Mullard

TECHNICAL HANDBOOK

VOL. 2

RECEIVING VALVES FOR MAINTENANCE

VOLUME 2

Maintenance Types

receiving and amplifying valves

cathode ray tubes

Issued by
CENTRAL TECHNICAL SERVICES
MULLARD LIMITED
MULLARD HOUSE, TORRINGTON PLACE, LONDON W.C.1
TELEPHONE: 01-580 6633 *Telex:* 264341

TECHNICAL HANDBOOK SERVICE

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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

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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.

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MAINTENANCE TYPE
RECEIVING VALVES

R.F. PENTODE

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

6AU6

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES

Pentode connected

	Shielded	*Unshielded*	
c_{in}	5.5	5.5	pF
c_{out}	5.0	5.0	pF
c_{a-g1}	<0.003	<0.003	pF

Triode connected

c_{in}	3.2	3.2	pF
c_{out}	8.5	1.2	pF
c_{a-g1}	2.6	2.6	pF

CHARACTERISTICS

Pentode connected

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

Triode connected (g_2 and g_3 connected to a)

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

6AU6

R.F. PENTODE

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

LIMITING VALUES

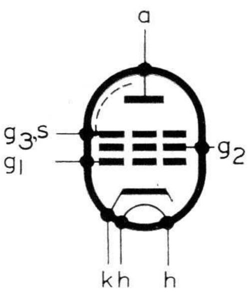
Pentode connected

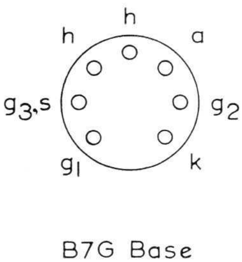
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	150	V
p_{g2} max.	650	mW
$+V_{g1}$ max.	0	V
$-V_{g1}$ max.	50	V
V_{h-k} max.	100	V

Triode connected

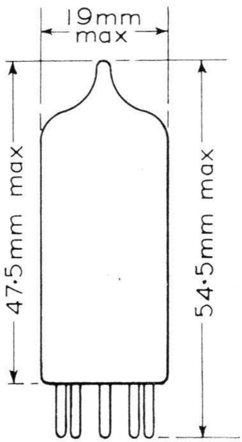
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.2	W
$+V_{g1}$ max.	0	V
$-V_{g1}$ max.	50	V
V_{h-k} max.	100	V

4750





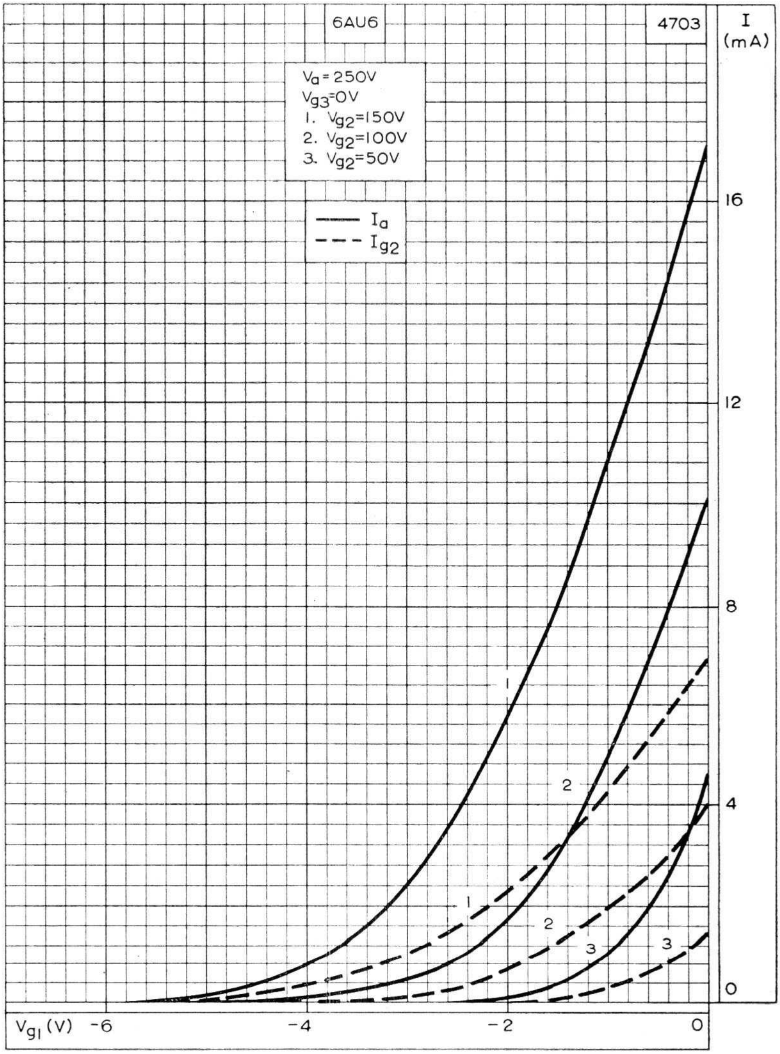
B7G Base



R.F. PENTODE

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

6AU6

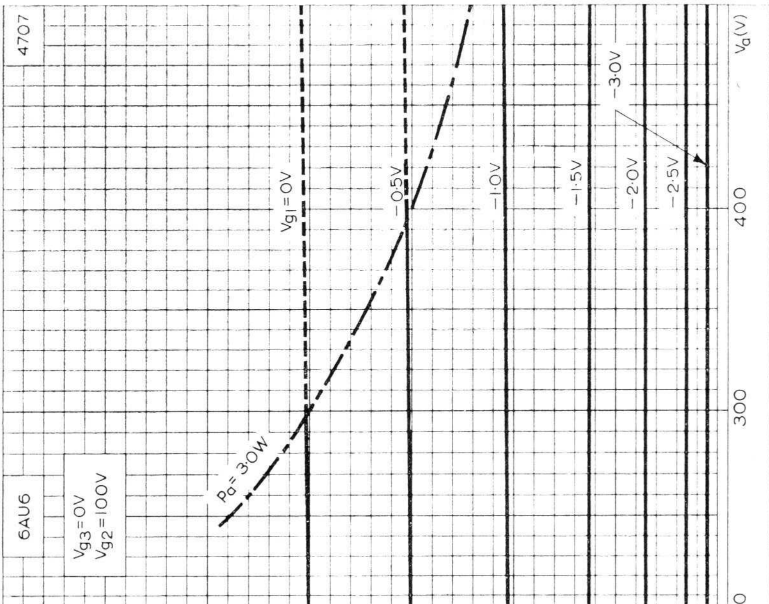


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

6AU6

R.F. PENTODE

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

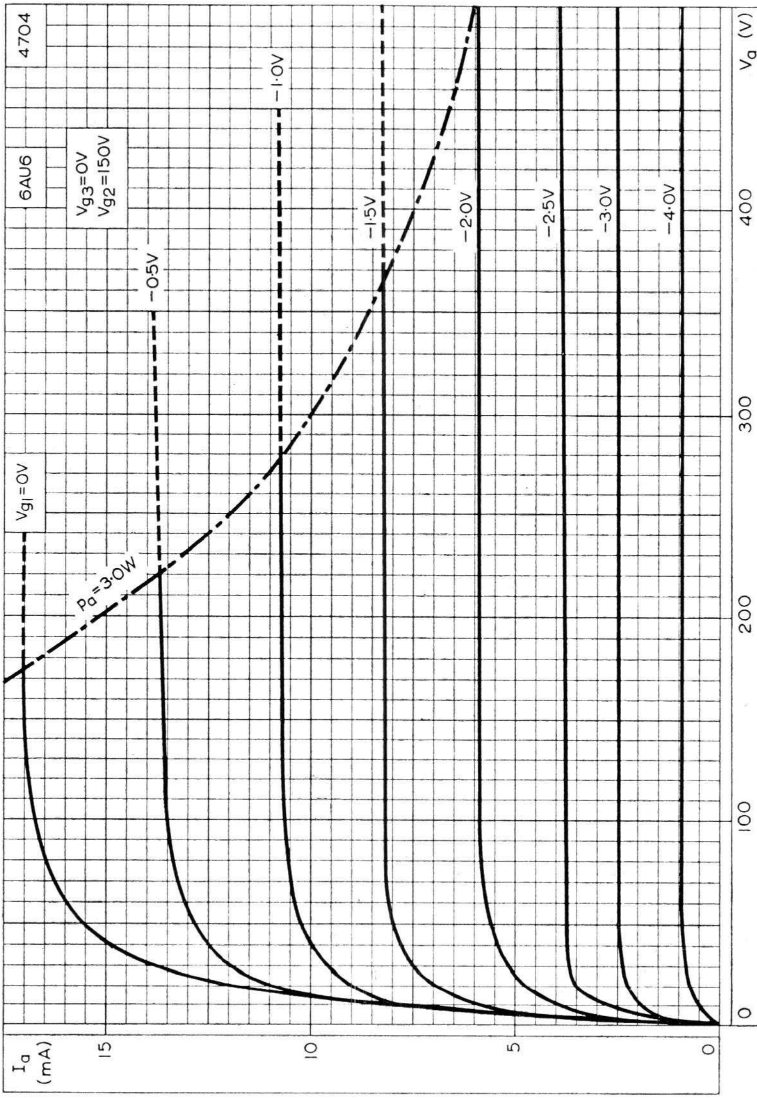


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} 100V

R.F. PENTODE

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

6AU6

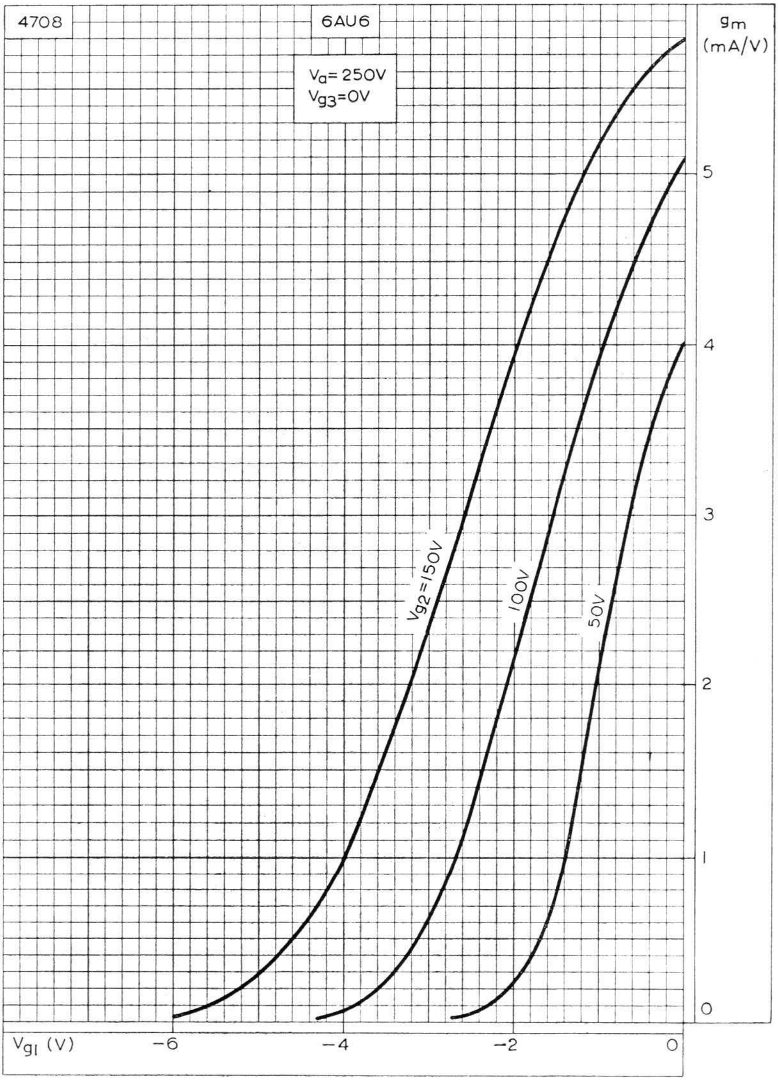


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2} = 150V

6AU6

R.F. PENTODE

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

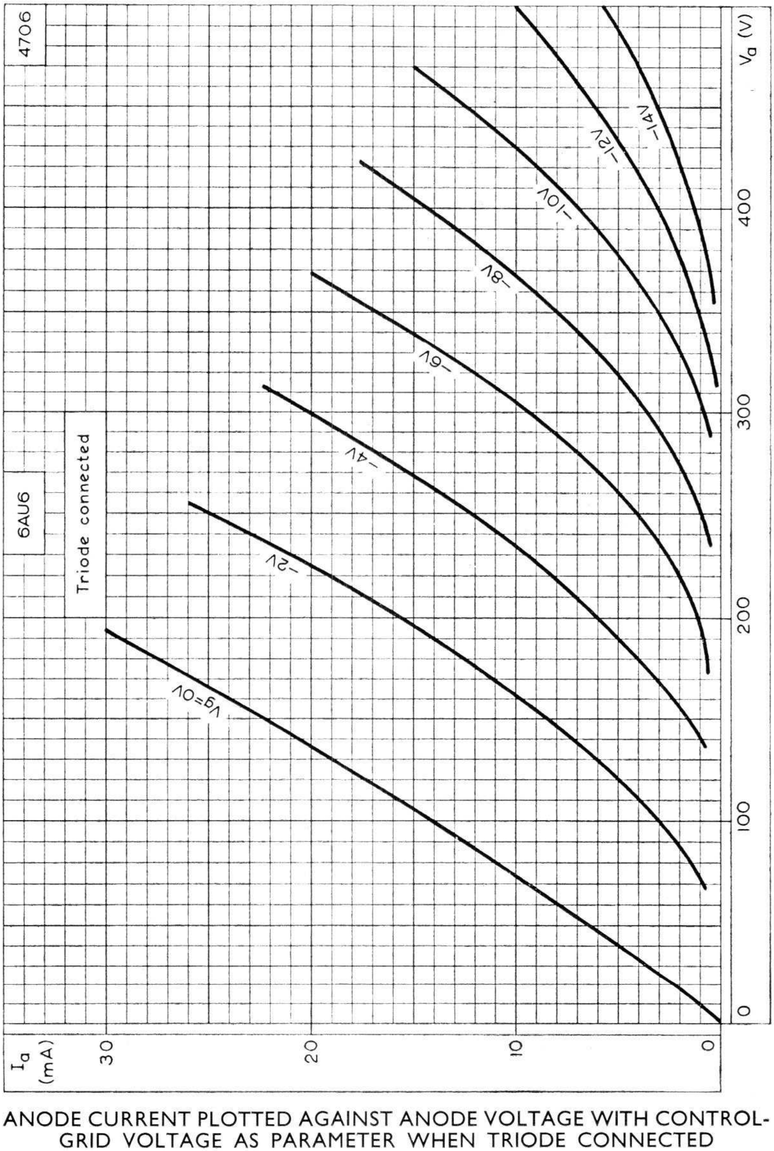


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

R.F. PENTODE

6AU6

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



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

R.F. PENTODE

6CB6

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

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES

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

CHARACTERISTICS

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

LIMITING VALUES

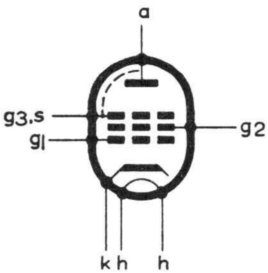
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	150	V
p_{g2} max.	500	mW
V_{h-k} max.	100	V
$v_{h-k(pk)}$ max.	200	V

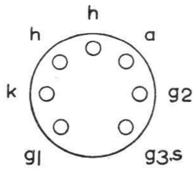
6CB6

R.F. PENTODE

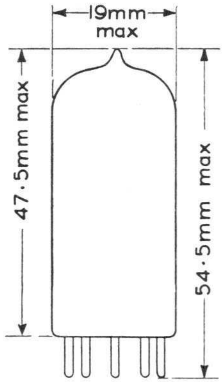
High slope pentode primarily intended for use as r.f. or i.f. amplifier.

4694





B7G Base



TRIODE PENTODE

6U8

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

HEATER

V_h	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

CAPACITANCES

	Shielded	Unshielded	
c_{ap-at}	0.018	0.07	pF
c_{ap-gt}	0.0035	0.008	pF
c_{gp-at}	0.1	0.11	pF
c_{gp-gt}	0.0025	0.003	pF
Pentode section			
c_{a-g1}	$<$0.006	$<$0.01	pF
c_{in}	5.0	5.0	pF
c_{out}	3.5	2.6	pF
c_{kp-h}	3.0	3.0	pF
Triode section			
c_{a-k+h}	1.0	0.4	pF
c_{g-k+h}	2.5	2.5	pF
c_{a-g}	1.8	1.8	pF
c_{kt-h}	3.0	3.0	pF

CHARACTERISTICS

Pentode section

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

Triode section

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

6U8

TRIODE PENTODE

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

TYPICAL OPERATING CONDITIONS

As a frequency changer

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

Triode section as an oscillator

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

LIMITING VALUES

Pentode section

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

Triode section

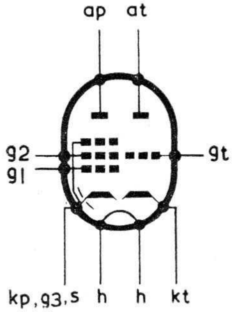
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.7	W
I_k max.	20	mA
R_{g-k} max.	1.0	MΩ
V_{h-k} max. (cathode negative)	90	V
V_{h-k} max. (cathode positive)	90	V
R_{h-k} max.	20	kΩ

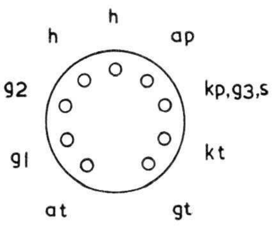
TRIODE PENTODE

6U8

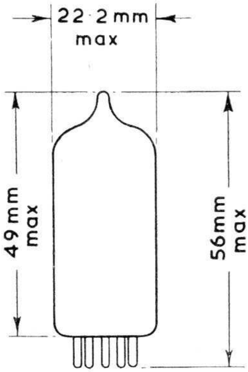
Combined triode and high slope r.f. pentode with separate cathodes. Primarily intended for use as a frequency changer at frequencies up to 220Mc/s.

3222





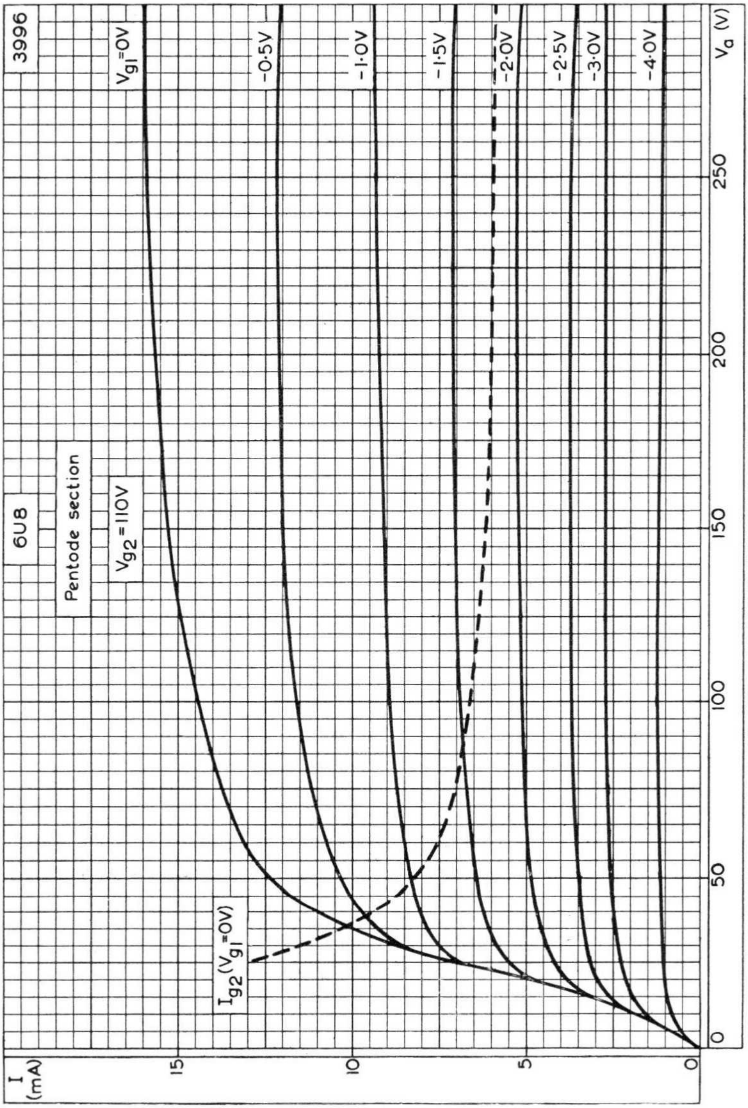
B9A Base



6U8

TRIODE PENTODE

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



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

SPECIAL QUALITY R.F. PENTODE

5636

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

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

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

CAPACITANCES[2] (measured with external shield)

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

CHARACTERISTICS[3]

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

LIMITING VALUES[4] (absolute ratings)

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

TEST CONDITIONS (unless otherwise specified)

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

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

GROUP B

Insulation								
a-rest, measured at –300V	2.5	—	100	—	—	—	—	MΩ
g_1-rest, measured at –100V	2.5	—	100	—	—	—	—	MΩ
Change in mutual conductance $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Screen-grid current	2.5	—	2.8	5.4	—	—	—	mA
Anode current $V_{g3-e} = -8.0V$	2.5	—	—	100	—	—	—	μA
Mutual conductance $_{(g3-a)}$ $V_{g3-e} = -1.0V$	2.5	—	0.5	1.8	—	—	—	mA/V
Reverse grid current $V_h = 7.5V$, $V_{g1} = -7.5V$, $R_{g1} = 1.0M\Omega$, $R_k = 0\Omega$. Measured after 5 minutes preheat under standard test conditions, except $V_h = 7.5V$, $R_{g1} = 1.0M\Omega$	2.5	—	0	0.5	—	—	—	μA
†A.F. noise at anode, $V_{g2-e} = 19V$, $R_{g1} = 100k\Omega$, $R_{g2} = 1.0k\Omega$, $R_a = 200k\Omega$	2.5	—	—	70	—	—	—	mV
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.5	4.5	—	—	—	pF
c_{out}	—	—	2.9	3.9	—	—	—	pF
c_{g3-all}	—	—	3.5	4.5	—	—	—	pF
c_{a-g1}	—	—	—	20	—	—	—	mpF
c_{a-g3}	—	—	—	1.1	—	—	—	pF
c_{g1-g3}	—	—	—	150	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55 ± 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		—	—	20	—	—	—	%
Microphonic noise as in group B		—	—	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	—	—	—	%
Microphonic noise as in group B		—	—	200	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

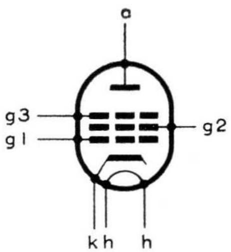
Heater cycling life test								
$V_h = 7.0V$ 1 minute on, 4 minutes off								
$V_{h-k} = 140V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature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

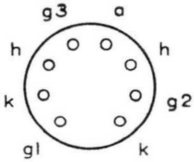
Intermittent life test

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

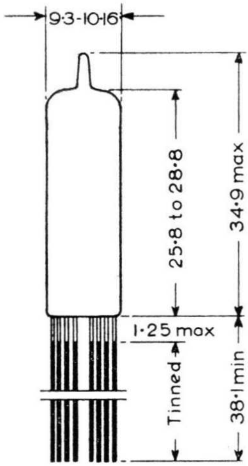
Intermittent life test end points (500 hours)	*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Inoperatives[16]	4.0	—	—	
Heater current	6.5	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	6.5	—	10	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	4.0	0	0.9	μA
Change in mutual conductance (individuals)	4.0	—	20	%
Change in mutual conductance $V_h = 5.7V$	6.5	—	15	%
Insulation as in group B	6.5	50	—	MΩ
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

5636 SPECIAL QUALITY R.F. PENTODE





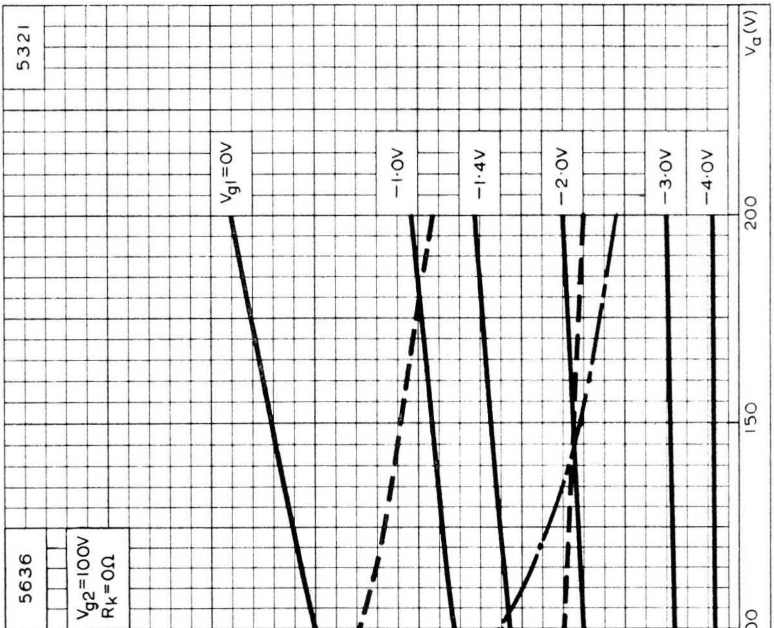
B8D/F Base



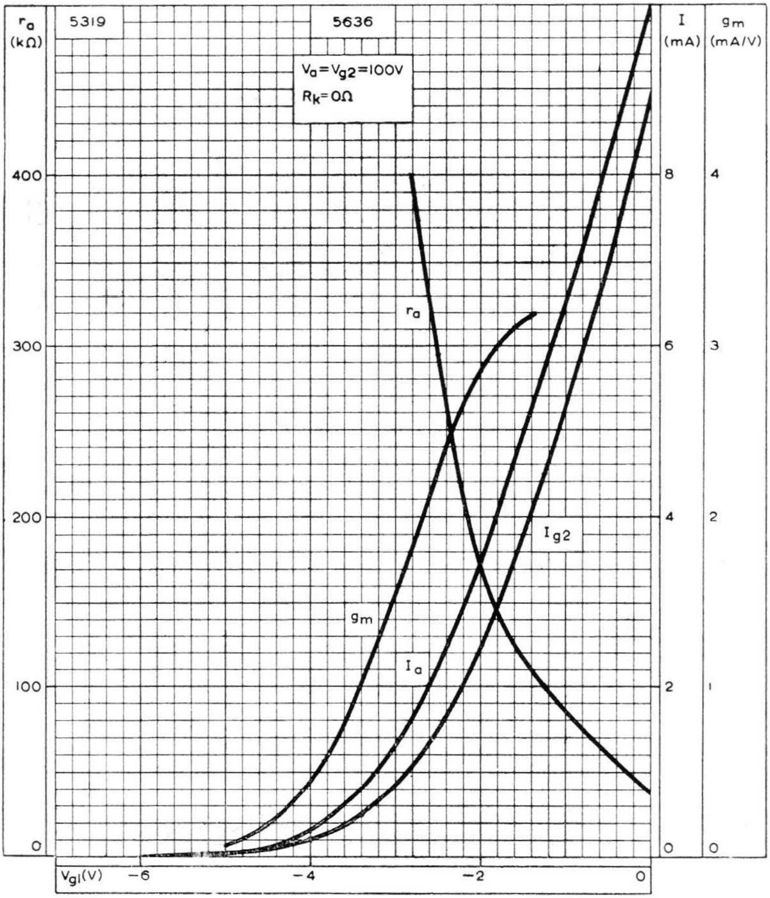
5325

All dimensions in mm

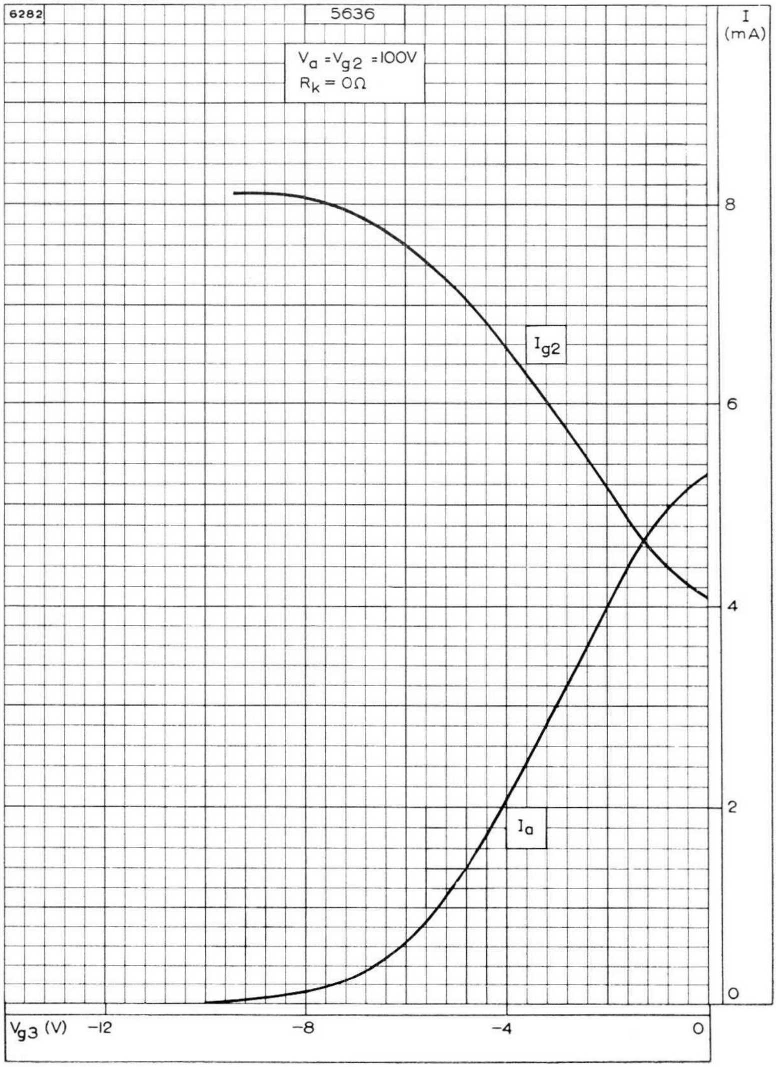
The bulb and base dimensions of this valve are in accordance with BS.448, Section B8D/F.



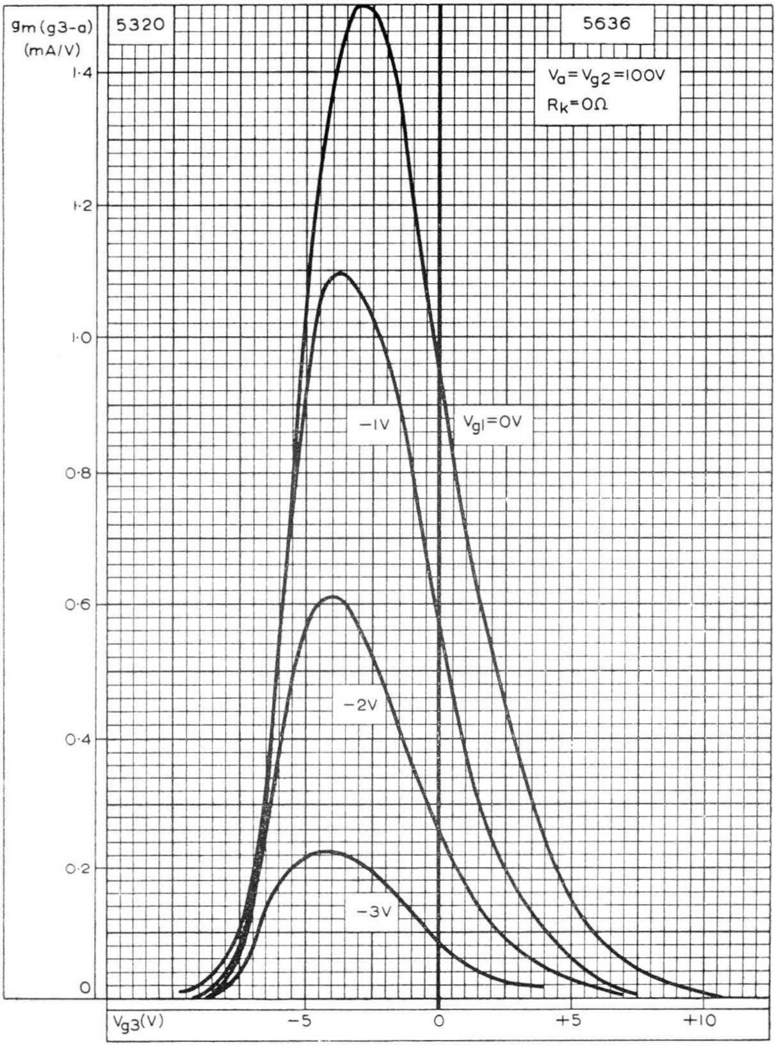
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER



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



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



MUTUAL CONDUCTANCE (g_3–a) PLOTTED AGAINST SUPPRESSOR-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

HALF-WAVE RECTIFIER 5642

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

FILAMENT

Vf	1.25	V
If	200	mA

CAPACITANCE

ca-f	600	mpF

TYPICAL OPERATING CONDITIONS

Sine wave input

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

DESIGN CENTRE RATINGS

Sine wave input

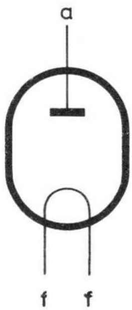
P.I.V. max.	10	kV
Ia max.	250	µA
ia(pk) max.	1.5	mA
‡ C max.	0.02	µF
Rlim min.	470	kΩ

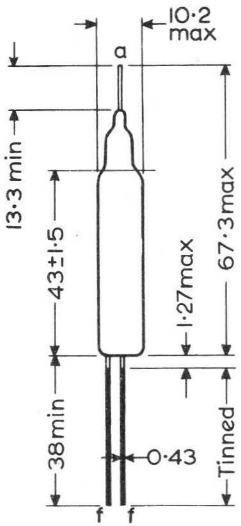
Pulse input

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

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

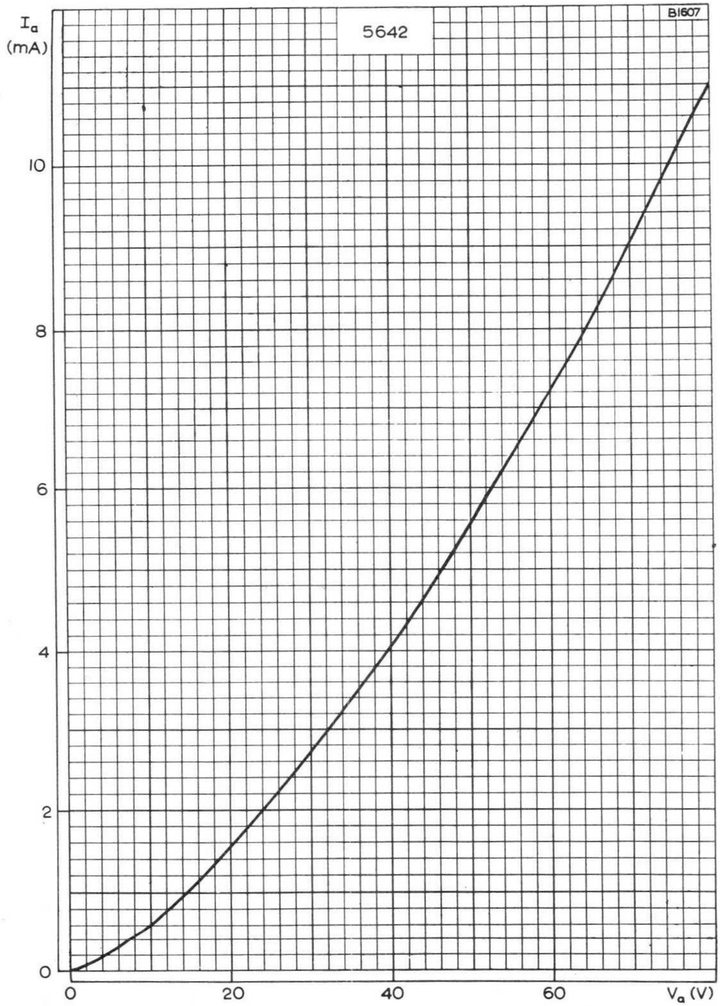
‡ 50 c/s supply





All dimensions in mm

B1576



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SPECIAL QUALITY U.H.F. TRIODE

5718

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

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

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

CAPACITANCES[2] (measured without external shield)

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

CHARACTERISTICS[3]

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

LIMITING VALUES[4] (absolute ratings)

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

TEST CONDITIONS (unless otherwise specified)

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

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals 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 $V_{h-k} = \pm 100$V	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_g = 1.0$MΩ $V_{a-e} = 150$V, $R_k = 380\Omega$	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 $V_g = -7.0$V, $R_k = 0\Omega$	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.

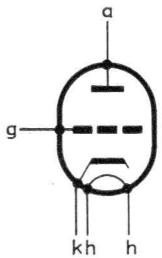
TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
V_h = 6.3V. No other voltages applied. 2.5g min. peak acceleration, 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	—	—	—	—	—	—	

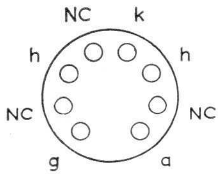
GROUP D

Heater cycling life test								
V_h = 7.0V. 1 minute on, 4 minutes off V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions R_g = 1.0MΩ, V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature								
Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions R_g = 1.0MΩ V_{h-k} = 200V (cathode negative), $T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	4.5	—	—	—	—	mA/V
					A.Q.L.[5] (%)	*Min.*	*Max.*	
Intermittent life test								
Running conditions, Rg = 1.0MΩ, V_{h-k} = 200V (cathode negative), T_{bulb} min. = 220°C								
Intermittent life test end points (500 hours)								
Inoperatives[16]					2.5	—	—	
Heater current					4.0	138	164	mA
Heater-to-cathode leakage current V_{h-k} = ±100V					4.0	—	10	µA
Reverse grid current R_g = 1.0MΩ					2.5	0	0.6	µA
Change in mutual conductance (individuals)					2.5	—	20	%
Change in mutual conductance V_h = 5.7V					4.0	—	15	%
Insulation as in group B.					4.0	50	—	MΩ
Average change in mutual conductance					—	—	15	%
Sub-group quality level[10]					10	—	—	

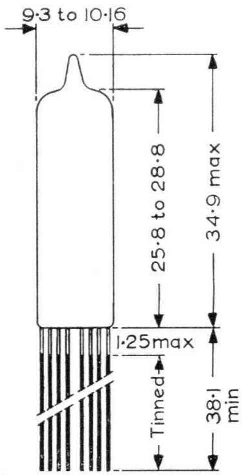
SPECIAL QUALITY U.H.F. TRIODE

5604



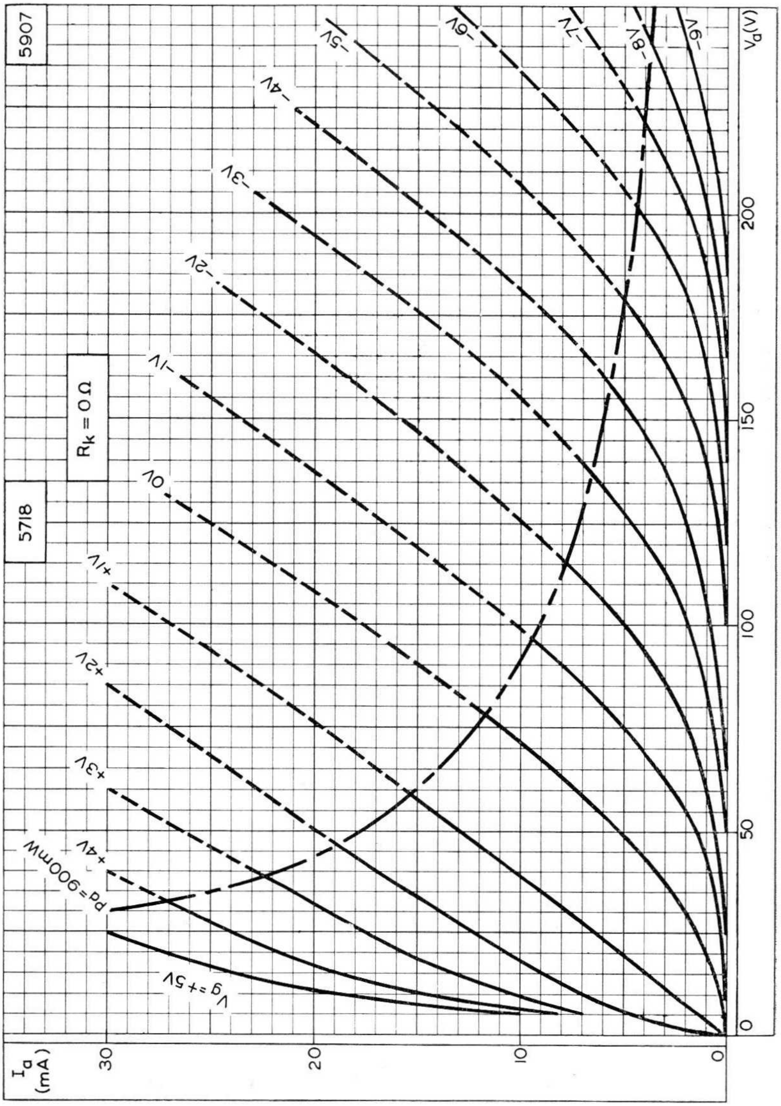


B8D/F Base

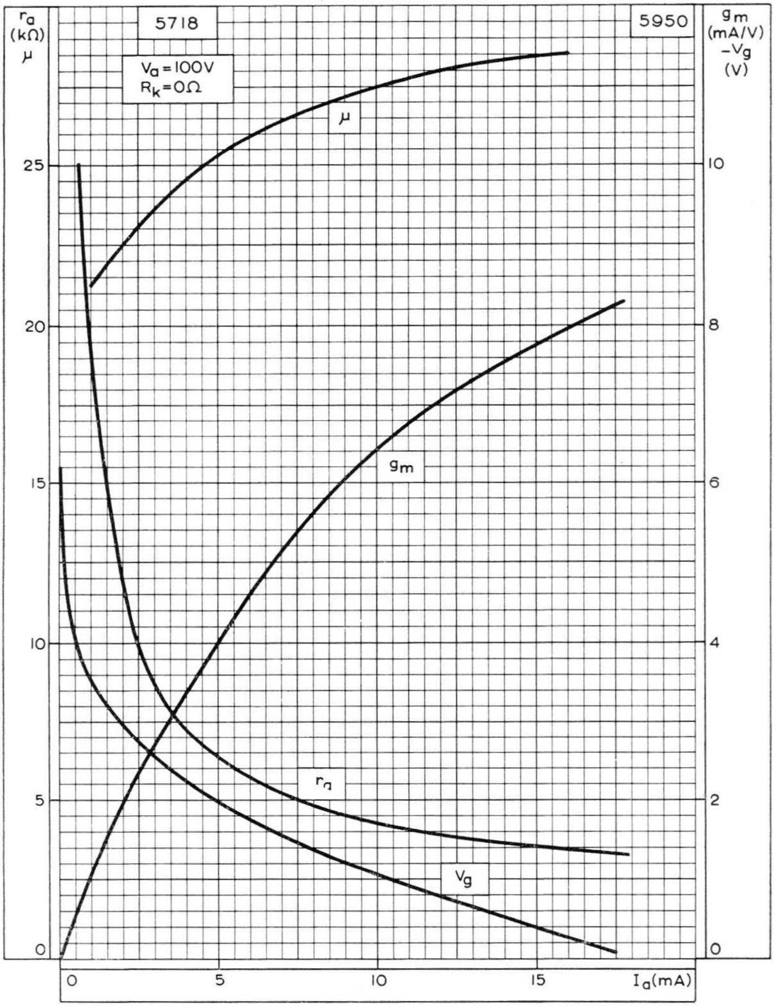


All dimensions in mm

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



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

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

5899

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

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

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

CAPACITANCES[2] (measured with an external shield)

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

CHARACTERISTICS[3]

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

LIMITING VALUES[4] (absolute ratings)

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

TEST CONDITIONS (unless otherwise specified)

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

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

GROUP B

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

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

GROUP C

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

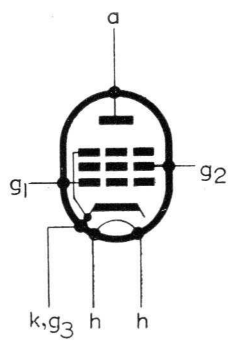
GROUP D

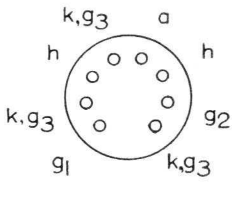
Heater cycling life test								
$V_h = 7.0V$, 1 minute on, 4 minutes off								
$V_{h-k} = 140V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions $R_{g1} = 1.0M\Omega$								
$V_{h-k} = 200V$ (cathode negative)								
$T_{ambient}$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

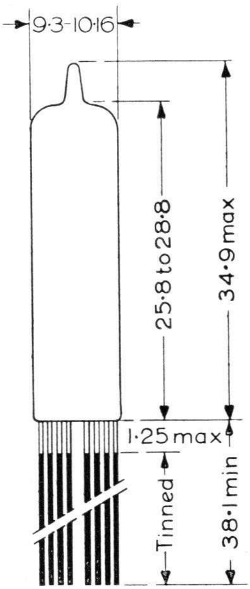
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

5494





B8D/F Base

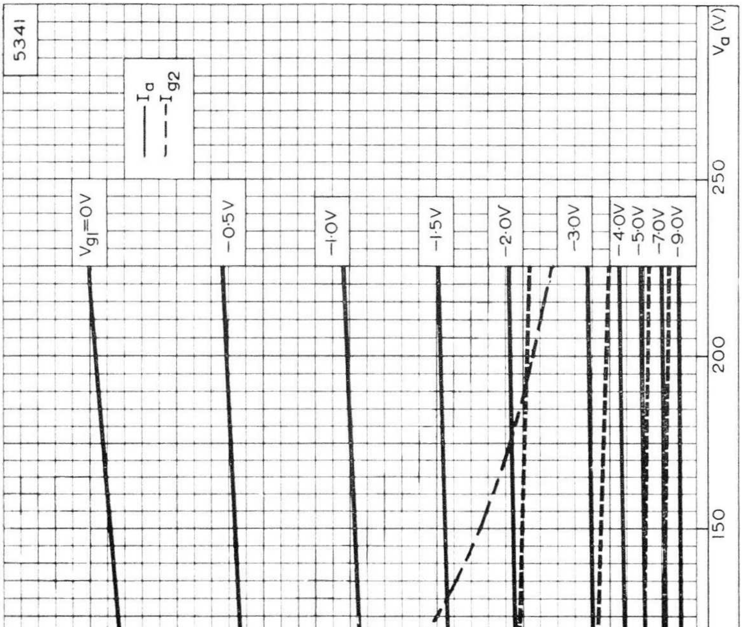


All dimensions in mm

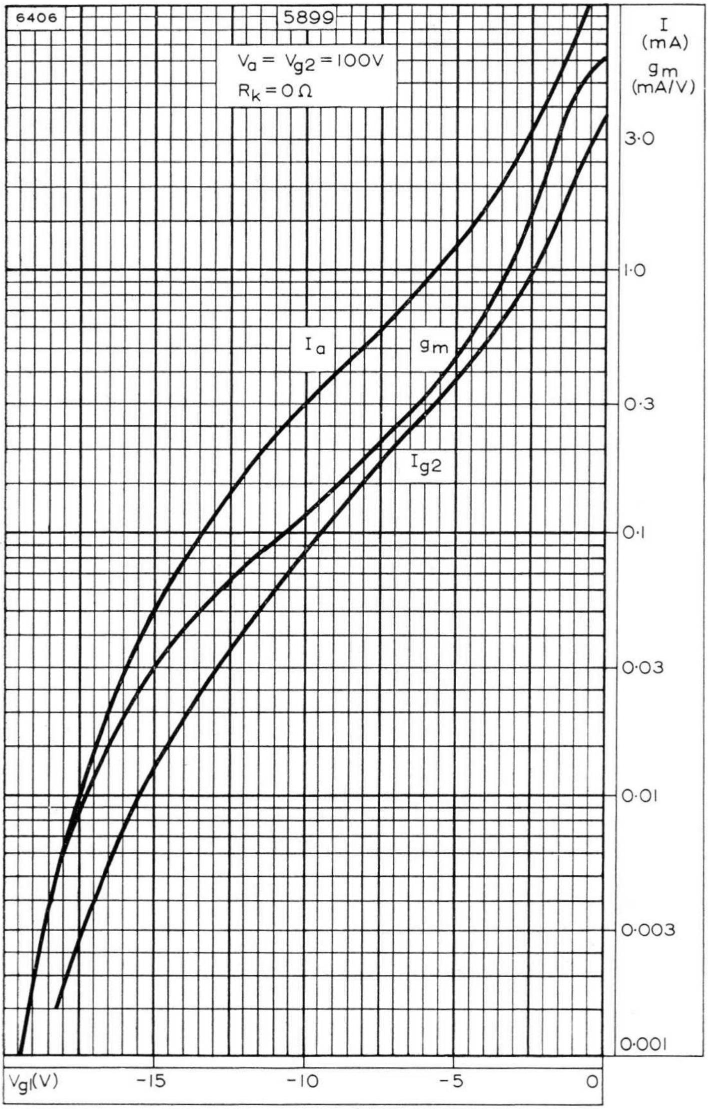
The bulb and base dimensions of this valve are in accordance with BS.448, Section B8D/F.

SPECIAL QUALITY VARIABLE-MU
R.F. PENTODE

5899



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



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

SPECIAL QUALITY OUTPUT PENTODE

5902

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

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

HEATER

V_h[1]	6.3	V
I_h	450	mA

MOUNTING POSITION — Any

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

CAPACITANCES[2] (measured with an external shield)

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

CHARACTERISTICS[3]

V_a	100	V
V_{g2}	100	V
I_a	30	mA
I_{g2}	1.2	mA
g_m	4.2	mA/V
μ_{g1-g2}	6.0	
r_a	>10	kΩ
V_{g1}	−8.3	V
R_k	0	Ω
V_{g1} ($I_a < 100\mu A$)	−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] Bogey[9]	Individuals Min.	Individuals Max.	Lot average[7] Min.	Lot average Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	450	420	480	—	—	—	mA
	—	—	—	—	432	468	12.5	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	15	—	—	—	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	0.65	—	0	1.0	—	—	—	μA
Anode current	0.65	30	23	37	—	—	—	mA
	—	—	—	—	27	33	2.8	mA
Anode current $V_{g1} = -40V$, $R_k = 0\Omega$	0.65	—	—	100	—	—	—	μA
Power output $V_{in(r.m.s.)} = 6.4V$, $R_a = 3.0k\Omega$	0.65	—	750	—	—	—	—	mW
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

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

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

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

GROUP D

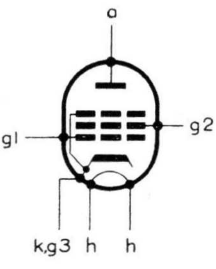
Heater cycling life test								
V_h = 7.0V, 1 minute on, 4 minutes off								
V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Heater cycling life test end point								
Heater-to-cathode leakage current $V_{h-k}=\pm$100V	—	—	—	40	—	—	—	µA
Stability life test[14]								
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

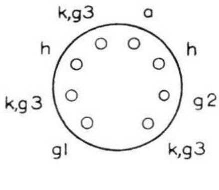
Intermittent life test

Running conditions, R_{g1}=470kΩ, R_k=220Ω, $V_a=V_{g2}$=100V, V_{h-k} = 200V (cathode negative), T_{bulb} min. = 220°C

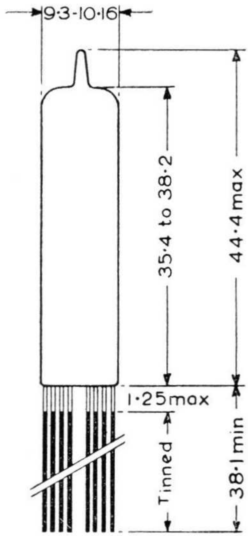
Intermittent life test points (500 hours)	*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Inoperatives[16]	4.0	—	—	
Heater current	6.5	414	492	mA
Heater-to-cathode leakage current $V_{h-k}=\pm$100V	6.5	—	60	µA
Reverse grid current R_{g1} = 1.0MΩ	4.0	0	2.0	µA
Change in power output (individuals)	4.0	—	20	%
Change in power output V_h = 5.7V	6.5	—	15	%
Insulation as in group B	6.5	25	—	MΩ
Average change in power output	—	—	15	%
Sub-group quality level[10]	10	—	—	

5902 SPECIAL QUALITY OUTPUT PENTODE





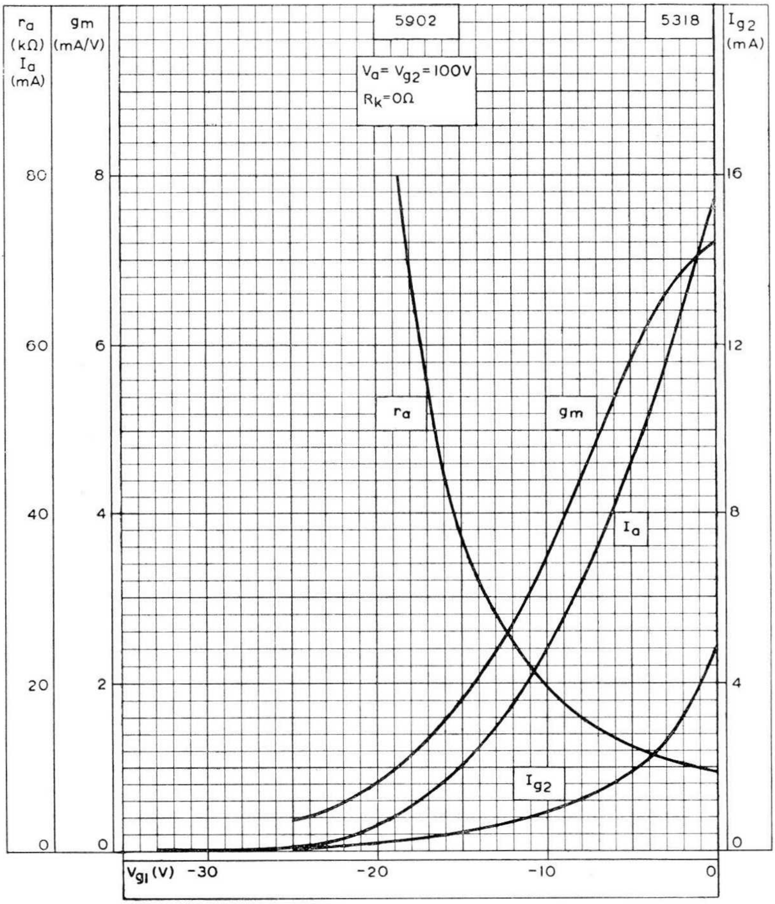
B8D/F Base



5326

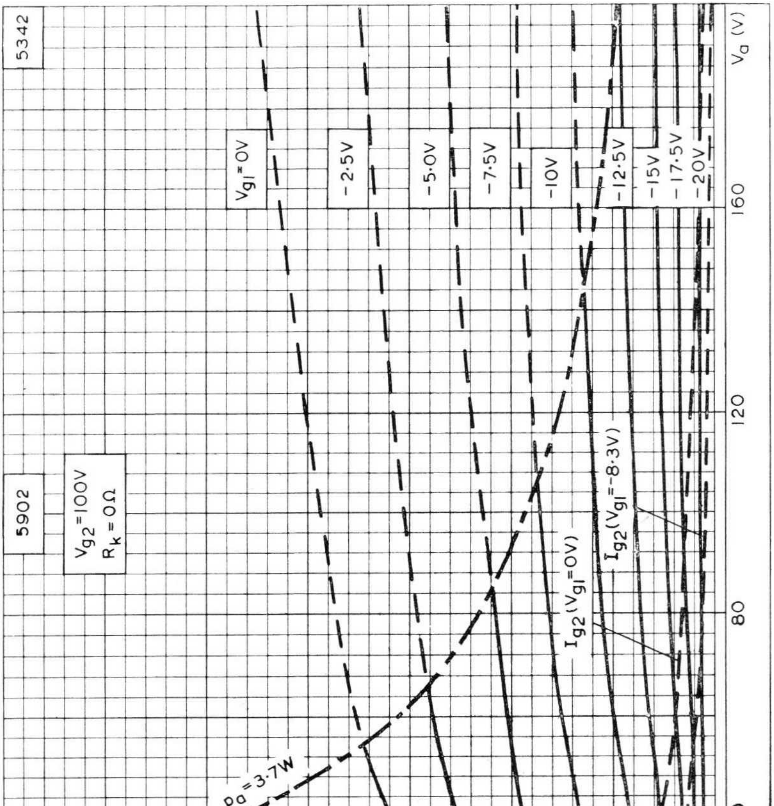
All dimensions in mm

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



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

5902 SPECIAL QUALITY OUTPUT PENTODE



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

SPECIAL QUALITY R.F. PENTODE

6205

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

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

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

CAPACITANCES[2] (measured with external shield)

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

CHARACTERISTICS[3]

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

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

LIMITING VALUES[4] (absolute ratings)

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

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 $= 55 \pm 5$mmHg Voltage $= 300V_{r.m.s.}$ No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min. peak acceleration, $R_a = 10k\Omega$	—	—	—	60	—	—	—	mV (r.m.s.)

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

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

GROUP D

Heater cycling life test								
$V_h = 7.0V$ 1 minute on, 4 minutes off, 2000 switchings. $V_{h-k} = 140V_{r.m.s.}$ (continuous)								
No other applied voltages	2.5	—	—	—	—	—	—	
Stability life[14]								
Running conditions: $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Stability life end points								%
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	
Survival rate life test[14]								
Running conditions $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	3.75	—	—	—	—	mA/V

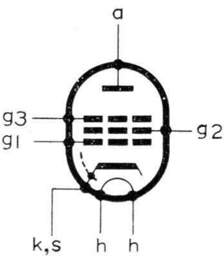
Intermittent life test

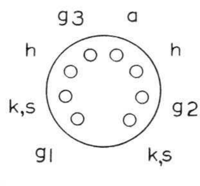
Running conditions: $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), T_{bulb}min. $= 220°C$

Intermittent life test end points (500 hours)	*A.Q.L.*[5] (%)	*Min.*	*Max.*	
Inoperatives[16]	2.5	—	—	
Heater current	4.0	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm100V$	4.0	—	10	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	2.5	0	0.8	μA
Change in mutual conductance (individuals)	2.5	—	20	%
Change in mutual conductance $V_h = 5.7V$	4.0	—	15	%
Insulation as in group B	4.0	50	—	MΩ
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

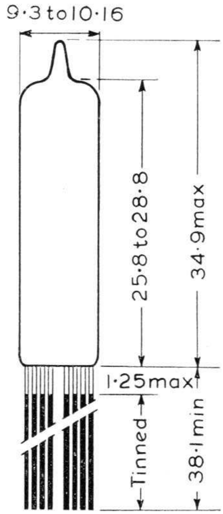
6205

SPECIAL QUALITY R.F. PENTODE





B8D/F Base

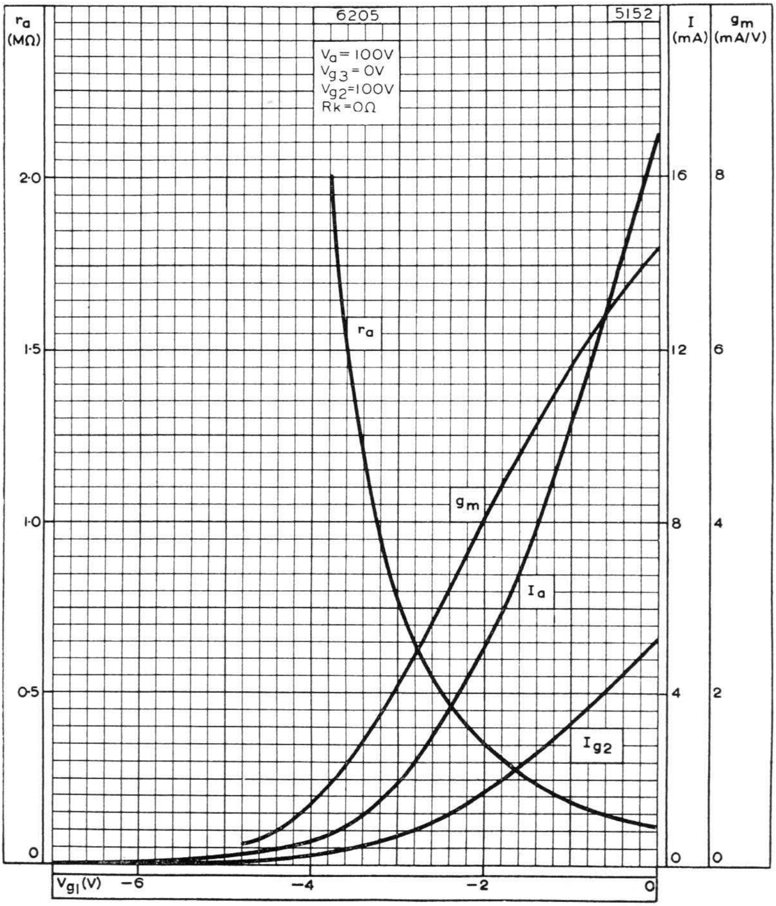


5544

All dimensions in mm

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

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



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

SPECIAL QUALITY DOUBLE TRIODE

6211

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

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

HEATER

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

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

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

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

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

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

CAPACITANCES[2] (measured without an external shield)

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

*Each section

CHARACTERISTICS[3] (each section)

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

6211 SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

INSULATION

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

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

LIMITING VALUES[4] (absolute ratings) each section

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

†Maximum duration = $10\mu s$. Duty cycle = 1%.

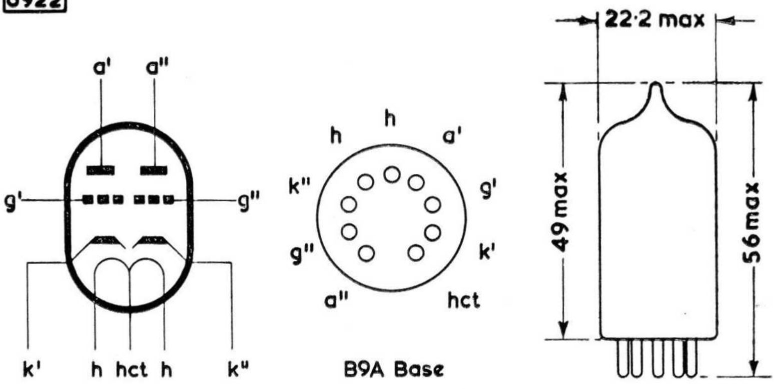
SHOCK AND VIBRATION

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

OPERATING NOTE

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

6922



All dimensions in mm

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

SPECIAL QUALITY DOUBLE TRIODE

6463

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

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

HEATER

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

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

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

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

CAPACITANCES[2] (measured without an external shield)

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

*Each section

CHARACTERISTICS[3]

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

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

INSULATION

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

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

LIMITING VALUES[4] (absolute ratings) each section

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

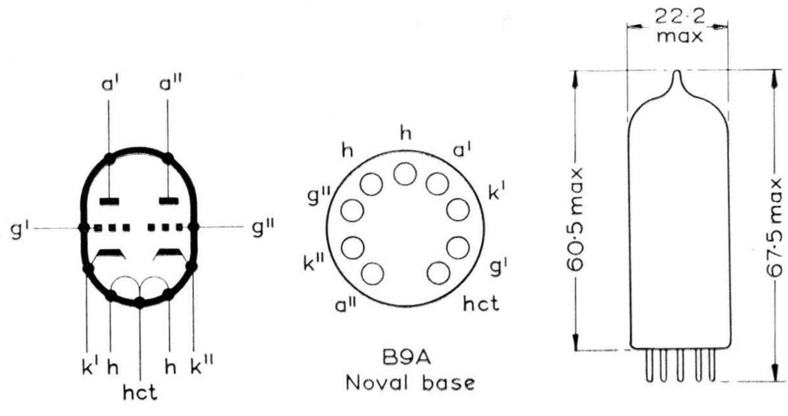
†Maximum duration = 10µs. Duty cycle = 1%

SHOCK AND VIBRATION

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

OPERATING NOTE

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



5613

All dimensions in mm

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

DIRECTLY HEATED FULL-WAVE RECTIFIER

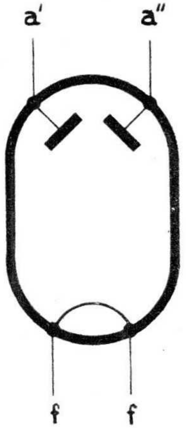
AZ1

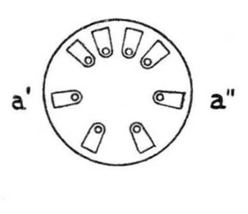
FILAMENT

V_f	4	V
I_f	1.1	A

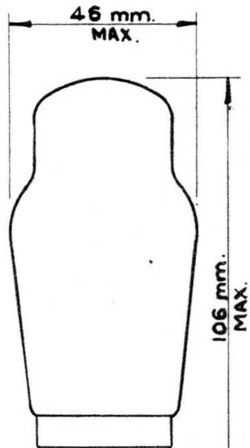
OPERATING CONDITIONS

For characteristics, curves and operating data, see type AZ31. Except for base, the AZ1 and AZ31 are identical.





SIDE-CONTACT BASE



FULL-WAVE RECTIFIER

AZ31

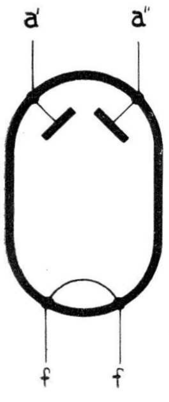
Directly-heated power rectifier for a.c. mains-operated equipment.

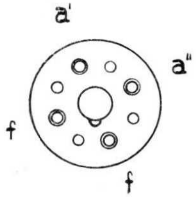
FILAMENT

V_f	4.0	V
I_f	1.1	A

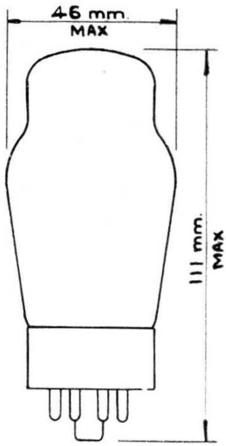
LIMITING VALUES

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



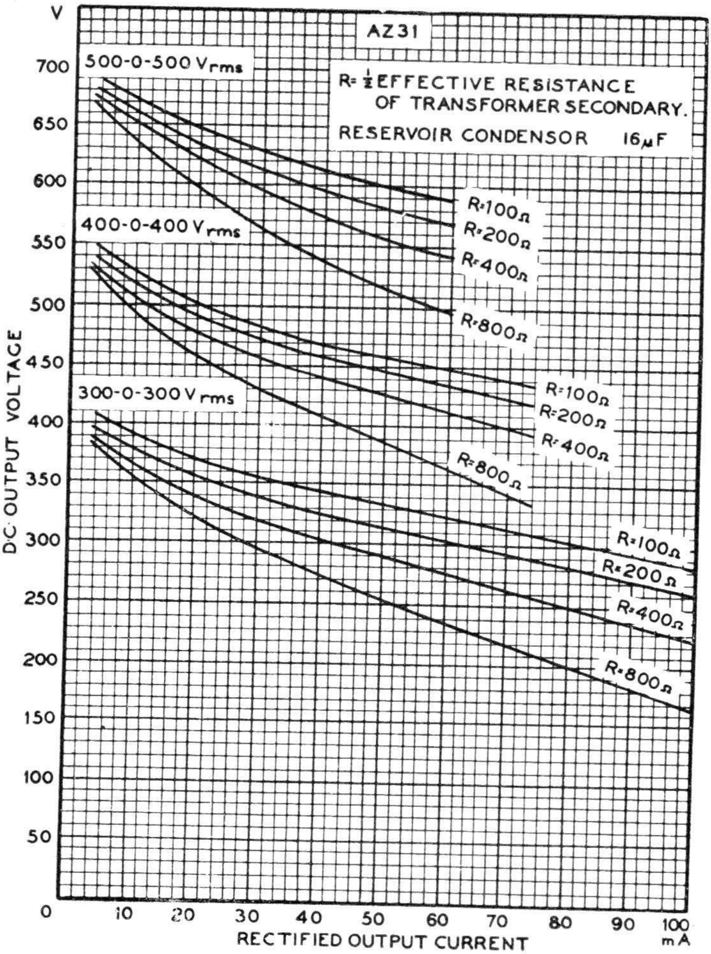


OCTAL BASE



FULL-WAVE RECTIFIER

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



RECTIFIER CHARACTERISTICS

DOUBLE DIODE OUTPUT PENTODE

CBL1
CBL31

Except for basing, capacitances and dimensions the CBL1 and CBL31 are identical

HEATER

Suitable for d.c./a.c. operation

I_h	200	mA
V_h	44	V

CAPACITANCES

	CBL1	CBL31	
$c_{a'd-k}$	3.1	3.5	pF
$c_{a''d-k}$	3.2	3.5	pF
$c_{a'd-a''d}$	<0.25	<0.5	pF
$c_{a'd-g1}$	0.28	<0.2	pF
$c_{a''d-g1}$	0.08	<0.2	pF

OPERATING CONDITIONS

V_a	200	V
V_{g2}	200	V
V_{g1}	−8.5	V
I_a	45	mA
I_{g2}	6.0	mA
g_m	8.0	mA/V
r_a	35	kΩ
R_a	4.5	kΩ
$V_{in\ (r.m.s.)}$	5.0	V
$V_{in\ (r.m.s.)}$ ($P_{out} = 50$mW)	500	mV
P_{out}	4.0	W
D_{tot}	10	%
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V

LIMITING VALUES

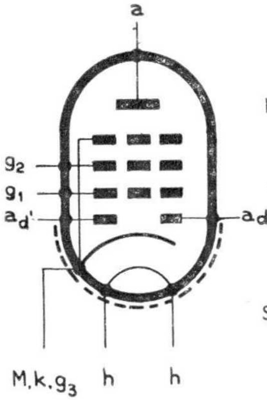
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	9	W
I_k max.	70	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	2.0	W
R_{g1} max. (self bias)	1.0	MΩ
V_{h-k} max.	125	V
R_{h-k} max.	5.0	kΩ
$V_{a'd}$ max.	200	V
$V_{a''d}$ max.	200	V
$I_{a'd}$ max.	800	μA
$I_{a''d}$ max.	800	μA
$V_{a'd}$ max. ($I_{a'd} = +0.3\mu A$)	−1.3	V
$V_{a''d}$ max. ($I_{a''d} = +0.3\mu A$)	−1.3	V

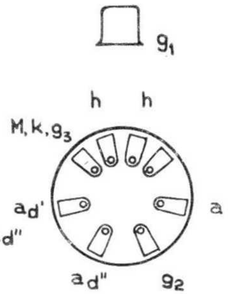
CBL1

CBL31

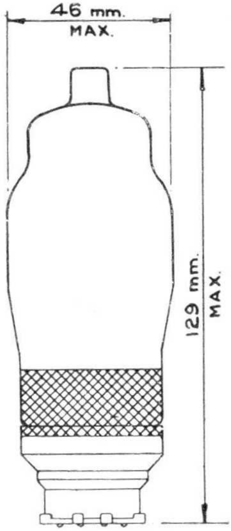
DOUBLE DIODE OUTPUT PENTODE

CBL1

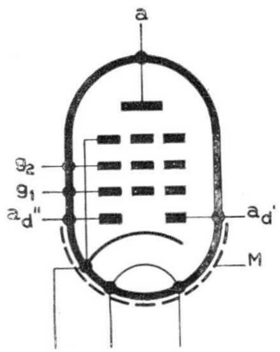


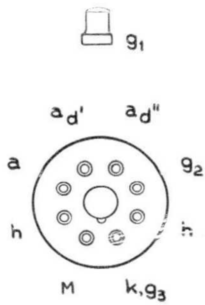


SIDE-CONTACT BASE

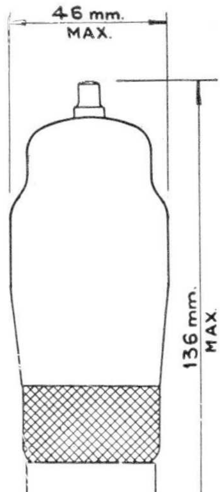


CBL31





OCTAL BASE



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

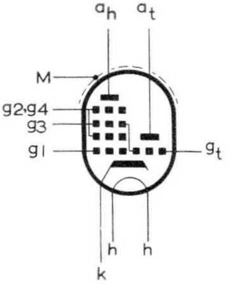
I_h	200	mA
V_h	7.0	V

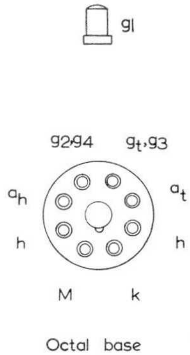
CHARACTERISTICS

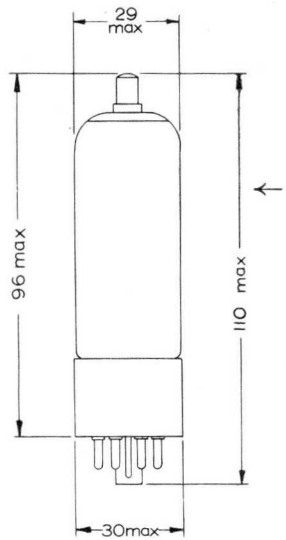
For characteristics, curves and operating conditions, see data for type ECH35.

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

6710







All dimensions in mm

OUTPUT PENTODE

CL4

CL33

Output pentode for use in d.c./a.c. mains-operated equipment.

Except for basing and dimensions, the CL4 and CL33 are identical.

HEATER

Suitable for d.c./a.c. operation.

I_h	200	mA
V_h	33	V

OPERATING CONDITIONS

V_a	200	V
V_{g2}	200	V
V_{g1}	−8.5	V
I_a	45	mA
I_{g2}	6	mA
g_m	8	mA/V
r_a	35	kΩ
μ_{g1-g2}	13.5	
R_a	4.5	kΩ
$V_{in(r.m.s.)}$	5.0	V
$V_{in(r.m.s.)}$ ($P_{out}=50$ mW)	500	mV
P_{out}	4.0	W
D_{tot}	10	%
R_k	167	Ω

LIMITING VALUES

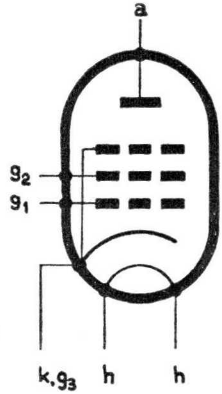
$V_{a(b)}$ max.	400	V
V_a max.	250	V
p_a max.	9	W
I_k max.	70	mA
$V_{g2(b)}$ max.	400	V
V_{g2} max.	250	V
p_{g2} max.	2	W
V_{g1} max. ($I_{g1}=+0.3$ μA)	−1.3	V
R_{g1-k} max. (self bias)	1.0	MΩ
V_{h-k} max.	175	V
R_{h-k} max.	5	kΩ

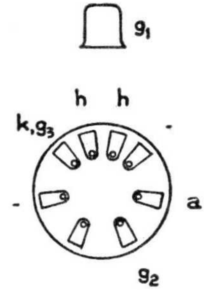
CL4

CL33

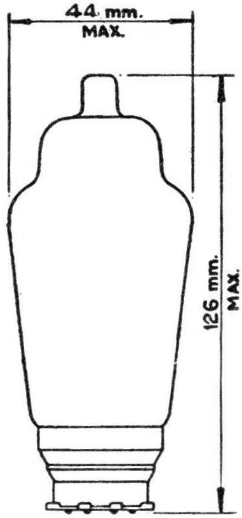
OUTPUT PENTODE

CL4

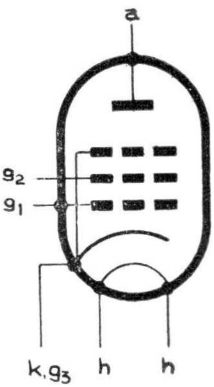


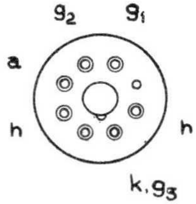


SIDE-CONTACT BASE

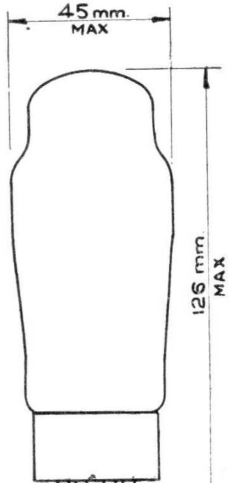


CL33





OCTAL BASE



HALF-WAVE RECTIFIER

CY1

CY31

Indirectly heated power rectifier for use in d.c./a.c. mains-operated equipment.

Except for base connections and dimensions the CY1 and CY31 are identical.

HEATER

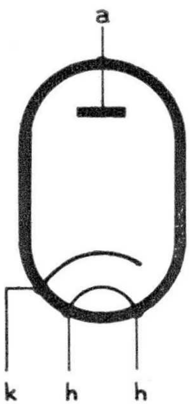
Suitable for d.c./a.c. operation.

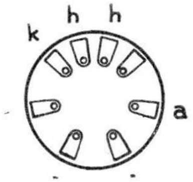
I_h	200	mA
V_h	20	V
Heating time	70	s

OPERATING CONDITIONS

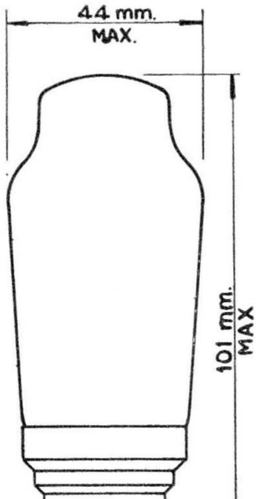
$V_{a(r.m.s.)}$ max.			250	V
I_{out} max.			120	mA
$v_{h-k(pk)}$ max.			350	V
$C_{max.}$	8	16	32	μF
$R_{lim.\ min.}$	0	75	125	Ω

CY1

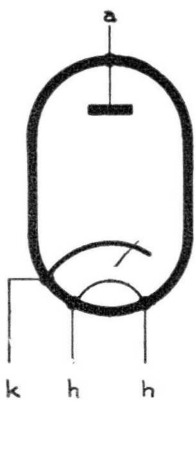


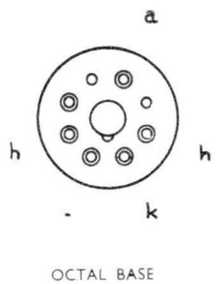


SIDE-CONTACT BASE

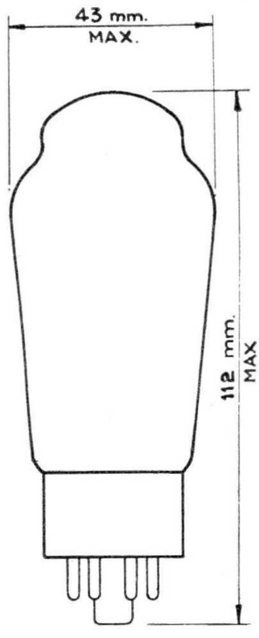


CY31





OCTAL BASE



SINGLE DIODE

DA90

Indirectly-heated single diode primarily intended for use in battery-operated equipment.

HEATER

V_h	1.4	V
I_h	0.15	A

MOUNTING POSITION Any

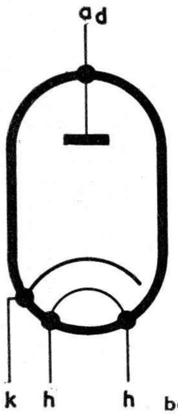
CAPACITANCES (measured without external shield)

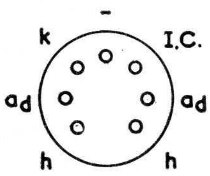
c_{a-k}	0.4	μμF
c_{a-h}	0.8	μμF
c_{h-k}	0.6	μμF

RESONANT FREQUENCY (approximate) 1,000 Mc/s

LIMITING VALUES

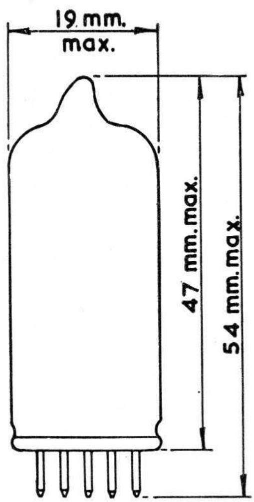
P.I.V. max.	330	V
I_a max.	0.5	mA
$i_{a(pk)}$ max.	5	mA
V_{h-k} max.	140	V





B7G BASE

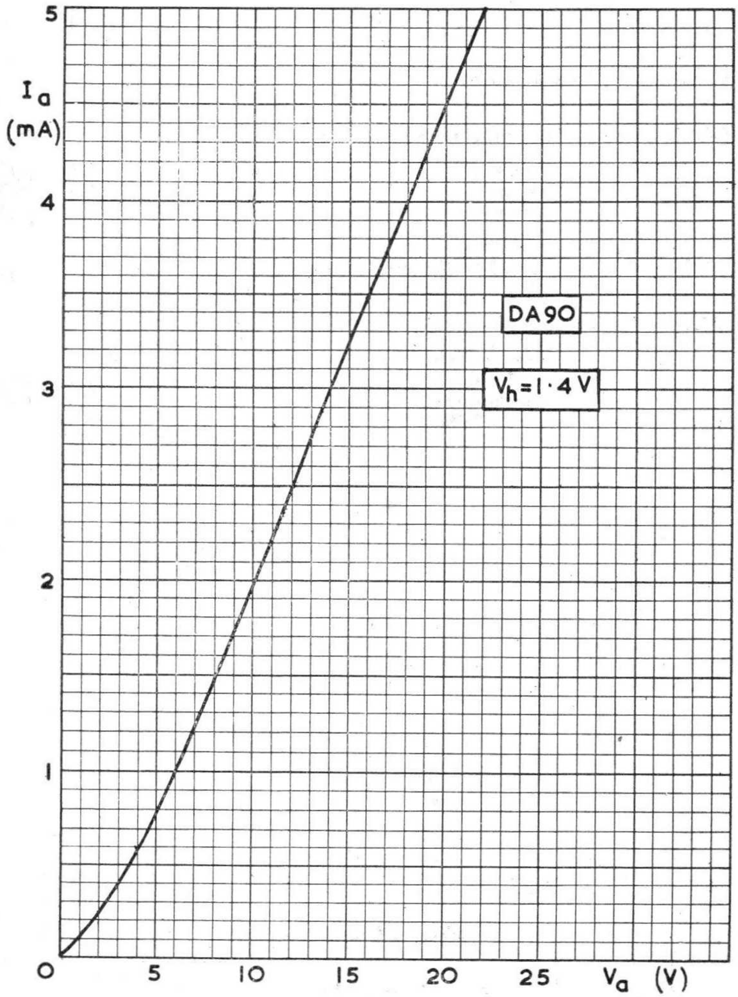
Pin 5 must not be used for external connections.



DA90

SINGLE DIODE

Indirectly-heated single diode primarily intended for use in battery-operated equipment.



DIODE TRIODE

DAC32

Medium gain triode for use as a.f. voltage amplifier, combined with a single diode for signal or a.g.c. rectification.

DF33
OVERLEAF

FILAMENT

Suitable for d.c. operation only.

V_f	1.4	V
I_f	50	mA

CAPACITANCES

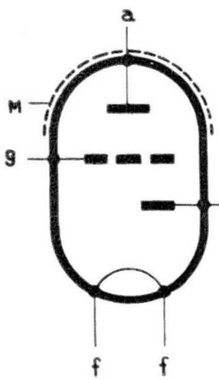
c_{in}	1.3	pF
c_{out}	6.0	pF
c_{a-g}	1.0	pF
c_{ad-f}	3.2	pF
c_{ad-g}	0.002	pF
c_{ad-at}	0.2	pF

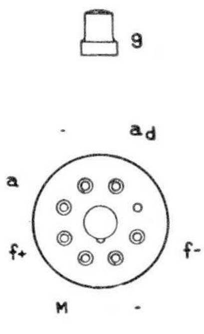
CHARACTERISTICS

V_a	90	V
V_g	0	V
I_a	150	μA
μ	65	
r_a	240	kΩ
g_m	275	μA/V

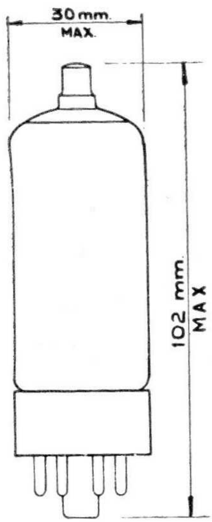
LIMITING VALUE

V_a max.	110	V





OCTAL BASE



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

DF33

VARIABLE-MU R.F. PENTODE

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

FILAMENT

Suitable for d.c. operation only.

V_f	1.4	V
I_f	50	mA

CAPACITANCES

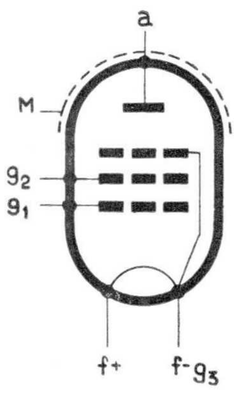
c_{a-g1}	<0.007	pF
c_{in}	3.8	pF
c_{out}	9.5	pF

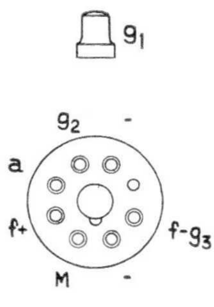
TYPICAL OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_a	90	V
V_{g2}	90	V
V_{g1}	0	V
I_a	1.2	mA
I_{g2}	300	µA
r_a	1.5	MΩ
g_m	750	µA/V
V_{g1} (for 150 : 1 reduction in g_m)	–4.0	V

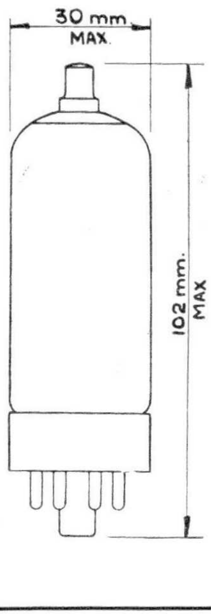
LIMITING VALUES

V_a max.	110	V
V_{g2} max.	110	V





OCTAL BASE



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 (MΩ)	I_a (μA)	R_{g2} (MΩ)	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}** (MΩ)
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).

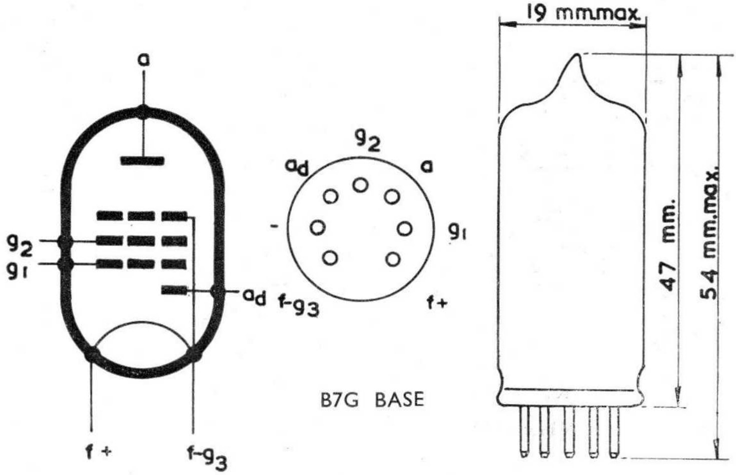
V_b (V)	R_a (kΩ)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	D_{tot} (%)	R_{g1}* (MΩ)
90	220	0.25	11.0	5	1.0	0.68
90	470	0.13	11.5	5	0.8	1.5

* Grid resistor of following valve.

MINIATURE DIODE PENTODE

DAF91

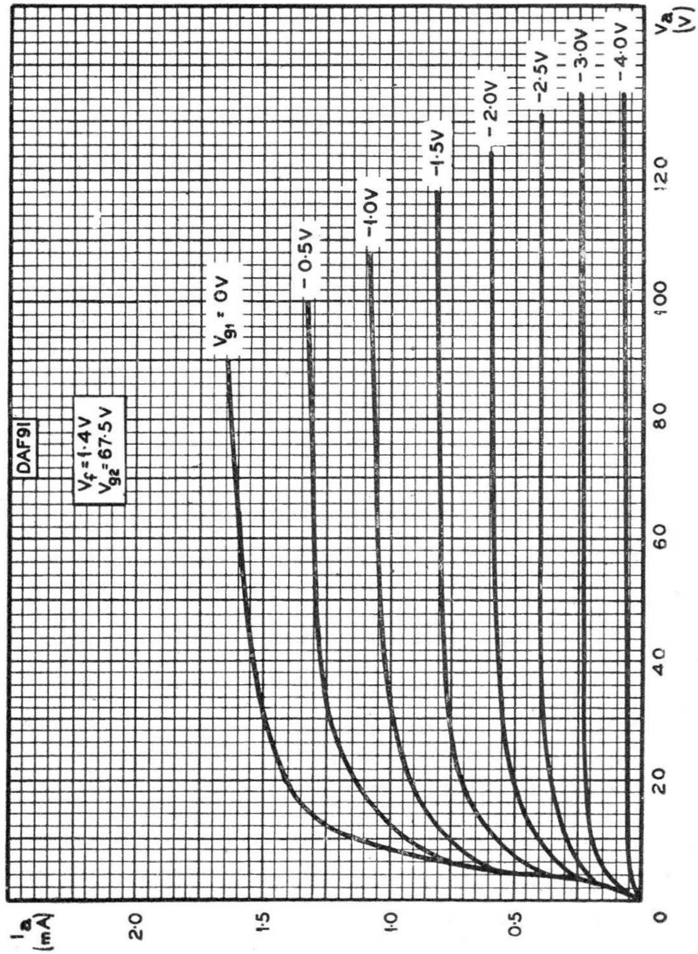
Short grid-base pentode, particularly suitable for A.F. voltage amplification, combined with a single diode.



DAF91

MINIATURE DIODE PENTODE

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



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

DIODE A.F. PENTODE

DAF96

Short grid-base pentode, suitable for a.f. voltage amplification in battery operated receivers, combined with a single diode.

FILAMENT

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

	Series	Parallel	
V_f	1.3	1.4	V
I_f	24	25	mA

CAPACITANCES (measured without external shield)

c_{a-g1}	$<$ 0.3	pF
c_{in}	1.8	pF
c_{out}	2.5	pF←
c_{ad-all}	1.1	pF
c_{ad-ap}	$<$ 0.9	pF
c_{ad-g1}	0.03	pF

CHARACTERISTICS

Pentode section

V_a	67.5	V
V_{g2}	67.5	V
I_a	170	μA
I_{g2}	55	μA
V_{g1}	−1.5	V
g_m	170	μA/V
μ_{g1-g2}	16	
V_{g1} max. ($I_{g1} = +0.3\mu$A)	0	V

Diode section

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

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

Pentode connection

V_b* (V)	R_a (MΩ)	R_{g2}** (MΩ)	R_{g1} (MΩ)	Source impedance (kΩ)	R_{g1}*** (MΩ)	I_k (μA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	D_{tot} (%)
85	1.0	2.7	10	0	1.0	85	55	5.0	2.5
85	1.0	2.7	10	470	1.0	85	50	5.0	2.5
85	1.0	2.7	10	0	2.0	85	65	5.0	2.0
85	1.0	2.7	10	470	2.0	85	60	5.0	2.5
64	1.0	2.7	10	0	1.0	60	45	5.0	4.0
64	1.0	2.7	10	470	1.0	60	40	5.0	4.0
64	1.0	2.7	10	0	2.0	60	57	5.0	3.5
64	1.0	2.7	10	470	2.0	60	52	5.0	3.5

*Based on line voltages of 67.5 and 90V decreased by the negative bias for the output valve.

**R_{g2} by-passed to earth by 0.47μF capacitor.

***Grid resistor of following valve.

DAF96

DIODE A.F. PENTODE

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

Triode connection (g_2 to a)

V_b* (V)	R_a (MΩ)	R_{g1} (MΩ)	Source impedance (MΩ)	R_{g1}** (MΩ)	I_k (μA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	D_{tot} (%)
85	0.22	10	0	1.0	210	11	5.0	2.0
85	1.0	10	0	1.0	60	12.5	5.0	2.0
64	0.22	10	0	1.0	135	11	5.0	3.0
64	1.0	10	0	1.0	40	12	5.0	3.0

*Based on line voltages of 67.5 and 90V decreased by the negative bias for the output valve.

**Grid resistor of following valve.

LIMITING VALUES

Pentode section

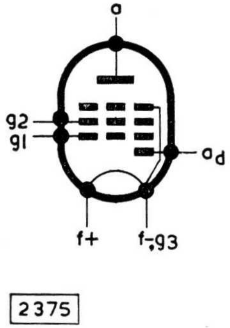
V_b max. (absolute)	110	V
V_a max.	90	V
p_a max.	30	mW
V_{g2} max.	90	V
p_{g2} max.	10	mW
I_k max.	250	μA
R_{g1-f} max. ($I_k < 250\mu A$)	3.0	MΩ
R_{g1-f} max. ($I_k < 100\mu A$)	22	MΩ

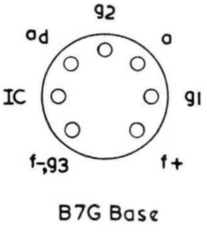
This valve can be used without special precautions against microphony in circuits in which the input voltage, V_{in}, is not less than 20mV for an output of 50mW from the output stage.

Diode section

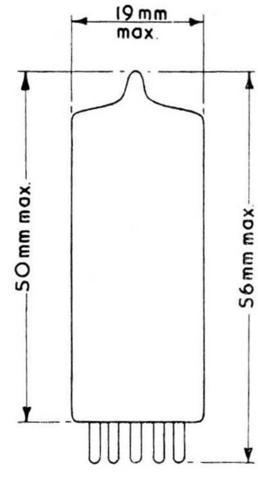
P.I.V.	100	V
I_{ad} max.	200	μA
$i_{ad(pk)}$ max.	1.2	mA

DIODE A.F. PENTODE DAF96





B7G Base



2375

SUBMINIATURE U.H.F. TRIODE

DC70

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.

This valve is primarily intended for use in communications equipment of the 'push to talk' type and its continuous life rating under typical supply voltage conditions is relatively short and is chiefly a function of hours of filament operation and filament temperature.

Under 'push to talk' conditions an operating life of about 200 hours may be expected.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	200	mA

MOUNTING POSITION

Any

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

If the valve is used with an earthed metal clip a decrease in output power of approximately 10% can be expected up to 200Mc/s.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g}	1.5	1.5	pF
c_{g-f}	1.3	1.25	pF
c_{a-f}	1.9	1.0	pF

CHARACTERISTICS

V_a	150	V
I_a	14.5	mA
V_{g1}	−4.5	V
g_m	3.75	mA/V
r_a	4.0	kΩ
μ	15	

OPERATING CONDITIONS AS CLASS 'C' TELEGRAPHY R.F. OSCILLATOR

f	10	50	200	400	500	Mc/s
V_a	150	150	150	150	150	V
I_a	17.1	17.1	17.3	18.5	18.7	mA
I_g	2.9	2.9	2.7	1.5	1.3	mA
R_g	5.6	4.7	3.9	6.8	6.8	kΩ
P_{load}	1.4	1.4	1.0	0.8	0.55	W
η_{load}	55	55	39	29	20	%
$v_{a(pk)}$	120					V
$v_{g(pk)}$	32					V

DC70

SUBMINIATURE U.H.F. TRIODE

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s

OPERATING CONDITIONS AS CLASS 'C' TELEGRAPHY R.F. AMPLIFIER

f	50	200	Mc/s
V_a	150	150	V
V_g	–18	–18	V
I_a	16.4	16.8	mA
I_g	3.6	3.2	mA
P_{load}	1.5	1.2	W
η_{load}	61	48	%

P_{drive} measured at the grid is approximately 200mW at f=200Mc/s and does not include the power lost in the grid tuned circuit.

OPERATING CONDITIONS AS FREQUENCY MULTIPLIER

Single valve doubler

f_{out}	50	Mc/s
V_a	150	V
V_g	–45	V
I_a	17.3	mA
I_g	2.7	mA
P_{load}	1.0	W
η_{load}	39	%

Two valve push-push doubler

f_{out}	200	470	500	Mc/s
V_a	150	150	150	V
V_g	–45	–40	–40	V
I_a	2×18	2×11.8	2×11.9	mA
I_g	2×2.0	2×0.7	2×0.6	mA
P_{load}	1.6	0.38	0.34	W
η_{load}	30	11	10	%

Single valve trebler

f_{out}	50	470	500	Mc/s
V_a	150	150	150	V
V_g	–80	–80	–80	V
I_a	18.1	14.3	14.4	mA
I_g	1.9	0.7	0.6	mA
P_{load}	650	220	190	mW
η_{load}	24	10	9.0	%

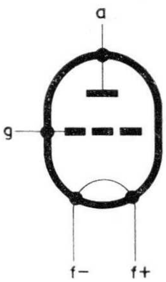
SUBMINIATURE U.H.F. TRIODE

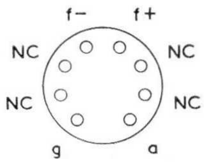
DC70

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.

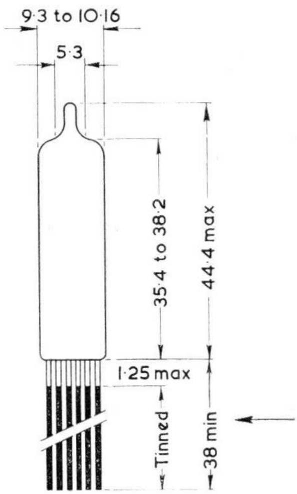
LIMITING VALUES

V_a max.		150	V
p_a max.		2.4	W
I_g max.		5.0	mA
R_{g-f} max.		500	kΩ
V_f max. (absolute)		1.35	V
V_g max.:—	r.f. amplifier	−30	V
	frequency doubler	−45	V
	push-push doubler (f < 400Mc/s)	−45	V
	push-push doubler (f > 400Mc/s)	−40	V
	frequency trebler	−80	V
I_k max.:—		20	mA
	push-push doubler (f < 400Mc/s)	2 × 20	mA
	push-push doubler (f > 400Mc/s)	2 × 12.5	mA
	frequency trebler (f > 400Mc/s)	15	mA





B8D/F Base



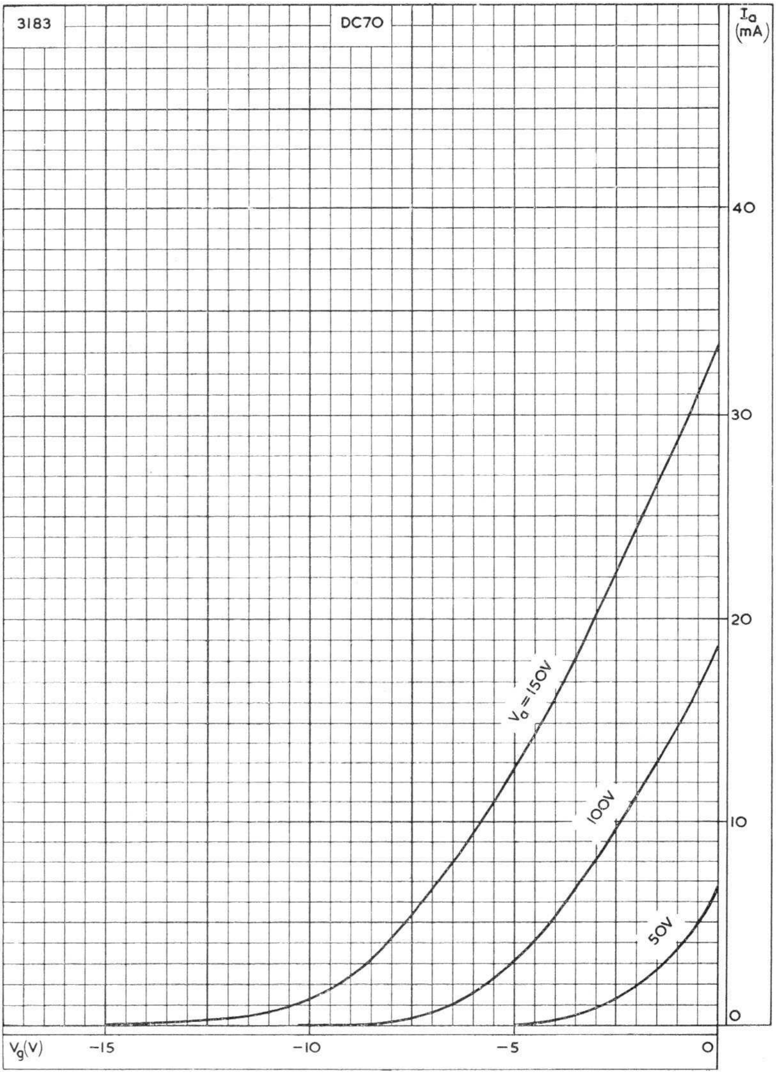
3228

All dimensions in mm

DC70

SUBMINIATURE U.H.F. TRIODE

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.

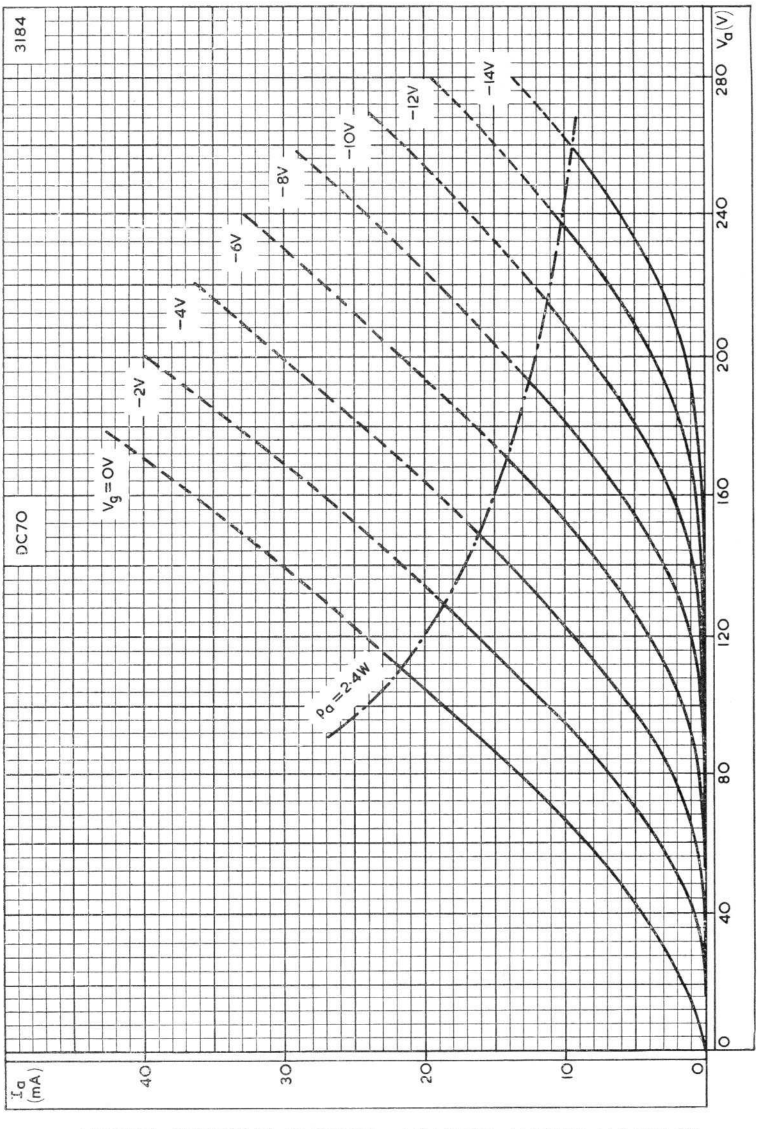


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

SUBMINIATURE U.H.F. TRIODE

DC70

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.

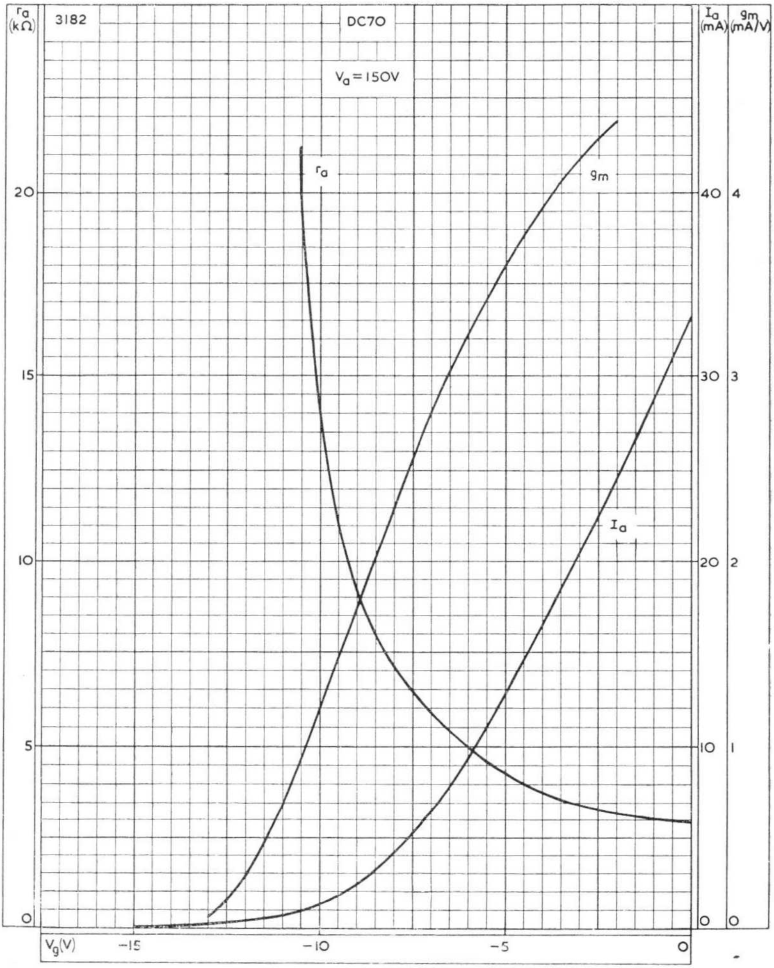


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

DC70

SUBMINIATURE U.H.F. TRIODE

Triode primarily intended for use as an oscillator in battery-operated equipment at frequencies of the order of 500Mc/s.



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

MINIATURE DOUBLE TRIODE

DCC90

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

FILAMENT

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

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

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

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

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

MOUNTING POSITION Any

CAPACITANCES (measured without external shield)

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

CHARACTERISTICS (each section)

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

DCC90

MINIATURE DOUBLE TRIODE

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

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

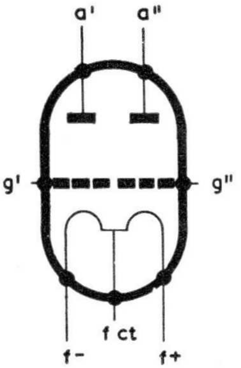
V_a	135	V
$*V_g$	−20	V
R_g	4	kΩ
R_k	570	Ω
$v_{in(pk)}$	2×45	V
I_a	2×15	mA
I_g (approx.)	2×2.5	mA
p_g (approx.)	0.2	W
P_{out} (approx.)	2	W

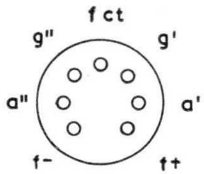
* Obtained from fixed supply, or by means of cathode or grid resistor of valve shown.

LIMITING VALUES (Intermittent operation)

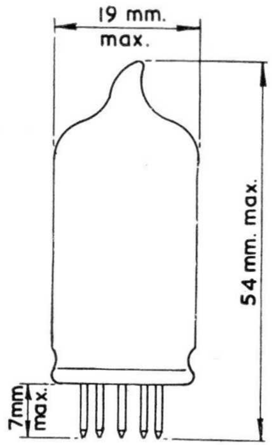
V_a max.	135	V
V_g max.	−30	V
I_a max.	2×15	mA
I_g max.	2×2.5	mA
p_a max.	2×1	W

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





B7G BASE



SUBMINIATURE R.F. PENTODE

DF60

Subminiature sharp cut-off r.f. pentode for use in battery-operated equipment.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	50	mA

MOUNTING POSITION

Any

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

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	3.7	pF
c_{out}	4.6	pF

CHARACTERISTICS

V_a	45	67.5	V
V_{g2}	45	67.5	V
V_{g1}	0	0	V
R_{g1}	5.0	5.0	MΩ
I_a	0.8	1.8	mA
I_{g2}	220	480	μA
g_m	0.82	1.1	mA/V
r_a	1.2	1.0	MΩ
V_{g1} (g_m=10μA/V)	−3.0	−4.0	V
R_{in} (f=50Mc/s)	–	34.5	kΩ
R_{eq}	–	8.2	kΩ

OPERATING CONDITIONS AS A FREQUENCY CHANGER

V_a	45	67.5	V
V_{g2}	45	67.5	V
R_{g1}	100	100	kΩ
I_a	0.56	1.06	mA
I_{g2}	150	300	μA
$V_{osc(r.m.s.)}$	3.0	4.0	V
I_{g1}	33	40	μA
g_c	270	320	μA/V
g_m (eff)	320	400	μA/V
r_a	1.6	1.46	MΩ

DF60

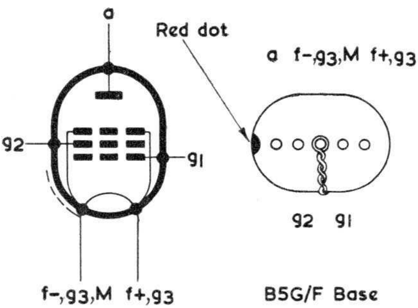
SUBMINIATURE R.F. PENTODE

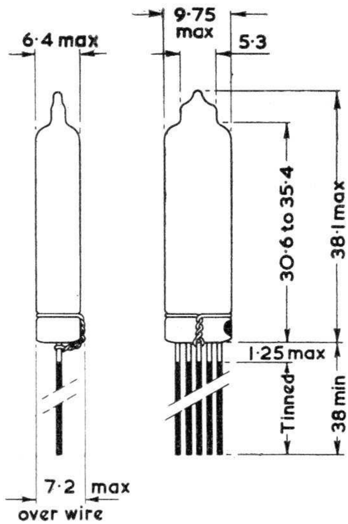
Subminiature sharp cut-off r.f. pentode for use in battery-operated equipment.

LIMITING VALUES

V_a max.	90	V
V_{g2} max.	67.5	V
I_k max.	4.0	mA

2926





g3 consists of two plates one being connected to lead 3 and the other to lead 5

All dimensions in mm

SUBMINIATURE R.F. PENTODE

DF61

R.F. Pentode for use in battery operated receivers.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	25	mA

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	3.1	pF
c_{out}	3.6	pF

CHARACTERISTICS

V_a	45	67.5	V
V_{g2}	45	67.5	V
V_{g1}	0	0	V
I_a	0.8	1.7	mA
I_{g2}	200	450	μA
g_m	750	950	μA/V
r_a	1.4	1.6	MΩ
μ_{g1-g2}	21	21	
V_{g1} (for 100:1 reduction in g_m)	−2.6	−4.0	V
R_{in} (f=50Mc/s)	—	57	kΩ
R_{eq}	—	10	kΩ

OPERATING CONDITIONS AS A FREQUENCY CHANGER

V_a	45	67.5	V
V_{g2}	45	67.5	V
R_{g1-f}	100	100	kΩ
I_a	0.6	1.35	mA
I_{g2}	140	400	μA
$V_{osc(r.m.s.)}$	3.0	4.0	V
I_{g1}	30	30	μA
g_c	220	290	μA/V
g_m(eff)	300	450	μA/V
r_a	1.4	2.0	MΩ

LIMITING VALUES

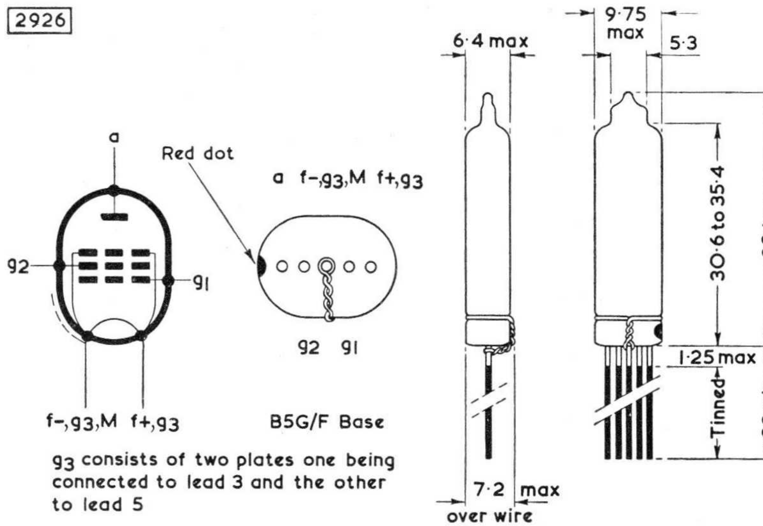
V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	67.5	V
I_k max.	2.5	mA
V_{g1}(I_{g1}=+0.3μA)	>0	V

DF61

SUBMINIATURE R.F. PENTODE

R.F. Pentode for use in battery operated receivers.

