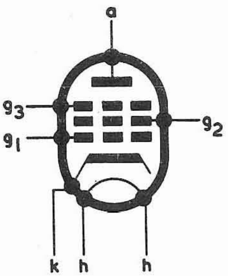
EL822

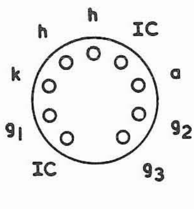
VIDEO OUTPUT PENTODE

DESIGN CENTRE RATINGS

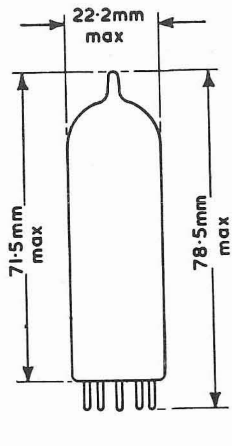
$V_{a(b)}$ max.	550	V
V_a max.	275	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max.	2.5	W
I_k max.	60	mA
R_{g1-k} max.	100	kΩ
V_{h-k} max.	90	V
T_{bulb} max.	220	°C

3310





B9A Base



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.

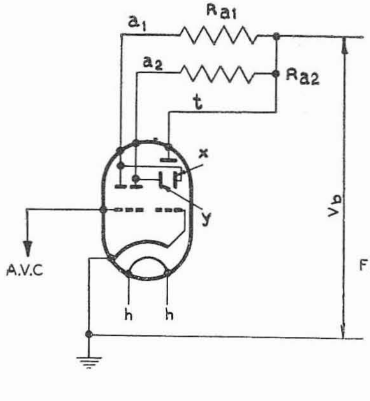
V_h	6.3	V
I_h	0.2	A

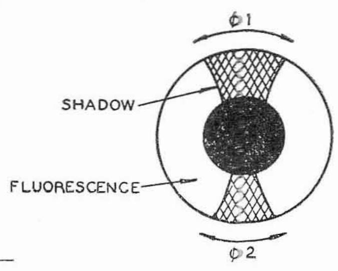
OPERATING CONDITIONS

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.





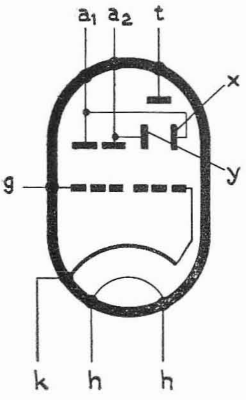
EM34

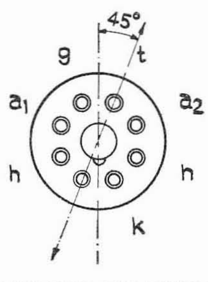
ELECTRON BEAM INDICATOR

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

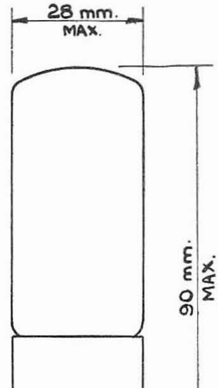
LIMITING VALUES

$V_{a1(b)}$ 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





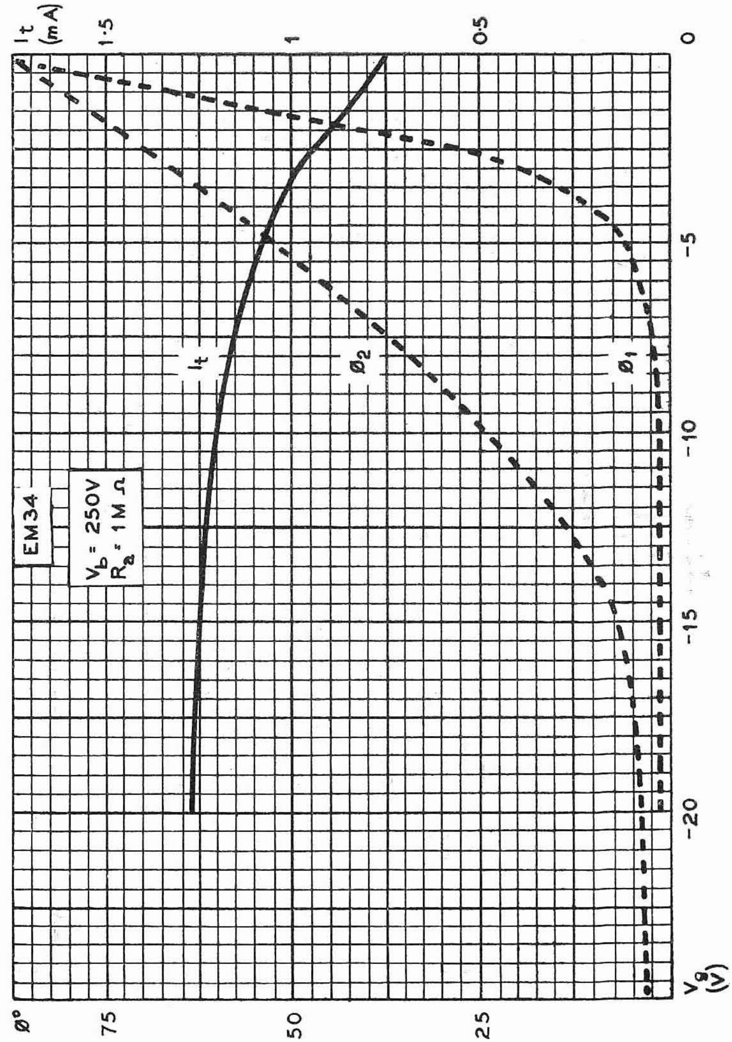
OCTAL BASE



ELECTRON BEAM INDICATOR

EM34

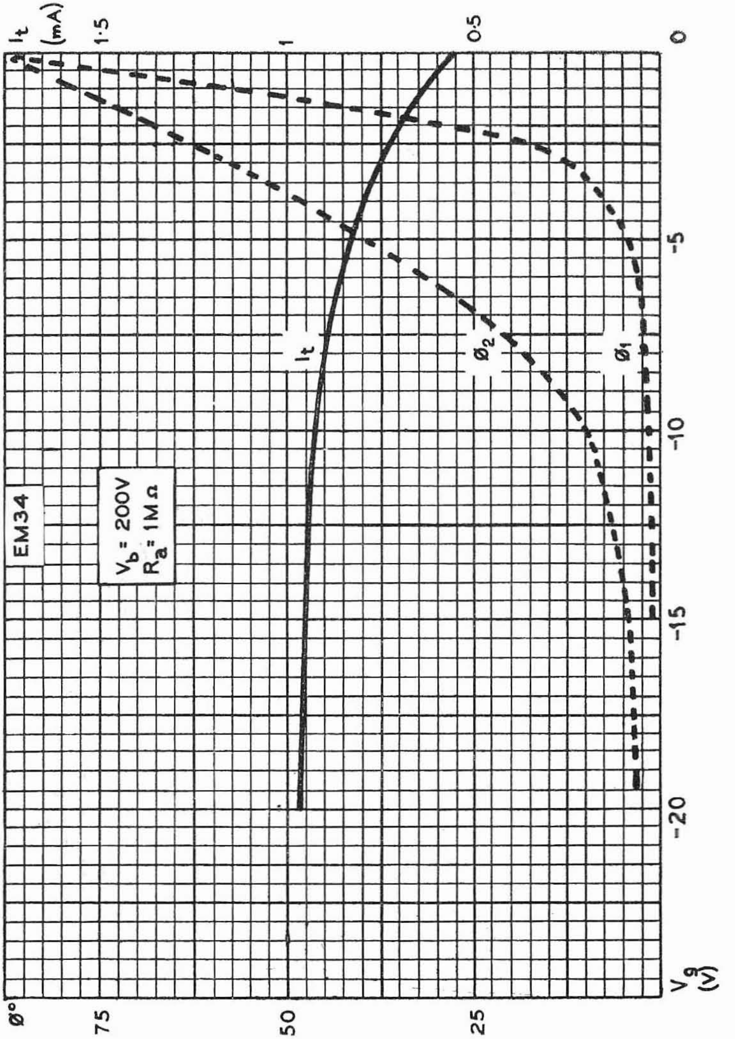
Electron beam tube for use as tuning indicator in radio receivers or as null indicator in test equipment.



EM34

ELECTRON BEAM INDICATOR

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



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)

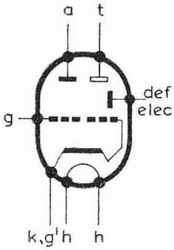
V_b		250		V
V_t		250		V
R_a		470		kΩ
R_{g-k}		3.0		MΩ
V_g	0		−22	V
I_a	450		60	μA
I_t	1.0		1.8	mA
*L	21±5		0	mm←

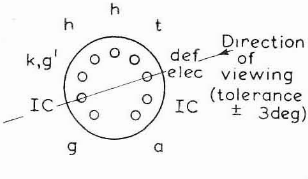
*Length of column

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

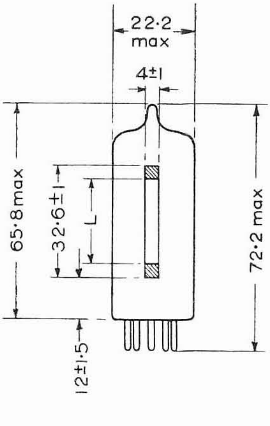
4678

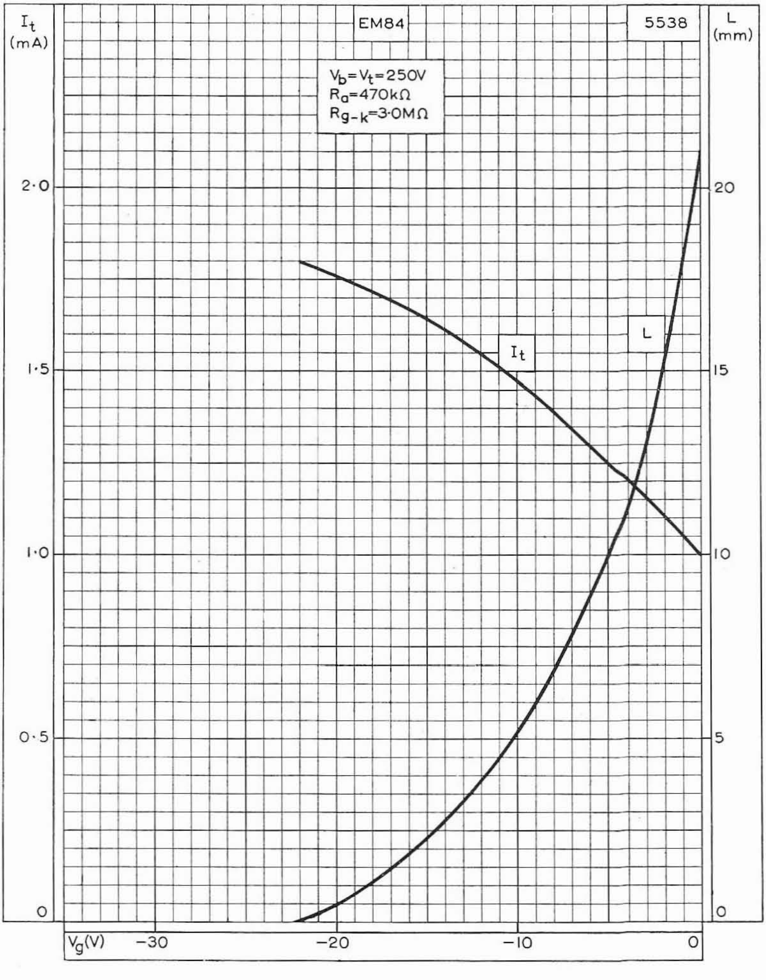




B9A Base

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

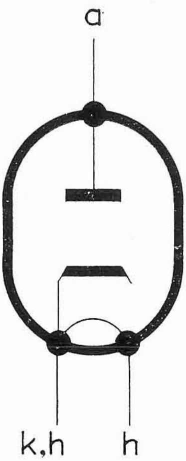
*Max. pulse duration 5.0% of a line scanning cycle with a maximum of 5.0μs

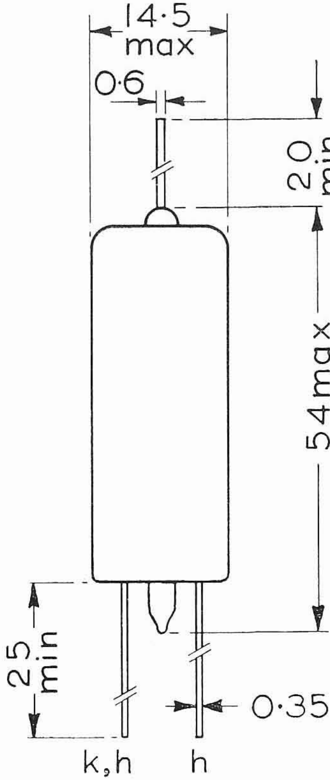
EY51

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



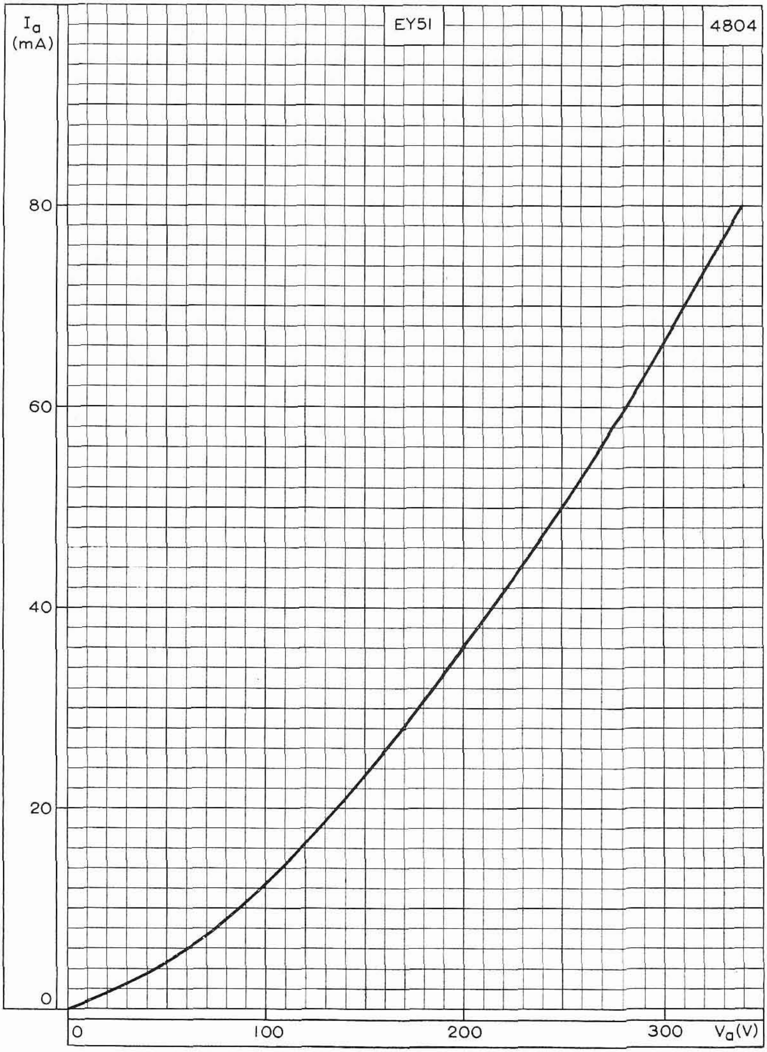


All dimensions in mm

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.

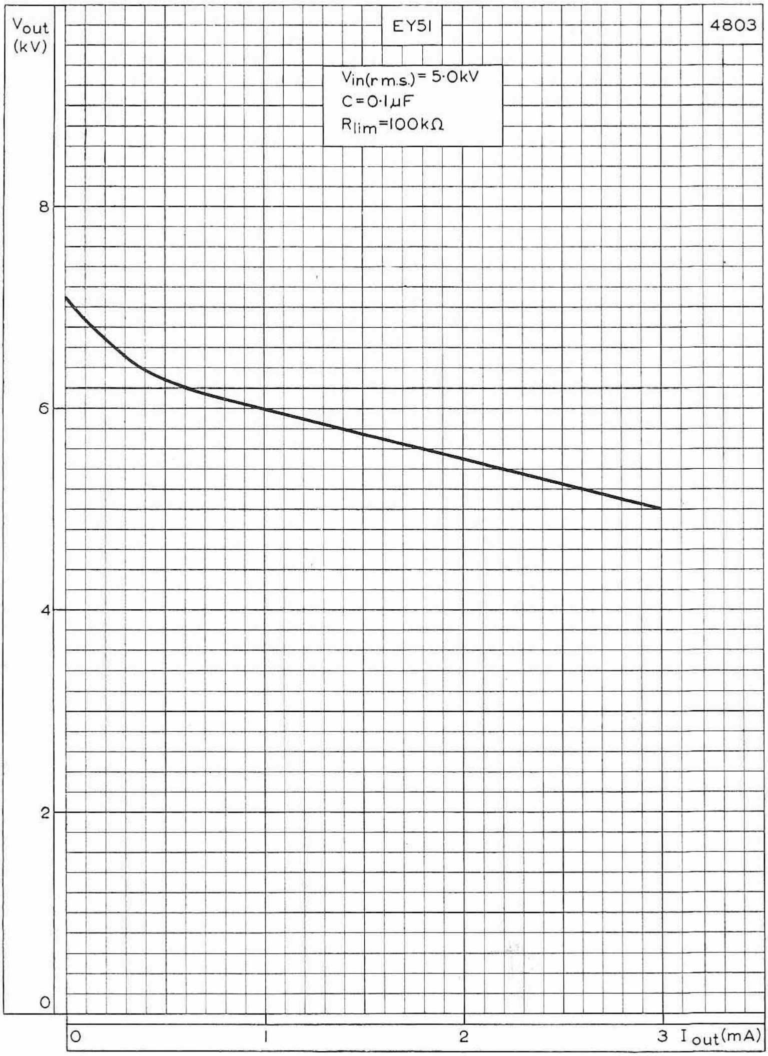


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

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 fy-back pulse.



REGULATION CURVE FOR 50c/s SINUSOIDAL INPUT

HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

HEATER

V_h	6.3	V
I_h	1.0	A

LIMITING VALUES

P.I.V. max.	2.0	kV
$i_{a(pk)}$ max.	900	mA
$i_{a(surge)}$ max.	3.2	A
V_{h-k} max. (cathode positive)	650	V

Capacitor input

I_{out} max. } See rating chart 1
$V_{in(r.m.s.)}$ max. }
R_{lim} min. See rating charts 2 and 3 and capacitor input regulation curves.

Choke input

I_{out} max. } See rating chart 1
$V_{in(r.m.s.)}$ max. }
L min. (at 50c/s) See choke regulation curves

CHARACTERISTICS

Anode voltage drop (I_{out}=150mA)	22	V

TYPICAL OPERATION OF TWO EY84 AS FULL-WAVE RECTIFIER

Capacitor input

$V_{in(r.m.s.)}$	2×500	2×625	V
R_{lim} (per anode)	150	250	Ω
*C (50c/s)	16	16	μF
I_{out}	300	250	mA
V_{out}	500	635	V

*For 1.6kc/s operation the same I/V relation would be obtained using a capacitor of 0.5μF.

Choke input

$V_{in(r.m.s.)}$	2×500	2×700	V
L	10	10	H
I_{out}	365	300	mA
V_{out}	408	592	V

OPERATING NOTES

The design of a power supply 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.

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

Rating chart 2

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

Rating chart 3

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

Capacitor input filter circuits

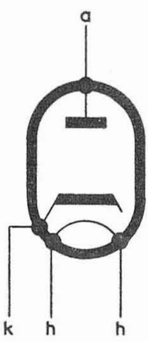
Reference should be made to rating charts 2 and 3 and the regulation curves. The circuit is set-up and the input and output voltage and output current are measured. If the operating conditions lie within the boundary lines of the regulation curves an improvement in the rectification efficiency may be 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.

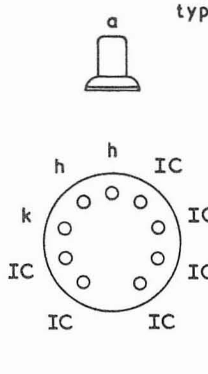
Comparison of the calculated rectification efficiency $\frac{V_{out}}{\sqrt{2} \times V_{in(r.m.s.)}}$ with rating chart 3 will show whether the limiting resistance must be increased to lower the rectification efficiency to the area of safe operation. Operation within this area indicates that the limiting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

Choke input circuit

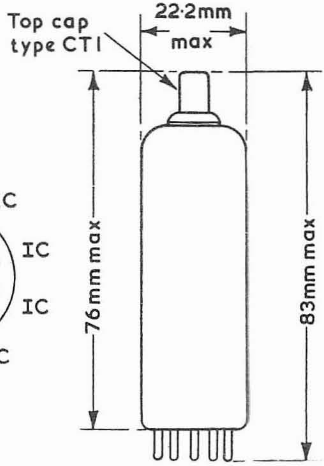
Reference should be made to rating chart 1. A suitable value of choke can be obtained from the choke regulation curves.

3367





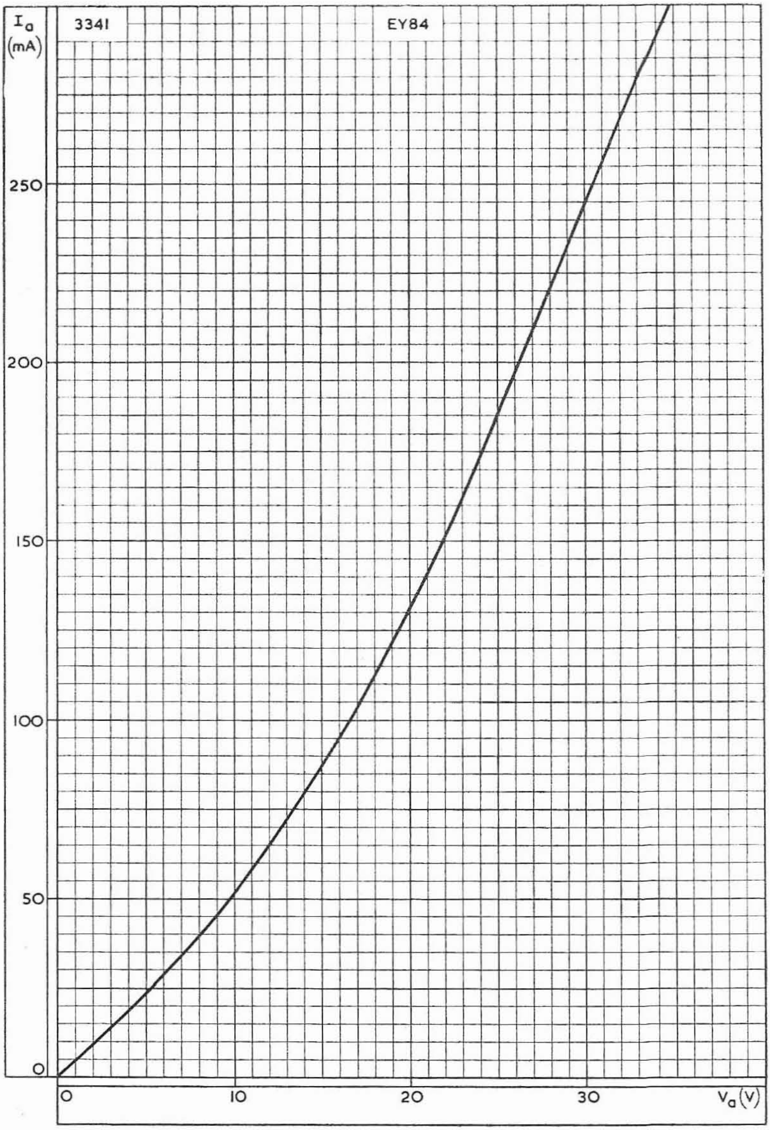
B9A Base



HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

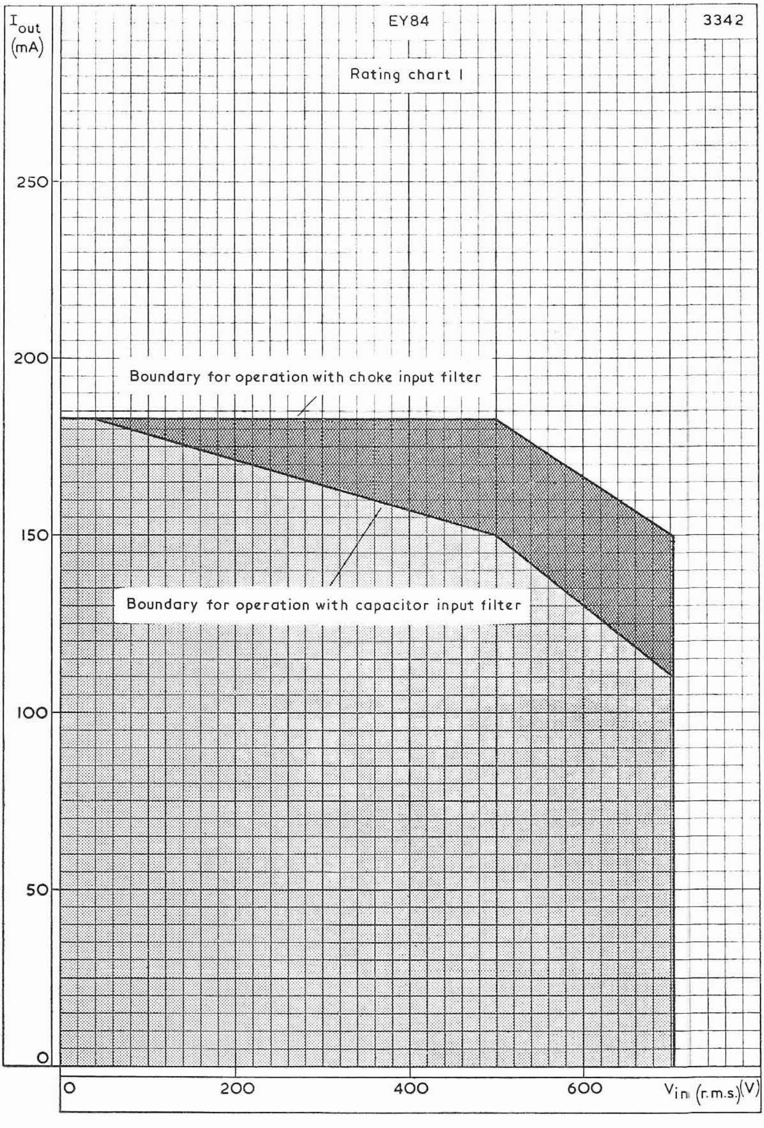


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

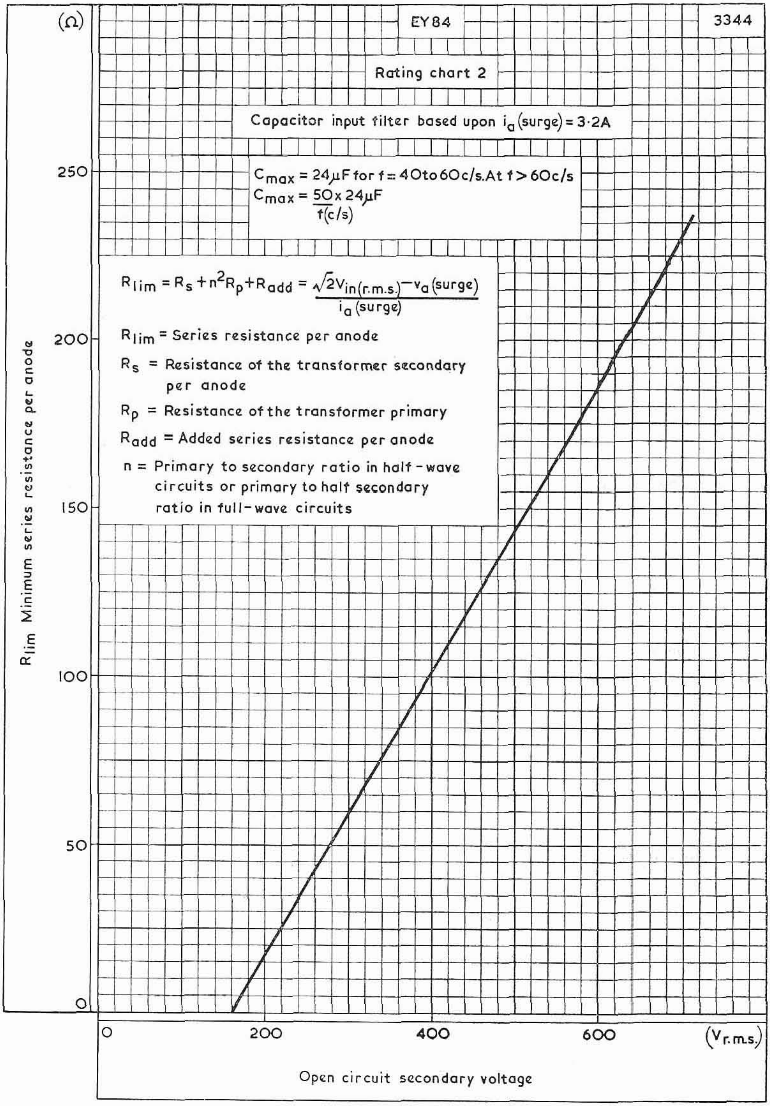


BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER

HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

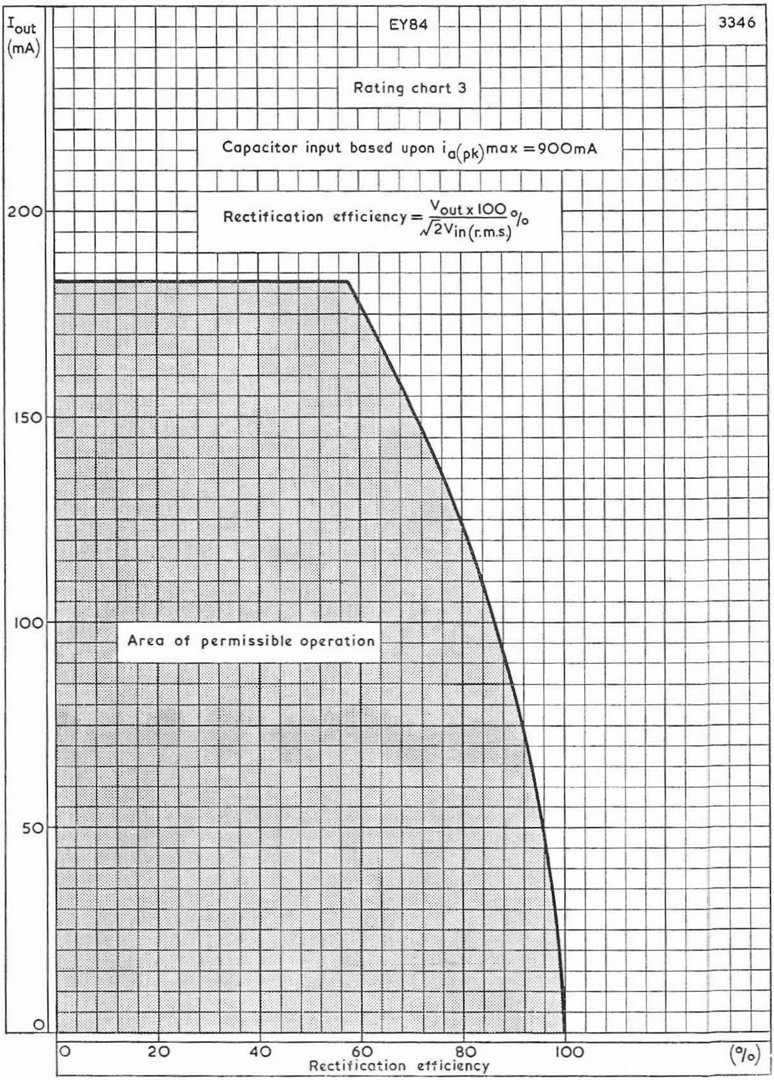


MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST OPEN CIRCUIT SECONDARY VOLTAGE

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

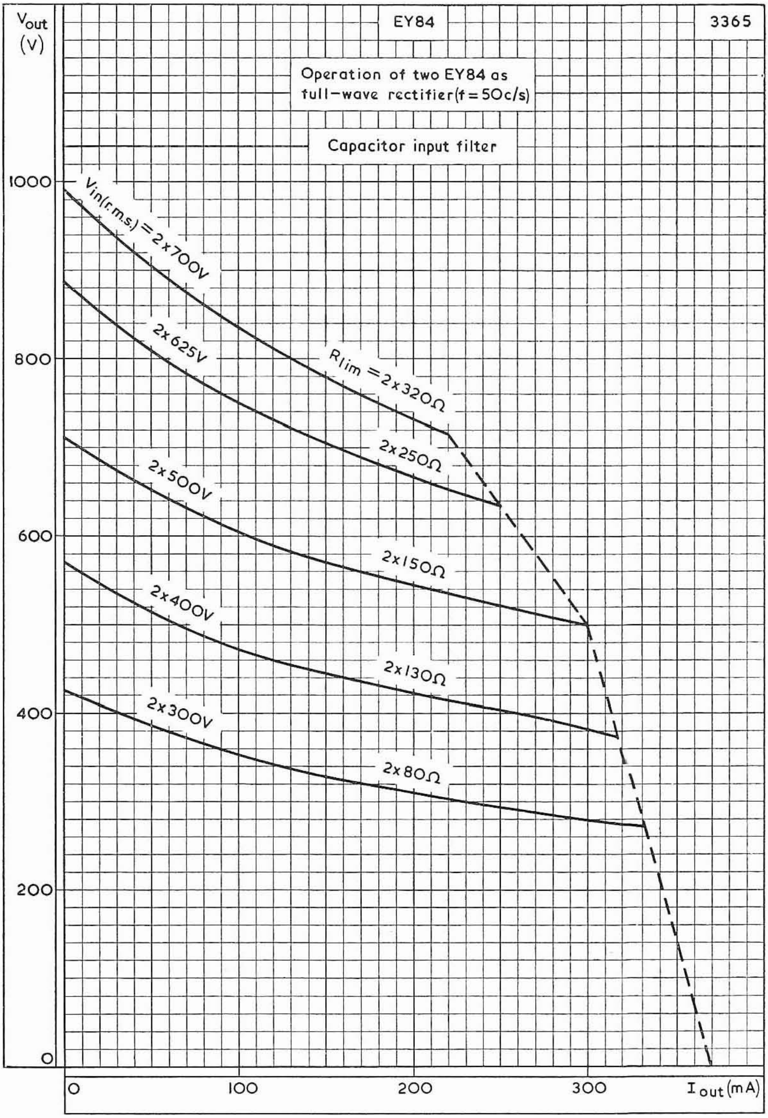


OUTPUT CURRENT PLOTTED AGAINST RECTIFICATION EFFICIENCY

HALF-WAVE RECTIFIER

EY84

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.

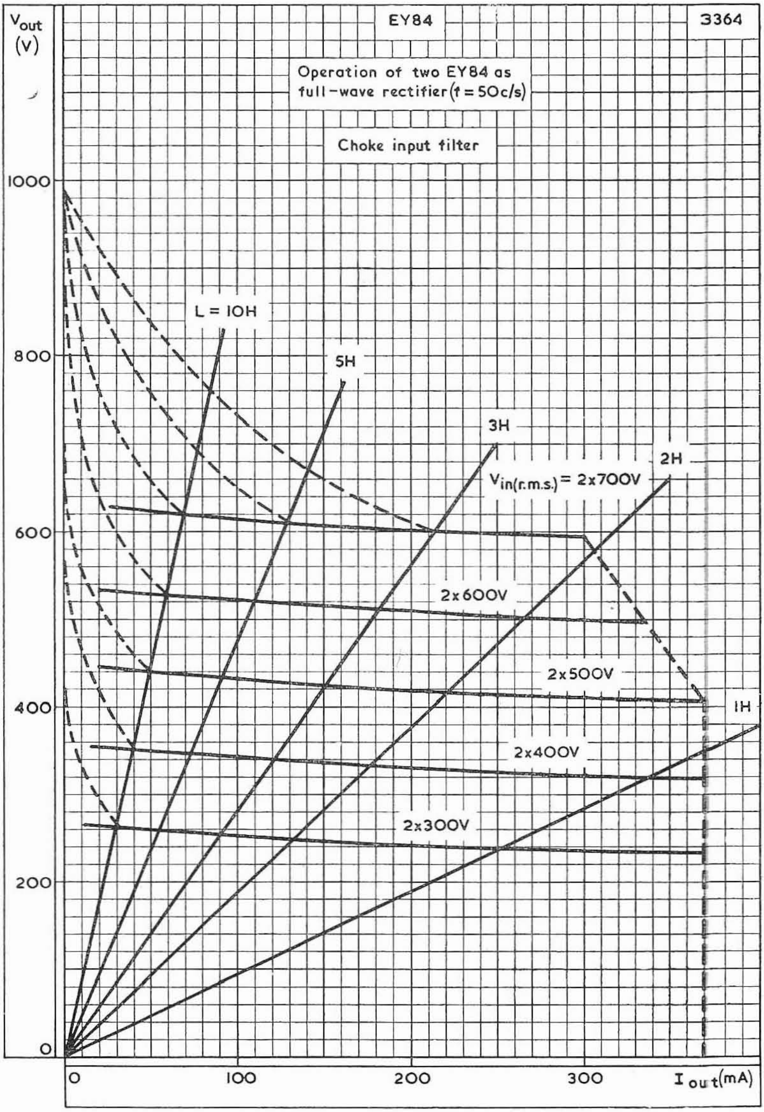


CAPACITOR INPUT FILTER REGULATION CURVES

EY84

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier primarily intended for operation at high altitudes.



CHOKE INPUT FILTER REGULATION CURVES

FULL-WAVE RECTIFIER

EZ35

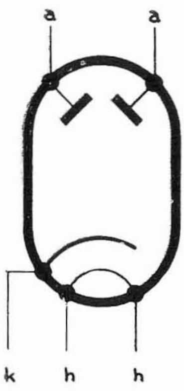
Indirectly-heated power rectifier with 6.3 V. heater for use in A.C. mains-operated equipment.

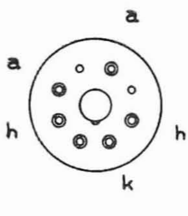
HEATER

V_h	6.3	V
I_h	0.6	A

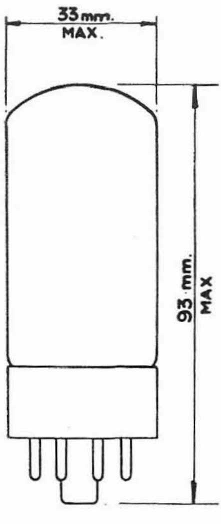
LIMITING VALUES

$V_{a(r.m.s.)}$ 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) ($C=16\mu F$)	350	Ω





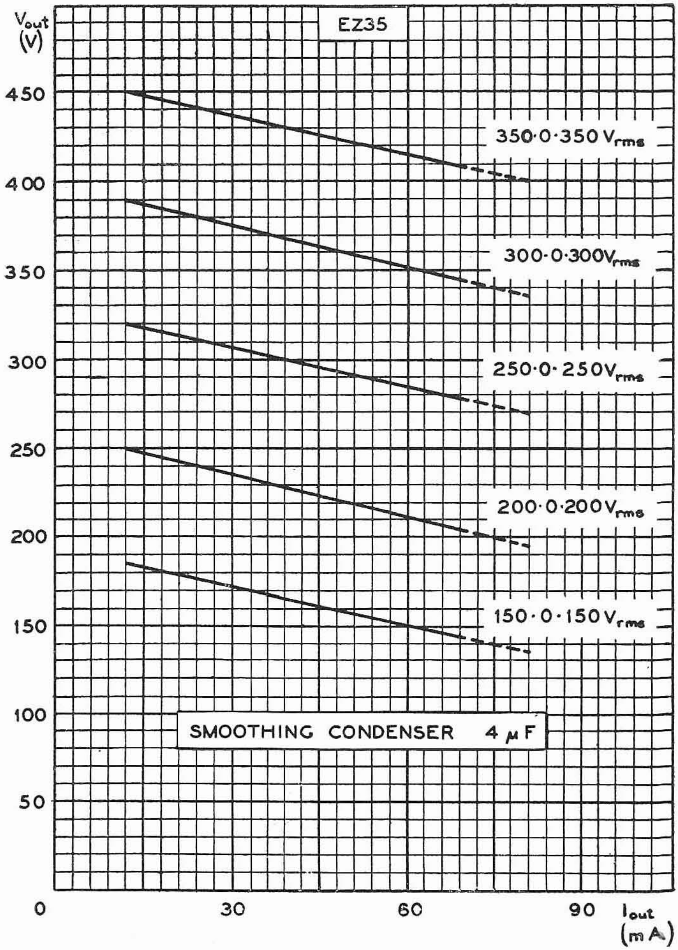
OCTAL BASE



EZ35

FULL-WAVE RECTIFIER

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



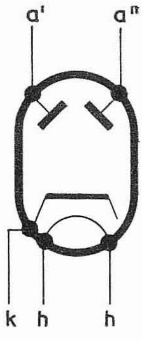
OUTPUT VOLTAGE PLOTTED AGAINST INPUT CURRENT WITH ANODE VOLTAGES AS PARAMETER

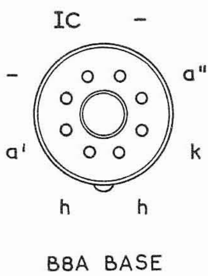
FULL-WAVE RECTIFIER

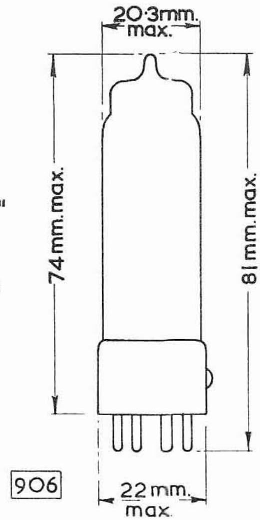
EZ40

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.







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

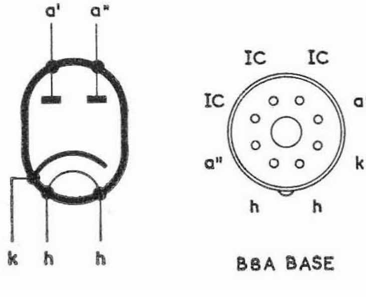
MOUNTING POSITION

Any

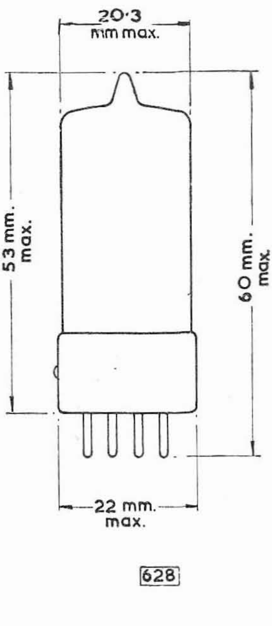
LIMITING VALUES

$V_{a\ (r.m.s.)}$ 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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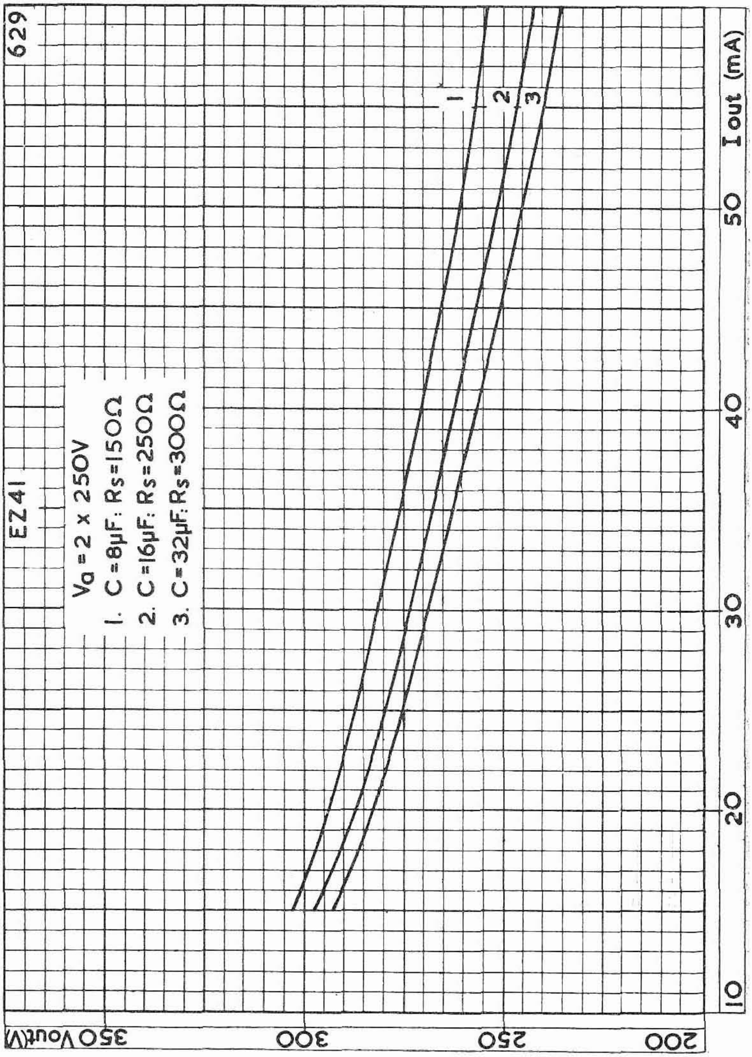
EZ41

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.

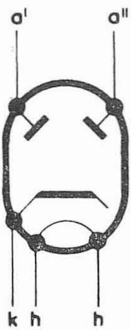
Comparison of the calculated rectification efficiency $\frac{V_{out}}{\sqrt{2}\times V_{in(r.m.s.)}}$

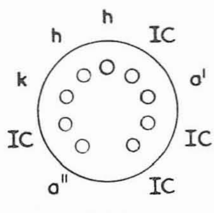
with rating chart 3 will show whether the limiting resistance must be increased to lower the rectification efficiency to the area of safe operation. Operation within this area indicates that the limiting value $i_{a(pk)}$ has not been exceeded.

Choke input circuit

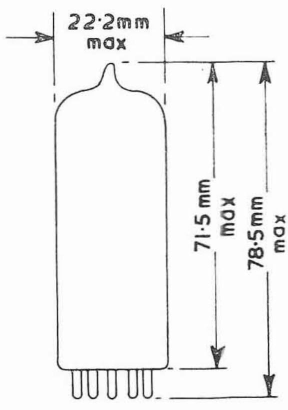
Reference should be made to rating chart 1. A suitable value of choke can be obtained from the choke regulation curves.

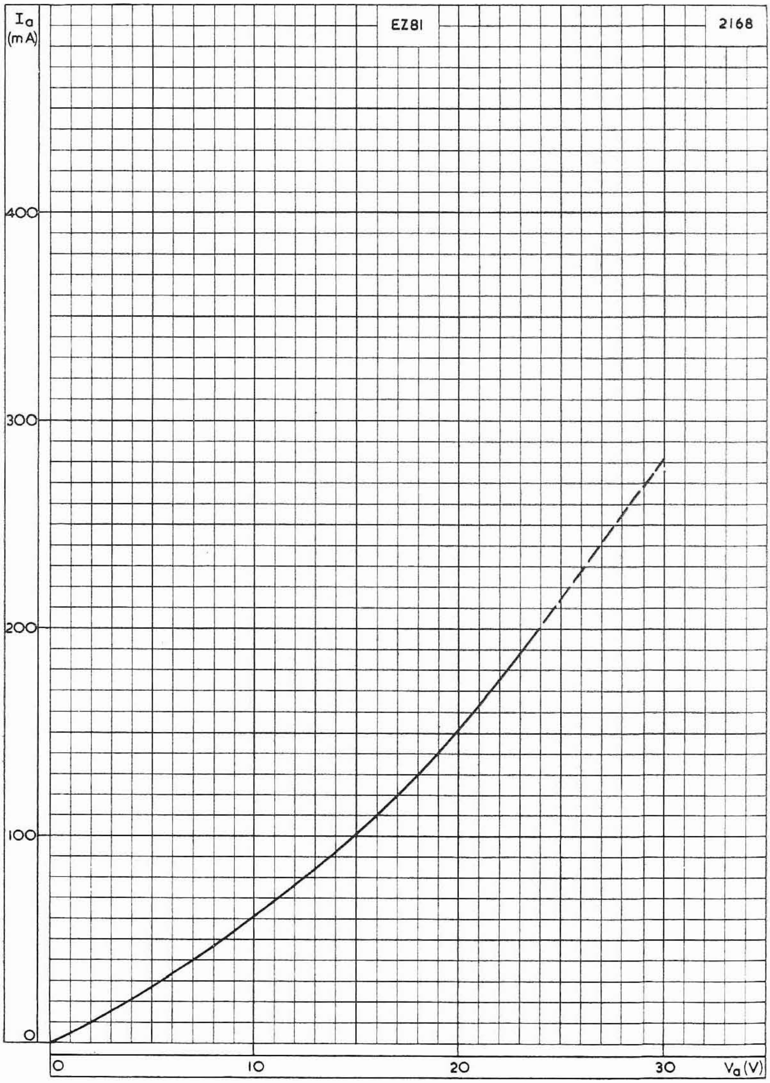
2170



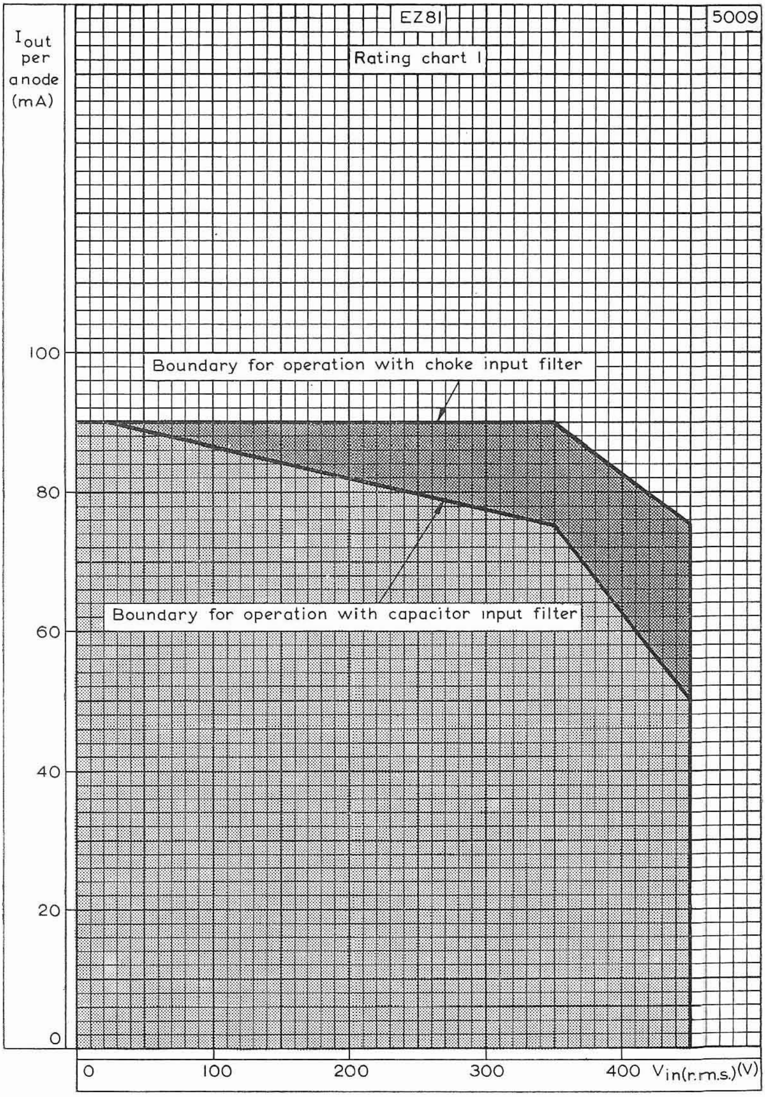


B9A
Noval Base

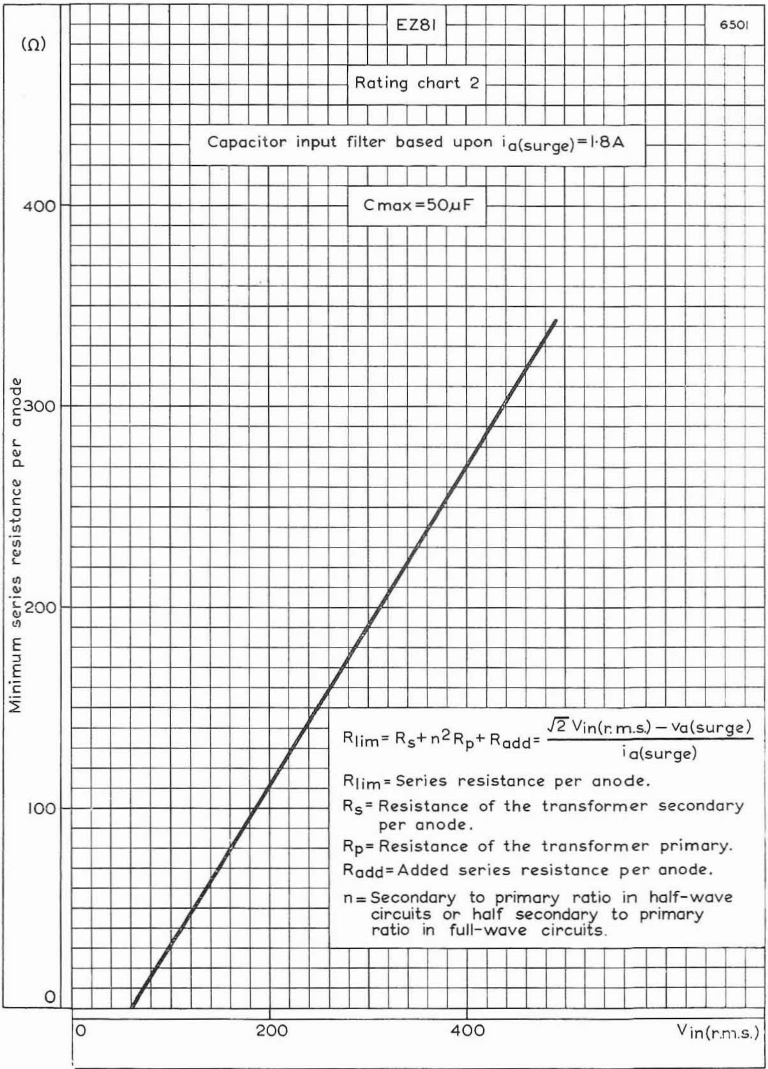




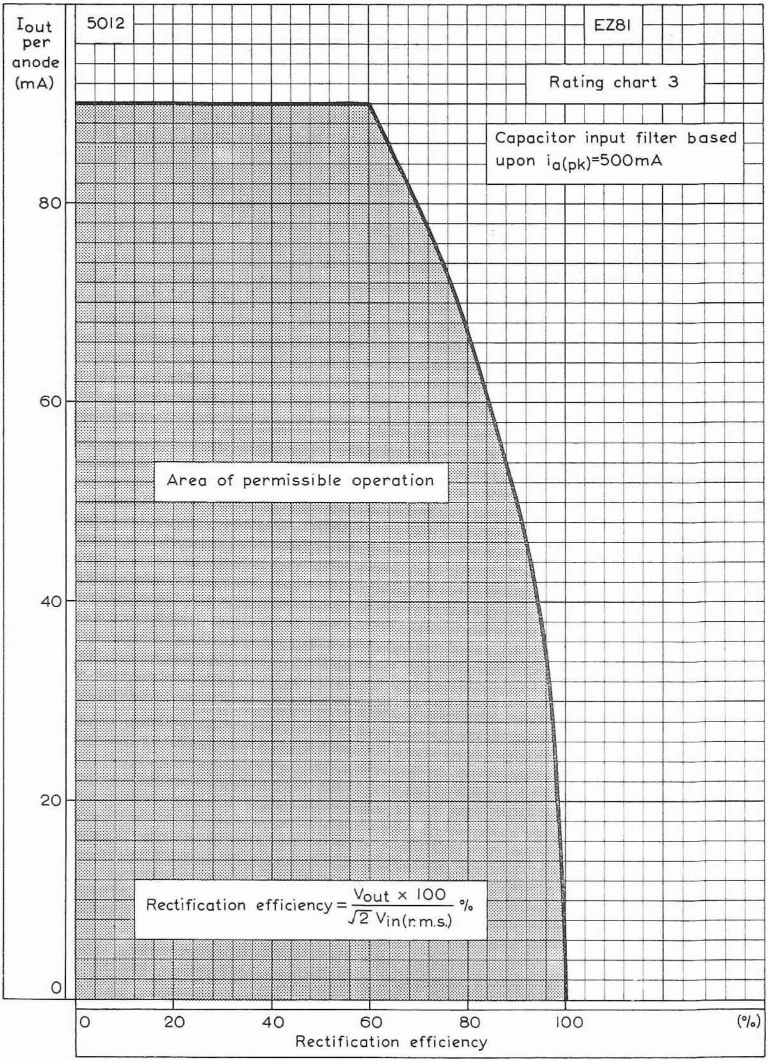
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



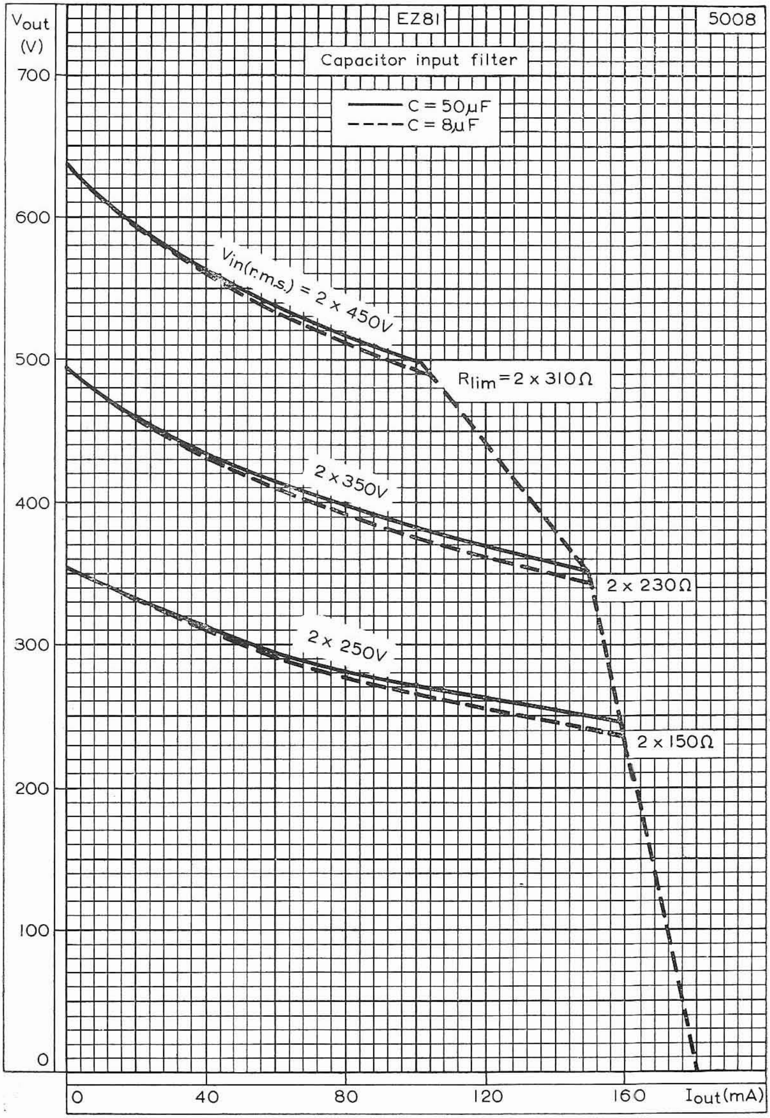
BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER



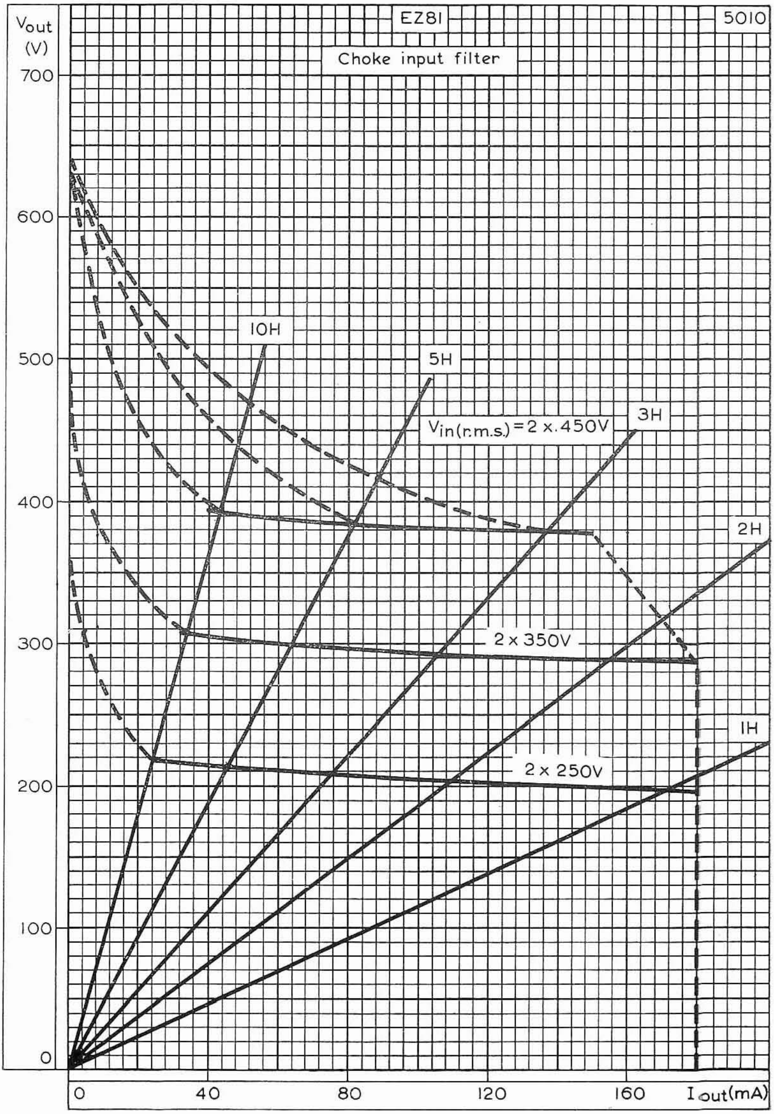
MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST OPEN CIRCUIT SECONDARY VOLTAGE



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

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	C (μF)	R_{lim} min. (per anode) (Ω)	V_{out} (V)
2×250	125	8	190	242
2×300	125	8	260	292
2×350	125	8	300	344
2×250	125	50	240	236
2×300	125	50	310	282
2×350	125	50	380	327

Choke Input

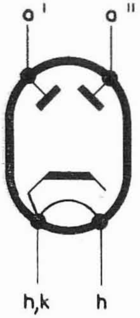
$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	V_{out} (V)
2×250	125	10	205
2×300	125	10	249
2×350	125	10	295
2×400	125	10	340
2×450	125	10	384
2×500	125	10	429

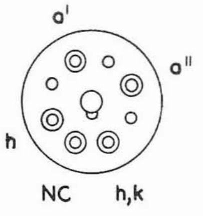
GZ30

FULL-WAVE RECTIFIER

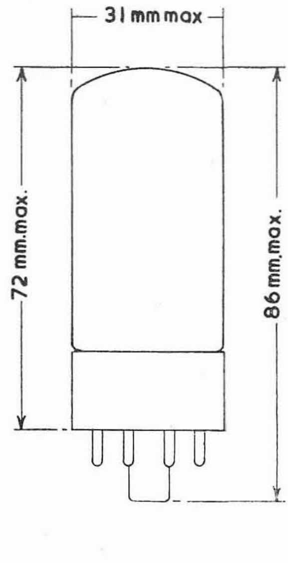
Indirectly-heated full-wave rectifier with 5-volt heater.

1332





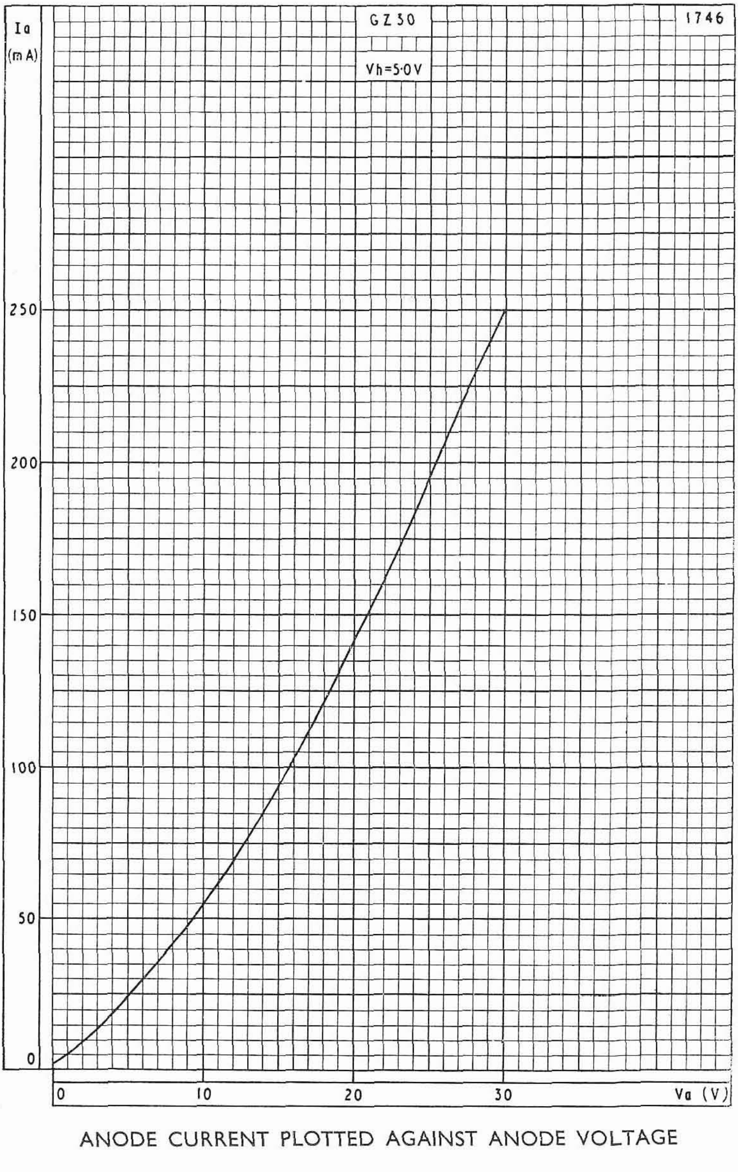
Octal Base.



FULL-WAVE RECTIFIER

GZ30

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

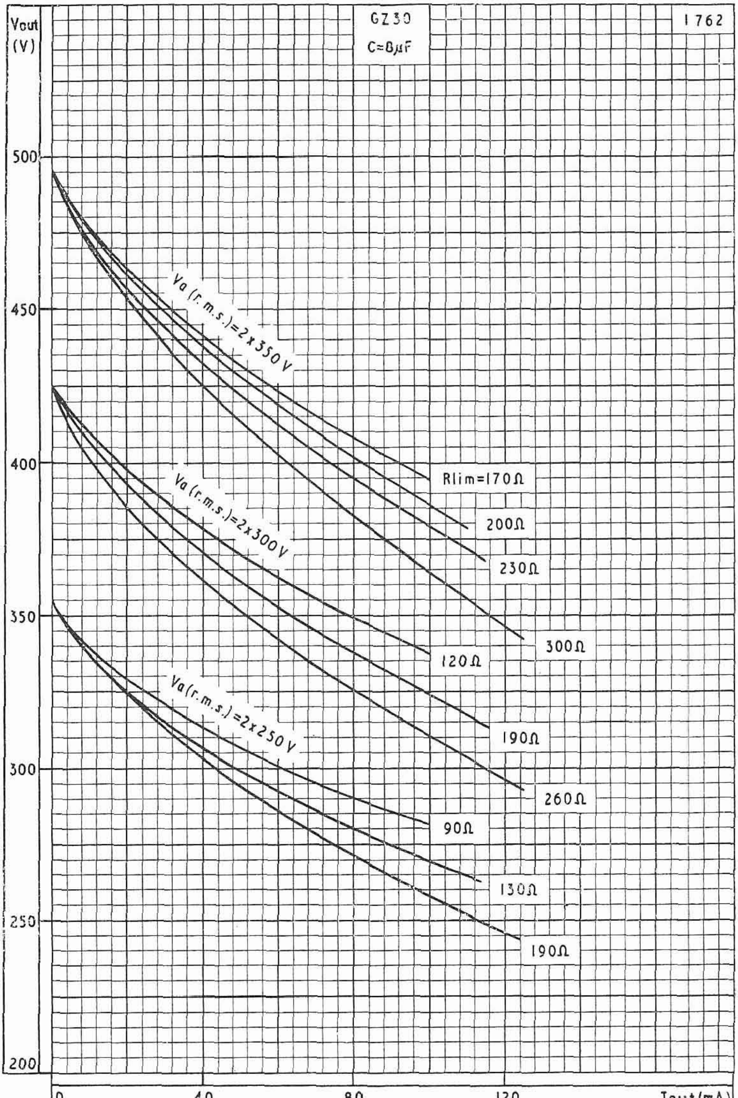


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

GZ30

FULL-WAVE RECTIFIER

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

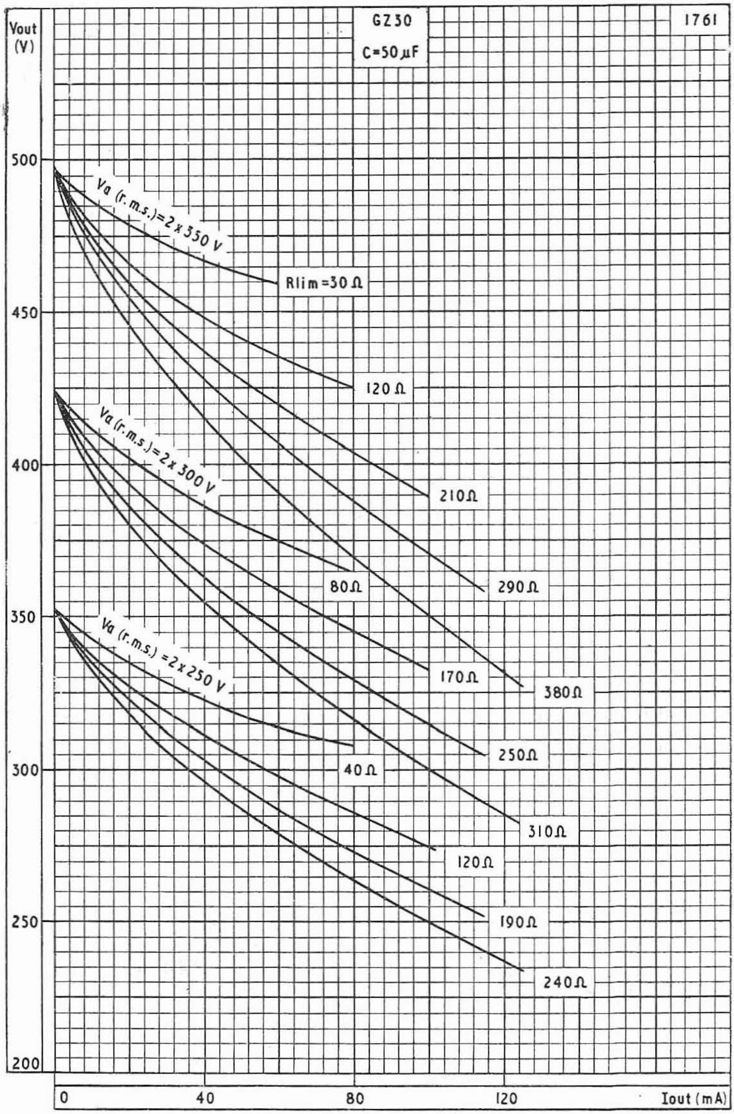


REGULATION CURVES FOR CAPACITOR INPUT C=8μF

FULL-WAVE RECTIFIER

GZ30

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

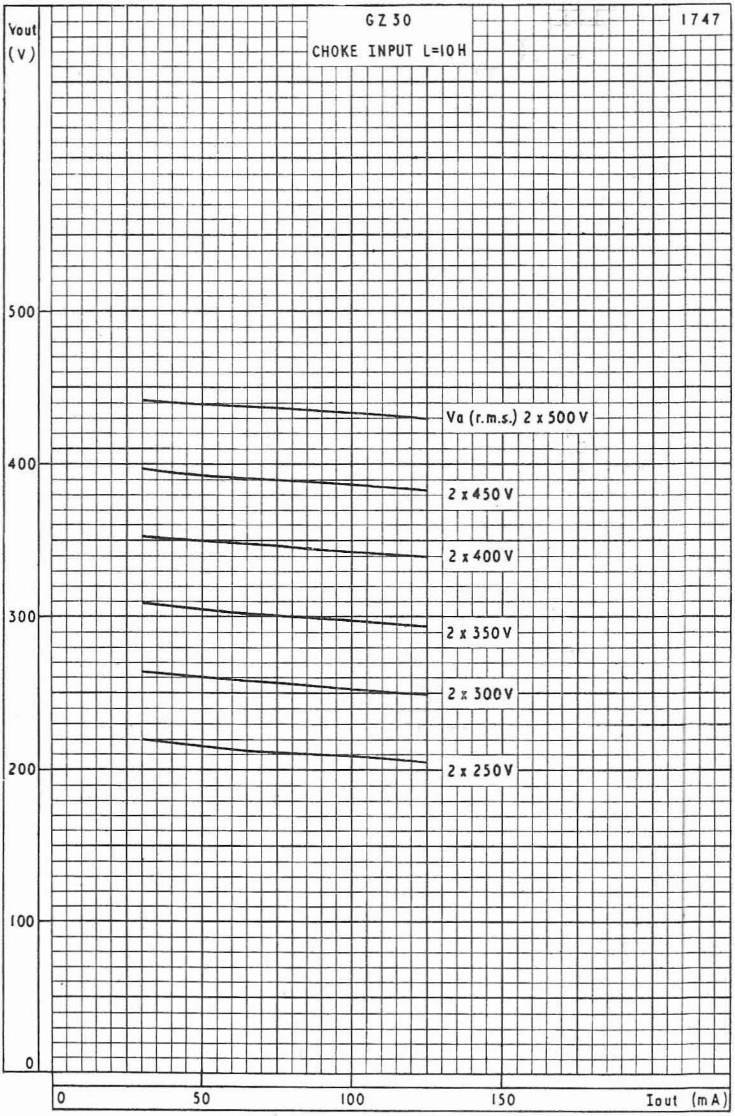


REGULATION CURVES FOR CAPACITOR INPUT C = 50μF

GZ30

FULL-WAVE RECTIFIER

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



REGULATION CURVES FOR CHOKE INPUT

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.