2926



g3 consists of two plates one being connected to lead 3 and the other to lead 5

All dimensions in mm

SUBMINIATURE R.F. PENTODE

DF62

Subminiature sharp cut-off R.F. Pentode for use in battery operated equipment.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	100	mA

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	4.0	pF
c_{out}	4.0	pF

CHARACTERISTICS

V_a	45	V
V_{g2}	45	V
V_{g1}	0	V
R_{g1}	2.0	MΩ
I_a	3.0	mA
I_{g2}	800	μA
g_m	2.0	mA/V
r_a	500	kΩ
μ_{g1-g2}	17.5	
R_{in} (f=50Mc/s)	20	kΩ
R_{eq}	5.5	kΩ

OPERATING CONDITIONS AS A FREQUENCY CHANGER

V_a	45	67.5	V
V_{g2}	45	67.5	V
R_{g1-f}	100	100	kΩ
I_a	0.8	1.4	mA
I_{g2}	250	450	μA
$V_{osc(r.m.s.)}$	3.5	4.0	V
I_{g1}	40	45	μA
g_c	490	600	μA/V
g_m(eff)	600	800	μA/V
r_a	525	450	kΩ

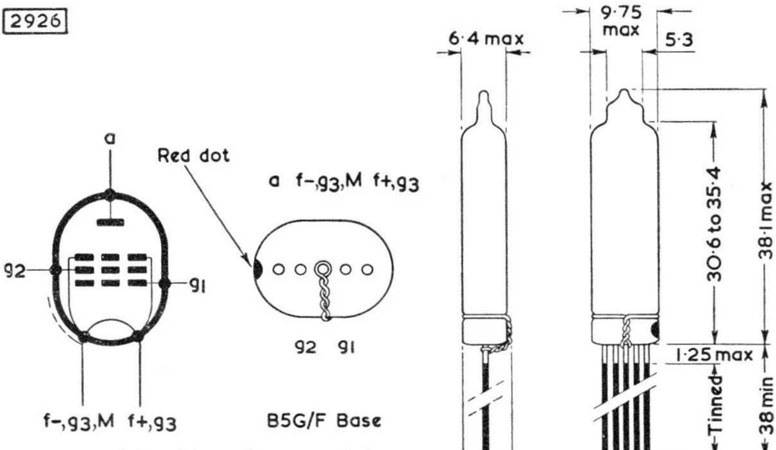
LIMITING VALUES

V_a max.	90	V
V_{g2} max.	90	V
I_k max.	6.5	mA
$V_{g1}(I_{g1}=+0.5\mu A)$	−0.5	V

DF62

SUBMINIATURE R.F. PENTODE

Subminiature sharp cut-off R.F. Pentode for use in battery operated equipment.



g3 consists of two plates one being connected to lead 3 and the other to lead 5

All dimensions in mm

SUBMINIATURE VARIABLE-MU R.F. PENTODE

DF63

Subminiature variable-mu r.f. pentode suitable for battery operated equipment.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	25	mA

MOUNTING POSITION

Any

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

CAPACITANCES

c_{a-g1}	$<$0.01	pF
c_{in}	3.0	pF
c_{out}	3.5	pF

CHARACTERISTICS

V_a	67.5	V
V_{g2}	67.5	V
V_{g1}	0	V
I_a	1.7	mA
I_{g2}	490	μA
g_m	850	μA/V
r_a	1.6	MΩ
V_{g1} (for 100 : 1 reduction in g_m)	–14	V
$+V_{g1}$ min. ($I_{g1} = +0.3\mu$A)	0	V

LIMITING VALUES

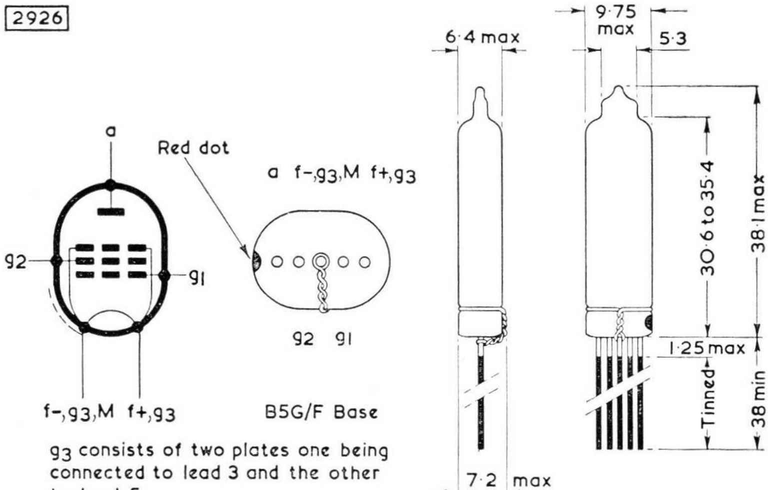
V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	67.5	V
I_k max.	2.5	mA

DF63

SUBMINIATURE VARIABLE-MU R.F. PENTODE

Subminiature variable-mu r.f. pentode suitable for battery operated equipment.

2926



g3 consists of two plates one being connected to lead 3 and the other to lead 5

All dimensions in mm

SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

DF64

Subminiature voltage amplifying pentode suitable for use in hearing aids. It has a filament current of 10mA and is primarily intended for use with an h.t. battery supply of 15volts.

FILAMENT

V_f	0.62	V
I_f	10	mA

MOUNTING POSITION

Any

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

CAPACITANCES (measured without external shield)

c_{a-g1}	<0.2	pF
c_{in}	1.8	pF
c_{out}	2.0	pF

CHARACTERISTICS

V_a	15	V
V_{g2}	15	V
I_a	50	μA
V_{g1}	−0.75	V
I_{g2}	17	μA
g_m	90	μA/V
r_a	1.2	MΩ
μ_{g1-g2}	7.5	

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER (see circuit for component references)

With fixed bias

V_b	15	V
R_a	2.2	MΩ
R_{g2}	2.7	MΩ
V_{g1}	−0.62	V
I_k	6.6	μA
Gain	27.4	dB
R_{out}	5.0	MΩ

With grid current biasing (zero source impedance)

V_b	15	V
R_a	2.2	MΩ
R_{g2}	4.7	MΩ
R_{g1}	10	MΩ
I_k	5.9	μA
Gain	28	dB
R_{out}	5.0	MΩ

LIMITING VALUES

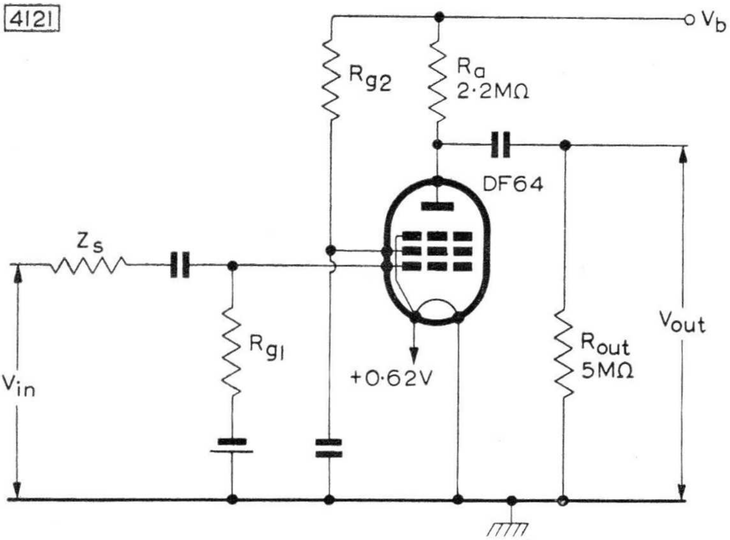
V_a max.	45	V
V_{g2} max.	45	V
I_k max.	75	μA

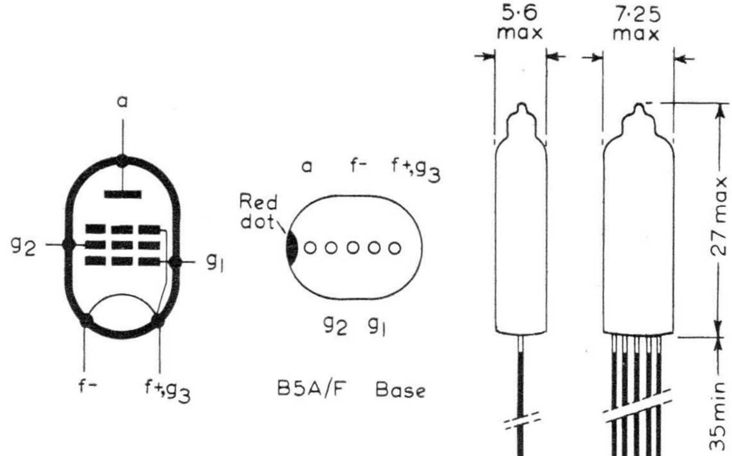
DF64

SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

Subminiature voltage amplifying pentode suitable for use in hearing aids. It has a filament current of 10mA and is primarily intended for use with an h.t. battery supply of 15volts.

4121





4134

All dimensions in mm

SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

DF66

Subminiature voltage amplifying pentode suitable for use in hearing-aids. It has a filament current of 15 mA and is primarily intended for use with an H.T. battery supply of 22.5 volts.

FILAMENT

V_f	0.625	V
I_f	15	mA

MOUNTING POSITION

Any.

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

CAPACITANCES (measured without external screen)

c_{a-g1}	0.15	μμF
c_{in}	1.6	μμF
c_{out}	2.2	μμF

CHARACTERISTICS

V_a	22.5	V
V_{g2}	22.5	V
I_a	50	μA
I_{g2}	15	μA
V_{g1}	−1.05	V
g_m	100	μA/V
r_a	>2	MΩ
μ_{g1-g2}	11.5	

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER (*see circuit overleaf*)

(*a*) With fixed bias

V_b	22.5	V
R_a	1.0	MΩ
R_{g2}	2.0	MΩ
V_{g1}	−0.625	V
I_k	16	μA
V_{out}/V_{in}	33	
R_{out}	5	MΩ

(*b*) With grid current biasing

V_b	22.5	V
R_a	1.0	MΩ
R_{g2}	2.7	MΩ
R_{g1}	10	MΩ
Z_s	0	
I_k	16	μA
V_{out}/V_{in}	35	
R_{out}	5	MΩ

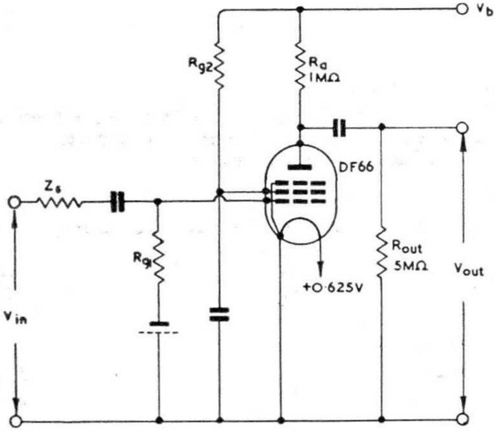
LIMITING VALUES

V_a max.	45	V
V_{g2} max.	45	V
I_k max.	100	μA

DF66

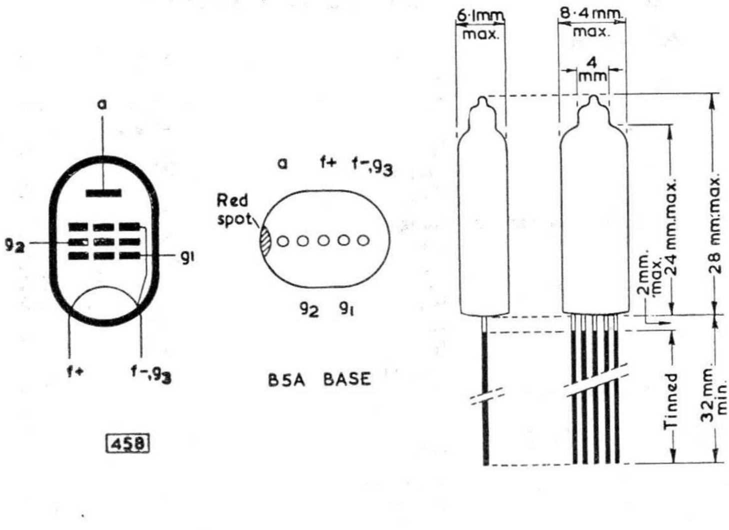
SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

Subminiature voltage amplifying pentode suitable for use in hearing-aids. It has a filament current of 15 mA and is primarily intended for use with an H.T. battery supply of 22.5 volts.



472

Circuit of DF66 as Resistance Coupled A.F. Amplifier



458

MINIATURE VARIABLE-MU R.F. PENTODE

DF91

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

FILAMENT

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

V_f	1.4	V
I_f	0.05	A

CAPACITANCES

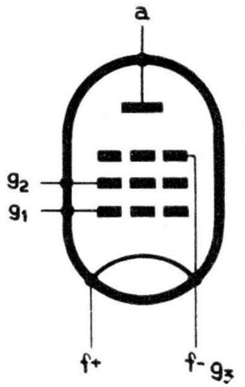
c_{a-g1}	<0.01	μμF
c_{in}	3.6	μμF
c_{out}	7.5	μμF

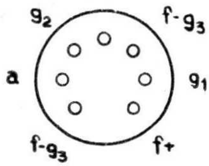
OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

V_a	45	67.5	90	90	V
V_{g2}	45	67.5	45	67.5	V
V_{g1}	0	0	0	0	V
I_a	1.7	3.4	1.8	3.5	mA
I_{g2}	0.7	1.5	0.65	1.4	mA
g_m	700	875	750	900	μA/V
V_{g1} (g_m = 10 μA/V)	−10	−16	−10	−16	V
r_a	350	250	800	500	k Ω

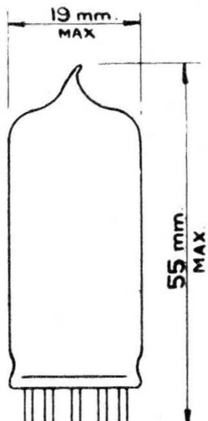
LIMITING VALUES

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



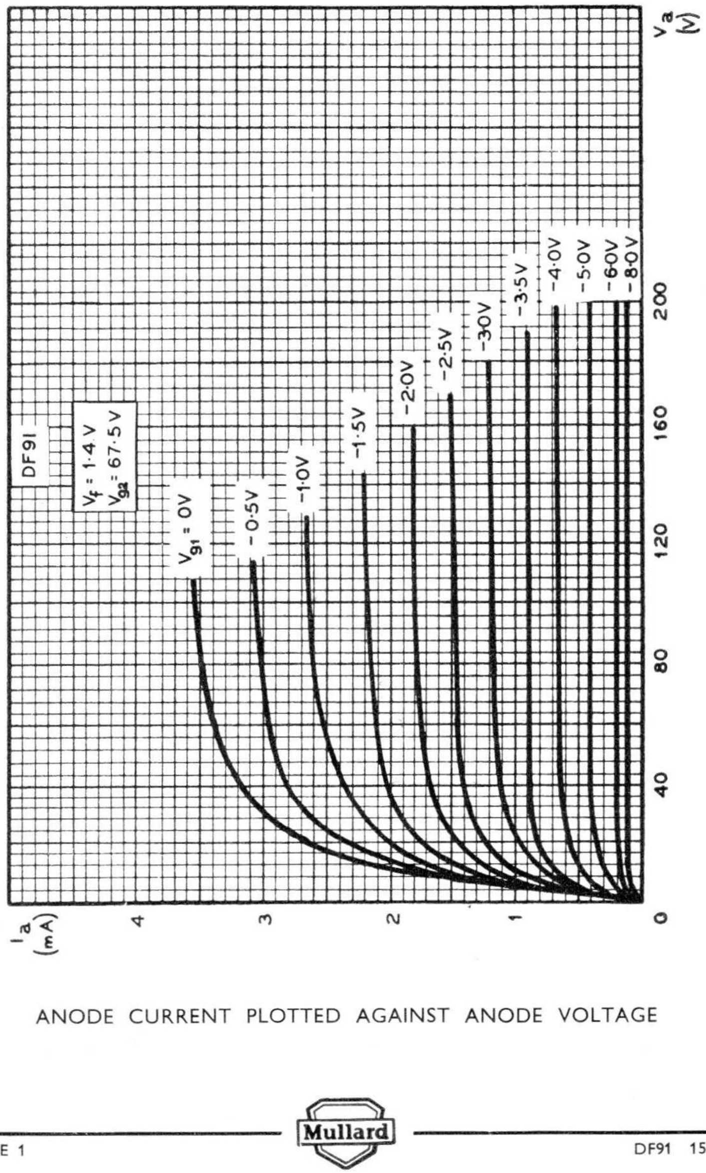


B7G BASE



MINIATURE VARIABLE-MU R.F. PENTODE

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

R.F. PENTODE

DF92

Short grid-base miniature R.F. pentode for use in battery-operated equipment.

FILAMENT This valve is suitable for D.C. operation only.

V_f	1.4	V
I_f	0.05	A

MOUNTING POSITION Any.

CAPACITANCES (Measured without external screening.)

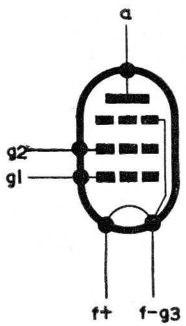
c_{a-g1}	<0.01	$\mu\mu$F
c_{in}	3.6	$\mu\mu$F
c_{out}	7.5	$\mu\mu$F

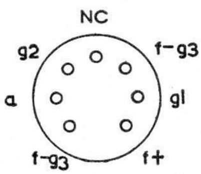
CHARACTERISTICS

V_a	90	90	V
V_{g2}	45	67.5	V
V_{g1}	0	0	V
I_a	1.9	3.7	mA
I_{g2}	0.7	1.4	mA
g_m	0.85	1.0	mA/V
r_a	900	500	kΩ
μ_{g1-g2}	11	11	

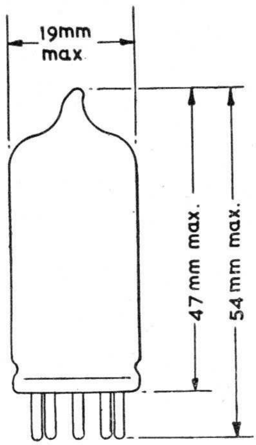
LIMITING VALUES

V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	70	V
V_{g1} max.	0	V
I_k max.	6.0	mA





B7G BASE



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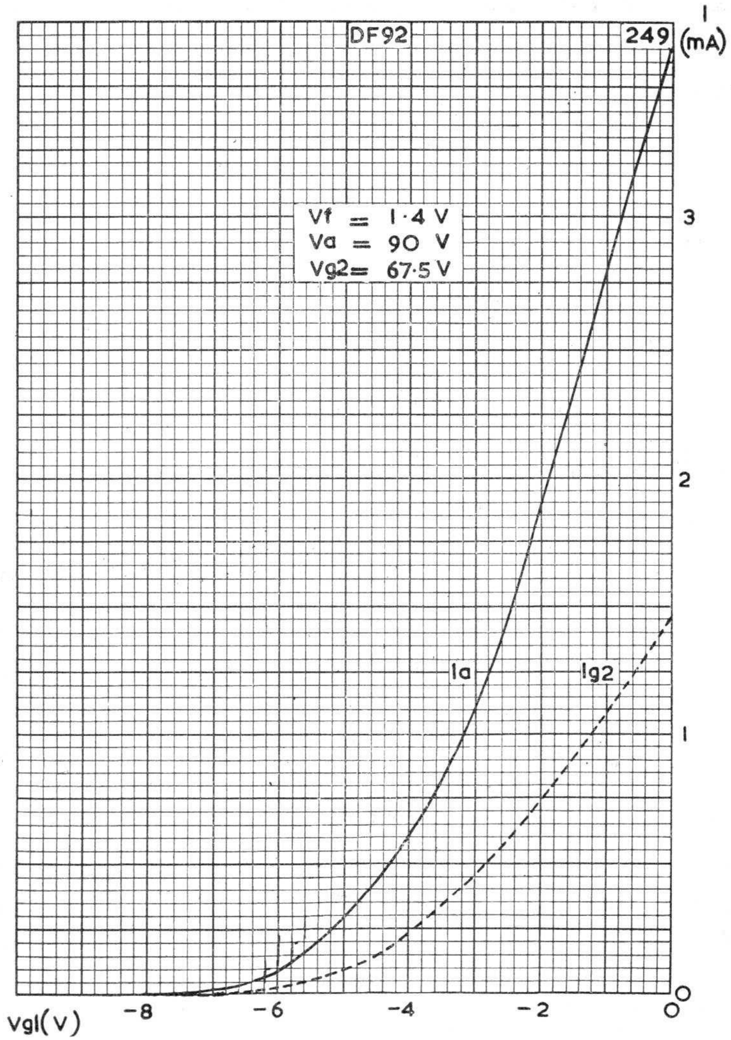
DF92

R.F. PENTODE

Short grid-base miniature R.F. pentode for use in battery-operated equipment.



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

MINIATURE I.F. PENTODE

DF96

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

FILAMENT ←

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

	Series	Parallel	
V_f	1.3	1.4	V
I_f	24	25	mA

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	3.3	pF
c_{out}	7.8	pF

OPERATING CONDITIONS AS I.F. AMPLIFIER

$*V_a = V_b$	64	85	V
R_{g2}	0	39	kΩ
V_{g1}	0	0	V
V_{g2}	64	64	V
I_a	1.65	1.65	mA
I_{g2}	550	550	μA
g_m	850	850	μA/V ←
r_a	0.7	1.0	MΩ
μ_{g1-g2}	18	18	
$V_{g1} (g_m = 10\mu A/V)$	−4.1	−5.5	V
R_{eq}	14	14	kΩ ←

*Based on line voltages of 67.5 and 90V decreased by the negative bias for the output valve.

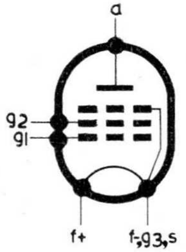
LIMITING VALUES

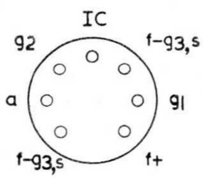
V_b max. (absolute)	110	V
V_a max.	90	V
p_a max.	250	mW
V_{g2} max.	90	V
p_{g2} max.	100	mW
I_k max.	2.2	mA
R_{g1-k} max.	3.0	MΩ
V_{g1} max. ($I_{g1} = +0.3\mu A$)	0	V

DF96

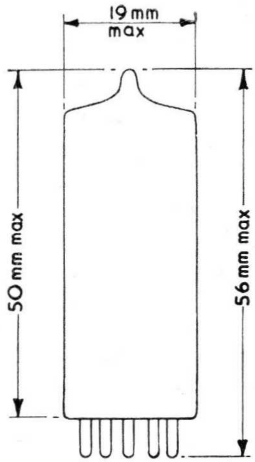
MINIATURE I.F. PENTODE

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





B7G Base



2380

R.F. PENTODE

DF97

R.F. pentode for use as an i.f. amplifier, frequency changer or self-oscillating mixer in f.m./a.m. receivers.

FILAMENT

This valve is not recommended for operation in a series filament chain.

V_f	1.4	V
I_f	25	mA

CAPACITANCES

Pentode connection

c_{in}	3.7	pF
$c_{in(g3)}$	5.2	pF
c_{out}	7.5	pF
c_{a-g1}	$<$0.01	pF
c_{g1-g3}	$<$0.1	pF
c_{g1-g2}	2.5	pF

Triode connection (g_2 and g_3 connected to a)

c_{in}	1.1	pF
c_{out}	8.1	pF
c_{a-g1}	2.6	pF

CHARACTERISTICS

*$V_a = V_b$	64	64	85	85	V
V_{g3}	0	0	0	0	V
R_{g2}	1.5	4.7	33	47	kΩ
V_{g2}	63	61	62	57	V
V_{g1}	0	0	0	0	V
I_a	1.7	1.6	1.7	1.5	mA
I_{g2}	780	725	700	595	µA
g_m	880	870	940	900	µA/V
r_a	250	270	450	525	kΩ
μ_{g1-g2}	20	20	20	20	
V_{g1} ($g_m = 10\mu A/V$)	−3.8	−3.8	−5.0	−5.0	V

TYPICAL OPERATING CONDITIONS

Frequency changer with oscillator voltage on g_3

*$V_a \doteq V_b$	64	85	V
R_{g2}	4.7	47	kΩ
V_{g2}	58	47	V
R_{g3}	300	300	kΩ
V_{g1}	0	0	V
I_a	670	540	µA
I_{g2}	1.25	0.8	mA
$V_{osc(r.m.s.)}$	12	12	V
g_c	280	265	µA/V
r_a	300	500	kΩ
V_{g1} ($g_m = 10\mu A/V$)	−3.5	−4.6	V

DF97

R.F. PENTODE

R.F. pentode for use as an i.f. amplifier, frequency changer or self-oscillating mixer in f.m./a.m. receivers.

Self-oscillating mixer (triode connection, g_2 and g_3 connected to a)

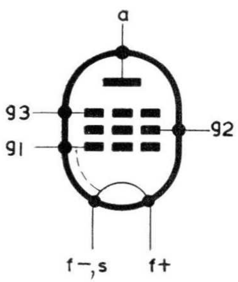
$^*V_a = V_b$	64	85	V
I_a	1.3	1.9	mA
R_{g-f}	1.0	1.0	MΩ
I_{g1}	3.1	4.4	μA
$V_{osc(r.m.s.)}$	3.0	4.0	V
g_c	465	500	μA/V
r_a	29	26	kΩ

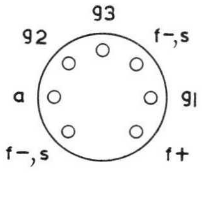
*Based on battery voltages of 67.5 and 90V decreased by the negative bias for the output valve.

LIMITING VALUES

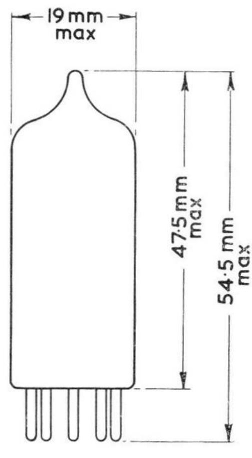
V_b max. (absolute)	150	V
V_b max.	120	V
V_a max.	120	V
p_a max.	250	mW
V_{g2} max.	90	V
p_{g2} max.	150	mW
I_k max.	2.5	mA
R_{g1-f} max.	3.0	MΩ
R_{g3-f} max.	1.5	MΩ
$+V_{g1}$ min. ($I_{g1} = +0.3\mu A$)	0	V

3383





B7G Base



MINIATURE HEPTODE FREQUENCY CHANGER

DK91

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

FILAMENT

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

V_f	1.4	V
I_f	0.05	A

CAPACITANCES

c_{g3-all}	7.0	μμF
c_{a-all}	7.5	μμF
c_{g1-all}	3.8	μμF
c_{g3-a}	<0.4	μμF
c_{g3-g1}	<0.2	μμF
c_{a-g1}	<0.1	μμF

OPERATING CONDITIONS

V_a	45	67.5	90	90	V
V_{g2+g4}	45	67.5	45	67.5	V
V_{g3}	0	0	0	0	V
R_{g1}	100	100	100	100	K Ω
r_a	600	500	800	600	K Ω
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

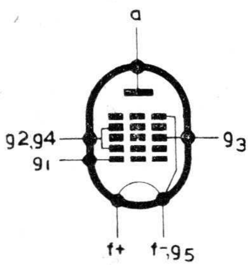
In these circuits—

C designates a decoupling capacitor.

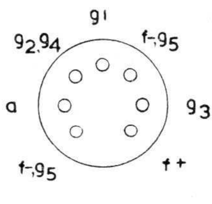
L_C is a filament choke of 12 μH inductance and with a d.c. resistance of less than 0.5 Ω.

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.

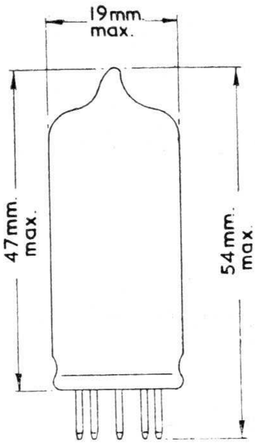
L_D is the short wave coil and should have a Q of approximately 115 at 6.5 Mc/s.



533



B7G BASE

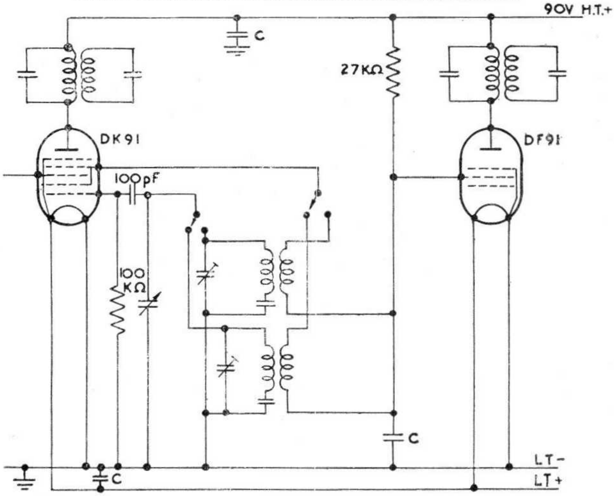


MINIATURE HEPTODE FREQUENCY CHANGER

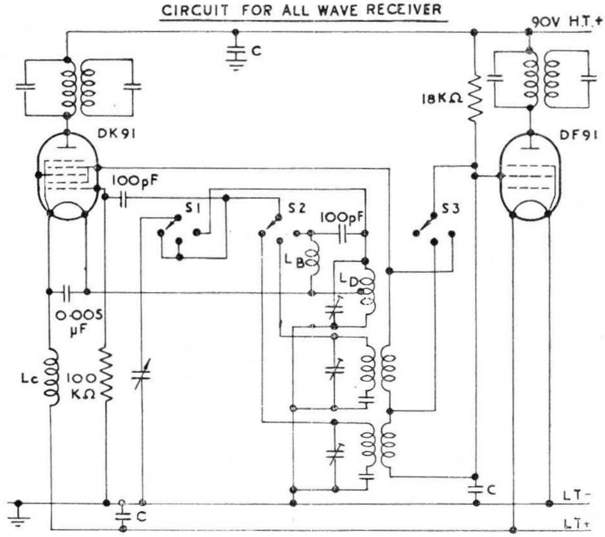
DK91

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

CIRCUIT FOR MEDIUM AND LONG WAVE RECEIVER



CIRCUIT FOR ALL WAVE RECEIVER

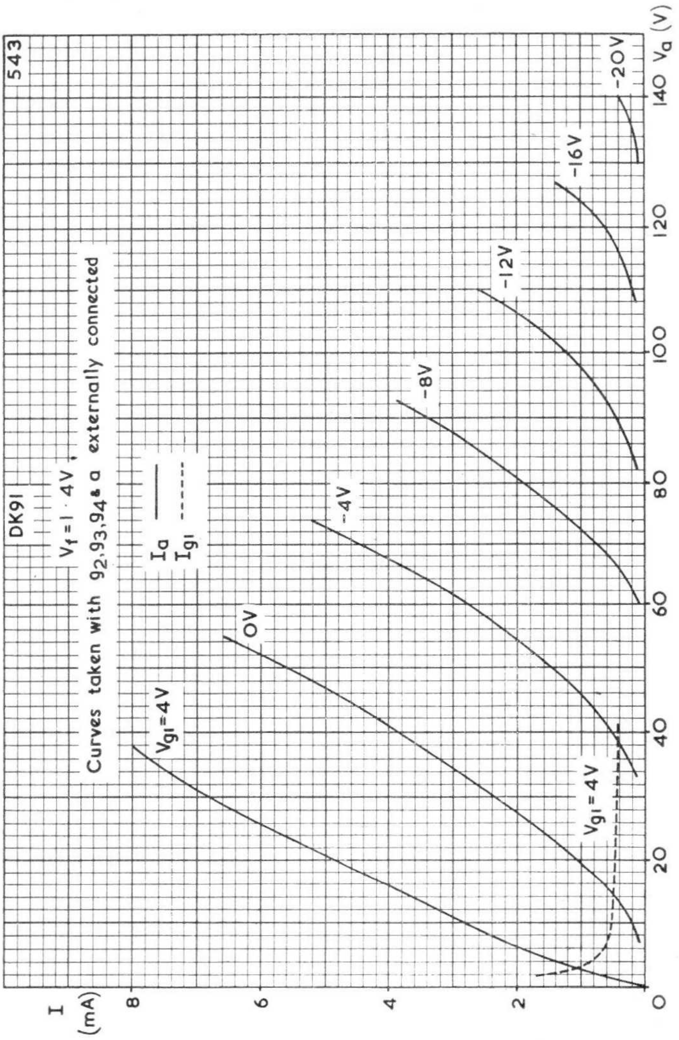


063

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

HEPTODE FREQUENCY CHANGER

DK92

Miniature heptode, primarily intended as frequency changer in battery-operated receivers, and suitable for a.v.c. It combines a high conversion conductance for this type of valve with a low oscillator drive voltage.

FILAMENT

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

	Series	*Parallel*	
V_f	1.3	1.4	V
I_f	48	50	mA

CAPACITANCES

c_{a-all}	8.5	pF
c_{g3-all}	7.5	pF
c_{g2-all}	5.0	pF
c_{g1-all}	4.0	pF
c_{a-g3}	<400	mpF
c_{g2-g3}	1.6	pF
c_{g1-g3}	<200	mpF
c_{g1-g2}	3.0	pF

OPERATING CONDITIONS

$V_a = V_b$	85	V
V_{g3}	0	V
R_{g4}	180	kΩ
R_{g2}	33	kΩ
R_{g1-f+}	27	kΩ
V_{g4} (approx.)	60	V
V_{g2} (approx.)	30	V
$V_{g1(r.m.s.)}$	4.0	V
I_k	2.55	mA
I_a	700	μA
I_{g4}	150	μA
I_{g2}	1.6	mA
*I_{g1}	100	μA
g_c	325	μA/V
r_a	650	kΩ
V_{g3} (for 100 : 1 reduction in g_c)	–6.0	V

*Optimum value. In a typical circuit, I_{g1} should be between 50μA and 250μA.

Oscillator Section (with $_{g1}$ connected to f+)

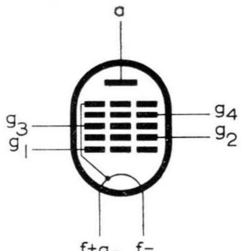
V_a	85	V
V_{g4}	60	V
V_{g3}	0	V
V_{g2}	30	V
I_{g2}	2.5	mA
$g_{m(g1-g2)}$	900	μA/V
μ_{g1-g2}	7.5	

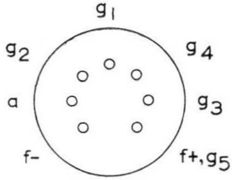
DK92

HEPTODE FREQUENCY CHANGER

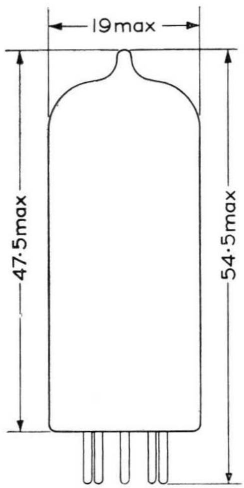
LIMITING VALUES

V_b max. (absolute)	140	V
V_b max.	120	V
V_a max.	90	V
V_{g4} max.	90	V
V_{g2} max.	60	V
I_k max.	4.0	mA
R_{g3-f} max.	3.0	MΩ
R_{g1-f} max.	35	kΩ





B7G Base



7081

All dimensions in mm

MINIATURE HEPTODE FREQUENCY CHANGER

DK96

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

FILAMENT

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

	Series	*Parallel*	
V_f	1.3	1.4	V
I_f	24	25	mA

CAPACITANCES

c_{a-all}	8.1	pF
c_{g1-all}	3.9	pF
c_{g2-all}	4.8	pF
c_{g3-all}	7.4	pF
c_{a-g1}	$<$0.11	pF
c_{a-g2}	$<$0.3	pF
c_{a-g3}	$<$0.36	pF
c_{g1-g2}	3.0	pF
c_{g1-g3}	$<$0.2	pF
c_{g2-g3}	1.6	pF

TYPICAL OPERATING CONDITIONS

$*V_a = V_b$	64	85	V
V_{g3}	0	0	V
R_{g4}	0	120	kΩ
R_{g2}	18	33	kΩ
R_{g1-f+}	27	27	kΩ
V_{g4} (approx.)	64	68	V
V_{g2} (approx.)	35	35	V
$V_{g1(r.m.s.)}$	4.0	4.0	V
I_k	2.45	2.4	mA
I_a	550	600	µA
I_{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.

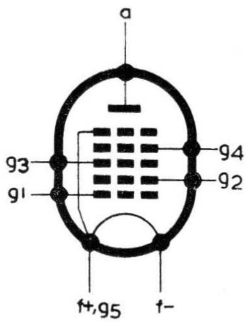
DK96

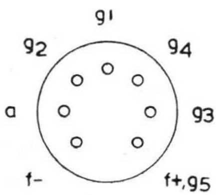
MINIATURE HEPTODE FREQUENCY CHANGER

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

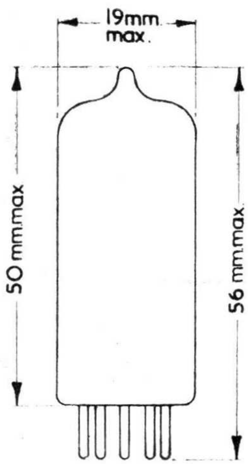
LIMITING VALUES

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

OUTPUT PENTODE

DL33

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

DL35
OVERLEAF

FILAMENT

Suitable for d.c. operation only.

	Series	Parallel	
V_f	2.8	1.4	V
I_f	50	100	mA

TYPICAL OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

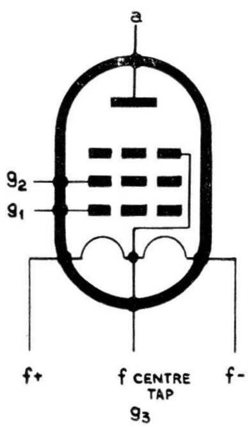
Filament connection:

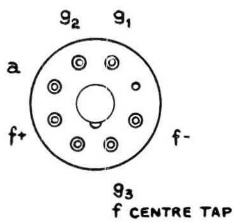
	Series		Parallel			
V_a	90	110	85	90	110	V
V_{g2}	90	110	85	90	110	V
V_{g1}	−4.5	−6.6	−5.0	−4.5	−6.6	V
V_{in} (r.m.s.)	3.2	3.6	3.5	3.2	3.8	V
I_a	8.0	8.5	7.0	9.5	10	mA
I_{g2}	1.0	1.1	0.8	1.3	1.4	mA
g_m	2.0	2.0	1.95	2.2	2.2	mA/V
r_a	80	110	70	90	100	kΩ
R_a	8	8	9	8	8	kΩ
P_{out}	230	330	250	270	400	mW
D_{tot}	8.5	8.5	5.5	6.0	6.0	%

LIMITING VALUES

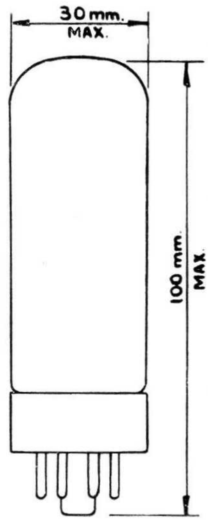
V_a max.	110	V
V_{g2}	110	V
*I_k max.	6	mA
R_{g1} max.	1.0	MΩ

* I_k max. is 6mA for each 1.4V filament section.





OCTAL BASE



DL35

OUTPUT PENTODE

Output pentode for use in battery operated equipment.

FILAMENT

Suitable for d.c. operation only.

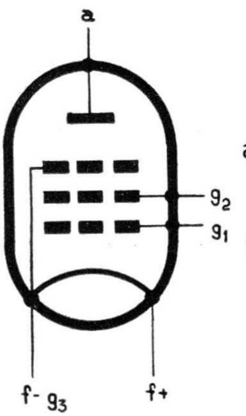
V_f	1.4	V
I_f	100	mA

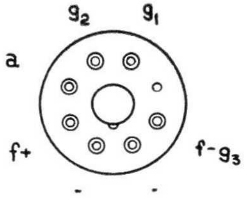
TYPICAL OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_a	83	90	V
V_{g2}	83	90	V
V_{g1}	−7.0	−7.5	V
$V_{in(r.m.s.)}$	5.0	5.3	V
I_a (max. sig.)	7.3	7.8	mA
$I_{a(o)}$	7.0	7.5	mA
I_{g2} (max. sig.)	3.5	3.5	mA
$I_{g2(o)}$	1.6	1.6	mA
r_a	110	115	kΩ
g_m	1.5	1.55	mA/V
R_a	9	8	kΩ
$P_{out}(D_{tot}=10\%)$	200	240	mW

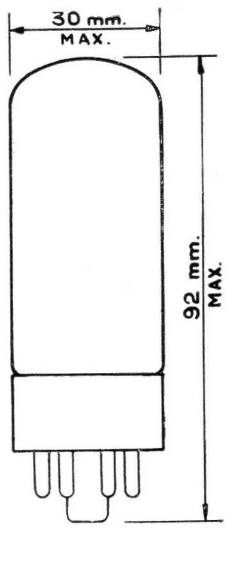
LIMITING VALUES

V_a max.	110	V
V_{g2} max.	110	V
I_k max.	12	mA





OCTAL BASE



SUBMINIATURE OUTPUT PENTODE

DL64

Subminiature output pentode suitable for use in hearing aids. It has a filament current of 10mA and is primarily intended for use with an H.T. battery supply of 15 volts.

FILAMENT

V_f	1.25	V
I_f	10	mA

MOUNTING POSITION

Any

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

CAPACITANCES (Measured without external screen)

c_{a-g1}	<0.25	$\mu\mu F$
c_{in}	2.5	$\mu\mu F$
c_{out}	2.4	$\mu\mu F$

CHARACTERISTICS

V_a	15	V
V_{g2}	15	V
I_a	160	μA
I_{g2}	40	μA
V_{g1}	−1.5	V
g_m	180	$\mu A/V$
r_a	400	$k\Omega$
μ_{g1-g2}	4.5	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

V_a	15	V
V_{g2}	15	V
V_{g1}	−1.55	V
R_a	100	$k\Omega$
$I_{a(o)}$	150	μA
$I_{g2(o)}$	37	μA
$V_{in(r.m.s.)}$	0.85	V
P_{out}	950	μW
D_{tot}	10	%

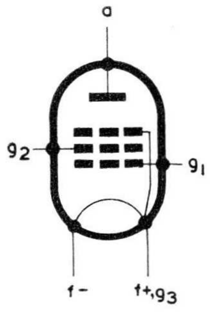
LIMITING VALUES

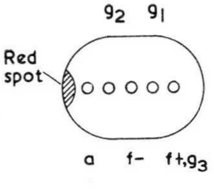
V_a max.	45	V
V_{g2} max.	45	V
I_k max.	600	μA

DL64

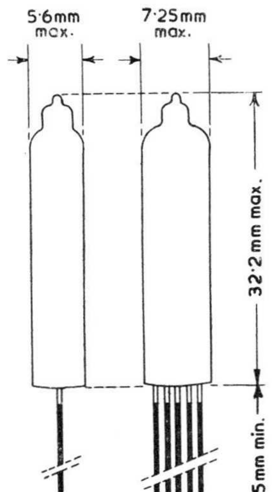
SUBMINIATURE OUTPUT PENTODE

Subminiature output pentode suitable for use in hearing aids. It has a filament current of 10mA and is primarily intended for use with an H.T. battery supply of 15 volts.





B5A BASE



1338

SUBMINIATURE OUTPUT PENTODE

DL68

Subminiature output pentode suitable for use in hearing-aids. It has a filament current of 25mA and is primarily intended for use with an H.T. battery supply of 22.5 volts.

FILAMENT

V_f	1.25	V
I_f	25	mA

MOUNTING POSITION

Any

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

CAPACITANCE

c_{a-g1}	0.15	$\mu\mu$F

CHARACTERISTICS

V_a	22.5	V
V_{g2}	22.5	V
I_a	600	μA
I_{g2}	150	μA
V_{g1}	−2.2	V
g_m	430	μA/V
r_a	100	k Ω
μ_{g1-g2}	5.0	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

V_b	22.5	V
V_{g2}	22.5	V
V_{g1}	−2.2	V
R_a	37.5	k Ω
$I_{a(0)}$	600	μA
$I_{g2(0)}$	150	μA
$V_{in\ (r.m.s.)}$	1.3	V
P_{out}	5.0	mW
D_{tot}	10	%

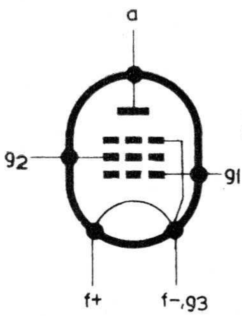
LIMITING VALUES

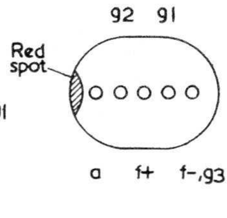
V_a max.	45	V
V_{g2} max.	45	V
p_a max.	100	mW
p_{g2} max.	25	mW
I_k max.	2.3	mA

DL68

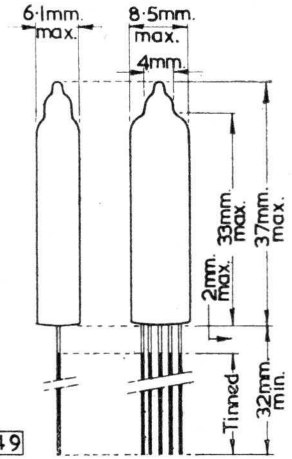
SUBMINIATURE OUTPUT PENTODE

Subminiature output pentode suitable for use in hearing-aids. It has a filament current of 25mA and is primarily intended for use with an H.T. battery supply of 22.5 volts.





B5A BASE



849

SUBMINIATURE OUTPUT PENTODE

DL69

Subminiature output pentode suitable for battery operation with an h.t. supply of 90V.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	25	mA

MOUNTING POSITION

Any

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

CAPACITANCES (shielded)

←

c_{a-g1}	50	mpF
c_{in}	2.9	pF
c_{out}	3.2	pF

CHARACTERISTICS

V_a	90	V
V_{g2}	90	V
I_a	1.75	mA
I_{g2}	400	µA
V_{g1}	−2.5	V
g_m	850	µA/V
r_a	800	kΩ
μ_{g1-g2}	15	

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	67.5	90	V
V_{g2}	67.5	90	V
$I_{a(0)}$	0.9	1.3	mA
$I_{g2(0)}$	200	300	µA
V_{g1}	−2.0	−3.0	V
R_a	70	60	kΩ
$V_{in(r.m.s.)}$	1.2	1.6	V
P_{out}	23	50	mW
D_{tot}	10	10	%

DL69

SUBMINIATURE OUTPUT PENTODE

Subminiature output pentode suitable for battery operation with an h.t. supply of 90V.

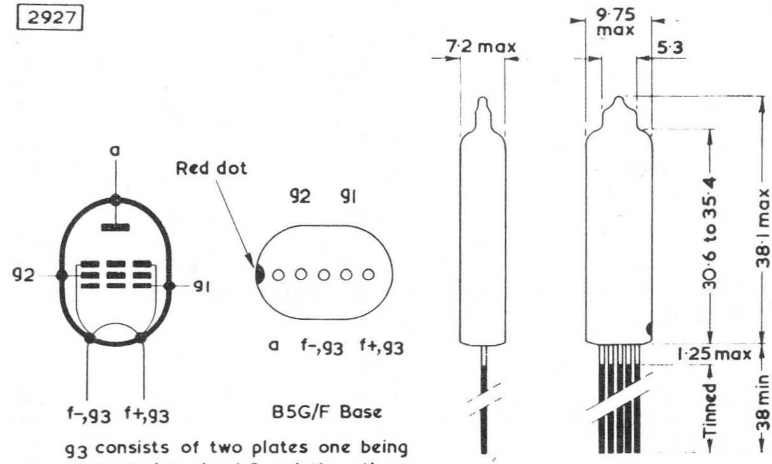
OPERATING CONDITIONS FOR TWO VALVES IN CLASS 'AB' PUSH-PULL

V_{a-e}	90	V
V_{g2-e}	90	V
$I_{a(o)}$	2×800	µA
I_a(max. sig.)	2×1.0	mA
$I_{g2(o)}$	2×150	µA
I_{g2}(max. sig.)	2×425	µA
R_k	1.8	kΩ
R_{a-a}	100	kΩ
$V_{in(g1-g1)r.m.s.}$	8.0	V
P_{out}	100	mW
D_{tot}	5.0	%

LIMITING VALUES

V_a max.	90	V
V_{g2} max.	90	V
I_k max.	2.5	mA

2927



g3 consists of two plates one being connected to lead 3 and the other to lead 5

All dimensions in mm

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

This valve is primarily intended for use in communications equipment of the 'push to talk' type and its continuous life rating under typical supply voltage conditions is relatively short and is chiefly a function of hours of filament operation and filament temperature.

Under 'push to talk' conditions an operating life of about 200 hours may be expected.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	110	mA

MOUNTING POSITION

Any

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

If the valve is used with an earthed metal clip a decrease in output power of approximately 10% can be expected up to 200Mc/s.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g1}	<0.1	0.08	pF
c_{in}	3.0	3.1	pF
c_{out}	5.6	3.9	pF

CHARACTERISTICS

V_a	135	V
V_{g2}	90	V
I_a	7.5	mA
I_{g2}	1.5	mA
V_{g1}	−7.5	V
g_m	1.9	mA/V
r_a	150	kΩ
μ_{g1-g2}	6.5	

OPERATING CONDITIONS AS A CLASS 'C' TELEGRAPHY R.F. OSCILLATOR

f	10	50	Mc/s
V_a	150	150	V
V_{g2}	110	110	V
I_a	10	10	mA
I_{g2}	3.0	3.0	mA
I_{g1}	40	40	μA
R_{g1}	470	390	kΩ
P_{load}	800	800	mW
η_{load}	53	53	%
$v_{a(pk)}$	120	—	V
$v_{g1(pk)}$	23	—	V

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

OPERATING CONDITIONS AS A CLASS 'C' TELEGRAPHY R.F. AMPLIFIER

f	50	200	Mc/s
V_a	150	150	V
V_{g2}	110	110	V
V_{g1}	−22	−22	V
I_a	9.7	10.5	mA
I_{g2}	3.2	2.5	mA
I_{g1}	80	60	μA
P_{load}	820	450	mW
η_{load}	56	29	%

P_{drive} measured at the control-grid is approximately 50mW at f=200Mc/s and does not include the power lost in the grid tuned circuit.

OPERATING CONDITIONS AS A FREQUENCY MULTIPLIER

Doubler

f_{out}	50	50	100	100	Mc/s
V_a	90	150	90	150	V
V_{g2}	90	110	90	110	V
V_{g1}	−32	−40	−32	−40	V
I_a	4.3*	9.4	4.7*	9.9	mA
I_{g2}	1.5	3.4	1.3	3.0	mA
I_{g1}	13	140	8.0	90	μA
P_{load}	180	590	150	510	mW
η_{load}	47	42	36	34	%

Trebler

f_{out}	50	50	100	100	Mc/s
V_a	90	150	90	150	V
V_{g2}	90	110	90	110	V
V_{g1}	−60	−70	−60	−70	V
I_a	4.4*	9.3	4.6*	9.7	mA
I_{g2}	1.6	3.4	1.4	3.1	mA
I_{g1}	30	24	24	190	μA
P_{load}	140	420	120	360	mW
η_{load}	35	30	29	25	%

Quadrupler

f_{out}	50	50	Mc/s
V_a	90	150	V
V_{g2}	90	110	V
V_{g1}	−65	−80	V
I_a	4.5*	6.2	mA
I_{g2}	1.5	1.8	mA
I_{g1}	32	27	μA
P_{load}	100	220	mW
η_{load}	25	24	%

*For class 'C' r.f. operation at $V_a \leq 90V$, I_k max.=6.0mA.

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	45	67.5	90	120	135	V
V_{g2}	45	67.5	90	120	90	V
V_{g1}	−2.9	−3.8	−6.5	−12	−7.5	V
I_a	3.0	7.5	9.0	8.0	7.5	mA
$I_{g2(0)}$	0.8	1.8	2.1	1.8	1.5	mA
I_{g2}(max. sig.)	1.2	2.7	3.1	3.0	2.5	mA
R_a	12	6.5	7.0	13	16	kΩ
$V_{in(r.m.s.)}$ (P_{out}=50mW)	1.9	1.5	1.5	1.3	1.1	V
P_{out}	58	190	360	460	500	mW
$V_{in(r.m.s.)}$	2.2	3.4	4.7	4.7	4.0	V
D_{tot}	10	10	10	10	10	%

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

V_{a-e}	90	150	V
V_{g2-e}	90	120	V
$I_{a(0)}$	2×6.5	2×6.3	mA
I_a(max. sig.)	2×7.6	2×7.95	mA
$I_{g2(0)}$	2×1.5	2×1.4	mA
I_{g2}(max. sig.)	2×2.6	2×2.65	mA
R_k	390	680	Ω
R_{a-a}	11	18	kΩ
$V_{in(g1-g1)r.m.s.}$ (P_{out}=50mW)	2.8	4.2	V
P_{out}	0.65	1.35	W
$V_{in(g1-g1)r.m.s.}$	14.5	11.3	V
D_{tot}	5.7	4.7	%

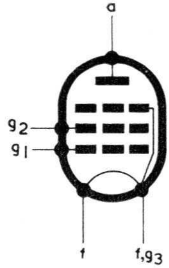
LIMITING VALUES

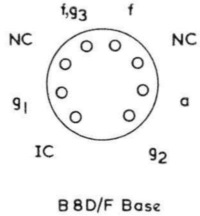
V_a max.	150	V
p_a max.	1.0	W
V_{g2} max.	150	V
p_{g2} max.	450	mW
R_{g1-f} max.	2.2	MΩ
V_f max. (absolute)	1.35	V
V_{g1} max.:—r.f. amplifier	−25	V
frequency doubler	−40	V
frequency trebler	−70	V
frequency quadrupler	−80	V
I_k max.:—	13	mA
frequency quadrupler (V_a≧90V)	8.0	mA

DL70

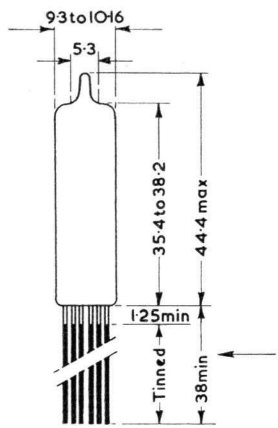
SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.





B 8D/F Base



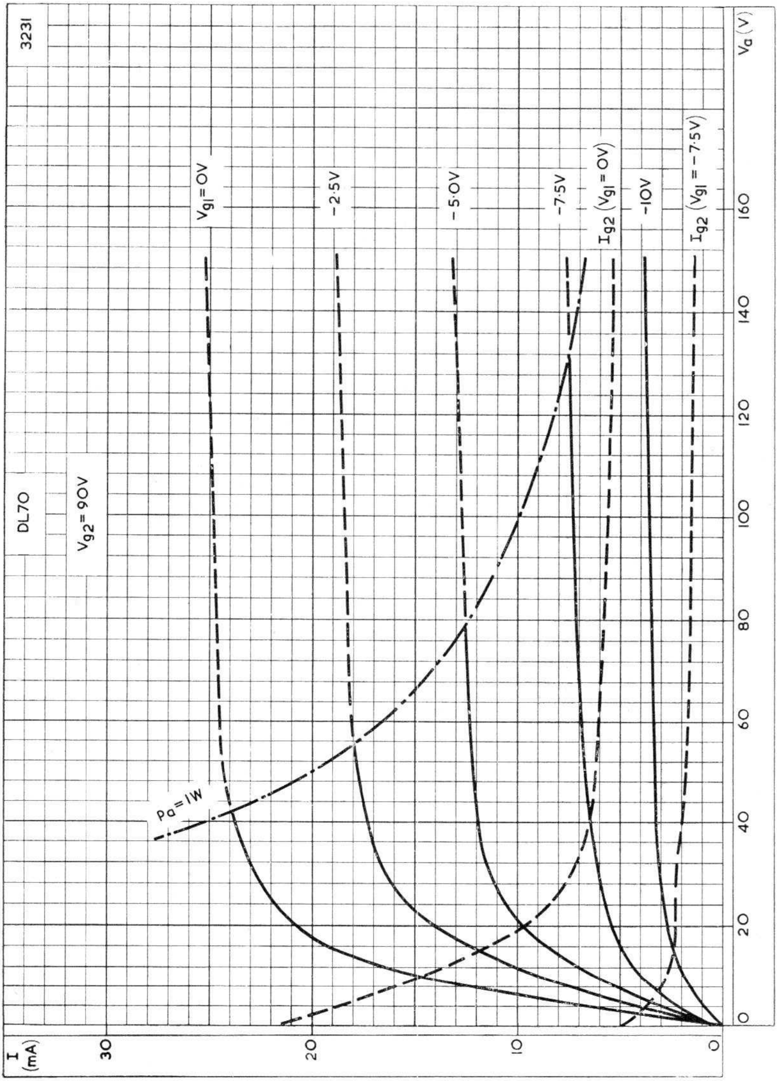
3230

All dimensions in mm

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

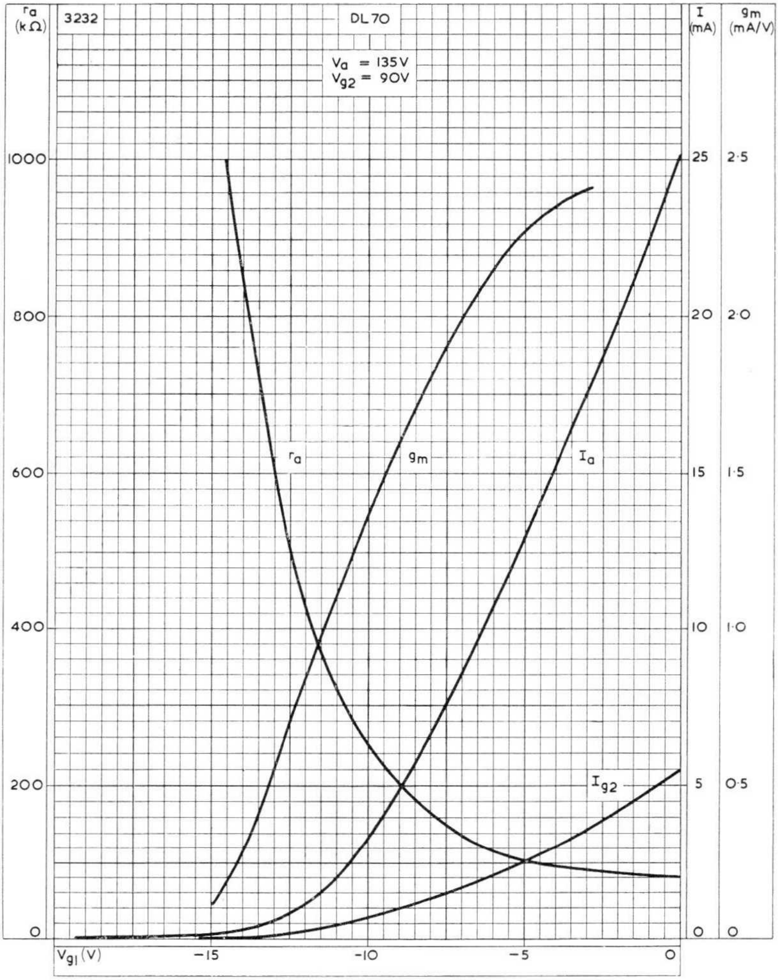


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 90V

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



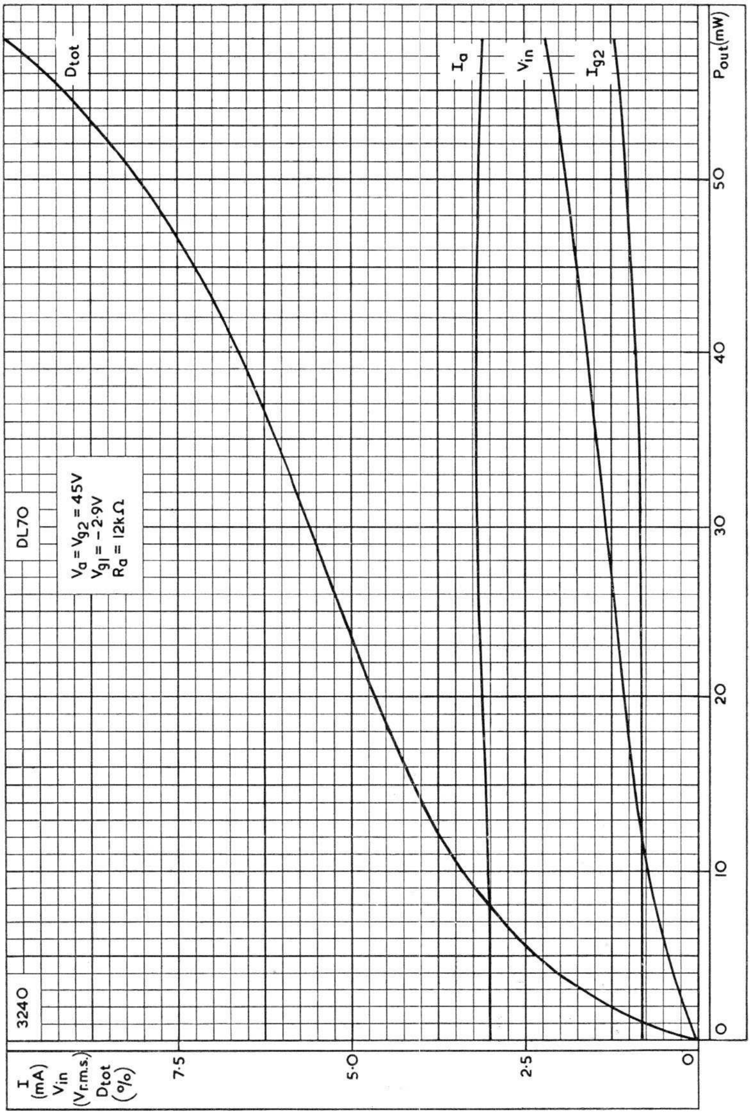
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE

$V_a = 135V$, $V_{g2} = 90V$

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

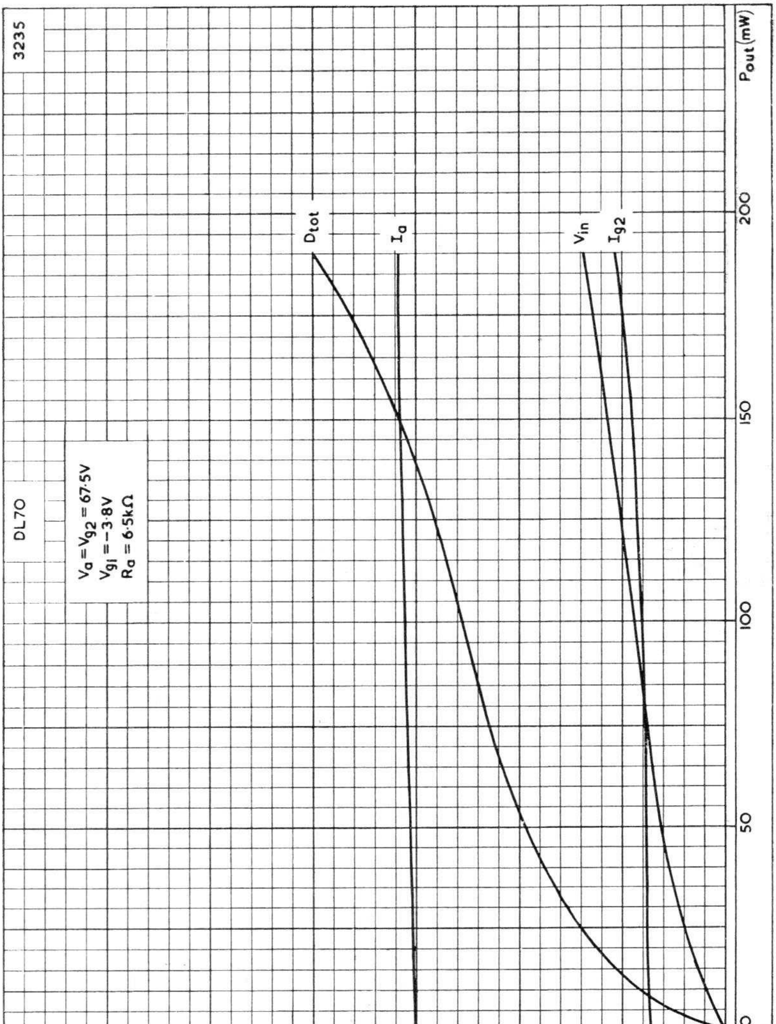


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_a = V_{g_2} = 45V$

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

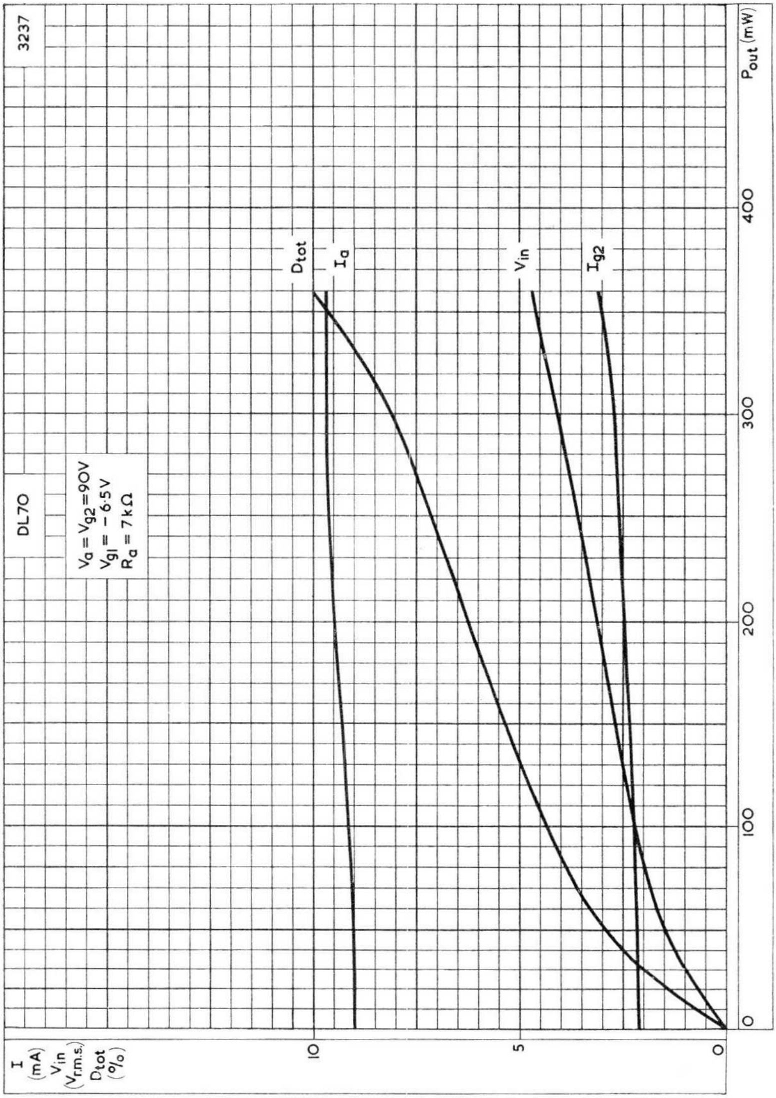


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_a = V_{g2} = 67.5V$

SUBMINIATURE
V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

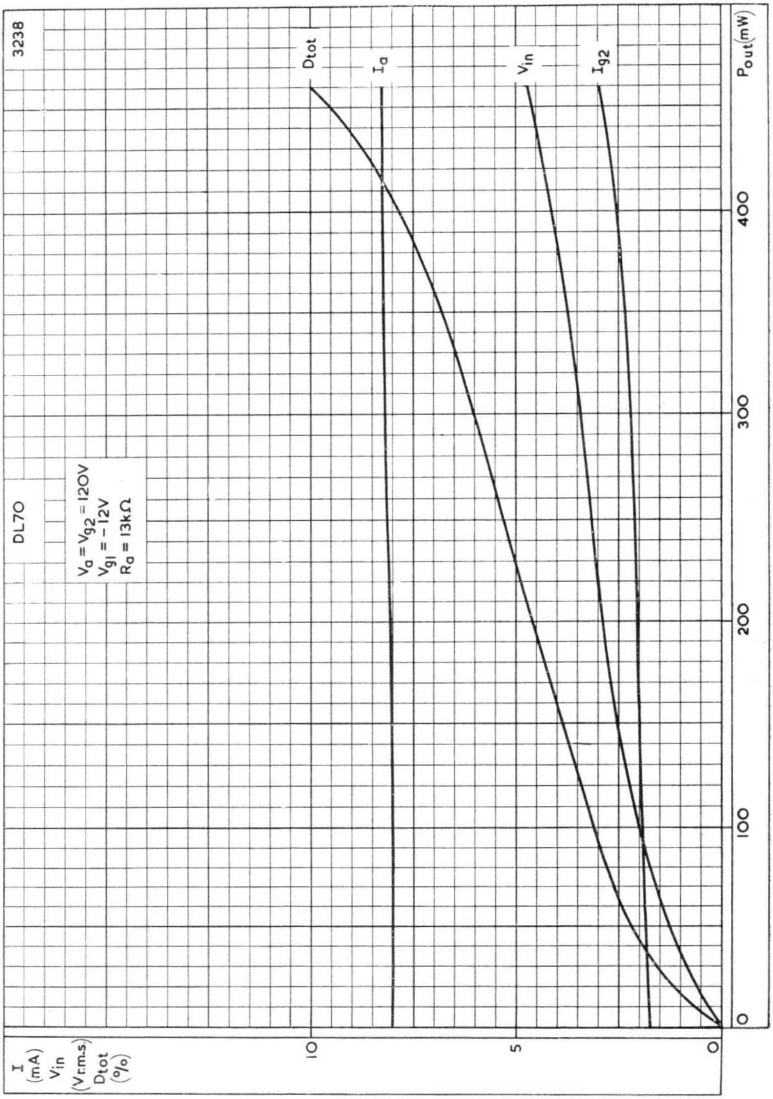


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_a = V_{g2} = 90V$

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

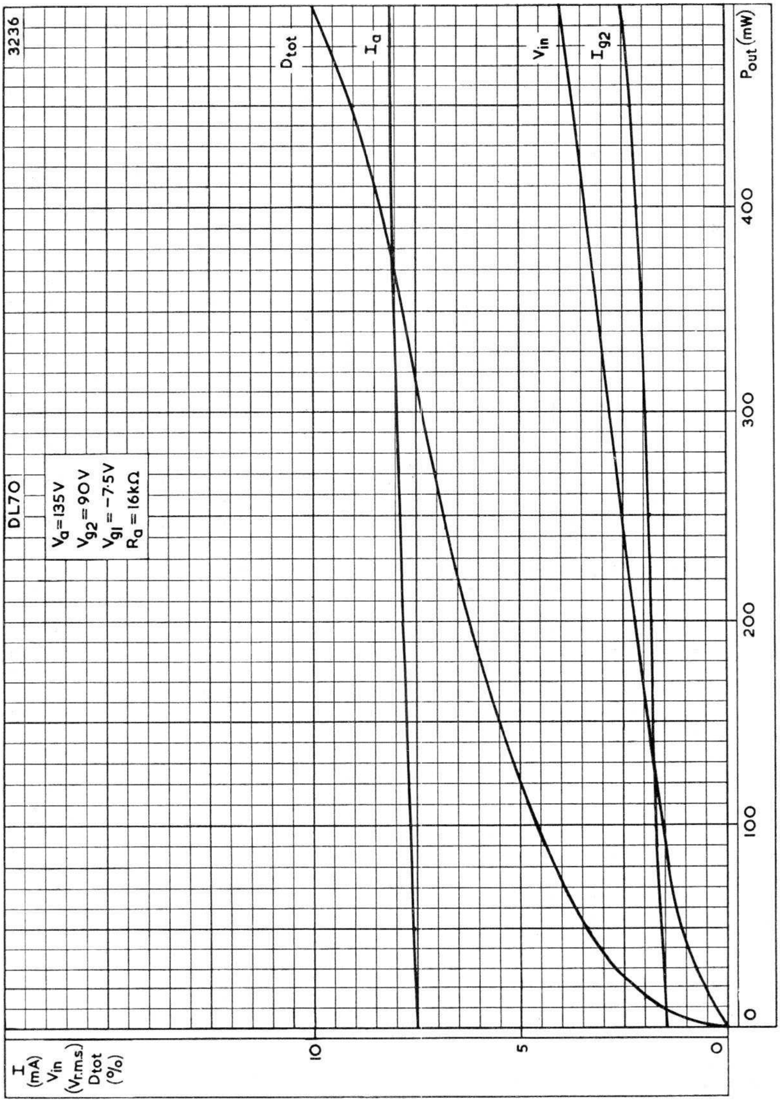


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_a = V_{g2} = 120V$

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

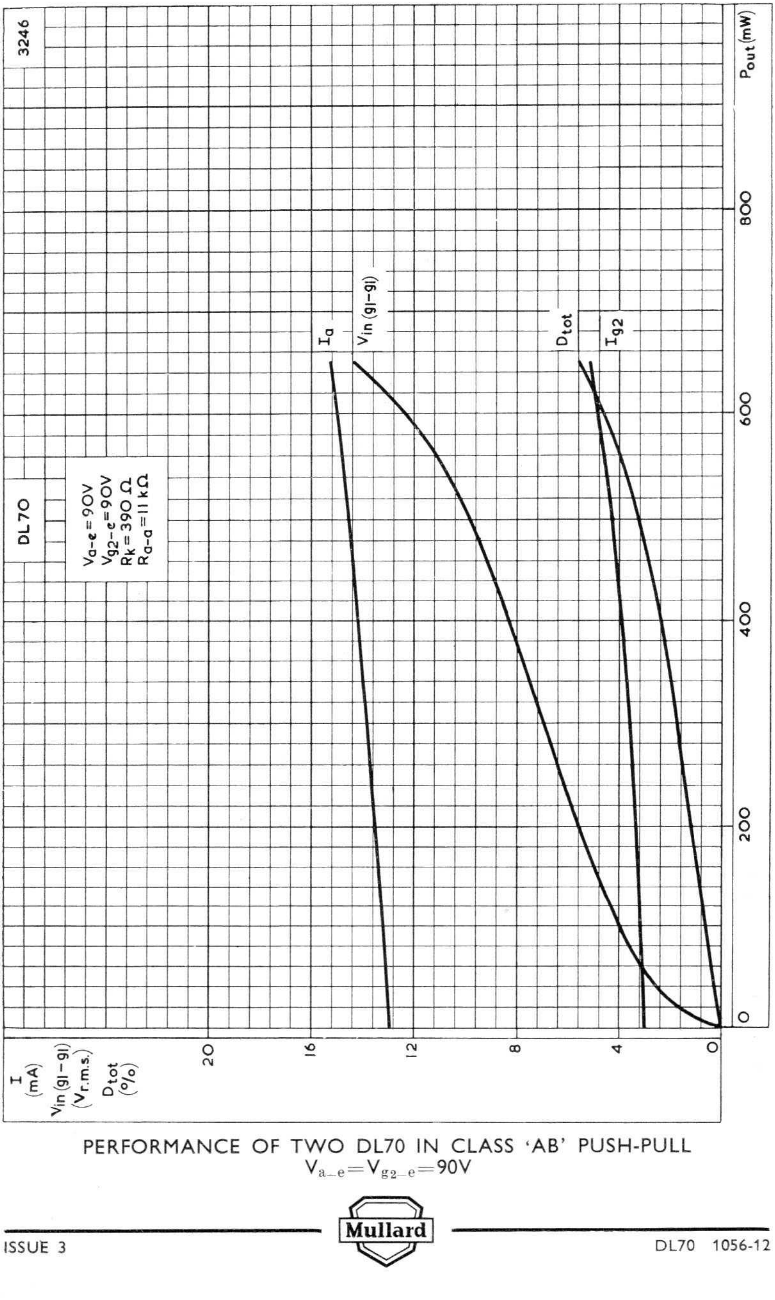


PERFORMANCE OF SINGLE DL70 AS CLASS 'A' AMPLIFIER. $V_a = 135V$, $V_{g2} = 90V$

DL70

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



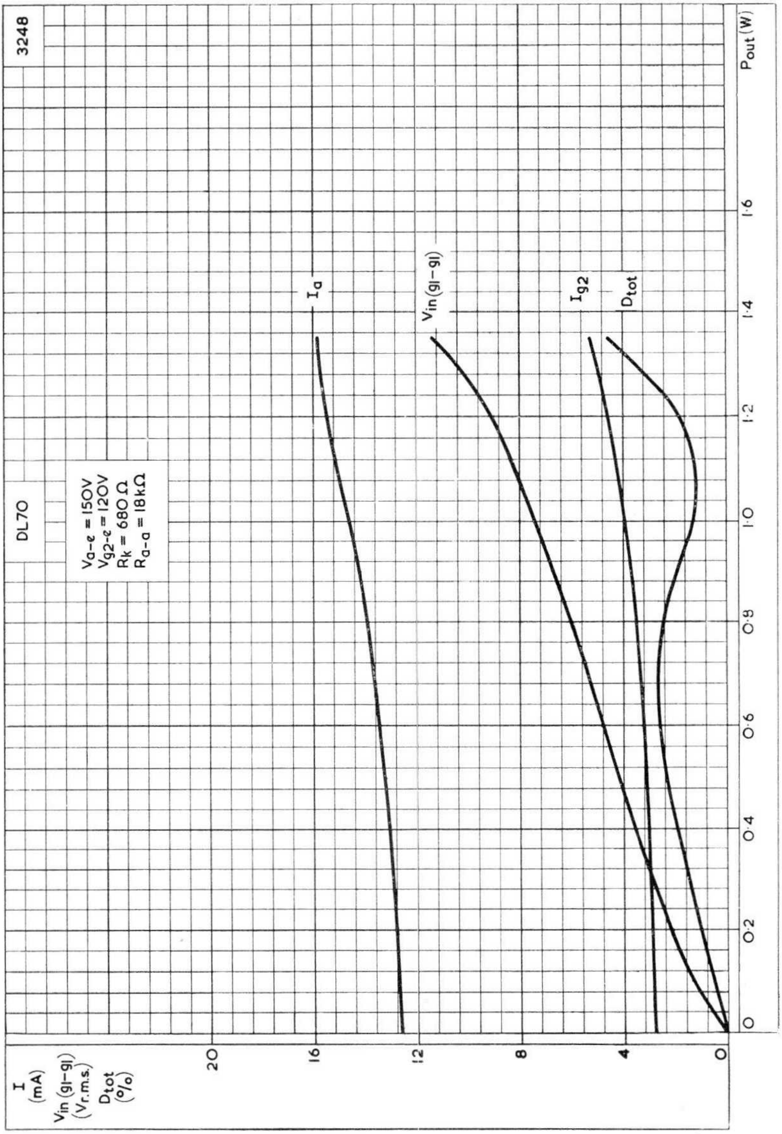
PERFORMANCE OF TWO DL70 IN CLASS 'AB' PUSH-PULL

$V_{a-e}=V_{g2-e}=90V$

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL70

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



PERFORMANCE OF TWO DL70 IN CLASS 'AB' PUSH-PULL
$V_{a-e}=150V$, $V_{g2-e}=120V$

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL73

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

This valve is primarily intended for use in communications equipment of the 'push to talk' type and its continuous life rating under typical supply voltage conditions is relatively short and is chiefly a function of hours of filament operation and filament temperature.

Under 'push to talk' conditions an operating life of about 200 hours may be expected.

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	200	mA

MOUNTING POSITION

Any

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

If the valve is used with an earthed metal clip a decrease in output power of approximately 10% can be expected up to 200Mc/s.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g1}	<0.15	<0.1	pF
c_{in}	3.6	3.5	pF
c_{out}	3.9	3.0	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	−9.0	V
I_a	15	mA
I_{g2}	3.8	mA
g_m	2.5	mA/V
r_a	16	kΩ
μ_{g1-g2}	6.0	

OPERATING CONDITIONS AS A CLASS 'C' TELEGRAPHY R.F. OSCILLATOR

f	10	50	Mc/s
V_a	150	150	V
V_{g2}	75	75	V
I_a	17	17	mA
I_{g2}	7.0	7.0	mA
I_{g1}	1.0	1.0	mA
R_{g1}	22	18	kΩ
P_{load}	1.4	1.4	W
η_{load}	55	55	%
$v_{a(pk)}$	130	—	V
$v_{g1(pk)}$	32	—	V

DL73

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

OPERATING CONDITIONS AS A CLASS 'C' TELEGRAPHY R.F. AMPLIFIER

Single valve

f	50	180	200	Mc/s
V_a	150	150	150	V
V_{g2}	75	75	75	V
V_{g1}	−20	−20	−20	V
I_a	17.3	18.3	18.6	mA
I_{g2}	6.7	5.8	5.6	mA
I_{g1}	1.0	0.9	0.8	mA
P_{load}	1.6	1.3	1.2	W
η_{load}	62	47	43	%

P_{drive} measured at the control-grid is approximately 100mW at f=200Mc/s and does not include the power lost in the grid tuned circuit.

P_{load} is approximately 1W at f=250Mc/s.

Two valves in push-pull

f	180	250	Mc/s
V_a	150	150	V
V_{g2}	75	75	V
V_{g1}	−20	−20	V
I_a	2×18.1	2×18.7	mA
I_{g2}	2×5.6	2×5.0	mA
I_{g1}	2×1.2	2×1.2	mA
P_{load}	2.8	2.3	W
η_{load}	52	41	%

Two valves parallel connected

f	180	Mc/s
V_a	150	V
V_{g2}	75	V
V_{g1}	−20	V
I_a	2×18.2	mA
I_{g2}	2×5.6	mA
I_{g1}	2×1.2	mA
P_{load}	2.5	W
η_{load}	46	%

SUBMINIATURE V.H.F. OUTPUT PENTODE

DL73

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

OPERATING CONDITIONS AS FREQUENCY MULTIPLIER

Doubler

f	50	Mc/s
V_a	150	V
V_{g2}	75	V
V_{g1}	−35	V
I_a	17.7	mA
I_{g2}	6.2	mA
I_{g1}	1.1	mA
P_{load}	1.1	W
η_{load}	42	%

Trebler

f	50	Mc/s
V_a	150	V
V_{g2}	75	V
V_{g1}	−70	V
I_a	17.9	mA
I_{g2}	5.8	mA
I_{g1}	1.3	mA
P_{load}	800	mW
η_{load}	30	%

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	120	150	V
V_{g2}	90	90	V
V_{g1}	−8.8	−8.5	V
$I_{a(o)}$	12	13	mA
I_a (max. sig.)	11.6	12.8	mA
$I_{g2(o)}$	2.5	2.3	mA
I_{g2} (max. sig.)	6.6	6.3	mA
R_a	9.0	10	kΩ
$V_{in(r.m.s.)}$ (P_{out}=50mW)	1.3	1.2	V
P_{out}	730	900	mW
$V_{in(r.m.s.)}$	6.9	6.5	V
D_{tot}	10	10	%

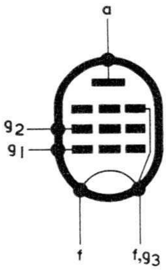
LIMITING VALUES

V_a max.	150	V
p_a max.	2.0	W
V_{g2} max.	150	V
p_{g2} max.	700	mW
I_k max.	25	mA
R_{g1-f} max.	2.2	MΩ
V_f max. (absolute)	1.35	V
V_{g1} max.:—r.f. amplifier	−30	V
frequency doubler	−35	V
frequency trebler	−70	V

DL73

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



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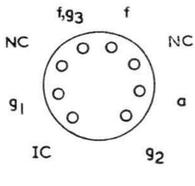
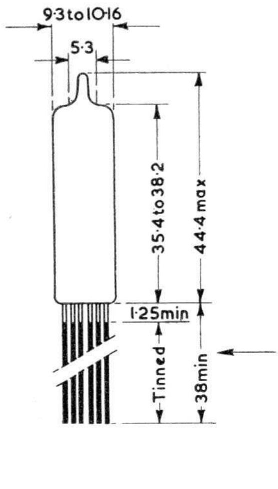


B8D/F Base

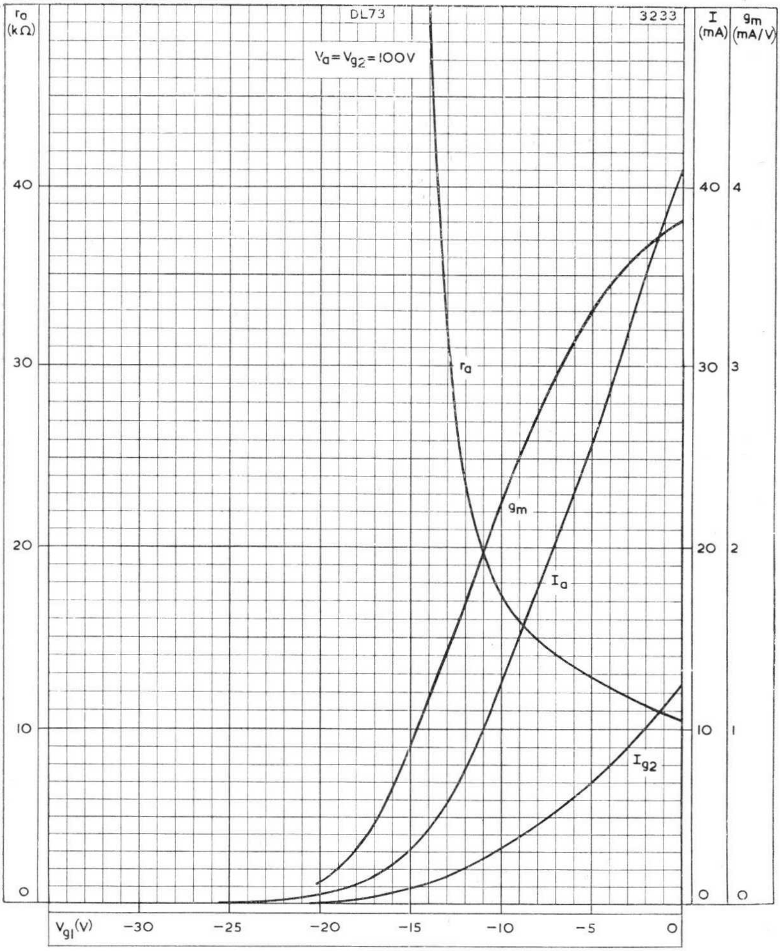
All dimensions in mm



SUBMINIATURE
V.H.F. OUTPUT PENTODE

DL73

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

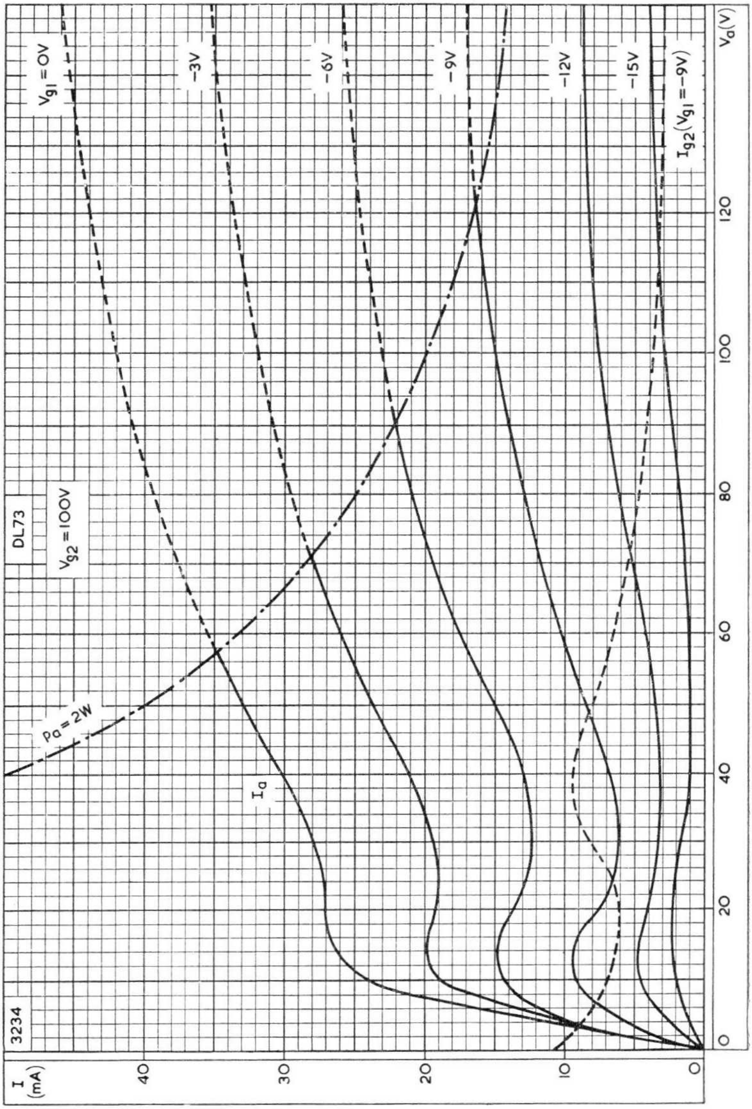


ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE

DL73

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

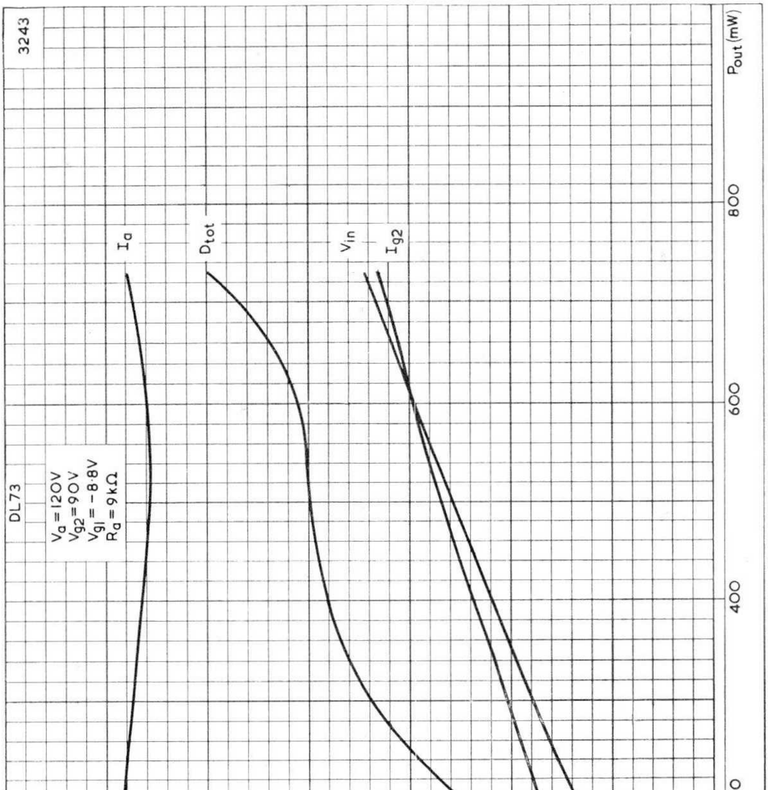


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SUBMINIATURE
V.H.F. OUTPUT PENTODE

DL73

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.

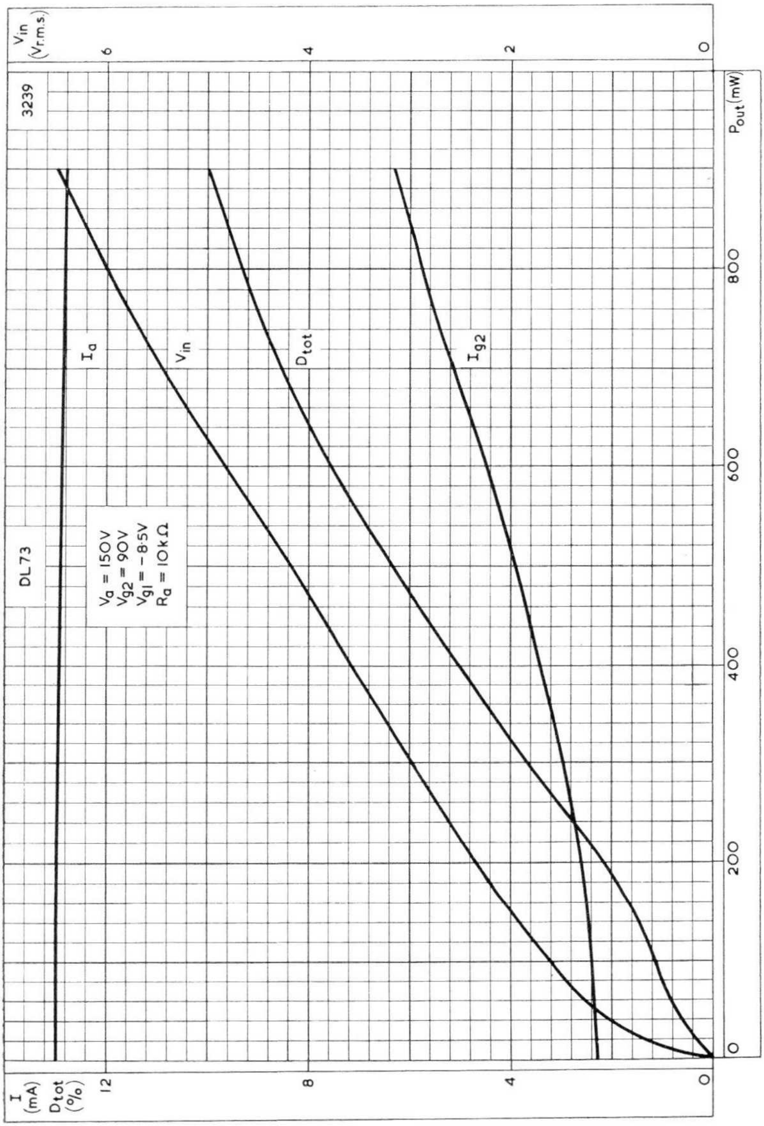


PERFORMANCE OF SINGLE DL73 AS CLASS 'A' AMPLIFIER
$V_a = 120V$

DL73

SUBMINIATURE V.H.F. OUTPUT PENTODE

Subminiature output pentode suitable for v.h.f. applications in battery-operated equipment.



PERFORMANCE OF SINGLE DL73 AS CLASS 'A' AMPLIFIER
$V_a = 150V$

Mullard

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	$\mu\mu$F
c_{in}	4.35	$\mu\mu$F
c_{out}	6.0	$\mu\mu$F

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	%

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	%

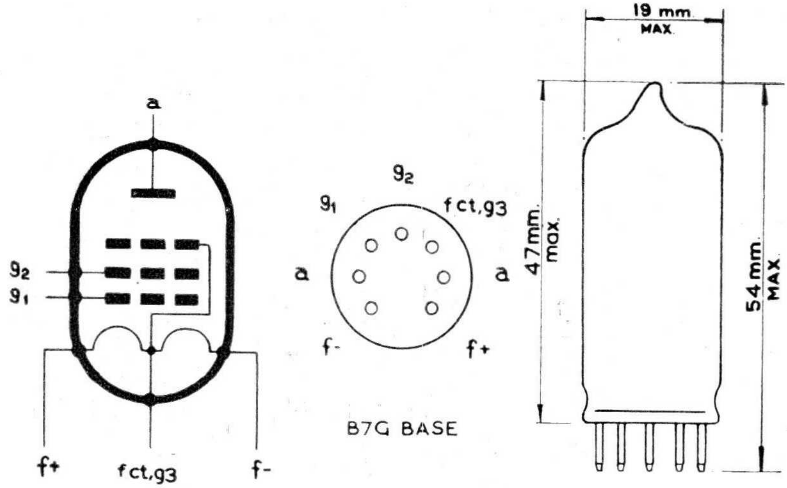
LIMITING VALUES

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.



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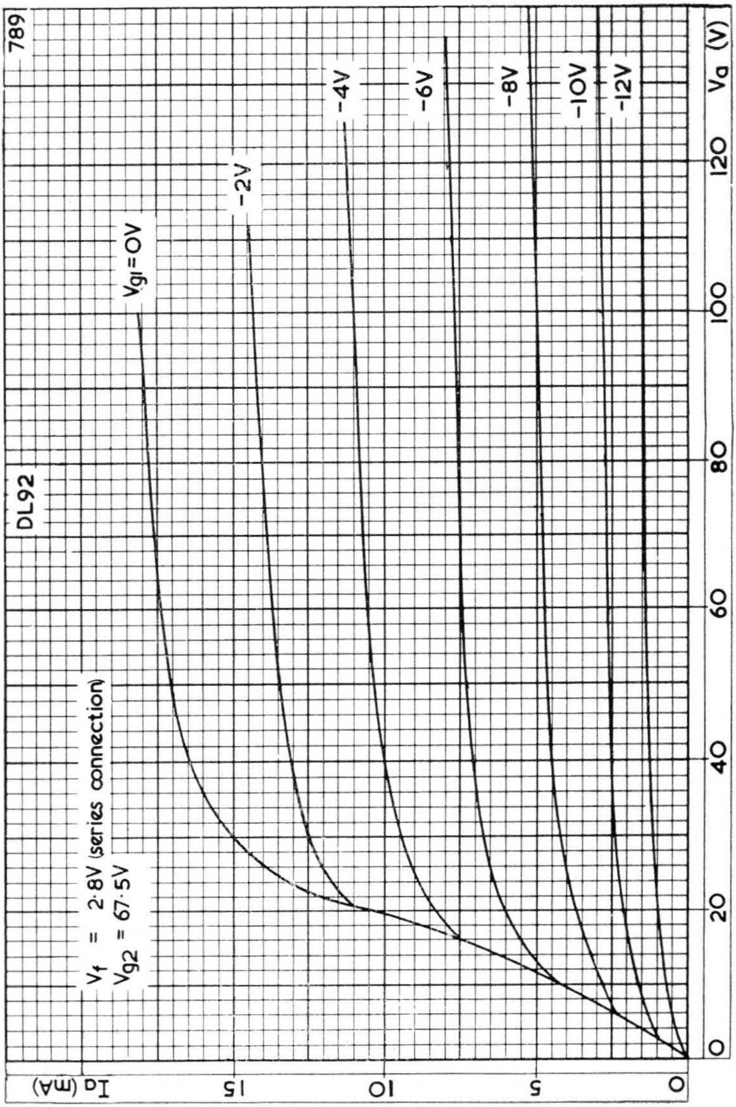
DL92

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

OUTPUT PENTODE

DL93

Output pentode with centre-tapped filament, suitable for R.F. and A.F. applications.

FILAMENT

This valve is suitable for D.C. operation only.

Series V_f applied across the two filament sections in series, between pins 1 and 7. V_{g1} referred to pin 1.

Parallel V_f applied across the two filament sections in parallel, between pin 5 and pins 1 and 7 connected together. V_{g1} referred to pin 5.

	Series	*Parallel*	
V_f	2.8	1.4	V
I_f	0.1	0.2	A

For series filament operation a shunting resistor must be connected across one filament section, between pins 1 and 5 to by-pass the excess cathode current in this section. The value of the resistor should be such that the voltage across the shunted section equals that across the other section.

MOUNTING POSITION

Any

CAPACITANCES (without external shield)

c_{a-g1}	<0.34	μμF
c_{in}	4.8	μμF
c_{out}	4.2	μμF

OPERATING CONDITIONS AS CLASS "A" A.F. AMPLIFIER.

Parallel filament connection

V_a	135	150	V
V_{g2}	90	90	V
V_{g1}	–7.5	–8.4	V
$I_{a(o)}$	14.8	13.3	mA
I_a (max. sig.)	14.9	14.1	mA
$I_{g2(o)}$	2.6	2.2	mA
I_{g2} (max. sig.)	3.5	3.5	mA
g_m	1.9	1.9	mA/V
r_a	90	100	kΩ
R_a	8	8	kΩ
$v_{in(pk)}$	7.5	8.4	V
P_{out}	600	700	mW
D_{tot}	5	6	%

DL93

OUTPUT PENTODE

Output pentode with centre-tapped filament, suitable for R.F. and A.F. applications.

OPERATING CONDITIONS

As R.F. power amplifier at 50 Mc/s. (Intermittent operation)

V_a	150	V
V_{g2}	135	V
R_{g1}	200	kΩ
I_a	18.3	mA
I_{g2}	6.5	mA
I_{g1}	0.13	mA
P_{out} (approx.)	1.2	W

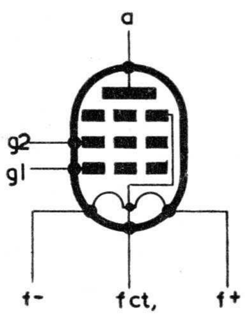
LIMITING VALUES

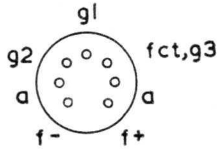
(*a*) A.F. power amplifier

V_a max.	150	V
V_{g2} max.	90	V
p_a max.	2	W
p_{g2} max.	0.4	W
$I_{k(0)}$ max.	18	mA

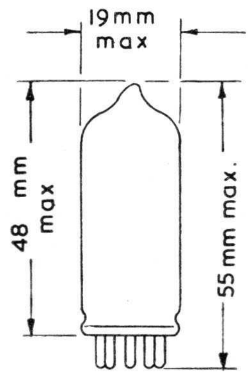
(*b*) R.F. power amplifier (intermittent operation)

V_a max.	150	V
V_{g2} max.	135	V
V_{g1} max.	−30	V
p_a max.	2	W
p_{g2} max.	0.9	W
p_{in} max.	3	W
I_a max.	20	mA
I_{g1} max.	0.25	mA
I_k max.	25	mA





B7G Base



MINIATURE OUTPUT PENTODE

DL94

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

FILAMENT

This valve is suitable for D.C. operation only.

Series — V_f applied across the two filament sections in series, between pins 1 and 7. V_{g1} referred to pin 1.

Parallel — V_f applied across the two filament sections in parallel, between pin 5 and pins 1 and 7 connected together. V_{g1} referred to pin 5.

Single-Section — V_f applied across one section of the filament only, between pin 5 and either pin 1 or pin 7.

	Series	*Parallel*	*Single-Section*	
V_f	2.8	1.4	1.4	V
I_f	0.05	0.1	0.05	A

MOUNTING POSITION Any

CAPACITANCES (Measured without external screening)

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

CHARACTERISTICS

	Filament Connection		
	Series	*Parallel*	
V_a	90	90	V
V_{g2}	90	90	V
V_{g1}	−4.5	−4.5	V
I_a	7.7	9.5	mA
I_{g2}	1.7	2.1	mA
g_m	2.0	2.15	mA/V
μ_{g1-g2}	7.5	7.5	
r_a	0.12	0.1	MΩ

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Series filament connection.

V_a	90	V
V_{g2}	90	V
V_{g1}	−4.5	V
$I_{a(o)}$	7.7	mA
$I_{g2(o)}$	1.7	mA
R_a	10	kΩ
$V_{in(r.m.s.)}$	3.2	V
P_{out}	240	mW
D_{tot}	7	%

Parallel filament connection.

V_a	85	90	V
V_{g2}	85	90	V
V_{g1}	−5.0	−4.5	V
$I_{a(o)}$	6.9	9.5	mA
$I_{g2(o)}$	1.5	2.1	mA
R_a	10	10	kΩ
$V_{in(r.m.s.)}$	3.5	3.2	V
P_{out}	250	270	mW
D_{tot}	10	7	%

DL94

MINIATURE OUTPUT PENTODE

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

Single section of filament.

V_a	85	V
V_{g2}	85	V
V_{g1}	–5.0	V
$I_{a(o)}$	3.5	mA
$I_{g2(o)}$	0.8	mA
R_a	20	kΩ
$V_{in(r.m.s.)}$	3.9	V
P_{out}	150	mW
D_{tot}	12	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH–PULL

Series or parallel filament connection.

V_a	82	90	V
V_{g2}	82	90	V
V_{g1}	–8.2	–9.4	V
$I_{a(o)}$	2×2.0	2×2.0	mA
I_a(max. sig.)	2×5.6	2×6.4	mA
$I_{g2(o)}$	2×0.5	2×0.5	mA
I_{g2}(max. sig.)	2×2.1	2×2.3	mA
R_{a-a}	14	14	kΩ
$V_{in(g-g)(r.m.s.)}$	12.2	14	V
P_{out}	460	580	mW
D_{tot}	3.5	3.8	%

Single section of filament.

V_a	82	90	V
V_{g2}	82	90	V
V_{g1}	–8.0	–9.1	V
$I_{a(o)}$	2×1.0	2×1.0	mA
I_a(max. sig.)	2×2.9	2×3.3	mA
$I_{g2(o)}$	2×0.3	2×0.3	mA
I_{g2}(max. sig.)	2×1.1	2×1.3	mA
R_{a-a}	30	30	kΩ
$V_{in(g-g)(r.m.s.)}$	12	13.8	V
P_{out}	230	300	mW
D_{tot}	2.6	2.7	%

LIMITING VALUES

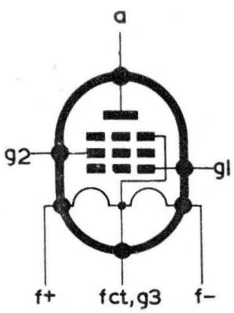
V_a max.	90	V
p_a max.	1	W
V_{g2} max.	90	V
p_{g2} max.	0.3	W
*I_k max.	12	mA
R_{g1-f} max.	1.0	MΩ

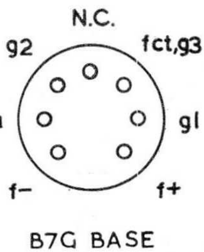
*I_k max. for each 1.4–volt section of filament is 6mA.

MINIATURE OUTPUT PENTODE

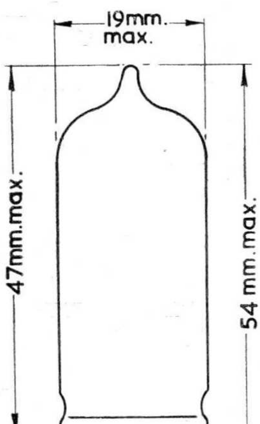
DL94

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





B7G BASE



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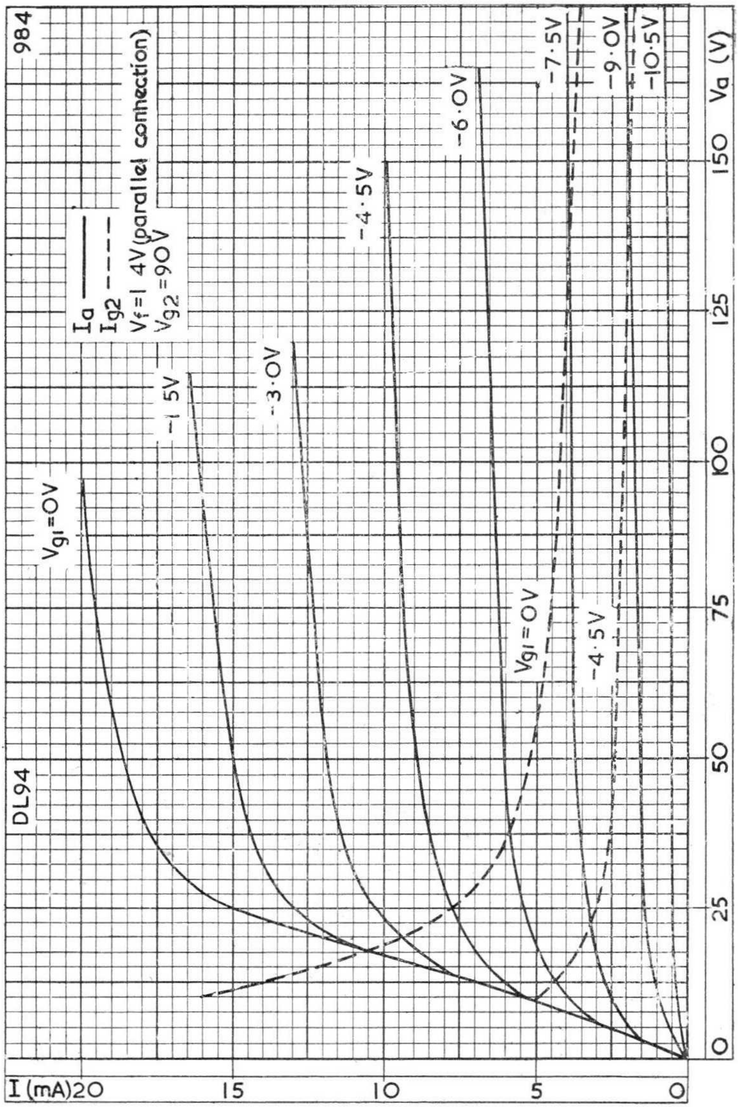
DL94

MINIATURE OUTPUT PENTODE

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



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

OUTPUT PENTODE

DL96

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

FILAMENT

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

Series

V_f applied across the two filament sections in series, between pins 1 and 7. V_{g1} referred to pin 1.

Parallel

V_f applied across the two filament sections in parallel, between pin 5 and pins 1 and 7 connected together. V_{g1} referred to pin 5.

Single Section

V_f applied across one section of the filament only, between pin 5 and either pin 1 or 7.

	Series	*Parallel*	
From a parallel supply			
V_f	2.8	1.4	V
I_f	25	50	mA
From a series supply			
V_f	2.6	1.3	V
I_f	24	48	mA

The filament must be shunted to ensure the correct filament voltage across each section. If separate l.t. and h.t. batteries are employed it is recommended that each filament section is shunted separately to h.t.

If a pair of valves are used in push-pull in a 50mA series chain, then the corresponding filament sections of each valve must be connected in parallel and the pairs of sections in series. A resistor must shunt the more negative pair of sections. V_{g1} referred to pin 1.

CAPACITANCES

c_{a-g1}	<0.4	pF
c_{in}	4.8	pF←
c_{out}	4.4	pF←

CHARACTERISTICS (parallel filament connection)

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	3.5	5.0	mA
I_{g2}	650	900	μA
g_m	1.3	1.4	mA/V
μ_{g1-g2}	7.0	7.0	
r_a	170	150	kΩ
V_{g1} max. ($I_{g1}=+0.3\mu$A)		0	V

DL96

OUTPUT PENTODE

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER ←

Series filament connection

V_b	90	V
V_a	85	V
V_{g2}	85	V
V_{g1}	−5.2	V
I_a	4.3	mA
I_{g2}	700	µA
R_a	15	kΩ
$V_{in(r.m.s.)}$	3.0	V
P_{out}	160	mW
D_{tot}	10	%

Parallel filament connection

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	3.5	5.0	mA
I_{g2}	650	900	µA
R_a	15	13	kΩ
$V_{in(r.m.s.)}$	2.6	3.5	V
P_{out}	100	200	mW
D_{tot}	10	10	%

Single section of filament

V_b	67.5	90	V
V_a	64	85	V
V_{g2}	64	85	V
V_{g1}	−3.3	−5.2	V
I_a	1.75	2.5	mA
I_{g2}	330	450	µA
R_a	30	25	kΩ
$V_{in(r.m.s.)}$	2.6	3.6	V
P_{out}	50	100	mW
D_{tot}	10	10	%

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

All filament sections in parallel

V_b	67.5	90	V
*R_k	470	560	Ω
$I_{a(o)}$	2×2.3	2×3.25	mA
I_a (max. sig.)	2×3.4	2×4.75	mA
$I_{g2(o)}$	2×430	2×600	µA
I_{g2} (max. sig.)	2×0.95	2×1.5	mA
R_{a-a}	20	20	kΩ
$V_{in(g1-g1)r.m.s.}$	11.4	15.8	V
P_{out}	220	420	mW
D_{tot}	3.0	4.0	%

*An additional 3.5mA is fed through R_k to simulate the current from previous stages.

OPERATING CONDITIONS FOR TWO VALVES IN CLASS "B" PUSH-PULL

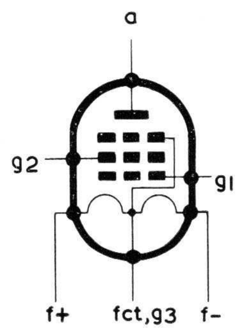
All filament sections in parallel

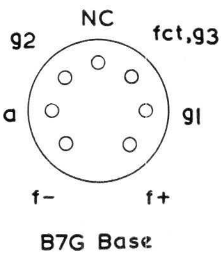
V_b	67.5	90	V
V_a	61.5	81.5	V
V_{g2}	61.5	81.5	V
V_{g1}	–5.8	–8.5	V
$I_{a(o)}$	2×0.75	2×1.0	mA
I_a (max. sig.)	2×3.4	2×5.0	mA
$I_{g2(o)}$	2×140	2×180	µA
I_{g2} (max. sig.)	2×0.95	2×1.3	mA
R_{a-a}	20	16	kΩ
$V_{in(g1-g1)r.m.s.}$	11.4	15.8	V
P_{out}	220	440	mW
D_{tot}	3.0	2.6	%

LIMITING VALUES

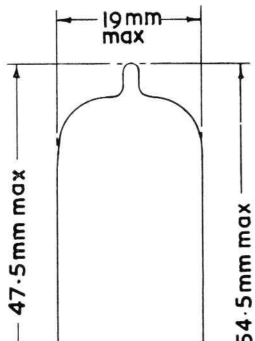
V_b max. (absolute)	110	V
V_b max.	90	V
V_a max.	90	V
p_a max.	600	mW
V_{g2} max.	90	V
p_{g2} max.	200	mW
*I_k max. (parallel filament connection)	6.0	mA
R_{g1-f} max.	2.0	MΩ

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





B7G Base



3373

R.F. OUTPUT PENTODE

DL98

R.F. output pentode intended for use in portable equipment as a class 'C' r.f. amplifier, oscillator and frequency multiplier.

FILAMENT

	Series	Parallel	
V_f	2.5	1.25	V
I_f	165	330	mA

When the filament sections are series connected, the lower section of the filament should be shunted by a resistor to by-pass the cathode current of the upper section.

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{a-g1}	< 160	mpF
c_{in}	4.6	pF
c_{out}	7.6	pF

CHARACTERISTICS

V_a	90	135	V←
V_{g2}	90	120	V←
I_a	15	30	mA
I_{g2}	1.0	1.8	mA
g_m	1.7	2.15	mA/V←
r_a	22	22	kΩ
μ_{g1-g2}	3.2	3.45	
V_{g1}	−9.9	−10	V

OPERATING CONDITIONS

As class 'C' amplifier or oscillator

		†	
f	100	100	Mc/s
V_a	90	150	V
V_{g2}	90	135	V
V_{g1}	−18	−39	V
I_a	15	25	mA
I_{g2}	4.8	6.2	mA
I_{g1}	400	550	μA
P_{drive}	30	70	mW
P_{load}	0.45	1.25	W

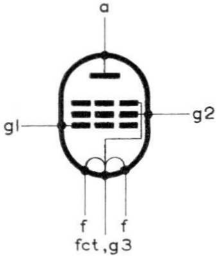
†This condition represents operation at the absolute limit of V_a, V_{g2} and I_a

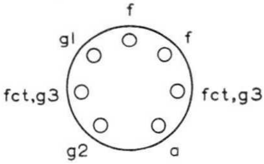
DL98

R.F. OUTPUT PENTODE

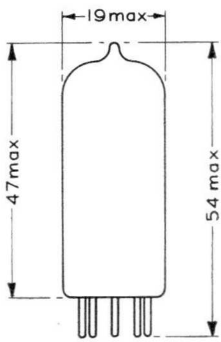
ABSOLUTE MAXIMUM RATINGS

V_a max.	150	V
p_a max.	3.0	W
V_{g2} max.	135	V
p_{g2} max.	1.1	W
$-V_{g1}$ max.	75	V
I_a max.	25	mA
I_{g1} max.	1.5	mA
R_{g1-k} max.	100	kΩ
I_k max.	32	mA





B7G Base



5485

All dimensions in mm

SUBMINIATURE OUTPUT PENTODE DL620

Subminiature output pentode suitable for battery operation with an h.t. supply of 90V.

FILAMENT

Suitable for d.c. operation only.

V_f	1.25	V
I_f	50	mA

MOUNTING POSITION

Any

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

CAPACITANCES (measured without external shield)

c_{a-g1}	<0.2	pF
c_{in}	2.8	pF
c_{out}	3.5	pF

CHARACTERISTICS

V_a	67.5	V
V_{g2}	67.5	V
I_a	3.1	mA
I_{g2}	950	μA
V_{g1}	−6.5	V
g_m	650	μA/V
r_a	110	kΩ
μ_{g1-g2}	5.0	

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	45	67.5	90	V
V_{g2}	45	67.5	67.5	V
$I_{a(o)}$	1.8	3.25	3.25	mA
$I_{g2(o)}$	0.6	1.0	0.9	mA
$I_{g2\ (max.sig.)}$	1.1	1.75	1.5	mA
V_{g1}	−3.8	−6.2	−6.7	V
$V_{in(r.m.s.)}$	3.4	5.0	4.8	V
R_a	20	15	25	kΩ
P_{out}	30	85	110	mW
D_{tot}	10	10	10	%

DL620

SUBMINIATURE OUTPUT PENTODE

Subminiature output pentode suitable for battery operation with an h.t. supply of 90V.

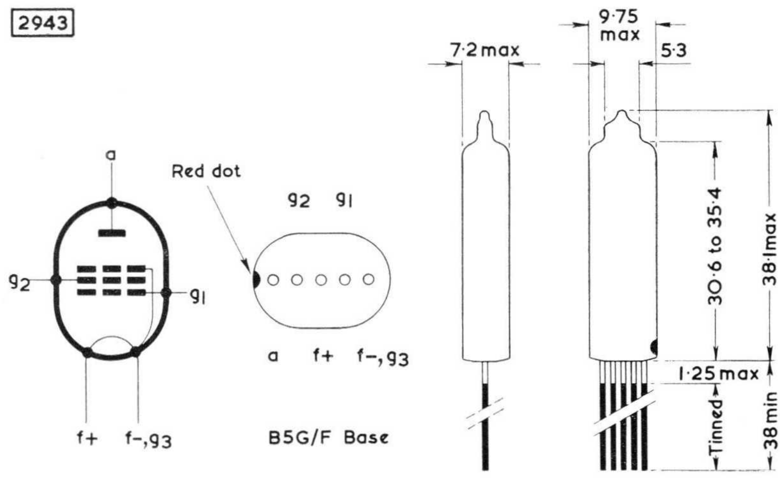
OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL CLASS 'AB'

V_{a-e}	67.5	V
V_{g2-e}	67.5	V
$I_{a(o)}$	3.3	mA
$I_{a\ (max.\ sig.)}$	3.6	mA
$I_{g2(o)}$	1.0	mA
$I_{g2\ (max.\ sig.)}$	2.25	mA
R_k	1.8	kΩ
R_{a-a}	30	kΩ
$V_{in(g1-g1)r.m.s.}$	16	V
P_{out}	100	mW
D_{tot}	3.0	%

LIMITING VALUES

V_a max.	90	V
V_{g2} max.	90	V
I_k max.	5.0	mA

2943



All dimensions in mm

SUBMINIATURE TUNING INDICATOR

DM70

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

FILAMENT

V_f	1.4	V
I_f	25	mA

Notes on filament voltage supplies :—

Battery-operated receivers

The filament may be fed from a 1.4V battery or it may be connected in series with the filaments of other valves in the receiver, provision being made for a suitable shunting resistor if necessary. The operating conditions indicate which filament pin should be connected to the earthed side of the demodulator circuit.

Mains-operated receivers ($V_f = 1.3$V)

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

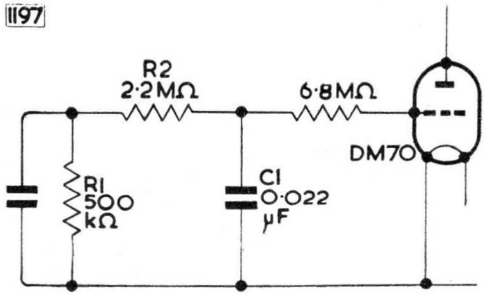
*Length of fluorescent column observed, measured from the top of the aperture. The maximum value is approximately 14 mm.

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

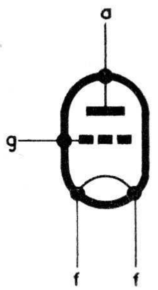
Directly heated subminiature tuning indicator suitable for use in mains or battery-operated receivers.

LIMITING VALUES

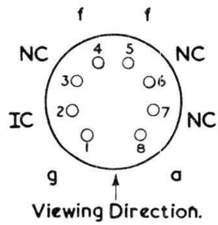
$V_{b(0)}$ max.	450	V
V_b max.	300	V
*V_a max.	90	V
V_a min.	45	V
**p_a max. ($V_a \leqq 90$ V)	25	mW
**p_a max. ($V_a = 200$ V)	10	mW
I_k max.	300	μA
R_{g-f} max.	10	MΩ

*In circuits without anode series resistor.

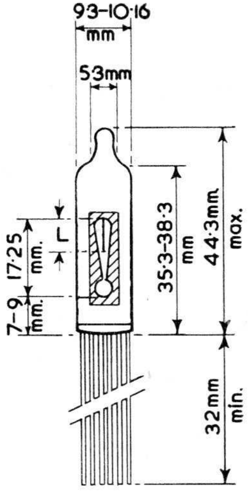
**Values of p_a max. for intermediate values of V_a may be determined by linear interpolation.



1198



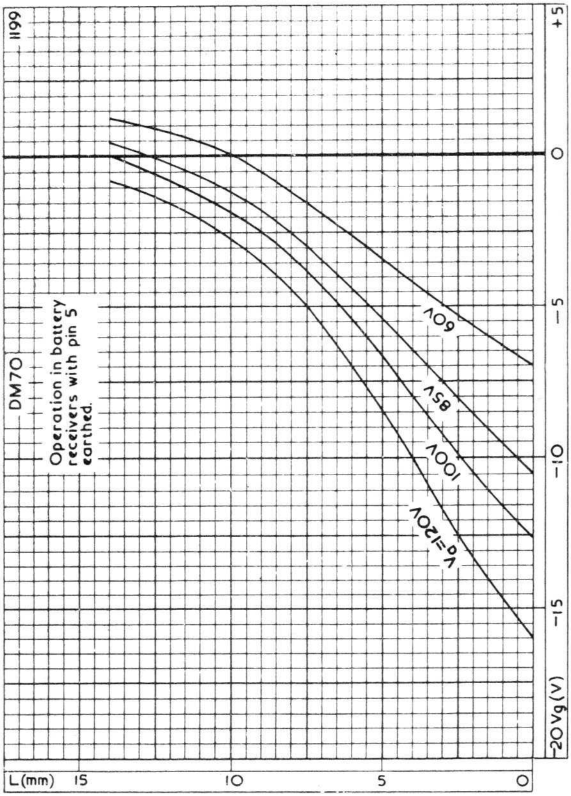
Viewing Direction.
B8D BASE
(10mm. subminiature.)



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.)

DIRECTLY HEATED FULL-WAVE RECTIFIER

DW4-350

FILAMENT

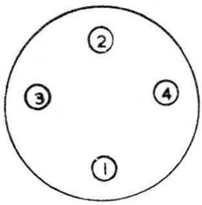
V_f	4.0	V
I_f	2.0	A

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×350	V
I_{out} max.	120	mA
C max.	16	μF
R_{lim} min.	0	Ω

CONNECTIONS

Brit. 4-Pin Base



Pin No. 1 Anode
,, 2 Anode
,, 3 Filament
,, 4 Filament

DIMENSIONS

Overall length	142	mm.
Overall diameter	51	mm.

SPECIAL QUALITY HIGH SLOPE PENTODE

E83F

Special quality high slope 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 Vh=6.3V is ±15mA.
In order to achieve a useful valve life with the heater in a series connected chain the absolute maximum variation of heater current due to voltage fluctuations and component tolerances should be $<\pm1.5\%$.

MOUNTING POSITION

Any

CAPACITANCES[2] (measured without an external shield)

c_{in} av.	8.0	pF
c_{in} max.	8.7	pF
c_{out} av.	3.6	pF
c_{out} max.	4.2	pF
c_{a-g1}	<0.015	pF
c_{g1-h}	<0.15	pF
c_{h-k}	4.0	pF
c_{in} (I_k=12.1mA)	10.8	pF
*$c_{g1-shield}$	<0.025	pF
*$c_{a-shield}$	<0.025	pF

*Capacitance of the electrode to a surrounding shield with an inner diameter of 52mm and a height of 98mm, all other electrodes being earthed.

CHARACTERISTICS[3]

V_{a-k}	210	V
V_{g3-k}	0	V
V_{g2-k}	120	V
R_k	165	Ω
*I_a	10±1.3	mA
*I_{g2}	2.1±0.4	mA
*g_m	9.0±1.2	mA/V
r_a	500	kΩ
r_a min.	300	kΩ
μ_{g1-g2}	34	
R_{eq} (r.f.)	750	Ω
R_{eq} max. (r.f.)	1.0	kΩ
R_{eq} max. (f=0 to 10kc/s)	36	kΩ
−*I_{g1} max. (R_{g1}=100kΩ)	0.5	μA
V_{g1-k} max. (I_a=500μA)	−5.25	V

*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	7.0	mA
I_{g2}	1.25	mA
g_m	6.4	mA/V
$-I_{g1}$ (R_{g1}=100kΩ)	1.0	μA

E83F

SPECIAL QUALITY HIGH SLOPE PENTODE

OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_{a-k}	120	210	V
V_{g3-k}	0	0	V
$V_{g2(b)}$	120	120	V
R_k	180	180	Ω
R_a	10	20	kΩ
R_{g2}	5.6	5.6	kΩ
I_a	8.3	8.3	mA
I_{g2}	1.7	1.7	mA
g_m	8.2	8.2	mA/V
r_a	420	440	kΩ
$V_{in\ (r.m.s.)}$	1.1	1.1	V
$V_{in\ (r.m.s.)}$ (P_{out}=50mW)	350	250	mV
P_{out}	340	660	mW
*P_{out}(I_{g1}=+0.3μA)	400	870	mW
D_{tot}	10	10	%

*Measured with R_{g1}=330kΩ

INSULATION

Between heater and cathode

V_h	6.3	V
V_{h-k}	100	V
Series resistor	1.0	MΩ
Leakage current	<15	μA

Between any two arbitrary electrodes >100 MΩ

LIMITING VALUES (design centre ratings)

$V_{a(b)}$ max.	550	V
V_a max.	210	V
p_a max.	2.1	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	210	V
p_{g2} max.	350	mW
I_k max.	16	mA
*$i_{k(pk)}$ max.	80	mA
V_{g1} max. (I_{g1}=+0.3μA)	−1.1	V
−V_{g1} max.	100	V
−*$v_{g1(pk)}$ max.	200	V
p_{g1} max.	50	mW
R_{g1-k} max. (cathode bias)	1.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ
T_{bulb} max. (absolute rating)	170	°C

*Max. duty cycle=10%, max. pulse duration=200μs

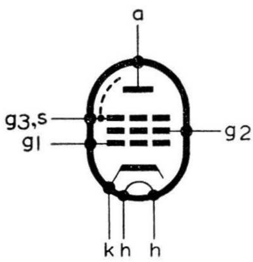
OPERATING NOTES

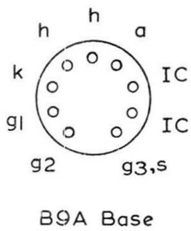
The hum voltage referred to g_1 has a maximum value of 500μV(r.m.s.) with a grid leak of 500kΩ.

SPECIAL QUALITY
HIGH SLOPE PENTODE

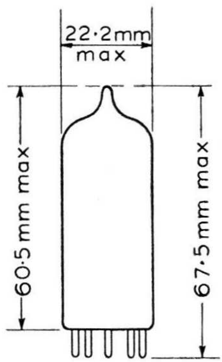
E83F

5167





B9A Base



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

SPECIAL QUALITY U.H.F. TRIODE

E86C

Special quality U.H.F. triode for use as amplifier, oscillator or mixer in grounded grid or grounded cathode circuits at frequencies up to 800 Mc/s, 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.

Vh[1]	6.3	V
Ih	165	mA

The maximum variation of heater current at Vh = 6.3 V is ± 10 mA.

CAPACITANCES[2]

	Minimum	Average	Maximum	
Unshielded				
ca - g	1.7	2.0	2.3	pF
ca - k	160	200	240	mpF
cg - k	3.0	3.6	4.2	pF
cg - k (Ia = 5.6 mA)	-	5.6	-	pF
cg - h	-	-	300	mpF
ck - g + h	5.5	6.6	7.7	pF
ca - g + h	1.75	2.1	2.45	pF
ca - k + h	250	300	350	mpF
cg - k + h	3.3	3.9	4.5	pF
$\triangle$cg - k (Ia 0 to 12 mA, Vh = 6.3 V)	-	2.0	-	pF
Shielded				
ca - g + s	2.8	3.1	3.4	pF
cg + s - k + h	3.6	4.2	4.8	pF
ca - k + h	200	250	300	mpF

CHARACTERISTICS

Va	175	V
Ia	12	mA
Vg	-1.5	V
gm	14	mA/V
μ	68	

OPERATING CONDITIONS

Grounded-grid r.f. amplifier

Va-e	175	185	V
Vg-e	0	+8.0	V
Rk	125	800	Ω
Ia	12	12	mA
gm	14	14	mA/V
Req (r.f.)	-	250	Ω
rg1 (f = 100 Mc/s)	-	2.0	kΩ
Øgm(f = 100 Mc/s)	-	-7.0	deg

Additive mixer

Vb	220	V
Ra	5.6	kΩ
Vosc (r.m.s.)	2.5	V
Rg-k	47	kΩ
Ig	50	μA
Ia	12	mA
gc	5.5	mA/V

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	Initial range	End of life *	
Anode current Va-e = 185V, Vg-e = +8V Rk = 800Ω	12	11.2 to 12.8	> 10.5	mA
Mutual conductance Va-e = 185V, Vg-e = +8V Rk = 800Ω	14	11.5 to 17	> 9.5	mA/V
Negative grid current Va-e = 185V, Vg-e = +8V Rk = 800Ω	-	< 0.5	< 1.0	μA

Negative grid voltage Va - e = 185V, Ia = 100μA	-	< 5.0	-	V
Insulation resistance anode to any electrode Vg = 300V grid to any electrode Vb = 100V	-	> 100	-	MΩ
Heater cathode insulation Vh - k = 100V	-	< 10	-	μA
Heater current Vh = 6.3V	165	155 to 175	-	mA

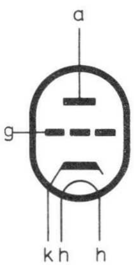
* To allow for valve deterioration during life, circuits should be designed to function with a valve in which one or more of the characteristics have changed to the values stated.

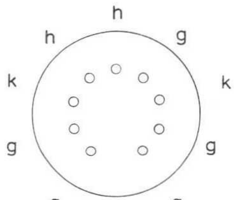
SHOCK AND VIBRATION

The E86C can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 400g.

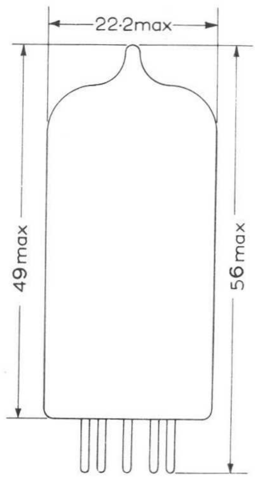
ABSOLUTE MAXIMUM RATINGS[4]

f max.	800	Mc/s
Va(b) max.	440	V
Va max.	250	V
pa max.	2.4	W
-Vg max.	50	V
Ik max.	20	mA
pg max.	20	mW
Rg - k max.	1.2	MΩ
Vh - k max.	100	V
T bulb max.	165	°C
Vh max.	6.6	V
Vh min.	6.0	V





B9A Base

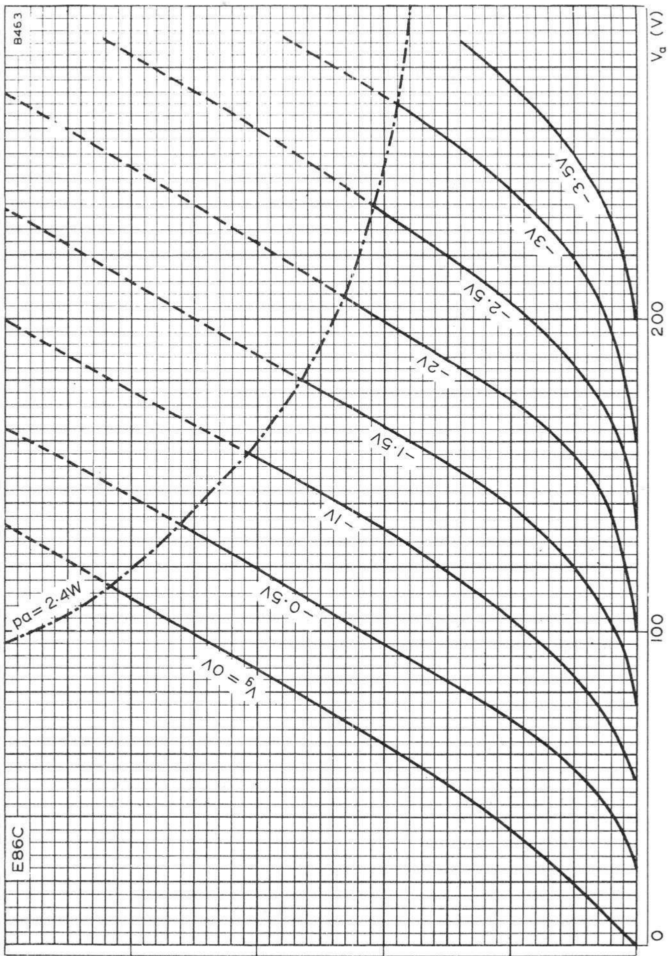


All dimensions in mm

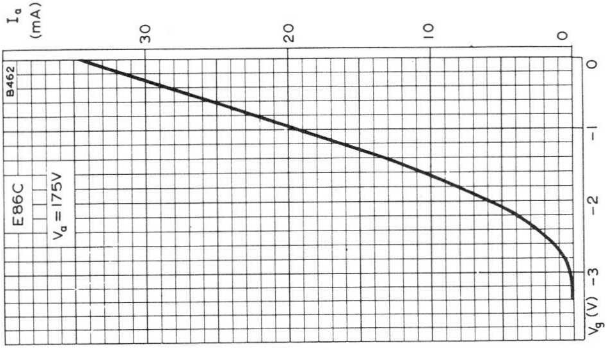
8370

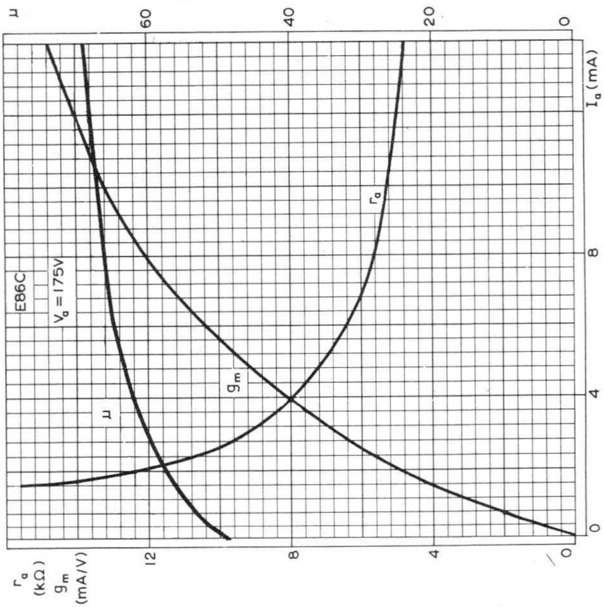
SPECIAL QUALITY
U.H.F. TRIODE

E86C



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





ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE. Va = 175 V.

MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT. Va = 175 V

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)

$c_{a'-g'}$	3.2 ± 0.5	pF
$c_{in'}$	3.4 ± 0.5	pF
$c_{out'}$	0.4 ± 0.07	pF
$c_{g'-h}$	<0.3	pF
$c_{a''-g''}$	3.5 ± 0.5	pF
$c_{in''}$	3.4 ± 0.5	pF
$c_{out''}$	0.35 ± 0.07	pF
$c_{g''-h}$	<0.15	pF
$c_{a'-a''}$	<1.4	pF
$c_{g'-g''}$	<0.22	pF
$c_{a'-g''}$	<0.15	pF
$c_{a''-g'}$	<0.35	pF
c_{k-h}	7.6	pF

CHARACTERISTICS[3] (each section)

V_a	100	V
I_a	8.5 ± 4.0	mA
V_g	−2.1	V
†g_m	6.0 ± 1.5	mA/V
μ	27	
V_g ($I_g = +0.3\mu A$)	−0.2	V
V_g max. ($I_g = +0.3\mu A$)	−1.3	V
R_k	0	Ω

†See note on page D2.

E90CC

SPECIAL QUALITY DOUBLE TRIODE

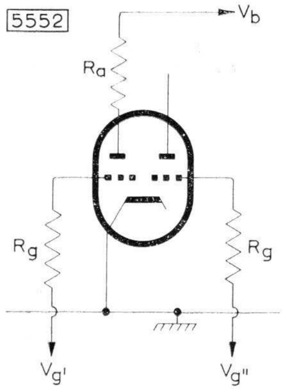


Fig. 1

BALANCE AND CUT-OFF CHARACTERISTICS (see fig. 1)

V_b	150	V
R_a	20	kΩ
R_g	47	kΩ
†I_a (at $V_{g(b)} = 0V$)	5.6 ±0.6	mA
†I_a (at $V_{g(b)} = -10V$)	<100	μA
†$V_{g'(b)} \sim V_{g''(b)}$ (at $I_a = 100\mu A$)	<2.0	V

†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 (at $V_{g(b)} = 0V$)	≤4.5	mA
I_a (at $V_{g(b)} = -10V$)	≥100	μA
g_m	≤3.0	mA/V
$V_{g'(b)} \sim V_{g''(b)}$	2.0	V

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
Max. bulb temperature	170	°C

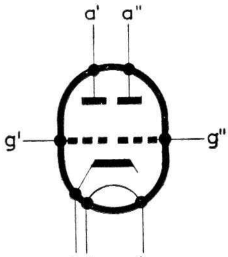
*Max. averaging time = 10ms

INSULATION

Between heater and cathode		
V_h	6.3	V
V_{h-k}	100	V
Leakage current	<50	μA
Between any two arbitrary electrodes	>20	MΩ

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.



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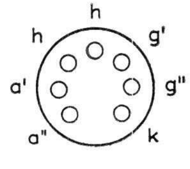
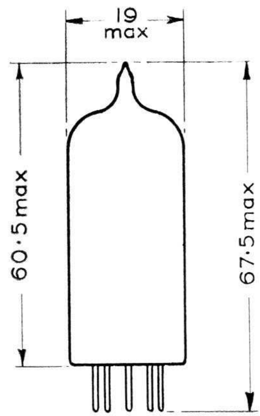
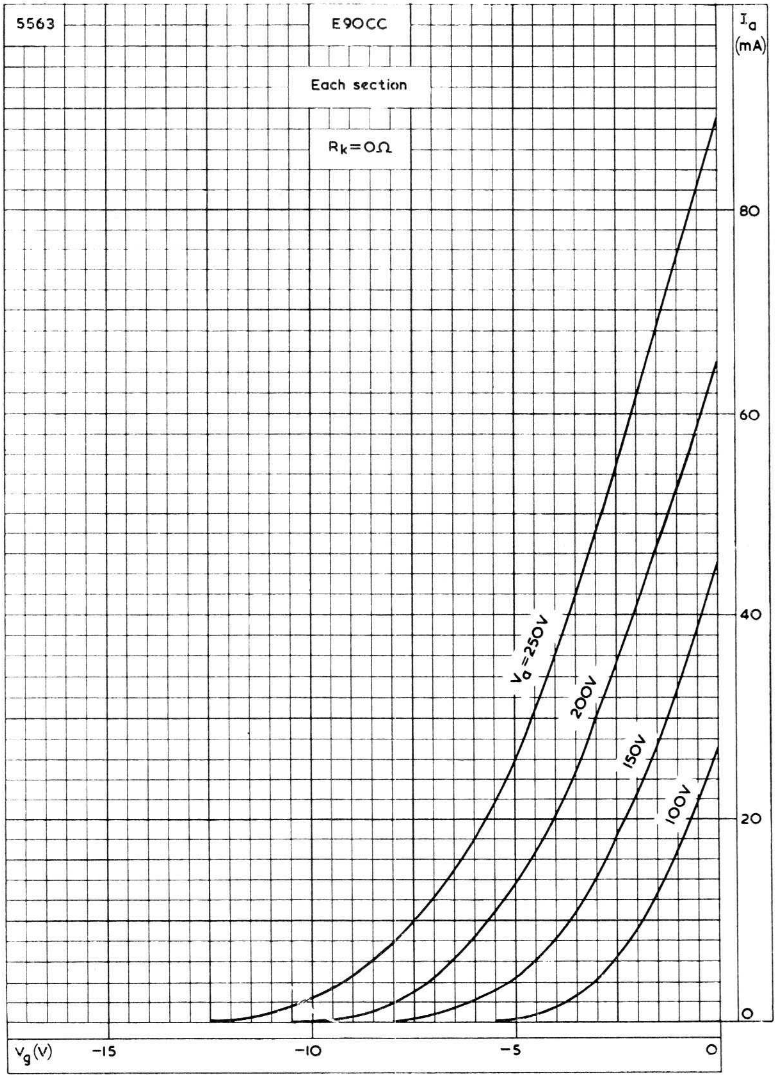


B7G Base



All dimensions in mm

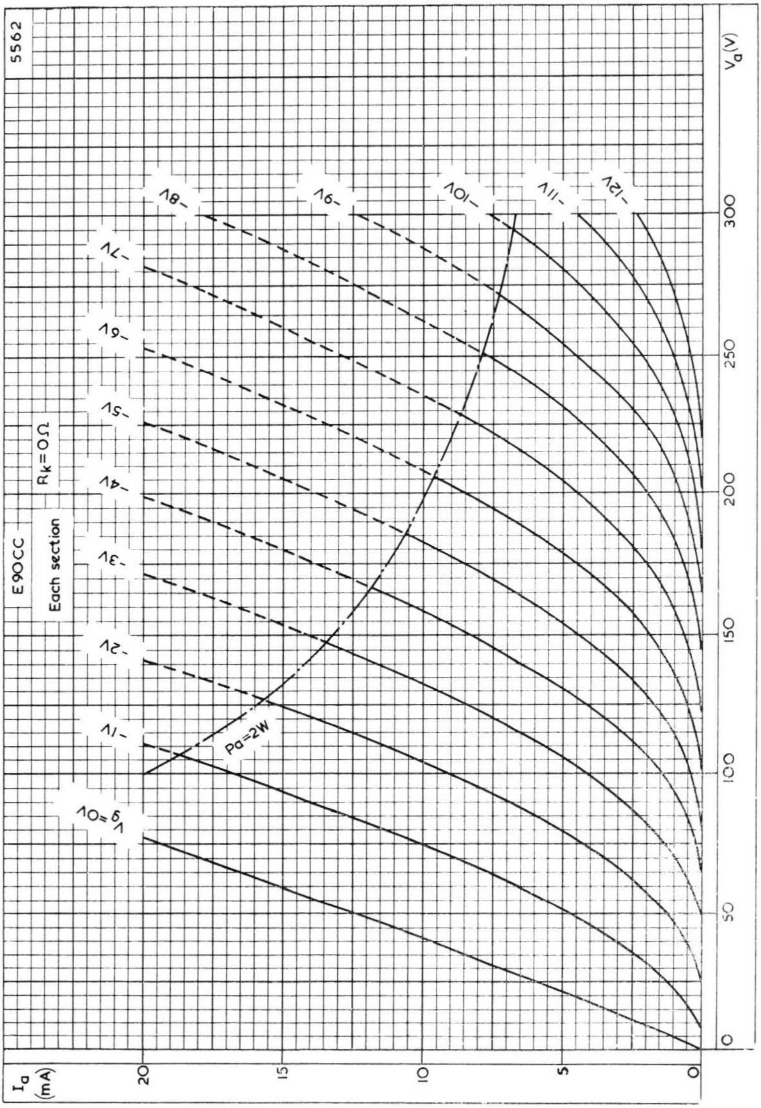
The bulb and base dimensions of this valve are in accordance with BS448, section B7G.



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER

E90CC

SPECIAL QUALITY DOUBLE TRIODE



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

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 $\pm20mA$. 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 $< \pm1.5\%$.

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

E90CC

SPECIAL QUALITY DOUBLE TRIODE

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

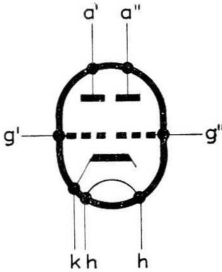
LIMITING VALUES[4] (absolute ratings) each section

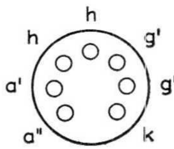
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
I_k max.	15	mA
$^*i_{k(pk)}$ max.	75	mA
$-V_g$ max.	100	V
$^*-v_{g(pk)}$ max.	200	V
$+V_g$ max.	0	V
I_g max.	250	µA
$^*i_{g(pk)}$ max.	1.0	mA
R_{g-k} max. (cathode bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	500	kΩ
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

*Max. averaging time = 10ms.

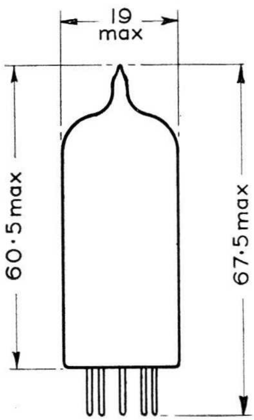
OPERATING NOTES

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 DUAL CONTROL HEPTODE

E91H

Special quality dual control heptode for use as a gating valve in computer 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	270	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 14mA$.

MOUNTING POSITION — Any

CAPACITANCES[2] (measured without an external shield)

c_{a-g1}	<0.08	pF
c_{a-g3}	<0.45	pF
c_{g1-g3}	<0.2	pF
c_{g1-all}	5.4	pF
c_{g3-all}	7.0	pF←
c_{a-all}	7.9	pF←

CHARACTERISTICS[3] (see fig. 1)

$V_{a(b)}$	150	150	150	150	V
$V_{g2+g4(b)}$	75	75	75	75	V
$V_{g1(b)}$	0	0	−10	0	V
$V_{g3(b)}$	0	−10	0	+55	V
R_a	20	20	20	—	kΩ
R_{g2+g4}	470	470	470	—	Ω
R_{g1}	47	47	47	—	kΩ
R_{g3}	47	47	47	—	kΩ
I_a	>5.5 <7.0	<0.2	<0.2	—	mA←
I_{g3}	—	—	—	>0	mA

2551

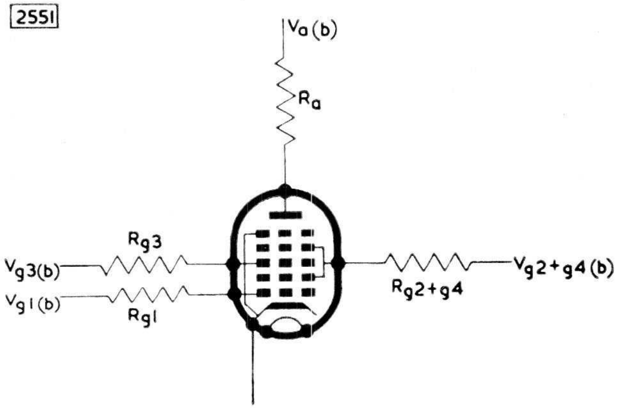


Fig 1

Inverse grid current (g_1 and g_3)

$V_{a(b)}$	150	V
$V_{g2+g4(b)}$	75	V
$V_{g1(b)}$	−1.5	V
$V_{g3(b)}$	−1.5	V
R_a	20	kΩ
R_{g2+g4}	470	Ω
R_{g1}	47	kΩ
R_{g3}	47	kΩ
$-I_{g1}$	<0.2	μA
$-I_{g3}$	<0.5	μA←

INSULATION

Between heater and cathode.

V_h	6.3	V
V_{h-k}	120	V
Leakage current	<15	μA

TYPICAL OPERATING CONDITIONS

As a frequency changer

V_a	250	V
V_{g2+g4}	100	V
V_{g3}	−5.0	V
I_a	3.3	mA
I_{g2+g4}	6.5	mA
$V_{g1(r.m.s.)}$	10	V
I_{g1}	530	μA
R_{g1}	20	kΩ
g_c	450	μA/V
r_a	850	kΩ

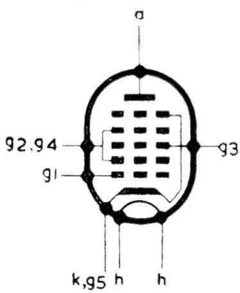
SPECIAL QUALITY DUAL CONTROL HEPTODE

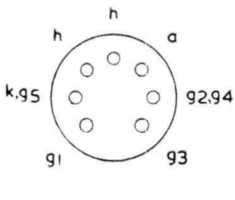
E91H

LIMITING VALUES[4] (absolute ratings)

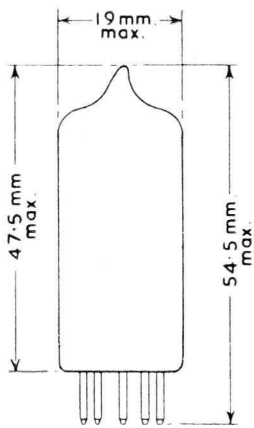
$V_{a(b)}$ max.	500	V
V_{a} max.	250	V
p_{a} max.	1.0	W
$V_{g2+g4(b)}$ max.	500	V
V_{g2+g4} max.	100	V
p_{g2+g4} max.	1.0	W
$+V_{g1}$ max.	0	V
$-V_{g1}$ max.	100	V
$-v_{g1(pk)}$ max.	200	V
p_{g1} max.	500	mW
$+V_{g3}$ max.	0	V
$-V_{g3}$ max.	100	V
$+v_{g3(pk)}$ max.	90	V
$-v_{g3(pk)}$ max.	200	V
p_{g3} max.	500	mW
I_{k} max.	20	mA
$i_{k(pk)}$ max.	70	mA
R_{g1-k} max. (cathode bias)	1.0	MΩ
R_{g1-k} max. (fixed bias)	500	kΩ
R_{g3-k} max. (cathode bias)	1.0	MΩ
R_{g3-k} max. (fixed bias)	500	kΩ
V_{h-k} max.	120	V

1507





B7G Base.



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

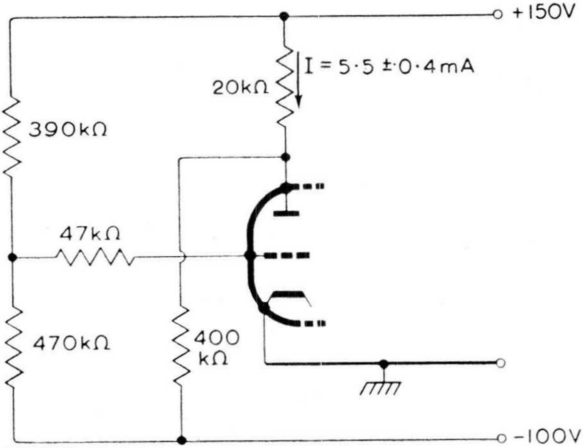


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Fig.1

E92CC SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

INSULATION

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

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

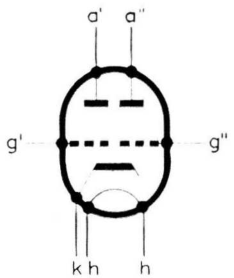
LIMITING VALUES[4] (absolute ratings) each section

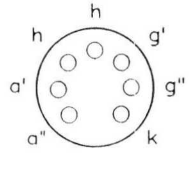
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
$+V_g$ max.	500	mV
$-V_g$ max.	100	V
†$-v_{g(pk)}$ max.	200	V
I_k max.	15	mA
†$i_{k(pk)}$ max.	75	mA
I_g max.	250	μA
†$i_{g(pk)}$ max.	1.0	mA
R_{g-k} max. (self bias)	1.0	$M\Omega$
R_{g-k} max. (fixed bias)	500	$k\Omega$
V_{h-k} max.	100	V
T_{bulb}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

†Maximum duration = 10ms

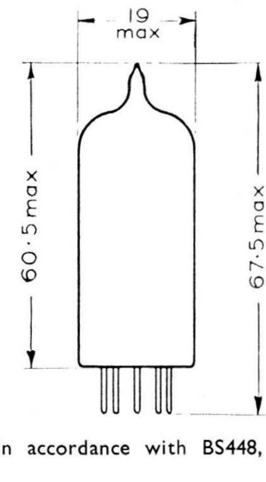
OPERATING NOTE

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





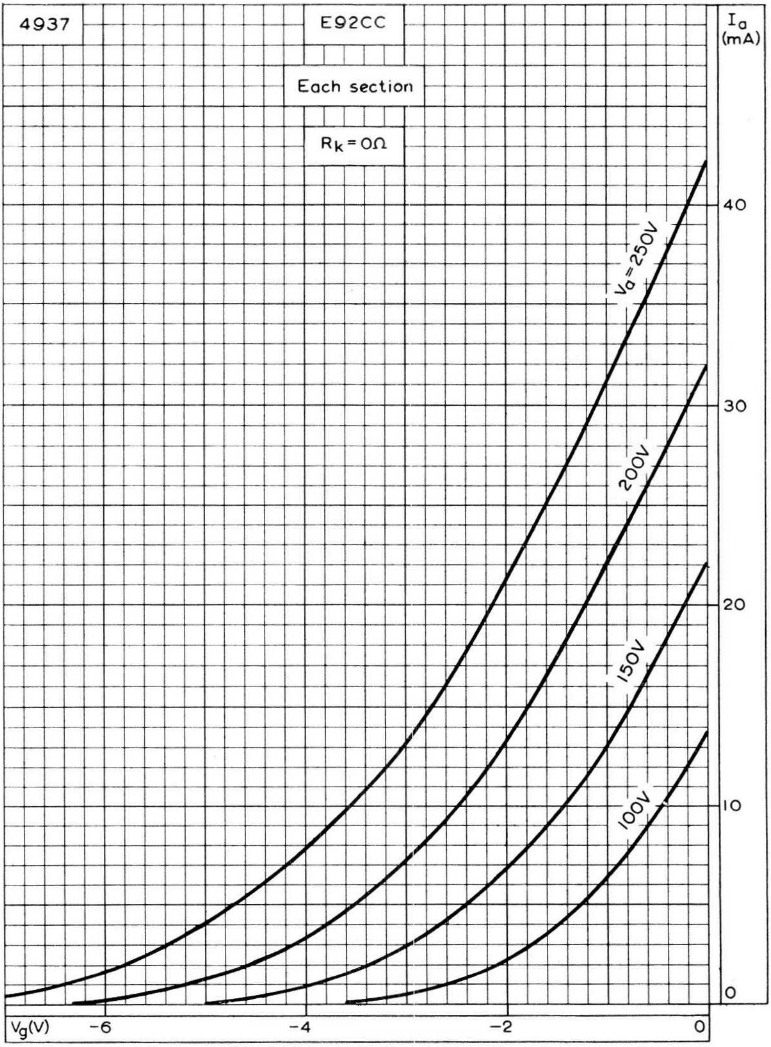
B7G Base



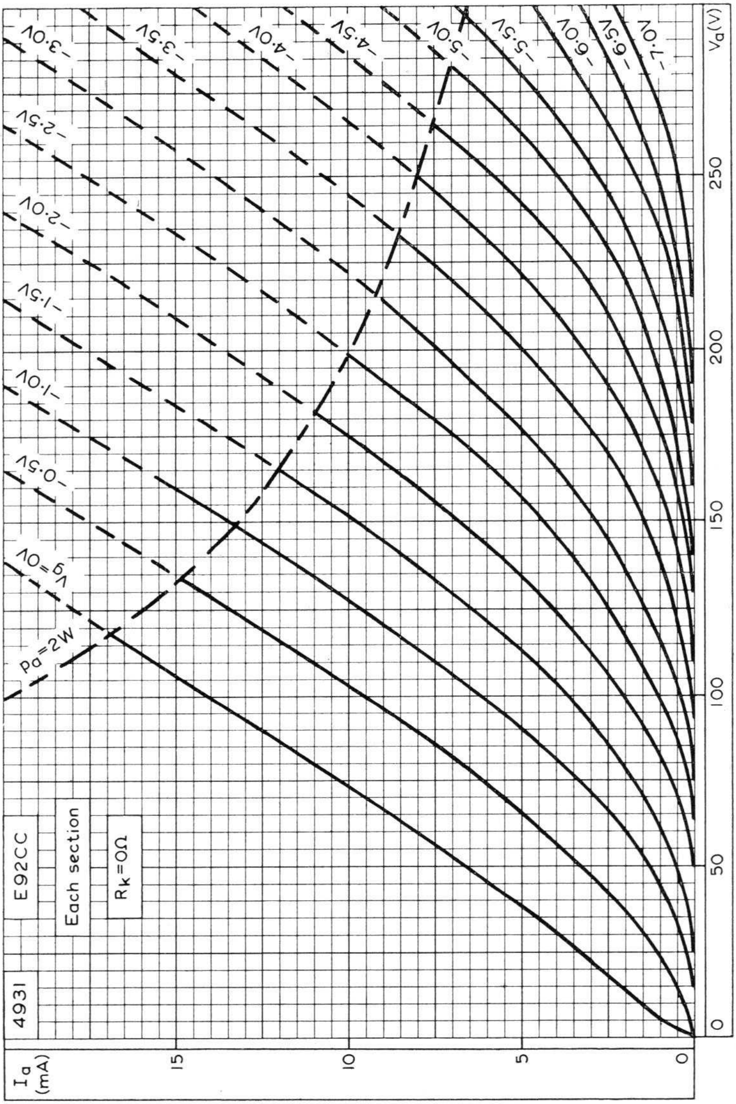
5770

All dimensions in mm

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

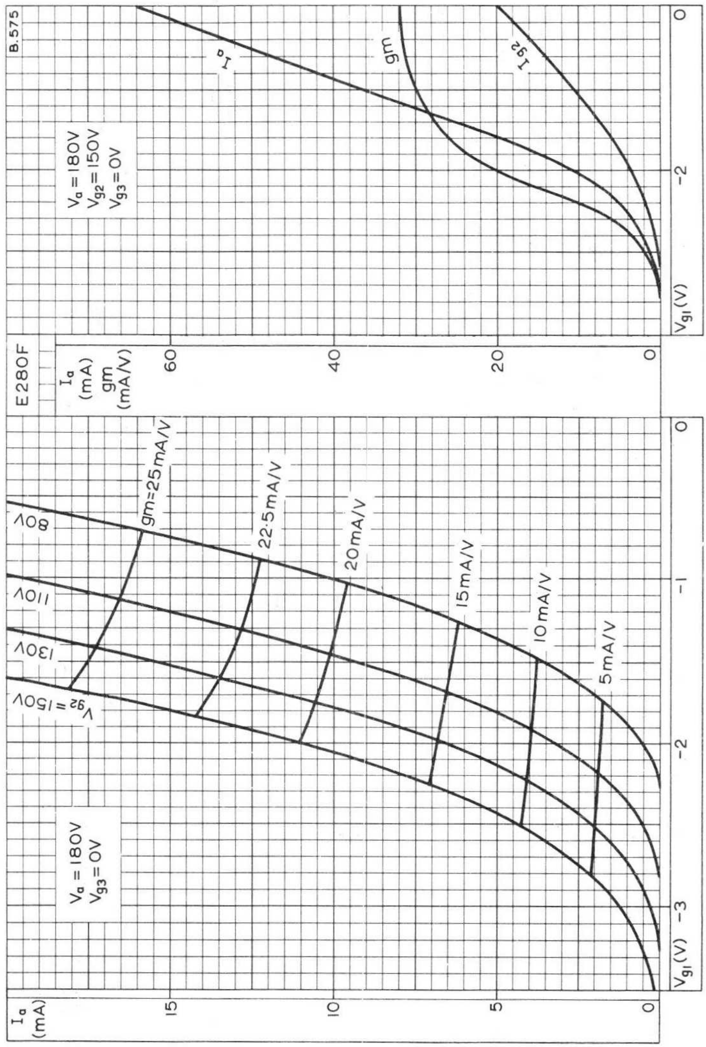


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER FOR EACH SECTION

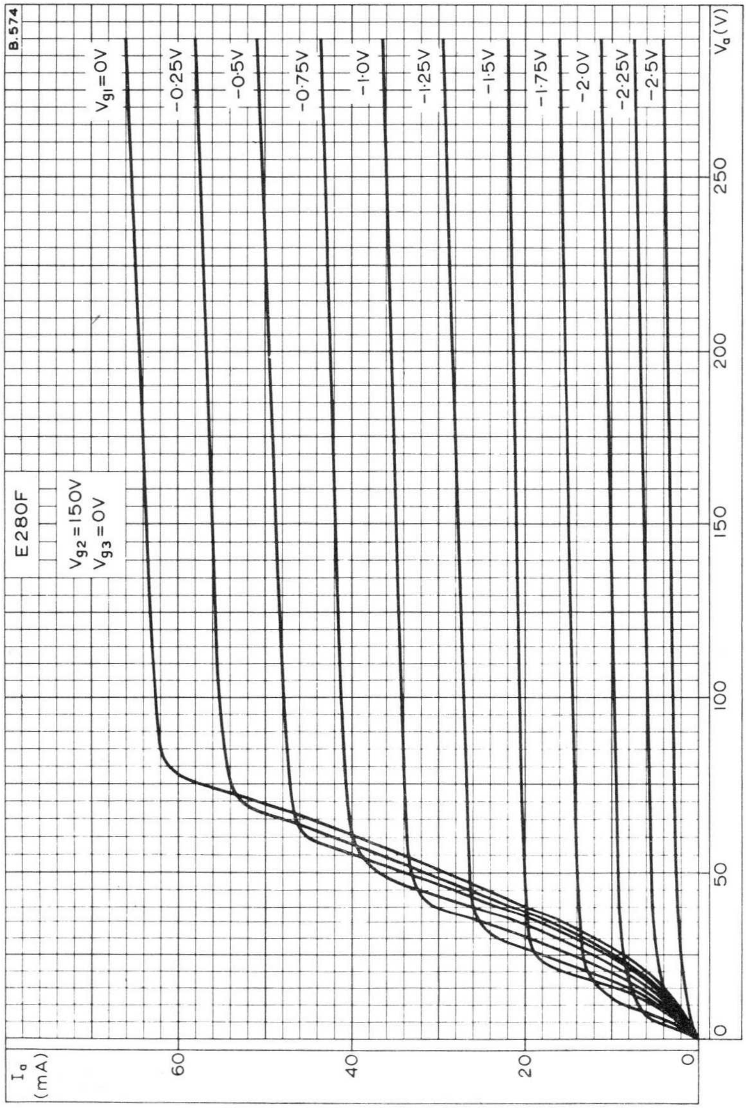


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER FOR EACH SECTION

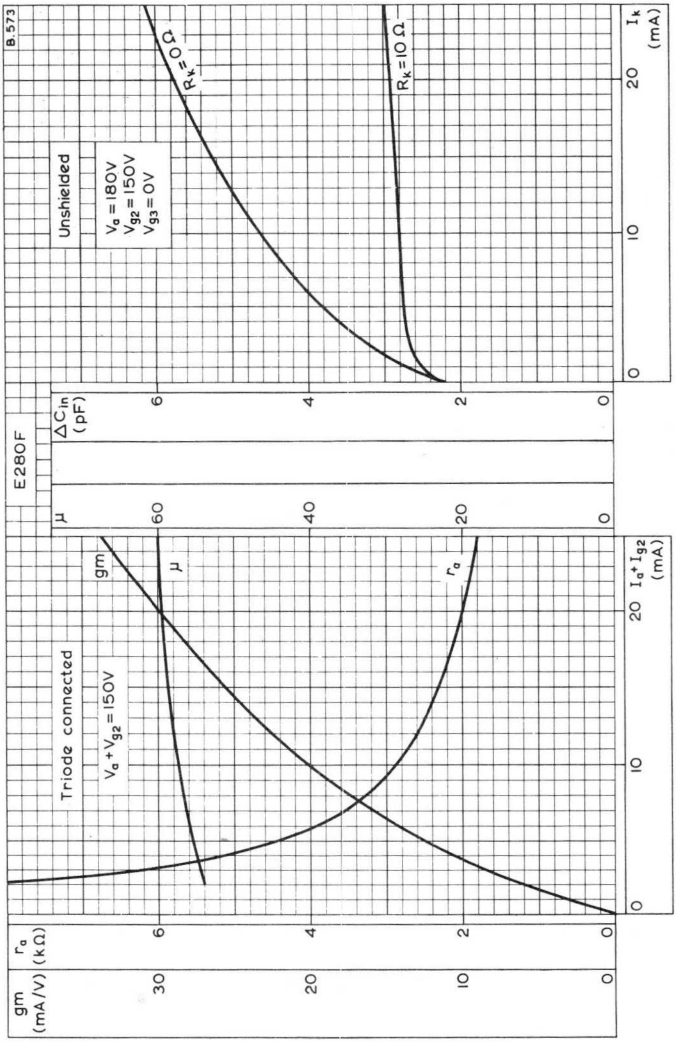
Special quality high slope pentode for use as a wideband amplifier where stability of characteristics and long life are required.



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER $V_a = 180V$
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_{g2} = 150V$



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



MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND AMPLIFICATION FACTOR PLOTTED AGAINST CATHODE CURRENT. TRIODE CONNECTED. CHANGE IN INPUT CAPACITANCE (UNSHIELDED) PLOTTED AGAINST CATHODE CURRENT

SPECIAL QUALITY PENTODE

E280F

Special quality high slope pentode for use as a wideband amplifier where stability of characteristics and long life are required.

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

HEATER

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

V_h[1]	6.3	V
I_h	315	mA

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

CAPACITANCES[2]

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

CHARACTERISTICS[3]

Pentode connected

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

Triode connected

(g_2 to a, g_3 to k)

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

E280F

SPECIAL QUALITY PENTODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

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

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

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

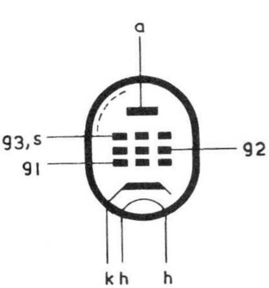
*Pins 1 and 3 strapped together.

**Measured without external shield. ←

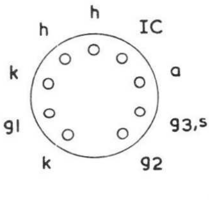
†Gain bandwidth product $= \dfrac{g_m}{2\pi(c_{in(w)} + c_{out} + 5pF)}$

ABSOLUTE MAXIMUM RATINGS[4]

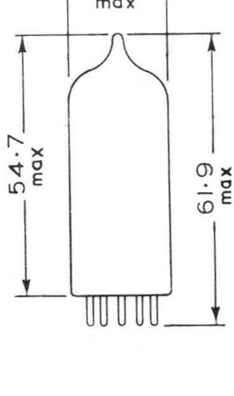
$V_{a(b)}$ max.	400	V
V_{a} max.	220	V
p_{a} max.	4.0	W
$V_{g2(b)}$ max.	400	V
V_{g2} max.	180	V
p_{g2} max.	1.1	W
$-V_{g1}$ max.	50	V
$+V_{g1}$ max.	2.0	V
I_{g1} max.	5.0	mA
I_{k} max.	30	mA
R_{g1-k} max.	500	kΩ ←
V_{h-k} (k positive) max.	120	V
V_{h-k} (k negative) max.	60	V
T_{bulb} max.	180	°C
V_{h}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



B563



B9A Base



SPECIAL QUALITY WIDEBAND R.F. PENTODE

E810F

Special quality high slope pentode designed for use in industrial equipment where stability of characteristics and long life are required.

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

HEATER

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

V_h [1]	6.3	V
I_h	340	mA

The maximum variation of heater current at 6.3V is ±20mA.

CAPACITANCES[2]

Heptode connected

Shielded	Min.	Av.	Max.	
c_{a-g1}	-	-	32	mpF
c_{in}	13	14.5	16	pF
$c_{in(w)}$ (I_k = 40mA)	22	24	26	pF
c_{out}	3.9	4.1	4.3	pF
c_{a-k}	26	33	40	mpF
c_{g1-h}	35	55	75	mpF
c_{a-h}	12	20	28	mpF
c_{h-k}	4.2	5.2	6.2	pF
Unshielded				
c_{a-g1}	-	-	36	mpF
c_{in}	13	14.5	16	pF
$c_{in(w)}$ (I_k = 40mA)	22	24	26	pF
c_{out}	3.2	3.5	3.8	pF
c_{a-k}	53	60	67	mpF
c_{g1-h}	40	60	80	mpF
c_{a-h}	26	31	36	mpF

Triode connected

	Unshielded	Shielded	
c_{in}	10	10	pF
c_{out}	7.2	8.2	pF
c_{a-g}	4.7	4.6	pF

CHARACTERISTICS[3]

Pentode connected

V_a	120	V
V_{g3}	0	V
V_{g2}	150	V
V_{g1}	-1.9	V
R_k	0	Ω
I_a	35	mA
I_{g2}	5.0	mA
g_m	50	mA/V
r_a	42	kΩ
μ_{g1-g2}	57	
r_{g1} (f = 100MHz)	420	Ω
R_{eq} (f = 40MHz)	110	Ω

Triode connected (g_2 to a, g_3 to k)

V_a	150	V
V_{g1}	-2	V
I_a	35	mA
g_m	53	mA/V
r_a	1.1	kΩ ←
μ	57	

CHARACTERISTIC RANGE VALUE FOR EQUIPMENT DESIGN

	Average	Initial range	End of Life*	
Anode current				
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = 0V, R_k = 47Ω	35	31 to 39	25	mA
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = +12.5V, R_k = 360Ω	35	34 to 36	-	mA
Screen-grid current				
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = +12.5V, R_k = 360Ω	5	4.4 to 5.6	-	mA
Mutual conductance				
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = +12.5V, R_k = 360Ω	50	42 to 58	35	mA/V
Negative control-grid current				
at V_{a-e} = 135V, V_{g2-e} = 165V, V_{g1-e} = +12.5V, R_k = 360Ω	-	<0.1	<0.2	µA

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

SPECIAL QUALITY WIDEBAND R.F. PENTODE

E810F

Insulation

	Initial Range	End of Life	
Between heater and cathode measured at V_{h-k} = 100V Leakage current	<10	<20	μA
Between any two arbitrary electrodes except k-g1 measured at 250V	>100	>40	MΩ

OPERATING CONDITIONS

V_{a-e}	135	V
V_{g3-e}	0	V
V_{g2-e}	165	V
V_{g1-e}	+12.5	V
R_k	360	Ω
I_a	35	mA
I_{g2}	5.0	mA
g_m	50	mA/V

SHOCK AND VIBRATION

The E810F can withstand vibrations of 2.5g at 50Hz for 32 hours and is proof against impact accelerations of approximately 500g.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

$V_{a(b)}$ max.	400	V
V_a max.	250	V
p_a max.	5.0	W
$V_{g2(b)}$ max.	400	V
V_{g2} max.	200	V
p_{g2} max.	1.0	W
$-v_{g1(pk)}$ max.	50	V
$-V_{g1}$ max.	25	V
$+V_{g1}$ max.	0	V
*I_k max.	50	mA
R_{g1-k} max.	200	kΩ
V_{h-k} max.	100	V
*T_{bulb} max.	200	°C

*In applications where a long life is not required, I_k max. can be increased to 65mA and T_{bulb} max. to 220°C.

OPERATING NOTES

1. Hum

The hum referred to g_1 has a maximum value of 150μVr.m.s. measured under the following conditions:

V_h (centre tap earthed)	6.3	V
V_{a-k}	120	V
V_{g2-k}	150	V
V_{g3-k}	0	V
R_{g1-k}	500	kΩ
R_k	47	Ω
C_k	1000	pF

2. Microphony

The microphonic noise voltage has a maximum value of 25mVr.m.s. at 50Hz and a maximum value of 500mVr.m.s. over the frequency range 50 to 2000Hz measured at the anode, under the following conditions:

V_h	6.3	V
$V_{a(b)}$	155	V
V_{g2-e}	160	V
v_{g3-k}	0	V
V_{g1-e}	+7	V
R_a	680	Ω
R_k	220	Ω
C_k	0	μF
peak acceleration	10	g

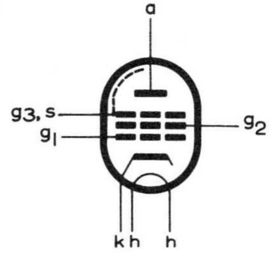
3. Distortion

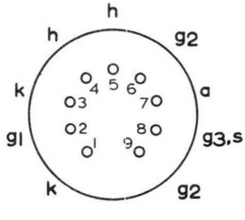
The average value of harmonic distortion is 7.5% when $i_{a(pk)}$ = 40mA measured under the following conditions:

V_h	6.3	V
$V_{a(b)}$	155	V
V_{g2-e}	165	V
V_{g3-k}	0	V
V_{g1-e}	+12.5	V
I_a	35	mA
R_a	560	Ω
R_k	360	Ω
C_k	1000	μF

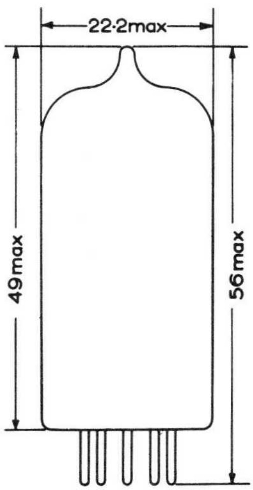
SPECIAL QUALITY WIDEBAND R.F. PENTODE

E810F





B9A Base



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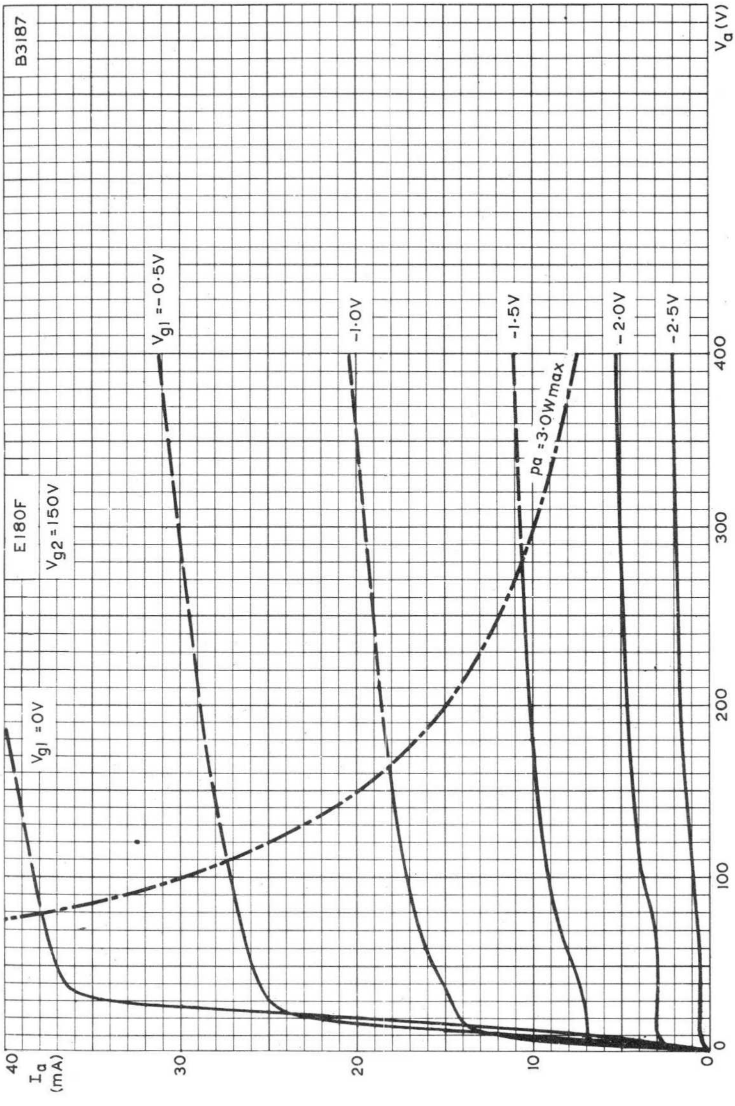
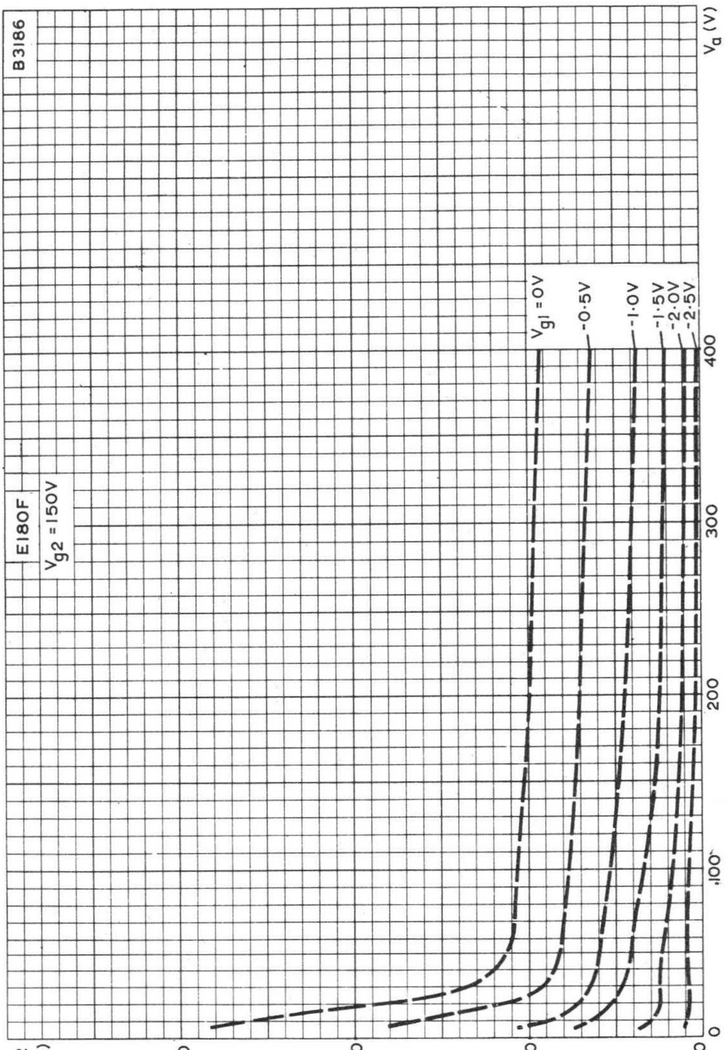
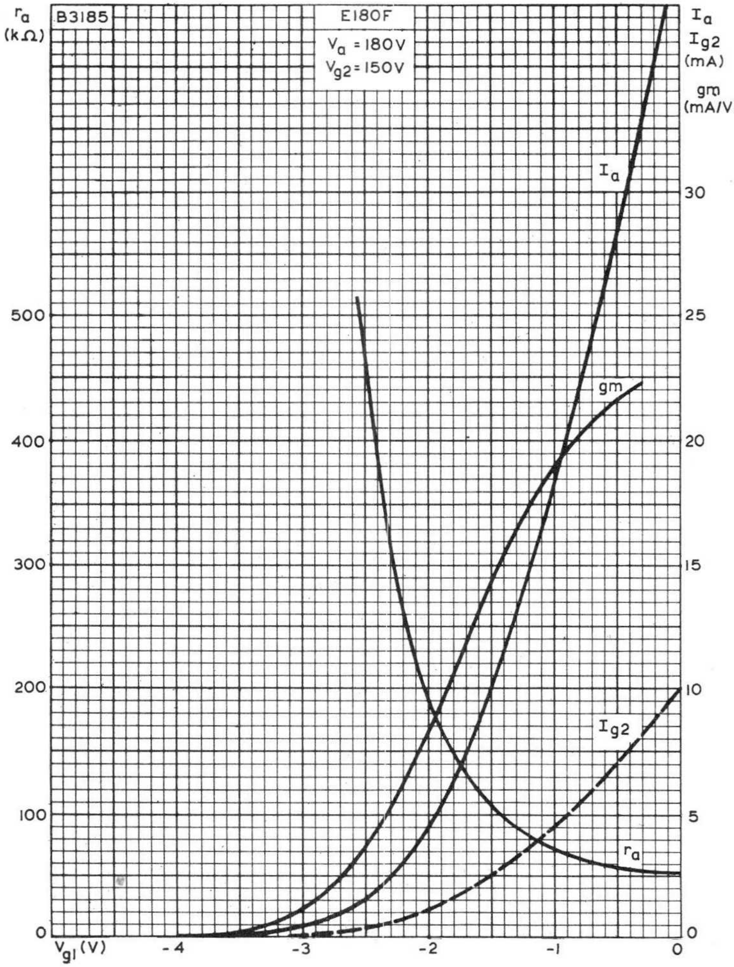
All dimensions in mm



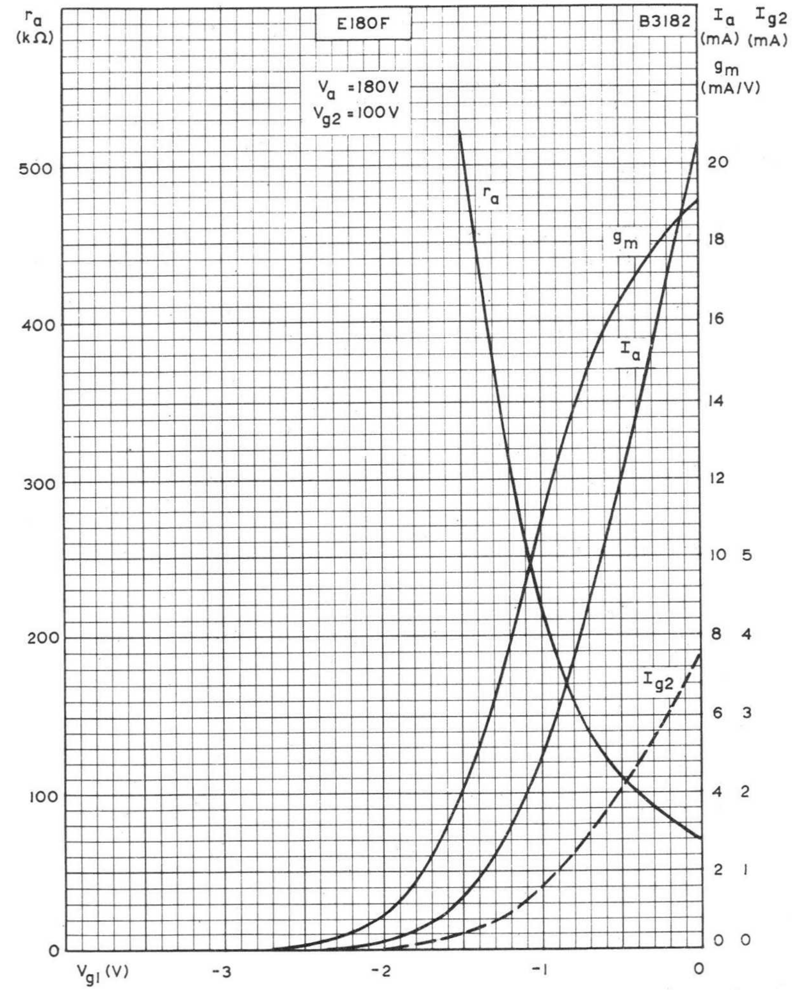
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. Vg2 = 150V



SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER. Vg2 = 150V

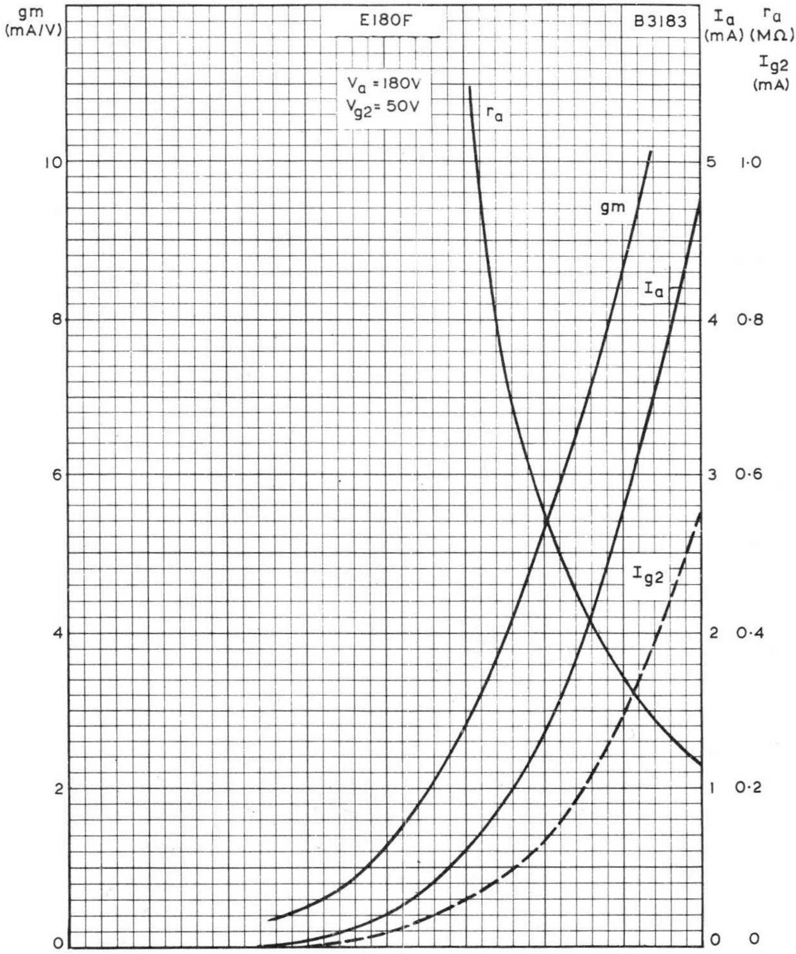


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
Va = 180V, Vg2 = 150V.



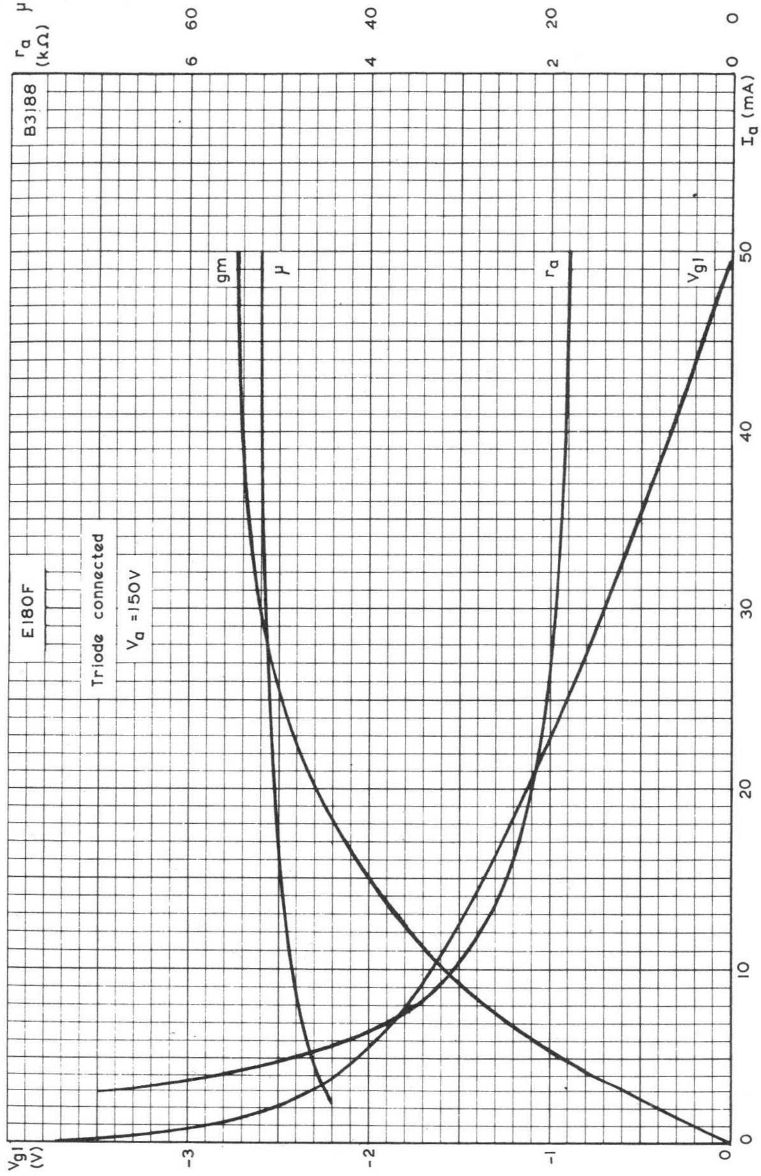
ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST COLTROL-GRID VOLTAGE.

Va = 180V, Vg2 = 100V

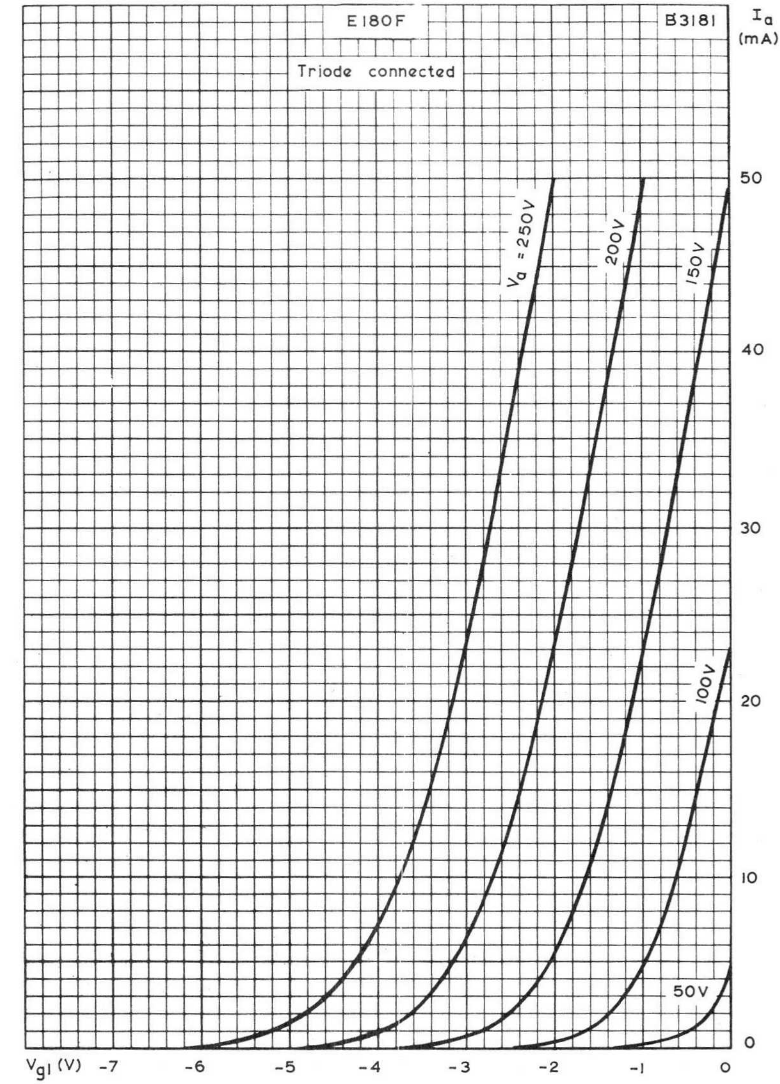


ANODE CURRENT, SCREEN-GRID CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.

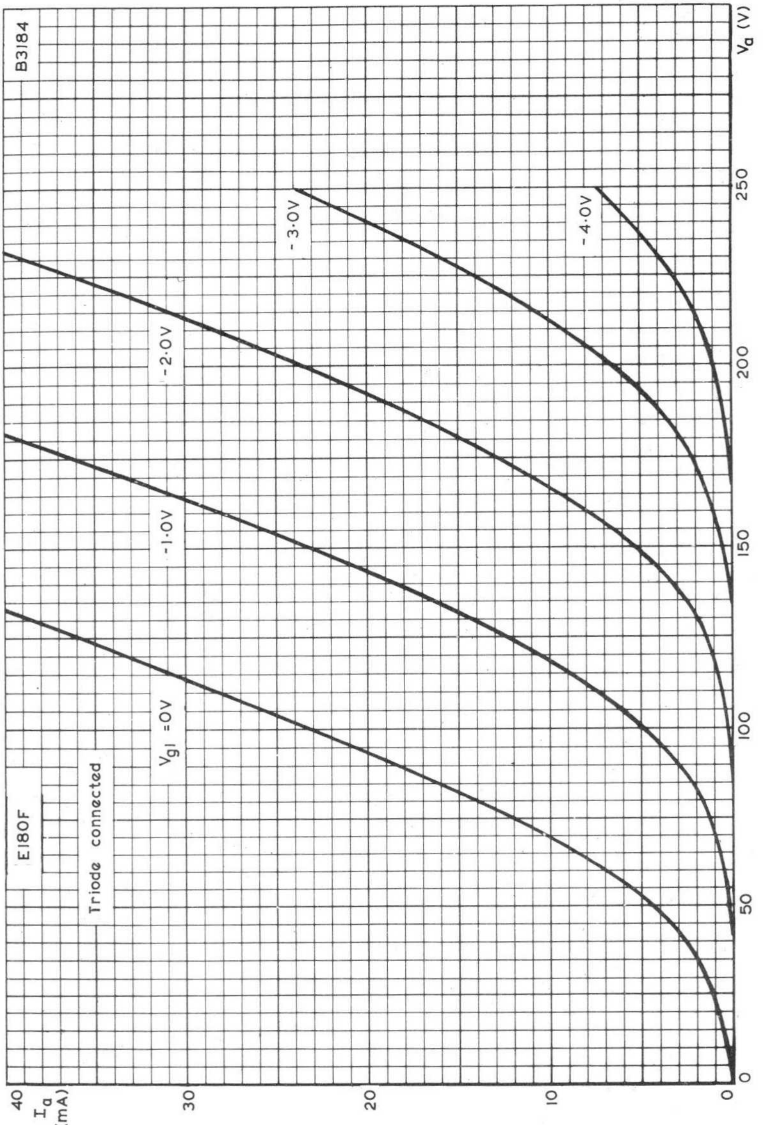
Va = 180V, Vg2 = 50V



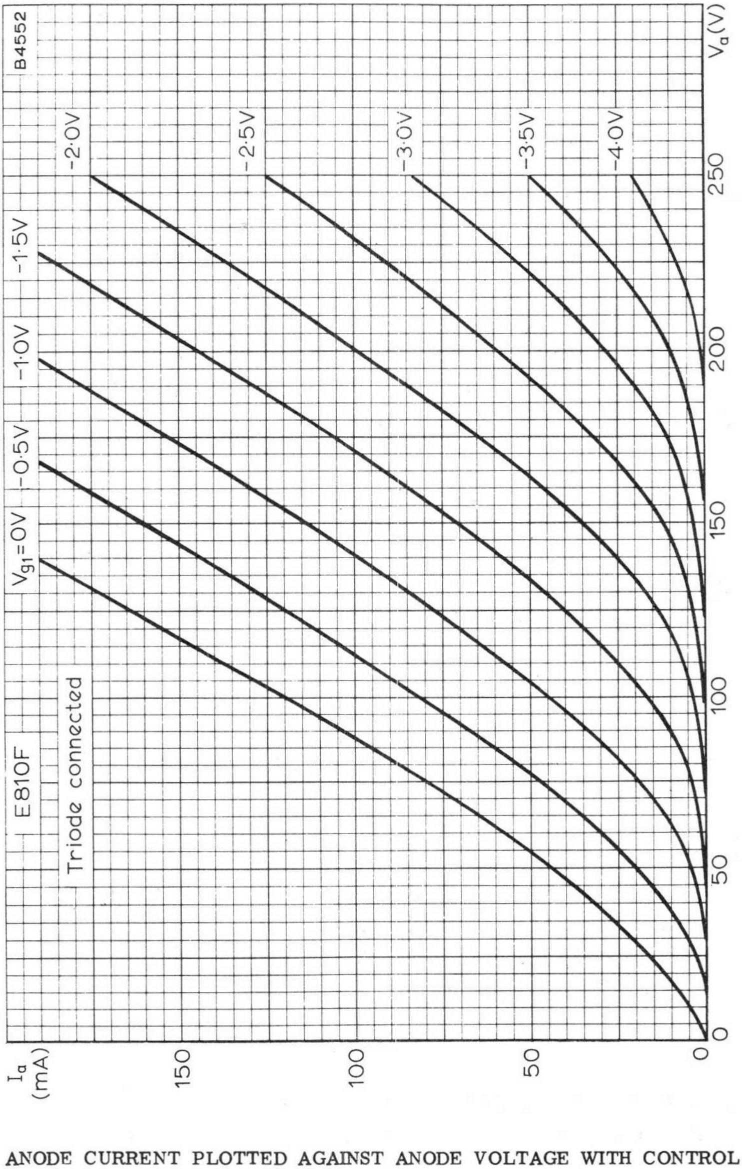
MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR, ANODE IMPEDANCE, AND CONTROL-GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT TRIODE CONNECTED.



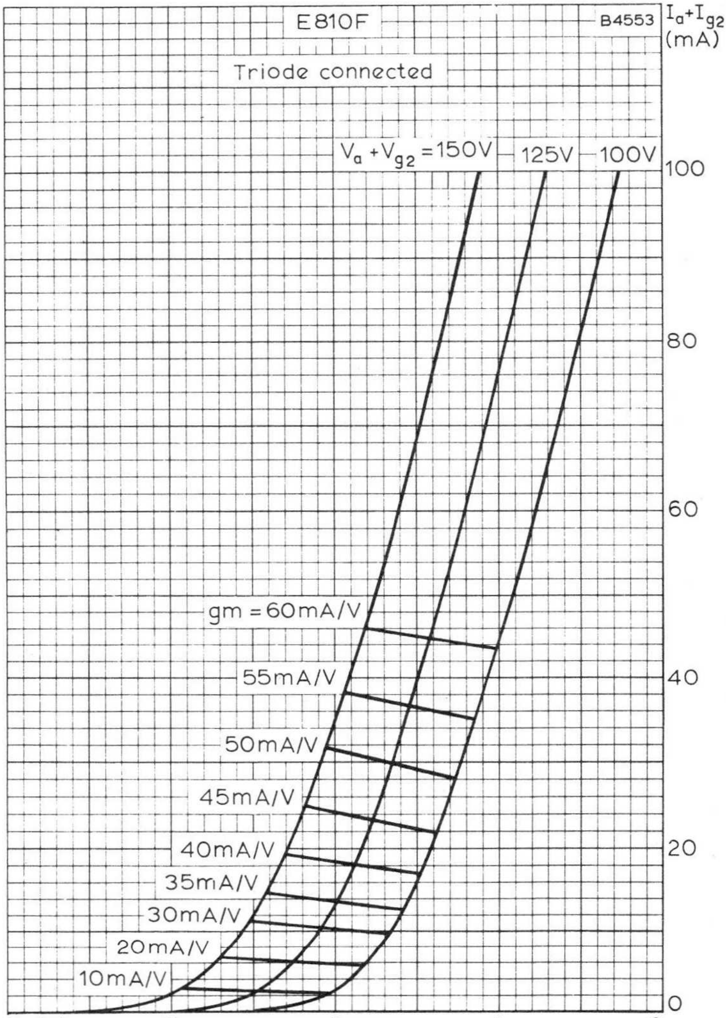
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER. TRIODE CONNECTED.



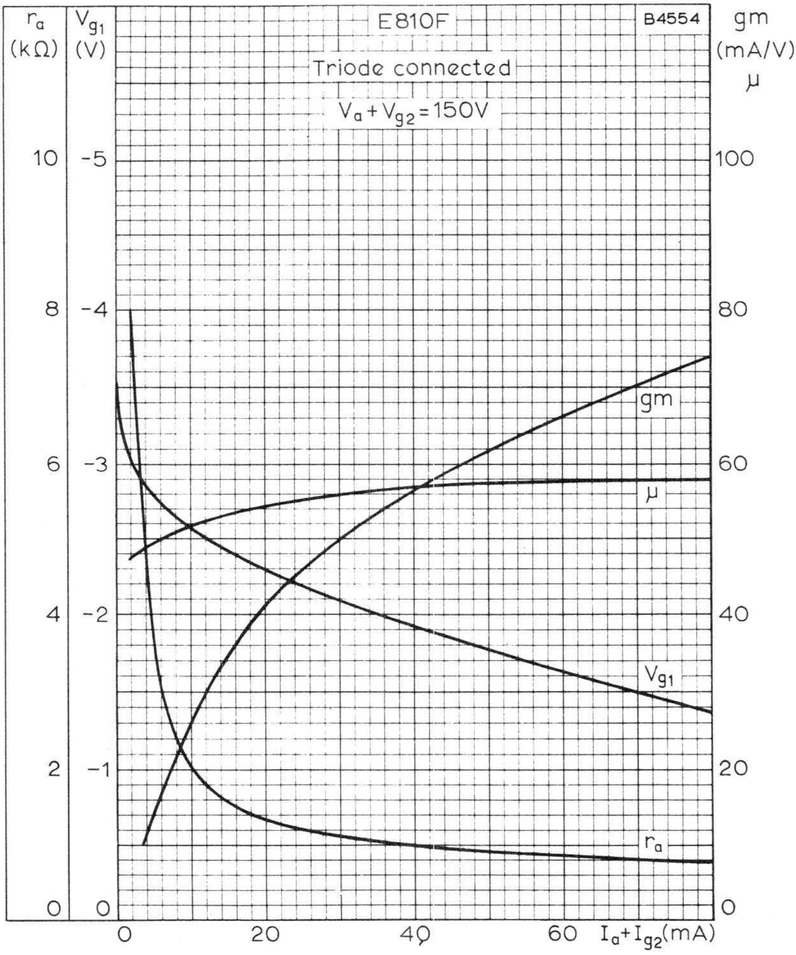
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. TRIODE CONNECTED.



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



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



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

MINIATURE DIODE

EA50

Miniature diode primarily designed for use as signal detector in television equipment.

HEATER

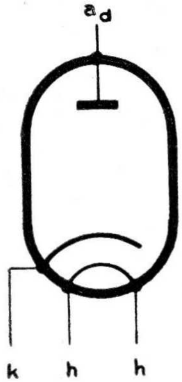
V_h	6.3	V
I_h	0.15	A

CAPACITANCE

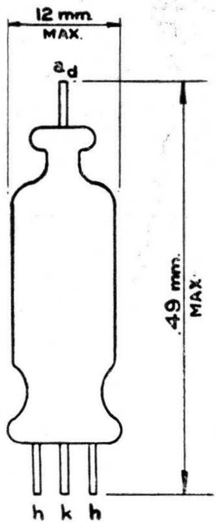
c_{a-k}	2.1	μμF

LIMITING VALUES

V_a max.	50	V
I_a max.	5.0	mA
V_a max. ($I_a = +0.3$ μA)	−1.3	V
V_{h-k} max.	50	V
R_{h-k} max.	20	KΩ



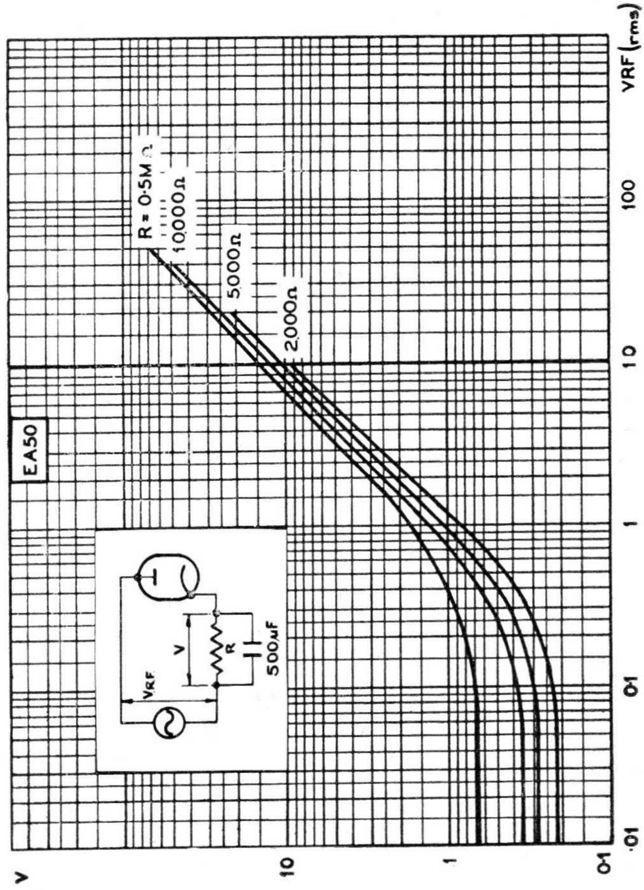
B3G BASE



EA50

MINIATURE DIODE

Miniature diode primarily designed for use as signal detector in television equipment.



DIODE CHARACTERISTICS

SUBMINIATURE SINGLE DIODE

EA76

Indirectly-heated subminiature diode with 6.3V heater.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

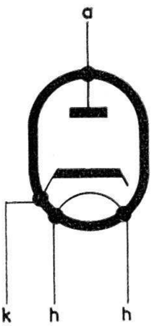
In operation this valve may become very hot and therefore, in the interests of long life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis.

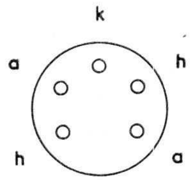
CAPACITANCES

	Shielded	Unshielded	
c_{a-k+h}	4.0	3.1	pF
c_{k-a+h}	4.5	4.55	pF
c_{a-h}	0.74	0.9	pF
c_{h-k}	1.98	2.0	pF

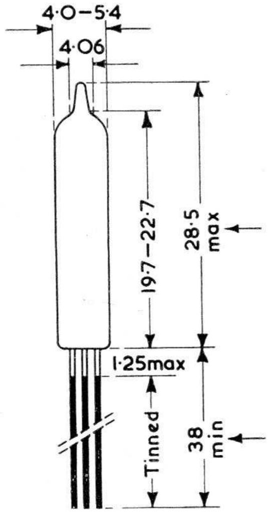
LIMITING VALUES

P.I.V. max.	420	V
V_a max.	150	V
I_a max.	9.0	mA
$i_{a(pk)}$ max.	54	mA
$v_{h-k(pk)}$ max. (cathode positive)	330	V





B5B/F Base



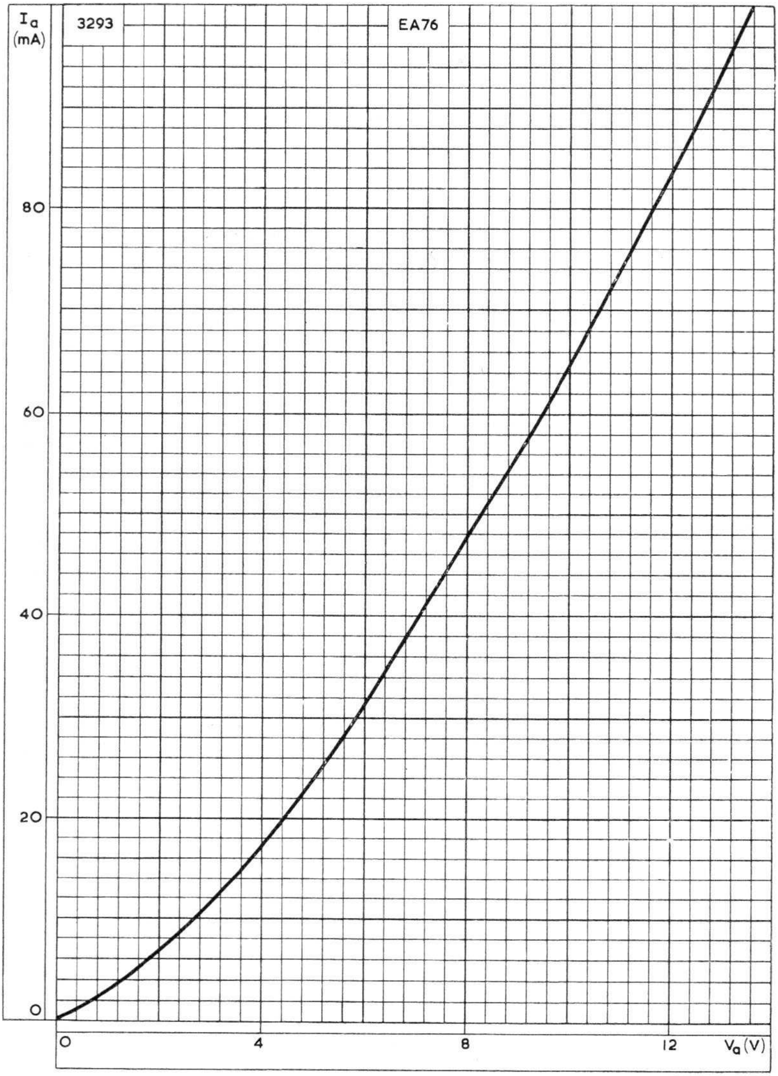
3274

All dimensions in mm

EA76

SUBMINIATURE SINGLE DIODE

Indirectly-heated subminiature diode with 6.3V heater.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

DIODE TRIODE

Low impedance diode with medium μ triode.

EAC91

HEATER

V_h		6.3	V
I_h		300	mA

CAPACITANCES ←

	Shielded	*Unshielded*	
c_{g-ad}	20	—	mpF
c_{at-ad}	110	190	mpF
Triode section			
c_{in}	1.85	1.7	pF
c_{out}	1.25	0.4	pF
c_{a-g}	1.6	1.7	pF
Diode section			
c_{a-k}	1.8	2.0	pF
c_{a-h}	250	300	mpF

CHARACTERISTICS

Triode section ←

V_a	200	V
I_a	5.5	mA
V_g	−4.0	V
g_m	2.5	mA/V
μ	31	
r_a	12.5	kΩ

LIMITING VALUES

Triode section

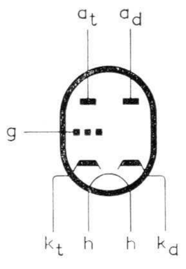
$V_{a(b)}$ max.	500	V←
V_a max.	250	V
p_a max.	2.0	W
$-V_g$ max.	50	V←
I_k max.	10	mA
V_{h-k} max.	100	V←

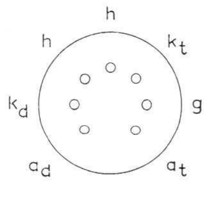
Diode section ←

P.I.V. max.	350	V
I_k max.	5.0	mA
$i_{k(pk)}$ max.	50	mA
V_{h-k} max.	100	V
T_{bulb} max.	200	°C

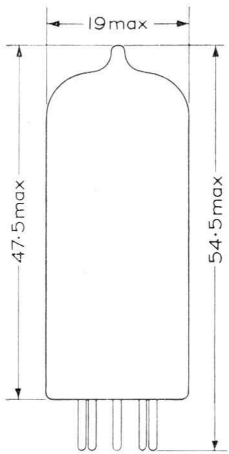
EAC91

DIODE TRIODE





B7G Base



All dimensions in mm

8667

SINGLE DIODE R.F. PENTODE

EAF42

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

HEATER

V_h	6.3	V
I_h	0.2	A

MOUNTING POSITION

Any

CAPACITANCES

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

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

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

* For 100 : 1 reduction in mutual conductance.

LIMITING VALUES

Pentode Section

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

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

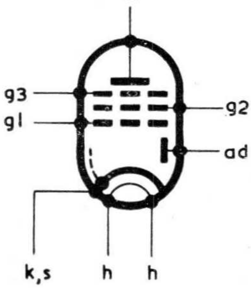
EAF42

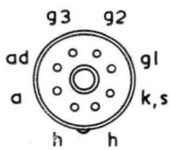
SINGLE DIODE R.F. PENTODE

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

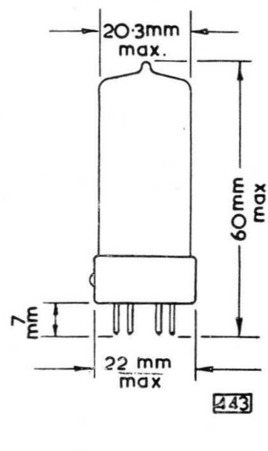
Diode Section

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





B8A BASE



443

DOUBLE DIODE

EB34

Double diode with separate cathodes
Each section is internally screened.

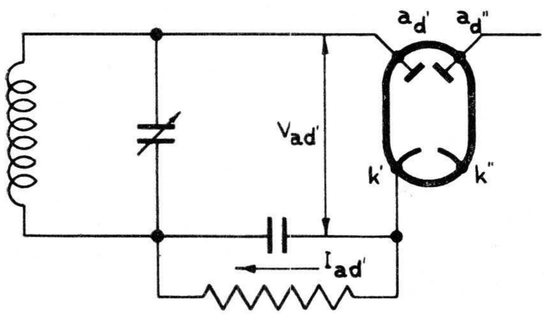
HEATER

This valve is suitable for DC/AC operation.

V_h	6.3	V
I_h	0.2	A

CAPACITANCES

$c_{ad'-k}$	4.5	μμF
$c_{ad''-k}$	4.5	μμF
$c_{ad'-ad''}$	0.5	μμF



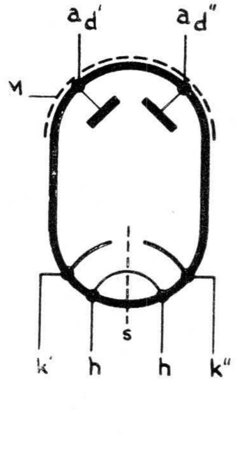
LIMITING VALUES

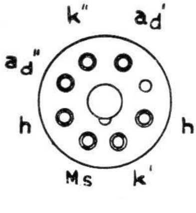
$V_{ad'}$ max.	200	V
$V_{ad''}$ max.	200	V
$I_{ad'}$ max.	0.8	mA
$I_{ad''}$ max.	0.8	mA
$V_{h-k'}$ max.	75	V
$V_{h-k''}$ max.	75	V
$R_{h-k'}$ max.	20	kΩ
$R_{h-k''}$ max.	20	kΩ
$V_{ad'}$ max. ($I_{ad'}=0.3\mu A$)	−1.3	V
$V_{ad''}$ max. ($I_{ad''}=0.3\mu A$)	−1.3	V
$V_{k'-k''}$ max.	50	V

EB34

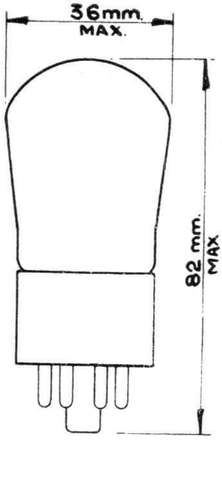
DOUBLE DIODE

Double diode with separate cathodes.
Each section is internally screened.





OCTAL BASE



DOUBLE DIODE

EB41

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

HEATER

V_h	6.3	V
I_h	0.3	A

MOUNTING POSITION   Any

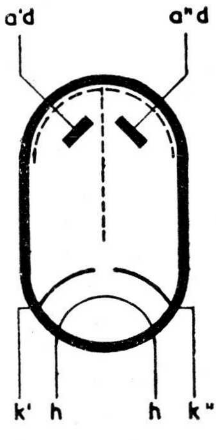
CAPACITANCES

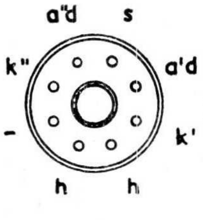
$c_{a'd-a''d}$	<0.03	$\mu\mu F$
$c_{k'-k''}$	<0.01	$\mu\mu F$
$c_{a'd-k''}$	<0.01	$\mu\mu F$
$c_{a''d-k''}$	<0.01	$\mu\mu F$
$c_{a'd-k'+h+screen}$	4	$\mu\mu F$
$c_{a''d-k''+h+screen}$	3.5	$\mu\mu F$
*$c_{k'-rest}$	4.5	$\mu\mu F$
*$c_{a'd-rest}$	4	$\mu\mu F$

*External skirt connected to rest

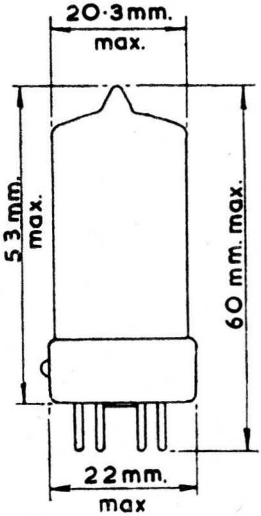
LIMITING VALUES (each section)

V_{ad} max.	150	V
I_{ad} max.	9	mA
$i_{ad\ (pk)}$ max.	54	mA
V_{ad} max. ($I_{ad}=+0.3\mu A$)	−1.3	V
V_{h-k} max.	300	V
R_{h-k} max.	20,000	Ω





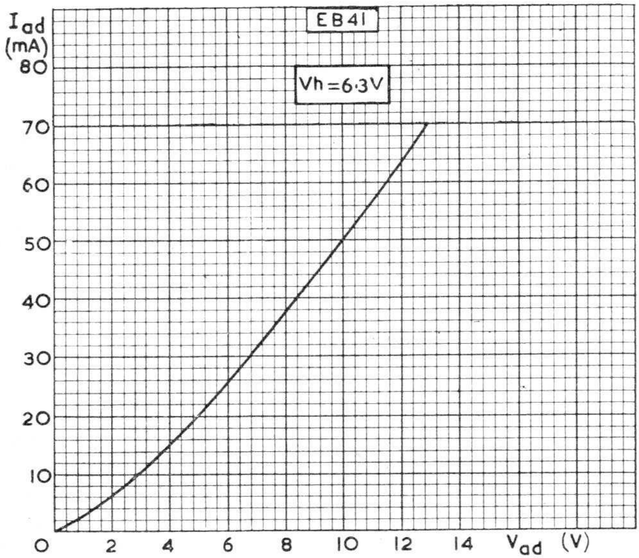
B8A BASE

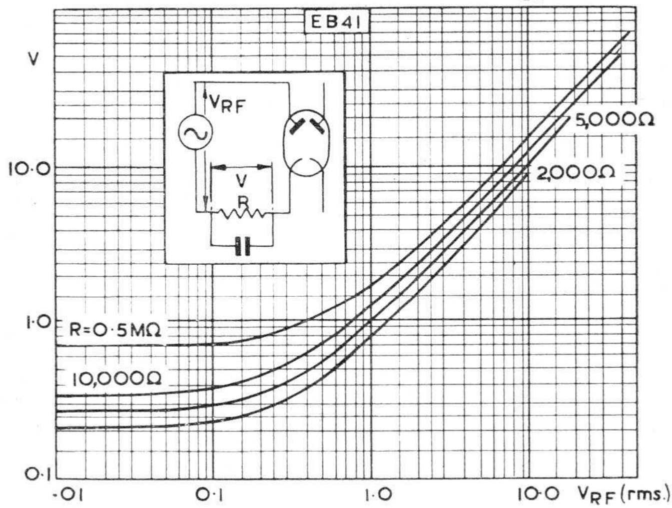


EB41

DOUBLE DIODE

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





DOUBLE DIODE

EB91

Miniature double diode with separate cathodes and internal screening between sections.

HEATER

Suitable for series or parallel operation, A.C. or D.C.

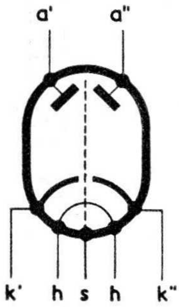
V_h	6.3	V
I_h	0.3	A

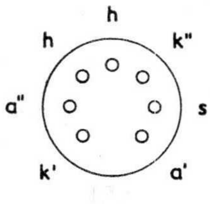
CAPACITANCES

$c_{a'-k'+h+s}$	3.0	$\mu\mu F$
$c_{a''-k''+h+s}$	3.0	$\mu\mu F$
$c_{k'-a'+h+s}$	3.4	$\mu\mu F$
$c_{k''-a''+h+s}$	3.4	$\mu\mu F$
$c_{a'-a''}$	<0.025	$\mu\mu F$

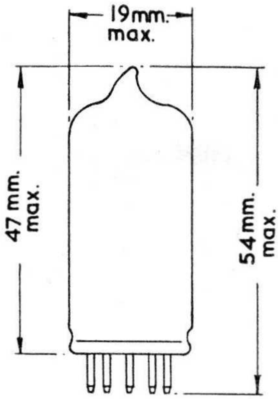
LIMITING VALUES (each section)

P.I.V. max.	420	V
I_a max.	9	mA
$i_{a(pk)}$ max.	54	mA
V_a max ($I_a = 0.3\ \mu A$)	-1.3	V
$v_{h-k(pk)}$ max.	330	V





B7G BASE

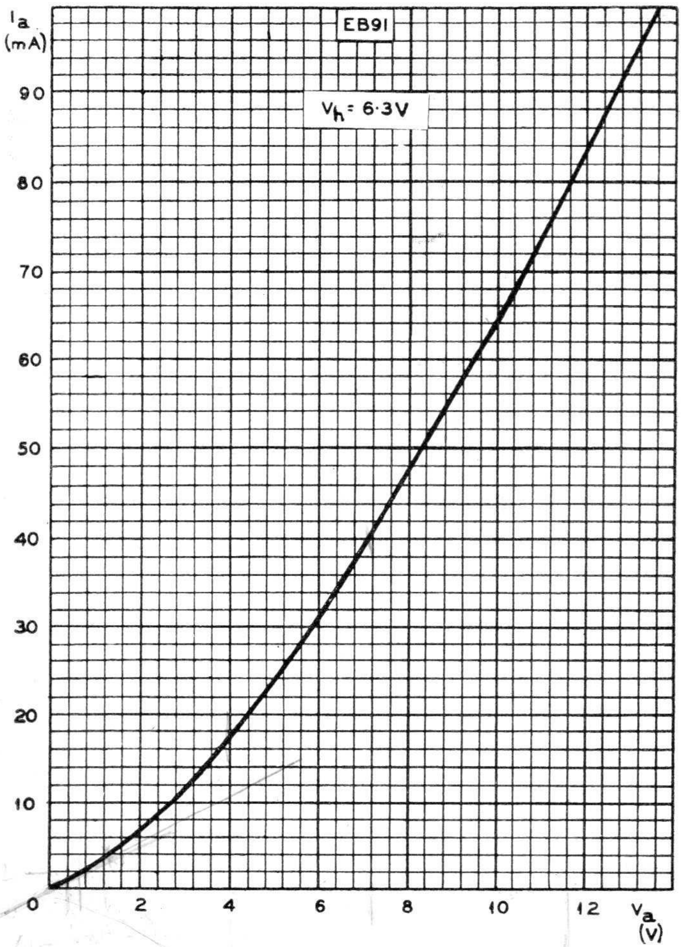


518

EB91

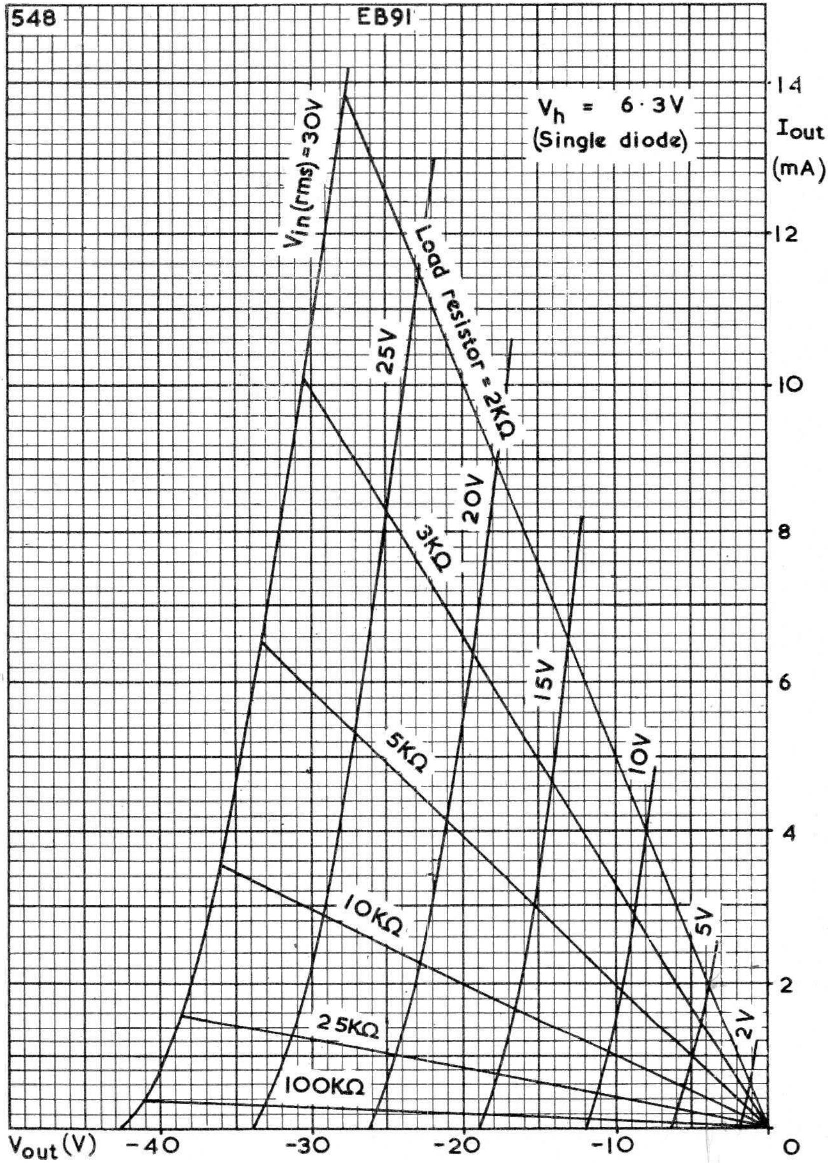
DOUBLE DIODE

Miniature double diode with separate cathodes and internal screening between sections.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

Miniature double diode with separate cathodes and internal screening between sections.



OUTPUT CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE AS PARAMETER

DOUBLE DIODE TRIODE

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.

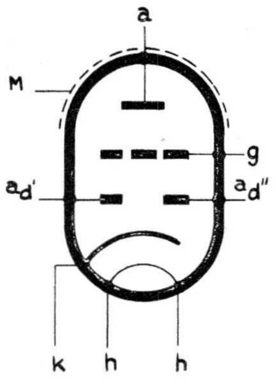
LIMITING VALUES

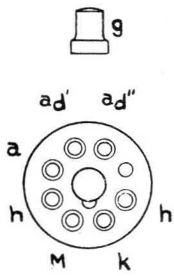
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.5	W
V_{ad} max.	200	V
I_{ad} max.	0.8	mA
I_k max.	10	mA
V_g max. (I_g = 0.3µA)	−1.3	V
R_g max. (Self bias)	3.0	MΩ
R_g max. (Fixed bias)	1.0	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

EBC33

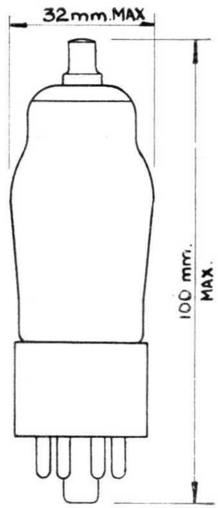
DOUBLE DIODE TRIODE

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





OCTAL BASE



DOUBLE DIODE TRIODE

EBC41

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

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

CAPACITANCES

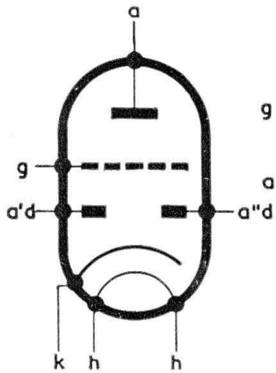
$c_{a'd-gt}$	<0.007	pF
$c_{a''d-gt}$	<0.03	pF
c_{ad-at}	<0.01	pF

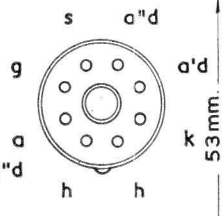
Triode section

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

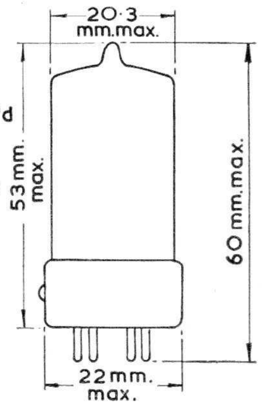
Diode sections

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





B8A BASE



633

DOUBLE DIODE TRIODE

EBC90

High gain triode for use as a.f. voltage amplifier combined with twin diodes.