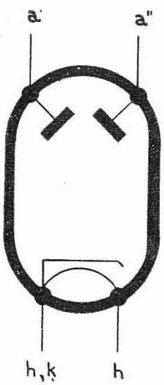
LIMITING VALUES—CAPACITOR INPUT

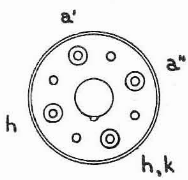
$V_{a\ (r.m.s.)}$ max.	2×300	2×350	2×500	V
I_{out} max.	300	250	125	mA

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

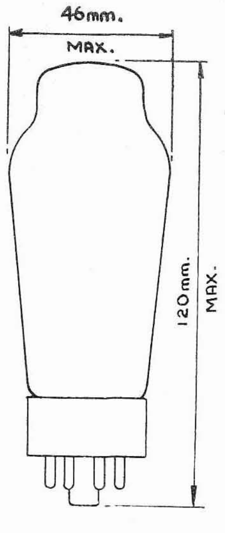
LIMITING VALUES—CHOKE INPUT

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





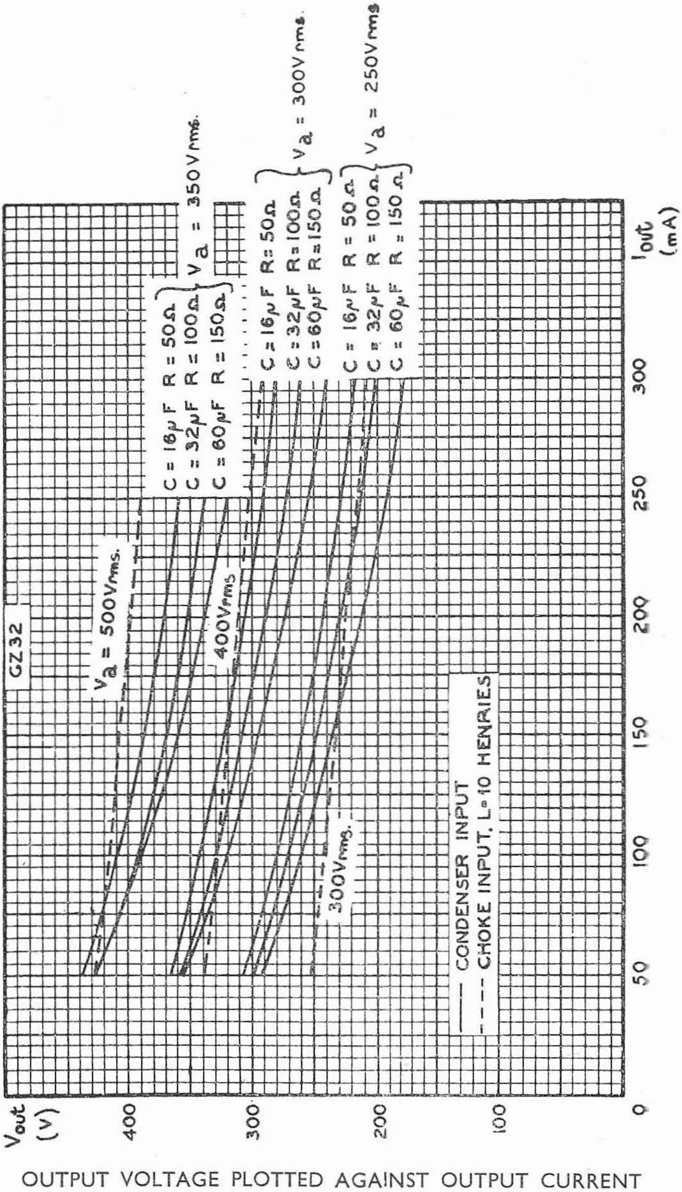
OCTAL BASE



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

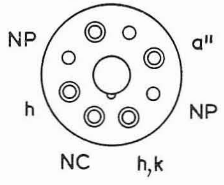
Choke input

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

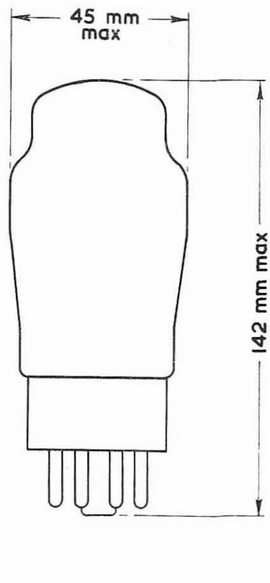
GZ33

FULL-WAVE RECTIFIER

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



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

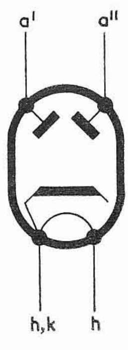
$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	R_{lim} (per anode) (Ω)	V_{out} (V)
2×300	250	10	0	250
2×350	250	10	0	290
2×400	250	10	0	330
2×450	250	10	0	375
2×500	250	10	0	420
2×550	225	10	0	465

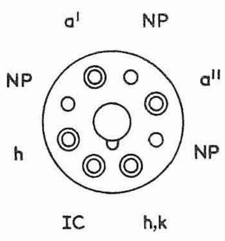
GZ34

FULL-WAVE RECTIFIER

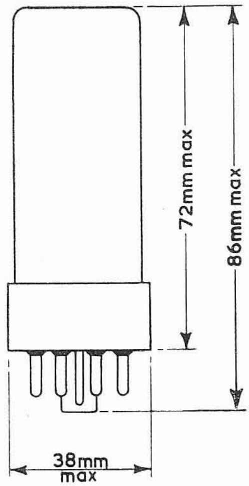
Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

5305





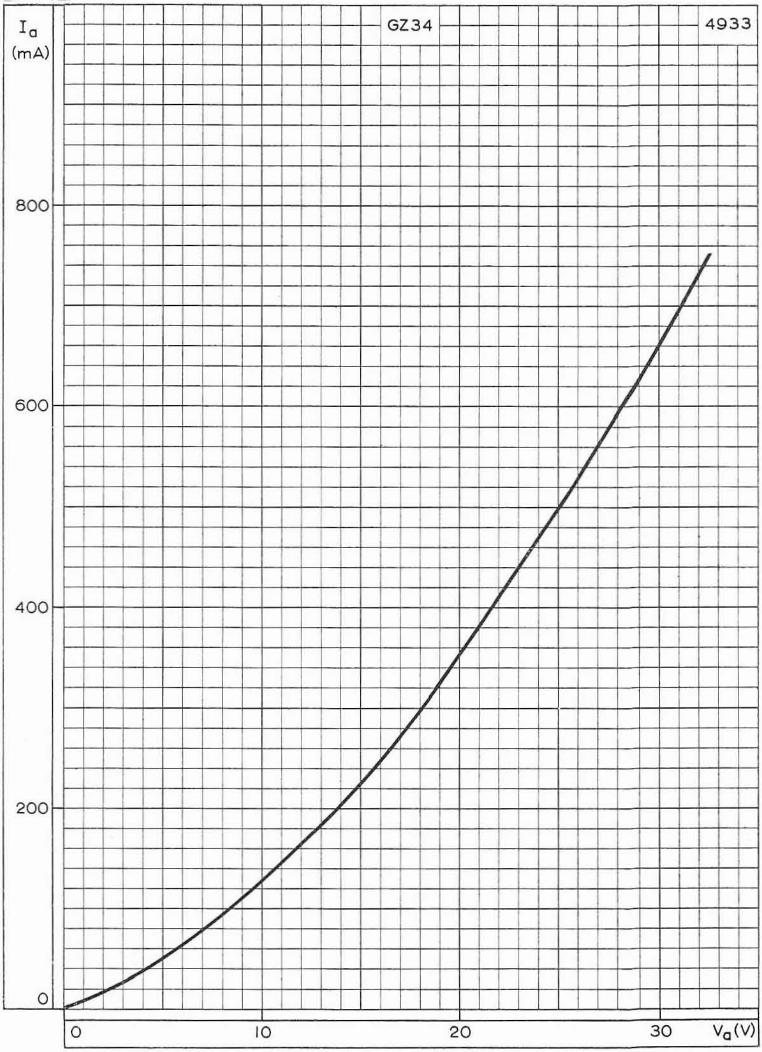
Octal Base



FULL-WAVE RECTIFIER

GZ34

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

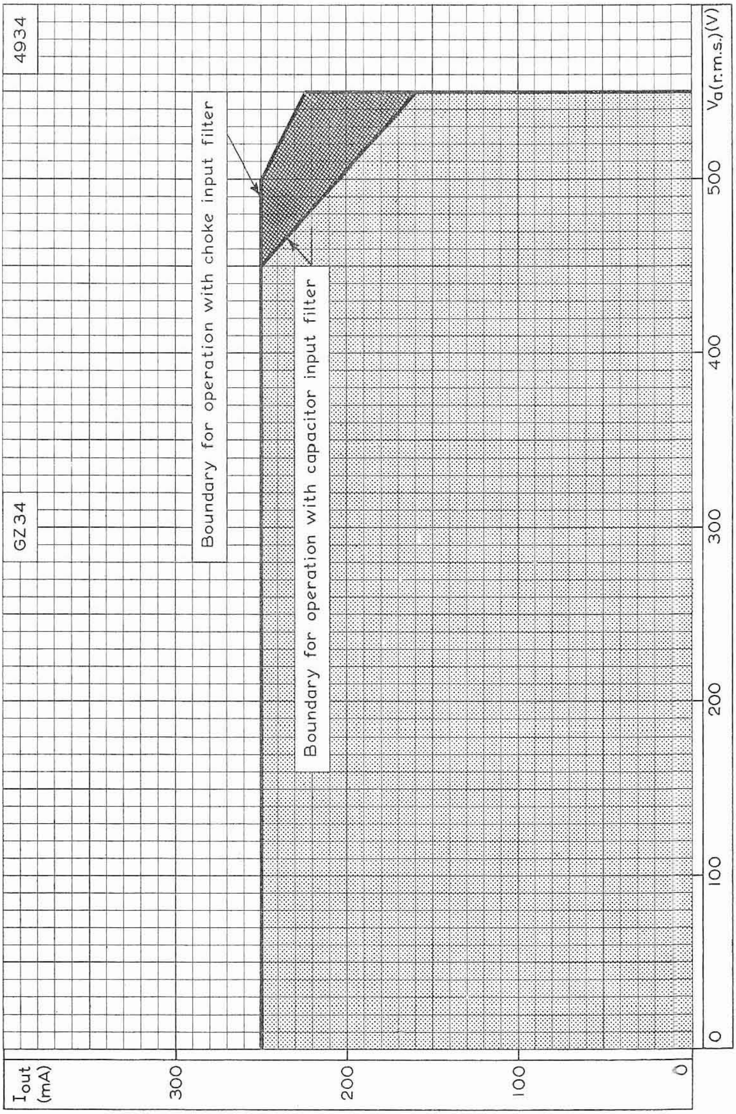


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

GZ34

FULL-WAVE RECTIFIER

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

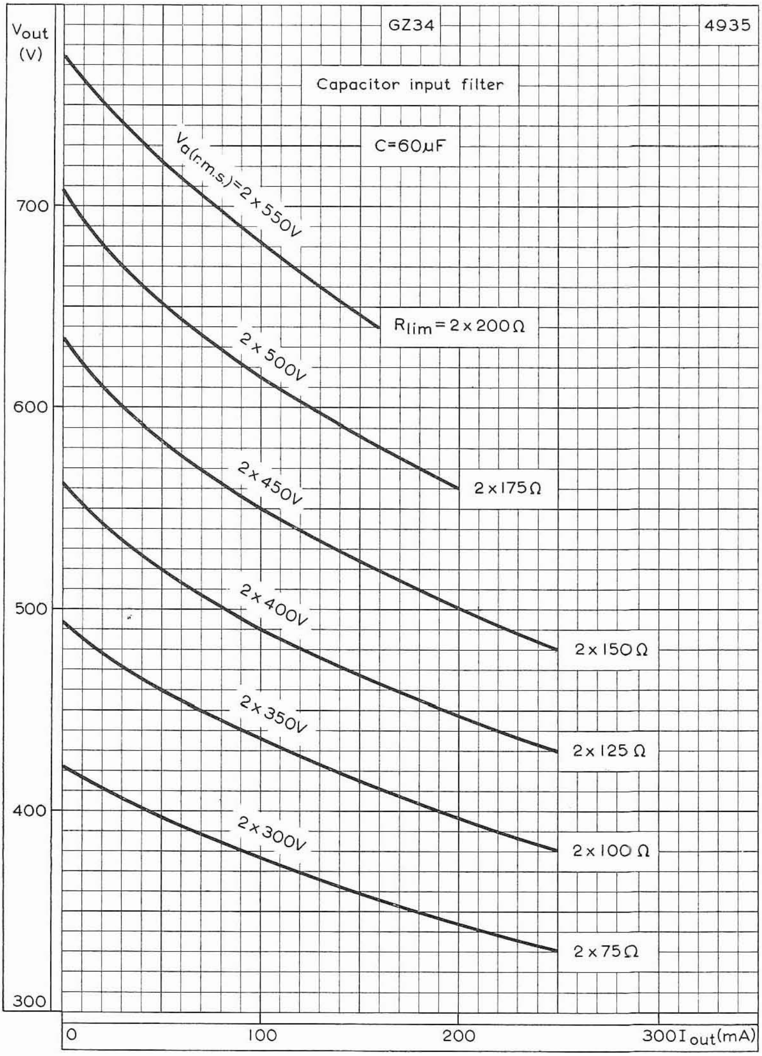


BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER

FULL-WAVE RECTIFIER

GZ34

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

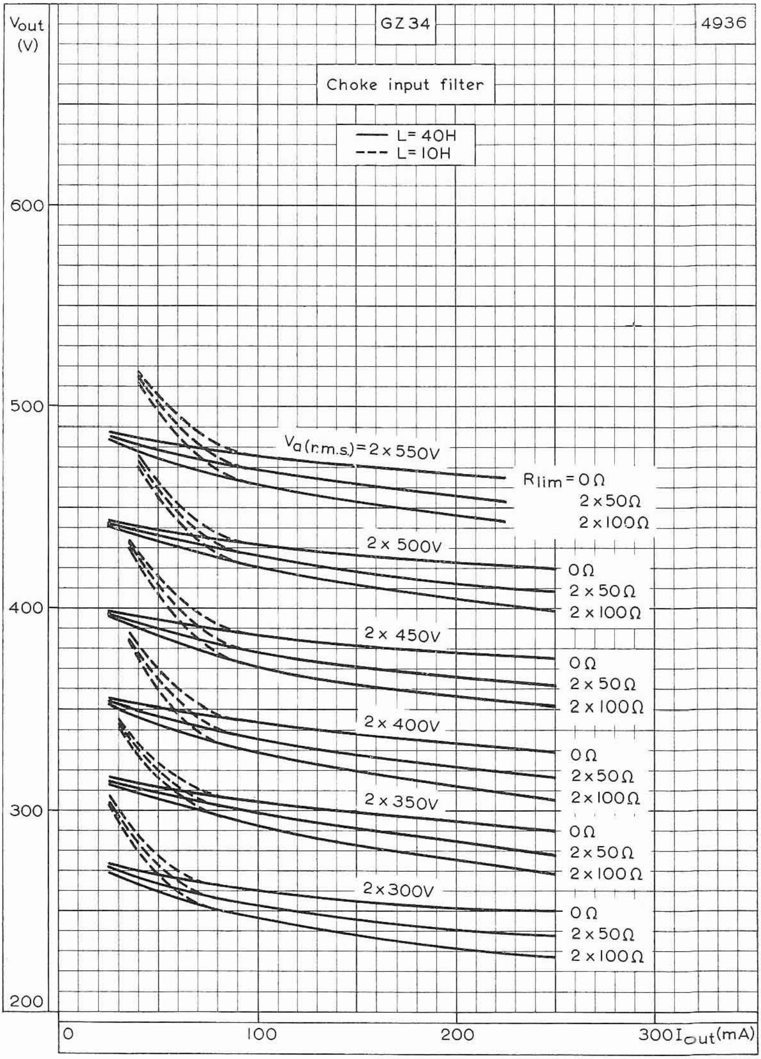


CAPACITOR INPUT FILTER REGULATION CURVES

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

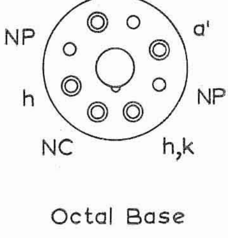
Capacitor input

$V_{a(r.m.s.)}$	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

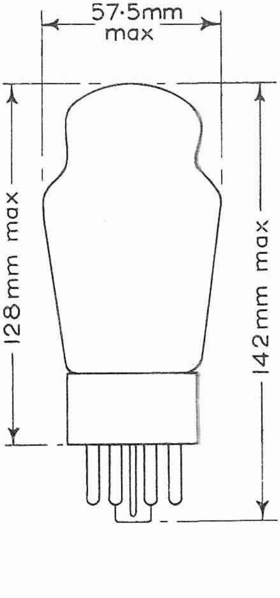
Choke input

$V_{a(r.m.s.)}$	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

FULL-WAVE RECTIFIER



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

Mullard

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

Mullard

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170±5c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current $R_g$max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.6	2.65	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	15	—	—	—	mV (r.m.s.)
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current $R_g$max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.6	2.65	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	15	—	—	—	mV (r.m.s.)

TESTS

GROUP F

Stability life test[14]

Running conditions. V_{a-e} = 250V, R_k = 500Ω, V_{h-k} = 150V (cathode negative)

Stability life test end point

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

Intermittent life test

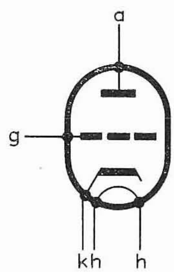
Running conditions. V_{a-e} = 250V, R_k = 500Ω, V_{h-k} = 150V (cathode negative)

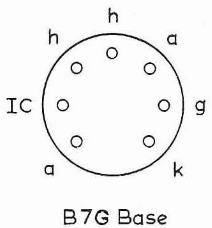
Intermittent life test end points

		A.Q.L.[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	138	162	mA
Heater to cathode leakage current V_{h-k} = ±100V	500 hours	2.5	—	20	µA
	1000 hours	4.0	—	20	µA
Reverse grid current. R_g max. = 500kΩ	500 hours	2.5	—	0.5	µA
	1000 hours	4.0	—	0.5	µA
Mutual conductance	500 hours	2.5	1.6	2.65	mA/V
	1000 hours	4.0	1.5	2.65	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Anode current	500 hours	4.0	5.5	14.5	mA
	1000 hours	6.5	5.0	14.5	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

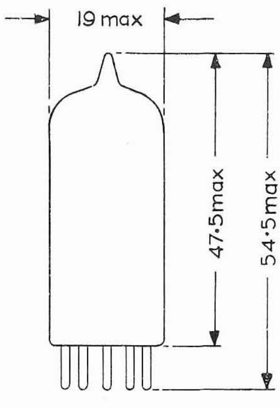
GROUP G	*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Valves are held for 28 days and retested for				
Inoperatives[16]	0.5	—	—	
Reverse grid current. R_g max. = 500kΩ	0.5	—	0.5	μA

5606





B7G Base



All dimensions in mm

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

SPECIAL QUALITY V.H.F. DOUBLE TRIODE

M8081

Special quality double triode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

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

HEATER

V_h[1]	6.3	V
I_h	450	mA

CAPACITANCES[2] (measured without an external shield)

$*c_{a-g}$	1.6	pF
$*c_{in}$	2.1	pF
$c_{out'}$	450	mpF
$c_{out''}$	350	mpF
c_{h-k}	4.0	pF

*Each section

CHARACTERISTICS[3] (each section)

V_a	100	V
I_a	9.0	mA
$*V_g$	−0.9	V
g_m	5.6	mA/V
μ	38	
r_a	6.8	kΩ
R_k	0	Ω

* Fixed bias operation is not recommended

LIMITING VALUES[4] (absolute ratings)

f max.	250	Mc/s
$V_{a(b)}$ max.	550	V
V_a max.	330	V
p_a max.	2×1.6	W
I_k max.	25	mA
$-V_g$ max.	110	V
I_g max.	2×4.5	mA
V_{h-k} max.	100	V
R_{g-k} max. (cathode resistor bias)	500	kΩ
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

TEST CONDITIONS (unless otherwise specified)

V_h	V_{a-e}	V_{g-e}	R_k	C_k
(V)	(V)	(V)	(Ω)	(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 Min.*	*Individuals Max.*	*Lot average*[7] *Min.*	*Lot average 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	—	—	—	—	—	—	

Mullard

GROUP C

Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Microphonic noise at the anode at 50c/s and 2.0g min. peak acceleration, both sections connected in parallel, $V_b = 250V$, $R_a = 2k\Omega$, $R_k = 1.5k\Omega$, $R_{g'} = R_{g''} = 0\Omega$.	2.5	—	—	15	—	—	—	mV (r.m.s.)

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	1.4	2.8	—	—	—	pF
$c_{out'}$	—	—	250	650	—	—	—	mpF
$c_{out''}$	—	—	250	550	—	—	—	mpF
c_{a-g}	—	—	1.2	1.8	—	—	—	pF
c_{h-k}	—	—	3.3	7.5	—	—	—	pF
Amplification factor	6.5	—	28	48	—	—	—	
Reverse grid current. $V_h = 7.0V$, $R_g = 1M\Omega$ both sections connected in parallel	6.5	—	—	1.0	—	—	—	µA

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	Lot average[7] Min.	Max.	Lot standard deviation[8] Max.	
GROUP E								
***Fatigue*[14]**								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 2g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. $V_{h-k} = \pm100V$	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. $V_{h-k} = \pm100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current as in group A	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	3.5	7.5	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	35	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	

GROUP F

Stability life test[14]

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

Stability life test end points

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

Intermittent life test

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

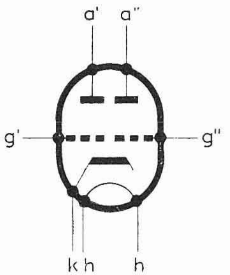
Intermittent life test end points

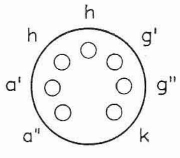
		A.Q.L.[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	420	480	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse grid current as in group A	500 hours	2.5	—	0.75	μA
	1000 hours	4.0	—	1.0	μA
Mutual conductance	500 hours	2.5	3.5	7.5	mA/V
	1000 hours	4.0	3.25	7.5	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

M8081

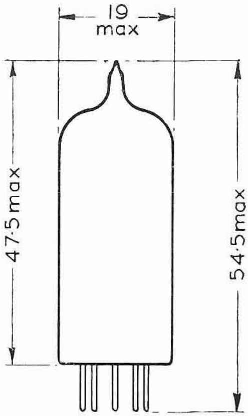
SPECIAL QUALITY V.H.F. DOUBLE TRIODE

	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



4749

All dimensions in mm

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

SPECIAL QUALITY OUTPUT PENTODE

M8082

Special quality output pentode for use in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

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

HEATER

V_h[1]	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

CAPACITANCES[2] (measured with an external shield)

c_{in}	3.8	pF
c_{out}	6.5	pF
c_{a-g1}	<300	mpF

CHARACTERISTICS[3]

V_a	250	V
V_{g2}	250	V
I_a	16	mA
I_{g2}	2.3	mA
g_m	2.5	mA/V
r_a	130	kΩ
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 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	—	—	

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	—	—	—	—	—	—	

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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

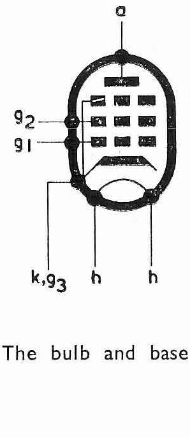
		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	184	216	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	30	µA
	1000 hours	4.0	—	30	µA
Reverse control-grid current. R_{g1} max $= 500k\Omega$	500 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	—	—	

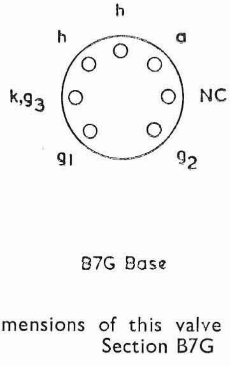
	A.Q.L.[5] (%)	Min.	Max.	
Dynamic life test 100 hours				
Running conditions as a trebler. $V_b = 300V$, decoupling resistor = 1.0kΩ $I_a + I_{g2} = 20mA$, $I_{g1} = 1.6mA$, f = 70 to 75Mc/s $P_{out} = 900mW$				
Dynamic life test end point				
Change in P_{out}	—	—	20	%

GROUP G

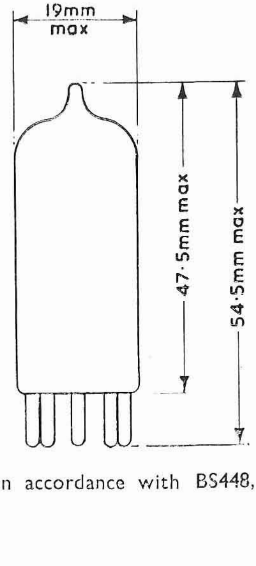
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse control-grid current. R_{g1} max. = 500kΩ	0.5	—	0.75	μA

2831





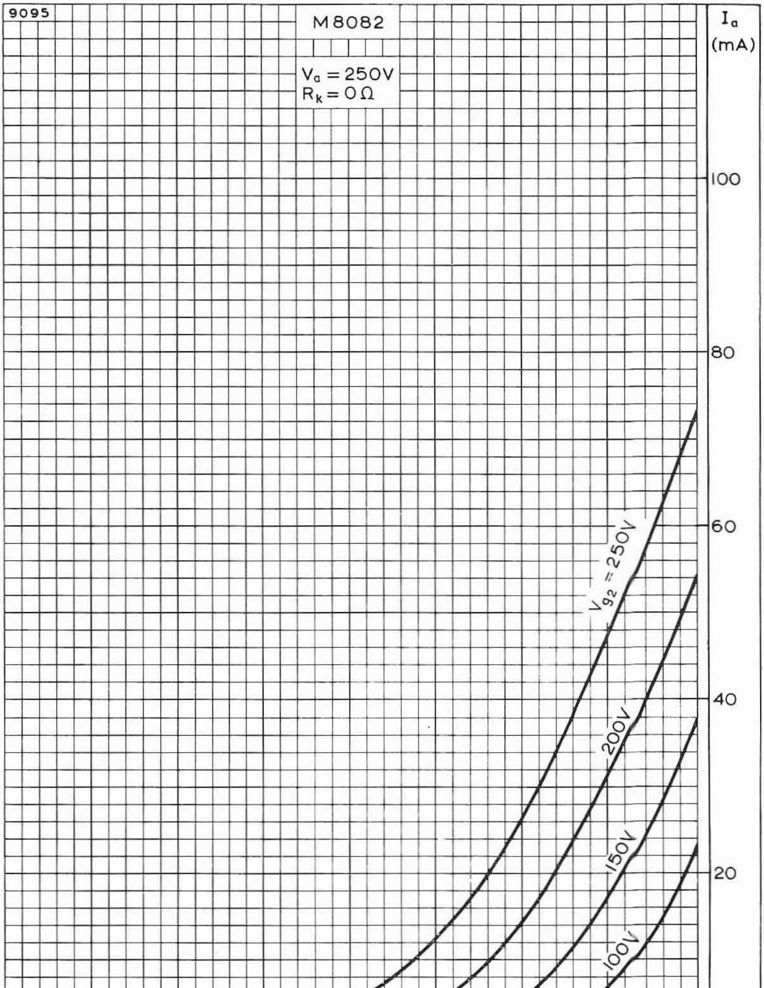
B7G Base



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

SPECIAL QUALITY OUTPUT PENTODE

M8082

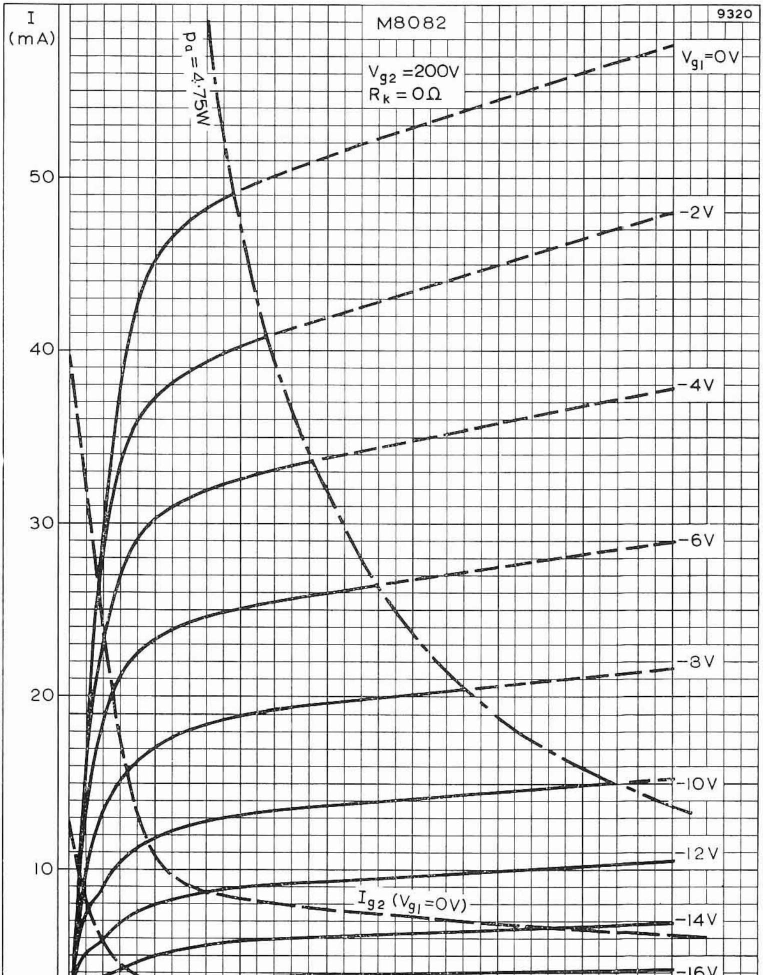


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

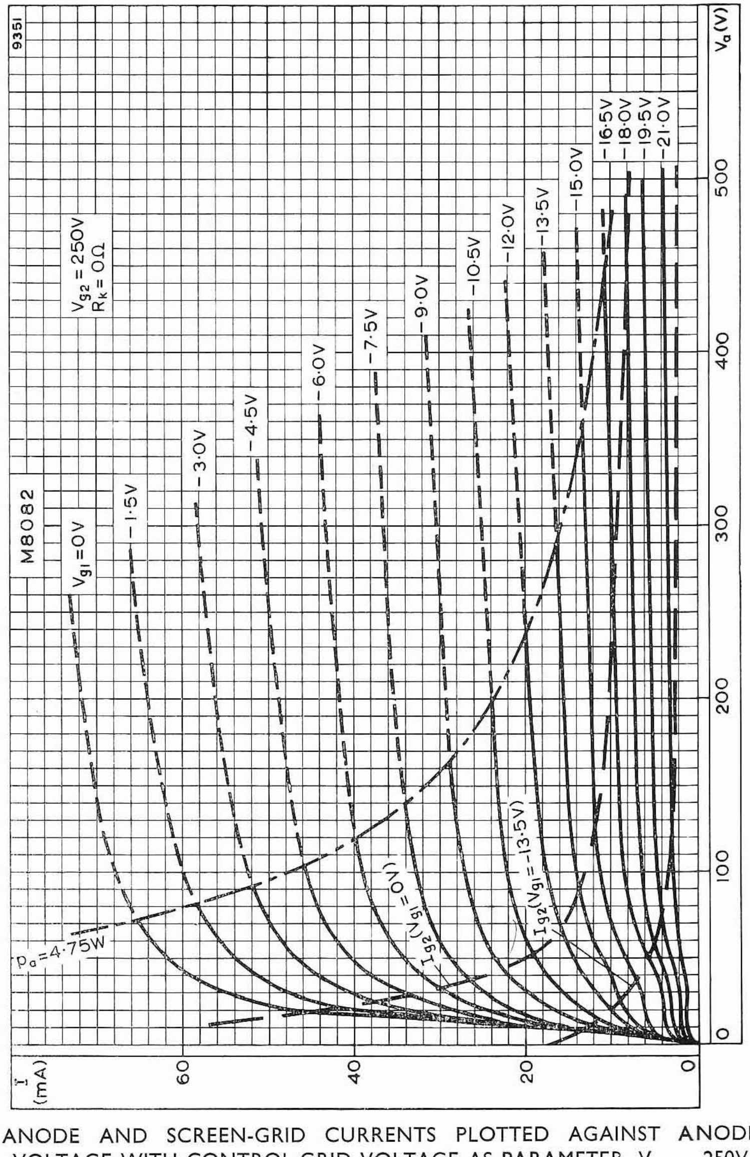
M8082

SPECIAL QUALITY OUTPUT PENTODE

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



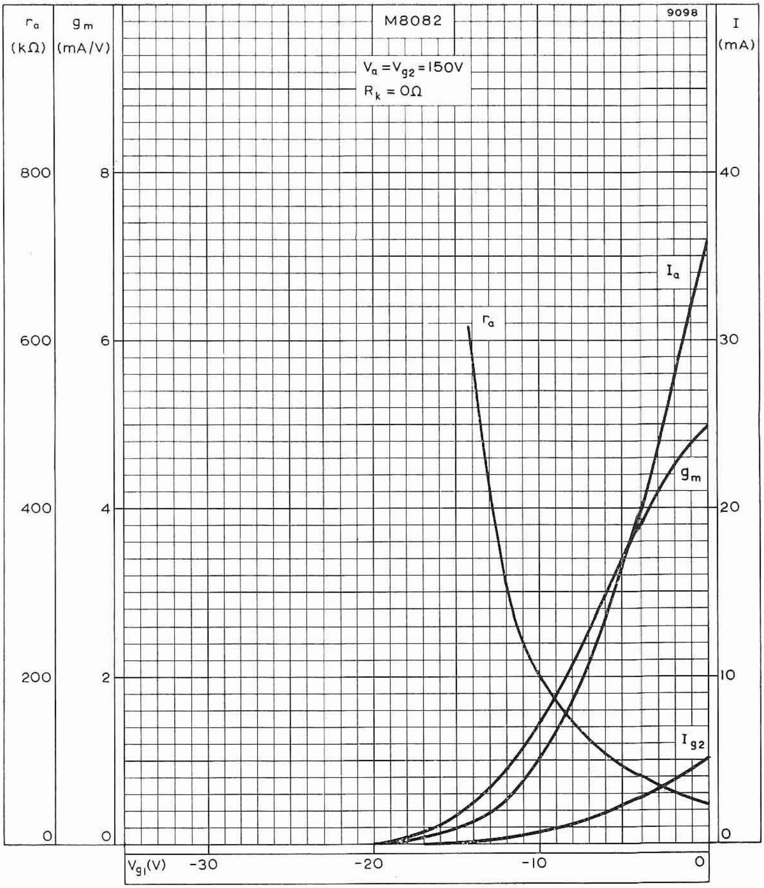
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V