HEATER

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

V_h	6.3	V
I_h	300	mA

CAPACITANCES (measured without an external shield)

$c_{a''d-g}$	<0.025	pF
Triode section		
c_{a-g}	2.1	pF
c_{g-k}	2.3	pF
c_{a-k}	1.1	pF

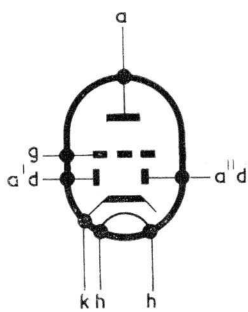
CHARACTERISTICS

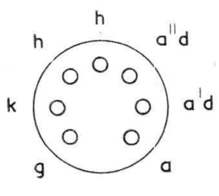
V_a	100	250	V
V_g	−1.0	−3.0	V
I_a	0.8	1.0	mA
g_m	1.3	1.2	mA/V
μ	70	70	
r_a	54	58	kΩ

LIMITING VALUES

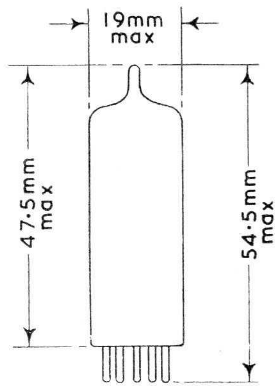
Triode section		
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
R_{g-k} max.	3.0	MΩ
V_{h-k} max.	90	V
Diode sections (each section)		
I_{ad} max.	1.0	mA

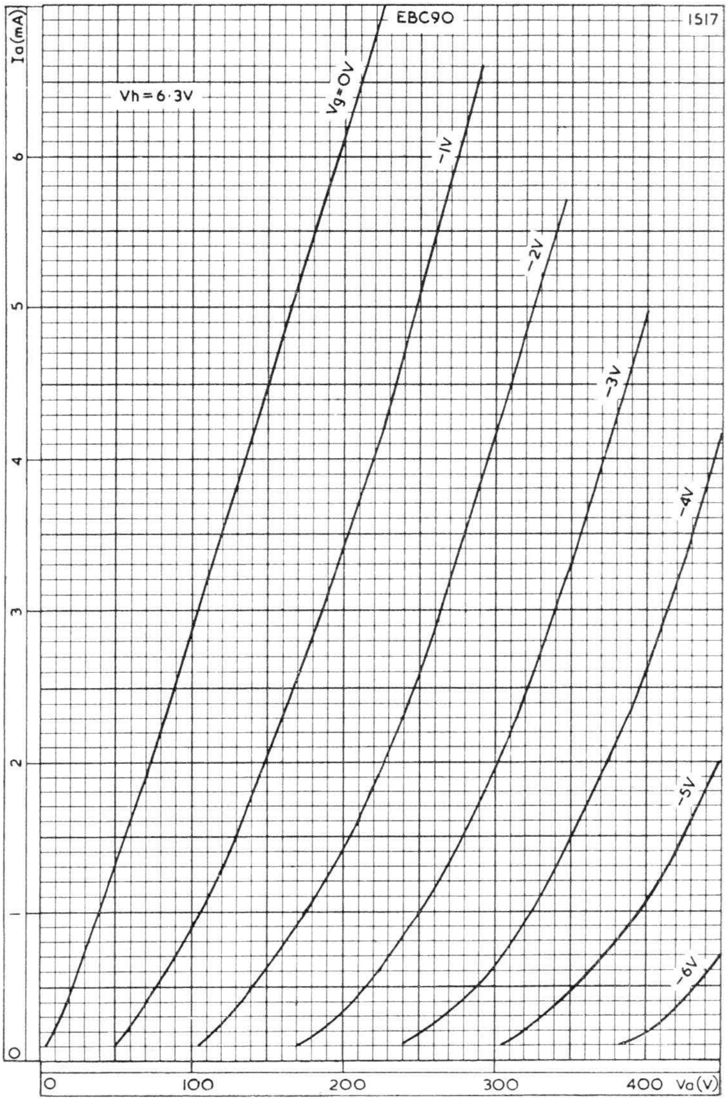
4520





B7G Base





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

DOUBLE DIODE TRIODE

EBC91

High gain triode for use as a.f. voltage amplifier combined with twin diodes.

HEATER

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

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

$c_{a''d-g}$	0.04	pF

Triode section

c_{a-g}	2.0	pF
c_{in}	2.2	pF
c_{out}	0.8	pF

CHARACTERISTICS

V_a	100	250	V
I_a	0.5	1.2	mA
V_g	−1.0	−2.0	V
g_m	1.25	1.6	mA/V
r_a	80	62.5	kΩ
μ	100	100	

LIMITING VALUES

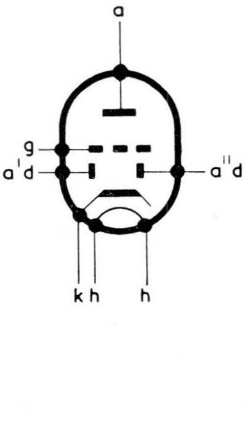
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	500	mW
I_k max.	1.0	mA
$i_{k(pk)}$ max.	6.0	mA
V_g max.	0	V
$-V_g$ max.	50	V
V_{h-k} max.	100	V

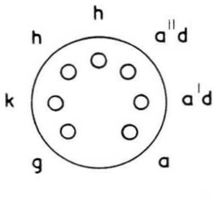
EBC91

DOUBLE DIODE TRIODE

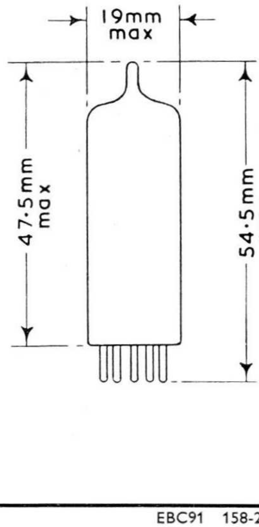
High gain triode for use as a.f. voltage amplifier combined with twin diodes.

4520





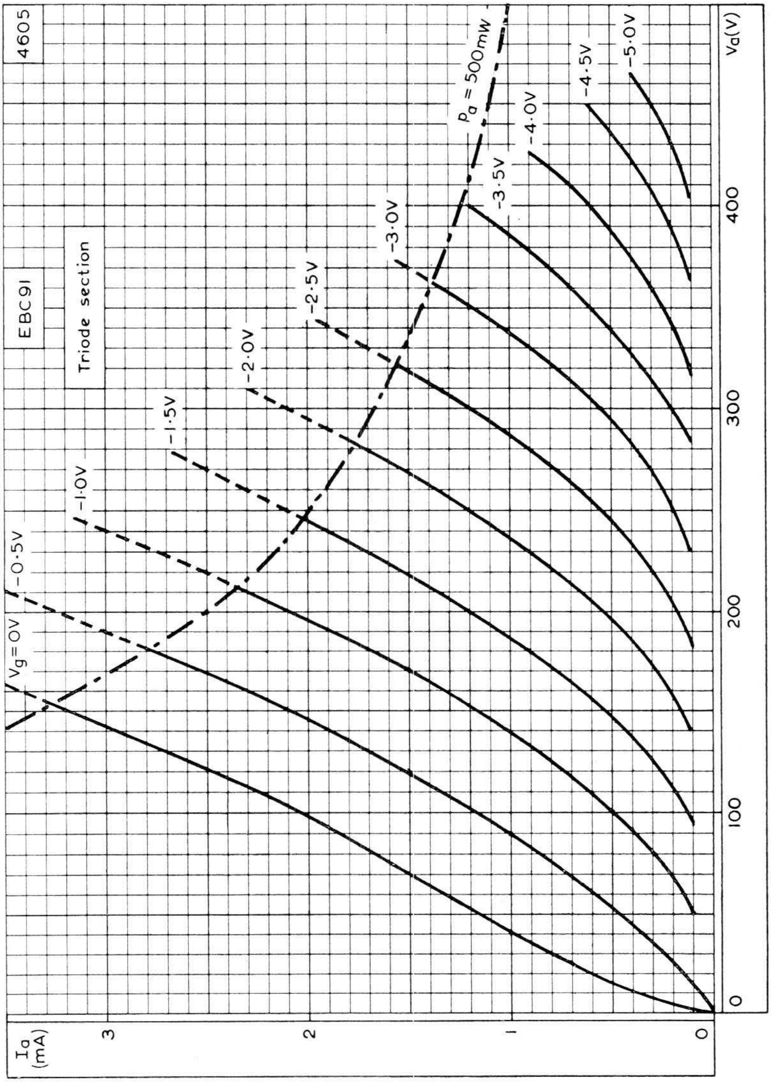
B7G Base



DOUBLE DIODE TRIODE

EBC91

High gain triode for use as a.f. voltage amplifier combined with twin diodes.



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

DOUBLE DIODE 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 μA)	−1.3	V
*R_{g1-k} max.	3	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) ←

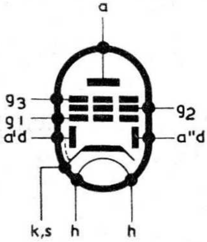
P.I.V.	350	V
I_{ad} max.	0.8	mA
$i_{ad(pk)}$ max.	5.0	mA
R_{h-k} max.	20	k Ω
V_{h-k} max.	100	V

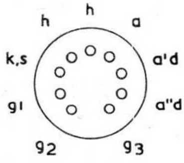
This valve can be used without special precautions against microphony if the input voltage, V_{in}, is not less than 25 mV for an output of 50 mW from the output valve.

DOUBLE DIODE PENTODE

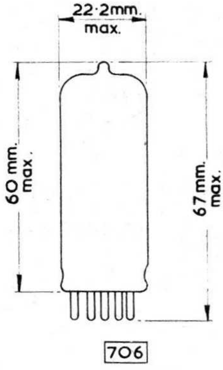
EBF80

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





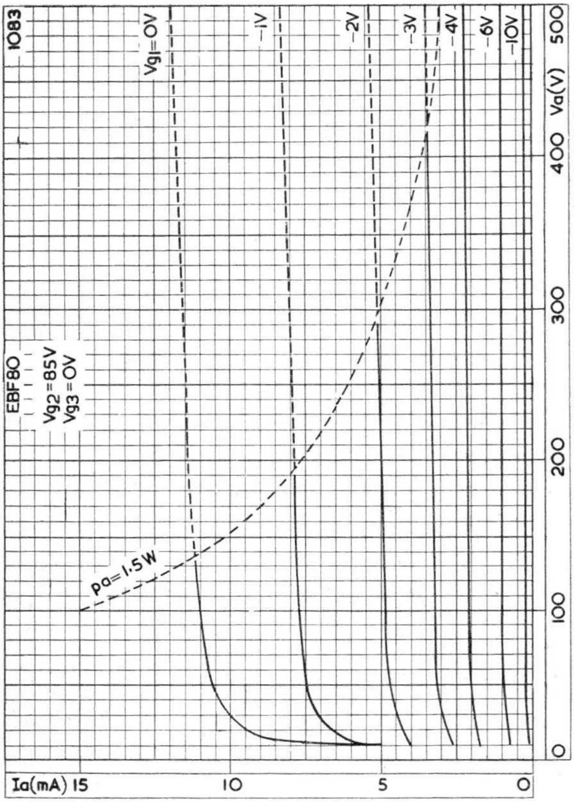
B9A (Noval) BASE



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

SUBMINIATURE U.H.F. TRIODE

EC70

Triode primarily intended for use as an oscillator at frequencies of the order of 500Mc/s.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and therefore, in the interests of satisfactory life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis and should result in a bulb temperature of approximately 100°C.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g}	2.1	2.1	pF
c_{g-k}	1.8	1.7	pF
c_{a-k}	2.8	0.6	pF

CHARACTERISTICS

V_a	100	V
V_g	−2.0	V
I_a	13	mA
g_m	5.5	mA/V
μ	20	
r_a	3.6	kΩ

TYPICAL OPERATING CONDITIONS AS AN OSCILLATOR AT 500 Mc/s

V_a	175	V
I_a	20	mA
I_g	2.0	mA
R_{g-k}	5.6	kΩ
P_{load}	750	mW

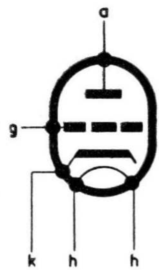
EC70

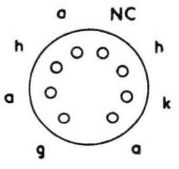
SUBMINIATURE U.H.F. TRIODE

Triode primarily intended for use as an oscillator at frequencies of the order of 500Mc/s.

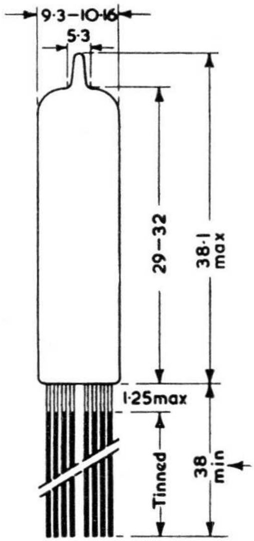
LIMITING VALUES

$V_{a(b)}$ max.	300	V
V_a max.	175	V
p_a max.	3.0	W
I_k max.	22	mA
R_{g-k} max.	500	kΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V





B8D/F Base



3273

All dimensions in mm

SUBMINIATURE U.H.F. TRIODE

EC71

Subminiature medium-μ triode intended for use as an oscillator at frequencies up to 500Mc/s.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
c_{a-g}	1.2	1.3	pF
c_{in}	2.4	2.3	pF
c_{out}	2.3	0.8	pF

CHARACTERISTICS

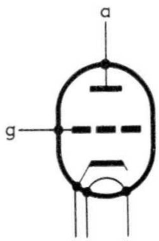
V_a	100	V
I_a	8.5	mA
g_m	5.8	mA/V
r_a	4.7	kΩ
μ	27	
V_g	−1.3	V
$V_g(I_a = 10\mu A)$	−7.0	V

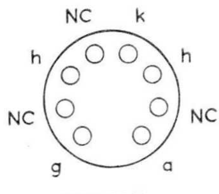
LIMITING VALUES (absolute ratings)

$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	3.3	W
$-V_g$ max.	55	V
I_k max.	22	mA
I_g max.	5.5	mA
V_{h-k} max.	200	V

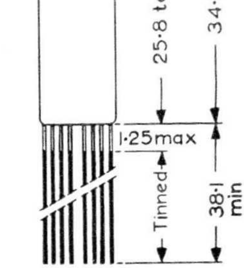
SUBMINIATURE U.H.F. TRIODE

5604

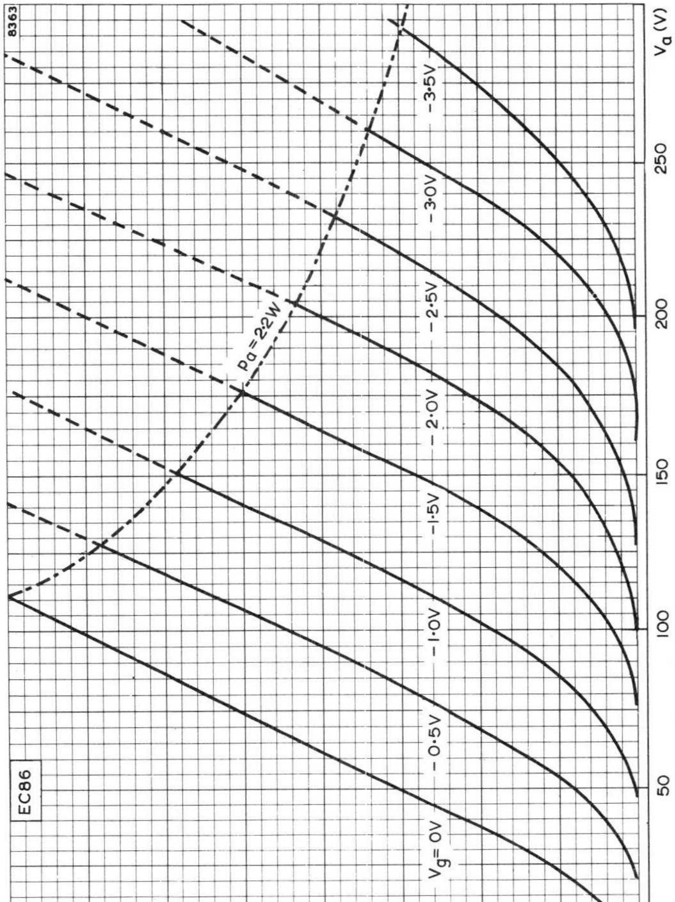




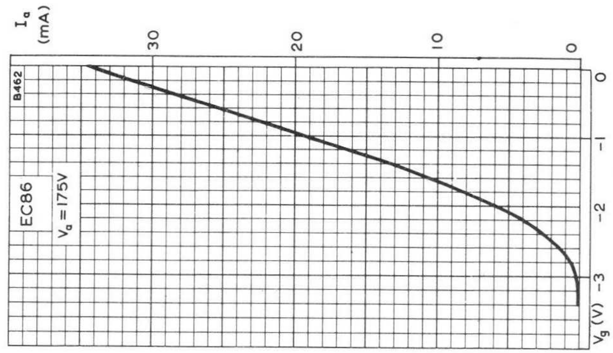
B8D/F Base

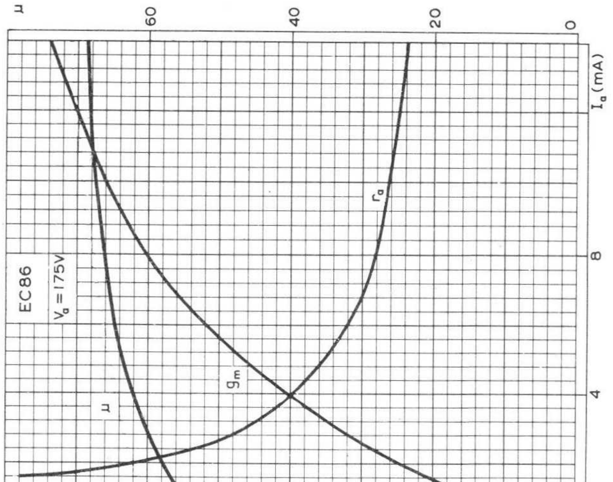


All dimensions in mm



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





ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE. Va = 175 V.

MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT. Va = 175 V

U.H.F. TRIODE

EC88

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

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 $\left(\frac{\lambda}{4}\text{ trough line}\right)$

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

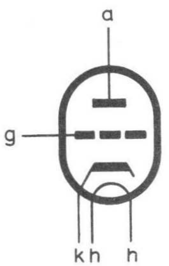
V_b	200	V
R_a	6.8	kΩ
I_a	9.0	mA
I_g	52	µA
$V_{osc(r.m.s.)}$	2.0	V
R_g	47	kΩ
g_c	5.4	mA/V
$g_{m(eff)}$	7.0	mA/V

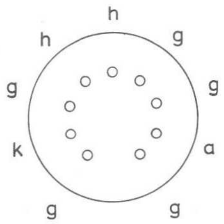
EC88

U.H.F. TRIODE

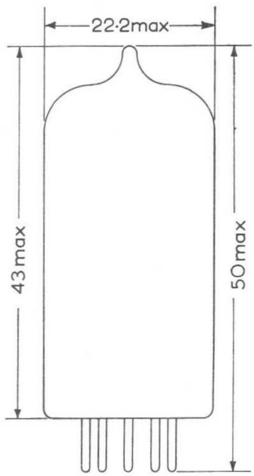
DESIGN CENTRE RATINGS

$V_{a(b)}$ 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



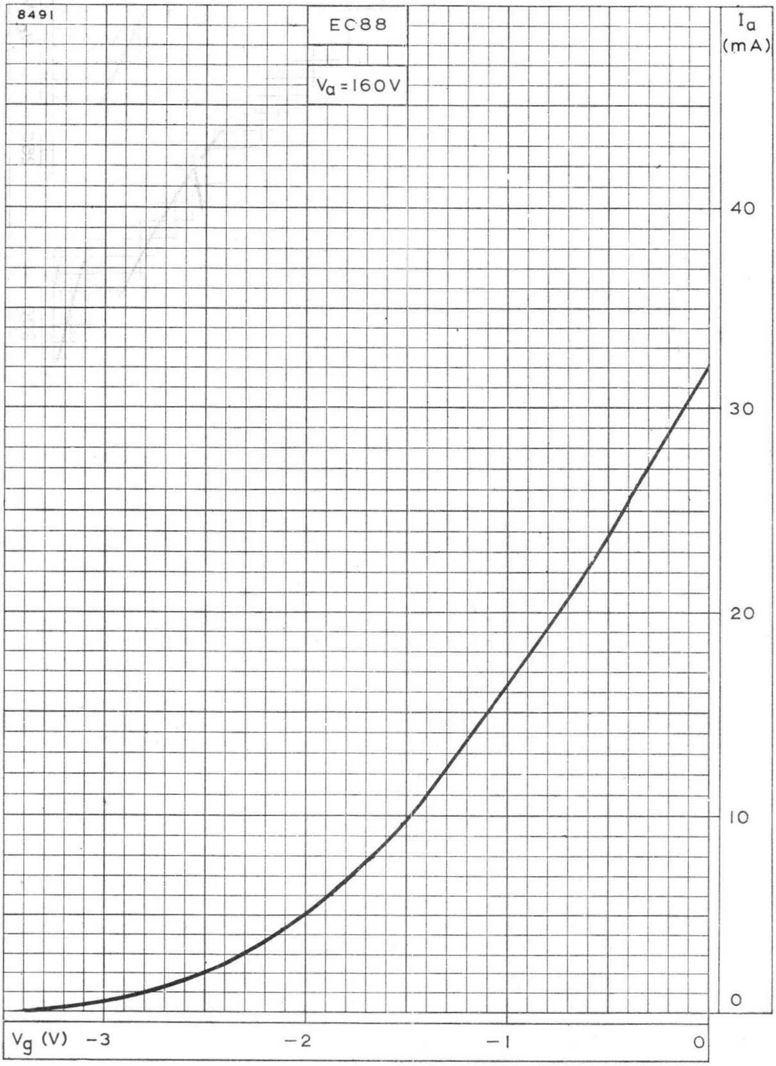


B9A Base

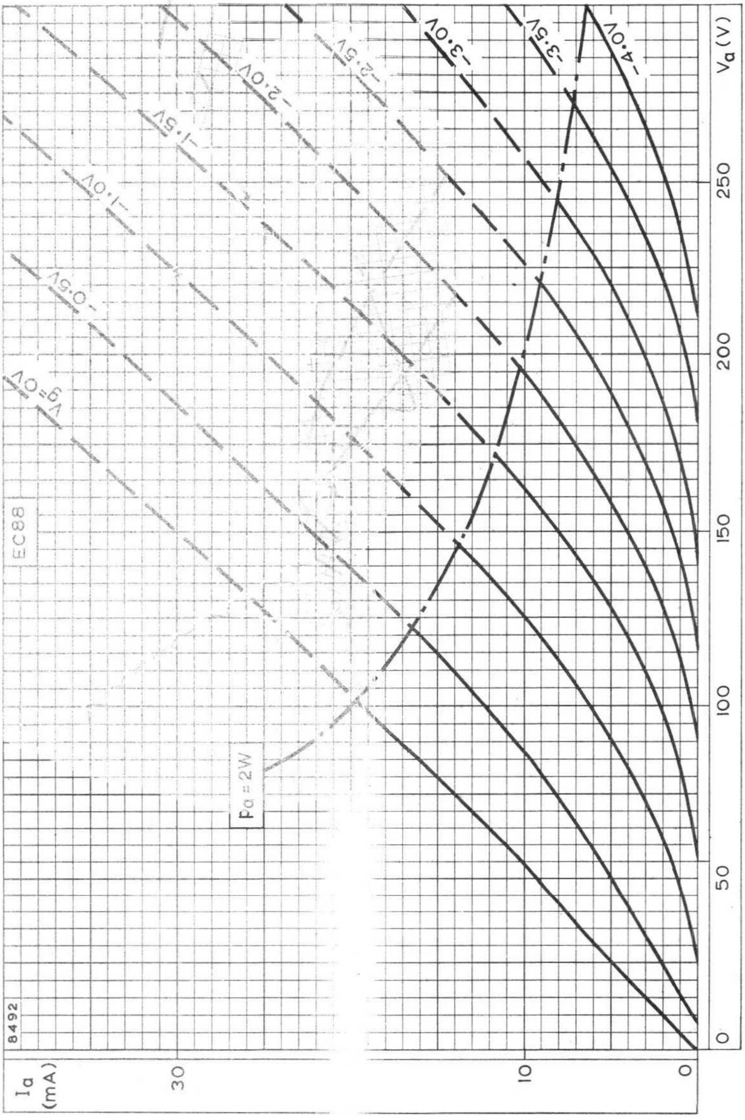


All dimensions in mm

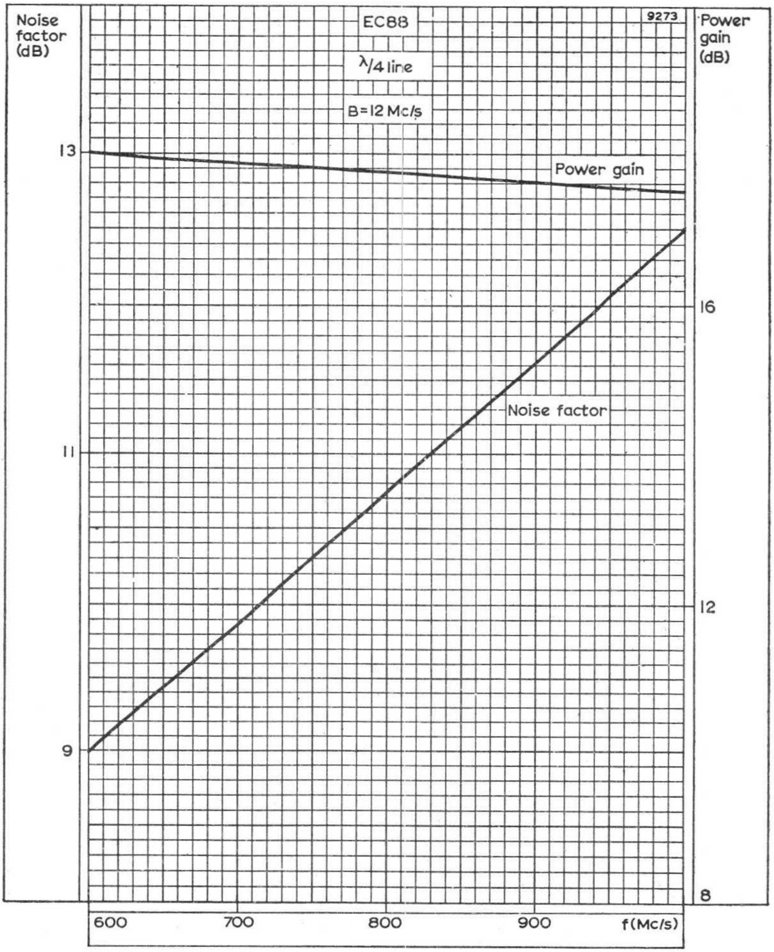
8371



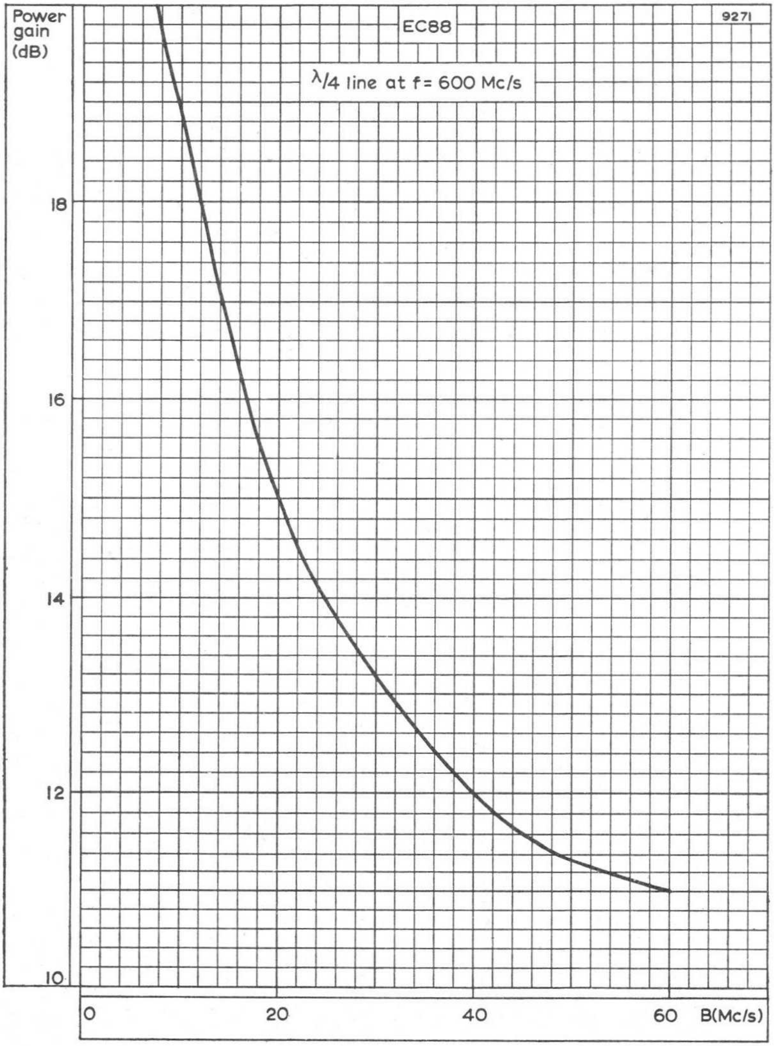
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE



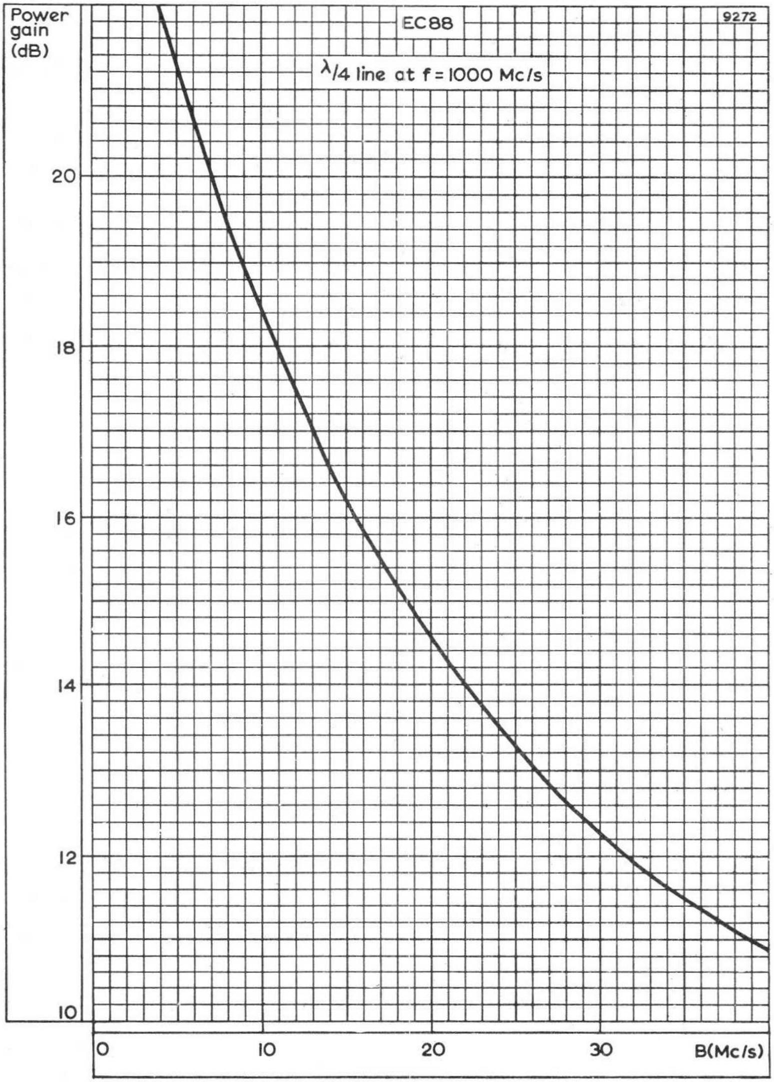
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



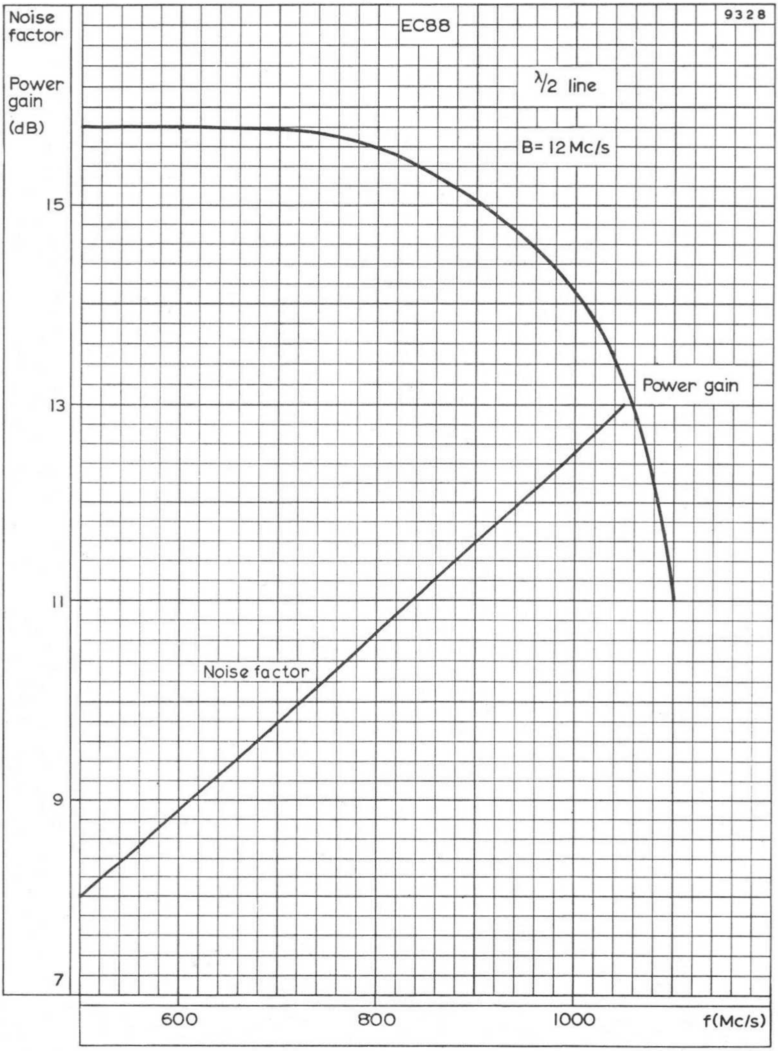
POWER GAIN AND NOISE FACTOR PLOTTED AGAINST FREQUENCY. λ/4 TROUGH LINE AT CONSTANT BANDWIDTH. B=12Mc/s



POWER GAIN PLOTTED AGAINST BANDWIDTH. λ/4 TROUGH LINE AT f=600Mc/s



POWER GAIN PLOTTED AGAINST BANDWIDTH. $\lambda/4$ TROUGH LINE AT f=1000Mc/s



POWER GAIN AND NOISE FACTOR PLOTTED AGAINST FREQUENCY. λ/2 TROUGH LINE AT CONSTANT BANDWIDTH. B=12Mc/s

R.F. POWER TRIODE

EC90

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

HEATER

V_h	6.3	V
I_h	150	mA

CAPACITANCES ←

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

CHARACTERISTICS

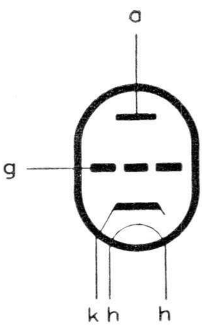
V_a	100	250	V
V_g	0	−8.5	V
I_a	11.8	10.5	mA
g_m	3.25	2.2	mA/V ←
μ	21.5	17	←
r_a	6.6	7.7	kΩ ←

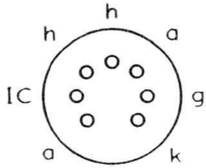
OPERATING CONDITIONS AS R.F. AMPLIFIER OR OSCILLATOR ←
(Class "C" Telegraphy or F.M.)

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

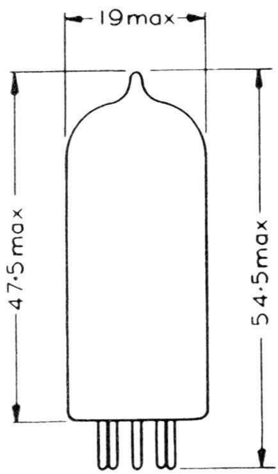
LIMITING VALUES ←

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





B7G Base



6403

All dimensions in mm

GROUNDED GRID TRIODE

EC91

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

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES ←

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

*External shield connected to grid.

CHARACTERISTICS

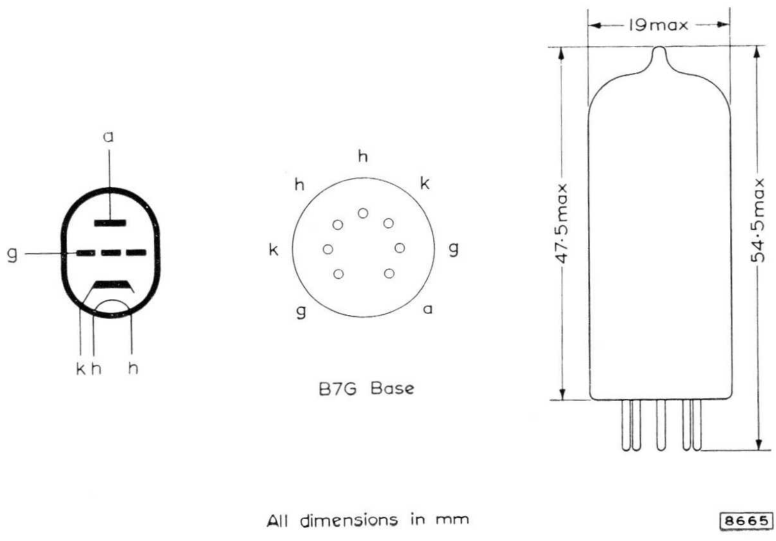
V_a	250	V
I_a	10	mA
V_g	−1.5	V
g_m	8.5	mA/V
μ	90	←
r_a	10.5	kΩ ←
R_{eq}	400	Ω

LIMITING VALUES

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

EC91

GROUNDED GRID TRIODE



All dimensions in mm

8665

U.H.F. TRIODE

EC98

Triode intended for use as a grounded-grid amplifier in U.H.F. receivers.

HEATER

V_h	6.3	V
I_h	400	mA

CAPACITANCES (measured with external shield)

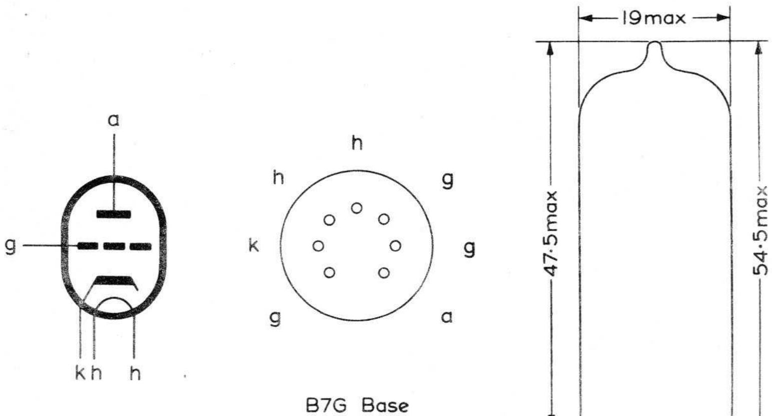
c_{a-g}	2.8	pF
c_{a-k}	80	mpF
c_{h-k}	3.8	pF
$c_{k-g+h+S}$	8.8	pF
$c_{a-g+h+S}$	4.0	pF

CHARACTERISTICS

V_a	150	V
I_a	13.5	mA
V_g	−1.35	V
g_m	13.5	mA/V
μ	50	
r_a	3.7	kΩ
R_k	0	Ω
V_g ($I_a \leqslant 60\mu A$)	−15	V

DESIGN CENTRE RATINGS

$V_{a(b)}$ max.	300	V
V_a max.	150	V
p_a max.	2.2	W
$-V_g$ max.	50	V
$+V_g$ max.	0	V
I_k max.	18	mA
I_g max.	3.2	mA
R_{g-k} max.	250	kΩ
V_{h-k} max.	90	V



All dimensions in mm

7824

DOUBLE TRIODE

ECC32

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

HEATER

V_h	6.3	V
I_h	0.95	A

CAPACITANCES

c_{a-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 (Ω)	I_a (mA)	R_k (Ω)	$\frac{V_{out}}{V_{in}}$	V_{out}* (V)	D_{tot} (%)	R_{g1}** (Ω)
400	47,000	3.9	1,200	21	67	3.7	150,000
350	47,000	3.4	1,200	20.5	57	3.6	150,000
300	47,000	2.9	1,200	20	48	3.5	150,000
250	47,000	2.4	1,200	19.5	37	3.4	150,000
200	47,000	1.9	1,200	19.5	26	3.2	150,000
400	100,000	2.1	2,700	25	81	3.0	330,000
350	100,000	1.8	2,200	25	69	2.9	330,000
300	100,000	1.6	2,200	24.5	54	2.8	330,000
250	100,000	1.3	2,200	24.5	44	2.6	330,000
200	100,000	1.05	2,200	24	32	2.4	330,000
400	220,000	1.1	3,900	27.5	81	2.3	680,000
350	220,000	0.95	3,900	27.5	68	2.2	680,000
300	220,000	0.85	3,900	27	56	2.2	680,000
250	220,000	0.7	3,900	27	45	2.1	680,000
200	220,000	0.55	3,900	26.5	34	2.0	680,000

*V_{out} = Output voltage at start of I_{g1} or at D_{tot} = 10%.

**R_{g1} = Grid resistance of following valve.

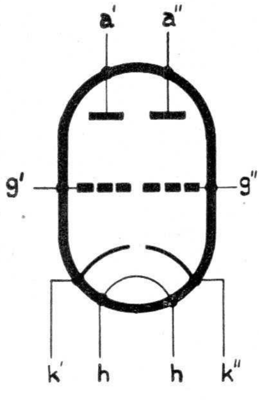
LIMITING VALUES

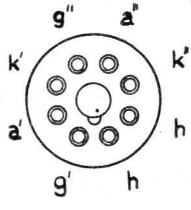
V_a max.	300	V
p_a max.	5	W
I_k max.	50	mA
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	20	KΩ

ECC32

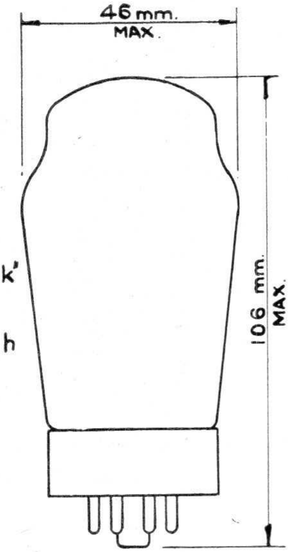
DOUBLE TRIODE

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





OCTAL BASE



DOUBLE TRIODE

ECC33

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

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

V_h	6.3	V
I_h	0.4	A

CAPACITANCES

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

CHARACTERISTICS (each section)

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

LIMITING VALUES (each section)

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

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

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

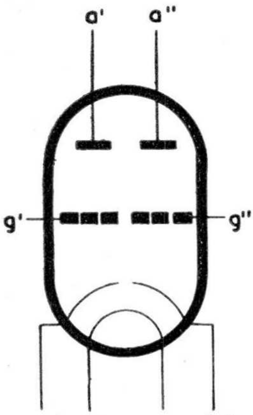
*Output voltage at the start of I_g. At output voltages lower than those shown the distortion is approximately proportional to voltage.

**Grid resistor of following valve.

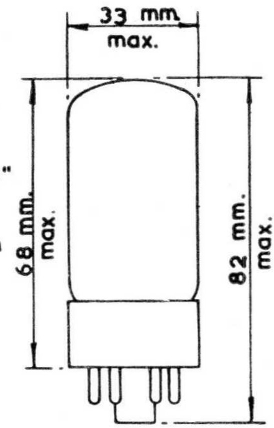
ECC33

DOUBLE TRIODE

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



OCTAL BASE



DOUBLE TRIODE

ECC34

Low impedance double triode with separate cathodes for use as combined frame time base oscillator and current amplifier to feed the deflector coils in A.C. television receivers.

HEATER

V_h	6.3	V
I_h	0.95	A

CAPACITANCES

$c_{a'-a''}$	0.48	μμF
$*c_{a-g}$	4.0	μμF
$*c_{g-k}$	3.5	μμF
$*c_{a-k}$	1.8	μμF

*Each section

TYPICAL OPERATING CONDITIONS (each section)

V_a	250	V
I_a	10	mA
V_g	−16	V
g_m	2.2	mA/V
r_a	5.2	kΩ
μ	11.5	

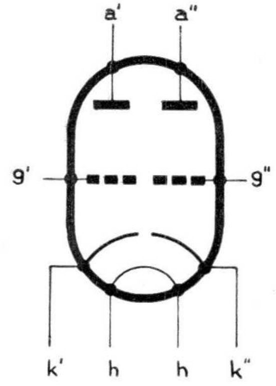
LIMITING VALUES (each section)

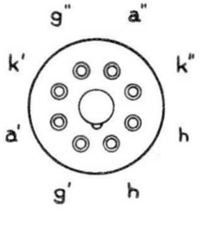
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.25	W
I_k max.	50	mA
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ
R_{g-k} max.	2.0	MΩ

ECC34

DOUBLE TRIODE

Low impedance double triode with separate cathodes for use as combined frame time base oscillator and current amplifier to feed the deflector coils in A.C. television receivers.





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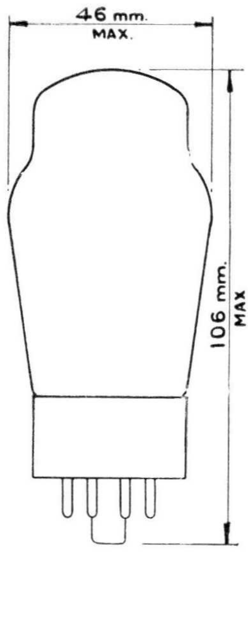


DOUBLE TRIODE

ECC35

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

HEATER

V_h	6.3	V
I_h	0.4	A

CAPACITANCES

$c_{a'-a''}$	0.75	μμF
$c_{a'-g'}$	2.5	μμF
$c_{in'}$	3.0	μμF
$c_{out'}$	1.0	μμF
$c_{a''-g''}$	3.0	μμF
$c_{in''}$	3.0	μμF
$c_{out''}$	1.3	μμF

CHARACTERISTICS (each section)

V_a	250	V
V_g	−2.5	V
i_a	2.3	mA
g_m	2.0	mA/V
μ	68	
r_a	34	kΩ

LIMITING VALUES (each section)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.5	W
I_k max.	8.0	mA
R_{g-k} max.	1.5	MΩ
V_{h-k} max.	90	V

ECC35

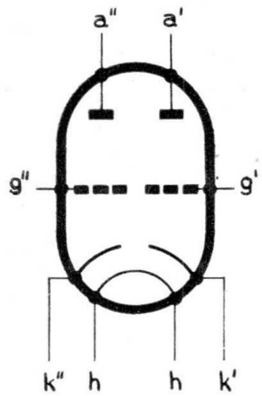
DOUBLE TRIODE

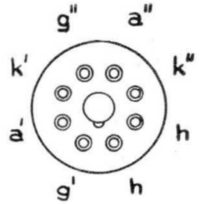
High-gain double triode with separate cathodes for use in paraphase A.F. voltage amplifiers.

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

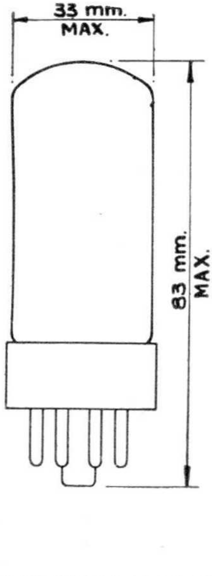
V_b (V)	R_a (k Ω)	I_a (mA)	R_k (k Ω)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	V_{out}† ($V_{r.m.s.}$)	D_{tot} (%)	R_{g1}‡ (k Ω)
400	100	1.3	2.7	40.5	37.5	66.2	10	330
350	100	1.1	2.7	40.5	32.2	57.0	10	330
300	100	1.0	2.7	40	28.0	48.7	10	330
250	100	0.8	2.7	40	23.2	41.1	10	330
200	100	0.65	2.7	39.5	18.7	28.5	8	330
400	220	0.73	4.7	46	44	80	10	680
350	220	0.63	4.7	45.5	38	69.3	10	680
300	220	0.53	4.7	45.5	32.5	59	10	680
250	220	0.45	4.7	45	27	43	8.5	680
200	220	0.38	4.7	45	21.5	33.6	8.2	680

* At D_{tot}=5%
† At D_{tot}=10% or start of I_g
‡ Grid resistor of following valve.





OCTAL BASE



DOUBLE TRIODE

ECC40

Low-microphony double triode with separate cathodes, primarily intended for use as A.F. voltage amplifier or phase splitter.

HEATER

V_h	6.3	V
I_h	0.6	A

MOUNTING POSITION

Any

CAPACITANCES

$c_{g'-h}$	<0.1	µµF	$c_{g''-h}$	<0.1	µµF
$c_{a'-g'}$	2.7	µµF	$c_{a''-g''}$	2.6	µµF
$c_{g'-k}$	2.6	µµF	$c_{g''-k''}$	3.0	µµF
$c_{a'-g''}$	<0.1	µµF	$c_{a''-g'}$	<0.1	µµF

CHARACTERISTICS (each section)

V_a	250	V
V_g	−5.2	V
I_a	6	mA
g_m	2.7	mA/V
r_a	11	kΩ
μ	30	

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_{rms})	D_{tot} (%)	R_g† (kΩ)
400	47	4.1	1.2	21	72.5	4.4	150
350	47	3.6	1.2	20.5	60	4.1	150
300	47	3.1	1.2	20	50	4.0	150
250	47	2.6	1.2	20	40	3.8	150
200	47	2.0	1.2	20	29.5	3.4	150
400	100	2.2	2.2	24.5	76	3.9	330
350	100	1.9	2.2	24	65	3.9	330
300	100	1.6	2.2	24	54	3.8	330
250	100	1.4	2.2	24	44	3.7	330
200	100	1.1	2.2	24	33	3.6	330
400	220	1.1	3.9	25	72	3.8	680
350	220	1.0	3.9	25	63	3.7	680
300	220	0.87	3.9	25	53	3.7	680
250	220	0.72	3.9	25	44	3.6	680
200	220	0.58	3.9	24.5	32	3.5	680

* Output voltage at start of I_{g1}, at lower output voltages the distortion is reduced in proportion.

† Grid circuit resistance of following valve.

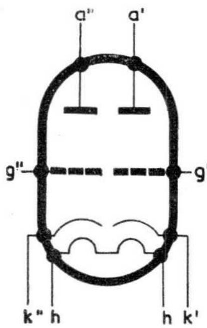
ECC40

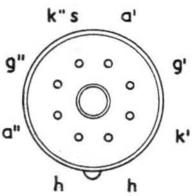
DOUBLE TRIODE

Low-microphony double triode with separate cathodes, primarily intended for use as A.F. voltage amplifier or phase splitter.

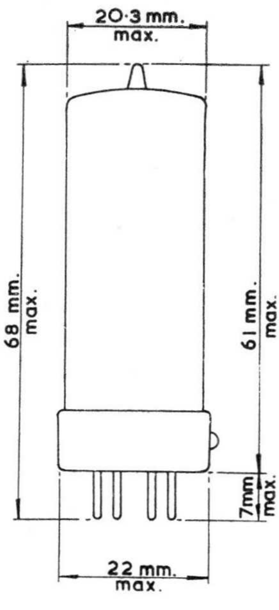
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.5	W
p_g max.	50	mW
I_k max.	10	mA
R_{g-k} max.	1.0	MΩ
V_{h-k} max.	175	V
R_{h-k} max.	50	kΩ





B8A BASE



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SUBMINIATURE DOUBLE TRIODE

ECC70

Subminiature medium-μ double triode intended for use at v.h.f.

HEATER

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
$c_{a'-a''}$	<0.33	<0.52	pF
c_{a-g} (each section)	1.4	1.6	pF
$c_{g'-g''}$	<0.011	<0.015	pF
c_{in} (each section)	—	2.4	pF
$c_{out'}$	1.2	0.3	pF
$c_{out''}$	1.3	0.35	pF

CHARACTERISTICS (each section)

V_a	100	V
V_g	−1.0	V
I_a	6.5	mA
g_m	5.4	mA/V
r_a	6.5	kΩ
μ	35	
V_g ($I_a = 10\mu A$)	−6.5	V

LIMITING VALUES (absolute ratings) each section

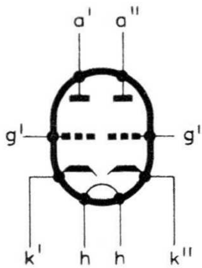
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
I_a max.	22	mA
$-V_g$ max.	55	V
I_g max.	5.5	mA
V_{h-k} max.	200	V

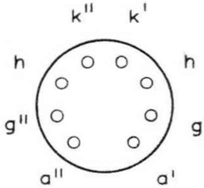
ECC70

SUBMINIATURE DOUBLE TRIODE

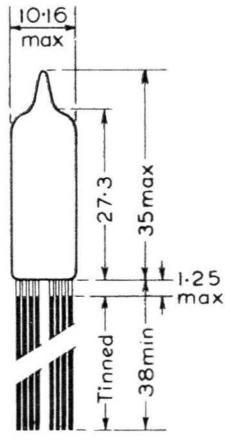
Subminiature medium-μ double triode intended for use at v.h.f.

5262





B8D/F Base



All dimensions in mm

DOUBLE TRIODE

ECC84

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

HEATER

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

V_h	6.3	V
I_h	330	mA

CAPACITANCES (measured without external shield)

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

Grounded cathode section

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

Grounded grid section

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

CHARACTERISTICS (each section)

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

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

ECC84

DOUBLE TRIODE

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

TYPICAL OPERATING CONDITIONS

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

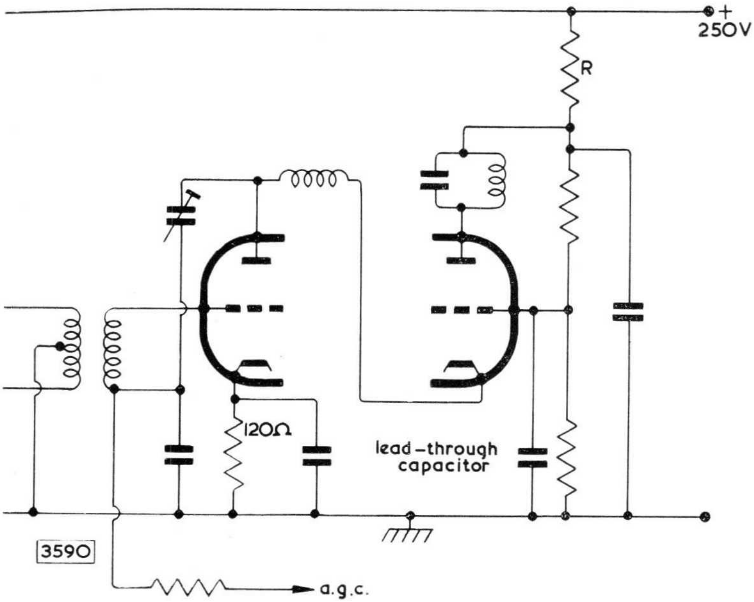


Fig 1

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

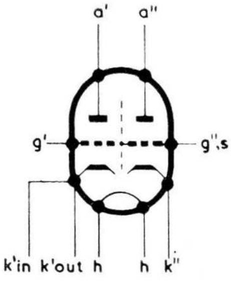
DOUBLE TRIODE

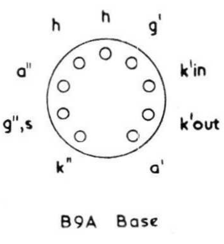
ECC84

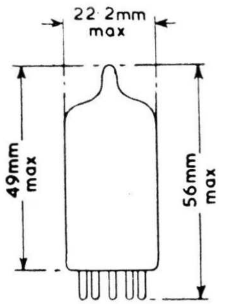
Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers.

LIMITING VALUES (each section unless otherwise specified)

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







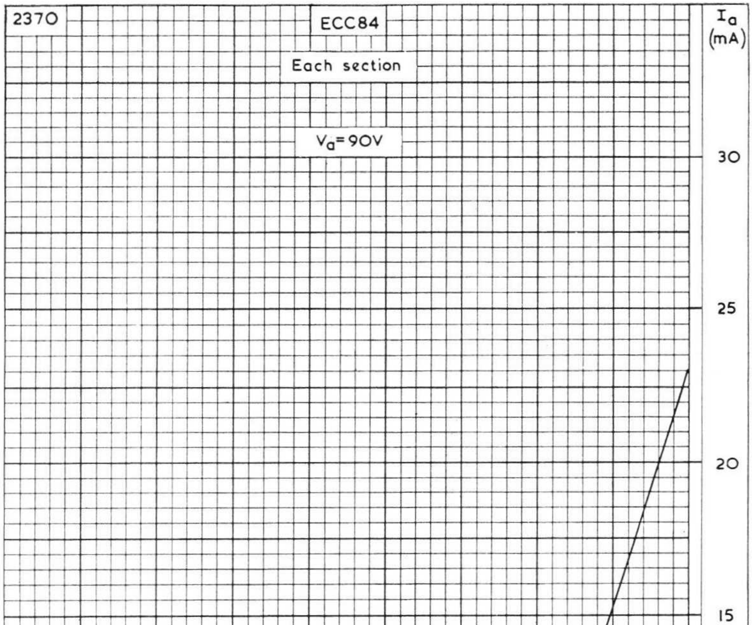
1390

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

ECC84

DOUBLE TRIODE

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



ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

R.F. DOUBLE TRIODE

ECC86

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

HEATER

V_h	6.3	V
I_h	330	mA

CAPACITANCES

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

*Each section

CHARACTERISTICS (each section)

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

OPERATING CONDITIONS

As r.f. amplifier

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

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

As self-oscillating mixer

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

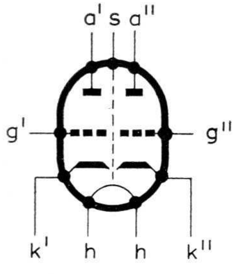
ECC86

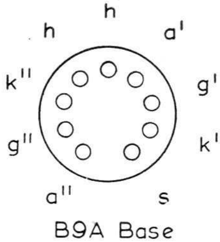
R.F. DOUBLE TRIODE

DESIGN CENTRE RATINGS

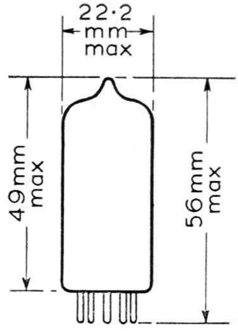
V_a max.	30	V
p_a max.	600	mW
I_k max.	20	mA
R_g max.	1.0	MΩ
V_{h-k} max.	30	V
R_{h-k} max.	20	kΩ

5242





B9A Base



V.H.F. DOUBLE TRIODE

ECC91

Double triode with common cathode for use as r.f. power amplifier or oscillator.

HEATER

V_h	6.3	V
I_h	450	mA

CAPACITANCES

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

*Each section.

CHARACTERISTICS (each section)

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

OPERATING CONDITIONS—CLASS "C" TELEGRAPHY PUSH-PULL

As r.f. amplifier

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

As a frequency trebler

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

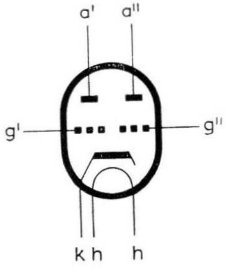
*This bias is obtained by grid current bias, or a combination of grid current and fixed or cathode bias.

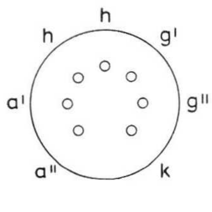
ECC91

V.H.F. DOUBLE TRIODE

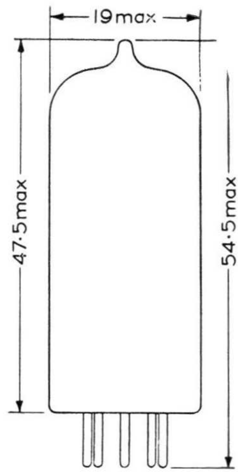
LIMITING VALUES

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



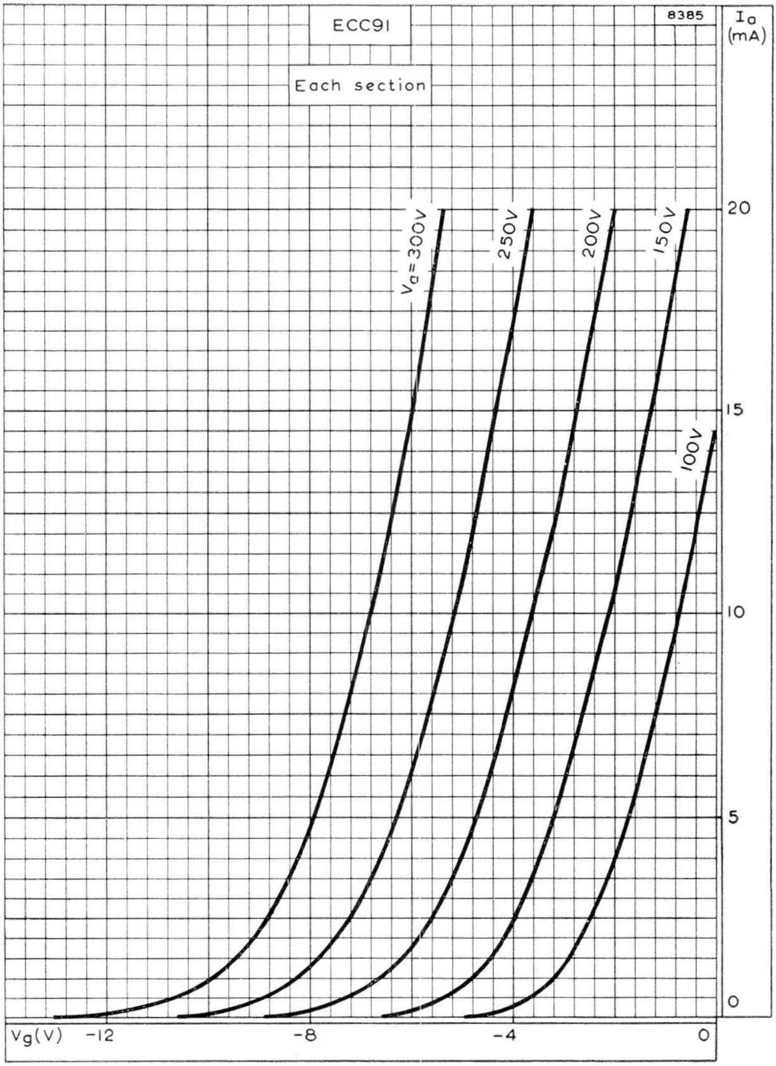


B7G Base

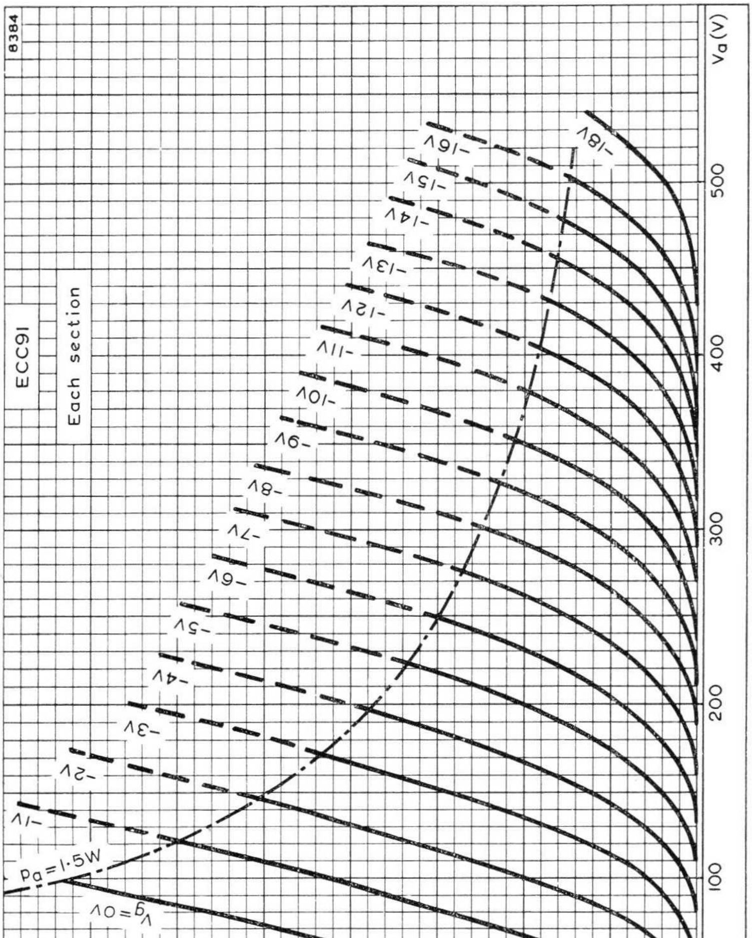


All dimensions in mm

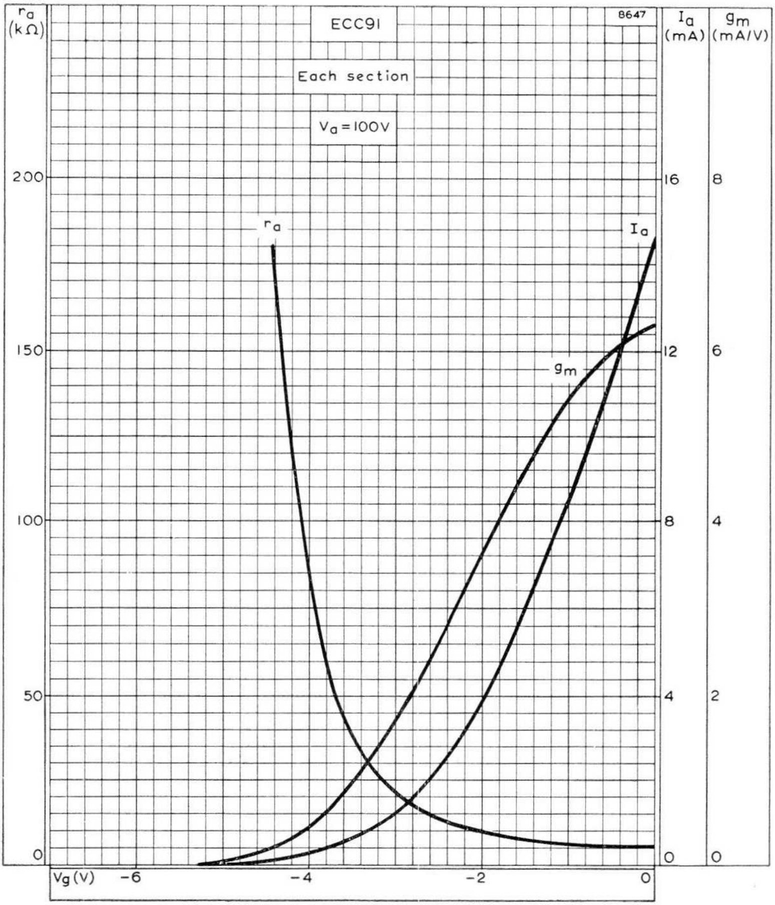
8417



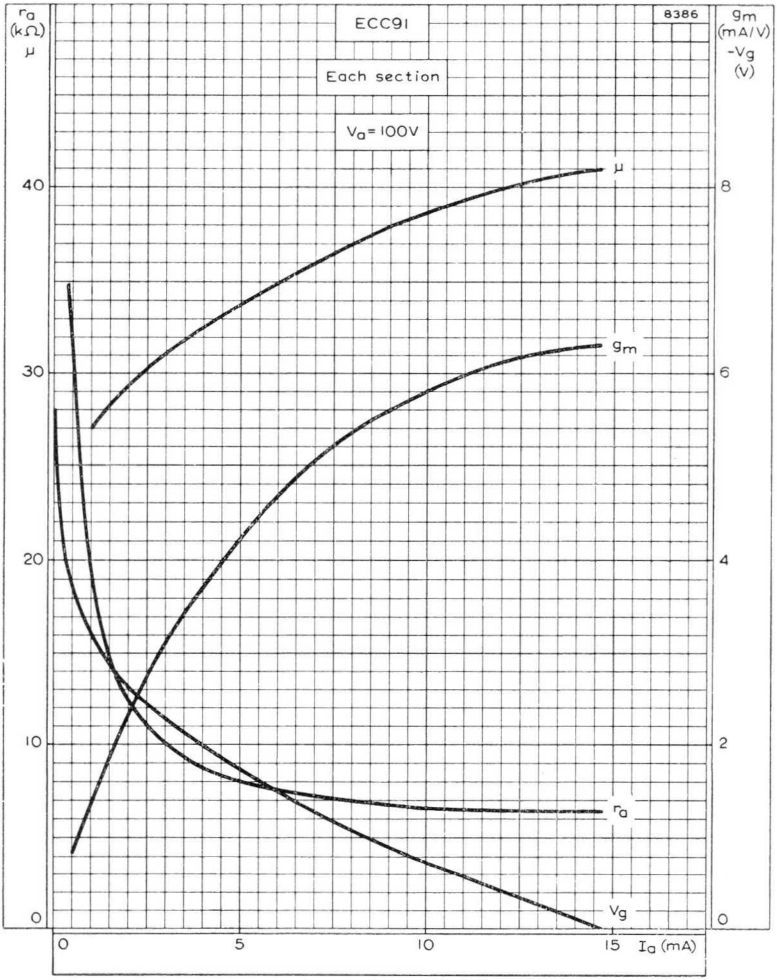
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH GRID VOLTAGE AS PARAMETER



ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE FOR EACH SECTION



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

V.H.F. DOUBLE TRIODE

ECC189

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

HEATER

V_h	6.3	V
I_h	365	mA

CAPACITANCES

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

CHARACTERISTICS (each section)

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

DESIGN CENTRE RATINGS (each section)

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

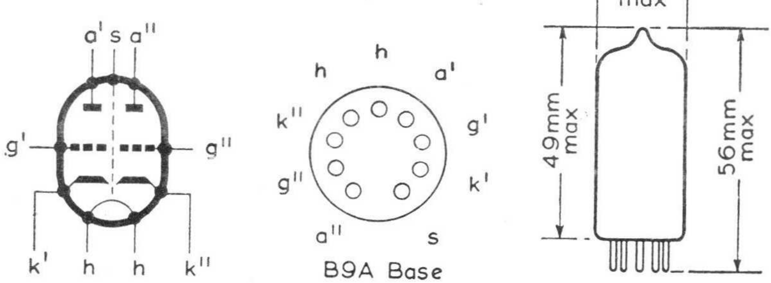
ECC189

V.H.F. DOUBLE TRIODE

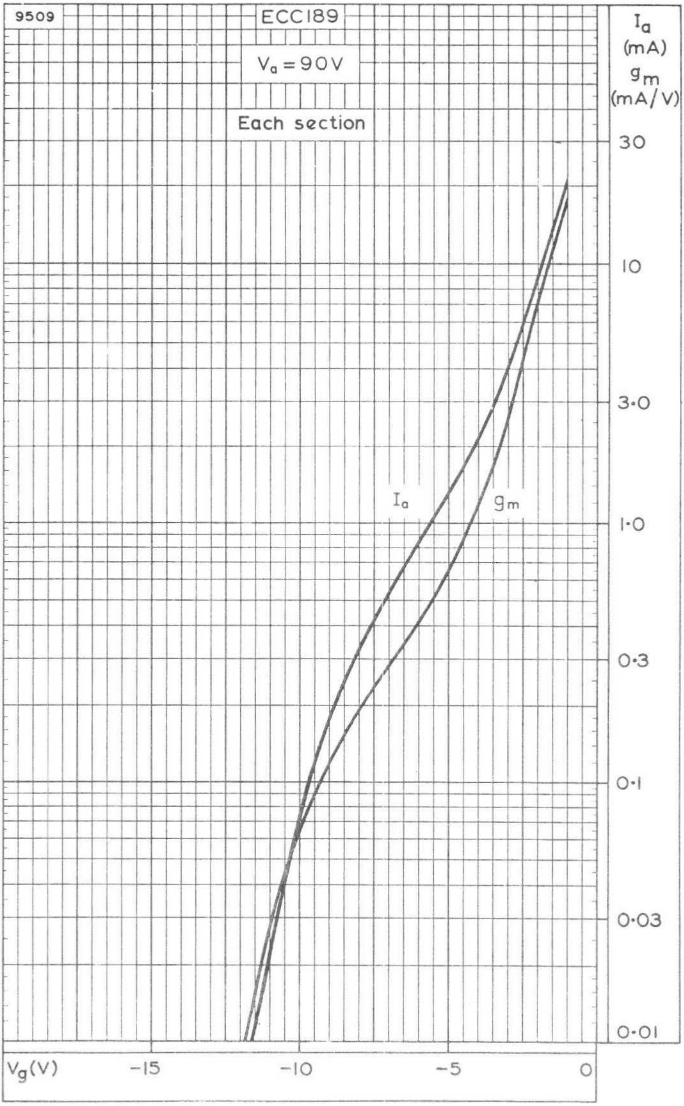
NOTE

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

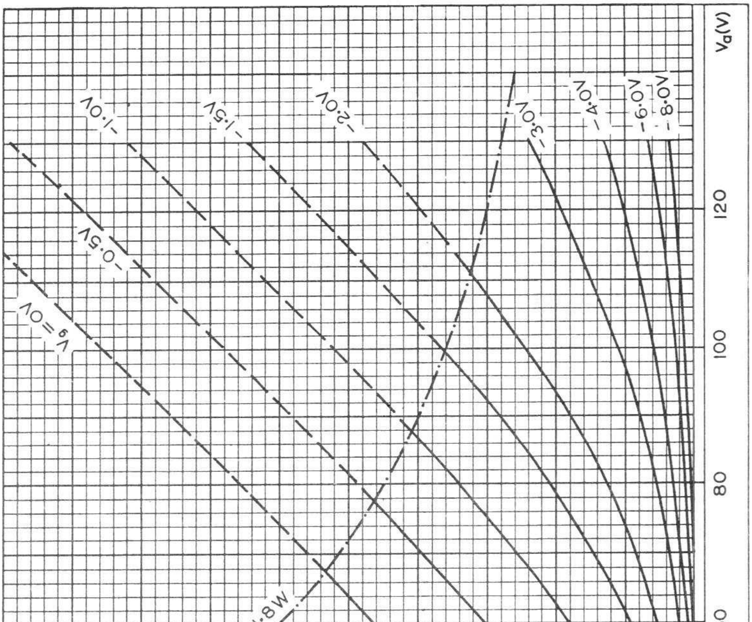
5242



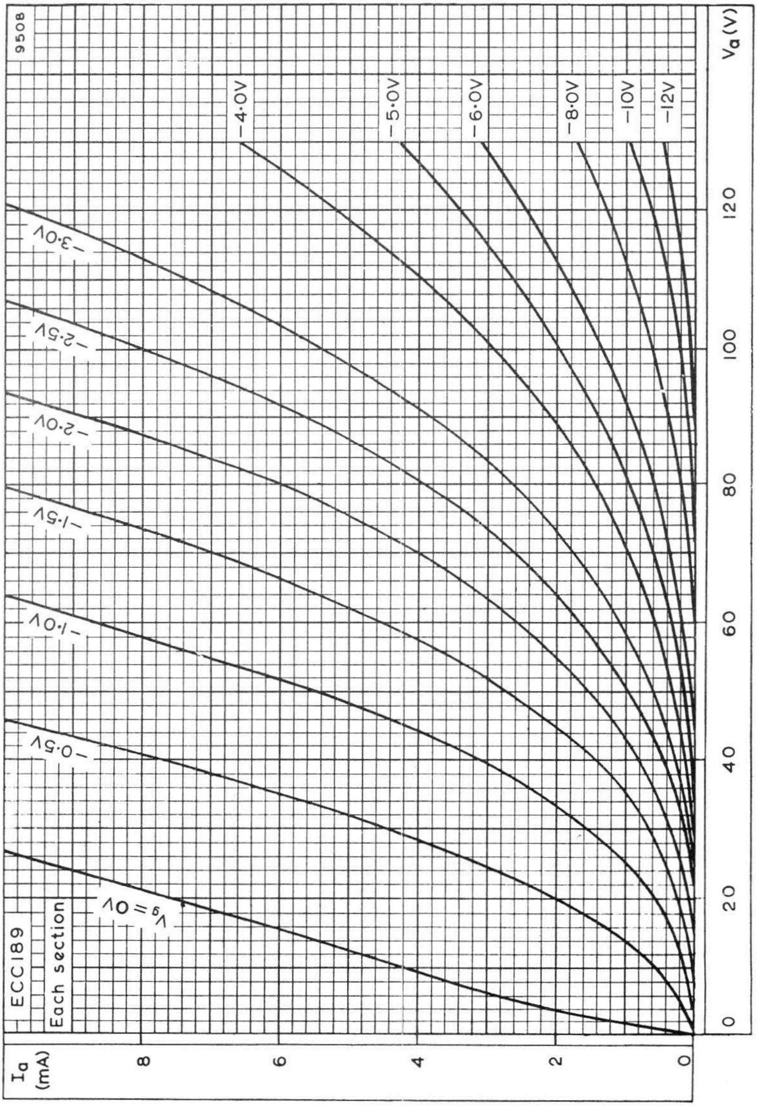
The triode on pins 6, 7, 8, should have the grounded cathode connection and that on pins 1, 2, 3, should have the grounded grid connection.



ANODE CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE



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

TRIODE HEXODE

ECH3

HEATER

This valve is suitable for DC/AC operation.

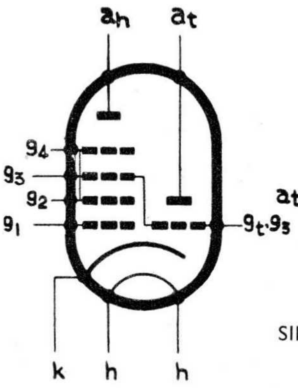
	V_h	6.3	V
	I_h	0.2	A

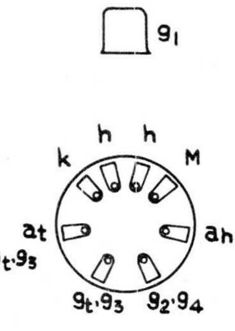
CAPACITANCES

Hexode	c_{gt-g1}	<0.3	$\mu\mu$F
	c_{g1-k}	4.9	$\mu\mu$F
	c_{a-k}	9.0	$\mu\mu$F
	c_{a-g1}	<0.003	$\mu\mu$F
Triode	c_{g-k}	8.8	$\mu\mu$F
	c_{a-k}	4.4	$\mu\mu$F
	c_{a-g1}	1.4	$\mu\mu$F

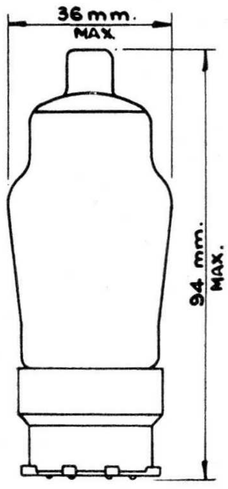
OPERATING CONDITIONS

For characteristics, curves and operating data, see Type ECH35. Except for base, capacitances and heater current, the ECH3 and ECH35 are identical.





SIDE CONTACT BASE



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

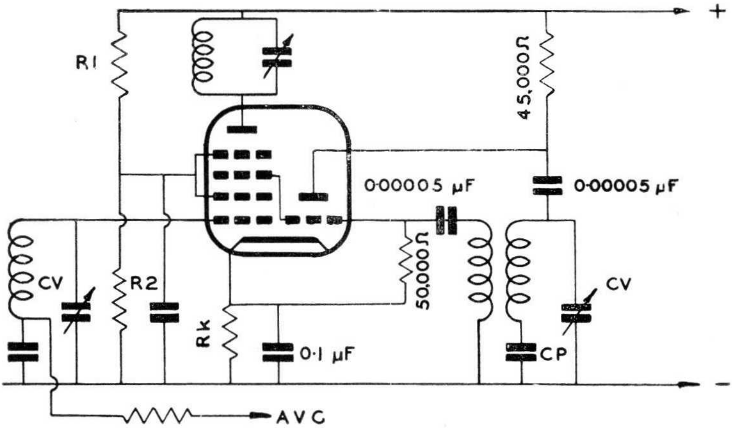
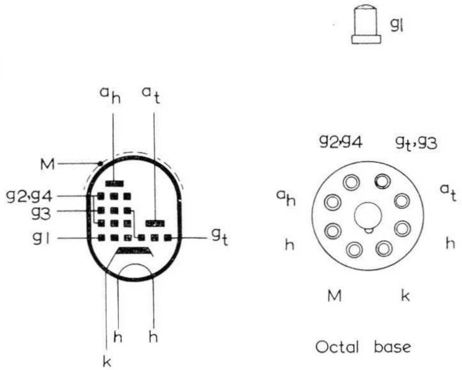
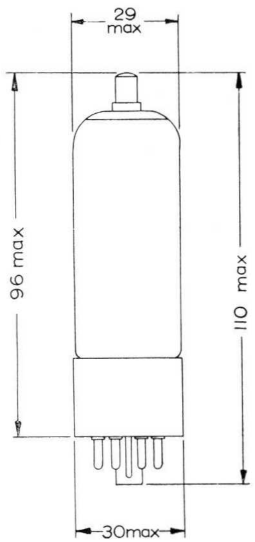


Fig. 1.—ECH35 as frequency changer with screen grid fed by a potentiometer.

6710





All dimensions in mm

TRIODE HEXODE FREQUENCY CHANGER

ECH42

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

HEATER

V_h	6.3	V
I_h	0.23	A

MOUNTING POSITION Any

CAPACITANCES

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

Hexode Section

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

Triode Section

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

OPERATING CONDITIONS AS FREQUENCY CHANGER

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

Hexode Section

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

Triode Section

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

The effective mutual conductance under the above conditions is approximately 0.55 mA/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	mA
R_{g1-k} max.	3	MΩ
R_{g3-k} max.	3	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	50	V

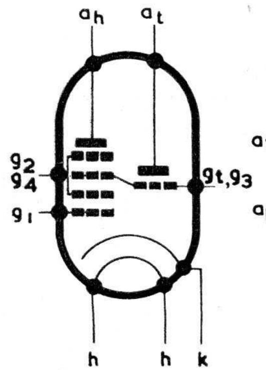
Triode Section

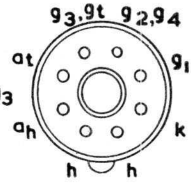
$V_{a(b)}$ max.	550	V
V_a max.	175	V
p_a max.	0.8	W
V_{gt} max. (I_{gt}=+0.3 μA)	−1.3	V
I_k max.	6	mA
R_{gt-k} max.	3	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	50	V

TRIODE HEXODE FREQUENCY CHANGER

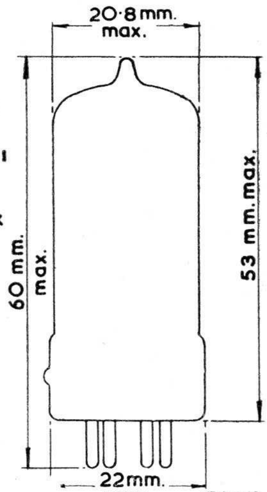
ECH42

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



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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.

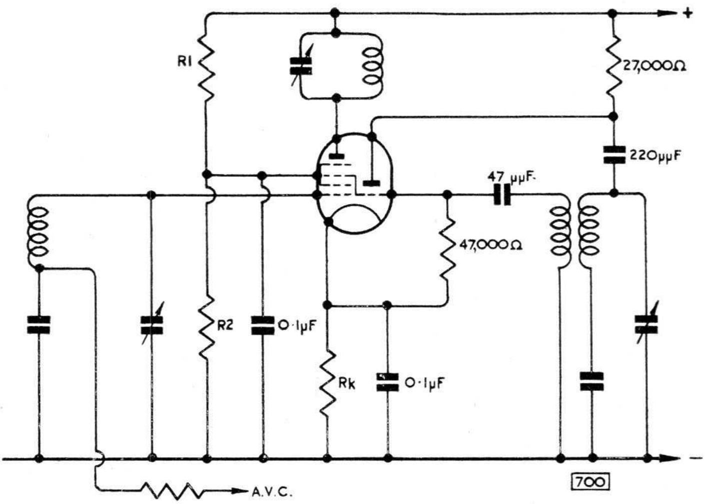


Fig. 1—ECH42 as Frequency Changer

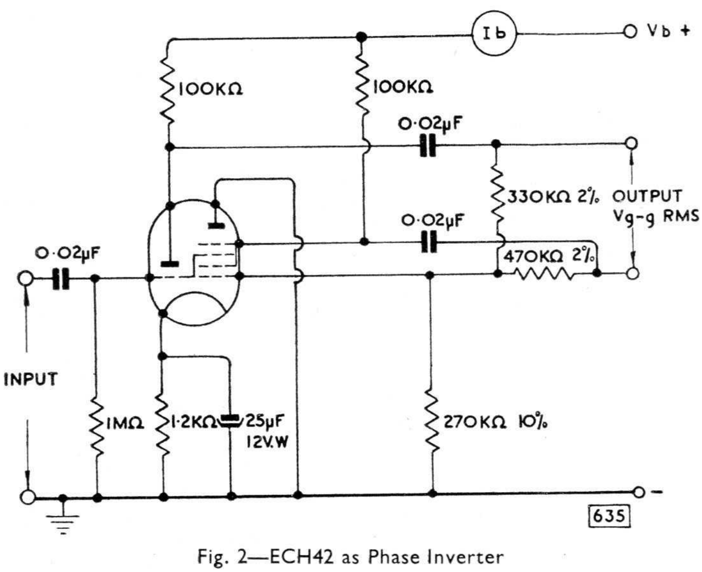


Fig. 2—ECH42 as Phase Inverter

TRIODE PENTODE

ECL83

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

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

V_h	6.3	V
I_h	600	mA

MOUNTING POSITION Any

CAPACITANCES (measured without an external shield)

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

Pentode section

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

Triode section

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

CHARACTERISTICS

Pentode section

V_a	170	200	V
V_{g2}	170	200	V
I_a	30	27	mA
I_{g2}	5.0	4.4	mA
V_{g1}	−9.5	−13	V
g_m	5.5	5.0	mA/V
r_a	53	65	kΩ
μ_{g1-g2}	10	10	

Triode section

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

ECL83

TRIODE PENTODE

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

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−9.5	−13	V
$I_{a(o)}$	30	27	mA
$I_{g2(o)}$	5.0	4.4	mA
R_k	270	410	Ω
R_a	5.5	7.5	kΩ
$V_{in(r.m.s.)}$	5.0	5.2	V
P_{out}	2.2	2.5	W
D_{tot}	10	10.5	%

Two valves in class 'AB' push-pull

V_a	170	200	V
V_{g2}	170	200	V
*R_k	180	220	Ω
$I_{a(o)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g2(o)}$	2×3.8	2×3.9	mA
I_{g2} (max. sig.)	2×6.25	2×8.5	mA
R_{a-a}	6.5	7.5	kΩ
$V_{in(g1-g1)r.m.s.}$	17	23.5	V
P_{out}	5.0	7.2	W
D_{tot}	3.6	4.2	%

*Common cathode bias resistor

TRIODE SECTION AS A.F. VOLTAGE AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (μA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	R_{g1}* (kΩ)
170	100	650	1.8	49	15.3	330
200	100	720	2.2	47	17.7	330

$\frac{V_{out}}{V_{in}}$ measured with an input of 100mV

V_{out} measured for a total harmonic distortion of 5%

*Grid resistor of following valve.

TRIODE PENTODE

ECL83

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

LIMITING VALUES

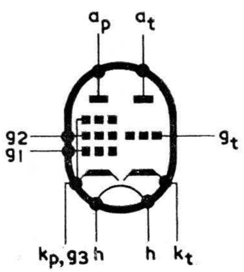
Pentode section

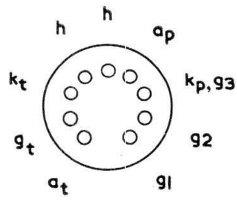
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	5.4	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.2	W
p_{g2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g1-k} max. (self-bias)	500	kΩ
R_{g1-k} max. (fixed bias)	250	kΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max.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

Triode section

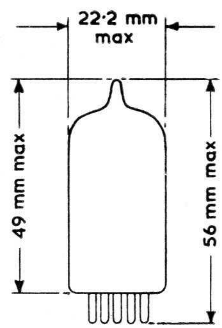
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k} max. (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

3749





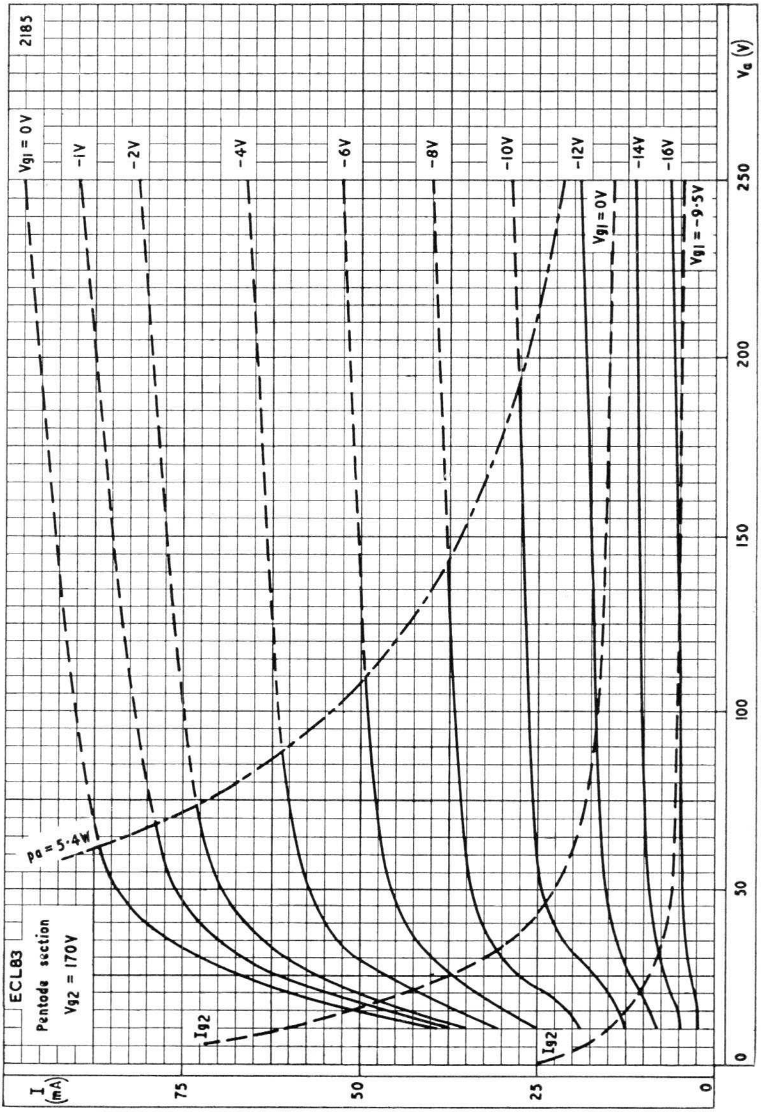
B9A Base



ECL83

TRIODE PENTODE

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



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

TRIODE PENTODE

ECL86

Combined high-μ triode and output pentode for use in audio amplifier circuits.

HEATER

Vh	6.3	V
Ih	660	mA

CAPACITANCES

cap - gt	< 6.0	mpF
cat - g1	< 200	mpF
cgt - g1	< 20	mpF
cat - ap	< 150	mpF

Pentode section

cin	10	pF
ca - g1	< 400	mpF
cg1 - h	< 240	mpF

Triode section

cin	2.3	pF
cout	2.5	pF
ca - g	1.4	pF
cg - h	< 6.0	mpF

CHARACTERISTICS

Pentode section

Va	250	V
Vg2	250	V
Vg1	- 7.0	V
Ia	36	mA
Ig2	6.0	mA
gm	10	mA/V
ra	48	kΩ
μg1 - g2	21	
- Vg1 max. (Ig1 = + 0.3 μA)	1.3	V

Triode section

Va	250	V
Vg	- 1.9	V
Ia	1.2	mA
gm	1.6	mA/V
μ	100	
ra	62	kΩ
- Vg1 max. (Ig1 = +0.3 μA)	1.3	V

OPERATING CONDITIONS AS SINGLE VALVE AMPLIFIER ←

Pentode section

Va	250	250	V
Vg2	250	250	V
Rk	270	170	Ω
Ia	27	37	mA
Ig2	8.2	10	mA
Ra	10	7.0	kΩ
Pout	2.8	4.0	W
Vin (r.m.s.)	2.7	3.2	V
Dtot	10	10	%
Vin (r.m.s.) (Pout = 50 mW)	280	300	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL ←

Cathode bias

Va (b)	250	300	V
Vg2 (b)	250	300	V
Rk (per valve)	180	260	Ω
Ra - a	8.2	9.1	kΩ
Ia (o)	2 x 32.5	2 x 31	mA
Ia (max. sig.)	2 x 35.5	2 x 37	mA
Ig2 (o)	2 x 5.6	2 x 5.5	mA
Ig2 (max. sig.)	2 x 8.9	2 x 10.6	mA
Vin (g1 - g1) r.m.s.	11.0	16.8	V
Pout	10	13.6	W
Dtot	5.0	4.0	%
Vin (r.m.s.) (Pout = 50 mW)	480	520	mV

OPERATING CONDITIONS FOR TRIODE SECTION AS RESISTANCE COUPLED A.F. AMPLIFIER

Cathode bias

Vb	300	250	250	200	V
Ra	220	220	220	220	kΩ
Ia	0.8	0.6	0.6	0.42	mA
Rk	1.2	1.75	1.75	2.6	kΩ
Vout / Vin	80	75	70	66	
Vout (r.m.s.)	9.0	5.0	3.2	3.2	V
Dtot	0.4	0.4	0.4	0.6	%
* Rg	10	10	0.68	0.68	MΩ

* Grid resistor of following valve.

At lower values of Vb, grid current bias should be used.

Grid current bias (Rg = 10 MΩ)

Zs = 47 kΩ

Vb (V)	Ra (kΩ)	Rg* (MΩ)	Ia (mA)	Dtot (%)	Vout / Vin	Vout(r.m.s.) (V)
300	220	10	0.8	0.4	80	9
250	220	10	0.6	0.4	75	5
250	220	0.68	0.6	0.4	70	3.2
200	220	0.68	0.42	0.6	66	3.2

* Grid resistor of following valve.

LIMITING VALUES

Pentode section

Va (b) max.	550	V
Va max.	300	V
pa max.	9.0	W
Vg2 (b) max.	550	V
Vg2 max.	300	V
pg2 max.	1.8	W
Ik max.	55	mA
Rg1 - k max.	0.5	MΩ
Vh - k max.	100	V

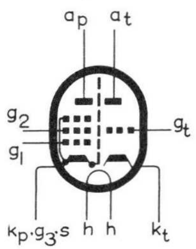
Triode section

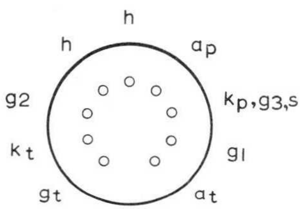
Va (b) max.	550	V
Va max.	300	V
pa max.	500	mW
Ik max.	4.0	mA
Rg - k max.	1.0	MΩ
Vh - k max.	100	V

OPERATING NOTES

1. Microphony

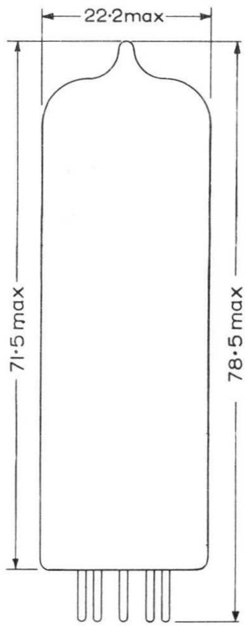
This valve may be used without special precautions against microphony in equipment where the input voltage is not less than 4 mV for an output of 50 mW.





B9A Base

All dimensions in mm



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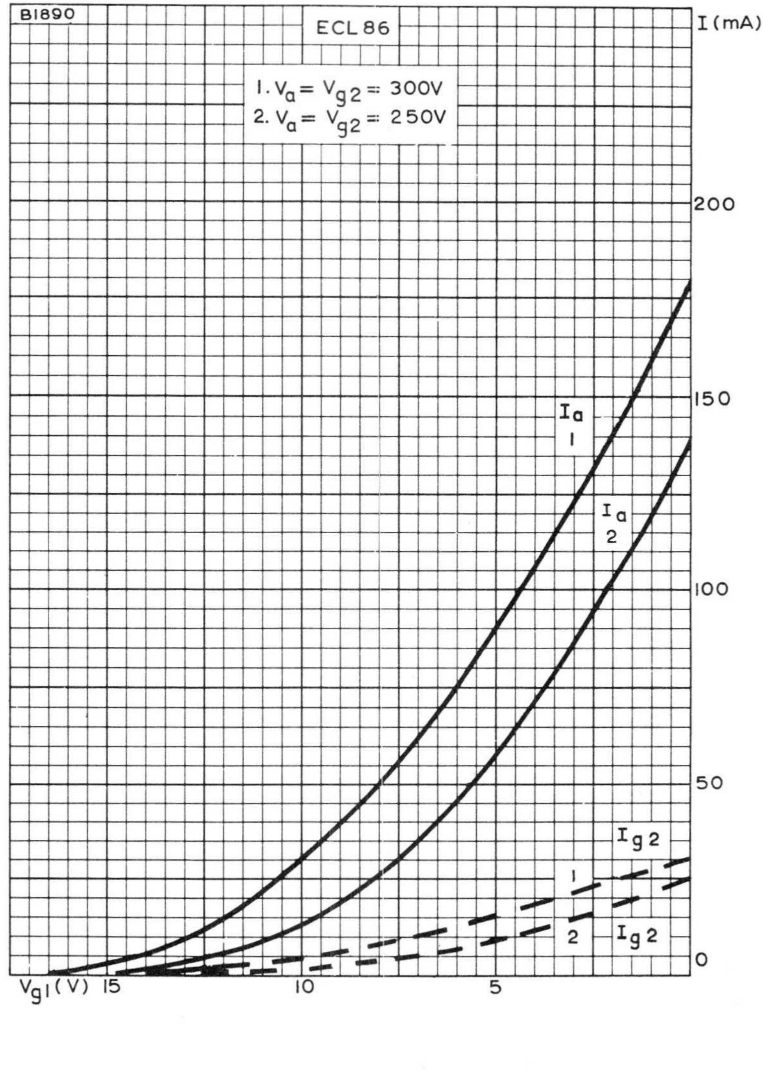
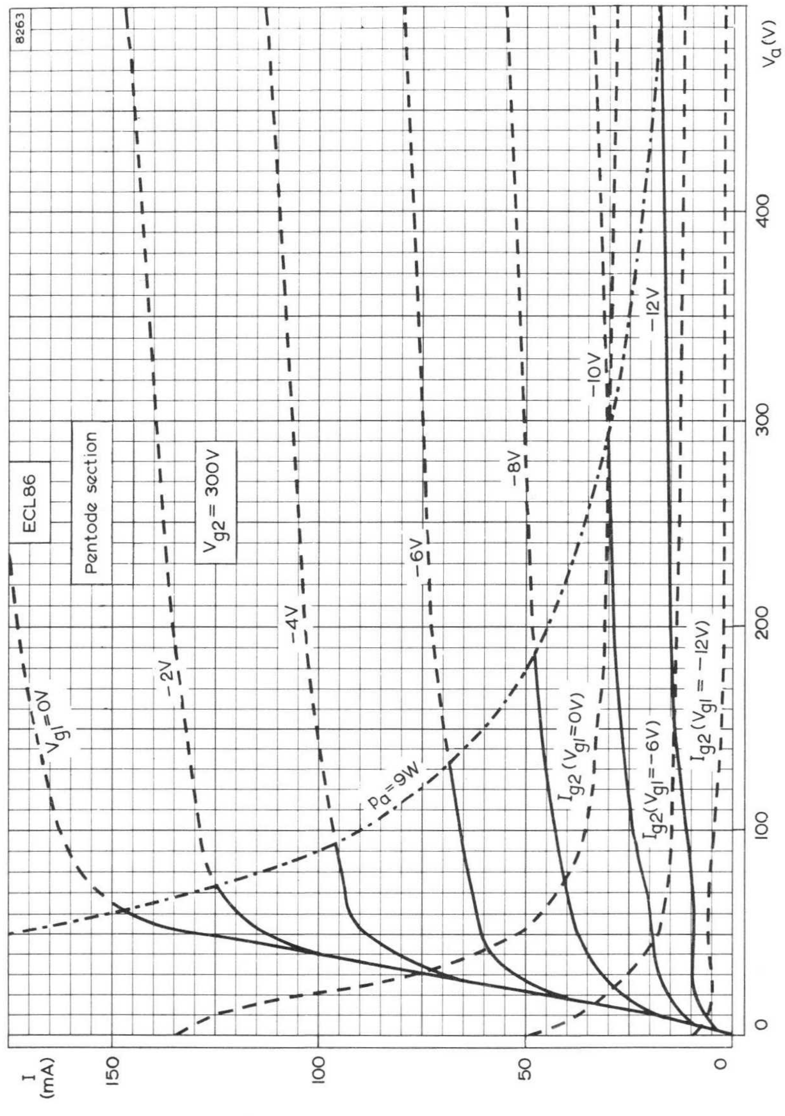
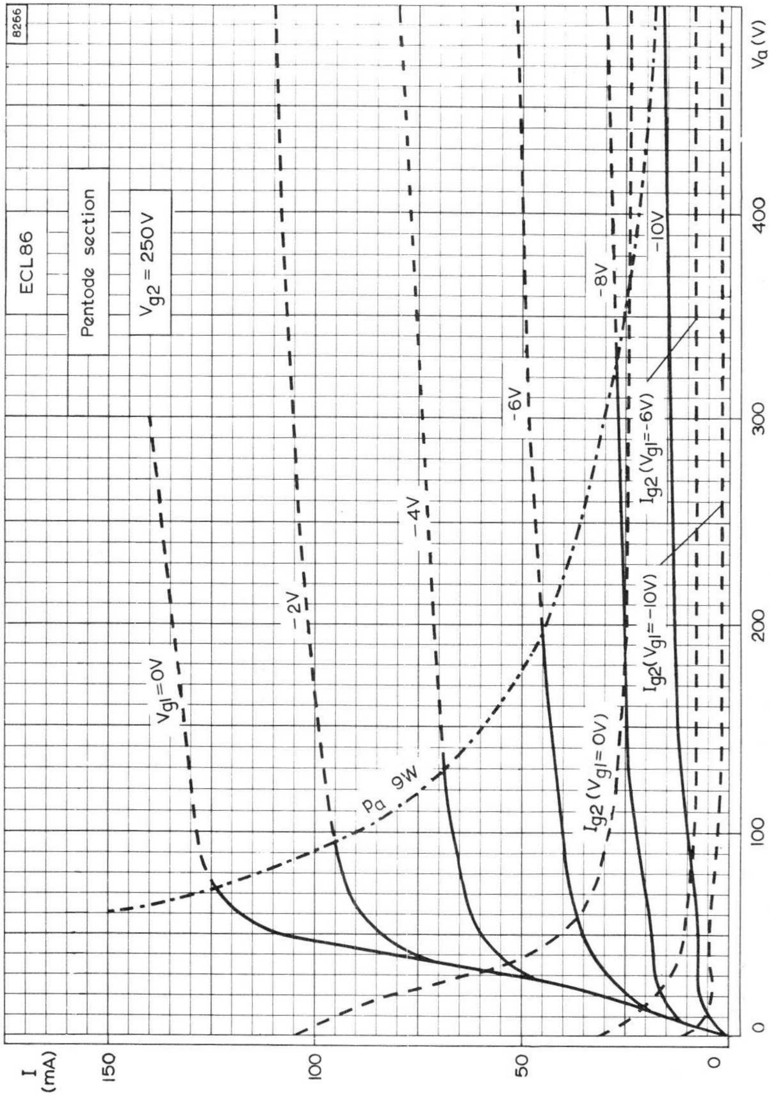


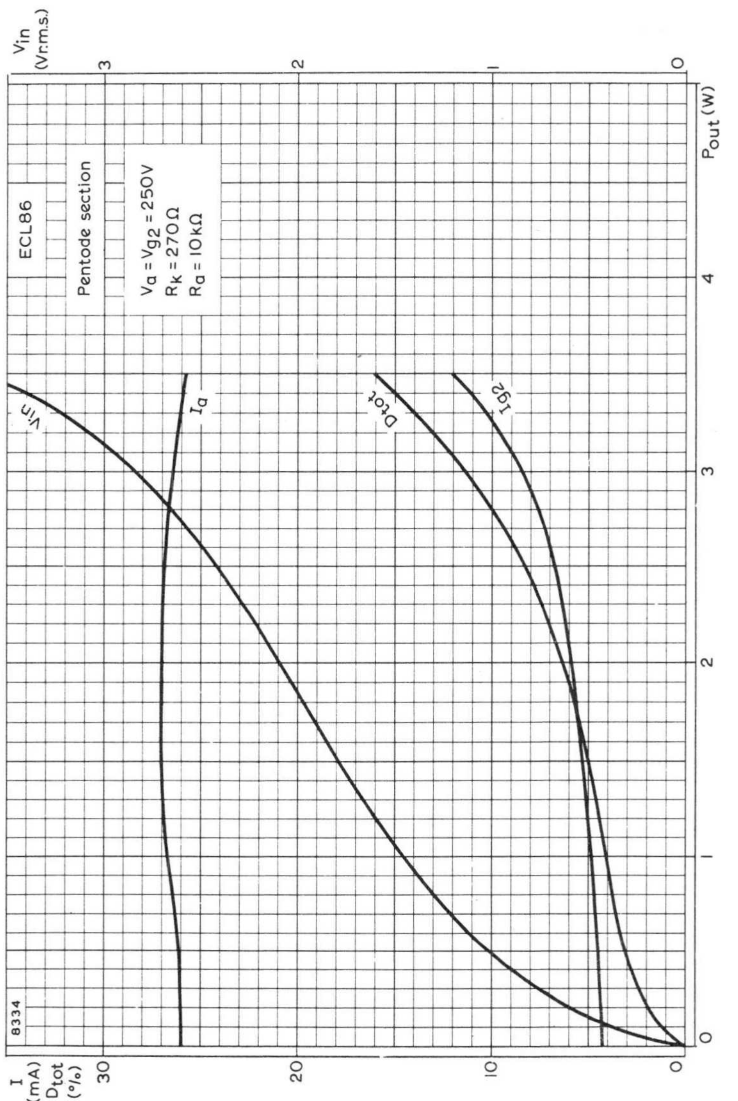
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. PENTODE SECTION.



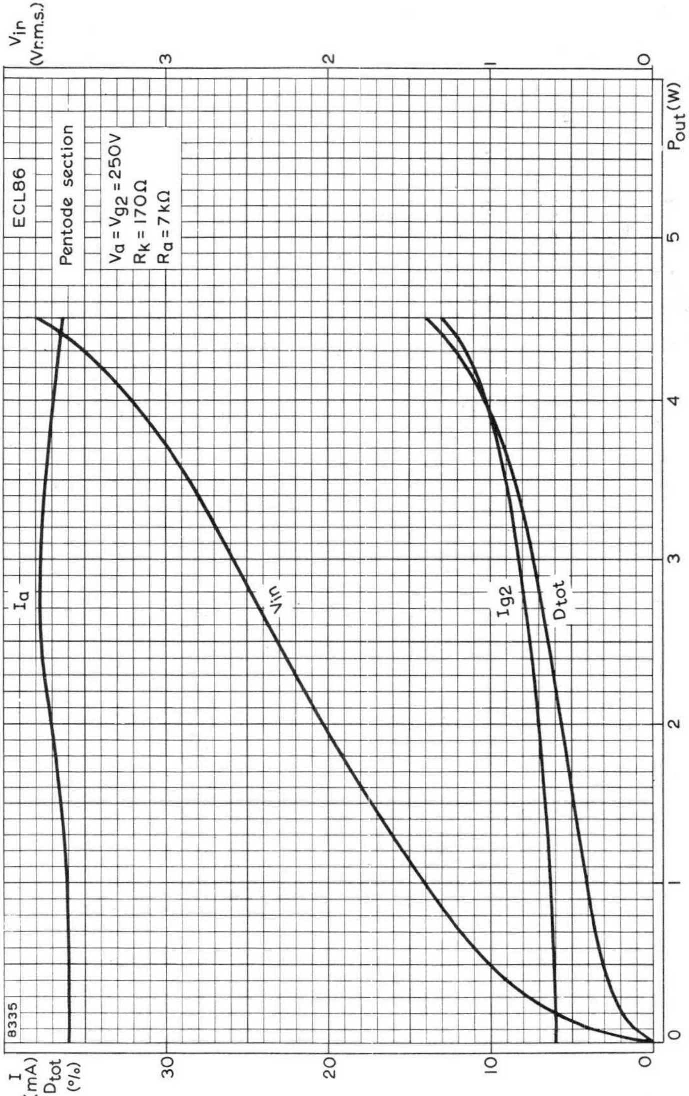
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE, WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION Vg2 = 300V.



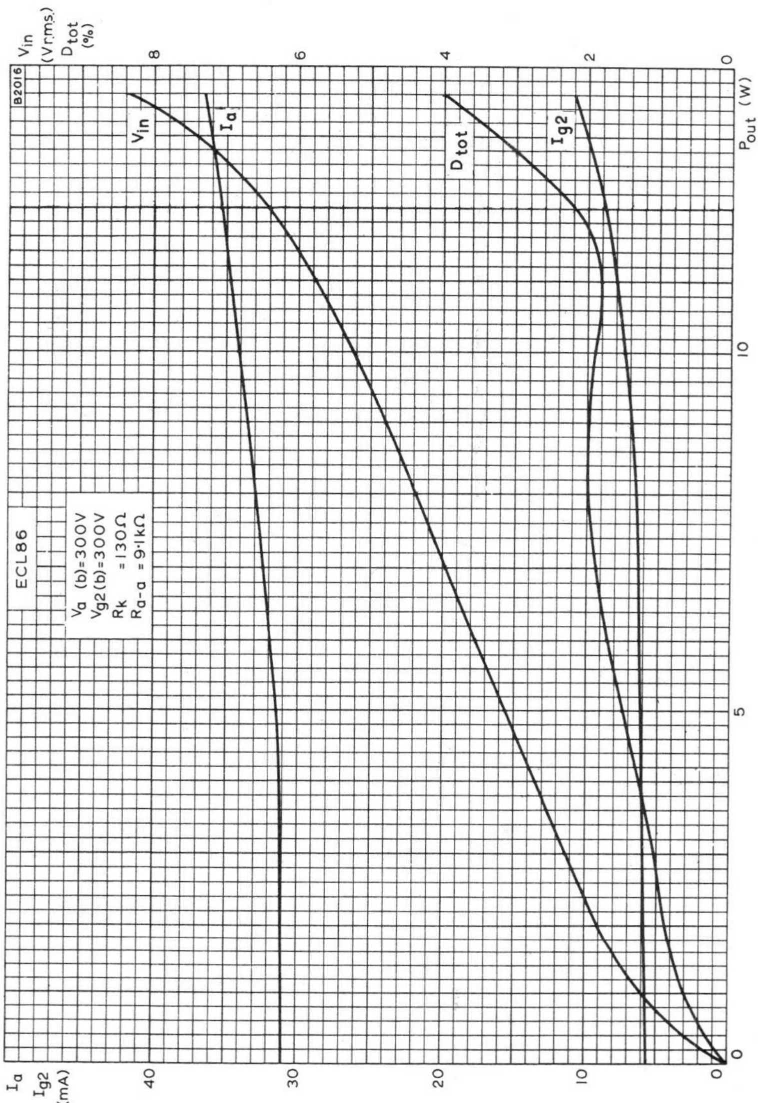
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE, WITH CONTROL-GRID VOLTAGE AS PARAMETER. PENTODE SECTION Vg2 = 250V.



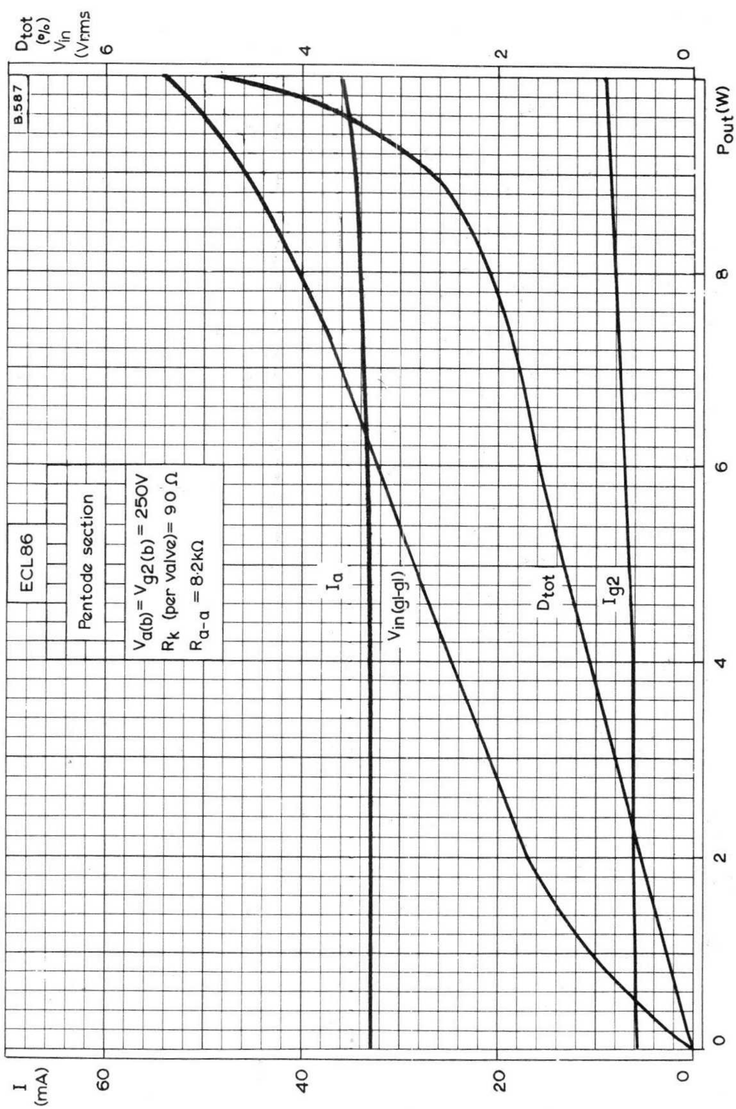
PERFORMANCE OF ECL86 AS SINGLE VALVE AMPLIFIER.
PENTODE SECTION Va = Vg2 = 250V, Rk = 270Ω.



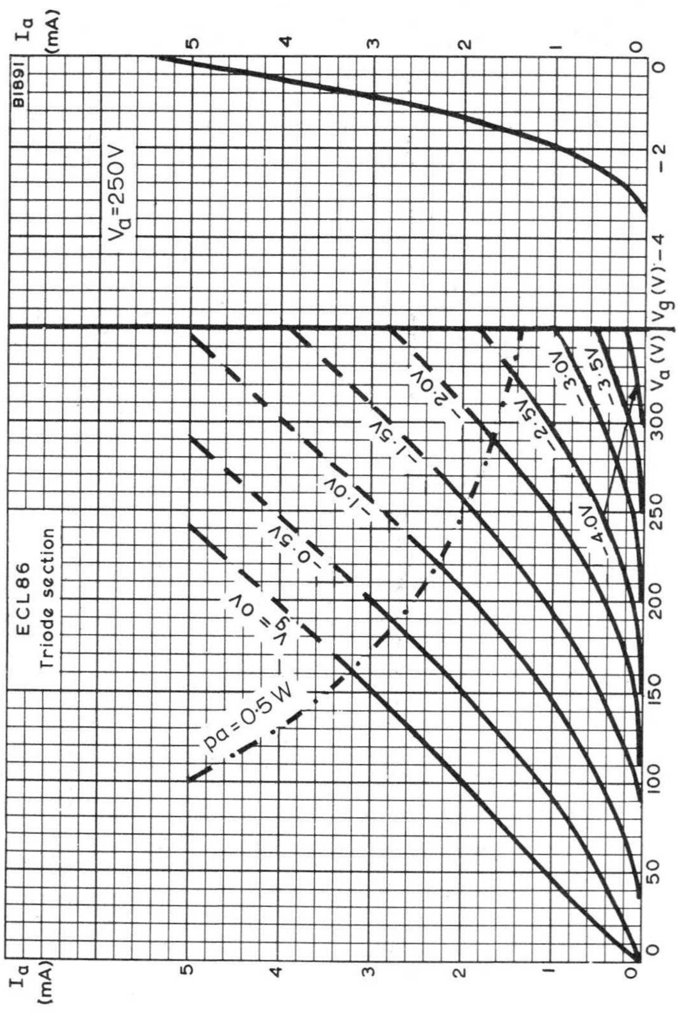
PERFORMANCE OF ECL86 AS SINGLE VALVE AMPLIFIER.
PENTODE SECTION Va = Vg2 = 250V, Rk = 170Ω.



PERFORMANCE OF ECL86 IN PUSH-PULL
PENTODE SECTION Va(b) = Vg2(b) = 300V



PERFORMANCE OF ECL86 IN PUSH-PULL
PENTODE SECTION Va(b) = Vg2(b) = 250V



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

ANODE CURRENT PLOTTED AGAINST CONTROL GRID VOLTAGE. Va = 250V

TRIODE SECTION

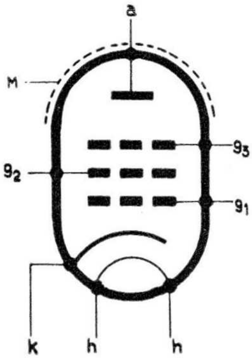
R.F. PENTODE

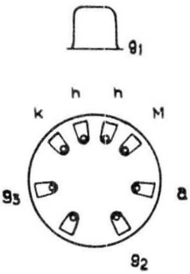
EF9
EF22

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.

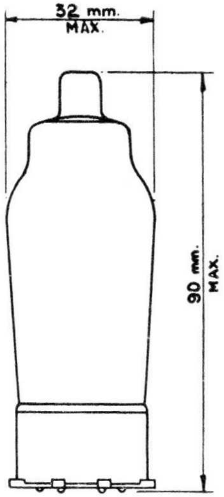
Except for basing, the EF9 and the EF22 are identical to the EF39.

EF9

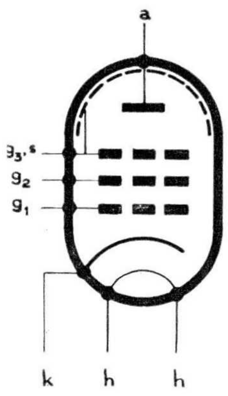


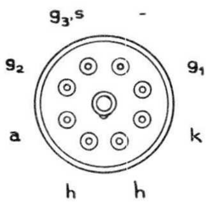


SIDE CONTACT BASE

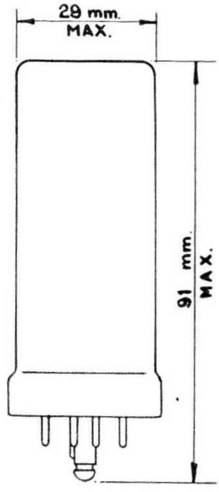


EF22

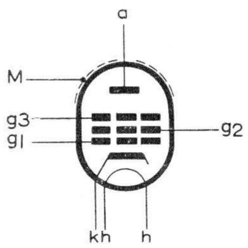


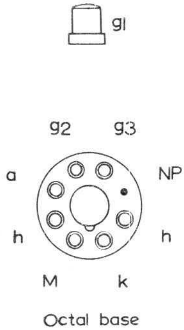


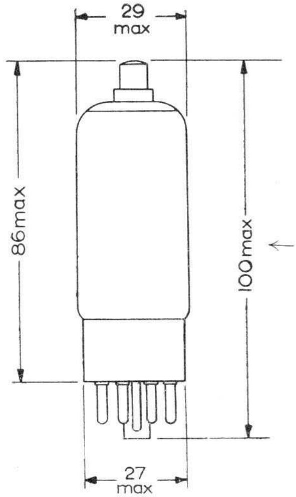
B8G BASE



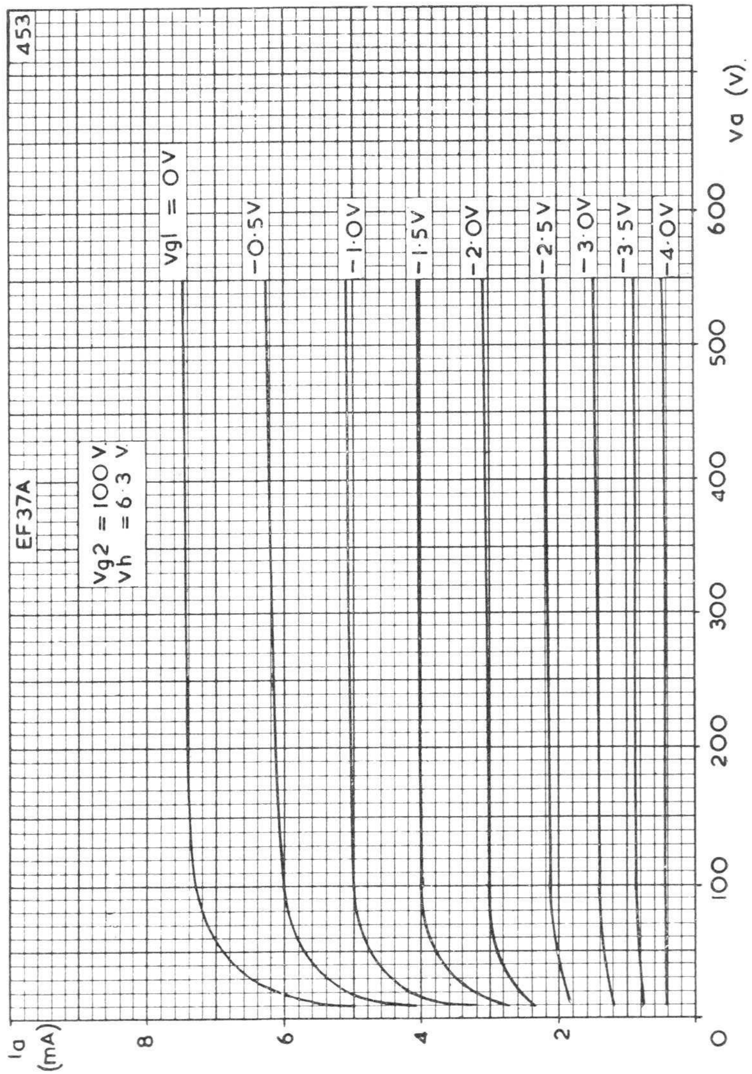
6709







All dimensions in mm



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE.
$V_{g2} = 100V$.

VARIABLE-MU R.F. PENTODE

EF39

Variable-mu r.f. pentode with sliding screen characteristics, for use as controlled r.f. or i.f. amplifier.

HEATER

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

V_h	6.3	V
I_h	200	mA

CAPACITANCES

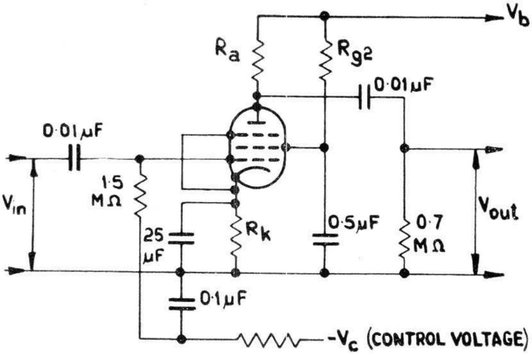
c_{a-g1}	<3.0	mpF
c_{in}	5.5	pF
c_{out}	7.2	pF

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

$V_b = V_a$	200	200	250	250	V
R_{g2}	60	60	90	90	kΩ
V_{g2}	100	200	100	250	V
V_{g3}	0	0	0	0	V
V_{g1}	−2.5	−39	−2.5	−49	V
I_a	6.0	—	6.0	—	mA
I_{g2}	1.7	—	1.7	—	mA
g_m	2.2	0.0055	2.2	0.0045	mA/V
r_a	0.9	>10	1.25	>10	MΩ
R_k	325	325	325	325	Ω

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

OPERATING CONDITIONS AS CONTROLLED GAIN R.C. COUPLED AMPLIFIER



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

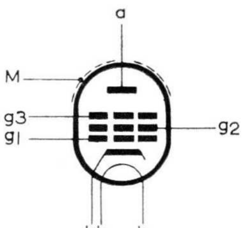
EF39

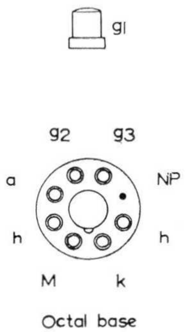
VARIABLE-MU R.F. PENTODE

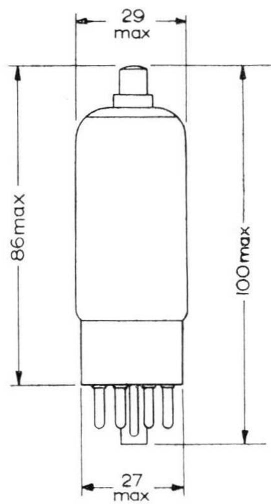
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2	W
I_k max.	10	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max. (I_a = 6mA)	125	V
V_{g2} max. (I_a = 3mA)	300	V
p_{g2} max.	300	mW
R_{g1-k} max.	3.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

6709







All dimensions in mm

VOLTAGE AMPLIFYING PENTODE

EF40

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

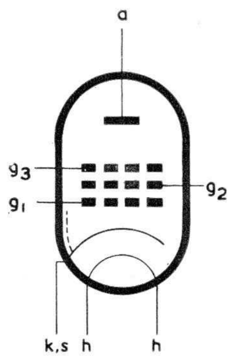
EF41

OVERLEAF

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

LIMITING VALUE

V_{h-k} max.	50	V



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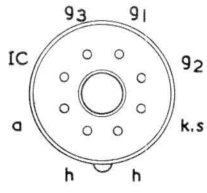
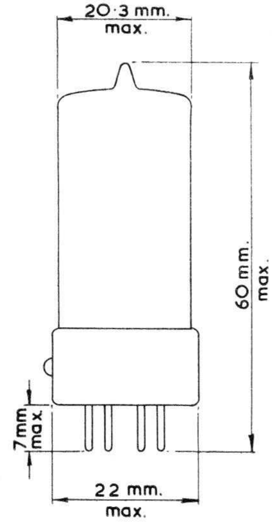


B8A BASE



VARIABLE-MU R.F. PENTODE

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

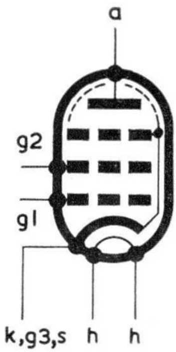
Except for capacitances, basing, dimensions and heater to cathode voltage ratings the EF41 is identical to the EF39.

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



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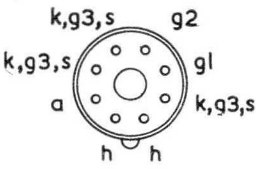
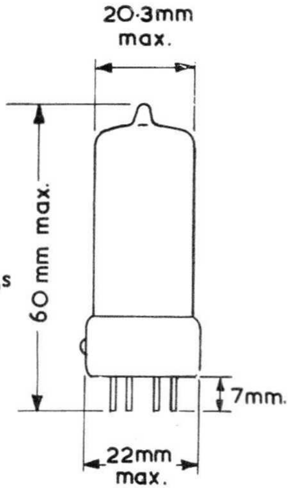


B8A Base



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.

H.F. PENTODE

EF42

High slope pentode, primarily intended for use as R.F. or I.F. amplifier in A.C. mains-operated equipment.

HEATER

V_h	6.3	V
I_h	0.33	A

CAPACITANCES

c_{in}	9.5	$\mu\mu$F
c_{out}	4.5	$\mu\mu$F
c_{a-g}	$<$0.005	$\mu\mu$F

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
V_{g1}	−2	V
I_a	10	mA
I_{g2}	2.3	mA
g_m	9.5	mA/V
r_a	440	k Ω
V_{g3} (for I_a cut-off)	−60	V
R_{eq}	750	Ω
Input damping (at 50 Mc/s)	5	k Ω

LIMITING VALUES

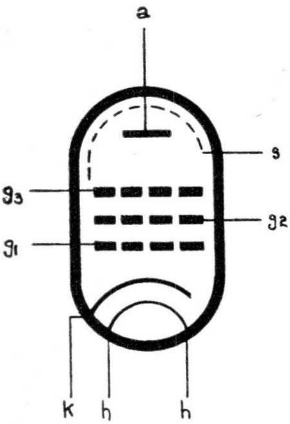
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	0.7	W
I_k max.	13	mA
V_{g1} ($I_{g1}=+0.3$ μA) max.	−1.3	V
V_{h-k} max.	90	V
R_{h-k} max.	20	k Ω
R_{g1-k} max. (auto. bias)	1.0	M Ω

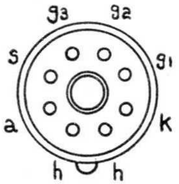
EF42

H.F. PENTODE

High slope pentode, primarily intended for use as R.F. or I.F. amplifier in A.C. mains-operated equipment.

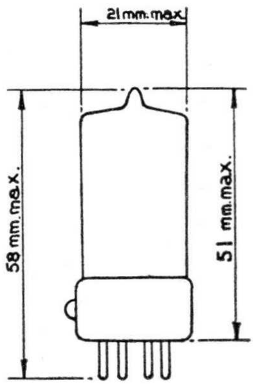
ARRANGEMENT OF ELECTRODES
AND BASE CONNECTIONS





B8A BASE

DIMENSIONS



R.F. PENTODE

EF50

Single-ended r.f. pentode, fully controlled by voltages of 0 to —6V or 0 to —55V according to the circuit used.

HEATER

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

V_h	6.3	V
I_h	300	mA

CAPACITANCES

	Min.	Av.	Max.	
c_{a-g1}	—	—	0.007	pF
c_{g1-g2}	—	2.4	—	pF
c_{in}	7.1	8.3	9.5	pF
c_{out}	4.8	5.2	5.6	pF

OPERATING CONDITIONS

V_a	250	250	250	250	V
V_{g2}	250	250	250	250	V
V_{g1-c}	−2	−1.55*	**	††	V
V_{g3}	0*	0	−30*	−20*	V
I_a	10	10	10	10	mA
I_{g2}	3.0	3.0	5.5	4.0	mA
g_m	6.5	6.5	5.2	6.0	mA/V
r_a	1.0	1.0	0.1	0.2	MΩ
μ_{g1-g2}	75	—	—	—	
R_{eq}	1.4	—	—	—	kΩ
Input damping (f = 50Mc/s)	4.0	—	—	—	kΩ
Output damping (f = 50Mc/s)	50	—	—	—	kΩ
R_k	0	32	0	32	Ω
C_k	0	50	0	50	pF
V_{g1} (for 10 : 1 reduction in g_m)	—	−4.5	**	††	V
V_{g3} (for 10 : 1 reduction in g_m)	−53	—	−55.5	−51.5	V

* Valve not controlled by a.g.c.

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

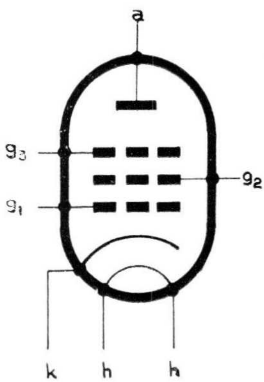
†† V_{g1} is obtained from V_{g3} by means of a potentiometer of 50kΩ and 4kΩ.

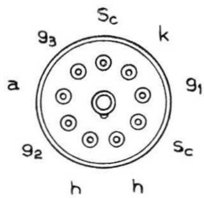
EF50

R.F. PENTODE

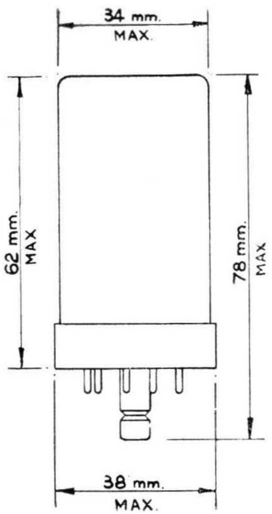
LIMITING VALUES

$V_{a\ (b)}$ max.	550	V
V_a max.	300	V
p_a max.	3	W
I_k max.	15	mA
$V_{g2\ (b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	1.7	W
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
V_{g3} max. ($I_{g3} = +0.3\mu A$)	−1.3	V
R_{g1} max.	3	MΩ
R_{g3} max.	3	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ





B9G BASE



SHORT WAVE R.F. PENTODE

EF54

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

HEATER

V_h	6.3	V
I_h	0.3	A

CAPACITANCES

c_{in}	6.2	μμF
c_{out}	4.9	μμF
c_{a-g1}	0.02	μμF
c_{g1-g2}	2.2	μμF

OPERATING CONDITIONS

V_a	250	V
V_{g2}	250	V
V_{g1}	–1.7	V
R_k	150	Ω
I_a	10	mA
I_{g2}	1.45	mA
g_m	7.7	mA/V
r_a	500	K Ω
μ_{g1-g2}	80	
R_{eq}	700	Ω
Input resistance (at 50 Mc/s)	10	K Ω

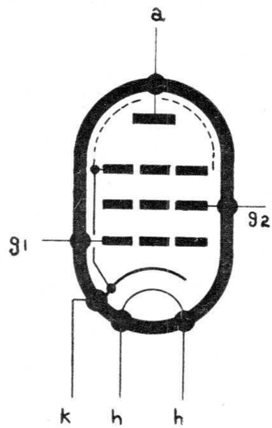
LIMITING VALUES

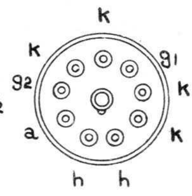
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	1.7	W
I_k max.	15	mA
V_{g1} max. ($I_{g1} = +0.3$ μA)	–1.3	V
R_{g1} max.	3	M Ω
V_{h-k} max.	100	V
R_{h-k} max.	20	K Ω
f max.	250	Mc/s

EF54

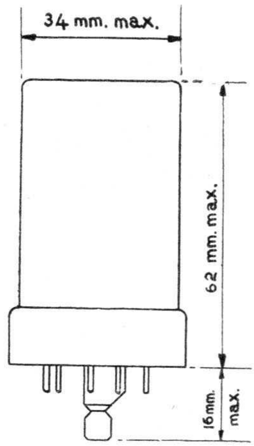
SHORT WAVE R.F. PENTODE

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





B9G BASE



g_3 and screen internally connected to cathode

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

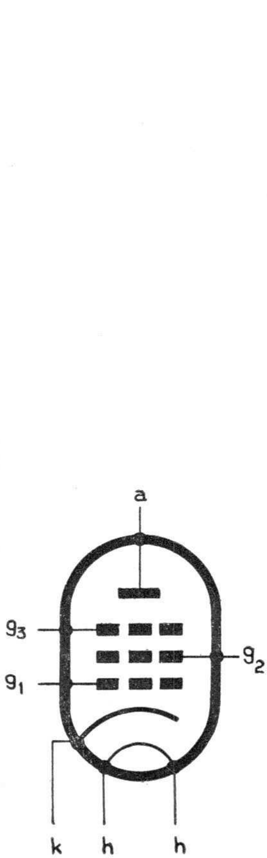
LIMITING VALUES

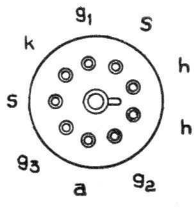
$V_{a(b)}$ max.	500	V
V_a max.	300	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	250	V
p_a max.	10	W
p_{g2} max.	2.0	W
V_{h-k} max.	150	V
R_{g1-k} max.	700	kΩ
$i_{k(pk)}$ max. (with 50 μ sec. pulse, 500 pp.s.)	1.5	A

EF55

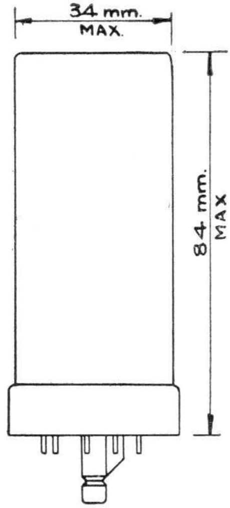
VIDEO FREQUENCY PENTODE

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.

SUBMINIATURE R.F. PENTODE

EF70

Subminiature high slope r.f. pentode with a short suppressor grid base. A diode is connected internally to the suppressor grid to prevent this grid locking at a positive voltage.

HEATER

V_h	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and, therefore, in the interests of satisfactory life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis and should result in a bulb temperature of 100°C.

CAPACITANCES (measured with external shield)

c_{a-g1}	$<$0.025	pF ←
c_{in}	4.5	pF
c_{out}	4.7	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g3}	0	V
I_a	3.0	mA
I_{g2}	2.25	mA ←
V_{g1}	–2.0	V
g_m	2.5	mA/V
r_a	100	kΩ
μ_{g1-g2}	38	
$V_{g3}(I_a = 100\mu A)$	–8.0	V ←

EF70

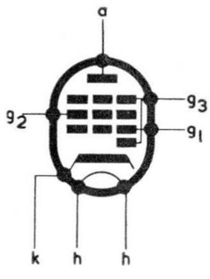
SUBMINIATURE R.F. PENTODE

Subminiature high slope r.f. pentode with a short suppressor grid base. A diode is connected internally to the suppressor grid to prevent this grid locking at a positive voltage.

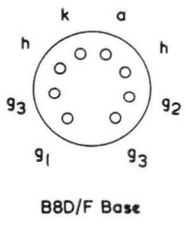
LIMITING VALUES

$V_{a(b)}$ max.	300	V
V_a max.	175	V
p_a max.	750	mW
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
p_{g2} max.	400	mW
I_k max.	10	mA
R_{g1-k} max.	500	kΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V

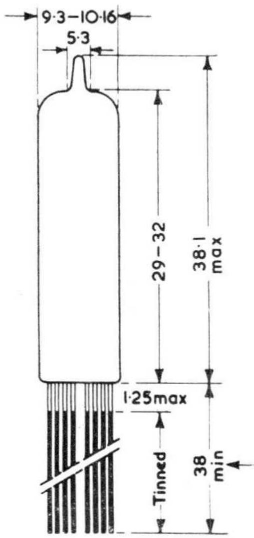
Note – A diode is connected internally to g_3 in order to prevent this grid locking at a positive voltage.



3270



B8D/F Base



All dimensions in mm

SUBMINIATURE VARIABLE-MU R.F. PENTODE

EF71

Variable-mu pentode suitable for use in controlled r.f. amplifiers.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

CAPACITANCES

	Shielded	Unshielded	
c_{in}	4.5	4.0	pF
c_{out}	3.4	1.9	pF
c_{a-g1}	<0.015	<0.035	pF

CHARACTERISTICS

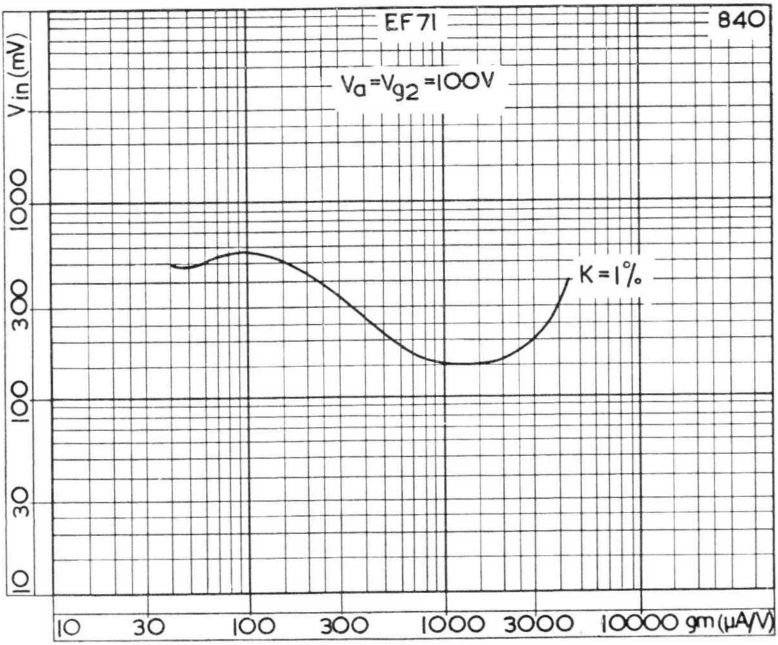
V_a	100	V
V_{g2}	100	V
R_k	120	Ω
I_a	7.2	mA
I_{g2}	2.2	mA
g_m	4.5	mA/V
r_a	260	kΩ
V_{g1} ($g_m = 25\mu A/V$)	−14	V

LIMITING VALUES

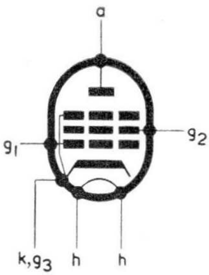
$V_{a(b)}$ max.	300	V
V_a max.	175	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
p_{g2} max.	500	mW
I_k max.	10	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V

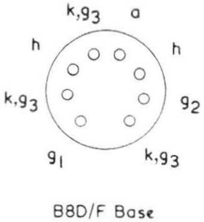
EF71

SUBMINIATURE VARIABLE-MU R.F. PENTODE

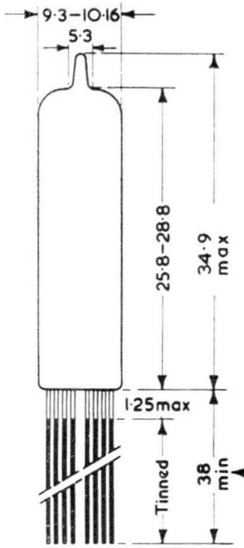


CROSS-MODULATION CURVE





B8D/F Base



3267

All dimensions in mm

SUBMINIATURE R.F. PENTODE

EF72

High slope r.f. pentode

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and therefore, in the interests of long life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis and should result in a bulb temperature of approximately 100°C.

CAPACITANCES

Pentode connected

	Shielded	Unshielded	
c_{a-g1}	<0.015	<0.02	pF
c_{in}	4.1	4.0	pF
c_{out}	2.5	2.0	pF

Triode connected

c_{a-g1}	1.65	pF
c_{in}	2.8	pF
c_{out}	4.2	pF

CHARACTERISTICS

Pentode connected

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.4	V
I_a	7.0	mA
I_{g2}	2.2	mA
g_m	5.0	mA/V
r_a	250	kΩ
μ_{g1-g2}	36	
R_{eq}	1.6	kΩ
R_{in} (f = 50Mc/s)	25	kΩ

Triode connected

V_a	100	V
V_{g1}	−1.4	V
I_a	9.2	mA
g_m	6.8	mA/V
r_a	5.3	kΩ
μ	36	

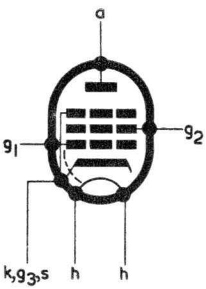
EF72

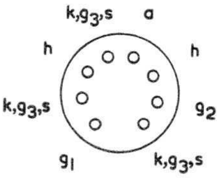
SUBMINIATURE R.F. PENTODE

High slope r.f. pentode

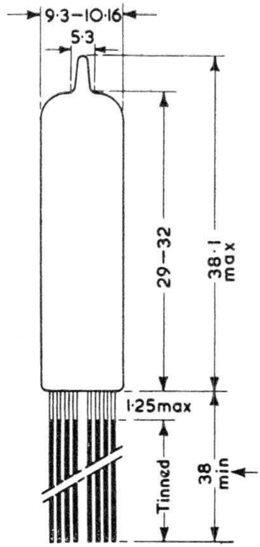
LIMITING VALUES

$V_{a(b)}$ max.	300	V
V_a max.	175	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
p_a max.	800	mW
p_{g2} max.	300	mW
p_{a+g2} max.	1.0	W
I_k max.	12	mA
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ





B8D/F Base



3271

All dimensions in mm

SUBMINIATURE HIGH SLOPE PENTODE

EF73

High slope pentode primarily intended for industrial applications.

HEATER

V_h	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and, therefore, in the interests of satisfactory life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis and should result in a bulb temperature of 100°C.

CAPACITANCES

	Shielded	Unshielded	
c_{a-g1}	<0.15	<0.2	pF
c_{in}	4.5	5.0	pF
c_{out}	5.0	3.0	pF

CHARACTERISTICS

V_a	100	V
V_{g3}	0	V
V_{g2}	100	V
I_a	7.5	mA
I_{g2}	2.5	mA
V_{g1}	−2.0	V
g_m	5.5	mA/V
r_a	250	kΩ
μ_{g1-g2}	28	
V_{g3}max. (for $I_a = 100\mu A$)	−60	V

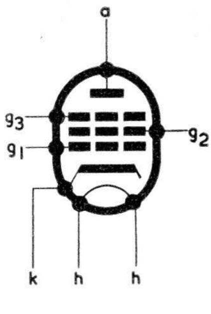
EF73

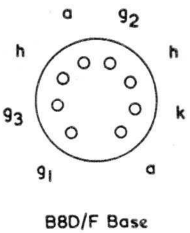
SUBMINIATURE HIGH SLOPE PENTODE

High slope pentode primarily intended for industrial applications.

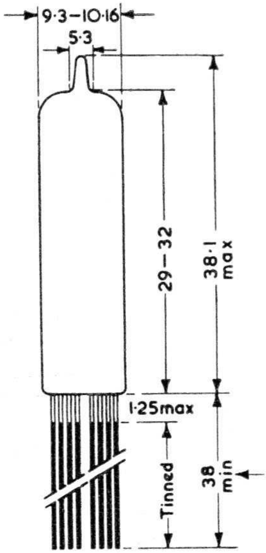
LIMITING VALUES

$V_{a(b)}$ max.	300	V
V_a max.	175	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
I_k max.	14	mA
p_a max.	1.5	W
p_{g2} max.	1.0	W
p_{a+g2} max.	2.0	W
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
R_{g1-k} max.	500	kΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	100	V





B8D/F Base



3272

All dimensions in mm

SUBMINIATURE LOW MICROPHONY PENTODE

EF74

Voltage amplifying pentode primarily designed for low microphony applications.

HEATER

V_h	6.3	V
I_h	200	mA

To reduce the possibility of hum the heater should be operated from d.c.

MOUNTING POSITION

Any

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

COOLING

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

CAPACITANCES (measured with external shield)

c_{a-g1}	<0.3	pF
c_{in}	3.6	pF
c_{out}	4.2	pF

CHARACTERISTICS

V_a	100	V
V_{g3}	0	V
V_{g2}	100	V
I_a	7.0	mA
I_{g2}	2.4	mA
V_{g1}	−1.4	V
g_m	3.1	mA/V
r_a	200	kΩ
μ_{g1-g2}	28	

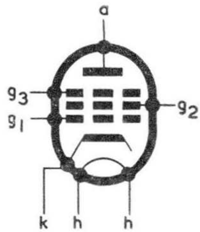
EF74

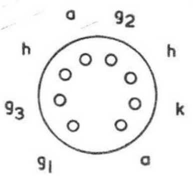
SUBMINIATURE LOW MICROPHONY PENTODE

Voltage amplifying pentode primarily designed for low microphony applications.

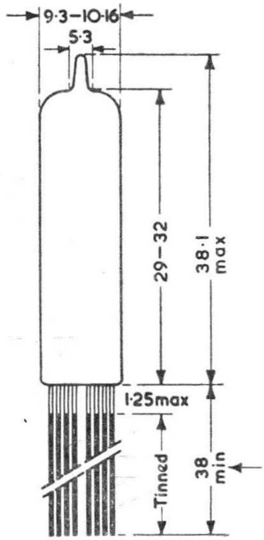
LIMITING VALUES

$V_{a(b)}$ max.	300	V
V_a max.	175	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	175	V
p_a max.	900	mW←
p_{g2} max.	350	mW←
I_k max.	10	mA
R_{g1-k} max. (cathode bias)	3.0	MΩ
R_{g1-k} max. (fixed bias)	1.0	MΩ
V_{h-k} max.	100	V





B8D/F Base



3326

All dimensions in mm

VARIABLE-MU A.F. PENTODE

EF83

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

HEATER

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

V_h	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

CAPACITANCES (measured without external shield)

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

CHARACTERISTICS

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

OPERATING CONDITIONS

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

*Grid resistor of the following valve.

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

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

EF83

VARIABLE-MU A.F. PENTODE

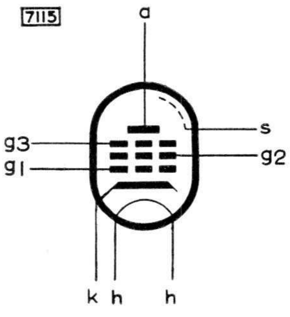
LIMITING VALUES

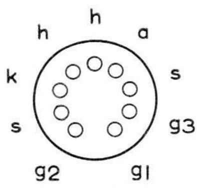
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	200	mW
I_k max.	6.0	mA
R_{g3-k} max.	10	kΩ
R_{g1-k} max.	3.0	MΩ
V_{h-k} max. (cathode positive)	100	V
V_{h-k} max. (cathode negative)	50	V
R_{h-k} max.	20	kΩ

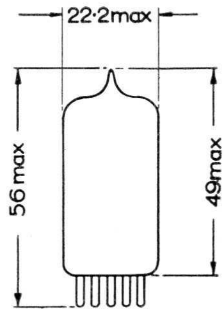
MICROPHONY AND HUM

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

7115







B9A Base

All dimensions in mm

VARIABLE-MU R.F. PENTODE

EF93

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

HEATER

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

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{in}	5.5	pF
c_{out}	5.0	pF
c_{a-g1}	3.5	mpF

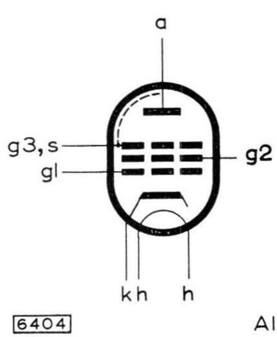
CHARACTERISTICS

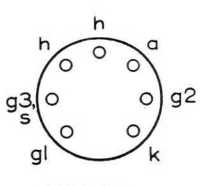
V_a	100	250	V
V_{g3}	0	0	V
R_{g2}	0	33	kΩ
V_{g2}	100	100	V
I_a	10.8	11	mA
I_{g2}	4.4	4.2	mA
V_{g1}	−1.0	−1.0	V
g_m	4.3	4.4	mA/V
r_a	0.25	1.5	MΩ
V_{g1} for 100 : 1 reduction in g_m	−20	−20	V

LIMITING VALUES

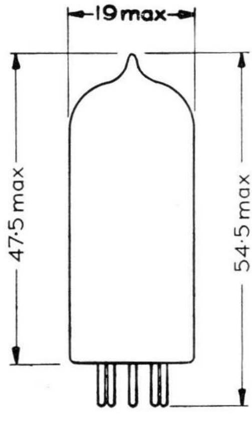
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3.0	W
$V_{g2(b)}$ max.	300	V
V_{g2} max.	125	V
p_{g2} max.	600	mW
I_k max.	18	mA
R_{g1-k} max.	3.0	MΩ
V_{h-k} max.	90	V

VARIABLE-MU R.F. PENTODE



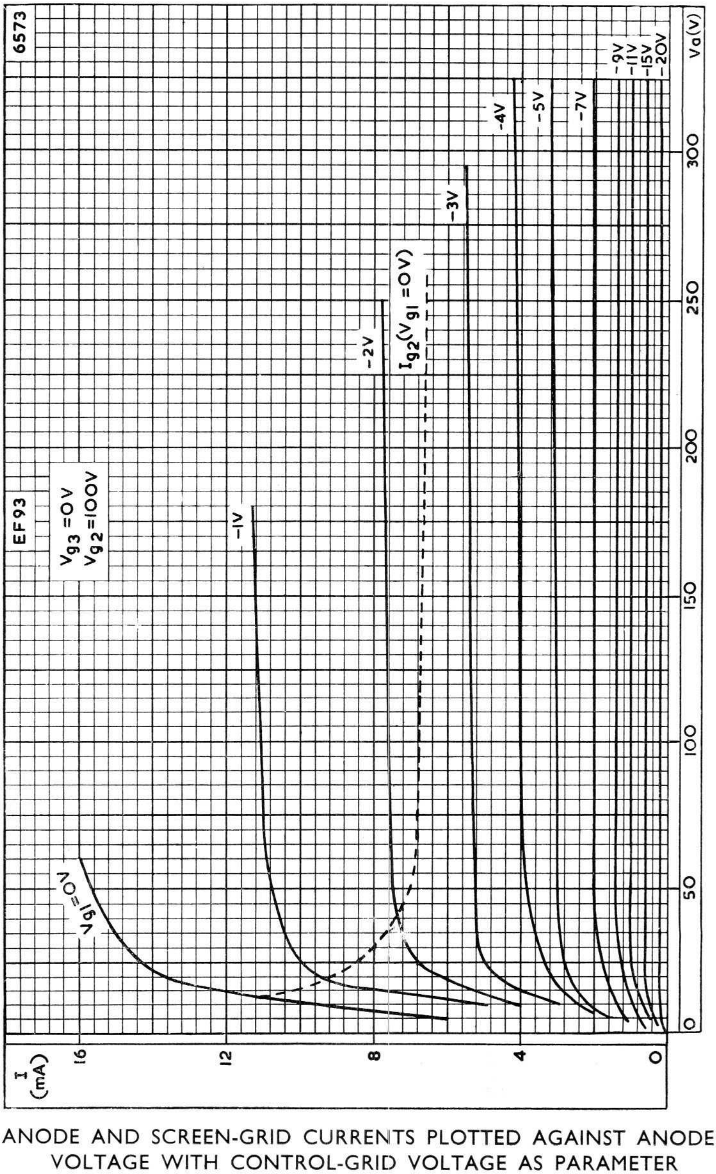


B7G Base

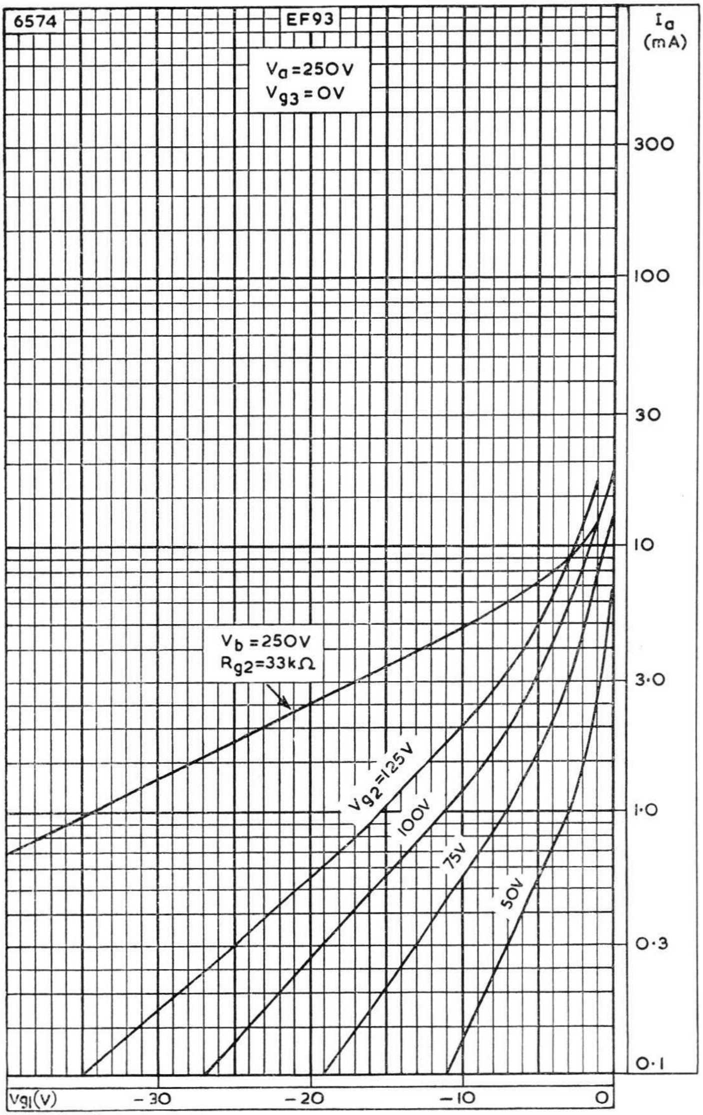


6404

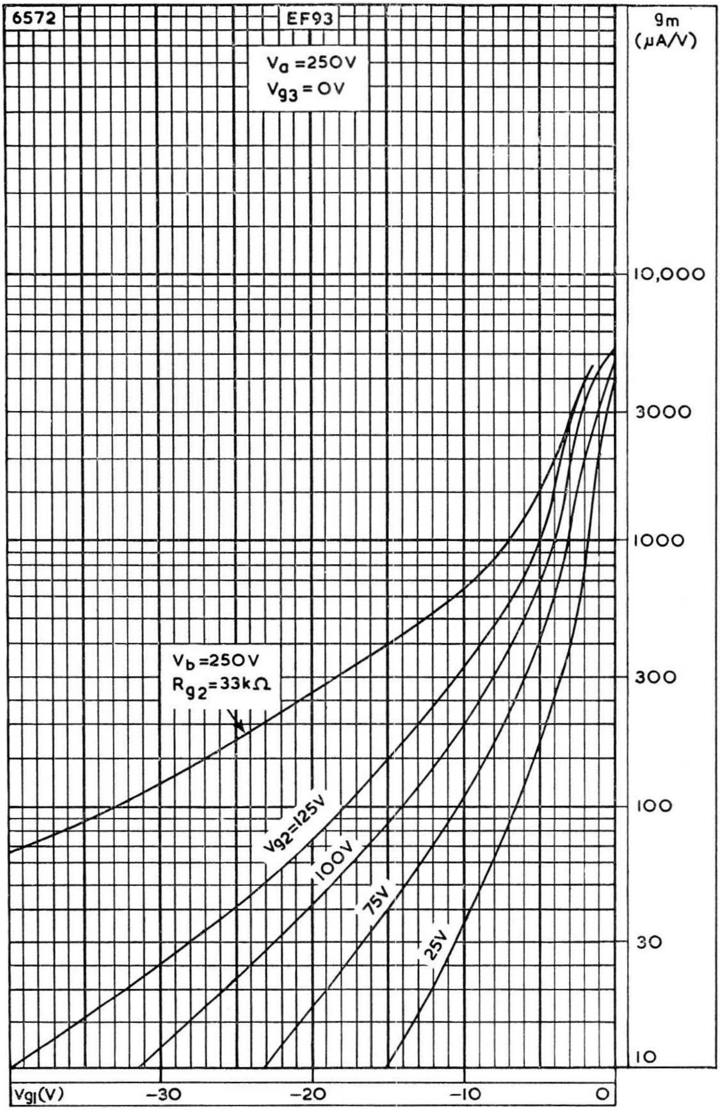
All dimensions in mm



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



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



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

R.F. PENTODE

EF97

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

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

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

CHARACTERISTICS

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

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

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

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

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

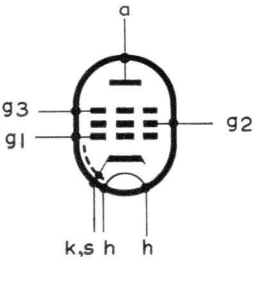
EF97

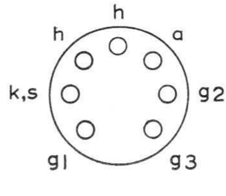
R.F. PENTODE

LIMITING VALUES

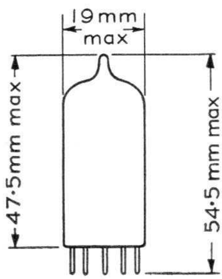
V_a max.	50	V
p_a max.	500	mW
V_{g3} max.	50	V
V_{g2} max.	50	V
p_{g2} max.	500	mW
I_k max.	15	mA
R_{g1} max.	22	MΩ
R_{g3} max.	5.0	MΩ
V_{h-k} max.	50	V

5101





B7G Base



PENTODE

EF98

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

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

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

CHARACTERISTICS

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

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

OPERATING CHARACTERISTICS AS A TRANSISTOR DRIVER STAGE

Tetrode connection (g3 connected to anode)

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

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

OPERATING CONDITIONS AS A TRANSISTOR DRIVER STAGE

(driven by triode section of ECH83)

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

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

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

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

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

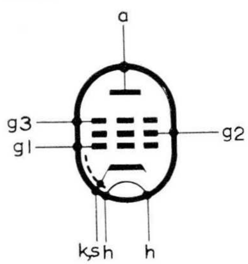
$V_a = V_b$	6.3	12.6	25	V
R_{g3}	100	100	100	kΩ
R_{g2}	12	6.8	22	kΩ
$V_{osc(r.m.s.)}$	6.0	6.0	12	V
V_{g1}	*	*	*	V
I_a	0.25	1.05	1.1	mA
I_{g2}	300	950	900	µA
g_c	310	675	705	µA/V
r_a	80	45	65	kΩ

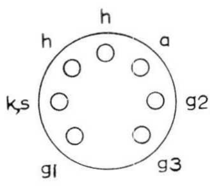
*Obtained by grid current biasing, R_{g1} = 10MΩ.

LIMITING VALUES

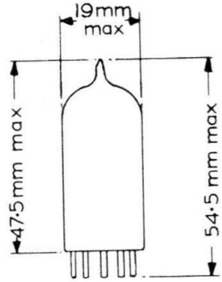
V_a max.	50	V
p_a max.	500	mW
V_{g3} max.	50	V
V_{g2} max.	50	V
p_{g2} max.	500	mW
I_k max.	15	mA
R_{g1} max.	22	MΩ
R_{g3} max.	100	kΩ
V_{h-k} max.	50	V

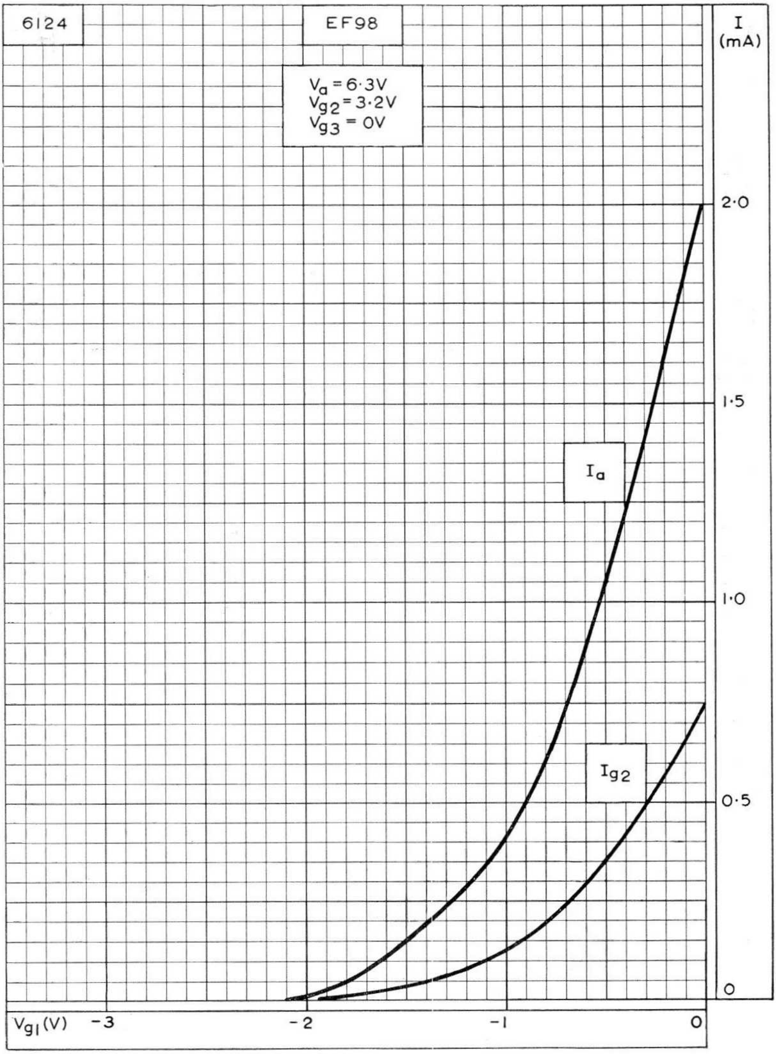
5101





B7G Base

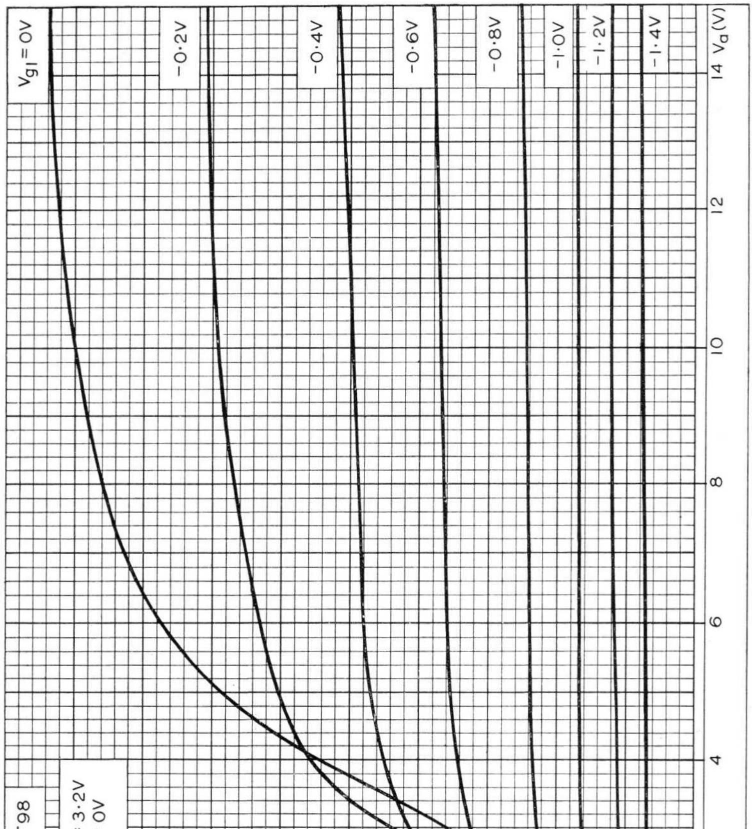




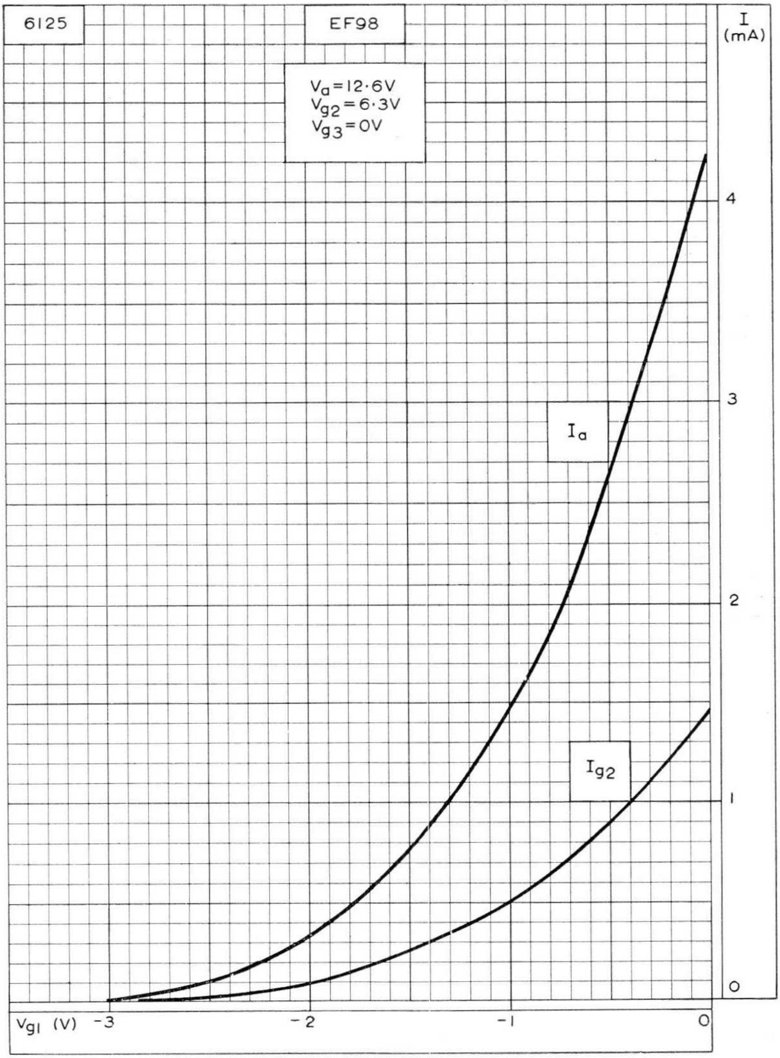
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = 6.3V$, $V_{g2} = 3.2V$

EF98

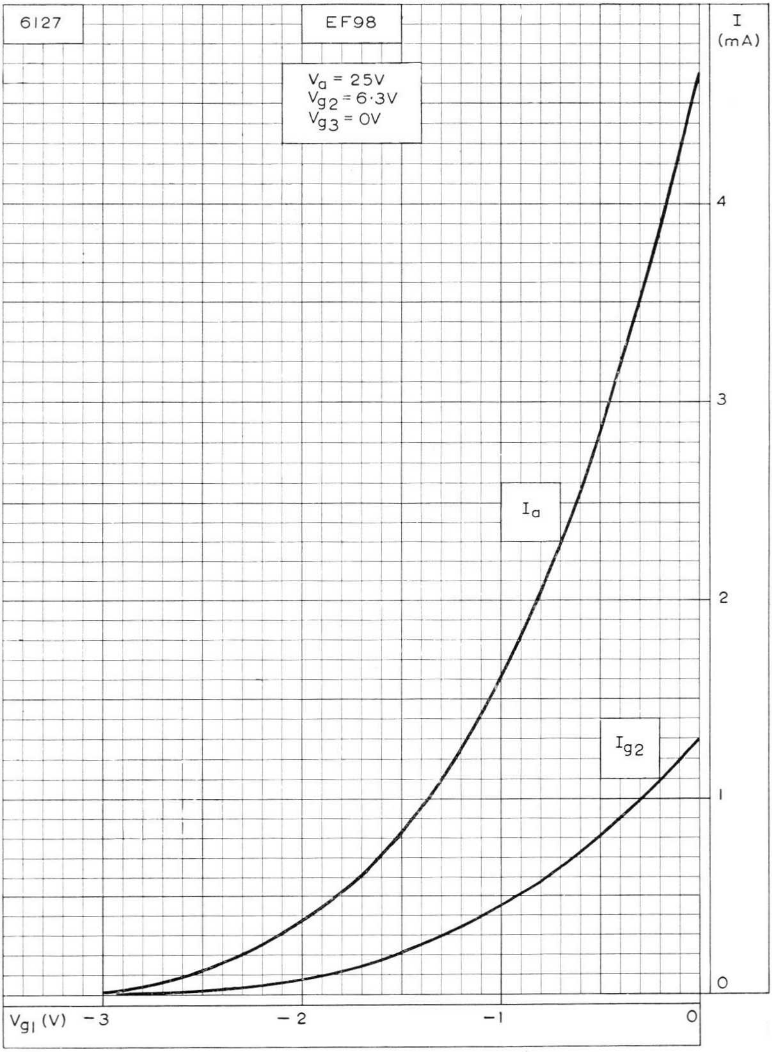
PENTODE



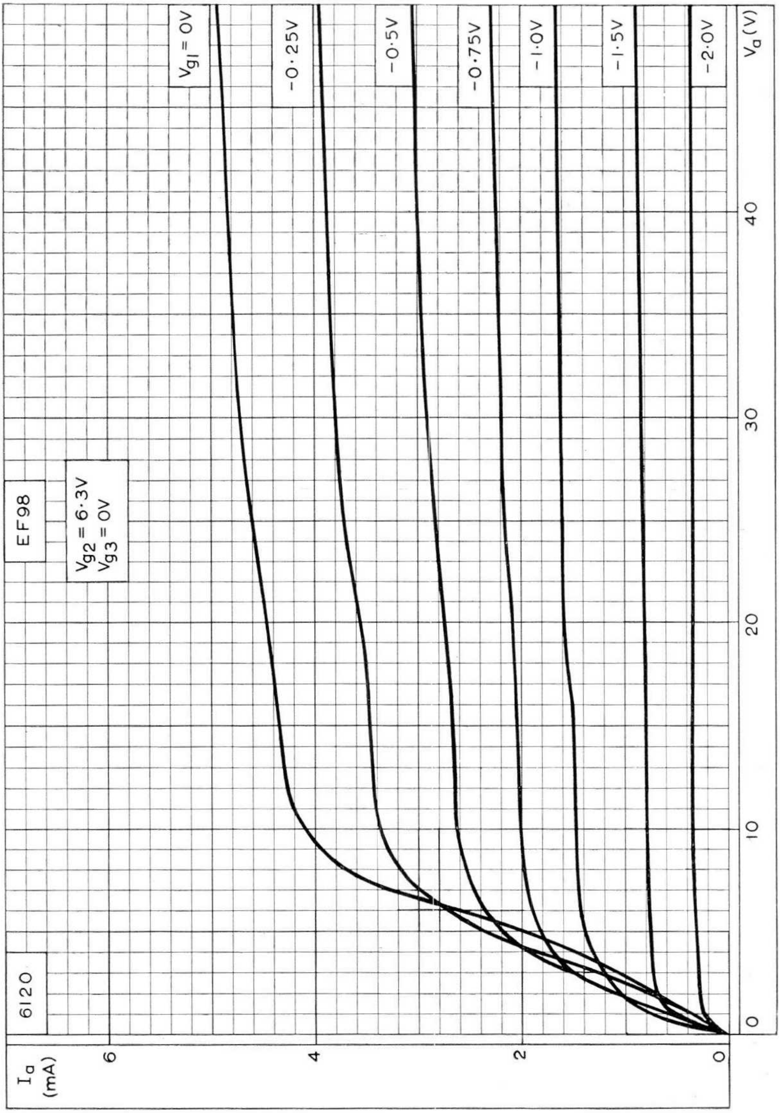
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 3.2V$



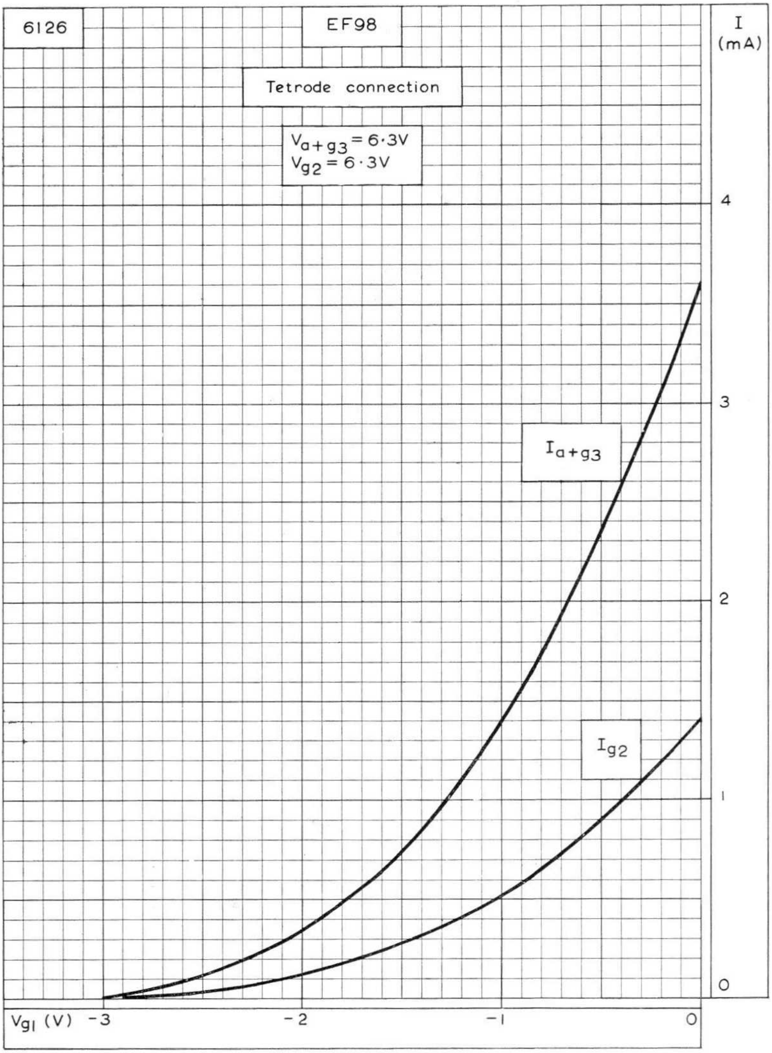
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = 12.6V$, $V_{g2} = 6.3V$



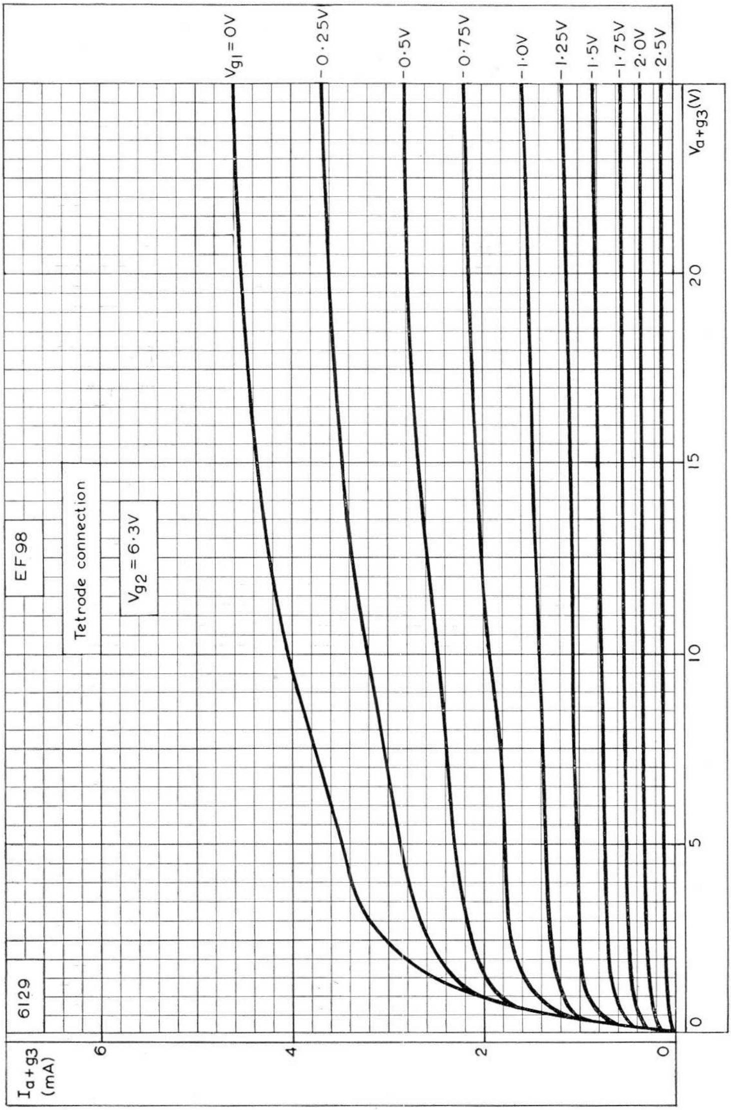
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = 25V$, $V_{g2} = 6.3V$



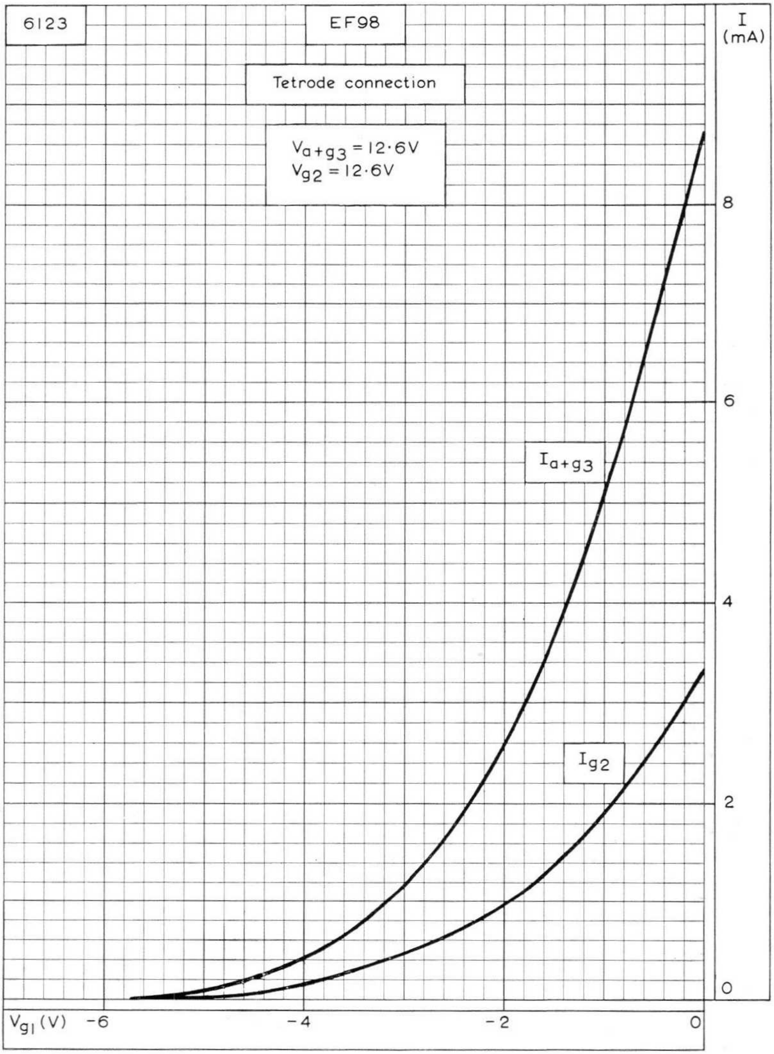
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID AS PARAMETER. $V_{g2} = 6.3V$



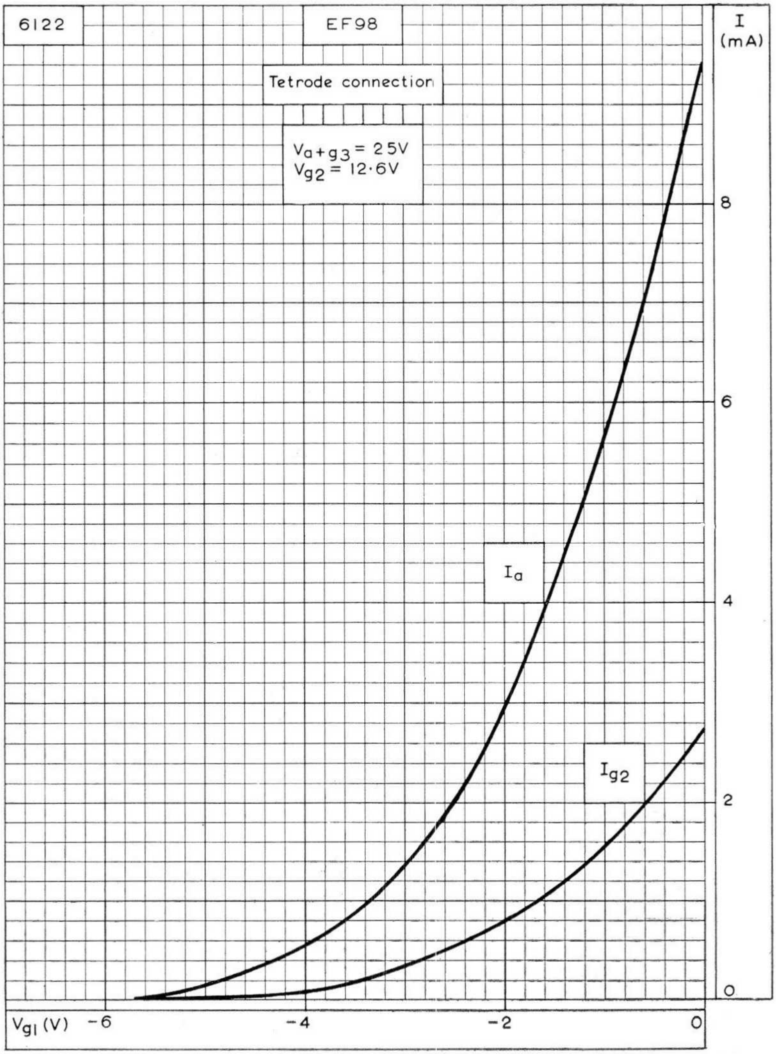
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE, WHEN TETRODE CONNECTED.
$V_{a+g3} = V_{g2} = 6.3V$



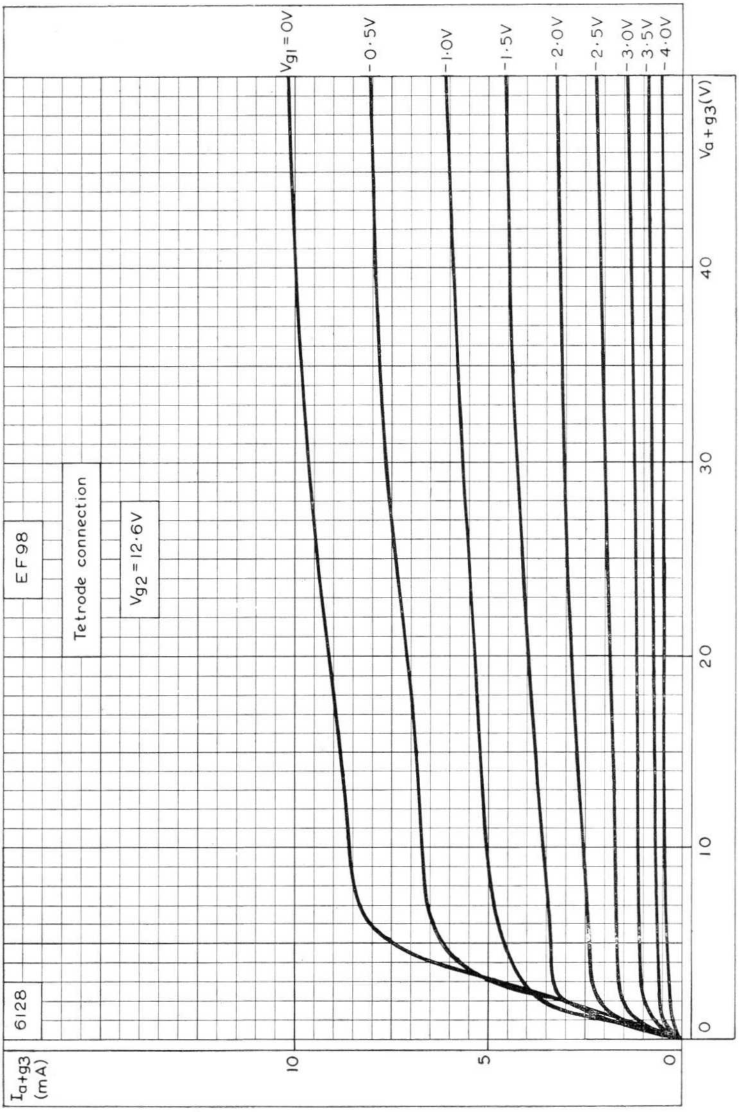
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, WHEN TETRODE CONNECTED. $V_{g2} = 6.3V$



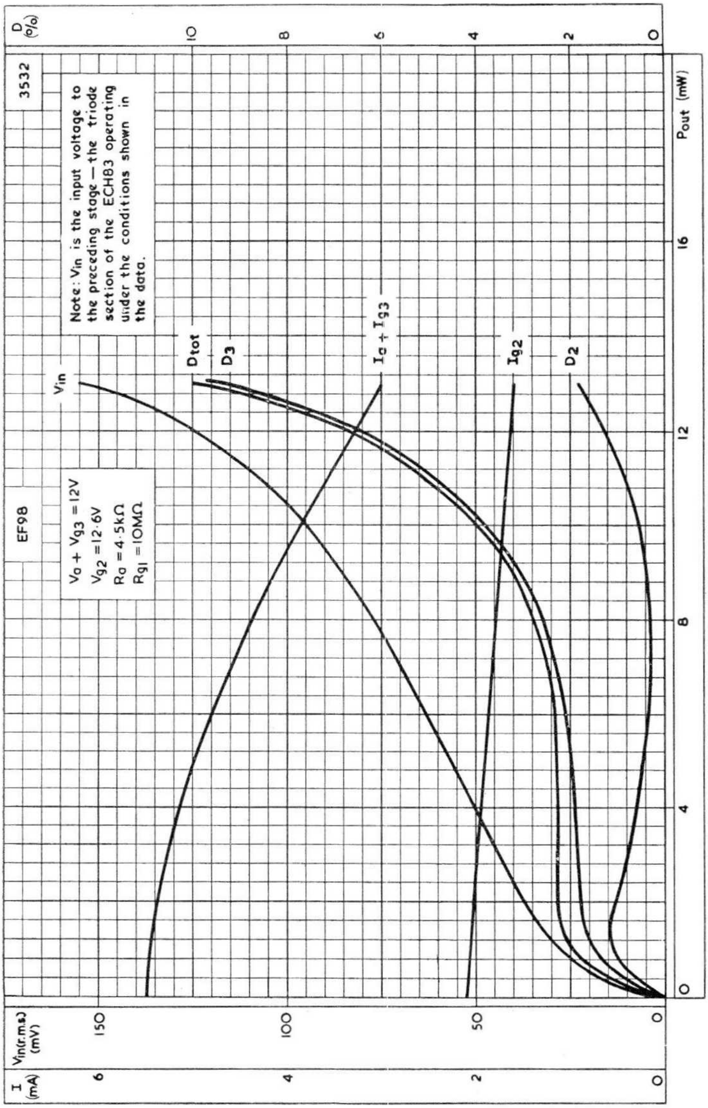
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE, WHEN TETRODE CONNECTED.
$V_{a+g3} = V_{g2} = 12.6V$



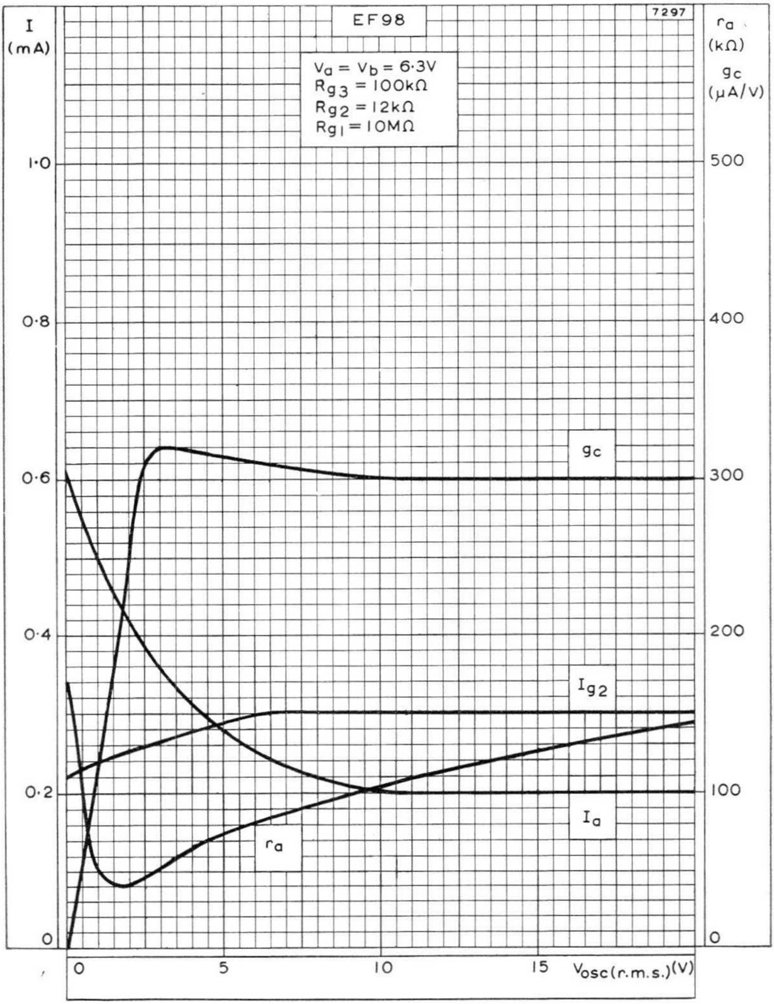
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST CONTROL-GRID VOLTAGE, WHEN TETRODE CONNECTED.
$V_{a+g3} = 25V$, $V_{g2} = 12.6V$



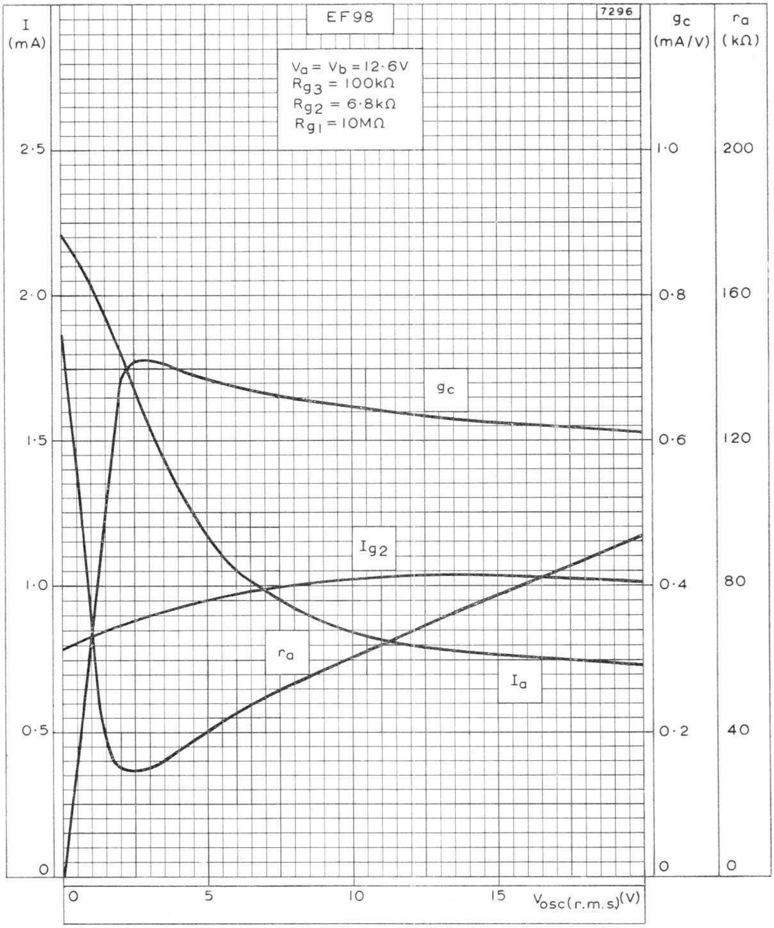
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER, WHEN TETRODE CONNECTED. $V_{g2} = 12.6V$



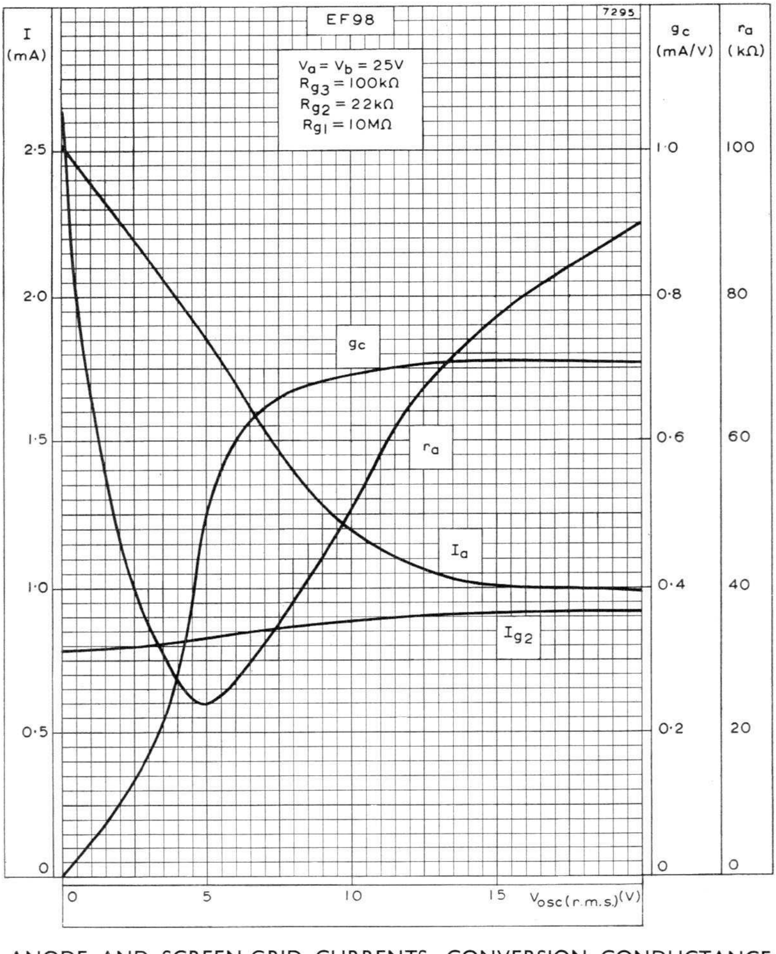
OPERATION AS A TRANSISTOR DRIVER STAGE, DRIVEN BY THE TRIODE SECTION OF ECH83



ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_b = 6.3V$



ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_b = 12.6V$



ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_b = 25V$

SUBMINIATURE R.F. PENTODE

EF730

R.F. pentode with short suppressor-grid base.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
c_{a-g1}	<0.02	<0.034	pF
c_{a-g3}	<1.1	<1.1	pF
c_{g1-g3}	<0.15	<0.17	pF
$c_{in(g1)}$	4.0	4.0	pF
$c_{in(g3)}$	3.7	3.7	pF
c_{out}	3.4	2.1	pF

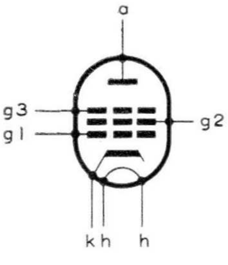
CHARACTERISTICS

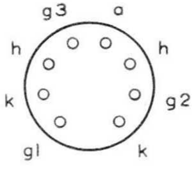
V_a	100	V
V_{g3}	0	V
V_{g2}	100	V
V_{g1}	−1.4	V
I_a	5.3	mA
I_{g2}	4.1	mA
$g_{m(g1-a)}$	3.2	mA/V
$g_{m(g3-a)}$	500	µA/V
r_a	110	kΩ
V_{g1} ($I_a = 10\mu A$)	−7.5	V
V_{g3} ($I_a = 10\mu A$)	−8.0	V

LIMITING VALUES (absolute ratings)

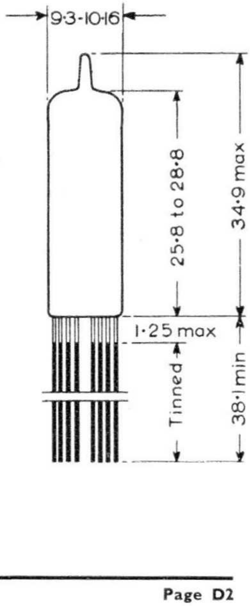
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
$+V_{g3}$ max.	30	V
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
$-V_{g1}$ max.	55	V
p_{g2} max.	700	mW
I_a max.	11	mA
I_{g2} max.	7.0	mA
V_{h-k} max.	200	V

SUBMINIATURE R.F. PENTODE





B8D/F Base



5325

All dimensions in mm

SUBMINIATURE VARIABLE-MU R.F. PENTODE

EF731

Subminiature variable-mu r.f. pentode for use as a controlled r.f. amplifier.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	Shielded	*Unshielded*	
c_{a-g1}	<0.015	<0.03	pF
c_{in}	4.3	4.0	pF
c_{out}	3.4	1.9	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.1	V
I_a	7.2	mA
I_{g2}	2.2	mA
g_m	4.5	mA/V
r_a	260	kΩ
g_m ($V_{g1} = -14$V)	25	μA/V

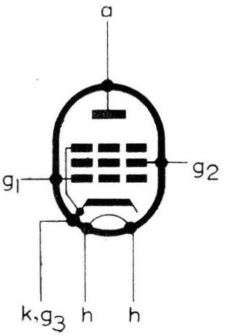
LIMITING VALUES (absolute ratings)

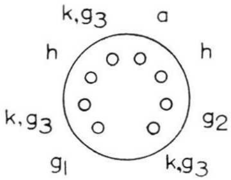
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	550	mW
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
V_{h-k} max.	200	V

EF731

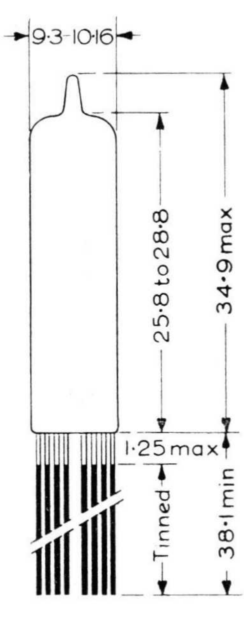
SUBMINIATURE VARIABLE-MU R.F. PENTODE

5494





B8D/F Base



All dimensions in mm

SUBMINIATURE R.F. PENTODE

EF732

High slope r.f. pentode.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	shielded	*unshielded*	
c_{a-g1}	<0.015	<0.03	pF
c_{in}	4.2	4.0	pF
c_{out}	3.4	1.9	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.5	V
I_a	7.5	mA
I_{g2}	2.4	mA
g_m	5.0	mA/V
r_a	260	kΩ
V_{g1} ($I_a = 10\mu A$)	−9.0	V

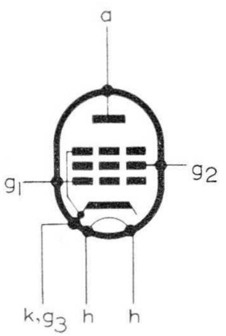
LIMITING VALUES (absolute ratings)

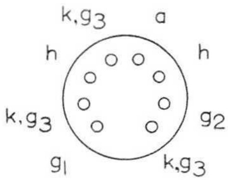
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	550	mW
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
V_{h-k} max.	200	V

EF732

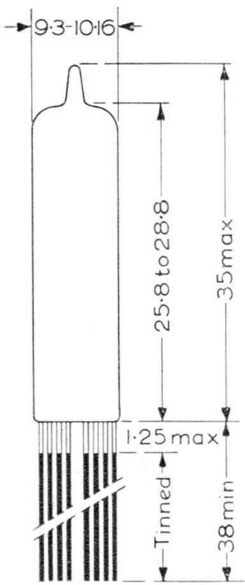
SUBMINIATURE R.F. PENTODE

High slope r.f. pentode.





B8D/F Base



4071

All dimensions in mm

SUBMINIATURE R.F. PENTODE

EF734

High slope r.f. pentode.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

	shielded	*unshielded*	
c_{a-g1}	<0.015	<0.03	pF
c_{in}	4.2	4.0	pF
c_{out}	3.4	1.9	pF

CHARACTERISTICS

V_a	100	V
$*V_{g3}$	0	V
V_{g2}	100	V
V_{g1}	−1.5	V
I_a	7.5	mA
I_{g2}	2.4	mA
g_m	5.0	mA/V
r_a	260	kΩ
V_{g1} ($I_a = 10\mu A$)	−9.0	V

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

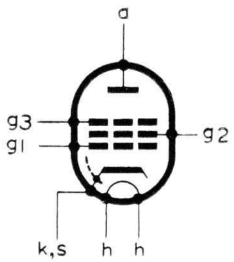
LIMITING VALUES (absolute ratings)

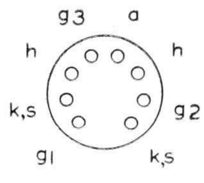
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	1.1	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	550	mW
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
V_{h-k} max.	200	V

EF734

SUBMINIATURE R.F. PENTODE

High slope r.f. pentode.





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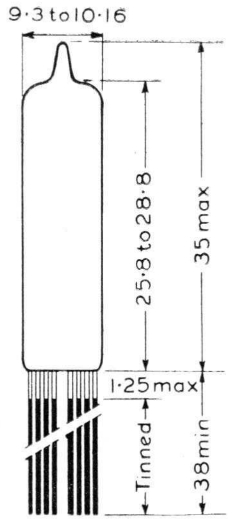


5164

All dimensions in mm

HEPTODE FREQUENCY CHANGER

EK90

Heptode primarily intended for use as a frequency changer.

HEATER

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

V_h	6.3	V
I_h	0.3	A

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

c_{a-all}	8.6	μμF
c_{g1-all}	5.5	μμF
c_{g3-all}	7.2	μμF
c_{a-g1}	<0.05	μμF
c_{a-g3}	<0.3	μμF
c_{g1-g3}	<0.15	μμF
c_{g1-k}	2.8	μμF

OPERATING CONDITIONS (with separate excitation)*

V_a	100	250	V
V_{g2+g4}	100	100	V
V_{g3}	−1.5	−1.5	V
R_{g1-k}	20	20	kΩ
I_k	10.6	10.6	mA
I_a	2.8	3.0	mA
I_{g2+g4}	7.3	7.1	mA
I_{g1}	500	500	μA
g_c	455	475	μA/V
r_a	0.5	1.0	MΩ
V_{g1} (for 100 : 1 reduction in g_c)	−30	−30	V

*The operating conditions shown with separate excitation correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.

OSCILLATOR SECTION

V_a	100	V
V_{g2+g4}	100	V
V_{g3}	0	V
V_{g1}	0	V
I_a	25	mA
$g_{m(g1-g2+g4+a)}$	7.25	mA/V
$\mu_{(g1-g2+g4+a)}$	20	

LIMITING VALUES

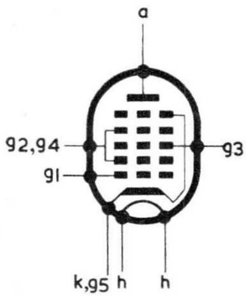
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2+g4(b)}$ max.	300	V
V_{g2+g4} max.	100	V
p_{g2+g4} max.	1.0	W
I_k max.	14	mA
R_{g3-k} max.	3.0	MΩ
V_{h-k} max.	90	V

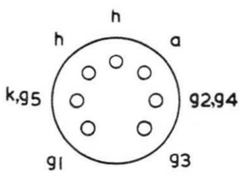
EK90

HEPTODE FREQUENCY CHANGER

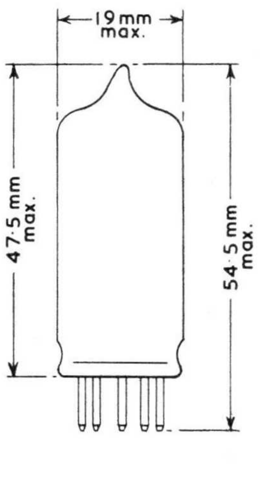
Heptode primarily intended for use as a frequency changer.

1507





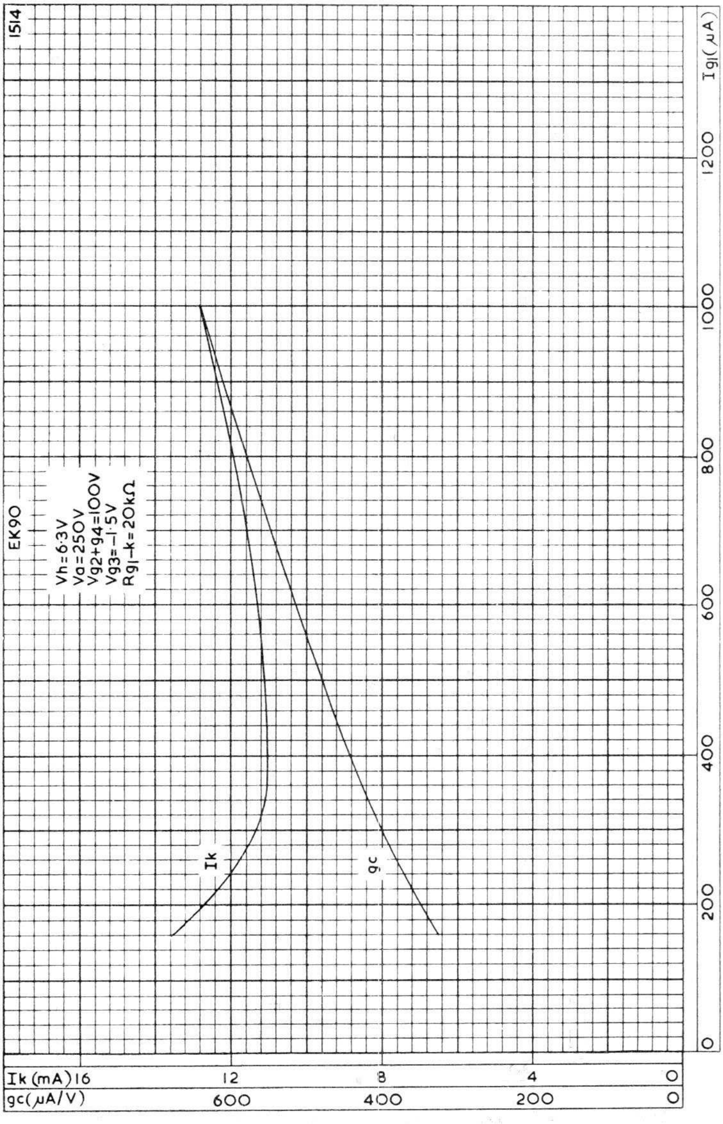
B7G BASE



HEPTODE FREQUENCY CHANGER

EK90

Heptode primarily intended for use as a frequency changer.

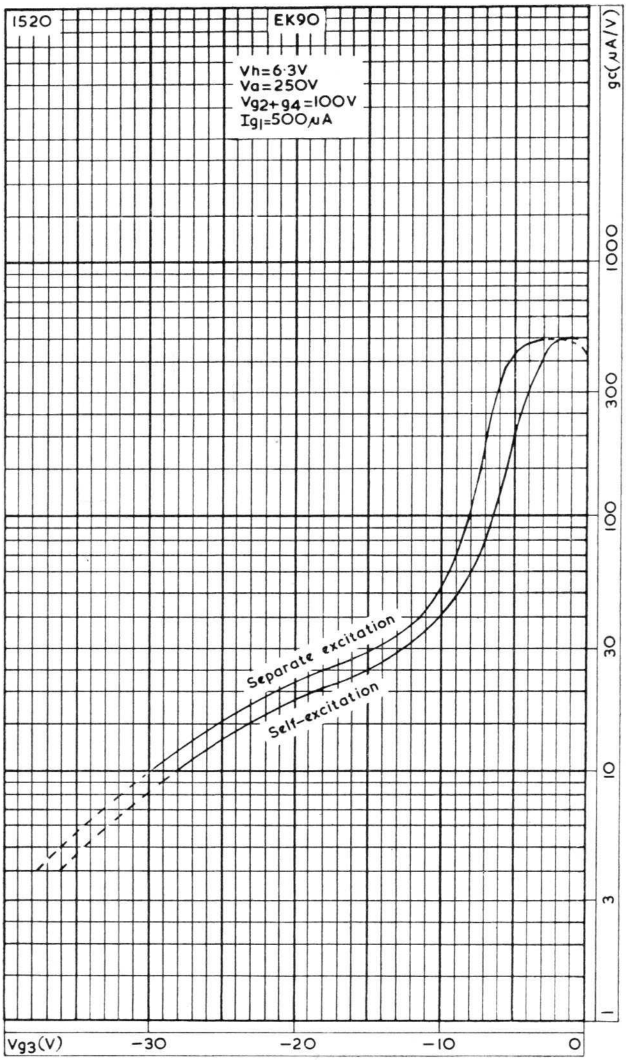


CONVERSION CONDUCTANCE AND CATHODE CURRENT PLOTTED AGAINST OSCILLATOR GRID CURRENT

EK90

HEPTODE FREQUENCY CHANGER

Heptode primarily intended for use as a frequency changer.



CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL GRID VOLTAGE

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	μμF
c_{in}	10.2	μμF
c_{a-g1}	<1.0	μμF
c_{g1-h}	<0.15	μμF

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	k Ω
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	k Ω
P_{out}	2.5	4	W
$V_{in\ (g-g)\ (r.m.s.)}$	5.4	6.7	V
D_{tot}	1	1	%

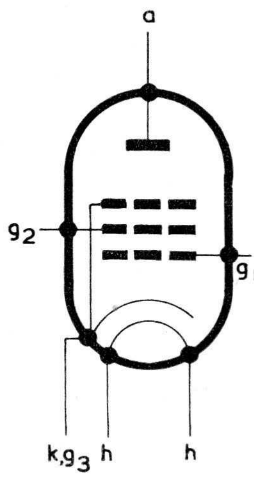
LIMITING VALUES

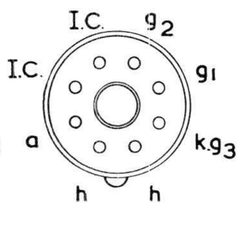
$V_{a\ (b)}$ max.	550	V
V_a max.	300	V
p_a max.	9	W
$V_{g2\ (b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} (zero sig.) max.	1.4	W
p_{g2} (max. sig.) max.	3.3	W
I_k max.	55	mA
V_{g1} max. ($I_{g1}=+0.3\mu A$)	–1.3	V
R_{g1-k} max.	1	M Ω
V_{h-k} max.	50	V
R_{h-k} max.	20	k Ω

OUTPUT PENTODE

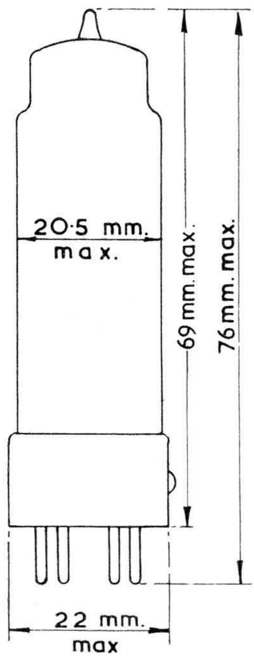
EL41

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





B8A BASE



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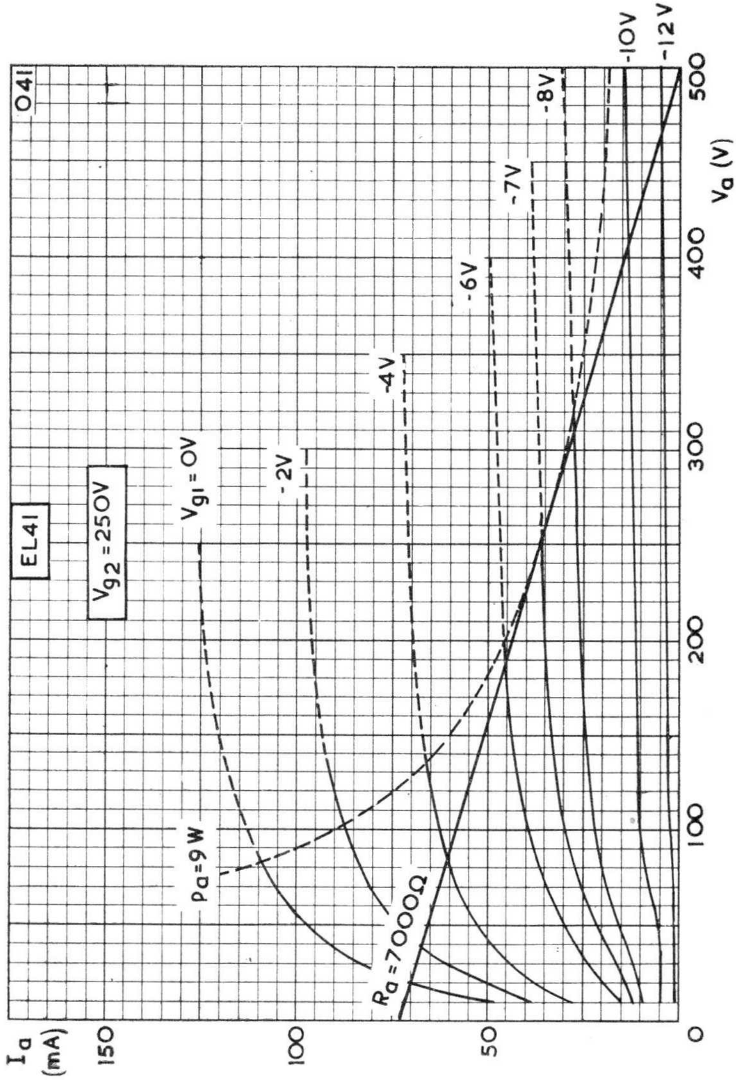
EL41

OUTPUT PENTODE

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



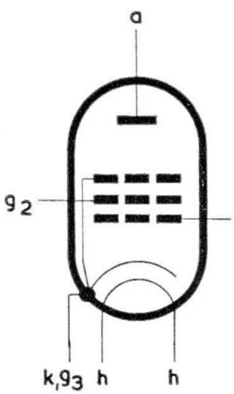
ANODE CURRENT PLOTTED AGAINST ANODE VOLTS

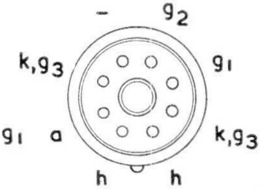
OUTPUT PENTODE

EL42

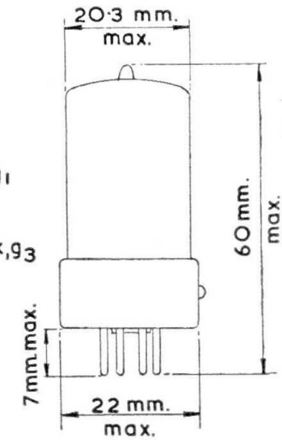
Output pentode with an anode dissipation of 6W, suitable for use in car radio receivers.

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





B8A BASE



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SUBMINIATURE OUTPUT PENTODE

EL71

Audio output pentode.

HEATER

V_h	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

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

COOLING

In operation this valve may become very hot and to obtain satisfactory life it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to a suitable heat sink.

CAPACITANCES

c_{a-g1}	<0.2	pF
c_{in}	6.5	pF
c_{out}	7.5	pF

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
I_a	30	mA
I_{g2}	1.2	mA
g_m	4.2	mA/V
r_a	15	kΩ
V_{g1}	−8.3	V
V_{g1} ($I_a = 10\mu A$)	−40	V

TYPICAL OPERATING CONDITIONS

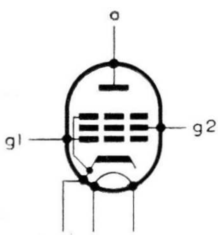
V_{a-e}	110	V
V_{g2-e}	110	V
I_a	30	mA
I_{g2}	1.2	mA
R_k	270	Ω
R_a	3.0	kΩ
$V_{in(r.m.s.)}$	6.4	V
P_{out}	1.0	W
D_{tot}	10	%

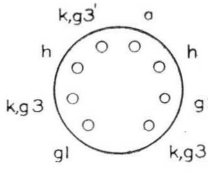
LIMITING VALUES (absolute ratings)

$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	4.0	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	1.0	W
$-V_{g1}$ max.	55	V
I_k max.	50	mA
V_{h-k} max.	200	V

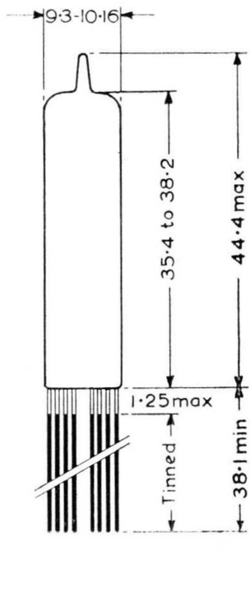
EL71

SUBMINIATURE OUTPUT PENTODE





B8D/F Base



5326

All dimensions in mm

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

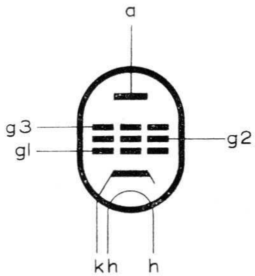
*At 20°C ambient, in free air at normal atmospheric pressure and without external screening can.

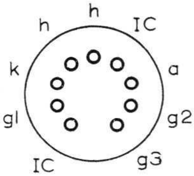
LIMITING VALUES

$V_{a(b)}$ 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

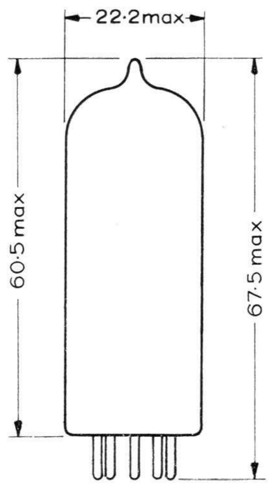
EL821

VIDEO OUTPUT PENTODE



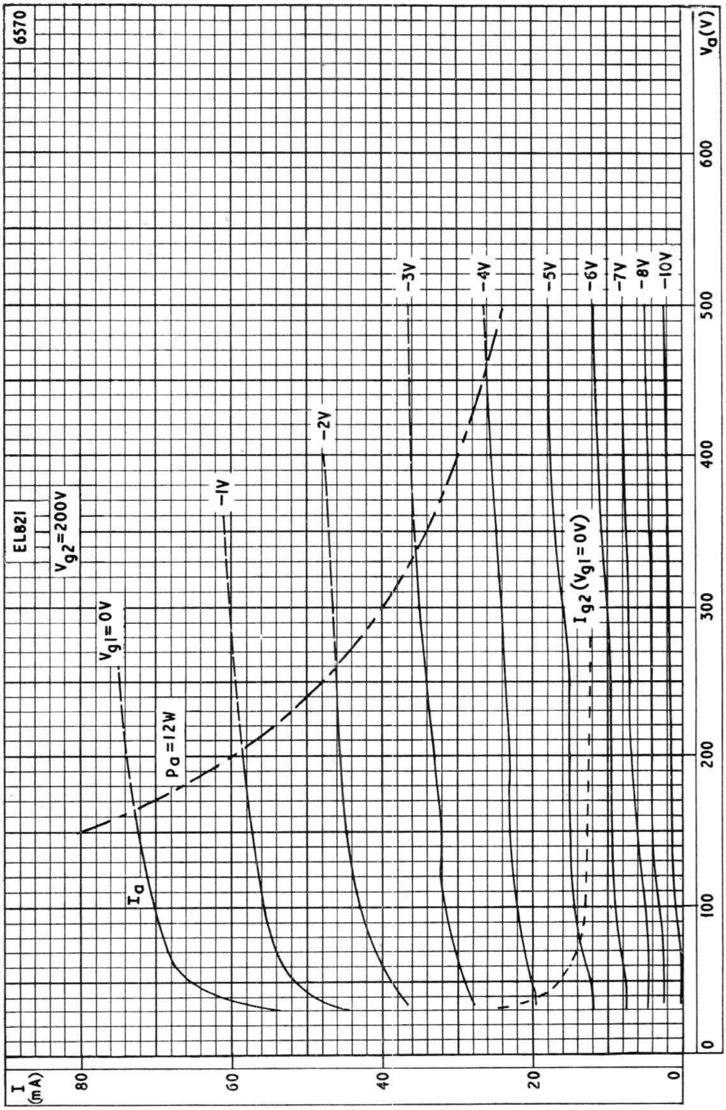


B9A Base

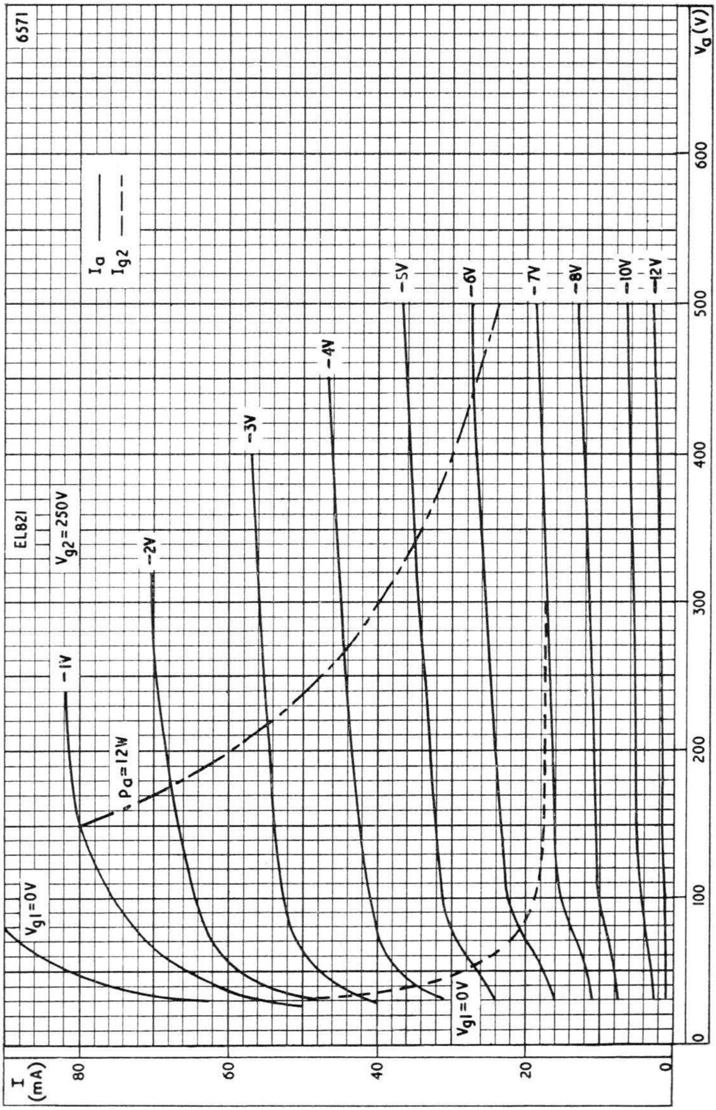


All dimensions in mm

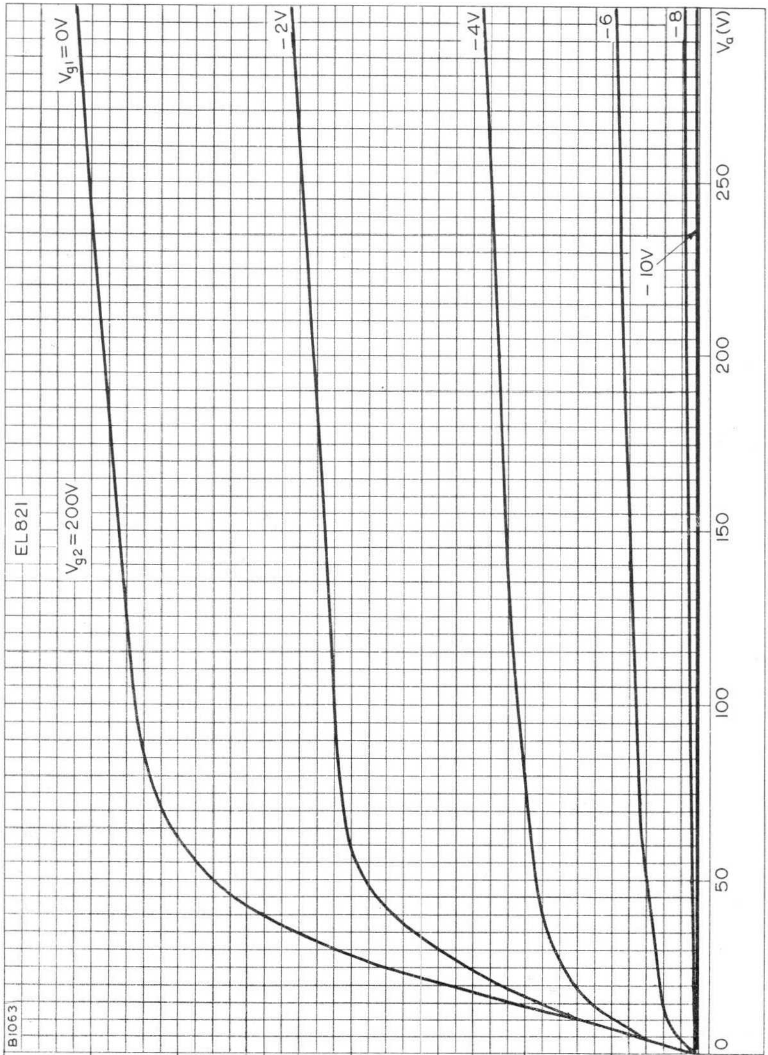
6396



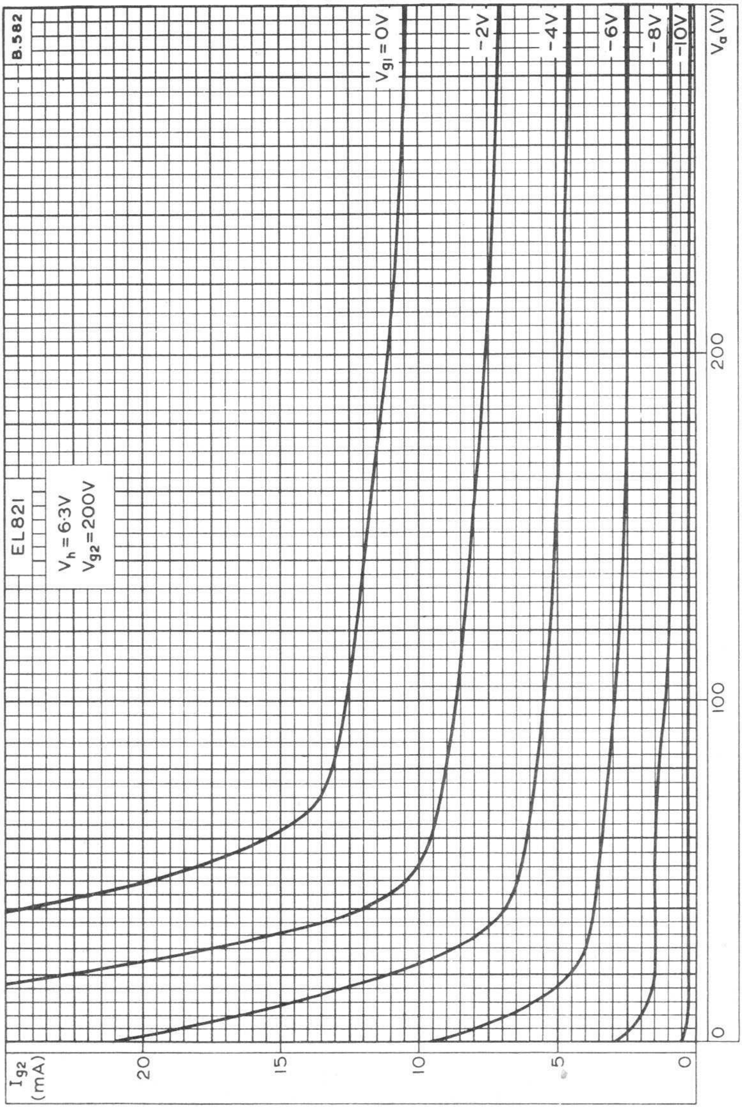
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



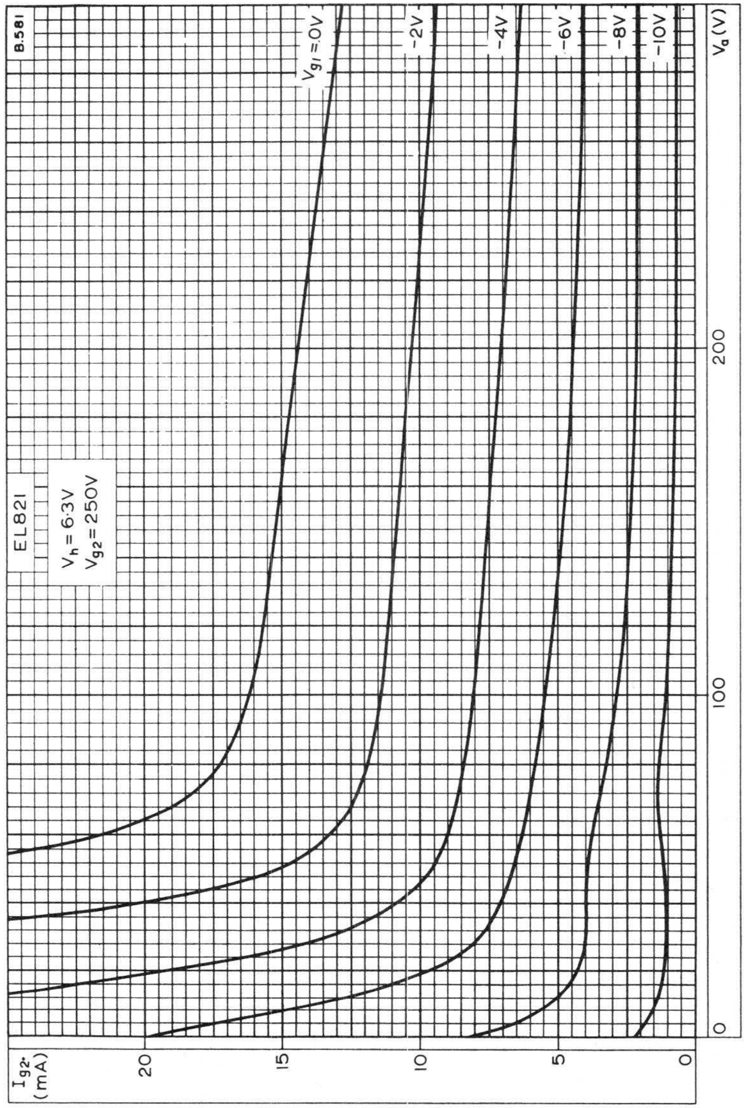
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE. $V_{g2} = 200V$



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



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

VIDEO OUTPUT PENTODE

EL822

Video output pentode having a high mutual conductance.