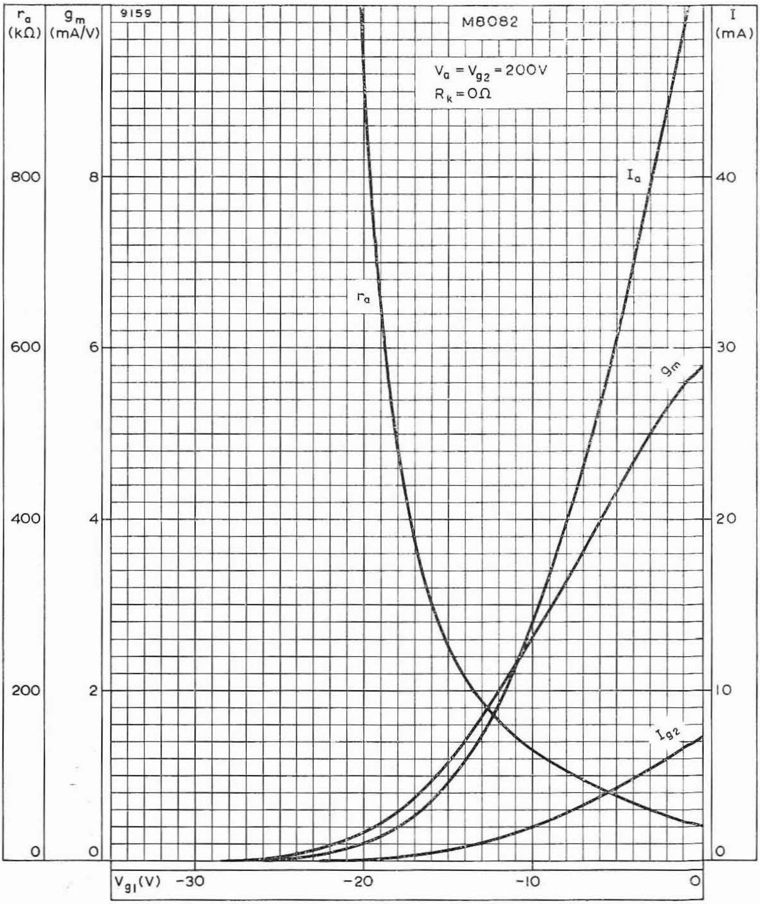
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$

SPECIAL QUALITY OUTPUT PENTODE

M8082



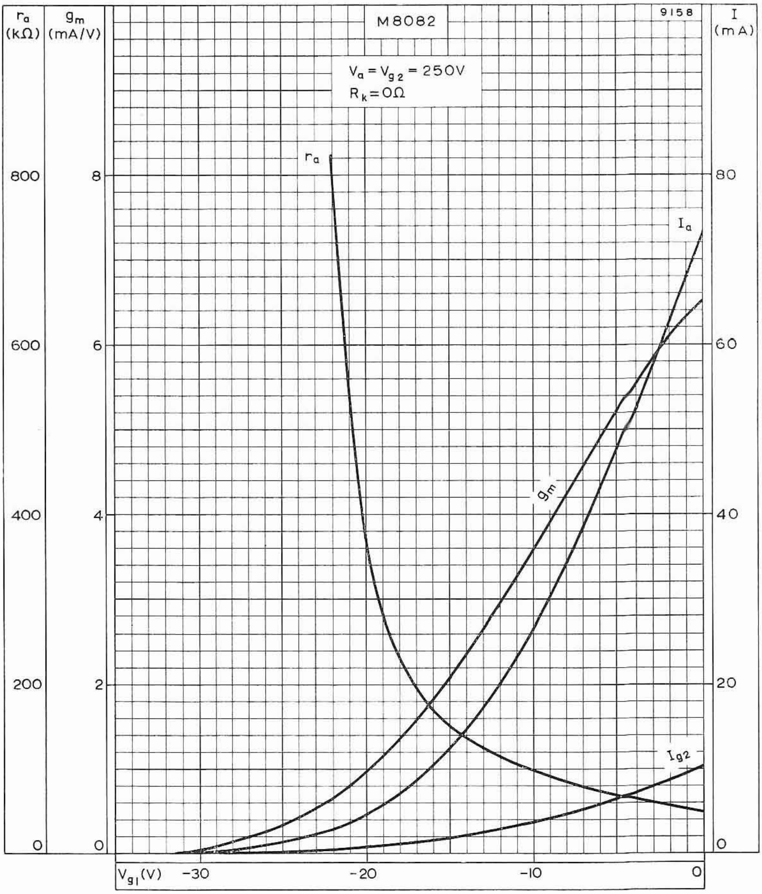
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



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

SPECIAL QUALITY OUTPUT PENTODE

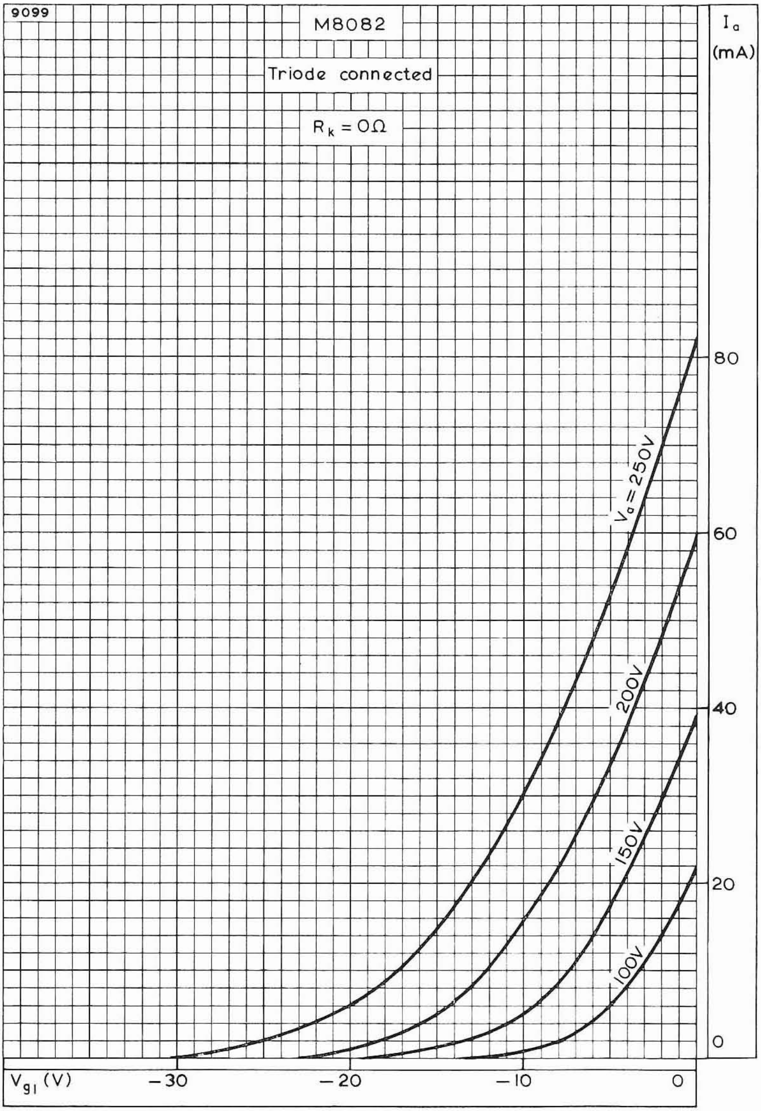
M8082



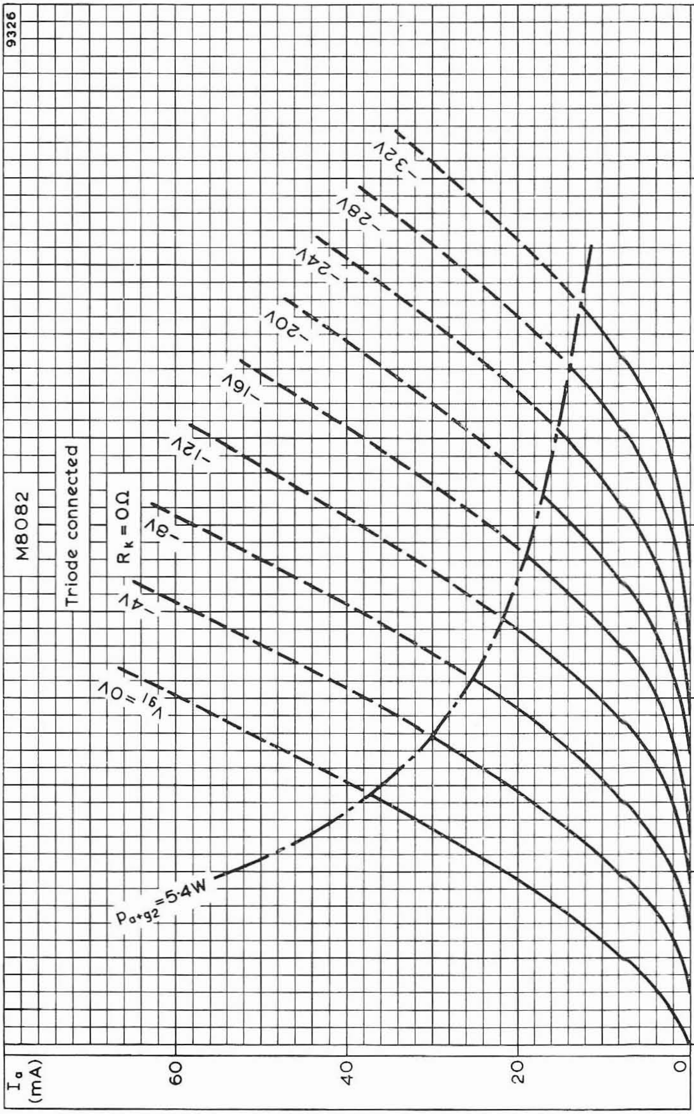
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 250V$

M8082

SPECIAL QUALITY OUTPUT PENTODE



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



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

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)

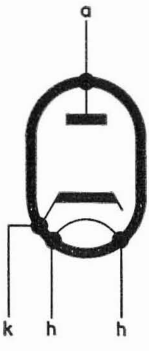
P.I.V. max.	2.0	kV
$i_{a(pk)}$ max.	900	mA
V_{h-k} max.	650	V
Maximum altitude for full P.I.V. rating	60,000	ft
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

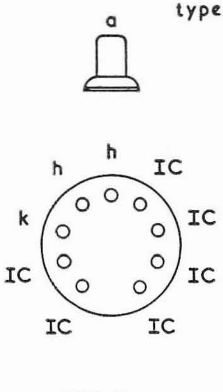
TYPICAL OPERATION OF TWO M8091 AS FULL-WAVE RECTIFIER

Capacitor input

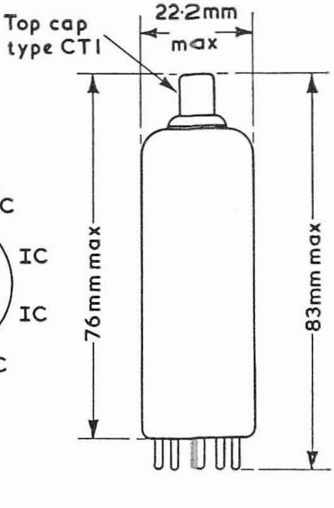
$V_{in(r.m.s.)}$	2×500	2×625	V
R_{lim} min. (per anode)	150	250	Ω
C max.	16	16	μF
I_{out} max.	300	250	mA

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} = 3kΩ..	2.5	—	145	—	mA
†Hot switch	2.5	—	—	—	
†Hot switch. f = 1.5 to 2.4kc/s C reduced to suit frequency	6.5	—	—	—	

†The anode voltage is switched on and off six times and no arcing must occur within the valve.

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	

GROUP E

***Fatigue*[14]**

V_h = 7.0V, 1 minute on 3 minutes off. No other voltages applied, minimum peak acceleration = 5g, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes.

Post fatigue tests

Heater to cathode leakage current. V_{h-k} = 330V (cathode positive)	2.5	—	—	200	µA
Output current	2.5	—	120	—	mA

***Shock*[15]**

No applied voltages, 500g.

Post shock tests

Heater to cathode leakage current. V_{h-k} = 330V (cathode positive)	2.5	—	—	200	µA
Output current	2.5	—	120	—	mA
Voltage breakdown	2.5	—	—	—	
Group quality level[10]	6.5	—	—	—	

GROUP F

	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	

Life[14]

Running conditions. $V_{in(r.m.s.)} = 500V$, $R_{load} = 3k\Omega$
$V_{h-k} = V_{out}+150V r.m.s.$, $C = 8\mu F$

Stability life test end point

	A.Q.L.[5] (%)	Bogey[9]	Min.	Max.	
Change in anode voltage after 1 hour. $I_a = 150mA$	1.0	—	—	10	%

Intermittent life test

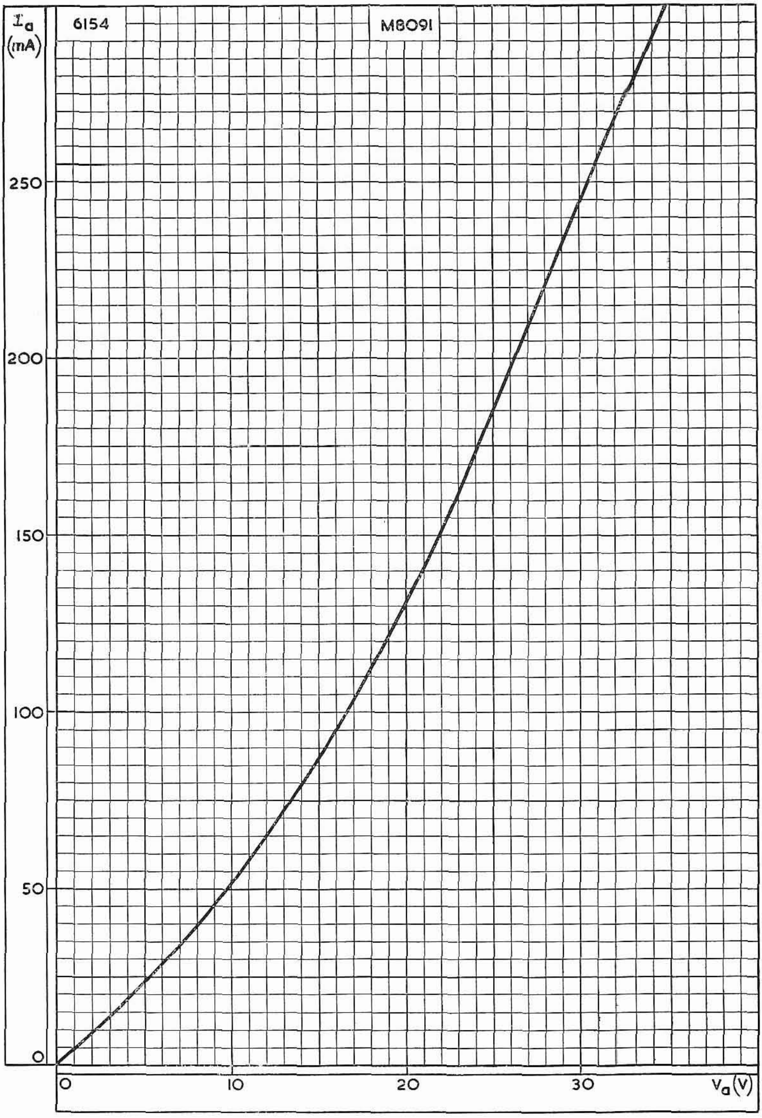
Running conditions. $V_{in(r.m.s.)} = 500V$, $R_{load} = 3k\Omega$
$V_{h-k} = V_{out}+150V$ r.m.s., $C = 8\mu F$

Intermittent life test end points

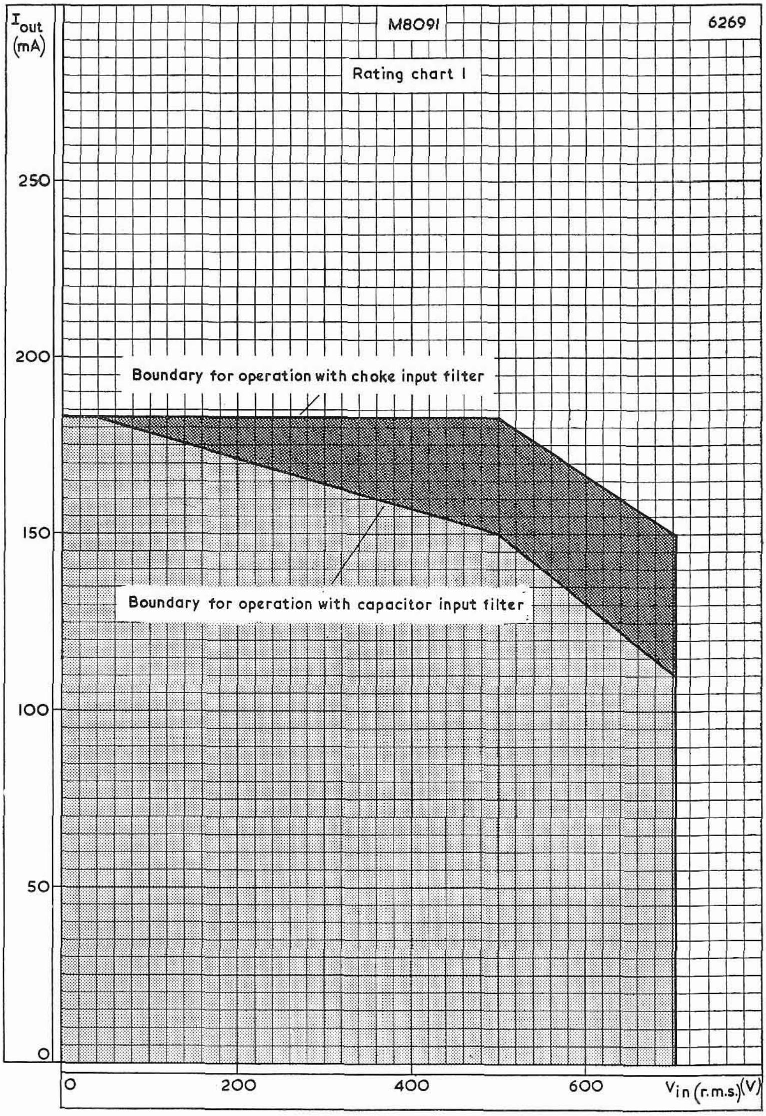
		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	0.9	1.4	A
Heater to cathode leakage current. $V_{h-k} = 300V$ (cathode positive)	500 hours	2.5	—	150	μA
	1000 hours	4.0	—	150	μA
Sub-group (b)					
Output current	500 hours	4.0	120	—	mA
	1000 hours	6.5	120	—	mA
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

GROUP G

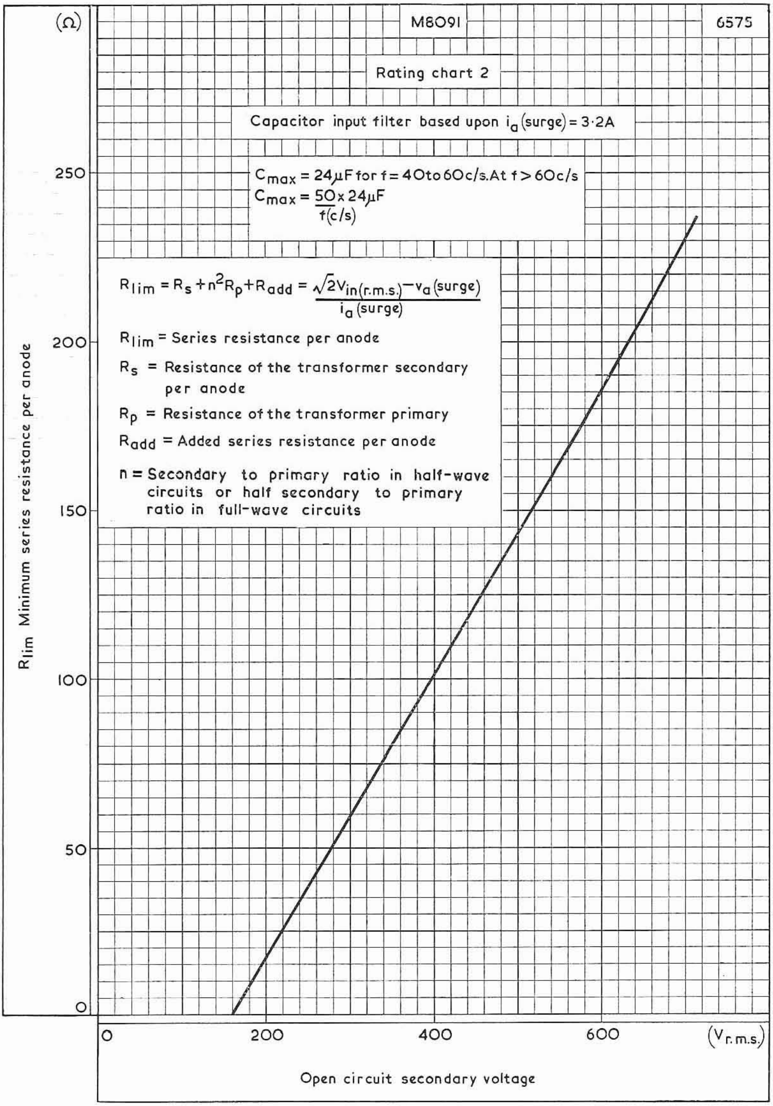
	A.Q.L. (%)	Min.	Max.
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—



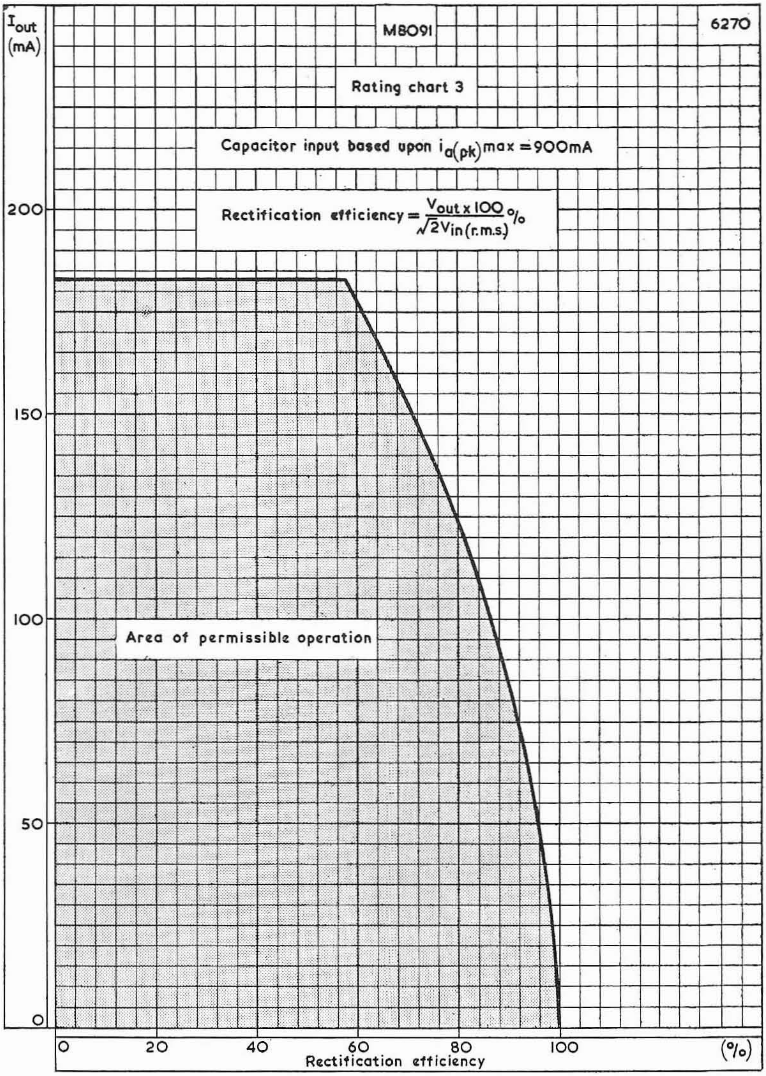
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



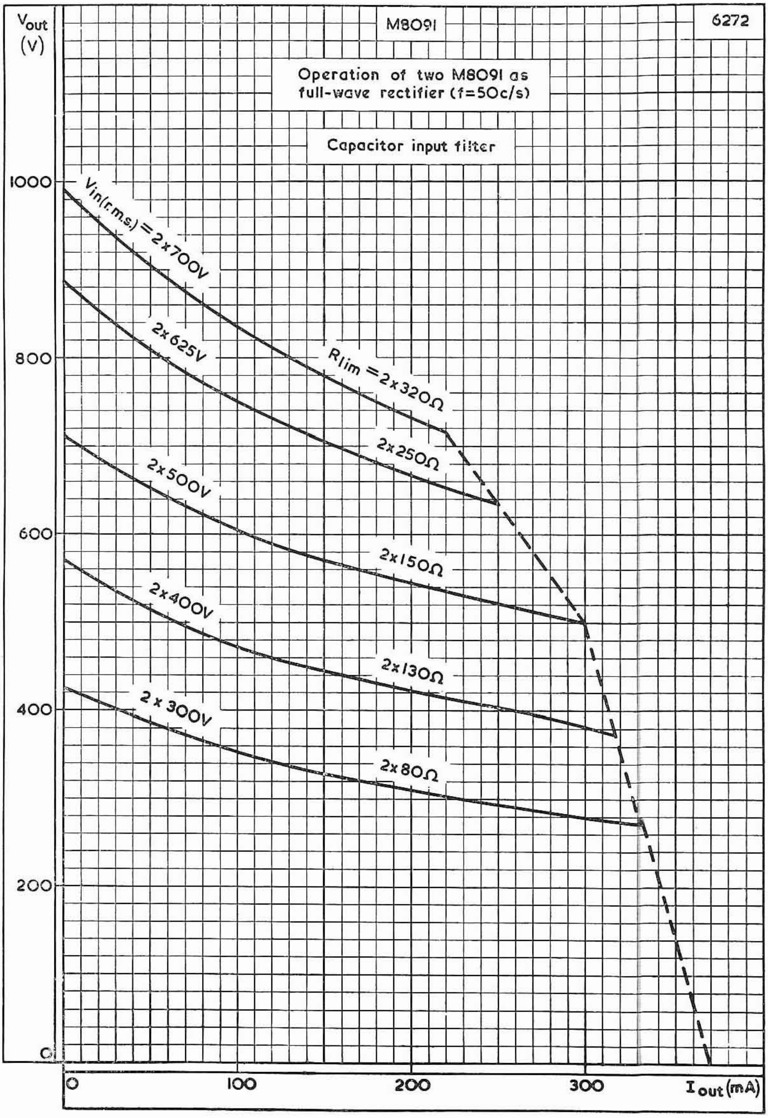
BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER



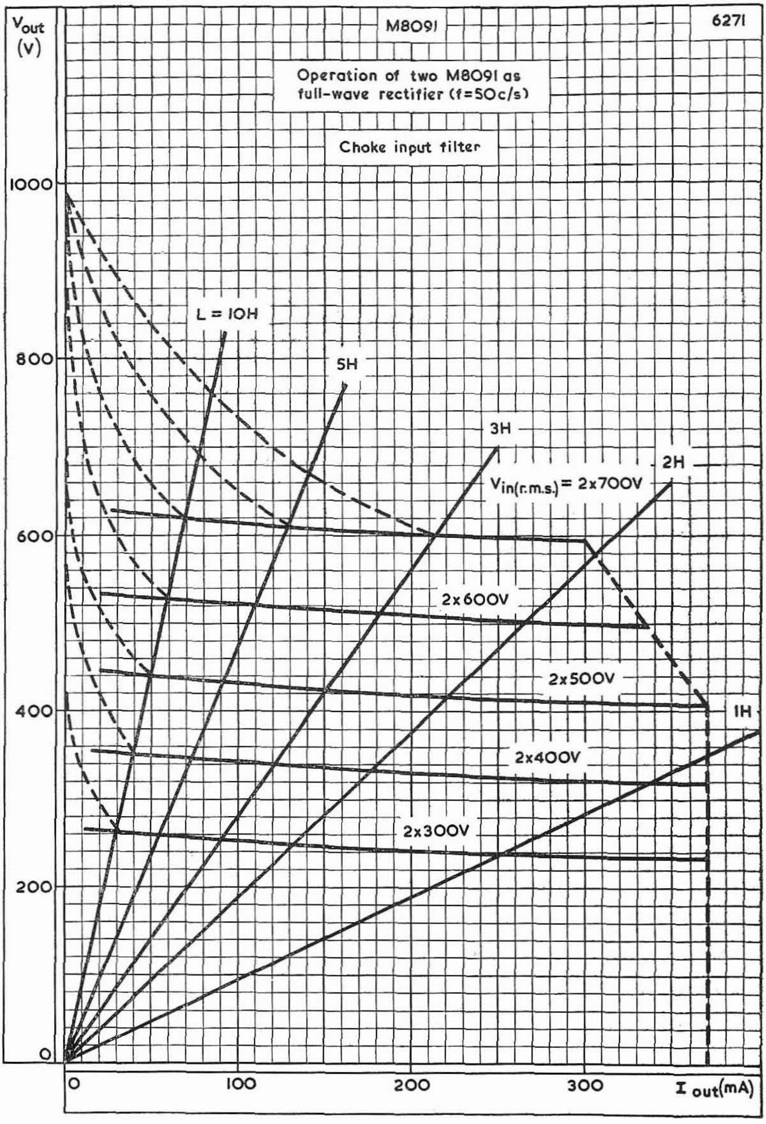
MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST
OPEN CIRCUIT SECONDARY VOLTAGE



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

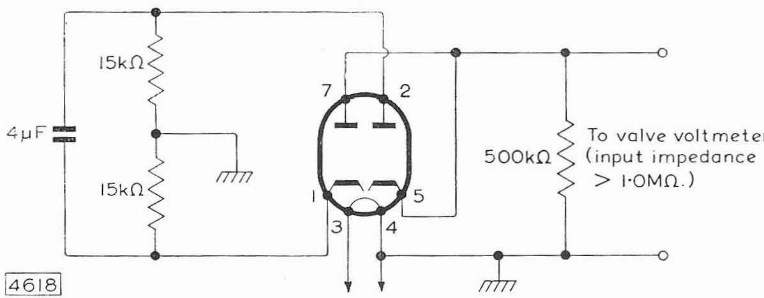
TEST CONDITIONS (unless otherwise specified)

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]	*Min.*	*Max.*	*Lot average*[7] *Min.*	*Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Insulation								
a-rest, screen-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
GROUP B								
Heater current	0.65	—	275	325	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	5.0	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	5.0	—	—	—	μA
Output current	0.65	18	16	—	—	—	—	mA
Emission V_a = 10V	0.65	—	40	—	—	—	—	mA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_a = 0V$, $R_a = 40k\Omega$	2.5	—	2.0	20	—	—	—	µA
Anode current difference between sections $V_a = 0V$, $R_a = 40k\Omega$	2.5	—	—	5.0	—	—	—	µA
Change in emission $V_h = 5.7V$, $V_a = 7.0V$	2.5	—	—	15	—	—	—	%
Hum $V_h = 7.0V$ Tested in circuit shown below	2.5	—	—	10	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	



GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
$c_{a'-a''}$	—	—	—	26	—	—	—	mpF
$c_{a'-k'+h+s+S}$	—	—	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

GROUP E

	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.	
***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.

Intermittent life test end points

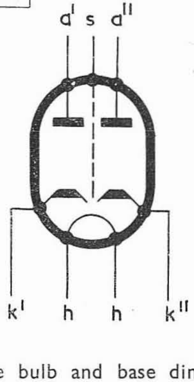
		A.Q.L.[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	275	325	mA
	1000 hours	4.0	275	325	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	10	μA
	1000 hours	4.0	—	10	μA
Emission $V_a = 10V$	500 hours	2.5	35	—	mA
	1000 hours	6.5	30	—	mA
Sub-group (b)					
Change in emission $V_h = 5.7V$, $V_a = 7.0V$	500 hours	4.0	—	20	%
Anode current $V_a = 0V$, $R_a = 40k\Omega$	500 hours	4.0	1.0	20	μA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	50	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

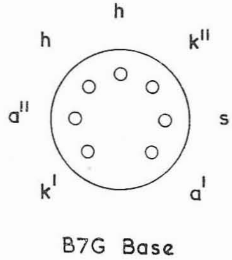
GROUP G

	A.Q.L. (%)	Min.	Max.
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—

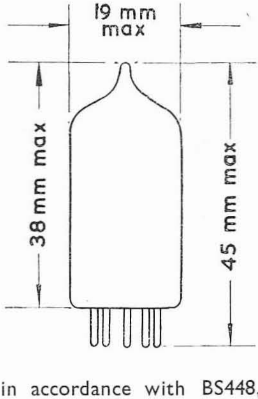
M8212 SPECIAL QUALITY DOUBLE DIODE

3577

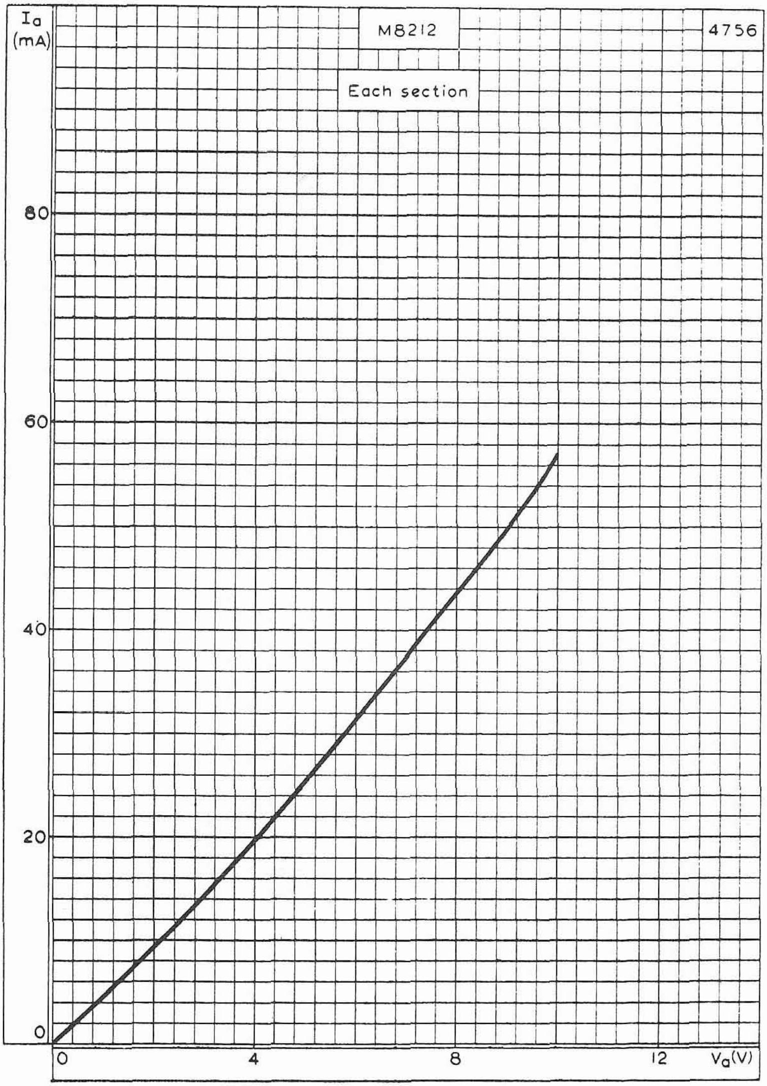




B7G Base



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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

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

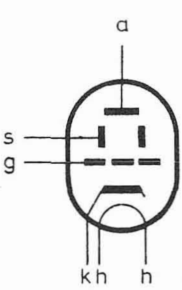
R.F. TRIODE

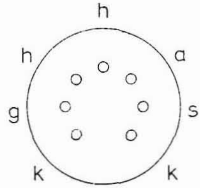
Condition	5	6	7	8	
V_b	200	200	200	200	V
R_a	5.6	5.6	6.8	6.8	kΩ
R_k	82	0	0	0	Ω
R_g	0	1.0	0.22	0.56	MΩ
R_{g-a}	—	—	22	22	MΩ
I_a	12	13	14	14	mA
g_m	14	15.5	16	16	mA/V
V_g for 100 : 1 reduction in g_m	–7.5	–7.3	–9.0	–12.5	V

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.

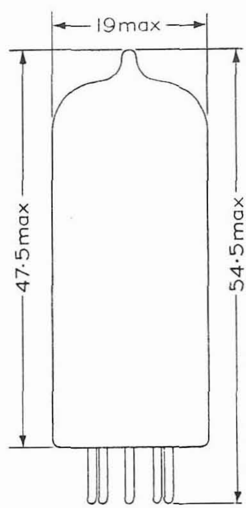
DESIGN CENTRE RATINGS

$V_{a(b)}$ 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

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	k Ω
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	M Ω
μ_{g1-g2}	18	18	18	
*V_{g1}	−16	−28	−34	V
R_{eq}	5.8	7.5	7.5	k Ω

* 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

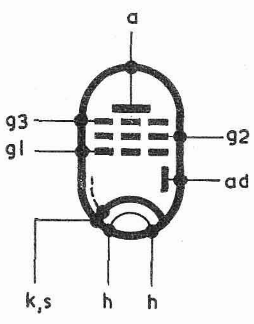
Pentode Section

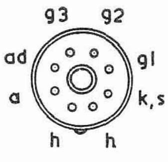
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
$V_{g2}(I_a<2.5$ mA) max.	250	V
V_{g2} ($I_a=5.0$ mA) max.	125	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} ($I_{g1}= +0.3\mu$A) max.	−1.3	V
R_{g1-k} max.	3.0	MΩ
*R_{g3-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

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

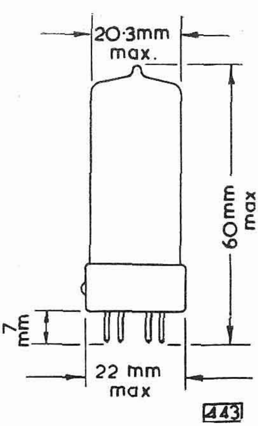
Diode Section

$v_{ad(pk)}$ max.	200	V
I_{ad} max.	0.8	mA
V_{ad} max. ($I_{ad}=+0.3$ μA)	−1.3	V
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V





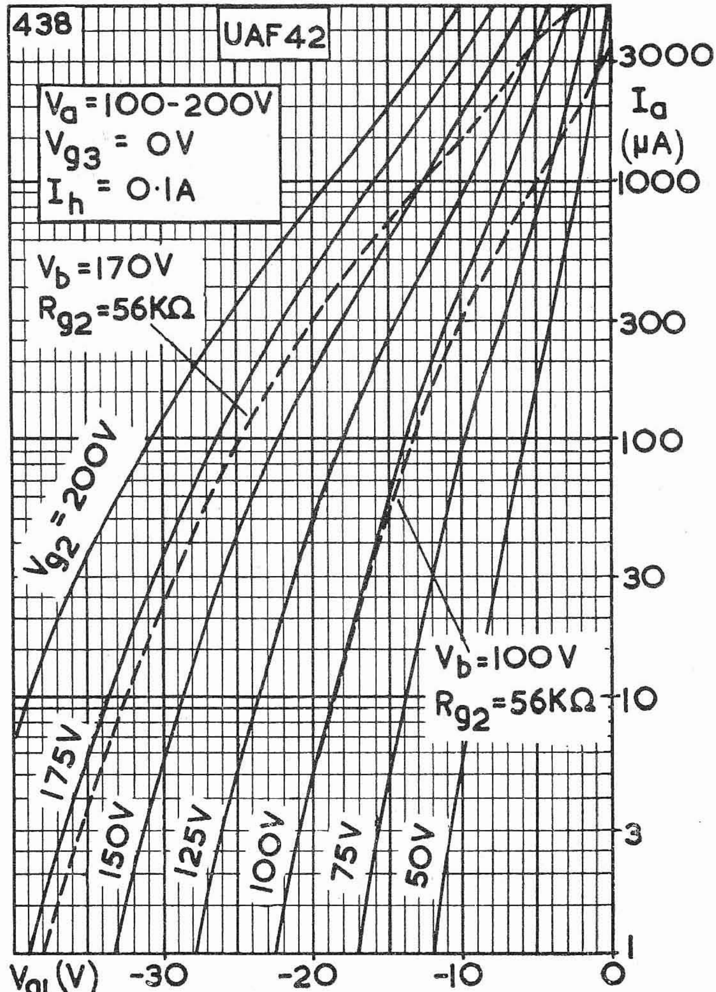
B8A BASE



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.

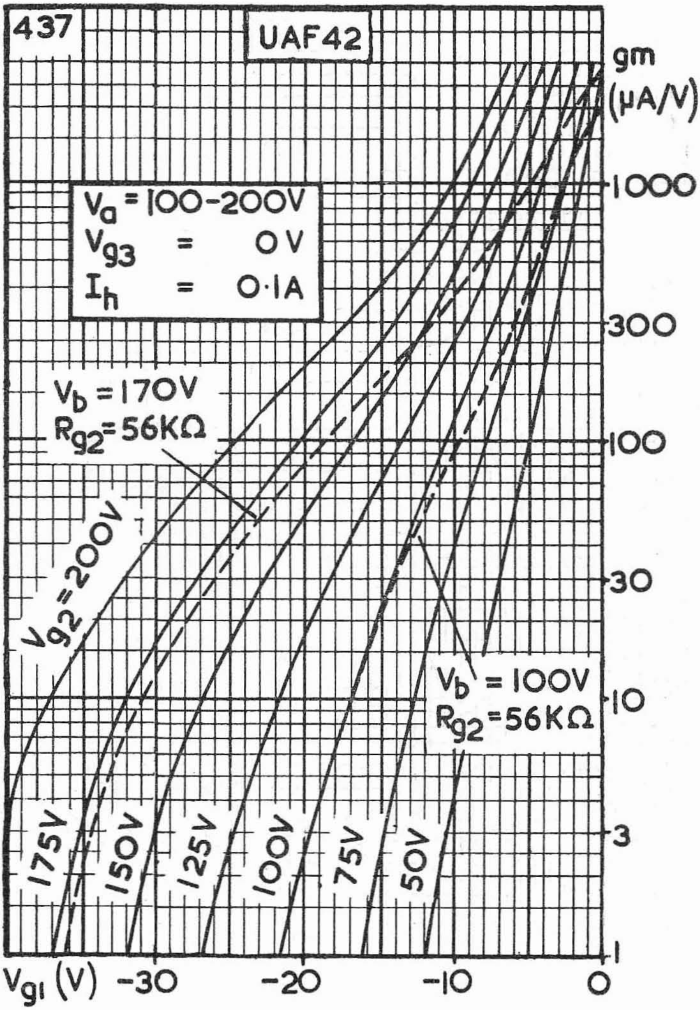


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR DIFFERENT VALUES OF SCREEN-GRID VOLTAGE

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.

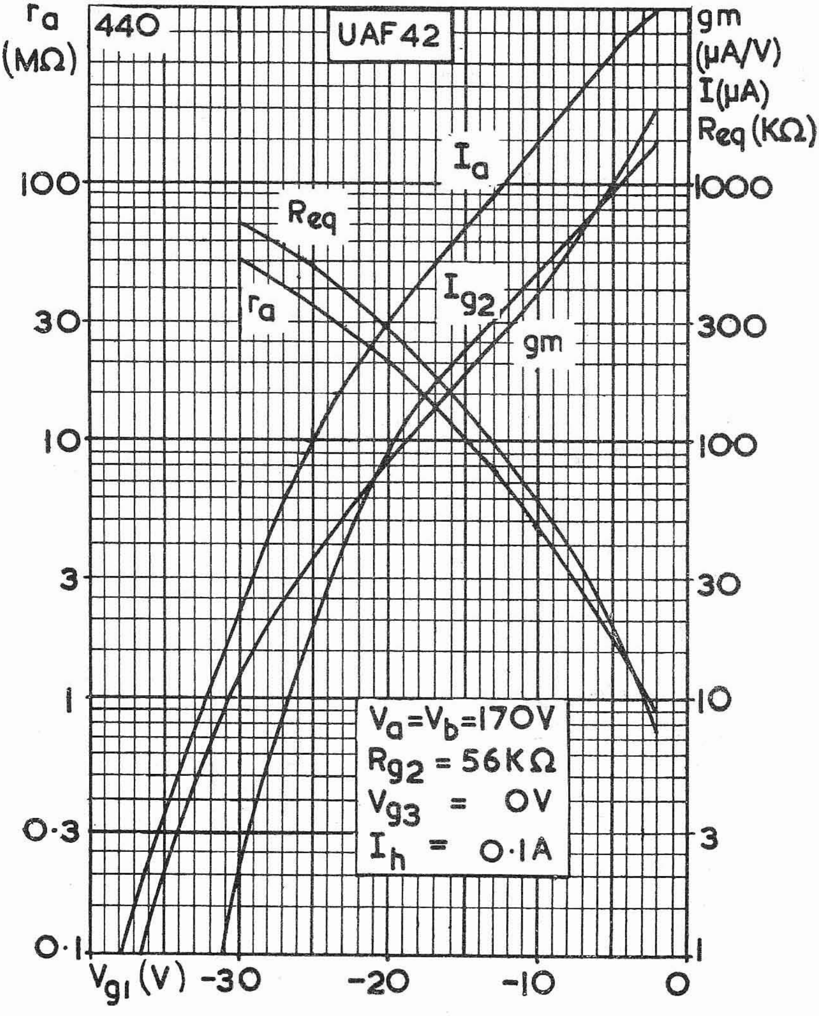


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR DIFFERENT VALUES OF SCREEN-GRID VOLTAGE

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.



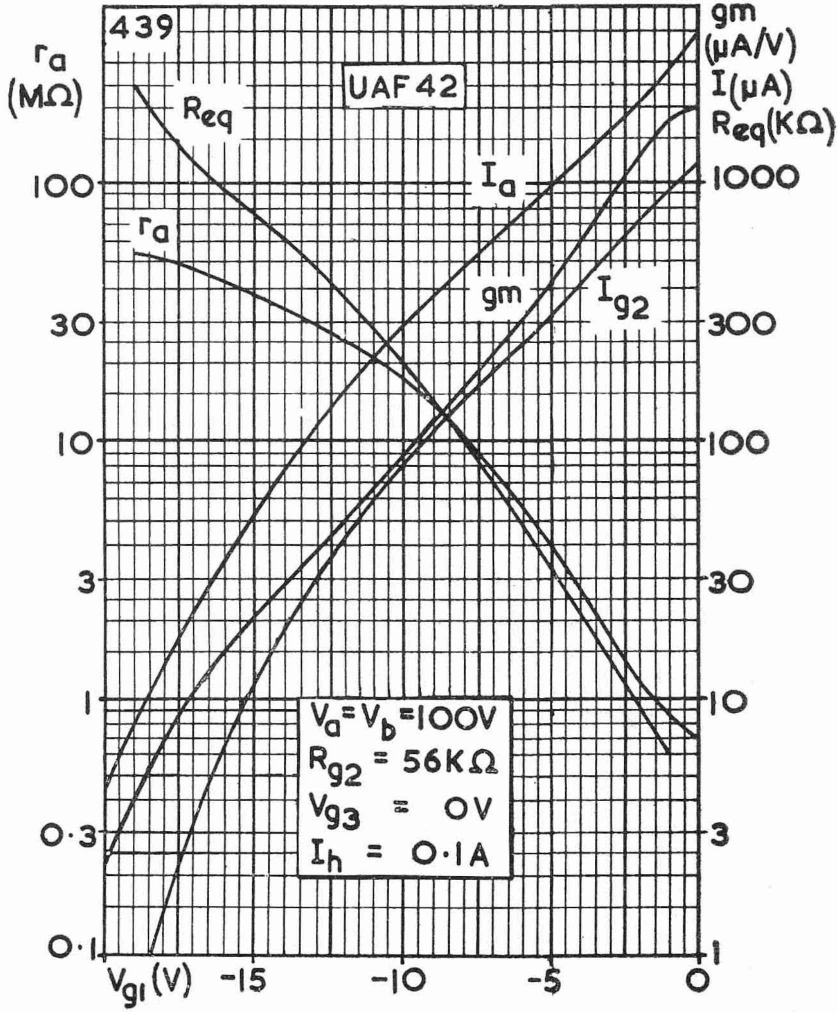
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, INTERNAL RESISTANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGES

For $V_b=170V$ and with a resistance of 56K Ω in series with the screen grid

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.



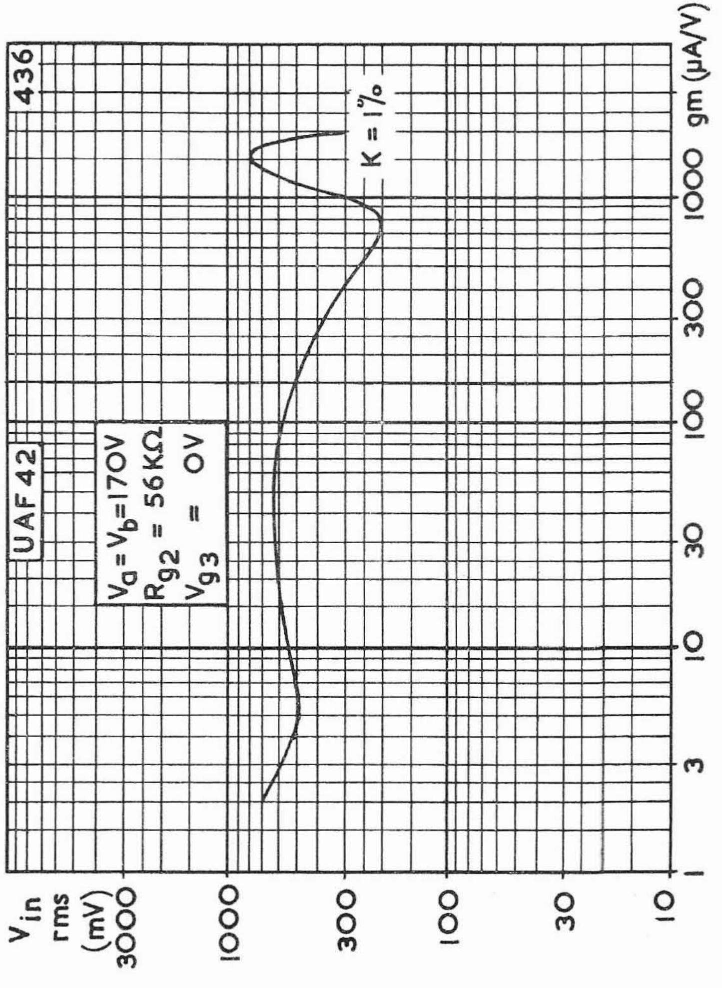
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, INTERNAL RESISTANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

For $V_b = 100V$ and with a resistance of 56K Ω in series with the screen grid

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.

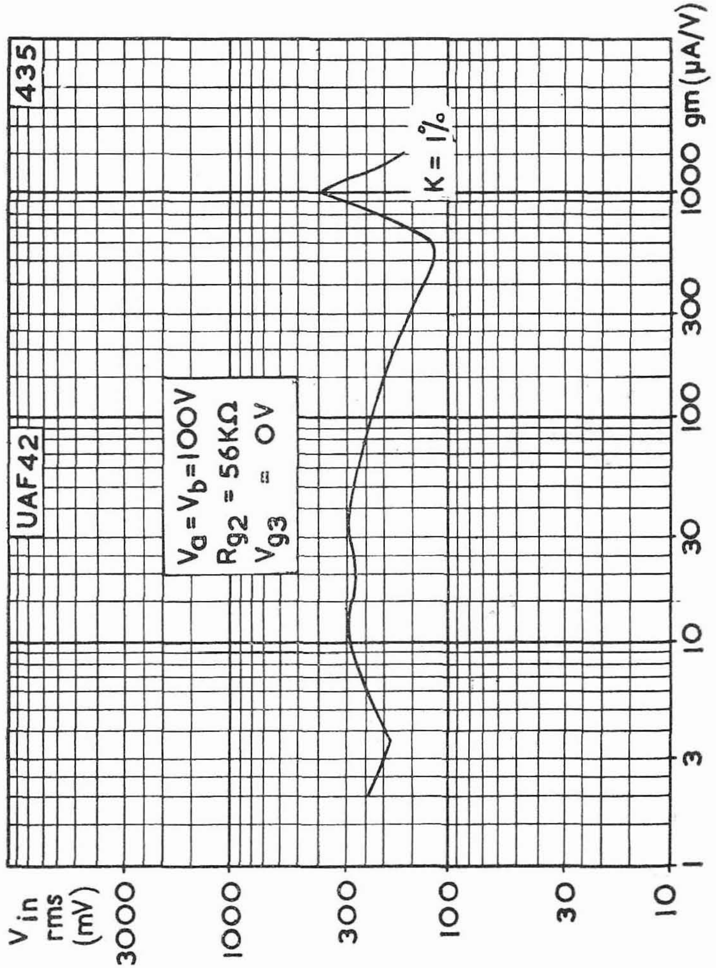


CROSS MODULATION CURVE FOR V_b=170V WITH A RESISTANCE OF 56K Ω IN SERIES WITH THE SCREEN GRID

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.



CROSS MODULATION CURVE FOR V_b=100V WITH A RESISTANCE OF 56K Ω IN SERIES WITH THE SCREEN GRID

DOUBLE DIODE

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

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

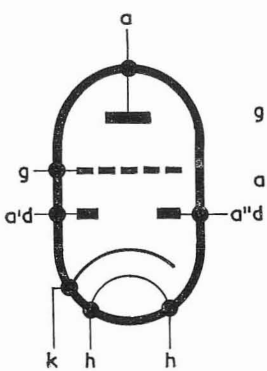
DOUBLE DIODE TRIODE

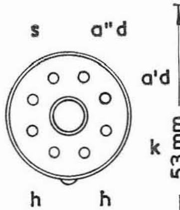
High gain triode for use as a.f. voltage amplifier, combined with twin diodes, for d.c./a.c. mains operation.

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

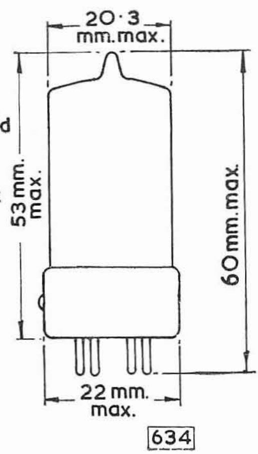
CAPACITANCES

$c_{a'd-gt}$	<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





B8A BASE



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)

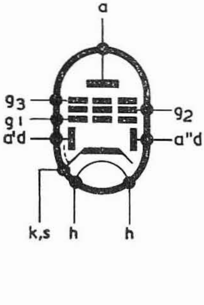
P.I.V.	350	V
I_{ad} max.	0.8	mA
$i_{ad(pk)}$ max.	5	mA
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

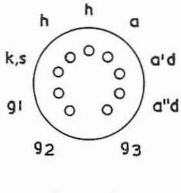
This valve can be used without special precautions against microphony if the input voltage, V_{in}, is not less than 25 mV for an output of 50 mW from the output valve.

DOUBLE DIODE PENTODE

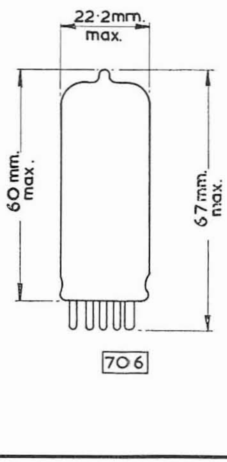
UBF80

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





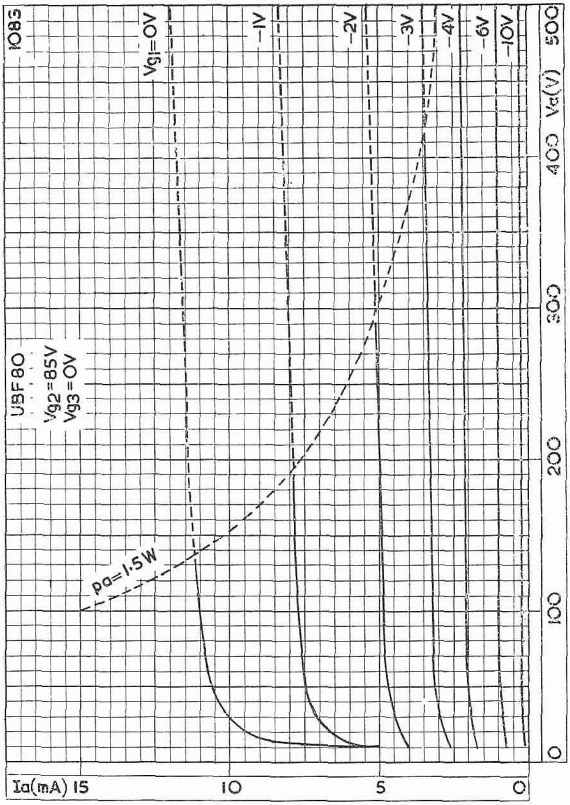
B9A (Noval) BASE



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.

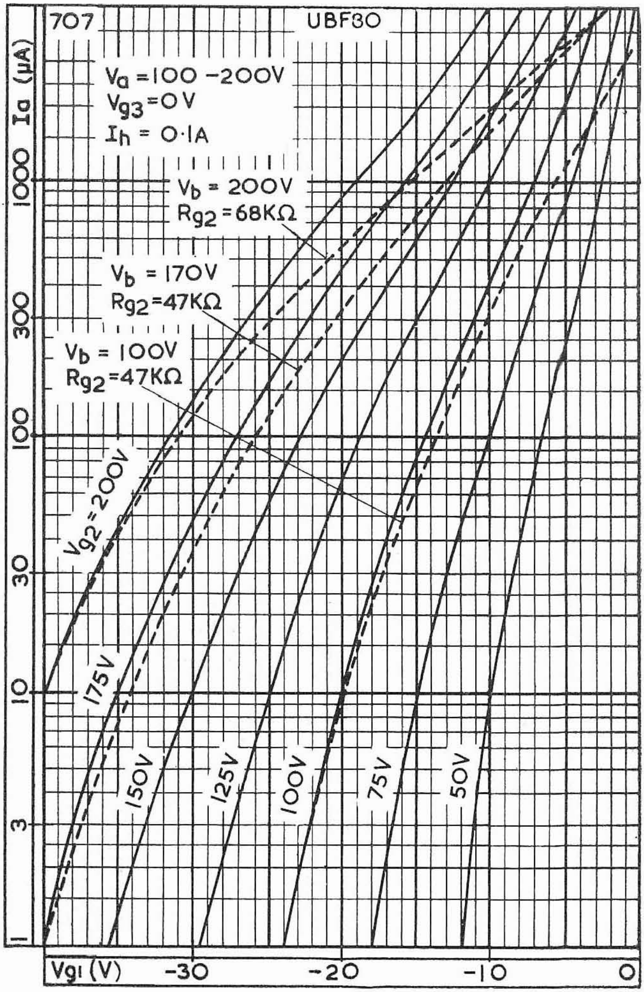


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

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.

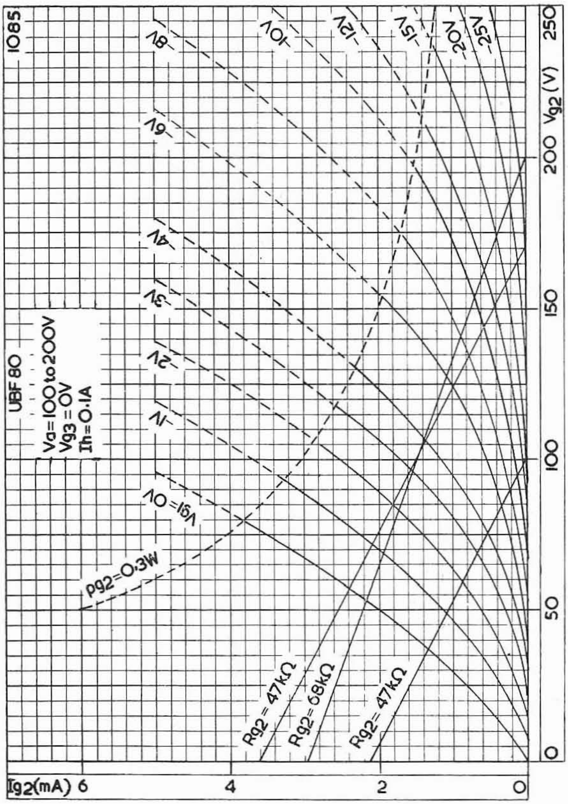


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

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.

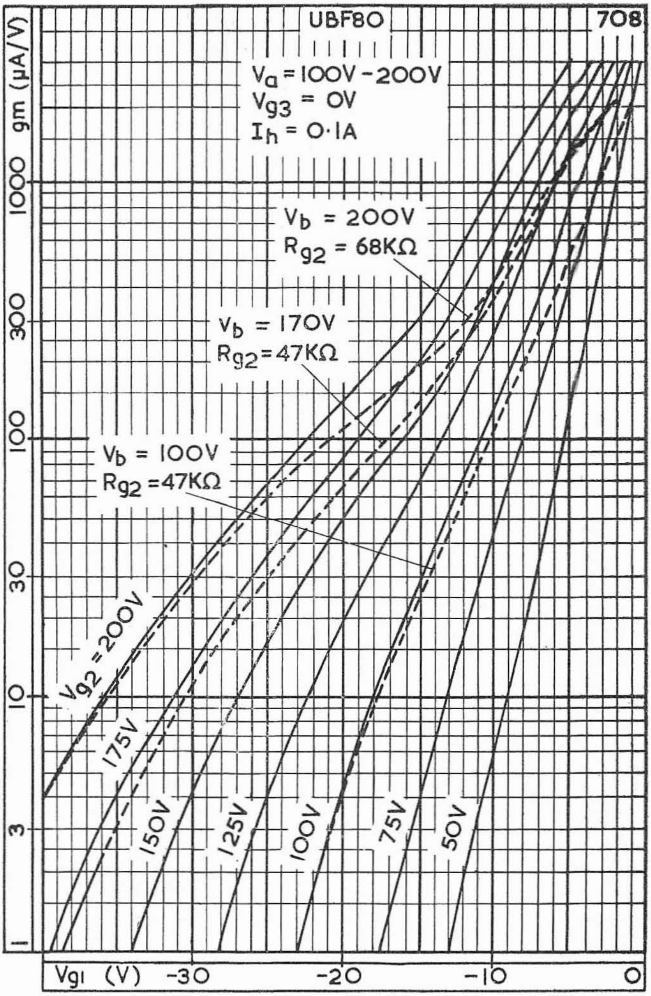


SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

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.

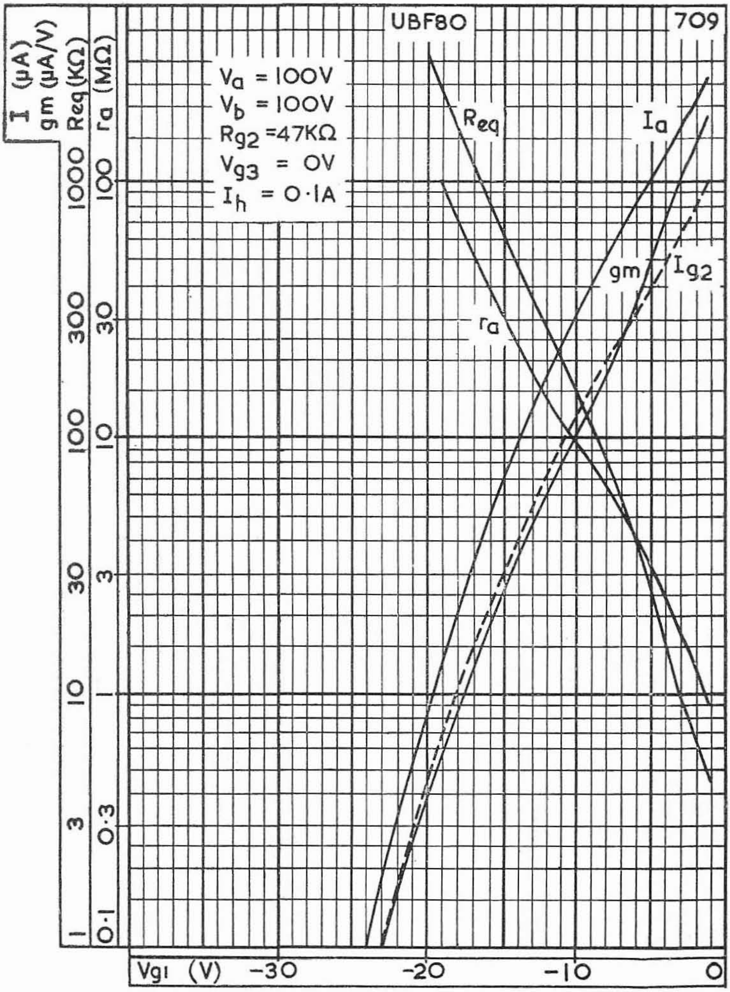


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

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.

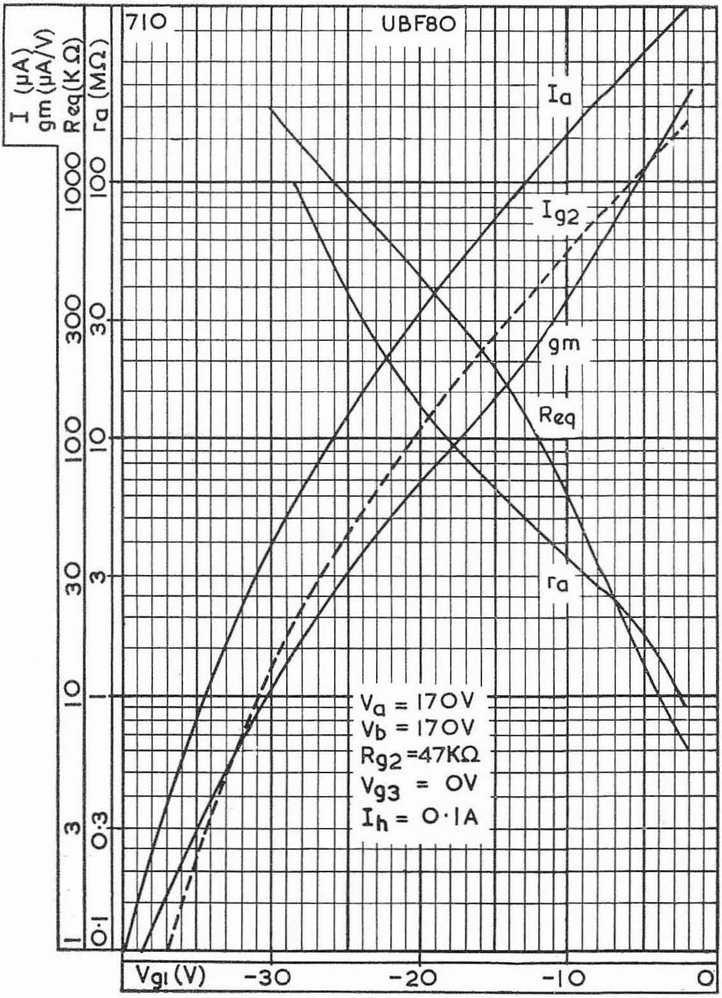


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE, INTERNAL RESISTANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR ANODE VOLTAGE OF 100 V

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.

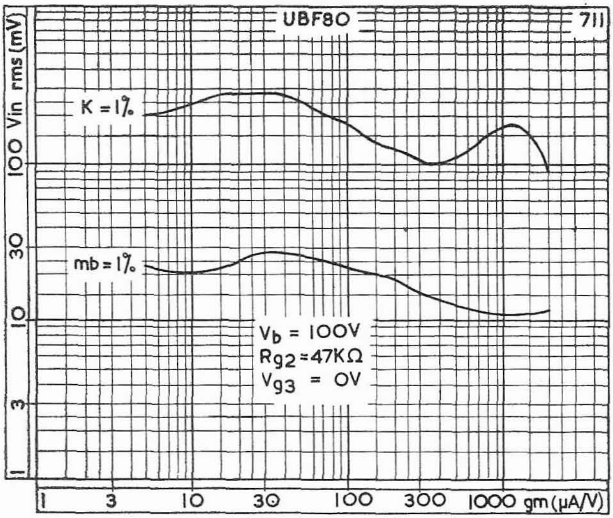


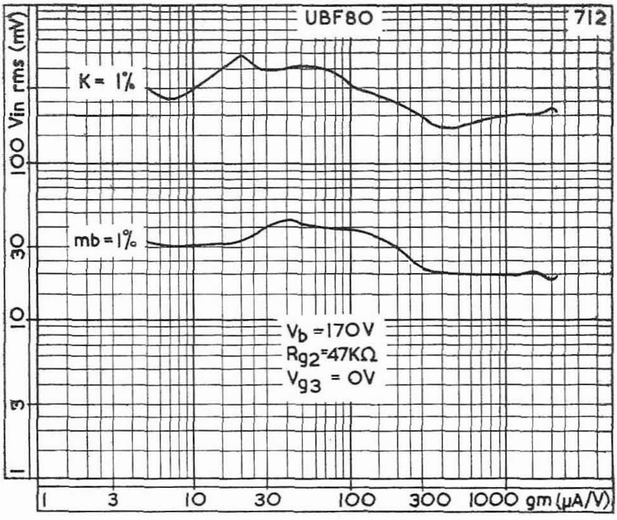
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE, INTERNAL RESISTANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR ANODE VOLTAGE OF 170 V

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.





CROSS MODULATION AND MODULATION HUM CURVES

DOUBLE DIODE OUTPUT PENTODE

UBL21

High-sensitivity output pentode combined with twin diodes for use in D.C./A.C. mains-operated equipment.

HEATER

This valve is suitable for a.c./d.c. operation.

I_h	0.1	A
V_h	55	V

CAPACITANCES

$c_{a'd-ap}$	<0.06	μμF
$c_{a''d-ap}$	<0.02	μμF
$c_{a'd-g1}$	<0.1	μμF
$c_{a''d-g1}$	0.05	μμF
$c_{a'd-k}$	1.8	μμF
$c_{a''d-k}$	2.0	μμF
$c_{a'd-a''d}$	<0.15	μμF

Pentode Section

c_{ap-g1}	<1.2	μμF

TYPICAL OPERATION AS CLASS "A" AMPLIFIER (Single Valve)

V_a	100	180	200	V
V_{g2}	100	180	200	V
R_k	140	140	200	Ω
V_{g1}	–5.3	–10	–13	V
I_a	32.5	61	55	mA
I_{g2}	5.5	10	9.5	mA
g_m	7.5	9.0	8.0	mA/V
r_a	25	22	25	kΩ
μ_{g1-g2}	9.0	9.0	9.0	
R_a	3.0	3.0	3.5	kΩ
$V_{in(r.m.s.)}$ (P_{out}=50 mW)	0.55	0.5	0.5	V
P_{out} (D_{tot}=10%)	1.35	4.8	4.8	W
$V_{in(r.m.s.)}$ (D_{tot}=10%)	3.8	6.2	6.2	V

LIMITING VALUES—Pentode Section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	11	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max. (max. sig.)	3.5	W
p_{g2} max. (zero sig.)	1.9	W
I_k max.	75	mA
V_{g1} max. (I_{g1}=+0.3 μA)	–1.3	V
R_{g1-k} max.	1.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

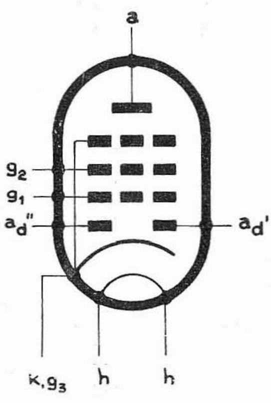
UBL21

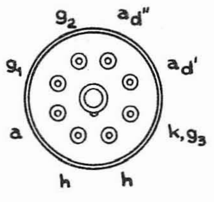
DOUBLE DIODE OUTPUT PENTODE

High-sensitivity output pentode combined with twin diodes for use in D.C./A.C. mains-operated equipment.