HEATER

V_h	6.3	V
I_h	750	mA

CAPACITANCES (unshielded)

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

CHARACTERISTICS

Pentode connection

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

Triode connection (g_2 connected to a)

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

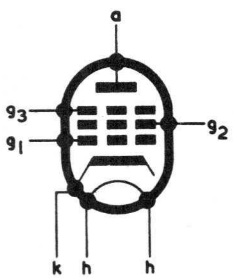
EL822

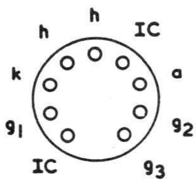
VIDEO OUTPUT PENTODE

DESIGN CENTRE RATINGS

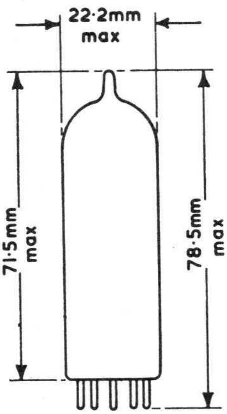
$V_{a(b)}$ max.	550	V
V_a max.	275	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max.	2.5	W
I_k max.	60	mA
R_{g1-k} max.	100	kΩ
V_{h-k} max.	90	V
T_{bulb} max.	220	°C

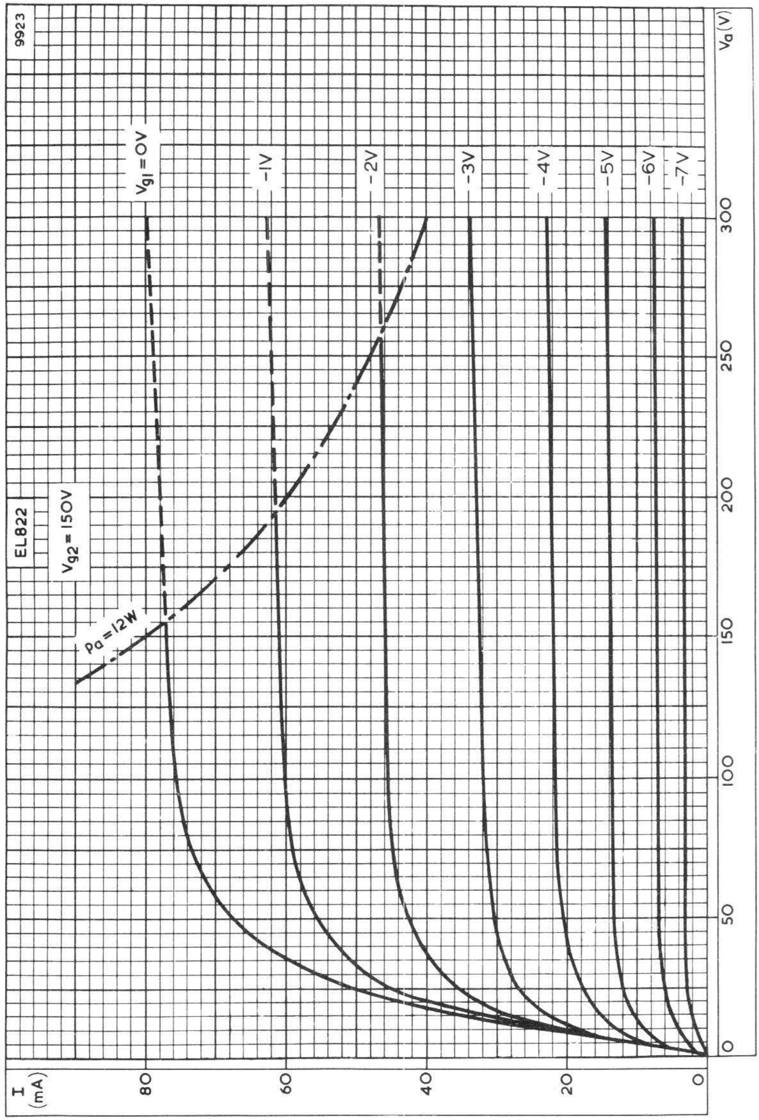
3310





B9A Base



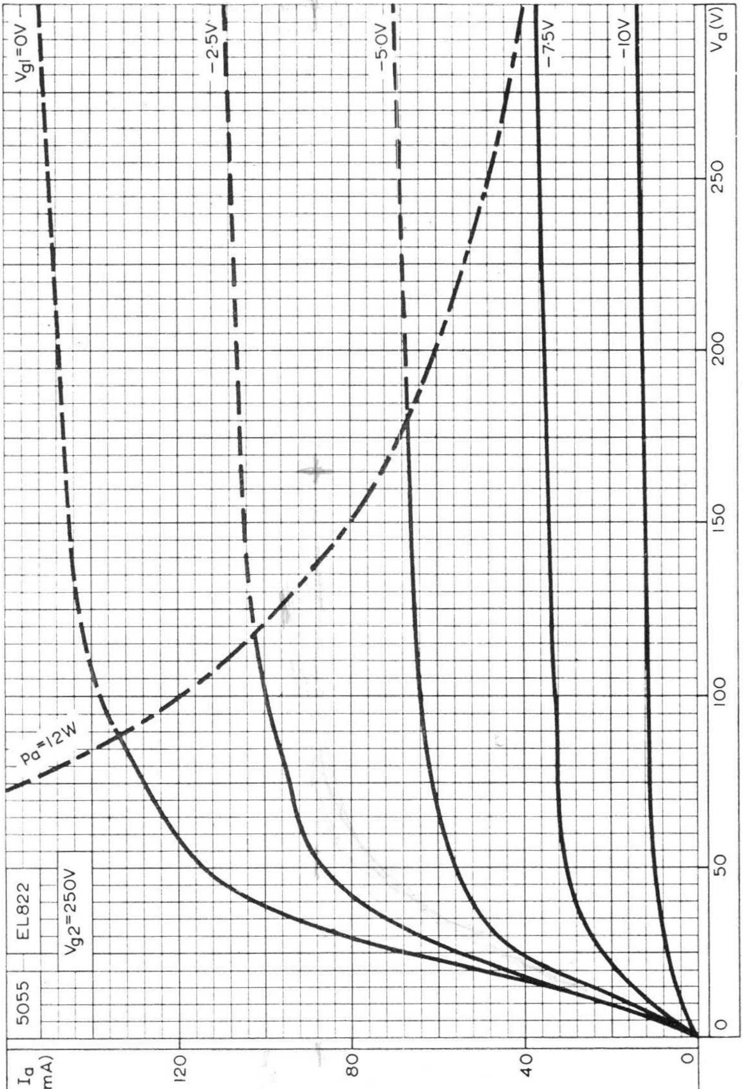


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 150V$

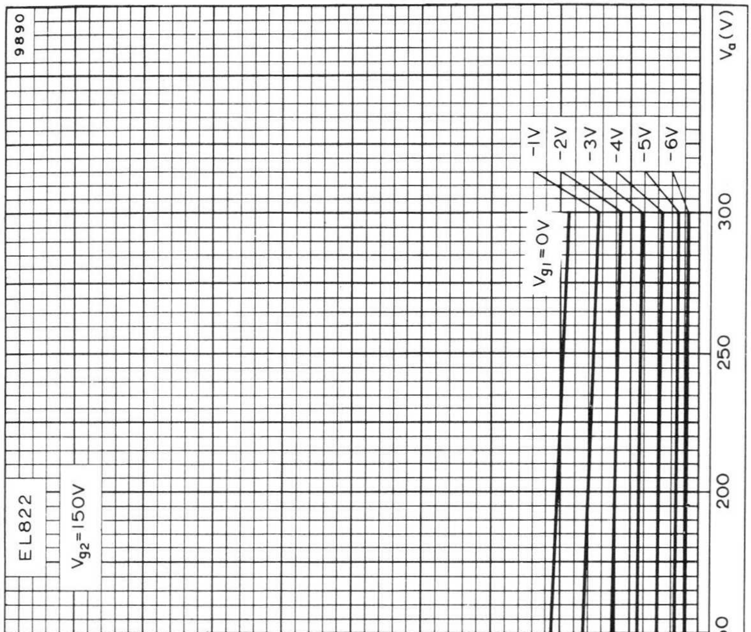
EL822

VIDEO OUTPUT PENTODE

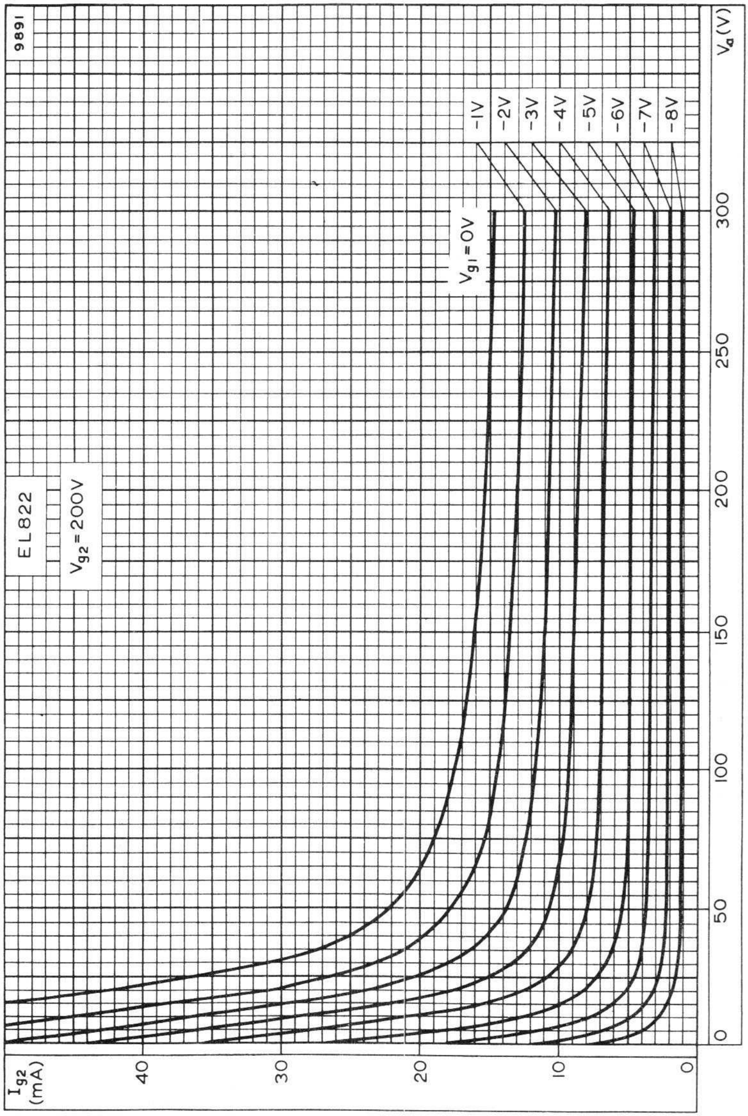
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



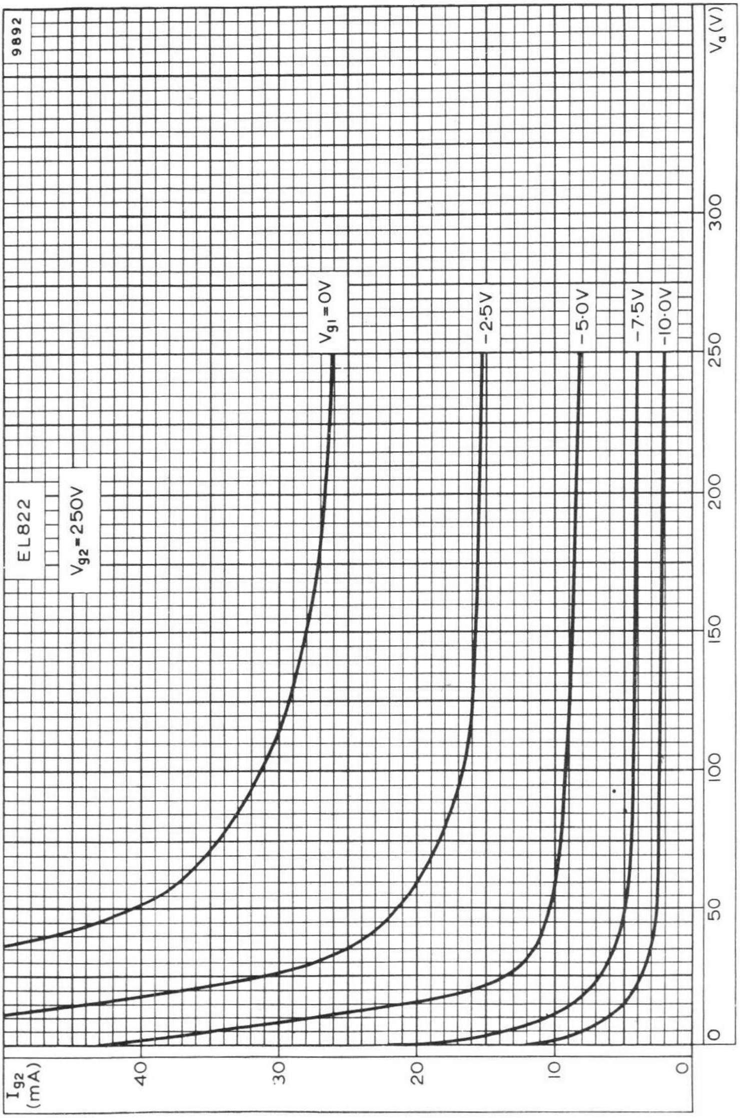
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



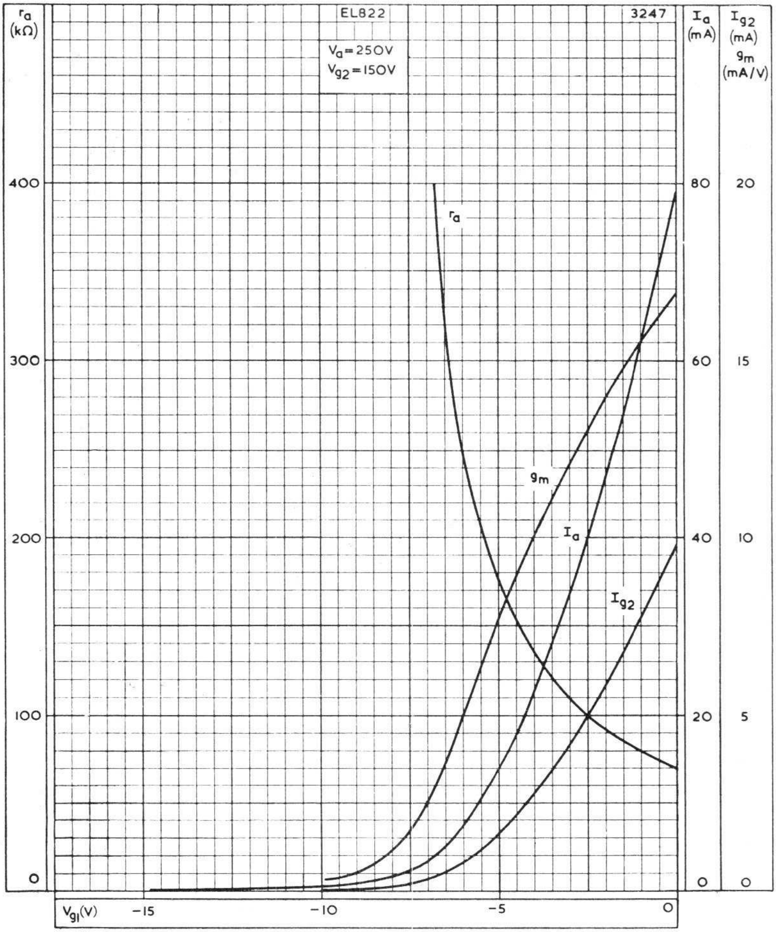
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 150V$



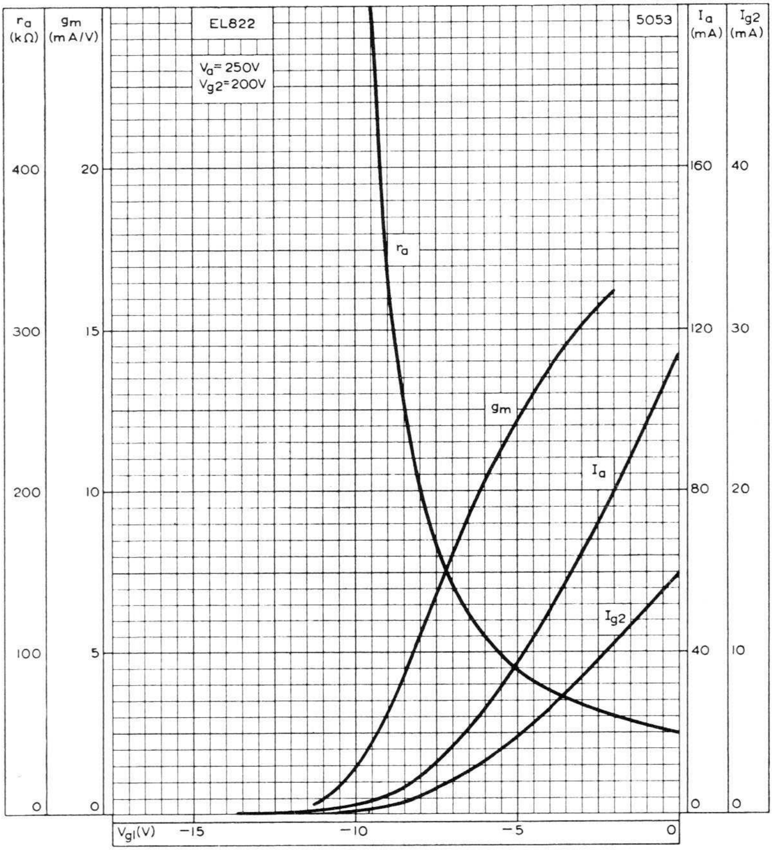
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



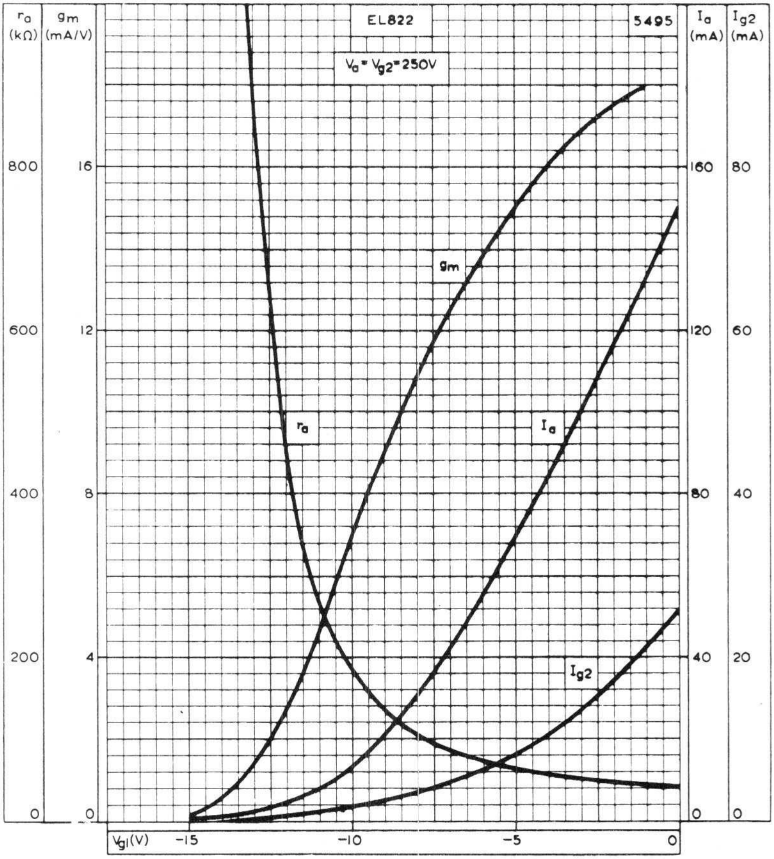
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



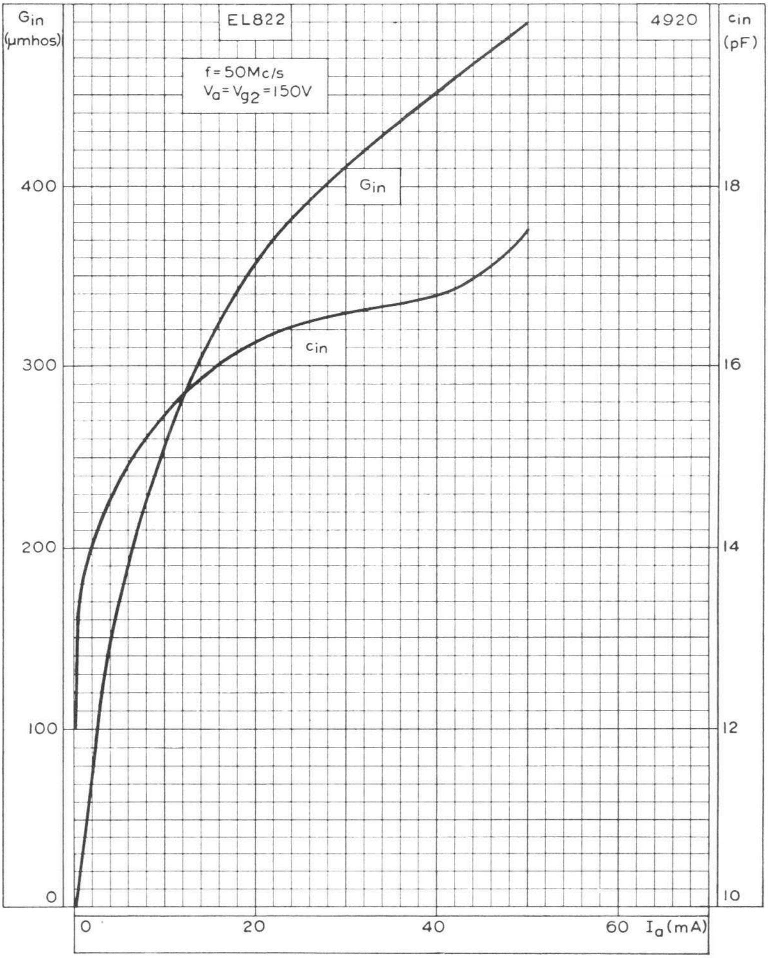
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE
$V_a = 250V$, $V_{g2} = 150V$



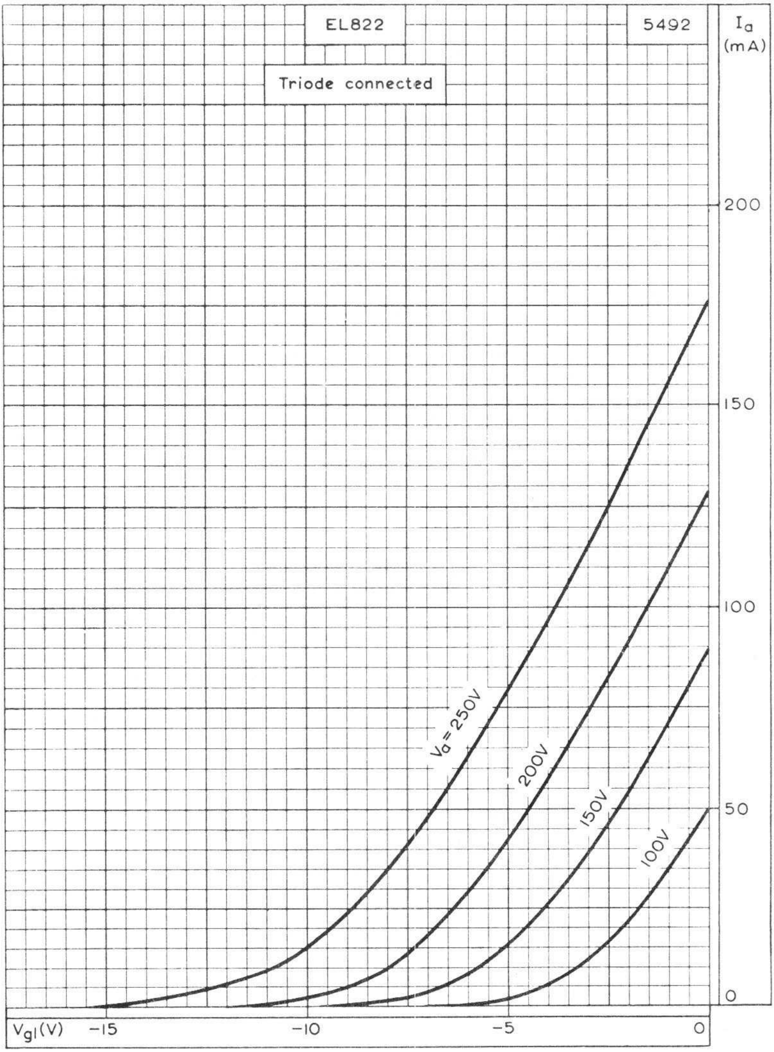
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE
$V_a = 250V, \quad V_{g2} = 200V$



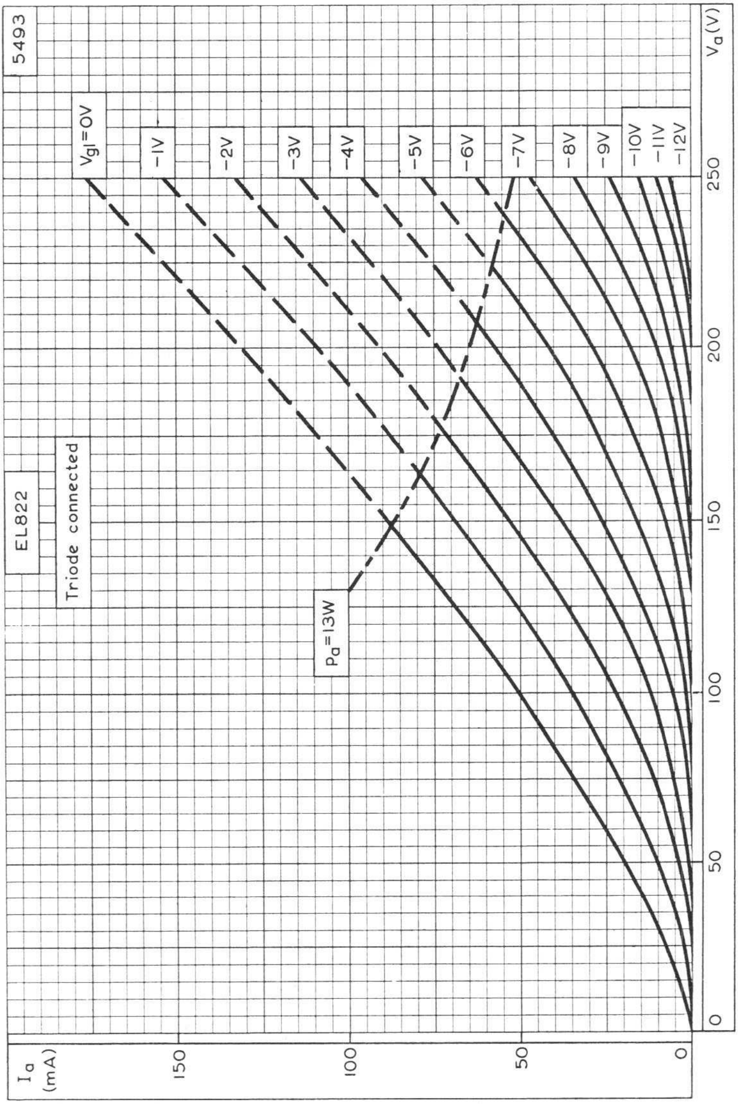
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE $V_a = V_{g2} = 250V$



INPUT CAPACITANCE AND INPUT CONDUCTANCE PLOTTED AGAINST ANODE CURRENT



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

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.

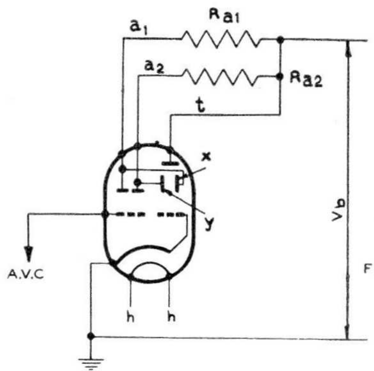
V_h	6.3	V
I_h	0.2	A

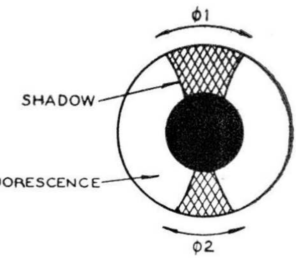
OPERATING CONDITIONS

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.





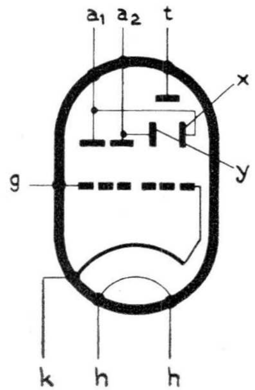
EM34

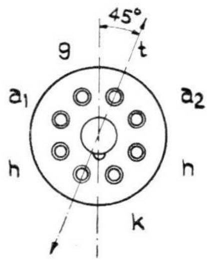
ELECTRON BEAM INDICATOR

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

LIMITING VALUES

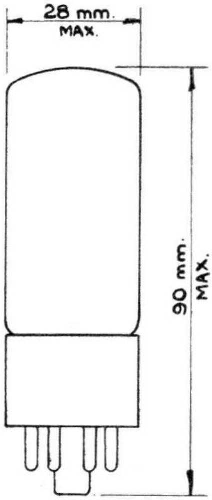
$V_{a1(b)}$ max.	550	V
V_{a1} max.	275	V
$V_{a2(b)}$ max.	550	V
V_{a2} max.	275	V
$V_{t(b)}$ max.	550	V
V_t max.	275	V
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ
R_{g-k} max.	3.0	MΩ





DIRECTION OF CATHODE SCREEN SUPPORT

OCTAL BASE



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		
$I_{out} \leq 200\mu A$	±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

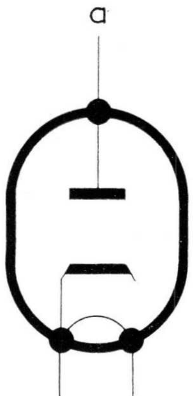
*Max. pulse duration 5.0% of a line scanning cycle with a maximum of 5.0μs

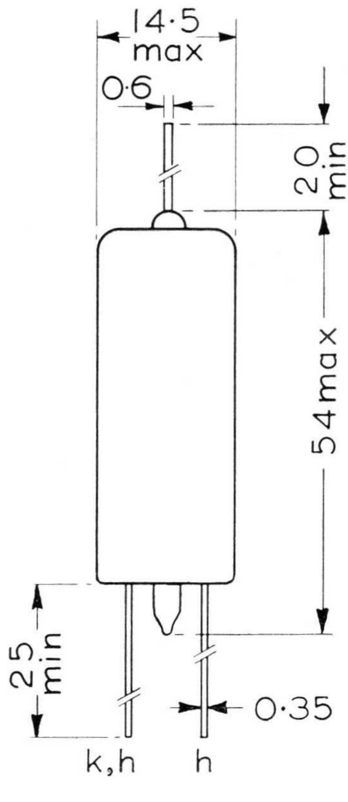
EY51

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

SUBMINIATURE HALF-WAVE RECTIFIER

EY70

Indirectly heated half-wave rectifier.

HEATER

V_h	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

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

LIMITING VALUES

P.I.V. max.	850	V
$V_{a(r.m.s.)}$ max.	250	V
I_a max.	45	mA
$i_{a(pk)}$ max.	270	mA
$v_{h-k(pk)}$ max.	425	V

TYPICAL OPERATING CONDITIONS

Half-wave operation—single valve

$V_{a(r.m.s.)}$		235	V
R_{lim} min.		270	Ω
I_{out}		45	mA
V_{out}	C = 20 μF	216	V
	C = 8 μF	207	V
	C = 4 μF	190	V

Full-wave operation—two valves

Capacitor input

$V_{a(r.m.s.)}$	250	V
R_{lim} min. (per anode)	300	Ω
C	4.0	μF
I_{out}	90	mA
V_{out}	207	V

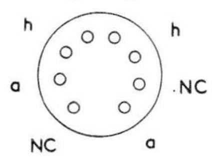
Choke input

$V_{a(r.m.s.)}$	300	V
L min.	5.0	H
I_{out}	90	mA
V_{out}	240	V

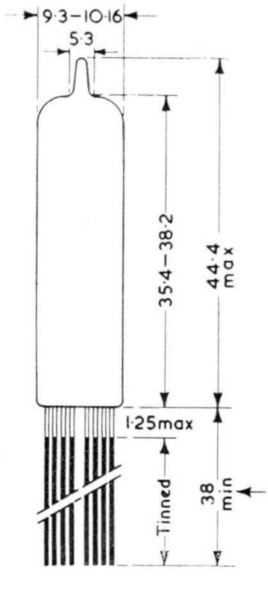
EY70

SUBMINIATURE HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier.



B8D/F Base



3392

All dimensions in mm

BOOSTER DIODE

EY81

Booster diode with high peak inverse voltage and high heater-to-cathode insulation, intended for use in energy recovery circuits in television equipment.

HEATER

V_h	6.3	V
I_h	0.8	A

Note—The heating time of this valve is likely to be longer than that of the other valves in the equipment, and precautions should therefore be taken to ensure that valves in the equipment which are fed from the boosted voltage are not damaged (for example, by the application of the screen-grid voltage before the anode voltage).

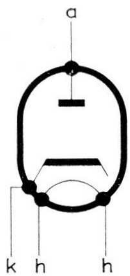
CAPACITANCES

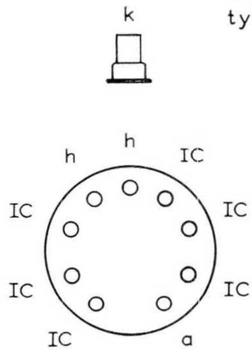
c_{a-k}	6.4	pF
c_{h-k}	2.5	pF

LIMITING VALUES

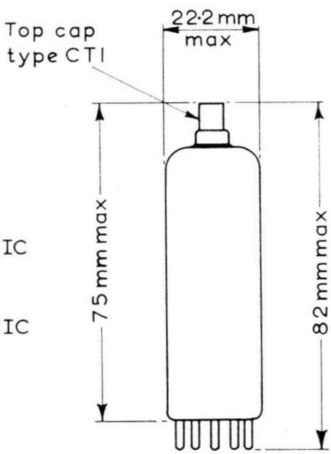
*P.I.V. max.	4.5	kV
$i_{a(pk)}$ max.	450	mA
I_a max.	150	mA
C max.	4	μF
V_{h-k} max.	600	V
*$v_{h-k(pk)}$ max. (cathode positive)	4.5	kV
*$v_{a-h(pk)}$ max. (anode negative)	3.0	kV

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





B9A Base

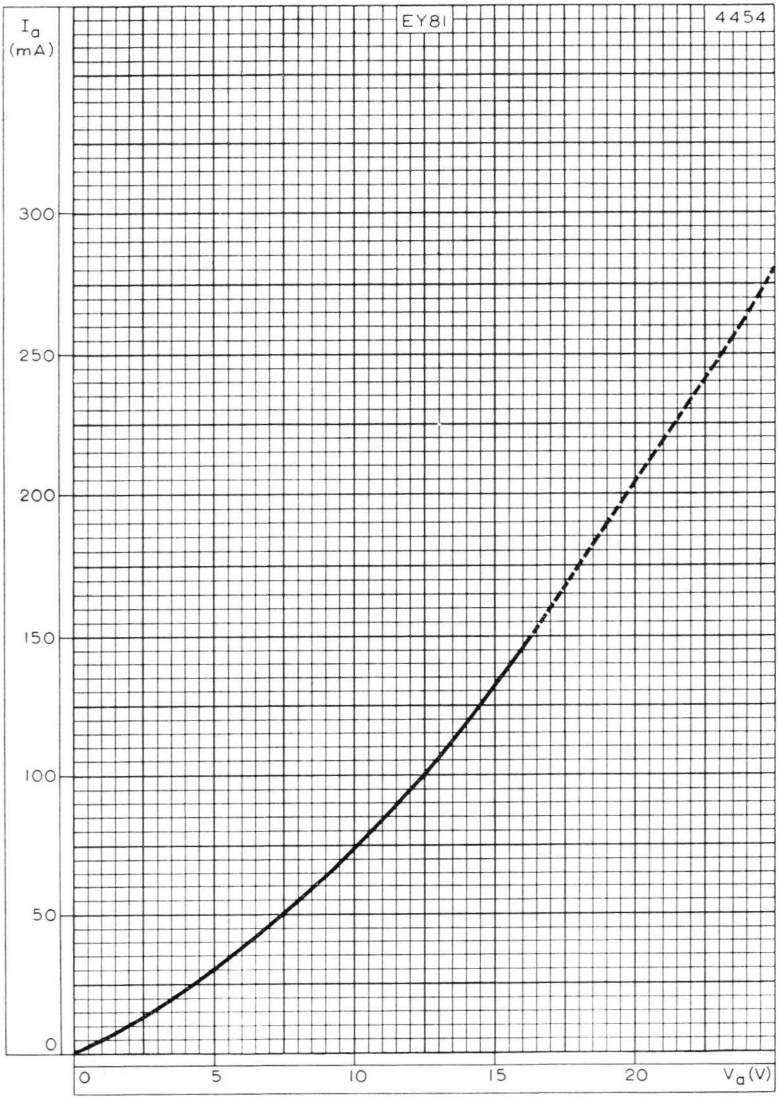


4455

EY81

BOOSTER DIODE

Booster diode with high peak inverse voltage and high heater-to-cathode insulation, intended for use in energy recovery circuits in television equipment.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

BOOSTER DIODE

EY88

Booster diode intended for use in television receivers with 110° deflection angle cathode ray tubes.

HEATER

V_h	6.3	V
I_h	1.55	A

CAPACITANCES

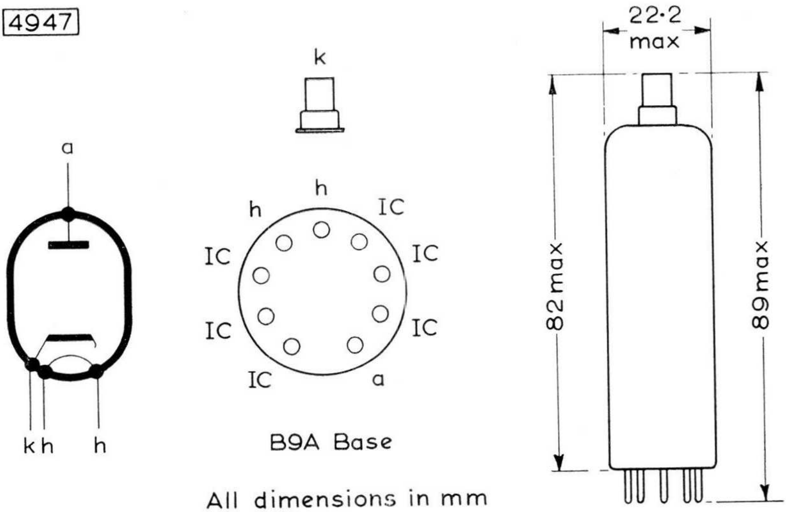
c_{a-k}	8.6	pF
c_{h-k}	2.0	pF

LIMITING VALUES

*P.I.V. max.	6.6	kV
*$i_{a(pk)}$ max.	550	mA
$I_{a(av)}$ max.	220	mA
$v_{h-k(pk)}$ max. (cathode positive)	6.6	kV

*Maximum pulse duration 22% of a cycle with a maximum of 18μs.

4947



All dimensions in mm

MINIATURE HALF WAVE RECTIFIER.

EY91

Indirectly-heated miniature rectifier for use in miniature equipment.

HEATER

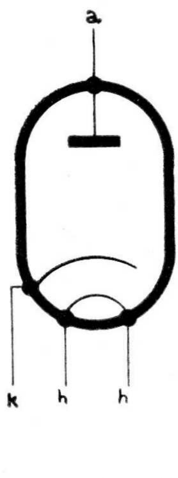
V_h	6.3	V
I_h	0.42	A
Heating Time (approx.)	20	secs.

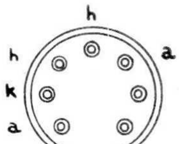
OPERATING CONDITIONS

V_a $V_{(r.m.s.)}$	C (μF)	R_{lim} (Ω)
250	32	100
250	16	50
250	8	0
200	32	70
200	16	30

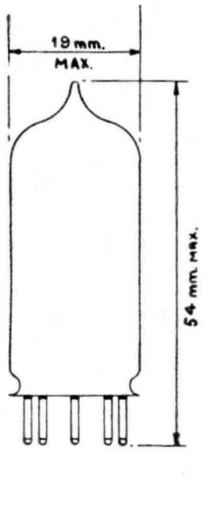
LIMITING VALUES

$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	75	mA
$v_{h-k(pk)}$ max.	300	V
C max.	32	μF





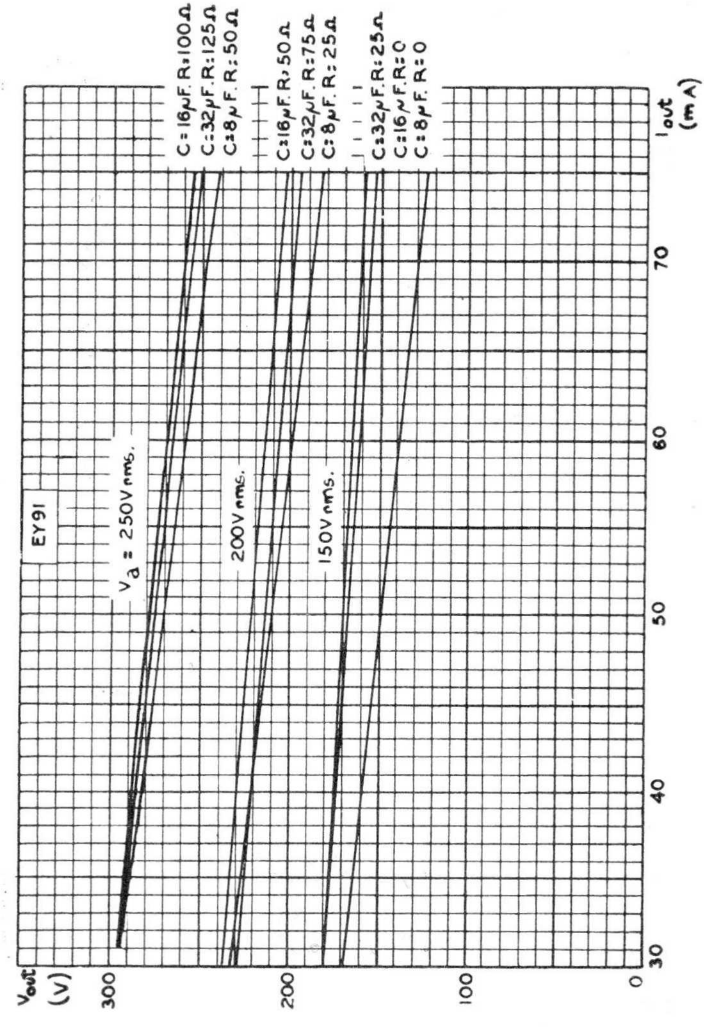
B7G BASE



EY91

MINIATURE HALF WAVE RECTIFIER.

Indirectly-heated miniature rectifier for use in miniature equipment.



OUTPUT VOLTAGE PLOTTED AGAINST OUTPUT CURRENT
WITH ANODE VOLTAGE AS PARAMETER

FULL-WAVE RECTIFIER

EZ35

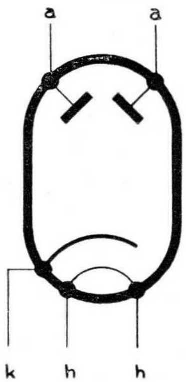
Indirectly-heated power rectifier with 6.3 V. heater for use in A.C. mains-operated equipment.

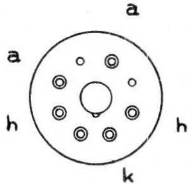
HEATER

V_h	6.3	V
I_h	0.6	A

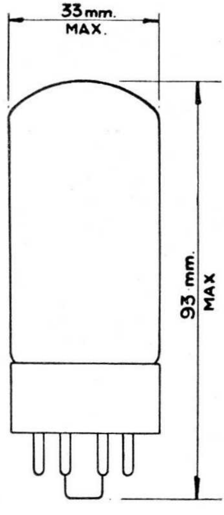
LIMITING VALUES

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





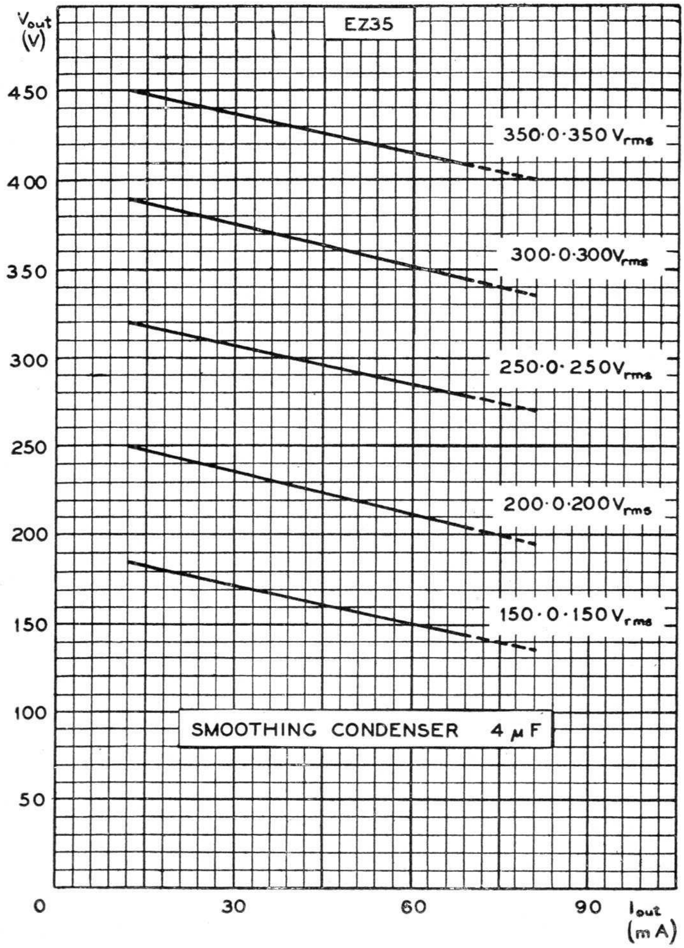
OCTAL BASE



EZ35

FULL-WAVE RECTIFIER

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



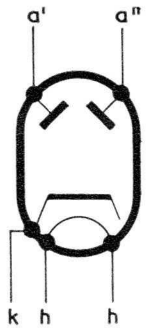
OUTPUT VOLTAGE PLOTTED AGAINST INPUT CURRENT WITH ANODE VOLTAGES AS PARAMETER

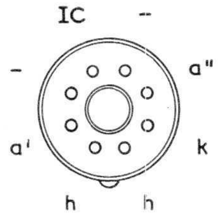
FULL-WAVE RECTIFIER

EZ40

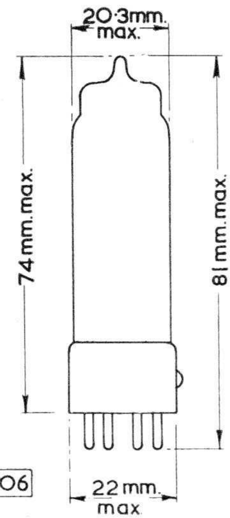
Indirectly heated full-wave rectifier primarily intended for use in a.c. mains operated equipment.

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





B8A BASE



906

FULL-WAVE RECTIFIER

EZ41

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

HEATER

V_h	6.3	V
I_h	0.4	A

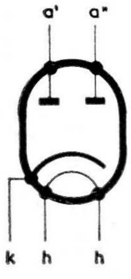
MOUNTING POSITION

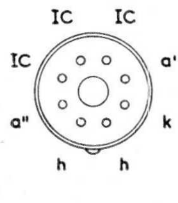
Any

LIMITING VALUES

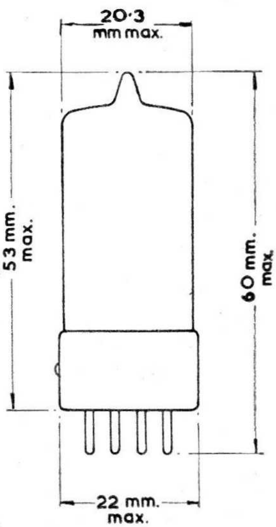
$V_{a\ (r.m.s.)}$ max.	2×250	V
I_{out} max.	60	mA
$v_{h-k\ (pk)}$ max.	350	V

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





B8A BASE

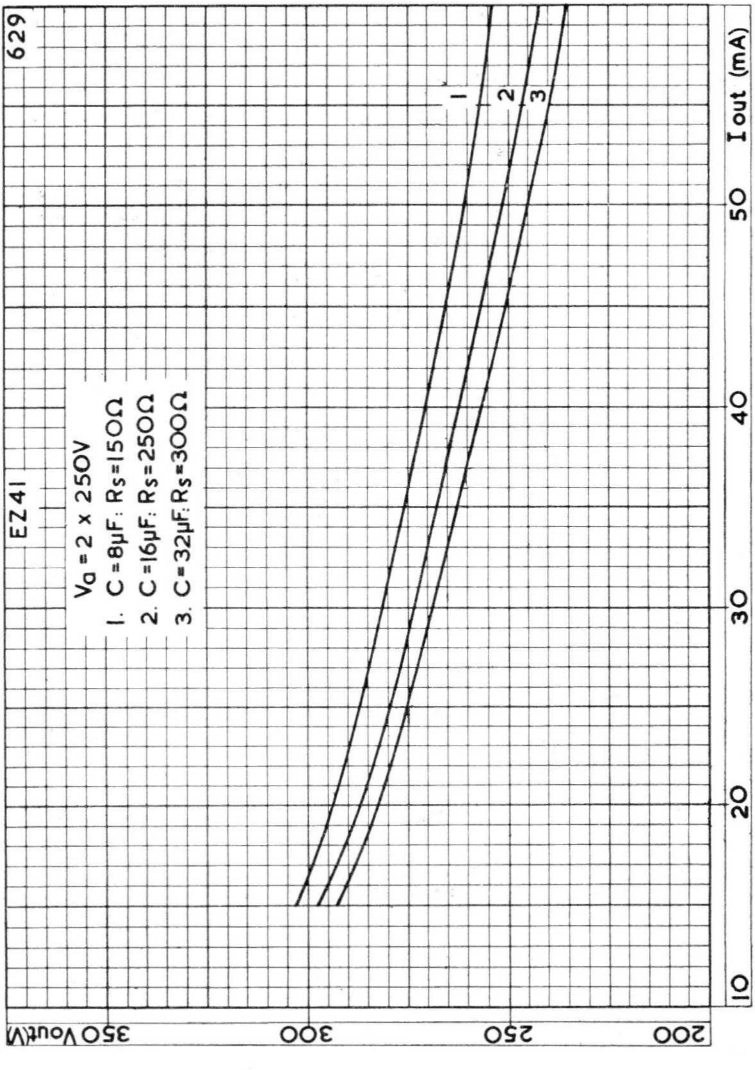


628

EZ41

FULL-WAVE RECTIFIER

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



FULL-WAVE RECTIFIER

GZ30

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

HEATER

V_h	5.0	V
I_h	2.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	375	mA
I_{out} max.	125	mA
C max.	50	μF
L min.	5	H

TYPICAL OPERATING CONDITIONS ←

Capacitor Input

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

Choke Input

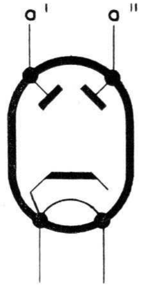
$V_{a(r.m.s.)}$	I_{out}	L	V_{out}
(V)	(mA)	(H)	(V)
2×250	125	10	205
2×300	125	10	249
2×350	125	10	295
2×400	125	10	340
2×450	125	10	384
2×500	125	10	429

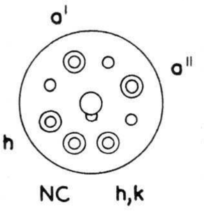
GZ30

FULL-WAVE RECTIFIER

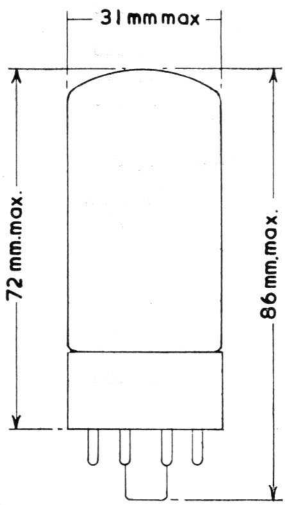
Indirectly-heated full-wave rectifier with 5-volt heater.

1332





Octal Base.



FULL-WAVE RECTIFIER

GZ32

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

HEATER

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

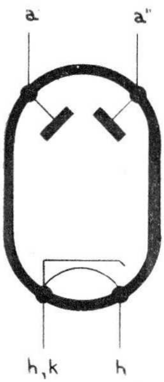
LIMITING VALUES—CAPACITOR INPUT

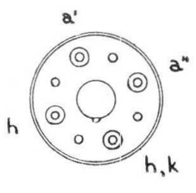
$V_{a\ (r.m.s.)}$ max.	2×300	2×350	2×500	V
I_{out} max.	300	250	125	mA

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

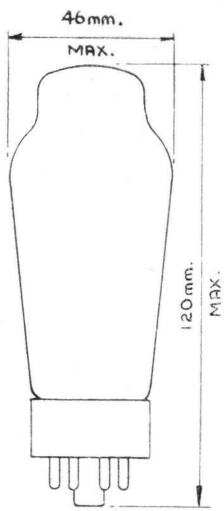
LIMITING VALUES—CHOKE INPUT

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





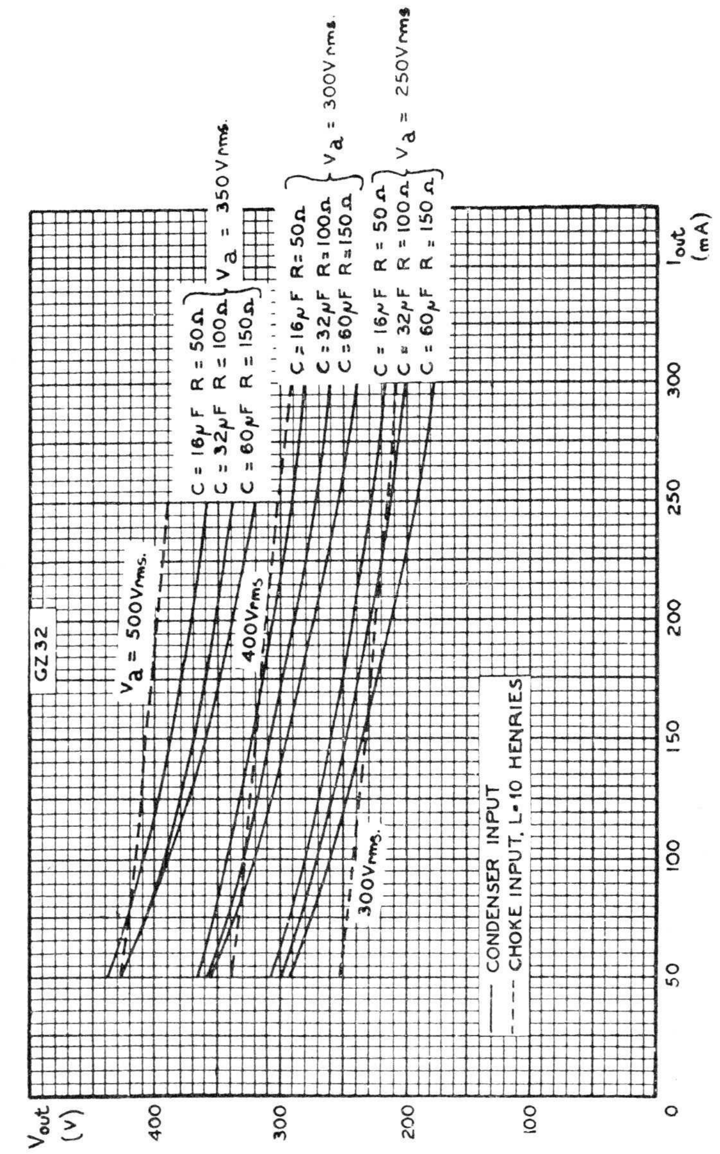
OCTAL BASE



GZ32

FULL-WAVE RECTIFIER

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



OUTPUT VOLTAGE PLOTTED AGAINST OUTPUT CURRENT

FULL-WAVE RECTIFIER

GZ33

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

HEATER

V_h	5.0	V
I_h	3.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	750	mA
i_a surge max.	2.5	A

Capacitor input

$V_{a(r.m.s.)}$ max.	500	V
I_{out} max.	250	mA
C max.	60	μF

Choke input

$V_{a(r.m.s.)}$ max.	500	V
I_{out} max.	300	mA
L min.	10	H

TYPICAL OPERATING CONDITIONS

Capacitor input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	C (μF)	$R_{lim.}$ min. (per anode) (Ω)	V_{out} (V)
2×300	250	8	140	271
2×400	250	8	200	375
2×500	250	8	250	479
2×300	250	60	140	289
2×400	250	60	200	388
2×500	250	60	250	493

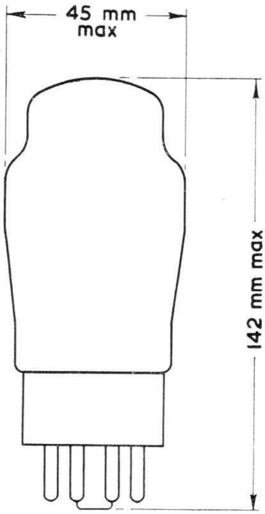
Choke input

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

GZ33

FULL-WAVE RECTIFIER

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



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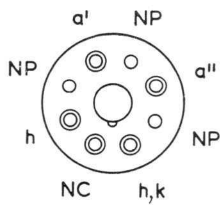
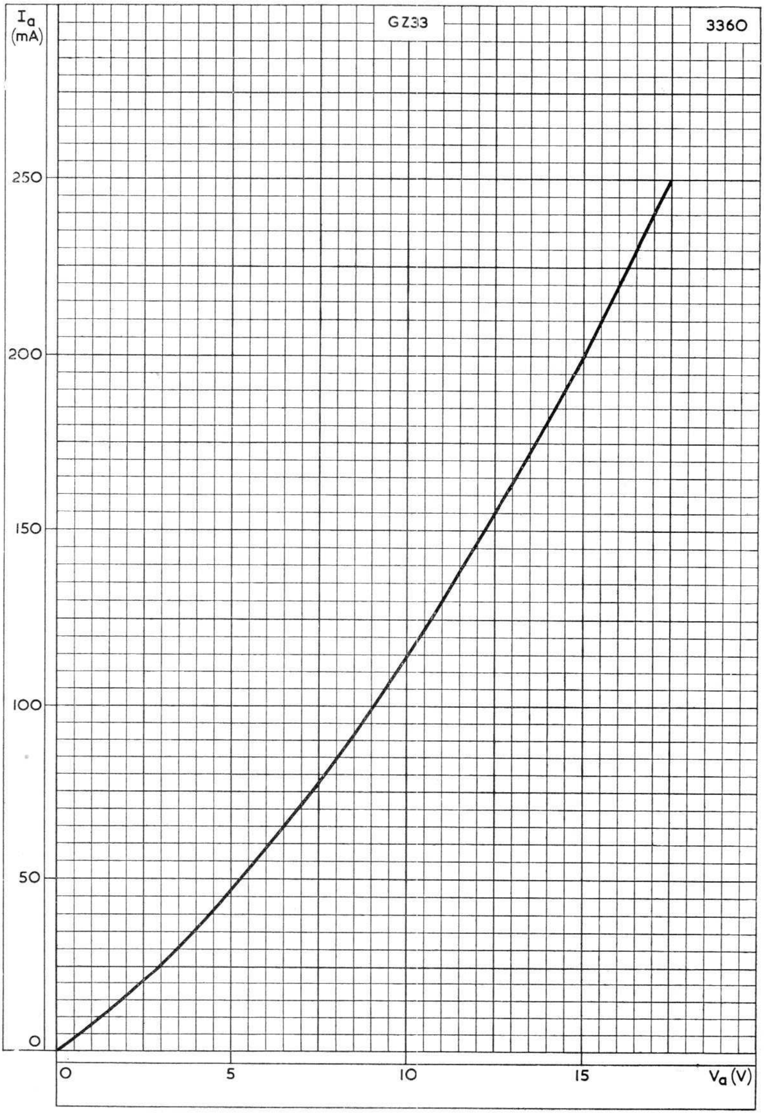


Octal Base

FULL-WAVE RECTIFIER

GZ33

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

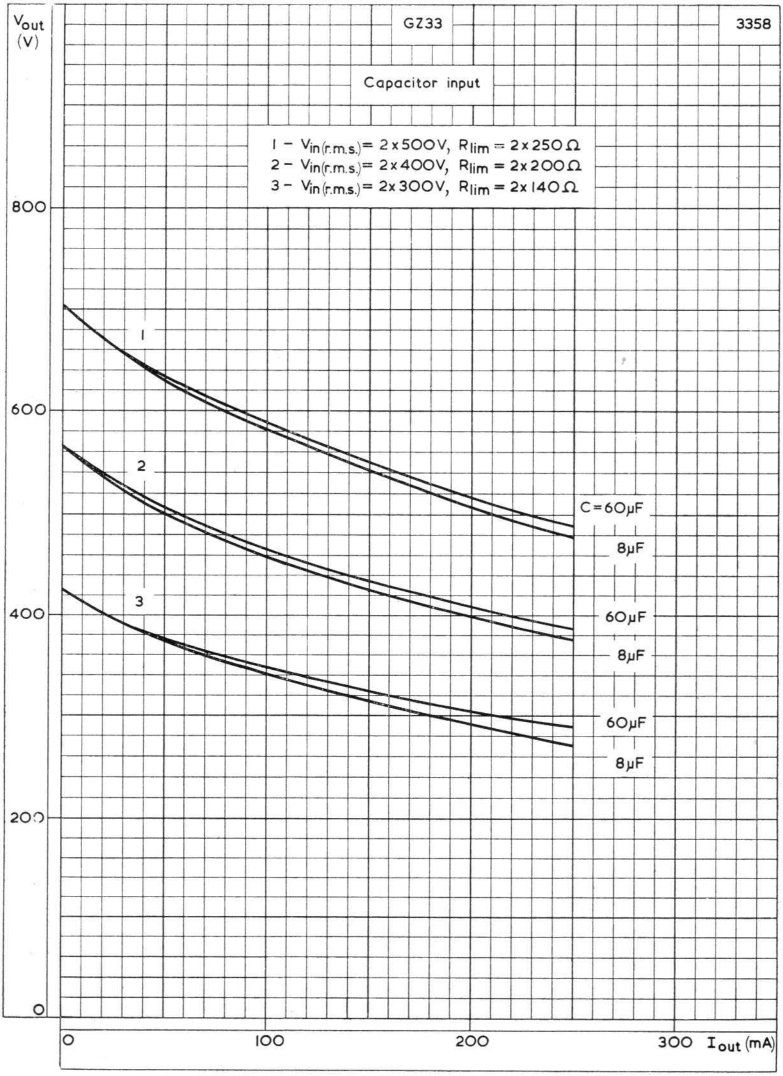


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

GZ33

FULL-WAVE RECTIFIER

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

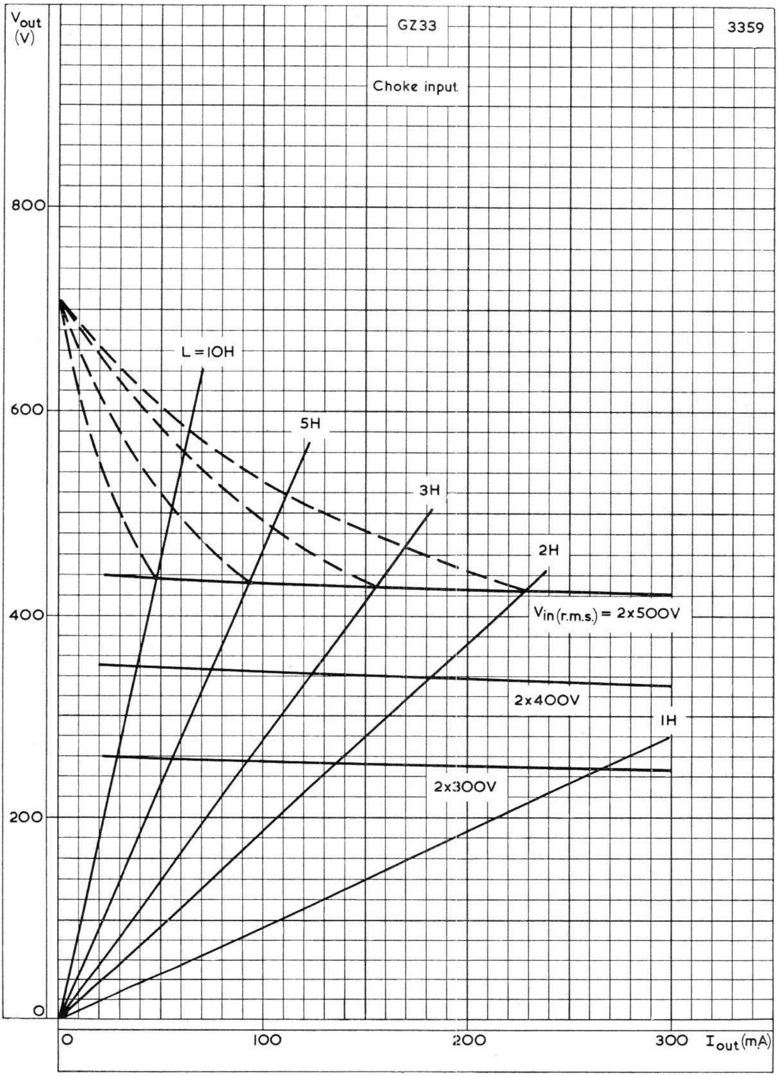


CAPACITOR INPUT REGULATION CURVES

FULL-WAVE RECTIFIER

GZ33

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



CHOKE INPUT 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

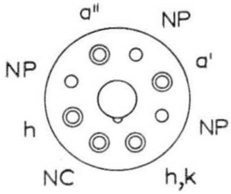
Capacitor input

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

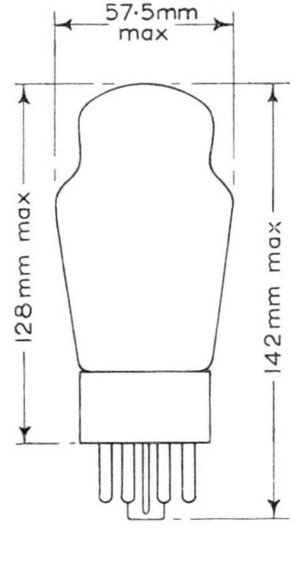
Choke input

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



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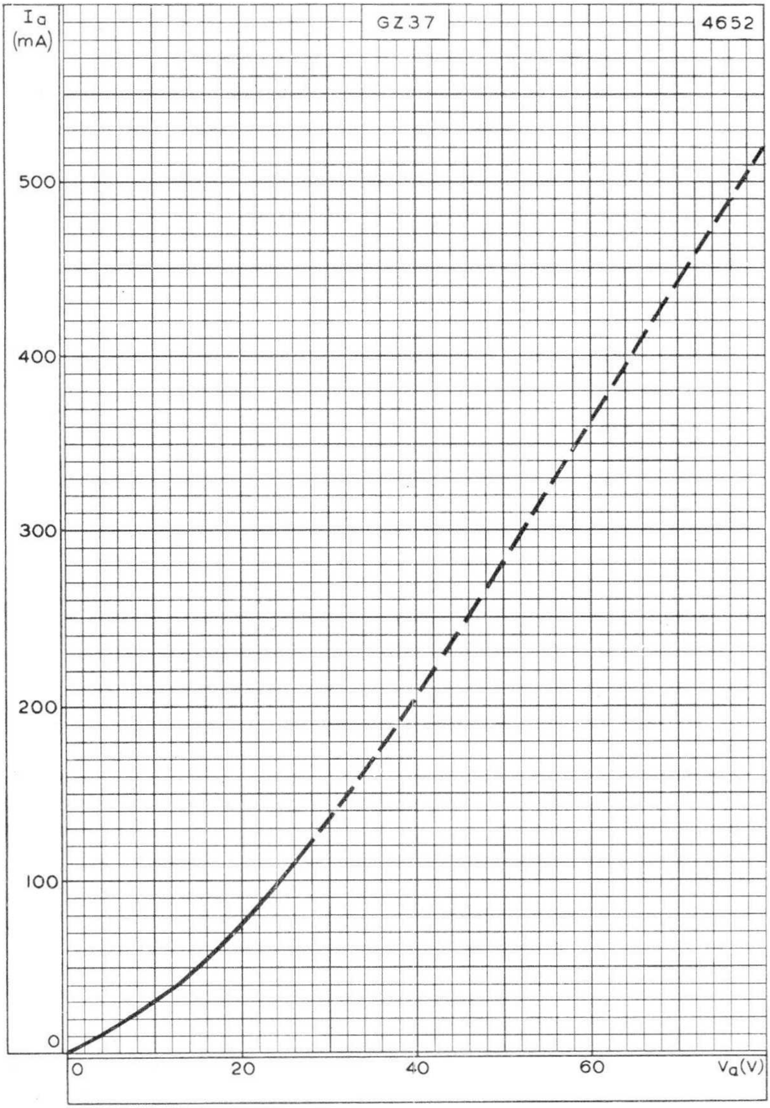
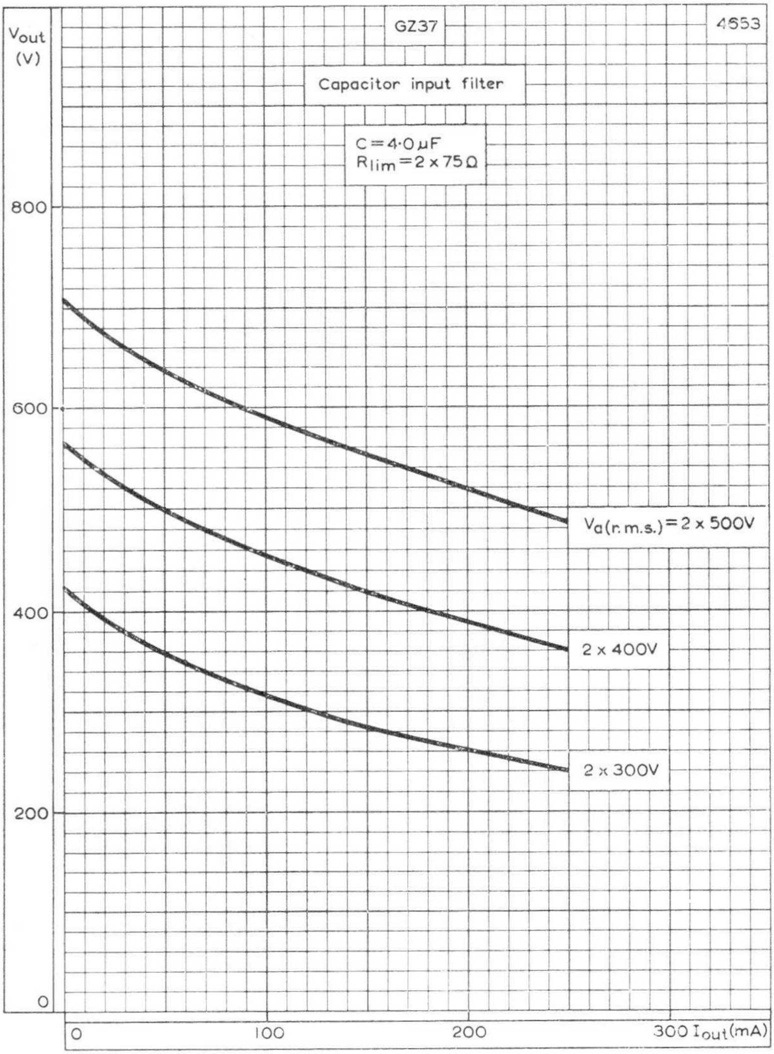
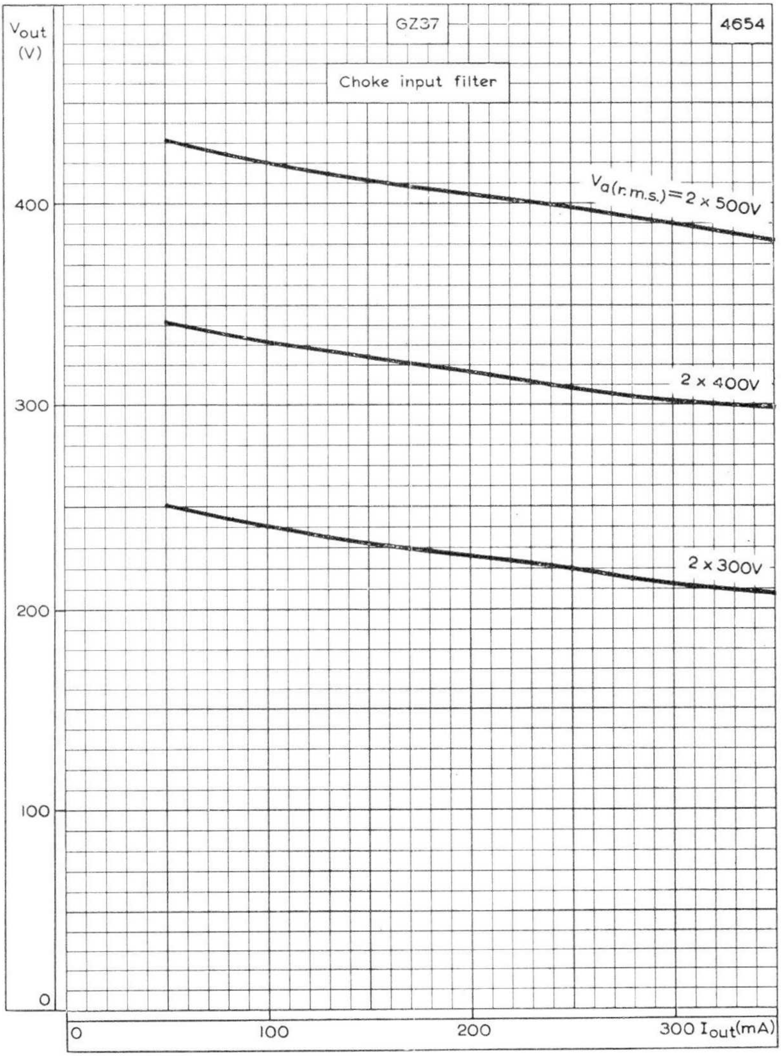


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



CAPACITOR INPUT FILTER REGULATION CURVES



CHOKE INPUT FILTER REGULATION CURVES

SPECIAL QUALITY R.F. POWER TRIODE

M8080

Special quality power triode for use as an r.f. power amplifier or oscillator in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

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

HEATER

V_h[1]	6.3	V
I_h	150	mA

CAPACITANCES[2] (measured without an external shield)

c_{in}	1.5	pF
c_{out}	1.2	pF
c_{a-g}	1.4	pF

CHARACTERISTICS[3]

V_a	250	V
I_a	10.5	mA
V_g	–8.5	V
g_m	2.2	mA/V
μ	17	
r_a	7.7	kΩ
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

f max.	150	Mc/s
$V_{a(b)}$ max.	550	V
V_a max.	330	V
p_a max.	3.8	W
$-V_g$ max.	110	V
I_g max.	5.5	mA
I_k max.	21	mA
R_{g-k} max. (cathode bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	250	kΩ
V_{h-k} max.	150	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	170	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_g (V)	R_k (Ω)	V_{h-k} (V)
6.3	250	-8.5	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current, R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	138	162	—	—	—	mA
Heater cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	3.0	—	μA
Anode current	0.65	10.5	6.5	14.5	—	—	—	mA
	—	—	—	—	9.0	12	1.22	mA
Mutual conductance	0.65	2.2	1.75	2.65	—	—	—	mA/V
	—	—	—	—	2.0	2.4	0.157	mA/V
Group qaulity level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_g = -30V$	2.5	—	—	50	—	—	—	μA
Reverse grid current. $V_h = 6.9V$, $V_{a-e} = 250V$ $V_{g-e} = 0V$, $R_k = 810\Omega$	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration, $V_b = 250V$, $R_a = 2k\Omega$, $V_{g-e} = 0V$, $R_k = 810\Omega$, $C_k = 1000\mu F$	2.5	—	—	7.0	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages; pin 2 connected to pin 7	6.5	—	—	—	—	—	—	
c_{in}	—	—	1.35	2.25	—	—	—	pF
c_{out}	—	—	0.98	1.62	—	—	—	pF
c_{a-g}	—	—	1.2	2.0	—	—	—	pF
Mutual conductance. $V_a = 100V$, $V_g = 0V$	6.5	3.25	2.5	4.0	—	—	—	mA/V
	—	—	—	—	2.82	3.68	0.33	mA/V
Change of mutual conductance. $V_a = 100V$, $V_g = 0V$, $V_h = 5.7V$	6.5	—	—	15	—	—	—	%
Amplification factor	6.5	17	15.5	18.5	—	—	—	
	—	—	—	—	16.15	17.85	0.66	
Power oscillation. $V_a = 300V$, $R_g = 8.5k\Omega$, $f = 150Mc/s$	4.0	—	1.8	—	—	—	—	W

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	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. $V_{a-e} = 250V$, $R_k = 500\Omega$, $V_{h-k} = 150V$ (cathode negative)

Stability life test end point

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

Intermittent life test

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

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

M8080

SPECIAL QUALITY R.F. POWER TRIODE

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

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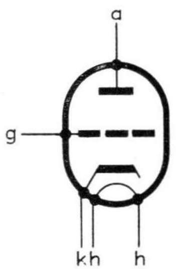
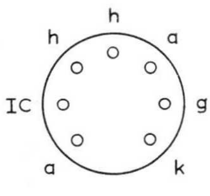
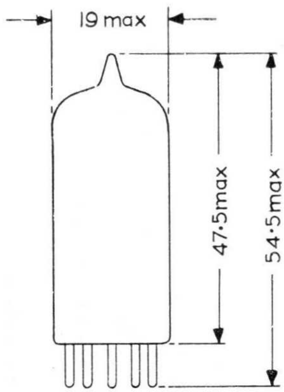


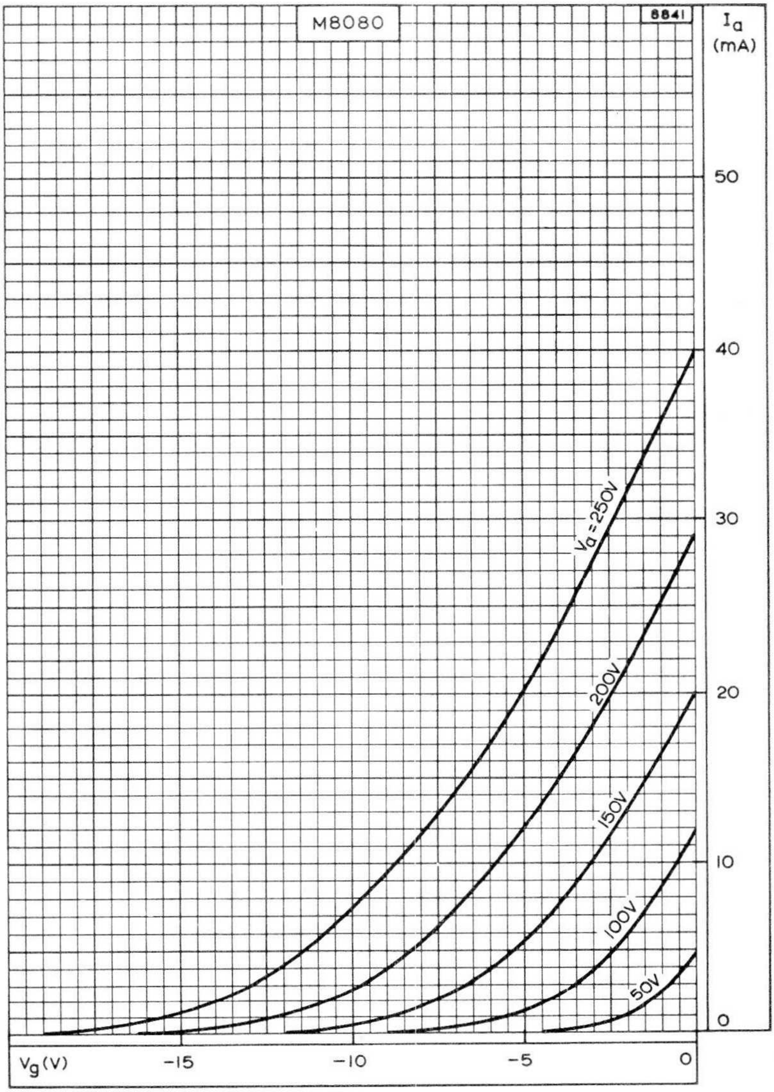


B7G Base

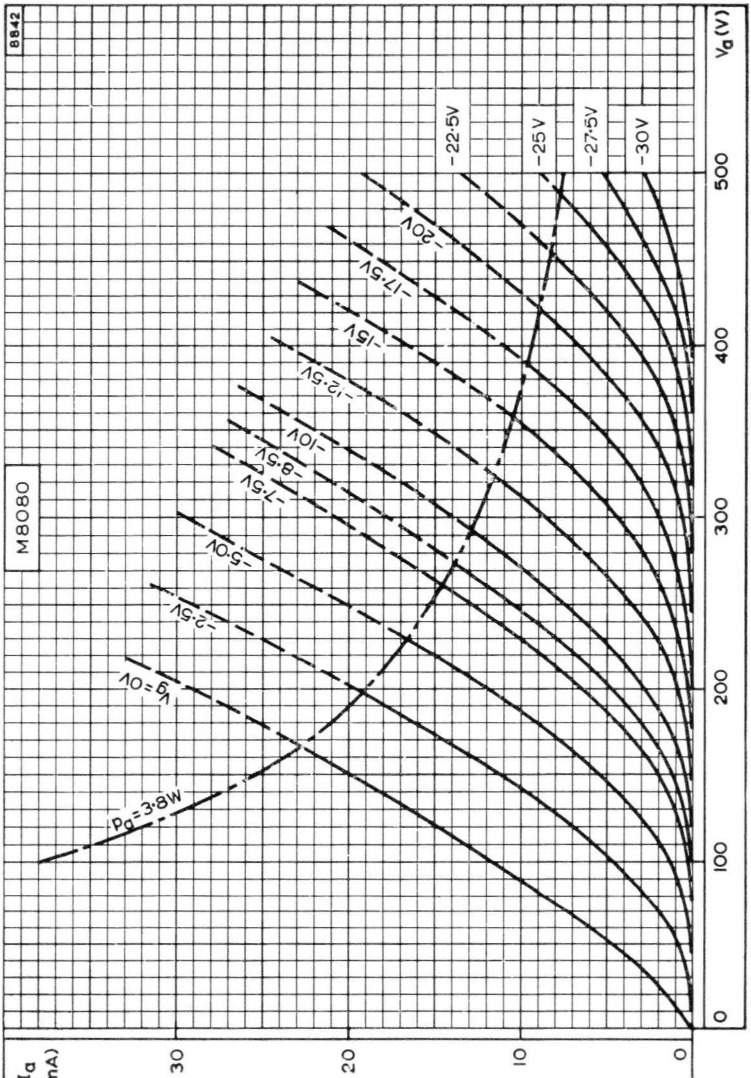


All dimensions in mm

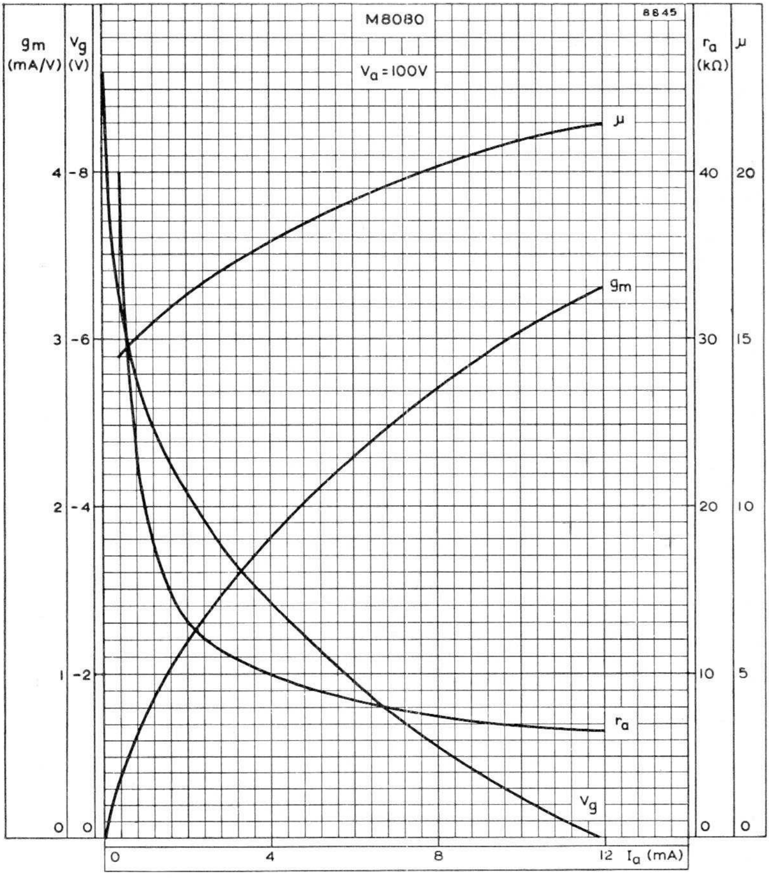
The bulb and base dimensions of this valve are in accordance with BS448 Section B7G.



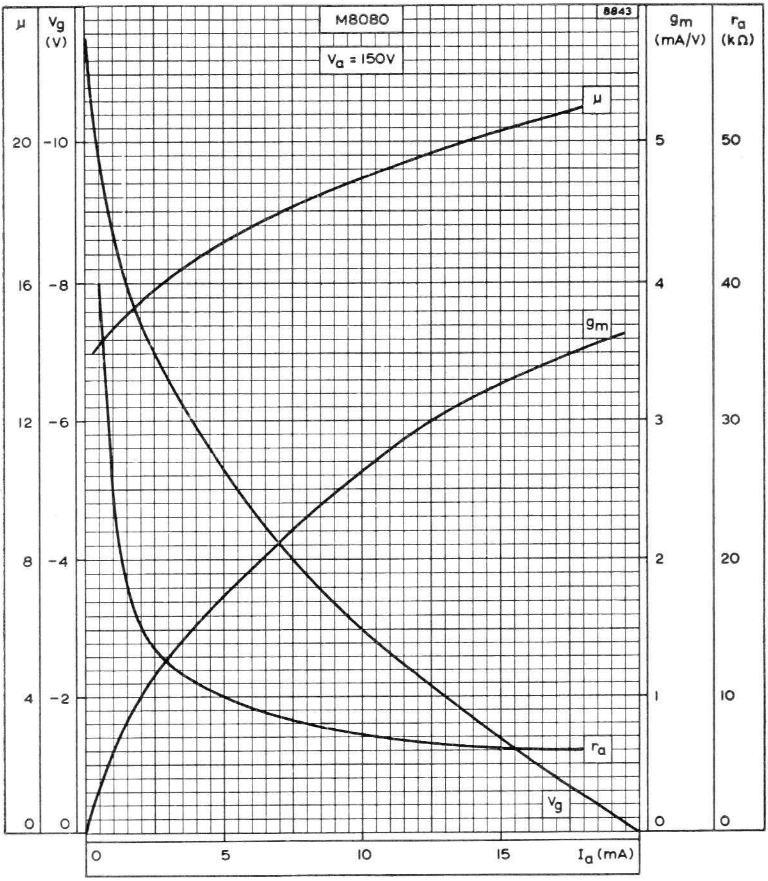
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER



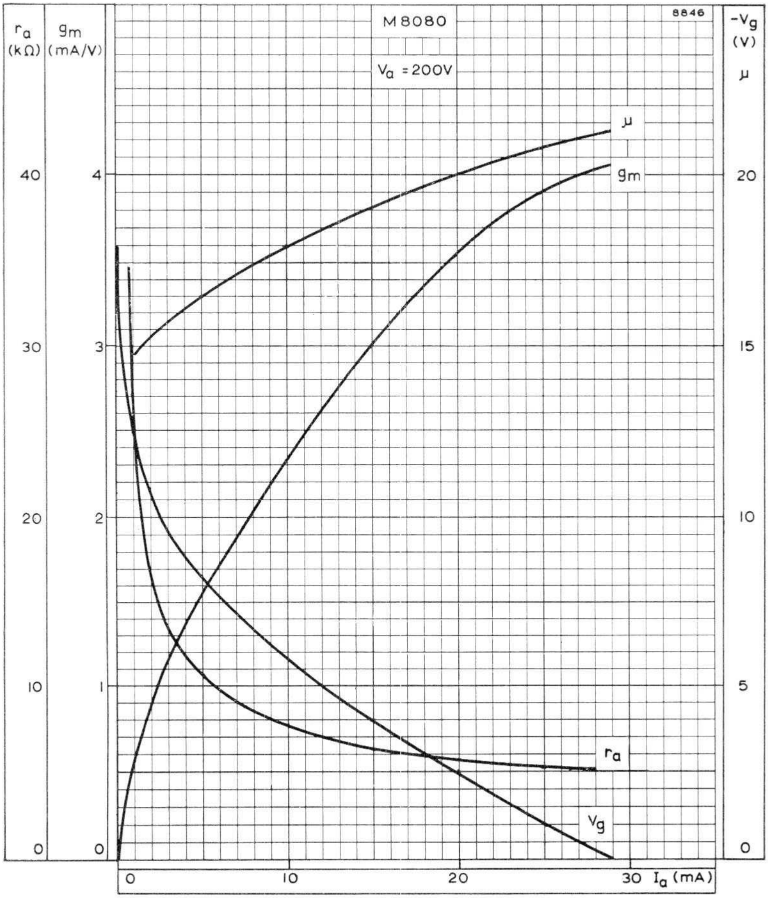
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER



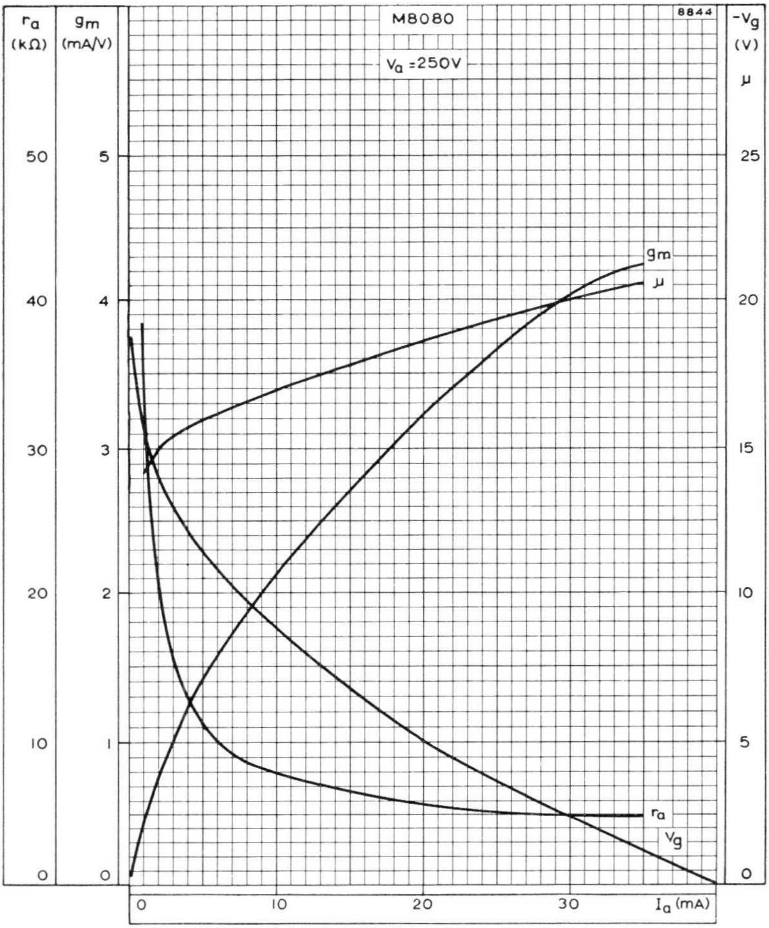
ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. $V_a = 100V$



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



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



ANODE IMPEDANCE, AMPLIFICATION FACTOR, MUTUAL CONDUCTANCE AND GRID VOLTAGE PLOTTED AGAINST ANODE CURRENT. $V_a = 250V$

SPECIAL QUALITY V.H.F. DOUBLE TRIODE

M8081

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

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

HEATER

V_h [1]	6.3	V
I_h	450	mA

CAPACITANCES[2] (measured without an external shield)

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

*Each section

CHARACTERISTICS[3] (each section)

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

* Fixed bias operation is not recommended

LIMITING VALUES[4] (absolute ratings)

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

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g-e} (V)	R_k (Ω)	C_k (μF)
6.3	100	0	50	1000

Voltages are applied simultaneously to both sections. The measurements apply to each section, unless otherwise stated.

TESTS	*A.Q.L.*[5] (%)	*Individuals*[6] *Bogey*[9]	*Min.*	*Max.*	*Lot average*[7] *Min.*	*Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Insulation								
a-rest, measured at –300V	0.25	—	100	—	—	—	—	MΩ
g-rest, measured at –100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current								
$R_g$max. = 1MΩ, V_{a-e} = 250V, R_k = 500Ω both sections strapped	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	420	480	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V cathode negative	—	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive	—	—	—	10	—	—	—	μA
Anode current	0.65	—	6.5	11.5	—	—	—	mA
Mutual conductance	0.65	—	4.0	7.5	—	—	—	mA/V
Anode current V_{g-e} = –30V, V_{a-e} = 250V	0.65	—	—	75	—	—	—	μA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

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

GROUP D

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

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
***Fatigue*[14]**								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 2g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100$V	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. $V_{h-k} = \pm 100$V	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

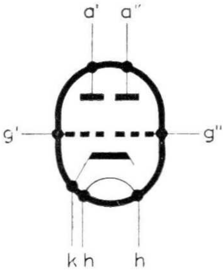
Change in mutual conductance after 1 hour	1.0	—	—	15	—	—	—	%

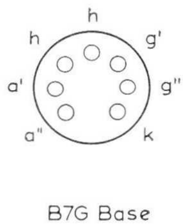
Intermittent life test

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

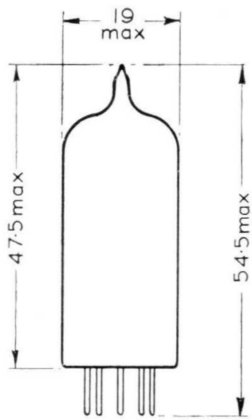
Intermittent life test end points		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	420	480	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse grid current as 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	—	—	

GROUP G	A.Q.L.[5] (%)	Min.	Max.	
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse grid current as in group A.	0.5	—	0.75	μA





B7G Base



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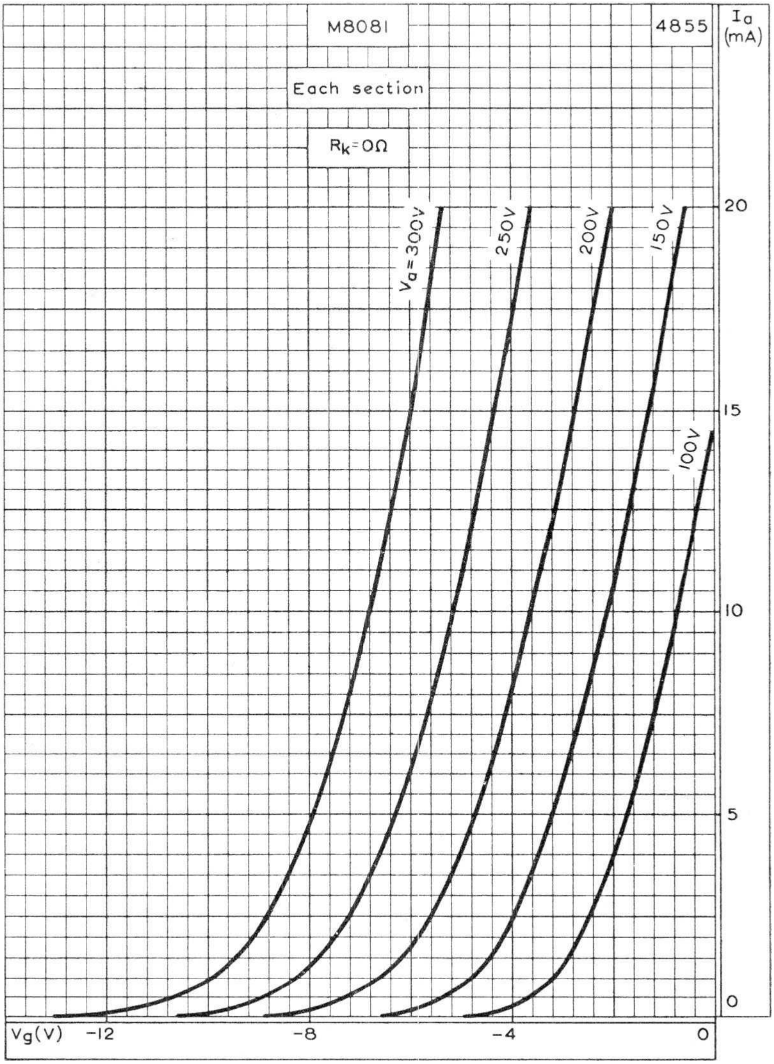
All dimensions in mm

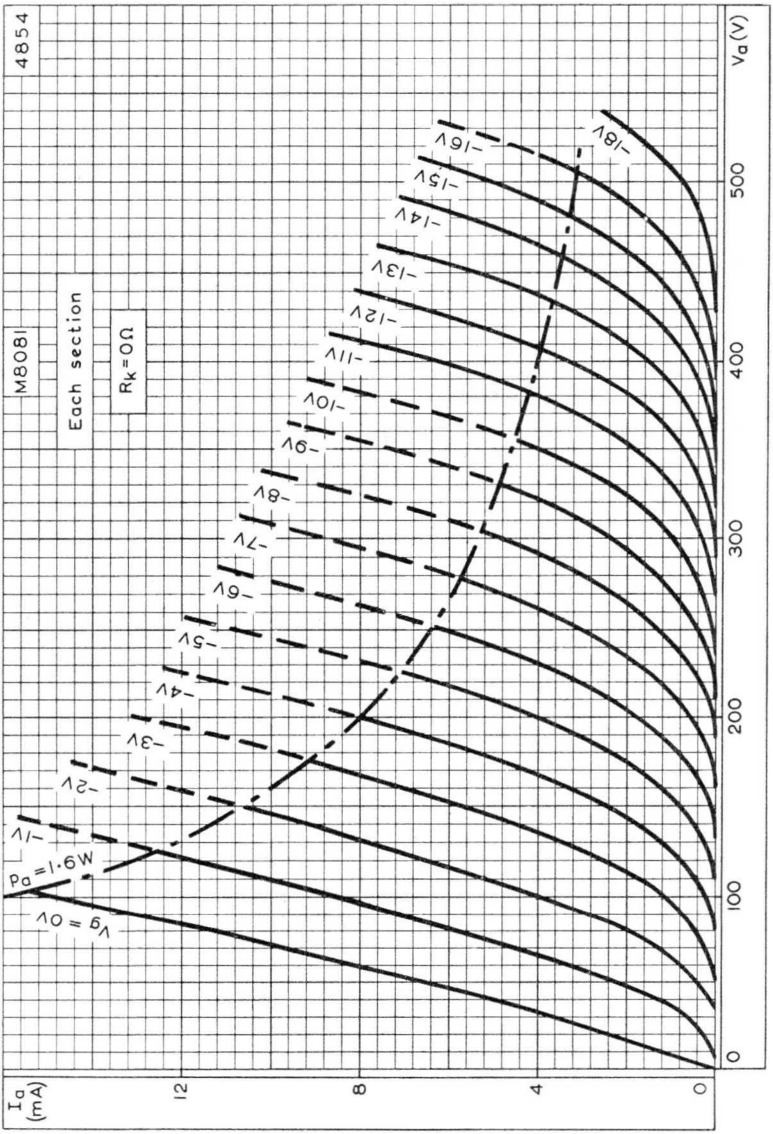
The bulb and base dimensions of this valve are in accordance with BS448, Section B7G



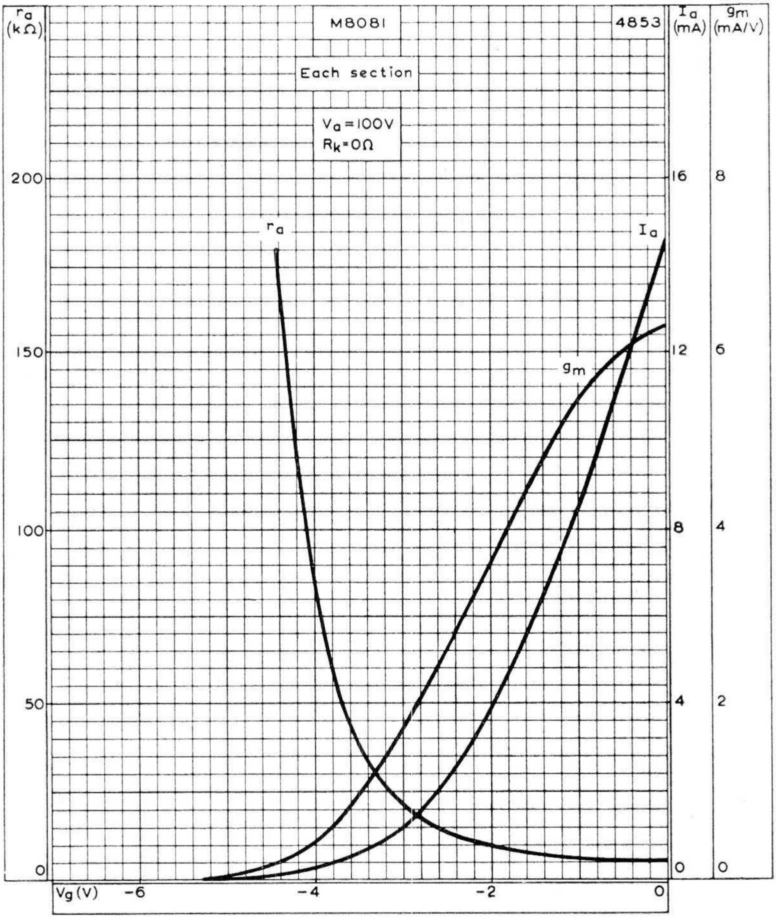
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER.

M8081

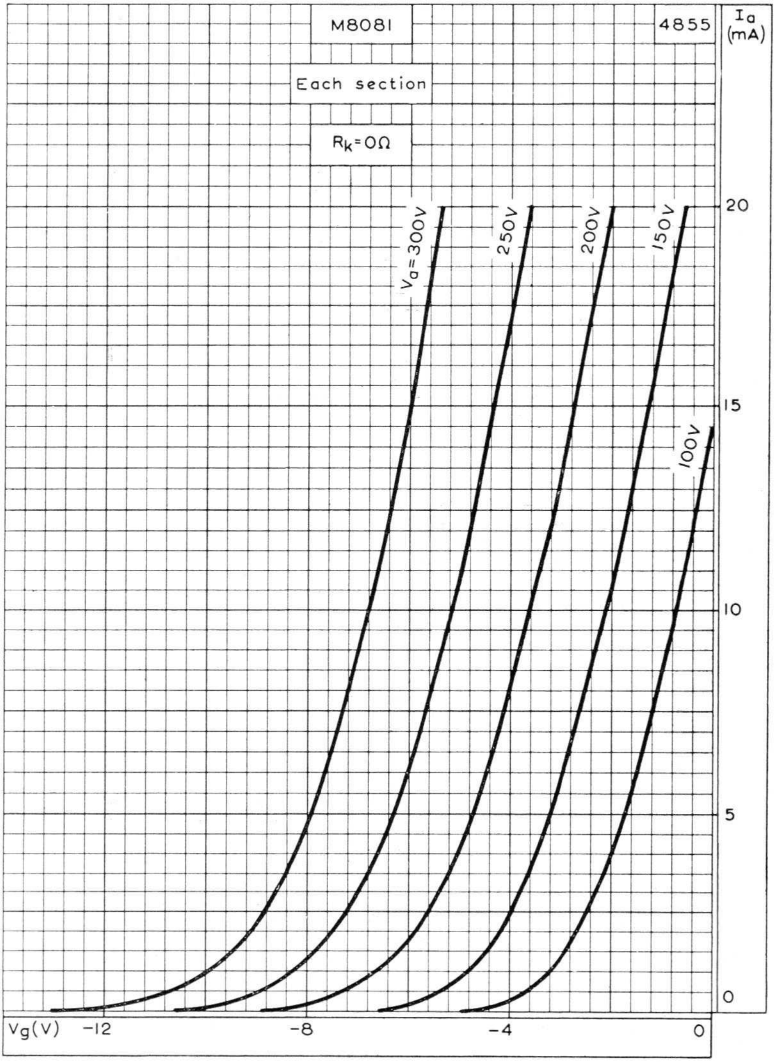
SPECIAL QUALITY MINIATURE V.H.F. DOUBLE TRIODE



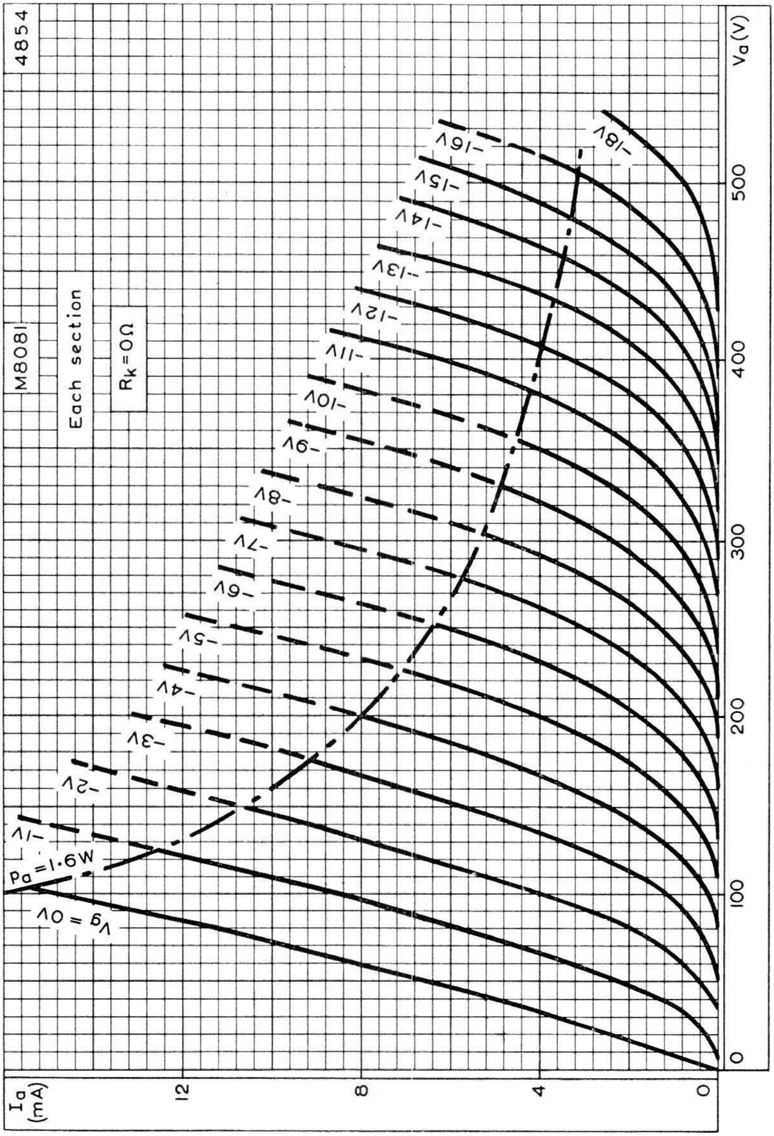
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER.



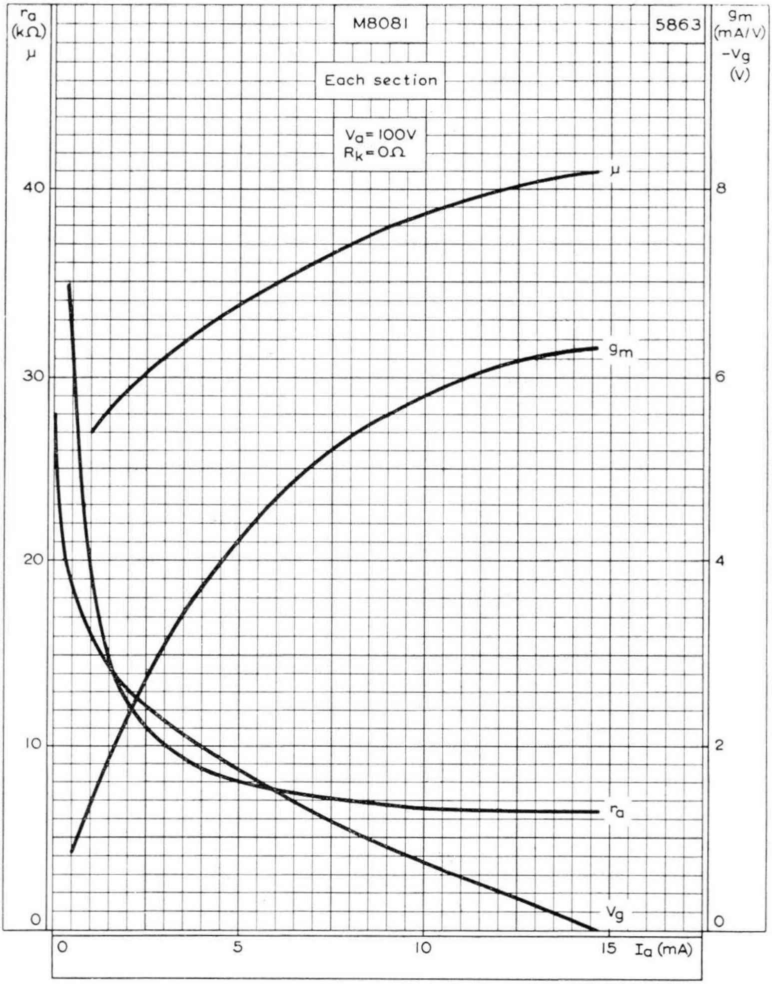
ANODE CURRENT, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST GRID VOLTAGE FOR EACH SECTION



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER FOR EACH SECTION



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER FOR EACH SECTION



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

SPECIAL QUALITY VOLTAGE AMPLIFYING PENTODE

M8195

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

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

HEATER

V_h[1]	6.3	V
I_h	200	mA

CAPACITANCES[2] (measured without an external shield)

c_{a-g1}	<50	mpF
c_{in}	3.8	pF
c_{out}	5.1	pF

CHARACTERISTICS[3]

V_a	250	V
V_{g3}	0	V
V_{g2}	140	V
I_a	3.0	mA
I_{g2}	550	μA
g_m	2.0	mA/V
r_a	2.5	MΩ
μ_{g1-g2}	38	
V_{g1}	−2.0	V
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	200	V
p_{g2} max.	200	mW
I_k max.	6.0	mA
R_{g1-k} max. ($p_a > 200$mW)	3.0	MΩ
R_{g1-k} max. ($p_a < 200$mW)	10	MΩ
V_{h-k} max.	100	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

M8195

SPECIAL QUALITY VOLTAGE AMPLIFYING PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_{g3} (V)	V_{g2} (V)	V_{g1} (V)	R_k (Ω)	V_{h-k} (V)
6.3	250	0	140	−2.0	0	0

TESTS	*A.Q.L.*[5] (%)	*Individuals*[6] *Bogey*[9]	*Min.*	*Max.*	*Lot average*[7] *Min.*	*Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Insulation								
a-rest, g_2-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current, R_{g1} max. = 500kΩ	0.25	—	—	0.4	—	—	—	μA
GROUP B								
Heater current	0.65	—	185	215	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	2.0	—	μA
Anode current	0.65	3.0	2.15	3.85	—	—	—	mA
	—	—	—	—	2.69	3.31	0.28	mA
Screen-grid current	0.65	—	—	850	—	—	—	μA
Mutual conductance	0.65	2.0	1.55	2.45	—	—	—	mA/V
	—	—	—	—	1.83	2.17	0.13	mA/V
Microphony. V_b = 200V, R_a = 100kΩ, R_{g2} = 680kΩ, R_{g1} = 470kΩ, R_k = 1.2kΩ, C_k = 100μF, C_{g2} = 0.1μF. Impact = 50g, at rt. angles to the axis.								
Control grid voltage (r.m.s.)	0.65	—	—	3.5	—	—	—	mV (pk–pk)

Grid hum. $V_b = 200V$, $R_a = 100k\Omega$, $R_{g2} = 680k\Omega$, $R_{g1} = 470k\Omega$, $R_k = 1.2k\Omega$, $C_k = 100\mu F$, $C_{g2} = 0.1\mu F$. Pins 4 and 5 earthed alternately. Hum referred to the grid	0.65	—	—	8.0	—	—	—	μV
Cathode hum. $V_b = 200V$, $R_a = 100k\Omega$, $R_{g2} = 680k\Omega$, $R_{g1} = 470\Omega$, $R_k = 1.2k\Omega$, $C_{g2} = 0.1\mu F$. Pins 4 and 5 earthed alternately. Hum referred to the grid	0.65	—	—	60	—	—	—	μV
Hiss. $V_h = 6.3V$ d.c., $V_b = 200V$, $R_a = 100k\Omega$, $R_{g2} = 680k\Omega$, $R_{g1} = 470k\Omega$, $R_k = 1.2k\Omega$, $C_{g2} = 0.1\mu F$, $C_k = 100\mu F$. Hiss referred to the grid	0.65	—	—	5.0	—	—	—	μV
Group quality level[10]	2.5	—	—	—	—	—	—	
GROUP C								
Anode current, $V_{g1} = -7.0V$, $R_a = 1.0M\Omega$	2.5	—	—	40	—	—	—	μA
Change in mutual conductance, $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse grid current, $V_h = 6.9V$	2.5	—	—	1.0	—	—	—	μA
Group quality level[10]	6.5	—	—	—	—	—	—	
GROUP D								
Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances[2] (unshielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{a-g1}	—	—	—	50	—	—	—	mpF
c_{in}	—	—	3.4	4.3	—	—	—	pF ←
c_{out}	—	—	4.5	5.8	—	—	—	pF
Amplification factor (μ_{g1-g2})	6.5	—	34	42	—	—	—	

TESTS	A.Q.L.[5] (%)	Individuals Bogey[9]	Individuals Min.	Individuals Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170 ±5c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current, R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.0	—	—	—	—	mA/V
Microphonic noise as in group B	2.5	—	—	1.0	—	—	—	V (pk–pk)
Cathode hum as in group B	2.5	—	—	120	—	—	—	μV
Sub-group quality level[10]	6.5	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current, R_{g1} max. = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.0	—	—	—	—	mA/V
Microphonic noise as in group B	2.5	—	—	1.0	—	—	—	V (pk–pk)
Cathode hum as in group B	2.5	—	—	120	—	—	—	μV
Sub-group quality level[10]	6.5	—	—	—	—	—	—	

GROUP F

Intermittent life test

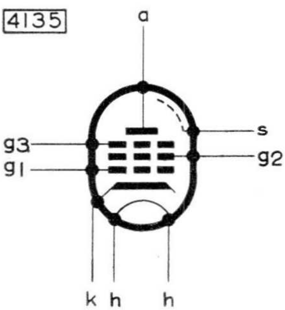
Running conditions, $V_{a-e} = 300V$, $V_{g2-e} = 200V$, $R_k = 820\Omega$, $V_{h-k} = 100V$ (cathode negative)

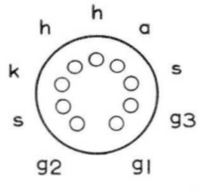
Intermittent life test end points

		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	185	215	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	20	μA
	1000 hours	4.0	—	20	μA
Reverse grid current. R_{g1} max. = 500kΩ	500 hours	2.5	—	0.4	μA
	1000 hours	4.0	—	0.5	μA
Mutual conductance	500 hours	2.5	1.2	—	mA/V
	1000 hours	4.0	1.0	—	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Anode current	500 hours	4.0	2.0	3.85	mA
	1000 hours	6.5	1.5	3.85	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
Cathode hum as in group B	500 hours	4.0	—	120	μV
	1000 hours	6.5	—	250	μV
Hiss as in group B	500 hours	4.0	—	10	μV
	1000 hours	6.5	—	15	μV
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

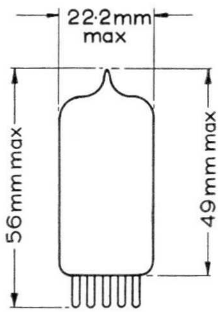
	A.Q.L.[5] (%)	Min.	Max.	
GROUP G				
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—	
Reverse grid current R_{g1} max. = 500kΩ	0.5	—	0.4	µA

4135

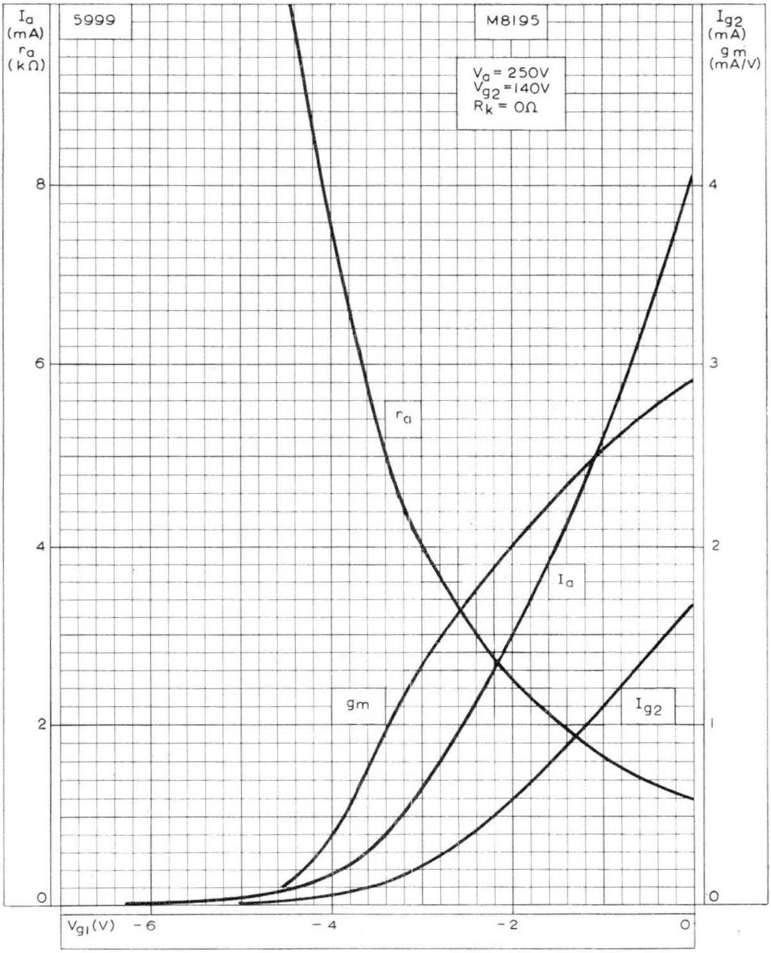




B9A Base



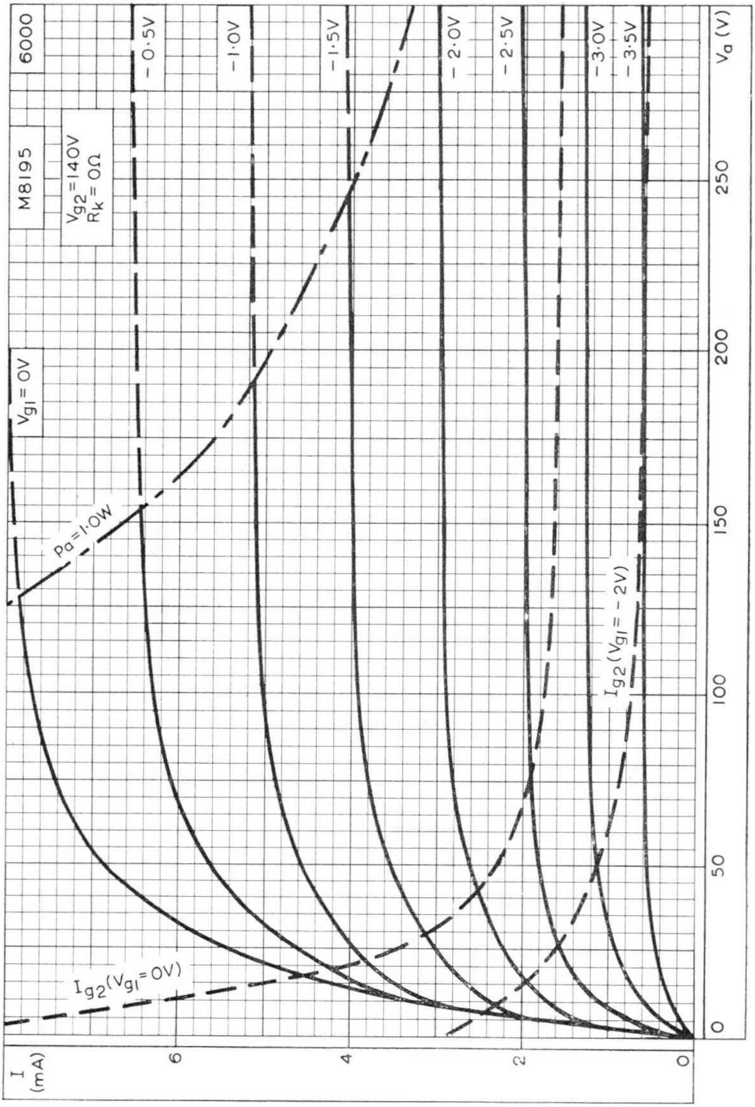
The bulb and base dimensions of this valve are in accordance with BS448, Section B9A.



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

M8195

SPECIAL QUALITY VOLTAGE AMPLIFYING PENTODE



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

SPECIAL QUALITY U.H.F. TRIODE

M8248

Special quality triode for use as a grounded grid amplifier in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

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

HEATER

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

V_h[1]	6.3	V
I_h	400	mA

CAPACITANCES[2] (measured with external shield)

c_{a-k}	80	mpF
c_{a-k} max.	150	mpF
c_{h-k}	3.8	pF
c_{a-g}	2.8	pF
$c_{k-g+h+sh}$	8.8	pF
$c_{a-g+h+sh}$	4.0	pF

CHARACTERISTICS[3]

V_a	150	V
I_a	13.5	mA
V_g	−1.35	V
g_m	13.5	mA/V
r_a	3.7	kΩ
μ	50	
R_k	0	Ω
V_g ($I_a \leqslant 60\mu A$)	−15	V

ABSOLUTE MAXIMUM RATINGS[4]

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	2.7	W
$+V_g$ max.	0	V
$-V_g$ max.	55	V
I_k max.	20	mA
I_g max.	3.5	mA
R_{g-k} max.	250	kΩ
V_{h-k} max.	90	V
Maximum acceleration (continuous operation)	50	g
Maximum shock (short duration)	500	g
T_{bulb} max.	120	°C

TEST CONDITIONS (unless otherwise specified)

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

TESTS	*A.Q.L.*[5] (%)	*Individuals*[6] *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	400	375	425	—	—	—	mA
Heater-cathode leakage current $V_{h-k} \pm 100V$	0.65	—	—	10	—	—	—	μA
Reverse grid current V_{a-e} 175V, R_k 150Ω, R_{g1} 250kΩ	0.65	—	—	0.5	—	—	—	μA
Anode current	0.65	13.5	9.0	18.0	—	—	—	mA
	—	—	—	—	11.8	15.2	1.35	mA
Anode current $V_g = -15V$, $R_k = 0\Omega$	0.65	—	—	60	—	—	—	μA
Mutual conductance	0.65	13.5	11.0	16.0	—	—	—	mA/V
	—	—	—	—	12.6	14.4	0.73	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest measured at –300V	2.5	—	200	—	—	—	—	MΩ
g-rest measured at –100V		—	200	—	—	—	—	MΩ
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Amplification factor	6.5	—	40	65	—	—	—	
Capacitances[2] (shielded). No applied voltages	6.5							
c_{a-k} shield to earth		—	—	150	—	—	—	mpF
c_{h-k} shield to earth		—	2.5	5.0	—	—	—	pF
c_{a-g} shield to earth		—	2.3	3.3	—	—	—	pF
c_{k-g+h} shield to grid		—	8.0	11.0	—	—	—	pF
c_{a-g+h} shield to grid		—	—	5.0	—	—	—	pF
Low pressure voltage breakdown pressure 55 ± 5mm Hg, voltage 500V o.c. No other applied voltages	6.5	—	—	—	—	—	—	
Microphone noise at the anode at 50c/s, 2.0g minimum peak acceleration, $R_a = 2000\Omega$	6.5	—	—	200	—	—	—	mV (r.m.s.)

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
***Fatigue*[14]**								
V_h = 6.3V. No other voltages applied. 2.5g minimum peak acceleration, fixed frequency. f = 25c/s min., 60c/s max. for 32 hours in each of 3 mutually perpendicular planes.								
Post Fatigue Tests								
Heater to cathode leakage current $V_{h-k} \pm 100V$	6.5	—	—	20	—	—	—	μA
Change in mutual conductance		—	—	20	—	—	—	%
Reverse grid current		—	—	1.0	—	—	—	μA
Microphonic noise as in Group B		—	—	300	—	—	—	mV (r.m.s.)
***Shock*[15]**								
V_{h-k} = 100V (cathode negative) V_g = –1.5V d.c. R_g = 100kΩ, 500g.								
Post Shock Tests								
Heater-cathode leakage current $V_{h-k} \pm 100V$	20	—	—	20	—	—	—	μA
Change in mutual conductance		—	—	20	—	—	—	%
Reverse grid current		—	—	1.0	—	—	—	μA
Microphonic noise as in Group B		—	—	300	—	—	—	mV (r.m.s.)
Base strain[12]. No applied voltages	—	—	—	—	—	—	—	
Glass strain[11A]. No applied voltages	2.5	—	—	—	—	—	—	

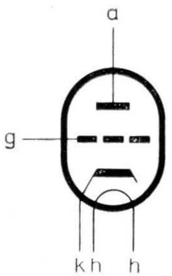
GROUP D

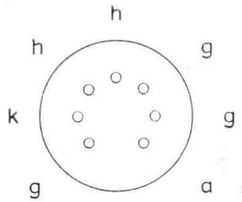
Heater cycling life test
V_h = 7.0V. V_{h-k} + 100V d.c.
1 minute on 4 minutes off. No other voltages.

Heater cycling life end points								
Heater to cathode leakage								
$V_{h-k} \pm 100V$ d.c.	1.0	—	—	20	—	—	—	μA
Insulation as in Group B	2.5	—	30	—	—	—	—	MΩ
Stability life test[14]								
Running conditions, V_{h-k} +100V d.c. $R_g = 250\ k\Omega$								
$T_{ambient}$ = Room temperature.								
Stability life end point								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions. V_{h-k} +100V d.c. $R_g = 250k\Omega$								
$T_{ambient}$ = room temperature								
Survival rate end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	10	—	—	—	—	mA/V
Intermittent life test								
Running conditions								
V_{h-k} +100V d.c. $R_g = 250k\Omega$								
T_{bulb} min. = 120°C								
Intermittent life test end points (500 hours)								
Inoperatives[16]	2.5							
Heater current	2.5	—	370	460	—	—	—	mA
Reverse grid current	2.5	—	—	2.0	—	—	—	μA
Change in mutual conductance. $V_h = 5.7V$	4.0	—	—	15	—	—	—	%
Change in mutual conductance (individuals)	2.5	—	—	20	—	—	—	%
Heater to cathode leakage								
$V_{h-k} = \pm 100V$ d.c.	2.5	—	—	20	—	—	—	μA
Insulation as in Group B	2.5	—	100	—	—	—	—	MΩ
Average change in mutual conductance	—	—	—	10	—	—	—	%
Sub-group quality level[10]	10.0							

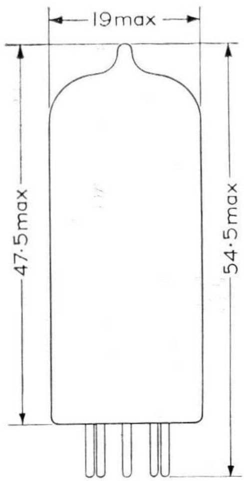
M8248

SPECIAL QUALITY U.H.F. TRIODE





B7G Base



All dimensions in mm

7824

TRIODE

PC95

Variable μ frame-grid triode for use in v.h.f. television tuners with series connected heaters.

HEATER

I_h	300	mA
V_h	3.6	V

CAPACITANCES

	Unshielded	*Shielded*	
c_{a-g}	380	360	mpF
c_{in}	4.4	4.4	pF
c_{out}	3.0	4.0	pF
c_{g-h}	$<$ 280	$<$ 280	mpF
c_{a-k}	240	200	mpF
c_{g-k}	3.1	3.1	pF
c_{h-k}	2.8	2.8	pF

CHARACTERISTICS

V_a	200	V
V_g	−1.2	V
I_a	10	mA
g_m	10.5	mA/V
μ	80	
V_g (g_m = 500μA/V)	−3.8	V
V_g (g_m = 100μA/V)	−5.6	V

Cross modulation

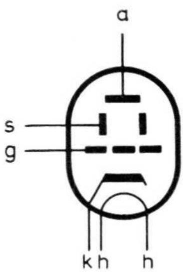
$V_{in(r.m.s.)}$ for k = 1%		
At g_m = 10.5mA/V	$\geqq$100	mV
At g_m = 500μA/V	100	mV
At g_m = 100μA/V	$\geqq$100	mV

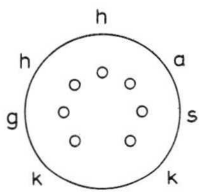
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	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

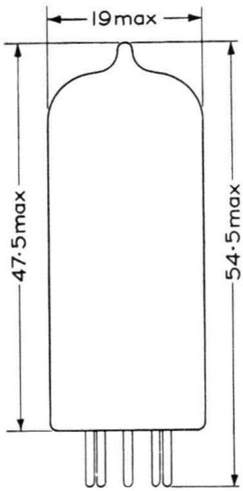
PC95

TRIODE





B7G Base



7438

All dimensions in mm

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

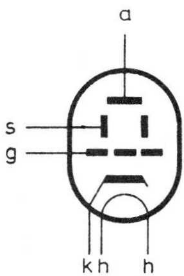
R.F. TRIODE

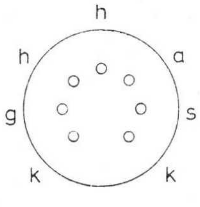
Condition	*5*	*6*	*7*	*8*	
V_b	200	200	200	200	V
R_a	5.6	5.6	6.8	6.8	kΩ
R_k	82	0	0	0	Ω
R_g	0	1.0	0.22	0.56	MΩ
R_{g-a}	—	—	22	22	MΩ
I_a	12	13	14	14	mA
g_m	14	15.5	16	16	mA/V
V_g for 100 : 1 reduction in g_m	−7.5	−7.3	−9.0	−12.5	V

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.

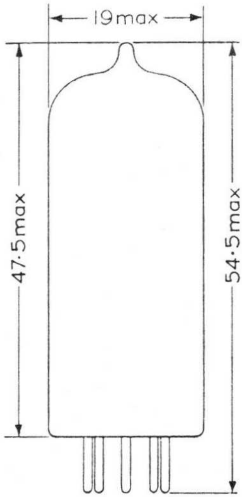
DESIGN CENTRE RATINGS

$V_{a(b)}$ 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

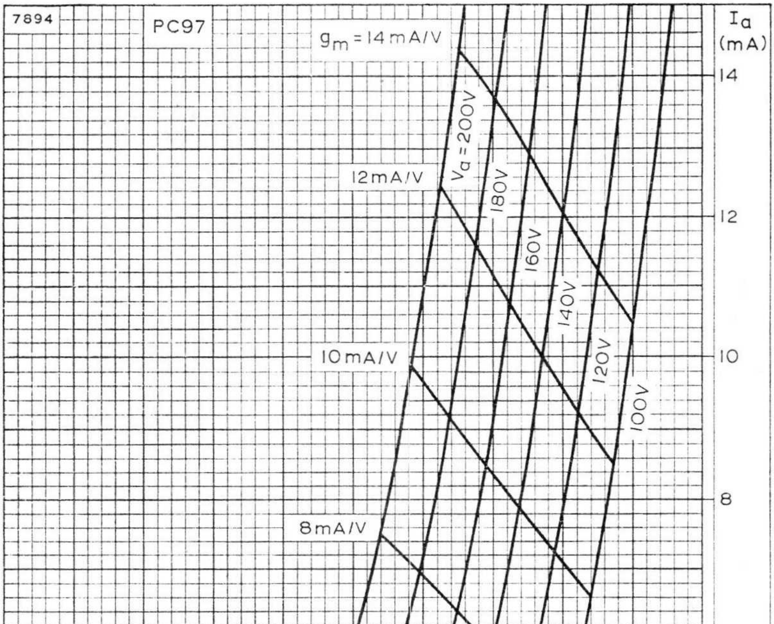


7438

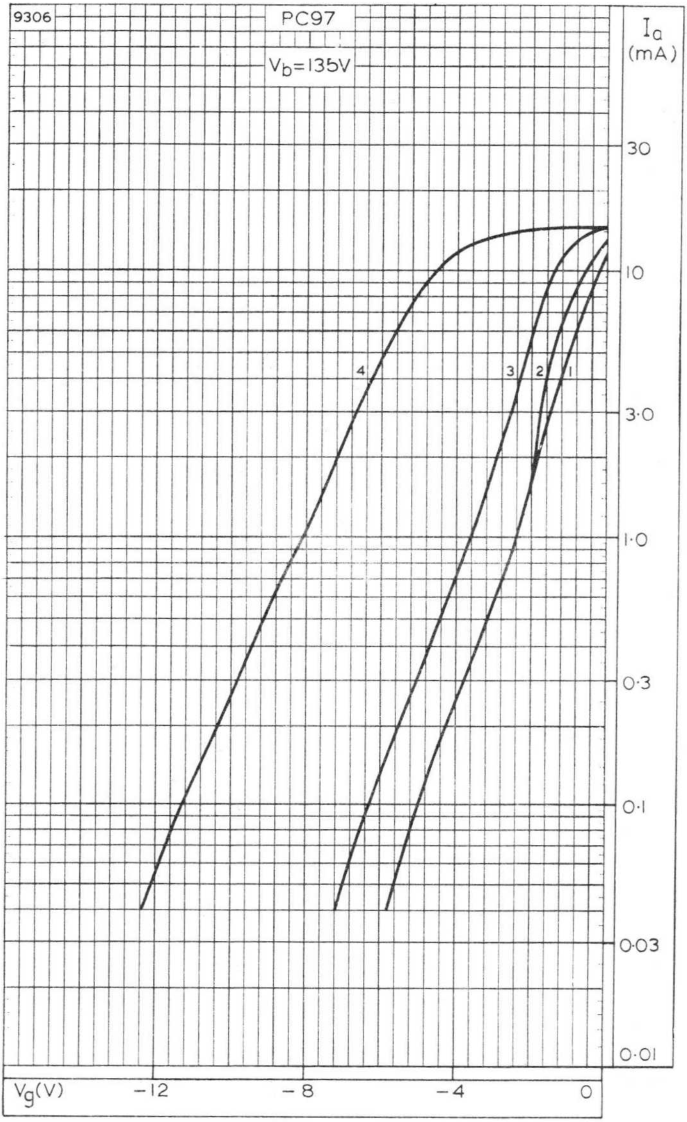
All dimensions in mm

R.F. TRIODE

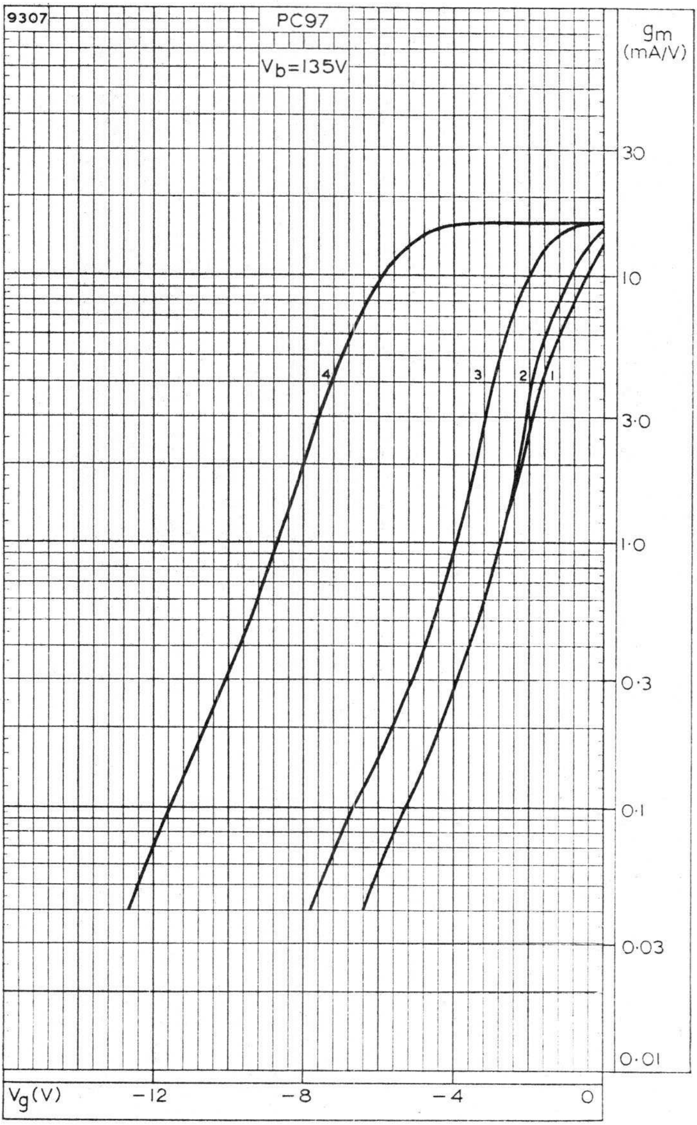
PC97



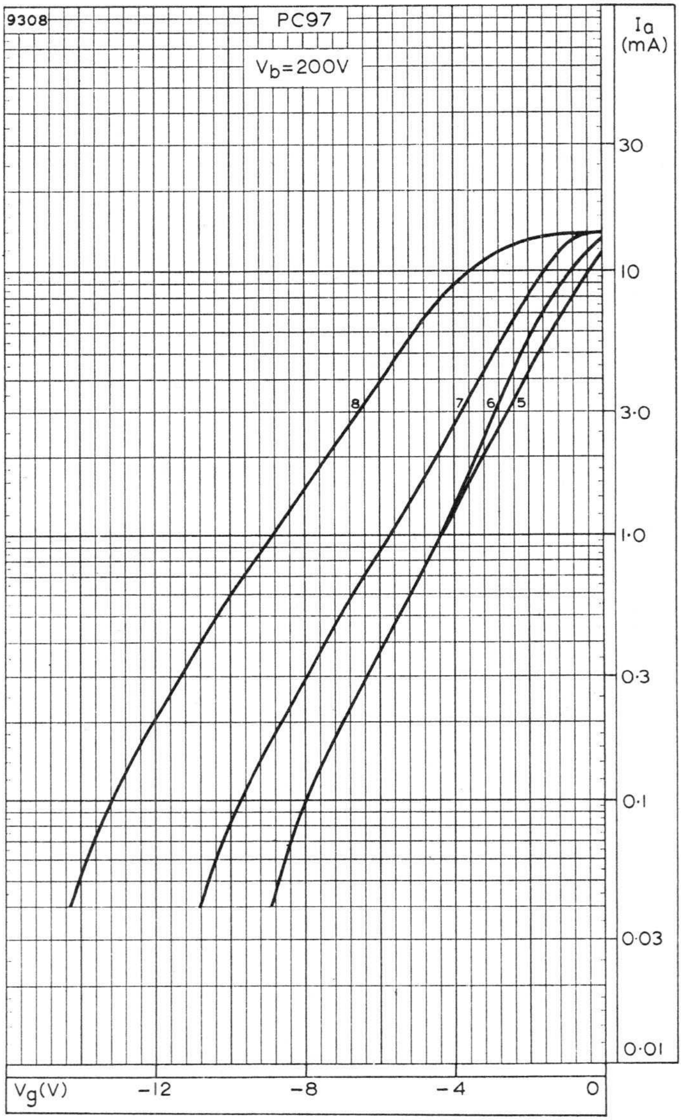
ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER AND WITH MUTUAL CONDUCTANCE CONTOURS



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

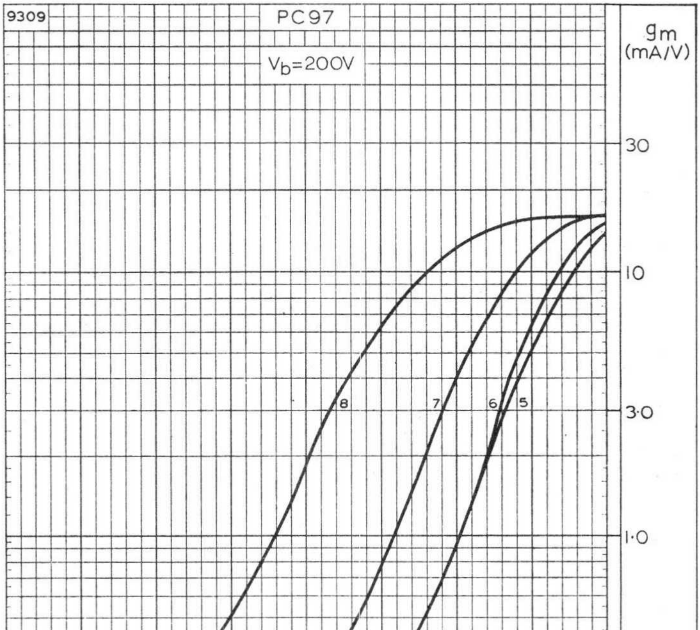


MUTUAL CONDUCTANCE PLOTTED AGAINST GRID VOLTAGE. V_b=135V
Curve numbers refer to Operating Conditions on page D1.

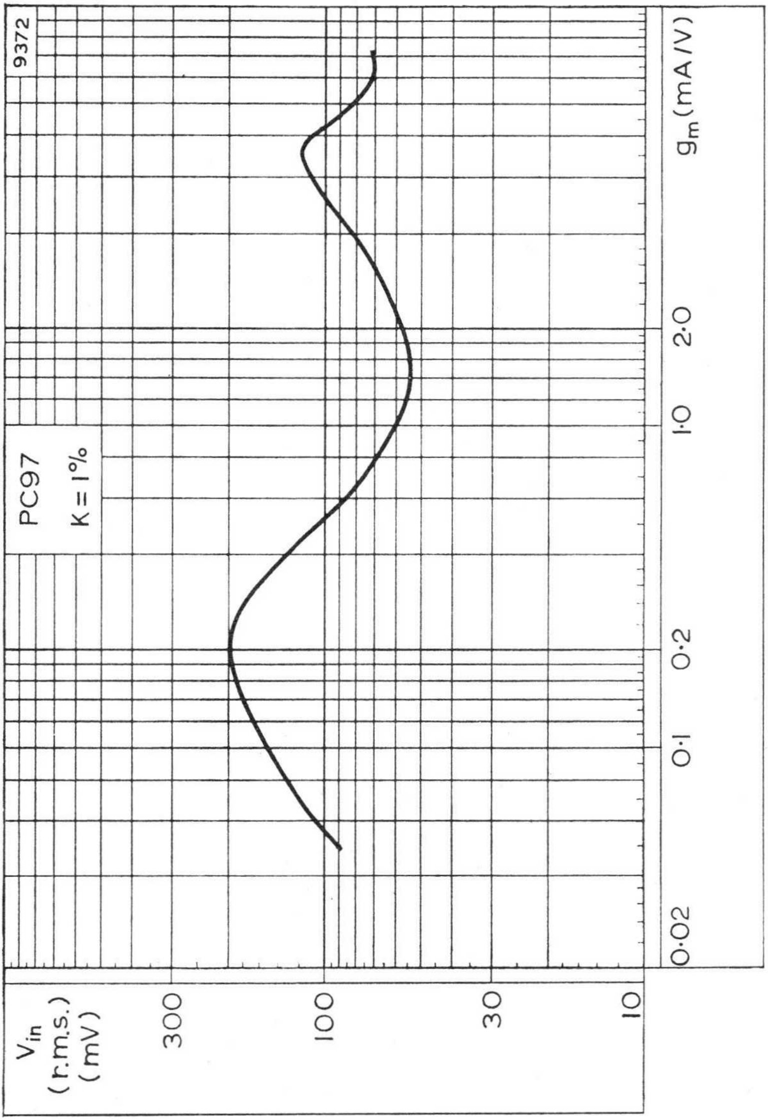


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE. $V_b = 200V$

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

PCC84

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

HEATER

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

I_h	300	mA
V_h	7.0	V

CAPACITANCES (measured without external shield)

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

Grounded cathode section

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

Grounded grid section

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

CHARACTERISTICS (each section)

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

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

PCC84

DOUBLE TRIODE

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

TYPICAL OPERATING CONDITIONS

V_b	180	V
I_a	12	mA
V_g	–1.5	V

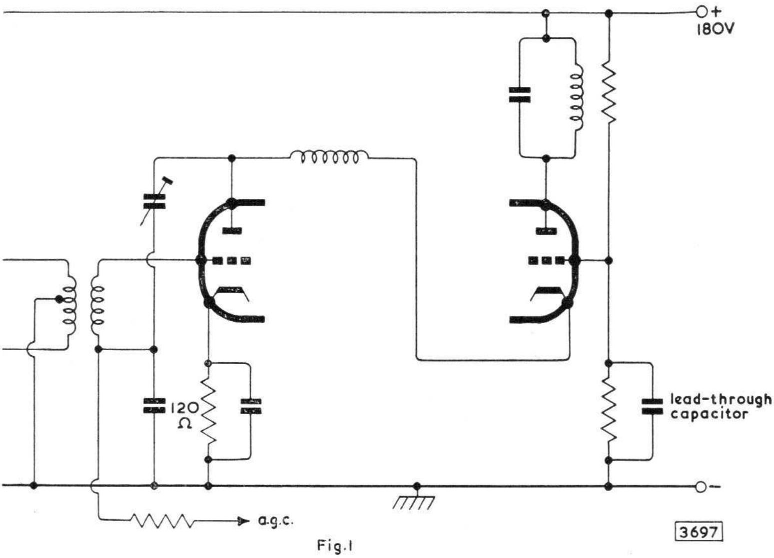


Fig.1

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

DOUBLE TRIODE

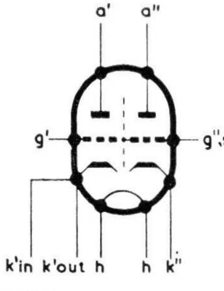
PCC84

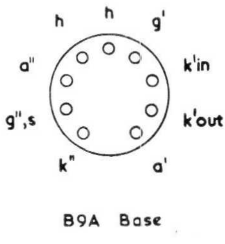
Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220Mc/s in television receivers with series-connected heaters.

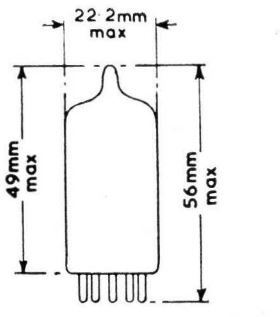
LIMITING VALUES (each section unless otherwise specified)

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

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







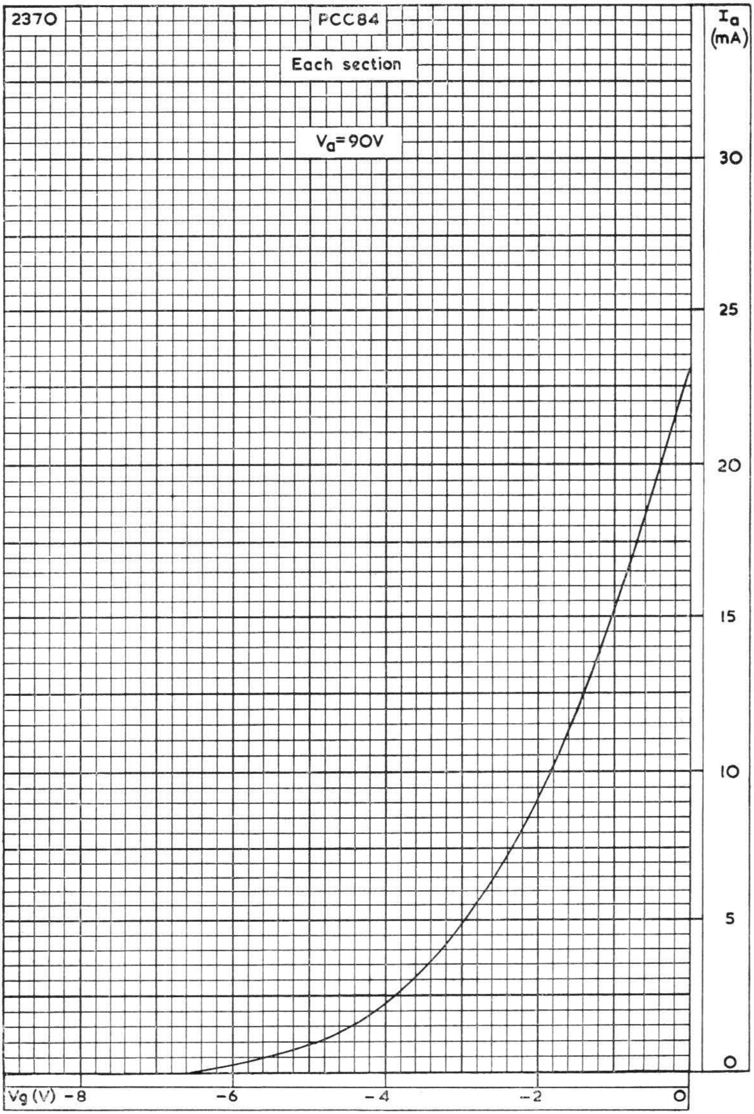
1390

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

PCC84

DOUBLE TRIODE

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



ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE

TRIODE PENTODE

PCL83

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

HEATER

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

I_h	300	mA
V_h	12.6	V

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

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

Pentode Section

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

Triode Section

c_{a-g}	1.6	pF
c_{a-k+h}	0.35	pF
c_{g-k+h}	2.0	pF
c_{g-h}	0.1	pF

CHARACTERISTICS

Pentode Section

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

Triode Section

V_a	250	V
I_a	10.5	mA
V_g	−8.5	V
g_m	2.2	mA/V
r_a	7.7	kΩ
μ	17	

PCL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

PENTODE SECTION AS FRAME OUTPUT VALVE

Circuit design

To allow for valve spread and deterioration during life the frame output circuit should be designed around the following values.

V_a	70	70	V
V_{g2}	170	200	V
$i_{a(pk)}$	54	64	mA

For an average new valve the following figures will apply.

V_a	70	70	V
V_{g2}	170	200	V
$i_{a(pk)}$	81	96	mA

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single Valve Class 'A'

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−9.5	−13	V
$I_{a(o)}$	30	27	mA
$I_{g2(o)}$	4.8	4.4	mA
R_a	5.5	7.5	kΩ
$V_{in(r.m.s.)}$	5.0	5.2	V
P_{out}	2.2	2.5	W
D_{tot}	10	10.5	%

Two Valves in Class 'AB' Push-Pull

V_a	170	200	V
V_{g2}	170	200	V
R_k	180	220	Ω
$I_{a(o)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g2(o)}$	2×3.8	2×3.9	mA
I_{g2} (max. sig.)	2×6.25	2×8.5	mA
R_{a-a}	6.5	7.5	kΩ
$V_{in(g1-g1)}$	17	23.5	V
P_{out}	5.0	7.2	W
D_{tot}	3.6	4.2	%

TRIODE SECTION AS A.F. VOLTAGE AMPLFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	R_{g1}* (kΩ)
170	100	1.07	2.7	14	21	330
200	100	1.17	3.3	13.5	26.5	330

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV

V_{out} measured for a total harmonic distortion of 5%

*Grid resistor of following valve.

TRIODE PENTODE

PCL83

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

LIMITING VALUES

Pentode Section

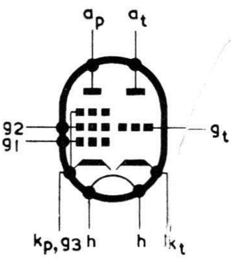
$V_{a(b)}$ max.	550	V
V_a max.	250	V
$+v_{a(pk)}$ max.	2.0	kV
$-v_{a(pk)}$ max.	500	V
p_a max.	5.4	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.2	W
p_{g2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g1-k} max. (self bias)	500	kΩ
R_{g1-k} max. (fixed bias)	250	kΩ
R_{g1-k} max. (timebase operation)	2.2	MΩ
V_{h-k} max. (d.c. heater negative with respect to cathode or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. heater positive with respect to cathode)	150	V

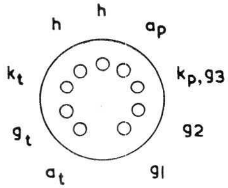
Triode Section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	20	mA
*$i_{k(pk)}$ max.	250	mA
$-v_{g1(pk)}$ max.	350	V
R_{g1-k} max.	1.0	MΩ
V_{h-k} max. (d.c. heater negative with respect to cathode or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. heater positive with respect to cathode)	150	V

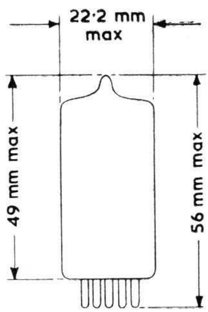
*Max. pulse duration 400μsec.

2224





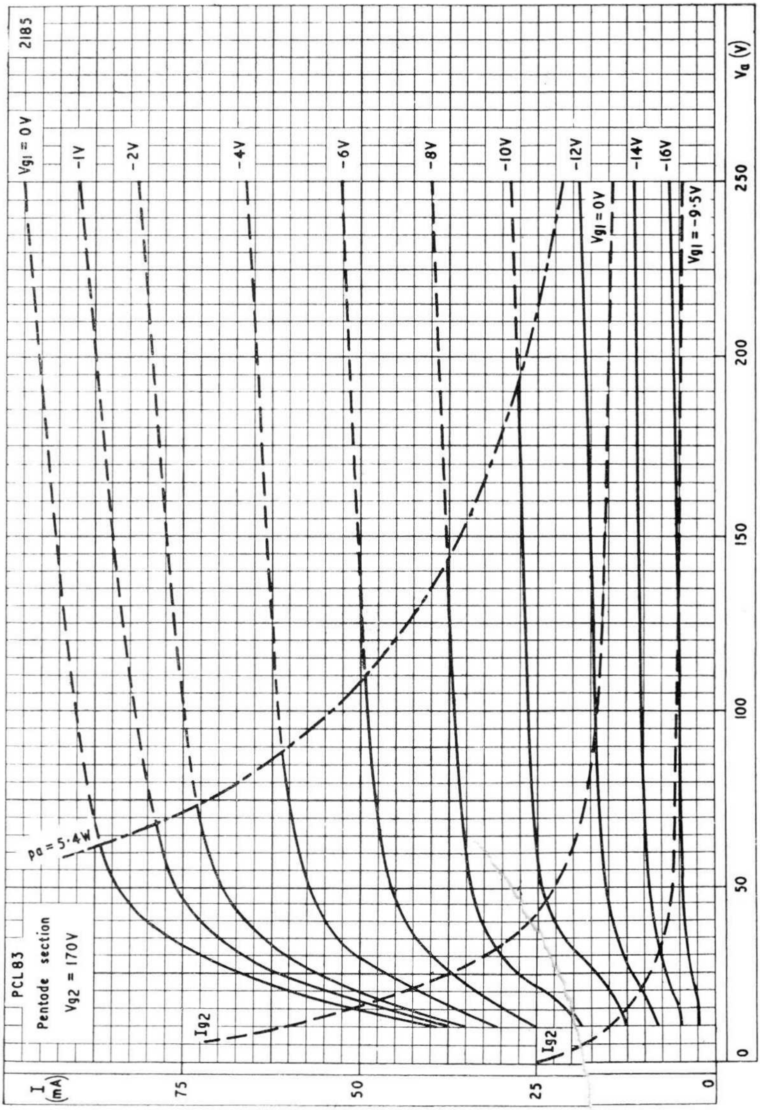
B9A
Noval Base



PCL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.



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

Mullard

OUTPUT PENTODE

PL33

High sensitivity output pentode with maximum anode dissipation of 9 watts, suitable for use in frame time base or audio output stage of D.C./A.C. television receivers.

HEATER

I_h	0.3	A
V_h	19	V

MOUNTING POSITION

Any

CAPACITANCE

c_{a-g1}	1.0	μμF

OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

V_a	175	200	225	V
V_{g2}	175	200	225	V
R_k	150	150	150	Ω
V_{g1}	−4	−4.65	−5.3	V
I_a	24	28	32	mA
I_{g2}	2.6	3.0	3.4	mA
g_m	8	8.6	9	mA/V
r_a	60	55	50	kΩ
μ_{g1-g2}	23	23	23	
R_a	7	7	7	kΩ
$V_{in\ (r.m.s.)}$ (D_{tot}=10%)	—	—	3.4	V
P_{out} (D_{tot}=10%)	—	—	3.3	W
$V_{in\ (r.m.s.)}$ (Start of I_{g1})	2.6	3.1	3.6	V
P_{out} (Start of I_{g1})	1.8	2.55	3.45	W
D_{tot} (Start of I_{g1})	8.8	10	11	%

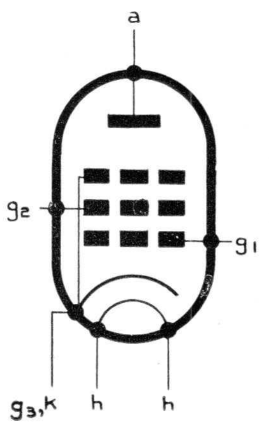
PL33

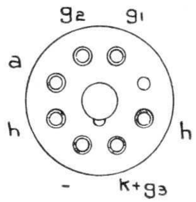
OUTPUT PENTODE

High sensitivity output pentode with maximum anode dissipation of 9 watts, suitable for use in frame time base or audio output stage of D.C./A.C. television receivers.

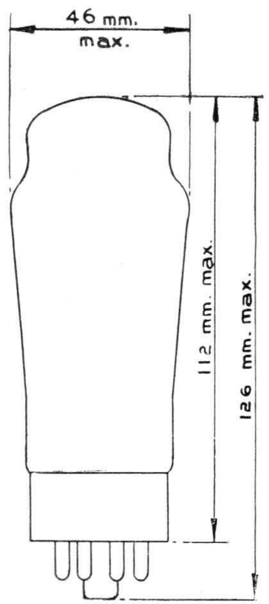
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	9	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max. (no sig.)	1.2	W
p_{g2} max. (max. sig.)	2.5	W
I_k max.	55	mA
V_{g1} max. ($I_{g1}=+0.3\mu A$)	-1.3	V
R_{g1-k} max. (Self-bias)	1.0	MΩ
V_{h-k} max.	300	V
R_{h-k} max.	5.0	kΩ





OCTAL BASE



OUTPUT PENTODE

PL38
PL38M

Output pentode primarily intended for use as line time base output valve in television receivers with series connected heaters.

HEATER

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

I_h		300	mA
V_h		30	V

CAPACITANCES

	PL38M	PL38	
c_{in}	18	18	pF
c_{out}	9.5	6.5	pF
c_{a-g1}	<1.0	<1.2	pF

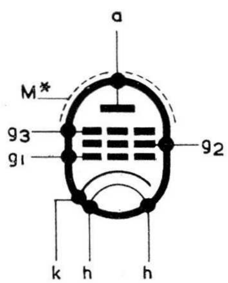
CHARACTERISTICS

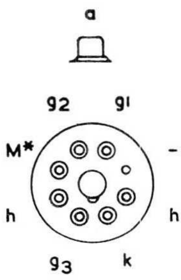
V_a	200	V
V_{g2}	200	V
V_{g1}	−5.5	V
I_a	75	mA
I_{g2}	9.0	mA
g_m	13.5	mA/V
r_a	20	kΩ
μ_{g1-g2}	16.5	

LIMITING VALUES

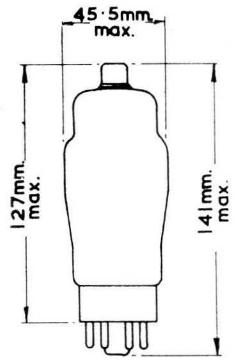
$V_{a(b)}$ max.	1.2	kV
V_a max.	800	V
$v_{a(pk)}$ max.	8.0	kV
$V_{g2(b)}$ max.	800	V
V_{g2} max.	400	V
p_a max.	25	W
p_{g2} max.	8.0	W
I_k max.	200	mA
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
*R_{g1-k} max. ($p_a < 25W$)	500	kΩ
*R_{g1-k} max. ($p_a < 9W$)	800	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

*For self bias operation.





OCTAL BASE



* External metallising on type PL38M only.

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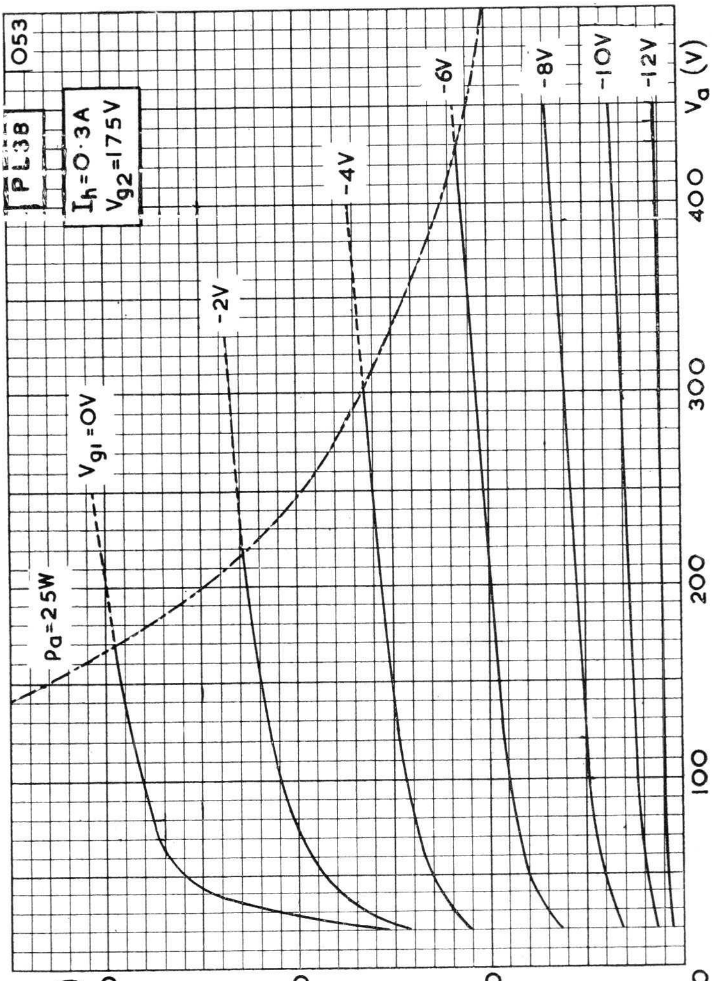


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER AT V_{g2}=175V

LINE OUTPUT PENTODE

PL81

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

HEATER

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

I_h	300	mA
V_h	21.5	V

CAPACITANCES

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

CHARACTERISTICS

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

OPERATION AS LINE OUTPUT PENTODE

Circuit Design

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

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

LIMITING VALUES

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

PL81

LINE OUTPUT PENTODE

Line output applications

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

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

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

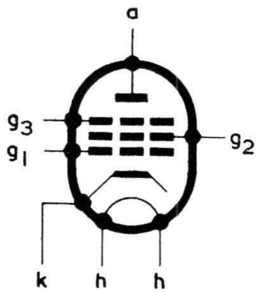
PEAK ANODE CURRENT NOMOGRAM

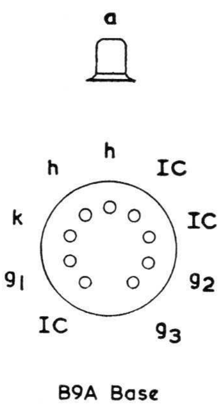
The nomogram shown on the following pages gives directly the recommended peak values of anode current, i_a(design), for a wide range of h.t. line potentials and screen-grid resistors.

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

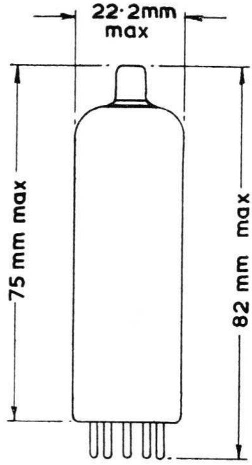
The use of the nomogram does not exempt the designer from checking that the valve is operating within its limiting values. During measurements of the operating conditions in a line timebase a valve whose characteristic is close to that of a nominal valve and a nominal screen-grid resistor should be used.

In receivers designed for a range of declared values of mains voltages, measurements should be made at the nominal declared value of mains voltage producing the lowest nominal h.t. voltage. The timebase should be synchronised and the raster adjusted to nominal scan. The beam current drawn from the e.h.t. supply should be adjusted to 300μA. ←





B9A Base



2710

OUTPUT PENTODE

PL82

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

HEATER

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

I_h	0.3	A
V_h	16.5	V

CAPACITANCES

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

CHARACTERISTICS

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

OPERATING CONDITIONS AS AUDIO OUTPUT VALVE ←

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

PL82

OUTPUT PENTODE

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

OPERATION AS FRAME OUTPUT VALVE

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

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

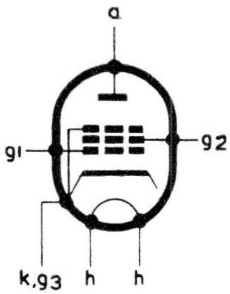
For an average new valve the following figures will apply:—

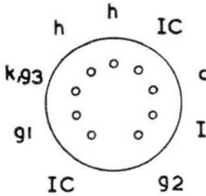
V_a	50	60	V
V_{g2}	170	200	V
V_{g1}	−1	−1	V
I_a	140	175	mA

LIMITING VALUES

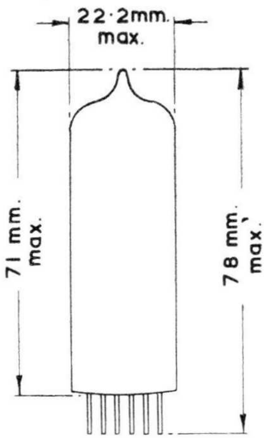
$V_{a(b)}$ max.	550	V
V_a max.	250	V
* $+v_{a\ (pk)}$ max.	2,500	V
$-v_{a\ (pk)}$ max.	500	V
p_a max.	9	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	2.5	W
I_k max.	75	mA
V_{g1} max. ($I_{g1}=+\ 0.3\ \mu A$)	−1.3	V
R_{g1-k} max. (audio output valve)	1.0	MΩ
R_{g1-k} max. (frame output valve)	2.2	MΩ
V_{h-k} max.	200	V←
R_{h-k} max.	20	kΩ

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





B9A
Noval Base



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HALF WAVE RECTIFIER

PY31

Indirectly heated half wave rectifier with 300mA heater for DC/AC operation.

HEATER

I_h	0.3	A
V_h	17	V

MOUNTING POSITION

Any

OPERATING CONDITIONS

$V_{a(r.m.s.)}$ (V)	C max. (μF)	R_{lim} min. (Ω)
250	60	175
250	32	125
250	16	75
250	8.0	0
170	60	100
170	32	75
170	16	30
127	60	0

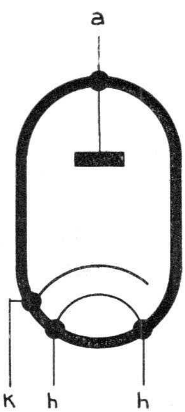
LIMITING VALUES

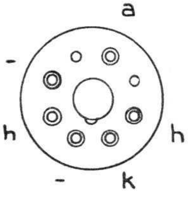
P.I.V. max.	1.0	kV
$V_{a(r.m.s.)}$ max.	250	V
I_a max.	125	mA
$v_{h-k(pk.)}$ max.	300	V
C max.	60	μF

PY31

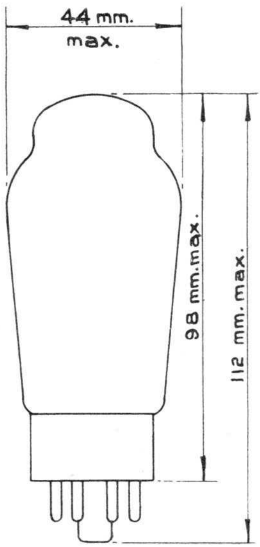
HALF WAVE RECTIFIER

Indirectly heated half wave rectifier with 300mA heater for DC/AC operation.





OCTAL BASE



HALF-WAVE RECTIFIER

PY32

Indirectly-heated half-wave rectifier with 300mA heater for use in television receivers with series connected heaters.

HEATER

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

I_h	300	mA
V_h	29	V

LIMITING VALUES

P.I.V. max.	700	V	
$V_{a(r.m.s.)}$ max.	250	V	
I_{out} max.	325	mA	←
$i_{a(pk)}$ max.	2.1	A	←
$i_{a(surge)}$ max.	7.5	A	
C max.	100	μF	
*$v_{h-k(pk)}$ max. (cathode positive)	550	V	

*Max. d.c. component = 250V. Max. a.c. component = $220V_{r.m.s.}$

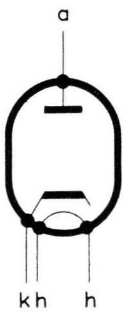
OPERATING CONDITIONS*

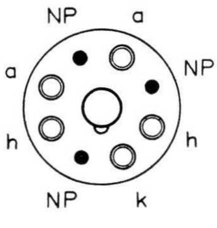
$V_{in(r.m.s.)}$	200	210	220	230	240	250	V	
I_{out}	325	325	296	267	238	210	mA	←
C	100	100	100	100	100	100	μF	
R_{lim} min.	23	25	27	29	31	33	Ω	
V_{out}	182	194	212	230	248	264	V	←

*For television receivers, where a constant output voltage is required for different input voltages, the values of limiting resistor required can be obtained from the curves on pages C3 and C4.

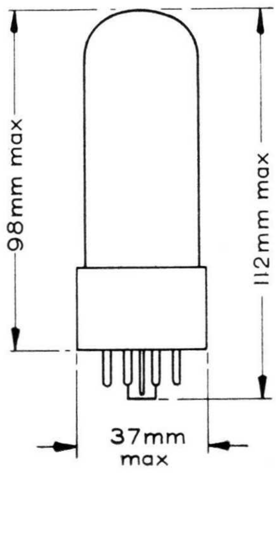
PY32

HALF-WAVE RECTIFIER





Octal Base



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HALF-WAVE RECTIFIER

PY33

Indirectly-heated half-wave rectifier with 300mA heater for use in television receivers with series connected heaters.

HEATER

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

I_h	300	mA
V_h	29	V

DESIGN CENTRE RATINGS

P.I.V. max.	700	V
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	325	mA
$i_{a(pk)}$ max.	2.6	A
$i_{a(surge)}$ max.	9.5	A
C max.	200	μF
*$v_{h-k(pk)}$ max. (cathode positive)	625	V

*Max. d.c. component = 275V. Max. a.c. component = 250$V_{r.m.s.}$

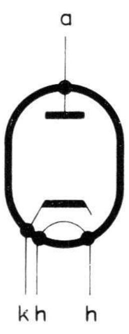
OPERATING CONDITIONS*

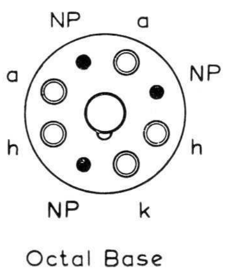
$V_{in(r.m.s.)}$	200	210	220	230	240	250	V
I_{out}	325	325	295	270	240	220	mA
C	200	200	200	200	200	200	μF
R_{lim} min.	15	17	19	21	23	25	Ω
V_{out}	209	219	234	249	264	280	V

*For television receivers, where a constant output voltage is required for different input voltages, the values of limiting resistor required can be obtained from the curves on pages C3 and C4.

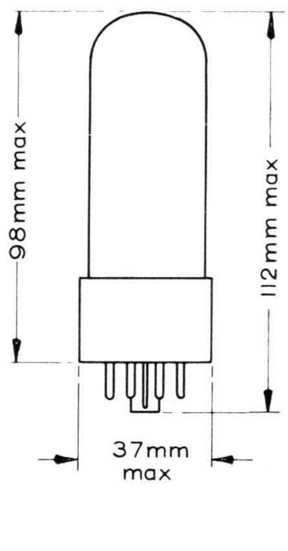
PY33

HALF-WAVE RECTIFIER





Octal Base



7575

BOOSTER DIODE

PY80

Booster diode with high peak inverse voltage and high heater-to-cathode insulation, primarily intended for use in energy recovery circuits in television receivers with series connected heaters.

HEATER

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

I_h	300	mA
V_h	19	V

CAPACITANCE

c_{a-k}	5.5	pF

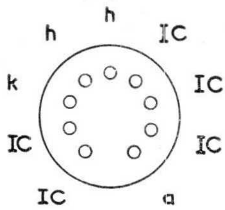
LIMITING VALUES

* P.I.V.	4.0	kV
† $i_{a(pk)}$ max.	400	mA
$I_{a(av)}$ max.	180	mA
‡ $v_{h-k(pk)}$ max.	650	V

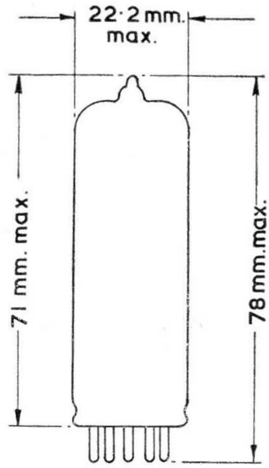
* Max. pulse duration 18% of one cycle, with a maximum of 18µs

† Including switching surges.

‡ Max. 160V r.m.s. or d.c. (cathode negative with respect to heater) + Max. 500V d.c. (cathode positive with respect to heater).



B9A
Noval Base



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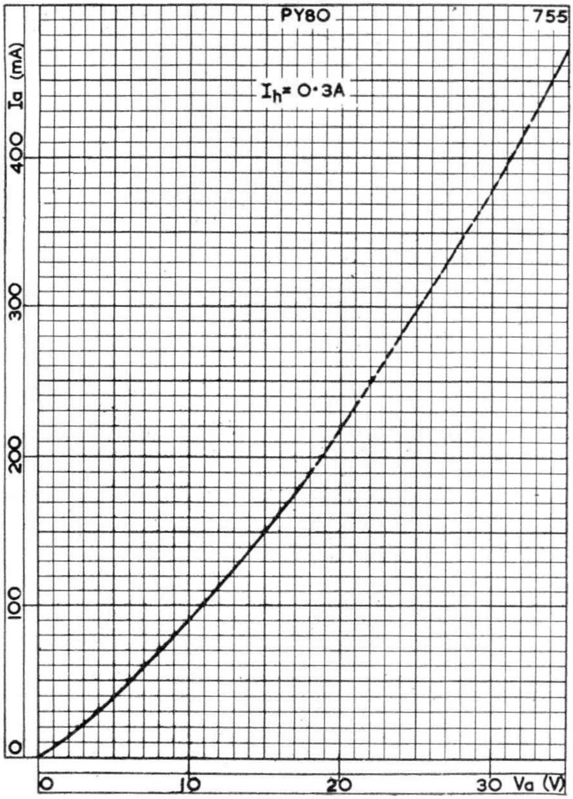


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

HALF-WAVE RECTIFIER

PY82

Half-wave rectifier with 300mA heater for use in television receivers with series connected heaters.

HEATER

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

I_h	300	mA
V_h	19	V

LIMITING VALUES

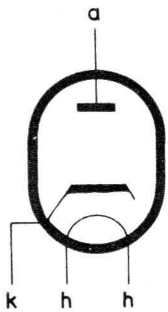
P.I.V. max.	700	V
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	180	mA
$i_{a(pk)}$ max.	1.12	A ←
$i_{a(surge)}$ max.	5.0	A ←
C max. (single valve)	60	μF
C max. (two valves in parallel)	100	μF
*$v_{h-k(pk)}$ max. (cathode positive)	550	V

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

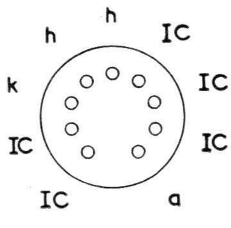
OPERATING CONDITIONS FOR TWO PY82 IN PARALLEL* ←

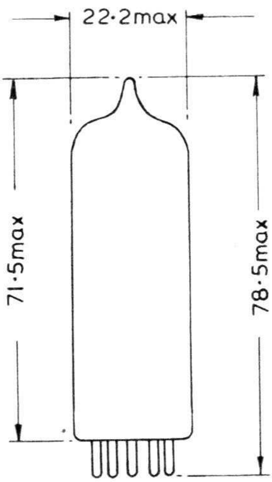
$V_{in(r.m.s.)}$	200	210	220	230	240	250	V
R_{lim} min. (per anode)	30	33	36	39	42	45	Ω
C	100	100	100	100	100	100	μF
I_{out}	350	328	306	284	262	240	mA
V_{out}	198	212	226	242	256	270	V

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



7102





B9A Base

All dimensions in mm

INDIRECTLY HEATED RECTIFIER

PZ30

Indirectly heated rectifier with two separate half-wave sections, primarily intended for use as half-wave or voltage-doubling rectifier in d.c./a.c. television equipment.

HEATER

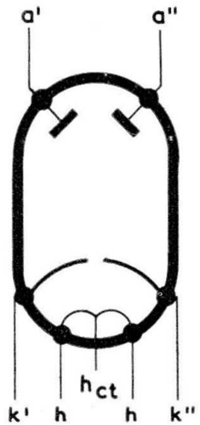
I_h	300	mA
V_h	52	V

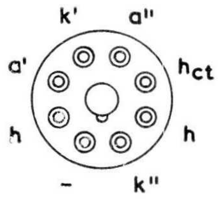
OPERATING CONDITIONS

	In half-wave circuit			In voltage doubler circuit		
$V_{a(r.m.s.)}$	200	220	240	220	240	V
I_{out}	400	400	400	200	200	mA
V_{out}	160	180	205	425	480	V
R_{lim} (each anode)	50	50	50	30	30	Ω
C	50	50	50	2×32	2×32	μF

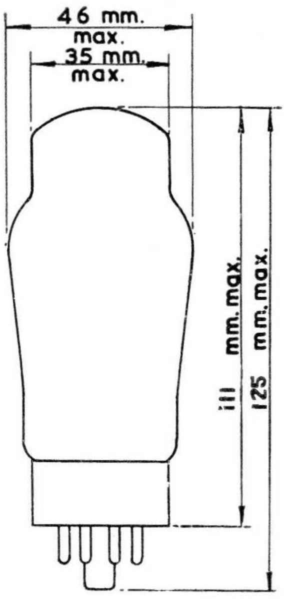
LIMITING VALUES

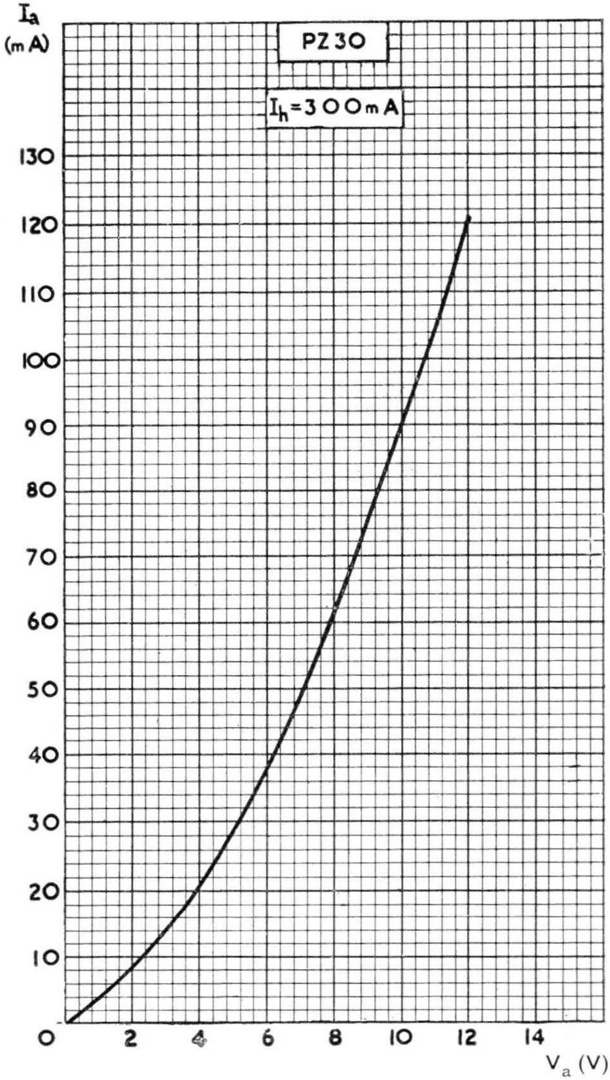
$V_{a(r.m.s.)}$ max.	240	V
I_a max. (each anode)	200	mA
$v_{h-k(pk)}$ max.	650	V
C max.	50	μF





OCTAL BASE





ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
FOR SINGLE SECTION

SINGLE DIODE R.F. PENTODE

UAF42

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

HEATER

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

I_h	0.1	A
V_h	12.6	V

MOUNTING POSITION

Any

CAPACITANCES

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

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

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

* For 100 : 1 reduction in mutual conductance.

UAF42

SINGLE DIODE R.F. PENTODE

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

LIMITING VALUES

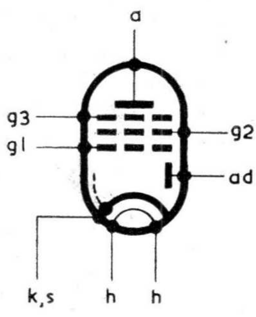
Pentode Section

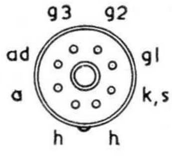
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
$V_{g2}(I_a < 2.5\text{ mA})$ max.	250	V
V_{g2} $(I_a = 5.0\text{ mA})$ max.	125	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} $(I_{g1} = +0.3\mu\text{A})$ max.	-1.3	V
R_{g1-k} max.	3.0	MΩ
*R_{g3-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k}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

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

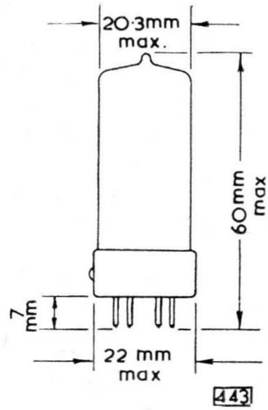
Diode Section

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





B8A BASE



443

DOUBLE DIODE

UB41

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

UBC41

OVERLEAF

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

HEATER

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

I_h	100	mA
V_h	19	V

UBC41

DOUBLE DIODE TRIODE

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

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

CAPACITANCES

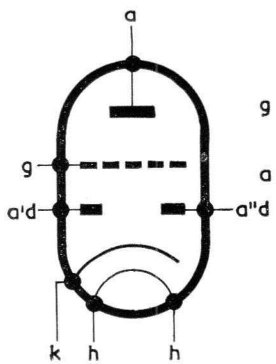
$c_{a'd-gt}$	<0.007	pF
$c_{a''d-gt}$	<0.03	pF
c_{ad-at}	<0.01	pF

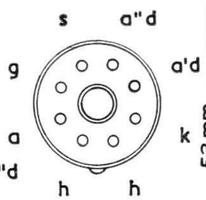
Triode section

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

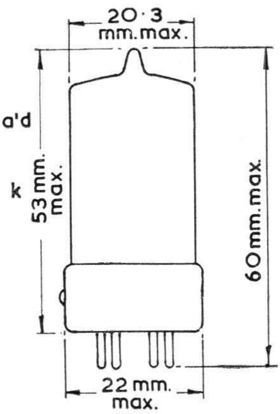
Diode sections

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





B8A BASE



634

DOUBLE DIODE TRIODE

UBC41

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

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

I_h	0.1	A
V_h	14.0	V

MOUNTING POSITION Any

CAPACITANCES

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

Triode Section

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

Diode Sections

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

CHARACTERISTICS

V_a	100	170	V
V_g	−1	−1.6	V
I_a	0.8	1.5	mA
g_m	1.4	1.65	mA/V
μ	70	70	
r_a	50	42	k Ω

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

V_b (V)	R_a (k Ω)	I_a (mA)	R_k (k Ω)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$) (D_{tot}=5%)	V_{out} ($V_{r.m.s.}$) (D_{tot}=10%)	R_{g1} † (k Ω)
350	100	1.18	2.2	43	30.5	54	330
300	100	1.0	2.2	42.5	25.5	46	330
250	100	0.85	2.2	42	21	38	330
200	100	0.7	2.2	41	16	28.5	330
150	100	0.5	2.2	40	12	19.5	330
100	100	0.28	3.3	33.5	6	10.5	330
350	220	0.67	3.9	47.5	34.5	64	680
300	220	0.56	3.9	47	27	54	680
250	220	0.48	3.9	46.5	24.5	44.5	680
200	220	0.4	3.9	46	19	34	680
150	220	0.32	3.9	44	16.5	24	680
100	220	0.18	5.6	38	8	13.5	680

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.

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

V_b (V)	R_a (k Ω)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$) (D_{tot}=2.5%)	V_{out} ($V_{r.m.s.}$) (D_{tot}=5%)	R_{g1} † (k Ω)
350	100	2.0	55	27	43	330
300	100	1.95	53.5	22	35	330
250	100	1.3	51	17	27	330
200	100	0.95	48.5	12	19	330
150	100	0.6	44	7	11	330
100	100	0.3	35.5	3	5	330
350	220	1.1	61.5	29	47	680
300	220	0.9	59.5	23	38	680
250	220	0.7	57	17	29.5	680
200	220	0.5	54	12.5	21	680
150	220	0.33	49	8	14	680
100	220	0.18	40	4	7	680

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

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

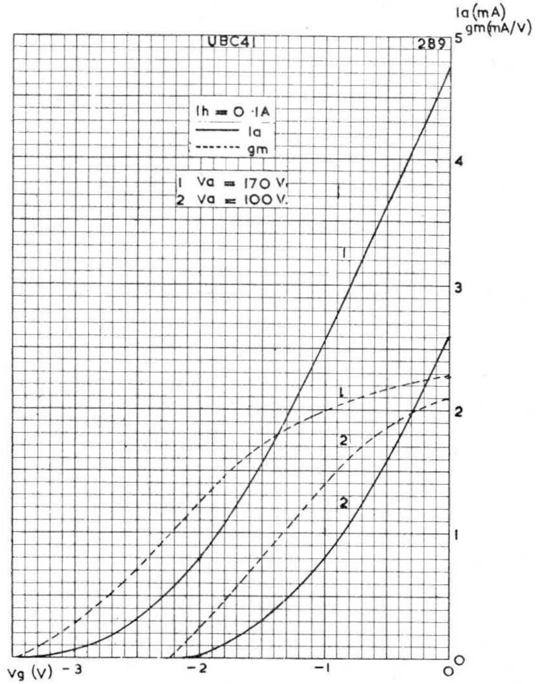
LIMITING VALUES

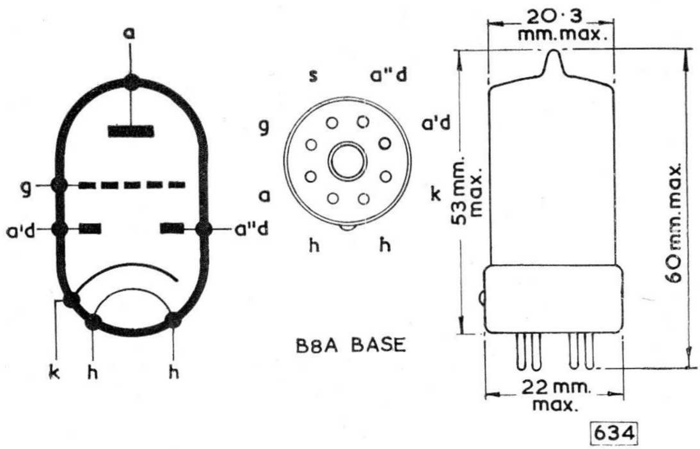
Triode Section	$V_{a(b)}$ max.	550	V
	V_a max.	250	V
	p_a max.	1	W
	I_k max.	5	mA
	V_g max. ($I_g = +0.3\ \mu A$)	−1.3	V
	R_{g-k} max. (cathode bias)	3.0	M Ω
	V_{h-k} max.	150	V
	R_{h-k} max.	20	k Ω
Diode Sections			
	$v_{ad\,(pk)}$ max.	200	V
	I_{ad} max.	0.8	mA

DOUBLE DIODE TRIODE

UBC41

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

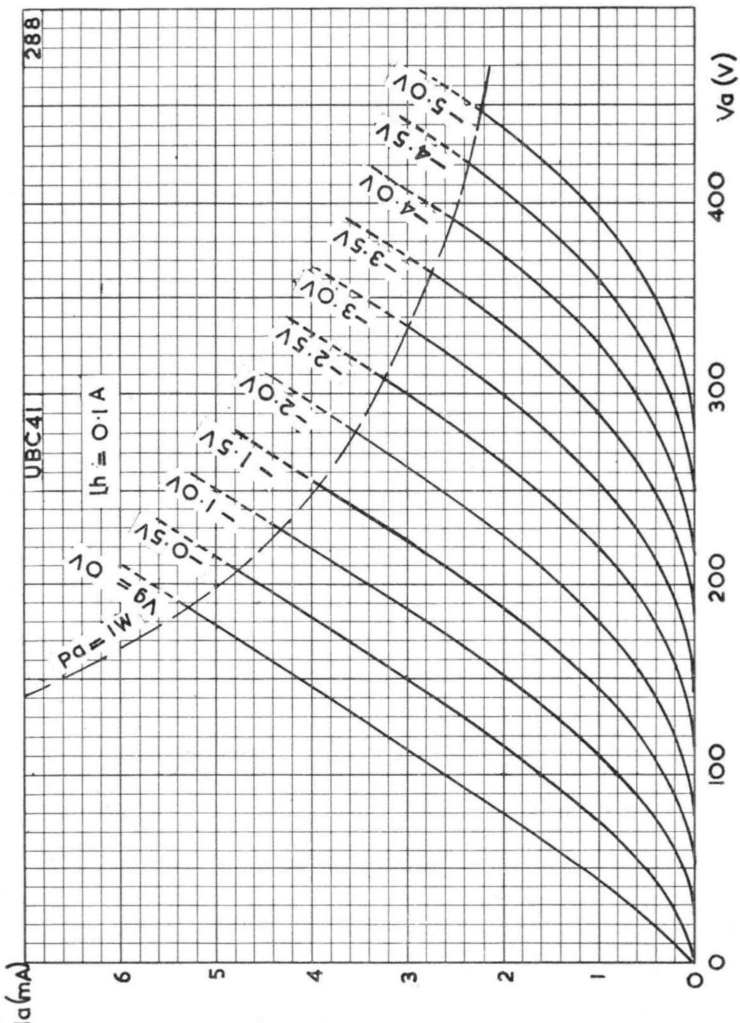




UBC41

DOUBLE DIODE TRIODE

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



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

DOUBLE DIODE TRIODE

UBC81

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

HEATER

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

I_h	100	mA
V_h	14	V

MOUNTING POSITION

Any

CAPACITANCES

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

Triode section

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

Diode sections

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

CHARACTERISTICS

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

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

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

UBC81

DOUBLE DIODE TRIODE

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

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

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

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

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

LIMITING VALUES

Triode section

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

Diode sections (each section)

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

MICROPHONY

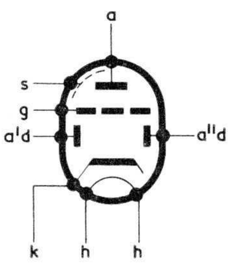
This valve can be used without special precautions against microphony in circuits in which the input voltage is >10mV (r.m.s.) for an output of 50mW from the output valve.

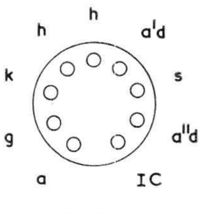
DOUBLE DIODE TRIODE

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

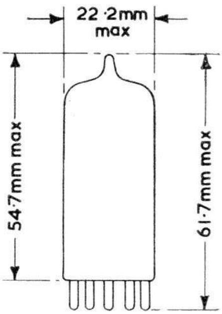
UBC81

3684





B9A Base

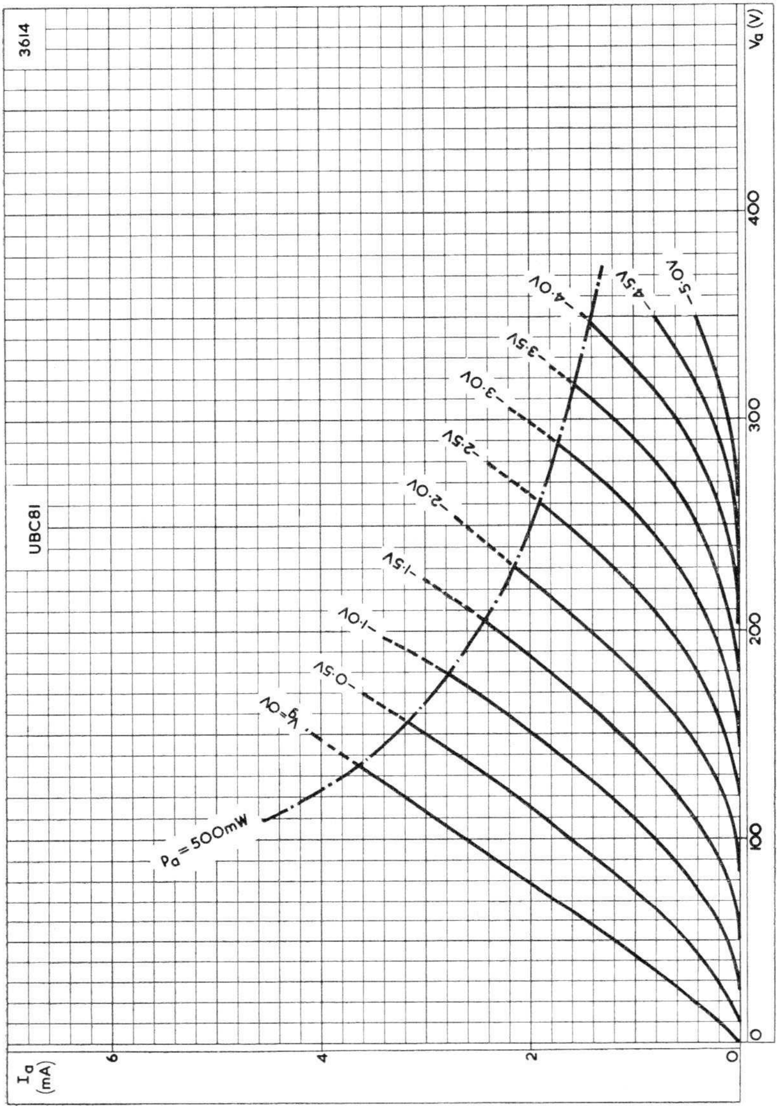


Pin 4 should be connected to the earthed side of the heater circuit

UBC81

DOUBLE DIODE TRIODE

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

DOUBLE DIODE PENTODE

UBF80

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

HEATER

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

I_h	0.1	A
V_h	17	V

MOUNTING POSITION

Any

CAPACITANCES

←

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

$V_a = V_b$	100	170	200	V
R_{g2}	47	47	68	kΩ
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	MΩ
μ_{g1-g2}	18	18	18	
R_{eq}	4.6	6.2	6.2	kΩ
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 (kΩ)	I_a (mA)	R_{g2} (kΩ)	I_{g2} (mA)	R_k (kΩ)	R_{g1} (MΩ)	$\frac{V_{out}}{V_{in}}$	D_{tot}* (%)	R_{g1}** (kΩ)
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. ($I_a<2mA$)	250	V
V_{g2} max. ($I_a=5mA$)	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)

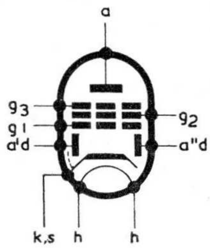
P.I.V.	350	V
I_{ad} max.	0.8	mA
$i_{ad(pk)}$ max.	5	mA
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

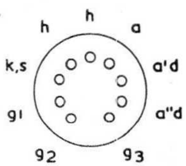
This valve can be used without special precautions against microphony if the input voltage, V_{in}, is not less than 25 mV for an output of 50 mW from the output valve.

DOUBLE DIODE PENTODE

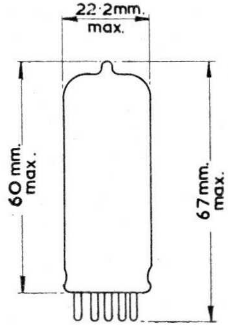
UBF80

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

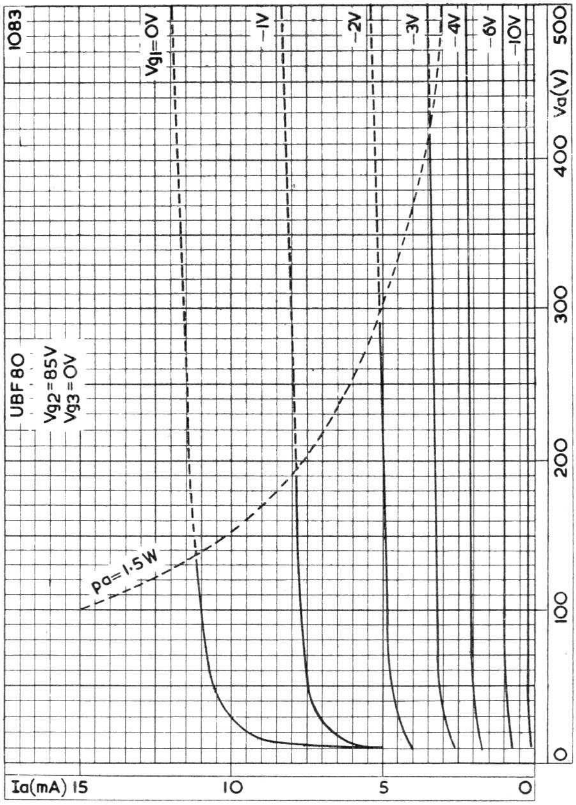


706

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 TRIODE

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

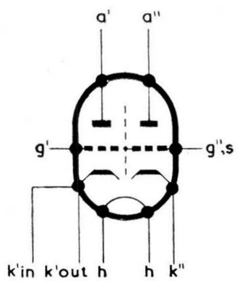
UCC84

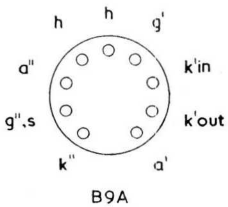
HEATER

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

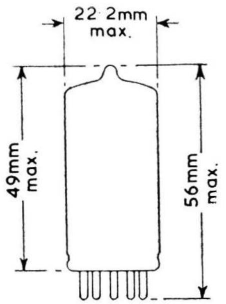
I_h	100	mA
V_h	21	V

For characteristics, operating conditions and limiting values see Type PCC84.





B9A
Noval Base.



1390

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

TRIODE PENTODE

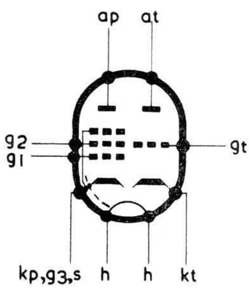
UCF80

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220 Mc/s in television equipment with series-connected heaters.

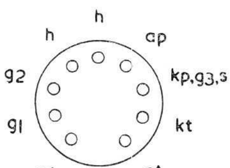
HEATER

I_h	100	mA
V_h	27	V

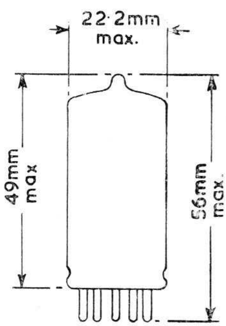
For characteristics, operating conditions and limiting values see Type PCF80.



1388



B9A
Noval Base



TRIODE HEXODE FREQUENCY CHANGER

UCH42

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

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

I_h	0.1	A
V_h	14	V

MOUNTING POSITION

Any

CAPACITANCES

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

Hexode Section

$c_{gl-h+k+g2+g4+skirt}$	3.8	μμF
$c_{a-h+k+g2+g4+skirt}$	9.2	μμF
c_{a-gl}	<0.1	μμF
c_{gl-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

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

Triode Section

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

UCH42

TRIODE HEXODE FREQUENCY CHANGER

Triode hexode primarily intended for use as frequency changer in D.C./A.C. mains-operated receivers. The hexode section is designed for A.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} max. (I_a=3mA)	125	V
V_{g2+g4} max. (I_a<1mA)	250	V
p_{g2+g4} max.	0.3	W
V_{g1} max. (I_{g1}=+0.3μA)	−1.3	V
I_k max.	7.0	mA
R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

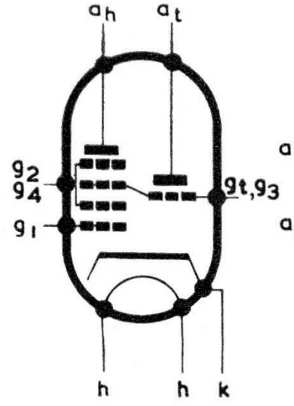
Triode Section

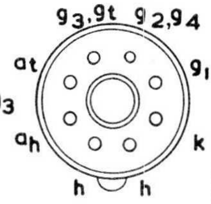
$V_{a(b)}$ max.	550	V
V_a max.	175	V
p_a max.	0.8	W
V_g max. (I_g=+0.3μA)	−1.3	V
I_k max.	6.0	mA
R_{gt-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

TRIODE HEXODE FREQUENCY CHANGER

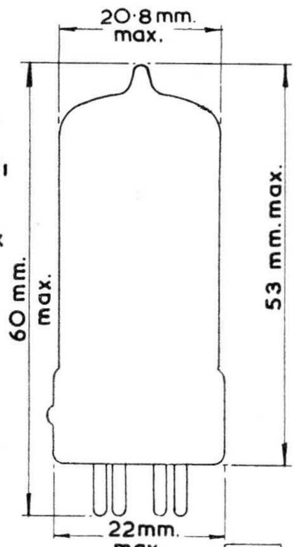
UCH42

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





B8A BASE



UCH42

TRIODE HEXODE FREQUENCY CHANGER

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

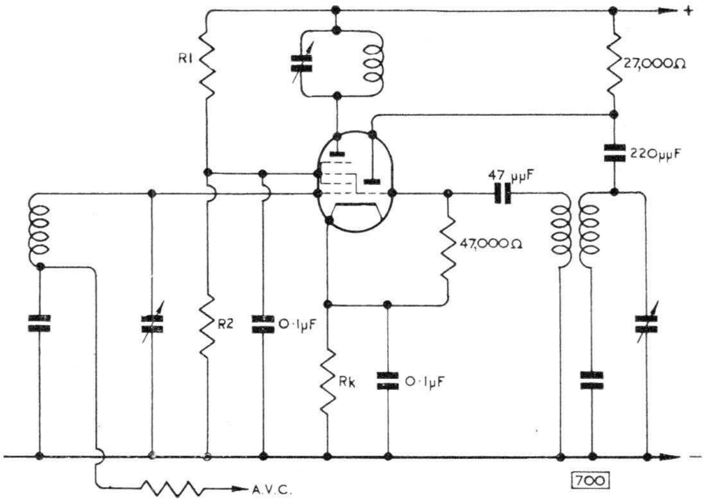


FIG. 1. UCH42 AS FREQUENCY CHANGER

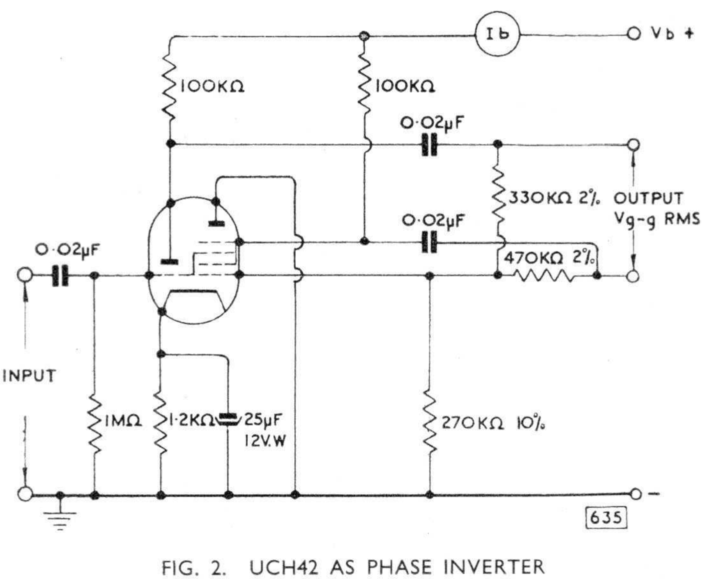


FIG. 2. UCH42 AS PHASE INVERTER

TRIODE PENTODE

UCL83

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

HEATER

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

I_h	100	mA
V_h	40	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. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

TRIODE PENTODE

UCL83

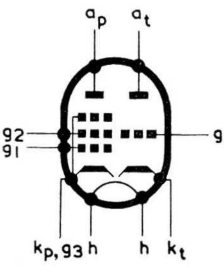
Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

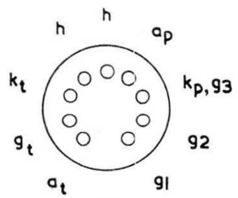
LIMITING VALUES

Triode Section

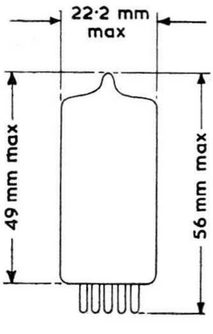
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k}max (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

2224





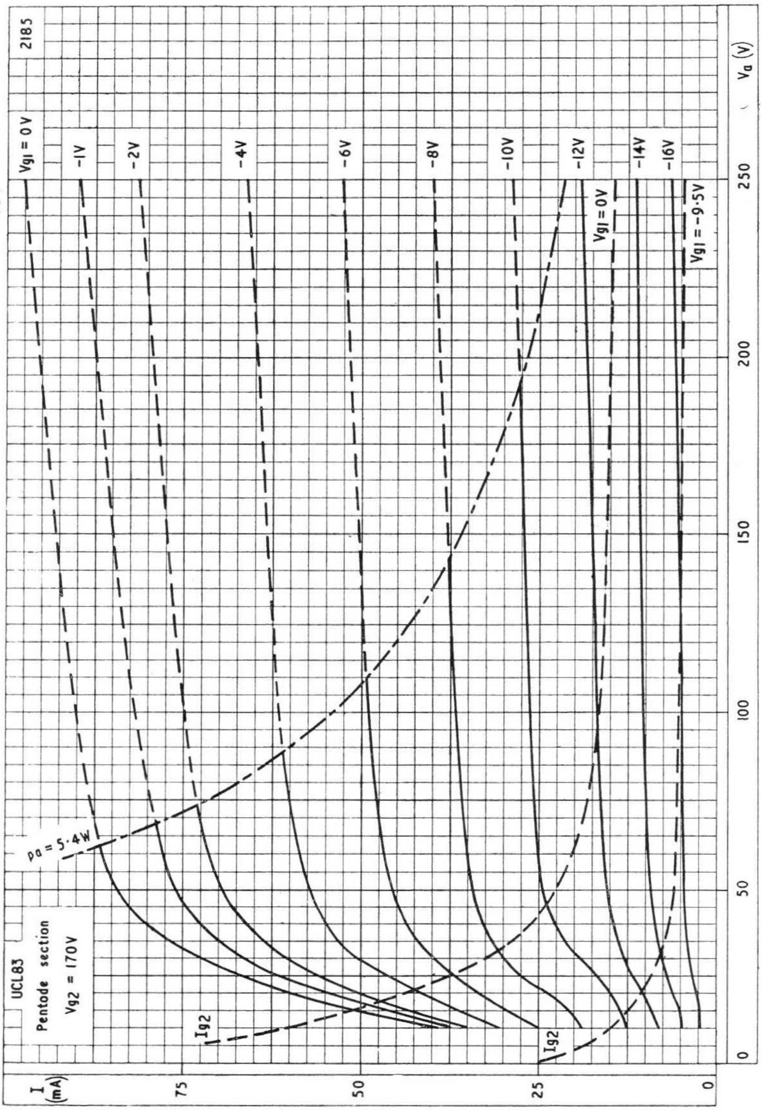
B9A
Noval Base



UCL83

TRIODE PENTODE

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



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

VARIABLE-MU R.F. PENTODE

UF41

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

HEATER

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

I_h	0.1	A
V_h	12.6	V

CAPACITANCES

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

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

$V_a = V_b$	100	170	200	V
R_{g2}	40	40	40	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

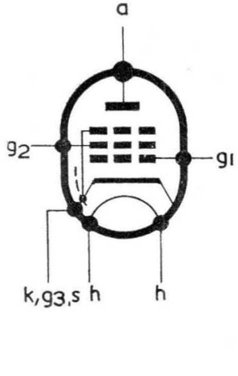
LIMITING VALUES

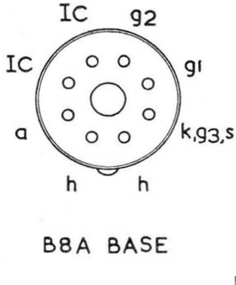
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_a < 4$mA)	250	V
V_{g2} max. ($I_a = 7.2$mA)	150	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} max. ($I_{g1} = +0.3\mu$A)	–1.3	V
R_{g1-k} max.	3	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

UF41

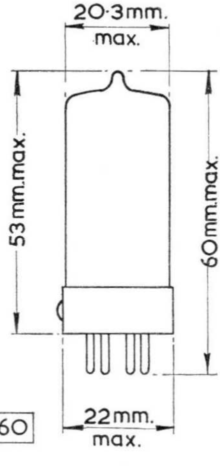
VARIABLE-MU R.F. PENTODE

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





B8A BASE



960

R.F. PENTODE

UF42

R.F. pentode having high mutual conductance, primarily intended for use in television receivers in which the heaters are series connected.

HEATER

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

I_h	100	mA
V_h	21	V

MOUNTING POSITION

Any

CAPACITANCES

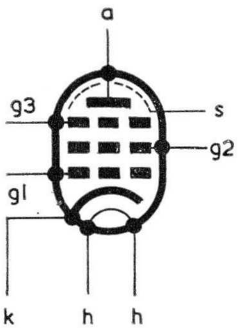
c_{a-g1}	0.005	pF
c_{in}	9.5	pF
c_{out}	4.5	pF

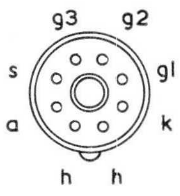
CHARACTERISTICS

V_a	170	V
V_{g2}	170	V
V_{g1}	−2.0	V
I_a	10	mA
I_{g2}	2.8	mA
r_a	200	kΩ
g_m	8.5	mA/V
V_{g3} ($I_a = 10\mu A$)	−48	V
V_{g1} max. ($I_{g1} = 0.3\mu A$)	−1.3	V

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	700	mW
I_k max.	13	mA
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ
R_{g1-k} max. (cathode bias)	1.0	MΩ





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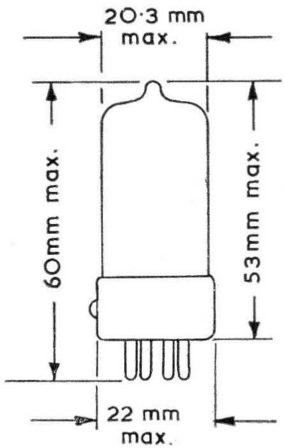

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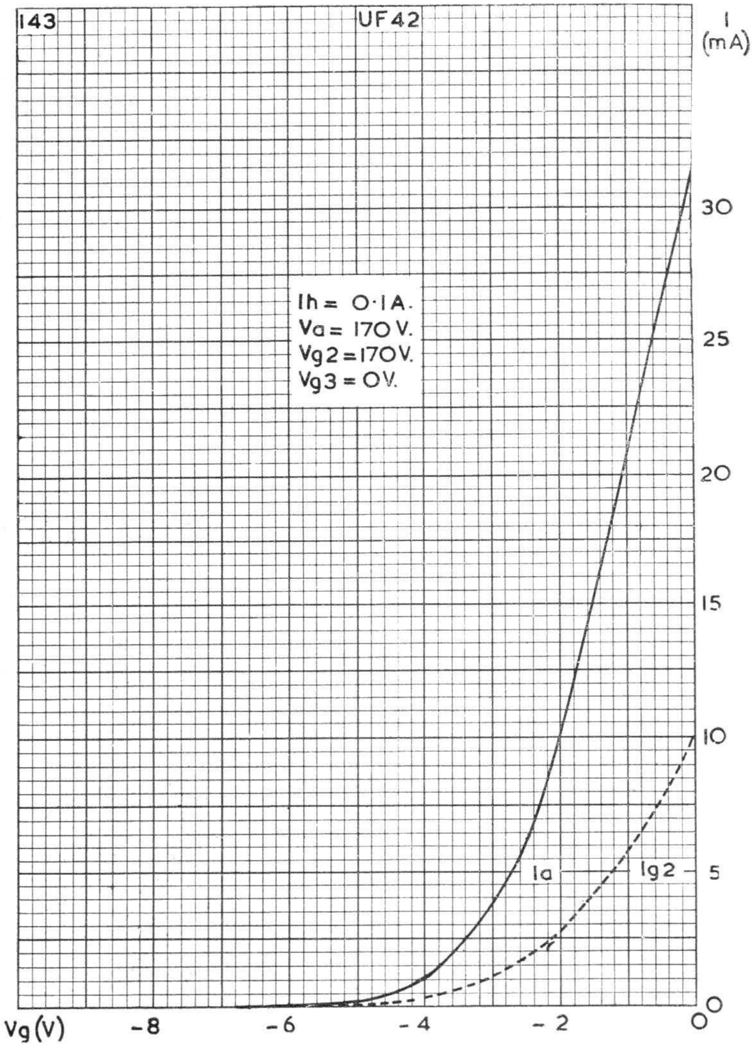


ANODE CURRENT AND SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE

R.F. PENTODE

UF80

High slope r.f. pentode primarily intended for use as an r.f. amplifier or mixer in f.m. receivers.

HEATER

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

I_h	100	mA
V_h	19	V

MOUNTING POSITION

Any

CAPACITANCES

$c_{in(g1)}$	7.5	pF
$c_{in(g2)}$	5.4	pF
c_{out}	3.3	pF
c_{a-g1}	<0.007	pF
c_{g2-g1}	2.6	pF
c_{a-k}	<0.01	pF
c_{g1-h}	<0.15	pF

CHARACTERISTICS

V_a	170	V
V_{g2}	170	V
V_{g3}	0	V
I_a	10	mA
I_{g2}	2.5	mA
V_{g1}	−2.0	V
g_m	7.4	mA/V
r_a	400	kΩ
μ_{g1-g2}	50	
R_{eq}	1.0	kΩ
R_{in} (at f=50Mc/s)	10	kΩ

UF80

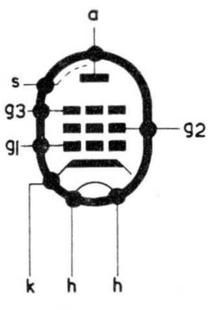
R.F. PENTODE

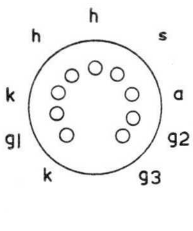
High slope r.f. pentode primarily intended for use as an r.f. amplifier or mixer in f.m. receivers.

LIMITING VALUES

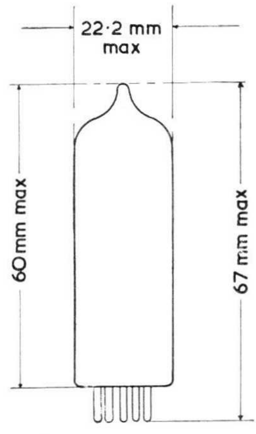
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	700	mW
I_k max.	15	mA
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
R_{g1-k} max. (self bias)	1.0	MΩ
R_{g1-k} max. (fixed bias)	500	kΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

3785





B9A Base



VARIABLE-MU R.F. PENTODE

UF85

High slope variable-mu r.f. pentode, with 100mA heater primarily intended for use in f.m./a.m. receivers with series connected heaters.

HEATER

I_h		100	mA
V_h		19	V

CAPACITANCES (measured without an external shield)

c_{in}		6.9	pF
c_{out}		3.2	pF
c_{a-g1}		<0.007	pF
c_{g1-h}		<0.15	pF

CHARACTERISTICS

$V_b = V_a$	170	200	V
V_{g3}	0	0	V
R_{g2}	27	27	kΩ
V_{g2}	100	116	V
I_a	9.7	11.4	mA
I_{g2}	2.6	3.1	mA
V_{g1}	−2.0	−2.3	V
g_m	5.9	6.1	mA/V
r_a	300	350	kΩ
R_{eq}	1.4	1.5	kΩ
R_{in} (f = 50Mc/s)	7.6	8.0	kΩ
V_{g1} (for 100 : 1 reduction in gm)	−24	−28	V

LIMITING VALUES

$V_{a(b)}$ max.		500	V
V_a max.		250	V
p_a max.		2.5	W
$V_{g2(b)}$ max.		550	V
V_{g2} max.		250	V
p_{g2} max.		650	mW
I_k max.		15	mA
V_{g1} max. ($I_{g1} = +0.3\mu A$)		−1.3	V
R_{g1-k} max.		3.0	MΩ
V_{h-k} max.		150	V
R_{h-k} max.		20	kΩ

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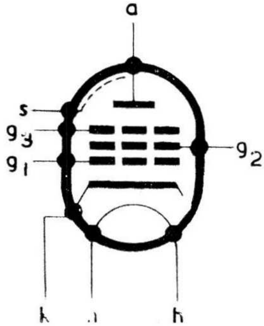
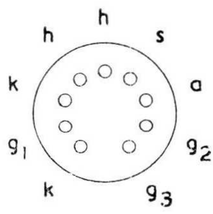
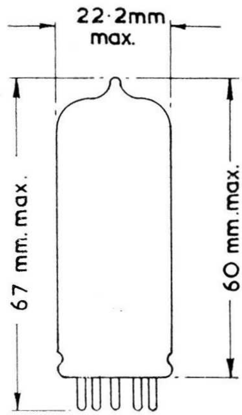
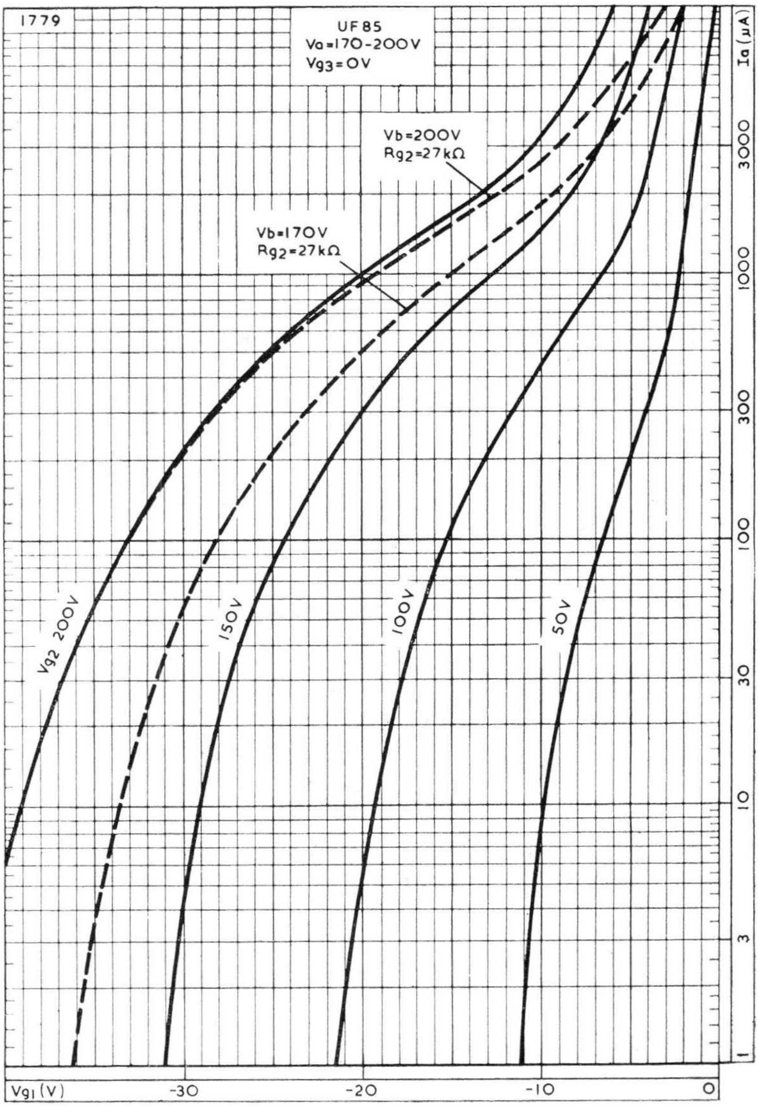




B9A
Noval Base





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

VOLTAGE AMPLIFYING PENTODE

UF86

Low-noise pentode intended for use as r.c. coupled a.f. voltage amplifier, particularly in the early stages of high-gain audio amplifiers and microphone preamplifiers with series connected heaters.

HEATER

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

I_h	100	mA
V_h	12.6	V

CAPACITANCES (measured without an external screen) ←

c_{out}	5.3	pF
c_{in}	3.8	pF
c_{a-g1}	<50	mpF
c_{g1-h}	<2.5	mpF

CHARACTERISTICS

V_a	200	V
V_{g3}	0	V
V_{g2}	140	V
I_a	3.0	mA
I_{g2}	600	μA
V_{g1}	–2.0	V
g_m	2.0	mA/V ←
r_a	2.5	MΩ
μ_{g1-g2}	38	
V_{g1} max. ($I_{g1} = +0.3\mu$A)	–1.3	V

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

Pentode connection

V_b (V)	R_a (kΩ)	R_{g2} (MΩ)	R_k (kΩ)	I_a (mA)	I_{g2} (μA)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	R_{g1}** (kΩ)
200	100	0.39	1.0	1.35	280	115	38	330
150	100	0.47	1.5	0.8	180	104	26	330
100	100	0.47	1.8	0.5	100	90	12	330
200	220	1.0	2.2	0.7	120	188	37	680
150	220	1.0	2.7	0.5	100	165	26	680
100	220	1.0	3.3	0.3	80	130	15	680

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV.

*Output voltage at $D_{tot} = 5\%$.

**Grid resistor of following valve.

Triode connection (g_2 connected to a, g_3 to k)

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	D_{tot}* (%)	R_{g1}† (kΩ)
200	47	1.8	1.2	25.8	26.5	3.9	150
150	47	1.2	1.5	24	22	5.8	150
100	47	0.67	2.2	22	15	8.8	150
200	100	1.0	2.2	30	31	4.0	330
150	100	0.7	2.7	28	25	5.5	330
100	100	0.4	3.3	26	16.5	6.5	330
200	220	0.55	3.9	32	31	3.7	680
150	220	0.4	3.9	31	24	4.1	680
100	220	0.25	4.7	30	13	3.8	680

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV.

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

†Grid resistor of following valve.

LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	1.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	200	V
p_{g2} max.	200	mW
I_k max.	6.0	mA
R_{g1-k} max. ($p_a > 200$mW)	3.0	MΩ
R_{g1-k} max. ($p_a < 200$mW)	10	MΩ
V_{h-k} max. (cathode positive)	150	V
V_{h-k} max. (cathode negative)	100	V
*R_{h-k} max.	20	kΩ

*When used as a phase inverter immediately preceding the output stage, R_{h-k} max. may be 120kΩ.

VOLTAGE AMPLIFYING PENTODE UF86

OPERATING NOTES

1. Hum

When used as a normal voltage amplifier with a line voltage of 200V, an anode load of 100kΩ and a grid resistor of 470kΩ the maximum hum level of the valve alone is 12μV, the average value being about 8μV when operated with one side of the heater earthed. The low level of hum attained with this valve can be completely masked by that due to an unsuitable valveholder, in which excessive leakage and capacitive coupling between pins will introduce considerable hum. The hum will be increased if the valve is not operated at the bottom of the chain.

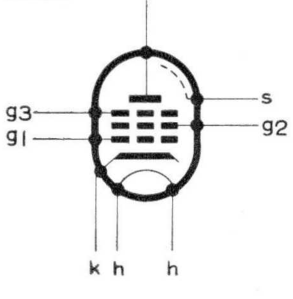
2. Noise

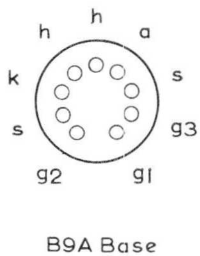
The low-frequency noise generated by a valve is most conveniently specified as an equivalent voltage on the control grid for a specific bandwidth. For the UF86 under normal conditions, i.e. line voltage of 200V and an anode load of 100kΩ, the equivalent noise voltage is approximately 2μV for a frequency range 25 to 10,000c/s.