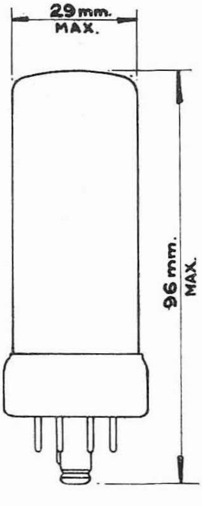
LIMITING VALUES—Diode Section

$V_{ad(pk)}$	200	V
I_{ad} max.	0.8	mA
V_{ad} max. ($I_{ad}=+0.3\ \mu A$)	−1.3	V





B8G BASE



TRIODE PENTODE

UCL83

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

HEATER

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

I_h	100	mA
V_h	38	V←

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{at-gp}	<0.1	pF
c_{at-ap}	<1.6	pF
c_{gt-gp}	<0.03	pF
c_{gt-ap}	<0.05	pF

Pentode section

c_{a-g1}	<0.2	pF
c_{in}	5.7	pF
c_{out}	4.7	pF
c_{g1-h}	0.4	pF

Triode section

c_{a-g}	1.6	pF
c_{in}	2.3	pF
c_{out}	0.32	pF

CHARACTERISTICS

Pentode section

V_a	170	V
V_{g2}	170	V
I_a	30	mA
I_{g2}	5.0	mA
V_{g1}	−9.5	V
g_m	5.5	mA/V
r_a	53	kΩ
μ_{g1-g2}	10	

Triode section

V_a	170	200	V
I_a	1.6	2.4	mA
V_g	−1.5	−1.5	V
g_m	2.1	2.5	mA/V
r_a	40	34	kΩ
μ	82	85	

UCL83

TRIODE PENTODE

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

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−9.5	−13	V
$I_{a(0)}$	30	27	mA
$I_{g2(0)}$	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
$I_{a(0)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g2(0)}$	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

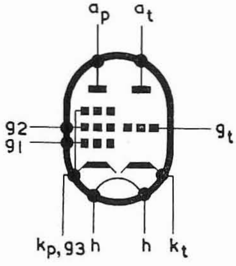
Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

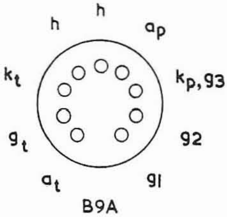
LIMITING VALUES

Triode Section

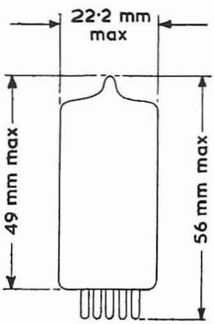
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k}max (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

2224





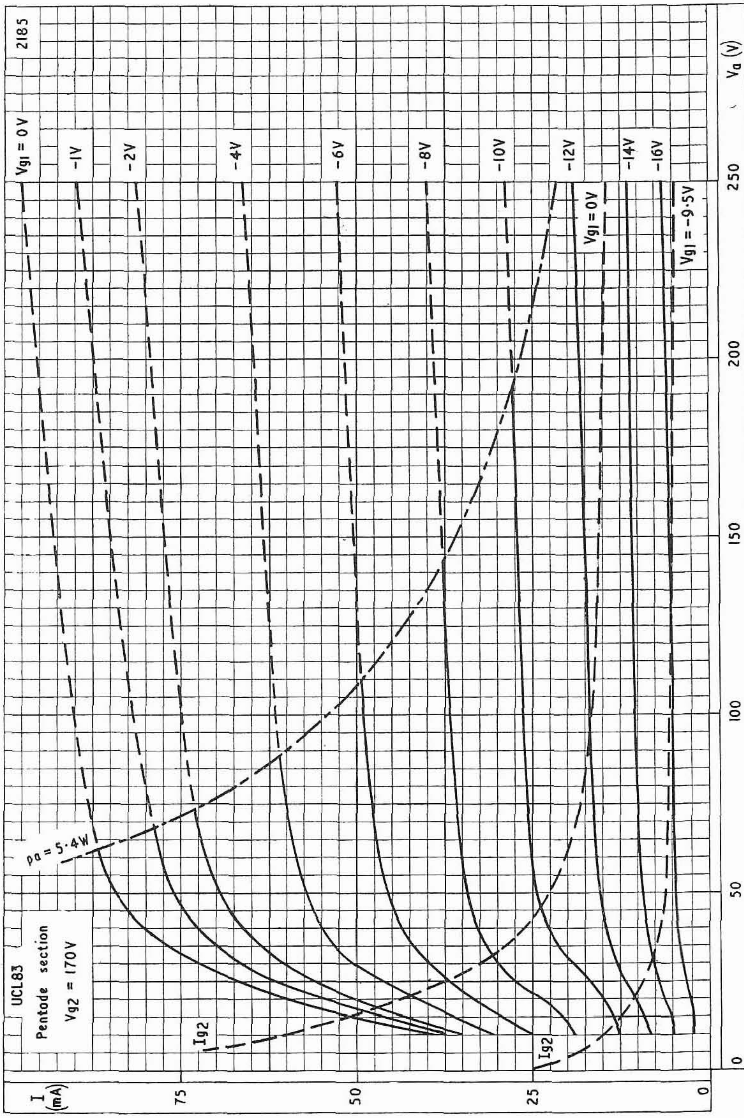
B9A
Noval Base



UCL83

TRIODE PENTODE

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

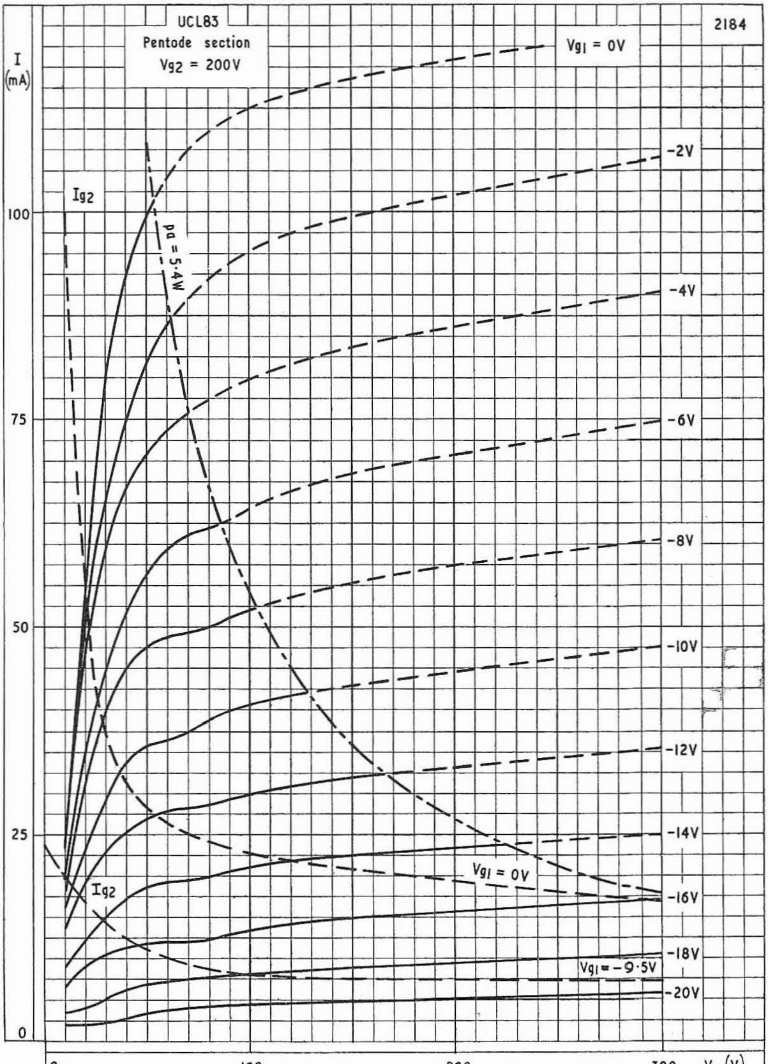


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2}=170V

TRIODE PENTODE

UCL83

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

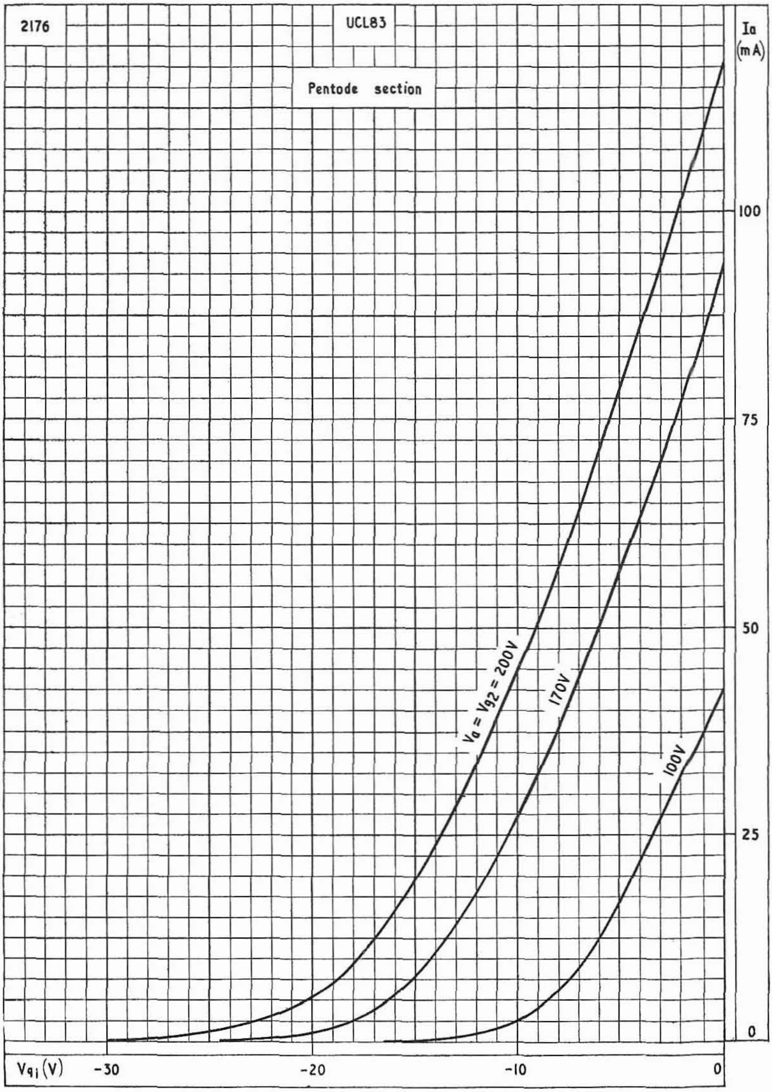


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2}=200V$

UCL83

TRIODE PENTODE

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

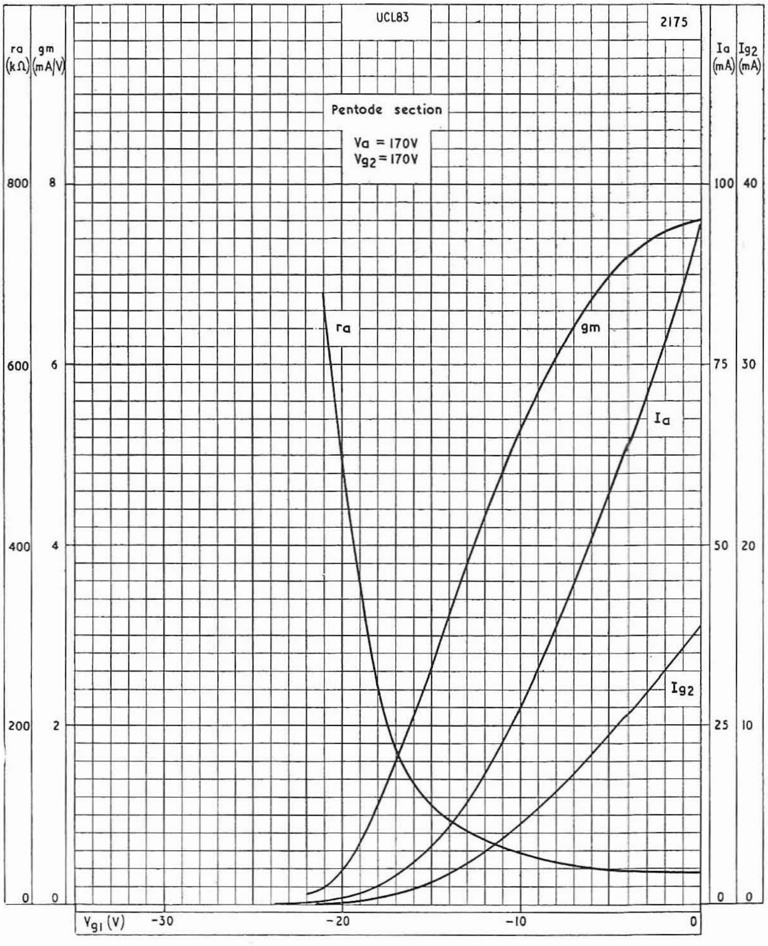


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR VARIOUS ANODE AND SCREEN-GRID VOLTAGES

TRIODE PENTODE

UCL83

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



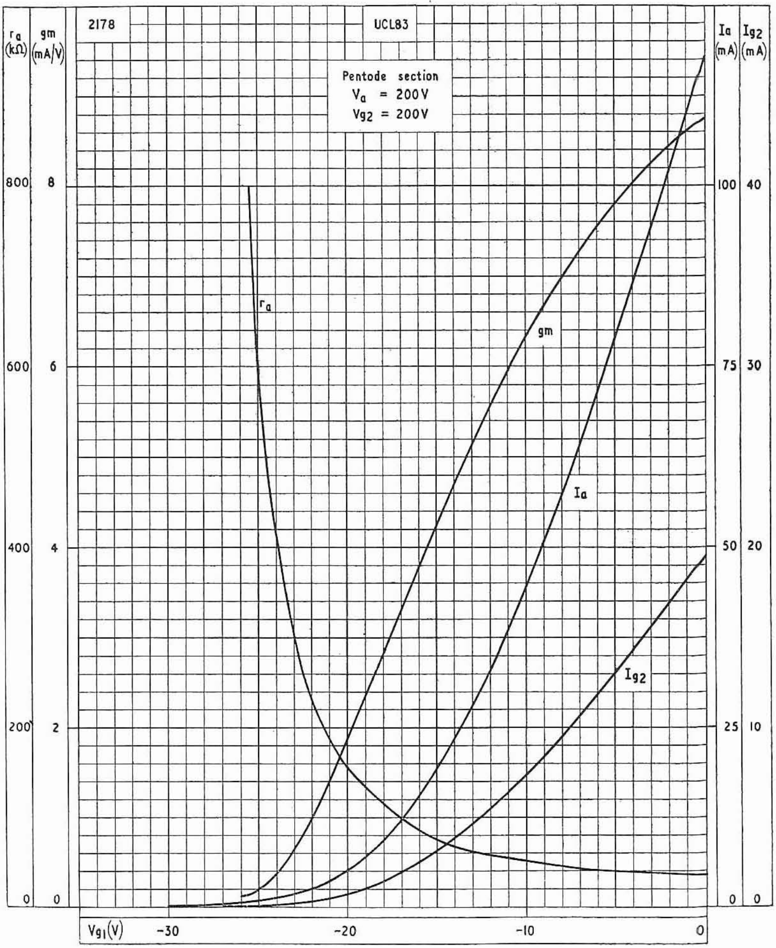
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

$V_a = V_{g_2} = 170V$

UCL83

TRIODE PENTODE

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



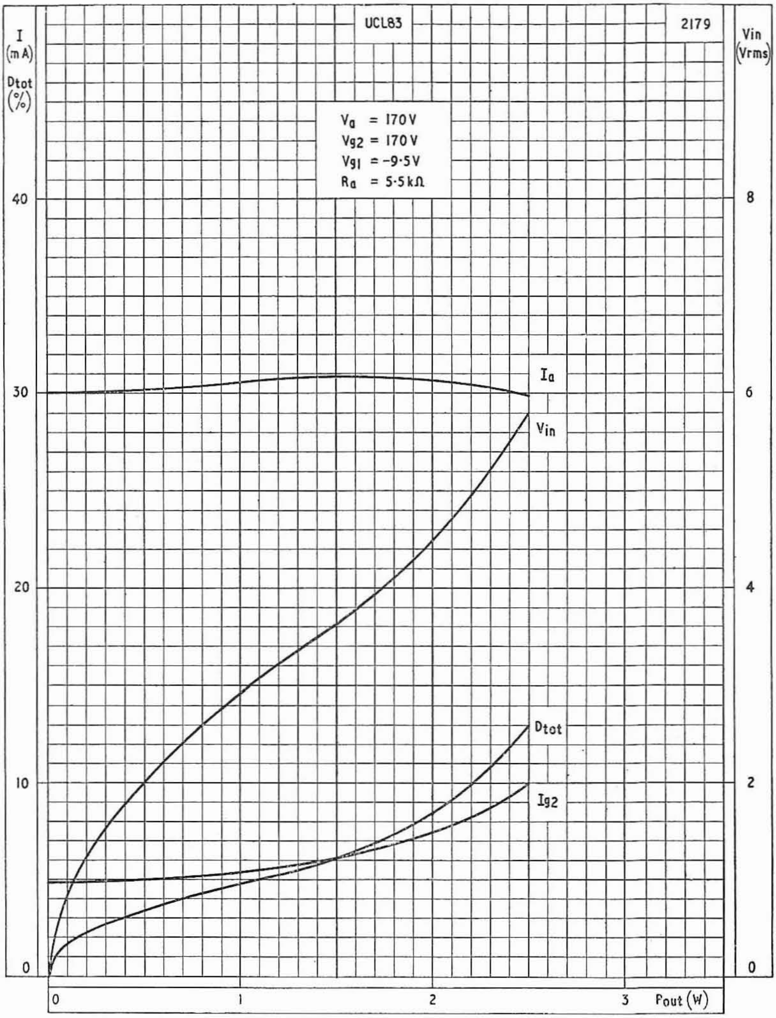
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

$V_a = V_{g2} = 200V$

TRIODE PENTODE

UCL83

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

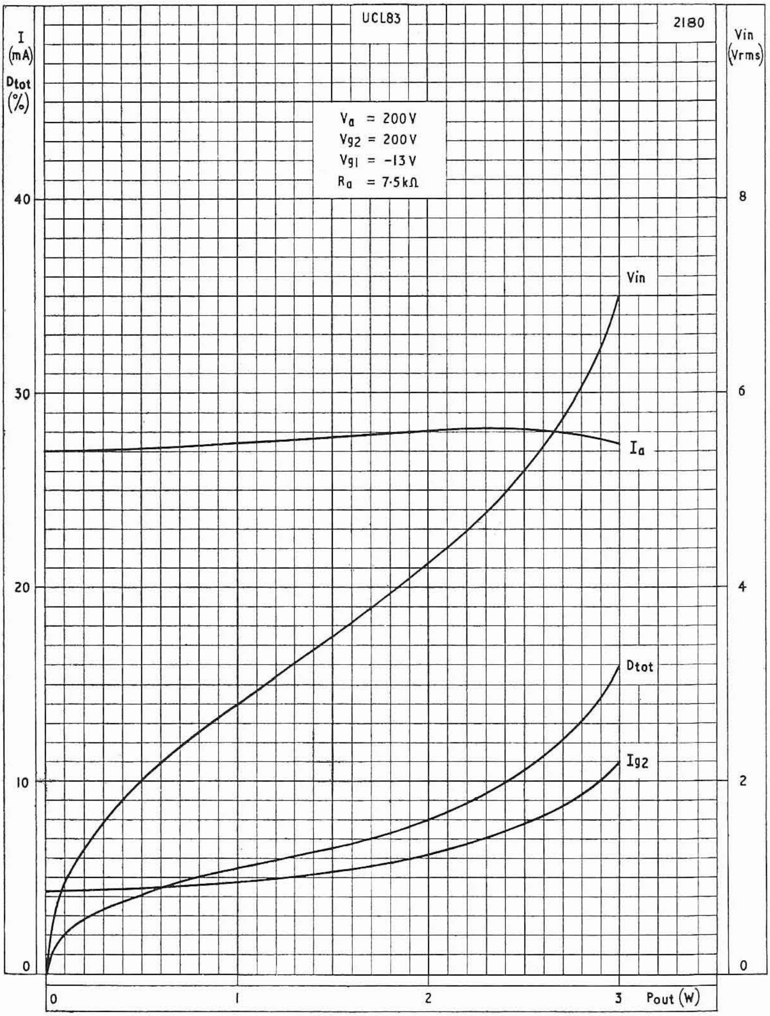


PERFORMANCE OF PENTODE SECTION AS CLASS 'A' AMPLIFIER WITH FIXED BIAS. $V_a = 170V$

UCL83

TRIODE PENTODE

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

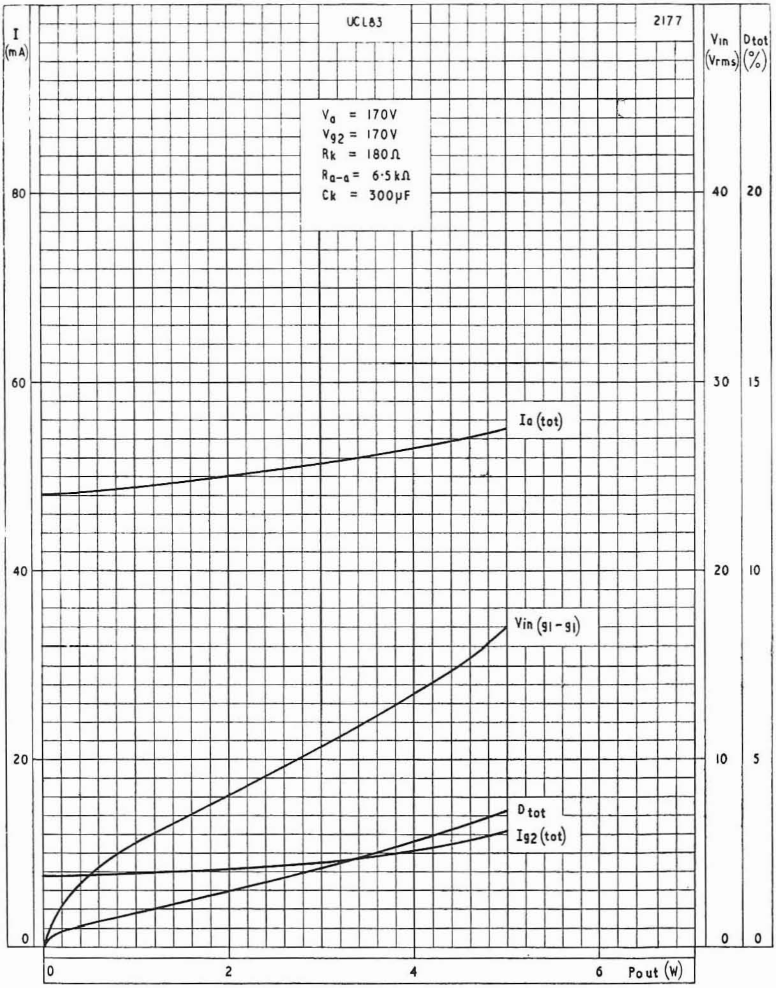


PERFORMANCE OF PENTODE SECTION AS CLASS 'A' AMPLIFIER WITH FIXED BIAS. $V_a = 200V$

TRIODE PENTODE

UCL83

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

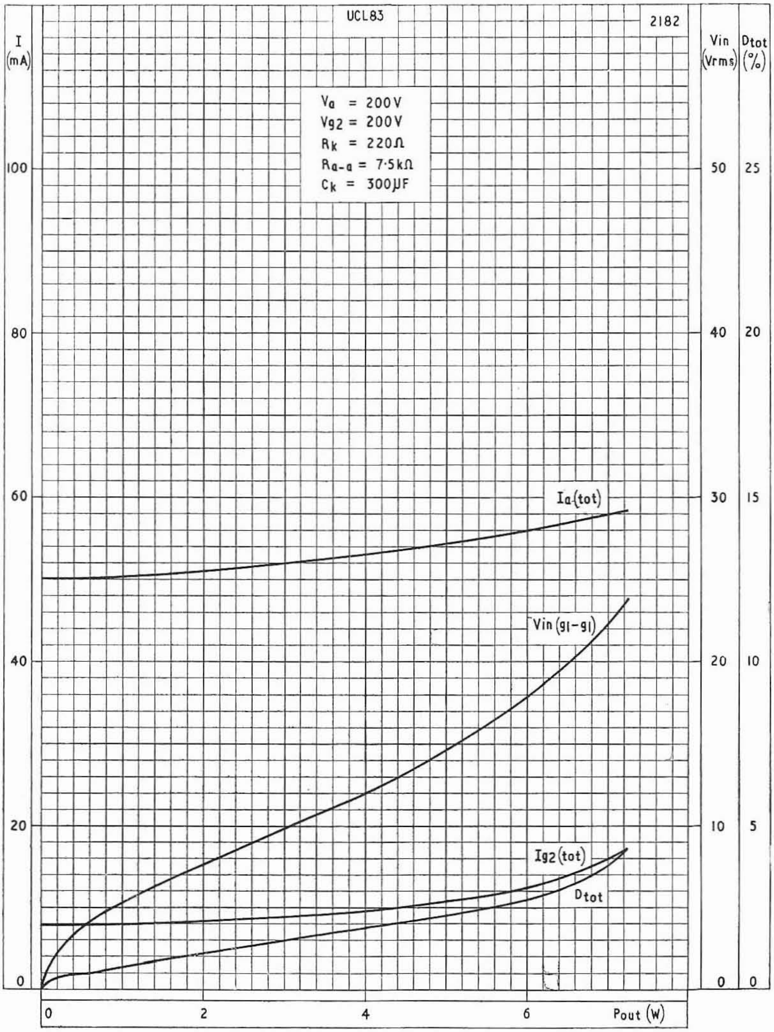


PERFORMANCE OF UCL83 IN PUSH-PULL. V_a=170V

UCL83

TRIODE PENTODE

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

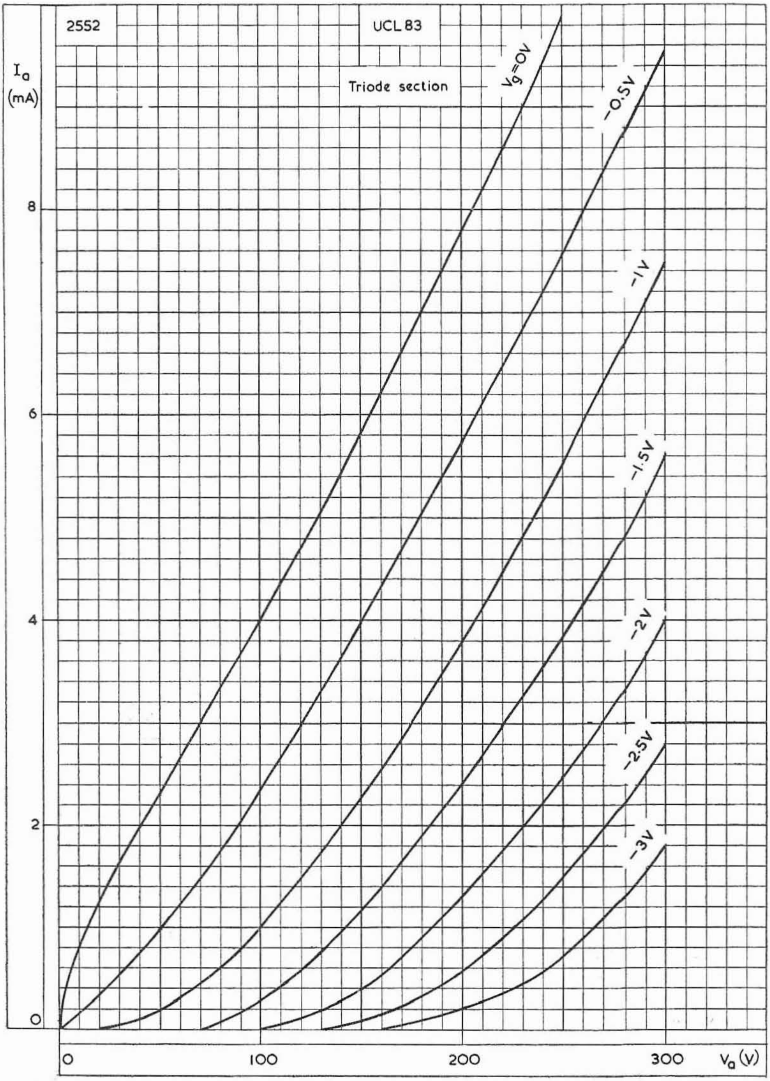


PERFORMANCE OF UCL83 IN PUSH-PULL. $V_a = 200V$

TRIODE PENTODE

UCL83

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

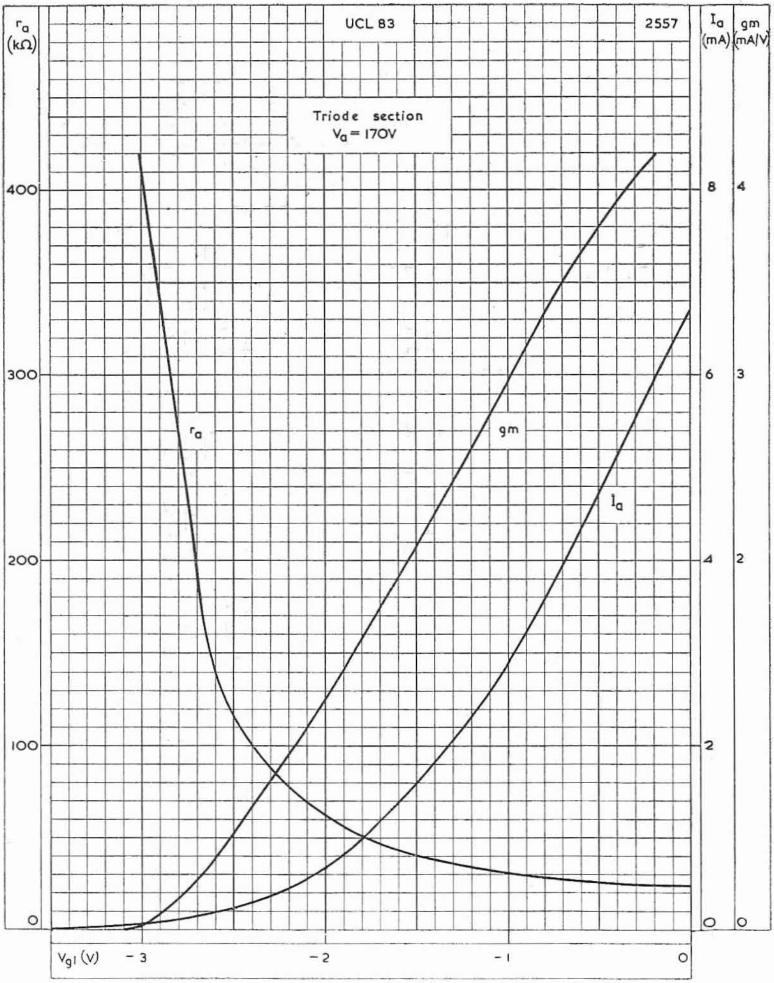


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

UCL83

TRIODE PENTODE

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

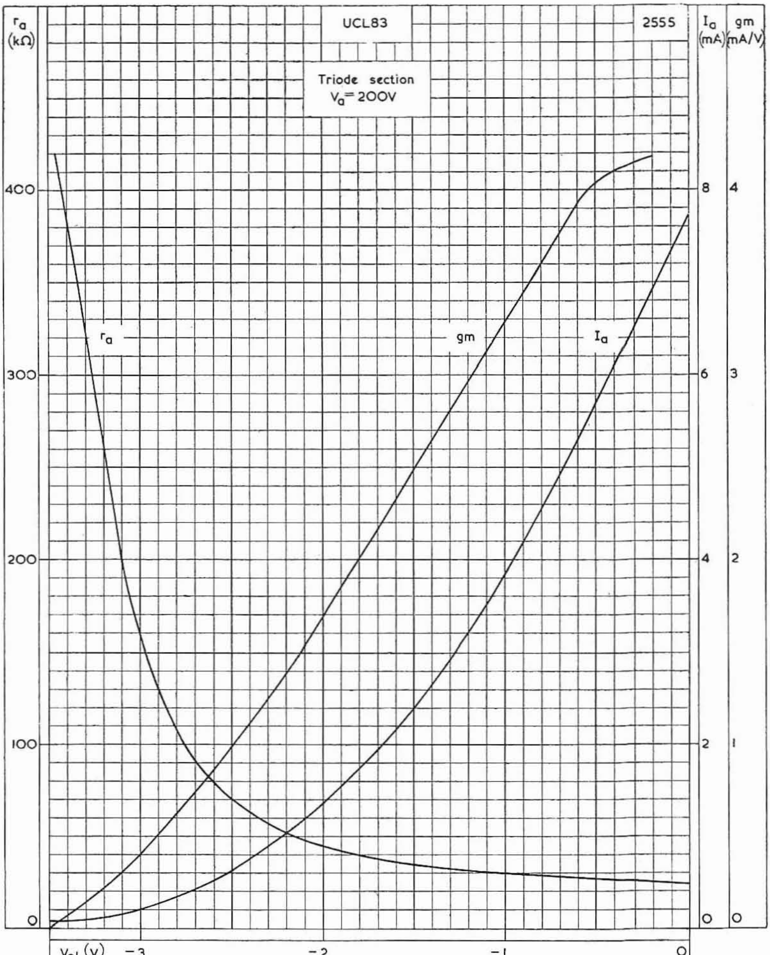


ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE. $V_a = 170V$

TRIODE PENTODE

UCL83

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



ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE. $V_a = 200V$

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	kΩ
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	MΩ
μ_{g1-g2}	18	18	18	
R_{eq}	5.5	6.5	7.0	kΩ
V_{g1} for 100 : 1 reduction in g_m	−17	−28	−34	V

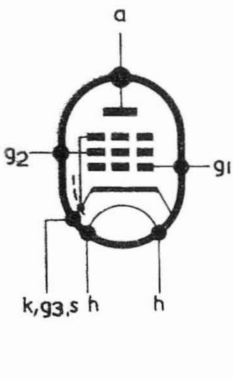
LIMITING VALUES

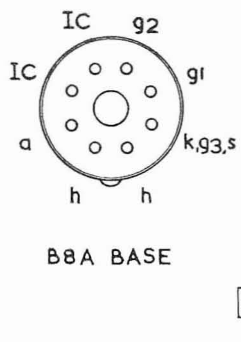
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_a < 4$mA)	250	V
V_{g2} max. ($I_a = 7.2$mA)	150	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} max. ($I_{g1} = +0.3\mu$A)	−1.3	V
R_{g1-k} max.	3	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

UF41

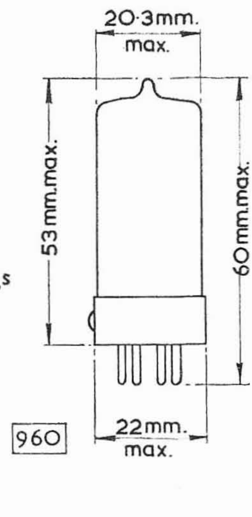
VARIABLE-MU R.F. PENTODE

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





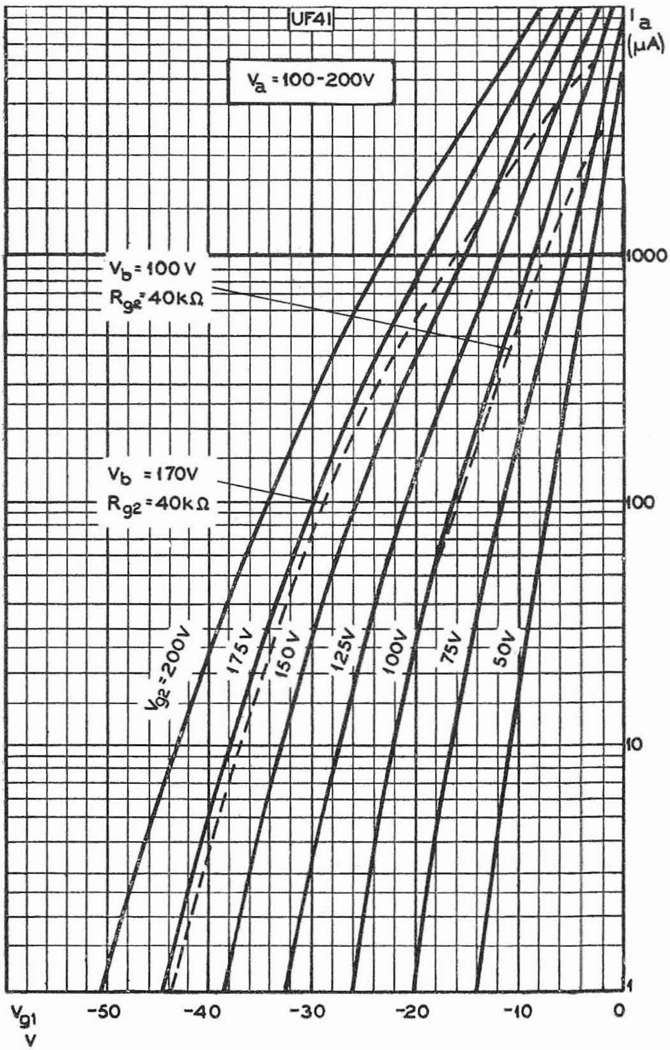
B8A BASE



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.

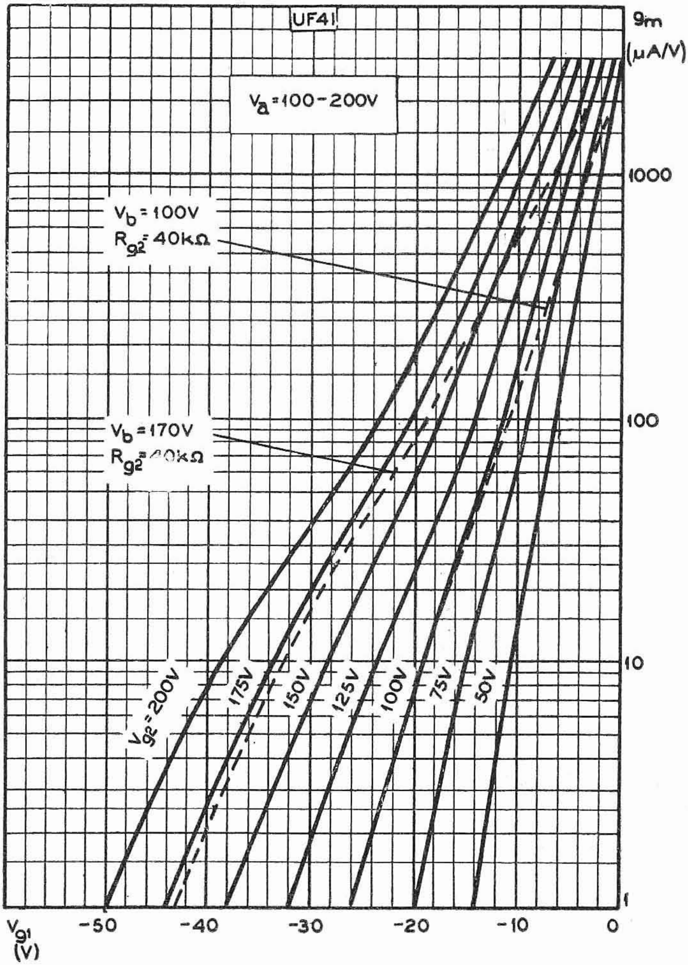


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

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.

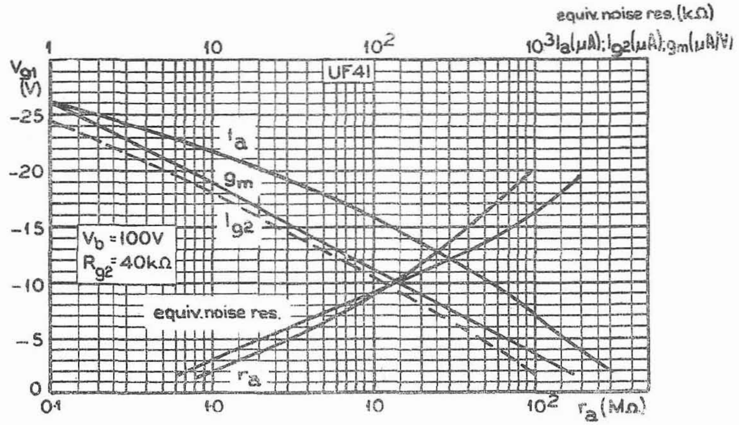


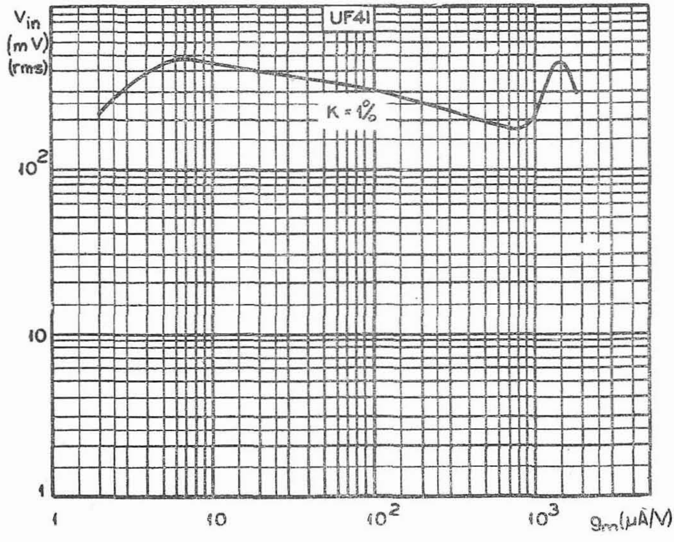
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

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.



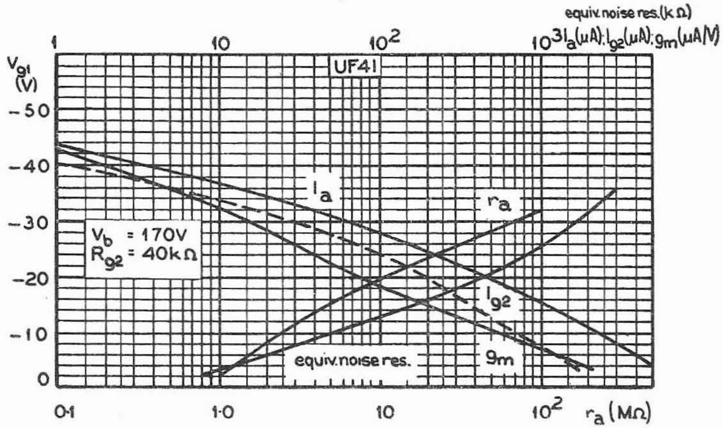


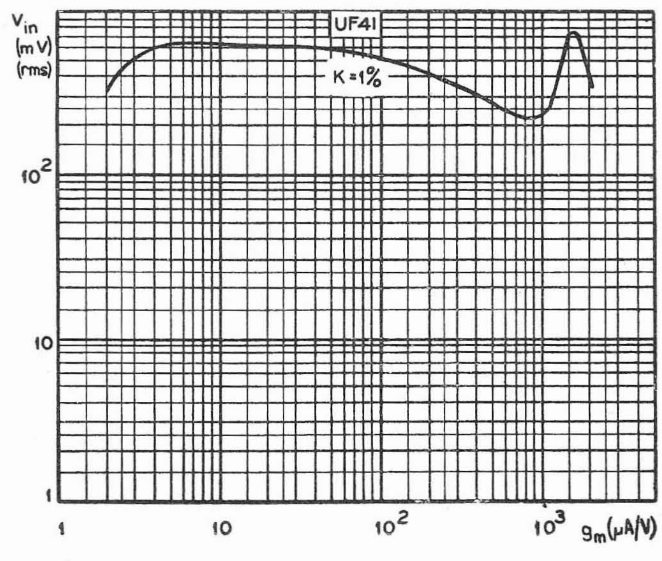
CONTROL CHARACTERISTICS AND CROSS-MODULATION CURVE, WITH SUPPLY VOLTAGE AT 100V

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.



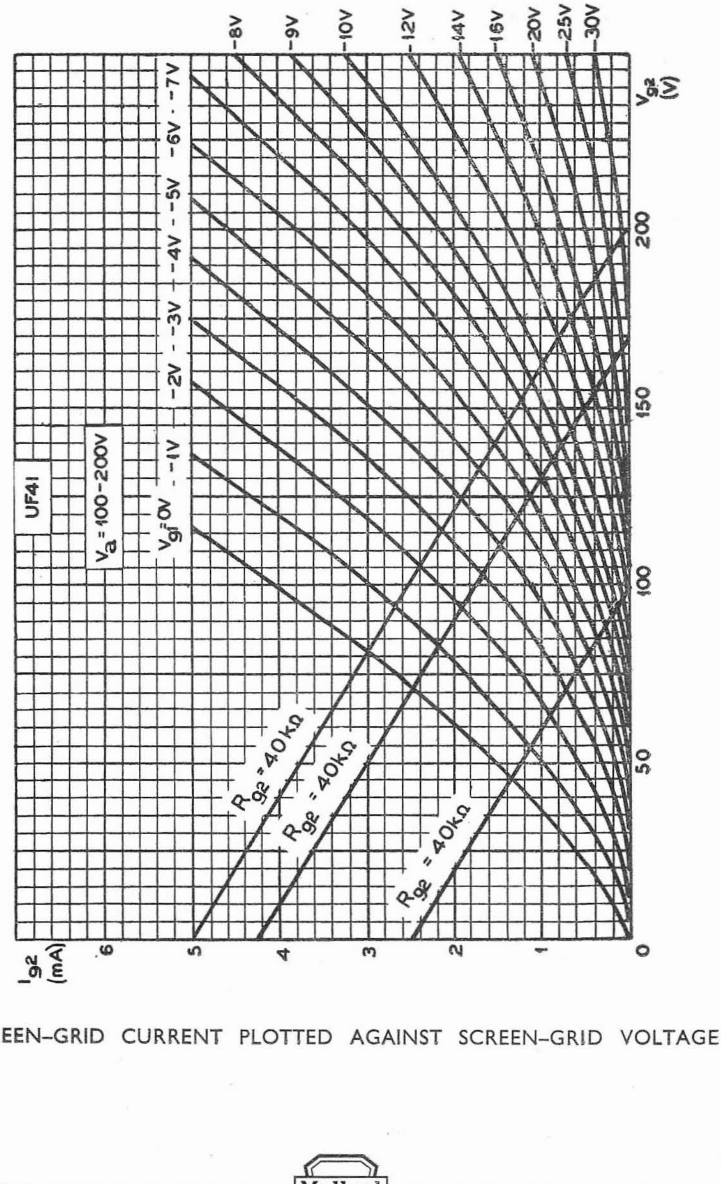


CONTROL CHARACTERISTICS AND CROSS-MODULATION CURVE, WITH SUPPLY VOLTAGE AT 170V

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.

UF41



SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE

OUTPUT PENTODE

UL41

Output pentode rated for a maximum anode dissipation of 9W, and with 100mA heater for use with DC/AC 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	k Ω
μ_{g1-g2}	10	10	10	
R_a	3.0	3.0	4.3	k Ω
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	k Ω
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	%

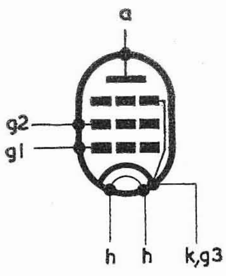
UL41

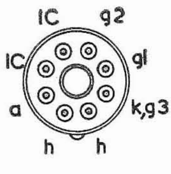
OUTPUT PENTODE

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

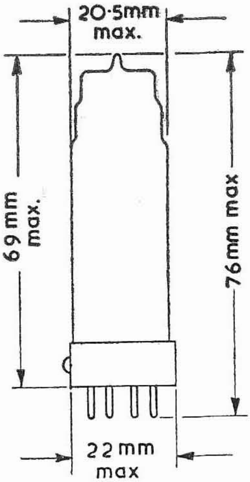
LIMITING VALUES

$V_{a(b)}$ 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	M Ω
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V





B8A BASE

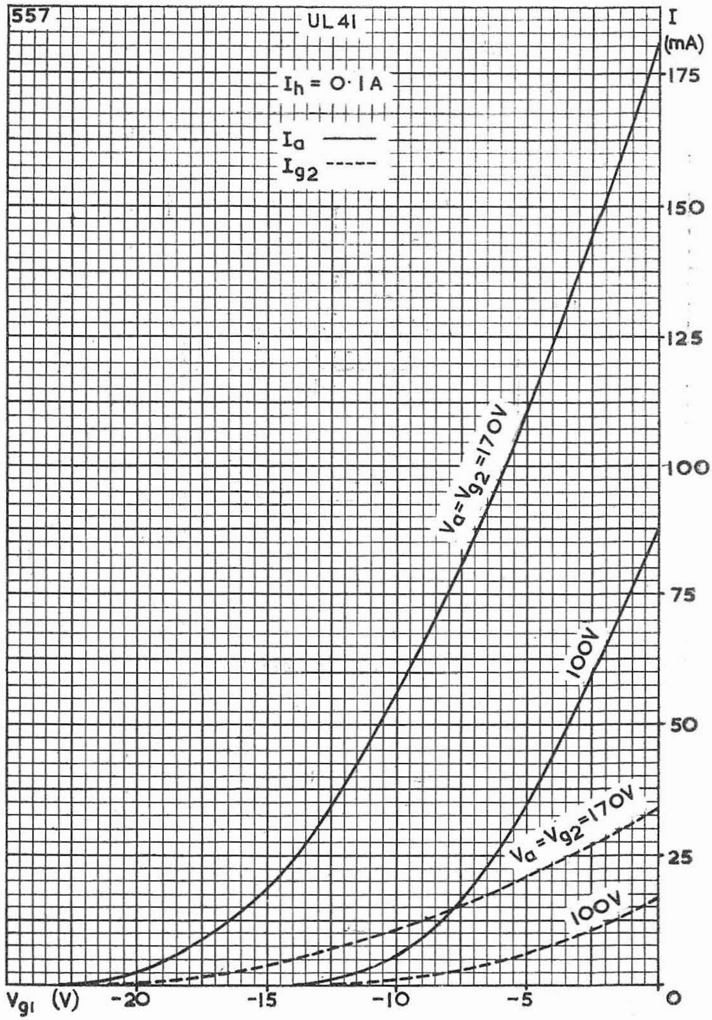


610

OUTPUT PENTODE

UL41

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

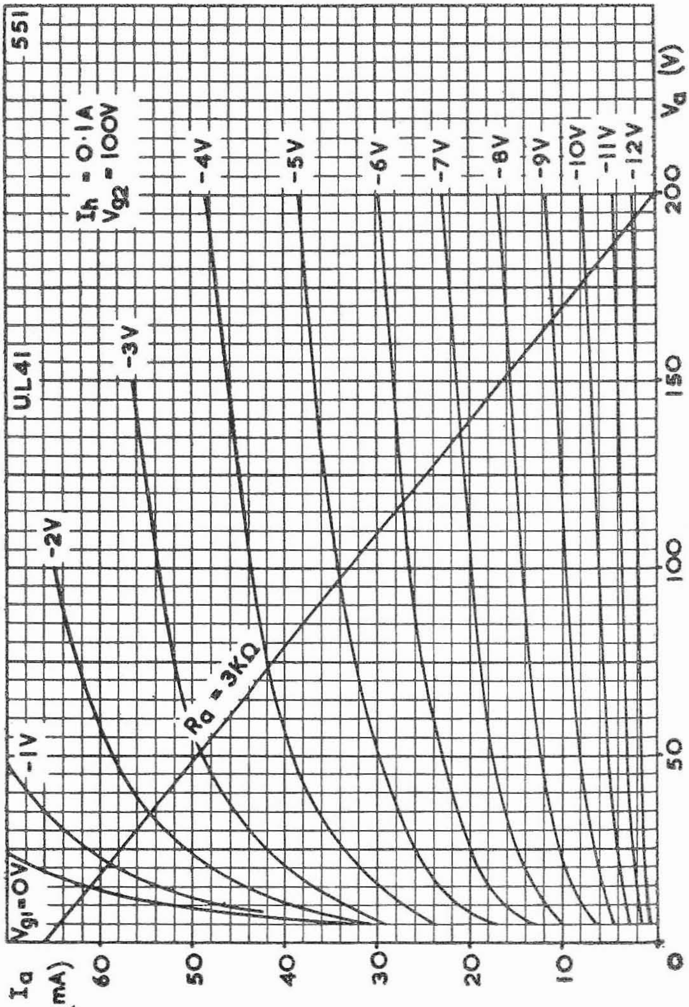


ANODE AND SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

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.

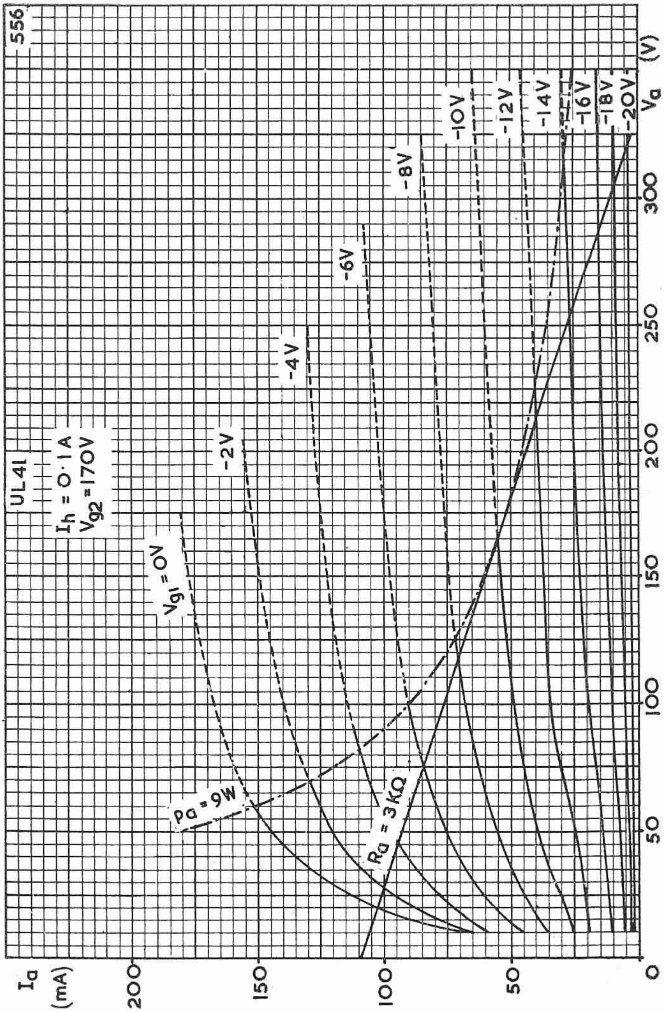


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE OF 100 V

OUTPUT PENTODE

UL41

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

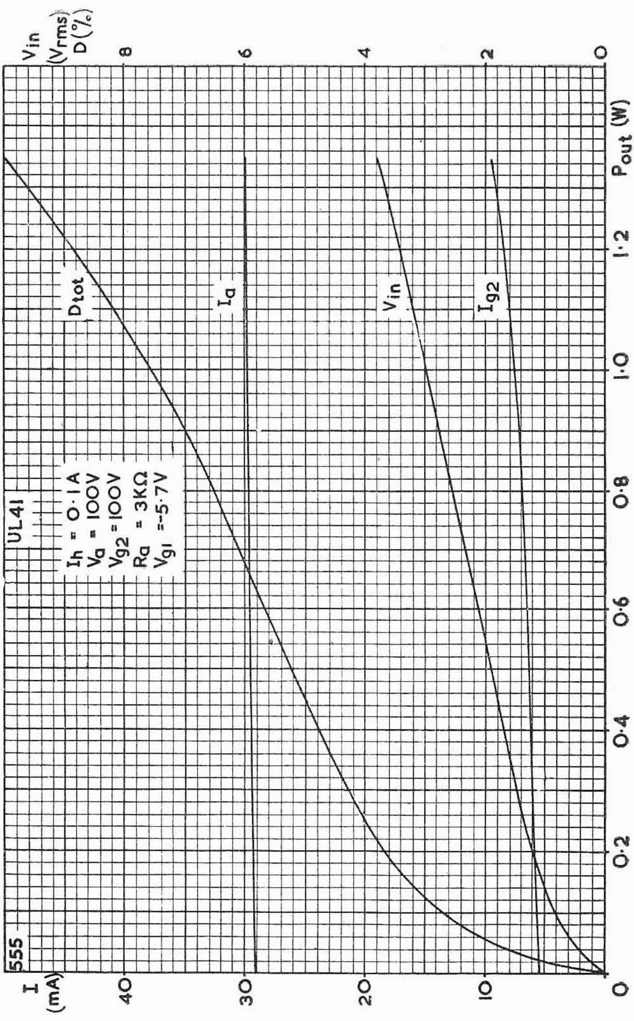


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE OF 170 V

UL41

OUTPUT PENTODE

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

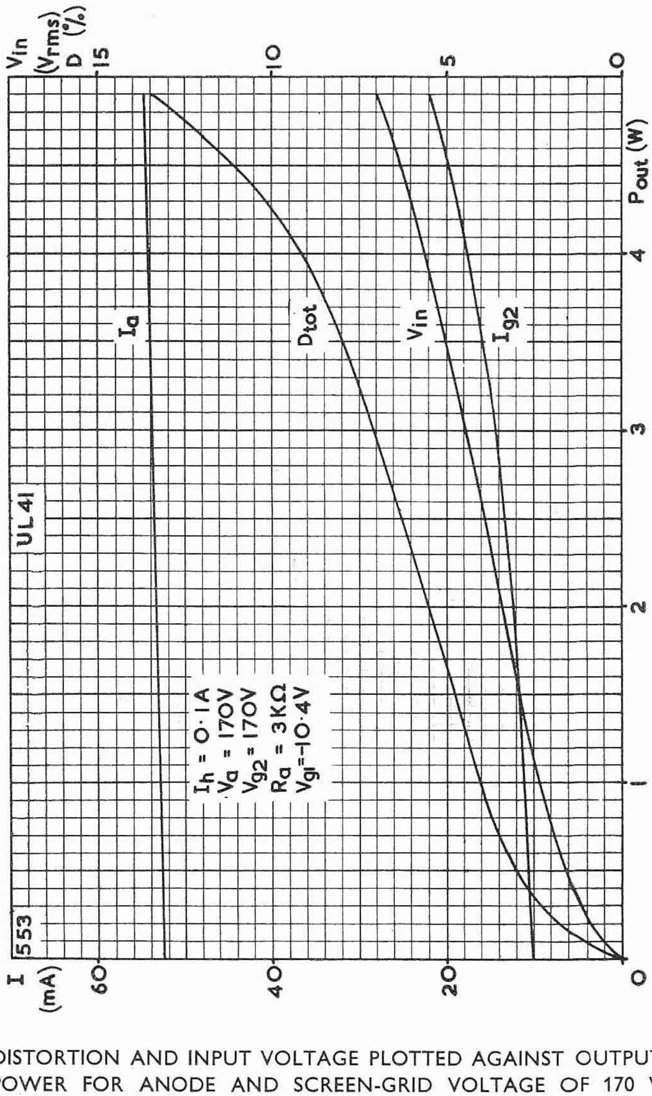


DISTORTION AND INPUT VOLTAGE PLOTTED AGAINST OUTPUT POWER FOR ANODE AND SCREEN-GRID VOLTAGE OF 100 V

OUTPUT PENTODE

UL41

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

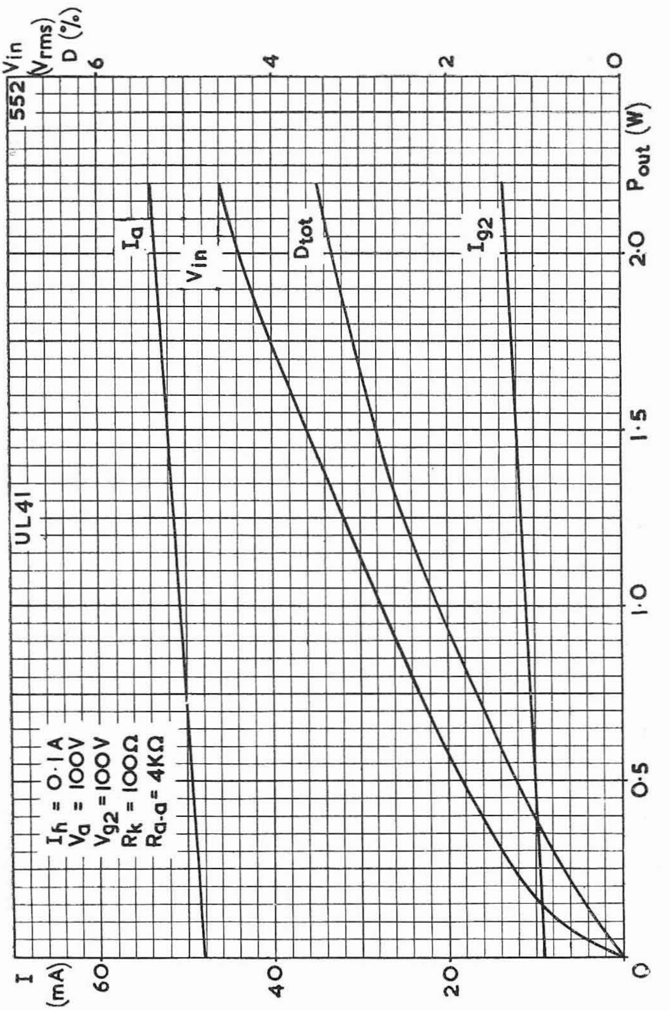


DISTORTION AND INPUT VOLTAGE PLOTTED AGAINST OUTPUT POWER FOR ANODE AND SCREEN-GRID VOLTAGE OF 170 V

UL41

OUTPUT PENTODE

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

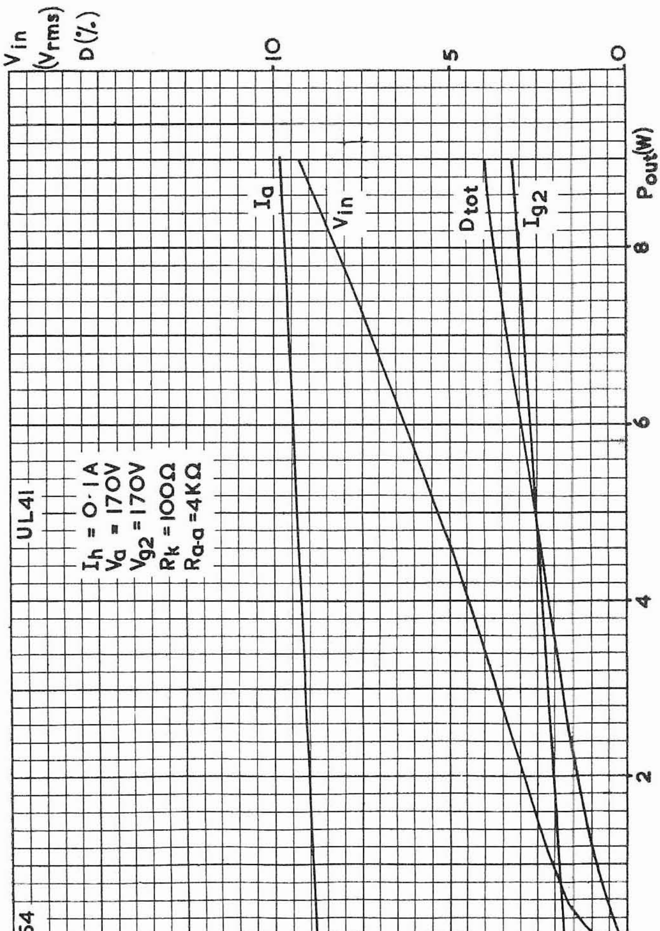


DISTORTION AND INPUT VOLTAGE PLOTTED AGAINST OUTPUT POWER FOR PUSH-PULL OPERATION WITH ANODE AND SCREEN-GRID VOLTAGE OF 100 V

OUTPUT PENTODE

UL41

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



DISTORTION AND INPUT VOLTAGE PLOTTED AGAINST OUTPUT POWER FOR PUSH-PULL OPERATION AT ANODE AND SCREEN-GRID VOLTAGE OF 170 V

HALF-WAVE RECTIFIER

UY41

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

HEATER

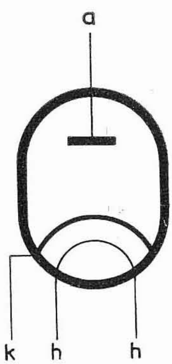
Suitable for series operation a.c. or d.c.

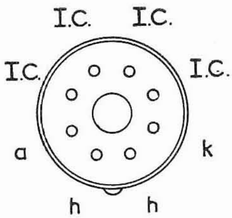
I_h	100	mA
V_h	31	V

LIMITING VALUES

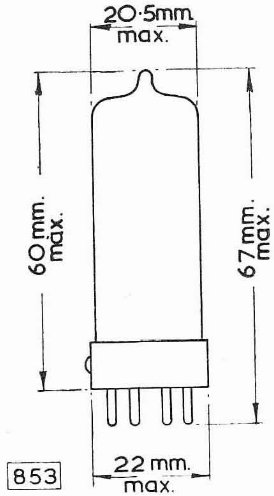
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	100	mA
$v_{h-k\ (pk)}$ max.	550	V
C max.	50	μF

$V_{a(r.m.s.)}$ (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





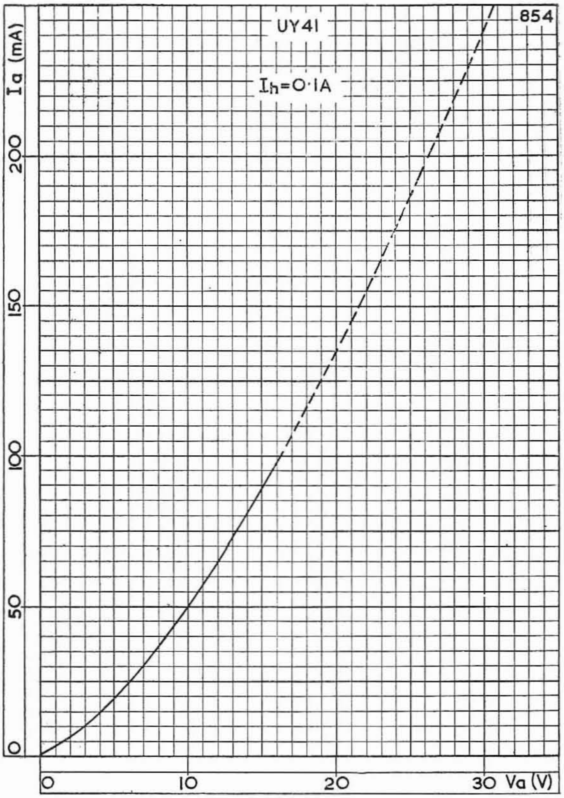
B8A BASE



UY41

HALF-WAVE RECTIFIER

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

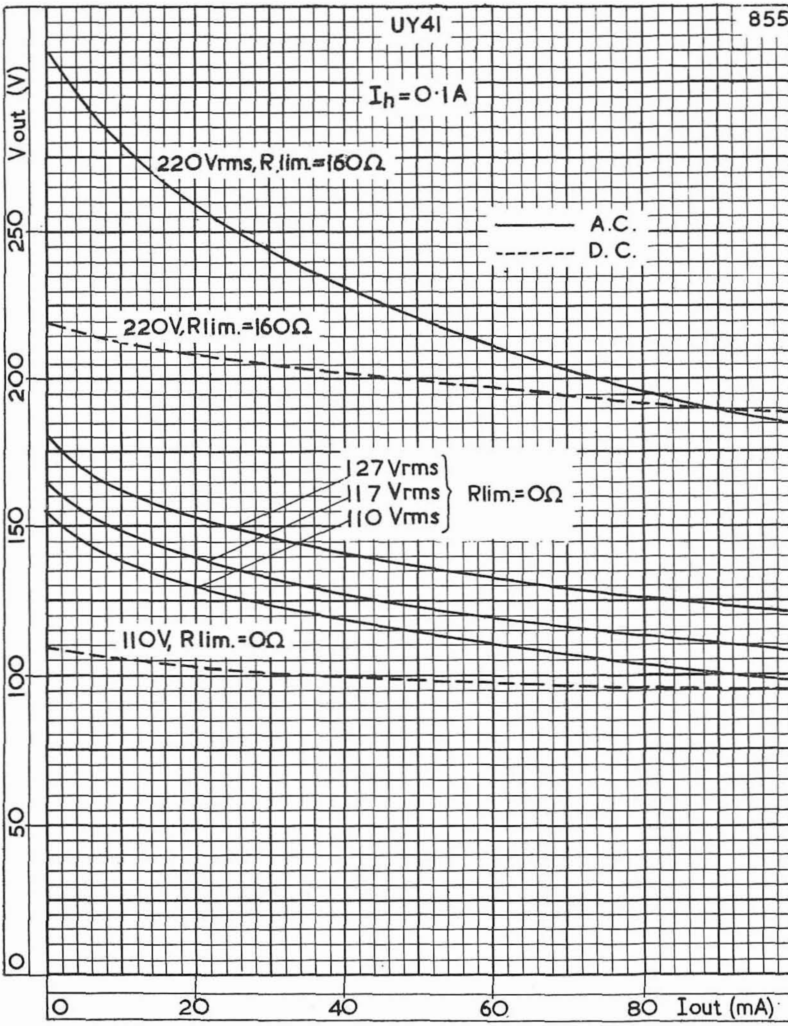


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

HALF-WAVE RECTIFIER

UY41

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



OUTPUT VOLTAGE PLOTTED AGAINST OUTPUT CURRENT

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

	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
Power amplifier	300	150	–35	40
	250	150	–35	40
	200	150	–35	40
	150	150	–35	32
	100	100	–23	22

	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
Frequency doubler	300	150	–90	40
	250	150	–90	40
	200	150	–90	38
	150	150	–90	32
	100	100	–60	20

	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
Frequency trebler	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

	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max (mA)
Power amplifier	300	150	–35	30
	250	150	–35	37
	200	150	–35	40
	150	150	–35	40
	100	100	–23	28

	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
Frequency doubler	300	150	–90	26
	250	150	–90	32
	200	150	–90	38
	150	150	–90	32
	100	100	–90	20

	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
Frequency trebler	250	150	–100	27
	200	150	–100	32
	150	150	–100	28
	100	100	–100	20

YL1000

TYPICAL OPERATION CLASS 'C' OPERATION F.M. TELEPHONY

Amplifier at f = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+V_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–35	10	1.45	0.006	–4.5	1.68	56
			20	2.6	0.045	2.5	3.8	63.3
			30	3.0	0.45	9.0	6.1	67.8
			40	3.5	0.85	14.5	8.0	66.6
250	150	–35	10	1.62	0.008	–2.0	1.5	60
			20	3.1	0.08	3.5	3.3	65
			30	4.0	0.55	10	5.1	68
			40	5.0	0.95	17	6.7	67
200	150	–35	10	1.95	0.025	–1.5	1.3	65
			20	3.8	0.20	5.5	2.75	69
			30	5.0	0.75	12	4.1	68
			40	6.0	1.05	18	5.2	65
150	150	–35	10	2.6	0.038	–1.0	1.0	67
			20	4.3	0.24	6.0	2.05	68
			30	6.0	0.85	13.5	2.95	65.5
100	100	–23	10	2.1	0.09	1.5	0.6	60
			20	3.4	0.7	9.0	1.22	61
			25	4.5	1.2	13	1.45	57.6

Frequency doubler at f_{out} = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+V_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–90	10	1.38	0.015	0.5	1.58	52.7
			20	2.15	0.28	8.5	3.42	57
			30	2.6	0.73	15	5.15	57.2
			40	3.4	0.95	21	6.62	55.1
250	150	–90	10	1.6	0.024	1.2	1.36	54.4
			20	2.4	0.38	9.5	3.0	60
			30	3.2	0.80	15.5	4.45	59.3
			40	4.2	1.02	22	5.6	56
200	150	–90	10	2.05	0.04	2.0	1.16	58
			20	2.9	0.45	10	2.5	62.5
			30	3.6	0.85	16.5	3.5	58.3
150	150	–90	10	2.4	0.05	2.5	0.86	57.3
			20	3.8	0.56	11	1.8	60
			30	4.5	0.95	18	2.48	55.2
100	100	–60	10	1.95	0.26	6.0	0.53	53
			20	3.1	0.92	13	0.94	47

Frequency trebler at f_{out} = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+v_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	–100	10	1.0	0.01	0.8	1.2	40
			20	1.75	0.26	9.5	2.6	43.3
250	150	–100	10	1.16	0.012	1.0	1.05	42
			20	1.9	0.3	10	2.24	44.8
			30	2.3	0.7	17	3.2	42.7
200	150	–100	10	1.4	0.015	1.3	0.9	45
			20	2.05	0.35	10.5	1.88	47
			30	2.45	0.72	17.5	2.7	45
150	150	–100	10	1.7	0.027	1.9	0.67	44.7
			20	2.35	0.39	11	1.44	48
100	100	–100	10	1.1	0.29	7.5	0.47	47
			20	2.2	1.02	17	0.8	40

Amplifier at f = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
300	150	–35	15	0.9	0	0.98	21.7
			20	1.34	0	1.66	27.7
			25	1.56	0.01	2.48	33.1
			30	2.08	0.07	3.3	36.7
250	150	–35	15	1.0	0	0.91	24.3
			20	1.42	0	1.48	29.4
			25	1.96	0.01	2.17	34.7
			30	2.25	0.1	2.88	38.5
			35	2.42	0.2	3.6	41.1
200	150	–35	15	1.3	0	0.81	27
			20	1.96	0	1.37	32.5
			25	2.12	0.02	1.9	38
			30	2.4	0.11	2.5	41.7
			35	2.64	0.28	3.08	44
			40	3.0	0.5	3.69	46.1
150	150	–35	15	1.74	0	0.7	31.1
			20	2.14	0.01	1.14	38
			25	2.5	0.03	1.56	41.7
			30	2.9	0.12	2.0	44.5
			35	3.2	0.3	2.42	46.1
			40	3.5	0.55	2.82	47
100	100	–23	15	1.28	0.04	0.56	37.3
			20	1.5	0.22	0.89	44.5
			25	1.82	0.54	1.18	47.2

Frequency doubler at f_{out} = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
300	150	−90	15	0.84	0	0.82	18.2
			20	1.1	0.12	1.46	24.3
			25	1.22	0.34	2.1	28
250	150	−90	15	0.98	0.02	0.8	21.3
			20	1.26	0.15	1.35	27
			25	1.4	0.4	1.88	30
			30	1.62	0.6	2.4	32
200	150	−90	15	1.2	0.04	0.73	24.3
			20	1.4	0.22	1.2	30
			25	1.6	0.42	1.7	34
			30	1.85	0.66	2.15	35.9
			35	2.0	0.8	2.55	36.5
150	150	−90	15	1.58	0.06	0.66	29.4
			20	1.76	0.26	1.04	34.7
			25	2.07	0.46	1.42	37.9
			30	2.25	0.72	1.78	39.5
			35	2.36	0.88	2.1	40
100	100	−60	15	1.0	0.38	0.54	36
			20	1.36	0.7	0.74	37

Frequency trebler f_{out} = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
250	150	−100	15	0.88	0.04	0.6	16
			20	1.12	0.18	0.95	19
			25	1.26	0.4	1.29	20.7
200	150	−100	15	1.02	0.05	0.55	18.3
			20	1.24	0.22	0.86	21.5
			25	1.42	0.42	1.15	23
			30	1.66	0.6	1.42	23.7
150	150	−100	15	1.26	0.07	0.49	21.8
			20	1.42	0.30	0.76	25.3
			25	1.64	0.44	0.99	26.4
100	100	−100	15	0.94	0.52	0.4	26.7
			20	1.5	0.84	0.5	25

CLASS 'C' A.M. TELEPHONY

Maximum carrier conditions for 100% modulation

Output tuned circuit

	Single valve operation			Push-pull operation		
	Parallel	Parallel	Series			
f	50	175	175	50	175	Mc/s
V_a	250	200	200	250	200	V
V_{g2}	150	150	150	150	150	V
V_{g1}	−35	−35	−35	−35	−35	V
I_a	32	31	32	2×32	2×32	mA
I_{g2}	4.2	2.45	2.5	2×4.2	2×2.5	mA
I_{g1}	0.62	0.14	0.18	2×0.62	2×0.18	mA
P_{load}	5.4	2.65	3.05	12	6.2	W
η	67.5	42	47	75	48.5	%
For 100% modulation						
P_{mod}	4.2	3.2	3.3	8.4	6.4	W
$v_{g2}(pk)$	135	120	120	135	120	V

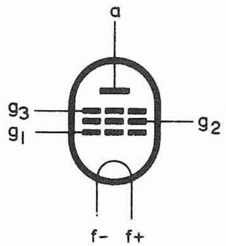
Maximum carrier conditions for anode and screen-grid modulation for various modulation depths. f = 175Mc/s

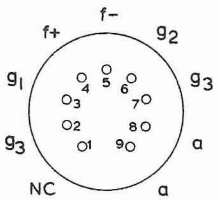
m (%)	V_a (V)	I_a (mA)	p_a (max.) (W)	p_{g2} (max.) (W)	P_{load}* (W)	Output tuned circuit
100	200	31	3.3	0.67	2.65	Parallel
	200	32	3.3	0.67	3.05	Series
	200	64	2×3.3	2×0.67	6.2	Push-Pull
75	220	34	3.9	0.78	3.2	Parallel
	220	35	3.9	0.78	3.65	Series
	220	70	2×3.9	2×0.78	7.4	Push-Pull
50	235	35	4.45	0.89	3.47	Parallel
	235	36	4.45	0.89	3.96	Series
	235	72	2×4.45	2×0.89	8.0	Push-Pull
25	245	37	4.85	0.97	3.82	Parallel
	245	38	4.85	0.97	4.37	Series
	245	76	2×4.85	0.97	8.8	Push-Pull
0	250	38	5.0	1.0	4.02	Parallel
	250	39	5.0	1.0	4.55	Series
	250	80	2×5.0	2×1.0	9.6	Push-Pull

*Estimated value

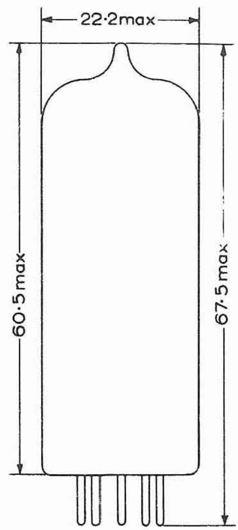
These conditions may be varied for operation at lower frequencies. Operation at 100% modulation with $V_a > 250V$, $I_a > 32mA$ is not permitted and the p_a max. and p_{g2} max. limits shown above must never be exceeded.