3. Microphony

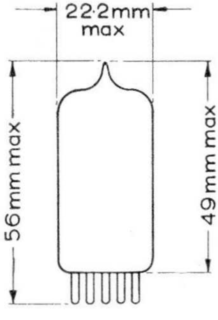
Care in the design of the valve, to ensure that the electrode structure and its mounting are as rigid as possible, has reduced the microphony of the UF86 to a very low level. There are no appreciable internal resonances at frequencies below 1000c/s. At higher frequencies the effect of vibration is usually negligible on account of the damping provided by the chassis and the valveholder. In high-gain applications, such as tape recording, care should be taken in siting the valve, particularly when a loudspeaker is present in the same cabinet or when a motor is mounted on the same chassis. In such cases a flexible mounting for the valveholder or a separate weighted sub-chassis is advisable.

4135





B9A Base



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	$\mu\mu F$
c_{in}	11.0	$\mu\mu F$
c_{out}	8.3	$\mu\mu F$

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

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

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

V_a	100	170	200	V
V_{g2}	100	170	200	V
$I_{a(0)}$	2×24	2×44	2×45	mA
I_a (max. sig.)	2×27	2×49	2×53	mA
$I_{g2(0)}$	2×4.6	2×8.8	2×9	mA
I_{g2} (max. sig.)	2×6.8	2×16.5	2×19	mA
R_k	100	100	130	Ω
R_{a-a}	4.0	4.0	4.0	kΩ
P_{out}	2.2	9.0	12.5	W
$V_{in(g-g)\ (r.m.s.)}$	9.2	18.6	24.5	V
D_{tot}	3.5	4.0	4.0	%

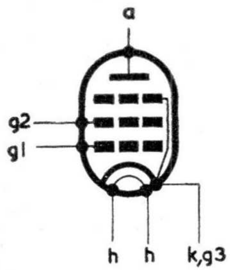
UL41

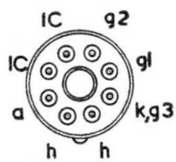
OUTPUT PENTODE

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

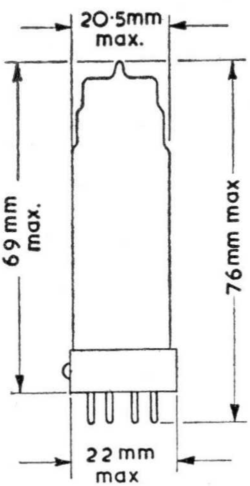
LIMITING VALUES

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





B8A BASE



610

TUNING INDICATOR

UM80

Electron beam valve for use as a tuning indicator in f.m. or a.m. receivers with series connected heaters.

HEATER

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

I_h	100	mA
V_h	19	V

OPERATING CONDITIONS

V_b		200		V
V_t		200		V
R_a		500		kΩ
R_{g-k}		3.0		MΩ
V_g	–1.0		–14	V
I_a	350		10	μA
I_t	5.7		7.0	mA
β	4.0		50	deg.
V_g max. ($I_g = +0.3\mu A$)			–1.3	V

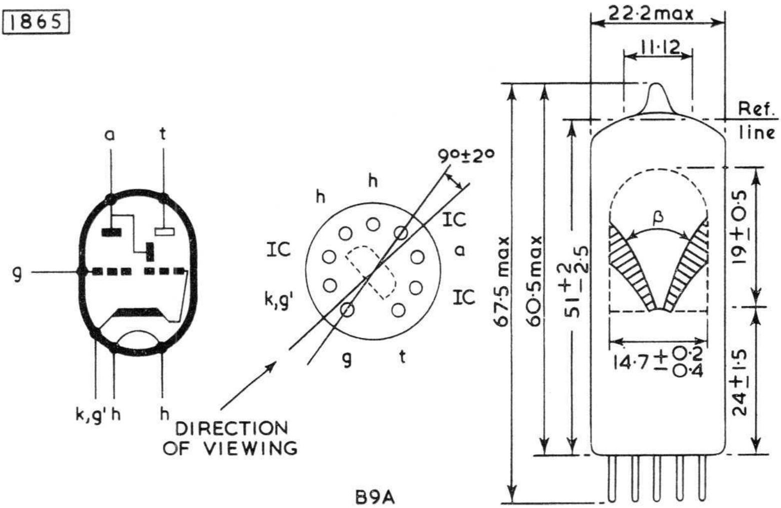
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	200	mW
$V_{t(b)}$ max.	550	V
V_t max.	250	V
V_t min.	90	V
I_k max.	10	mA
R_{g-k} max.	3.0	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

UM80

TUNING INDICATOR

1865



B9A
Noval Base

All dimensions in mm

VOLTAGE INDICATOR

UM84

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

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

I_h	100	mA
V_h	12	V

OPERATING CONDITIONS (def. elec. connected to a)

V_b		170		V
V_t		170		V
R_a		470		kΩ
R_{g-k}		3.0		MΩ
V_g	0		–15	V
I_a	300		40	μA
I_t	0.6		1.05	mA
*L	20±5		0	mm

*Length of column

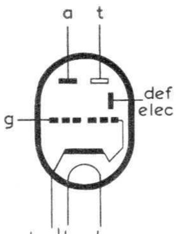
V_g max. ($I_g = +0.3\mu A$)	–1.3	V

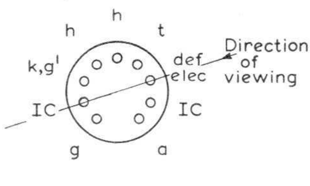
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	500	mW
$V_{t(b)}$ max.	550	V
V_t max.	250	V
V_t min.	170	V
I_k max.	3.0	mA
R_{g-k} max.	3.0	MΩ
V_{h-k} max. (cathode positive)	250	V
*$v_{h-k(pk)}$ max. (cathode negative)	330	V
T_{bulb} max.	120	°C

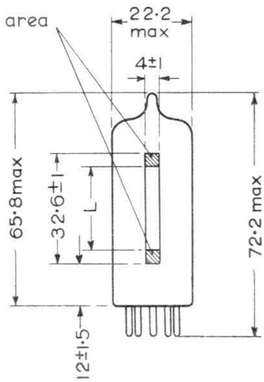
*Max. d.c. component = 50V

VOLTAGE INDICATOR



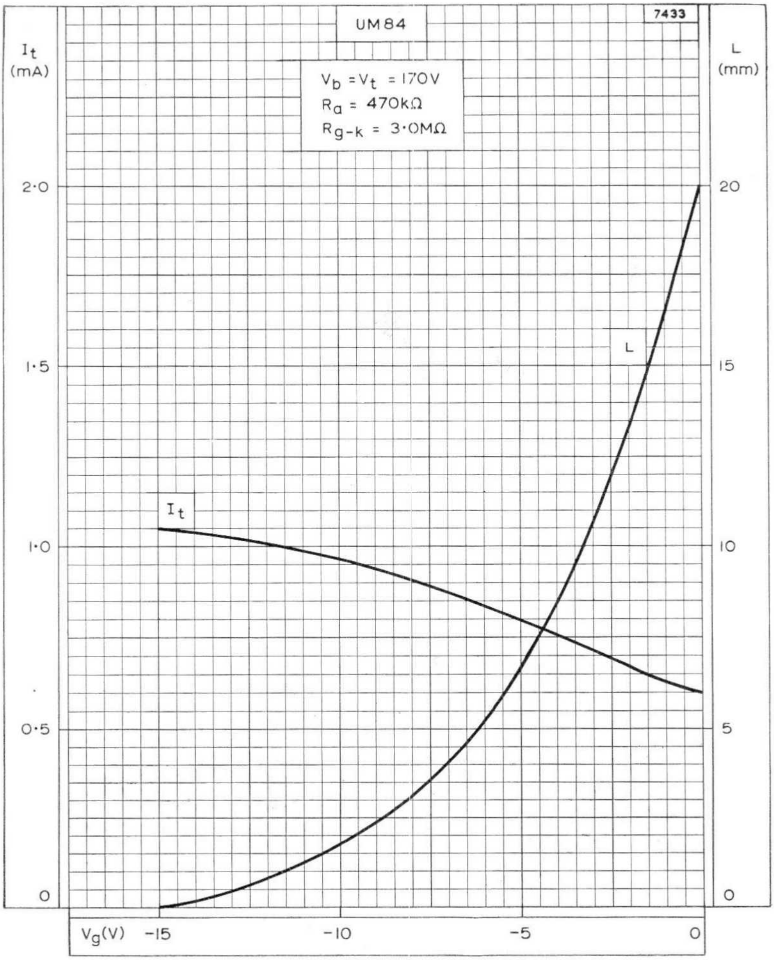


B9A Base



All dimensions in mm

7432



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

HALF-WAVE RECTIFIER

UR1C

Indirectly heated half-wave power rectifier for use in D.C./A.C. mains receivers, where the heater is run in series with those of the preceding valves.

HEATER

I_h	0.2	A
V_h	20.0	V
Heating time	70	secs.

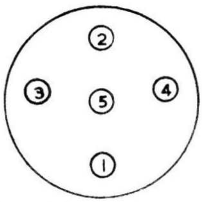
OPERATING CONDITIONS

$V_{a\ (r.m.s.)}$ max.	250	V
I_{out} max.	75	mA
$v_{h-k(pk)}$ max.	350	V
C max.	8.0	μF
* R_{lim} min.	0	Ω

* In order to protect the valve, it is essential that a resistance is included directly in the anode lead when large capacity smoothing condensers are used. Without this resistance the charging current of the first smoothing condenser may destroy the cathode of the rectifier should the receiver be switched off and on again quickly.

The maximum capacity of the smoothing condenser when no resistance is included is 8.0 μF. Where a 16 μF condenser is used the resistance value should be 75 Ω, and for a 32 μF condenser 125 Ω.

CONNECTIONS



Viewed from free end of pins

Brit. 5–Pin Base

Pin No. 1 Anode
,, 2 N.C.
,, 3 Heater
,, 4 Heater
,, 5 Cathode

DIMENSIONS

Overall length	118	mm.
Overall diameter	43	mm.

HALF-WAVE RECTIFIER

UY41

Indirectly heated half-wave rectifier with 100 mA heater for use in DC/AC mains-operated equipment.

HEATER

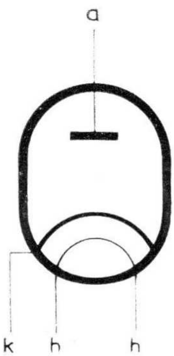
Suitable for series operation A.C. or D.C.

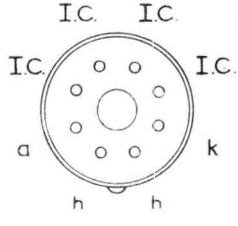
I_h	0.1	A
V_h	31	V

LIMITING VALUES

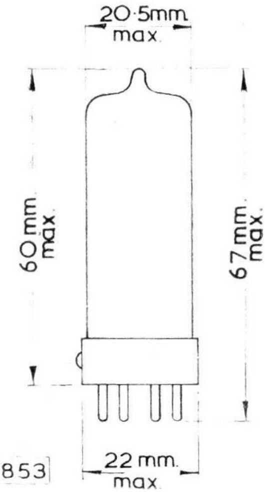
$V_{a\ (r.m.s.)}$ max.	250	V
I_{out} max.	100	mA
$V_{h-k\ (pk)}$ max.	550	V
C max.	50	μF

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

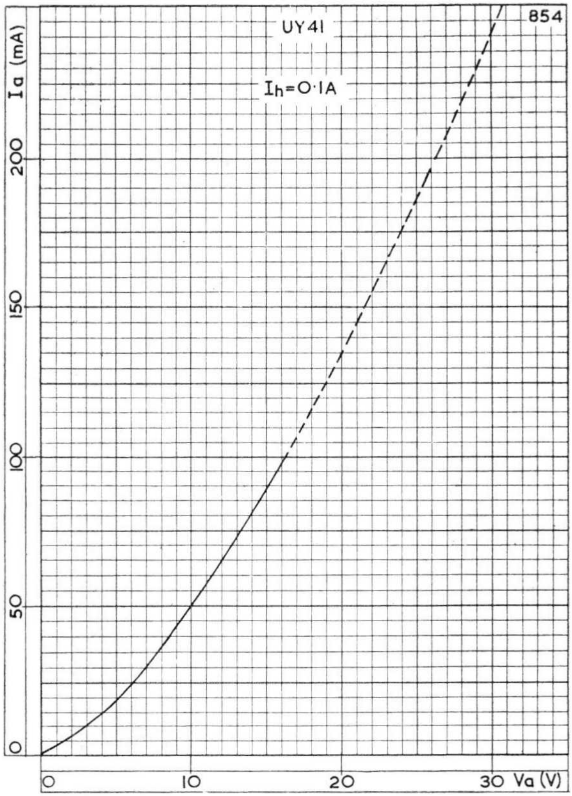


853

UY41

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier with 100 mA heater for use in DC/AC mains-operated equipment.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

MAINTENANCE TYPE
CATHODE RAY TUBES

TELEVISION TUBE

AW36-20Z

Direct viewing television tube with 14-in. diagonal rectangular metal-backed grey-glass screen. This tube has electrostatic focusing and 70° magnetic deflection.

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	<8.0	pF
c_{k-all}	<6.0	pF
$c_{a3+a5-M}$	900	pF

SCREEN

Fluorescent colour	white	
Light transmission	70	%
Useful screen area	See drawing on p. 3	

FOCUSING

Electrostatic

The range of focus voltage shown under "typical operating conditions" results in optimum focus at the centre of the screen. An increase in focus voltage of 100 to 200V in the positive direction will give a greater uniformity of focus over the whole screen.

DEFLECTION

Double magnetic

REFERENCE LINE

See 'General operational recommendations—cathode ray tubes'

ION TRAP

This tube does not use an external ion trap magnet. When used as a replacement for ion trap types, the ion trap magnet and any lead connected to it should be discarded.

AW36-20Z

TELEVISION TUBE

RASTER CENTRING

See note under this heading in 'General operational recommendations—cathode ray tubes'.

Centring magnet field intensity	0 to 10	G
Maximum distance of centre of centring field from reference line	70	mm

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

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 55mm which is centred upon the perpendicular from the centre of the face.

TYPICAL OPERATING CONDITIONS

V_{a3+a5}	12	kV
V_{a2+a4} (focus electrode)	−55 to +145	V
V_{a1}	300	V
V_g for cut-off	−40 to −80	V

LIMITING VALUES (design centre ratings)

**V_{a3+a5} max.	14	kV
V_{a3+a5} min.	9.0	kV
$+V_{a2+a4}$ max.	500	V
$-V_{a2+a4}$ max.	500	V
V_{a1} max.	410	V
V_{a1} min.	200	V
*$-V_g$ max.	150	V
$\pm I_{a2+a4}$ max.	15	μA
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
‡$v_{h-k(pk)}$ max. (cathode positive)	410	V
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50Hz)	500	kΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

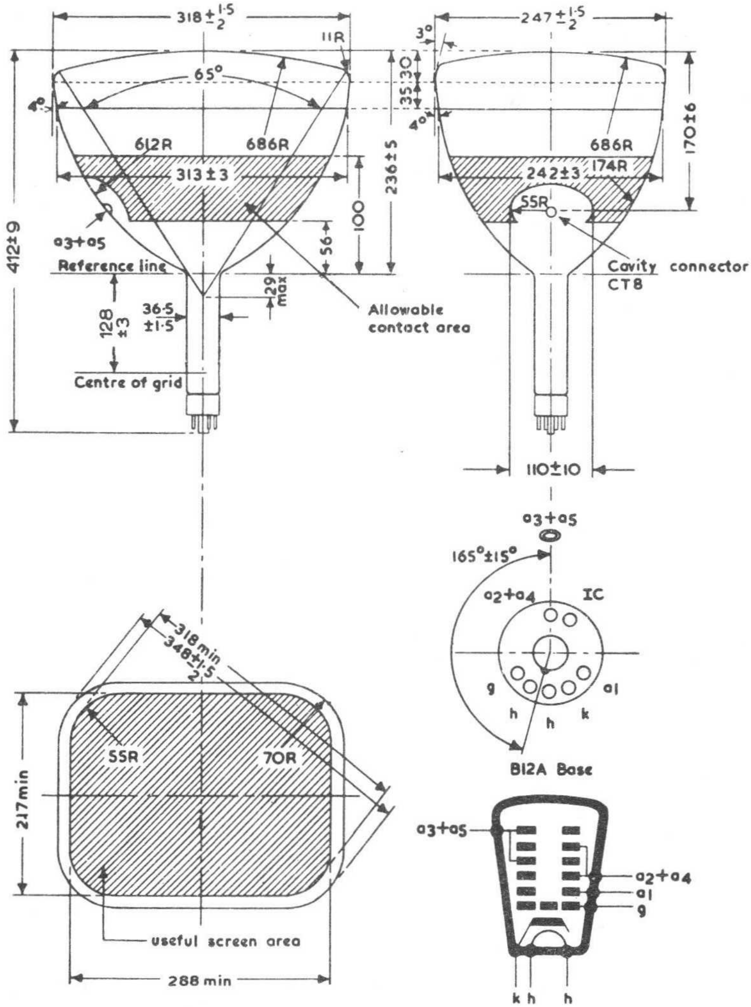
**The product of V_{a3+a5} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

‡During a warming-up period not exceeding 45s.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50Hz impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1.0MΩ.

Mullard



All dimensions in mm

The indicated radius of faceplate curvature is not an exact but an average value.

TELEVISION TUBE

AW43-80Z

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. This tube has electrostatic focusing and 90° magnetic deflection.

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

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	4.0	pF
$c_{a3+a5-M}$	1200	pF

SCREEN

Metal-backed		
Fluorescent colour	white	
Light transmission	70	%
Useful screen area	See drawing on p. 3	

FOCUSING

Electrostatic

The range of focus voltage shown under "typical operating conditions" results in optimum focus at the centre of the screen. An increase in focus voltage of 100 to 200V in the positive direction will give a greater uniformity of focus over the whole screen.

DEFLECTION

Double magnetic

ION TRAP

This tube does not use an external ion trap magnet. When used as a replacement for ion trap types, the ion trap magnet and any lead connected to it should be discarded.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes.'

AW43-80Z

TELEVISION TUBE

RASTER CENTRING

See notes under this heading in 'General operational recommendations—cathode ray tubes.'

Centring magnet field intensity	0 to 10	G
Maximum distance of centre of centring field from reference line	75	mm

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

MOUNTING POSITION — Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 55mm which is centred upon the perpendicular from the centre of the face.

TYPICAL OPERATING CONDITIONS

V_{a3+a5}	16	kV
V_{a2+a4} (focus electrode)	0 to +210	V
V_{a1}	300	V
V_g for cut-off	−40 to −80	V

LIMITING VALUES (design centre ratings)

**V_{a3+a5} max.	16	kV
V_{a3+a5} min.	12	kV
$+V_{a2+a4}$ max.	500	V
$-V_{a2+a4}$ max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
*$-V_g$ max.	150	V
$\pm I_{a2+a4}$ max.	10	μA
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
‡$v_{h-k(pk)}$ max. (cathode positive)	410	V
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50Hz)	500	kΩ

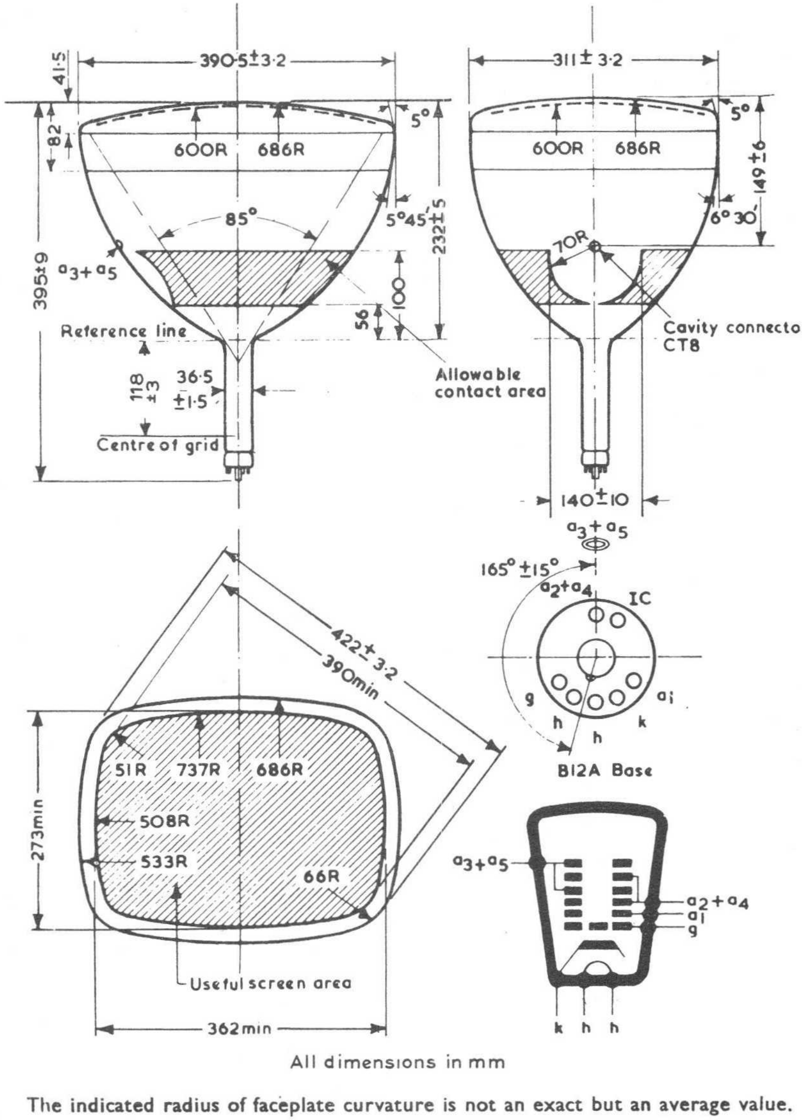
*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a3+a5} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

‡During a warming-up period not exceeding 45s.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50Hz impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1.0MΩ.



All dimensions in mm

The indicated radius of faceplate curvature is not an exact but an average value.

TELEVISION TUBE

AW43-88

Direct viewing television tube with 17in. diagonal metal-backed rectangular grey glass screen. This tube is electrostatically focused and has a 110° deflection angle. An ion trap magnet is not required.

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

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes'.

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	6.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	1100	pF

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission	75	%
Useful screen area	see drawing on page D4	

FOCUSING

Electrostatic

The range of focus voltage shown in 'operating conditions' results in optimum overall focus at a beam current of 100μA.

DEFLECTION

Double magnetic

For timebase designs, the following spreads in the useful screen area should be considered.

	Min.	*Max.*	
Picture height	295	302	mm ←
Picture width	374.5	381	mm
Picture diagonal	400	407	mm

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with JETEC gauge 126.

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations – cathode ray tubes'.

RASTER CENTRING

See notes under this heading in 'General operational recommendations – cathode ray tubes'.

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

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

MOUNTING POSITION — Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 45mm which is centred upon the perpendicular from the centre of the face.

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

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

OPERATING CONDITIONS

V_{a2+a4}	16	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
†V_g for visual extinction of focused raster	−38 to −94	V
†V_k for visual extinction of focused raster	36 to 78	V

†For grid modulation all voltages are measured with respect to the cathode: for cathode modulation, all voltages are measured with respect to the grid.

LIMITING VALUES (design centre ratings)

V_{a2+a4} max.	16	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
$**-v_{g(pk)}$ max.	400	V ←
$*-V_g$ max.	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	15	μA
$\dagger V_{h-k}$		←
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V and at this voltage the grid current may be expected to be approximately 2mA.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).
During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

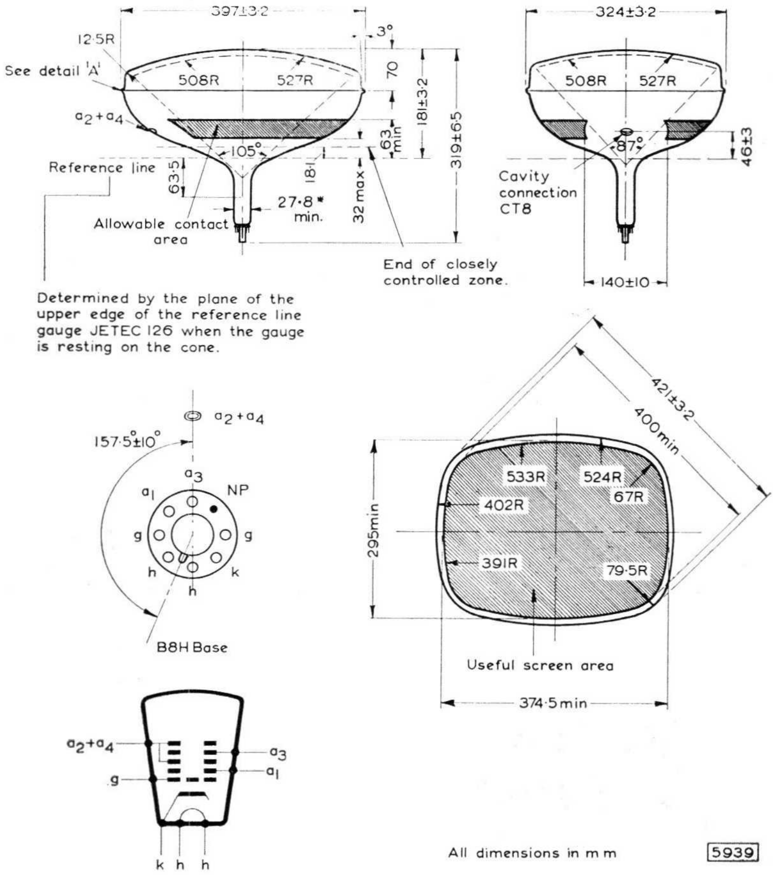
**Maximum pulse duration 22% of a cycle with a maximum of 1.5ms.

WEIGHT

Tube alone	5	kg
	11	lb

AW43-88

TELEVISION TUBE



*The maximum value is determined by the reference line gauge.

TELEVISION TUBE

AW43-89

Direct viewing television tube with 17in. diagonal metal-backed rectangular grey glass screen. This tube is electrostatically focused and has a 110° deflection angle. An ion trap magnet is not required.

PRELIMINARY DATA

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

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes'.

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	5.0	pF
c_{a3-M}	1100	pF

SCREEN

Metal backed		
Fluorescent colour	white	
Light transmission (approx.)	75	%
Useful screen area	see drawing on page D4	

FOCUSING

Electrostatic
The range of focus voltage shown in the curves results in optimum centre focus at a beam current of 100µA.

AW43-89

TELEVISION TUBE

DEFLECTION

Double magnetic
For timebase designs the following spreads in the useful screen area should be considered

	Min.	Max.	
Picture height	295	302	mm
Picture width	374.5	381	mm
Picture diagonal	400	407	mm

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with JETEC gauge 126.

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations—cathode ray tubes'.

RASTER CENTRING

See note under this heading in 'General operational recommendations—cathode ray tubes'.

Centring magnet field intensity	0 to 15	G
Maximum distance of centre of centring field from reference line	57	mm

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

MOUNTING POSITION Any

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

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

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

OPERATING CONDITIONS

	*Grid modulation	*Cathode modulation	
V_{a3}	16	16	kV
V_{a2} focus electrode control range)	0 to 400	40 to 440	V
V_{a1}	500	540	V
V_g for visual extinction of focused raster	–35 to –75	—	V
V_k for visual extinction of focused raster	—	35 to 69	V

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

AW43-89

LIMITING VALUES (design centre ratings)

V_{a3} max.	16	kV
V_{a3} min.	13	kV
$+V_{a2}$ max.	750	V
$-V_{a2}$ max.	500	V
V_{a1} max.	700	V
V_{a1} min.	500	V
**$-v_{g(pk)}$ max.	400	V
*$-V_g$ max.	150	V
$\pm I_{a2}$ max.	15	μA
$\pm I_{a1}$ max.	5.0	μA
†V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f=50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50c/s)	500	kΩ

*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V and at this voltage the grid current may be expected to be approximately 2mA.

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

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

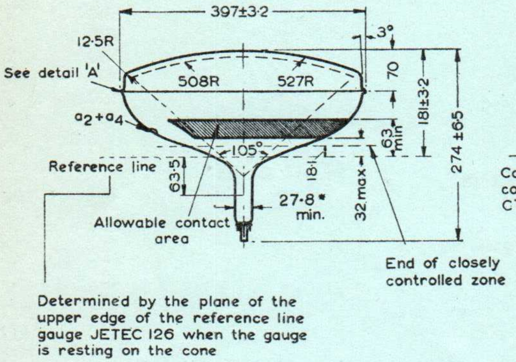
During a warming-up period not exceeding 45s, $V_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

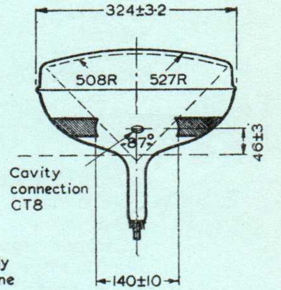
WEIGHT

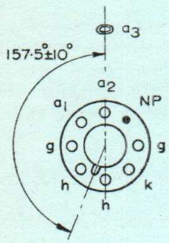
Tube alone	5	kg
	11	lb

AW43-89

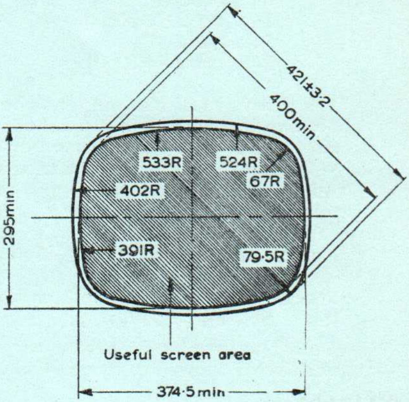
TELEVISION TUBE

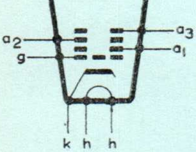






B8H Base





All dimensions in mm

6340

*The maximum value is determined by the reference line gauge

PRELIMINARY DATA

QUICK REFERENCE DATA

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

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

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

HEATER

Suitable for series or parallel operation

Vh	6.3	V
Ih	300	mA

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

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

OPERATING CONDITIONS

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

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

SCREEN

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

FOCUSING

Electrostatic

The range of focus voltages shown in "OPERATING CONDITIONS" results in optimum overall focus at a beam current of $100\,\mu A$.

DEFLECTION

Double magnetic

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

CAPACITANCES

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

EXTERNAL CONDUCTIVE COATING

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

RASTER CENTRING

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

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

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

REFERENCE LINE GAUGE

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

MOUNTING POSITION Any

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

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

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

DESIGN CENTRE RATINGS

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

Rg - k max.	1.5	MΩ
Zg - k max. (f = 50 c/s)	500	kΩ

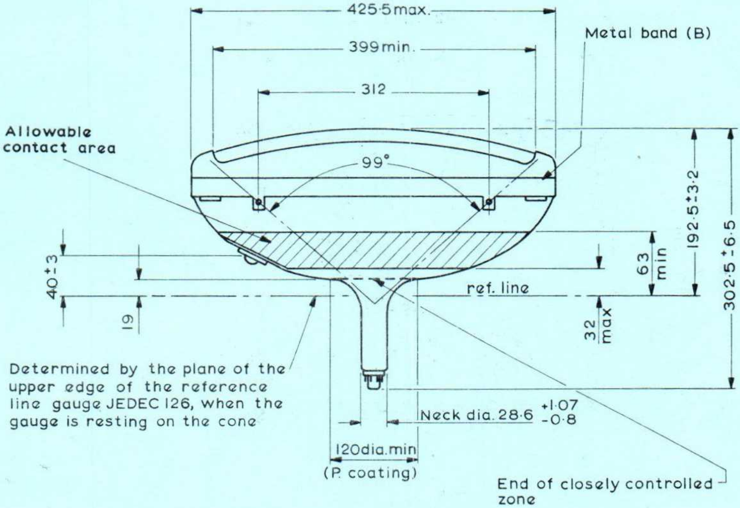
* Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

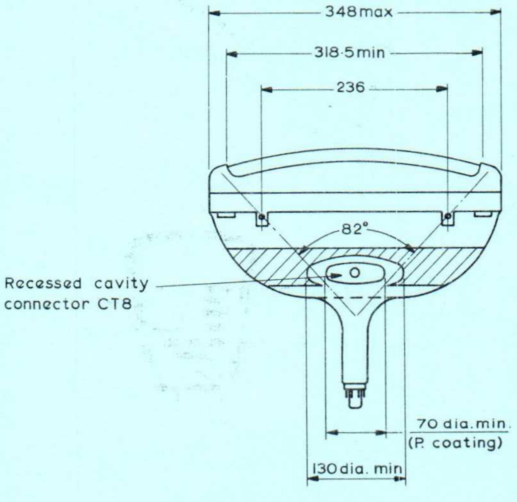
** Maximum pulse duration 22 % of a cycle with a maximum of 1.5 ms.

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

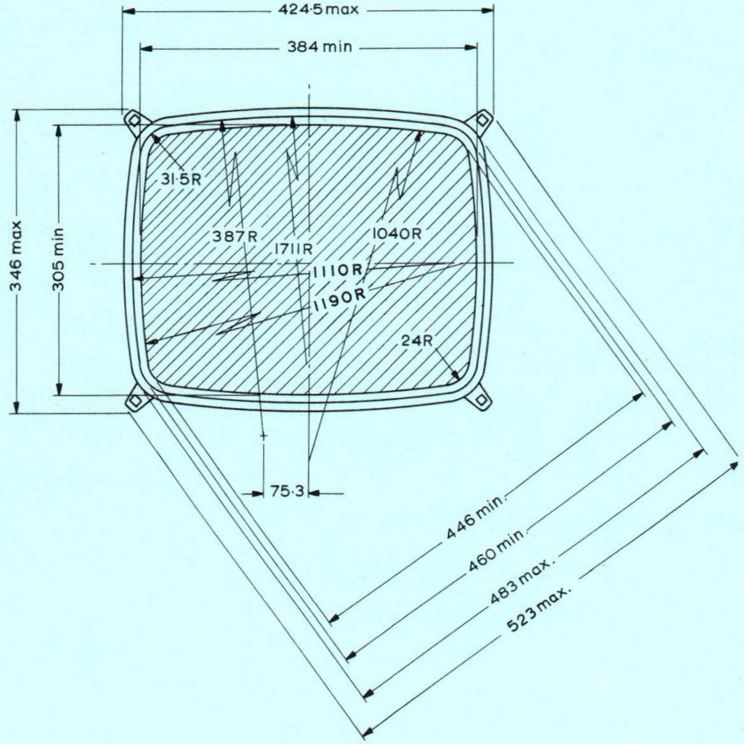
†During an equipment warm-up period not exceeding 15 seconds $v_{h-k\ (pk)}$ max. (cathode positive) is allowed to rise to 410V. Between 15 and 45 seconds after switching-on a decrease in $v_{h-k\ (pk)}$ max. (cathode positive) proportional with time from 410V to 250V is permissible.

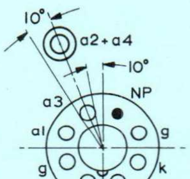
Note. - The metal band (B) must be connected to the chassis via a 2 MΩ resistor, soldering tags are provided for this purpose.
The mounting lugs will not necessarily be in electrical contact with the metal band.



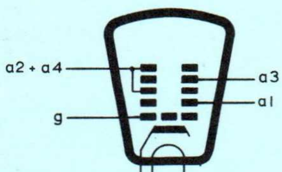


All dimensions in mm.





B8H Base



All dimensions in mm

TELEVISION TUBE

AW21-11

Direct viewing television tube with $8\frac{1}{2}$in. diagonal metal-backed rectangular grey glass screen, intended for use in portable transistor television receivers. This tube is electrostatically focused and has a 90° deflection angle. An ion trap magnet is not required.

PRELIMINARY DATA

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

HEATER

Suitable for parallel operation

$^*V_h$	11.5	V
I_h	60	mA

*The heater supply must be designed to provide a nominal 11.5V. The heater voltage must not rise above 13.8V and must not fall below 9.25V.

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	250	pF

SCREEN

Metal backed

Fluorescent colour	White
Useful screen area	see drawing on page D4

FOCUSING

Electrostatic

The range of focus voltage shown in 'Operating conditions' results in optimum overall focus at a beam current of $50\mu A$.

DEFLECTION

Double magnetic

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with the reference line gauge shown on page D3.

REFERENCE LINE GAUGE

See page D5

RASTER CENTRING

See notes under this heading in 'General operational recommendations – cathode ray tubes'.

Centring magnet field intensity	0 to 10	G

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

MOUNTING POSITION

Any

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

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

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

OPERATING CONDITIONS

V_{a2+a4}	12	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
†V_g for visual extinction of focused raster	−32 to −69	V
†V_k for visual extinction of focused raster	29 to 62	V

†For grid modulation all voltages are measured with respect to the cathode; for cathode modulation, all voltages are measured with respect to the grid.

ABSOLUTE MAXIMUM RATINGS

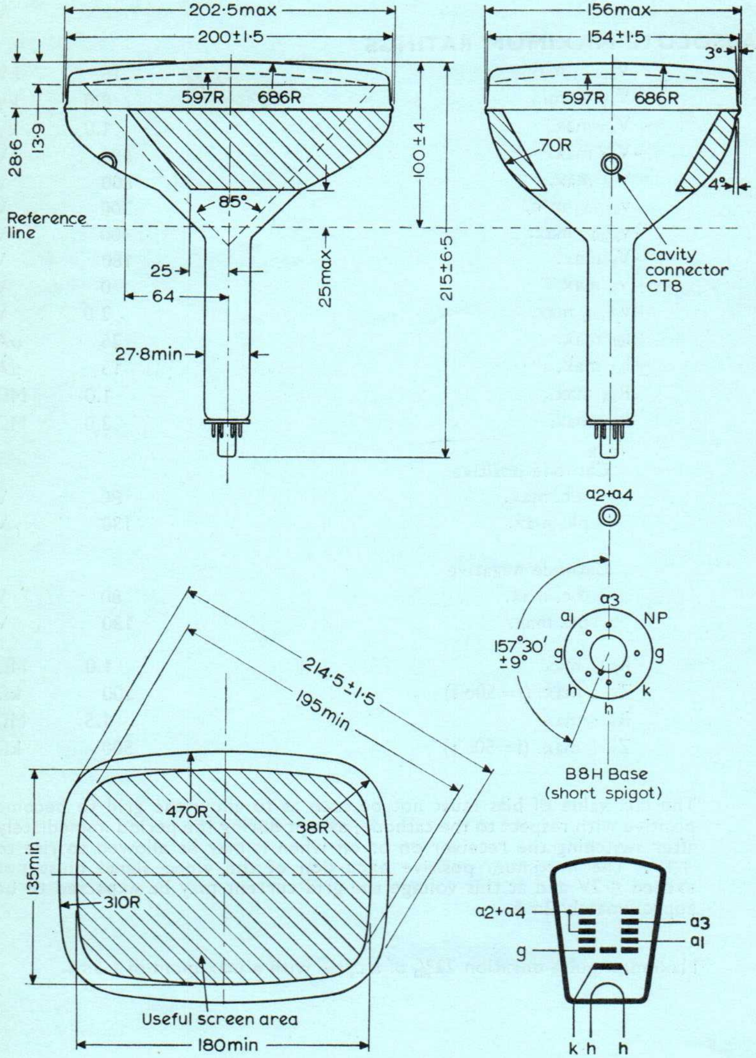
V_{a2+a4} max.	16	kV
V_{a2+a4} min.	8.0	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	800	V
$v_{a1(pk)}$ min.	300	V
**$-v_{g(pk)}$ max.	400	V
*$-V_g$ max.	180	V
$+V_g$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$\pm I_{a3}$ max.	25	µA
$\pm I_{a1}$ max.	15	µA
R_{a1} max.	1.0	MΩ
R_{a3} max.	3.0	MΩ
V_{h-k}		
Cathode positive		
d.c. max.	80	V
pk. max.	130	V
Cathode negative		
d.c. max.	80	V
pk. max.	130	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f=50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50c/s)	500	kΩ

*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V and at this voltage the grid current may be expected to be approximately 2mA.

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

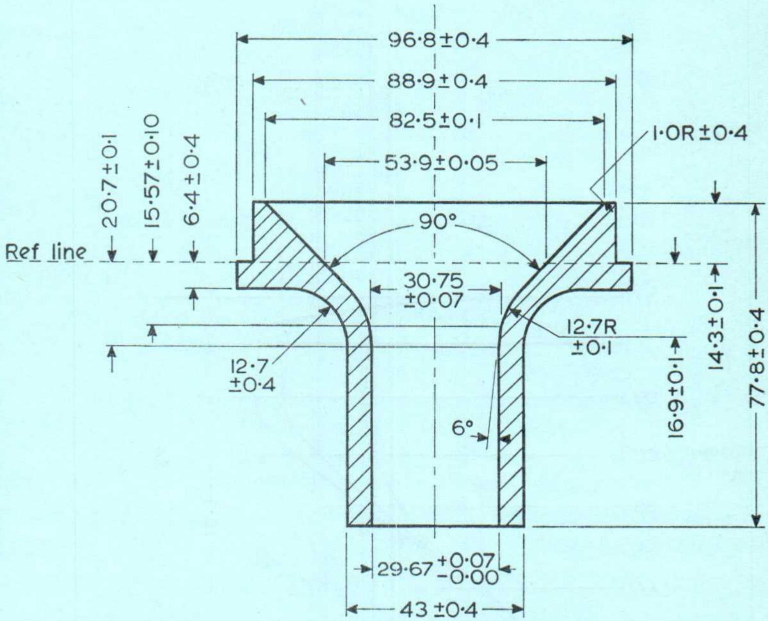
AW21-11

TELEVISION TUBE



All dimensions in mm

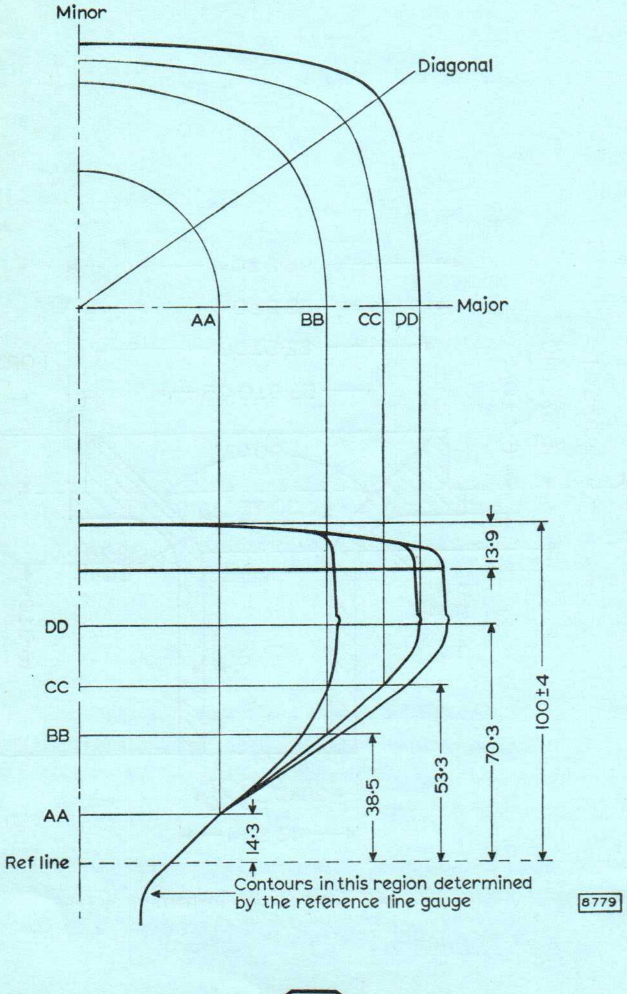
9074

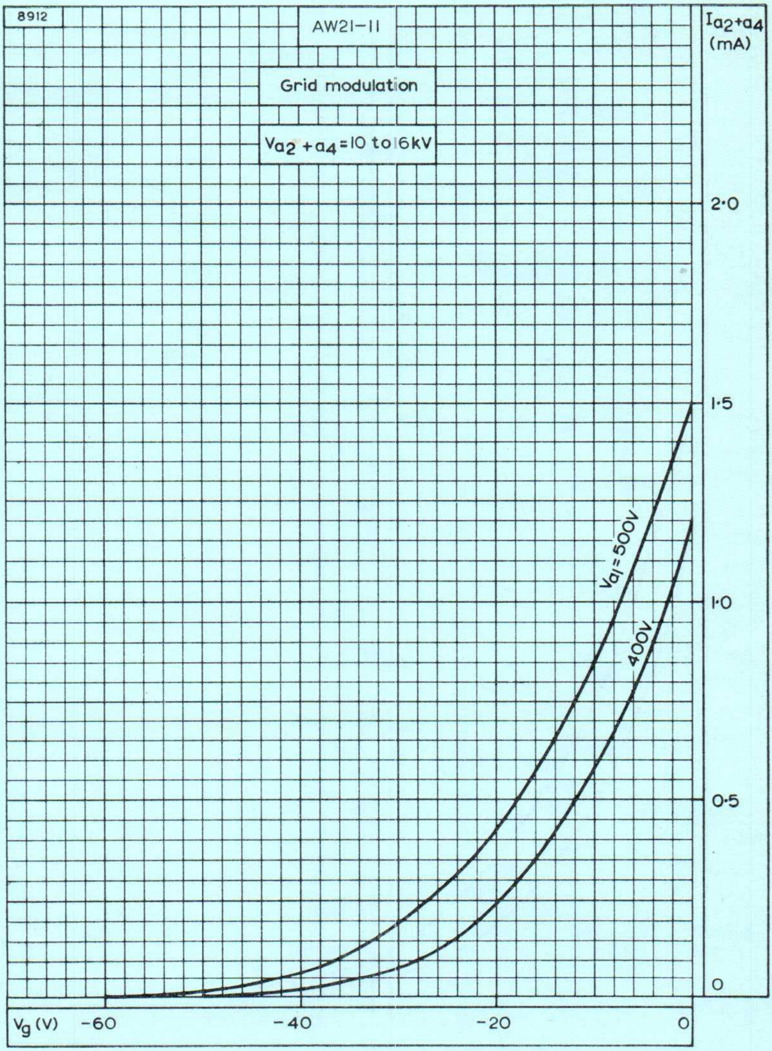


All dimensions in mm

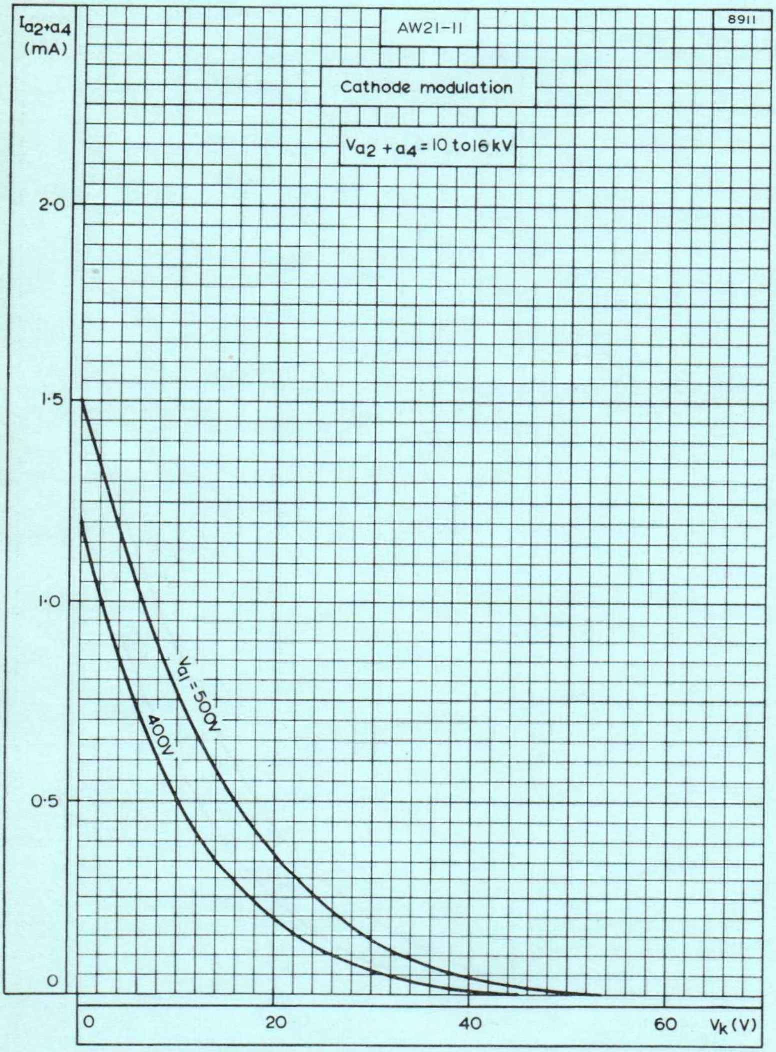
8343

Section	Nominal height above reference line (mm)	Major (mm)	Minor (mm)	Diagonal (mm)
AA	14·3	Circle 87·4 mm dia		
BB	38·5	151	139	158
CC	53·3	185	154	198
DD	70·3	206	160	221

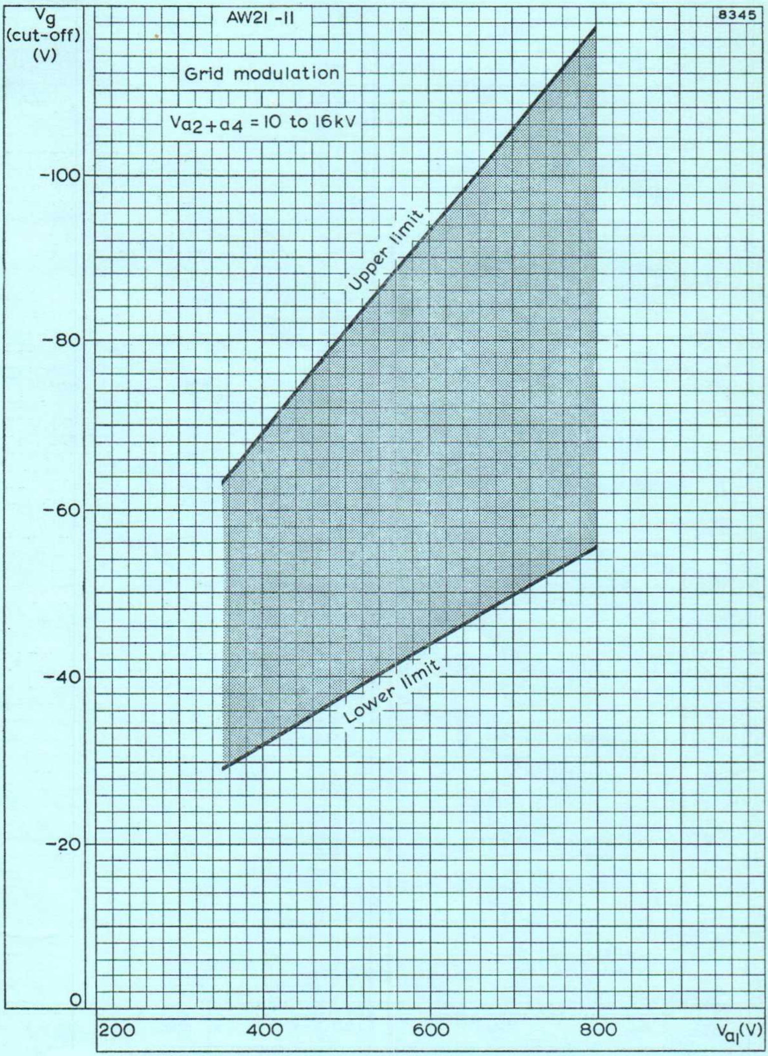




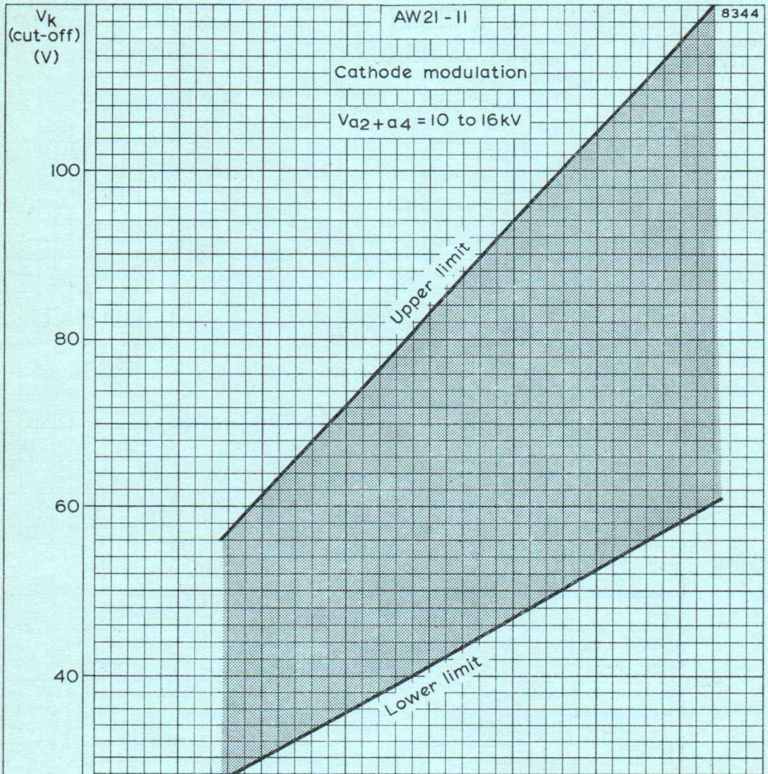
FINAL ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE. GRID MODULATION



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



LIMITS OF GRID CUT-OFF VOLTAGE FOR FIRST ANODE VOLTAGES OF 350 TO 800V. GRID MODULATION



LIMITS OF CATHODE-TO-GRID VOLTAGE FOR FIRST ANODE VOLTAGES OF 350 TO 950V. CATHODE MODULATION

TELEVISION TUBE

AW47-90

Direct viewing television tube with 19in. diagonal metal-backed rectangular grey glass screen. This tube is electrostatically focused and has a 110° deflection angle. An ion trap magnet is not required.

MAINTENANCE TYPE

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

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes.'

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	6.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	1150	pF

SCREEN

Metal backed		
Fluorescent colour	white	
Light transmission	75	%
Useful screen area	See drawing on pages D4 and D7	

FOCUSING

Electrostatic

The range of focus voltage shown in 'Typical operating conditions' results in optimum overall focus at a beam current of 100μA.

DEFLECTION

Double magnetic

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with JETEC gauge 126.

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations—cathode ray tubes.'

RASTER CENTRING

See notes under this heading in 'General operational recommendations—cathode ray tubes.'

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

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

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 45mm which is centred upon the perpendicular from the centre of the face.

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

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

TYPICAL OPERATING CONDITIONS

V_{a2+a4}	16	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
†V_g for visual extinction of focused raster	−38 to −94	V
†V_k for visual extinction of focused raster	36 to 78	V

†For grid modulation all voltages are measured with respect to the cathode: for cathode modulation, all voltages are measured with respect to the grid.

LIMITING VALUES (design centre ratings)

‡V_{a2+a4} max.	18	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
**$-v_{g(pk)}$ max.	400	V
*$-V_g$ max.	150	V
$\pm I_{a3}$ max.	25	µA
$\pm I_{a1}$ max.	15	µA
†V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f=50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50c/s)	500	kΩ

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

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

*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V and at this voltage the grid current may be expected to be approximately 2mA.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).
During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WEIGHT

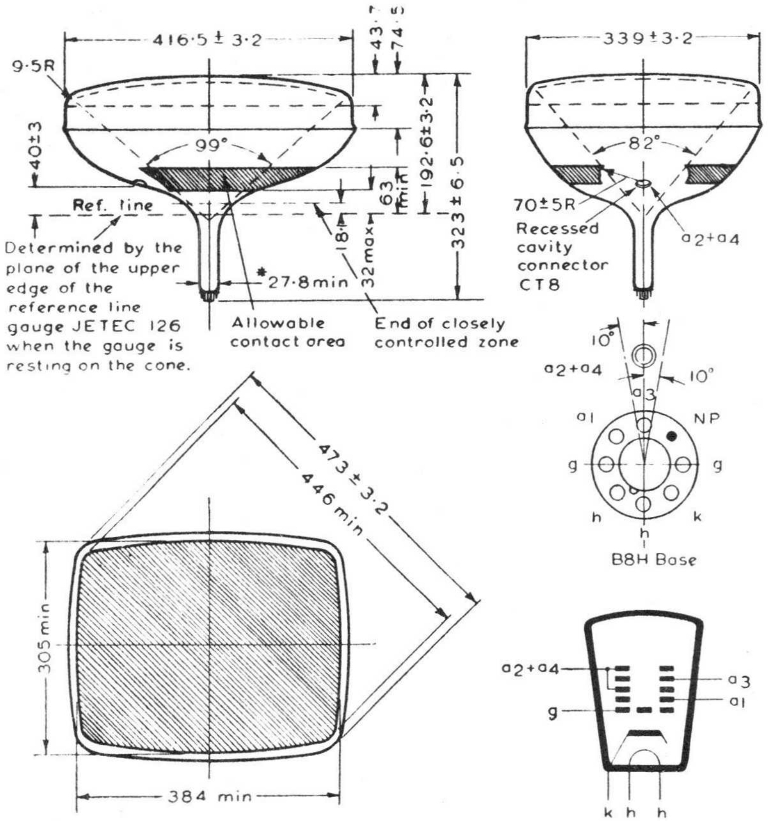
Tube alone	7	kg
	15	lb

WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 16 kV.

AW47-90

TELEVISION TUBE



All dimensions in mm

*The maximum value is determined by the reference line gauge

7646

TELEVISION TUBE

AW47-91

Direct viewing television tube with 19in diagonal metal-backed grey glass screen. This tube is electrostatically focused and has a 110° deflection angle. An ion trap magnet is not required.

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

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations – cathode ray tubes'.

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	6.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	1150	pF

SCREEN

Metal backed		
Fluorescent colour	White	
Light transmission	75	%
Useful screen area	See drawings on pages D4 and D7	

FOCUSING

Electrostatic

The range of focus voltage shown in 'Typical operating conditions' results in optimum overall focus at a beam current of 100μA.

DEFLECTION

Double magnetic

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with JETEC gauge 126.

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations – cathode ray tubes'.

RASTER CENTRING

See notes under this heading in 'General operational recommendations – cathode ray tubes'.

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

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

MOUNTING POSITION Any

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

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

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

TYPICAL OPERATING CONDITIONS

V_{a2+a4}	16	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
†V_g for visual extinction of focused raster	−40 to −77	V ←
†V_k for visual extinction of focused raster	36 to 66	V ←

†For grid modulation all voltages are measured with respect to the cathode; for cathode modulation, all voltages are measured with respect to the grid.

DESIGN CENTRE RATINGS

‡V_{a2+a4} max.	18	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
**$+v_{a3(pk)}$ max.	2·5	kV←
V_{a1} max.	550	V
$v_{a1(pk)}$ min.	400	V←
**$-v_{g(pk)}$ max.	400	V
*$-V_g$ max.	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	15	μA
†V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

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

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

*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V and at this voltage the grid current may be expected to be approximately 2mA.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WARNING

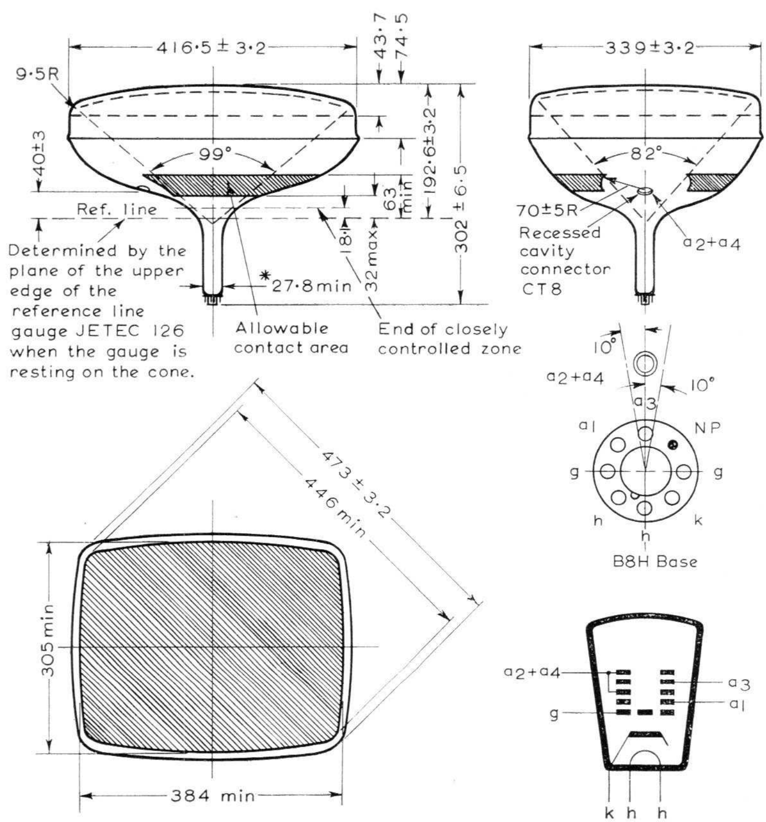
X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 16kV.

WEIGHT

Tube alone	7	kg
	15	lb

AW47-91

TELEVISION TUBE



All dimensions in mm

*The maximum value is determined by the reference line gauge

8807

TELEVISION TUBE

AW53-80

Direct viewing television tube with 21-in. metal-backed diagonal rectangular grey glass screen. This tube has electrostatic focusing 90° magnetic deflection and incorporates an ion trap.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—CATHODE RAY TUBES, included in this volume of the handbook.

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	4.0	pF
$c_{a3+a5-M}$	1500	pF

SCREEN

Metal-backed		
Fluorescent colour	white	
Light transmission	70	%
Useful screen area	See drawing on p. 3	

FOCUSING

Electrostatic

The range of focus voltage shown in the curves results in optimum focus at the centre of the screen. An increase in focus voltage of 100 to 200V in the positive direction will give a greater uniformity of focus over the whole screen.

DEFLECTION

Double magnetic

ION TRAP

Ion trap magnet field intensity	63 to 78	G

The space between a point 75mm from the reference line along the neck of the tube and the edge of the base should be kept clear for the ion trap magnet. The direction of the field of the ion trap magnet should be such that the south pole is adjacent to the spigot. The procedure for adjusting the ion trap magnet is given in the 'General operational recommendations—cathode ray tubes' preceding this section of the handbook. The ion trap magnet assembly should be earthed.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'.

AW53-80

TELEVISION TUBE

Direct viewing television tube with 21-in. metal-backed diagonal rectangular grey glass screen. This tube has electrostatic focusing 90° magnetic deflection and incorporates an ion trap.

RASTER CENTRING

See notes under this heading in 'General operational recommendations—cathode ray tubes'.

Centring magnet field intensity	0 to 10	G
Maximum distance of centre of centring field from reference line	75	mm

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

MOUNTING POSITION — Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 55mm which is centred upon the perpendicular from the centre of the face.

TYPICAL OPERATING CONDITIONS

V_{a3+a5}	16	kV
V_{a2+a4} (focus electrode)	See curves	
V_{a1}	300	V
V_g for cut-off	−40 to −80	V

LIMITING VALUES (design centre ratings)

**V_{a3+a5} max.	16	kV
V_{a3+a5} min.	12	kV
$+V_{a2+a4}$ max.	500	V
$-V_{a2+a4}$ max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
*$-V_g$ max.	150	V
$\pm I_{a2+a4}$ max.	10	μA
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
‡$v_{h-k\,(pk)}$ max. (cathode positive)	410	V
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a3+a5} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).

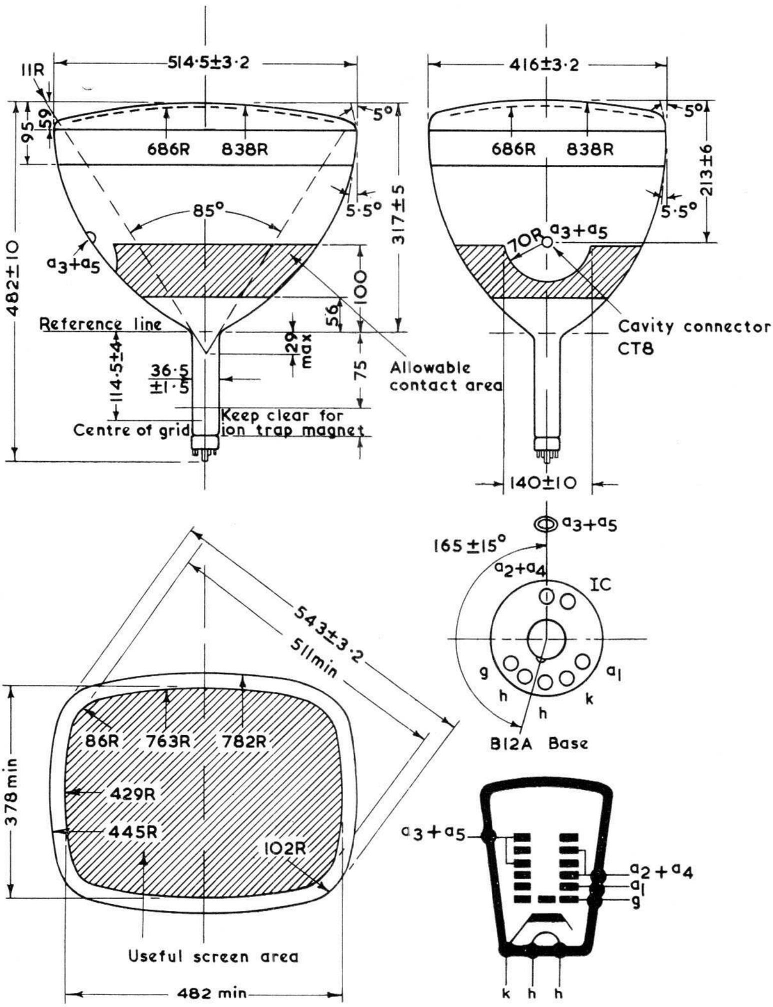
‡During a warming-up period not exceeding 45s.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50c/s impedance between earth and the cathode. When the heater is supplied from a separate transformer R_{h-k} max. is 1.0MΩ.

TELEVISION TUBE

AW53-80

Direct viewing television tube with 21-in. metal-backed diagonal rectangular grey glass screen. This tube has electrostatic focusing 90° magnetic deflection and incorporates an ion trap.



3160

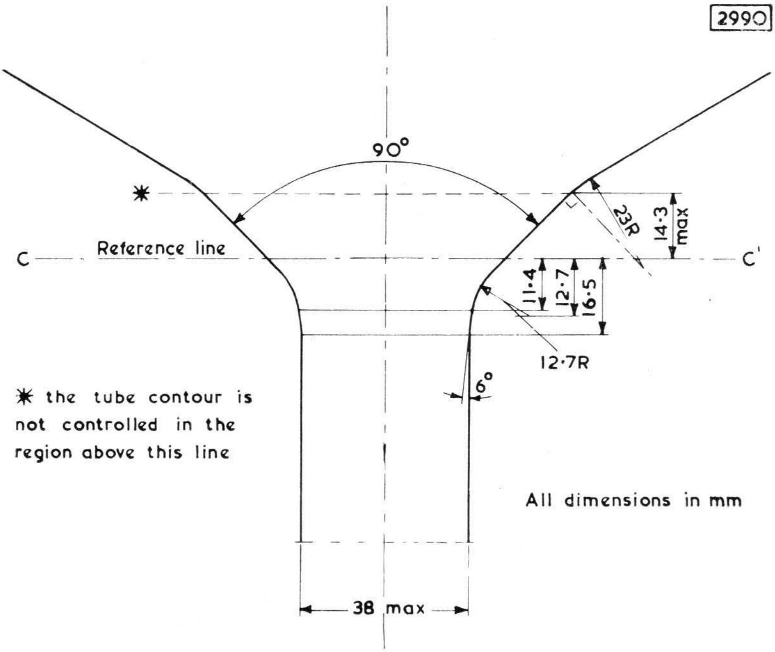
All dimensions in mm

The indicated radius of the faceplate curvature is not an exact but an average value.

AW53-80

TELEVISION TUBE

Direct viewing television tube with 21-in. metal-backed diagonal rectangular grey glass screen. This tube has electrostatic focusing 90° magnetic deflection and incorporates an ion trap.



Deflection coil dimensions

The mechanical design of the deflection coils is governed by the bulb shape at the junction of the neck and cone. The profile of the AW53-80 in this region is shown above. No production tube will impose more severe limitations on coil design than those given in the figure.

TELEVISION TUBE

AW53-88

Direct viewing television tube with 21 in. diagonal rectangular metal-backed grey glass screen. This tube is electrostatically focused and has a 110° deflection angle. An ion trap magnet is not required.

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

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes'.

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	6.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	1850	pF

SCREEN

Metal backed

Fluorescent colour	White	
Light transmission (approx.)	75	%
Useful screen area	see drawing on page D4	

FOCUSING

Electrostatic

The range of focus voltage shown in 'operating conditions' results in optimum overall focus at a beam current of 100μA.

DEFLECTION

Double magnetic

For timebase designs, the following spreads in the useful screen area ← should be considered.

	Min.	*Max.*	
Picture height	382.5	388	mm
Picture width	484	490	mm
Picture diagonal	514.5	520	mm

The spread in the cone length can be obtained from the outline drawing. The deflection coils should be designed so that their internal contour is in accordance with JETEC gauge 126.

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations – cathode ray tubes'.

RASTER CENTRING

See note under this heading in 'General operational recommendations – cathode ray tubes'.

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

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

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 45mm which is centred upon the perpendicular from the centre of the face.

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

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

OPERATING CONDITIONS

V_{a2+a4}	16	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
†V_g for visual extinction of focused raster	−38 to −94	V
†V_k for visual extinction of focused raster	36 to 78	V

†For grid modulation, all voltages are measured with respect to the cathode: for cathode modulation, all voltages are measured with respect to the grid.

LIMITING VALUES (design centre ratings)

V_{a2+a4} max.	16	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
**$-v_{g(pk)}$ max.	400	V ←
*$-V_g$ max.	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	15	μA
†V_{h-k}		←
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ

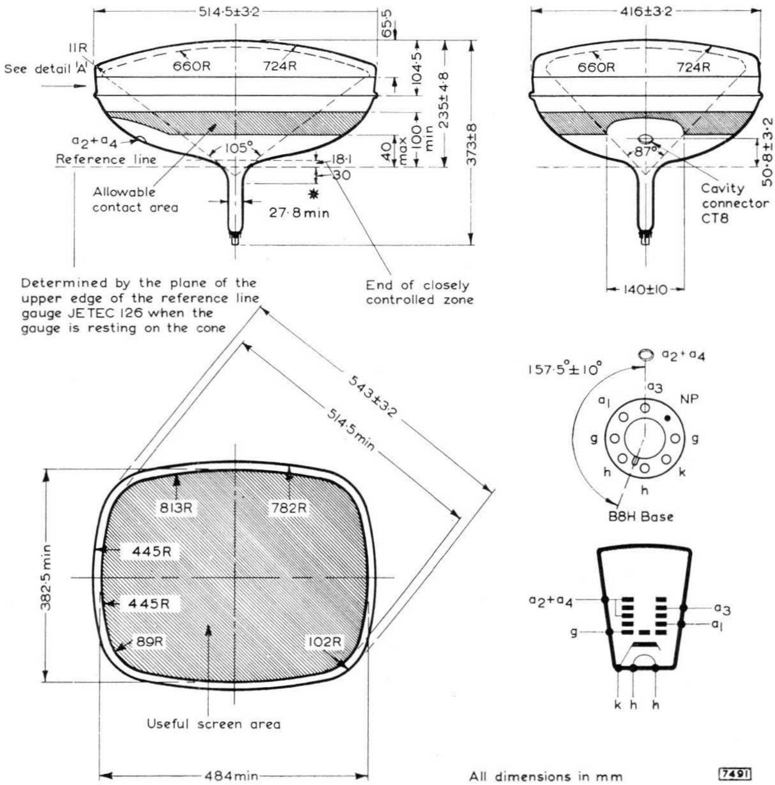
*The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V, and at this voltage the grid current may be expected to be approximately 2mA.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible (<20$V_{r.m.s.}$).
During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

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

WEIGHT

Tube alone	10	kg
	22	lb



*The maximum value is determined by the reference line gauge

TELEVISION TUBE

AW59-90

Direct viewing television tube with 23in. diagonal rectangular metal-backed grey glass screen. This tube has electrostatic focusing and 110° magnetic deflection.

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

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes'

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	6.0	pF
c_{k-all}	4.0	pF
$c_{a2+a4-M}$	1800	pF

SCREEN

Metal backed		
Fluorescent colour	White	
Light transmission (approx.)	75	%
Useful screen area	see page D4	

FOCUSING

Electrostatic

The range of focus voltage shown in 'Operating conditions' results in optimum overall focus at a beam current of 100μA.

DEFLECTION

Double magnetic

The spread in the cone length can be obtained from the outline drawing.

The deflection coils should be designed so that their internal contour is in accordance with JETEC gauge 126.

REFERENCE LINE GAUGE

JETEC 126. For details see 'General operational recommendations—cathode ray tubes'.

RASTER CENTRING

See note under this heading in 'General operational recommendations—cathode ray tubes'.

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

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

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 45mm diameter which is centred upon the perpendicular from the centre of the face.

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

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

OPERATING CONDITIONS

V_{a2+a4}	16	kV
V_{a3} (focus electrode control range)	0 to 400	V
V_{a1}	400	V
†V_g for visual extinction of focused raster	−38 to −94	V
†V_k for visual extinction of focused raster	36 to 78	V

†For grid modulation, all voltages are measured with respect to the cathode; for cathode modulation, all voltages are measured with respect to the grid.

LIMITING VALUES (design centre ratings)

**V_{a2+a4} max.	18	kV
V_{a2+a4} min.	13	kV
$+V_{a3}$ max.	1.0	kV
$-V_{a3}$ max.	500	V
V_{a1} max.	500	V
V_{a1} min.	200	V
*$-v_{g(pk)}$ max.	400	V
†$-V_g$ max.	150	V
$\pm I_{a3}$ max.	25	μA
$\pm I_{a1}$ max.	15	μA
‡V_{h-k}		
Cathode positive		
d.c. max	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f=50c/s)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50c/s)	500	kΩ

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

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

†The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive excursion of the video signal must not exceed +2V, and at this voltage the grid current may be expected to be approximately 2mA.

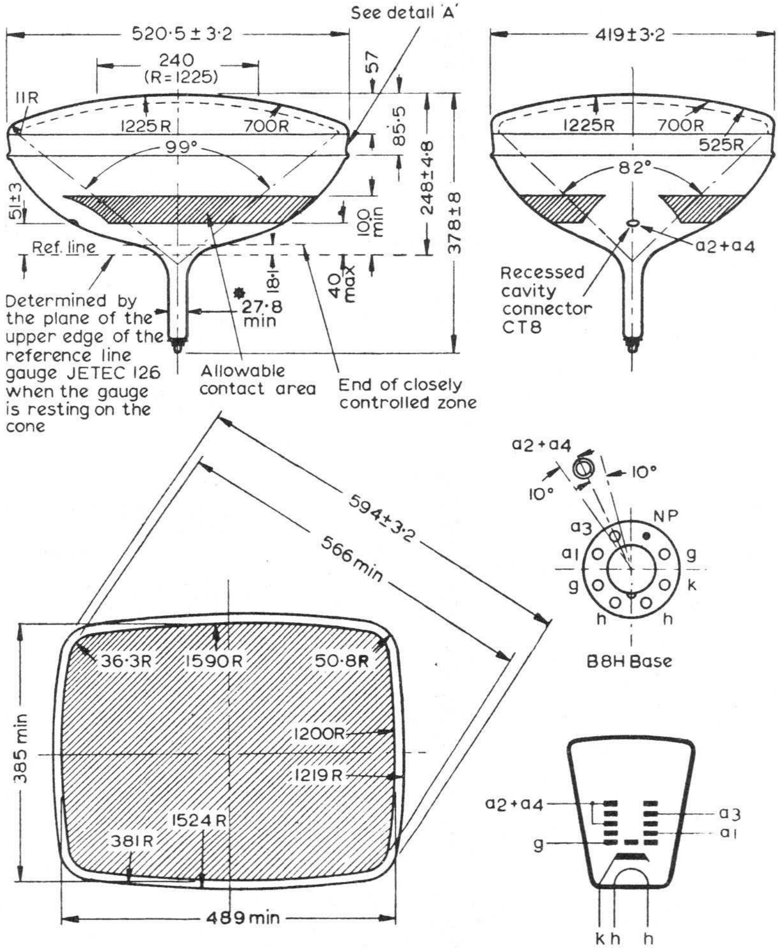
‡In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible ($<20V_{r.m.s.}$).
During a warming up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 16kV.

AW59-90

TELEVISION TUBE



All dimensions in mm

7279

* The maximum value is determined by the reference line gauge

QUICK REFERENCE DATA

59 cm (23 in) direct viewing television tube with metal backed grey glass screen.

Deflection	110	deg
Focusing	Electrostatic	
Light transmission	75	%
Overall length	36.7	cm

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

HEATER

Suitable for series or parallel operation

Vh	6.3	V
Ih	300	mA

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

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

OPERATING CONDITIONS

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

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

SCREEN

Metal backed	
Fluorescent colour	White

Light transmission (approx.)	75	%
Useful screen area	see pages D5 and D7	

FOCUSING

Electrostatic

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

DEFLECTION

Double magnetic

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

CAPACITANCES

cg-all	6.0	pF
ck-all	4.0	pF
ca2 + a4 - M	2100	pF

EXTERNAL CONDUCTIVE COATING

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

RASTER CENTRING

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

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

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

REFERENC LINE GAUGE

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

MOUNTING POSITION

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

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

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

DESIGN CENTRE RATINGS

* Va2 + a4 max. (at Ia2 + a4 = 0)	18	kV
Va2 + a4 min.	13	kV
+ Va3 max.	1.0	kV
- Va3 max.	500	V
** +va3(pk) max.	2.5	kV
Va1 max.	550	V
va1(pk) min.	400	V
** - vg(pk) max.	400	V
*** - Vg max.	150	V
± Ia3 max.	25	μA
± Ia1 max.	5	μA
**** Vh - k		
Cathode positive		
d.c. max.	250	V
pk max.	300	V
Cathode negative		
d.c. max.	135	V
pk max.	180	V
Rh-k max.	1.0	MΩ
Zk-e max. (f = 50 c/s)	100	kΩ

Rg-k max.	1.5	MΩ
Zg-k max. (f = 50 c/s)	500	kΩ

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

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

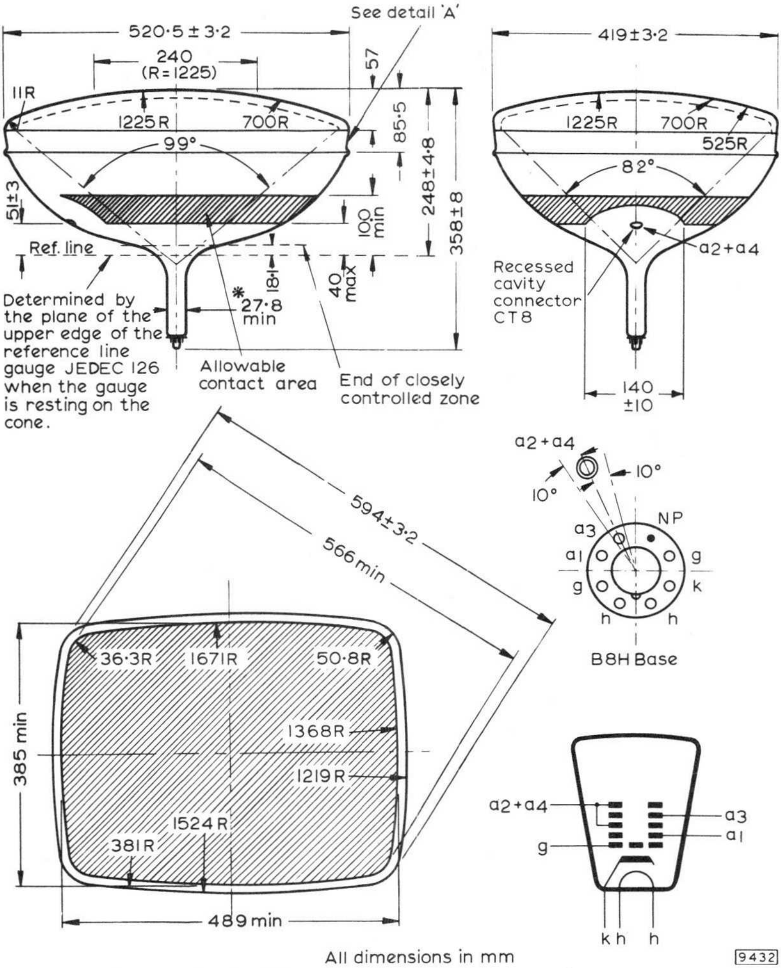
*** The d.c. value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to + 1 V. To ensure long life of the tube it is advisable to limit the positive excursion of the video signal to + 5 V (pk) max. This may be achieved automatically by the series connection of a 10 kΩ resistor.

**** In order to avoid excessive hum the a.c. component of Vh-k should be as low as possible (< 20 V r.m.s.).

During a warming up period not exceeding 15 secs, vh-k(pk) max. (cathode positive) is allowed to rise to 410V.

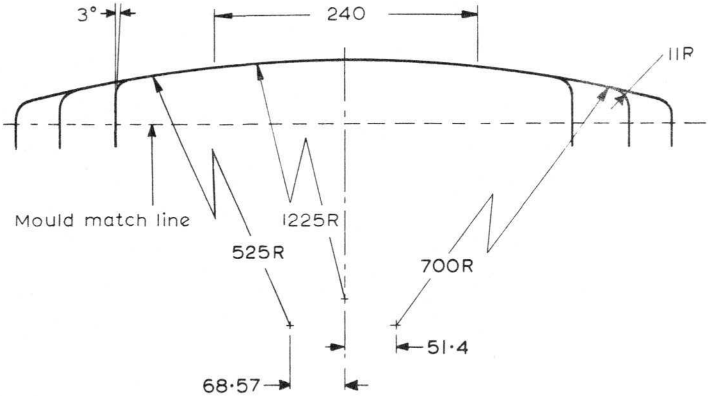
WARNING

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this tube when operated above 16 kV.

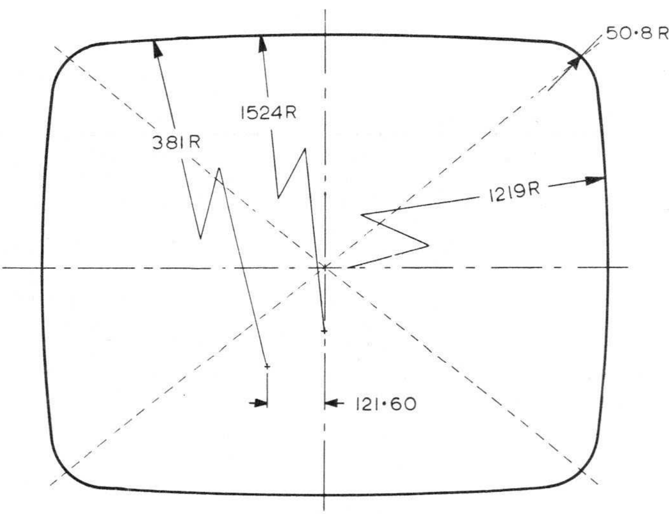


All dimensions in mm

* The maximum value is determined by the reference line gauge



External screen radii



Radii mould match line

All dimensions in mm

7356

QUICK REFERENCE DATA		
5in diameter, flat-faced precision oscilloscope tube with helical p.d.a. and side connections to the x and y plates. This tube is suitable for high quality wide band oscilloscopes.		
Final anode voltage (p.d.a.)	10	kV
Display area (at $V_{a4} = 6V_{a3}$)	6.0 × 10	cm
Deflection factor y	10.9	V/cm
Deflection factor x	30	V/cm

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

HEATER

Suitable for parallel operation only

V_h	6.3	V
I_h	300	mA

OPERATING CONDITIONS

Beam forming

Final anode + luminescent screen	V_{a4}	10	kV
Astigmatism control electrode	V_{a3}	1670 ± 85	V
Focus electrode	V_{a2}	320 to 500	V
First accelerator	V_{a1}	1670	V
Geometry control electrode	V_{s2}	1670 ± 170	V
Deflection plate shield	V_{s1}	1670 ± 85	V
Control grid (for visual cut-off)	V_g	-53 to -82	V

Raster distortion

A graticule, consisting of concentric rectangles 10 × 6.0cm and 9.81 × 5.82cm is aligned with the electrical x-axis of the tube. The edges of a raster will fall between these rectangles, with optimum correction potentials applied.

Line width (GH screen)

V_{a4}	10	kV
V_{a3}	1.67	kV
V_{a1}	1.67	kV
I_t	10	μA
*Line width	0.4	mm

*Measured by the shrinking raster method in the centre of the screen

DEFLECTION

Double electrostatic

Mean y-plate voltage	V_y mean	1.67	kV
Mean x-plate voltage	V_x mean	1.67	kV
Vertical deflection factor	S_y	9.5 to 12.4	V/cm
Horizontal deflection factor	S_x	27 to 33	V/cm
Angle between x and y traces		90 ± 1	deg

If use is made of the full deflection capabilities of the tube, the deflection plates will intercept part of the electron beam near the edge of the scan. Therefore a low impedance deflection plate drive is necessary.
Both x and y plates are intended for symmetrical deflection.

Linearity of deflection

The sensitivity at a deflection of less than 75% of the useful scan will not differ from the sensitivity at a deflection of 25% of the useful scan by more than 2%.

CORRECTION POTENTIAL RANGES

Astigmatism control range	V_{a3}	1.58 to 1.76	kV
Geometry control range	V_{s2}	1.5 to 1.84	kV

SCREEN

Phosphor	BE	GH	GM	GP
Fluorescent colour	blue	green	purplish blue	bluish green
Phosphorescent colour	blue	green	yellowish green	green
Persistence	medium short	medium short	long	medium short

Minimum useful screen diameter	11.4	cm
Minimum useful scan (at $V_{a4} = 6V_{a3}$)		
y1-y2	6.0	cm
x1-x2	10	cm

The useful scan may be shifted vertically to a maximum of 3.0mm with respect to the geometric centre of the tube face.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{a4} max. (p.d.a.)	12	kV
V_{a4} min.	6.0	kV
V_{a3} max.	2.1	kV
V_{a3} min.	1.0	kV
Ratio V_{a4}/V_{a3} max.	6.0	
V_{a2} max.	1.5	kV
V_{a1} max.	2.1	kV
V_{a1} min.	1.0	kV
V_{s2} max.	2.2	kV
V_{s1} max.	2.1	kV
$-V_g$ max.	200	V
$+V_g$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$v_{x-a3(pk)}$ max.	500	V
$v_{y-a3(pk)}$ max.	500	V
$I_{k(av.)}$ max.	300	μA
V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{g-k} max.	1.5	MΩ
R_{y-a3} max.	1.0	MΩ
R_{x-a3} max.	1.0	MΩ
$-I_{a2}$ max.	15	μA
$+I_{a2}$ max.	10	μA
p_t max.	3.0	mW/cm^2

HELIX RESISTANCE

Minimum post deflection helix resistance	200	MΩ

CAPACITANCES (measured on three terminal capacitance bridge)

High potential	Low potential	Earthed	Capacitance (pF)
k	all	-	3.5
g	all	-	6.0
x1	all	x2	3.0
x2	all	x1	3.0
y1	all	y2	3.0
y2	all	y1	3.0
x1	x2	all	1.9
y1	y2	all	1.0

EQUIPMENT DESIGN RANGE

Focusing voltage	V_{a2}	190 to 300	V/kV of V_{a3}
Grid cut-off voltage	V_g	-32 to -49	V/kV of V_{a1}
Deflection factor ($V_{a4} = 6V_{a3}$)			
Vertical	S_y	5.7 to 7.4	V/cm/kV of V_{a3}
Horizontal	S_x	16 to 20	V/cm/kV of V_{a3}

MOUNTING POSITION

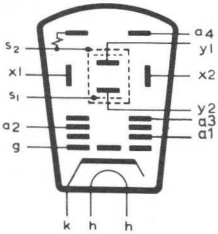
The tube should not be supported by the base alone and under no circumstances should the socket be allowed to support the tube.

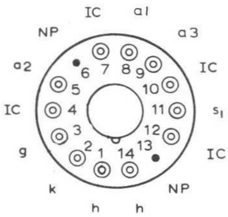
WEIGHT

Tube alone (approx.)	910	g

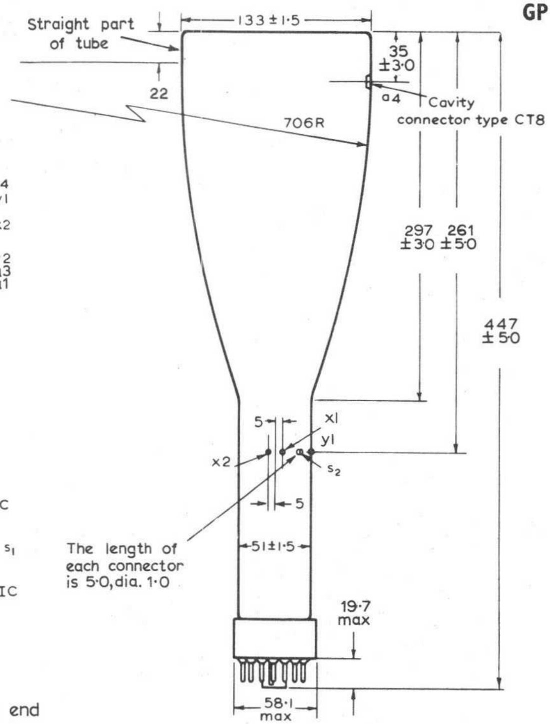
ACCESSORIES

Socket	5914/20
Final accelerator contact connector (CT8)	55563
Side contact connector	55561
Mu-metal shield	55551

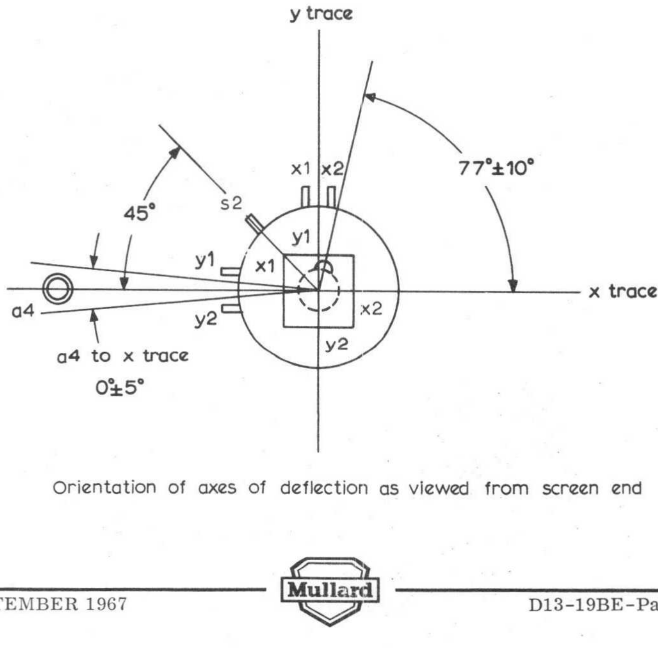




B 14 A Base
As viewed from base end



All dimensions in mm



Orientation of axes of deflection as viewed from screen end

QUICK REFERENCE DATA		
5in diameter, flat-faced precision oscilloscope tube with helical p.d.a. and side connections to the x and y plates. This tube is suitable for high quality wide band oscilloscopes.		
Final anode voltage (p.d.a.)	10	kV
Display area (at $V_{a4} = 6V_{a3}$)	4 × 10	cm
Deflection factor y	6.4	V/cm
Deflection factor x	30	V/cm

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

HEATER

Suitable for parallel operation only

V_h	6.3	V
I_h	300	mA

OPERATING CONDITIONS

Beam forming

Final anode + luminescent screen	V_{a4}	10	kV
Astigmatism control electrode	V_{a3}	1670 ± 85	V
Focus electrode	V_{a2}	320 to 500	V
First accelerator	V_{a1}	1670	V
Geometry control electrode	V_{s2}	1670 ± 170	V
Deflection plate shield	V_{s1}	1670 ± 85	V
Control grid (for visual cut-off)	V_g	-50 to -80	V

Raster distortion

A graticule, consisting of concentric rectangles 10 × 4cm and 9.88 × 3.9cm is aligned with the electrical x-axis of the tube. The edges of a raster will fall between these rectangles, with optimum correction potentials applied.

Line width (GH screen)

V_{a4}	10	kV
V_{a3}	1.67	kV
V_{a1}	1.67	kV
I_t	10	μA
*Line width	0.4	mm

*Measured by the shrinking raster method in the centre of the screen.

DEFLECTION

Double electrostatic

Mean y-plate voltage	V_y mean	1.67	kV
Mean x-plate voltage	V_x mean	1.67	kV
Vertical deflection factor	S_y	5.7 to 7.1	V/cm
Horizontal deflection factor	S_x	27 to 33	V/cm

If use is made of the full deflection capabilities of the tube, the deflection plates will intercept part of the electron beam near the edge of the scan. Therefore a low impedance deflection plate drive is necessary.
Both x and y plates are intended for symmetrical deflection.

Linearity of deflection

The sensitivity at a deflection of less than 75% of the useful scan will not differ from the sensitivity at a deflection of 25% of the useful scan by more than 1.5% horizontally and 1.0% vertically.

CORRECTION POTENTIAL RANGES

Astigmatism control range	V_{a3}	1.59 to 1.75	kV
Geometry control range	V_{s2}	1.5 to 1.84	kV
Linearity of vertical deflection	V_{s1}	1.59 to 1.75	kV

SCREEN

	BE	GH	GM	GP
Phosphor	BE	GH	GM	GP
Fluorescent colour	blue	green	purplish blue	bluish green
Phosphorescent colour	blue	green	yellow-green	green
Persistence	medium short	medium short	long	medium short

Minimum useful screen diameter	11.4	cm
Minimum useful scan (at $V_{a4} = 6V_{a3}$)		
y1-y2	4.0	cm
x1-x2	10	cm

The useful scan may be shifted vertically to a maximum of 3.0mm with respect to the geometric centre of the tube face.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_{a4} max. (p.d.a.)	12	kV
V_{a4} min.	6.0	kV
V_{a3} max.	2.1	kV
V_{a3} min.	1.0	kV
Ratio V_{a4}/V_{a3} max.	6.0	
V_{a2} max.	1.5	kV
V_{a1} max.	2.1	kV
V_{a1} min.	1.0	kV
V_{s2} max.	2.2	kV
V_{s1} max.	2.1	kV
$-V_g$ max.	200	V
$+V_g$ max.	0	V
$+v_{g(pk)}$ max.	2.0	V
$v_{x-a3(pk)}$ max.	500	V
$v_{y-a3(pk)}$ max.	500	V
$I_{k(av)}$ max.	300	μA

V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{g-k} max.	1.5	MΩ
R_{y-a3} max.	1.0	MΩ
R_{x-a3} max.	1.0	MΩ
$-I_{a2}$ max.	15	μA
$+I_{a2}$ max.	10	μA
p_t max.	3.0	mW/cm^2

HELIX RESISTANCE

Minimum post deflection helix resistance 200 MΩ

CAPACITANCES (measured on three terminal capacitance bridge)

High potential	Low potential	Earthed	Capacitance (pF)
k	all	-	3.5
g	all	-	6.0
x1	all	x2	2.8
x2	all	x1	2.8
y1	all	y2	2.8
y2	all	y1	2.8
x1	x2	all	1.9
y1	y2	all	1.5

EQUIPMENT DESIGN RANGE

Focusing voltage	V_{a2}	190 to 300	V/kV of V_{a3}
Grid cut-off voltage	V_g	-30 to -48	V/kV of V_{a1}
Deflection factor ($V_{a4} = 6V_{a3}$)			
Vertical	y	3.4 to 4.25	V/cm/kV of V_{a3}
Horizontal	x	16.2 to 19.8	V/cm/kV of V_{a3}

MOUNTING POSITION Any

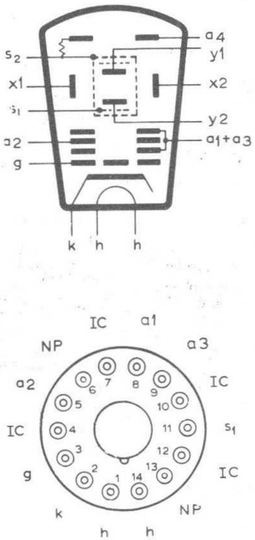
The tube should not be supported by the base alone and under no circumstances should the socket be allowed to support the tube.

WEIGHT

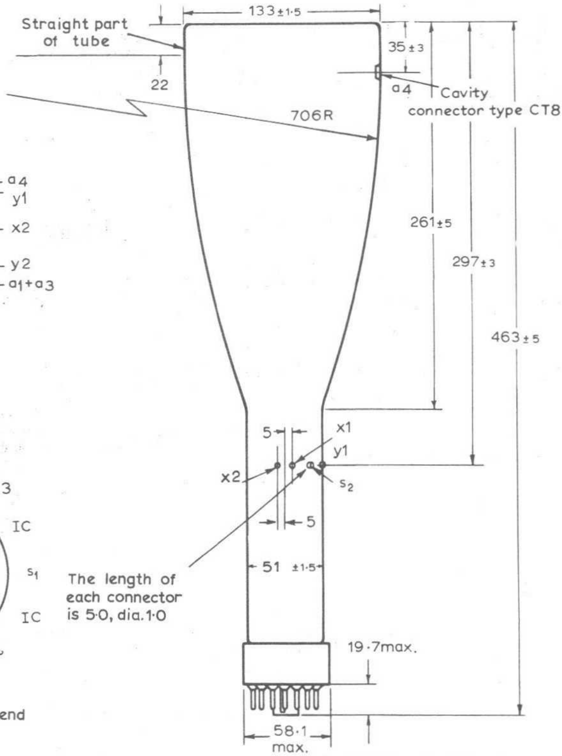
Tube alone (approx.)	910	g

ACCESSORIES

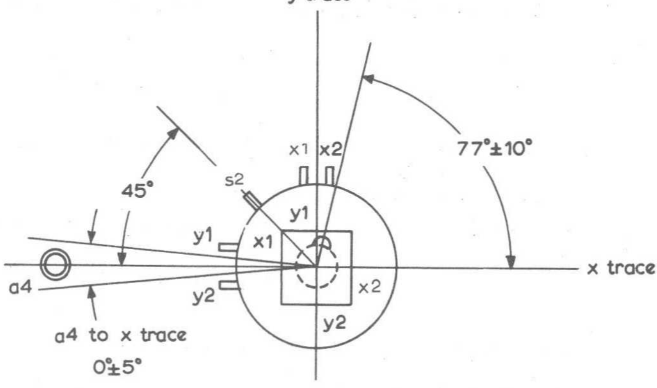
Socket	5914/20
Final accelerator contact connector (CT8)	55563
Side contact connector	55561
Mu-metal shield	55551



B14A Base
As viewed from base end



All dimensions in mm



Orientation of axes of deflection as viewed from screen end

TELEVISION TUBE

MW43-69Z

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. This tube has magnetic focusing and 70° magnetic deflection.

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

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	<8	pF
c_{k-all}	<6	pF
c_{k+a_2-all}	<11	pF
c_{a_3-M}	1100	pF

SCREEN

Metal-backed		
Fluorescent colour	White	
Light transmission	66	%
Useful screen area	See drawing on p. 3	

FOCUSING

Magnetic

DEFLECTION

Double magnetic

ION TRAP

This tube does not use an external ion trap magnet. When used as a replacement for ion trap types, the ion trap magnet and any lead connected to it should be discarded.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'.

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle having a diameter of 55mm which is centred upon the perpendicular from the centre of the face.

MW43-69Z

TELEVISION TUBE

PREFOCUSING

The spot size and uniformity of focus depend upon V_{a2}. At V_{a2} zero or negative with respect to cathode the spot size at the centre of the screen and the width of the electron beam are such that optimum uniformity of focus is obtained over the whole screen. If V_{a2} is increased, the spot size at the centre of the screen is reduced but the width of the electron beam is increased, resulting in inferior focus at the edges of the screen.
With increased V_{a2}, the power of the external focusing magnet has to be increased.

TYPICAL OPERATING CONDITIONS

V_{a3}	14	kV
V_{a2}	0	V
V_{a1}	300	V
*V_g for cut-off	−40 to −86	V

LIMITING VALUES (Design centre ratings)

**V_{a3} max.	16	kV
V_{a3} min.	10	kV
V_{a2} max.	410	V
V_{a2} min.	−100	V
V_{a1} max.	410	V
V_{a1} min.	200	V
*$-V_g$ max.	150	V
†V_{h-k} max. (cathode negative)	125	V
†V_{h-k} max. (cathode positive)	200	V
††$v_{h-k(pk)}$ max. (cathode positive)	410	V
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f=50Hz)	500	kΩ
R_{h-k} max.	See note §	
Max. a_1 supply source impedance	1.5	MΩ
Max. a_2 supply source impedance	1.5	MΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a3} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible (<$20V_{r.m.s.}$).

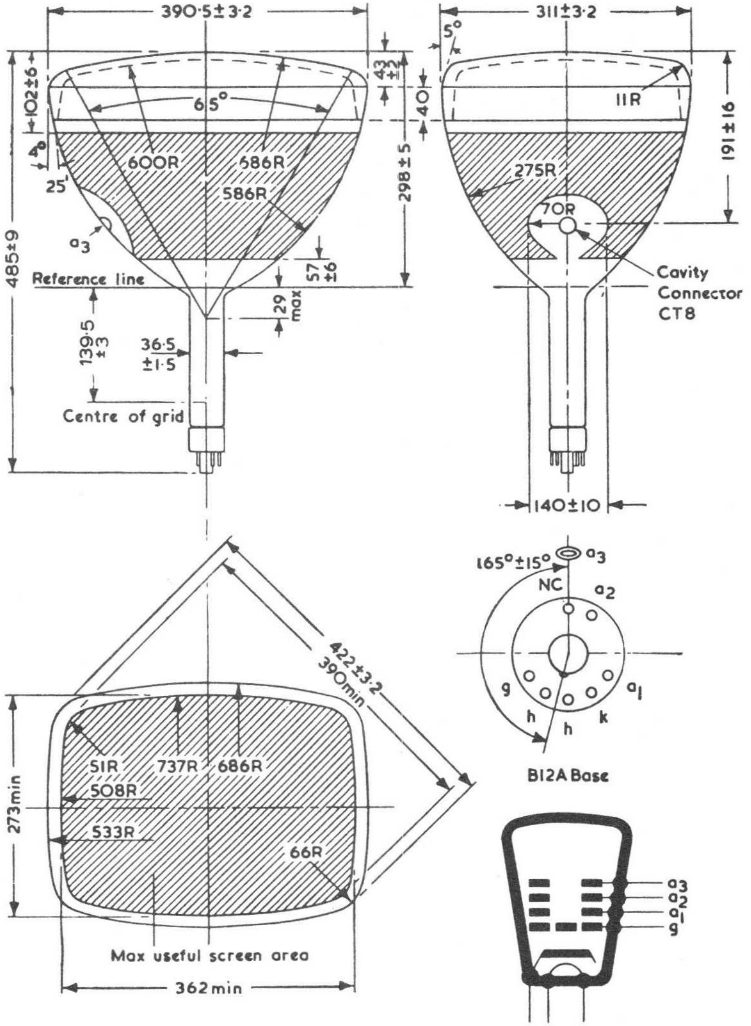
††During a warming-up period not exceeding 45 sec.

§When the heater is in a series chain, or earthed, Z_k max. is 100kΩ where Z_k is the 50Hz impedance between earth and the cathode.
When the heater is supplied from a separate transformer R_{h-k} max is 1.0MΩ.

WEIGHT

Tube alone: 7.5 kg / 17 lb

MW43-69Z



All dimensions in mm

The indicated radius of faceplate curvature is not an exact but an average value.

TELEVISION TUBE

MW43-80Z

Direct viewing television tube with 17-in. diagonal rectangular metal-backed grey-glass screen. This tube has magnetic focusing and 90° magnetic deflection.

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

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes'.

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	<8.0	pF
c_{k-all}	<5.0	pF
$c_{k+a2-all}$	<11	pF
c_{a3-M}	1200	pF

SCREEN

Metal backed		
Fluorescent colour	white	
Light transmission	70	%
Useful screen area	see drawing on page D4	

FOCUSING

Magnetic

DEFLECTION

Double magnetic

For timebase designs the following spreads in the useful screen area should be considered.

Picture height		
Maximum	284	mm
Minimum	273	mm
Picture width		
Maximum	369	mm
Minimum	362	mm
Picture diagonal		
Maximum	400	mm
Minimum	390	mm

The spread in the cone length can be obtained from the outline drawing.

MW43-80Z

TELEVISION TUBE

ION TRAP

This tube does not use an external ion trap magnet. When used as a replacement for ion trap types, the ion trap magnet and any lead connected to it should be discarded.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'.

MOUNTING POSITION

Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle having a diameter of 55mm which is centred upon the perpendicular from the centre of the face.

PREFOCUSING

The spot size and uniformity of focus depend upon V_{a2}. At V_{a2} zero or negative with respect to cathode the spot size at the centre of the screen and the width of the electron beam are such that optimum uniformity of focus is obtained over the whole screen. If V_{a2} is increased, the spot size at the centre of the screen is reduced but the width of the electron beam is increased, resulting in inferior focus at the edges of the screen.

With increased V_{a2}, the power of the external focusing magnet has to be increased.

OPERATING CONDITIONS

V_{a3}	14	kV
V_{a2}	0	V
V_{a1}	300	V
V_g for visual extinction of focused raster	−40 to −86	V

LIMITING VALUES (design centre ratings)

**V_{a3} max.	16	kV
V_{a3} min.	10	kV
V_{a2} max.	410	V
V_{a2} min.	–100	V
V_{a1} max.	410	V
V_{a1} min.	200	V
*–V_g max.	150	V
†V_{h-k}		
Cathode positive		
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ
Z_{k-e} max. (f = 50Hz)	100	kΩ
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50Hz)	500	kΩ
Max. a_1 supply source impedance	1.5	MΩ
Max. a_2 supply source impedance	1.5	MΩ

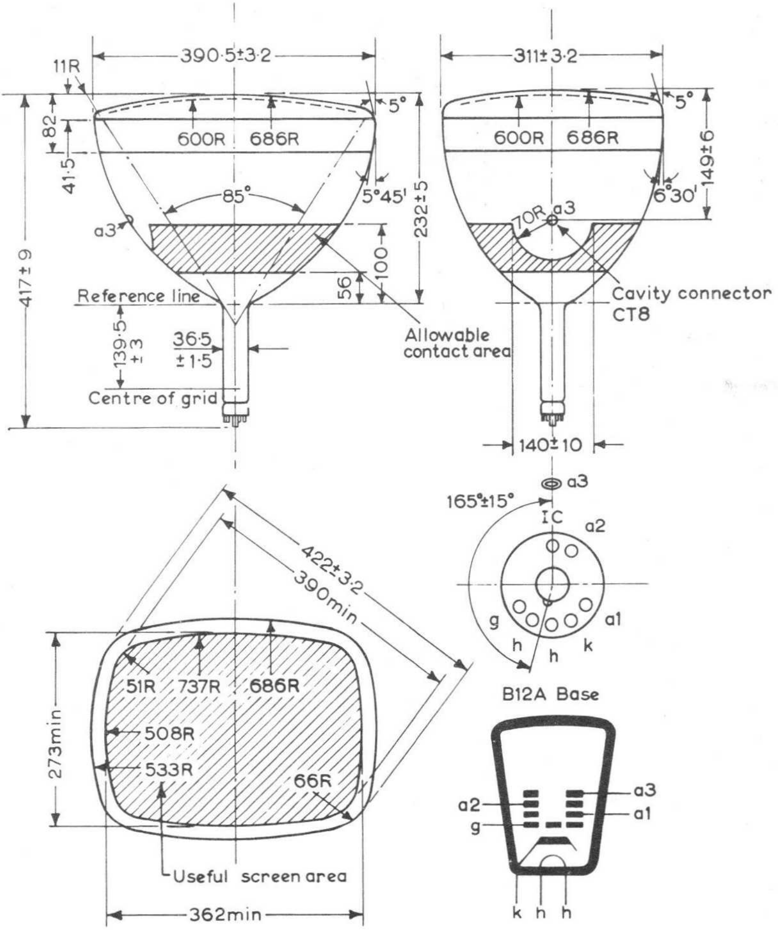
*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

**The product of V_{a3} and I_t (average value for the whole screen) must not exceed 6W.

†In order to avoid excessive hum the a.c. component of V_{h-k} should be as low as possible (<$20V_{r.m.s.}$).
During a warming-up period not exceeding 45s $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WEIGHT

Tube alone	6.4	kg
	14	lb



All dimensions in mm

TELEVISION TUBE

Direct-viewing television tube with 21-in. diagonal rectangular metal-backed grey-glass screen having a 90° deflection angle. This tube incorporates an ion trap.

MW53-80

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

HEATER

Suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

The limits of heater voltage and current are contained in 'General operational recommendations—cathode ray tubes'.

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

EXTERNAL CONDUCTIVE COATING

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

CAPACITANCES

c_{g-all}	7.0	pF
c_{k-all}	4.0	pF←
$c_{k+a2-all}$	9.0	pF
c_{a3-M}	1500	pF

SCREEN

Metal backed		
Fluorescent colour	white	
Light transmission	75	%←
Useful screen area	see drawing on page D4	

FOCUSING

Magnetic

DEFLECTION

Double magnetic

MW53-80

TELEVISION TUBE

MOUNTING POSITION Any

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle having a diameter of 55mm which is centred upon the perpendicular from the centre of the face.

ION TRAP

Ion trap magnet field intensity	63 to 78	G

The space between a point 112mm from the reference line along the neck of the tube and the edge of the base should be kept clear for the ion trap magnet. The direction of the field of the ion trap magnet should be such that the south pole is adjacent to the spigot. The procedure for adjusting the ion trap magnet is given in the 'General operational recommendations—cathode ray tubes' which precede this section of the handbook.

The ion trap magnet assembly should be earthed.

REFERENCE LINE GAUGE

See 'General operational recommendations—cathode ray tubes'.

PREFOCUSING

The spot size and uniformity of focus depends upon V_{a2}. At V_{a2} zero or negative with respect to cathode, the spot size at the centre of the screen and the width of the electron beam are such that optimum uniformity of focus is obtained over the whole screen. If V_{a2} is increased, the spot size at the centre of the screen is reduced but the width of the electron beam is increased: resulting in inferior focus at the edge of the screen.

With increased V_{a2}, the power of the external focusing magnet has to be increased.

OPERATING CONDITIONS

V_{a3}	16	kV
V_{a2}	0	V
V_{a1}	300	V
*V_g for visual extinction of focused raster	−40 to −80	V

LIMITING VALUES (design centre ratings)

†V_{a3} max.	18	kV
V_{a3} min.	12	kV
V_{a2} max.	500	V
V_{a2} min.	–100	V
V_{a1} max.	500	V
V_{a1} min.	200	V
*–V_g max.	150	V
‡V_{h-k}		
Cathode positive		←
d.c. max.	200	V
pk max.	300	V
Cathode negative		
d.c. max.	125	V
pk max.	250	V
R_{h-k} max.	1.0	MΩ←
Z_{k-e} max. (f = 50c/s)	100	kΩ←
R_{g-k} max.	1.5	MΩ
Z_{g-k} max. (f = 50c/s)	500	kΩ
Max. a_1 supply source impedance	1.5	MΩ
Max. a_2 supply source impedance	1.5	MΩ

*The d.c. value of grid bias must not be allowed to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to +1V. The maximum positive grid excursion of the video signal may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

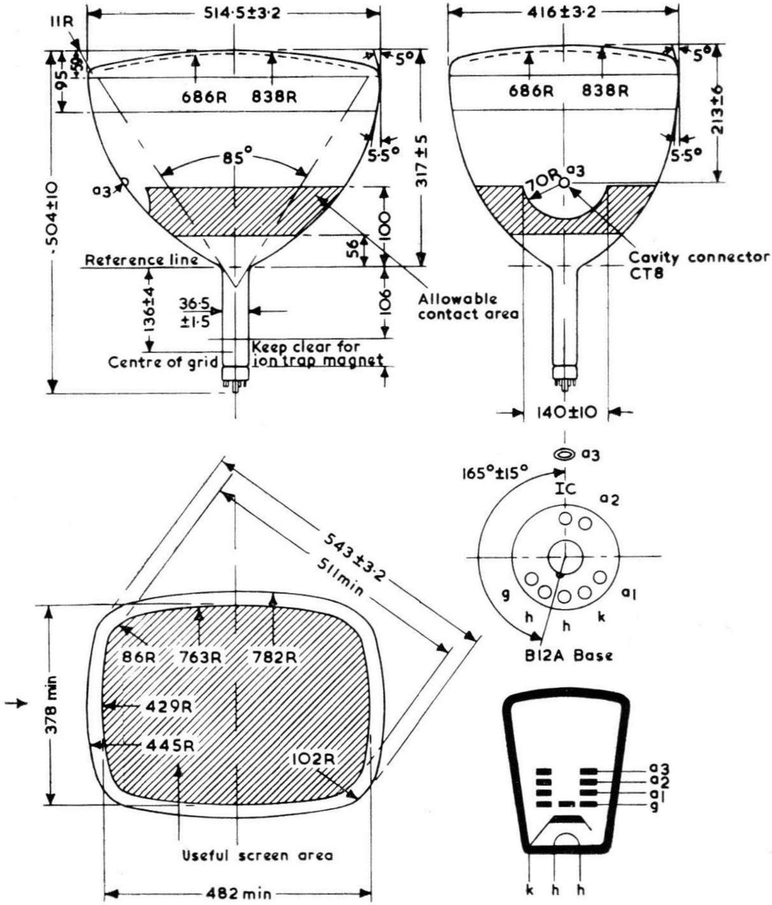
†The product of V_{a3} and I_t (average value for the whole screen) must not exceed 6.0W.

‡In order to avoid excessive hum the a.c. component of V_{h-k} should be as← low as possible ($<20V_{r.m.s.}$).

During a warming-up period not exceeding 45s, $v_{h-k(pk)}$ max. (cathode positive) is allowed to rise to 410V.

WEIGHT

Tube alone	11.25	kg
	25	lb



All dimensions in mm

7884