YL1000



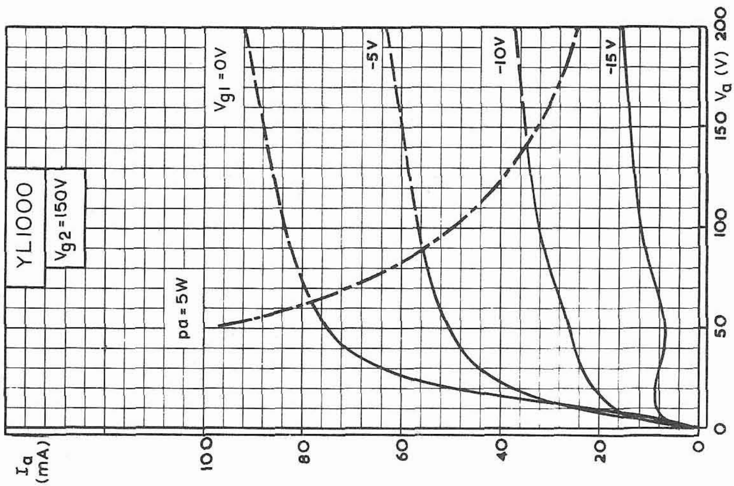


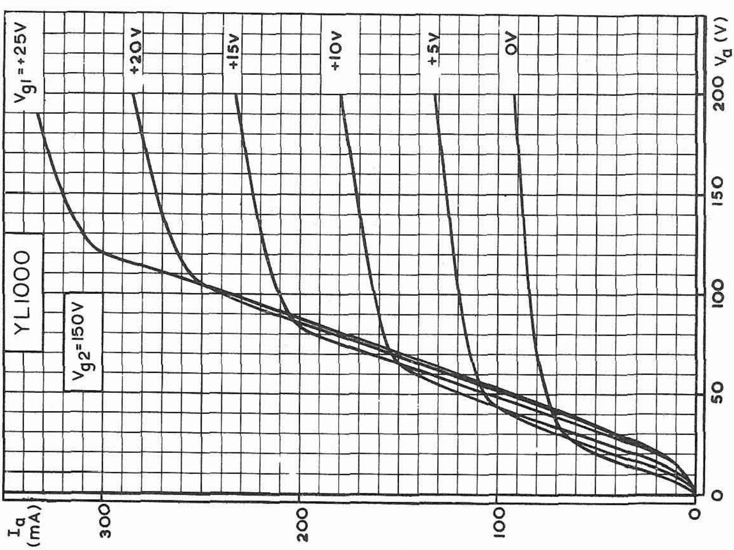
B9A Base



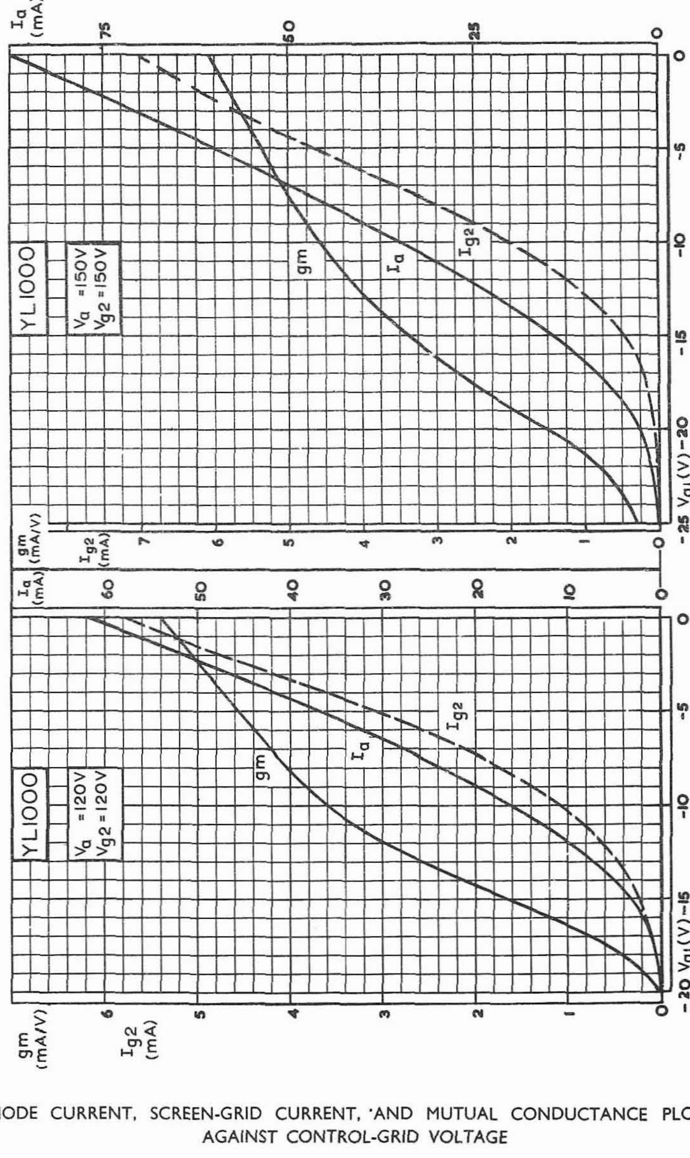
All dimensions in mm

B 4662

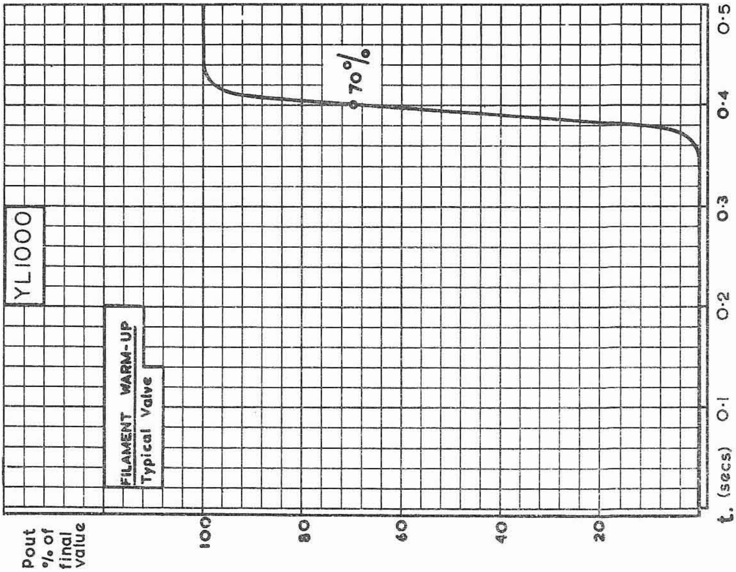


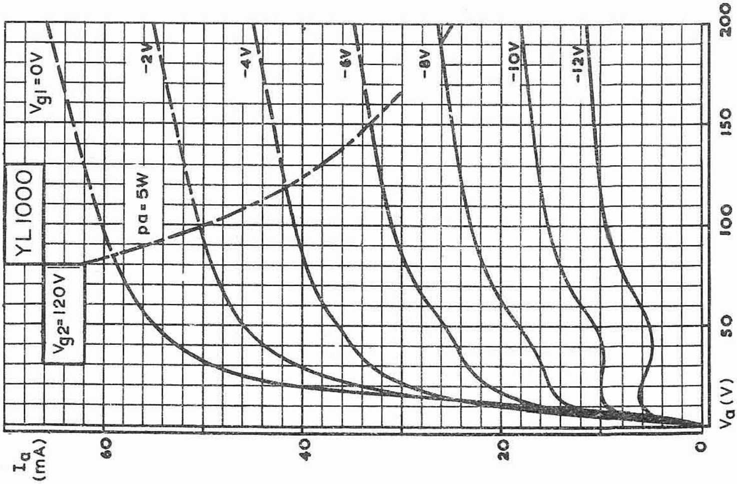


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=150V



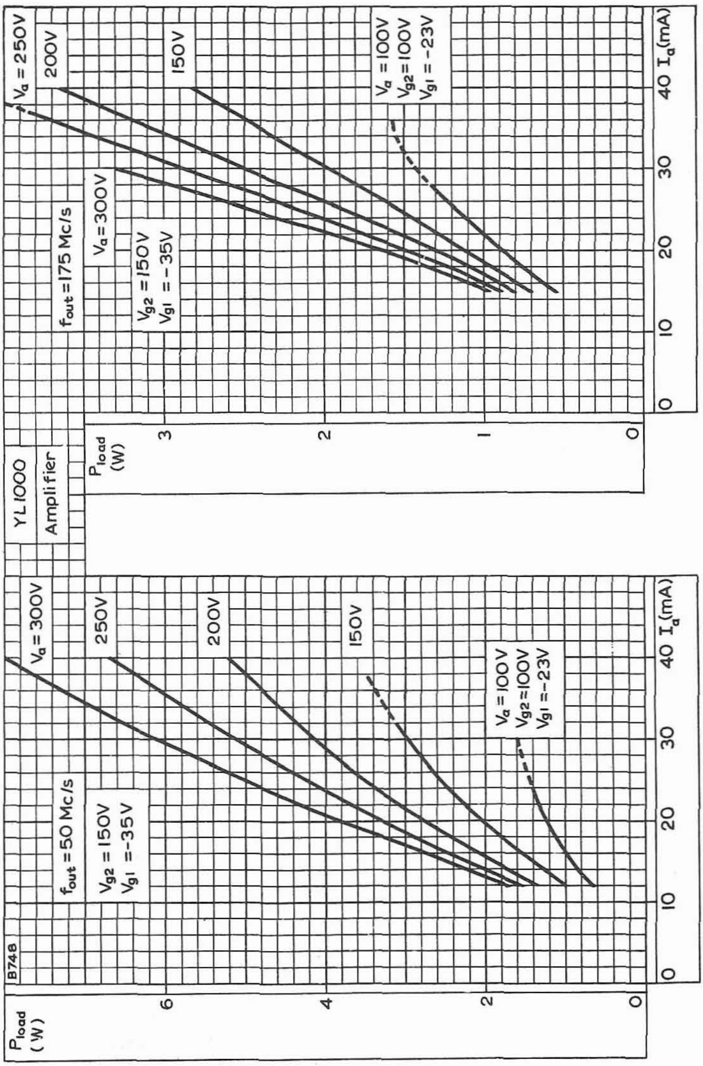
ANODE CURRENT, SCREEN-GRID CURRENT, 'AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



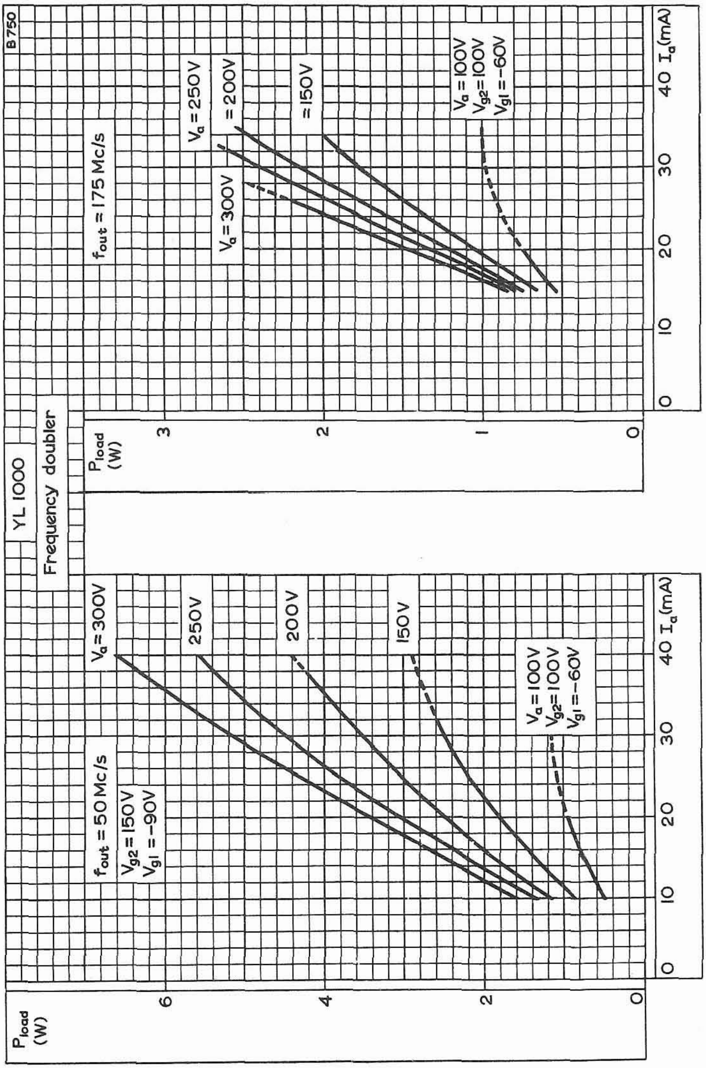


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=120V

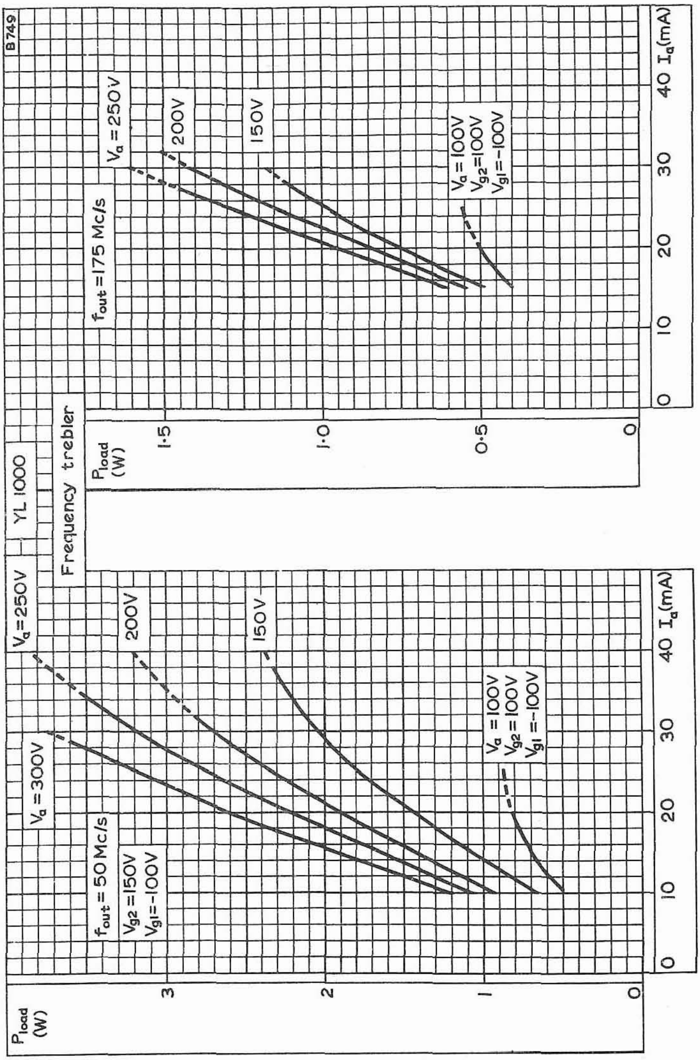
FILAMENT WARM-UP TIME



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

Double diode with separate cathodes and internal screening between sections.

6AL5

HEATER

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

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

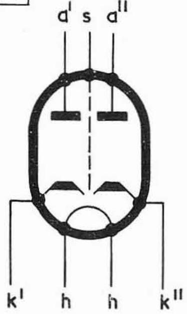
CAPACITANCES

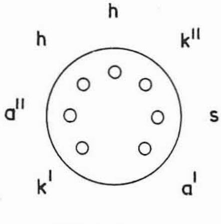
	Shielded	Unshielded	
$c_{a'-k'+h+s}$	3.1	2.5	pF
$c_{a''-k''+h+s}$	3.1	2.5	pF
$c_{k'-a'+h+s}$	3.9	3.4	pF
$c_{k''-a''+h+s}$	3.9	3.4	pF
$c_{a'-a''}$	<0.026	<0.068	pF

LIMITING VALUES (each section)

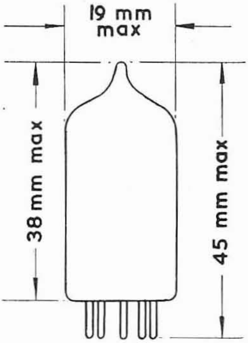
P.I.V. max.	330	V
I_a max.	9.0	mA
$i_{a(pk)}$ max.	54	mA
V_a max. ($I_a = +0.3\mu A$)	-1.3	V
$v_{h-k(pk)}$ max.	330	V

3577





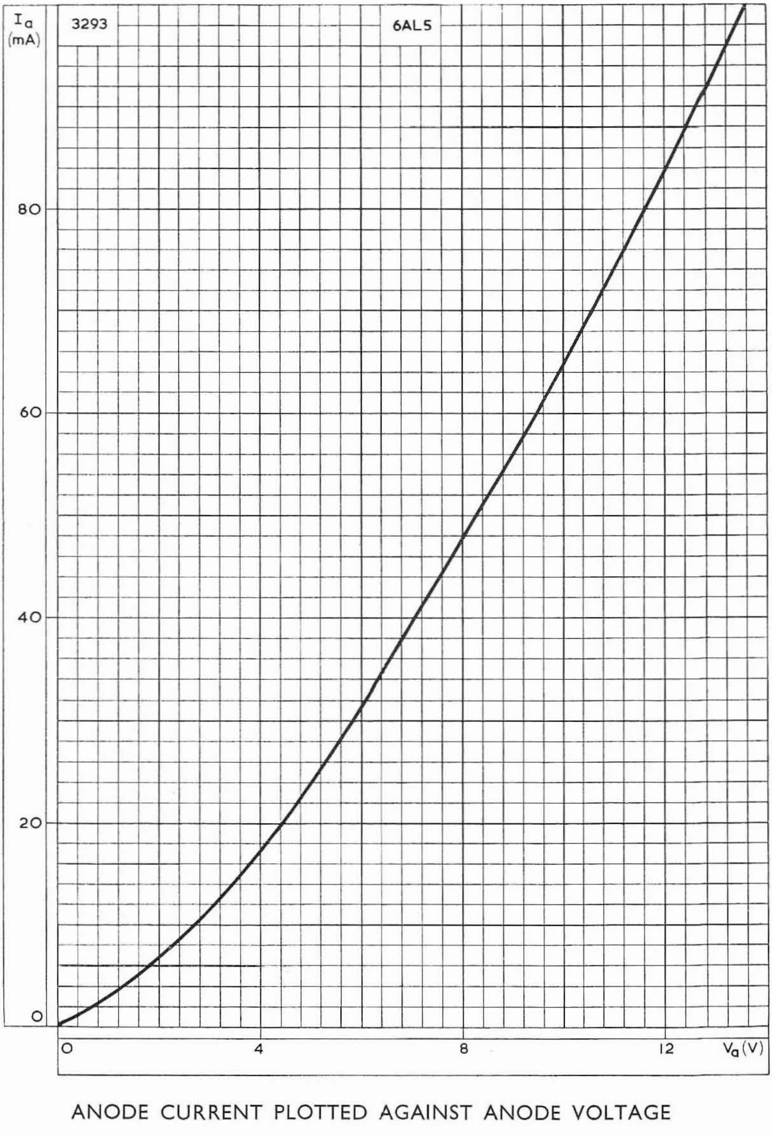
B7G Base



6AL5

DOUBLE DIODE

Double diode with separate cathodes and internal screening between sections.

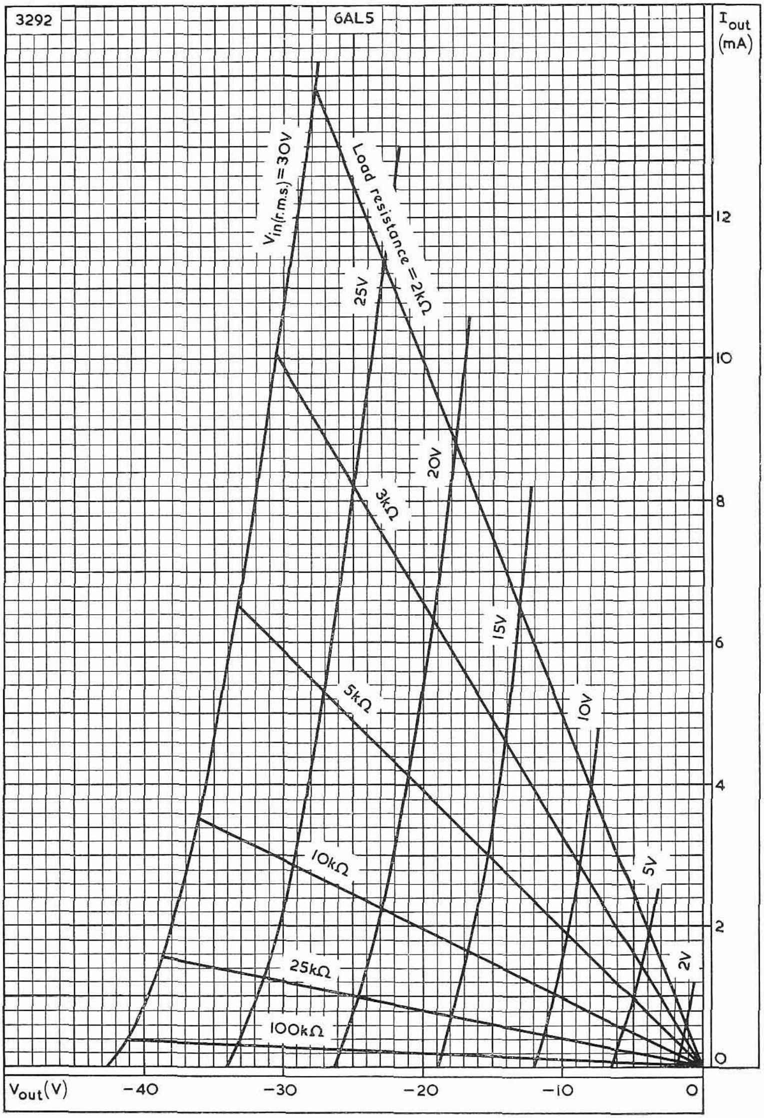


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

DOUBLE DIODE

Double diode with separate cathodes and internal screening between sections.

6AL5



OUTPUT CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE AS PARAMETER

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

GROUP B

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

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

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	—	—	—	—	—	—	

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GROUP D

Heater cycling life test								
V_h = 7.0V 1 minute on, 4 minutes off								
V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature								
Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	15	—	—	—	%
Survival rate life test[14]								
Running conditions R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	2.35	—	—	—	—	mA/V

	A.Q.L.[5] (%)	Min.	Max.	
Intermittent life test				
Running conditions, R_{g1} = 1.0MΩ, V_{h-k} = 200V (cathode negative), T_{bulb} min = 220°C				
Intermittent life test end points (500 hours)				
Inoperatives[16]	4.0	—	—	
Heater current	6.5	138	164	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	10	μA
Reverse grid current R_{g1} = 1.0MΩ	4.0	0	0.9	μA
Change in mutual conductance (individuals)	4.0	—	20	%
Change in mutual conductance V_h = 5.7V	6.5	—	15	%
Insulation as in group B	6.5	50	—	MΩ
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

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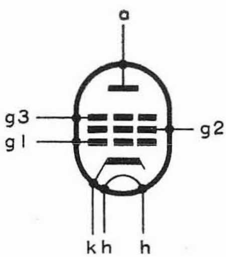
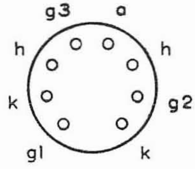
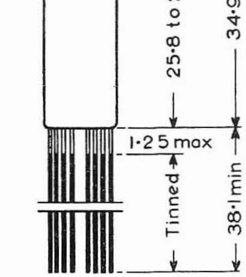
SPECIAL QUALITY R.F. PENTODE





B8D/F Base



5325

All dimensions in mm

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

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 $<$100μA)	−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

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

GROUP B

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

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

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100$V.	6.5	—	—	15	—	—	—	μA
Change in mutual conductance	6.5	—	—	15	—	—	—	%
Microphonic noise as in group B	6.5	—	—	100	—	—	—	mV
Shock[15]								
V_{h-k} = 100V (cathode negative), R_g = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100$V	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 $V_{h-k} = \pm100V$	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	—	—	

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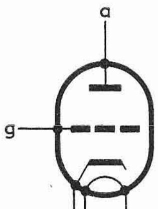
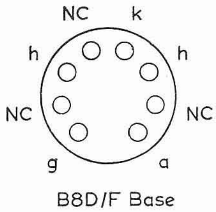
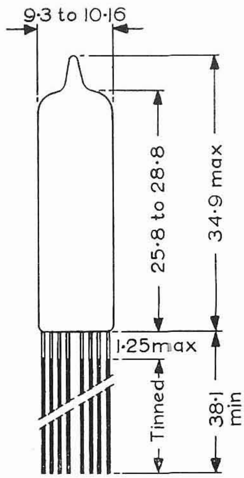
5718 SPECIAL QUALITY U.H.F. TRIODE

5604







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

GROUP A	*A.Q.L.*[5] (%)	*Individuals*[6] *Bogey*[9]	*Individuals Min.*	*Individuals Max.*	*Lot average*[7] *Min.*	*Lot average Max.*	*Lot standard deviation*[8] *Max.*	
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	—	—	—	—	—	—	

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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.

	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals Min.	Individuals Max.	Lot average[7] Min.	Lot average 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 $V_{h-k} = \pm100V$	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 $V_{h-k} = \pm100V$	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

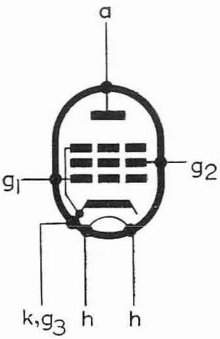
Heater cycling life test								
$V_h = 7.0V$, 1 minute on, 4 minutes off $V_{h-k} = 140V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions $R_{g1} = 1.0M\Omega$								
$V_{h-k} = 200V$ (cathode negative)								
$T_{ambient}$ = Room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

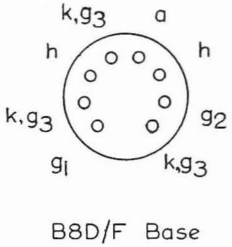
	A.Q.L.[5] (%)	Min.	Max.	
Intermittent life test				
Running conditions, $R_{g1} = 1.0M\Omega$				
$V_{h-k} = 200V$, T_{bulb} min = 220°C				
Intermittent life test end points (500 hours)				
Inoperatives[16]	4.0	—	—	
Heater current	6.5	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$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

5899

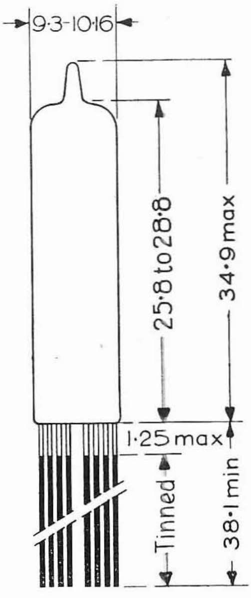
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

5494





B8D/F Base



All dimensions in mm

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

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} ($I_a < 100\mu A$)	−40	V

LIMITING VALUES[4] (absolute ratings)

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

TEST CONDITIONS (unless otherwise specified)

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

TESTS

	A.Q.L.[5]	*Individuals*[6]			*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]	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	—	—	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} = 100kΩ, 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	—	—	—	—	—	—	

Mullard

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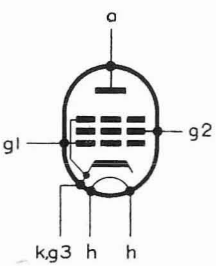
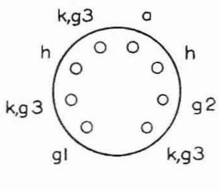
GROUP D

Heater cycling life test								
V_h = 7.0V, 1 minute on, 4 minutes off V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Heater cycling life test end point								
Heater-to-cathode leakage current $V_{h-k}=\pm 100V$	—	—	—	40	—	—	—	μA
Stability life test[14]								
Running conditions R_{g1} = 470kΩ, R_k = 220Ω, $V_a=V_{g2}$=100V, V_{h-k}=200V (cathode negative), $T_{ambient}$=Room temperature								
Stability life test end point								
Change in power output after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions R_{g1} = 470kΩ, R_k = 220Ω, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives	0.65	—	—	—	—	—	—	
Power output	1.0	—	650	—	—	—	—	mW

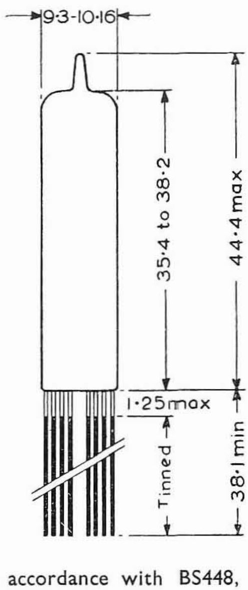
	A.Q.L.[5] (%)	Min.	Max.	
Intermittent life test				
Running conditions, R_{g1}=470kΩ, R_k=220Ω, $V_a=V_{g2}$=100V, V_{h-k} = 200V (cathode negative), T_{bulb} min. = 220°C				
Intermittent life test points (500 hours)				
Inoperatives[16]	4.0	—	—	
Heater current	6.5	414	492	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	60	μA
Reverse grid current R_{g1} = 1.0MΩ	4.0	0	2.0	μA
Change in power output (individuals)	4.0	—	20	%
Change in power output V_h = 5.7V	6.5	—	15	%
Insulation as in group B	6.5	25	—	MΩ
Average change in power output	—	—	15	%
Sub-group quality level[10]	10	—	—	

5902 SPECIAL QUALITY OUTPUT PENTODE





B8D/F Base



5326

All dimensions in mm

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

DOUBLE TRIODE 6080

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.

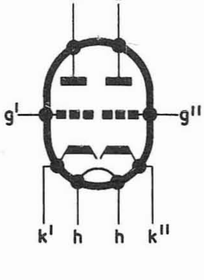
*With fixed bias the anode circuit should contain a protective resistance to provide a minimum drop of 15V d.c. at the normal operating conditions. When two or more sections are used in parallel at dissipations approaching the rated maximum, separate anode and cathode resistors must be used to assist load sharing.

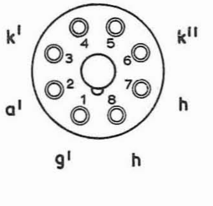
When combined fixed and cathode bias is used, the cathode bias portion should have a minimum value of 7.5V d.c. at the normal operating conditions and R_{g-k} max. = 100kΩ.

It is not recommended that fixed bias be used when the valve is used in a booster scanning circuit.

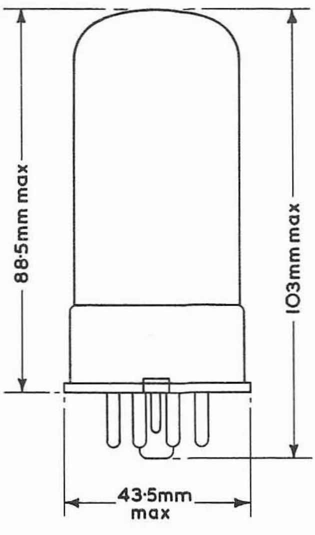
DOUBLE TRIODE 6080

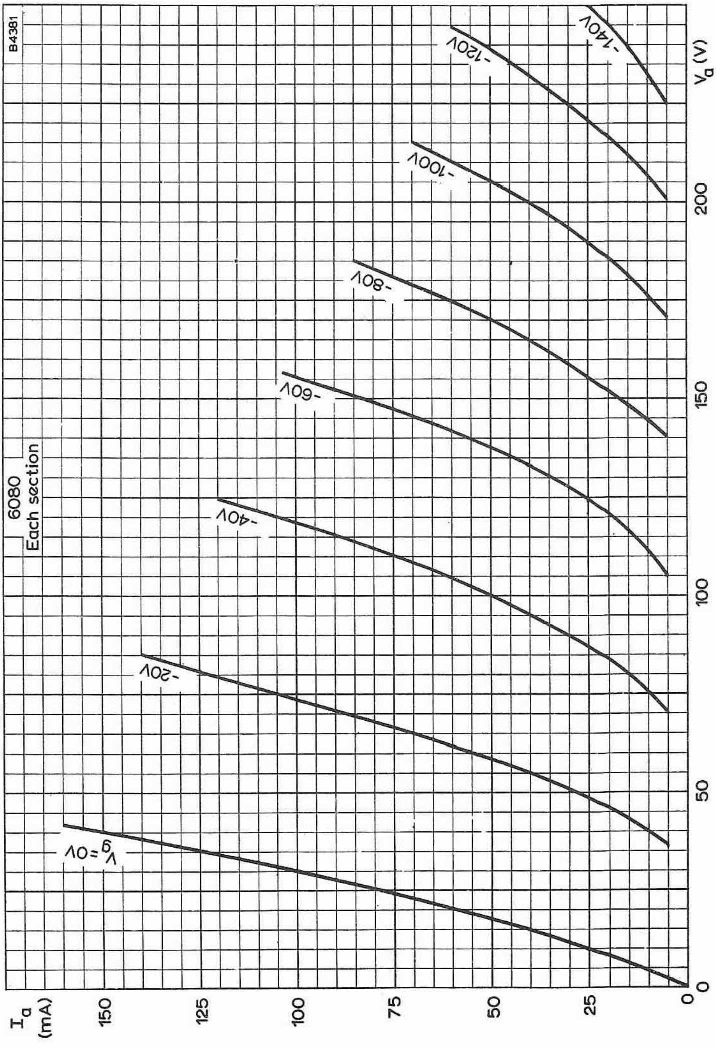
3761





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 <50μA)	−9.0	V

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

LIMITING VALUES[4] (absolute ratings)

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

TEST CONDITIONS (unless otherwise specified)

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

TESTS

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

GROUP B

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

Mullard

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals Min.	Individuals Max.	Lot average[7] Min.	Lot average 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} = 100kΩ, 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	—	—	—	—	—	—	

Mullard

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

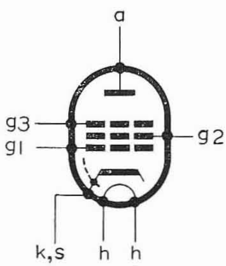
Intermittent life test

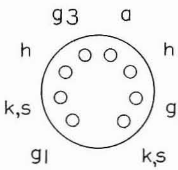
Running conditions: $R_{g1} = 1.0M\Omega$,
$V_{h-k}=200V$ (cathode negative), T_{bulb}min.$=220°C$

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 $V_{h-k} = \pm 100V$	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	—	—	

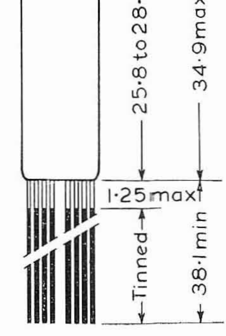
6205

SPECIAL QUALITY R.F. PENTODE





B8D/F Base



5544

All dimensions in mm

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

Mullard

MAINTENANCE TYPE
RECEIVING VALVES AND
CATHODE RAY TUBES

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